Environment and Sustainable Resource Development—Flood Mitigation Systems

SUMMARY

Flooding is one of the most costly and destructive natural disasters in Canada. Every year, governments typically spend millions of dollars cleaning up after floods and providing disaster assistance to municipalities, businesses and people who suffered losses. Flooding is also a significant risk to public safety.

Effective flood mitigation can reduce the damage caused by floods. Flood mitigation is the process of planning and acting to reduce and avoid the effects of flooding and minimize the damages it causes. In Alberta, the Department of Environment and Sustainable Resource Development is responsible for flood mitigation.

The Government of Alberta recently developed two documents on flood mitigation:

- *Resilience and Mitigation Framework for Alberta Floods* (December 2013)—to plan, coordinate, assess and implement flood mitigation in Alberta's watersheds
- *Respecting Our Rivers: Alberta's Approach to Flood Mitigation* (April 2014)—to outline the government's mitigation actions to provide resilience against future floods and to bring together projects at the regional and local levels

The Government of Alberta has approved $1.4 billion in funding for structural and non-structural projects to reduce the risk of floods in Alberta.

Context of our audit

When we started the audit, the Government of Alberta was already providing recovery support to communities affected by June 2013 flooding in southern Alberta. Since then, the government has developed a plan for dealing with future floods. Its flood mitigation initiatives are now at various stages of completion. Our audit focused on the department's flood mitigation planning, which should include systems to identify where flood risk exists, who is at risk and what is at risk. We did our audit at this time so that we could provide the department with timely recommendations to improve its flood mitigation systems.

What we examined

We assessed whether the department has adequate systems to develop and implement a flood mitigation plan.[1] We examined the department's plan as well as its flood risk identification and assessment systems, which are foundational pieces to any flood mitigation plan.

Overall conclusion

The department has taken significant actions since the June 2013 floods to develop and implement a flood mitigation plan. However, the department needs to further improve its systems to identify where

[1] In this report, "flood mitigation plan" refers to both documents: Resilience and Mitigation Framework for Alberta Floods and Respecting Our Rivers: Alberta's Approach to Flood Mitigation.

the risk is, who is at risk and what is at risk. These system improvements will allow the department to better assess, plan for and mitigate flood risks.

What we found

The Department of Environment and Sustainable Resource Development has not:

- created complete and up-to-date maps to identify flood hazard areas—Some communities at risk of flooding have never been mapped. Others have maps over 20 years old. Not having complete and up-to-date maps limits the department's ability to manage flood risks.
- developed processes to identify and quantify flood risks—Risk assessment is a function of knowing where the flood hazard is and estimating its consequences. The department has not captured information about the consequences of past floods, such as lives lost, injuries, property damage and business interruption. Good risk assessment processes inform decision makers and stakeholders, and can be used to select the best flood mitigation options from a number of alternatives.
- developed adequate systems to assess what will be the cumulative effect of flood mitigation programs and initiatives on communities—Because it offers various flood mitigation programs, the department should have processes to assess what will be the cumulative effect of flood mitigation actions before approving new projects.

Alberta has not had a consistent approach to managing development in flood hazard areas. Municipalities have not been required to deal with flood hazards in their land use by-law. This has resulted in inconsistent land use by-laws across the province because some municipalities restricted development in the floodway and others did not. In 2013 the *Municipal Government Act* was changed to allow the Government of Alberta to create regulations that would control, regulate or prohibit development of land in a floodway. The Department of Municipal Affairs is currently developing the *Floodway Development Regulation*. The regulation is intended to bring a more consistent approach to land use in flood hazard areas across the province. Floodways are identified by ESRD on flood hazard maps prepared as part of its flood hazard identification program.

Why this is important to Albertans

Effective flood mitigation improves public safety and reduces the effects and costs of flooding in Alberta.

What needs to be done

Experience from disasters around the world shows a window of 18 to 24 months after a major event when there is strong public and political support to spend money on measures to improve public safety. Since the 2013 flood, the department has developed a flood mitigation plan and allocated significant resources to manage future flood risks. This sense of urgency needs to continue to ensure Albertans receive the full benefit of that investment.

The Department of Environment and Sustainable Resources needs to:

- improve its processes to update its flood hazard maps and mapping guidelines, and map previously unmapped areas at risk
- implement flood risk assessment processes to justify spending money on flood mitigation
- establish processes to cumulatively assess what the effects will be of various flood mitigation efforts at the community level when approving new projects or initiatives

To control future development in Alberta's flood hazard areas, the departments of ESRD and Municipal Affairs have complementary roles. ESRD needs to identify flood hazard areas and Municipal Affairs needs to establish processes for controlling, regulating or prohibiting future land use and development in

the flood hazard areas. Municipal Affairs also needs to put processes in place to enforce the regulatory requirements once they are complete.

AUDIT OBJECTIVES AND SCOPE

We assessed whether the Department of Environment and Sustainable Resource Development has adequate systems to develop and implement a flood mitigation plan. We focused on its planning and risk assessment processes. We did not examine the progress made on individual flood mitigation projects because most of the flood mitigation projects had just been approved while we performed our audit, or they were still being assessed. The department continues to refine the processes to develop and implement the flood mitigation plan that we audited.

We were assisted on this audit by two specialists with significant experience with the subject matter. The first specialist, a consulting engineering firm with expertise in flood mapping, hydrologic and hydraulic computing modelling, reviewed the department's methodology and processes to conduct flood hazard mapping studies and flood risk assessments. The second specialist, a university professor and contributing author to numerous publications on reducing the risk of loss from floods and other natural disasters, reviewed the department's flood mitigation plan.

We did not examine the Government of Alberta's emergency response to the 2013 flood, nor did we examine the Department of Municipal Affairs' disaster recovery program.

We conducted our field work from May 2014 to December 2014. We substantially completed our audit on January 12, 2015. Our audit was conducted in accordance with the *Auditor General Act* and the standards for assurance engagements set by the Chartered Professional Accountants of Canada.

BACKGROUND

Floods in Alberta

A flood is an overflow of water onto land that is usually dry. Flooding can occur due to overflow of water from water bodies such as rivers and lakes. The main causes of flooding in Alberta are heavy rainfall and snowmelt, alone or combined. Heavy rainfall causes most of Alberta's worst floods.

Floods in Alberta happen regularly, but timing, size and location make each flood unique. Alberta has had large floods in 12 of the past 135 years, mostly in southern Alberta:

- 1879 and 1897, Fort Calgary
- June 1915, Calgary
- June 1929, Calgary and southern Alberta
- 1964 and 1975, southern Alberta (Oldman River Basin)
- 1986, central and southern Alberta (Milk, North Saskatchewan and Athabasca river basins)
- 1995, southern Alberta (Oldman River and Red Deer River Basin)
- 2005, central and southern Alberta
- June 2010, southern Alberta, Cypress Hills
- June 2011, central and southern Alberta
- June 2013, Calgary, High River, Canmore and southern Alberta

The June 2013 flood began when a slow, intense low-pressure weather system delivered 80 to 275 mm of rain to the eastern slope of the Rocky Mountains, causing the Bow, Elbow, Highwood and other rivers to overflow their banks. The flooding across southern Alberta affected an area of 55,000 square kilometres. Significant damage occurred to roads, critical infrastructure and public facilities. Alberta declared the first provincial state of emergency in its history, for the Town of High River. More than 30 local states of emergency were also declared.

The June 2013 flood had the following effects on Albertans and their communities:[2]

- Five people lost their lives.
- Rebuilding costs were estimated at over $6 billion.
- 100,000 people were displaced, in 30 communities.
- About 14,500 homes were damaged.
- The government received 10,500 Disaster Recovery Program applications.
- More than 1,500 businesses were disrupted.
- Several schools, health facilities and bridges were damaged.

Roles and responsibilities

In July 2013 the Government of Alberta published a framework[3] describing how the government will support communities in their recovery, from the onset of flooding to the completion of long-term recovery efforts. The key governance structures to lead and support these efforts were the Ministerial Flood Recovery Task Force and an Assistant Deputy Ministers Flood Recovery Task Force.[4] Within the Assistant Deputy Ministers Task Force, the Resilience and Mitigation Team reviewed and prioritized flood mitigation projects. The task forces wound down operations by September 2014.

The Department of ESRD is now responsible for provincial flood mitigation. The department's River Hazard Management Team is responsible for producing flood hazard studies and maps. The Resilience and Mitigation Team joined the department in April 2014. Other departments that support mitigation include Municipal Affairs, Infrastructure, Transportation, Agriculture and Rural Development, and Treasury Board and Finance.

All levels of government have a role in flood mitigation. The federal government pays federal disaster assistance funds to the provinces for floods. Municipalities develop land use by-laws in their communities. Local authorities (municipalities, First Nations, irrigation districts, watershed planning and advisory councils, non-government organizations) play various roles. So do homeowners.

A 100-year flood—not what it seems

Alberta uses the concept of a "100-year flood" as a benchmark (a specific water level or flow rate) to assess and manage flood hazards on its rivers. A 100-year flood has a one per cent chance of occurring in any given year. It is also called a one per cent flood. Common misconceptions are that a 100-year flood occurs only once in 100 years and that there will be 100 years between floods of this size. In reality, a river has a 63 per cent chance of having one or more 100-year floods in any 100-year period.[5] A 100-year flood can happen two years in a row.[6] Most floods are either larger or smaller than the 100-

[2] Southern Alberta Floods: One-Year Report, June 2014.
[3] The Provincial Recovery Framework published by the Government of Alberta in July 2013.
[4] The ministerial task force comprised ministers led by the Minister of Municipal Affairs. It set direction and made decisions, specifically policy decisions, on behalf of the government to support and coordinate the flood response and recovery. The Assistant Deputy Minister Task Force supported the ministerial task force and coordinated the intermediate and long-term recovery efforts.
[5] *Operations of River Hazard Management Team*, Kerr Wood Leidal Associates Ltd.
[6] http://water.usgs.gov/edu/100yearflood.html

year flood. Peak flows for the June 2013 flood were greater than the peak flows for a 100-year flood on some rivers and came close to such a flow on others.

Flood mitigation

Flood mitigation is the process of planning and acting to reduce or avoid the effects of flooding and minimize the damage it causes to people and society. Mitigation involves non-structural and structural actions. Non-structural flood mitigation includes plans and policies that help government to:

- better understand and predict floods
- identify, map and designate flood hazard areas[7]
- use zoning by-laws and other tools to prohibit building in areas that will flood (floodways) and restricting development in areas that could flood periodically (flood fringe zones)
- adopt building codes that minimize flood damage to structures
- create or support a homeowner flood insurance program (as in other G8 countries.[8])

Structural flood mitigation includes:

- raised riverbanks, including berms and dikes or specialized walls
- dams and storage areas
- ditches, diversion channels and underground flood tunnels
- erosion control works like rock slopes and riverbank vegetation

The Alberta government published two documents on flood mitigation:

- Resilience and Mitigation Framework for Alberta Floods (December 2013)—to plan, coordinate, assess and implement flood mitigation in Alberta's watersheds
- Respecting Our Rivers: Alberta's Approach to Flood Mitigation (April 2014)—to outline the government's mitigation actions to provide resilience against future floods and to bring together projects at the regional and local levels

The documents outline roles and responsibilities, guidance and evaluation criteria for selecting mitigation projects and actions. The Alberta government has approved $1.4 billion for various flood mitigation programs and initiatives. (See Appendix A for a breakdown of the funding.[9])

[7] Appendix B defines the flood hazard area, floodway and flood fringe.
[8] http://www.theglobeandmail.com/news/national/province-was-warned-of-alberta-disaster-fund-problems/article19233823/#dashboard/follows/
[9] The Department of ESRD provided this information to us in November 2014.

FINDINGS AND RECOMMENDATIONS

Identifying flood hazards through mapping

Background

The department has produced flood hazard maps since the 1970s. From 1989 to 1999, it produced maps under the Canada–Alberta Flood Damage Reduction Program. Since 1999, the department has produced flood hazards maps under the Flood Hazard Identification Program. Its objectives[10] were to:

- identify flood prone areas and minimize the risks and costs associated with flooding
- provide advice for the use and non-use of flood prone lands
- increase public awareness of flood hazards in communities

The department uses the 100-year flood as the benchmark for floods and water elevation increases. To create a flood hazard study, the department assesses the river system's stream flow data and historical flood records. The outcome of the study is a report and a flood hazard map showing the flood hazard area. Flood hazard maps are divided into two zones: the floodway, where further development is discouraged, and the flood fringe, where development is possible with minimum flood mitigation measures. (See Appendix B for definitions of flood hazard area, floodway and flood fringe.)

RECOMMENDATION 10: UPDATE FLOOD HAZARD MAPS AND MAPPING GUIDELINES

We recommend that the Department of Environment and Sustainable Resource Development improve its processes to identify flood hazards by:

- mapping flood areas that are not currently mapped but are at risk of flooding communities
- updating and maintaining its flood hazard maps
- updating its flood hazard mapping guidelines

Criteria: the standards for our audit

The department should have adequate processes to identify flood risks.

Our audit findings

KEY FINDINGS

- The department does not have complete and up-to-date flood hazard maps to identify flood hazard areas throughout the province.
- The department produces technically sound flood hazard maps. However, the department's mapping guidelines have not been updated to deal with all types of flood hazards.

Flood hazard maps

The department does not have complete and up-to-date flood hazard maps to identify flood hazard areas throughout the province. Under the Canada–Alberta program, the partners compiled a priority list of 66 candidate communities for flood hazard mapping. As of September 2014, the department has created 63 maps; 48 of them, covering 960 kilometres of river, are finalized. A recent review of Canadian floodplain mapping programs estimates that Alberta requires another 770 kilometres of river mapping to document its flood hazard areas.[11]

Several flood hazard maps have not been updated. Before 2013 the department's focus was on mapping new areas, not re-mapping high-risk areas. So about a third of the maps are more than 20 years old (see table below). These maps are for communities such as High River, Red Deer, Cochrane, Canmore, Vegreville, Bragg Creek, Slave Lake, Black Diamond, Turner Valley, Medicine Hat, Cardston

[10] Flood Hazard Identification Program Guidelines (July 2011), page 2.
[11] National Floodplain Mapping Assessment (June 2014), MMM Group Ltd., page 33.

and St. Albert. As the department will be funding mitigation projects, it needs to update the maps to recognize subsequent development in the floodway or significant changes to topography or peak flow estimates.

AGE OF MAPS (in years)	NUMBER OF MAPS
0-5	9
5-10	14
10-15	7
15-20	12
20-25	19
>25	2
Total	**63**

The degree of community acceptance of flood hazard maps has varied, depending on local perceptions of risks. For example, Drumheller developed its own flood hazard maps based on regulated flows,[12] but its maps do not match the department's. Some communities did not participate in flood hazard mapping studies. For example, Peace River experienced flooding in 1992 and 1997 costing the governments of Canada and Alberta over $50 million, yet it did not participate in a flood hazard mapping study until recently.

Flood hazard mapping guidelines

The department produces technically sound flood hazard maps. However, the department's mapping guidelines have not been updated to deal with all types of flood hazards. The guidelines cover flooding caused by overland flow from a water body (such as a river or lake) caused by excessive flow or an ice jam. They do not cover geo-hazard events such as debris flows or debris floods,[13] or the risk that erosion and rapid channel change will cause flooding. The 2013 flooding of Cougar Creek in Canmore was significantly impacted by debris in the river, which shows the danger of not considering all flood hazards.

The department's mapping program had inconsistent funding over the years. The current flood mitigation plan's allocation of $8.7 million aims to resolve the shortcomings in identifying flood hazards. But despite the new funding, policy uncertainties have limited the department's progress on flood hazard mapping initiatives. Department employees know they need to update the guidelines, but cannot proceed effectively until the policy uncertainties are resolved, including:

- how to manage the consequences of changes to flood hazard areas in communities that are already mapped
- whether special allowances should be made for areas protected by dikes and berms
- whether the current level of acceptable risk is appropriate

Implications and risks if recommendation not implemented

The department cannot adequately protect people and communities from floods and their effects without current and complete information on flood hazards.

[12] Regulated flow assumes that existing flood control infrastructure is working effectively to control flood levels.

[13] Debris flows and debris floods represent an extension of the stream flow process with much higher sediment to water ratios and different flow behaviours that reflect their origins in steeply-sloping mountain watersheds.

Assessing flood risk

Background

Many jurisdictions throughout Canada and around the world use flood risk assessment as a tool to support flood mitigation decisions. The words “hazard” and “risk” are often used interchangeably, although they are different concepts. A hazard is an event that can harm society, infrastructure or the environment. Risk is a function of both a hazard and its consequences. Consequences of a flood hazard could include lives lost, injuries, property damage, business interruption, environmental degradation, population displacement and disruption of social services.

Risk assessment is the process of estimating the probability of hazards, determining the consequences for each hazard, and combining results to estimate the expected risk. The table below shows a qualitative example of how risk depends on both the probability and the consequences of hazards.

CONSEQUENCES	PROBABILITY OF HAZARD		
	Low	Moderate	High
Low	Low Risk	Low Risk	Moderate Risk
Moderate	Low Risk	Moderate Risk	**High Risk**
High	Moderate Risk	**High Risk**	**High Risk**

The results of a flood risk assessment are used to select the best of a number of flood mitigation alternatives. For example, decision makers may choose to mitigate a high risk flood area and choose not to spend money in a low risk area.

RECOMMENDATION 11: ASSESS RISK TO SUPPORT MITIGATION POLICIES AND SPENDING

We recommend that the Department of Environment and Sustainable Resource Development conduct risk assessments to support flood mitigation decisions.

Criteria: the standards for our audit

The department should have adequate processes to assess flood risks.

Our audit findings

KEY FINDINGS

- The department does not have the capacity to do flood risk assessments.
- The department does not have historical information on the consequences of previous floods such as lives lost, injuries, property damage and business interruption.

The department does not have what it needs to do flood risk assessments. It does not have historical information on the consequences of previous floods, such as lives lost, injuries, property damage and business interruption. For several decades the department’s focus was modeling the flow of water and identifying the hazard through flood mapping. After the June 2013 floods the department determined that it lacked the damage information and tools to assess the consequences of previous floods.

The department hired external consultants to prepare cost benefit analyses for major flood mitigation infrastructure projects such as the Springbank storage site and Highwood River diversion. The department’s review found differences in the cost–benefit methodologies used to evaluate the projects. The department subsequently hired technical experts to build the provincial flood damage assessment model to estimate damage to building structures and contents. This model is due to be completed in

2015. The department can then use it to track the benefits of flood mitigation spending, and assess mitigation alternatives consistently.

Effective flood mitigation planning requires applying flood hazard identification and flood risk analysis tools at varying levels of complexity, specific to each situation. The Town of Canmore is an example of good flood risk assessment practices. Canmore's flood mitigation plan[14] involves three phases: understanding the hazard, assessing the risk and mitigating the risk. To assess the risk, it uses computer models to show where people and property are at risk, and it is quantifying these risks. Canmore is assessing where the risk is and what is at risk before it decides on flood mitigation.

Flood risk assessments can help stakeholders understand the trade-offs between mitigation alternatives. The department lacks the expertise to do flood risk assessment, but it recognizes the value of more expertise in this area.

Implications and risks if recommendation not implemented

The department cannot effectively develop flood mitigation strategies without current flood hazard and risk assessment information.

Managing future development in flood hazard areas

Background

The department's flood mitigation plan stresses the importance of keeping people away from the water rather than keeping the water away from the people.[15] People living and carrying on business in flood hazard areas, particularly in floodways, pose a public safety and financial risk. Governments can control these risks by restricting development in such areas.

The *Water Act*[16] authorizes the minister to, subject to regulations, designate (i.e., to mark or point out) any area of land in the province as a flood hazard area if there is or may be a threat to human life or property as a result of flooding. The minister may also specify acceptable land uses in the flood hazard area. The minister must consult with the local authority responsible for a proposed flood hazard area before making the designation.

Designation by the minister under Section 96 of the *Water Act* represents the department's formal acknowledgement of the flood hazard area. Once designated, the area's local authorities are expected to consider flood risk when planning and approving future development in those areas.

The *Municipal Government Act,*[17] amended in December 2013, also provides the Lieutenant Governor in Council with the power to regulate land use, by:

- controlling, regulating or prohibiting any use or development in a floodway
- exempting municipalities with significant development that already exists in a floodway

[14] Mountain Creek Hazard Mitigation Plan
[15] Respecting Our Rivers: Alberta's Approach to Flood Mitigation (April 2014), page 4.
[16] RSA 2000 Chapter W-3.
[17] RSA 2000 Chapter M-26, Section 693.1(1).

RECOMMENDATION 12: DESIGNATE FLOOD HAZARD AREAS AND COMPLETE FLOODWAY DEVELOPMENT REGULATION

To minimize public safety risk and to avoid unnecessary expenditure of public money, we recommend that the:

- Department of Environment and Sustainable Resource Development identify flood hazard areas for designation by the minister
- Department of Municipal Affairs:
  - establish processes for controlling, regulating or prohibiting future land use or development to control risk in designated flood hazard areas
  - put in place processes to enforce the regulatory requirements

We have made recommendations to two departments because both departments have complementary roles to mitigate flood risk by managing future development in floodways. ESRD is responsible for identifying Alberta's floodways through its flood hazard identification program. Municipal Affairs is responsible for developing regulations to control, regulate or prohibit development in floodways.

Criteria: the standards for our audit

The departments should use all available flood mitigation tools and options to manage flood risks.

Our audit findings

KEY FINDINGS

- Alberta has not had a consistent approach to managing development in flood hazard areas. Some municipalities restricted development in the floodway and others did not.
- Municipal Affairs has not finalized the supporting regulation for controlling, regulating or prohibiting any use or development of land in a floodway, or developed processes to implement and enforce it.

Through its flood hazard studies, the Department of Environment and Sustainable Resources has identified and mapped flood hazard areas. It has formally designated flood areas for less than half of 48 finalized flood hazard maps: 20 flood hazard areas were designated under the Canada–Alberta program and two were designated by the department under the *Water Act* over 10 years ago. The lack of designation often reflects a lack of local community support, and the department's reluctance to impose designation on a community that does not want it. Some communities may oppose restricting development in the floodway because these areas are desirable to develop. In some cases, communities have existing development in flood hazard areas.

In May 1994 the department finalized the flood hazard maps for Hinton. In March 1995 the town rejected designation as it did not see any clear benefits of doing so. Under the Canada–Alberta program, the department recommended that areas of land within Drumheller and Fort McMurray be designated, but they were not. Currently, these two communities have substantial development, including their town centres, within the floodway.

Simply identifying land as being in the floodway—without changes to provincial legislation and regulations and municipal by-laws—will not restrict new development in floodways. Municipalities have not been required to deal with flood hazard areas in their land use by-law. This led to inconsistent by-laws across the province; some municipalities restricted development in the floodway and others did not.

In December 2013 the Legislative Assembly enacted the *Flood Recovery and Reconstruction Act*, with the goal of preventing further inappropriate development on land within the floodway.[18] That act amended the *Municipal Government Act* to give the Lieutenant Governor in Council the power to make regulations for controlling, regulating and prohibiting any use or development of land in a floodway. It also has provisions to exempt floodway development in municipalities with significant existing development such as Fort McMurray and Drumheller. The Department of Municipal Affairs completed its consultations with stakeholders in November 2014. The department is currently drafting the *Floodway Development Regulation* and expects it will be ready in spring 2015.

The government is spending significant amounts of money to build engineered flood mitigation structures to protect existing development in floodways. The following example illustrates the importance of designating flood hazard areas and restricting development in floodways—and the high cost of not making the designation. A neighbourhood in High River was developed on land that had already been identified as a flood hazard area through the department's flood mapping program. The land was not provincially designated as a flood risk area and restrictions were not placed on its use. After the June 2013 flood, the Department of Infrastructure purchased all homes in this neighbourhood at a cost of approximately $21 million under its home buyout program. Had the area been designated as a floodway and development prohibited, the province could have avoided spending these funds.

The Government of Alberta spent $72 million on its voluntary floodway relocation compensation program for the year ended March 31, 2014 and forecasts an additional cost of $55 million for the year ended March 31, 2015. The program was designed to relocate people out of the floodway by purchasing about 250 homes in southern Alberta, including those purchased in High River.

Implications and risks if recommendation not implemented

Allowing development in floodways unnecessarily risks public safety and the public purse. Keeping people and infrastructure away from floodways is the most cost effective approach to managing flood risk in areas where experts can predict water flows will be deepest, fastest and most destructive.

Assessing the effects of flood mitigation actions

Background

The department is taking steps through various flood mitigation programs to reduce or avoid the effects of flooding and minimize the damage it causes. These mitigation programs, which include structural and non-structural projects are:

- **Flood Recovery Erosion Control Program—**provides funding to deal with immediate critical erosion control projects and priority flood mitigation projects identified by individual communities
- **Alberta Community Resilience Program—**provides grants to develop projects that provide long-term mitigation from the consequences of flood and drought
- **Floodway Relocation Program**—acquires property in floodways to enable homeowners to move outside of the floodway. Homeowners who choose to stay in the floodway are ineligible for disaster assistance after future floods
- **Water Management Infrastructure**—funds upgrades to water management infrastructure to protect them from failure during significant flood events

Other flood mitigation initiatives include the Water Resiliency and Restoration Program to improve natural watershed functions, and the development of Major Mitigation Infrastructure such as storage sites and diversion tunnels. (See Appendix A for a breakdown of the funding for these programs.)

[18] Overview of Bill 27, Floodway Development Regulation Consultation, Department of Municipal Affairs.

RECOMMENDATION 13: ASSESS EFFECTS OF FLOOD MITIGATION ACTIONS

We recommend that the Department of Environment and Sustainable Resource Development establish processes to assess what will be the cumulative effect of flood mitigation actions in communities when approving new projects and initiatives.

Criteria: the standards for our audit

The department should have systems to allocate resources to areas of greatest impact and consequence.

Our audit findings

KEY FINDING

The department does not have adequate processes to assess what will be the cumulative effect of flood mitigation programs and initiatives within communities when it approves new projects.

The department does not have a planned approach to assess the cumulative effects of its flood mitigation actions. The department's management agreed that they could improve its processes to assess the overall effect of flood mitigation programs and determine whether communities were receiving too much or too little assistance to understand and mitigate flood risks.

We found that flood mitigation actions were implemented independently through various flood programs without a full consideration of whether a community was already adequately protected by existing programs and initiatives. For example, the Department of Infrastructure purchased homes in High River under the floodway relocation program. At the same time, ESRD approved funding for a new dike system. High River has now asked the government to make those properties available for sale to the public again because it believes the new dike system has reduced the risk for those properties.

Assessing what will be the cumulative effect of mitigation initiatives, while planning and approving them, is an essential step in allocating scarce resources and ensuring that communities receive appropriate flood mitigation assistance. The department plans to improve this process in its 2015–2020 Operational Plan for its Resilience and Mitigation Team. The team plans to implement the best combination of upstream, local and individual mitigation measures focusing on river basins with the highest flooding risks. The team's operational objectives include:

- engaging key stakeholders and understanding their needs
- developing an integrated approach to watershed mitigation
- working collaboratively to develop flood mitigation plans
- working with municipalities to assess the risks and mitigation initiatives that make economic sense

The department's flood mitigation practices are evolving—moving from recovery planning to future planning. The evolution is not complete. The department should build on the early stages of this transition as it continues to approve flood mitigation projects and initiatives in communities.

Implications and risks if recommendation not implemented

If the department does not assess the cumulative effect of flood mitigation programs and initiatives prior to approving new ones, some communities may be over protected and others under protected from future floods.

APPENDIX A

FLOOD MITIGATION FUNDING

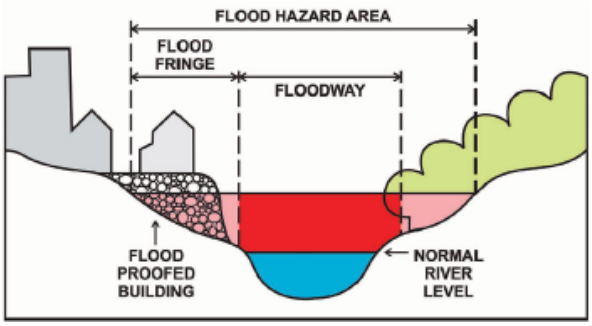
MITIGATION PROGRAM/ INITIATIVE[19]	MINISTRY	APPROVED FUNDING ($ millions)
Alberta community resilience program (Part I)	ESRD	325
Flood recovery erosion control program	ESRD	216
Alberta community resilience program (Part II)	ESRD	156
Floodway relocation program - Southern Alberta	Infrastructure	137
Water management infrastructure	ESRD / Transportation	110
Provincial park restoration and flood mitigation	ESRD	81
Engineering and design for the Springbank storage site	ESRD	75
Engineering and design for the Highwood River diversion	ESRD	75
Mitigation of highway system infrastructure	Transportation	70
Floodway relocation program - Wallaceville	ESRD	38
Berms and mitigation plan for High River	ESRD	29
Funding to southern Alberta communities to prepare for the 2014 flood season	Municipal Affairs	27
Water Resiliency and Restoration Program	ESRD	21
Restoration of damaged schools in High River and Calgary	Education	20
Engineering and feasibility studies of flood mitigation projects	ESRD	14
Flood hazard mapping	ESRD	9
Other programs and initiatives under $10 million	Various	39
TOTAL		**$ 1,442**

[19] This list does not include the potential costs of developing major mitigation infrastructure such as the Springbank storage site ($214 million), McLean Creek storage site ($294 million), Glenmore Reservoir diversion tunnel ($500 million) and Highwood River diversion ($260 million).

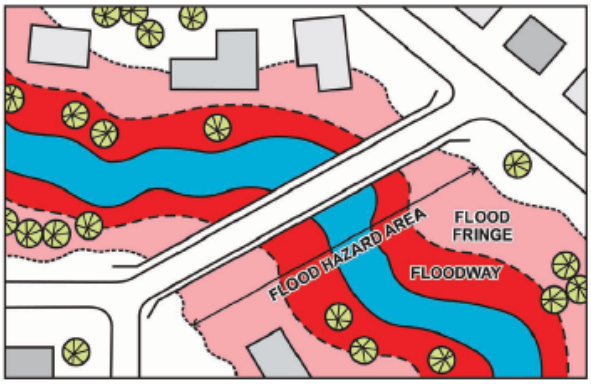
APPENDIX B

FLOOD HAZARD AREA AND DEFINITIONS

Flood Hazard Area[20]—The flood hazard area is the area of land affected by the design flood.[21] It is typically divided into two zones, the floodway and the flood fringe.



Cross-section view of a flood hazard area[22]



Aerial view of a flood hazard area[23]

Floodway—The floodway typically includes the river channel and adjacent overbank areas of the design flood where:

- water is 1 metre deep or greater
- local velocities are 1 metre/second or faster
- the water level is 0.3 metre or more above normal

Flows are deepest, fastest and most destructive in the floodway.

Flood fringe—The fringe is the land along the edges of the flood hazard area not included in the floodway. The fringe has relatively shallow water (less than 1 metre deep) with lower velocities (less than 1 metre/second).

[20] Alberta flood hazard maps can be found at www.envinfo.gov.ab.ca/FloodHazard.
[21] The current standard in Alberta is the one per cent flood. Although it can be referred to as a 100-year flood, this does not mean that it will only occur once every hundred years.
[22] http://esrd.alberta.ca/water/programs-and-services/flood-hazard-identification-program/documents/FH-IdentificationProgram-Dec10-2014.pdf
[23] Ibid.