IRDR International Centre of Excellence (ICoE)
Disaster Resilient Homes, Buildings and Public Infrastructure

A Proposal

Institute for Catastrophic Loss Reduction
Western University, London, Canada

The challenge

Each year, hazards result in tens of billions of dollars of loss and damage. Most direct damage involves homes, buildings and public infrastructure. Most indirect damage is a result of disruptions due to damage to public infrastructure and buildings. The proposed ***IRDR International Centre of Excellence for Disaster Resilient Homes, Buildings and Public Infrastructure (ICoE-DRHBPI)*** would work to advance the science foundation for enhancing the resilience of the built environment to damage from hazards including earthquakes, flood and severe weather.

Recent major loss events in Nepal, Japan, New Zealand, the United States, Japan, Thailand, Haiti, Chile and elsewhere consistently provide evidence that the majority of the direct damage from natural hazards involves homes, buildings and public infrastructure that did not include current knowledge about resilient design and construction practices. Newer structures are more resilient to damage from hazards than older structures. Countries with modern building codes and standards have a reduced risk of fatalities and property damage from hazards than countries that do not have modern codes.

The opportunity – New construction

Each disaster is unique and provides lessons to enhance the resilience of homes, buildings and public infrastructure around the world to loss and damage from future hazards. One focus of the ***ICoE-DRHBPI*** would involve seeking to improve the process of discovering these lessons and capturing this knowledge in building codes and standards. Beyond learning from disasters there is a growing capacity for research in laboratories, facilities that can simulate extreme wind, catastrophic earthquakes and other hazards. The ***ICoE-DRHBPI*** would focus on the process for transforming this learning into action by those who construct homes, buildings and public infrastructure.

The opportunity – Existing structures

Trillions of dollars have been invested in the existing stock of homes, buildings and public infrastructure. Each disaster and ongoing research has the potential to identify possible actions to retrofit existing structures to enhance their resilience to local hazards. Available research finds that significant enhancement in resilience can be added to new homes, buildings and public infrastructure at little or no cost, but improving the resilience of existing structures can be expensive. Homes, buildings and public infrastructure seek to provide service for a period of several decades, and some emerging research is assessing opportunities to modify maintenance practices to enhance resilience.

Much of the risk of damage to homes, buildings and public infrastructure is preventable. Scientific research can provide the knowledge that can be the foundation to help decision makers invest in public

safety and disaster risk reduction. Yet the challenge remains to translate emerging knowledge into effective action.

Incorporating IRDR's objectives into a vision for the ICoE-DRHBPI

The vision for the ***ICoE-DRHBPI*** will support the IRDR objectives/sub-objectives of:

Characterization of hazards, vulnerability and risk: ICLR is the oldest University-based research institute in Canada working to understand the relationship between natural processes and human activities that contribute to vulnerability and community resilience. Since inception, ICLR has worked with a broad range of academic disciplines to identify and address gaps in knowledge, methodologies and types of information that prevent the effective application of science to mitigate the impact of hazards and encourage the reduction of risk.

Improving the quality of decision-making practice: ICLR strives to transform trans-disciplinary science into actions that reduce the risk of a natural hazard becoming a disaster. One of the ways that ICLR works to meet this goal is through the production and dissemination of relevant, timely and scientifically rigorous information to public and private sector decision-makers. ICLR is committed to the idea that good decisions depend on the information available and the manner in which this information is provided to individuals, groups and systems. As such, the Institute works hard to ensure that the information it generates and shares is in an acceptable format and is aimed at the proper target audience in order to get the full effect.

Reducing risk and curbing losses through knowledge-based actions: This has been a central tenet of ICLR since it was formed close to 18 years ago and a space in which the Institute excels. ICLR works from the premise that while extreme events can be relentless and unforgiving, they need not result in disasters. Individuals, businesses and communities that invest in disaster resilience will reduce the risk that hazards become disasters.

The Institute's program "science to action, building disaster resilient communities" focuses on actions that can be taken by property owners and local governments to address the alarming international trend of increasing damage from natural disasters. The research objective is to identify best practices for the construction and maintenance of homes and public infrastructure to enhance resilience to damage from flood, extreme weather and earthquakes.

Links to the March 2015 Sendai Framework for Disaster Risk Reduction

The Sendai Framework sets out the following goal: "Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience."

The work of the proposed ***ICoE-DRHBPI*** will support this goal through the study of the underlying drivers of disaster risk and identification of best practices for building resilience. In particular, the program will explore options to build back better homes, buildings and public infrastructure in recovery, rehabilitation and reconstruction.

Links to the IRDR Working Groups

The objectives for the ***ICoE-DRHBPI*** include natural links to established IRDR working groups – Risk Interpretation and Action (RIA), Assessment of Integrated Research on Disaster Risk (AIRDR), Forensic Investigations of Disasters (FORIN) and Societal and Economic Research and Applications (SERA). For example, FORIN provides a structure to secure lessons learned from major international disasters. SERA offers the means to assess the cost and benefit of potential risk reduction actions. RIA provides processes to assess and enhance the complex processes involved in translating knowledge generation into action by decision-makers. The AIRDR approach to integrated research is essential to the study of resilience of homes, buildings and public infrastructure to loss and damage from hazards.

Over time there is an expectation of extensive links between the work of the ***ICoE-DRHBPI*** and the IRDR working groups.

Governance ICoE-DRHBPI

Glenn McGillivray would be the Director for the ***ICLR / ICSU ICoE for Resilient Homes, Buildings and Public Infrastructure***. Mr. McGillivray will provide overall managerial direction for the initiative. Greg Kopp and Paul Kovacs would be co-Principal Investigators. Dr. Kopp and Mr. Kovacs will provide scientific leadership, and would co-Chair the International Advisory Board.

An International Advisory Board will be established. ICLR will recommend five to nine individuals from around the world for consideration by the ICSU IRDR Scientific Committee as members of the International Advisory Board.

Milestones

When the IRDR Scientific Committee approves this proposal, within 30 days ICLR will identify potential members of the International Advisory Board and begin work on development of a five-year strategic plan. By year-end 2015 the International Advisory Committee would hold its first meeting at Western University, London, Canada, to consider the proposed five-year plan.

The expectation is the initial five-year plan would focus on two major issues. First, how to enhance the process of securing knowledge about best practices for the design and construction of new homes, buildings and public infrastructure to enhance resilience from damage resulting from hazards, and how to enhance the application of this knowledge into practice. And second, focus on cost-effective advice for decision-makers to enhance the resilience of existing homes, buildings and public infrastructure. Some immediate outcomes may involve documenting a review of international efforts underway in these areas. There will also be scope to document actions underway in Canada given the work lead by the Institute for Catastrophic Loss Reduction.

The Institute for Catastrophic Loss Reduction

The Institute for Catastrophic Loss Reduction (ICLR) is the oldest and largest university-based disaster risk reduction research institute in Canada. It is a world-class centre for trans-disciplinary disaster prevention research and communications. ICLR was established by Canada's property and casualty insurance industry as an independent, not-for-profit research institute affiliated with Western University, London, Canada. Institute staff and research associates are leaders in wind and seismic engineering, atmospheric science, risk perception, hydrology, economics, geography, health sciences, public policy and a number of other disciplines.

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

Principles

- The threat of severe weather and earthquakes is increasing, sustained action can reduce catastrophic losses.
- Hazard assessment and risk identification are the cornerstones of catastrophic loss mitigation.
- Solid, applied research provides an essential foundation for effective action to reduce future losses.
- Those who knowingly choose to assume greater risk must accept an increased degree of responsibility for their choice.
- Communication with the public before a peril strikes is an important means of reducing losses.
- Local and individual actions are the most effective means of reducing the loss of life and property.
- Partnership is the best approach to resolving shared problems, particularly public safety concerns.

Research and outreach capacity
The Institute has more than 40 research associates. Several research associates are active in international initiatives including ICSU-ISDR (Gordon McBean and Ian Burton), IPCC (Paul Kovacs and Gordon McBean), UNESCO-IFI (Slobodan Simonovic), UN-ISDR (Gordon McBean and Paul Kovacs), WMO-SERA (Paul Kovacs), MCII (Paul Kovacs and Ian Burton), UNEP-FI (Paul Kovacs), and IDRiM Society (Slobodan Simonovic and Paul Kovacs).

ICLR has worked with research associates to secure world-class research facilities. This includes the Boundary Layer Wind Tunnel (BLWT), Insurance Research Lab for Better Homes (IRLBH) and the WindEEE Dome.

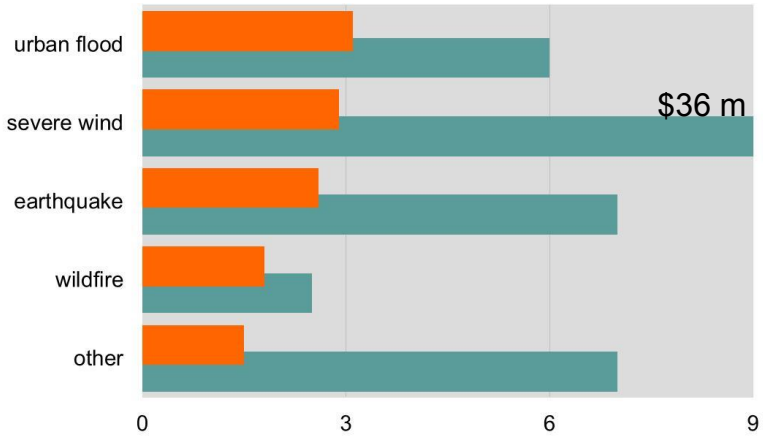
The Institute is committed to sharing its research findings with stakeholders around the world. This includes participation of research team members in international boards, committees, conferences and other initiatives; the publication of two electronic newsletters (one weekly, one bi-monthly); an active social media presence on Twitter (1,675+ followers), Facebook, Google+ and YouTube (138 hazard research-related videos with 75,000+ views), a monthly workshop series that has been extended to utilize webinar technology (please see Appendix B for a list of recent workshops 2010-2014), and online publication of research findings across three websites: www.iclr.org, www.basementfloodreduction.com and http://www.reduirelesinondationsdesous-sol.com/.

The Institute has been host to more than dozen national and international disaster management conferences. In particular, ICLR was host to the UNESCO-IFI's fourth International Conference of Flood Defense held in Toronto, Canada, and the 2014 international conference on Integrated Disaster Risk Management of the IDRiM Society, held at Western University.

Institute funding

Most of Canada's (indeed, the world's) largest insurance and reinsurance companies are members of ICLR, as are many mid-sized and smaller insurers. Assessment income from member insurance companies provides the core funding to support the administration of ICLR (with annual assessment revenue exceeding CAD1 million), while most research is funded by academic support agencies of the Government of Canada. The organization has grown through funding from project revenue, joint initiatives and support for our network of academic research associates.

Since 1997 the Institute and its research associates have secured more than CAD 65 million in public and private funding for trans-disciplinary research at Western University.



Research spending by ICLR staff (orange) and affiliates (green), 1997-2011, $ m

Key Institute personnel

Paul Kovacs, Executive Director and Founder, ICLR. An economist specializing in insurance issues, natural disaster loss prevention, and public policy. He is President and CEO, PACICC and Adjunct Research Professor, Economics, Western University. Since 1997 he has been a lead author with the UN/WMO Intergovernmental Panel on Climate Change. He currently serves as Co-Chair of the Canadian Adaptation Platform's Infrastructure and Buildings Working Group, Natural Resources Canada.

Dr. Gordon McBean, Director, Policy Studies. Professor in the Departments of Geography and Political Science, Western University. He is a leading expert on climate change, its impacts and response strategies. He is the former head of the Meteorological Service of Canada and has worked with colleagues around the world on weather and climate issues. He was Chair of the IRDR Scoping Group (2005), Planning Group (2006-08) and the initial IRDR Science Committee (2008-11). He currently serves as President of the International Council for Science Union (ICSU)(2014-17) and as Co-Chair, Governing Council of Future Earth Program (2015-16).

Dr. Slobodan Simonovic, Director, Engineering Studies. Professor in the Department of Civil and Environmental Engineering, Western University. He is a leading expert on flood prevention and management issues. He has been very involved in risk and adaptation strategies around the world. He was a member of the International Joint Commission's Red River Task Force and is serving as an officer for a number of national and international water organizations.

Dr. Mike Bartlett, Associate Dean and Professor, Civil and Environmental Engineering Department, Western University. He is a registered Professional Engineer in British Columbia, Alberta, Yukon and Ontario. His research focuses on housing damage caused by natural hazards (snow loads, high winds and earthquakes), structural safety (resistance to heavy loads and stresses) and structural engineering (new construction materials and recycling in construction applications).

Dr. Kristy Tiampo, Professor, Earth Sciences, Western University. Her research focuses on reducing losses from Canada's next earthquake through the assessment of earthquake damage risk over shorter time periods, i.e. the next five or ten years. She is developing comprehensive simulation models to assess near term seismic risk in British Columbia, Quebec and elsewhere.

Dr. Greg Kopp , Professor in Environmental Fluid Mechanics with Faculty of Engineering, Western University. He is a leader in the study of wind engineering and the response of structures to full-scale loads. His study of the response of structures to wind includes research in the laboratory and extensive field research.

Dr. Gail Atkinson, Professor and Canadian Research Chair in Earthquake Hazard and Ground Motions, Department of Earth Sciences, Western University. An international leader in engineering seismology. She is working to enhance building codes, advance community preparedness and map seismic vulnerability.

Glenn McGillivray, Managing Director, ICLR. He has more than 24 years experience in corporate communications with Swiss Re and ICLR. He has written more than 140 publications, journal, and magazine articles on a range of insurance, reinsurance, natural hazard and disaster management/recovery related issues.

Institute governance

Oversight of the Institute is the responsibility of a Board of Directors. The Board includes up to 14 members – a maximum of ten from member (re)insurance companies, between one and three members appointed by the President of Western University; and the Executive Director. Directors are elected annually at the annual meeting of members.

The Board sets the strategic direction of the Institute; prioritizes issues to be addressed; builds consensus among the membership; represents the interests of the industry; ensures that the operations of the Institute are effective and efficient and guided by the Institute's mission; and, evaluates, on a regular basis, the performance of the Executive Director.

The Board established the Insurance Advisory Committee in 2008 which provides a forum for the Institute's senior researchers to work directly with insurance industry leaders to guide ICLR's research and communications work.

The Insurance Advisory Committee meets quarterly in Toronto, Ontario or London, Ontario. All of ICLR's senior researchers attend Committee meetings, depending on the subject addressed. All ICLR member insurers are invited to send staff to Committee meetings and presently almost 80 percent choose to do so regularly. Most industry participation is from senior officials involved in underwriting or claims.

Institute partners
Partnership is the best approach to resolving shared problems -- particularly public safety concerns. ICLR has established strong working relationships with numerous parties, including:

National
– Canadian Red Cross
– Canadian Forest Service
– Environment Canada - Meteorological Service of Canada
– Federation of Canadian Municipalities
– Health Canada
– Insurance Bureau of Canada
– National Research Council of Canada
– Natural Resources Canada - Geological Survey of Canada
– Partners in Protection - FireSmart Canada
– Public Safety Canada

International
– Disaster Prevention Research Institute, Kyoto
– Institute for Business and Home Safety, Tampa
– International Flood Initiative, UNESCO, Tsukuba
– International Strategy for Disaster Reduction, United Nations, Geneva
– Intergovernmental Panel on Climate Change, United Nations, Geneva
– Integrated Research on Disaster Risk Programme, International Council for Science, Beijing
– United Nations Environment Programme Finance Initiative, Geneva
– World Weather Research Program, SERA programme, WMO, Geneva

Current research and outreach plan
ICLR's current plan concentrates on turning emerging research into actions that build disaster resilience. Our focus is on four hazards – urban earthquake, water damage, severe wind, and wildfires near the urban interface. ICLR seeks to secure and share scientific knowledge that will support action to reduce the risk that these hazards cause loss of life or damage to property.

Plans for each hazard include a comprehensive review of potential actions. These actions include investment in public infrastructure to reduce the risk of loss and damage; local by-laws and planning actions to manage exposure; influence design and construction of new homes and public infrastructure to include disaster resilience; and, build public awareness and knowledge about disaster resilience.

Three priority issues identified in ICLR's current the five-year strategic plan:

- partner with municipalities to advance homeowner urban flood risk reduction efforts,
- promote best practices to enhance the resilience of existing homes to damage from water, wind, earthquake and wildfire, and
- work with builders to champion resilient design and construction of new homes.

In addition to these three priority areas, ICLR is seeking to work with its member insurers to design and launch a program to be called *Insurers Rebuild Stronger*. Rebuild Stronger would use the insurance claims process to help Canadians rebuild homes that are stronger and more resilient to damage from natural hazards. The Build Back Better program would provide an opportunity for the industry to further demonstrate its commitment to resilience.

The program would have two elements – responding to large water damage claims and responding to total loss claims. The program would most frequently apply to large water damage claims, yet demonstrate the industry's knowledge and commitment to reducing the risk of damage from a broad range of hazards. The industry would develop guidelines for responding to large water damage claims that include investments in best practices that reduce the risk of future damage from urban flooding. The industry would also develop guidelines for responding to a total loss that would include features to reduce the risk of future damage from intense rainfall, severe wind, wildfire and earthquakes.

Please see
Appendix A - Major accomplishments in 2014 and planned activities for 2015
Appendix B - Recent ICLR workshops (2010-2014)
Appendix C - Recent ICLR publications (2007-2014)
Appendix D - Members and Associate Members

Appendix A
Key accomplishments in 2014 and planned activities in 2015

Key accomplishments in 2014

- Released the first book in our 'Cities Adapt' series. The 100-page publication, ICLR's first book, features 20 case studies of local leadership working to reduce the risk of loss and damage from extreme rainfall. ICLR is planning a series of volumes, with the second featuring case studies on cities adapting to extreme heat.

- Commissioned research to identify best practices for the design and construction of new subdivisions to reduce the risk of damage from sewer backup. We hope the report will provide provincial governments with information that can be used to guide local government practices.

- Completed a Showcase Home retrofit in Burlington, Ontario, Canada to demonstrate actions that can be taken to reduce the risk of sewer backup.

- The Insurance Advisory Committee begun work on the idea of including loss mitigation in the claims response of insurers. The emerging *Insurers Rebuild Stronger Homes* program would set out mitigation ideas for insurers when responding to a total loss, a major water damage claim, or in response to a major disaster like a wildfire or tornado.

- Proposed a joint strategy for Insurance Bureau of Canada (IBC) and ICLR to seek to modify Canada's building codes to reduce the risk of damage from flood, extreme weather and earthquakes. IBC would focus on advocacy and public relations, while ICLR would focus on the science of building design and construction, within a joint strategy.

- Submitted five proposals to the national building code dealing with resilience to wind and water damage. We are also working with several builders to test the practicality of our resilient construction findings.

- Completed a paper *Building Permits: An emerging policy instrument for local governments to manage interface fire risk in a changing climate* advising local governments to use their planning powers to require safer construction of new homes.

- Worked with the Insurance Brokers Association of Canada to co-brand ICLR's 'Protect your home from…' series of homeowner disaster risk reduction brochures and make them available to independent insurance brokers across the country.

- Maintained ICLR's strong social media presence as a way of reaching out to key stakeholders who are interested in the Institute's work; continued producing ICLR News, a weekly electronic summary of key hazard-related news; and produced six issues of CatTales, the Institute's popular bi-monthly electronic newsletter.

- Advanced the Institute's strategy of promoting education and fostering dialogue with key stakeholders by holding nine Friday Forum workshops and three webinars throughout the year. Additionally, ICLR staff assisted in delivering or conducted several webinars for research affiliates and member companies.

- Dr. Slobodan Simonovic was Chair of the 6th International Conference on Flood Management, held in Sao Paulo, Brazil.

- Hosted the 2014 conference of the Integrated Disaster Research Management Society (IDRiM), which brought together more than 100 experts in disaster research from more than 20 countries.

- Dr. Gordon McBean was elected President of the Paris-based International Council for Science (ICSU). Over the next three years Dr. McBean will be the primary spokesperson for the international science community.

- Continued to build on our longer-term strategy of fostering a strong science foundation to support actions that increase community resilience to earthquakes and severe weather risks. Multidisciplinary disaster loss reduction research across a broad range of hazards remains the Institute's core function.

- Completed all tasks within the approved budget for the 17th consecutive year.

Planned activities in 2015

- ICLR will actively promote *Cities Adapt to Extreme Rainfall* setting out practices that local governments can take to reduce the risk of basement flooding. We will work with partner organizations, like the Federation of Canadian Municipalities and ICLEI Canada, to share these findings with local governments across the country.

- ICLR will promote emerging research on best practices for storm and sanitary water management in new developments to prevent urban flooding. This will include a research paper and active outreach program with local and provincial governments.

- The Insurance Advisory Committee will continue work on the *Insurers Rebuild Stronger Homes* proposal to include mitigation in the claims response. The major focus of the Committee will likely be on scope for industry action on water damage claims.

- The Institute will publish research providing a FireSmart audit of the homes destroyed by wildfire in Kelowna, B.C. and Slave Lake, Alberta. The study will assess whether homes were rebuilt, properties landscaped and neighbourhoods treated to mitigate the impact of future wildfire events.

- The *Showcase Homes* program will likely include an earthquake retrofit in North Vancouver, British Columbia and sewer backup retrofit in Windsor, Ontario. The media and local insurance officials will be invited to explore the home to learn about the specific actions taken.

- The Institute will publish a new homeowner safety brochure *Protect your home from earthquake*.

- The Institute will begin work on the second of the Cities Adapt books – *Cities Adapt to Extreme Heat*. Health Canada will be a partner in preparation of the report.

  ICLR will seek to partner with the Insurance Research Lab for Better Homes and the WindEEE Research Lab to prepare a simulation of a major urban tornado, like the 1985 Barrie event.

- The Institute will seek to influence new home construction by working with IBC to press for change in building codes and by encouraging local government by-law to prevent water and wildfire damage.

- ICLR will seek to launch a quick response grant program to support the travel of social scientists to conduct research immediately following a natural disaster. The program will be managed by ICLR and the Natural Hazards Center at the University of Colorado at Boulder.

- ICLR will conduct 9 to 10 Friday Forum seminars on various topics of interest to Institute members and others, and two ‘Forecast’ webinars, one on the 2015 wildfire season and one on the 2015 North Atlantic hurricane season.

Appendix B
Recent ICLR workshops (2010-2014)

2014

December 2014 - A multifaceted approach to hail losses; Tanya Brown, IBHS (PDF)
October 2014 - The national riverine floodplain mapping framework; Tim Mereu, MMM Group (PDF)
September 2014 - The role of groundwater in flooding; Cathy Ryan, University of Calgary (PDF)
Special Webinar: July 3, Observations from the Angus tornado; Greg Kopp, Western University (PDF)
Forecast Webinar: June 20 - 2014 Canadian hurricane season; Bob Robichaud, Canadian Hurricane Centre (PDF)
Forecast Webinar: June 6 - 2014 Canadian wildfire season; Kerry Anderson, Canadian Forest Service (PDF)
May 2014 - Predicting and projecting the frequency of extreme marine events; Keith Thompson, Dalhousie (PDF)
April 2014 - Forest fire management: A risk management perspective; Dave Martell, U of T (PDF)
March 2014 - Tornadoes in Canada: Improving our understanding; David Sills; Environment Canada (PDF)
February 2014 - Earthquake hazard maps for Ottawa, ON and Gatineau, QC; Dariush Motazedian; Carleton University (PDF)
January 2014 - CIA Water Damage Risk and Canadian Property Pricing Research Project; Jacqueline Friedland et al; KPMG (PDF)

2013

November 2013 - Floodplain management in Ontario and emerging issues; Ryan Ness; TRCA (PDF)
October 2013 - Recent earthquakes that Canada can learn from; Garry Rogers; Geological Survey of Canada (PDF)
June 2013 - 2013 Hurricane Briefing; Bob Robichaud; Canadian Hurricane Centre (PDF)
May 2013 - How global catastrophe risks affect the supply chain; Paul Cutbush; Aon Benfield (PDF)
April 2013 - 1) Fire season prediction for Canada, 2013; Kerry Anderson, CFS (PDF)
April 2013 - 2) The Burn-P3 fire simulation model; Kerry Anderson, CFS (PDF)
March 2013 - Blown away - Monetary and human impacts of the 2011 tornadoes; Kevin Simmons, Austin College (PDF)
February 2013 - Global Earthquake Model (GEM); Ross Stein; USGS (PDF)
January 2013 - Superstorm Sandy: An Environment Canada perspective; Geoff Coulson; EC (PDF)

2012

November 2012 - Linking strain and seismicity for earthquake hazard estimation; Kristy Tiampo; UWO (PDF)
October 2012 - Modelling dynamic resilience to climate change; Slobodan Simonovic; UWO (PDF)
September 2012 - Canadian cat risk & modelling: 2012 and beyond; Guy Carpenter (PDF)
June 2012 - 2012 Hurricane briefing; Bob Robichaud, CHC (PDF)
May 2012 - Catastrophe reinsurance; Donald Morrison, Guy Carpenter (PDF)
April 2012 - Seasonal wildfire prediction for Canada; Kerry Anderson, CFS (PDF)
March 2012 - Observations from the Goderich tornado; Sarah Stenabaugh; UWO (PDF)
February 2012 - Increasing the reliability of flood risk modelling; David J. Ward & Ivo Banovsky, Intermap Technologies (PDF)
January 2012 - Earthquake risk in Canada and the National Building Code; Tuna Onur (PDF)

2011

November 2011 - Performance of housings in extreme wind; Greg Kopp, UWO (PDF)
October 2011 - The science of climate change; Gordon McBean, UWO (PDF)
September 2011 - Scenario ShakeMaps for Canadian cities; Gail Atkinson, UWO (PDF)
June 2011 - 2011 Canadian hurricane briefing; Bob Robichaud, CHC (PDF)
April 2011 - 2011 Seasonal wildfire prediction for Canada; Kerry Anderson, CFS (PDF)
March 2011 - Drought, heavy precipitation and climate; Ron Stewart, UofM (PDF)
February 2011 - Fire sprinlers save lives; Sean Pearce, CASA (PDF)
January 2011 - Seismic hazard and seismic risk in Canada; John Adams, GSC (PDF)

2010

January 2010 - Windthrow of trees - a geotechical engineer's perspective; Tim Newsom, UWO (PDF)
February 2010 - Urban Seismic Hazard Mapping Using Geophysical Techniques; Jim Hunter, GSC (PDF)
March 2010 - Infrastructure Climate Risk Assessmen: Principles & Applications; David Lapp, PIEVC (PDF)
April 2010 - El Nino Southern Oscillation; Amir Shabbar, Envrionment Canada (PDF)
May 2010 - Some observations from the recent earthquake in Chile; Hanping Hong, UWO (PDF)
June 2010 - Hurricane briefing 2010; Bob Robichaud, Canadian Hurricane Centre (PDF)
September 2010 - Hamilton's stormwater management; Nahed Ghbn, City of Hamilton (PDF);
October 2010 - Assessment of climate change risk to muncipal infrastructure; Slobodan Simonovic et al, UWO (PDF)
November 2010 - Physics-based earthquake forecasting: Past, present and future; Kristy Tiampo, UWO (PDF)

Appendix C
Recent ICLR publications (2007-2014)

Best practices guide: Management of inflow and infiltration in new urban developments (February 2015)

CIties adapt to extreme rainfall: Celebrating local leadership (December 2014)

Best practices for reducing the risk of future damage to homes from riverine and urban flooding: A report on recovery and rebuilding in southern Alberta (September 2013)

Urban flooding in Canada: Lot-side risk reduction through voluntary retrofit programs, code interpretation and by-laws (February 2013)

Involving Homeowners in Urban Flood Risk Reduction: A Case Study of the Sherwood Forest Neighbourhood, London, Ontario (May 2011)

Climate change information for adaptation: Climate trends and projected values for Canada 2010 to 2050 (March 2011)

Making flood insurable for Canadian homeowners (November 2010)

Reducing the risk of earthquake damage in Canada: Lessons from Haiti and Chile (November 2010)

Canadians at Risk: Our exposure to natural hazards (February 2010)

Handbook for reducing basement flooding (June 2009)

Human dimensions of fire management at the wildland-urban interface in Alberta: A summary report (November 2009)

The resilience of the City of Kelowna: Exploring mitigation before, during and after the Okanagan Mountain Park Fire (January 2009)

Sewer Backup: Homeowner perception and mitigative behaviour in Edmonton and Toronto (November 2007)

Appendix D
Members (re)insurers

Alberta Motor Association Insurance Company
Allstate Canada
Arch Insurance Canada
Aviva Canada Inc.
- Aviva Elite
- Aviva Pilot
- Aviva Scottish & York
- Aviva Traders

Canadian Direct Insurance Inc.
Chubb Group of Insurance Companies
The Commonwell Mutual Insurance Group
The Co-operators Group Limited
- Co-operators General Insurance Company
- Coseco Insurance Company
- L'Equitable Compagnie D'Assurances Generales
- L'Union Canadienne Compagnie D'Assurances
- Sovereign General Insurance Company
- The CUMIS Group Limited

Desjardins General Insurance
- The Personal Insurance Company

The Dominion of Canada General Insurance Company (Travelers Canada)
Dufferin Mutual Insurance Company
Ecclesiastical Insurance
The Economical Insurance Group
- Economical Mutual Insurance Company
- Federation Insurance Company of Canada
- Perth Insurance Company
- The Mississquoi Insurance Company
- Waterloo Insurance Company

Farm Mutual Reinsurance Plan (FMRP) Inc.
Gore Mutual Insurance Company
Intact Insurance Company
- Intact Financial Corporation
- Intact Insurance
- Novex
- Nordic
- BELAIRdirect
- Trafalgar

Lambton Mutual Insurance Company
Liberty Mutual Insurance Company
Lloyd's Underwriters
Munich Reinsurance America Inc.
Munich Reinsurance Company of Canada
Northbridge
- Northbridge Insurance
- Federated Insurance
- Zenith Insurance Company

Odyssey America Reinsurance Corporation
PartnerRe Canada
Peace Hills Insurance
The Portage la Prairie Mutual Insurance Company
RBC Insurance

RSA Canada Group
- Ascentus Insurance Ltd.
- Canadian Northern Shield Insurance Company
- Quebec Assurance Company
- Royal & SunAlliance Insurance Company of Canada
- Unifund
- Western Assurance Company

SCOR Canada Reinsurance Company
Sirius America (Canada)
State Farm Group Insurance Companies
Swiss Re
TD Insurance
- Meloche-Monnex
- Primmum Insurance Company
- Security National
- TD General Insurance Company
- TD Direct Insurance Inc.
- TD Home and Auto Insurance Group

The Guarantee Company of North America (GCNA)
The TOA Reinsurance Company
The Wawanesa Mutual Insurance Company

Associate members
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Aon Benfield
Curo Claims Services
Gus Group Inc.
Emergency Management Ontario
Guy Carpenter & Company, (Canada) Ltd.
Marsh Canada Limited
Paul Davis Systems - Simcoe County
Risk Management Solutions (RMS)
Shear Seismic Inc.

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