Infrastructure Canada

PLANNING FOR A SOFT LANDING

NON-RENEWABLE RESOURCE DEVELOPMENT AND COMMUNITY INFRASTRUCTURE IN THE NORTHWEST TERRITORIES

A Researcher Backgrounder Prepared for the Experts Workshop on Northern Communities: Boom, Bust and the Role of Infrastructure, November 15-17, 2005, Norman Wells, Northwest Territories

Research & Analysis Division
Infrastructure Canada

Canada

PLANNING FOR A SOFT LANDING: NON-RENEWABLE RESOURCE DEVELOPMENT AND COMMUNITY INFRASTRUCTURE IN THE NORTHWEST TERRITORIES

"Perhaps the most immediate and critical challenge is the impact that resource development activities are having on community infrastructure." (MACA et al., 2004, p. ii)

INTRODUCTION

Modernizing public infrastructure to meet the needs of Canadians in communities across the country is one of the most important public policy challenges for Canada in the early 21st century. Failure to make the strategic investments that are required in our roads, highways, wastewater treatment facilities, bridges and the like has immediate and direct consequences for Canada's economic performance and for the quality of life of Canadians from coast-to-coast-to-coast. This is recognized in the federal government's commitment to renewing Canada's public infrastructure through strategic and community-based investments and advancing the New Deal for Cities and Communities.[1]

Governments, researchers, communities and others generally agree that meeting the infrastructure needs of Canadians in the Northwest Territories (NWT) poses unique challenges given its northern geography and climate and its socio-political environment (see, e.g., MACA et al, 2004; CMHC, 2005; Econex, 2004; Robinson et al., 2001). In addition, however, the NWT is the fastest growing regional market in Canada (GNWT, 2005; Centre for Spatial Economics, 2002). It is currently experiencing an unprecedented boom in its natural resources sector, primarily as a result of the discovery of diamonds and renewed interest in the territory's natural gas. The boom is accelerating existing pressures on fragile key infrastructure by increasing utilization of existing infrastructure while simultaneously creating demands for new infrastructure such as communications systems, housing and electrification and for even greater capacity to finance and manage community capital assets. It is anticipated, based on the projects that are being planned, that the region's economy will continue to run "at full tilt" for a number of years (TD Economics, 2003, p. i).

Communities in the NWT are in a unique position to take advantage of the opportunities presented by increased resource exploration and development. Community infrastructure can play an important role in allowing Northern communities to capitalize on the influx of people and resources, both social and economic, as well as on a growing national and international profile. It can also play an important role in enhancing community resiliency to the economic unpredictability characteristic of non-renewable resource-based communities.

[1] For more details on these commitments and the roles, responsibilities, programs, policies, research and other activities of Infrastructure Canada vis-à-vis infrastructure and the New Deal, see www.infrastructure.gc.

Improving understanding of how the boom and bust of resource development affects – as is affected by - community infrastructure[2] is therefore more important than ever. The issues are not as yet well understood, by governments, researchers or communities. But they need to be in order to support the development and implementation of effective strategies designed to ensure a "soft landing" for communities in the NWT that are facing unprecedented infrastructure challenges in tandem with unprecedented resource-based economic development.

OBJECTIVES AND METHODOLOGY

This paper is intended to provide a high-level overview of research related to the boom and bust cycle of resource-based economic development and community infrastructure in the Northwest Territories and the North more generally. It has been prepared by the Research and Analysis Division of Infrastructure Canada as background for the experts workshop on Northern Communities: Boom, Bust and the Role of Infrastructure being co-hosted by Infrastructure Canada and the NWT Department of Municipal and Community Affairs in Norman Wells, on November 15-17, 2005.

The paper is necessarily selective and focuses on what is known, as well as knowledge gaps that need to be filled, in each of the three theme areas for the experts workshop: the connections between non-renewable resources development and community infrastructure in the North; planning for resource development; and strategies for moving ahead – putting ideas into practice. The paper pays particular attention to one of the key conclusions of the *Building Healthy Communities* report by the Department of Municipal and Community Affairs, the Government of the Northwest Territories and the NWT Association of Communities that strategies for dealing with the boom-induced infrastructure challenges facing NWT communities must focus on: making more creative use of available funding; promoting technical innovation; and improving maintenance capacity at the community level.

The key message from the review of literature is that, as for many other infrastructure and communities topics, the connections between resource-based economic development and community infrastructure in the North are not well understood. That being said, there are fairly rich sources of literature that help to shed light on the connections and their implications for policy, program and tool development, as well as for those who live and work in the smaller communities most affected by the current natural resources boom in the NWT. The literature examining economic development; resource-based economies; infrastructure design, maintenance and rehabilitation, especially in cold climates; infrastructure financing; infrastructure and climate change; community development; and the impacts of community-size on infrastructure requirements and strategies for meeting them is the most helpful for our present purposes.[3]

[2] Community infrastructure is "the physical assets required by a community government to support the delivery of mandated programs and services in a sustainable manner" (MACA et al, 2004).
[3] A selected bibliography can be found at the end of this paper.

THEME 1: THE CONNECTIONS BETWEEN NON-RENEWABLE RESOURCE DEVELOPMENT AND COMMUNITY INFRASTRUCTURE IN THE NORTH

The connections between non-renewable resource development and community infrastructure in Canada's North have not as yet received focused research attention. However, the literature that is available offers a striking snapshot of the real and potential effects of resource-based boom and bust on community infrastructure in the NWT, especially the Mackenzie Valley region. Key gaps in knowledge are also evident.

General

There is no question that community infrastructure, and infrastructure in general, is essential for resource development. Well-functioning community infrastructure is a key factor in attracting investment, enabling the movement of workers to and from an area and transporting construction materials in and primary products out.

Community infrastructure also plays a fundamental role in helping communities affected by the cyclical nature of resource-based economies, both positively and negatively, to be more resilient (e.g. by enabling diversification or by promoting social cohesion and community participation) (Provincial and Territorial Depts., 2005; Halseth et al., 2003). This seems to be especially true for smaller remote communities and for communities located in areas affected by climate change and variability and other stressors (see, e.g., Robinson et al., 2001).

There are many detailed descriptions of the effects of the boom phase of natural resource development on community infrastructure (Preparing for the Pipeline Conference Report, 2004). Development activities and the subsequent influx of people and equipment instantly produce short-term pressures on existing community infrastructure. Case study descriptions of resource development scenarios vividly describe impacts on basic infrastructure assets such as roads, water and sewage systems, solid and hazardous waste management systems, and affordable housing. Impacts are also felt on community service infrastructure such as fire protection, social services, and recreation.

The literature offers equally detailed descriptions of the downward spiral following industry closure (Feser et al., 1999; Provincial and Territorial Depts., 2005). What is less clear is how bust specifically affects infrastructure requirements and investments. It is likely that infrastructure requirements will be "sticky" and stay artificially high relative to the downturn in the local economy. There may be a shift towards increased investment in maintenance and repair.

Much of the literature on boom and bust naturally focuses on economic impacts. Less common is research on environmental, social and cultural impacts, especially for small remote communities. Based on impacts research in general, a more integrated identification and assessment of impacts would be helpful for policy and program purposes and the development of capacity-building tools.[4]

[4] See, e.g., the papers prepared for and the discussions from the federal family research workshop on Community-level Impacts of Infrastructure, organized by the Research and Analysis Division, INFC, in collaboration with Industry Canada, in February 2005. They are available at: http://www.infrastructure.gc.ca/research-recherche/rresul/wr_e.shtml.

Changes in the Infrastructure "Mix"

The evidence suggests that capitalizing on a boom in the resource sector puts a particular premium on having effective transportation and communications infrastructure in place, as well as other community infrastructure that responds to the needs of residents, new and old (Halseth et al., 2002, 2004).

A boom results in increased utilization of community infrastructure. On the one hand, community roads, water systems and solid waste sites are used for industrial purposes in addition to the residential purposes for which they were originally designed and built. This in turn causes capacity pressures and often causes existing infrastructure to decay more quickly than expected, especially in the case of transportation assets. At the same time, there tend to be demands for new infrastructure and new types of infrastructure to deal with the direct (e.g. housing) and indirect consequences of boom (e.g. recreation centres). In short, there are changes in both the degree and kind of utilization. Overall, too, increased utilization of community infrastructure results in an accelerated need for maintenance, repair and rehabilitation of existing community infrastructure, as well as requirements for the maintenance, repair and rehabilitation of the new community infrastructure.

One of the principal challenges associated with infrastructure investment occurring in this context is to achieve a balance between short-term and long-term needs. Ideally, the design and construction of community infrastructure anticipates both the boom and the bust parts of the cycle. This includes technologies that lend themselves to cost-effective decommissioning or re-adaptation, and the orderly reuse or removal of redundant infrastructure assets. It may also include deliberately temporary infrastructure, as is planned for the construction phase of the Mackenzie Valley pipeline project (see www.mackenziegasproject.com).

The research suggests that redundancy is a more pressing issue for community infrastructure systems in the North given the cold climate and other factors (MACA et al., 2004, pp. 2-5). Redundancy may take on added importance in infrastructure design when the number and diversity of users and the criticality of the infrastructure itself increase in times of rapid economic growth.

Infrastructure and Climate Change

The Mackenzie Valley has undergone greater warming (1.7 degrees) over the last century than any other region in Canada[5]. The transportation sector is known to be one of the most challenged sectors in the North due to climate change, especially when it comes to winter roads and ice crossings. Overall, however, scientists, engineers and practitioners have not focused on the technical impacts of climate change on infrastructure in Northern regions, nor on the consequences of these impacts for public health, socio-cultural activities, ecosystem health and public policy, including regulations and standards (Robinson et al., 2001, p. 5).

[5] Environment Canada (1995). More generally, see the work of the Geological Survey of Canada on climate change impacts, permafrost and community infrastructure in the Mackenzie Valley, including Robinson et al., 2001.

Several relatively recent regional studies of the Arctic and the Mackenzie Valley have focused on climate change, permafrost and community infrastructure (Maxwell, 1997; Cohen, 1997). Much of the infrastructure in Northern communities relies on the properties of frozen materials for stability. As a result, as these studies have concluded, the partial or complete disappearance of permafrost over large areas of the North in the event of predicted climate change will degrade the performance of many existing and new infrastructures, including roads, foundations, utilities and embankments. In many cases the evidence suggests this is already happening.[6]

In general, many of the changes predicted as a result of climate change and variability, such as reductions in water levels, increased soil instability, changes in ambient temperature, wind events and impacts on biodiversity, imply the need for new engineering design, construction, maintenance and rehabilitation techniques for community infrastructure in the North. Similarly, relevant regulatory standards must be updated to take account of climate change for new infrastructure, as well as the need to introduce adaptation measures for existing infrastructure.

While climate change and variability are expected to produce some benefits for resource development and community infrastructure in the North (e.g. longer construction and shipping seasons), they will also likely create significant costs (e.g. increased demands for gravel roads and for repair/replacement of infrastructure anchored in permafrost and reduced life expectancies for some assets, for instance due to heaving). Increased resource development in the Mackenzie Valley and elsewhere in the NWT may also accelerate climate change impacts and add to the need for effective adaptation and mitigation strategies for community infrastructure, although this is not an issue that has been carefully examined in the research, for instance using different scenarios for growth (Robinson et al., 2001 pp.55-58).

Infrastructure Financing

Community infrastructure is a costly asset to build, operate and maintain, especially in the North. Even without the impacts of resource development, it has been estimated that the shortfall in investment in community public infrastructure in the NWT over the next 10 years may be close to $190-million (in 2004 dollars) (MACA et al., 2004). If all things remain the same[7], a further one-time capital investment of up to $37-million could be required over the next two decades to meet the demands for infrastructure as a result of the proposed Mackenzie Valley pipeline (MACA et al., 2004).

Neither community governments nor the GNWT presently have adequate financial resources to address these needs, and the gap between investment and need is growing annually. Even the largest Northern communities are challenged to adequately finance their infrastructure requirements. As is the case elsewhere, however, the scope

[6] See, for instance, the case study of Norman Wells presented in Geological Survey of Canada, 2001, which documents performance problems with housing, buildings, electricity, natural gas, water service, sewage and sewer system, educational, recreational, air transportation, roads, pipeline and other miscellaneous infrastructure.

[7] For instance, in the absence of the use of innovative financing mechanisms, or the introduction of innovations in technological processes and service delivery arrangements. Addressing the supply side of community infrastructure requirements is equally as important as addressing the demand side. See, e.g., Research and Analysis, INFC, "Assessing Canada's Infrastructure Needs: A Review of Key Studies" (2004).

for managing demand and supply side factors affecting community infrastructure in the NWT merits more detailed examination.

In addition, the toolkit of mechanisms for financing infrastructure is much more limited in the NWT.[8] Many financing mechanisms that are available elsewhere are not available to Northern communities, especially non-tax based communities. As a result, some communities have begun to explore more innovative mechanisms, such as public-private partnerships with industry and cost-sharing arrangements between two or more communities, as well as options for integrating infrastructure requirements into resource development and sharing agreements (e.g. impact and benefits agreements and shared resource management agreements).

THEME 2: PLANNING FOR RESOURCE DEVELOPMENT

A review of the literature confirms that there are tools available to assist with planning for community infrastructure through all stages of the resource development cycle. Here, the focus is on the distinctive context in which planning takes place in communities in the North, as well as lessons-learned about some of the tools and approaches that communities have adopted for capital asset planning.

Uncertainty

Uncertainty is an inherent feature of infrastructure planning, but this is especially true in resource-based communities in the NWT. Local economies are subject to fluctuations in the global market for diamonds, natural gas and other natural resources. In addition, Northern communities are experiencing some of the most significant – but uncertain – changes in climate and climate variability.

Knowledge

The nascent state of the science of cold climates in the early post-war period is considered to be one of the most important reasons why the life expectancy of many community infrastructure assets in the North is proving to be much shorter than planned. While progress has been made to better understand infrastructure design, operation and maintenance in the context of cold climates, lack of knowledge in this area continues to constrain the ability of communities to manage their infrastructure for boom and bust scenarios. The timing of the introduction of technical and technological advances is also characterized by uncertainty and, to some degree, unpredictability, although this can be affected by policies and programs deliberately introduced to foster less *ad hoc-ism*, more coordination and more rigorous monitoring of long term results.

Knowledge about the impacts of development on community infrastructure is key for effective planning. Several tools are currently in place to anticipate the impact of development on community infrastructure: proponent project applications made to regulatory authorities consider infrastructure as part of the project; environmental impact assessments (EIAs) and social impact assessments (SIA) indicate infrastructure needs required to mitigate any environmental or social concerns. However, reports produced as a result of these regulatory processes typically address infrastructure provision from the perspective of industrial investment, not long-term

[8] For an overview of the toolbox of mechanisms for infrastructure finance, see, e.g., Research and Analysis, INFC, “A Literature Review of Financing Mechanisms” (2004).

community development. Furthermore, many of the existing guidelines relating to EIA and SIA tools do not generally touch upon community infrastructure.

Impacts typically not present in these proponent-funded assessments include cumulative impacts or those experienced in other phases of development such as exploration. Many of the indirect costs to the community are usually not accounted for by EIAs. These include damage to road infrastructure caused by transporting heavy equipment or increased loads on existing sewage capacity. Northern communities also face increased administrative and employment costs, insurance costs and deferred maintenance and capital costs. In these cases, local governments and residents with access to traditional knowledge have an important role in determining the full impact of development activity.

Several studies suggest that small remote communities in the NWT often lack expertise and experience with asset management and planning in general and that capacity-building measures to address this knowledge gap should be a priority.

Short, Medium, and Long-term Planning Tools

Contemporary planning in North America is moving away from a blueprint approach and towards more of a guide for development. Plans are meant to provide certainty and stability for investors and citizens, while also permitting flexibility to achieve desired development goals and outcomes.

Tools available for sustainable community infrastructure planning share several important characteristics. The most promising of these tools rely on a collectively defined vision of the future, are based on a comprehensive and integrated understanding of development, and involve the active participation of a range of stakeholders. These planning tools are useful for prioritizing strategic infrastructure investments in order to achieve deliberately defined economic, social and environmental outcomes.

Discussions regarding community planning and infrastructure in northern contexts are well developed in the literature. These refer to both short-term planning tools for communities facing imminent resource development impacts, and longer-term approaches. An example of a short-term tool is community strategic planning, typically based on a three- to five-year horizon. The strategic planning process involves a combination of visioning, goal setting, detailed action planning, and implementation.

Longer-term planning tools typically take the form of community official plans, designed with 15 to 20 year horizons. Planning for long-term sustainability can also rely on 50 to 100 year horizons. A long-range perspective on community infrastructure is an important aspect of adaptation to climate change, the early effects of which are already being felt.

Community planning for boom and bust cycles should also draw upon the planning tools and experience of the resource industry itself, for example industry estimates of the life cycle of a particular resource can inform community infrastructure planning and development.

Participation of Multiple Stakeholders

The importance of engaging multiple local stakeholders in the planning process builds on a central theme of the 2004 Preparing for the Pipeline conference, which was premised on the

observation that "our people know our communities."[9] Similarly, the 2005 Resiliency and Recovery Project found that local communities want to be more involved in the decision making process and have control in determining impacts. Local government was seen as playing a key leadership role in the planning and transition management process.

While the nature of the collaboration will vary, project proponents and communities can work collaboratively at each stage of the infrastructure development life cycle, for example in planning, up-grading or relocating transportation infrastructure; in design and construction; in the negotiation of service agreements; and in the development and delivery of training and skills development (MACA et al, 2004).

Measuring and Monitoring Planning Implementation

Indicator-based systems can be used to measure and monitor quality of life outcomes associated with infrastructure investments in northern communities. Quality of life reporting systems in Canada tend to focus on larger cities. For example, the Federation of Canadian Municipalities Municipal Quality of Life Reporting System covers many outcomes of community quality of life, including some considerations of physical, environmental and social infrastructure. However, the municipalities included in the system are limited to 20 large and medium-sized southern communities.

The use of socio-economic agreements (SEAs) is also recommended as a means of monitoring resource development impacts. SEAs are typically negotiated in the context of resource development and can be used as a precondition to the granting of regulatory licenses. The central purpose of the SEA is to establish a framework that promotes the efficient use of resources by the relevant territory or province, the company, and the local residents.[10]

Data Availability and Accessibility

Local decision-makers and communities require information in order to make timely and effective decisions regarding infrastructure planning. Ultimately, the quality and effectiveness of planning and monitoring tools depends on the accessibility and accuracy of relevant data and information. Data collection, data management and data integration tools and technologies such as remote sensing, GIS, and institutional sharing can be important factors in effective community planning and decision-making. Ultimately, however, it is not the comprehensiveness of the data that matters, but its relevance; in fact, the record shows that having comprehensiveness as a goal frequently stands in the way of improving asset management, particularly in small communities. Local and traditional knowledge are also invaluable sources of information that can complement data available through other means. Local and traditional knowledge can help to inform the community planning process, set infrastructure development priorities and contribute to infrastructure design.

THEME 3: STRATEGIES FOR MOVING AHEAD: PUTTING IDEAS INTO PRACTICE

The unique context within which resource exploration and development is taking place in Northern Canada demand solutions that are context specific and informed by local experience

[9] Community Government Leaders Conference: Preparing for the Pipeline. December 6-8th, 2004, Inuvik, NWT.
[10] See: http://www.atns.net.au/

and knowledge. Nevertheless, experiences and lessons learned from other regions can help to inform strategies for Northern infrastructure planning, funding, provision, maintenance and management.

This section presents initiatives undertaken by communities and industries illustrating ideas that have been put into practice. Many of these examples have not taken place in the North, which reinforces the importance of bringing together researchers and local experts in order to adapt solutions and tools to the specific context of Northern communities.

Funding Mechanisms

Public-Private Partnerships

One infrastructure financing mechanism that is being tested in various jurisdictions, not without controversy, is public-private partnerships (PPP, or P3). An example of a community–resource industry P3 project is the planned Slate Falls First Nations access road in Northern Ontario. Slate Falls does not have an all-weather access road to link it to the regional and provincial roadways or to the closest town, which prevents the community from taking advantage of opportunities in the local forestry, mining and tourism industries. Because the estimated cost of road construction is $7 million, the First Nation started exploring the possibilities of a joint-venture project with local industry. They found a potential partner in McKenzie Forest Products Inc., which holds timber-harvesting rights south of Slate Falls. In order to harvest this timber over the next few years, the company planned to construct a suitable access road. Now, in partnership with the Slate Falls First Nation, McKenzie Forest Products will raise the proposed road's standard to a level suitable for all-weather community access.

A significant constraint to the use of P3 funding mechanisms in Northern communities is that communities often lack the expertise and organizational structures to effectively carry out a P3. Expertise in the form of specialized legal, financial, procurement or technical P3 specialization often does not exist within the community and would have to be imported at a potentially prohibitive expense.

Technological Innovation

Temporary infrastructure

Remotely operated and fully integrated community infrastructure systems are highly sophisticated systems combining water, waste, and energy services. These systems are designed in a modular format adaptable to rapid population change. An important innovation is the ability to rely on broadband technology in order to provide long-distance operation and maintenance support.

The emerging field of temporary infrastructure offers some potential solutions for the construction of temporary facilities that could help to mitigate the negative financial and environmental impacts of resource development. The Mackenzie Valley pipeline proponents have indicated that they plan to use temporary infrastructure in the construction phase of the project and will consult with local communities to determine appropriate locations and decommissioning strategies for the infrastructure they build.

Renewable energy in remote communities

Remote Northern communities are not connected to the electrical or power grid, and face energy costs far higher than the rest of Canada. While remote communities are largely dependent on conventional forms of energy, there are increasing numbers of examples of northern renewable energy projects. Small hydro is a substantial source of community energy in the Yukon. Wind-diesel hybrid energy projects are more commonly used in remote communities, including the NWT. Ground source heat pumps, which use the earth for heating in the winter and cooling in the summer and work well in permafrost conditions, also show promise.

In the late 1990s, Fort Smith, NWT built a new recreation centre using a solar wall. The solar wall preheats ventilation air, reducing substantially the energy costs and CO2 emissions. On cloudy days and nights the wall conserves energy by holding the heat that would otherwise be lost through a normal wall. The solar wall also acts as a heat shade in the summer. Even snow creates a reflective solar effect that enhances the system's performance. This project was the first solar air heating project in the far north and a number of new systems have been installed since.

Community Capacity Building

Community-based risk assessment

Community-based participatory risk assessment is meant to influence the actions of local government, private sector or others in order to address identified risks. The assessments use qualitative data collection and analysis, including consultations with those at risk, and mechanisms for self-reflection and community empowerment. Community-based risk assessment could be a useful tool for Northern communities to take stock of their infrastructure assets and formulate strategies to protect those assets during resource exploration and development.

In Canada, the Sudbury Soil Study is one of the most interesting initiatives of this kind.[11] Two major companies involved with the local metal mining and smelting industry voluntarily sponsored a study to assess the potential impact of soil contamination on the local environment and on human health. The Technical Committee supervising the study includes the two companies, federal and provincial environment and health authorities and local government officials. A Public Advisory Committee (PAC) was also established to represent citizens' interests. The PAC has held regular public meetings, published community newsletters. Finally, the stakeholders named an Independent Process Observer to oversee and report on the Soils Study process to ensure that it is transparent to the community.

Asset management

Integrated asset management is the foundation for short, medium and long term planning for the efficient and effective provision of infrastructure services. Asset management provides the tool by which communities can answer the following questions about their capital assets:

- What do we have and where is it? (inventory)

[11] See Cantox Environmental (2003) and www.sudburysoilstudy.com.

- What is it worth? (costs/replacement rates)
- What is its condition and expected remaining service life? (condition and capacity analysis)
- What is the level of service expectation, and what needs to be done? (capital and operating plans)
- When do we need to do it? (capital and operating plans)
- How much will it cost and what is the acceptable level of risk(s)? (short- and long-term financial plan)
- How do you ensure long-term affordability? (financial sustainability)

By integrating demand into asset management processes, communities are able to forecast the functional life of their infrastructure and develop adequate plans to deal with changes in utilization and the nature of their populations.

Studies confirm that asset management for small communities does not require complex data management and analysis technologies or expensive data collection systems. Simple tools and basic knowledge of their capital assets can suffice to establish and implement effective asset management plans.

Training development for facility operations and maintenance

The town of Oujé-Bougoumou, located in the James Bay area, provides an interesting example of how to institutionalize local capacity building for infrastructure management. After a series of relocations, a permanent community was established in the early 1990s. One critical element of the community plan was the area of public works. Negotiations with the provincial and federal governments led to the creation of a local Public Works department. All public works staff were involved in some way in the construction of the basic community infrastructure. From the beginning, construction contracts typically required the involvement of the community members, and contracts for all major facilities required the preparation of operation and maintenance manuals. As a result, troubleshooting is usually handled by local staff without requiring the services of an outside technician. This on-the-job training is complemented with regular training sessions to upgrade skills. Most capital works in the community are now managed locally. This approach provides employment in the community and ownership in regards to infrastructure building, maintenance and operation.

CONCLUSIONS

This paper has, in a selective way, reviewed the current state of knowledge about the boom and bust cycle of resource-based economic development and community infrastructure in the NWT. It has highlighted the significance and complexity of the issues facing community infrastructure in the NWT in general, and especially in the context of the boom and bust cycle that is characteristic of resource-based economies. It has also pointed to:

- Issues where the knowledge base appears to be relatively strong and others where this is not the case and, on the contrary, there seem to be pressing needs for generating new insights in order to support the design and implementation of effective policy, program and capacity-building strategies;
- The value and the promise of bringing together knowledge from very different disciplines and perspectives - engineering, planning, regional development, economics, public

policy, industry, communities and traditional knowledge - in order to foster the more integrated, multi-disciplinary and innovative knowledge base that the importance and complexity of the issues dictate.

Building knowledge is an ongoing, iterative process that takes place in short, medium and long term timeframes. Building it is only one step in the path forward, however. It must also be shared amongst and be useable by those grappling with the issues the knowledge relates to, whether communities and their citizens, local mayors and chiefs, government policy-makers, industry representatives or others. This paper – and the workshop which gave it impetus – are intended to help build, but also to help connect and share knowledge. Pursuing all three activities concurrently is central to making progress on a "soft landing" for communities in the NWT and the quality of life of those who live and work in them.

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