by Dan Sandink

Retrofitting Homes to Reduce Basement Flood Risk

Lessons Learned

Over the past few years, the Institute for Catastrophic Loss Reduction (ICLR) has retrofitted 10 Canadian homes to exemplify measures that can be taken by homeowners to reduce risk from hazards that affect communities across the country, including severe wind, wildfire, earthquake, and basement flooding. These retrofits were undertaken as part of the Designed for Safer Living "Showcase Homes" series, where ICLR conducts a home retrofit and invites the media and insurers to view risk reduction measures during National Emergency Preparedness Week. Dozens of insurance professionals attend the events each year and often comment on the benefits of seeing on-the-ground application of homeowner mitigation options. Due to the localized nature of natural hazard impacts and differences in home design, all of the retrofits were undertaken as collaborative efforts with local municipalities.

Since 2009, ICLR has retrofitted three homes to reduce basement flood risk as part of this program. The experience with basement flood retrofits highlights the complicated nature of home drainage systems and the need to customize retrofits for each individual home.

Toronto, 2009

The first house retrofitted to reduce basement flood risk was in the North York area of Toronto. This home was located in an area of the city that suffered severe and widespread flooding during an extreme rainfall event on August 19, 2005 and was at risk of future flood events.

Investigation of sewer backup events sometimes leads to surprising discoveries – as well as extensive remedial work, as shown above.

One of the first steps in any flood retrofit project should be a plumbing inspection by a licensed plumber, including a camera inspection of the home's sewer laterals. In this case, the camera inspection revealed that a backwater valve had been installed without proper disconnection of the foundation drains from the sanitary sewer. This type of arrangement can cause "self flooding" in the home, because when the backwater

For more information on basement flood reduction, download the *Handbook for Reducing Basement Flooding* and view videos on basement flood reduction at <www.iclr.org>.

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valve closes during an extreme rainfall event, water from the foundation drainage would not be able to exit the home and may backup into the basement through floor drains or bathroom drains and flood the basement. Thus, disconnection of the foundation drain from the sanitary sewer and installation of a sump pump system to pump foundation drainage to the surface of the lot were necessary measures incorporated into the home. Downspout drainage outlets were also rearranged with a French drain system installed on a downspout that was discharging directly onto the home's driveway.

Hamilton, 2011

The home retrofitted in Hamilton in 2011 had experienced a severe sewer backup flood on July 26, 2009 and was serviced by a combined sewer system. The homeowner had taken advantage of the City of Hamilton's basement flood retrofit financial assistance program, and had a mainline backwater valve and sump pump system installed. Downspouts were also disconnected from the foundation drain before ICLR conducted its work.

The existence of a driveway catch-basin complicated this retrofit – and necessitated the installation of additional measures to reduce risk. This catch-basin was connected to the home's foundation drainage and, surprisingly, served to drain the neighbour's driveway, which was sandwiched between the two homes. The catch-basin essentially made the neighbour's driveway into a huge funnel that directed massive quantities of rainwater into the foundation drainage and risked overloading of the sump pit and pump during heavy rainfall events. This arrangement was a relic from a time when property developers did not fully appreciate and understand property drainage issues.

A second, large-capacity sump pit and pump were installed, and a part of the front yard was re-graded to direct as much water away from the driveway catch-basin as possible. An automatic natural gas generator was also installed to power the pumps in the event of a power outage. Had the catch-basin not been there, a simple backwater valve/sump pump arrangement would likely have been sufficient for this home, along with other relatively simple measures including window well covers and disconnecting downspouts.

Moncton, 2012

The Moncton retrofit was conducted on a home that had experienced a severe sewer backup event when tropical storm Danny dumped heavy rain on the city in late August 2009. In this case, the home was serviced by a separated sewer system and sewage had backed up into the basement from the storm sewer. This home's plumbing arrangement necessitated the installation of backwater valves on the storm and sanitary sewer laterals, as well as a sump pump system with a battery backup. A small part of the back yard was also re-graded to direct water away from the foundation, and with window wells and window well covers installed on two basement windows.

Two surprises were found in this home. When the plumbers conducted the camera inspection of the laterals on the day that the backwater valves were to be installed, they found that both laterals were full of standing water and sewage. Normally, sewer laterals are graded in a manner that directs water away from the home quickly, and should never have any standing water. Thus, before the backwater valves were installed, the laterals had to be torn up and replaced, requiring the excavation of the front yard. When installing the window wells, the landscapers also found that the foundation drains were plugged with silt and were not properly draining groundwater away from the home's foundation. Before the window wells were installed, the foundation drainage needed to be cleared using a large vacuum truck.

Lessons Learned

Failure to disconnect the foundation drainage in the Toronto home meant that the backwater valve would have provided little flood protection, as the home could have still flooded from its own foundation drainage had the valve closed during a heavy rainfall event. Further, in the Moncton home, backwater valves would have been ineffective and may have even increased flood risk if they were installed in the laterals when they were full of standing water. In this case, replacement of the laterals was absolutely necessary to ensure that the backwater valves would work properly. Both of these cases illustrated the complex nature of basement flood risk reduction and the fact that the simple, straight-forward installation of a backwater valve on the sanitary sewer lateral is not always an effective or meaningful risk reduction option.

The need to balance the costs and benefits of mitigation measures and the realization that it is difficult to implement perfect or ideal mitigation options in homes was exemplified in the Hamilton case. For this home, ICLR explored the possibility of re-grading the neighbour's driveway and installing a permeable pavement system. This would have totally eliminated the need for the catch-basin. However, to facilitate this approach, huge quantities of fill would have had to be brought in to re-grade the driveway, causing significant disruption for the homeowner and neighbours. It would have also resulted in a cost of tens of thousands of dollars – so, it was decided that the second sump, a powerful pump, and generator system offered a reasonable compromise.

Generally, the plumbers and contractors who helped to retrofit the homes were knowledgeable and conducted the work within a reasonable period of time. However, it was more difficult than expected to find contractors and plumbers who were knowledgeable and willing to complete this type of work. In some instances, it was necessary to convince contractors that certain flood reduction measures were necessary. For example, there was push-back from the contractor when asked to locate the foundation drainage connection in the Toronto home. The contractor cited difficulties in locating the connection and the possible need to tear up several spots in the basement floor as reasons not to complete this measure. In the end, ICLR insisted that the work be performed; however, a homeowner who was not confident in their knowledge of basement flood risk reduction might have been persuaded by

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the contractor that this measure was not worth the aggravation.

It was clear how some homeowners could be intimidated by the retrofit process if they are not armed with clear, consistent information from authorities and if they are not confident in their knowledge of what needs to be done to address basement flood risk. Some municipalities publish lists of plumbers who are knowledgeable about basement flood risk reduction measures, and some municipalities also provide assistance in the form of home inspections to identify necessary flood reduction options – useful tools for homeowners interested in starting the retrofit process but not knowing where to begin.

Conclusion

The experience with these three homes brings to mind an old cliché: Easier said than done. Anyone who has undertaken relatively major home improvement projects would likely be all too familiar with this concept, and basement flood retrofits are no different. Indeed, each home had its own idiosyncrasies that increased the complexity of the retrofit.

The most important lesson learned was that every home, neighbourhood, and municipality is different, and mitigation measures have to be tailored to suit these differences. Complications underscore the need for full understanding of home drainage systems before retrofit measures are installed and the need to communicate with a range of professionals, including city staff, plumbers, and contractors. However, complexities should not detract from the importance of homeowner-level basement flood mitigation – lot-level mitigation remains an absolutely necessary piece of the basement flood risk reduction puzzle. MW

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