Floodplain Mapping Backgrounder

to the BC Real Estate Association *Floodplain Mapping Funding Guidebook for BC Local Governments*

April 2014

Prepared by:

Yuill Herbert, Ian Picketts
Sustainability Solutions Group

Tamsin Lyle
Ebbwater Consulting

British Columbia
Real Estate Association

Prepared for:

BRITISH COLUMBIA REAL ESTATE ASSOCIATION

With funding from:

real estate foundation BRITISH COLUMBIA

Contents

1. INTRODUCTION

Flooding poses a catastrophic risk to Canada and British Columbia's economic vitality, infrastructure, environment and citizen safety. Flooding is consistently Canada's most costly and frequent natural hazard[1] and will likely continue to be so in the future, especially in light of Canada's changing climate.[2]

Evidence exists that preparation and planning ahead of a disaster greatly reduces the costs and suffering incurred during and after a disaster event. For example, $63.2 million invested in the Manitoba Red River Floodway in 1960 is estimated to have saved $8 billion in potential damage and recovery costs over 45 years.[3] And in 2012, Public Safety Canada recommended developing "a mitigation program that would apply to all provinces/territories to enhance infrastructure to better withstand future floods."[4]

A key tool for preparing and planning for disasters is the floodplain map. Floodplain maps and other technical studies form a foundation to inform decisions about how and where communities grow and mitigate the risk of flood events. Floodplain maps may also be used for public education, emergency planning and response, and in actuarial models to develop flood insurance rates.[5]

This document aims to discuss the variety and types of floodplain maps. It was funded by the Real Estate Foundation of British Columbia and the British Columbia Real Estate Association.

2. OVERVIEW OF FLOODPLAIN MAPPING

Floodplain maps provide information on where flood waters are expected to go; that is, they visualize a flood hazard.

Broadly, the calculation of flood hazards involves three steps:

1. Estimating the amount of water accumulated and discharged during a rain or other water inflow event.
2. A hydraulic model is then used to determine where the water might go.
3. Potential flood areas are mapped by combining water levels with a digital elevation model (a virtual interpretation of the topography) or base maps and surveys.

---

[1] Public Safety Canada, 2013
[2] Intergovernmental Panel on Climate Change, 2013
[3] Public Safety Canada, 2008
[4] Public Safety Canada, 2012
[5] In Canada, overland flood insurance is limited to commercial coverage, although residential coverage is under investigation (see Thistelthwaite & Feltmate, 2013).

3. EXAMPLES OF FLOOD MAPS

Flood maps can be used for a range of different purposes, from outlining the extent of floodplains (Figure 1a) to applied tools that can consider risk (such as threats to life, health, property or the environment) and projected changes.

Each type of floodplain map requires different sets of data, expertise and levels of detail and effort, resulting in a range of associated costs. The choice to develop a particular type of map is based on available resources, the purpose and the end user.

Specifically, flood depth maps or flood propagation maps (Figure 1b, 1c) can inform hazard documentation. There are flood maps for emergency response (Figure 2) and risk and consequence mapping (Figure 3) can be produced if suitable information on the elements at risk is available. Web-based technologies and mobile applications support wider access of interactive mapping and flood management tools (Figure 4).

The effort and resources required to create these maps generally increases from the flood extent map to applied flood tools. Applied tools and risk maps, which require more significant investment, may provide more useful information than simple extent maps. However, the basic flood map (extent and/or depth) is the essential starting point for any type of mapping effort.

Flood Mapping in Canada

The majority of flood mapping in Canada was developed during the era of the Federal Damage Reduction Program (1975 to mid-1990s) and the subsequent provincial-federal agreements on flood mapping, which provided 50/50 cost-sharing between the federal and provincial governments. Under this program numerous, but not all, inhabited floodplains were mapped, and differing approaches to flood hazard mapping methodologies were used. The FDRP cost over $50 million (Environment Canada, 2013).

Summary of Flood Maps Developed Under FDRP (1975 to 1995)

Province/ territory	# of communities mapped	Regulatory flood (generalized)
BC	70	1:200
Alberta	20	1:100
Saskatchewan	22	1:500
Manitoba	18	1:100
Ontario	318	1:00+
Québec	211	1:100
New Brunswick	12	1:100
Nova Scotia	6	1:100
Prince Edward Island	-	-
Newfoundland and Labrador	19	1:100
Yukon Territory	-	-
Northwest Territories	9	1:100
Nunavut	-	-

Based on Institute for Catastrophic Loss Reduction, 2010

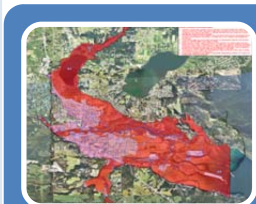
Figure 1: Different Types of Maps[6]

Flood Extent Map (a)

- Relatively common, simple
- Minimal Inputs (1D Hydraulic Model, Basic Topography)
- Limited use

Flood Depth Map (b)

- Relatively common, simple
- Minimal Inputs (1D Hydraulic Model, Digital Elevation Model)
- Useful for basic land use planning

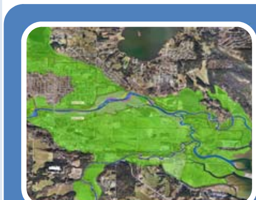


Flood Velocity and Propogation Map (c)

- In use in some parts of Canada, but relatively uncommon
- More complex inputs (2D hydraulic model, digital elevation model)
- Useful for emergency response, land use planning and policy development

Flood Event Map (d)

- Relatively rare
- Documentation of a specific flood event used for future flood planning
- Straightforward inputs, significant resource time (survey, digitisation of available imagery)



Channel Migration Map (e)

- Relatively rare
- Geomorphic based map, used to establish future potential zones of erosion
- Requires specific geomorphic resources and historic imagery

[6] Northwest Hydraulic Consultants, 2009

Figure 2: Emergency Management and Response Maps[7]

Flood Evacuation Map (a)

- Shows basic information on floodplain as well as disaster response routes
- For public use, generally presented in easily accessible locations such as bus shelters or phone books

Probabilistic Flood Hazard Map Series (b)

- Relatively uncommon, relatively simple
- A series of flood hazard maps of any types showing hazard under various flow/coastal events
- Useful for emergency response

Figure 3: Example Flood Consequence and Risk Maps[8]

Flood Consequence Map (a)

- Provides information on the potential economic, and sometimes social and environmental, consequences of flooding
- Useful for planning and emergency response

Flood Risk Map (b)

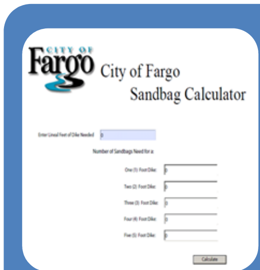
- Relatively rare, more common in European Union
- Extensive inputs (probabilistic flood hazard mapping, asset inventory)
- Used by general public, planners and insurance industry

[7] Northwest Hydraulic Consultants, 2009; Toshima City, 2010
[8] Landmark Information Group, 2013; US Federal Emergency Management Agency, 2013

Figure 4: Interactive Flood Tools[9]

Internet-Based Flood Information Tool (a)

- Provides local, real-time information on flood hazard
- Useful for emergency response
- Can also provide probabilistic flood hazard information useful for flood planning



Applied Internet-Based Flood Information Tool (b)

- Provides local, real-time information on flood hazard
- Useful for emergency response
- Provides practical information to the public (e.g., number of sandbags required to protect home)

Applied Internet-Based Flood Information Tool - Insurance (c)

- Provides local information on flood hazard, in this case a flood risk rating based on a postal code
- Provides practical information to the public (e.g., availability of insurance)

The examples presented in figures 1-4 focus on riverine flooding. However, British Columbia also faces coastal, pluvial, snowmelt runoff and ice jam flooding, and man-made flooding from catastrophic dam or dike failure. Coastal flooding maps are similar to riverine floodplain maps, in that they highlight potential inundation areas under various storm scenarios. Pluvial mapping, and the related snowmelt runoff mapping, is a relatively new type of analysis and is not well defined as of yet.[10] Dam-break inundation mapping is generally similar to riverine floodplain mapping, except that it requires that the timing of a floodwave moving down the flow path be included in the hydraulic modelling studies and in the final mapping.

3.1 Floodplain Maps as Regulatory Tools

Floodplain maps can serve as regulatory and administrative tools providing basic flood extent or depth maps that depict minimum elevations for flood-proofing. Minimum flood-proofing requirements can then be incorporated into building bylaws, subdivision approvals, and local government planning and regulations. This is the most common application of floodplain maps in British Columbia.

---

[9] City of Fargo, 2013; Iowa Flood Information Centre, 2013; Landmark Information Group, 2013
[10] Falconer et al., 2009

More detailed floodplain mapping that differentiates floodways from the flood fringe can be used for long-range planning. Development in the floodway is discouraged, as this area is particularly vulnerable and can also increase the hazard to neighbouring properties. Development in the flood fringe presents a lower risk, as long as appropriate flood-proofing techniques are used. The research conducted for this report did not reveal any BC municipality using this two-zone approach in its bylaws, but this approach is common in Alberta and other Canadian provinces.

Other types of floodplain maps that define geomorphic hazards (such as channel erosion and avulsions) can be used in bylaws to discourage development in high hazard areas. Examples of this approach can be seen in the Cowichan Memorandum of Understanding, which discourages development in high geomorphic hazard areas (which are also high habitat value areas) along the Cowichan and Koksilah Rivers.[11] The District of North Vancouver 2011 Official Community Plan also discourages development in areas of mapped debris-flood hazard.[12]

A recent survey of flood bylaws in BC found that 55 of the 159 municipalities had adopted either a separate flood bylaw (33) or had adopted flood risk management provisions into their zoning bylaw (22).[13] This low number may be due to the lack of a systematic mandate and lack of funding for disaster assistance.

3.2 Preparing for Climate Change

As the climate changes, more frequent and more intensive flood events are occurring and predicted, posing catastrophic risks to economic vitality, infrastructure, environment, safety, property and communities all over the world.[14]

For example, a recent study for the National Flood Insurance Program (NFIP) found that in the US the typical 1% annual chance floodplain area[15] is projected to grow by about 45% by 2100, primarily due to the influence of climate change. Detailed knowledge regarding the impacts of climate change is critical to the ability to employ a range of adaptation strategies (see Table 1).

---

[11] Northwest Hydraulic Consultants, 2009
[12] District of North Vancouver, 2011
[13] Stevens & Hanschka, 2013
[14] Intergovernmental Panel on Climate Change, 2007
[15] The NFIP characterizes the flood hazard at any place, in part, by the floodwater surface elevation having a 1% chance of being equalled or exceeded in any given year (AECOM, 2013).

Table 1: Contribution of Floodplain Maps to Adaptation and Disaster Risk Management[16]

Adaptation and disaster risk management responses	Benefits of updated floodplain maps
Transfer and share risks	Develop strategies, such as floodplain insurance, to share risk collectively, or to ensure that those who are willing to knowingly take a risk assume the burden of that risk.
Prepare, respond and recover	Enable a better understanding of disaster risk, strategies for risk reduction and for recovery practices that advance well-being and sustainable development.
Reduce vulnerability	Enable the identification and support for those who have a predisposition to be adversely impacted by floods.
Enable transformation	Enable society to alter value systems, regulatory, legislative or bureaucratic regimes, financial institutions and technological systems.
Increase resilience to changing risks	Enable society to increase its ability to anticipate, absorb, accommodate and recover from a flood in a timely and efficient manner.
Reduce exposure	Enable government, businesses and private individuals to avoid developing social, cultural or economic assets in locations that can be adversely affected by floods.

Floodplain maps are a foundational piece of information for land use planning. A floodplain map shows areas that are subject to high flood hazard and guides integrated decision making for how and where communities grow. This type of information helps societies avoid "lock-in" or path dependence, in which a decision has important and irreversible influences on the future allocation of resources.[17]

In this context, the built environment expands into an area with a known hazard from flooding, because it has amenities that might include level ground or water views.[18] Subsequently, society will expend disproportionate resources responding to the emergency accompanying a flood, repairing damage in the aftermath and developing protective infrastructure going forward. The social and economic investment by society in the built environment is difficult and costly to abandon.[19] Often, people will not leave their homes, even when it is well established that the houses are built in an unsuitable location and that it is far more cost effective to relocate them rather than protect infrastructure or respond to frequent floods.

Changes in flood risk over time (which can relate to many climate-related factors ranging from forest ecosystems, watershed hydrology, riverbed geomorphology and precipitation patterns), leads to existing floodplain maps becoming outdated. These maps consequently provide an unreliable basis for decisions regarding flood management. There are also changes to flood vulnerability over time through development and growth in floodplains, leading to more extensive and severe consequences when a flood occurs.

[16] Based on: Intergovernmental Panel on Climate Change, 2012
[17] Curtis & Low, 2009; Liebowitz & Margolis, 2009
[18] Stevens & Hanschka, 2013
[19] Intergovernmental Panel on Climate Change, 2012

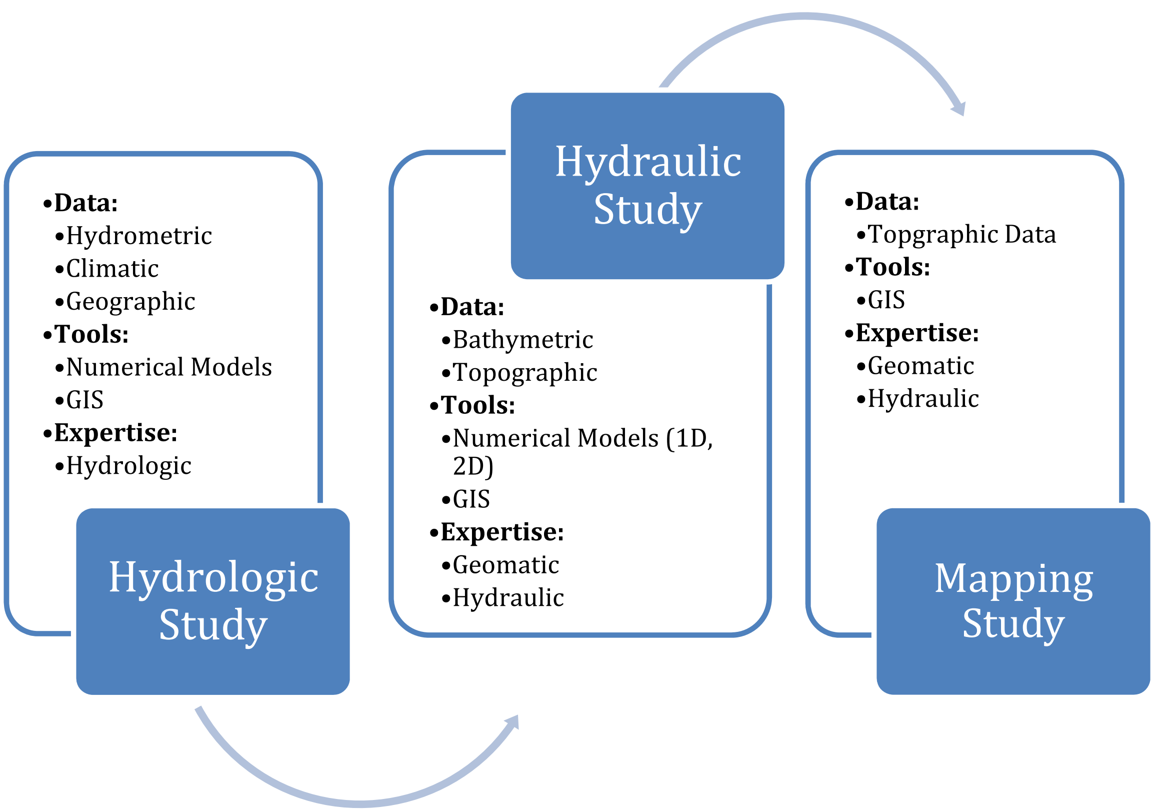
Efforts need to be made on an ongoing basis to update floodplain maps to illustrate the impacts of climate change and development on hydrology, ecosystems and geography. In addition, improved mapping technology, such as LiDAR (Light Detection and Ranging), new advances in hydro-technical models and new software tools enable an analysis that more accurately redefines the flood inundation areas. Floodplain maps should be updated routinely and at least once every ten years.[20]

3.3 Costs of Floodplain Mapping

While floodplain maps (hazard, risk or otherwise) require significant resources and expertise to develop, the return on investment can be significant. A study by the US Federal Emergency Management Agency (FEMA) indicates a return on investment of 2:1 on floodplain mapping.[21]

The basic components of a floodplain mapping study are outlined in Figure 5. The figure outlines resources required for the development of a riverine floodplain map.

Figure 5: Summary of Resources Required for Floodplain Mapping



Significant costs are associated with all the resources outlined in Figure 5. For many of the mapping studies completed in BC, costs can range from $100,000 for a small community if there is existing topographic and bathymetric data, to $250,000 for a similarly-sized community with no base information. Flood risk studies (see Figure 3) are significantly more expensive, as they require additional vulnerability and asset information. Recent proposed work and interviews with local governments in BC

[20] BC Real Estate Association, 2013
[21] Association of State Floodplain Managers, 2013

indicate that flood risk studies generally cost approximately twice as much as basic floodplain hazard mapping studies.

It is important to put this cost in context of the costs of flooding on lost wages, agricultural products, emergency management expenses, infrastructure damage, human health (both physical and mental) and social cohesion. In the US, almost 40% of small businesses do not reopen after a disaster and another 25% fail within a year of the event.[22] An often-cited benefit-cost analysis of North Carolina's floodplain mapping program calculated annual savings at $102.1 million in reduced flood damages.[23]

Table 2: Costs and Benefits of Improved Floodplain Maps[24]

Category	Category	Benefits	Costs
Land use: floodplain regulations	Reduced loss of life	• Able to target higher-risk areas • Able to identify evacuation needs • Areas can be used as parklands or farmlands	• Loss of desirable development lands • Existing land uses may have to change
	Reduced loss of property	• Able to target higher-risk areas • Lower-risk areas less restricted • Building restrictions match risk • Less time and money spent on contesting maps • Eventual payback on freeboard costs • Wise floodplain investment, including infrastructure	• Increased construction costs • Loss of land to development • Need to update regulations and inform public of changes
	Reduced loss of business	• Fewer business interruptions • Fewer public service interruptions	• Increased construction costs
	Preservation of natural functions of floodplains	• Natural stormwater management • Improved water quality • Increased ecological diversity	• Loss of land to development
Insurance[25]	Rates	• Structures insured at appropriate levels • More consistent insurance ratings through better information about risk	• Rates may increase for some
	Coverage	• More insurance purchased due to improved understanding of risk	

[22] Association of State Floodplain Managers, 2013
[23] State of North Carolina, 2008
[24] Adapted from: Committee on FEMA Flood Maps, 2009
[25] Residential overland flood insurance is not currently available in Canada.

Category	Category	Benefits	Costs
Property values		• Lower (or no) devaluations because of better information on risk • Change in practices that have led to devaluations	
Emergency services	Resource deployment	• More efficient allocation in planning and response	

4. CONCLUSION

Floodplain maps are the essential tool for good flood management, as they provide information on where water will go and what will be wet during a flood. The information contained within floodplain maps can inform building bylaws, subdivision approvals and community planning and regulations. A floodplain map can also be used for public education, emergency response and planning.

Maintaining current and accurate floodplain maps is an important community effort. Floodplain maps require significant resources and expertise to create—and the value they deliver far outweighs their cost.

GLOSSARY

1% Annual Chance Flood: A flood that has a 1% chance of being equalled or exceeded in any given year; also known as a 100-year flood (1:100). Similarly, 200-year flood (1:200) means a 0.5% chance of flooding in any year.

Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate.

Avulsion: Abandonment of an old river channel and the creation of a new one.

Bathymetric: the study of underwater depth of lake or ocean floors.

Climate change: A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Digital elevation model (DEM): A file with terrain elevations recorded for the intersection of a fine-grained grid and organized by quadrangle as the digital equivalent of the elevation data on a topographic base map.

Disaster: Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.

Exposure: The presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected.

Flood: A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood fringe: A plain bordering a river and subject to flooding.

Floodway: is an area of fastest, deepest flowing waters.

Flood hazard: A flood hazard is the threat to life, health, property or the environment as a result of flooding.

Flood-proofing: Strategies to protect the built or natural environment from flooding events.

Fluvial mapping: Mapping of rivers and streams and how they change in different conditions.

Freeboard: A vertical distance added to the actual calculated flood level to accommodate uncertainties in flood levels. Such uncertainties include hydraulic and hydrological variables, potential for waves, surges and other natural phenomena.

Geomorphic hazards: Hazards related to landforms including floods, landslides, snow avalanches and soil erosion.

Hazard: The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources.

Hydrological analysis: An engineering analysis of a flooding source carried out to establish peak flood discharges and their frequencies of occurrence.

Hydraulic model: A computer program that uses flood discharge values and floodplain characteristic data to simulate flow conditions and determine flood elevations.

Hydrometric: The monitoring of the components of the hydrological cycle including rainfall, groundwater characteristics, as well as water quality and flow characteristics of surface waters.

Resilience: The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.

Return period: An estimate of the average time interval between occurrences of an event (e.g., flood or extreme rainfall) of (or below/above) a defined size or intensity.

Riverine flooding: The overbank flooding of rivers and streams.

Vulnerability: The propensity or predisposition to be adversely affected.

BIBLIOGRAPHY

AECOM (2013). *The Impact of Climate Change and Population Growth on the National Flood Insurance Program Through 2100*. Retrieved May 2014 from: www.aecom.com/deployedfiles/Internet/News/Sustainability/FEMA%20Climate%20Change%20Report/Climate_Change_Report_AECOM_2013-06-11.pdf.

Association of State Floodplain Managers (2013). *Flood Mapping for the Nation: A Cost Analysis for the Nation's Flood Map Inventory* (pp. 1–15). Retrieved January 2014 from www.floods.org/ace-files/documentlibrary/2012_NFIP_Reform/Flood_Mapping_for_the_Nation_ASFPM_Report_3-1-2013.pdf.

BC Real Estate Association (2013). *Planning to Avoid Disaster: Action Plan to Update Floodplain Maps in British Columbia*. Vancouver, BC. Retrieved from www.bcrea.bc.ca/docs/government-relations/floodplainmaps_action_plan.pdf.

City of Fargo. (2013). *City of Fargo Interactive Flood Map*. Retrieved from http://gis.cityoffargo.com/FargoFloodStages/FargoFloodApp.html.

Committee on FEMA Flood Maps (2009). *Mapping the Zone: Improving Flood Map Accuracy*. National Academy of Sciences, New York, NY. Retrieved from www.nap.edu/catalog.php?record_id=12573.

Curtis, C. and Low, N. (2009). The Implementation Gap in Land Use Transport Integration: A Case of Path Dependence? *Conference on Future Urban Transport*. Retrieved from www.vref.se/download/18.778e24d112a169fd1c180006136/Low+-+Path+dependence.pdf.

District of North Vancouver. *District of North Vancouver Official Community Plan*. Schedule B. (2011). Retrieved from www.dnv.org/upload/pcdocsdocuments/15v_301!.pdf.

Environment Canada (2013). Flood Damage Reduction Program. Retrieved January 2014 from www.ec.gc.ca/eau-water/default.asp?lang=En&n=0365F5C2-

Falconer, R.H., Cobby, D., Smyth, P., Astle, G., Dent, J. and Golding, B. (2009). "Pluvial flooding: new approaches in flood warning, mapping and risk management." *Journal of Flood Risk Management*, *2*, 198–208.

Institute for Catastrophic Loss Reduction (2010). *Making Flood Insurable for Canadian Homeowners*. Toronto, ON. Retrieved from www.iclr.org/images/Making_Flood_Insurable_for_Canada.pdf.

Intergovernmental Panel on Climate Change (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. (M.L. Parry, J.P. Palutikof, C.E. Hanson, P.J. van der Linden, & O.F. Canziani, Eds.) (p. 976 pp). Cambridge University Press. Retrieved from www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg2_report_impacts_adaptation_and_vulnerability.htm.

Intergovernmental Panel on Climate Change (2012). *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. (C.B. Field, V. Barros, T.F. Stocker and Q. Dahe, Eds.). Cambridge: Cambridge University Press. Retrieved from www.ipcc-wg2.gov/SREX/images/uploads/SREX-All_FINAL.pdf.

Intergovernmental Panel on Climate Change (2013). *Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Climate Change 2013: The Physical Science Basis*. Switzerland.

Iowa Flood Information Centre (2013). *Iowa Flood Information System*. Retrieved from http://ifis.iowafloodcenter.org/ifis/en.

Landmark Information Group (2013). *Flood Services*.

Liebowitz, S. and Margolis, S. (2009). "Path Dependence, Lock-in and History." *Journal of Law, Economics and Organisation*, 11(1), 205–226.

Northwest Hydraulic Consultants (2009). *Lower Cowichan/Koksilah River Integrated Flood Management Plan*.

Public Safety Canada (2008). *Canada 's National Disaster Mitigation Strategy*. Ottawa, ON. Retrieved from www.publicsafety.gc.ca/cnt/rsrcs/pblctns/mtgtn-strtgy/index-eng.aspx.

Public Satefy Canada (2012). *2011-2012 Evaluation of the Disaster Financial Assistance Arrangements Program*. Ottawa, ON. Retrieved from www.publicsafety.gc.ca/cnt/rsrcs/pblctns/vltn-dsstr-fnncl-ssstnc-2011-12/index-eng.aspx.

Public Safety Canada (2013). Canadian Disaster Database. Retrieved from www.publicsafety.gc.ca/cnt/rsrcs/cndn-dsstr-dtbs/index-eng.aspx.

State of North Carolina (2008). *North Carolina Floodplain Mapping Program: 2000 – 2008 Program Review* (pp. 2000–2008).

Stevens, M.R. and Hanschka, S. (2013). Multi-Level Governance of Flood Hazards: The Case of Municipal Flood Bylaws in British Columbia, Canada. *Natural Hazards Review*, 130510010705007. doi:10.1061/(ASCE)NH.1527-6996.0000116

Thistelthwaite, J. and Feltmate, B. (2013). *Assessing the viability of overland flood insurance: The Canadian residential property market*. Waterloo, ON. Retrieved from www.cooperators.ca/~/media/Cooperators%20Media/Section%20Media/AboutUs/Sustainability/Assessing%20the%20Viability%20of%20Flood%20Insurance%20in%20Canada%20-%20Eng.pdf.

Toshima City (2010). *Flood Hazard Map*.

US Federal Emergency Management Agency (2013). *Hazus*. Retrieved from www.fema.gov/hazus.