

Local Adaptation in Canada

SURVEY REPORT | JUNE 2019



Photo: Xicotencatl

A collaboration between the Federation of Canadian Municipalities, the University of British Columbia, and the University of Waterloo

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Climate Change Adaptation

The Quebec-Ontario 1998 ice storm. The 2013 floods in Calgary and Toronto. The 2016 Fort McMurray and 2011 Slave Lake, Alberta wildfires. The New Brunswick floods, the Ottawa-Gatineau tornadoes, and the BC windstorm of 2018. Many of the images from these events are seared in our memories. They represent some of the worst natural disasters in Canada's history, and all have been linked to changes in the climate.

It is no longer a question of 'if' climate change impacts occur, it is a matter of 'when'. In October 2018, the United Nations Intergovernmental Panel on Climate Change (IPCC) released its most urgent report to date, stating that the global community may have as little as 10 to 12 years to slow greenhouse gas emissions and limit global temperature increase to 1.5°C.¹

Communities across Canada are now dealing with the effects of climate change. For some, increased drought seasons impact water and agricultural resources and increase the risk of forest fires. For northern communities, warmer winters mean more permafrost melt and less ice, leading to a variety of challenges with transportation and buildings. Many communities are contending with the damage caused by more frequent and intense storms. Higher sea temperatures are eroding coastlines and impacting vital public infrastructure. Invasive species and plants bring a host of complications, not the least of which are the implications for biodiversity and to human and forest health.

MOST EXPENSIVE NATURAL DISASTERS IN RECENT CANADIAN HISTORY

Fort McMurray wildfires	2016	\$3.6 billion
Southern Alberta flooding	2013	\$1.72 billion
Ice Storm, Ontario-Quebec	1998	\$1.49 billion

Sources: Insurance Bureau of Canada, Seafirst Insurance Company

Responding to these changes will be expensive across the country.² It is estimated that it will cost \$5 billion annually to cover the cost of extreme weather events by 2020, and that figure could rise to \$43 billion by 2050.³ Taking the recent Ottawa-Gatineau tornadoes as only one example, the damage to the electrical grid, roads, and the hundreds of buildings and homes will have an economic impact in the hundreds of millions of dollars.⁴ Although not all of the costs are borne by the local government, there is, as the saying goes, only one taxpayer.

Canada's economic wellbeing depends on adapting vital infrastructure to this new reality, and local governments can play a key role in helping the federal government reach its national and international climate goals and commitments. Canada's municipalities influence half of the country's greenhouse gas emissions,⁵ and major portions of critical physical and natural infrastructure are susceptible to changes in the climate. All levels of government, industry, and the public must work together to reduce emissions and respond to climate impacts.

Adaptation planning is designed to reduce the negative impacts of climate change-related events that may take place, and to take advantage of cost, resource, and other benefits that accrue regardless of whether or not the event occurs in the future.

¹ https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf

² These costs are rising not only due to more or more extreme events. The municipal infrastructure deficit—the amount needed just to maintain or replace current infrastructure—is roughly \$200 billion, reported in Yale Insights, <https://insights.som.yale.edu/insights/what-will-it-cost-to-rebuild-canada-s-infrastructure>. For many local governments, new infrastructure will be necessary to service growing populations.

³ http://www.citiescan.ca/climate_change

⁴ Canadian Underwriter, October 17, 2018. Were the Ottawa-Gatineau tornadoes the costliest in Canadian history? <https://www.canadianunderwriter.ca/claims/much-ottawa-gatineau-tornadoes-cost-insurers-1004138373/>

⁵ The most recent annual dataset (2016) has Canada's total GHG emissions at just over 700 megatonnes. <https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/greenhouse-gas-emissions.html>

CLIMATE CHANGE MITIGATION OR ADAPTATION? BOTH APPROACHES ARE NEEDED.

Mitigation measures reduce or eliminate point-source GHG emissions. Examples include switching gas or diesel-powered vehicles to electric or hybrid models, and capturing landfill gas for reuse as electricity or heat.

Adaptation measures reduce the negative impacts of climate change and take advantage of new opportunities. Actions can be reactive or proactive. After a flood, a community might immediately install protective berms, and later amend land-use policies or bylaws to limit future uses in vulnerable areas, such as floodplains.

Using a **combination** of climate change mitigation and adaptation measures (including some proven winning options already being used by Canadian communities) could cut emissions by between 20 and 55 megatonnes.⁶ To put that figure in perspective, the City of Toronto's 2016 emissions totaled just over 18 megatonnes.⁷

Despite mounting evidence of the benefits of adaptation planning, the 2018 survey indicates that more work needs to be done to enable local government to undertake the necessary steps to plan for climate change impacts. A 2017 survey⁸ of 63 Canadian municipalities found that a minority had assessed their community's vulnerability to specific climate change impacts. Further, of those communities with plans that consider adaptation, only a few had assessed the impacts of climate change on specific neighbourhoods and industries.

Financial signals are key to advancing action. As of January 1, 2019 carbon has a price in Canada and that will impact local climate change planning decisions. The economic benefits of taking action now, rather than later (or at all), are becoming clearer every day, and the evidence is coming from many different sectors.

FCM's Big City Mayors' Caucus has estimated that for every dollar invested in adaptation, between \$9 and \$38 can be saved in future damage.⁹ The U.S. National Institute of Building Sciences reported in 2018 that measures that meet or exceed best practice building codes have a benefit-cost ratio (BCR) of 11:1, and actions to protect infrastructure have a 4:1 BCR.¹⁰ A study by the United Nations Development Programme¹¹ found that global economic growth associated with climate change actions could be as much as \$12 trillion U.S. over the next twenty years.

COMMUNITIES OR LOCAL GOVERNMENTS?

Community is a broad term that often refers to places where people live, and sometimes in our report it is used in place of the terms local government or municipalities. While we use the terms interchangeably, it is important to note that the survey was sent to local governments and results we report reflect such places.

⁶ Smart Prosperity Institute. Municipalities and the federal government should work together to create a green economy in Canada. <https://institute.smartprosperity.ca/news/municipalities-and-federal-government-should-work-together-create-green-economy-canada-new-0>

⁷ C40 is a network of the world's megacities committed to addressing climate change.

⁸ Climate Change, Floods, and Municipal Risk Sharing in Canada. Jason Thistelwaite, University of Waterloo, School of Environment, 2017. Accessed at: www.researchgate.net/publication/317003731_Climate_Change_Floods_and_Municipal_Risk_Sharing_in_Canada/download

⁹ Ibid.

¹⁰ National Institute for Building Sciences. www.nibs.org/resource/resmgr/mmc/NIBS_MSv2-2018_Interim-Rep.pdf

¹¹ The report was released at COP22 in Marrakesh in 2016. www.undp.org/content/undp/en/home/presscenter/pressreleases/2016/11/16/un-report-1-5-degree-limit-to-improve-growth-jobs-and-safety.html

2018 Climate Change Adaptation Survey

This report presents the findings of a survey of Canadian municipalities and helps inform other projects studying local adaptation planning in Canada. These initiatives help to:

- improve the understanding of adaptation planning by local governments
- generate applied knowledge to help local governments with their adaptation efforts
- support policy development, and
- continue to share and develop best practices.

The 2018 Climate Change Adaptation Survey of Canadian municipalities ran from January to April 2018.¹² The survey was conducted by the Federation of Canadian Municipalities (FCM) with researchers at the Centre for Environmental Assessment Research at the University of British Columbia, and the Faculty of Environment at the University of Waterloo. The survey was open to all local governments in Canada. Most 2018 survey responses were anonymous, but some respondents did self-identify.

A request to participate was sent to all local governments that are members of FCM,¹³ and most were sent by direct email to the lead(s) on climate change within the local government, if known. Requests were also made through newsletters sent from provincial and territorial municipal associations, and other partners such as the Canadian Institute of Planners and Engineers Canada. Additional outreach was done to target under-represented regions or municipalities of different size classes.

The survey was designed such that respondents were invited to answer questions based on how they responded to preceding questions. For example, those local governments that are less involved in adaptation planning answered fewer questions than those that are more engaged. For many questions, responses were only captured from local governments that are engaged in some degree of adaptation planning. The survey contained no opinion-based questions and included a limited number of short-answer questions.

There were "drop offs" in the survey—those respondents that did not answer foundational questions (e.g., location, size of municipality, etc.), or those that skipped questions, whether or not they were applicable to their local government—and, except where noted, the findings in this report exclude those drop offs.

The survey captured a snapshot of municipal adaptation planning. Its findings are not meant to be representative of the entire Canadian municipal sector—no single study could capture all of the variations found across a country as large as Canada, or even within the same province—and participants' responses can be influenced by their perceptions and are not necessarily data- or science-driven.

A similar survey was conducted in 2012 by some of the same members of the project team as the 2018 survey, under the title "National Municipal Adaptation Project" (NMAP). Despite challenges in data comparison, which are noted in the next section, the 2018 survey provides an updated understanding of the state of adaptation planning across Canada. The findings are helpful for identifying areas for future capacity building work and knowledge sharing.



Photo: Ryan L. C. Quan

¹² Some additional outreach was extended in certain municipalities through May 2018.

¹³ FCM's 2,000+ members received the invitation to participate in the survey. The precise number of invitations is not possible due to the wide promotion of the survey through provincial and territorial municipal associations, the Canadian Institute of Planners, Engineers Canada, and other organizations. As a comparison, in the 2012 survey, more than 3,500 requests were made.

Limitations and Assumptions

This report is generated from the survey results data, based on a data review and quality control assessment conducted on August 24, 2018. This included removing duplicate responses and copy-editing written answers in the fixed-selection responses to improve legibility and clarity, where appropriate, while retaining the integrity of the responses.

The project team refined some of the questions from the 2012 survey and added new ones to provide a deeper understanding of local adaptation planning in Canada. A direct comparison between the 2012 and 2018 data—particularly as it relates to climate-induced events—was not possible due to differences in survey outline and method. This report has been prepared to provide a broad summary

of the 2018 results, including comparisons to 2012 where possible. In some cases, percentages have been rounded.

Some findings are highly regionalized. For example, coastal erosion is not a consideration for Prairie communities, nor is permafrost melt of great concern to southern communities. Some of the results confirm other Canadian and global research trends, but in other cases the data are incomplete. For example, more local governments in Nova Scotia have climate change plans than the survey findings would suggest. Wherever possible, clarification of the data is provided.

Survey Snapshot

- Over the last 10 years, local governments report that above-average rain and snowfall, and more severe storms are the most frequent weather events in their communities.
- More than half of local governments surveyed have initiated formal adaptation planning discussions in their community within the last four years.
- Municipal engineering and public works, planning, and traditional departments such as emergency management and public safety, play an increasingly important role in adaptation planning.
- Results show that adaptation planning is more often undertaken on an as-needed basis, such as for infrastructure projects or risk assessments, than as part of a broader plan or strategy.
- Very few local governments have one or more full-time staff dedicated to adaptation planning or related initiatives.
- Local governments are increasingly using climate change and other data to make adaptation-related decisions.
- Local governments see the connections between adaptation planning and emergency management and disaster response, but struggle to take action because of a lack of human and financial resources.
- FCM, provincial and territorial governments, and the federal government are seen as the main sources for municipal adaptation planning and implementation funding, and for information and training resources that support adaptation.

Detailed Results Summary

Participating Local Governments and Populations

Of 180 respondents, about 40% (~70 respondents) have undertaken some form of adaptation planning.

The majority of respondents (74%) were lower-tier (e.g. city, town, village, etc.), with the others being upper-tier (e.g. regional district or municipality, county, planning district, etc.). Responses by province and territory loosely followed population densities. Ontario, Quebec, British Columbia and Alberta represented over 63.5% of the completed surveys (Table 1). Marked changes in participation rates were noted in Saskatchewan (4.2% vs. 11.4% in 2012), and Newfoundland and Labrador (8.9% vs. 2.9% in 2012).

Mid-to-large size communities¹⁵ were well-represented with 64% of all respondents, compared with 53% of respondents in 2012. Twenty-one communities in the 2018 survey had populations over 500,000 compared with 15 communities in 2012. These factors highlight an urban shift in participation between the 2012 and 2018 surveys.

Less participation by rural governments emphasizes the need for continued engagement of smaller communities. Climate change will affect all municipalities over time, however, specific adaptation approaches will be needed for smaller, northern and rural governments to address their unique needs, and in consideration of their more limited resources.

Table 1.

Responses by Province / Territory

Province/Territory	%	Count
Ontario	23.04%	44
Quebec	20.42%	39
British Columbia	10.47%	20
Alberta	9.42%	18
Newfoundland and Labrador	8.90%	17
New Brunswick	7.33%	14
Manitoba	5.76%	11
Nova Scotia	4.19%	8
Saskatchewan	4.19%	8
Yukon	2.09%	4
Prince Edward Island	2.09%	4
Northwest Territories	1.57%	3
Nunavut	0.52%	1
Total	100%	191¹⁴

¹⁴ Some participants dropped off after only completing the initial location questions, leaving 180 who fully completed the survey.

¹⁵ FCM uses 10,000 as the maximum population for rural communities.

Climate Change Impacts

Collectively, respondents reported close to 800 events that had impacted their communities over the last 10 years. Table 2 shows how respondents ranked the risk. For both questions, respondents could choose more than one event. However, the survey only recorded the experience, and not the number of times a type of event was experienced within that timeframe. For example, if a community had two major floods in one year, it was only counted as having experienced a flood event, not the number times it occurred.

The contrast of permafrost melt—no change in ranking from 2012 to 2018—and a decrease in severe cold periods—from 5th in 2012 to 10th in 2018—speaks to a warming climate in the Canadian South, and to the geographical weighting of respondents (more respondents from the South than the North). Permafrost melt remains a concern in the North. The results of the survey should be taken in appropriate regional context.

Table 2.
Most Frequent Climate Change Impacts, Current (2018) and Expected (2028)

Impacts or Events	Rank (over last decade)	Rank (expected between now and 2028)	# selecting event
High rain or snowfall, above the annual normal.	1	2	118 (15%)
Increased severe storm events (high wind, etc.).	2	1	106 (14%)
Flood requiring significant or uncommon protection measures, or causing significant damage to public and private property.	3	3	101 (13%)
Invasive species (insects, plants, etc.).	4	4	80 (10%)
Severe cold periods, for a prolonged period of time, below the seasonal normal.	5	10	71 (9%)
High temperatures for a prolonged period of time, above the seasonal normal.	6	5	70 (9%)
Other severe weather-related event or events that have resulted in significant damage to public and private property.	7	8	59 (8%)
Drought requiring significant or uncommon water restrictions.	8	6	50 (6%)
Climate-related change to vegetation or animal populations (loss of natural vegetation, change in migration patterns, etc.)	9	7	46 (6%)
Human health-related (heat stress, smog, etc.)	10	9	43 (6%)
A forest fire that resulted in evacuations or an evacuation alert.	11	11	13 (2%)
Other (please specify).	12	13	11 (1%)
A forest fire that resulted in damage to buildings or other infrastructure	13	12	8 (1%)
Permafrost melt	14	14	4 (0.5%)

Selected Results

The three most extreme events and impacts experienced by communities over the past decade were ranked as high rain or snowfall, above the annual normal; increased frequency of severe storm events; and flooding events requiring significant or uncommon protection measures, or causing significant damage to public and private property.

When asked about future events of concern, respondents identified the same three, but in a slightly different order: increased storm events, above normal precipitation, and significant flooding.

Of the eight local governments in Nova Scotia that completed the survey, six (75%) reported uncommon flood events over the last 10 years. Similar numbers were reported from local governments in New Brunswick (9 of 14 respondents or 64%) and Newfoundland and Labrador (10 of 17 respondents or 58%).

Of the 44 local governments in Ontario that completed the survey, 32 reported above-average snow or rainfall, and 30 reported uncommon flood events. Local governments in BC and Alberta were more likely to report significant drought events (67% of respondents in Alberta, 70% of those in BC).

Other events not listed included acting as emergency/refugee centres during evacuations (flood and fire) and reports of higher tides. One respondent reported a noticeable 10-year increase in crop production. The crop was not specified, but this could be indicative of the types of crops that could potentially be grown in warmer temperatures.

Local governments in forest-rich British Columbia, Ontario and Quebec reported far higher instances of invasive species, such as the mountain pine beetle and emerald ash borer, than local governments in other provinces. Both insects have had devastating impacts on the forestry industry and in forest ecosystems. Some respondents also commented on increases in vector-borne illnesses linked to changes in temperature, such as the West Nile virus and Lyme disease.

Floods are the most frequent natural hazard in Canada. They can occur at any time of the year and are most often caused by heavy rainfall, rapid melting of a thick snow pack, ice jams, or more rarely, the failure of a natural or man-made dam.

Source: Government of Canada.

As well as being an important economic industry in Canada, forests provide critical environmental services such as erosion, flood, and wind control, and carbon sequestration. Research into the economic impact of the mountain pine beetle suggests that there will be cumulative, present value loss of about \$57 billion (1.34% of GDP), and a \$90 billion decline in compensating values (the benefits provided by forest ecosystems) from 2009 to 2054 in British Columbia.

Source: Forestry: An International Journal of Forest Research

Adaptation Planning

Climate Change Adaptation Dialogue

More than half of respondents (57%) indicated that formal adaptation planning discussions began within the last four years; 40% had started these discussions between 2000 and 2013; and three municipalities started before 2000.

Respondents said that climate change adaptation discussions were most frequently held among municipal councils and staff, indicating that local government remains a key driver for adaptation planning and activities. This is consistent with the 2012 survey findings. Discussions with community organizations and other provincial/territorial levels of government followed suit.

Adaptation Planning Efforts

Just over 42% of local government respondents (~70 of 180 respondents) indicated that they carry out some level of adaptation planning, whether within the context of other projects (i.e., adaptation considerations for infrastructure projects), or as a stand-alone practice (Figure 1).

Of these 70 or so local governments that have incorporated adaptation into their planning regimes, 34% had done so either as part of an integrated plan with core municipal planning efforts, or as a stand-alone plan (Figure 2).

Municipalities with adaptation-specific documents most frequently developed plans (63%) and strategies (28%), indicating a mix of prescriptive and vision-oriented approaches. One respondent indicated that they had developed an adaptation-specific program.

The remaining local governments integrate adaptation planning on an ad hoc basis, with the most frequent measures listed as consultations with other municipalities, and integration of adaptation into existing projects. A majority of the local governments without formal adaptation planning efforts (68% of respondents) noted that they were considering adaptation for specific projects.

These findings highlight a need to better understand why such a high percentage of local governments are aware of adaptation-related value, but have yet to formalize steps to integrate it within their planning programs.

Figure 1. Municipalities that engage in adaptation planning

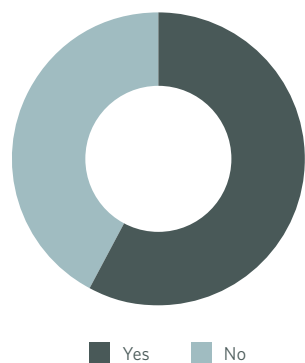
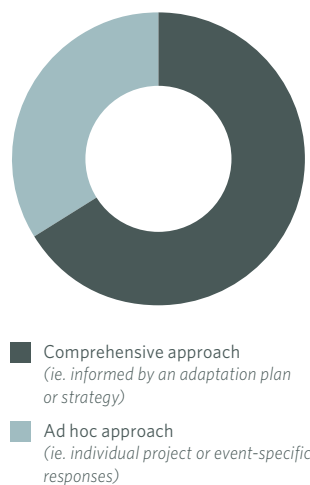


Figure 2. Approach used by municipalities that engage in adaptation planning



Scope of Adaptation

From a list of potential activities, survey respondents chose the adaptation actions that their local government have taken. Table 3 shows a comparison of the 2012 and 2018 survey results.

Table 3.

Adaptation Actions

Action	2018 %	2018 Count	2012 %	2012 Count
Improving existing public infrastructure.	14.31	80	15.6	75
Risk management/risk assessment.	13.24	74	16.8	81
Reducing contributions to climate change (i.e., mitigation), such as reducing the carbon or other greenhouse gas outputs of local government operations and areas of local responsibility.	12.16	68	<i>Not included as an option in the 2012 survey</i>	
Planning for new public infrastructure.	11.09	62	12.5	60
Seeking new external revenue sources for adaptation activities.	9.48	53	4.8	23
Land use zoning changes (for example, uses based on flood plain identification or densification to channel growth away from 'at risk' areas).	9.48	53	13.1	63
Bylaws aimed at changing public behaviour (for example, new water use restrictions).	6.08	34	7.5	36
Seeking new internal revenue sources for adaptation activities.	5.72	32	3.5	17
Examining insurance costs and other potential liabilities.	5.01	28	5.6	27
Municipal procurement policies.	3.94	22	<i>Not included as an option in the 2012 survey</i>	
Other (please specify).	2.33	13	6.5	31

The highest ranked adaptation-specific actions in the 2012 and 2018 surveys were improving public infrastructure, and risk management and assessment. Reducing contributions to climate change (mitigation), which was not included in the 2012 survey, ranked third.

In the 2018 survey, respondents also noted actions taken that were not included as options, including capacity building efforts (e.g., training/education for staff or community members); collecting data and conducting gap analyses; and reviewing local engineering standards for certain infrastructure.

The top two actions remain the same in 2018 as in 2012, but in reverse order, which could be a result of an increased engineering focus. Additional research is needed to understand why land use planning dropped from 3rd in 2012 to 6th in 2018.

Staffing Levels and Approaches

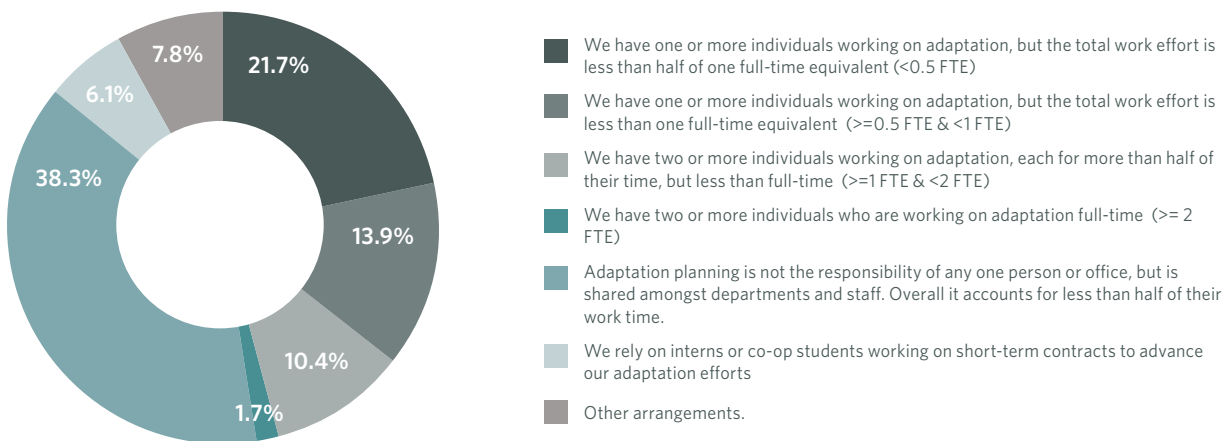
Only 12% of respondents that have some form of adaptation planning indicated that one or more full time equivalent (FTE) staff was assigned to adaptation-related planning efforts. Of these respondents, 38% indicated that adaptation planning was not the responsibility of a single person or office, but was shared among departments and staff; and that adaptation-related responsibilities accounted for less than half of staff work time. The second most common response (22%) was that one or more employees were assigned to adaptation, but that the total effort was less than half a FTE. About one-third of the local governments that conduct some level of adaptation planning had created a formal team to work on this issue (Figure 3).

The shortage of dedicated human resources for adaptation planning is not a new issue and may, in large part, explain the degree to which planning takes place within local governments. Further study is needed to examine how formal planning processes are conducted or approached within local governments.

As more local governments recognize the role of non-traditional departments in adaptation planning, there is an opportunity to promote inter-disciplinary approaches that meet related objectives and initiatives, such as public safety and disaster risk reduction.

Figure 3.

Adaptation planning staffing levels



Lead Municipal Departments

The vast majority of adaptation planning efforts are led by municipal Planning or Environment departments (24% and 22% respectively). Almost half of respondents that have adaptation plans (46%) said these two departments lead their adaptation efforts. In 2012, 56% of survey respondents reported that Planning and Environment departments led their adaptation efforts. Engineering / Public Works was the third most cited function at 17%, up from just under 10% in 2012. These data suggest that Engineering and Public Works departments play a greater role in adaptation planning than in previous years.

These findings could indicate that more local governments recognize the role of other, less traditional departments in adaptation planning; that adaptation responses are increasingly technical in nature; or that other professional organizations, such as Engineers Canada, are encouraging members to take more active roles in sustainability issues, including adaptation. Further research is needed to examine this more fully.

In a support capacity, Engineering / Public Works and Planning were the two most noted at 18% and 15%, respectively. Public Safety was the third most frequently cited support department (13%). Several municipalities also commented on the links between adaptation planning and disaster mitigation efforts.

Adaptation Services and Resources Used

Planning & Implementation

From a list of organizations, respondents chose FCM and Engineers Canada as the top two sources for information about adaptation planning and implementation, followed closely by university or research hubs and non-government organizations (NGOs). Additional sources included planning consultants, other municipal associations, utilities, community groups, and federal government departments like Natural Resources Canada, Transport Canada, and Environment and Climate Change Canada.

Respondents were also asked about the type of information they sought and could choose more than one option. Table 4 shows that most municipalities seek information on local examples (i.e., case studies), funding, and technology and design alternatives.

Funding

Almost half of external funding received by local governments (46%) for adaptation-related infrastructure projects is from provincial or territorial governments; the Government of Canada accounts for 34%. Other external sources included the private sector and foundations. More than one respondent named Public Safety Canada’s National Disaster Mitigation Program.

Respondents identified two sources of external funding for planning initiatives: Provincial/territorial governments and FCM. Compared with similar questions posed in the 2012 survey, FCM¹⁶ has become an important source of external funding for adaptation-related activities, such as neighbourhood sustainability plans.

Table 4.

Types of Adaptation Planning Information Sought

Answer	%
Examples of adaptation planning in other Canadian local governments.	26.95%
Information about funding.	23.05%
Technology and design alternatives for infrastructure.	19.50%
Training to improve skills or capacity.	14.89%
Examples of adaptation planning in local governments outside Canada.	12.06%
Other (please specify).	3.55%
Total	100%



Housing in Cambridge Bay, Nunavut. Climate change and adaption poses unique challenges for Canada’s north. New approaches to construction are needed to respond to changing environments. Photo. K. Hanna

¹⁶ Several respondents mentioned FCM’s Green Municipal Fund (GMF) and its Municipalities for Climate Innovation Program (MCIP) as implementation resources. GMF is funded through a \$625 million endowment from the Government of Canada; MCIP is a five-year \$75-million program, delivered by FCM and funded by the Government of Canada.

Climate Change Data

Almost two-thirds of the 106 respondents who said they had accessed some form of climate change data (e.g., related to historical or future projections for rain/snowfall, extreme temperature, etc.) had done so in support of adaptation efforts.

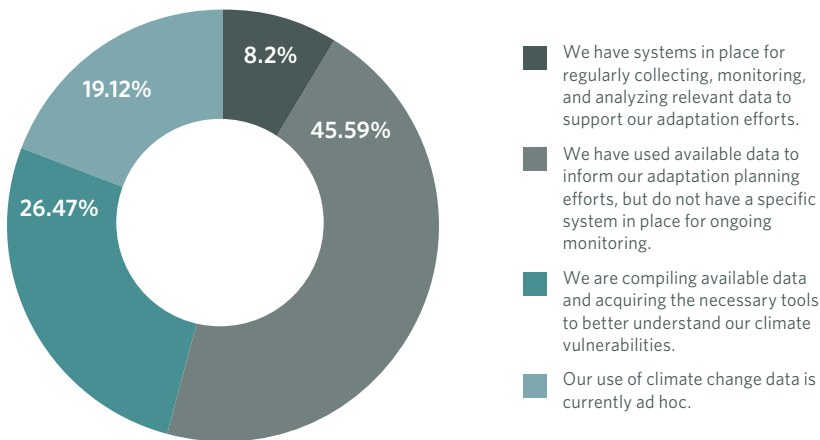
More than 30 respondents identified the regular use of climate change and other data (e.g., energy and emission inventories) to support adaptation efforts and understand climate vulnerabilities, but had no formal adaptation system in place (Figure 4).

Respondents most frequently identified Environment and Climate Change Canada and FCM for climate-related data or related resources. A second tier of sources includes ICLEI - Local Governments for Sustainability (ICLEI Canada), Natural Resources Canada, provincial/territorial government departments, and regional research agencies or universities.

Data collection, monitoring and validation systems are more robust in 2018 than they were in 2012. Initiatives such as the federal government’s energy benchmarking programs, the Canadian Centre for Climate Services, provincial water and energy registries, real-time utility data availability, funding and training in support of asset management, and FCM and ICLEI (Canada)’s ongoing support for data collection at the local level have helped local governments make better decisions based on real numbers. Additional work may be required to encourage more local governments to use, collect, monitor, validate, and act upon this type of data to make informed adaptation-related decisions.

Figure 4.

Use of climate change data by Canadian municipalities.



Comparing Results

As noted at the beginning of this report, survey findings should be taken in their regional context, and with the knowledge that survey responses can be influenced by perception. Revisions to the 2018 survey tool made a strict comparison with findings from the 2012 survey data challenging and this reflects the manner in which climate-induced events have been characterized in the surveys. For instance, in 2018, high rain and snowfall were combined, whereas in the 2012 survey the events were separate. However, high rainfall was the most frequently cited event in 2012, and remained the same in 2018, so the degree to which the addition of snowfall influenced this result is unknown.

The 2012 survey did not explicitly ask about increased severe storm events¹⁷, so its inclusion in 2018 will help with future versions of this work. More importantly, recent events (e.g., tornadoes, wind storms, forest fires, etc.) highlight the need to track, plan for, and support efforts to minimize negative impacts of severe storm events. Respondents made links between adaptation, emergency management and risk reduction in several survey responses.

Given the last several fire seasons and the climate analysis modeling that has been done to predict the probability of future events, it was initially surprising that forest fires ranked relatively low overall in the 2018 survey. A comparison among the responses by province, however, shows that BC, one of the provinces most impacted by forest fires, ranked them higher than local governments in other provinces. Twelve of twenty BC local governments that completed the survey reported a forest fire event that resulted in evacuations or an evacuation alert.

The combination of drought and extended above-average heat events was comparable to the 2012 results. Looking at regional results in the 2018 survey, 67% of the local governments in Alberta that completed the survey, and 70% of those in BC reported significant drought events. More than half of the local governments in Alberta, BC, Ontario and Quebec also reported prolonged, above-average

temperatures. The addition of invasive species, which may be linked to heat- and drought-related events, was a logical addition to the 2018 survey, and regional findings again show that BC, Ontario and Quebec ranked invasive species higher than in other provinces.



Forest fire scarred landscape near Rock Creek, BC. In some parts of Canada forest fire risk will increase with changing environmental conditions. Preparation and new approaches to planning will be required to protect communities. Photo, K. Hanna

¹⁷ Natural Resources Canada. Fire Weather. The length of the fire season is expected to increase in almost all areas of Canada and, by 2100, be almost a month longer in certain regions. www.nrcan.gc.ca/forests/climate-change/forest-change/17776.

Future Research

Improved Data for Trend Analysis

Administering this survey on a regular basis will allow for improved and ongoing analyses of adaptation trends, both nationally and regionally. Researchers had little control over who within a local government responded to the survey; in future, therefore, it might be instructive to select specific elected officials and staff to survey. Certain portions of the survey would still be answered on an anonymous basis, resulting in better insights into local adaptation planning efforts. Most 2018 survey responses were anonymous, but some respondents did self-identify.

Positive Aspects of Adaptation

The 2018 survey examined the potential negative impacts of climate change and the adaptation requirements to reduce its impact on communities. Future versions of the survey could examine potential benefits of climate change within regional and sub-regional contexts, and how adaptation measures could be implemented to maximize resources, or spur new and sustainable economic development.

Sustainability and Natural Disaster Risks

Respondents touched on the links between adaptation efforts and their sustainability objectives throughout the survey. This relationship needs to be better understood to support adaptation efforts in Canada. It would be particularly relevant in municipalities where sustainability efforts are already well-received as a way to promote adaptation integration. Flooding and forest fires have become the most expensive natural disasters over the last decade, so the relationship between adaptation and the reduction of disaster risk should also be explored, either as an extension of this survey or in concert with other research.

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