Seeing Beyond Risk

Canadian Institute of Actuaries / Institut canadien des actuaires

Voir au-delà du risque

Research Project

Water Damage Risk and Canadian Property Insurance Pricing

Prepared by:
KPMG

February 2014
Document 214020
Ce document est disponible en français

P&C Research Subcommittee of the Research Committee

Canadian Institute of Actuaries
1740-360 Albert, Ottawa ON K1R 7X7
Tel: 613-236-8196
Fax: 613-233-4552
head.office@cia-ica.ca

cia-ica.ca

TABLE OF CONTENTS

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Purpose of Research Paper

The Canadian Institute of Actuaries (CIA) engaged KPMG to conduct a research project on water damage risk and Canadian property insurance pricing on behalf of the P&C Research Subcommittee of the Committee on Research (CIA Subcommittee). In recent years, damage from water and other climate-related perils have emerged to replace fire and theft as the largest source of claim costs for Canada's property and casualty (P&C) insurers. Systematic under-pricing of water damage risk threatens insurance company profitability and capital and has the potential to lead to property insurance availability issues for both personal and commercial property products.

Historically, actuaries have conducted ratemaking analyses for property insurance using traditional methods in which historical claims are developed to an ultimate basis and adjusted for trend to the prospective policy period. Provisions for catastrophes and large claims (such as those associated with water damage) are added as loadings based on the long-term experience of the insurer. Many believe that historical claims may no longer be predictive of future claims due to:

— Climate change;

— Aging and inadequate infrastructure;

— Lifestyle changes;

— Construction-related issues; and

— Human behaviour.

KPMG was asked to investigate the question: "What can Canadian P&C actuaries do to adapt their property pricing models in order to incorporate these external measures of potential risk exposure?"

Scope

The scope of this research paper is limited to water damage as defined by the Insurance Bureau of Canada (IBC), which specifically excludes damage caused by flood water. The complete definition of water damage is provided in the Scope section of this research paper.

Research Approach

The CIA Subcommittee appointed a Research Project Management Team (RPMT) to oversee the research project on water damage and property pricing. We met with the RPMT regularly by conference call and communicated as necessary by e-mail.

To conduct this research assignment, our methodology incorporated the following three approaches to gather information:

— Literature review;

— Questionnaires; and

— Interviews (in person and by telephone).

Numerous papers and articles on the topic of climate change and water damage (including flood) were identified through internet-based research as well as in the original request for proposals (RFP) from the CIA for the research project. A complete list of all source references used for this paper is included in appendix A.

Findings

This research paper summarizes the detailed findings from our research. Good practices are set out in the following areas:

1. Identification of and access to the data required for pricing;
2. The IBC's Municipal Risk Assessment Tool (MRAT);
3. Coding of claim data;
4. Prioritization of property pricing by P&C insurers;
5. Collective efforts by the P&C insurance industry at large; and
6. Emerging models.

This research paper does not specifically address the fundamentals of P&C insurance pricing. Nevertheless, it is assumed that any efforts by actuaries to use new categories of data or apply new methodologies to develop improved pricing for the risk of water damage for property insurance would be consistent with the fundamental principles underlying P&C insurance pricing as set out by the Casualty Actuarial Society (CAS). While the CAS Statement of Principles regarding P&C insurance ratemaking is currently under review by the leadership of the CAS, the basic concepts have not changed. Appendix D of this paper includes section II Principles and section III Conclusions of the latest discussion draft.

INTRODUCTION

The CIA engaged KPMG to conduct a research project on water damage risk and Canadian property insurance pricing. In recent years, damage from water and other climate-related perils have emerged to replace fire and theft as the largest source of claim costs for Canada's P&C insurers. Systematic under-pricing of water damage risk threatens insurance company profitability and capital and has the potential to lead to property insurance availability issues for both personal and commercial property products.

Historically, actuaries have conducted ratemaking analyses for property insurance using traditional methods in which historical claims are developed to an ultimate basis and adjusted for trend to the prospective policy period. Provisions for catastrophes and large claims (such as those associated with water damage) are added as loadings based on the long-term experience of the insurer. Many believe that historical claims may no longer be predictive of future claims due to:

— Climate change;

— Aging and inadequate infrastructure;

— Lifestyle changes;

— Construction-related issues; and

— Human behaviour.

KPMG was asked to investigate the question: "What can Canadian P&C actuaries do to adapt their property pricing models in order to incorporate these external measures of potential risk exposure?"

Acknowledgement

CIA Research Committee/P&C Research Subcommittee

Marc-Olivier Faulkner
Matthew Buchalter
Denise Leung Yu Cheung
Nathalie Ouellet
Étienne Plante-Dubé

Prepared by:

KPMG

Jacqueline Friedland
Houston Cheng
Adam Peleshok

SCOPE

The scope of this research paper is limited to water damage as defined by the IBC:

> In Canada, home insurance policy covers damage caused by water main breaks (aqueducts) and damage caused by overflowing sanitary installations (i.e., washing machine that overflows, leaking hot water tank or broken water main).
>
> Optional coverage (endorsements) exists to cover risks such as:
>
> — Water Damage – Ground Water and Sewers Coverage;
>
> — Sudden and accidental seepage of underground or surface water;
>
> — Sudden and accidental discharge, backing up or overflow from sewer connections; and
>
> — Rising of the water table.
>
> Water Damage – Above-Ground Water Coverage:
>
> — Sudden and accidental leaking of rain or snow; and
>
> — Sudden and accidental discharge, backing up or overflow of rain water gutters, eaves troughs or downspouts.
>
> However, damage caused by flood water is never covered.[1]

While the above definition is focused on personal property insurance, our research was directed at both personal and commercial property insurance. It is important to note, however, that water damage, including flood coverage, is provided to a greater extent in commercial property insurance products than in personal property insurance.

Flood, such as intense rain from hurricanes or the breach of riverbanks causing sewer backup or ground seepage, is specifically excluded from this research report. Flood is not covered in personal property insurance policies in Canada.

This report is specifically directed at findings that are related to the actuarial pricing of personal and commercial property insurance for the risk of water damage. Through our research, which included both personal interviews and an extensive review of literature, we amassed a significant volume of information about climate change and flood. However, much of this information is either not related to water damage as defined by the IBC or is not related to the actuarial pricing of property insurance. Thus, a significant amount of the information that we collected is not included in this research project. Appendix C of this report includes a summary of further resources that may be valuable to actuaries and other parties interested in exploring the issues beyond the specific scope of this paper.

[1] The definition was provided to KPMG by the CIA's RPMT and is based on the IBC publication All About Insurance and Water Damage, page 7-8, accessed August 12, 2013, http://www.infoinsurance.ca/static/pdf/en/Brochure_Water_ENG.pdf.

RESEARCH APPROACH

The CIA Subcommittee appointed a RPMT to oversee the research project on water damage and property pricing. We met with the RPMT regularly by conference call and communicated as necessary by e-mail.

To conduct this research assignment, our methodology incorporated the following three approaches to gather information:

— Literature review;

— Questionnaires; and

— Personal interviews (in person and by telephone).

Through the internet as well as the original request for proposals from the CIA for the research project, numerous papers and articles on the topic of climate change and water damage (including flood) were identified. A complete list of all source references used for this paper is included in appendix A.

Working closely with the RPMT, questionnaires were developed to assist in collecting information. We distributed these questionnaires, along with a request for interview, to representatives from insurers, brokers, actuarial consultants, regulators, catastrophe modelling firms, and insurance industry organizations (such as the IBC and the Institute for Catastrophic Loss Reduction, the ICLR). While we used the questionnaires to guide discussions during the interviews, some respondents preferred to submit written responses instead of participating in personal interviews. In appendix B, we include the questionnaire that we created for insurers. We modified it slightly to make it more applicable and relevant to brokers, consultants, catastrophe modelling firms, and regulators.

We met with and/or received written responses from:

— Nine insurers;

— Two catastrophe modelling firms;

— Two provincial regulators;

— Three actuarial consulting firms; and

— Two insurance industry organizations.

In reporting on the results of our interviews and literature research, we limit this report to information relevant to the specific scope requested by the RPMT, which is water damage risk (as defined by the IBC) and property pricing. Thus, there are some questions for which we gathered information but the feedback is not included in this report.

STATEMENT OF THE ISSUE

The CIA asked KPMG to begin the research paper with a statement of the issue, specifically addressing the following three topics:

— Discuss the shortcomings of historic-based pricing methodologies in the assessment of future water damage loss potential.

— Why is the past no longer predictive of the future?

— Why is this issue particularly crucial for the peril of water?

Significance of Water Damage Claims

In a media release dated April 10, 2013, Aviva stated:

> Approximately 40 per cent of all home insurance claims are the result of water damage . . . and the average cost of water damage claims rose 117%, from $7,192 in 2002 to over $15,500 in 2012, a year in which the company paid out over $111 million in property water damage claims.[2]

An older media release in early 2011 also highlights the concern: "Aviva Canada's data found that in 2000, the average cost of a water damage claim was $5,423. In 2010, it was over $14,000 – an increase of nearly 160 percent".[3]

In 2010, the Autorité des marches financiers (AMF) conducted a survey of P&C insurers operating in Québec about the impact of climate change (AMF Survey). The purpose of the AMF Survey was to generate an overview of the climate change issue and determine the extent to which individual insurers:

- Were up to date on the issue and concerned by it;
- Had identified the associated risks;
- Were making efforts to measure the impact of climatic disturbances;
- Were taking concrete measures to anticipate such disturbances and adapt thereto; and
- Were monitoring developments.[4]

The report on the AMF Survey noted:

> The majority of insurers indicated that water damage currently represents the principal source of claims, and some suggested that this is the result of an increase in the frequency and severity of precipitation. This is consistent with work being carried out by Ouranos.[5]

On June 12, 2012, Jack Chardijian of the IBC delivered a presentation at a fire safety forum on the topic of Québec personal property data. He shared the following table:

---

[2] Aviva, "Nearly 40 per cent of all home insurance claims are the result of water damage, Aviva Canada data shows", accessed June 22, 2013, http://www.avivacanada.com/press/nearly-40-cent-all-home-insurance-claims-are-result-water damage-aviva-canada-data-shows.

[3] ILSTV, "Average water damage claim rose 160% in ten years: Aviva Canada", last modified March 30, 2011, http://www.ilstv.com/average-water damage-claim-rose-160-in-ten-years-aviva-canada/.

[4] Autorité des marchés financiers, "Managing Climate Change Risk", (2011): 6.

[5] Ibid.: 18. Per the report on the AMF Survey, "Ouranos is a consortium that brings together some 250 scientists and professionals from different disciplines. It focuses on two main themes: climate sciences and impacts and adaptation. Ouranos' mission is to acquire and develop knowledge on climate change, its impact, and related socioeconomic and environmental vulnerabilities in order to inform decision makers about probable climate trends and advise them on identifying, assessing, promoting and implementing local and regional adaptation strategies. Ouranos carries out detailed analyses in a Québec-specific context".

Kind of Loss Distribution for Home Insurance Claims in 2011

Kind of Loss	Number of Claims	Paid Claims
Fire	4%	31%
Water	48%	47%
Theft	18%	7%
Other	30%	14%
Total	100%	100%

Based on the data collected by the IBC, water damage is the leading cause of loss with respect to both the number of claims and the paid dollars of claims. Mr. Chardijian reported that damage caused by water in Québec alone resulted in paid claims of more than $500 million dollars in 2011. He continued:

> One of every two dollars paid by home insurers are for damage caused by water. This represents $500 million per year . . . It is clear we must insure against damage caused by climate change: wind, snow, hail . . . but mostly water.

Shortcomings of Historic-Based (Traditional) Pricing Methodologies

Traditional actuarial pricing methodologies are based on the fundamental assumption that the past is predictive of the future. In using these methodologies, actuaries rely on the historical relationships between claims and exposures (e.g., earned house years or total insured values) or between claims and premiums. In addition, many of the actuarial assumptions required to determine the values (i.e., claims, exposures, and premiums) underlying these relationships are also based on the same fundamental assumption. For example, actuaries rely on the historical reporting and payment relationships of claims when selecting development factors to project current claims to an ultimate basis. The changes in historical claims over time are used to select frequency and severity trends.

In relying on historical experience to predict the future, actuaries assume that there have been no changes that would result in future relationships that are different from those observed in the past. Extraordinary changes to the environment, either to the internal or external environments in which insurers are operating, or to the interpretation of policy language that might affect the cost, frequency, or future incidence of claims, would therefore invalidate the fundamental assumption of traditional historic-based actuarial methodologies.

Actuarial estimates derived using traditional pricing methodologies are based on historical claims. To the extent that certain claim types are either not present or have very limited frequency in the database, projections of future claims will not provide for such claims. For example, there are very few claims for 50-year and 100-year storms in Canadian property data; similarly there are very few claims for losses resulting from failing infrastructure. In “From Risk to Opportunity: 2008 – Insurer Responses to Climate Change”, Dr. Evan Mills writes: “A major obstacle to insurers taking action on climate change has been that the models the industry uses to manage and price risk have been backward-looking and thus, by definition, unable to take climate change into account”.[6] To the extent that climate change, aging and inadequate infrastructure, and changing lifestyles lead to a greater number of claims and/or more costly claims in the future than in the past, traditional actuarial pricing methodologies based on historical data will not capture the potential for these claims.

[6] Evan Mills, “From Risk to Opportunity: 2008 – Insurer Responses to Climate Change”, *Ceres* (April 2009): 17.

Another concern regarding the applicability of historical data to predict the future is related to the policy language itself. To the extent that policy language has changed over time or that the interpretation of what is an included or an excluded claim has changed, comparisons of historical claims to historical measures of exposures may not be reflective of current or future policy conditions.

An additional shortcoming of using traditional pricing methodologies for the specific risk of water damage is related to the quality of the data available as input to the actuarial work. Feedback obtained from participants to the survey reveals the level of detail and the accuracy of internal data vary from insurer to insurer; however, virtually all respondents commented on the lack of available external data. Ideally, actuaries pricing the risk of water damage associated with property insurance would have access to data that are sufficient and reliable. Canadian actuarial standards of practice define data to be sufficient "if they include the needed information for the work", and reliable "if that information is accurate".[7] Actuaries, however, are often faced with situations in which sufficient and reliable data are not readily available to support the actuarial work requested by their employer and/or client. Based on the results of the survey, many actuaries are currently facing this situation with regards to the risk of water damage associated with property insurance.

Why is the Past No Longer Predictive of the Future?

The CIA suggested three reasons why the past may no longer be predictive of the future:

— Climate change;

— Aging and inadequate infrastructure; and

— Lifestyle changes.

KPMG investigated each of the above through a review of literature and numerous interviews. Throughout our research process, construction-related issues (including the pace and quality of construction) and human behaviour were also noted as reasons why the past is no longer predictive of the future.

Climate Change

Environment Canada defines climate change as:

> Changes in long-term weather patterns caused by natural phenomena and human activities that alter the chemical composition of the atmosphere through the build-up of greenhouse gases which trap heat and reflect it back to the earth's surface.[8]

While there are differing opinions as to the existence and/or extent of climate change, none of the respondents to the survey questioned the increase in the frequency and severity of extreme weather events in recent years. Weather-related information, statistics, forecasts, reports, and research studies appear regularly in globally-reported news. In an April 1, 2013, article, Thompson's World Insurance News Service (Thompson's) reported that "Canada is now experiencing 20 more days of rain on average compared to the 1950s".[9]

While the increase in extreme weather events is well documented, the consequences on the insurance industry are uncertain.

---

[7] Canadian Institute of Actuaries Standards of Practice, subsection 1530 (2013): 1036.
[8] Environment Canada, "Definitions and Glossary", last modified June 21, 2013, http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=B710AE51-1#section3.
[9] "Spring showers bring renewed attention to water damage", *Thompson's World Insurance News*, April 1, 2013: 5.

In its October 2011 report *Managing Climate Change Risk*, the AMF reported the findings from its survey. The report opened with the following comments:

> Faced with a seeming threat that could jeopardize the physical well-being and the material and financial wealth of consumers, the AMF has the duty to assess the extent to which climate change could affect the operations of insurers, particularly as regards their ability to satisfy their commitments, maintain affordable insurance coverage and remain financially sound.[10]

The issue of climate change has also been at the forefront of activities of the Institute of Actuaries of Australia (Institute Australia). In a submission to Australia's Senate Standing Committee on Environment and Communications examining trends and preparedness to extreme weather events, the Institute Australia reported:

> Based on the additional annual claims costs of $1.0bn per annum, projected to occur over the next 60 years due to climate change, we would, therefore, expect an increase of around $1.5bn per annum, or around 8% of $19bn in overall premiums. It should be stressed that this increase will not be spread uniformly across the policyholder base and will fall disproportionately on those at high risk. This increase will occur over 60 years and so represents only a relatively small increase each year. As a result the insurance industry is well placed to adapt to this projected change.[11]

The submission by the Institute Australia modelled bushfire, flood, cyclone, hail, and wind, all of which are perils that are outside of the scope of this CIA research report. The Institute Australia stated: "the relative proportion of insured losses to total economic losses aggregated across all events is expected to be between 50% and 70% for mature insurance markets.[12] The submission by the Institute Australia provides a perspective on the total magnitude of climate change on covered risks for the insurance industry and notes that for flood:

> Following recent changes to product offerings in Australia, availability of flood cover is no longer an issue for the vast majority of policyholders. However, for very high risk areas the premiums required to cover the risk makes cover prohibitively expensive for some policyholders. As such there are still high risk areas which are uninsured. This situation is unlikely to change and under climate change, it is likely that more properties will fall into this category.[13]

The submission of the Institute Australia noted that "to assist in managing the risk of climate change the Government should take a long term view on how to provide solutions to individuals who will be most affected by climate change".[14]

In discussions with Paul Kovacs, founder and executive director of the ICLR, he noted that an Environment Canada study found that in an 80-year forecast period, climate change alone will result in only a 30% increase in water-related insured losses, with all other variables held constant.[15] Mr. Kovacs expressed the opinion that climate change alone does not explain the changes that insurers are experiencing in water-related claims.

---

[10] Autorité des marchés financiers, "Managing Climate Change Risk", (2011): 5.
[11] Institute of Actuaries of Australia, "Inquiry into recent trends in and preparedness for extreme weather events", *Standing Committee on Environment and Communication* (2013): 21.
[12] Ibid.: 2.
[13] Ibid.: 21.
[14] Ibid.: 4.
[15] Chad Shouquan Cheng, Qian Li, Guilong Li, and Heather Auld, "Climate Change and Heavy Rainfall-Related Water

Mr. Kovacs' opinions were echoed by one of the catastrophe modelling firms that responded to the survey. This respondent commented that climate change happens over decades to a greater scale; climate change increases variability of weather events but is not necessarily a major contributing factor to the increase in water damage claims that the Canadian P&C insurance industry is experiencing.

Infrastructure

Climate change has ripple effects in the soundness of infrastructure. Joel Nodelman and Joan Nodelman, principals at Nodelcorp Consulting, delivered a presentation titled "Climate Change and Infrastructure Vulnerability Assessment" in February 2012 at a workshop on the Public Infrastructure Engineering Vulnerability Committee (PIEVC) protocol delivered by the Federation of Canadian Municipalities (FCM) and Engineers Canada. According to the presentation, "Climate change threatens the ability of engineers to safely and effectively design infrastructure to meet the needs of Canadians".[16] Nodelman and Nodelman state that climate change calls into question current rules and design standards and that design, operation, and maintenance practices must adapt to the changing environment.[17]

The current state of infrastructure in Canadian municipalities is believed to be a significant contributor to the increase in water damage claims for Canadian P&C insurers. Not only is current infrastructure "being operated beyond [its] intended design life and capacity"[18] in some areas, the infrastructure is also believed by many to be inadequate for the demands being placed upon it, particularly during extreme weather events that are occurring with greater frequency. In the presentation by Nodelman and Nodelman, they note that "design safety margins may not last through the full operational life of an infrastructure system" and that "margins may be consumed by day-to-day uses/activities".[19] Furthermore, Urban Flooding in Canada, a February 2013 study by Dan Sandink of the ICLR, reports that "in older subdivisions, infrastructure capacity may be designed to a lower standard (e.g., one-in-two-year precipitation events)".[20]

Municipalities have expressed concerns about limited budgets that are available to address the significant expenses of maintaining infrastructure; these concerns are exacerbated when issues such as waste water and storm water management are not given priority attention. The FCM states:

> Public infrastructure is the backbone of our economy and quality of life, but after decades of underinvestment, Canada is only just beginning to confront its "infrastructure deficit", a backlog of delayed repairs and construction that hurts every Canadian family and business. For 25 years Canadians have watched the symptoms of the infrastructure deficit grow: rusting bridges, crumbling roads, crowded buses and subways, and thousands of drinking water warnings. [21]

As the scope of infrastructure projects are reduced and/or delayed for other pressing issues (such as healthcare and education), the cost of infrastructure renewal typically increases even further.

Damage Insurance Claims and Losses in Ontario, Canada", *Journal of Water Resource and Protection* (January 2012): 1.

[16] Nodelcorp Consulting, "Climate Change and Infrastructure Vulnerability Assessment", slide 2, accessed August 20, 2013, http://www.fcm.ca/Documents/presentations/2012/workshops/PIEVC_Joel_Nodelman_Risk_Assessment_EN.pdf.

[17] Ibid.

[18] E.N. Allouche and P. Freure, "Management and maintenance practices of storm and sanitary sewers in Canadian Municipalities", *ICLR Research,* Paper Series No. 18 (2002): 7.

[19] Nodelcorp Consulting, "Climate Change", slide 11.

[20] Dan Sandink, "Urban flooding in Canada", *Institute for Catastrophic Loss Reduction* (February 2013): 7.

[21] Federation of Canadian Municipalities, "About the Issue", last modified March 18, 2013, http://www.fcm.ca/home/issues/infrastructure/about-the-issue.htm.

Repair costs can increase exponentially as damages occur and when existing damages become more challenging to fix.[22]

Infrastructure renewal backlog is estimated to be $1.6 billion in the City of Toronto alone.[23] In an article for Mediaplanet, Karen Leibovici, the president of the FCM, commented on the poor condition of current infrastructure in Canada; she noted that one-third of existing infrastructure needs significant repair and/or upgrades.[24]

Governments at different levels are taking notice of the need of infrastructure funding, as noted in a media release by the IBC on March 21, 2013, on the Federal Government's 2013 Federal Budget:

> IBC is pleased to have worked with the Federation of Canadian Municipalities and other stakeholders to urge the Government to make a priority of critical infrastructure spending. IBC is committed to working with all levels of government and stakeholders to ensure that storm and waste water infrastructure are priorities in the expanded program.[25]

On July 1, 2013, the Province of Manitoba increased its provincial sales tax (PST) from 7% to 8% to fund needed infrastructure projects. According to the Manitoba Provincial Budget, $620 million will be invested to:

- Upgrade and build roads, highways, and bridges;
- Continue with flood repairs from the 2011 flood; and
- Support future flood-fighting engineering and construction projects.[26]

Intact Financial Corporation and the University of Waterloo partnered the Climate Change Adaptation Project (Canada) (CCAP). The CCAP was "designed to identify and operationalize practical, meaningful and cost-effective adaptation solutions to the most challenging impacts of climate change facing Canada".[27] The final report of the CCAP was released in May 2013 and is titled Climate Change Adaptation: A Priorities Plan for Canada (CCAP Report). In this report, the need for investing in municipal infrastructure is supported based on the collective vote of the Adaptation Advisory Committee.

In the CCAP Report, Darrel Danyluk, Chair of the World Federation of Engineering Organizations Committee of Engineering and Environment, presents the case for infrastructure improvement. He states:

> The cost of identifying and addressing infrastructure vulnerability to a future climate during construction is much cheaper than the cost of restoring infrastructure after it has been damaged.[28]

---

[22] M. Saeed Mirza and Murtaza Haider, "The State of Infrastructure in Canada: Implications for Infrastructure Planning and Policy", *Infrastructure Canada* (March 2003): 3.
[23] "Council approves 2013 City Budget", City of Toronto: *Our Toronto* vol. 5, issue 1 (Spring 2013): 4. http://www.toronto.ca/ourtoronto/spring2013/citynews/article04.utf8.htm.
[24] Karen Leibovici, "Investing in infrastructure generates several long term benefits", *Mediaplanet,* Insight section (March 10, 2013). http://www.fcm.ca/Documents/news/2013/Investing_in_Infrastructure_EN.png.
[25] Insurance Bureau of Canada, "IBC Supports Federal Government's Funding for Infrastructure", accessed on July 6, 2013, http://www.ibc.ca/en/Media_Centre/News_Releases/2013/03-21-2013.asp.
[26] Manitoba, "Budget 2013 – Focused on what matters most to families", accessed on July 6, 2013, http://www.gov.mb.ca/finance/budget13/index.html.
[27] Blair Feltmate and Jason Thistlewaite, "Climate Change Adaptation: A Priorities Plan for Canada", *Climate Change Adaptation Project* (May 2013): vi.
[28] Ibid.: 2.

Mr. Danyluk recommends a three-step process: (1) estimate the probability that municipal infrastructure exceeds a climate threshold, (2) conduct a vulnerability and risk assessment, and (3) incorporate adaptation into city planning policy.[29]

Many believe that the aging and inadequate infrastructure contributes substantially to the rising frequency and severity of water damage claims for the Canadian P&C industry.

Lifestyle Changes

Lifestyle changes is a broad "catch-all" type of category used to explain a range of other factors leading to increased P&C insurance claims associated with water damage. Examples of lifestyle changes include (but are not limited to):

- An increased number of people living in condominiums;
- An increased number of finished basements;
- Extended periods of time away from home; and
- Busy lives and attitudes towards prevention.

While we have separately recognized human behaviour and construction-related issues as reasons why historical claims are no longer predictive of the future, there is overlap between lifestyle changes and both of these other reasons. Thus, this section of the report should be considered together with the subsequent descriptions of construction-related issues and human behaviour.

There has been tremendous growth in the number of condominium developments in western Canada and Ontario, particularly in the Greater Toronto Area (GTA). The increase in condominiums has been accompanied by an increase in water damage claims. The "leaky condo" problems in Canada are well-known across the country and around the world. The British Columbia leaky condominiums were an agenda topic at the 2005 triennial conference of the International Housing and Home Warranty Association in Tokyo, Japan. Water damage for condominiums is evident beyond simply the exterior shells of the buildings. Condominiums are experiencing a significant number of claims from water damage for a variety of reasons. One reason is that laundry facilities have been moved out of basements and into owners' units. A rupture in the pipe in one unit can have repercussions for many neighboring units. Similarly, dishwashers are now a common feature in most condominium units, and a burst pipe, water seepage, or malfunction in the machinery that leads to water damage in one unit frequently damages other units as well. The quality of construction materials has also been a cited reason for water damage losses in condominiums.

It is noteworthy that condominiums tend to have fewer water damage claims (i.e., lower frequency of claims) caused by weather events than homeowners' policies because there is typically less land (i.e., surface area) covered by a condominium building than by a home.

The practice of using a basement primarily for storage has changed significantly over time. Finished basements have become a common feature in many homes today. These basements are often used as entertainment centres or recreational rooms and contain expensive furnishings and equipment. Basements are also frequently used as rental properties; as such, the basement would contain all of the renters' belongings and additional appliances such as laundry machines and dishwashers. Such usage can increase both the frequency (e.g., multiple appliances in the home could result in a covered event) and severity (e.g., more expensive contents in basements) of claims.

[29] Feltmate and Thistlewaite, "Climate Change Adaptation": 3–4.

Ontario Bill 140 amended the Planning Act in 2011 preventing municipalities from prohibiting basement apartments and allowing for second units in detached, semi-detached, and townhouses.[30] The Planning Act allows a municipality to authorize the use of garden suites[31] which "may increase the density of construction in existing urban areas". Dan Sandink of ICLR commented on the implications of increasing density:

> Increasing densities mean more impervious surfaces and increased vulnerability to extreme rainfall in urban areas. There is a general movement toward more densification in the urban planning community, but many would argue that these requirements have not adequately accounted for the impacts of increased density on storm water management. In general, increasing urban densities is a very good thing, but will intensify the water damage problem if we do not adjust storm water management standards to reflect the changing nature of urban drainage.

Another contributing factor classified as a lifestyle change is that people are spending time away from home for much longer and more frequent periods than in the past. Thus, there is less time and attention paid to dwellings and to dwelling repairs in particular; extended periods of time away from a residence allow more time for seeping and bursting pipes resulting in damage that is not mitigated close to the time of occurrence.

The last lifestyle change noted is the incredibly busy lives that so many people have today where attention to loss prevention is not seen as a high priority. The 2013 Canadian Water Attitudes Study reported that "internet outage and burned-out light bulbs are fixed more immediately than a leaky faucet or broken pipe".[32] In this study, repairing a leaky faucet was the one household problem for which respondents had the largest proportion of repair time "longer than one month".[33]

Construction-Related Issues and Human Behaviour

This research report does not include an exhaustive list of reasons why the past is no longer predictive of the future for pricing the risk of water damage for property insurance. During our literature review and discussions with respondents to the survey, the two most frequently noted reasons other than climate change, infrastructure, and lifestyle changes were issues related to construction and human behaviour.

With respect to construction, the topics of the rapid pace of construction, the age and quality of construction, and the codes governing construction were raised. The Urban Flooding in Canada study contextualizes some of the opportunities to amend the 2010 National Building and Plumbing Codes to help reduce water damage in homes:

> These opportunities include clarifying requirements for lot grading around homes, requiring backup systems for sump pumps, clarification of requirements related to connection of foundation drainage to sanitary sewer systems and restricting use of manual devices that are designed to reduce the risk of sewer backup.[34]

The CCAP Report supports the idea of higher standards in the National Building Code as the Adaptation Advisory Committee prioritized the top P&C concerns for Canada as to better align

---

[30] Service Ontario, Planning Act, accessed September 20, 2013, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90p13_e.htm#BK30, 16. (3) and 16.1.
[31] Ibid., 39. (1) and 39.1 (1). Garden suite is defined under Section 39.1 (2).
[32] RBC Blue Water Project, "2013 RBC Canadian Water Attitudes Study", *RBC Insurance* (2013): 62.
[33] Ibid.
[34] Dan Sandink, "Urban flooding in Canada", *Institute for Catastrophic Loss Reduction* (February 2013): 52.

insurance coverage and champion building codes to reflect the climate change risk. The CCAP Report recommends that federal and provincial governments "should formally endorse building durability and resiliency as objectives for the national building code"[35] and that the insurance industry and building industry work together to identify high-priority risks.

Urban sprawl is an issue that can be considered under lifestyle changes or construction-related issues. Urban sprawl, which is defined as "the spreading of urban developments (as houses and shopping centers) on undeveloped land near a city",[36] can also contribute to increase in water damage claims. Such claims may be related to inappropriate zoning and/or building codes, lack of enforcement of building codes, and quality of construction. In some areas, rapid development may be exceeding the infrastructure capacity.

Just as lifestyle changes is a broad "catch-all" category, so is human behaviour. Human behaviour encompasses insureds' willingness or reluctance to change, responsiveness to incentives, moral and morale hazards, prioritization of issues, etc.

In a research paper titled Managing Catastrophic Risk, Howard Kunreuther of the Wharton School at the University of Pennsylvania and Geoffrey Heal of Columbia Business School note that catastrophic risk losses have been increasing because "several behavioral biases lead decision-makers not to invest in adaptation measures until after it is too late".[37] The research paper explains the following reasons why these "decision-makers" have not invested in protective measures:

— Budgeting heuristics;

— Safety-first behavior;

— Under-weighting the future;

— Myopic behavior;

— Procrastination; and

— Underestimation of risk.[38]

While Managing Catastrophic Risk is directed at catastrophic events such as floods, Kunreuther and Heal's discussion of "behavioral biases" would still be applicable to prevention measures to protect property from water damage arising from non-catastrophic events.

The 2013 RBC Canadian Water Attitudes Study noted that flooding caused by extreme weather and the state of the storm drainage systems were ranked at the bottom of the "greatest water-related problems"[39] 10 years from now. And although "nine out of 10 Canadians think a major disaster is possible in their community",[40] water damage to property ranked as the sixth greatest concern about extreme weather events; flood was fourth most important[41]. These rankings can be contrasted with the finding that Canadians rank storm water management outside of the top five highest and high-priority infrastructure areas for government funding.[42] Insurers, together with the IBC, have been much more proactive than insureds in looking towards mitigating future risk of water damage.

---

[35] Feltmate and Thistlewaite, "Climate Change Adaptation": 19.
[36] Merriam-Webster, "Definition of urban sprawl", accessed on July 15, 2013, http://www.merriam-webster.com/dictionary/urban%20sprawl.
[37] Howard Kunreuther and Geoffrey Heal, "Managing Catastrophic Risk", *Encyclopedia of Energy, Natural Resources and Environmental Economics* (2012): 1.
[38] Ibid.: 4-7.
[39] RBC Blue Water Project, "2013 RBC Canadian Water Attitudes Study", *RBC Insurance* (2013): 18.
[40] Ibid.: 23.
[41] Ibid.: 27.
[42] Ibid.: 76.

The views from around the world differ from the findings reported in the RBC study. ICLEI-Local Governments for Sustainability (ICLEI) partnered with the Massachusetts Institute of Technology to conduct a survey of its members "to gain insight into the status of adaptation planning globally, approaches cities around the world are taking, and challenges they are encountering".[43] In questions related to risk and vulnerability assessments, "all of the cities report that, based on the assessment results, they expect to face climate impacts . . . Specifically, 65% expect increased storm water runoff and a similar amount (61%) report that they will face changes in demand for storm water management".[44] It is interesting to note that Canada had the highest response rate of all the ICLEI's members, where over 60% of ICLEI Canadian members surveyed responded.[45]

The Inter-related Nature of Reasons Why the Past May No Longer Be Predictive of the Future

A July 28, 2013, article in the *Globe and Mail* demonstrates the inter-related nature of the reasons why the past may no longer be predictive of the future for property pricing. In an article titled "Infrastructure now solidly on voters' minds", John Ibbitson states:

> The Federation of Canadian Municipalities believes that "extreme weather is the single greatest threat to Canada's infrastructure and transportation system", according to its president Claude Dauphin, who is also the mayor Lachine, Que.
>
> A few years ago, the FCM estimated that it would take $120 billion to repair the nation's roads, sewers and other infrastructure. "I don't think we're making a mistake in saying we could double it, because of the climate-change threat", Mr. Dauphin said.
>
> The problem goes far beyond people living on once-dry land that turned out to be floodplain. Severe rain and flash flooding can back up storm sewers, flooding the basements of homes in neighbourhoods nowhere near water.[46]

Why is this Issue Particularly Crucial for the Peril of Water?

The increasing trends seen in the number of water damage claims (i.e., frequency of claims) as well as in the costs of claims (i.e., severity of claims) are alarming to many in the P&C industry. Trends in frequency are often attributed to the issues previously described (i.e., climate change, aging and inadequate infrastructure, and lifestyle changes). The reasons for increasing severities include but are not limited to the costs in addressing mould remediation as well as the costs required to address any concerns about the presence of asbestos in old drywall.

P&C insurers require rates that are adequate for the products that they sell. "Rate adequacy means that rates are sufficient to provide for all future claims and expenses associated with the insurance protection that is offered".[47] Over the long-term, inadequate pricing for water damage in property products could threaten the financial condition of an insurer. "A financially weak insurance company is a threat to its policyholders, to the public at large, and to the insurance industry".[48]

---

[43] JoAnn Carmin, Nikhil Nadkarni, and Christopher Rhie, "Progress and Challenges in Urban Climate Adaptation Planning: Results of a Global Survey", (2012): 1.
[44] Ibid.: 12.
[45] Ibid.: 5.
[46] John Ibbitson, "Infrastructure now on voters' minds", *Globe and Mail*, July 29, 2013: A4.
[47] Jacqueline Friedland, *Fundamentals of General Insurance Actuarial Analysis, Society of Actuaries,* (2013): 555.
[48] Ibid.

QUALITATIVE ASSESSMENT OF GOOD PRACTICE FOR CANADIAN P&C ACTUARIES

It is challenging, if not impossible, to comment on good practices currently being used by Canadian P&C actuaries, because no actuarial approaches or methodologies unique to the quantification of the risk of water damage were identified during our survey or through our literature review processes. It is important to recognize that not all Canadian insurers that were invited to participate in the survey accepted the invitation. Furthermore, insurers who declined to participate for competitive reasons may well have sophisticated modelling practices and comprehensive databases, but we are unable to share any insight on their processes. Rather than commenting on existing actuarial best practices in this section of the report, we identify issues where we believe future activity is required to move towards a good practice state.

Good Practice versus Best Practice

The book *Fundamentals of General Insurance Actuarial Analysis* comments on best practice. It states:

> The term "good practice" is often preferred to "best practice" as it is debatable whether or not a single best approach or method exists. It is important to recognize that good practice is continually evolving, becoming better as improvements are discovered.[49]

In describing good practice, it comments:

> It is challenging to find a precise definition of good practice. Good practice, a relatively new business buzzword, is used to describe a process for developing and adhering to a standard way of doing things that multiple people and organizations can use. Good practice refers to approaches or methods (under given circumstances) that have consistently shown superior results for achieving a specific objective and can thus be used as benchmarks. These approaches and methods, founded through experience and research, are used to maintain high quality within a profession and/or for a particular type of work.[50]

The Swiss Agency for Development and Cooperation states the following about good practice:

> The essence of identifying and sharing good practices is to learn from others and to re-use knowledge. The biggest benefit consists in well developed processes based on accumulated experience.[51]

Good Practice #1 – Identification of and Access to the Data Required for Pricing

One message that was heard repeatedly through the interview process is the need for data. In describing a good practice related to data, it is valuable to differentiate *data* from *information*. Data and information are defined by the Merriam-Webster on-line Dictionary as follows:

— Data – "factual information (as measurements or statistics) used as a basis for reasoning, discussion, or calculation";[52] and

---

[49] Friedland, *Fundamentals of General Insurance*: 13.
[50] Ibid.
[51] SDC L&N, "Good Practice", accessed March 10, 2013, http://www.sdc-learningandnetworking.ch/en/Home/SDC_KM_Tools/Good_Practice.
[52] Merriam-Webster, "Definition of data", accessed on March 11, 2013, http://www.merriam-webster.com/dictionary/data.

— Information – "knowledge obtained from investigation, study, or instruction".[53]

The U.S. actuarial standards of practice explicitly define data as "numerical, census, or classification information and not to general or qualitative information . . . Assumptions are not data, but data are commonly used in the development of actuarial assumptions".[54]

A first good practice for property pricing of water damage risk would be the clear articulation by actuaries of what their data needs are. Such a list could be prioritized according to "must have" and "nice to have" categories. Insurers could work with the IBC and/or the ICLR to identify the types of data that may best be achieved by industry-wide initiatives and the types of data that could be considered company-specific due to confidentiality purposes.

In identifying data requirements for pricing property insurance, both personal and commercial products, actuaries may consider whether it would be valuable to reactivate the property database formerly maintained by the IBC (i.e., "the brown book"). To price the specific risk of water damage, actuaries would require claim data aggregated by cause of loss; such data may not be readily available at this time due to different claims coding practices by Canadian insurers.

For pricing purposes, actuaries require the ability to link claim data with detailed exposure data. Exposure data would reflect the risk characteristics of the insured property as well as the local environment that are related to the risk of water damage.

Data Specific to the Insured Property

Valuable data about the insured property itself include but are not limited to the:

— Age and type of roof;

— Condition of the foundation;

— Slope of the driveway; and

— Landscaping surrounding the house.

In 2011, the ICLR published a handbook titled *Protect Your Home from Basement Flooding*. The handbook ends with a survey to measure the risk of a basement flooding. Depending on the responses to fourteen questions, points are assigned and an overall risk score is developed for the risk of basement flooding. The questions include:

— Has your basement ever flooded?

— Do you pour fats and cooking oils and grease down the sink?

— Are the sewer grates in front of your home clear of debris?

— Have you cleaned your eaves and downspouts within the past year?

— Are there any unsealed cracks in your foundation or basement floor?

— Are your downspouts directing water 1.8 meters (6 feet) away from your home?

— Is the soil directly beside your home 10 to 15 cm higher that the soil 1.5 meters away from the home?

— Does your home have a backwater valve?

---

[53] Merriam-Webster, "Definition of information", accessed on March 11, 2013, http://www.merriam-webster.com/dictionary/information.

[54] Actuarial Standards Board (U.S.), "Data Quality", *Actuarial Standard of Practice No.23* (1993): 1.

— Does your home have a sump pump?

— Have you tested the sump pump in the last 12 months?

— Does your sump pump have a backup power source?

— Are any of your eavestrough downspouts connected to the municipal sewer system?

— Do you have a reverse sloped driveway?

— Do you have basement windows close to the surface of your lot?[55]

While the ICLR questionnaire was not explicitly designed for the purpose of identifying the risk of water damage as defined for this CIA research paper, there are questions that could be useful for identifying heightened risk for sewer backup claims or water seepage. The answers to some of these questions may also provide a starting point for the identification of property-specific exposure data types.

The consistent use of a questionnaire that is modified to best reflect the specific causes of loss leading to water damage could represent a good practice if the data that was collected through underwriting were tied to claims for actuarial analyses.

Data about the Local Environment

Valuable data about the local environment would include data about infrastructure supporting the insured property such as the age, diameter, and construction material of pipes leading to a property. Collaboration of the P&C insurance industry with government could facilitate the collection of external data and thus be an important initiative to enhance good practice related to data.

The CCAP discusses the need for governments at all levels to support developing better data:

> Governments can serve Canadians by working with insurance companies to ensure appropriate information is available to better anticipate the risk of severe weather damage to homes and businesses. Without this information, insurers face information asymmetries when trying to accurately price the risk associated with climate change. This includes detailed, local data about historic severe weather events, including intense rainfall, severe wind (including hurricanes and tornadoes), winter storms, flooding, and wildland fires. Anticipating the risk of damage also requires reliable data regarding the state of public infrastructure and socio-economic information. Environment Canada, Natural Resources Canada, Infrastructure Canada, Statistic Canada and others have the potential to improve the information available.[56]

Other valuable data about the local environment would include (but not be limited to) weather and topological data; resources for such information are found in appendix C.

Current State

Currently, most P&C insurers have not captured all of the data (about either the properties or the local environments) required for detailed actuarial analyses of the risk of water damage. To move to a good-practice state with respect to data will require considerable investment of personnel, IT, and human resources.

One consultant who responded to the survey commented that if an insurer wants to provide coverage for water damage, it will have to take a leap of faith by simply extending coverage. The

[55] Institute for Catastrophic Loss Reduction, “Protect your home from basement flooding”, (2011): 10-11.
[56] Feltmate and Thistlewaite, “Climate Change Adaptation”: 25.

consultant spoke of "buying the data"; he used this expression to convey his belief that insurers should offer coverage for water damage so that over time they would have access to the necessary claim data to more appropriately price the risk. The consultant continued that if insurers do not cover the exposure, they will never get the claim data that they need.

Even if all of the property-specific characteristics could be identified and the data collected, there are questions as to the availability of the data needed about the local environment. A partnership, such as the IBC's Municipal Risk Assessment Tool described in the next section, will likely be required between the insurance industry and the government, particularly municipalities, to achieve a true good-practice state for data.

Good Practice #2 – Municipal Risk Assessment Tool

This section of our report was reviewed and edited by the IBC; any opinions expressed are those of the IBC and not KPMG.

The IBC is gathering information related to the infrastructure of cities for its Municipal Risk Assessment Tool (MRAT). MRAT uses municipal data to "quantify the risk being underwritten with respect to [sanitary sewer backup-caused] water damage".[57]

A web-based tool, MRAT will allow municipalities, and potentially insurers, to assess the impact of severe weather on urban drainage systems by displaying risk zones to indicate relative degree of risk. MRAT incorporates data related to the current state of infrastructure, claims history, and climate change, as well as future projections, to "predict and display with a high degree of accuracy the probability that infrastructure failure will occur within a quarter of a city block".[58]

MRAT combines data on the current condition of infrastructure and how it may be affected by future climatic events to produce risk maps that identify where potential municipal infrastructure vulnerabilities may exist. An example of the MRAT risk map output is provided in figure 1.

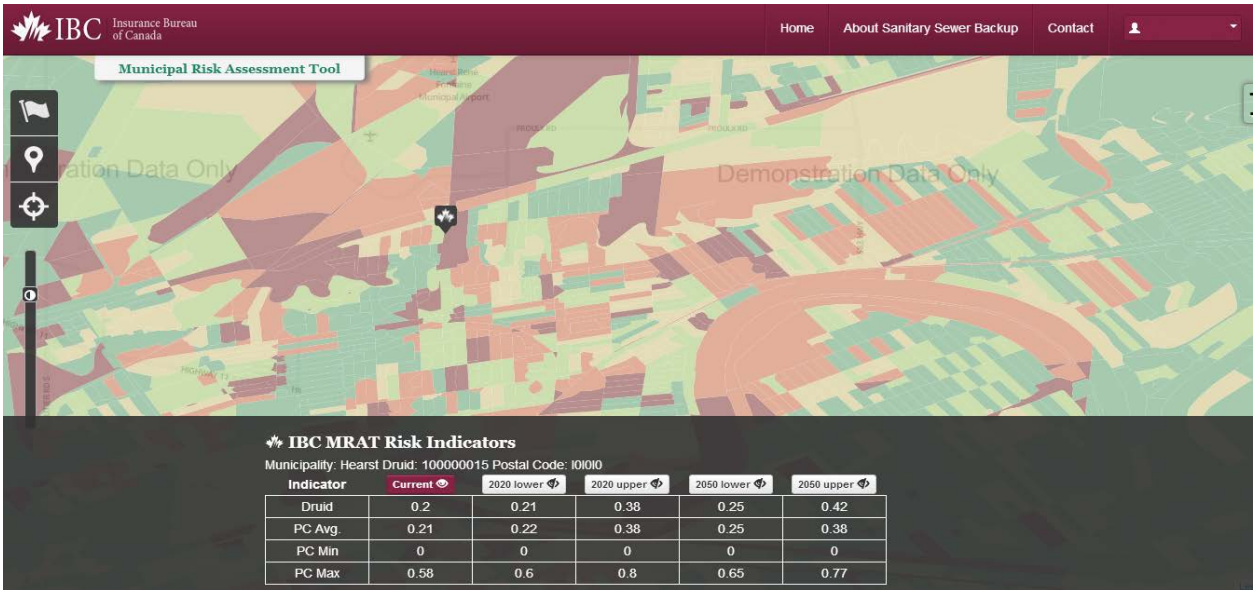

Figure 1. MRAT Map Viewer Output for Demo Municipality

[57] Insurance Bureau of Canada, "Municipal Storm and Sanitary Infrastructure Risk Assessment Tool Project", accessed August 15, 2013, http://www.ibc.ca/en/Natural_Disasters/documents/MRAT%20Leavebehind_EN_Jun3-11.pdf.

[58] Insurance Bureau of Canada, "Municipal Risk Assessment Tool", accessed on August 15, 2013, http://www.ibc.ca/en/Natural_Disasters/Municipal_Risk_Assessment_Tool.asp.

MRAT is currently in a pilot phase and is undergoing technical reviews with the pilot cities across Canada.

Participation in MRAT has the potential to lead many municipalities to revisit their data collection processes. As the tool has very specific data requirements, municipalities that are involved in the pilot are seeing the value in updating their data collection methods to ensure greater accuracy and robustness of the data that will underlie the system. Municipalities are expected to use MRAT to understand how future extreme weather events may affect their infrastructure. This is particularly valuable as municipalities currently have few, if any, tools available to quantify the susceptibility of infrastructure to severe weather events. The implementation of MRAT may also lead municipalities to collect and update data more often. Another benefit expected from the use of MRAT is the high level of municipal data standardization.

The widespread use of MRAT could potentially lead to:

— The ability of insurers to identify relevant variables for decision-making in both pricing and underwriting. Insurers' claims data could be matched with municipal infrastructure data in sophisticated regression-based pricing models.

— An improved availability of insurance coverage for sanitary sewer backups. The municipality will be able to prioritize infrastructure improvements for vulnerable areas with high risk. Insurers will be able to better understand risk, setting appropriate premiums resulting in improved availability of insurance coverage.

MRAT is a mutually beneficial partnership opportunity between the municipality and insurance industry. This partnership is a step towards tackling climate change through adaptation, because of MRAT's ability to evaluate sewer backup risk from climate change. Furthermore, the insurance industry and municipalities through MRAT stand to be able to provide a better service to the consumer that they both share.

Good Practice #3 – Coding of Claims Data

As noted in the previous discussion, good practice for property pricing requires that actuaries have the ability to link claims data with detailed exposure data. Thus, actuaries require accurate cause-of-loss coding for all property claims. This coding is particularly important following the occurrence of major events such as the Alberta and Toronto floods of 2013. Many losses arising from the Alberta floods, in particular, were covered by insurers as a goodwill measure and to enhance the long-term relationship with customers and not because the peril of water damage was covered in the insureds' policies. For actuarial pricing purposes, it is important that any such extension of coverage is distinctly coded so that analyses can be made of valid claims as defined by the coverage at any particular point in time as well as claims that are paid due to strategic business reasons.

Good Practice #4 – Prioritization of Property Pricing by P&C Insurers

Historically, Canadian P&C insurers have directed significant resources to the pricing and reserving of Canadian automobile insurance. This attention is understandable given the volume of automobile insurance written in Canada, the numerous reforms that have been implemented across the country in the recent past (particularly in Ontario and Alberta), and the financial significance of automobile insurance to many Canadian insurers. Furthermore, the active rate regulation that exists in many provinces for auto insurance necessitates a greater degree of actuarial involvement to comply with requirements for rate filings and justification for rate changes than for property insurance for which similar rate regulations do not apply.

Each year, there are numerous P&C insurance industry conferences sponsored by organizations such as the CIA, the Ontario Conference of Casualty Actuaries (OCCA), the IBC, MSA Research, and the major accounting firms. Actuaries are inevitably asked to lead sessions on automobile insurance at these conferences. It is the exception, not the rule, to find a session on property insurance at these industry events.

As a result of the emphasis on automobile insurance, the extent of actuarial resources dedicated to property pricing in Canada is far less than that of automobile pricing. The implications of fewer resources focused on property pricing include (but are not limited to):

— Less visible demand for the required data;

— Limited development and testing of pricing models; and

— Less expertise overall.

The limited actuarial resources that are allocated to property pricing restrict the ability of insurers (and the industry at large) to gain the sophistication in property pricing that is necessary given the increasing claims seen from water damage. New and innovative techniques to price the risk of water damage will not occur unless insurers are willing to make significant investments in both human resources and IT systems. IT systems are required for the collection and aggregation of data as well as for the development and maintenance of the sophisticated statistical models needed to analyze the data. Human resources are required in:

— Underwriting (or brokers) for the collection of required data at the issuance of new and renewal policies;

— Claims for coding of the required data fields during the claim management processes;

— IT to establish and maintain the systems for collection and aggregation of the data as well as the systems to support advanced actuarial modelling; and

— Actuarial for the development, testing, and maintenance of pricing models.

Given the increases in property losses in recent years, particularly in the area of water damage, it is important for insurers to commit additional resources (both actuarial and IT resources), and for actuaries to demonstrate their value in pricing this risk.

Good Practice #5 – Collective Efforts by the P&C Insurance Industry at Large

During the interview process, there was discussion with some participants about the need for developing an industry standard for data collection, both about the local environment as well as for the risk characteristics of insured properties.

There are two significant challenges in moving forward with any type of industry-based initiative related to the property pricing of water damage risk. First, there are a few large Canadian P&C insurers who have already dedicated significant resources to water damage risk and view their data, information, and models as proprietary. They believe that they have a competitive advantage due to commitments that they have already made and are not necessarily willing to make their knowledge and experience widely available. In the competitive environment that Canadian P&C insurers operate in for property insurance, we believe that such a position is understandable and reasonable.

The second significant challenge is related to the political consequences already mentioned in the discussion of MRAT. If the P&C industry were to collectively work with the government, particularly municipalities, to collect the data required about the local environment, a long-term plan would likely be needed to address any issues that could arise with respect to availability and affordability of future coverage.

Recognizing that there are challenges, we still believe that a state of good practice would have the P&C insurance industry working together to enhance all aspects of actuarial property pricing, not simply data collection as mentioned by respondents to the survey. The actuarial profession thrives—globally and in Canada—as a result of the continued contribution of actuaries with significant research papers as published by the CAS, the International Actuarial Association (IAA), the Institute and Faculty of Actuaries (UK), General Insurance Research Organisation (GIRO), and other leading actuarial organizations around the world.

The global actuarial papers, while developed for jurisdictions outside of Canada, exemplify initiatives that could be undertaken based on collective efforts of the Canadian P&C insurance industry described here. Within the actuarial community, collective efforts could be initiated by the CIA or by an industry organization such as the IBC.

Good Practice #6 – Emerging Models

With the state of rapidly evolving technology and global communications, there continue to be advances in modelling and particularly in models that are widely available and shared via the internet. In this section, we describe three models discovered in our research process. We expect that there are currently other models we are not aware of and that additional models will likely emerge in the near future. These are simply presented as examples of the types of models that may prove valuable in the future for quantifying the risk of water damage. Currently, none of these models precisely match the needs of Canadian actuaries for pricing property insurance. However, it is reasonable to expect that these or other models could be modified to provide useful tools in the near future for quantifying the risk.

Oasis Loss Modelling Framework

The Oasis Loss Modelling Framework (Oasis LMF) is a tool that is currently used for catastrophe modelling but may prove valuable in the future for modelling of water damage risk. Oasis has an open-architecture loss modelling framework that is available to the global community.

A news release by Lloyd's on January 18, 2013, states:

> Oasis is a not-for-profit company supported by Lloyd's and funded by a community of well-known re/insurers and brokers in the UK, Bermuda, Zurich and the US. Its ambition aim is to deliver a new method of catastrophe modelling to the industry in 2013. Aside from being not-for-profit and open source, Oasis does a few things differently. Its plug and play model makes it easy for new entrants to come into the market. By providing access to the simulation kernel and financial module for free (the part of the model that computes financial losses by applying insurance terms and conditions) Oasis allows new players to share their models and views of risk to the market.[59]

The Oasis LMF has four primary objectives:

— To encourage transparency in the development, use, and validation of models;

— To build a community that will increase the supply of catastrophe models and information;

— To stimulate innovation, software design, and hardware efficiency; and

[59] Lloyds, "2013: the year cat modelling changes?" accessed July 17, 2013, http://www.lloyds.com/news-and-insight/news-and-features/market-news/industry-news-2013/2013-the-year-cat-modelling-changes.

— To create a viable environment allowing for the commercialization of tools, models, and consultancy.[60]

In e-mail communications with Dickie Whitaker, project director of Oasis LMF, he explained the potential for the software's use for modelling water damage risk:

> We, Oasis, provide a simulation kernel (very fast and secure) and a financial module. The software that is being tested right now is also plug-and-play. That means that if you have a hydrologist that knows about "sewer backup potential or other non-flood related water damage", they could build a module that could be used on our platform and would include the impact of insurance conditions on an insurance portfolio.

Access to an online, global community could help facilitate the creation of new models for "un-modelled" perils such as water damage.

Computational Hydraulics International

Computational Hydraulics International (CHI) develops and supports PCSWMM, software for storm water, sanitary sewer, and watershed modelling. According to CHI,

> PCSWMM provides an efficient set of tools for designing storm water management control strategies for minimizing combined sewer overflows, sanitary sewer overflows, water in basements, surcharging, street flooding and/or rainfall-dependent inflow and infiltration.[61]

In our discussion with Rob James, CEO of CHI, he discussed the potential of using PCSWMM for the P&C insurance industry. Currently, PCSWMM is used almost exclusively by engineering firms and municipalities. PCSWMM relies on detailed infrastructure data such as (but not limited to) pipe diameter, pipe elevation, manhole locations, and connector pipes as the basis for calibrating, validating, simulating, and analyzing the impact of water-related events at very specific localized areas.

It would be challenging for insurers to use this software due to the requirements for copious and detailed data inputs, most of which is outside the actuary's expertise. As mentioned previously in this report, data about the existing infrastructure are not readily available to insurers at this time. Firms that currently use PCSWMM have the ability to survey the data themselves or have access to municipal data under restrictive terms regarding keeping and sharing the data. There would be a significant cost to insurers to get the software operational to model future weather events. Also, there is no specific insurance functionality currently built into PCSWMM to relate modelled weather events to an insurer's portfolio of exposures for estimating covered claims (as in a catastrophe model). PCSWMM does, however, have flexible generalized ability to derive costs associated with flood events (such as water in basements).

Despite the disadvantages noted, the foundation for a water damage model likely exists. Insurers would need to partner with engineering firms who are experts in this type of software and dedicate internal resources to support the model.

---

[60] Oasis Loss Modelling Framework, "The Objectives", accessed July 28, 2013, http://www.oasislmf.org/about-oasis/objectives/.

[61] Computational Hydraulics International, "Stormwater Management/Sanitary/Combined Sewer Remediation", accessed July 25, 2013, http://www.chiwater.com/Solutions/Software/Remediation.asp.

Ambiential

In the United Kingdom, Ambiential is a flood risk assessment firm that provides detailed flood risk information at the zip/postal code or individual building level for all sources of flood risk. Originally founded in 1997 as a partnership of researchers at Cambridge University, Ambiential is an example of organizations that have partnered with researchers and scientists for the purpose of modelling extreme weather events. According to the website of Ambiential, it can assist insurers by providing:

— Urban flood risk mapping and modelling for river, tidal, and surface water;

— Exposure mapping using geographical information systems;

— Catastrophe modelling (including storm surge, river flood, urban terrorism, and subsidence);

— Building vulnerability assessment; and

— Loss estimation via linkage of hazard maps with financial models.[62]

Ambiential's flood modelling also offers pluvial (a period of increased rainfall) flood risk data for the entire United Kingdom at the individual address level.

CURRENT CANADIAN PRACTICES

KPMG was specifically asked by the CIA to report on current Canadian practices to price water damage risk. Thus, as part of the research engagement, we conducted a survey to collect information about current practices. As noted previously, through our research, substantial information was collected about the broad topic of water damage, climate change, and the state of Canadian infrastructure. All of this information is not included in this report, as it is not directly relevant to current practices for pricing water damage risk in property policies. We have deliberately limited the reporting of survey responses to those we believe are relevant, either directly or indirectly, for pricing purposes by actuaries.

Each question is identified in italics text, and a summary of responses follow. Applicable findings from the literature review are included with survey responses where appropriate.

Questions Directed Primarily at the Actuary

1. Who is responsible for quantifying and making recommendations on the effect of water damage risk for the company's book of property business? In other words, who are the professionals (actuaries in pricing, valuation, or research and development; loss control; claims; risk management; other) that are involved in this process?

The unanimous response from all insurers participating in the survey was that actuaries and underwriters play the key roles in the decision-making related to the book of business subject to the peril[63] of water damage. Claims professionals also participate in decision-making not only in the management of water damage claims but also as contributors to special projects of insurers. Some insurers maintain research and development groups that have investigated the issue of water damage.

According to respondents, actuaries in both the pricing and reserving functions are major contributors to the quantification of water damage risk. Underwriters typically have responsibility for setting an insurer's overall policy and target markets.

[62] Ambiential, "Insurance Solutions", accessed July 20, 2013, http://www.ambiental.co.uk/insurance-solutions.html.
[63] The terms "peril" and "risk" are used interchangeably when referring to the cause of loss for water damage.

2. How unique is water damage as a peril compared to other types of covered perils? Do you view the peril of water damage different from other perils in property coverages? If yes, why? If no, why not?

Responses to this question included:

— We consider water damage to be a unique peril and price it separately from other perils; it requires rating that is specific to the characteristics that are unique to water damage.

— We don't consider the peril of water damage to be unique and price it as part of the basic policy.

— The peril is unique because of its high frequency and potentially large severity. Furthermore, the industry coverage is constantly evolving and insurers must adapt.

— The water peril is unique compared to other perils as it relates to frequency and severity trends.

— Water damage is perceived as the peril that is the most impacted by weather events and has a more and more important catastrophe exposure due to global warming. Addressing the peril of water damage necessitates the use of external data sources that are not yet widely used such as weather data, topographic maps, and infrastructure maps.

— The geographic component of water damage is more important than with most other perils.

— Water is a different type of peril as there is a greater chance of damage due to external forces; this is particularly true when the peril of water damage is compared to the peril of fire.

— Water damage is different from other property coverages, because the insured cannot control the losses that are related to municipal issues.

— Even though insurers may have added water-specific endorsements and raised deductibles (especially in areas that have been hit more frequently or severely by water damage events) and even if they have discussed the issue with the relevant authorities, they have yet to come up with solutions to prevent events leading to water claims from occurring in the first place. This makes the water damage peril somewhat different from other perils in property coverage.

— Water damage is unique, because water is a hidden peril and has a sense of urgency.

— In addressing water damage, it is important to take charge of the situation quickly from the very first notice of loss to determine if coverage is applicable. Early intervention is necessary to mitigate the loss, salvage items, and most importantly, prevent mold from setting in.

— It is hard to predict and probably even harder to limit the insured damages that can follow, because insurers have limited control over water sewer networks that are insufficient or simply outdated and even less on climate changes that may have an important role in the current trend in water damage events.

— There is an anti-selection element that is not prevalent in other lines, because people often do not buy coverage for water damage coverage until after a loss has happened. Our sophistication with pricing water damage peril is further ahead for losses arising from sewer backup and/or seepage than other causes of loss for water damage. Progress has been made in developing these endorsements due to the size of the claims and the resources we have available. The data exists to support these endorsements, and we are satisfied with the level of data detail available including geography, type of soil, and elevation.

3. Does your company treat the peril of water damage differently from other perils in pricing property coverages? If yes, how? If no, why not?

The majority of insurers responding to the survey indicated that they are currently rating property coverage by peril. One insurer responded that it had been rating by peril for 15 years; other insurers are in the process of transitioning to a system of rate-by-peril. For some insurers, water damage is the only separately-rated peril that is not an optional coverage.

The catastrophe modelling firms answered that water damage in general is different. They caution, however, that their answers are based on their experience with flood, which is different from water damage as defined for this CIA research project. One respondent noted that water damage is a hidden peril, as water can result in damage before such damage is visible. Furthermore, mold makes water damage different (and more costly), which is something the catastrophe models do not account for at this time.

4. Do you differentiate between water damage from catastrophe and other water damage? If yes, how? If no, why not?

The insurers said that they do differentiate between water damage from catastrophe and non-catastrophe events. In some instances, such differentiation is required for reinsurance purposes; actuaries also segregate the claims experience for the purpose of conducting large loss analyses that are required for ratemaking.

It was noted that the definition of catastrophe may vary from insurer to insurer. Because flood is not included in the definition of water damage coverage for this research project, respondents did not feel catastrophe claims were much of a concern.

In responding to this question, one regulator stated:

> The [regulator] does not differentiate between water damage from catastrophic events and other water related damage. Our current supervision framework and analysis structure does not address specific type or kind of loss. As per its Integrated Risk Management Guideline, the [regulator] expects insurers to identify, assess and quantify, control, mitigate and monitor the risks that they face. Water damage is one of those risks, be it catastrophic or not.

5. Does your company differentiate in its cause-of-loss coding (e.g., flood and sewer backup, bursting pipe, roof leak, etc.) for claims? Please comment on the accuracy/reliability of coding.

The respondents offered differing opinions regarding their confidence in the accuracy of data coding. Practices also differ with respect to the number of cause-of-loss codes used for water damage claims. Those insurers who have sewer backup and other optional endorsements expressed greater confidence in the quality of the coding. Insurers with relatively new processes for cause-of-loss coding have increasing confidence in their coding.

Additional responses to this question included:

— The quality of coding may become diminished, especially during times of frequent claims putting stress on the claims adjusting system.

— If a company wants to have a competitive advantage, a policy for auditing claims coding is imperative to pricing water damage risk.

— We follow catastrophe claims two to three months later to review and change codes if necessary.

6. Could you please describe your current processes for quantifying the effect of water damage loss potential for the purpose of ratemaking?

- *Do the processes differ for personal lines and commercial lines?*
- *Are there differences in the process by province?*
- *How are riders/endorsements priced? How often are they priced? Are they priced independently or are they a percentage of the underlying coverage?*
- *What current technologies are used, including both hardware and software?*
- *What are the processes for data management, including data scrubbing, cleansing, text recognition, etc.?*
- *Please describe the strengths and weaknesses of your current processes.*

Most respondents indicated that they are using general linear models (GLMs) to price water damage, while the others continue to rely upon traditional P&C ratemaking techniques.

In using traditional methods, catastrophe loadings are derived based on the historical relationship between catastrophe and non-catastrophe claims or based on the output from catastrophe models. Some insurers are using catastrophe models to reflect events such as severe convective storm. By using catastrophe models, the estimate of expected claims reflects the insurer's current portfolio. The catastrophe loading for water damage is then applied to the base rate.

One insurer who described their process for catastrophe loadings noted that (ideally) the loading developed from the catastrophe model output would be allocated to the different rating characteristics such as location of risk and type of construction. This insurer noted that some areas are more vulnerable to water damage from ground seepage or sewer backup because of the state of local infrastructure, topology of the land, as well as the type of construction. However, current pricing algorithms do not provide for this level of sophistication in the estimation of property prices.

Insurers varied in their responses as to whether or not the same processes are followed for the pricing of personal and commercial property products.

With respect to differences by province, most insurers do not change their processes for pricing by province. There were respondents who noted that differences exist in Québec due to the IBC's definition of water damage. In Québec, water damage is divided into three components: interior water damage, below-ground water damage, and above-ground water damage.

Insurers indicated that endorsements are priced independently. With respect to the timing of the pricing of endorsements, responses varied. Insurers conduct such analyses annually, biennially, or at the same time as the overall property rate review.

For standard ratemaking and data mining, insurers use the following technologies: SAS, R, SQL, APL, and Excel. For those insurers that are using GLMs, Emblem[64] was most frequently noted as the software used. Some insurers mentioned the use of @Risk. For catastrophe loadings, the most frequently cited software was IAX.

The use of the Habitational Insurance Tracking System (HITS) database was cited by some respondents. According to the HITS website:

[64] Emblem is software developed by Towers Watson that fits predictive models to large and complex datasets.

> The HITS database contains more than ten years of claims history information and more than 7 million claims (which are added on a regular and ongoing basis), making it the largest database of its kind in Canada.[65]

Some insurers reported that they have systematic processes for assessing data quality; others have no specific processes but address data quality through special projects when it is deemed necessary. The claims personnel who participated in the survey expressed confidence that the cause-of-loss coding was accurate.

In discussing the different techniques that are currently used to price water damage, we asked respondents to opine on the strengths and weaknesses of existing techniques. Respondents stated:

- It will require a few years of suboptimal efficiencies before reliable projections are likely available (said by insurers who are in the process of augmenting their data and/or changing rating algorithms).
- One of the weaknesses of existing models is that there is too great a reliance on historical experience that is reducing the predictive power of the models; that said, the quality of the historical data is high.
- Our current processes are adequate at the moment.
- We have used our current processes that include predictive modelling for numerous years and have become very familiar with the approach.
- We do not thoroughly review the elements of water damage often enough.
- Our lack of accurate allocation of catastrophe loadings between perils (such as water damage as defined in this research report) is a weakness of our existing process.

In commenting on the analysis of claim trends and modelling, the report on the AMF Survey stated:

> Four respondents stated that they go even further and formally evaluate the relationship between climatic events and claims. In particular, they systematically collect and record regional meteorological information, thereby allowing them to refine their models and carry out correlation studies[66]

It is not clear from the report on the AMF Survey if such detailed analysis is conducted only for flood or other types of major weather events that result in claims to the insurers.

Many respondents commented on the lack of industry data for benchmarking and modelling purposes. Specifically, respondents mentioned the absence of data about municipal infrastructure. At this time, insurers are unable to integrate significant external data into their modelling procedures because such data are not readily available, rather than because of a lack of technology that could handle additional data.

The report on the AMF Survey confirms the responses we heard during our interview process. The survey asked insurers to "discuss the risks that severe weather and climate change pose to your company".[67] The risk of pricing and underwriting was the most frequently cited specific risk by respondents to the survey. According to the report on the survey:

> One of the insurers indicated that traditionally, its pricing and underwriting are structured for fire and theft-related claims, and not for major weather events

---

[65] Opta Information Intelligence, "Habitational Insurance Tracking System (HITS)", accessed July 17, 2013, http://optaintel.ca/Products/HITS.
[66] Autorité des marchés financiers, "Managing Climate Change Risk" (2011): 13.
[67] Ibid.: 16.

> or water damage. It acknowledged that its current pricing is not necessarily well suited to this new reality. However, it considers that if the changes are gradual and observable, rates can also be adjusted gradually.[68]

One regulator stated that there are not any shortcomings for estimating water damage as "it seems that effects of water damage on property are now better known and . . . insurers have adapted to the new reality".

For pricing water damage, some insurers are using data aggregated by municipality, and others are using data by the first three characters of postal code (i.e., Forward Sortation Area, FSA). However, one respondent specifically commented that FSA is not the best measure for all water damage, particularly for sewer backup.

The respondents from catastrophe modelling firms commented that they do not have detailed kind-of-loss data and, as a result, do not have a strong understanding of what is and is not insured. In their modelling, water damage claims have not been a major component. They have not received data refined by cause-of-loss coding and are thus limited in the granularity of the perils with which their models apply. These respondents noted the trade-off between computational cost and model complexity.

7. What is the percentage distribution of water damage claims for homes, condominiums, and commercial property and by major region in Canada?

Respondents regularly indicated that water damage claims are both a high priority and a large proportion of claims. The majority of respondents answered water claims were roughly 40% or more of total claims. For some insurers, water damage claims range from 60% to 70% for Ontario and western regions. Condominium water claims comprise a much larger percentage of total claims relative to homeowners and commercial multi-peril policies; many of the respondents indicated claims from 60% to 90%.

Not only are water damage claims a large proportion of total claims, at least 90% of exposures are subject to water damage, depending on perils covered in the standard policy and what optional coverages are offered.

The report on the AMF Survey provided a similar result; the AMF noted that the majority of insurers indicated that water damage was the principal source of claims.

8. Is there known cross-subsidization (by line of business or region) with respect to pricing for water damage, either between types of insured or location of insureds?

Specific comments about cross-subsidization included:

— Because a portion of our water damage is a nominal endorsement, there is known subsidization.

— If subsidization does exist, it will be by another line in that region not by other regions.

— A subsidy may implicitly exist between risks. (This opinion was expressed by two respondents.)

— We could expect that a cyclical cross-subsidization exists between personal property and personal auto lines of business. The state of this cycle is different in each region due to regulatory differences.

— Losses would be implicitly subsidized by other areas where maximum limits exist in risk-prone areas or where premiums attributable to water damage are not adequate.

[68] Autorité des marchés financiers, "Managing Climate Change Risk" (2011): 16.

— Condominiums are the biggest problem that can inflate personal lines severity. This should be viewed as a problem in commercial lines and not personal lines. Subsidization can take place as a result.

9. Do you believe that the historical water damage claims data are a reliable source for predicting future claims? If yes, why? If no, why not?

The actuaries responding to the survey believe that historical data are still an important source for predicting the future. Actuaries commented that although the past data are "perhaps not perfect", they are "reliable enough" to project future claims, as recent experience will be given more weight when estimating expected claims for pricing purposes.

The majority of actuaries noted that while historical data can be relied upon, they would be more comfortable if other relevant information was available to supplement their historical data. Specifically, actuaries are seeking information on how to adjust historical claims for the effect of aging or inadequate infrastructure, lifestyle changes, and weather changes.

An insurance regulator also commented on the reliability of historical data as a source to predict future claims. This regulator responded that:

> Trends in frequency and severity that are part of an insurer's historical data need to be considered . . . When combined with external data, such as expertise and modelling results, historical data remains a reliable data source for predicting future claims.

This regulator cautioned that the use of any external data or modelling alone "would probably overlook some reliable information that is part of historical data". The regulator concluded by noting that how the data is taken into consideration when predicting future claims is distinct from the reliability of the data.

One catastrophe modelling firm noted that "every event changes the landscape"; and in particular for flood, "defenses are built to a higher protection level after past events". A link can be made between the peril of water damage in terms of how houses are built to changing specifications in building codes over time; such changes are often made to address weakness that resulted in prior losses. To the extent that building codes and practices are changing and thus future water damage claims are less frequent and/or costly in the future, then historical experience is less useful for pricing purposes.

10. Does your current property pricing model incorporate external measures of potential risk exposures, such as climate change, infrastructure issues, lifestyle changes, or other specific factors?

All respondents indicated that the pricing models currently in use do not include any explicit adjustments for climate change, changes in infrastructure or lifestyle, or other factors. There was a belief among many that the effects of changes in these areas would be reflected over time in the historical data. While additional data are sought and used (where available) there are no formal processes in place for the collection or integration of such data.

11. Do you use external resources, such as brokers or expert consultants, to assist in the quantification process? If so, how?

Participants to the survey indicated that they do not use brokers or external expert consultants to assist in the quantification of water damage risk; any expertise that is currently relied on has been developed internally within the insurer.

Catastrophe modelling firms responded that they have not assisted clients explicitly in quantifying and making recommendations for the financial effects of water damage. One consulting firm said that it had worked with a client in predictive modelling for sewer backup coverage. This firm noted that some of the modelling results were surprising.

12. What external sources of information do you incorporate in your analyses (e.g., flood plain, municipalities' infrastructures evaluation, scientific research, etc.)?

The responses to this question were somewhat contradictory to the responses in question 10, where actuaries indicated that they do *not* currently include adjustments for climate change, changes in infrastructure, lifestyle changes, and other factors. Nevertheless, the purpose of this section of the report is to summarize the feedback that we received during the interview process.

Responses to this question included the following:

— Flood maps prepared by provincial governments (where available);

— Past climatic data;

— Geo-demographic data;

— External studies for the determination of sewer backup zones;

— Competitor information; and

— Some reports on municipalities' infrastructure and engineering.

Respondents commented that flood maps are becoming less relevant over time, because governments have not had the resources to update them.

It was noted by one respondent that:

> Storm water master plans are publically available but hard to interpret. For example, the City of Toronto has a map of water damage claims reported. The City of Toronto updates its map and dots where people have complained.[69]

13. Have you made any significant modifications to your water damage pricing process in the last five years? Do you anticipate significant modifications to your current water damage pricing process within the next three to five years? If yes, please explain.

Five respondents noted that they have made significant changes within the last five years. Such changes include:

— Increased the number of sewer backup zones and rating territories;

— Implemented a rate-by-peril property algorithm for personal and commercial lines;

— Increased segmentation by territory and type of loss;

— Introduced rating based on per-insured limits;

— Reviewed more closely the geographical aspect of water damage;

— Modified processes by province;

— Moved to peril-based pricing in all provinces; and

[69] Toronto Water, "Toronto Water Basement Flooding EA Projects", accessed August 19, 2013, http://www.toronto.ca/involved/projects/basement_flooding/pdf/32_areas.pdf.

— Created finer rate segmentation and more refined underwriting.

Three insurers indicated that they would be making significant changes in the future. Anticipated changes included:

— Introduction of rate-by-peril;

— Changes to coverage limits and the approach for pricing by peril;

— Looking more closely at the geographical aspect of water damage rating; and

— Using the IBC's MRAT when it becomes available as quickly as possible.

14. Do you believe that actuaries have the requisite skill set to be able to address the issue of water damage risk? If yes, why? If no, why not?

Respondents expressed the opinion that resources dedicated to the development and pricing of water damage risk (and more broadly, property insurance products) lag behind those dedicated to automobile insurance. Automobile insurance has demanded substantial resources due to the regulatory changes over the past decade and the need to monitor results frequently to measure the effect of the changes as well as to report data for industry aggregation. Property insurance is not regulated in the same way as automobile insurance and has not been subject to the same types of product and tort reform. Thus, actuarial resources have not been allocated to property insurance in the same way that they have to automobile insurance.

Respondents commented that simply because resources have not been directed to property insurance does not mean that insurers, and in particular actuaries, are any less capable of pricing the risk of water damage than they are in pricing automobile insurance. In fact, respondents believe that actuaries have the skills necessary to price water damage but are lacking the credible data necessary to conduct such analyses.

Respondents stated that coordination is required with experts such as engineers, weather modellers, and geographers. They believe that industry data can be the input to technological tools that currently exist to derive new and innovative approaches for pricing the water damage risk.

One regulator agreed that coordination with other resources could help quantify the risk of water damage. This regulator expressed the belief that actuaries have access to reliable claims data and some external data to perform relevant analysis with regards to ratings, reinsurance, and claim liabilities. The regulator acknowledged that quantifying water damage risk may require specific expertise that may include:

— Mapping of known areas susceptible to water damage;

— Identification of new areas at risk due to new residential and commercial developments;

— Capacity analysis of current and upcoming water sewer networks; or

— Predictions about the effects of climate change.

One respondent specifically cited the importance of the ICLR to actuaries:

> Actuaries need to work with different groups such as the ICLR to better understand how water damage arises. We need to be informed on what mitigation devices are available and what should be their impact on the pricing algorithm. Pricing is an important part of driving policyholder positive behavior in water damage risk mitigation.

In conducting our research, we found a significant volume of material on risk mitigation; however, it is not included in this research paper given the narrow focus on actuarial pricing for the risk of water damage in property insurance.

15. What resources (e.g., literature, scientific papers, websites) do you currently turn for assistance in analyzing this risk?

Responses to this question included:

- Educational material available on the website of the Casualty Actuarial Society (the CAS) to help quantify water damage including GLMs, residual spatial smoothing, and catastrophe modelling;
- Internal expertise from underwriters and claims personnel within the insurer;
- The ICLR;
- l'Association des Actuaires IARD (AAIARD) documentation[70];
- Working Party at the GIRO[71];
- The CAS for information about climate change;
- Emblem[72];
- Intergovernmental Panel on Climate Change (IPCC)[73];
- Underwriting water damage pricing tiers;
- Word of mouth;
- Underwriting partners; and
- None.

The AMF Survey included similar questions that sought input on the exchange of information with scientific partners and the use of computer-assisted models to help manage climate-related risks. The report on the AMF Survey stated: "Several respondents referred to the Institute for Catastrophic Loss Reduction (ICLR) which is a key player and their principal source of scientific information about insurance".[74] With respect to models, the report stated:

> The situation in Québec indeed differs, for example, from that in the United States. Consequently, even the choice and use of natural disaster analysis software can be questioned, because such a tool may underestimate or overestimate climate risk due to inadequate adjustments for the geographical region being analyzed. In this regard, Ouranos offers a unique profile of climate change in Québec.[75]

---

[70] AAIARD is the Québec affiliate of the CAS for actuaries working in the field of damage insurance in Québec.
[71] GIRO is responsible for research and development, for the General Insurance Conventions, and for arranging the preparation of papers on general insurance topics for discussion at other types of meetings. The GIRO conventions are the premier professional event for general insurance (GI) actuaries in the United Kingdom.
[72] Respondents did not identify specifically whether the reference to Emblem was simply the software product or the consulting services available to support the software.
[73] The IPCC is a scientific body under the auspices of the United Nations (UN). It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It does not conduct any research nor does it monitor climate-related data or parameters.
[74] Autorité des marchés financiers, "Managing Climate Change Risk" (2011): 14.
[75] Ibid.: 20.

16. Do you think insurers currently have the necessary technological tools to address the issue of water damage risk? If yes, why? If no, why not?

Most responses focused on the lack of topographic maps and data on municipal infrastructure. Respondents commented that the lack of this type of data leads to "archaic" IT systems and unrefined pricing models. One respondent commented that MRAT will be a great technological tool when it becomes available.

Another respondent commented that insurers do not currently have the technological tools necessary to quantify water damage risk. This respondent believes that a sophisticated model (similar to earthquake catastrophe models) is required to evaluate the causes of loss inside a house, which are different from external causes of loss, and to be able to pinpoint the source of water damage. This respondent also noted that insurers have been able to capture the risk of sewer backup.

Others comments included:

— Water damage has nothing that is specifically measureable.

— The name of the builder would be a good variable for modelling purposes.

— Tools exist, but it is what you do with the pricing structure that is the most important.

In responding to this question, participants reiterated their responses to prior questions that they need more and better data in addition to claims data. "Some information such as topographic maps and infrastructure maps are costly to produce and require some collaboration to develop".

One regulator commented:

> Not all insurers have the available financial and human resources to provide the actuaries with the necessary technological tools to address water damage risk . . . It involves getting specific human expertise to develop, with related costs, or investing in third party models. In both cases, management could argue that it is too costly.

One catastrophe modelling firm indicated that they are interested in further researching and modelling mold.

17. Do you believe actuaries are proactive in addressing/identifying the issues or are the external pressures influencing the actuarial focus?

Responses to this question varied and included:

— We are proactive in responding to the claims that appear through our loss experience.

— We are proactive but are limited in what we can do.

— The prioritization of our resources to automobile insurance, especially for dealing with mandatory reform, has slowed our progress in innovation related to water damage.

— Actuaries have not been particularly proactive, but rather reactive, even though this topic has been on our radar for a while.

— Internal focus and external pressures are driving change at our company.

18. Has water damage risk been identified as a priority issue by senior management currently or in the recent past?

Every respondent indicated that water damage has been identified as a risk; however, respondents expressed different opinions as to the prioritization of water damage with other perils such as hail, earthquake, and wind. The priorities varied particularly from province to province.

During our interviews, catastrophe modelling firms responded that senior management of their clients had not (to their knowledge) specifically talked to them about water damage. Similarly, the regulators responding to the survey were not aware if water damage had been identified as a priority issue.

The AMF Survey asked a similar question about addressing severe weather in a company's risk management strategy. The report on the AMF Survey states:

> Two groups of respondents clearly emerged. The first is comprised of respondents who specifically integrate or are in the process of specifically integrating climate change in their risk management strategy, by seeking to address climate risk directly and explicitly. The second group is comprised of respondents who do not consider climate change in a clear and obvious manner, although their answers revealed that they do consider it indirectly. Only one insurer admitted that it did not have any strategy in this regard.[76]

19. Is the issue of water damage risk particularly important for your organization currently or in the recent past? How important do you anticipate it being in the future (i.e., five years)? Please rank its importance, to both past and future, on a scale of 1 to 10, with 1 being "not very important" to 10 "the most important".

Respondents expressed differing opinions to this question. For some, the risk of water damage was considered to be more important in the past than it is anticipated to be in the future. Others expressed an opposite view, with water damage gaining importance in future years.

From a regulatory perspective, insurers' current practices for assessing water damage risk are on their radar but are not necessarily a top concern compared to other perils in terms of "financial health". Our regulatory respondents gave the importance of water damage a 5, citing other perils as more important and this issue as not being a high priority for senior management.

The AMF Survey asked if an insurer's concern about climate change had changed in the past year. Six respondents to the AMF Survey reported the "same degree of concern", four reported "greater concern or still greatly concerned", and one reported "no concern". [77]

Questions Directed at the Regulator

The following questions were asked to participating regulators.

1. Are you concerned about the potential effect of water damage claims to the financial health of P&C companies?

One regulator expressed concern but not as much as the concern over hail and windstorm. Another regulator commented that if financial health is defined from a minimum capital test (MCT) perspective they "do not consider water damage claims to be a solvency issue. However, when looking from a profitability standpoint, water damage claims could have an impact on the financial

[76] Autorité des marchés financiers, "Managing Climate Change Risk" (2011): 11.
[77] Ibid.: 21.

health of a P&C insurer in any given year". The regulator noted that the magnitude of water damage claims that would trigger a solvency issue would be in the magnitude of "a very very large earthquake in downtown Montréal or Toronto or Vancouver, and even then, reinsurance would cover a good part of the losses". This regulator expressed the opinion that insurers would regain profitability by increasing premiums and limiting coverage. They also believe that insurers are being vigilant in their water damage exposure and have been mitigating the risk, "mostly through stronger underwriting rules, better mapping of water prone areas, enhanced risk selection, and higher premiums".

2. Do you see water damage risk addressed specifically in the risk management procedures of the companies you regulate?

One respondent commented that water damage is in its "infancy stage of risk management procedures". Another respondent stated:

> Our supervisory work has shown us that insurers are sensitive to this risk and that they are taking or have already taken specific actions to mitigate the impact of water-related claims and of future water events.

Questions Directed Primarily to Companies with Global Organizations

The following questions were asked to insurers that are part of a global organization.

1. Do you look to other companies within your organization for methodologies and approaches to address water damage risk? Please describe how their expertise expands upon your own.

There appears to be very little sharing of intelligence outside of Canada among actuaries within global organizations, with the possible exception of sharing studies. The reasons cited for the limited sharing of data is the weakness or irrelevance of external data that would be available globally. Furthermore, the coverage for water damage is very different in Canada when compared to international markets. One respondent noted:

> Flood insurance is usually included as part of the home insurance product in the UK, but excluded in Canada. There has been an exchange of coverage information but no real alignment because the marketplace expectations of coverage are very different.

2. Do the actuaries from your organization meet on a regular basis and has water damage risk ever been on the agenda at global meetings?

Actuaries working for global insurers and consulting firms indicated that regular and/or ad hoc meetings occur within their global organizations. However, water damage risk has not been a topic at global meetings.

3. Are there global tools that can be used for assessing the potential financial effect of water damage? How applicable are these global tools for the Canadian environment?

One respondent noted that "tools are available but have no input in an appropriate format and level of detail". Another respondent commented that "besides catastrophe models that we are using, we are not aware of any global tool that would help better assessing water damage in Canada".

Questions Directed Primarily at Claims and Underwriting

In developing the survey, the RPMT recognized that to price the risk of water damage, actuaries would seek input from underwriting and claims. Thus, questions were created to receive feedback from professionals in both of these areas for the research project. This section of the report sets out

the questions in the survey directed at claims and underwriting and the responses to each question. The questions and responses are limited to those that are related to the scope of this paper and thus do not include all survey responses.

As in the previous section, the survey questions are identified in italics; also similar to the previous section, survey results are supplemented with findings from our review of external literature.

1. What do you believe are the major contributing factors of water damage claims to your company?

- *Climate change;*
- *Aging or inadequate infrastructure;*
- *Lifestyle changes; and/or*
- *Other.*

Specifically cited examples of lifestyle changes include the building of condominiums in areas that are not equipped to handle such population density as well as density in new housing developments. Urban sprawl and living areas below ground were also mentioned and are considered lifestyle changes for the purpose of this report.

Various respondents to the survey identified each of the above as contributing factors of water damage claims. The following were also identified as "other" major factors:

- Frequency and severity of extreme weather events;
- Inadequate zoning rules;
- Building codes and the lack of enforcement;
- Construction quality of new developments;
- Geographic area (such as building near creeks and rivers);
- Use of water following weather events (such as the need for limited use of washing machines following a major storm); and
- Lack of prevention (such as sump pumps and waterproofing).

While climate change is not universally agreed upon, there was fairly unanimous recognition of an increase in the frequency and severity of extreme weather events.

2. What current prevention and mitigation efforts are in place to address water damage risk for your company?

Prevention refers to activities that are directed at reducing losses in advance of the occurrence of an event that can give rise to a loss; whereas *mitigation* refers to activities directing at reducing losses once an event has taken place. Insurers' activities related to prevention of water damage claims are directed at the behaviour of its insureds, at the definition of insurability, and in the insurance product itself. The AMF Survey noted that one company had created an in-house "team focusing on water damage loss prevention"[78]; the report also states that companies have created units to monitor emerging climate risks.

With respect to activities directed at modifying the behaviour of insureds, insurers:

[78] Autorité des marchés financiers, "Managing Climate Change Risk" (2011): 15.

— Produce brochures and educational material on water damage prevention tips for new and renewal policyholders;

— Use e-mail to distribute advice about loss prevention techniques;

— Reach out to policyholders through brokers via personal telephone calls at the time of renewal to gather information about changes in exposure and provide advice about prevention techniques;

— Utilize direct mail campaigns with inserts to policy documents and/or links to material on the Internet;

— Offer premium discount for prevention devices; and

— Inform policyholders of financial incentives for prevention where they exist in certain provinces and/or municipalities.

The results of the AMF Survey are similar to the responses above.[79]

In using the definition of insurability to address loss prevention, insurers may require the following prior to binding coverage for either new or renewal risks:

— Completed and signed sewer backup questionnaire for business in high-risk areas;

— A professionally installed backwater valve or sump pump;[80]

— An examination of the foundation for cracks and completed repairs for any cracks discovered;

— A specified time period (such as 20 years) for all roofing and related materials before repairs are required;

— A water heater that is within a specified age range; and

— A review of the number of water damage claims in recent years as well as the time frame and circumstances of such claims.

Depending on the insured's adherence to the insurer's requirements, the insurer may use a tiered rating system for determining premiums, impose limits on the coverage for water damage, or exclude coverage for water damage.

In using the insurance product to promote loss prevention, the insurer may:

— Sell the product with exclusions for specific types of water damage (such as sewer backup);

— Offer endorsements to a product that has exclusions associated with water damage losses;

— Require an increased deductible for water damage losses; and

— Provide decreased limits for water damage losses.

The comments we heard during the interview process are consistent with the findings in the CCAP Report, which states:

> There are several ways in which insurers can encourage risk-reducing behaviour by homeowners, including: adjusting the price charged for

[79] Autorité des marchés financiers, "Managing Climate Change Risk" (2011): 19.

[80] In discussions with Dan Sandink of ICLR, he cautions "a sump pump alone does nothing to reduce sewer backup risk for an individual household. In fact, a sump alone would only increase exposure of an insurer to water damage losses, as sump failures are usually insured. In most cases, both a backwater valve and a sump system have to be installed together in order to reduce risk".

> insurance coverage and deductibles, caps on the amount that policy holders will be paid for damage, excluding certain types of damages from insurance coverage, and cancelling insurance policies. Insurers should offer homeowners premium discounts and apply other signals for a wide range of adaptation practices, including the use of superior building products and the use of "better than building code" construction specifications for new builds and major renovations.[81]

Respondents to the survey commented on the difficulty in changing insureds' behaviour with respect to the use of prevention techniques. Awareness can be a helpful tool to get insureds to adjust to current practices, but education is considered a passive approach. The most effective methods for changing the behaviour of policyholders are mandatory requirements or premium discounts.

A few respondents indicated that insureds do not think about water damage coverage until they have a claim. Other respondents believe their policyholders are knowledgeable about the need for water damage coverage. One respondent shared a belief that municipalities should encourage insurance companies to charge more for non-compliance of proven prevention efforts, and insurers should require the homeowner to oblige.

In our review of the literature, we found much discussion about the lack of significant efforts directed at preventative measures, particularly by insureds for weather-related events. Reasons cited for general public apathy include the fact that weather events are considered by many to be rare and unpredictable occurrences. Furthermore, those who have been affected in the past often consider themselves unlikely to be affected again in the future.

Because of the aging infrastructure, one of the most important prevention actions cited by respondents is an investment in upgrading infrastructure. Insurers also noted that simply having access to data and information about the condition of infrastructure could assist in underwriting, as currently only limited data and information are readily available.

3. Is the interpretation of water damage more challenging in terms of the policy wording compared to other perils?

Most, although not all, respondents stated that the interpretation of water damage is more difficult than other perils. Water damage can arise from many different causes, including (but not limited to) accidental escape from a pipe, sudden opening in the dwelling, or the backup of a sewer system.

Over time, some insurers have attempted to respond to increasing claims from water damage by modifying coverage such that protection is not provided in the basic policy but instead through endorsements. These insurers commented on how policy changes have led to lengthy policy wording with complex definitions for the various potential causes of water damage. At times, it is extremely difficult to assess the true cause of loss and match the coverage and/or coverage exclusions with the cause of loss. Further complicating the situation is the threat of mold and the costly repairs associated with mold remediation.

In contrast, some respondents indicated that they did not believe that policy wording is more challenging today than it has been historically. These respondents cite reliance on clear and unambiguous legal terminology. One participant of the survey commented that the IBC in Québec had provided valuable assistance in revising policy wording and clarifying coverage.

[81] Feltmate and Thistlewaite, "Climate Change Adaptation": 21.

4. Do you anticipate that any changes from regulatory interaction will increase claims costs? If yes, then how?

Participants indicated that there could be regulatory action if the costs associated with claims from water damage continue to escalate such that availability becomes an issue in certain areas. If insurers are unable to provide the coverage that is deemed necessary by policyholders, then provincial regulators may become involved to address availability issues. Policyholders require coverage that addresses their needs in terms of both the breadth of protection as well as its financial costs.

In asking this question, the discussion frequently turned to the issue of flood claims. Flood is explicitly excluded from this research paper, and thus flood-related comments are not included in this report.

It is valuable to note, however, that regulatory action related to flood claims could have consequences for insurers offering sewer backup claims, because extreme weather events frequently lead to sewer backup claims in addition to the uninsured flood-related losses. Damage can arise in some circumstances from both flood and sewer backup, making it difficult for some insurers to determine what the true cause of loss is and whether or not a loss is due to a covered event. It is not unusual for insurers in these situations to provide coverage as a matter of goodwill rather than simply out of a contractual obligation.

One respondent indicated that regulatory action could increase overall costs due to the cost of compliance. Several participants responded that they believe the threat of regulatory intervention was low. It should be noted that our discussions took place prior to the 2013 floods in Alberta and the major storm in Toronto; thus, we do not know if responses would have changed following these events, which led to major water damage losses for the Canadian P&C insurance industry.

5. Do you believe that the government has a role to play in addressing the factors giving rise to increased water damage? Please describe.

In responding to the question of governments' role in addressing the factors that give rise to increasing water damage claims, "building codes" was among the most frequent answer. One participant stated:

> All future building needs further planning before providing building permits. Builders and developers need to complete appropriate research into infrastructure requirements before subdivisions are built. Government needs to monitor and set standards. In areas of known concern, tax incentives be provided to homeowners to correct the situation and minimize a reoccurrence.

Other respondents echoed this sentiment. One participant stated that there needs to be higher standards for drains around the house as there is "nothing guaranteeing the builder's work is done properly". Another participant stated: "changes to the building code for new construction requiring the installation of loss prevention devices [should] be mandatory".

The Urban Flooding in Canada study advised that building code authorities should:

> . . . provide guidance to local authorities about how code wordings related to protection of homes from sewer backflow should be interpreted. This guidance should outline that code wordings be interpreted in a way that

> requires the mandatory installation of backwater valves in all or most new Canadian homes.[82]

Thompson's reported on March 20, 2013, that Collingwood, Ontario, Canada is requiring that all new homes have backwater valves installed. Bill Plewes, chief building official, told Thompson's:

> The purpose of the document was to make recommendations to the Building Code Branches across Canada and to have the requirements for backwater valves clarified. As it is worded for most provinces, discretion is left to the authority having jurisdiction. This makes it very confusing when contractors go from one municipality to another. One requires it, one does not. No fault of the municipality. The code just needs to be black or white.[83]

In responding to the question on the role of government in addressing the factors that give rise to water damage losses, respondents also commented on municipal infrastructure for flood defenses, water management, and data sharing. One participant believes that the government has shifted the problem of aging infrastructure to the insurance industry. This respondent noted that insurers are unable to sue cities and municipalities for damages, "essentially downloading the problems to the insurance industry". The Municipality Act changed the conditions for being able to take legal action against municipalities. In the past, subrogation for water damage claims may have been sought from the municipality. Now insurers are required to prove negligence and sustain significant recovery costs as the process has become much more complex.

One respondent stated:

> The municipal governments, under the direction of provincial government, are responsible for providing adequate storm water sewer systems to reduce the risk of sewer backup. The entire infrastructure in a number of municipalities needs to be addressed and soon.

Another respondent replied similarly by stating "municipal governments need to set aside significant ongoing funding to improve aging infrastructure and to be adequately prepared for urban growth and changing climate. We know some municipalities are making significant funding available, while others are only discussing the issue".

6. What percentage of your portfolio (in terms of exposure) is subject to water damage claims? (Please clarify how the percentage is defined.)

Respondents from claims and underwriting indicated that, on average, more than 85% of their portfolios are subject to water damage claims. This value differs slightly from the response from actuaries who indicated that at least 90% of exposures are subject to water damage. Respondents commented that it is not clear whether or not the high proportion of coverage is due to a strong awareness of the risk by policyholders or due to brokers' efforts in selling the coverage.

For some insurers, the exposure arises from the basic property policies sold; and for other insurers, the coverage is offered through optional endorsements. Some insurers cover all water damage as part of their basic policy, while others include coverage for certain causes of water damage only through endorsements.

Sewer backup is the most utilized endorsement; insurers also offer endorsements for seepage, above-ground water, supply line breakage, weather-related events, and broad coverage for extended water.

---

[82] Dan Sandink, "Urban flooding in Canada", *Institute for Catastrophic Loss Reduction* (February 2013): iv.
[83] "Collingwood requires backwater valves", *Thompson's World Insurance News*, April 1, 2013, page 5.

7. What are the underwriting considerations for riders/endorsements? Are there restrictions on who coverage extension is offered to?

Insurers control their exposure to water damage risk through:

— Restrictions in underwriting;

— Changes to deductibles and policy limits;

— Modifications to policy wording;

— Use of exclusions and/or endorsements; and

— Increases in premium rates.

In determining what type of underwriting controls to implement, insurers consider:

— The claims history of the potential insured;

— The requested limits of coverage, which may vary depending on location, coverage type, building characteristics (e.g., foundation type), and the age of dwelling; and

— The installation of approved loss prevention devices following a loss (e.g., backwater valve or sump pump).

8. Have there been any recent changes to the wording of policies with respect to water damage? What prompted the changes? Have the changes been effective?

With respect to policy wording, over one-half of those surveyed have made recent changes. Those that had not made recent changes indicated that it had been at least five years since the previous change. Respondents were not able to comment as to the effectiveness of the changes in policy wording. However, one respondent indicated that there had been better coding of claims since the changes in policy wording had been implemented.

9. Do you anticipate significant modifications with respect to your current processes for underwriting water damage coverage within the next three to five years? If yes, please explain.

Although only one respondent indicated that significant modifications were intended in the next three to five years; these changes were in the area of underwriting eligibility. All other respondents indicated that they would continue to closely monitor the risk of water damage and make adjustments as needed.

10. Do you believe that there is a way to reduce your company's exposure to water damage risk while remaining competitive and at the same time providing insureds with the proper advice and required protection to meet their needs?

For this question, all respondents commented on the importance of encouraging loss prevention and mitigation.

11. Are discounts applied for insureds that have effective water damage mitigation and prevention measures in place? If so, what discounts are applied?

Participants indicated that the following types of discounts offered:

— Backwater valve;

— Sump pump;

— Foundation type;

— Underwriting zone; and

— Prevention devices if in higher-risk zone; and

— None.

Only one-half of the respondents to the survey indicated that their companies offer any form of discount. One participant stated that "monetary incentives on an $800 average premium are not an inducement to change behaviour". However, during the Insurance Brokers Association of Ontario (IBAO) Convention in October 2012, Maurice Tulloch, CEO of Aviva Canada, shared his belief that discounts were a good way to encourage prevention. He commented:

> . . . but what we better be prepared to do, when we inform and they act, is reward, and reward with a better rate because they've taken those preventative measures.[84]

One respondent to the survey described the following innovative prevention measure:

> We recently introduced a discount on premises protected with a water damage control device. This type of device in controlled by sensors that detect presence of water on the ground where they are installed and trigger an alarm as smoke would do for a fire alarm. The most sophisticated systems are central connected and can send an alarm signal to a smart phone. Some devices are also equipped with an automated valve that shuts down the main water entrance.

With the extension of mobile technology, tools for the remote mitigation of water damage losses already exist.

12. Are there any other specific rating variables used to price for water damage risk?

Respondents were asked to list specific rating variables that are used to price water damage. Specifically, we asked participants if finished basements were considered in the determination of premiums; the majority of respondents said the presence of a finished basement is not currently used other than to the extent of the determination of amount of insurance.

In considering the impact of changing lifestyles, one can consider the trends in finished basements, both as rentals and as extension of primary residences. Today, finished basements often include costly entertainment and technology equipment of homeowners and tenants. As such, incidents giving rise to water damage that affect the lower floors of homes (such as sewer backup) can lead to costly claims for insurers.

Some respondents were from insurers using GLMs for property pricing; because these participants considered the information proprietary to their companies, they were unable to share which variables had been identified through their modelling processes as significant for water damage risk. For insurers using traditional actuarial pricing methods, the rating variables used include:

— Location (based on first three digits of postal code);

— Deductible;

— Amount of insurance;

— Claim history; and

---

[84] Canadian Underwriter, "Taking steps to avoid water damage should be rewarded: CEO", last modified October 19, 2012, http://www.canadianunderwriter.ca/news/taking-steps-to-avoid-water damage-should-be-rewarded-ceo/1001781595/.

— Type of reimbursement.

Although flood is outside of the scope of the definition of water damage for this research paper, one of the catastrophe modelling firms that responded to the survey indicated that the absence or presence of a finished basement is considered in their models as well as building codes and the enforcement of building codes. While this modelling firm is developing its capabilities primarily for the modelling of flood claims, these models could be a starting point for the future development of claims arising from water damage as defined in this research report.

Disadvantages of the catastrophe models as they currently exist include a lack of refinement by detailed cause of loss and understanding what is insured or not insured. These disadvantages may come implicitly from the claims data used to construct the model or in the simplifying assumptions of the models themselves. When dealing with catastrophic events, these types of variables are not a major component of the claims, so models have not focussed on trying to create this distinction.

13. What are the major causes of water damage?

The most frequent causes of water damage were burst pipe (from corrosion or freezing), water escape, sewer backup, and seepage. Other major types of non-flood water damage claims include:

— Water main break;

— Appliance malfunction;

— Sprinkler system leak;

— Aperture (roof blow off);

— Roof leak;

— Internal pipe releasing (plumbing);

— Malfunctions in the hoses to washing machine, dishwasher, toilet, and refrigerator or freezer;

— Ice damming; and

— Heavy rain.

One respondent to the survey stated: “Outside water is more severe, and large-costing events are usually sewer backup-driven”.

14. Does your organization use internal or external resources to handle water damage claims? If external adjusters, why?

Respondents indicated that they are primarily using internal resources to manage water damage claims, unless unusual demand requires extra resources. One participant stated:

> Internal staff do it better, are more customer focused, understand our position on coverage, and follow our protocols for water mitigation.

15. What are best practices with adjusting for water damage claims?

In discussing best practices for the management of water damage claims, respondents identified the following:

— Identification of the cause of loss;

— Early and rapid mitigation;

— Use of appropriate equipment;

— Engaging properly-trained water mitigation and mold experts;

— Quality control;

— Corrective measures to prevent the recurrence of loss; and

— Adherence to standards set out in the *Standard and Reference Guide for Professional Water Damage Restoration* (IICRC-S500) and the *Standard and Reference Guide for Professional Mold Remediation* (S520).

16. When restoring a loss, what procedures or incentives are in place for action by the insured to prevent recurrence of loss in the future?

The responses from participants indicated a wide range of activities including simple advice from the insurer, reimbursement at lower proportions of the first loss for subsequent losses, and requirements for the installation of prevention equipment. Insureds that do not institute the insurers' recommended corrective actions could face consequences of higher deductibles, lower limits, or denial of coverage.

GLOBAL ALTERNATIVES

Questionnaire to the Global Community

The survey was sent to various actuaries and general insurers in Australia, Europe, South Africa, and Mexico. As of August 2013, however, no insurers from outside of Canada had responded to the survey. It may be that the risk of water damage as defined for the purposes of this research project was not deemed to be a major issue; or it may be that insurers were occupied with other pressing matters at the time we distributed the survey.

The literature search included global resources as well as Canadian-specific studies.

Review of Global Actuarial Literature

Description of Process

In conducting research on a global basis, we searched the websites of major international actuarial organizations including the CAS, Actuarial Studies in Non-life insurance (ASTIN)[85], Institute and Faculty of Actuaries (UK), GIRO, and the IAA using the broad keyword "water". We used various combinations of keywords "water damage", "pricing", and "actuaries" over the internet as well.

Three Relevant Papers on Water Damage Risk

While there are a number of papers on climate change, we discovered three papers specifically on the topic of water damage that are similar to the scope set out by the CIA for this research paper. These papers are:

— "Climate change and its impact on building water damage" by Ola Haug, Xeni Dimakos, Jofrid Vårdal, and Magne Aldrin;

— "Construction of rating territories for water-damage claims" by Patrik Emanuelsson; and

— "Spatial Analysis of Frequency and Severity for Water versus Non-water Homeowners Claims in California" by Gurbhag Singh.

It should be noted that all three of these papers rely on the use of historical data to predict future experience. If the past is no longer predictive of the future than the findings from these international papers may be less relevant for the purpose of building future pricing tools. Nevertheless, we

[85] ASTIN is a Section of the International Actuarial Association. ASTIN's main objective is to promote actuarial research, particularly in non-life insurance.

believe that it is important to include these papers as examples of work that has been done around the world in the area of water damage risk. Furthermore, these papers demonstrate different types of approaches and categories of data that may be considered. Finally, while historical data may be less predictive of the future than in the past, such data may still form the basis of property pricing exercises, possibly with the use of adjustment factors to reflect the effect of recent changes.

"Climate change and its impact on building water damage"

This paper reports on the collaborative efforts conducted by Gjensidige Forsikring and the Norwegian Computing Center. According to its website, Gjensidige Forsikring describes itself as a "leading Nordic general insurance company".[86] The Norwegian Computing Center is "a private, independent, non-profit foundation that carries out contract research and development projects in the areas of information and communication technology and applied statistical modeling".[87]

The paper summarizes the findings of a study establishing claims models that quantify the link between water damage to houses and weather variables using GLMs. The data used in the study include insurance data and meteorological and hydrological data from each Norwegian mainland municipality:

> For a certain municipality, claims data constitute daily figures on the number of water claims and their corresponding total payment (index-linked). Population data are monthly and hold information on the number of policies.
>
> The claims data are frequency claims, i.e., rather small losses that occur "often". They comprise externally inflicted water damage rising primarily from either precipitation, surface water, melting of snow, undermined drainage or blocked pipes.
>
> Damage to buildings due to major catastrophes like flood, storm, slide etc. are covered mainly through the Norwegian Natural Perils Pool (see http://www.naturskade.no). Such losses are not part of our analysis. The Perils Pool is a compulsory regulation that mutually divides responsibilities among insurance companies operating in Norway.[88]

The meteorological and hydrological data are based on observations from January 1, 1961, to December 31, 2006, as well as data from climate models using a control time period of January 1, 1961, to December 30, 1990, and a scenario period of January 1, 2071, to December 31, 2100. Observed and modeled data include daily values of precipitation, temperature, runoff, and snow water equivalent. The relatively short paper includes a description of the:

- Analysis;
- Claims models;
- Model fitting;
- Prediction; and
- Conclusions.

[86] Gjensidige Group, accessed on July 24, 2013, https://www.gjensidige.no/group/about-us/.
[87] Norsk Regnesentral, "About NR", accessed on July 24, 2013, https://www.nr.no/en/about-main?language=en/.
[88] Ola Haug et al., "Climate change and its impact on building water damage", *Norwegian Computing Center*: 2.

We also identified presentation documents for this paper from the July 2008 ASTIN Colloquium in Manchester.[89]

"Construction of rating territories for water-damage claims"

This report was a thesis prepared for credit in Mathematical Statistics supporting a Master of Science degree in Actuarial Mathematics from Stockholm University. The abstract of the report states:

> In an attempt to explain the increased number of water-damage claims during the past years we want to know how these are related to differences in geography. We investigate how one can create rating territories using generalized linear models, credibility theory, smoothing and clustering techniques.
>
> Under the hypothesis that all residual variation in a generalized linear model for claim frequency is a pure effect of geography we are able to estimate the relative risk of water-damage in each municipality. The estimates are used in order to aggregate the municipalities into larger territories reflecting an elevation and similarity of risk. We can conclude that the best way to group geographical units is using a minimum within territory variance criterion and aggregate by adjacency. Included in a generalized linear model the zone-variable turns out highly significant and there are no remaining detectable differences between the geographical units.[90]

The purpose of the thesis was to establish a methodology for establishing rating territories and specifically to use the methodology to reflect differences in claims for water damage. The author was seeking answers to the following five questions:

1. Where are water claims located spatially?
2. Is there any distinctive pattern, such as if water claims are located close to rivers and lakes?
3. How should a water claim zone variable, for both frequency and severity, optimally be constructed using credibility theory?
4. How does a GLM including a zone variable contribute to a non-spatial GLM?
5. Is non-random pattern in model residual reduced when the zone variable is added?[91]

Claim data was provided by a large general insurance company in Sweden and contained details for water damage claims from 2004 through 2010. There were 15,492 cases of damage representing coverage from more than 360,000 policies. In describing the data, the author reports:

> A water-damage can occur in many forms, e.g., pipes can rupture, machinery or home appliances might break down. In this study we are primarily interested in claims that can be seen as geographically contingent and impose a restriction on the claim definition.

---

[89] Ola Haug, "Climate change – and its impact on building water damage", Norwegian Computing Center, ASTIN Colloquium, Manchester, July 2008, http://www.actuaries.org/ASTIN/Colloquia/Manchester/Presentations/Haug.pdf.
[90] P. Emanuelsson, "Construction of rating territories for water-damage claims". Master thesis, Stockholm University, Stockholm, 2011.
[91] Ibid.

> The claims to be investigated are of damages to both personal property and buildings which are classified as one of the following two kinds.
>
> 1. Inflowing water, which can be attributed to precipitation, meltwater or rising level of a nearby lake.
> 2. Drainage system, water flowing from the sewer, usually as a consequence of how efficiently the municipality handles excess precipitation.
>
> Because the policies has multiple insured objects and the causes of damage can be different, one claim is defined as a unique date of damage and for a specific policy ID, one claim will hence not be counted twice.[92]

The paper includes a description of the:

— Modelling and model fit;

— Credibility theory;

— Smoothing techniques;

— Risk classification;

— Cluster analysis;

— Comparison and conclusions; and

— Discussion.

"Spatial Analysis of Frequency and Severity for Water versus Non-water Homeowners Claims in California"

In its final edition, the *Journal of Actuarial Practice* (2006) contained an article titled "Spatial Distribution of Frequency and Severity of Water Claims in California" by Gurbhag Singh, Max Tang, Don McNeill, and Lyn Hunstad of the Policy Research Division of the California Department of Insurance. The abstract to the article states:

> We examine the frequency and severity of water loss claims for homeowners insurance across the state of California for the experience years 2000, 2001, and 2002. The spatial distribution patterns of frequencies and severities are mapped and analyzed at the zip code level. The maps reveal the pockets of high frequencies and severities. The information provided in this paper will assist actuaries and policy makers in their quest to set accurate rates for homeowners insurance.[93]

The *Journal of Actuarial Practice* is no longer available through the internet, but we found a 2004 paper by Gurbhag Singh titled "Spatial Analysis of Frequency and Severity for Water versus Non-water Homeowners Claims in California".[94] We expect that the 2006 article was a summary of Singh's original 159-page research paper published in 2004.

In the introduction to the 2004 paper, Singh describes the importance of his research:

---

[92] Emanuelsson, "Construction of rating territories".
[93] Journal of Actuarial Practice, Vol. 13, 2006, accessed July 28, 2013, http://jofap.org/vol13.html.
[94] Gurbhag Singh, "Spatial Analysis of Frequency and Severity for Water versus Non-water Homeowners Claims in California", California Department of Insurance – Policy Research Division (2004).

> This research is important for three main reasons. One, it can identify the geographic areas with high risk Water claims and of Non-water claims. Two, if specific factors related to water losses can be identified, it could lead to effective strategies to manage risk attributed to water damages. Third, this study is unique because there is no other analysis currently available dealing with Water and Non-water claims frequencies and severities at ZIP code level. There is also no study that maps frequencies and severities of Water, Non-water and Homeowners claims at the ZIP code level. Additionally, there is no study that deals with adjusting the claim data for credibility of Water, Non-water and Homeowners claims using small geographic units. Thus, it is a pioneering attempt.[95]

At the zip code level, Singh analyzed average annual precipitation, housing density per square mile, median age of house, median house value, and per capita personal income. Data on exposures, claims, and counts were from various data calls of the California Department of Insurance. Two of the recommendations from the paper were the need for further analysis with additional data types and the need for "specific data about the home conditions such as leaky hoses in the kitchen and laundry room and pipe bursts".[96]

Other Relevant Actuarial Papers

Two other potentially valuable papers were identified in our search of the CAS literature. The first paper is directed at traditional actuarial pricing methods for the analysis of catastrophes and large claims while the second is focused on the use of more sophisticated GLM approaches.

"Quantifying the Impact of Non-Modeled Catastrophes on Homeowners Experience" by Israel Krakowski appeared in the CAS Forum in winter 2003. While the paper describes approaches for wind and hail catastrophes directed at analyses for U.S. states, we believe that much of the discussion is equally applicable to traditional methods that are used for water damage claims in Canada. Krakowski begins with a description of the traditional method, which is essentially "to take a long-term ratio of catastrophe losses—however defined—to non-catastrophe losses, and spread the losses across years (or equivalently load in the average)".[97] He proceeds to describe the many problems with such an approach. The paper then presents descriptions of simulation models, dual capping methodology, and credibility weighting state indications.

Edward Frees, Glenn Meyers, and David Cummings authored a paper titled "Predictive Modeling or Multi-Peril Homeowners Insurance" that was published in the 2012 Volume 06 Issue 01 edition of *Variance*. While the paper is not specifically directed at water risk, the models described in the paper would be appropriate for consideration given sufficient data for the water damage peril. The abstract of the paper states:

> Predictive models are used by insurers for underwriting and ratemaking in personal lines insurance. Focusing on homeowners insurance, this paper examines many predictive generalized linear models, including those for pure premium (Tweedie), frequency (logistic), and severity (gamma). We compare predictions from models based on a single peril, or cause of loss, to those

[95] Singh, "Spatial Analysis of Frequency and Severity": 6.
[96] Ibid.: 20.
[97] Israel Krakowski, "Quantifying the Impact of Non-Modeled Catastrophes on Homeowners Experience", Casualty Actuarial Society (2003).

based on multiple perils. For multi-peril models, we introduce an instrumental variable approach to account for dependencies among perils.[98]

Other papers that we identified but do not believe are as relevant to the scope of this paper are included in appendix C.

[98] Edward W. Frees et al., "Predictive Modeling of Multi-Peril Homeowners Insurance", *Variance* Vol.6, issue 1 (2012): 11. http://www.variancejournal.org/issues/06-01/variance06-01.pdf.

Appendix A – Reference Sources

Actuarial Standards Board (U.S.). "Data Quality". *Actuarial Standard of Practice No.23* (1993): 1.

Allouche, E.N. and Freure, P. "Management and maintenance practices of storm and sanitary sewers in Canadian Municipalities". *ICLR Research Paper Series* No. 18 (2002*):* 7.

Ambiential. "Insurance Solutions", accessed July 20, 2013. http://www.ambiental.co.uk/insurance-solutions.html.

Autorité des marchés financiers. "Managing Climate Change Risk" (2011): 5–24.

Aviva. "Nearly 40 per cent of all home insurance claims are the result of water damage, Aviva Canada data shows". Accessed June 22, 2013. http://www.avivacanada.com/press/nearly-40-cent-all-home-insurance-claims-are-result-water-damage-aviva-canada-data-shows.

Canadian Institute of Actuaries Standards of Practice. Subsection 1530 (2013): 1036.

Carmin, JoAnn, Nikhil Nadkarni, and Christopher Rhie. "Progress and Challenges in Urban Climate Adaptation Planning: Results of a Global Survey" (2012): 1–12.

Cheng, Chad Shouquan, Qian Li, Guilong Li, and Heather Auld. "Climate Change and Heavy Rainfall-Related Water Damage Insurance Claims and Losses in Ontario, Canada". *Journal of Water Resource and Protection* (January 2012): 1.

"Collingwood requires backwater valves". *Thompson's World Insurance News*, April 1, 2013: 5.

Computational Hydraulics International. "Stormwater Management/Sanitary/Combined Sewer Remediation". accessed July 25, 2013. http://www.chiwater.com/Solutions/Software/Remediation.asp.

"Council approves 2013 City Budget". City of Toronto: *Our Toronto* Vol. 5, issue 1 (Spring 2013): 4. http://www.toronto.ca/ourtoronto/spring2013/citynews/article04.utf8.htm. 5.1.4

Emanuelsson, P. "Construction of rating territories for water-damage claims". Master thesis, Stockholm University, Stockholm, 2011.

Environment Canada. "Definitions and Glossary". Last modified June 21, 2013. http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=B710AE51-1#section3.

Federation of Canadian Municipalities. "About the Issue". Last modified March 18, 2013. http://www.fcm.ca/home/issues/infrastructure/about-the-issue.htm.

Feltmate, Blair and Jason Thistlewaite. "Climate Change Adaptation: A Priorities Plan for Canada". Climate Change Adaptation Project (May 2013): vi–25.

Frees, Edward W. et al. "Predictive Modeling of Multi-Peril Homeowners Insurance". *Variance* Vol. 6, issue 1 (2012): 11. http://www.variancejournal.org/issues/06-01/variance06-01.pdf.

Friedland, Jacqueline. Fundamentals of General Insurance Actuarial Analysis, Society of Actuaries, (2013): 13, 555.

Gjensidige Group. Accessed on July 24, 2013. https://www.gjensidige.no/group/about-us/.

Haug, Ola. "Climate change – and its impact on building water damage". Norwegian Computing Center, ASTIN Colloquium, Manchester. July 2008. http://www.actuaries.org/ASTIN/Colloquia/Manchester/Presentations/Haug.pdf.

Haug, Ola et al. "Climate change and its impact on building water damage". Norwegian Computing Center: 2.

Ibbitson, John. “Infrastructure now on voters’ minds”. *Globe and Mail*, July 29, 2013: A4.

ILSTV. “Average water damage claim rose 160% in ten years: Aviva Canada”. Last modified March 30, 2011. http://www.ilstv.com/average-water-damage-claim-rose-160-in-ten-years-aviva-canada/.

Institute for Catastrophic Loss Reduction, “Protect your home from basement flooding”, (2011): 10–11.

Institute of Actuaries of Australia, “Inquiry into recent trends in and preparedness for extreme weather events”, *Standing Committee on Environment and Communication* (2013): 3–4.

Insurance Bureau of Canada. “IBC Supports Federal Government’s Funding for Infrastructure”. Accessed on July 6, 2013. http://www.ibc.ca/en/Media_Centre/News_Releases/2013/03-21-2013.asp.

Insurance Bureau of Canada. “All about insurance and water damage”: 7–8. Accessed August 12, 2013. http://www.infoinsurance.ca/static/pdf/en/Brochure_Water_ENG.pdf.

Insurance Bureau of Canada. “Water Damage is on the Rise: Are You Protected?” Accessed August 15, 2013. http://www.ibc.ca/en/home_insurance/documents/brochures/water_damage_on_rise_en_web.pdf.

Insurance Bureau of Canada. “Municipal Storm and Sanitary Infrastructure Risk Assessment Tool Project”. Accessed August 15, 2013. http://www.ibc.ca/en/Natural_Disasters/documents/MRAT%20Leavebehind_EN_Jun3-11.pdf.

Insurance Bureau of Canada. “Municipal Risk Assessment Tool”. Accessed on August 15, 2013. http://www.ibc.ca/en/Natural_Disasters/Municipal_Risk_Assessment_Tool.asp.

Journal of Actuarial Practice Vol. 13, 2006. Accessed July 28, 2013. http://jofap.org/vol13.html.

Krakowski, Israel. Quantifying the Impact of Non-Modeled Catastrophes on Homeowners Experience. Casualty Actuarial Society (2003).

Kunreuther, Howard and Geoffrey Heal. “Managing Catastrophic Risk”. *Encyclopedia of Energy, Natural Resources and Environmental Economics* (April 2012): 1–7.

Leibovici, Karen. “Investing in infrastructure generates several long term benefits”. Mediaplanet, Insight section (March 10, 2013). http://www.fcm.ca/Documents/news/2013/Investing_in_Infrastructure_EN.png.

Lloyds. “2013: the year cat modelling changes?” Accessed July 17, 2013. http://www.lloyds.com/news-and-insight/news-and-features/market-news/industry-news-2013/2013-the-year-cat-modelling-changes.

Manitoba. “Budget 2013 – Focused on what matters most to families”. Accessed on July 6, 2013. http://www.gov.mb.ca/finance/budget13/index.html.

Merriam-Webster. “Definition of data”. Accessed on March 11, 2013. http://www.merriam-webster.com/dictionary/data.

Merriam-Webster. “Definition of information”. Accessed on March 11, 2013. http://www.merriam-webster.com/dictionary/information.

Merriam-Webster. “Definition of urban sprawl”. Accessed on July 15, 2013. http://www.merriam-webster.com/dictionary/urban%20sprawl.

Mills, Evan. “From Risk to Opportunity: 2008 – Insurer Responses to Climate Change”. *Ceres* (April 2009): 17.

Mirza, M. Saeed and Murtaza Haider. “The State of Infrastructure in Canada: Implications for Infrastructure Planning and Policy”. *Infrastructure Canada* (March 2003): 3.

Nodelcorp Consulting. “Climate Change and Infrastructure Vulnerability Assessment”. Accessed August 20, 2013. http://www.fcm.ca/Documents/presentations/2012/workshops/PIEVC_Joel_Nodelman_Risk_Assessment_EN.pdf.

Norsk Regnesentral. “About NR”. Accessed on July 24, 2013. https://www.nr.no/en/about-main?language=en/.

Oasis Loss Modelling Framework, “The Objectives”. Accessed July 28, 2013. http://www.oasislmf.org/about-oasis/objectives/.

Opta Information Intelligence. “Habitational Insurance Tracking System (HITS)”. Accessed July 17, 2013. http://optaintel.ca/Products/HITS.

RBC Blue Water Project. “2013 RBC Canadian Water Attitudes Study”. *RBC Insurance* (2013): 18-76.

Sandink, Dan. “Urban flooding in Canada”. Institute for Catastrophic Loss Reduction (February 2013): iv, 52.

Service Ontario. Planning Act. Accessed September 20, 2013, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90p13_e.htm#BK30.

SDC L&N. “Good Practice”. Accessed March 10, 2013. http://www.sdc-learningandnetworking.ch/en/Home/SDC_KM_Tools/Good_Practice.

Singh, Gurbhag. “Spatial Analysis of Frequency and Severity for Water versus Non-water Homeowners Claims in California”. California Department of Insurance – Policy Research Division (2004).

“Spring showers bring renewed attention to water damage”. *Thompson’s World Insurance News*, April 1, 2013: 5.

“Taking steps to avoid water damage should be rewarded: CEO”. *Canadian Underwriter*. Last modified October 19, 2012. http://www.canadianunderwriter.ca/news/taking-steps-to-avoid-water-damage-should-be-rewarded-ceo/1001781595/.

Toronto Water. “Toronto Water Basement Flooding EA Projects”. Accessed August 19, 2013. http://www.toronto.ca/involved/projects/basement_flooding/pdf/32_areas.pdf.

APPENDIX B – SAMPLE QUESTIONNAIRE

Questions for Actuaries at Insurance Companies

1. Who is responsible for quantifying and making recommendations on the effect of water damage risk for the company's book of property business? In other words, who are the professionals (actuaries in pricing, valuation, or research and development; loss control; claims; risk management; other) that are involved in this process?
2. How unique is water damage as a peril compared to other types of covered perils? Do you view the peril of water damage different from other perils in property coverages? If yes, why? If no, why not?
3. Does your company treat the peril of water damage differently from other perils in pricing property coverages? If yes, how? If no, why not?
4. Do you differentiate between water damage from catastrophe and other water damage? If yes, how? If no, why not?
5. Does your company differentiate in its cause-of-loss coding (e.g., flood and sewer backup, bursting pipe, roof leak, etc.) for claims? Please comment on the accuracy/reliability of coding.
6. Could you please describe your current processes for quantifying the effect of water damage loss potential for the purpose of ratemaking?
   - Do the processes differ for personal lines and commercial lines?
   - Are there differences in the process by province?
   - How are riders/endorsements priced? How often are they priced? Are they priced independently or are they a percentage of the underlying coverage?
   - What current technologies are used, including both hardware and software?
   - What are the processes for data management, including data scrubbing, cleansing, text recognition, etc.?
   - Please describe the strengths and weaknesses of your current processes.
7. What is the percentage distribution of water damage claims for homes, condominiums, and commercial property and by major region in Canada?
8. Is there known cross-subsidization (by line of business or region) with respect to pricing for water damage, either between types of insured or location of insureds?
9. Do you believe that the historical water damage claims data are a reliable source for predicting future claims? If yes, why? If no, why not?
10. Does your current property pricing model incorporate external measures of potential risk exposures, such as climate change, infrastructure issues, lifestyle changes, or other specific factors?
11. Do you use external resources, such as brokers or expert consultants, to assist in the quantification process? If so, how?
12. What external sources of information do you incorporate in your analyses (e.g., flood plain, municipalities' infrastructures evaluation, scientific research, etc.)?

13. Have you made any significant modifications to your water damage pricing process in the last five years? Do you anticipate significant modifications to your current water damage pricing process within the next three to five years? If yes, please explain.
14. Do you believe that actuaries have the requisite skill set to be able to address the issue of water damage risk? If yes, why? If no, why not?
15. What resources (e.g., literature, scientific papers, websites) do you currently turn for assistance in analyzing this risk?
16. Do you think insurers currently have the necessary technological tools to address the issue of water damage risk? If yes, why? If no, why not?
17. Do you believe actuaries are proactive in addressing/identifying the issues or are the external pressures influencing the actuarial focus?

Importance of water damage risk

18. Has water damage risk been identified as a priority issue by senior management currently or in the recent past?
19. Is the issue of water damage risk particularly important for your organization currently or in the recent past? How important do you anticipate it being in the future (i.e., 5 years). Please rank its importance, to both past and future, on a scale of 1 to 10, with 1 “not very important” to 10 “the most important”.

For companies that are part of a global organization

20. Do you look to other companies within your organization for methodologies and approaches to address water damage risk? Please describe how their expertise expands upon your own.
21. Do the actuaries from your organization meet on a regular basis and has water damage risk ever been on the agenda at global meetings?
22. Are there global tools that can be used for assessing the potential financial effect of water damage? How applicable are these global tools for the Canadian environment?

Questions for Claims Professionals and Underwriters at Insurance Companies

Claims and Underwriting

1. What do you believe are the major contributing factors of water damage claims to your company?
   - — Climate change
   - — Aging or inadequate infrastructure
   - — Lifestyle changes
   - — Other.
2. What current prevention and mitigation efforts are in place to address water damage risk for your company?
3. Is the interpretation of water damage more challenging in terms of the policy wording compared to other perils?
4. How do the definitions of storms, hurricanes, and super-storms (all with water-related losses) influence the insurance coverage, deductibles, and limits?

5. Do you anticipate that any changes from regulatory interaction will increase claims costs? If yes, then how?
6. Do you believe that the government has a role to play in addressing the factors giving rise to increased water damage? Please describe.
7. Has there been any lobbying by your company to the government for infrastructure changes?
8. Is your company supporting any climate-related initiatives? If yes, which ones and why were those initiatives selected?

Underwriting

9. What percentage of your portfolio (in terms of exposure) is subject to water damage claims? (Please clarify how the percentage is defined.)
10. What are the underwriting considerations for riders/endorsements? Are there restrictions on who coverage extension is offered to?
11. Have there been changes in the past three to five years in the underwriting of policies with respect to water damage? What prompted the changes? Have the changes been effective?
12. Have there been any recent changes to the wording of policies with respect to water damage? What prompted the changes? Have the changes been effective?
13. Do you anticipate significant modifications with respect to your current processes for underwriting water damage coverage within the next three to five years? If yes, please explain.
14. Are your insureds specifically asking about water damage coverage? If yes, how are their needs addressed?
15. Are your brokers or agents specifically recommending homes prepare for water damage risk or purchase additional coverage?
16. Do you believe that there is a way to reduce your company's exposure to water damage risk while remaining competitive and at the same time providing insureds with the proper advice and required protection to meet their needs?
17. Are discounts applied for insureds that have effective water damage mitigation and prevention measures in place? If so, what discounts are applied?
18. Are finished basements a rating variable used to price for water damage risk? If not, do you believe it would be valuable to include?
19. Are there any other specific rating variables used to price for water damage risk?
20. What education or loss control programs are used at your company to stress the importance of reducing water damage risk? How are insureds incentivized to participate in such programs?

Claims

21. What are the major causes of water damage?
22. Does your organization use internal or external resources to handle water damage claims? If external adjusters, why?
23. Does your company handle water damage claims differently from other property claims? If yes, how? If no, why not?
24. Does your company differentiate in its cause-of-loss coding (e.g., flood and sewer backup, bursting pipe, roof leak, etc.) for claims? Please comment on the accuracy/reliability of coding.

25. What is the percentage distribution of water damage claims for homes, condominiums, and commercial property? (Please clarify how the percentage is defined.)
26. What are best practices with adjusting for water damage claims?
27. Are there any innovative loss adjusting solutions being used (such as ultrasonic cleaning equipment)?
28. When restoring a loss, what procedures or incentives are in place for action by the insured to prevent recurrence of loss in the future?

Questions for Actuaries at Consulting Firms and Brokerages

1. Have you assisted clients in quantifying and making recommendations on the effect of water damage risk for their book of property business?
2. Could you please describe your current processes for quantifying the effect of water damage loss potential for the purpose of ratemaking?
   - Do the processes differ for personal lines and commercial lines?
   - Are there differences in the process by province?
   - How are riders/endorsements priced? How often are they priced? Are they priced independently or are they a percentage of the underlying coverage?
   - What current technologies are used, including both hardware and software?
   - What are the processes for data management, including data scrubbing, cleansing, text recognition, etc.?
   - Please describe the strengths and weaknesses of your current processes.
3. What external sources of information do you incorporate in your analyses (e.g., flood plain, municipalities' infrastructures evaluation, scientific research, etc.)?
4. Do you differentiate between water damage from catastrophe and other water damage? If yes, how? If no, why not?
5. Do you believe that there are shortcomings in your current approach for estimating water damage? If yes, please explain.
6. Do you believe that the historical water damage claims data are a reliable source for predicting future claims? If yes, why? If no, why not?
7. Do you believe that the peril of water damage is different from other perils in property coverages? If yes, why? If no, why not?
8. In your models, is the peril of water damage treated differently from other perils in pricing property coverages? If yes, how? If no, why not?
9. Do you believe that actuaries have the requisite skill set to be able to address the issue of water damage risk? If yes, why? If no, why not?
10. Do you think actuaries currently have the necessary technological tools to address the issue of water damage risk? If yes, why? If no, why not?

Importance of water damage risk

11. Do you believe that the issue of water damage risk is particularly important for your clients? Please rank its importance on a scale of 1 to 10, with 1 "not very important" to 10 "the most important".

12. Has water damage risk been identified as a priority issue by senior management of your clients?

For consultants and brokers that are part of a global organization

13. Have you looked to other firms within your organization for methodologies and approaches to address water damage risk? Please describe how their expertise expands upon your own.
14. Do the actuaries from your organization meet on a regular basis and has water damage risk ever been on the agenda at global meetings?
15. Are there global tools that can be used for assessing the potential financial impacts of water damage? How applicable are these tools for the Canadian environment?

Questions for Insurance Regulators

1. Are you concerned about the potential effect of water damage claims to the financial health of P&C companies?
2. Do you differentiate between water damage from catastrophe and other water damage? If yes, how? If no, why not?
3. Do you believe that there are shortcomings in companies' current approach(es) for estimating the effect of water damage? If yes, what?
4. Do you believe that the historical water damage claims data are a reliable source for predicting future claims? If yes, why? If no, why not?
5. Do you believe that the peril of water damage is different from other perils in property coverages? If yes, why? If no, why not?
6. Is the issue of water damage risk particularly important for you as a regulator? Please rank its importance on a scale of 1 to 10, with 1 "not very important" to 10 "the most important".
7. Has water damage risk been identified as a priority issue by senior management in your organization?
8. Do you see water damage risk addressed specifically in the risk management procedures of the companies you regulate?
9. Do you believe that actuaries have the requisite skill set to be able to address the issue of water damage risk? If yes, why? If no, why not?
10. Do you think actuaries currently have the necessary technological tools to address the issue of water damage risk? If yes, why? If no, why not?

Questions for Catastrophe Modelling Companies

Note: all references to "water damage" exclude damage resulting from flood water.

1. Have you assisted your clients in quantifying and making recommendations for the financial effect of water damage?
2. What do you believe are the major contributing factors of water damage claims to your clients?

- — Climate change
- — Aging or inadequate infrastructure
- — Lifestyle changes
- — Other.

3. Do the definitions of storms, hurricanes, and super-storms (all with water-related losses) influence the insurance coverage, deductibles, and limits in your models?
4. Describe your current processes for quantifying the effect of such water damage loss potential. Please describe the strengths and weaknesses of your current processes.
5. Do you believe that there are shortcomings in your current models for estimating water damage? If yes, please explain.
6. Do you believe that the historical water damage claims data are a reliable source for predicting future claims? If yes, why? If no, why not?
7. Is the peril of water damage different from other perils in property coverages? If yes, why? If no, why not?
8. Do you believe that the issue of water damage risk is particularly important for your clients? Please rank its importance on a scale of 1 to 10, with 1 “not very important” to 10 “the most important”.
9. Has water damage risk been identified as a priority issue by senior management of your clients?
10. Do you believe that your existing models have the ability to address the issue of water damage risk? If yes, why? If no, why not?

APPENDIX C – FURTHER RESOURCES

ArcGIS: Maps on a variety of topics – http://www.arcgis.com/features/maps/index.html

Canadian Water Network: http://www.cwn-rce.ca/

Canadian Water and Wastewater Association: http://www.cwwa.ca/home_e.asp

CAS Loss Reserve Seminar 2004: Homeowners Reserving – http://www.casact.org/education/CLRS/2004/handouts/stohl.ppt

Ceres: From Risk to Opportunity: 2008 – Insurer Responses to Climate Change – http://www.ceres.org/resources/reports/insurer-responses-to-climate-change-2009

Ceres: Insurer Climate Risk Disclosure Survey 2012 – http://www.ceres.org/resources/reports/naic-report/ (download may require registration)

Ceres: Stormy Future for U.S. Property/Casualty Insurers: The Growing Costs and Risks of Extreme Weather Events – http://www.ceres.org/resources/reports/stormy-future/ (download may require registration)

City of Toronto GIS Data on Watermain Breaks: http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=31a525884184a310VgnVCM1000003dd60f89RCRD&vgnextchannel=1a66e03bb8d1e310VgnVCM10000071d60f89RCRD

City of Toronto Basement Flooding Studies: http://www.toronto.ca/involved/projects/basement_flooding/completed.htm

Committee on Climate Change: Is the UK preparing for flooding and water scarcity? (Adaptation Subcommittee progress report 2012) – http://www.theccc.org.uk/publication/climate-change-is-the-uk-preparing-for-flooding-and-water-scarcity-3rd-progress-report-2012/

Environment Canada Publications: http://www.cccsn.ec.gc.ca/?page=publication-index

Environment Canada Weather Data: http://ec.gc.ca/meteo-weather/default.asp?lang=En&n=4486D35B-1

Fireman's Fund Insurance Company: "Seeing" a Home in a Different Way – http://www.firemansfund.com/PersonalRiskAdvisor/Pages/SeeingaHomeinaDifferentWay.aspx

Friedman, D.G.: Insurance and the Natural Hazards – http://www.actuaries.org/LIBRARY/ASTIN/vol7no1/4.pdf

Government of Canada Climate: http://climate.weather.gc.ca/links/index_e.html

Government of Canada Weather: General Regularly-Distributed Information in Binary Form (GRIB) Meteorological Data – http://weather.gc.ca/grib/

IBC & ICLR: Telling the Weather Story – http://www.ibc.ca/en/natural_disasters/documents/mcbean_report.pdf

ICLEI: Local Governments for Sustainability – http://www.iclei.org/

Insurance Bureau of Canada: The Wingham Rain Barrel Study – http://www.ibc.ca/en/Natural_Disasters/documents/Barrel/RainBarrelPilot-Report.pdf

Insuring Future Climate Change Conference in Oslo, Norway 2008: http://www.climateinsure.no/presentations.html

International Panel on Climate Change
Reports: http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml

Kunreuther, Howard: A Framework for Risk Management of Extreme Events: Evidence from Firms – http://www.actuaries.org/PRESIDENTS/Documents/LA/Kunreuther.pdf

Mercer, London School of Economics and Vivid Economics: Climate Change Scenarios – Implications for Strategic Asset Allocation – http://www.mercer.com/articles/1406410

Municipal Government Subsidy
Programs: http://www.basementfloodreduction.com/forhomeowners/munisubsidyprograms.html

National Centre for Atmospheric Research (NCAR) models: http://ncar.ucar.edu/community-resources/models

Natural Resources Canada: GeoGratis – combines the former GeoPub, Mirage and GeoGratis collections – http://geogratis.gc.ca/geogratis/search?lang=en

Ouranos: Learning to Adapt to Climate Change –
http://www.ouranos.ca/en/publications/documents/sscc_anglais_br-V22Dec2011.pdf

Raichle, William M.: Insurance Geographics – http://www.casact.org/pubs/dpp/dpp97/97dpp141.pdf

Ribereau, Pierre: Climate change and flood risk management –
http://www.actuaries.org/mexico2012/presentations/Oct4/Ribereau.pdf

Solterra Solutions: Determining the Impact of Climate Change on Insurance Risk and the Global Community Phase I: Key Climate Indicators –
http://www.casact.org/press/index.cfm?fa=viewArticle&articleID=2094

U.K. Department for Business Innovation & Skills: Reducing Risks of Future Disasters –
http://www.bis.gov.uk/foresight/our-work/policy-futures/disasters/reports-documents

Willis Research Network: A simple inertial formulation of the shallow water equations for efficient two-dimensional flood inundation modelling – http://www.willisresearchnetwork.com/publications/a-simple-inertial-formulation-of-the-shallow-water-equations.html

APPENDIX D – DISCUSSION DRAFT: CAS STATEMENT OF PRINCIPLES REGARDING PROPERTY AND CASUALTY INSURANCE RATEMAKING[99]

II. PRINCIPLES

Ratemaking is prospective because the property and casualty insurance rate must be developed prior to the transfer of risk.

Principle 1: A rate is an estimate of the expected value of future costs.

Ratemaking should provide for all costs so that the insurance system is financially sound.

Principle 2: A rate provides for all costs associated with the transfer of risk.

Ratemaking should provide for the costs of an individual risk transfer so that equity among insureds is maintained. When the experience of an individual risk does not provide a credible basis for estimating these costs, it is appropriate to consider the aggregate experience of similar risks. A rate estimated from such experience is an estimate of the costs of the risk transfer for each individual in the class. A properly defined classification plan enables the development of actuarially sound rates.

Principle 3: A rate provides for the costs associated with an individual risk transfer.

Ratemaking produces cost estimates that are actuarially sound if the estimation is based on Principles 1, 2, and 3. Such rates comply with four criteria commonly used by actuaries: reasonable, not excessive, not inadequate, and not unfairly discriminatory.

Principle 4: A rate is reasonable and not excessive, inadequate, or unfairly discriminatory if it is an actuarially sound estimate of the expected value of all future costs associated with an individual risk transfer.

III. CONCLUSION

This statement provides principles applicable to the determination and review of property and casualty insurance rates. The principles contained in this statement provide the foundation for the development of actuarial procedures and standards of practice. The actuary should be familiar with standards of practice, which address the application of these principles. It is important that proper actuarial procedures be employed to derive rates that protect the insurance system's financial soundness and promote equity and availability for insurance consumers.

The actuary, by applying the ratemaking principles in this statement, will derive an estimation of the future costs associated with the transfer of risk. Other business considerations including marketing goals, competition, and legal restrictions are also a part of determining the final price. By interacting with professionals from various fields including underwriting, marketing, law, claims, and finance, the actuary has a key role in the ratemaking process and determining the final price.

[99] Casualty Actuarial Society. Discussion Draft: CAS Statement of Principles Regarding Property and Casualty Insurance Ratemaking, accessed August 22, 2013, http://www.casact.org/professionalism/SoP-ratemaking-discussion-draft.pdf.