

Building River Flood Resiliency in Calgary through Risk Communication and Engagement

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ABSTRACT

River flooding has always been a risk faced by Calgary, built as it was at the confluence of two mountain rivers. The devastating floods in June 2013 brought the resiliency of the city and its communities into sharp focus. Since then, The City has prioritized building flood resiliency by learning about not only the hazard, but the awareness and values of citizens, and improving flood risk communication and engagement. Informed citizens increase not only their own personal resiliency, but the resiliency of the entire city. Likewise, incorporating citizens' values and perspectives allows more sustainable flood risk management. Communicating risk and engaging the community is an ongoing opportunity, and The City is exploring innovative ways to continue to raise flood awareness and engage citizens.

RÉSUMÉ

Les inondations fluviales ont toujours été un risque pour Calgary, construite au confluent de deux rivières de montagne. Les inondations dévastatrices de juin 2013 ont mis en évidence la résilience de la ville et de ses communautés. Depuis lors, la Ville de Calgary a priorisé la résilience aux inondations en apprenant non seulement le danger, mais aussi la sensibilisation et les valeurs des citoyens, et en améliorant la communication et l'engagement en matière de risque d'inondation. Les citoyens informés augmentent non seulement leur propre résilience personnelle, mais la résilience de la ville entière. De même, l'intégration des valeurs et des perspectives des citoyens permet une gestion plus durable des risques d'inondation. La communication des risques et l'engagement de la communauté constituent une opportunité permanente, et la Ville explore des moyens novateurs de continuer à sensibiliser les citoyens aux inondations et à faire participer les citoyens.

1 FLOOD RISK IN CALGARY

Calgary is a city with over a million people, established, as many cities historically were, along a river. Calgary lies on not only one river, but at the confluence of two rivers – the Bow and the Elbow. With a combined catchment totaling 9000 square kilometres of mostly mountainous terrain, Calgary has always been at risk of river flooding. Records of large floods exist from the late 19th century, and into the 1930's. After the 1930's, however, there were no major flood events for seven decades (Figure 1).

After a minor flood event in 2005, major flooding occurred again in 2013, taking many people off guard. Despite regionally and municipally coordinated response measures that greatly reduced the potential impact of the flood, the downtown economic core, government buildings, social and health services, historic communities, commercial and industrial areas, major tourist attractions and recreation facilities were affected.

The 2013 flood emphasized the need to address flood risk in Calgary, protect public safety and reduce future flood damages (social, environmental, and economic damages). This imperative drove the recommendation for The City to gain a better understanding of Calgary's flood risk and the changing dynamics of the floodplain, and develop evidence-based strategies to reduce flood risk. Flood resiliency continues to be reconfirmed as a top priority by City Council. Public awareness of flood risk and the subsequent empowerment of citizens to act to reduce their flood risk is one of the key components of flood resiliency, along with structural mitigation, non-structural and policy measures, and risk transfer and sharing mechanisms. The

City has completed several studies, developed a strategy for flood resiliency, and begun mitigation projects. From the beginning, helping citizens understand their flood risk and incorporating their input was included as an integral, necessary component for building true city-wide flood resiliency.

2 PERCEIVED FLOOD RISK

A survey of Calgarians in 2014 by the Centre for Community Disaster Research indicated that, at the time of the 2013 flood, half of residents in communities at risk of flooding did not realize the risk existed (Haney, 2017). The survey also showed that when the order was given to evacuate, one third of residents who heard the order did not evacuate. The majority of those who did evacuate took one to two hours to evacuate, in which time flood waters can rise substantially (ibid.).

Experiencing a flood increases both risk awareness and perception in a community. In their research after the Calgary flood, Tanner and Arvai (2017) found that both people who were evacuated and those who were not had heightened near-term risk perception, which they attributed to the magnitude and widespread impact of the 2013 flood.

A subsequent survey in 2016 by Ipsos Reid on behalf of the City of Calgary showed that since the 2013 flood, the number of citizens aware of their flood risk has grown. In 2016, 85% of those living in a flood risk area reported having a "medium" or "high" flood risk, with 88% confident that they know their flood risk. In addition, 64% of those living in a flood risk area reported having an evacuation

plan. However, 19% of residents in flood risk areas reported having no evacuation plan or having taken any flood preparedness measures.

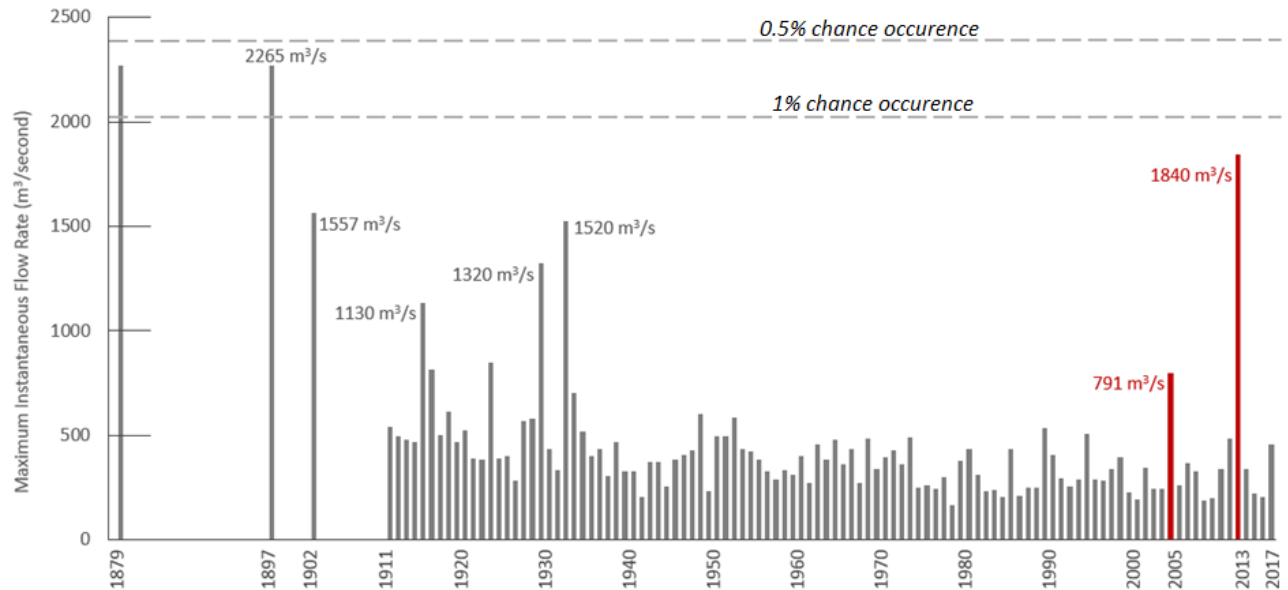


Figure 1. Historical annual peak flow events on the Bow River in Calgary. Note absence of major floods since 1930's.

3 FLOOD RISK COMMUNICATION

A city in which citizens are not aware of their flood risk and do not know what to do in a flood, or how to protect themselves against one, cannot be a flood resilient city. Empowering citizens in this regard – increasing their knowledge, tools and ability to recover from floods – is a major component of Calgary's flood resiliency strategy. Communicating the right information with citizens increases their personal and their community's resiliency to river floods.

Communicating flood risk, mitigation, preparedness and personal safety measures is an ongoing opportunity. As the memory of flooding fades, many residents become less concerned, less prepared, and revert to believing that a large flood will not happen again. In personal communications between City staff and residents, and as documented in literature (Oulahen & Doberstein, 2010), people often believe another extreme event will not happen again in their lifetime. The common terminology of the "1 in 100 year flood" only helps to reaffirm this misconception.

To help citizens understand their flood risk and motivate personal preparedness, the City of Calgary has been taking several actions:

- Updating flood maps to reflect current data and recent development, and making flood maps publicly available;
- Simplifying and clarifying language, for example using "1% chance of occurring in any given year" to describe river flood events, instead of "1 in 100 year";
- Hosting annual Flood Readiness campaigns
- Engaging citizens and stakeholders in the creation of a flood strategy, evaluation of flood mitigation

measures, and project design, including education of citizens on technical flood topics.

3.1 Flood Maps

The City has two sets of maps showing flood hazard: regulatory flood maps, and inundation maps.

Regulatory Flood Map: The official regulatory map (Figure 2) was created by the Province of Alberta in 1983 under the federal Flood Damage Reduction Program. It shows the floodway and flood fringe zones, in which specific land use and building regulations apply under Calgary's Land Use Bylaw. The regulatory flood map (showing floodway and flood fringe) is currently being updated by the Province (expected 2018).

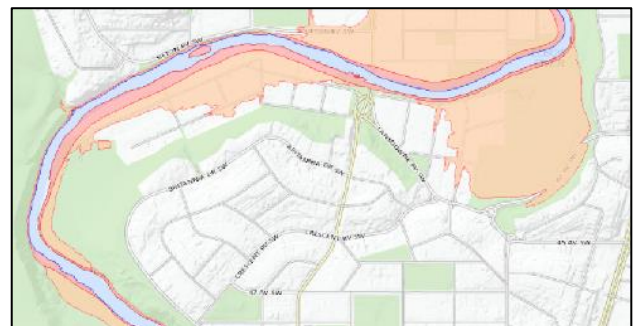


Figure 2. Current Regulatory Flood Map, Elbow River, showing floodway (dark pink) and flood fringe (light pink).

Inundation Maps: In 2012, the City of Calgary created up-to-date inundation maps in cooperation with the Province. These maps show which areas will be inundated

in various sized floods that can occur in Calgary (from 0.001% to 20% chance of occurrence in any given year). These maps were created to provide more current information for risk communication and emergency planning. The locations of the floodway/flood fringe were not calculated when these inundation maps were created, and so they do not show these zones, and are not linked to the bylaw. However, because they are more up to date, these maps give a more accurate picture of the flood hazard based on up to date river flow and channel geometry data, and reflect current development.

Following the 2013 flood and the changes it brought to the river channel and the hydrologic data record, the inundation maps were updated again in 2015 (Figure 3).

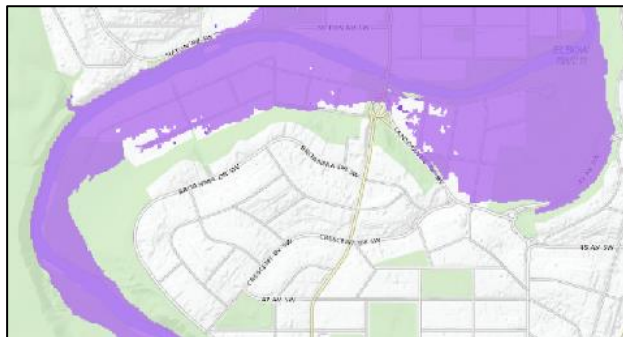


Figure 3. Inundation Map (2015), Elbow River, showing flooding with 1% chance of occurring in any year (purple).

Another way the probability of flooding in a community could be presented is to show all probabilities on one map, so citizens can determine their maximum likelihood of being flooded in any year, without having to look at several maps (Figure 4).

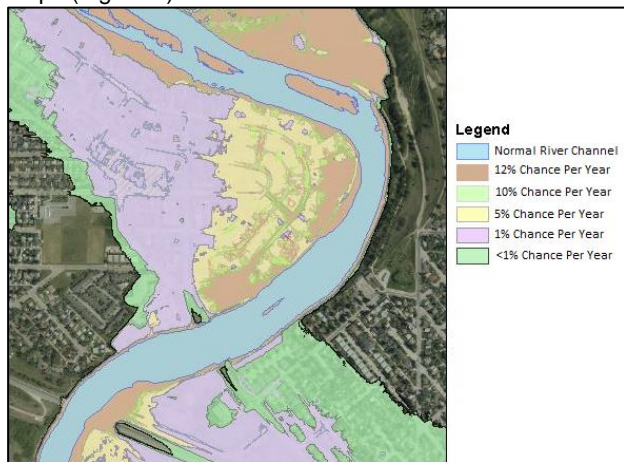


Figure 4. Flood Probability Map, Bow River.

Showing the extents of a historical flood, such as the 2013 flood, on maps would also help communicate risk to citizens in a tangible way that is easily understood and easy to relate to. While The City does make the 2013 flood data and aerial photos available, it could be made more easily accessible. Having it shown on the regulatory or

inundation/probability maps would give viewers a tangible reference point to a real and memorable event, perhaps making flood risk more “believable” and relevant to citizens.

Having two different sets of flood maps (i.e., regulatory and inundation maps) does create some confusion for citizens and unfamiliar City staff. Although the regulatory maps and bylaws may be difficult to update frequently, there is an ethical responsibility to make accessible to citizens and developers the most up-to-date hazard information available, and the new inundation maps were made publicly available despite the potential for confusion. The City has tried to remediate confusion over the two types of mapping by providing clear language around what a regulatory map is and what the inundation maps are, and why they both exist. Staff also spend time at each open house, community meeting and Flood Readiness Campaign event, as well as by phone and email with citizens who contact The City, showing citizens where they can access the maps, and how to interpret them. When property owners apply for development permits in a flood zone, both the official regulatory design flood elevation (based on the 1983 regulatory map) and the updated recommended flood elevation (based on the 2015 map) are provided.

When the updated Regulatory Map (showing the floodway/flood fringe) is finalized by the Province this year, it will be the most up-to-date map, and will replace both the older regulatory and inundation maps. If the regulatory map can be updated frequently enough to reflect new hydrologic/hydraulic data and new development in a reasonable interval, the issue of having two sets of maps could ideally be avoided in the future.

While updating flood maps can be a significant technical and financial commitment, it has been a worthwhile investment for the City of Calgary. The maps prepared in 2012 were instrumental in facilitating the response to the 2013 flood. They have also provided a technical foundation on which to strengthen flood policy and communicate and design requirements for flood resiliency across the city.

3.2 Clear Language

In addition to clarifying the types of flood maps available and their uses, The City is making the switch from describing river flood events as a “1 in 100 year flood” to using the Annual Exceedance Probability (AEP) terminology. As many people misinterpret the “1 in 100 year flood” as only occurring roughly once every 100 years, future communications from The City regarding river floods are using the “chance of being flooded in any year” instead. This is further simplified into plain language from “AEP”. For example, a community that floods at a flow rate currently equivalent to a “1 in 8 year flood”, or a “12% AEP”, is now reported to have a “12% chance of flooding in any year”. This more accurately and clearly communicates that a significant risk of flooding is present every year, not every eight years.

A third language-clarification The City continues to implement is emphasizing the difference between river (“fluvial”) flooding and stormwater flooding in streets and basements that is the result of local rainfall (“pluvial

flooding”, also sometimes called local or urban flooding). The term “flooding” on its own is not specific to mechanism - flooding means something gets wet that shouldn’t. While the two disciplines are split into different areas of responsibility within The City, they are not necessarily in the citizen’s mind, or in their experience. Clearly stating whether a document or public event is addressing river or stormwater flooding can help direct expectations and facilitate understanding. Currently, in materials regarding river flood risk, The City is attempting to be clear in identifying that river (not stormwater) flooding is being discussed, noting where the two overlap (e.g., stormwater gates are being installed that prevent the river from backing up into the stormwater system during river floods), and acknowledging that stormwater flooding is a concern also being addressed by The City.

Currently, The City is largely addressing the risk presented by different hazards (e.g., river flooding and stormwater flooding) separately. While there is exploration going on into taking a more All-Hazards approach to assessing, managing and communicating risk, there is also benefit to communicating each risk on its own. A major advantage is simplicity. While considering all hazards in an integrated approach makes sense strategically, and citizens should have information on all hazards that may affect them, it significantly complicates messaging, mapping and technical comprehensibility to present all hazards, or all forms of flooding, together at once. Further integrating river and stormwater flood risk assessments, mapping and messaging, and determining at what level and for which audiences this may be appropriate, is an ongoing opportunity.

3.3 Annual Flood Readiness Campaigns

Since the 2013 flood, The City has hosted annual Flood Readiness Campaigns leading up to and during the city’s “flood season”, when the risk of river flooding is highest from May 15 – July 15. The intention of the campaign is to raise awareness on river flooding, and provide information that will help citizens be prepared for and respond to a river flood. The campaign is also used to create awareness of The City’s flood mitigation strategy and projects, to build support for and understanding of the plans, to keep flood risk “top of mind” in an effort to maintain resiliency, and to advertise new maps, products or information available to assist citizens in these objectives.

In the past, the campaigns have included open houses in different locations through the city, an email newsletter series, tv and radio media, social media, presentations and booths at community events, door knocking and distribution of a Flood Readiness Guide.

As memory of the flood and the overall level of anxiety about flooding fades, and as many in the flood prone areas are reached, engagement in campaign events has tailed off over the years since 2013. Internal champions to maintain budget and a vision for the campaign is essential to maintaining effectiveness. New events, new tactics to reach residents not previously engaged, and new messages to catch the interest of citizens are required every year.

3.4 Engagement as a risk communication tool

At The City of Calgary, *Communication* and *Engagement* are different activities, with different objectives. Communication is a one-way flow of information to inform or educate. Engagement is collecting and using input from

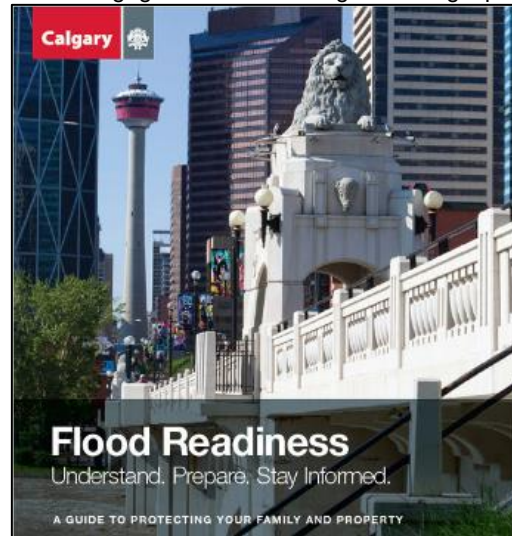


Figure 5. City of Calgary’s Flood Readiness Guide.

stakeholders to influence decisions and outcomes. While engagement (gathering input) is discussed below specifically as a means to create a stronger and sustainable strategy, there can – and should – be components of risk communication and education in any engagement program. Not only does this lead to a greater understanding of the risk among stakeholders or the public, thereby increasing their resiliency, but it is an important step in many engagement programs. It has been suggested that some technical education is required during engagement on hazard mitigation, to allow stakeholders and citizens to more fully understand the issue, how we got to the place we are in, and the options to mitigate it, so that they can make informed contributions to the process (Oulahen & Doberstein, 2010). This has been observed throughout communications and engagement on river flood issues in Calgary since 2013. Through the engagement program described below, many citizens commented that they learned a lot and had a better understanding of flood issues as a result of the process.

4 Engagement in Flood Mitigation Strategy

Engaging the public in the creation of a flood mitigation strategy for Calgary was a key piece of work in the years following the 2013 flood. Similarly, ongoing engagement for individual flood mitigation projects is intended to create projects that are sustainable, supported, and that meet the needs and concerns of the citizens who live, work and recreate along the rivers.

In the years following the 2013 flood, The City undertook several technical studies to better understand our waterways, changes to the rivers after the 2013 flood, the extent of our flood risk, and feasible mitigation options. In conjunction with a comprehensive study conducted by

IBI Group and Golder Associates, which quantified flood risk and assessed mitigation options for the city, The City ran a large public engagement program in 2016 to inform the consultants and City staff about citizens' and stakeholders' opinions, preferences and values regarding mitigation and development along the river. The input gathered was used to guide development of the study, create criteria for assessing the mitigation measures, and inform Administration's final recommendations to City Council.

In their case study of engagement on flood hazard mitigation in Ontario, Oulahen & Doberstein (2010) discuss three reasons (originally presented by Godschalk et al) that citizens often do not get involved in engagement on hazard mitigation. The first, that citizens think the government has the issue well in hand, would not necessarily be said to apply in this case, and if anything the reverse may be true for many citizens. Of the remaining two reasons, one is that citizens don't feel they know enough, another is they are less apt to get involved when the issue does not impact their daily lives (flooding being perceived as a possible future event, rather than a certain immediate event). The City's engagement program was intentionally designed to address all three of these issues, build knowledge and trust and stimulate engagement.

The components of the engagement program were designed to allow for varying levels of commitment, enable varying levels of "technical education", to reach as many citizens as possible and provide a variety of perspectives. Input from both flood-affected and non-flood-affected citizens was encouraged, with both groups targeted. The components of the program included:

- A Community Advisory Group, which met regularly over the course of several months and included residents from both flood-affected and non-flood-affected communities;
- Telephone survey of the general public, with oversampling in flood-affected areas;
- Pop-up booths around the city;
- Workshops with a presentation and small group discussions, as well as boards and one-on-one discussion opportunity with City staff;
- Open houses with the same material available as at workshops;
- Online engagement with the same reference materials and questions as presented during the workshops.

While participation was high from some communities, it was lower than anticipated from other communities. This may be due to some of the reasons for low interest in engagement on hazards discussed above, but may also reflect differences in ways residents in communities get information, starting levels of engagement and leadership on flood issues within each community, perceived flood risk, perceived mitigation certainty, or levels of trust in government processes.

While for some, interest in flood issues may have diminished over time, many citizens are still very engaged and it is still a "hot" topic for many Calgarians – particularly those who suffered losses. The dilemma over when to engage citizens in hazard mitigation – before a disaster,

after a disaster, how soon after a disaster – and the influence of timing on the effectiveness or content of public input is a relevant one for Calgary. Through engagement and interaction with flood affected citizens since 2013, it has been apparent that because flooding is a truly traumatic and emotional issue, sensitivity and time (sometimes years) are required to move from reactive, emotional conversations (e.g., in early days when citizens need support and resources post-flood), to more rational, constructive dialogue about feasible mitigation options. There is some dilemma here in that while it is advantageous to make use of opportunities to move forward with mitigation while there is public and political will immediately after a flood, it is more difficult during that time to engage in rational, constructive processes to arrive at decisions that are technically sound and also incorporate citizens' perspectives.

In the end, over one thousand citizens were constructively engaged in the 2016 program. Full results of the engagement are available in the "What We Heard Report" to the City (City of Calgary, 2016). Major themes heard from the engagement include:

- Flood mitigation should be expedited;
- A combination of reservoirs and berms/barriers are preferred to provide sufficient flood protection;
- Structural measures need to be combined with non-structural measures in order to provide sufficient flood protection;
- Concern about the cost of flood mitigation, and that projects should be cost-beneficial;
- More public education on reducing flood risk is needed;
- The City has a responsibility to protect flood prone communities;
- Property owners have to accept the risk associated with living in a flood-affected areas;
- Financial incentives, compensation programs, and cost-sharing opportunities between government and private landowners to flood proof homes and other buildings should be considered.

The input gathered, such as that listed above, as well as input from the Community Advisory Group, was used to build the criteria for evaluating mitigation measures, and form The City's flood mitigation strategy. Based on what was heard during engagement, additional mitigation measure scenarios were assessed by the consultants, including scenarios with both upstream reservoirs and low-height flood barriers where required in low-lying communities. This, along with recommendations to further explore non-structural and policy flood risk reduction measures, is what was ultimately included in the strategy recommended to – and endorsed by – City Council in 2017.

5 Lessons Learned and Next Steps

Through the years since the flood, The City has learned many lessons about communicating flood risk and engaging citizens on flood risk mitigation:

- It is critical to take the time to create an engagement strategy to set a clear course for all

of the integrated engagement activities over the course of the project or program. This creates a predictable timeline for citizens to follow, and sets up clear expectations of the role of citizens.

- With any tactic or program, there will always be citizens not reached. Both repeated and new creative approaches must continue if the goal is to increase flood resiliency by educating as many citizens as possible and keeping the issue “alive”.
- Effective tactics can be time and budget intensive. While some tactics can be implemented quickly and on a small scale budget, dedicated resources are required in accordance with the priority the organization places on having flood-aware and engaged citizens.
- Need to build trust – for citizens to understand their risk and effectively engage in constructive dialogue, they need to trust that the government understands the risk, and is committed to working together to manage it. This may take time, repeated interactions, and “proof” of both competency and a willingness to listen and act.
- Need to educate – risk and flood mitigation are often new and complex topics for citizens. A certain level of technical education is required for some forms of engagement to be effective, and to create true resiliency. This, again, takes time and repeated interactions – especially to reach a significant proportion of people, although the same level of education is not required for all citizens, depending on in which capacity they are engaged, and their level of risk exposure.
- Effective communication and engagement creates allies and constructive relationships. Citizens who are informed and engaged can be instrumental in helping form and support strategy, designs and implementation plans, policy, and resiliency in their communities, whether or not there is agreement on all aspects.
- The Community Advisory Group is an effective and useful tool to build knowledge and understanding on both sides. It is a significant commitment from both the government and the citizen members, but created the space and time for an effective two-way flow of constructive information and perspectives.

As the flood strategy is implemented, The City's risk communication efforts and engagement on mitigation projects will continue. Support from citizens is required to motivate provincial action and funding, as well as build local barriers and implement policy that effectively manage and share flood risk. Input from citizens is required to make mitigation sustainable, acceptable, and well integrated into the fabric and lifestyle of the community. While The City is fortunate to have many informed and engaged citizens to work with, there are many who are still unaware of their flood risk, and new tactics are being continually sought.

Opportunities for continuous improvement and innovation in flood risk communication and engagement for Calgary may include: the possibility of a community flood committee or group, including representatives from all

flood-affected communities, with the intention to foster two-way dialogue and facilitate communication between The City and communities; continued website improvements and accessibility to relevant and easy to understand information; flood probability mapping; easily accessible map of the 2013 flood with reference to current flood mapping; and new ideas to generate interest in and accessibility to the annual Flood Readiness campaign.

The City is striving to align flood risk management with other hazards, and to consistently communicate and manage flood risk across departments – not an easy task in such a large organization with various disciplines. Internal risk communication and education is also required, to ensure the corporation has a unified understanding and perspective on flood risk management.

6 Conclusion

The City of Calgary has been “learning by doing” through communicating and engaging with citizens on flood risk and mitigation since the 2013 flood. Increasingly, more municipalities across Canada, as well as provincial and federal departments, conservation authorities, non-profits and other institutions, are communicating and engaging with citizens on these issues. By sharing best practices, innovations and lessons learned, we can become more effective at communicating flood and hazard risks with citizens. Building the flood-literacy of our citizens and stakeholders will build flood resiliency and enable us to create better strategies and plans to share and effectively manage flood risk.

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