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**Reports of the Commissioner of the
Environment and Sustainable Development**

REPORT 2

Mitigating the Impacts of Severe Weather



Office of the Auditor General of Canada
Bureau du vérificateur général du Canada

OAG

Performance audit reports

This report presents the results of a performance audit conducted by the Office of the Auditor General of Canada under the authority of the *Auditor General Act*.

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Introduction

Background

Severe weather

2.1 Canada has experienced numerous **severe weather** events in recent years. From power outages caused by violent winds to entire communities flooded by intense precipitation or rapid snow melt, the impacts of severe weather events are escalating.

2.2 Severe weather events have resulted in rising costs to governments at all levels and, by extension, to all Canadians. In 2011, the country suffered severe flooding in most provinces, causing significant damage. In 2013, flood costs in Alberta alone were estimated at more than \$6 billion.

2.3 Climate change scientists expect severe weather events to grow increasingly more frequent and intense in coming years. This will have an even greater impact on Canadians. Physical, social, and economic impacts are significant, often resulting in long-term costs and disrupting everyday life.

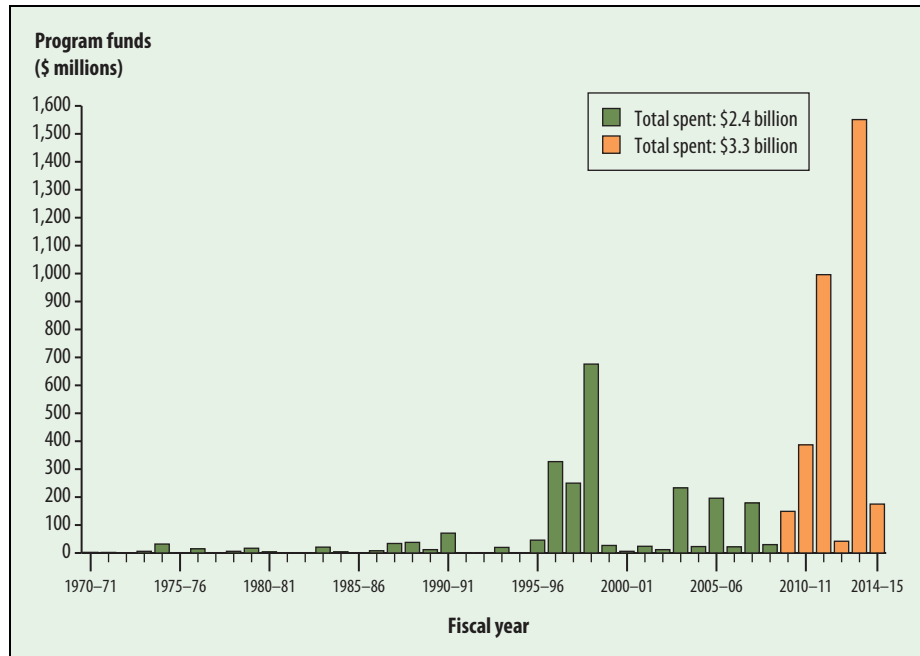
2.4 Disaster Financial Assistance Arrangements is a federal program that provides funds to help provinces and territories recover from natural disasters. Through a cost-sharing formula, the greater the disaster and the more affected the populations, the larger the portion of recovery costs paid by the federal government. Recovery payments have greatly increased during the program's 45-year history. Over the past 6 fiscal years, the federal government spent more on recovering from large-scale natural disasters than in the previous 39 fiscal years combined (Exhibit 2.1).

2.5 Provinces, territories, and municipalities have begun to plan for—or mitigate—severe weather events through strategic investments that improve resilience against future disasters. For example, land use plans encourage communities not to build in flood plains. Similarly, building codes that factor in minimum levels of weather and flood resilience help ensure that new infrastructure is designed to withstand severe weather effects.

Severe weather—A naturally occurring event that causes floods and flash floods, thunder and lightning storms, tornadoes, drought, tropical cyclones, thermal extremes, forest and wildland fires, heavy rain or snow, or strong winds.

Source: Adapted from the World Meteorological Organization's definition of natural hazards

Exhibit 2.1 Over the past 6 fiscal years, the Disaster Financial Assistance Arrangements program provided more recovery funding than in its first 39 fiscal years combined



2.6 **Disaster mitigation measures** can be very cost effective for government and society. For example, a government document estimates that the \$63 million invested in disaster mitigation measures to build the Manitoba Red River Floodway in 1960 saved \$8 billion by 2008 in avoided recovery costs. In addition, such foresight can reduce disruption of local economies and communities. International experience underscores the benefits of mitigation investments. Public Safety Canada estimates that every dollar invested in mitigation saves \$3 to \$5 in recovery costs.

Federal roles and responsibilities

2.7 The federal government has an important role in coordinating and assisting other levels of government to mitigate the effects of severe weather. This includes developing better technologies and providing decision makers with specialized information, tools, and guidelines to make well-informed decisions. The federal government provides weather, water, and climate data; building codes and standards; and information to predict the intensity, duration, and frequency of storms. It is also well

Disaster mitigation measures—Proactive measures that eliminate or reduce the impacts and risks of natural hazards. Such mitigation measures may be structural (for example, flood dikes) or non-structural (for example, zoning for land use).

Source: Adapted from Canada’s National Disaster Mitigation Strategy

placed to coordinate program support and the sharing of information about mitigation. All of these activities allow decision makers to make Canada's infrastructure more resilient to severe weather events.

Decision makers' needs

2.8 In the context of this report, decision makers are those responsible for mitigating the effects of severe weather. They include municipal, provincial, and territorial officials; federal partners; and members of the private sector. They are the emergency management representatives, city planners, and engineers who decide where highways and new communities should be built, and who ensure that structures are designed to withstand future severe weather events. Decision makers rely on data, information, and tools from federal partners to make informed decisions. Each decision can either increase or decrease the potential impacts and costs associated with future severe weather events.

Focus of the audit

2.9 This audit focused on the federal government's actions to support Canada's long-term mitigation efforts. It examined key federal organizations' data, information, tools, and funding that could help decision makers mitigate the effects of severe weather. The audit also examined whether the federal government was meeting its responsibilities to make Canada's infrastructure more resilient against severe weather events. Federal organizations audited were Environment and Climate Change Canada (formerly Environment Canada), Public Safety Canada, National Research Council Canada, Natural Resources Canada, and Infrastructure Canada.

2.10 This audit is important because severe weather events are increasing—resulting in higher costs to governments at all levels and, by extension, to Canadians. Studies show that dollars spent on mitigation efforts save money over time. But to mitigate the effects of severe weather and ultimately save lives and money, decision makers need timely information and tools to inform their actions.

2.11 More details about the audit objectives, scope, approach, and criteria are in **About the Audit** at the end of this report (see pages 19–21).

Findings, Recommendations, and Responses

Federal government coordination for disaster mitigation

Overall finding



2.12 Overall, we found that the federal government had not done enough to help mitigate the anticipated impacts of severe weather events. Activities of Public Safety Canada and Environment and Climate Change Canada did not focus on giving decision makers information and tools to address long-term severe weather effects. Coordination and consultations to define long-term user needs were also limited. Similarly, National Research Council Canada did not incorporate climate change trends into National Building Code updates, which could impact buildings and structures for decades to come. Although federal information and tools largely met departmental mandates, they did not fully meet decision makers' needs.

2.13 This is important because decision makers increasingly require certain types of information, such as floodplain maps and tools to measure the intensity, duration, and frequency of severe weather. The federal government is uniquely positioned to support Canada-wide mitigation activities—helping avoid needless overlaps and gaps, and using government resources more efficiently.

Context

2.14 Federal organizations are responsible for producing information to mitigate severe weather events, and disseminating it clearly to decision makers.

2.15 The *Emergency Management Act* identifies the Minister of Public Safety and Emergency Preparedness as responsible for promoting a common approach to emergency management, including standards and best practices. This coordination role includes, but is not limited to, establishing forums for information sharing and cooperation, providing leadership on issues of national importance and cross-jurisdictional impacts, and supporting provincial and territorial governments' efforts to mitigate severe weather. It includes addressing priorities such as floodplain mapping.

2.16 Decision makers need a wide range of accurate climate information to help them understand their vulnerabilities, assess the likelihood and severity of hazards, and predict the potential impact of future climate on their infrastructure.

2.17 Over the years, the federal government developed several risk assessment tools to help decision makers understand their risks and prioritize their actions and resources. Certain tools help them review historical climate information and project the nature, severity, and probability of future climate changes and events. Other tools help them

understand how their infrastructure will adapt to anticipated changes, as determined by their design, operation, and maintenance. Using these tools, decision makers can make well-informed decisions and take full advantage of investment dollars, including federal mitigation funding.

Departments did not always provide decision makers with the information and tools they needed

What we found

2.18 We found that Natural Resources Canada and Environment and Climate Change Canada produced information and a number of tools that helped decision makers in their mitigation activities. We also found, however, that Environment and Climate Change Canada did not produce key information needed to predict the intensity, duration, and frequency of precipitation. Similarly, we found that national guidelines for flood hazard assessment and mapping were obsolete and had not been updated since the Flood Damage Reduction Program, administered by Environment and Climate Change Canada, ended in 1996. We also found that the National Building Code administered by National Research Council Canada did not incorporate climate change trends.

2.19 Our analysis supporting this finding presents what we examined and discusses

- information and tools,
- intensity-duration-frequency curves,
- floodplain maps, and
- the National Building Code.

Why these findings matter

2.20 These findings matter because decision makers rely on various tools to assist them in making decisions to mitigate the effects of severe weather. Measuring the intensity, duration, and frequency of precipitation—called IDF curves—helps provincial, territorial, and municipal officials design their infrastructure to withstand anticipated severe weather events. Up-to-date floodplain maps allow municipalities to better plan future growth in areas of low flood risk and build in infrastructure resiliency in high-risk flood areas. With the anticipated increase in frequency and impacts of severe weather events, floodplain maps are even more important. They help to predict likely storm outcomes and the areas of greatest risk.

2.21 Similarly, the National Building Code is needed to provide safe building requirements across Canada. With the expected increase in severe weather events, more stress will be placed on Canada's buildings. This could have possible safety repercussions. Homes and other buildings built to withstand our current climate may not be strong enough to withstand climates in the decades to come.

2.22 When such critical pieces of information as these are missing or outdated, decision makers cannot anticipate future climate conditions or plan their mitigation efforts. Recent financial costs to the federal government show the importance of mitigating the impacts of severe weather to help save lives, reduce economic strain, and instill confidence in times of crisis.

Recommendations

2.23 Our recommendations in this area of examination appear at paragraphs 2.33, 2.40, and 2.45.

Analysis to support this finding

2.24 **What we examined.** We examined whether Natural Resources Canada and Environment and Climate Change Canada produced information, conducted research, and developed tools to help mitigate the effects of severe weather events in a manner consistent with their mandates. We examined how National Research Council Canada developed the National Building Code and integrated climate change information. We also surveyed decision makers to better understand their perspectives.

2.25 **Information and tools.** We found that several departments produced helpful items for decision makers. Natural Resources Canada funded a number of tools through various working groups under the Adaptation Platform—which brings together key groups from government, industry, and professional organizations to collaborate on climate change issues. For example, the Adaptation Platform released two important documents to assist decision makers in their mitigation decisions:

- *A Guidebook on Climate Scenarios: Using Climate Information to Guide Adaptation Research and Decisions*, and
- *Considerations for Addressing Climate Change Adaptation for Transportation Infrastructure in Highway Management, Design, Operation and Maintenance in British Columbia*.

2.26 We also found that Environment and Climate Change Canada produced important information for decision makers through its Meteorological Service of Canada and its Atmospheric Science and Technology Directorate. It provided weather, water, and climate information, including historical data on temperature and precipitation and real-time weather alerts.

2.27 We found that Environment and Climate Change Canada produced short-term information and tools for decision makers, such as water level and water flow data, weather forecasts (temperature, precipitation, and wind velocity), and published weather alerts. It also developed some longer-term information that could assist mitigation efforts, such as projected future climate information and models to estimate climate effects on water reserves and snow mass. However, the Department had

not consistently produced floodplain maps since 1996, nor regularly updated the data used to measure the intensity, duration, and frequency of storms in order to produce what are called IDF curves.

2.28 Intensity-duration-frequency curves. Decision makers responsible for designing infrastructure need current information on the probability of occurrence of extreme values of rainfall amounts, often for specific storm durations. Environment and Climate Change Canada produces this type of information—IDF curves—and makes it available through their website.

2.29 These IDF curves are critical for decision makers' infrastructure choices. They are useful for the planning, design, and operation of municipal water infrastructure, such as flood control. They are also used for determining the size of road culverts, the rain load a building roof can sustain, and the characteristics that drainage systems need to have. For example, engineers responsible for building new communities in known flood plains use IDF information to determine what infrastructure is needed to withstand an extreme weather event that is predicted to occur, say, once every 100 years.

2.30 We found that since 2006, Environment and Climate Change Canada had not continually produced IDF curves. Although not explicitly in its mandate, providing this information is consistent with its federal commitments to Ontario under the 2014 Canada–Ontario Agreement on Great Lakes Water Quality and Ecosystem Health. Instead, we found that the Department produced only some IDF curves and provided methodologies and models for others to use in calculating their own IDF curves.

2.31 Environment and Climate Change Canada officials indicated that the Department had not yet decided whether their role should include regularly producing and updating IDF curves, or whether they should just provide the methodology for others to produce them. The Department had updated existing IDF curves about every two years, depending on the data it had available. During the audit period, departmental documentation indicated a backlog of IDF curves to update.

2.32 Some provinces and territories lack the technical expertise and resources to interpret the data and produce their own IDF curves. Without this vital information, decision makers are not well equipped to make mitigation decisions that affect infrastructure.

2.33 Recommendation. Environment and Climate Change Canada should work with partners to determine how intensity-duration-frequency curves should be produced for decision makers.

Environment and Climate Change Canada's response. Agreed. Environment and Climate Change Canada will work with partners to investigate and clarify the federal role in how intensity-duration-frequency (IDF) curves should be produced.

As part of this, Environment and Climate Change Canada will continue to focus on modernizing its climate data archive. This will improve the integrity of the data and give efficient and ready access to all users to support a variety of scientific and engineering applications. Each year, Environment and Climate Change Canada issues thousands of severe weather warnings that decision makers use to mitigate the impacts of severe weather. These forecasts and warnings rely on the extensive collection of temperature, precipitation, and wind observations across Canada. These same data are quality controlled, archived, and used by scientists, partners, and clients to inform our understanding of climate change, and to develop specialized analysis and tools such as IDF curves and other extreme precipitation analyses.

2.34 Floodplain maps. Floodplain maps are essential to plan new infrastructure investments and decide on priorities to improve existing infrastructure.

2.35 Insurance companies also highlight floodplain maps as a precondition to enter the residential overland flooding insurance market. Overland flooding occurs when water levels outside a dwelling rise to cause water damage. Until 2015, Canada was the only G-7 country without residential insurance for overland flooding. Even in 2015, its availability was still quite limited. Without such insurance, federal government costs for recovery and assistance are higher than needed.

2.36 For more than 20 years, Environment and Climate Change Canada administered a flood damage reduction program that developed national guidelines and standards for floodplain maps. Using these guidelines and standards, the Department, in collaboration with provinces and territories, developed thousands of kilometres of flood hazard maps. After 1996, the federal government's program review cut all departmental services related to map production, guidelines, and standards. We found that national guidelines for flood hazard assessment and mapping were obsolete. This meant that provinces and territories had to manage and update their own maps with no federal standards or guidelines.

2.37 In 2013, Public Safety Canada commissioned a report on the state of flood mapping in Canada. The report indicated that only 65 percent of residences in Canada were mapped with respect to their flood risk. Moreover, 50 percent of current maps had not been updated since the end of the program in 1996. The report estimated that it would take from 5 to 10 years to update all existing floodplain maps, and that creating an additional 15,300 kilometres of maps in Canada would cost about \$365 million.

2.38 In 2015, Public Safety Canada identified the need to update and modernize national guidelines for flood hazard assessment and mapping. We noted that floodplain maps developed by provinces and territories after 1996 used different guidelines and standards.

2.39 Also in 2015, Public Safety Canada established a National Disaster Mitigation Program with a budget of \$200 million over five years to help provinces and territories undertake flood-related mitigation projects. This included developing floodplain maps.

2.40 **Recommendation.** Public Safety Canada, working with key stakeholders, should develop guidelines and standards for floodplain maps and encourage their consistent application in all provinces and territories.

***Public Safety Canada's response.** Agreed. Public Safety Canada recognizes the need for action to respond to the increase in frequency and severity of flooding in Canada, as well as the need for better risk information to inform effective investment in preventative and mitigative measures. In fall 2014, Public Safety Canada convened an interdepartmental committee to establish national principles, best practices, and guidelines on flood mapping in support of the National Disaster Mitigation Program. In 2015, Public Safety Canada initiated consultations with key stakeholders on developing these guidelines. The purpose of these consultations is to obtain a national perspective and approach on flood mapping, which will be used to inform long-term mitigation activities and initiatives. Public Safety Canada will continue to work with partners, including federal departments and agencies, provinces and territories, and key stakeholders, to develop and implement these guidelines and standards across the country.*

2.41 **The National Building Code.** Established by National Research Council Canada, the Canadian Commission on Building and Fire Codes (the Commission) is responsible for developing the National Building Code. National Research Council Canada provides technical, research, and administrative support to the Commission to produce and publish a new edition of the Code about every five years.

2.42 Provinces and territories are responsible for establishing building codes within their jurisdictions and rely on the National Building Code to do so. National Research Council Canada documentation suggests that the 2010 Code was adopted with few or no modifications by most provinces and territories—indicating its wide endorsement.

2.43 We found that the Code development process included a broad range of consultations with provincial and territorial governments, municipalities, the construction industry, and other government departments, including Environment and Climate Change Canada.

2.44 We also found, however, that although the Commission used some climatic load values in developing the 2015 Code—such as snow load values—the current approach to building design is based solely on historic data and does not take into account climate change trends. The Commission is expanding the mandate of its Task Group on Climatic Loads to include climate change adaptation.

2.45 **Recommendation.** National Research Council Canada should incorporate climate change trends into the National Building Code’s structural design provisions, to take into account the expected increase in frequency and severity of weather events that can directly affect buildings.

***National Research Council Canada’s response.** Agreed. The Canadian Commission on Building and Fire Codes, which is an independent committee of volunteers established by National Research Council Canada, is responsible for developing and updating the National Model Codes. Committee members (not National Research Council Canada) establish the content of the model codes based on input from the codes stakeholder community, including historical and trend analysis data from federal departments such as Environment and Climate Change Canada.*

The Committee will begin working on climate change adaptation by July 2016 for the 2015–2020 code cycle, with completion anticipated by 2020. Weather trends, increasing severity, and the effect on buildings and homes will be considerations as the Committee develops technical changes. Commencing 2016, National Research Council Canada code staff will work with other federal departments (such as Environment and Climate Change Canada and Natural Resources Canada) to obtain the latest data and trends so that these values are incorporated into the Committee’s deliberations and technical solutions. The solutions will be subjected to public consultation, a thorough cost-benefit analysis, and stakeholder engagement.

In addition, as custodians of the National Master Specification, National Research Council Canada will also be in a position to work with other government departments and industry partners to incorporate climate change adaptation changes into the construction specifications, with completion anticipated by 2018.

Federal efforts to define decision makers’ needs were insufficient

What we found

2.46 We found that the federal government did not adequately identify the most important information and tools for decision makers. We expected that as the lead department responsible for coordinating mitigation efforts, Public Safety Canada would have identified a lead—or itself have assumed the responsibility—to ensure that federal organizations clearly understood decision makers’ long-term needs.

2.47 Our analysis supporting this finding presents what we examined and discusses

- identifying decision makers’ needs.

Why this finding matters

2.48 This finding matters because without understanding the requirements of those with mitigation responsibilities, federal efforts may not be targeted to areas of greatest need.

Recommendation

2.49 Our recommendation in this area of examination appears at paragraph 2.53.

Analysis to support this finding

2.50 **What we examined.** We examined the federal government's efforts to identify decision makers' needs and prioritize its actions. We reviewed the scope and results of departmental surveys, their recommendations and impacts, and the various activities of national committees to identify decision makers' needs. We also surveyed decision makers to determine their priorities and inquire whether key federal departments consulted with them.

2.51 **Identifying decision makers' needs.** We found that Public Safety Canada did not conduct any national initiatives to better understand and address decision makers' long-term mitigation needs. Although the government's Adaptation Platform brought together key groups to help Canada adapt to climate change, surveys and committee activities did not specifically seek to understand long-term needs related to disaster mitigation.

2.52 We also found no clear federal strategy to identify decision makers' needs and no coordinated federal actions to address them. Although assessing decision makers' needs is not currently in its mandate, Public Safety Canada is uniquely positioned to identify decision makers' requirements and provide clear direction on which of the federal government's information and tools can best address them.

2.53 **Recommendation.** Working with key federal partners, Public Safety Canada should coordinate consultations with decision makers to better understand the information needed to support their disaster risk reduction efforts, including those related to severe weather.

***Public Safety Canada's response.** Agreed. Public Safety Canada recognizes the need to better understand the emergency management and disaster risk landscape in Canada. Risk management practices facilitate improved decision making by clarifying the dimensions of risk, including its causes, likelihood of occurrence, and possible severity of consequences. Public Safety Canada exercises its leadership role for emergency management and disaster risk reduction by working with key partners and stakeholders to understand and prioritize the risks posed by hazards to loss of life, damage to property, as well as risks to the economy and the environment. The Department further facilitates and coordinates the exchange of information through existing federal and federal/provincial/territorial governance forums, such as the Assistant Deputy Minister Emergency Management*

Committee, Senior Officials Responsible for Emergency Management, outreach activities, and other mechanisms (such as Canada’s Platform for Disaster Risk Reduction and the Domestic Group on Emergency Management), to better support decision makers in making evidence-based decisions regarding disaster risk reduction, including those related to severe weather. Public Safety Canada will continue to provide leadership and work in an integrated way with key federal partners and stakeholders to advance disaster risk reduction efforts.

Federal programs to support disaster mitigation

Overall finding



2.54 Overall, we found that federal government efforts and programs did not successfully encourage provinces and territories to invest in projects that reduce severe weather impacts. Although the federal government made funds available through various programs since 2008, it spent little on mitigation projects. We also found that the design of the mitigation programs did not encourage investments in infrastructure projects.

2.55 This is important because mitigation activities reduce recovery costs, avoid disruption of the Canadian economy, and can protect Canadians’ safety and security.

Context

2.56 The federal government has funding programs available to provincial and territorial governments to help them mitigate the impacts of severe weather, including

- the 2011 Flood Mitigation Investments program—a fund administered by Public Safety Canada, focused on flood risk mitigation;
- the New Building Canada Fund—a fund administered by Infrastructure Canada, focused on 14 types of infrastructure priorities, one related to disaster mitigation;
- the National Disaster Mitigation Program—a fund administered by Public Safety Canada, focused on flood risk mitigation; and
- the Disaster Financial Assistance Arrangements program—a fund administered by Public Safety Canada, focused primarily on funding recovery efforts.

Little federal money was spent on disaster mitigation projects

What we found

2.57 We found that although the federal government offers funding programs to support provincial and territorial mitigation projects, the federal government transferred little funding to the provinces and territories. We also found that very few of the proposed projects for these programs were designed to improve infrastructure resilience.

2.58 Our analysis supporting this finding presents what we examined and discusses

- mitigation payments, and
- provincial and territorial participation.

Why this finding matters

2.59 This finding matters because Canada has experienced an increased frequency and intensity of natural disasters requiring federal assistance, with a corresponding increase in the amount of federal assistance provided.

2.60 The costs to recover from severe weather disasters can far exceed investments to mitigate their negative impacts. Moreover, such investments can protect Canadians and lessen economic disruptions.

Recommendations

2.61 We made no recommendations in this area of examination.

Analysis to support this finding

2.62 **What we examined.** We examined four federal funding programs available to provinces and territories to mitigate the effects of severe weather disasters. These programs provide avenues for municipalities, through their provinces, to access federal funds for infrastructure projects aimed at building in greater resiliency against severe weather impacts.

2.63 We also reviewed the funding that provinces and territories requested during the audit period. We assessed the projects proposed, their approvals, and federal government payments.

2.64 **Mitigation payments.** We found that although the federal government offered programs to support mitigation investments, provinces and territories made little use of the funds.

2.65 Although each program differed, the federal government offered almost \$253 million in funding through three programs: the 2011 Flood Mitigation Investments program, the New Building Canada Fund, and the National Disaster Mitigation Program. Provinces and territories applied for less than half of these available funds. During the audit period, the federal government had dispensed only a fraction of the money owed (Exhibit 2.2).

Exhibit 2.2 Provinces and territories made little use of the almost \$253 million offered by three mitigation programs from the 2011–12 fiscal year to the 2015–16 fiscal year

Fund distribution for three mitigation programs*	Amount (\$ millions)
Funds available	\$253
Funds applied for	\$111
Funds approved	\$104
Funds paid	\$25
* The 2011 Flood Mitigation Investments program, the New Building Canada Fund, and the National Disaster Mitigation Program	

2.66 The federal government also supported mitigation projects through a fourth program, the Disaster Financial Assistance Arrangements. This program permitted provinces and territories to complete mitigation-related projects when rebuilding infrastructure damaged by natural disasters. Provinces and territories could claim up to 15 percent of eligible infrastructure costs associated with recovery efforts. As with the other programs, we found provinces and territories made minimal use of the funds (Exhibit 2.3).

Exhibit 2.3 Provinces and territories made little use of the estimated \$160 million in mitigation funding offered by the Disaster Financial Assistance Arrangements program from the 2008–09 fiscal year to the 2014–15 fiscal year

Fund distribution for the program	Amount (\$ millions)
Mitigation funds available*	\$160
Estimated value of federal share of recovery costs (65 disasters)	\$3,334
Mitigation funds applied for	\$13
Funds paid	nil
* An estimate based on unaudited data from a sample of seven disasters. The actual maximum amount available for mitigation enhancements under the program cannot be determined until provinces and territories submit final claims and audits are conducted.	

2.67 **Provincial and territorial participation.** We found that many projects the provinces and territories submitted—which the federal government approved—were related to developing flood risk assessments, flood maps, and other preliminary risk evaluation projects for major infrastructure projects. These analyses and reports are important. They help to ensure that future infrastructure projects will build in greater

resiliency in the higher-risk areas but do not improve infrastructure by themselves. We noted that only about one third of proposed projects involved infrastructure improvements.

2.68 The federal government and other third-party organizations, such as the Federation of Canadian Municipalities, estimated that more than \$111 billion is needed to replace aging infrastructure in poor or very poor condition. Although costly, this investment is an opportunity for all levels of government to save money in years to come by building greater infrastructure resilience and mitigation measures into their aging infrastructure.

Funding programs were not designed to encourage major investments in disaster mitigation projects

What we found

2.69 We found that existing programs were not designed to support long-term mitigation investment, nor did they encourage large-scale, multi-year mitigation projects. In two programs, the design made it difficult to prioritize mitigation investments.

2.70 Our analysis supporting this finding presents what we examined and discusses the

- 2011 Flood Mitigation Investments program,
- New Building Canada Fund,
- National Disaster Mitigation Program, and
- Disaster Financial Assistance Arrangements program.

Why this finding matters

2.71 This finding matters because the federal government has made funding available to help provinces and territories mitigate the effects of severe weather. But to successfully promote mitigation, programs should include incentives for provinces and territories to take proactive measures.

2.72 Public Safety Canada's role under the *Emergency Management Act* is to coordinate federal emergency management activities with the provinces and territories. Addressing high-risk areas and increasing infrastructure resilience from large-scale disasters is critical to reduce recovery costs. In addition, mitigation helps ensure less disruption to the safety and security of Canadians, and it supports economic stability.

Recommendation

2.73 Our recommendation in this area of examination appears at paragraph 2.84.

2.74 **What we examined.** We examined the design of existing programs available to provinces and territories, and their eligibility criteria, requirements, and features.

2.75 **2011 Flood Mitigation Investments program.** Established in 2011, this fund met provincial requests for financial investments in permanent flood mitigation measures not covered under other federal programs. This one-time fund was unique. It was not intended to promote future disaster mitigation, but addressed provincial funding pressures from severe flooding in parts of Canada in 2011. We found that the federal government received and approved 286 projects totalling an estimated \$76 million.

2.76 **New Building Canada Fund.** Created in 2014, this fund has a 10-year life span and is administered by Infrastructure Canada. It supports provinces and territories in making infrastructure improvements in 14 priority areas, including city transit, highway improvements, and water and sewer upgrades. Disaster mitigation is one of the priority areas.

2.77 We noted that funding across the 14 priority areas was not reserved or set aside so that specific amounts would be spent in any one area. This meant that provinces and territories were responsible for prioritizing what infrastructure projects to put forward for federal funding. Because of increasing costs associated with public transit and the replacement of aging infrastructure, only 18 of 343 approved submissions, or five percent, were related to disaster mitigation.

2.78 **National Disaster Mitigation Program.** Public Safety Canada administers this program, which was created in 2015. It helps build the foundation for informed mitigation investments through such activities as flood risk assessments and flood mapping in provinces and territories. The program has four funding streams:

- risk assessments,
- flood mapping,
- mitigation planning, and
- investments in non-structural and small-scale structural mitigation projects.

2.79 We found that the National Disaster Mitigation Program helped provinces and territories better understand their disaster risks and facilitated decision making on mitigation investments. Additionally, the program helped prepare provinces and territories to invest in infrastructure projects to mitigate severe weather flood risks. The program was not designed, however, to fund major investments in disaster mitigation.

2.80 **Disaster Financial Assistance Arrangements program.** We examined the provincial and territorial process to access this program's mitigation funds. When a natural disaster occurred, the federal

government, provinces, and territories entered into cost-sharing arrangements to support disaster recovery. The program allowed up to an additional 15 percent in mitigation funding, based on estimated infrastructure costs for disaster recovery. Sites affected by a natural disaster could access mitigation funding if the federal government was already providing recovery funding under the Disaster Financial Assistance Arrangements program. The program did not provide funding in anticipation of events.

2.81 Although there was an extra 15 percent in mitigation funding available to “build back better,” provinces and territories were not always prepared to propose such projects in the midst of recovery. Instead, their priority during disaster recovery typically focused on the population’s safety and mobility, minimizing economic disruptions, and returning to normal.

2.82 We found that Disaster Financial Assistance Arrangements funding did little to encourage provinces and territories to invest in disaster mitigation. Given that the federal government funds up to 90 percent of all recovery costs for large-scale disasters, this program offers little incentive for provincial, territorial, and municipal governments to use mitigation funds. Instead, the program may have been seen as a federal insurance fund for disaster-struck provinces and territories. Although the mitigation component to the funding was added in 2008, only 11 mitigation proposals had been received and approved, and no payments had been made, at the time of this audit.

2.83 All four of these programs serve a purpose, but none were designed to significantly improve the resilience of Canada’s infrastructure. If Canada’s infrastructure is to withstand increasing severe weather events in the coming decades, something more is needed.

2.84 **Recommendation.** Public Safety Canada, working with other departments, should examine the federal government’s mitigation programs to identify potential changes that facilitate provincial and territorial investments in disaster mitigation projects. It should encourage both large- and small-scale structural projects and continue to support non-structural projects.

Public Safety Canada’s response. Agreed. In recognition of the increasing disaster risks and costs, Public Safety Canada will continue to work with other federal departments to align mitigation programming across the Government of Canada. Public Safety Canada is collaborating with other federal departments to enhance risk assessment tools and identify opportunities that would encourage both large- and small-scale structural mitigation initiatives, including non-structural investments. Public Safety Canada will continue to work in close collaboration with federal departments, as well as provinces and territories and other key stakeholders, to advance an integrated approach to mitigation programming, in which mitigation investments will be focused on risks and building resilience.

As a first step, the National Disaster Mitigation Program, which was launched in early April 2015, aims to address the rising risks and costs of floods, and to build the foundation for future informed mitigation investments that could reduce the effects of flood events.

Conclusion

2.85 We concluded that the federal government has not provided adequate information and tools needed to support decision makers in their long-term efforts to mitigate the effects of severe weather. We also concluded that the federal government has not put in place funding provisions to significantly improve the resilience of Canada's infrastructure.

2.86 Overall, we concluded that the federal government has not made it a priority to help decision makers mitigate the anticipated impacts of severe weather.

About the Audit

The Office of the Auditor General's responsibility was to conduct an independent examination of federal government support for mitigating the effects of severe weather to provide objective information, advice, and assurance to assist Parliament in its scrutiny of the government's management of resources and programs.

All of the audit work in this report was conducted in accordance with the standards for assurance engagements set out by the Chartered Professional Accountants of Canada (CPA) in the CPA Canada Handbook—Assurance. While the Office adopts these standards as the minimum requirement for our audits, we also draw upon the standards and practices of other disciplines.

As part of our regular audit process, we obtained management's confirmation that the findings in this report are factually based.

Objectives

To assess whether information, research, and tools from selected federal organizations supported decision makers' long-term mitigation of severe weather events.

To assess whether federal mitigation funding led to increased infrastructure resilience against the effects of severe weather events.

Scope and approach

The scope of the audit focused on federal support to provinces and territories to help them mitigate the effects of severe weather events. It examined the scientific data, information, and tools provided by Environment and Climate Change Canada, Natural Resources Canada, National Research Council Canada, and Public Safety Canada in this context. Auditors examined documentation on what information was provided to decision makers, how decision makers' needs were determined, and any information gaps.

The Office administered a survey to allow selected recipients to identify what information is needed from those responsible for mitigating the effects of severe weather events. Survey recipients included representatives from various organizations, including academia, research centres, and provincial and territorial governments.

This audit also examined the federal funding programs of Public Safety Canada and Infrastructure Canada that help provinces and territories increase infrastructure resilience against severe weather effects. We examined sample documentation of approved project submissions, their details, and corresponding departmental actions.

We also audited Public Safety Canada to assess its role in coordinating federal efforts in mitigating the effect of severe weather events.

This audit did not examine provincial or territorial government mitigation programs. It did not assess the quality of weather, water, and climate data. Other programs related to mitigation activities, such as weather warnings, environmental science, or adapting to climate impacts, were not assessed per se, as they were audited between 2008 through 2013. We examined relevant program information and tools, however, to the extent that they informed mitigating the effects of severe weather.

Criteria

Criteria	Sources
To assess whether information, research, and tools from selected federal organizations supported decision makers' long-term mitigation of severe weather events, we used the following criteria:	
The federal government integrates severe weather risk mitigation into its planning.	<ul style="list-style-type: none"> • Federal Adaptation Policy Framework, Government of Canada, 2011 • Canada's National Disaster Mitigation Strategy, 2008 • Environment Canada's Science Strategy 2014–2019
Selected federal organizations support actions to mitigate severe weather effects by responding to decision makers' needs, obtaining necessary information or conducting research, or both, where appropriate and consistent with their mandates.	<ul style="list-style-type: none"> • <i>Emergency Management Act</i> • <i>Canada Water Act</i> • <i>Department of Natural Resources Act</i> • <i>Department of the Environment Act</i> • <i>National Research Council Act</i> • Canadian Commission on Building and Fire Codes—Policies and Procedures, National Research Council Canada, 2009 • Federal Adaptation Policy Framework, Government of Canada, 2011 • Canada's National Disaster Mitigation Strategy, 2008 • Environment Canada's Science Strategy, 2014–2019
Selected federal organizations disseminate their information and research results in a manner that helps decision makers interpret the information and apply it to mitigating the effects of severe weather.	<ul style="list-style-type: none"> • Canada's National Disaster Mitigation Strategy, 2008 • Federal Adaptation Policy Framework, Government of Canada, 2011 • Environment Canada's Science Strategy, 2014–2019 • <i>National Research Council Act</i> • Canadian Commission on Building and Fire Codes—Policies and Procedures, National Research Council Canada, 2009
To assess whether federal mitigation funding led to increased infrastructure resilience against the effects of severe weather events, we used the following criterion:	
Federal program funds for disaster mitigation projects lead to increased resilience of infrastructure from natural hazards.	<ul style="list-style-type: none"> • <i>Emergency Management Act</i> • <i>Department of Public Safety and Emergency Preparedness Act</i> • Order-in-Council PC 2004-0325 • Canada's National Disaster Mitigation Strategy, 2008 • Memorandum to Cabinet and Treasury Board submission for the New Building Canada Plan • Agreements for funding programs

Management reviewed and accepted the suitability of the criteria used in the audit.

Period covered by the audit

The audit covered the period between April 2010 and May 2015. Audit work for this report was completed on 30 November 2015.

Audit team

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List of Recommendations

The following is a list of recommendations found in this report. The number in front of the recommendation indicates the paragraph where it appears in the report. The numbers in parentheses indicate the paragraphs where the topic is discussed.

Recommendation	Response
Federal government coordination for disaster mitigation	
<p>2.33 Environment and Climate Change Canada should work with partners to determine how intensity-duration-frequency curves should be produced for decision makers. (2.28–2.32)</p>	<p>Environment and Climate Change Canada’s response. Agreed. Environment and Climate Change Canada will work with partners to investigate and clarify the federal role in how intensity-duration-frequency (IDF) curves should be produced.</p> <p>As part of this, Environment and Climate Change Canada will continue to focus on modernizing its climate data archive. This will improve the integrity of the data and give efficient and ready access to all users to support a variety of scientific and engineering applications. Each year, Environment and Climate Change Canada issues thousands of severe weather warnings that decision makers use to mitigate the impacts of severe weather. These forecasts and warnings rely on the extensive collection of temperature, precipitation, and wind observations across Canada. These same data are quality controlled, archived, and used by scientists, partners, and clients to inform our understanding of climate change, and to develop specialized analysis and tools such as IDF curves and other extreme precipitation analyses.</p>
<p>2.40 Public Safety Canada, working with key stakeholders, should develop guidelines and standards for floodplain maps and encourage their consistent application in all provinces and territories. (2.34–2.39)</p>	<p>Public Safety Canada’s response. Agreed. Public Safety Canada recognizes the need for action to respond to the increase in frequency and severity of flooding in Canada, as well as the need for better risk information to inform effective investment in preventative and mitigative measures. In fall 2014, Public Safety Canada convened an interdepartmental committee to establish national principles, best practices, and guidelines on flood mapping in support of the National Disaster Mitigation Program. In 2015, Public Safety Canada initiated consultations with key stakeholders on developing these guidelines. The purpose of these consultations is to obtain a national perspective and approach on flood mapping, which will be used to inform long-term mitigation activities and initiatives. Public Safety Canada will continue to work with partners, including federal departments and agencies, provinces and territories, and key stakeholders, to develop and implement these guidelines and standards across the country.</p>

Recommendation	Response
<p>2.45 National Research Council Canada should incorporate climate change trends into the National Building Code’s structural design provisions, to take into account the expected increase in frequency and severity of weather events that can directly affect buildings. (2.41–2.44)</p>	<p>National Research Council Canada’s response. Agreed. The Canadian Commission on Building and Fire Codes, which is an independent committee of volunteers established by National Research Council Canada, is responsible for developing and updating the National Model Codes. Committee members (not National Research Council Canada) establish the content of the model codes based on input from the codes stakeholder community, including historical and trend analysis data from federal departments such as Environment and Climate Change Canada.</p> <p>The Committee will begin working on climate change adaptation by July 2016 for the 2015–2020 code cycle, with completion anticipated by 2020. Weather trends, increasing severity, and the effect on buildings and homes will be considerations as the Committee develops technical changes. Commencing 2016, National Research Council Canada code staff will work with other federal departments (such as Environment and Climate Change Canada and Natural Resources Canada) to obtain the latest data and trends so that these values are incorporated into the Committee’s deliberations and technical solutions. The solutions will be subjected to public consultation, a thorough cost-benefit analysis, and stakeholder engagement.</p> <p>In addition, as custodians of the National Master Specification, National Research Council Canada will also be in a position to work with other government departments and industry partners to incorporate climate change adaptation changes into the construction specifications, with completion anticipated by 2018.</p>
<p>2.53 Working with key federal partners, Public Safety Canada should coordinate consultations with decision makers to better understand the information needed to support their disaster risk reduction efforts, including those related to severe weather. (2.51–2.52)</p>	<p>Public Safety Canada’s response. Agreed. Public Safety Canada recognizes the need to better understand the emergency management and disaster risk landscape in Canada. Risk management practices facilitate improved decision making by clarifying the dimensions of risk, including its causes, likelihood of occurrence, and possible severity of consequences. Public Safety Canada exercises its leadership role for emergency management and disaster risk reduction by working with key partners and stakeholders to understand and prioritize the risks posed by hazards to loss of life, damage to property, as well as risks to the economy and the environment. The Department further facilitates and coordinates the exchange of information through existing federal and federal/provincial/territorial governance forums, such as the Assistant Deputy Minister Emergency Management Committee, Senior Officials Responsible for Emergency Management, outreach activities, and other mechanisms (such as Canada’s Platform for Disaster Risk Reduction and the Domestic Group on Emergency Management), to better support decision makers in making evidence-based decisions regarding disaster risk reduction, including those related to severe weather. Public Safety Canada will continue to provide leadership and work in an integrated way with key federal partners and stakeholders to advance disaster risk reduction efforts.</p>

Recommendation	Response
<p>Federal programs to support disaster mitigation</p>	
<p>2.84 Public Safety Canada, working with other departments, should examine the federal government’s mitigation programs to identify potential changes that facilitate provincial and territorial investments in disaster mitigation projects. It should encourage both large- and small-scale structural projects and continue to support non-structural projects. (2.75–2.83)</p>	<p>Public Safety Canada’s response. Agreed. In recognition of the increasing disaster risks and costs, Public Safety Canada will continue to work with other federal departments to align mitigation programming across the Government of Canada. Public Safety Canada is collaborating with other federal departments to enhance risk assessment tools and identify opportunities that would encourage both large- and small-scale structural mitigation initiatives, including non-structural investments. Public Safety Canada will continue to work in close collaboration with federal departments, as well as provinces and territories and other key stakeholders, to advance an integrated approach to mitigation programming, in which mitigation investments will be focused on risks and building resilience.</p> <p>As a first step, the National Disaster Mitigation Program, which was launched in early April 2015, aims to address the rising risks and costs of floods, and to build the foundation for future informed mitigation investments that could reduce the effects of flood events.</p>