Institute for Catastrophic Loss Reduction

CATtales

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Inside this issue:

ICLR Board of Directors

Kathy Bardswick (Chair)
The Co-operators
Barbara Bellissimo
State Farm
Charmaine Dean
Western
Louis Gagnon
Intact
Andy Hrymak
Western
Paul Kovacs
ICLR
Sharon Ludlow
Swiss Re
Sylvie Paquette
Desjardins
Dan Shrubsole
Western

Return for refund

How useful are return periods for communicating flood risk to the public?

By Dan Sandink,
Manager, Resilient Communities and Research, ICLR

Return periods are frequently quoted by government officials when being interviewed by the media about flooding and extreme rainfall. The problem with this approach is well established, as return periods are prone to misinterpretation by the public. Further, extreme events are complicated and return periods do not often tell the full story about hazard risk and probability.

The basics

Assigning return periods to natural phenomena helps us understand and cope with random natural events. Though we can never say when an extreme rainfall event or flood will take place, we can look back into the records and identify how frequently certain types of events may occur over a given period of time. Statistical methods can help define within a certain confidence interval what types of peak flow rates you might expect on a river once every 100 or 200 years even if records are not available for the entire period of time.

The problem of using return periods to communicate risk to the public is well established. As early as the 1970s, researchers identified the problem of the 'gambler's fallacy,'[1] where an individual may think that the occurrence of an extreme event is dependent on the occurrence of a previous event. For example, return periods might lead one to think that if they experienced a 1 in 100 year flood one year, they will be safe for the next 99 years.

Of course, readers of this newsletter will be aware that extreme events are independent—experiencing one event does not affect the likelihood of experiencing a similar event in the future. A slightly better way of discussing extreme event likelihood is to identify a probability that it will occur in any given year. For example, a 1 in 100 year flood has a 1% chance of being met or exceeded in any given year, a 1 in 50 year flood has a 2% chance of being met or exceeded in any given year, and so on.

Public education materials associated with the US National Flood Insurance Program often use the above approach to communicate the probability that a home may be affected by ►

Measuring disaster losses

By Paul Kovacs
Executive Director, ICLR

Global leaders will meet next year in Sendai, Japan to finalize the global strategy for managing the risk of loss and damage from natural disasters. Disaster risk reduction has emerged as a priority for society around the world. Despite the growing interest in natural disasters, measurement of the damage remains poor. Incomplete information about damage and underestimates of the total loss is one of the reasons why there has been little progress in confronting the trend of rising losses.

Governments around the world invest in data to measure inflation, employment, and many other socio-economic indicators, but not disaster damage. Measurement is an important first step toward understanding and effectively addressing important issues.

Insurance is the business of managing risk and paying damage claims. Some companies, like Swiss Re and Munich Re, have been actively working for many decades to assess and share insurance information as a foundation for understanding disaster loss trends. Insurance data provides the foundation for most other global efforts to assess disaster trends, including the work of the International Red Cross, CRED, and the United Nations.

Using insurance data to estimate disaster loss and damage is an essential foundation for efforts around the world to confront the alarming trend of rising damage. There are limits, however, to the extent that insurance data can support effective decision making.

About 40% of the direct damage from natural hazards is covered by insurance in affluent countries like Canada. In the poorest countries less than 5% of the direct damage from natural disasters is covered by insurance. As a result, the use of insurance data to estimate direct damage requires important assumptions about the loss and damage experienced by those without insurance.

In addition, insurance information is based on claims paid and therefore largely focuses on direct damage to property. Indirect loss and damage is difficult to measure but likely exceeds direct damage. For example, when a major storm disrupts flights and other travel there is a significant cost to society in terms of lost production, but there may be relatively little direct damage. Like viewing the tip of an iceberg, insurance information describes a relatively small portion of the overall loss and damage. The focus of the United Nations, the World Bank and other international organizations on direct damage consistently underestimates the adverse impact of natural disasters.

Most importantly, the global disaster data and public information about insurance claims paid is typically available at a highly aggregate level. Detailed information essential to change behavior is seldom available. For example, homes with backwater valves are less likely to experience damage from sewers backing-up during an intense rainfall event but it is unclear if sufficient information is available about losses to influence homeowners and building code officials.

Over the next decade I expect that there will be a growing interest country by country by the major statistical agencies in the measurement of the impact of natural disasters. The initial focus will likely deal with the very large loss events – catastrophes – but over time agencies will become increasingly involved in measuring the impact of large and moderate events. The direct impact on housing and infrastructure will be an easy first step.

Measurement of the indirect impact of natural disasters will emerge in the broader analysis of economic performance. **CT**

ICLR a one-stop shop for basement flood risk reduction education material

By Glenn McGillivray
Managing Director, ICLR

Basement flooding is now so prevalent in Canada, there is scarcely a personal lines insurer or municipality that is not feeling its affects in one way or another. Some carriers and local governments have taken steps to develop risk reduction communication and education materials to help inform homeowners about mitigative actions they can take to reduce their risk. More, however, are contemplating the development of such materials but have yet to take concrete action. This is, at least in part, due to the complex nature of the hazard, which almost always forces insurers and municipalities to ask the nagging question: Where do we start?

Fortunately over the last few years, ICLR has become a centre of excellence on the subject of urban/basement flooding, and has developed numerous pieces to help inform insurers, local governments and homeowners about the nature of the problem and actions that can be taken, largely at the lot-level, to help reduce the risk. Much of the material is 'turnkey' - i.e. in a finished format that is suitable for sharing with homeowners straight off, and most pieces are available in both English and French.

Handbook for reducing basement flooding

Published in June 2009 in both English and French, the *Handbook for reducing basement flooding* serves as the foundation for much of the basement flood risk reduction material published by ICLR. The 50-plus page handbook provides information on how homeowners can reduce their chances and their neighbours` chances of experiencing basement flooding. The handbook contains 20 prioritized tips and contains some background information and descriptions of municipal sewer and stormwater management issues that have led to basement flooding problems. The handbook provides useful guidance to any homeowner who would like to reduce their chances of having basement flooding. Currently, the handbook can be found on the websites of over 100 local governments across Canada.

Protect your home from basement flooding booklet

Available in both English and French, *Protect your home from basement flooding* takes the substantial, possibly intimidating handbook and reduces it to a size that is likely more palatable to the average homeowner. The booklet provides the 20 tips in the handbook in an abridged format and also contains a brief quiz that homeowners can take to determine their level of risk. Insurers, brokers and municipalities are welcome to cobrand this booklet by placing their logo alongside ICLR`s.

Basement flood videos

At writing, ICLR had 99 videos on its YouTube Channel, with a significant number of them on the subject of basement flood risk reduction. Insurers and municipal governments are free to embed these videos onto their own sites using the embed codes available on YouTube.

Info to reduce basement flooding

This is a stand-alone four minute-plus video that explains why basements flood and goes through the 20 tips found in the *Handbook for reducing basement flooding*. This video is available in English only.

Basement flood risk reduction video series

The five professionally produced videos in this series are available in both English and French. The five titles are:

1) Why basements flood
2) Lot drainage issues
3) The ABCs of infiltration flooding
4) Plumbing measures to limit basement flooding, and
5) Taking action to reduce basement flooding. ►

Narrated animations

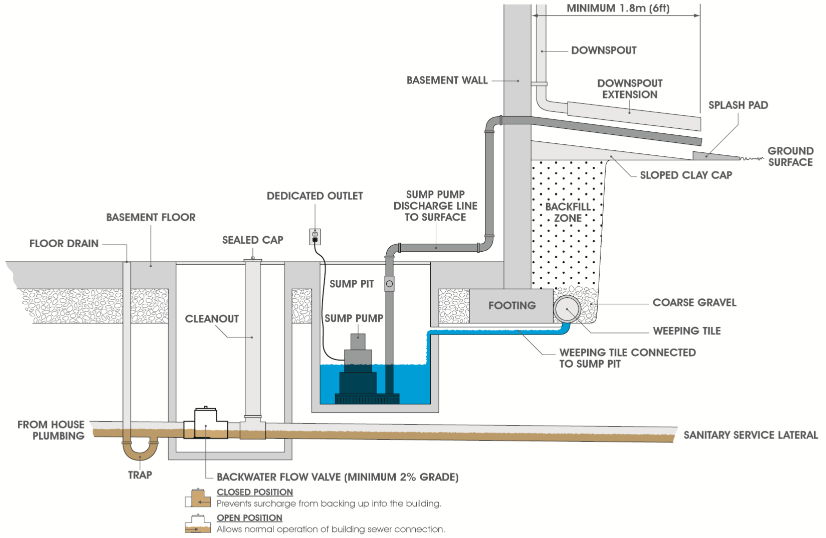
The six professionally produced videos in this series are available in both English and French. The very brief narrated animations (30 to 40 seconds) quickly explain a number of basic technical issues related to basement flooding and basement flood mitigation. The six titles are:

1) Proper lot grading to prevent basement flooding
2) Water from roof during a storm
3) Infiltration flooding
4) Backwater valves
5) Backwater valves and disconnecting foundation drains, and
6) Weeping tiles and sump pumps.

Technical drawings

The numerous technical engineering drawings that can be found in the *Handbook for reducing basement flooding* are available as separate files, in both English and French. Titles of the 13 professionally rendered drawings are:

1) Downspout extension
2) Weeping tile
3) Sump-pump installation
4) Backwater valve
5) Property line
6) Storm sewer lateral
7) Window wells and covers
8) How much water flows over a roof?
9) How flooding can occur in home: Infiltration flooding, overland flooding and sewer backup
10) Overland flooding
11) Infiltration flooding



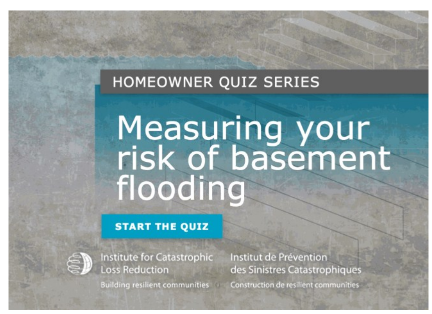
12) Sewer backup
13) Basement flood reduction in a typical two-storey home.

Basement flood reduction website

ICLR's basement flood risk reduction website is available in both English (www.basement floodreduction.com) and French (www.http://www.reduirelesi nondationsdesous-sol.com/). The site is directed at insurers, municipal governments and homeowners, and is largely based on the 20 tips found in the *Handbook for reducing basement flooding*.

The site takes the homeowner risk quiz, found in the *Protect your home from basement flooding* booklet and makes it interactive. The site also contains a rainfall calculator that allows homeowners to determine the amount of water that flows off their roofs during a rainfall event as well as a useful glossary of plumbing and basement flooding-related terms.

Essentially everything that ICLR has produced on the subject of basement flooding can be found at this site. ICLR encourages insurers and municipal governments to provide links to this site in their basement flooding-related education materials and websites.



Involving the homeowner

Most of ICLR's basement flood risk reduction information involves mitigation measures that homeowners can take at the lot-level. As basement flooding is not just a public infrastructure issue, taking such steps are essential if insurers, local governments and homeowners wish to reduce the risk of occurrence.

Being a technical problem that requires technical solutions, it is essential that insurers and local governments 'get it right' when developing education material for homeowners. ICLR has done its homework and has put the needed rigor into this material. **CT** flooding if located in a 1 in 100 year flood hazard area. Stretched over the life of a 30 year mortgage, a home in a 1 in 100 year flood hazard area has a 26% chance of being flooded.[2]

Misinterpretation of statistics is not the only problem with using return periods to communicate risk to the public. For example, it has been argued that the use of return periods results in people focussing too much on the frequency of an event, rather than on the harm it can cause.[3] Effective risk communication requires explanation of both the likelihood that someone might experience an event and the potential consequences of that event (e.g., death, injury, loss of property, loss of sentimental items, etc.).

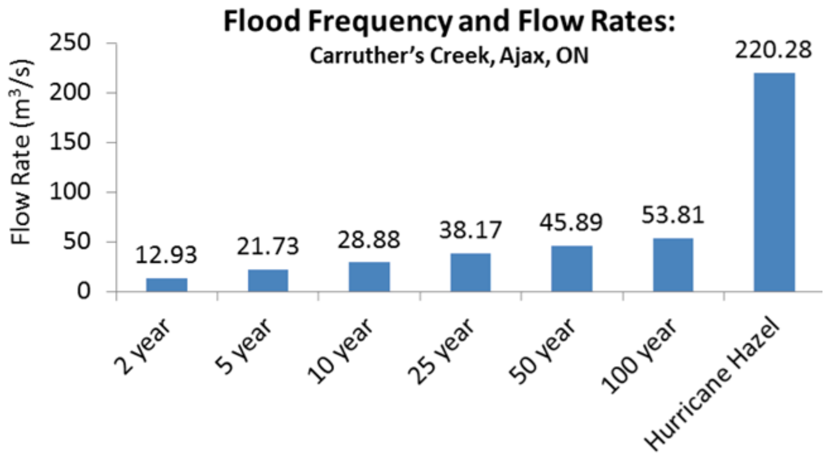


Figure 1: Flood Frequency and River Flow Rates: Return periods for a river in the Greater Toronto Area. In this region, the regional storm (Hurricane Hazel) is used to regulate flood hazard areas. Source: Ness, R. (2013). Floodplain Management in Ontario and Emerging Issues. Institute for Catastrophic Loss Reduction, Friday Forum. Series, November 15, 2013. Toronto.

Aside from these fairly simple problems with using return periods to communicate river and urban flood risk to the public, there are several other nuances to consider. Generally, return periods associated with river flooding are a little easier to understand, but rainfall return periods are more complicated. The use of hydraulic parameters to define river flood hazard areas in some provinces also complicates flood risk communication.

River flooding return periods

Return periods are used throughout Canada to define riverine flood hazards. In a good portion of the country, the 1 in 100 year return period flood is used to define flood hazard areas (for example, in Alberta, large parts of Manitoba and Ontario, Québec, most of the Atlantic provinces, and in the territories where flood hazard areas are defined). River flood return periods are relatively simple to understand, as they reflect the likelihood that a specific river will experience a specific flow rate, or that a flood hazard area will experience inundation over a given period of time (see Figures 1 and 2).

As discussed in previous ICLR papers[4], flood hazard areas are frequently broken into two component parts: The floodway and the flood fringe. In several Canadian jurisdictions, including Québec and several of the Atlantic Provinces, the floodway is defined as the portion of the flood hazard area that has a 1 in 20 year flood probability, and the flood fringe is the area that exists between the 1 in 20 year floodline and the 1 in 100 year floodline. While this approach helps communicate that those in the floodway will experience a greater likelihood of being flooded in any given year, it still relies on return periods which are difficult for the public to digest.

Using hydraulic parameters to define floodways is another common approach in Canada, and has been applied in Alberta, Saskatchewan, Manitoba, the Northwest Territories and Nunavut.[5] Using this approach, a floodway may be defined as the section of the flood hazard area where flood waters will, for example, travel at least 1 m/s and be at least 1 m deep during a 1 in 100 year return period flood. ►

Figure 2: Zone Flood Hazard Area, Alberta. In Alberta, a two-zone flood hazard area is defined. Pink areas include the 1 in 100 year flood fringe, and red areas represent the floodway, where flood waters would reach at least 1 m in depth and flow 1 m/s during a 1 in 100 year flood.
Source: http://www.envinfo.gov.ab.ca/FloodHazard/

Communicating flood probabilities to the public in this way may be more problematic than using return periods. For example, are people in the hydraulically defined floodway aware that they could flood far more frequently than others in the 1 in 100 year flood hazard area (for example, those in the fringes)? In other words, how likely is it that a homeowner in the floodway could be flooded with water 0.5 m deep flowing 0.5 m/s? While still a potentially serious flooding event, this information is not defined in existing maps.

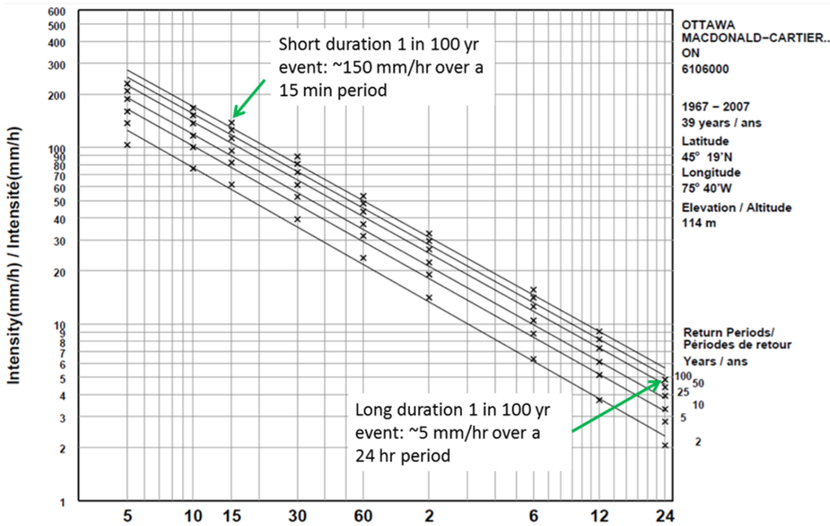


Figure 3: Rainfall IDF Curve—Ottawa International Airport. The above graph provides the rainfall IDF curve based on data from the Ottawa Macdonald-Cartier International Airport. The graph also displays events with return periods of 1 in 100, 50, 25, 10, 5 and 2 years. Return intervals are represented by "x" on the graph. Additional return intervals for each of the return periods are estimated and represented by the lines. Adapted from Environment Canada, 2012 (IDF curves available from: ftp://ftp.tor.ec.gc.ca/Pub/Engineering_Climate_Dataset/IDF/IDF_v_2.100_2011_05_17/IDF_Files__Fichiers/)

Rainfall return periods

Communication of risk through return periods associated with rainfall events is considerably more complicated than those associated with flow rates and flood hazards in rivers. For example, issues surrounding intensity and duration of rainfall events, as well as geographic areas that may be exposed to extreme rainfall events serve to complicate rainfall return periods.

When rainstorms are discussed in the media, reporters may refer to return periods quoted by government officials. However, what is not often reported are the other important components of rainfall intensity and duration. Indeed, when considering risk of urban flooding, the intensity of an event (e.g., the amount that falls over a period of time, usually represented in mm per hour) is often a more important consideration than the return period or frequency of the event.

Take the example of a '1 in 100 year' rainfall event. When considering flooding caused by extreme rainfall, a long, moderate intensity storm (e.g., 5 mm/hr over 24 hrs) may be less concerning than a very high intensity storm (e.g., 150 mm/hr over a 15 min period). However, in the case of the IDF curve generated using data from the Ottawa International Airport rain gauge, both of these events have return periods of 1 in 100 years (see Figure 3).

Another issue with communicating the severity of storms to the public with return periods is geography. Return periods represented in IDF curves like the one above provide the return intervals of specific rainfall events at the point of the monitoring station or rain gauge, from which data is used to generate the IDF curve.[6] For example, if a city uses rainfall data collected at its local airport to generate IDF curves for the city, the information represented in the IDF curves will reflect the time interval of rainfall events occurring *only at the specific point of the rainfall gauge* (e.g., the airport), not for the entire city or region.[7] It is important to note that 1 in 100 year rainfalls are much more likely to occur at a regional scale than at a specific point.

There are many other issues related to relying only on return periods to communicate risk associated with extreme rainfall. For example, return periods do not provide information on antecedent conditions related to rainfall that may have occurred during the weeks and days before an extreme event,[8] which can saturate soils and lead to more intense stormwater flows.

Moving forward with risk communication

Referring to a specific rainfall or flood event as exceeding 1 in 100 year design standards allows officials to communicate the fact that extreme events are rare, and that not every type of event can be planned for. When extreme events exceed infrastructure design standards, flooding will occur and municipalities can't necessarily be blamed for poor planning. However, communicating return periods may be counterproductive if municipalities would like to encourage individual homeowners to participate in risk reduction. Indeed, how likely is ►

It that a homeowner will invest thousands of dollars in property-level flood risk reduction if they think that a severe flood will only occur every century or more? Evidence has already revealed that private property owners are unlikely to engage in risk reducing behaviour, even after they have experienced disaster events.[9]

Further, return periods associated with specific floods or rainfall events do not tell the full risk story to property owners. It is true that, in any given year, a 1 in 100 year rainfall event might be rare. But what if you were to, more realistically, stretch the probability of the amount of time one might expect to live in a home or community? Over a 50 year period, a 1 in 100 year event is not rare. Indeed, the likelihood of experiencing a 1 in 100 year hazard over a 50 year period is nearly 40%.[10] These are very bad odds for a homeowner, especially considering the financial implications and misery associated with flood damages and recovery.

In an analysis of online flood hazard maps developed for both expert and public users in Germany, it was found that, while statistical return periods should be included in map outputs for expert communities, scales such as "very frequent floods" to "very rare...floods" should be used to communicate flood risk to public users.[11] Defining what is very frequent and very rare, as discussed above, depends on the time frame that is considered and may be subjective. Regardless of the approach, the difficulties associated with communicating flood risk and the problems of using return periods to communicate risk to the public are well documented—clearly a new approach is needed. **CT**

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Mission
To reduce the loss of life and property caused by severe weather and earthquakes through the identification and support of sustained actions that improve society's capacity to adapt to, anticipate, mitigate, withstand and recover from natural disasters.

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