

HAZARD PERCEPTIONS

Public education can help snap flooding

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Ontario has seen a number of urban flooding events over the past few years. In August of 2005, a severe rainfall event in the city of Toronto caused extensive overland flood and sewer backup damages, resulting in the most costly storm damage in Ontario's history. In 2004, 2005 and 2006, Hamilton experienced heavy rainfall events that resulted in significant urban flooding damages. The cities of Ottawa, Sarnia, Thunder Bay and Peterborough have also experienced damaging urban flooding events in the last 20 years. Indeed, the phenomenon is not just confined to Ontario: elsewhere in Canada, Edmonton, Calgary and Moncton have all experienced flood damage due to severe storms.

Climate change will increase the frequency and intensity of heavy rainfall events, thereby increasing the risk of severe urban flooding in Canada. Adaptation to climate change will require addressing damages caused by intense, heavy rainfall. Research is needed to understand how individuals perceive and react to natural hazards in order to implement effective damage mitigation programs.

The Institute for Catastrophic Loss Reduction (ICLR) in 2005 sponsored a perception study in Peterborough, Ontario, of 46 overland flood and 58 sewer backup respondents following two severe urban flooding events. The results of the study shed light on this growing threat of flood damage in many Canadian municipalities.

PETERBOROUGH STORMS

The city of Peterborough, northeast of Toronto, experienced a rare 1-in-100-year rainfall event in 2002 that caused severe damage to many homes and businesses. Two years later, in the summer of 2004, Peterborough experienced a 1-in-290-year heavy rainfall event. A state of emergency was declared, qualifying Peterborough for public relief funds through the Ontario Disaster Relief Assistance Program (ODRAP).

Insurance and public relief played a significant role in helping Peterborough residents recover from storm damages in 2004. All told, ODRAP paid Cdn\$25 million and private insurance companies paid out Cdn\$87 million. Sewer backup and overland flooding primarily accounted for the damages in Peterborough.

But what really caused the flooding in Peterborough?

Rain, and lots of it. There is no practical way in which a municipality can eliminate the risk of damages from such extraordinary heavy rainfall as Peterborough experienced. The 2004 heavy rainfall event was off the charts in terms of urban infrastructure planning; no sewer system in the world is designed to withstand a 1-in-290-year rainfall event.



In addition to heavy rainfall, a number of other factors come into play when urban flooding occurs.

Overland flooding can be attributed to impervious surfaces and inadequate storm sewer capacity. Where once there were pastures, forests and swamps – which reduce flooding by absorbing rainfall – urban development has resulted in impermeable streets, parking lots and roofs. Storm sewer systems are constructed to replace the absorptive qualities of natural surfaces, by conveying water from urban surfaces to prevent overland flooding from regular rain and snowmelt.

In Canada, storm sewer systems are sometimes designed to withstand 1-in-25-year rainfall events. More frequently, storm sewer criteria are designed to withstand 1-in-5-year storms. When rainfall events exceed the capacity of the storm sewer system, water has nowhere else to go but over the surface of the earth.

Overland flooding can be controlled by creating overland flow routes. This can be done, for example, by increasing the height of curbs so that streets act as water channels, or by placing drainage ditches to carry water not removed by the storm sewer system. However, in some of the older parts of Peterborough, overland flow routes were not clearly defined. Thus, water found paths through private property and backyards, sometimes entering basements through windows and doors. The placement of catch basins, the size and location of storm water management ponds and clogged storm sewer grates all played a role in the occurrence of overland flooding in Peterborough.

In addition, although not a cause of overland flooding, extensive development in the flood plains of Peterborough's rivers and creeks played a substantial role in flood damages. Flood plain development is a serious problem not only in Peterborough, but in cities across North America and the world.

The maintenance of Peterborough's sewer systems significantly affected sewer backup damage. Cracks in pipes led to cross-connections between sanitary and storm sewer systems and

AND URBAN FLOODING

victims out of fatalistic attitudes



improperly sealed manholes resulted in excess water entering the sanitary sewer system. The increased pressure in the sanitary system caused water and sewage to back-up into homes and businesses through basement drains.

Home and business owners also played a role in the occurrence of sewer backup damages. In Peterborough, many residents had eavestrough roof-leaders and foundation drains connected to the sanitary sewer system. Roof leaders significantly increased the amount of storm water entering the sanitary system and foundation drains continually contributed groundwater into the system. These water sources further increased pressure in the system, exacerbating sewage backup.

PERCEPTION RESEARCH

Since the first flood perception studies in the early 1960s, three findings have generally remained constant in natural hazard perception literature.

First, people who live in areas subject to hazards are largely unaware that they could sustain damages, personal injury or death. In most cases, less than half are aware of their exposure to natural hazards. People will often:

- deny their exposure (“It’ll never happen to me!”);
- denigrate the potential for a recurrence of the hazard;
- misinterpret hazard recurrence statistics (“It happened here last year, so we aren’t due for another 99 years.”); or
- denigrate the seriousness of a potential hazard (“I came out alright after the last hurricane, so why should I worry about the next one?”).

Second, people who live in hazard-prone areas rarely take actions to protect themselves from these hazards. Many studies reveal that less than 15% of individuals exposed to hazards take action to reduce their risk of sustaining damages. When people do take actions to reduce damages, they generally take inexpensive and less-effective actions such as evacuating at the last minute, or moving valuable items to a higher level in their home during a flood event.

Third, perception studies frequently reveal that people who own flood-prone property often rely on government-built structural mitigation mechanisms such as dams, levees and floodwalls to protect them from damages. This perception persists, despite longstanding evidence that structural mechanisms are prone to failure and can therefore increase overall flood damages (eg. the failure of flood walls in New Orleans during Hurricane Katrina). Studies also reveal a high reliance on the government for flood protection; often the blame for damages caused by natural hazards is assigned to entities or people other than those who suffered damages from natural hazards.

These findings have serious implications for how hazards are managed. Specifically, they highlight the importance of public awareness through effective hazard education.

PETERBOROUGH STUDY: PERCEPTIONS AND BEHAVIOUR

A relatively high proportion of respondents in Peterborough felt they would be threatened by flooding (61% of respondents) or sewer backup (59% of respondents) at some time in the future. These findings are promising, although there remains room for improvement on public awareness of flood damage potential.

The study also revealed a relatively high proportion of self-protective actions – with 61% and 43% of respondents taking actions to reduce future overland flood and sewer backup damages, respectively. Some of the most effective actions, however, including installation of backwater valves, were only rarely taken.

Study respondents believed the municipal government carried most of the responsibility for damages caused by overland flooding and sewer backup. Forces beyond human control – e.g. the weather, God – were secondarily responsible for damages, they believed. Homeowners who experienced sewer backup placed a greater amount of responsibility on the municipality for damages than did respondents who sustained damages from overland flooding. Conversely, overland flood respondents placed a greater amount of responsibility on forces beyond human control than respondents with sewer backup damages. These findings indicate a belief that the municipal government could have been more proactive in the prevention of damages from sewer backup by means of, for example, appropriately maintaining and upgrading sewer systems.

The study also revealed a perception that structural mechanisms – namely, larger and better maintained storm sewers – would be the most effective means of reducing damages from future heavy rainfall events. Respondents rated improvement of the storm sewer system ahead of non-structural mechanisms such as controlling new development and public education programs. This finding reflects previous hazard perception studies, which found that people favour structural mechanisms over non-structural mechanisms for protection against flooding.

INSURANCE AND ODRAP IN PETERBOROUGH

ODRAP paid a total of 2,783 claims to private homeowners in 2004. At an average of about Cdn\$2,000 per claim, the amount paid to homeowners through ODRAP totaled more than Cdn\$5 million. Including payments to businesses and government, total payouts from the ODRAP program amounted to about Cdn\$25 million. ODRAP covered 90% of the assessed value of essential items for homeowners, including wardrobes, furnaces, fridges and stoves. It did not cover luxury items such as finished recreation rooms and second televisions in basements. Thus, individuals who suffered damages caused by overland flooding often had to bear a considerable portion of damages on their own.

Insurance companies paid a total of 5,154 insurance claims in 2004, totalling more than Cdn\$87 million. The average claim for damages caused in 2004 was around Cdn\$17,000; some claims were much higher.

Applying for assistance from ODRAP and making insurance policy claims were the most popular adjustments taken following the flooding events. Sixty-seven per cent of respondents applied for ODRAP, and 93% made insurance claims.

Most homeowners (79%) said they received enough money from their insurance company to cover damages they sustained from sewer backup. Similarly, most respondents (81%) said they felt their insurance company was helpful when processing their claims. However, reflecting the newspaper reports of concern over future coverage for sewer backup damages, almost 60% of respondents who made an insurance claim were concerned that they would not be covered for sewer backup damages in the future.

Some respondents reported anger over cancellation of insurance coverage for sewer backup. Such cancellations present a potential problem: the absence of coverage reduces the ability of individuals to recover from sewer backup damages; it also transfers the burden of recovery funding to government relief programs and taxpayers at large.

INSURANCE IMPLICATIONS

Although coverage for sewer backup damage remained widely available following the 2004 Peterborough flood, it was a problem for some people. Rather than

creating an absence of coverage for high-risk properties, it would be preferable for insurance companies to provide coverage based on risk of a loss event.

In most cases, the necessary information for insurance companies to provide risk-based coverage for sewer backup has either been difficult to access or does not exist. Some Canadian municipalities, however, including Peterborough, have been working extensively to generate maps that identify areas in the city that are prone to sewage backup. This information could prove to be an invaluable tool for estimating the risk of urban flooding and setting insurance premiums that reflect that risk. Insurance companies would benefit from working with municipalities and government agencies interested in reducing sewer backup through the development and application of maps similar to those produced in Peterborough.

Insurance companies also have an opportunity to provide information to residents on how to prepare for and prevent damages caused by sewer backup and overland flooding. In a survey conducted by ICLR in 2004, over 80% of 2,100 respondents indicated they would like to receive information from their insurance companies on how to protect their homes from damages caused by natural hazards. More than 60% of respondents said they expect this information from their insurance companies. Studies on hazard education show that individuals who are well informed about hazards are more likely to employ protective actions. A well informed public will reduce damages and decrease insurance payouts.

Since insurance companies do not cover overland flood damages caused to homes in Canada, the only option available to homeowners who have sustained damages from overland flooding is to apply for assistance through a government program, receive money from the municipal government or recover using their own funds.

In the United Kingdom, Germany and the United States, federal governments have established special relationships and agreements with private insurance companies for provision of coverage for overland flood damage.

Studies have shown that individuals who have insurance coverage for flooding receive funding faster, receive coverage for a greater share of their total loss and are more satisfied with insurance coverage

than government relief funds. Furthermore, provision of insurance for flood damages reduces transfer of burden to government relief programs and taxpayers at large.

The Peterborough case study demonstrates a general satisfaction with insurance. Respondents said they were generally satisfied that they received enough money to cover the sewer backup damages they claimed through insurance. In contrast, individuals who claimed for assistance through ODRAP believed the payments came more slowly, and leaned towards a general dissatisfaction with the program.

ONGOING STUDY

Insurance is an important factor in the management of urban flooding in Ontario. However, large loss events in recent years may affect the role of insurance in addressing this problem. A range of damage mitigation and recovery mechanisms should be employed in order to effectively adapt to an increase in extreme rainfall events.

Some municipalities in Ontario and elsewhere in Canada have implemented public education programs that identify actions individuals can take to reduce urban flood damages. In addition, municipalities have historically applied bylaws that require the installation of backwater valves, swales and sump pumps in newly developed homes. Some cities that have had problems with urban flooding in the past are providing funding for the installation of backwater valves and sump pumps, and the disconnection of eaves-trough leaders from sewer systems.

Given the range of options available for reduction of these types of damages, the wide range of perceptions and behaviours of individuals subject to urban flooding and the forecasted increase in heavy rainfall events resulting from climate change, more research is needed to fully understand the issues surrounding urban flooding and implementation of effective solutions.

ICLR is continuing its research on perceptions of urban flooding with a study investigating perceptions of sewer backup in Toronto and Edmonton. This study, to be completed in 2007, will investigate homeowner hazard perceptions, individual and community mitigative actions, as well as attitudes toward insurance and government relief. The study will shed more light onto management options to reduce urban flooding in Canada. □