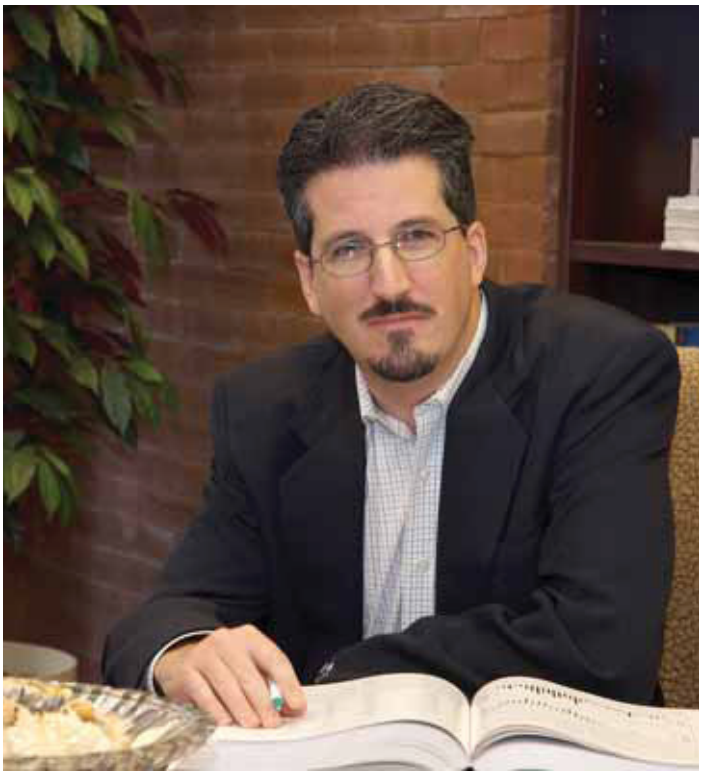
WINTER MAINTENANCE

More Stresses, More Strains, More Costs
Dealing with Climate Change and Infrastructure

By Glenn McGillivray



Climate change is going to add to the stress on infrastructure. More frequent freeze thaw cycles will damage pavements. The increased use of salt for winter maintenance will corrode bridges and degrade the natural environment. Higher snow loads can damage buildings while more runoff will tax storm sewers. Premature weathering and deterioration of infrastructure will lead to shorter life spans, reduced performance and increased maintenance and operating costs.

Dealing with the impact of climate change on infrastructure is going to be a long, hard, difficult and expensive task but municipalities have an obligation to their residents and to future generations to create a more resilient and sustainable urban environment.

While freezing rain is common, the ice storm that hit eastern Ontario, Quebec and New Brunswick in 1998 was exceptional. A hundred millimetres of freezing rain over six days left nearly three million households without electricity, 28 people dead and more than $5.5 billion in property damage, the most expensive natural disaster in Canadian history.

Was the ice storm a result of climate change? No one can say for sure. There have been ice storms in the past and there will undoubtedly be more in the future. You cannot attribute any single event or even one bad season to climate change. The record snowfalls of last year followed by the cool summer

INSIGHT

The Impact of Climate Change on Infrastructure

The Impact:
Premature weathering and deterioration of infrastructure will lead to
- shorter life spans
- reduced performance
- increased maintenance and operating costs.

The Question:
Has climate change been considered in the design and operation of roads, culverts and bridges?

Some Answers:
- Complete hazard assessments to identify infrastructure weaknesses
- Develop building codes to ensure the resistance and resilience of structures to natural hazards.
- Incorporate higher tolerances into public works infrastructure for unexpected events.
- Change local and national design codes, standards, and engineering practices to meet anticipated climate change impacts.

For more information
The Institute for Catastrophic Loss Reduction – www.iclr.org
Engineers Canada's Public Infrastructure Engineering Vulnerability Committee – www.Pievc.ca

this year does not refute the idea that the world is warming. In fact, some scientists would say that these sorts of extremes are confirmation that climate change is indeed producing more volatile and wilder weather.

The build-up of greenhouse gases in the atmosphere, which can be attributed largely to the human condition, traps infrared radiation warming the lower atmosphere. Temperatures over the last century have increased by about 0.74°C but the rate of warming in the last fifty years was almost double that of the first half century. Scientists believe that over the next century, temperatures will continue to increase by anywhere from 1°C to 6.4°C.

That is, of course, a broad generalization. Predicting what the average increase in temperature across a country as vast as Canada will be is not particularly helpful and why the term "global warming" is a bit misleading. It is not just warmer temperatures that we have to be concerned about but the impact of climate change as a result of those warmer temperatures. While we cannot predict what will happen in specific regions, we can be relatively sure that we will be seeing more deluges of biblical proportions in the summer months and more frequent winter storms and freeze thaw conditions in the cold months.

Climate Change and Municipalities

Climate change and wild weather will affect municipalities in two ways. The first is the short-term impact on operations and the second is the long-term impact on infrastructure.

As weather becomes more volatile, we can expect to see more precipitation and more freeze thaw cycles over a larger area of southern Ontario. Warmer temperatures in the north may challenge cherished transportation links such as ice roads, which are the only economical alternative to air transportation in the winter. Municipalities, already having to deal with the demands of an increasingly urban population, will come under increasing pressure to maintain minimum main-

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tenance standards and the levels of service that the public expects.

Climate change will also put additional stress on infrastructure. More frequent freeze thaw cycles will damage pavements. The increased use of salt for winter maintenance will corrode bridges and degrade the natural environment. Higher snow loads can damage buildings while more runoff will tax storm sewers. In short, premature weathering and deterioration of infrastructure will lead to shorter life spans, reduced performance and increased maintenance and operating costs.

These will not be isolated incidents that can be dealt with on as-needed basis. Infrastructure is a web of interwoven strands and when one starts to fray, the others come under additional stress. In effect, there can be a cascading infrastructure failure. In February 2006, for example, a major sinkhole opened up at the intersection of Highway 7 and Jane Street in Vaughan, the result of groundwater conditions undermining pipe infrastructure in the roadway, closing one of the GTA's major highways for several months. Last winter, parts of Toronto were blacked out when a watermain break flooded an underground hydro vault.

Added stress on infrastructure due to climate change could not come at a worse time given the sorry state that much of our infrastructure is in. Historically, governments have spent about 5 percent of GDP on infrastructure but in the last couple of decades infrastructure spending has dropped to about 3 percent of GDP. Even though there has been an influx of new money recently, many government agencies are still trying to catch up.

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Reactive and Proactive

When winter storms hit, municipalities have little choice but to react. There are minimum standards to be fulfilled and public expectations to be met. There are, of course, some proactive elements to dealing with winter maintenance and the anticipated changes that climate change will bring. A municipality has to ensure that it has sufficient resources in place to deal with extreme weather events and it can invest in new technology and new equipment so that it uses its resources as efficiently and effectively as possible. But for the most part, municipalities have to deal with whatever the weather throws at them.

The long-term situation is somewhat different. Countering the impact of climate change on infrastructure is going to be a long hard difficult and expensive task and one that given short-term pressures, many municipalities would be more than happy to put off. Nevertheless, given what we know about climate change, municipalities have an obligation to their residents and to future generations to be proactive.

Dealing with the implications of volatile weather and catastrophic loss goes far beyond developing emergency response plans. Emergency response defines how a municipality reacts to situations, whether brought on by single events or cascading failures over time. It does not show how to mitigate catastrophic failures in the first place. Municipalities need to determine where there are weaknesses in critical infrastructure and to be able to triage based on the most pressing needs. After the back to back floods in 2002 and 2004, for example, Peterborough developed a 10-year plan to deal with flood related issues. Hamilton is currently developing a 10-year plan in response to basement flooding.

A hazard assessment is an important first step in reducing vulnerability. Local governments have the authority to create an official plan to guide local development. Imbedding a hazard assessment ensures that development proposals can be assessed based on increased risks associated with climate change and land uses can be assigned to minimize risk to people and property.

The planning process can incorporate adaptation and ensure that future development is sustainable in light of expected changes in our climate. Building codes can protect the interests of citizens by establishing minimum standards for construction materials and techniques that contribute to the resistance and resilience of structures to natural hazards. Public works infrastructure like sanitary and storm sewers can incorporate higher tolerances to account for unexpected events.

Municipalities should also be aware of upcoming changes to building codes that will affect not only local development but infrastructure projects as well.

Engineers have traditionally relied upon historical data to design long lasting, safe and reliable infrastructure, but climate change challenges current design codes, standards and practices. In many cases, the minimum design standards are no longer appropriate.

Engineers Canada has formed a Public Infrastructure Engineering Vulnerability Committee to develop new design and operational standards. The standards will be developed based on an assessment of engineering vulnerability, which is a function of the character, magnitude, rate of change in climate conditions; the sensitivities of infrastructure to the changes; and the built-in capacity of infrastructure to absorb predicted changes. The committee will fulfil national and international requirements for a vulnerability assessment, and make recommendations for changes to local and national design codes, standards, and engineering practices.

While there is no specific timetable for the implementation of changes to codes and practices, the result will inevitably be more stringent construction requirements and an increase in capital costs.

Some of the larger municipalities may want to consider following the lead of some of the world's major corporations and hire a chief risk management officer, who will be responsible for including the impact of climate change in long-term planning. But even smaller municipalities with relatively limited resources can still take some initiatives to deal with the problem. The analysis does not need to be especially sophisticated. Simply asking the question "has climate change being considered in the design and operation of roads, culverts and bridges?" raises awareness for future short term and long term planning. **M**

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