2014 Annual Report

Flood Resiliency and Mitigation

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Message from director, Water resources

The 2013 floods reminded us that water is a powerful force as well as a precious resource for our community. With the 2013 flood still fresh in the minds of Calgarians, The City has placed an increased focus on flood resiliency. As we move from flood recovery to long term mitigation, we have a clear mandate through Council's Four-Year Plan for Calgary to build resiliency to flooding, and manage the interrelationships between flood protection, water quality and quantity, and land use.

Our corporate flood resiliency strategy allows us to continue to strengthen flood protection planning for Calgary. It will be linked to a comprehensive corporate resiliency plan that will provide overarching guidance to addressing hazards and vulnerabilities across the city. This strategy will only be achieved by a collaborative approach with many business units across the Corporation, other orders of government and community partners.

As the most densely populated watershed in Alberta, the Bow Watershed is home to over 1.4 million people in Calgary and surrounding communities. Sustainable watershed management balances land use planning with considerations for flooding, drought, water quality, and habitat protection in ways that support a healthy functioning watershed. Population growth, urban development, and a changing climate place combined pressures on our watershed. We understand that an integrated approach is crucial to building long-term resiliency to droughts and floods. This includes enhancing and protecting the riaparian areas that contribute to flood and drought resiliency within Calgary.

Integrated watershed management and building flood resiliency are a shared responsibility – with citizens, businesses, neighbouring communities, and other orders of government. Together we will protect the safety of our citizens and our critical services while advancing flood and drought resiliency in our communities.

Rob Spackman

Director, Water Resources

Message from program manager, flood resiliency and mitigation

The extreme flooding that Calgary experienced in 2013 showed how resilient we are as a community. Successful emergency response and recovery efforts demonstrated that public safety and critical services are essential for our community to continue building resiliency to be prepared for future floods. Our vision is that Calgary is a flood resilient city, and we are working to better understand and take action to mitigate flood risk. We've made great strides in recovery and resiliency, and the journey towards a more flood resilient Calgary continues.

The City of Calgary created an Expert Management Panel to steer The City's River Flood Mitigation Program in July 2013. The Expert Management Panel developed a report that included 27 recommendations for The City to initiate aimed at achieving a safer, more flood resilient city. We are building on these recommendations to guide a comprehensive implementation strategy and plan for flood mitigation and resiliency.

The City recognizes that we need to enhance our understanding of flood risk through improvements to forecasting, monitoring, and modelling. Understanding the vulnerabilities communities face also helps assess flood risk and how to manage that risk through infrastructure and policy investments. We are taking a comprehensive and collaborative approach to implementing the most effective combination of solutions to mitigate the impacts of flooding in our city. The Citizen Satisfaction Survey told us that 85 per cent of Calgarians believe protection from river flooding is important. Continued information flow and a two-way dialogue with citizens and partners is key throughout this process, as we are all responsible to be prepared for when flooding occurs.

This first annual report sets the stage for Calgary's Flood Resiliency Program and our accountability to Calgarians and Council. This report demonstrates progress in key performance areas, and how we are creating value for Calgarians as we work towards making Calgary a city of safe, flood-resilient communities. Future reports will include results-based performance measures to demonstrate The City's performance in contributing to making Calgary a more flood resilient city.

Carolyn Bowen,

Program Manager, Flood Resiliency and Mitigation

Working towards a flood resilient city

The City is committed to making Calgary a city of safe, flood resilient communities. A comprehensive approach starts with implementing the recommendations from the Expert Management Panel on River Flood Mitigation as part of a strategy that aligns with Council's Action Plan 2015 – 2018.

From flooding to recovery to resiliency

In 2013, Calgary experienced the largest flood since 1932, resulting in extensive mass evacuation, a downtown that was inaccessible for days, and extensive damage to public and private property. With damages and economic impacts estimated at $5 billion dollars, the southern Alberta flood was Canada's costliest disaster to date.

Recovery from the flood continues, with more than 200 flood-related infrastructure projects identified for repairs or restoration that will contribute to Calgary's flood resiliency. Extreme floods on the Bow and Elbow rivers are a hazard that has affected Calgary throughout its history, and will continue to pose a threat to our city. We cannot stop floods from occurring, but we can be prepared for when they do.

The City recognizes that flood resilience is not something that can be achieved overnight. It requires a sustainable watershed planning approach and commitment over the long term. A long-term approach allows us to adapt to a growing city and a dynamic watershed.

In June 2014, an external Expert Management Panel on River Flood Mitigation delivered 27 recommendations to Council aimed at achieving a safer, more flood resilient Calgary. Council approved the four-year implementation plan for the panel's recommendations in December 2014. A permanent team was established in Water Resources to oversee flood resiliency and mitigation that created a vision: ***Building a flood resilient Calgary*** with input from business units across the Corporation. The vision is supported by principles to guide our actions. A strategy to ensure a comprehensive and co-ordinated approach to flood resiliency planning is now underway through the collective efforts underway by many business units. This strategy will chart the way forward, building on resiliency activities already in progress, as well as the Expert Management Panel recommendations.

The Calgary Emergency Management Agency (CEMA) with the Recovery Operations Centre (ROC) have been leading a work plan to improve flood response and recovery, based on lessons learned from the 2013 flood. An internal debrief and third party review of both the flood response and recovery were undertaken to identify best practices and recommend actions during and following an emergency event. Emergency preparedness and recovery actions are critical elements of overall flood resiliency and complement the work described in this report.

Vision: Building a flood resilient Calgary

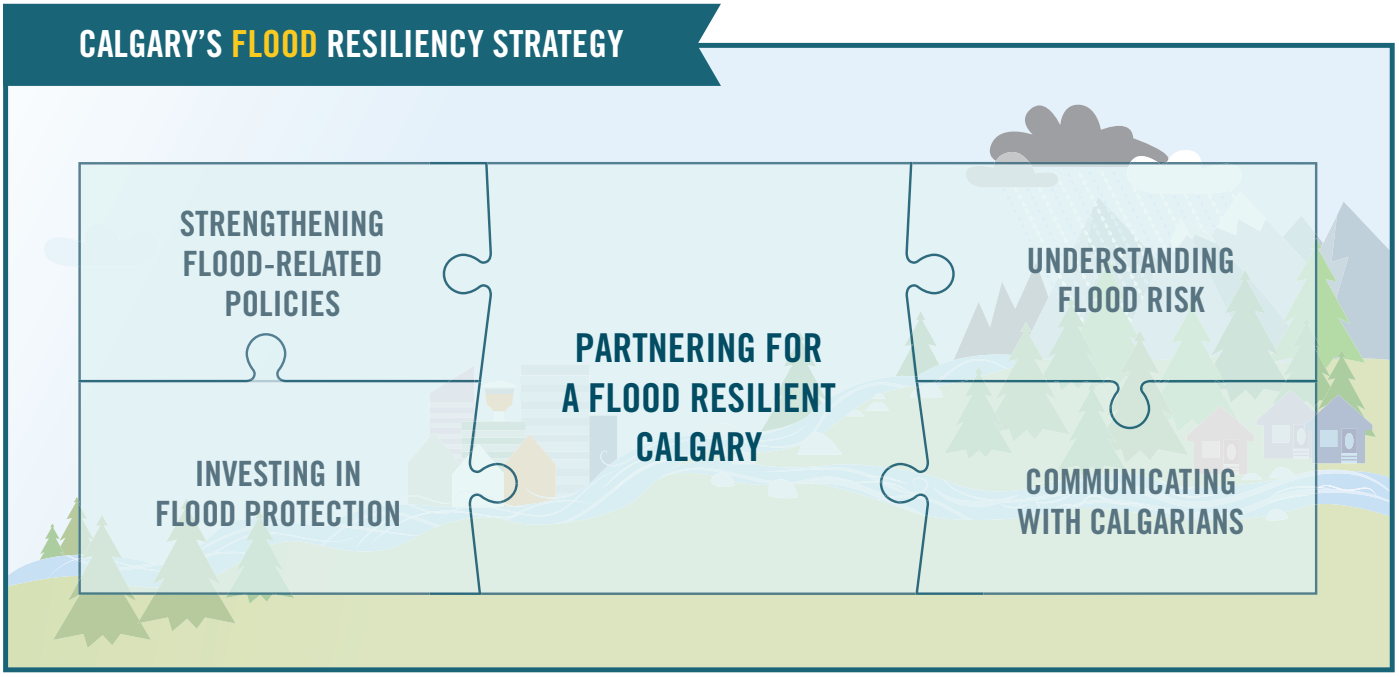
Principles

- Public safety and critical services are priorities in flood protection planning.
- Our communities are designed to be flood resilient.
- We maintain an open dialogue with citizens and businesses, and support them in being prepared and informed about flood risk.
- We take a social, economic, and environmental decision-making approach to investing in flood mitigation infrastructure.
- Sustainable watershed planning balances flood resiliency with considerations for drought and water supply and quality.
- We enhance and protect the riparian areas that contribute to flood resiliency within Calgary.
- Emergency response and recovery are elements for reducing impacts when flooding occur.

The flood resiliency strategy aligns with The City's Action Plan 2015 – 2018, with a focus on making Calgary a more flood-resilient city. Resiliency to flooding is considered part of The City's integrated approach to managing the relationships between flood protection, water supply and quality, watershed protection, and land use. It will be linked to a comprehensive corporate resiliency plan that will identify hazards and vulnerabilities across the city.

We cannot achieve flood resiliency alone. Cornerstones of this work include exploring flood mitigation options, improving mapping, forecasting and modelling, increasing citizen awareness and investing in flood protection. These can only succeed through strong partnerships and relationships with the community. Co-operation with partners including the Government of Alberta, TransAlta Utilities, citizens, businesses, watershed groups, and upstream and downstream communities, will be crucial to achieving a common vision for flood resiliency.

This inaugural report summarizes progress on the 27 recommendations of the Expert Management Panel and other corporate activities underway to improve Calgary's flood resiliency. As part of initiating the flood resiliency program, key indicators and performance measures will be developed in 2015 to help track how well our strategy is being implemented.



Expert Management Panel recommendations

By implementing the Expert Management Panel recommendations, we remain focused on building flood resiliency. To align with Calgary's Flood Resiliency Strategy, the recommendations have been refined into four key performance areas. Progress on many of the recommendations are dependent on the outcomes of others, which is reflected in this report. Below is a 2014 year end status update on The City's progress on implementing the Expert Management Panel recommendations.

UNDERSTANDING FLOOD RISK

EXPERT MANAGEMENT PANEL RECOMMENDATION	TIMELINE	STATUS	SEE PAGE(S)
Pursue a common river forecasting platform with Alberta Environment and Sustainable Resource Development (AESRD) and TransAlta for faster and more accurate information and alerts about future flood events.	2015-2016	Initiated	11
In partnership with AESRD and TransAlta, expand the network of river and weather monitoring stations upstream of Calgary and protect stations from damage during flooding.	2015-2016	Initiated	11
Publish up-to-date, graduated flood maps for public information.	2015	Underway	12
Urge the Province to regularly review and update official flood hazard maps.	2017	Initiated	12, 22
Maintain a comprehensive flood risk database integrated with existing geographic information systems.	2015-2018	Not started	11
Develop a suite of watershed-scale climate models to capture various weather event scenarios, with input from regional partners, post-secondary institutions and other levels of government.	2015-2018	Initiated	12
Collaborate with academic and other partners to develop computer models that identify groundwater movement in Calgary in relation to flood conditions.	2015-2018	Underway	12

COMMUNICATING WITH CALGARIANS

Expert Management Panel Recommendation	TIMELINE	STATUS	SEE PAGE(S)
Incorporate lessons learned from the 2013 flood to enhance communication channels to keep Calgarians informed of conditions that may lead to high river levels. Expand the flood risk communication strategy and provide information and tools that empower Calgarians to make informed choices and better manage their personal flood risk.	2015-2016	Underway	15-16
Strengthen partnerships with utility providers to improve resiliency of their infrastructure and operations, with first priority to energy supply and communication networks.	2015-2016	Underway	16
Develop programs that support building owners to implement flood resiliency measures.	2016	Underway	15
Host a national flood risk management workshop to share best practices and develop an ongoing networking group.	2015	Underway	16

INVESTING IN FLOOD PROTECTION

EXPERT MANAGEMENT PANEL RECOMMENDATION	TIMELINE	STATUS	SEE PAGE(S)
Connect with the provincial body overseeing flood protection and loss reduction and support the Province's continuing analysis of flood mitigation options and implementation of appropriate measures through the watersheds.	2015-2018+	Underway	18
In partnership with the Province, compare the three major capital works options for mitigating floods on the Elbow River: i. A diversion from the Elbow River to the Bow River, in accordance with the conclusions of the feasibility studies underway. ii. The Springbank off-stream diversion and storage site. iii. The McLean Creek dry dam.	2015-2016	Underway	18, 20
Increase the operating water storage capacity of the Glenmore Reservoir on the Elbow River through modifications to the Glenmore Dam.	2015-2017	Initiated	18
Continue to co-operate with TransAlta and the Province to increase flood storage on the Bow River through the operation of existing TransAlta facilities.	2015-2016	Underway	18
Construct additional or higher flood barriers in key locations throughout the city and update temporary flood barrier plans to protect against higher flood levels.	2015-2018+	Underway	18-20
Evaluate social, economic and environmental impacts of flood mitigation options.	2015-2017	Initiated	12, 20
Develop a comprehensive climate adaptation plan and implementation tools to reduce The City's infrastructure and operational vulnerabilities.	2015-2018	Underway	19
Create graduated flood protection level requirements for City infrastructure. Prepare a time-phased plan to modify structures that constrain river flow during flood events, such as pathways and bridges.	2015-2018 Consultation 2018+ Implementation	Not started	19

STRENGTHENING FLOOD-RELATED POLICIES

Expert Management Panel Recommendation	TIMELINE	STATUS	SEE PAGE(S)
Expand the review of the Land Use Bylaw and other development regulations to update flood resiliency requirements for private property in flood risk areas. Review The City's existing land-use planning documents and develop amendments, new guidelines or policies that will minimize development in the floodplain over time.	2015-2018	Initiated	22-23
Perform a social, economic and environmental analysis to evaluate the need for a minimum flood protection level above the 1:100 flood for land-use planning and structural protection across Calgary.	2015-2017	Initiated	20
In partnership with the Province, develop a time-phased plan to remove buildings from areas with high flood risk, while minimizing the disruption to affected communities.	2017-2018+	Not started	22

EXPERT MANAGEMENT PANEL RECOMMENDATION	TIMELINE	STATUS	SEE PAGE(S)
Establish a permanent team within The City to oversee flood preparedness and resilience.	2015-2016	Complete	6
Provide an annual update to City Council on progress related to the recommendations from the Expert Management Panel on River Flood Mitigation.	2015-2018+	Complete	1-23

Understanding flood risk

To protect people, property, critical services and our economy, The City is increasing its knowledge of flood mapping, forecasting and modelling, which will lead to better flood policy and infrastructure decisions.

About flood risk

There will always be a risk of river flooding, and The City uses a range of tools to prepare for and mitigate this risk – from river monitoring, forecasting models, updating flood maps to emergency response planning to building temporary and permanent flood barriers and developing policy tools. Flood risk is dynamic, and it evolves with changes to the rivers, our built environment and to the climate. Calgary's rivers were altered by the 2013 flood and will continue to change, and we are striving to improve our understanding of this dynamic risk. Addressing vulnerabilities through increased understanding of flood risk helps us to be better prepared to protect public safety and infrastructure when flooding happens.

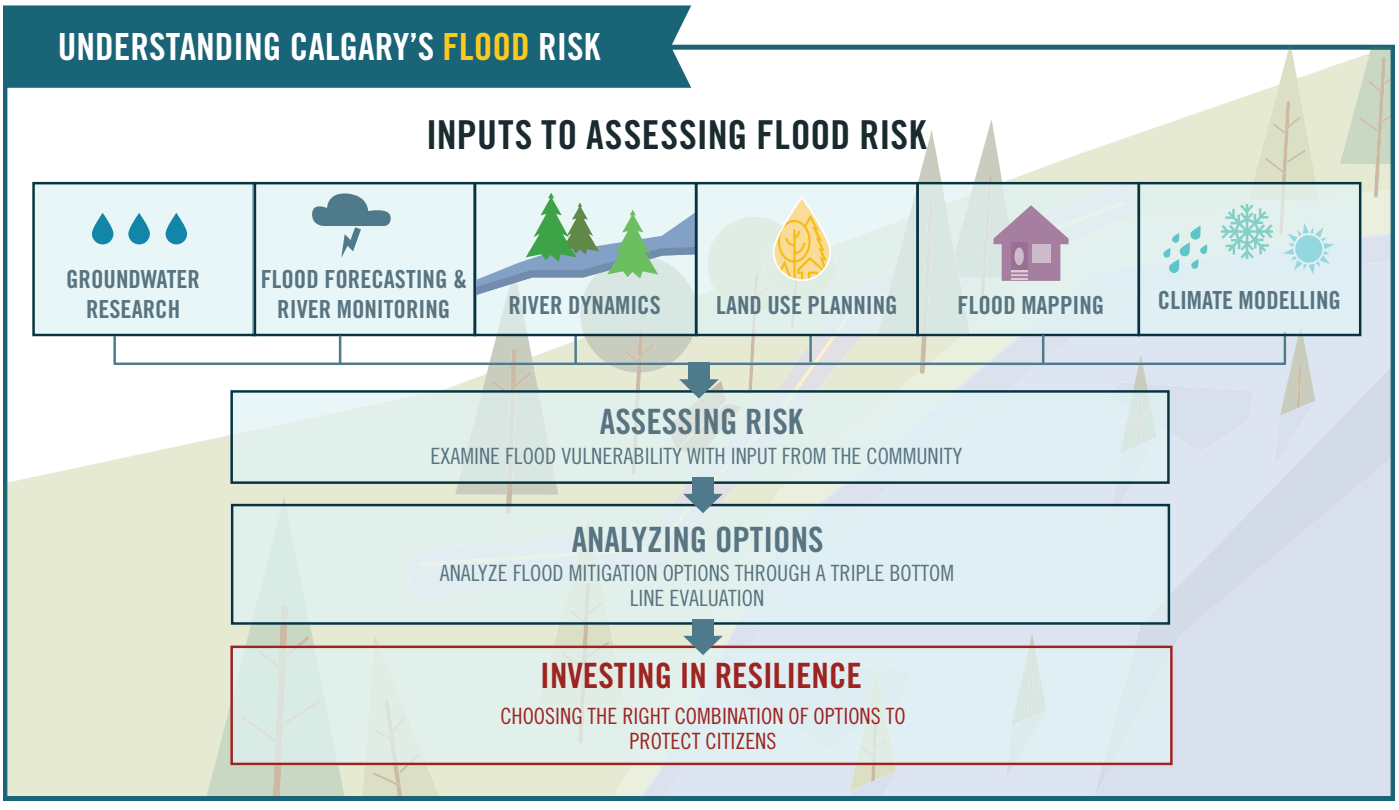
Assessing Calgary's flood risk is necessary to determine what size of floods to protect against and the most appropriate actions to reduce flood risk. Our assessment will look at the unique vulnerabilities and risks facing the many riverside communities in Calgary. This assessment is expected to be complete in Q2 2016, and inform a comprehensive analysis to identify the best mitigation solutions for each community. Data from the risk assessment will also be integrated into The City's flood risk database.

Improving forecasting and monitoring

Weather forecasting and river monitoring are important components of flood preparedness. Having the best tools to understand weather and river data can help forecast the severity of high river level conditions, so we can better respond to floods. These are especially important, given how rapidly weather in the mountains can change and Calgary's proximity to the mountains, which doesn't leave us much time to respond to impending floods.

River and weather monitoring information sharing is co-ordinated between The City, the Alberta River Forecast Centre and TransAlta Utilities. With these partners we are exploring one common forecasting platform that could distribute data more quickly and accurately. As a start, The City set up an improved data sharing arrangement with TransAlta Utilities in 2014.

In 2014, The City's river forecasting team took steps to improve its forecasting toolkit by streamlining weather and river inputs in the computer model we use to predict river conditions. The City repaired river monitoring stations located in Calgary, made them more resilient to future flooding, and installed new river monitoring cameras on the Elbow River in Mission and on the Bow River at Poppy Plaza. We've also made an agreement with a number of private companies that can be activated to assist The City with monitoring during a high water event.



Examining a dynamic watershed

The City is conducting a river morphology and fish habitat study to examine how the Bow and Elbow rivers have changed since the 2013 flood. The study will help to:

1. Determine how gravel deposition from the 2013 flood may affect future flood levels.
2. Determine where future erosion is likely to occur and could put infrastructure at risk.
3. Support the design of fish habitat projects.

A preliminary site visit in the fall of 2014 identified initial areas of concern. An analysis using air photos from various years between 1924 and 2014 is underway and will inform how the river has changed over time. The study is being supported by a partnership with the University of Calgary in which detailed modeling will assess different pre- and post-flood scenarios. Answers to the three main project goals are expected to be provided by the end of 2015.

Groundwater flooding plays a role during any flood event, and The City is working to better understand the influence of groundwater on river floods. As part of the Flood Protection Conceptual Design study, we are reviewing groundwater flooding at specific locations along the Bow and Elbow rivers where permanent flood barriers are being analyzed. Implications to groundwater flow with a flood barrier in place are being considered, as well as options to mitigate the flow. The City has also supported three University of Calgary student research projects over the past year to expand our understanding of groundwater flooding extents and mechanisms through Calgary.

Updating flood mapping

While The City uses the official Flood Hazard Area maps prepared by the Government of Alberta to regulate land use, The City provides publicly available flood inundation maps that are regularly updated for citizens, developers, civic partners, consultants and other businesses to understand flood risk. Inundation maps show the areas of surface flooding for various flood scenarios in Calgary. Organizations like the Calgary Zoo, Calgary Stampede, and ENMAX use The City's flood inundation maps for their planning purposes. The maps are also crucial for development approvals and The City's flood response and resiliency planning. We are continually improving our flood mapping and, in 2014, we partnered with the Province of Alberta to evaluate data from the 2013 flood that was then used to update the flood inundation maps. We revised The City's flood response plan based on these new maps.

Creating new climate models

The City is undertaking research on the potential impacts of future climate changes on the Bow Watershed to better understand vulnerabilities in the region. Current planning and operational activities focus on long-term, average trends to anticipate future climate impacts; however, climate models for western Canada predict an increase in the frequency and intensity of precipitation events and drought events. This project will enable The City and regional partners to better understand how the watershed will be affected by extreme events in the future.

This information can inform flood risk assessments, flood hazard maps, structural and land-use design standards, as well as contribute to flood and drought mitigation measures. Scenarios may also contribute to The City's climate adaptation planning for infrastructure, operations and emergency management. In 2015, The City will explore partnerships with other levels of government, academics, and other technical experts to develop a model that can forecast extreme events. We anticipate the creation of the model will be a multi-year project.

Assessing risk and mitigation options

Determining the best combination of structural and policy solutions to better protect our city from future river floods requires a thorough assessment of the options as part of a comprehensive and integrated water management approach. Mitigation options that involve significant investments, such as upstream dams and permanent barriers, need to be considered alongside options like changing land use policies in flood prone areas and other innovative design ideas.

In 2014, The City started planning a project to perform a social, economic, and environmental triple bottom line analysis to determine the most effective combination of flood mitigation investments and actions. This will be achieved through the use of external consultants and in-house expertise.

Community feedback on how to best address flood mitigation will be an important part of the process. Engagement will explore flood vulnerability of flood affected communities and citizen values related to flood risk. Feedback will be gathered on a community-by-community basis on proposed mitigation measures. This input will contribute to The City's decision-making and implementation processes.

In summary

In 2014, The City:

- Improved weather monitoring data exchange with TransAlta Utilities.
- Improved forecasting by streamlining the use of our computer models.
- Repaired and strengthened river monitoring stations and installed two new monitoring cameras.
- Entered an agreement with private companies to assist with monitoring as needed.
- Initiated studies on groundwater and how the river has changed since the 2013 flood.
- Updated flood inundation maps in partnership with the Province, using data from the 2013 flood and used these maps to revise our flood response plans.
- Scoped a climate modelling project for the region to better understand flooding.
- Started planning community engagement on flood risk and vulnerabilities.

Looking ahead

In 2015, The City will focus on:

- Completing a community-by-community flood vulnerability assessment and looking at social, environmental and economic impacts of flood mitigation options. Community engagement will be included in this process. Once complete, these assessments will be used to determine the best combination of solutions for investing in flood mitigation.
- Partnering with the Province and TransAlta Utilities to explore the feasibility of a common forecasting platform to streamline sharing of forecasting information.
- Continuing to pursue a partnership with the Province and TransAlta Utilities to install new monitoring stations throughout the watershed – four stations on the Elbow River and four on the Bow River upstream of Calgary.
- Undertaking a multi-year project on creating a climate model for the Calgary region.
- Publishing current flood inundation maps on CITYonline, updated since the 2013 flood.
- Making progress on the comprehensive river morphology and fish habitat study, to be complete by the end of 2015.
- Refining The City's Flood Emergency Response Management Manual with updated mapping and modeling information.

Communicating with Calgarians

To build civic resiliency The City is expanding the way it shares information and communicates with citizens. Improved citizen focused programs will help Calgarians understand their personal, business and community flood preparedness needs.

Focusing on Calgarians

Our work to improve and expand The City's flood communications with citizens began in July 2013. The City began receiving requests from river communities to attend meetings to answer questions and review plans. The City worked to build relationships with these communities to ensure citizens received the information they needed.

To prepare for the 2014 flood season, a thorough debrief of communication materials was completed and lessons learned were incorporated. The City approached the 2014 flood season with a view to ensuring that the public was informed, engaged and understood their flood risk. A flood information and awareness strategy was delivered in 2014.

Open houses, an enhanced web presence, information videos and updates, and a co-ordinated 311 Service Request response were undertaken to communicate with Calgarians. The City's flood website (calgary.ca/floodinfo) included information about flood recovery, preparation and commemoration of the 2013 flood, as well as a variety of tools and resource links. The site is updated frequently to provide current and relevant information to meet Calgarians' direct needs. Examples of the type of information included on the site are:

- Details on The City's recovery efforts and progress.
- Permit and development information specific to the needs of flood affected Calgarians.
- Grants and tax relief programs available to flood affected Calgarians.
- Frequently asked questions about hiring contractors.
- Land Use Bylaw changes to flood areas.
- Support of post flood property assessment and recovery.
- Insurance.
- Community, health and social services available.
- How-to materials.
- Government of Alberta programs.

Citizen engagement and safety continued to be a priority, and a broad scope of engagement occurred post-flood. City staff reached out to the community through direct individual service and door knocking (1,300 doors) to provide development permit and inspection information. They also attended public open houses and presentations (6,000 attendees) related to flood recovery and preparedness, answered over 9,000 property specific 311 calls and emails directly, and met with many citizens for one-on-one meetings.

Engagement at the community level focused on encouraging planning for business continuity and emergency preparedness. A Community Resiliency Table (later renamed to the Emergency Preparedness Initiative of Calgary) was convened between The City, the United Way of Calgary & Area and several community-based agencies to build a plan for response to emergencies, disasters and major interruptions. The focus of this group is to improve preparedness, co-ordination and communication among neighbourhoods, non-profits and governments. Ongoing support for organizations working with vulnerable populations will ensure they are supported during and after an emergency.

The Canadian Water and Wastewater Association recognized our communications following the 2013 flood and during the 2014 flood season by awarding The City the 2014 Community Outreach Award for Large Utilities.

Programs to support building owners from recovery to resiliency

To assist home and business owners recovering from the flood, The City streamlined its permit and inspection process for residents and businesses to align with the Provincial Disaster Recovery Program funding. Building permits for flood-affected properties continue to have priority for permit and inspection processes.

In May 2014, The City and Red Cross partnered to offer the Flood Permit Grant Program to help Calgarians in need rebuild and repair their homes after the flood. The initiative covers the costs of new city permits for such things as building, electrical and plumbing work when repairing or rebuilding properties damaged by the 2013 flood.

A recent study by Calgary Chamber of Commerce found that 81 per cent of Calgary businesses surveyed have taken steps since the 2013 flood to be better prepared for future disasters. The Chamber report recommended that both local and provincial governments should increase efforts to build mitigation capacity and preparedness within the community. Businesses surveyed felt that this is how the government can best help them in the event of another disaster.

In 2014, the Calgary Chamber and Calgary Emergency Management Agency (CEMA) co-produced a handbook outlining how businesses can prepare for, respond to, and recover from natural disasters. The need to increase support to businesses is highlighted in Council's key focus areas for 2015-2018 to support enhancements to community preparedness, self-activation and building resiliency, and pursue recovery and resiliency funding for impacted citizens, property owners and partners.

PERCENTAGE OF BUSINESSES IMPACTED BY 2013 FLOOD

SOURCE: Flood Resiliency: Insights from a survey of the Calgary Business Community. Calgary Chamber.

Strengthening partnerships with utility providers

CEMA continues to work with utility providers to encourage them to invest in the resiliency of their infrastructure, operations and emergency planning. In 2014, the integration of critical utility infrastructure into emergency management planning was improved. ENMAX, ATCO, TELUS and City of Calgary Water Services participated in a flood exercise, several lunch and learns, and other training activities that were held with CEMA members throughout the year. As well, two Emergency Operations Centre activations took place that required utility providers to be heavily engaged, which put into practice emergency response planning and training.

In summary

In 2014, The City:

- Incorporated lessons learned from 2013 into a flood information and awareness strategy.
- Attended open houses and gave presentations on flood recovery and preparedness to approximately 6,000 citizens.
- Answered over 9,000 311 calls and emails directly.
- Participated in the Emergency Preparedness Initiative of Calgary to improve preparedness and communication between neighbourhoods, non-profits and governments.
- Streamlined the permit and inspection process for flood-affected properties and offered a program to cover the permit costs for flood-related repair work.
- Continued to work closely with utility partners on emergency planning and flood resiliency.

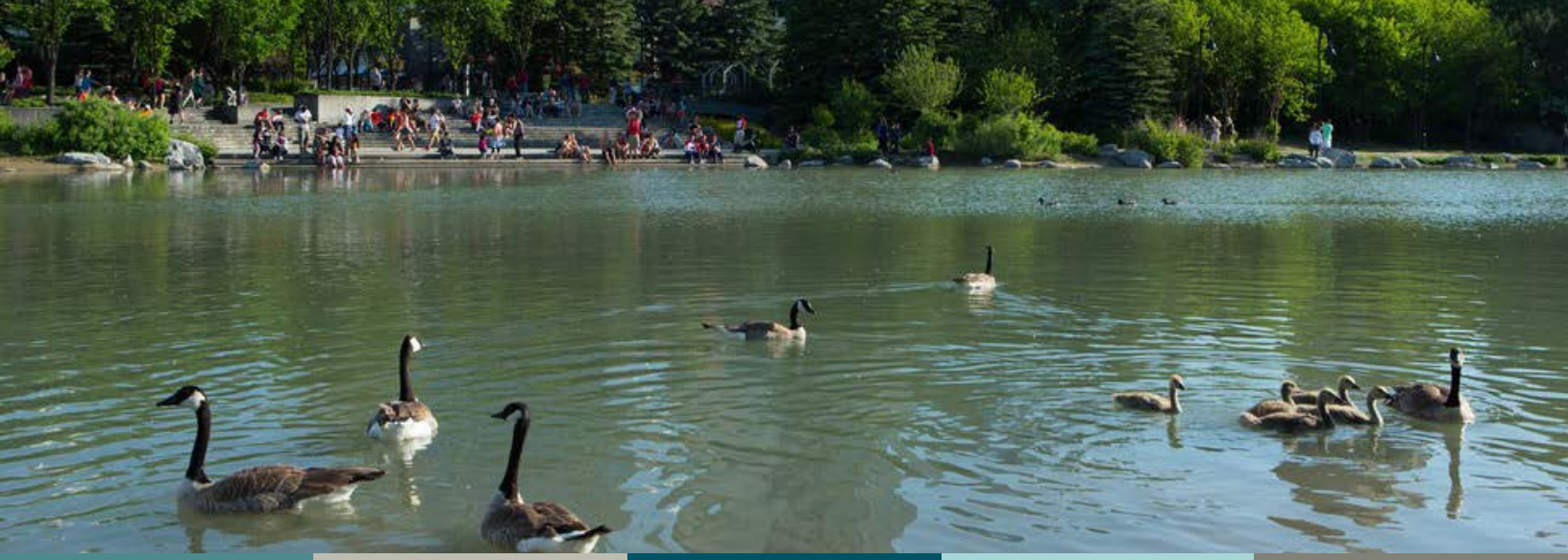
Looking ahead

In 2015, The City will focus on:

- Ongoing flood recovery for citizens, their property and The City through coordinated recovery operations.
- Supporting Calgarians in their personal flood preparedness through a comprehensive communication plan.
- Undertaking a community-by-community engagement process with flood affected areas to help us understand specific flood vulnerabilities. This process will inform the flood risk assessment and be used to inform the prioritization of mitigation activities.
- CEMA will continue to work with community partners to roll out READYCalgary emergency preparedness, as well as utility companies and the business community to improve communications and increase resiliency to disasters.
- Extending The City of Calgary and Canadian Red Cross permit grant program to help residential property owners pay for City permits to make repairs to flood-damaged properties.

Flood resilient communities across Canada

The City of Calgary is hosting the 2015 Livable Cities Forum on the theme of Building Flood Resilient Communities September 28-30, 2015. This national event is a chance for leaders, policy makers and experts to explore how we can build communities that are more resilient to floods. The City of Calgary is partnering on this event with ICLEI-Canada and the Canadian Water Resources Association.



Investing in flood protection

Developing a comprehensive suite of flood mitigation measures is an investment in the safety of our citizens and community resiliency. Structural flood protection options need to be carefully assessed using a triple bottom line approach and input from public engagement.

Flood storage and barriers

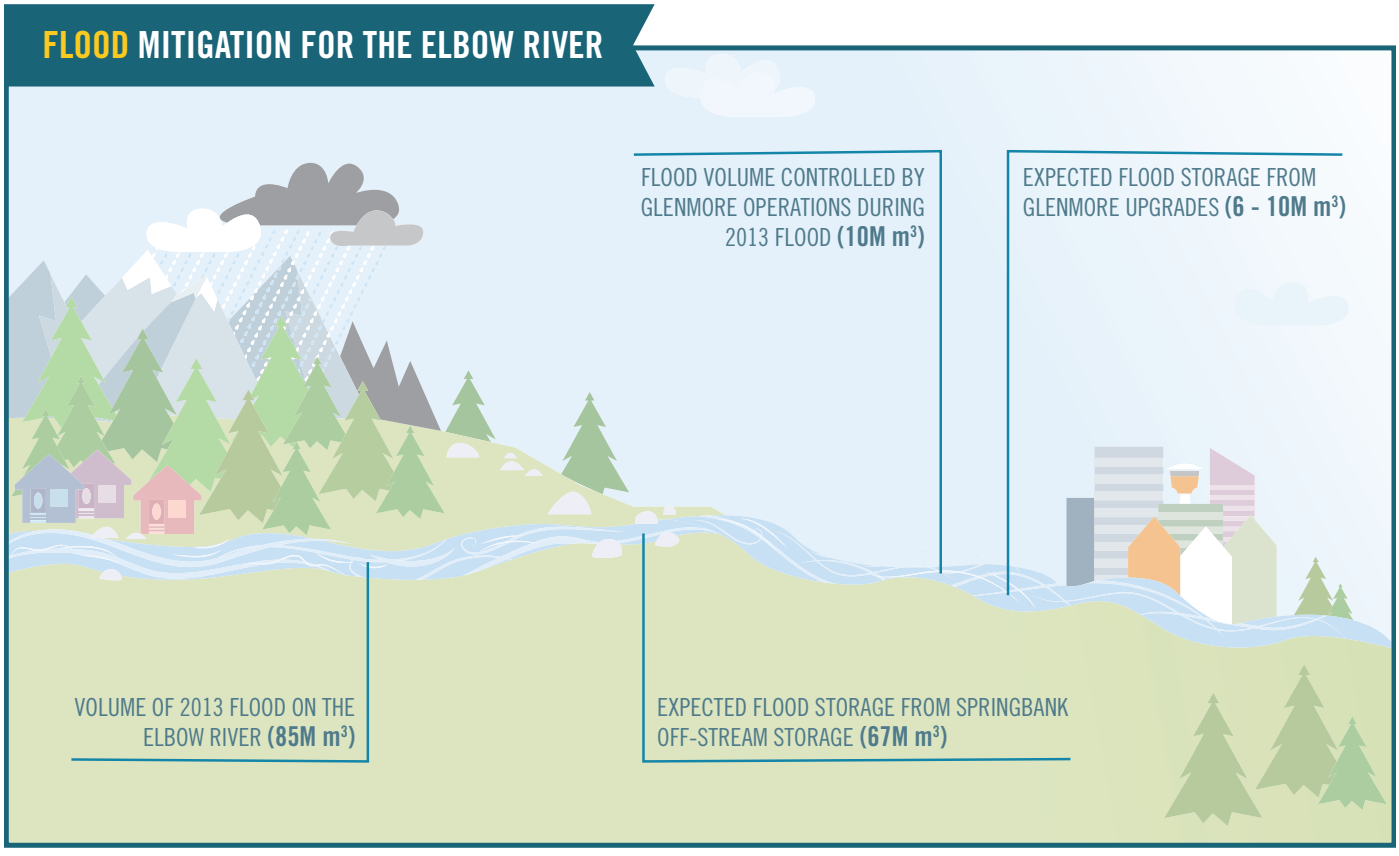
Options for additional flood protection are being explored by both the Government of Alberta and The City. On September 26, 2014, the Government of Alberta announced their decision to proceed with the Springbank Off-Stream Reservoir upstream of Calgary on the Elbow River. The Government of Alberta is aiming to have the design completed by the end of 2015 and construction complete by 2018. The feasibility report on the Glenmore Reservoir Diversion Tunnel, carried out by The City, was completed in July 2014, and an environmental review for the McLean Creek dry dam was initiated by the Government of Alberta in 2014. Provincial decisions on these two upstream flood mitigation options on the Elbow River are expected in 2015.

Also regarding the Elbow River, The City received $7.6 million provincial funding to increase the capacity of the Glenmore Reservoir for flood control and water supply as part of a project to retrofit and perform necessary life-cycle maintenance on the Glenmore Dam. This project is currently in the design phase. A study completed in 2014 on dredging the Glenmore Reservoir concluded that it would provide negligible benefit for flood mitigation at a significant cost.

Given the current flood protection within the city, at least 85 million m^3 of storage would be needed to significantly reduce damage along the Elbow during a flood equivalent to a 2013 event. Ideally, additional storage would be provided to account for:

- Potentially larger floods.
- Uncertainty in forecasting.
- Back-to-back flood events.
- Stormwater runoff downstream of Springbank and Glenmore.

Regarding the Bow River, the Government of Alberta announced that they will negotiate a long-term agreement with TransAlta Utilities to ensure that Ghost Reservoir is operated to accommodate flood waters. Details on this agreement are anticipated in 2015. While this will provide some flood protection, more is needed for the Bow River. The City is currently performing a study to identify locations where permanent barriers would provide cost-effective additional flood protection along both the Bow and Elbow rivers. The results of this study are expected in the fall of 2015.



Infrastructure resilience

Vulnerability assessments are underway to determine what City assets may be vulnerable to anticipated climate change impacts, including identifying opportunities to protect critical water and other infrastructure from the increased frequency and intensity of weather events. Best management practices for developing municipal climate change adaptation plans are being explored.

The City has taken the opportunity to incorporate additional resiliency into a number of flood recovery projects, for example:

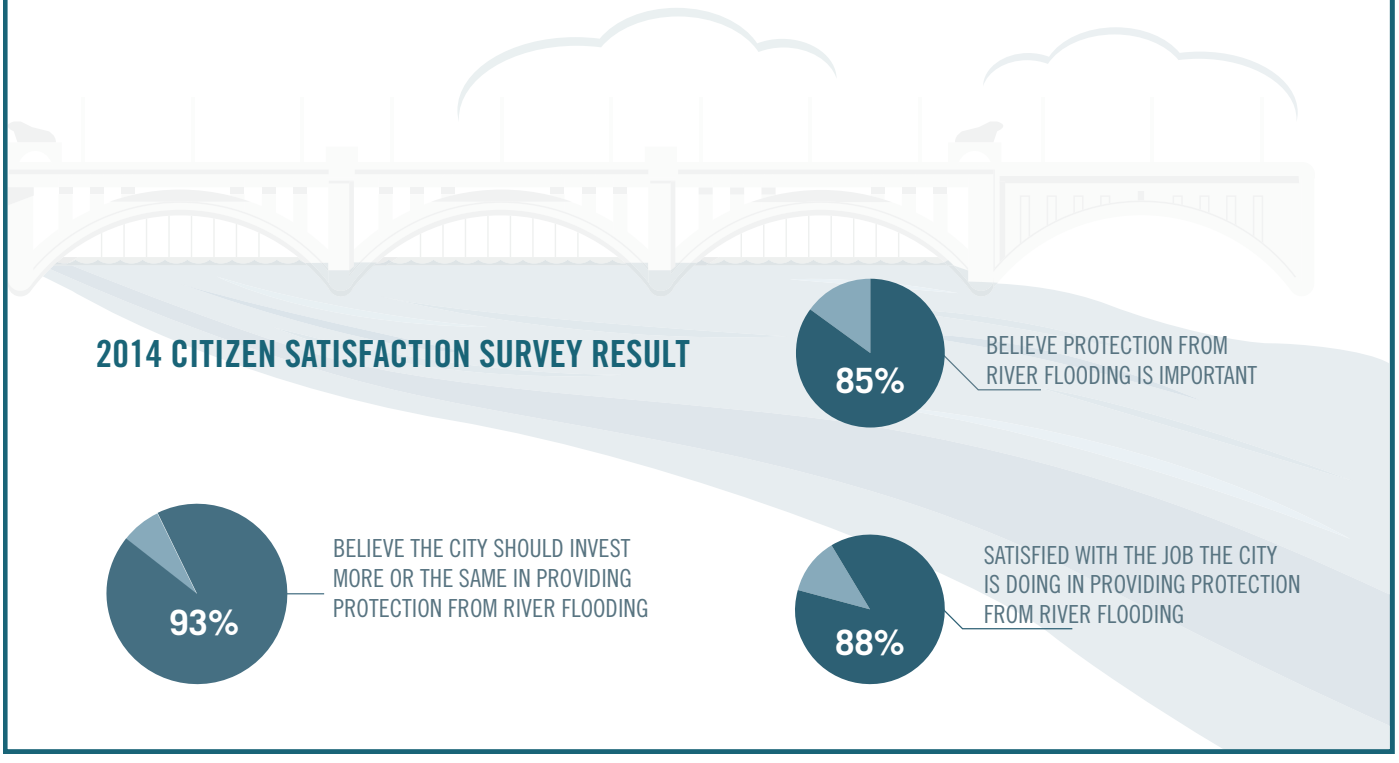
- Elbow River pedestrian bridges damaged in 2013 have been rebuilt to withstand larger floods
- Riverbank erosion sites repaired in 2013 and 2014 were reinforced to be more flood resistant.
- Two major lift-stations are being rebuilt to ensure faster recovery after a flood.
- Permanent flood barriers adjacent to restoration sites on the Bow were built or raised in key locations along Memorial Drive and in Inglewood.

The risk assessment described on page 11 will provide a basis for creating graduated protection level requirements for City infrastructure and modifying additional structures that may constrain river flow during floods. Consultation will begin on these in parallel with the risk assessment, with plans to start implementation in 2018.

Damage as a result of flooding of the Municipal Complex in 2013 was over $28 million, with an additional lost employee productivity cost of approximately $15 million. Almost 95 per cent of the damage sustained was due to underground flooding. In 2014 The City initiated a Calgary Municipal Complex Site Drainage Program to protect the complex and allow for quick recovery from future flood events. Work is underway and the majority of the improvements will be completed in 2015. This program will minimize damage as well as interruptions to critical service delivery and municipal governance during and after floods.

The Bonnybrook Wastewater Treatment Plant sustained $12 million in damages during the 2013 flood and lost treatment capabilities for 10 days. As a result treated wastewater wasn't meeting the regulatory requirements during that time. In 2014, The City developed a flood protection plan for Bonnybrook. A flood resiliency project for Bonnybrook will include the construction of a permanent flood barrier and relocation of the plant outfall to prevent backflow into the plant during a flood event. Design of the flood protection measures is currently underway, and the timing of the project will depend on when funding is available.

HOW CALGARIANS FEEL ABOUT FLOOD PROTECTION



Considering social, environmental and economic impacts in decisions

Infrastructure on both the Bow and Elbow rivers provides Calgary with some flood protection. The existing dams and permanent barriers were critical in allowing time for evacuations and reducing damage from the 2013 flood. Despite these safeguards, widespread damage affected infrastructure and private property, which traumatized residents, caused disruption to critical services, including electricity, gas, sewage and transportation, and resulted in the costliest disaster in Calgary's history. Experience from 2013 and ongoing studies indicate that additional protection is warranted to further protect Calgary from floods.

To inform decisions on flood protection investments, The City will undertake a risk and a social, environmental, and economic triple bottom line assessment of mitigation options. This assessment will also inform the need for increased flood protection levels for land-use planning and structural protection decisions. This work will include community engagement and will build on a project the Province has undertaken to assess the flood damage risk in Calgary.

The Province is currently updating flood damage risk assessments province-wide, with Calgary being one of the first communities to have an assessment completed. The study estimated flood damages for a range of flood events, so that average annual damages can be estimated and used to compare and assess flood mitigation options. In 2015, The City will refine the Provincial assessment with additional data so it can be used to evaluate The City's own flood mitigation options.

Financing investments

The City requested more than $41 million in project support for 14 projects in the 2014 submission to the Alberta Community Resilience Program (ACRP). Of the projects submitted, The City received a total of $14.89 million for:

- Glenmore Dam infrastructure improvements: $7.6 million
- Stormwater outfall improvements: $1.8 million
- Centre St. Bridge lower deck flood barrier improvements: $1.53 million
- Heritage Drive permanent flood barrier: $3.96 million

ACRP is a ten-year program, and The City will submit additional projects to the next rounds of funding.

In summary

In 2014, The City:

- Completed feasibility studies on the Glenmore Reservoir Diversion Tunnel and dredging of the Glenmore Reservoir.
- Initiated a conceptual study of the Bow and Elbow Rivers to identify potential spill points (where the river goes over the banks) throughout the city and to identify the feasibility of preventing them with permanent barriers.
- Rebuilt damaged bridges and riverbanks to be more resilient to future floods.
- Applied for provincial funding for over $41 million in investments in flood resiliency projects. Received $14.89 million for four of the projects submitted.
- Received $52 million for flood recovery erosion control from the Province.

Looking ahead

In 2015, The City will focus on:

- Engaging with the Government of Alberta on the design of the Springbank Off-Stream Reservoir and operational plans for the facility.
- Undertaking a triple bottom line comparison of mitigation options, including upstream options, permanent barriers and land use policy.
- Collaborating with the Government of Alberta to identify whether the Glenmore Reservoir diversion tunnel and McLean Creek dry dam will proceed.
- Providing input into operational procedures on TransAlta's infrastructure network in the Bow watershed.
- Identifying priorities and funding for new permanent flood barriers, and purchasing new temporary barrier materials.
- Preparing funding requests for the 2015 ACRP submission.
- Developing a climate change adaptation strategy to identify actions that will minimize or avoid damage to corporate assets from anticipated climate change impacts.

Strengthening flood-related policies

Ensuring that Calgary is growing into a more flood-resilient city requires examining policies for land use and infrastructure design alongside structural protection investments. The City will continue to review and refine key land use and design policies to ensure that flood prone areas of Calgary becomes more resilient.

Thoughtful community planning

A significant portion of Calgary is prone to flooding, including the downtown core and numerous residential areas, and our rapidly growing city continues to densify these areas. Land use in flood prone areas within the city has a direct effect on the amount of damage that may be sustained in floods, and the impact that floods have on people and communities as a whole. While The City will explore all reasonable options for protecting developed areas, there is a limit to the amount of flood protection that can be provided. There may be some locations where flood barriers are not feasible, and even areas that are protected by flood barriers or upstream civil works are at risk of being flooded if these structural measures are overwhelmed.

The Government of Alberta has indicated that the mapping of the Flood Hazard Area (FHA) will be reviewed and updated, with municipal consultation, in 2015. The standard for provincial maps is currently the 100-year flood; however, the Government of Alberta could revisit this as the federal government is currently exploring the possibility of a 350-year-flood national flood design standard. New flood hazard maps may increase the areas, infrastructure, and private property officially designated as being at risk of flooding. This could mean that areas currently developed and identified as higher risk through changes to mapping would have officially recognized flood risk in the future.

Areas could include significant parts of downtown and densely populated residential communities. Should this change occur, there would likely be insurance and liability implications for The City and for Calgarians. Land use policies are necessary for addressing the remaining risk after structural measures are in place and for ensuring that future development does not put Calgary and Calgarians at greater risk from future floods. In the future, this may mean working with the Province to examine the potential for removing additional buildings from areas with high flood risk.

As shown in the figure below, buildings were damaged both inside and outside the mapped Flood Hazard Area. This is explained in part because the provincial flood hazard maps have not been updated with the most recent inundation mapping available and also because groundwater damage of buildings can occur beyond the areas where there is overland flooding. This illustrates that flood risk doesn't stop at the boundary of the flood fringe and underscores the need for updated mapping and a review of land use policies to manage flood risk to properties in Calgary.

BUILDINGS DAMAGED DURING THE 2013 FLOOD IN CALGARY

TYPES OF BUILDINGS DAMAGED

1,632 HOUSES & DUPLEXES (61%)

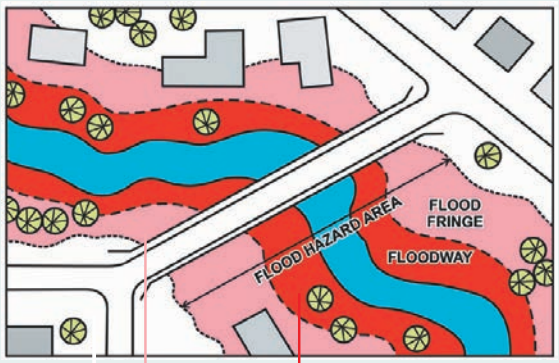
17,938 UNITS

469 CONDOS AND MULTI-FAMILY BUILDINGS **(18%)**

7,572 UNITS

575 COMMERCIAL & INDUSTRIAL BUILDINGS **(21%)**

BUILDINGS DAMAGED IN FLOOD HAZARD AREA



81 IN FLOODWAY **(3%)**

2061 IN FLOOD FRINGE + OVERLAND FLOW (77%)

534 NOT IN FLOOD HAZARD AREA **(20%)**

The City of Calgary currently regulates development in the Flood Hazard Area, which is mapped to a 100-year flood event. Focused amendments to Calgary's Land Use Bylaw and Municipal Development Plan were adopted by Council on June 9, 2014, as an initial step to increasing the resiliency of buildings in Calgary. Due to the varying levels of risk for the different zones within the Flood Hazard Area (floodway, flood fringe and overland flow), The City is taking a graduated approach to risk mitigation.

The Municipal Development Plan outlines The City's top priorities in the approach to reducing impacts from flood events as follows (Part 4 Section 4.4):

- Increase public safety through appropriate land use and development regulations in the Flood Hazard Area.
- Minimize property damage by requiring all development and redevelopment in the Flood Hazard Area to be designed to mitigate the potential impact or obstruction of floodwaters.
- Enhance Calgary's flood resiliency by employing a comprehensive approach to flood risk reduction measures.
- Align The City's policies and regulations to meet at least the minimum standards set by the Government of Alberta.

The Land Use Bylaw changes:

- Require that development in flood fringe and overland flow areas follow the same rules, regardless of parcel history (no "grandfathering").
- Make floodway redevelopment discretionary.
- Employ a "sliding-scale" approach to requiring mitigation measures. Small home alterations trigger minimal mitigation measures and large alterations trigger more robust mitigation measures.

The Riparian Program Implementation Plan for 2015 – 2026 was drafted in 2014 and outlines actions for protecting and restoring riparian areas, which overlap closely with flood prone areas in Calgary. The implementation of the Riparian Program will be co-ordinated closely with the second phase of reviews to land use policies related to flood resiliency.

In summary

In 2014, The City:

- Amended the Municipal Development Plan to highlight priorities for reducing impacts from floods.
- Amended the Land Use Bylaw to require flood mitigation measures for all buildings, regardless of history, in the flood fringe and overland flow areas when significant alterations are made to the property.
- Drafted the Riparian Program Implementation Plan for 2015 – 2026, outlining actions to protect and restore riparian areas.

Looking ahead

In 2015, The City will focus on:

- Engaging with the Government of Alberta concerning their flood hazard mapping updates floodway policy review, and Special Policy Areas.
- Reviewing and including flood resilience planning in key City policy and planning documents, and determining if new policies are required to ensure long-term management of the floodplain. This will include investigating the potential for expanding land use regulation for flood resiliency beyond the Flood Hazard Area.

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