



LCERPA

Laurier Centre for Economic Research & Policy Analysis

LCERPA Commentary No. 2016-4

May 2016

Flood Damage: The Hidden Cost of Climate Change

Derek Ensing,
Department of Economics, Wilfrid Laurier University

Climate Choices Canada Commentary¹

Flood Damage: The Hidden Cost of Climate Change²

By

Derek Ensing³

April 2016

Key Observations:

- Overland Flood Insurance is not provided to the vast majority of Canadians as overland flooding has historically been deemed uninsurable.
- The Federal Government provides after the fact flood relief through the Disaster Financial Assistance Arrangements which they decreased in 2015 shifting a large burden to the provinces.
- Forward looking policy is needed to shift investment to green infrastructure that can reduce the future risk of damage from flooding.

Introduction:

As the national conversation shifts to setting emissions targets, putting a price on carbon, and transitioning to a low carbon society, we lose focus of the real life consequences of climate change already taking place. The increased frequency of extreme weather events is already underway and having a real impact on everyday Canadian life (Bascaramurty, Nelson, Cryderman, & Stueck, 2013). Recent weather events in Calgary have put a spotlight on an emerging problem; Canadians are not prepared to appropriately deal with extreme weather events whether it be through storm mitigation infrastructure, storm and flood modelling technology, or insurance. Over the last decade the frequency of extreme weather events in Canada has increased dramatically and so too has the damage. Compounding this situation is a lack of reliable flood modelling which has led to a large number of homes being built on flood plains. Flood damage is not unique to Canada, internationally there have been a variety of approaches to mitigate damages, and reallocate risk through insurance and relief programs. Evidence from other countries suggests that Canada's approach is not sufficient in helping communities re-establish themselves after catastrophic natural disasters.

¹ *Climate Choices Canada* took place February 18 to 20, 2016 in Waterloo, Ontario. This commentary is based on the conference presentations and participants' discussions.

² Insight offered by Dr. Jason Thistlethwaite during Session 5 "Subfederal and Sectoral Approaches" of the Climate Choices Canada conference.

³ Derek Ensing is a MA Business Economics Student at Wilfrid Laurier University.

This commentary summarizes the current flood insurance picture in Canada, highlighting the economic and practical issues associated with flood insurance. The challenges of climate change for the provision of flood insurance are then considered. The commentary concludes with a discussion of some policy options for enhancing mitigation and decreasing future flood risk, as alternatives to overland flood insurance.

The Insurance Market:

Flood Insurance availability:

Private overland flood insurance is not a product that is offered in Canada for a variety of reasons (Sandrik, Kovacs, Oulahen, & McGillivray, 2010). The most logical reason being that floods are predictable and thus not included in the typical “act of god” clause in insurance policies that insure homeowners against lightning, windstorms, and hail. Floods are predictable in the sense that you must live near a flood plain to experience flooding. This is deemed an uninsurable risk by private insurance companies because individuals accept the risk of flooding when they choose the location of their house. The increasing frequency of extreme weather events has complicated this logic; houses that were previously deemed to have little or no risk of flood damage are now experiencing flood damage. Flood events are characterized by their recurrence interval in which the probability of an event of a magnitude is expressed in years. A 100 year storm has a probability of 1 in 100 or one percent probability of occurring in any given year. Climate change has altered the recurrence interval of storms. A storm that was previously deemed a 100 year storm now has a greater than one percent probability of occurring resulting in more damage to a wider area. There is evidence of this damage all over Canada including two recent high profile floods in Calgary and Toronto (Bascaramurty, Nelson, Cryderman, & Stueck, 2013).

Private flood insurance is not the only risk management avenue for flood damage. The federal government could choose to offer a form of flood insurance to help Canadian homeowners. This is the approach taken in the United States through the National Flood Insurance Program (NFIP) (Michel-Kerjan, 2010). This is a joint program between multiple levels of government and the private insurance industry where the federal government sets the premiums and assumes the liability while private insurance companies sell the policies and collect the premiums. The NFIP was instrumental in helping the city of New Orleans and its residents after Hurricane Katrina. However, the program suffers from many issues including outdated flood-risk maps; low insurance penetration and retention; lack of motivation by residents to invest in risk protection measures; repetitive losses that account for a large part of the claims; and how the NFIP can be financially sustainable in the face of truly catastrophic losses (Michel-Kerjan, 2010).

Classic economic problems with insurance (adverse selection, moral hazard)

Whether flood insurance is publicly or privately provided it faces some classic insurance issues that influence the availability of overland flood insurance. In economics, these issues are termed sources of market failure. Both moral hazard and adverse selection are issues in the market for insurance and arise from asymmetric information. The moral hazard problem, where individuals who have insurance increase their risk through their behaviour, increases the overall risk of the insurance pool. It is easy to think of reasons why moral hazard would plague this insurance

market. Those who choose to live on or near a flood plain are the much more likely to seek out overland flood insurance. Due to their behaviour of building homes on risky land, they have increased the overall risk in the theoretical flood insurance pool. The adverse selection problem is particularly relevant to the challenges of providing flood insurance. The only people who will tend to demand flood insurance are those who know they are high risk and are willing to pay the high premiums needed to make insurance profitable for private insurance firms. Usually, this is a losing proposition for private insurance firms. One option is to make overland flood insurance mandatory, as is done with car insurance. By adding in low risk individuals to the risk pool, more premiums are coming in and private insurance provision is more financially viable. This option has not been adopted in Canada. However, the increased frequency of extreme weather events due to climate change, will likely increase the risk of flooding and the demand for flood insurance. So there may be increased pressure on governments to consider this option in the future.

The discussion of the NFIP program above highlights a third problem - flood insurance must overcome the highly correlated nature of potential claims. It is reasonable to expect that if one home in the risk pool were to incur losses then the majority of homes in the risk pool will incur losses. For insurers this means that when someone in the risk pool receives a loss, it is very likely that many other individuals in the same risk pool will incur losses. In the provision of insurance, potential claims in a risk pool are supposed to be uncorrelated so that a claim can be paid out by the premiums from the rest of the pool. When claims are highly correlated insurers face large liabilities and do not have the funds to cover them. Insurance is not likely to be provided in these situations, if offered then insurance companies charge a high price so that premiums can cover claims in the event that there are a large number of claims in the risk pool.

Issues with government provided insurance

When correlated risks, adverse selection and moral hazard problems lead to market failure in the private insurance market, governments can provide insurance instead of private firms. Governments in the United States, France and the UK have taken this approach to offer more adequate coverage and reduce some of the liability to insurance companies (Sandrik, Kovacs, Oulahen, & McGillivray, 2010). An overview of some international approaches to flood insurance can be seen in Table 1. The Canadian approach has been disaster relief funding at both the federal and provincial level. The current federal Disaster Financial Assistance Arrangements (DFAA) program designates a cost sharing between the federal government and provincial or territorial government after a natural disaster. Some examples of the DFAA in use are the 2005 Alberta floods, the 2003 British Columbia wildfires, and the 2006 flood in Newfoundland (Government of Canada, 2015).

Recently, the federal government has begun reducing the size of its fund, leaving the provinces to pick up a greater share of the burden. One may question the reasons why the federal government would be reducing the size of this fund in the face of rising frequency of extreme weather events. A simple explanation would be that the expected net benefits from other government programs is higher than the DFAA. This would suggest that the DFAA is not the optimal allocation of government funds. An alternate explanation is that the DFAA program is a risk shifting scheme in which flood risk is shifted from those living near a flood plain to all Canadians. There is potential political pressure to have those living near flood plains accept the

consequence of their choices. However this reasoning is problematic given the inability to predict extreme weather events, their potential ability to cause flooding, and the inability to predict the damage from flooding.

Table 1: International Flood Insurance Programs			
Country	Private Insurance	Public Insurance	Flood Relief & Mitigation Programs
Canada	N/A	N/A	Disaster Financial Assistance Arrangements - Provincial and Federal governments provide relief funding to restore infrastructure
United States	National Flood Insurance Program (combined Public and Private) - Federal Government sets premiums and assumes liability, private insurance providers sell policies and collect premiums		FEMA - Three programs targeting at-risk communities: Flood mitigation assistance, Repetitive Flood Claims, Severe Repetitive loss
France	Combined Public and Private - Private insurance with government backstop	N/A	EU Solidarity Fund - covers a range of different catastrophic events including floods. Twenty-four European countries have been supported so far for an amount of over 3.7 billion €
Germany	Natural hazards insurance		
UK	General home insurance policies		

Source: Sandrik, Kovacs, Oulahen, & McGillivray (2010), European Commission (2016)

Looking Forward:

Data and modelling issues

The ability to estimate risk and damages should the adverse event occur is essential for the provision of insurance. The discussion on whether floods are an insurable risk is centered on the ability to predict flood risk and to estimate damages from flooding. Complicating the ability to model or predict flood damage is the aforementioned increased frequency of extreme weather events. In relation to the provision of flood insurance, predicting flood damage or the frequency of extreme weather events is not necessary when discussing the insurability of property already deemed uninsurable. Generally, they are deemed uninsurable because of their proximity to peril. Recent Canadian floods have complicated the insurability debate because of the wide scale damage. Properties that may previously have been deemed less risky are experiencing damages. To establish the risk of damage to a property, insurance companies need to rely on flood modelling. Flood modelling has relied on historical data to determine the risk of flooding in a particular area. The problem arises when historical data no longer becomes a good predictor of

future events. This is the issue that we are seeing as the frequency of extreme weather events increases. Property that may have previously been deemed low risk (because historically it has never experienced flood damage) is now being damaged by extreme weather.

Lack of foresight and mitigation

As outlined above, the DFAA is not a form of government provided insurance. The DFAA is an after the fact disaster relief fund and this distinction is important. Essential to this program is the use of provincial and federal funds, “[e]ligible expenses include, but are not limited to, evacuation operations, restoring public works and infrastructure to their pre-disaster condition, as well as replacing or repairing basic, essential personal property of individuals, small businesses and farmsteads” (Government of Canada, 2015). The use of public funds to restore public works and infrastructure to their pre-disaster condition is alarming. As the frequency of extreme weather events increases it makes little sense to repair public infrastructure like roads and bridges to the pre-disaster condition which was proven vulnerable by the disaster that damaged it.

Two distinct trends emerge, the increasing frequency of extreme weather events and the reduction of the DFAA program work counter to restoring public works and infrastructure to their pre-disaster condition. Restoring infrastructure increases the built environment which will be costs when the next disaster occurs. Further, these costs may come at a time when there is significantly less funding to repair them. As an alternative, investment in flood mitigation in conjunction with flood resilient infrastructure makes more fiscal sense than the restoration to pre-disaster condition. Not only would this reduce the likelihood of future damages, but it would also decrease the cost of the future damages, matching the path of the DFAA fund.

Forward looking policy like investment in flood mitigation does not necessarily mean an enlargement of the DFAA fund. There are some smart investments that can go a long way towards reducing flood damages. Green infrastructure like porous pavement which allows water to infiltrate pavement instead of running into storm water systems decreases the runoff in extreme weather events that need to be handled by conventional storm water systems. Vegetative swales⁴ can be built to direct storm water away from vulnerable properties at risk in extreme weather events. Many of these small scale, low cost investments can transform the way a city handles storm water in extreme weather events. Forward looking policy that emphasises these investments are key in mitigating future events.

Green infrastructure projects are real tangible investments that can have a large impact on the flood mitigation capability of a city. There are many projects underway across many cities to increase the flood mitigation of cities with green infrastructure. The City of Philadelphia has added 1,100 green stormwater investments since 2011 saving an estimated \$5.6 billion (Philadelphia Water, 2016).

Summary:

A central theme from the *Climate Choices Canada* Conference was the need for forward looking policy as it relates to both climate change and carbon pricing. Forward looking policy should be extended to deal with some of the consequences of climate change. Overland flooding is a large

⁴ A grassy sloped conveyance system that directs stormwater away from conventional systems and allows infiltration.

issue for many Canadians and the increasing frequency of extreme weather events means that it will likely get much worse. Traditional solutions like insurance to appropriately deal with the risk associated with climate change are not viable for flood damage. The Federal Government has some involvement in filling the void left by insurance but they are not involved in an insurance role and they have decreased the involvement that they do have. There are alternative options to the insurance market. As Canadians move towards a low carbon society and carbon pricing policies there is a need to develop green infrastructure that is adept at reducing the risk to individual's property and the built environment. Restoring infrastructure after flood damage does little to mitigate future flood damage and increases the value of the built environment that could incur future damage. Forward looking policy is needed to combat the consequences of climate change as well as climate change itself.

Works Cited

- Bascaramurty, D., Nelson, J., Cryderman, K., & Stueck, W. (2013, July 29). *Governments ponder how to weather the next big storm*. Retrieved from The Globe and Mail:
<http://www.theglobeandmail.com/news/national/weathering-the-next-one/article13331404/?page=all>
- European Commission. (2016, 04 15). *EU Solidarity Fund*. Retrieved from Europa Regional Policy:
http://ec.europa.eu/regional_policy/en/funding/solidarity-fund/
- Government of Canada. (2015, 12 16). *Disaster Financial Assistance*. Retrieved from Public Safety Canada: <https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/rcvr-dsstrs/dsstr-fnncl-ssstnc-rngmnts/index-eng.aspx#a04>
- Michel-Kerjan, E. O. (2010). Catastrophe Economics: The National Flood Insurance Program. *Journal of Economic Perspectives* 24 (4), 165-186.
- Philadelphia Water. (2016, 04 15). *Green City, Clean Waters*. Retrieved from Philadelphia Water Department:
[http://phillywatersheds.org/what_were_doing/documents_and_data/cso_long_term_control_p
lan](http://phillywatersheds.org/what_were_doing/documents_and_data/cso_long_term_control_plan)
- Sandrik, D., Kovacs, P., Oulahan, G., & McGillivray, G. (2010). *Making Flood Insurable for Canadian Homeowners: A Discussion Paper*. Institute for Catastrophic Loss Reduction & Swiss Reinsurance Company Ltd.
- Sri-Skanda-Rajah, A. (2015, June 1). *Drought to Deluge*. Retrieved from Canadian UnderWriter:
<http://www.canadianunderwriter.ca/features/drought-to-deluge/>