

# Room for the River Pilot in the Bow River Basin

Advice to the Government of Alberta  
With Addendum

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Please Note:

The *Room for the River* pilot process applied in the Bow Basin and the subsequent *Room for the River* report are not government policy. This is a pilot project. The advice in this report will be taken under consideration by the Government of Alberta to help inform sound water management and policy decisions.

This is not a public consultation process. This is a pilot project carried out with a technical working group and the WPAC to provide advice to the Government of Alberta. It is a first step to gaining a comprehensive inventory of flood mitigation projects.

## Executive Summary

In the 18 months since the 2013 floods occurred in Alberta, a wide range of mitigation options for the Bow River Basin has been identified, studied, and implemented by the Government of Alberta (GoA), municipalities, non-government organizations, and others. With a number of options still under consideration, the GoA announced in the fall of 2014 that it wanted to look more closely at the approach taken by the Netherlands to manage flooding in the Rhine River branches, called the *Room for the River* program. A pilot project was undertaken in the Bow River Basin to consider the Dutch program and measures and the extent to which they could be adapted and applied here to reduce vulnerability of people and infrastructure and improve the overall environmental quality of the Bow and Elbow rivers. A secondary objective was to develop and pilot a systematic *Room for the River* framework and process that, if valuable, could be replicated in other basins throughout the province. Contributors to the pilot reflected the many interests in the basin including water managers, watershed groups, municipalities, environmental groups, domain experts, and the interested public.

The pilot study area included the Bow and Elbow main stems, broken down into eight river segments – four in the Bow and four in the Elbow. Using a simple, systematic framework, an initial scan was done for each river segment, identifying examples of and opportunities for mitigation using *Room for the River* measures. Potential “no regrets” opportunities were identified as well as observations on how a broader *Room for the River*-type program might be effectively applied in Alberta.

Through previous experience and its *Room for the River* program, the Netherlands has learned that:

- Clear, specific objectives are essential, and they must be well defined and communicated.
- The assessment and selection process should rely on undisputed hydraulic modelling and cost-benefit analysis for every flood mitigation option being considered.
- Rivers are powerful; it is best to rely as little as possible on infrastructure that can fail, and berming is a last resort.
- It takes a lot of time to inform and engage citizens and to build the necessary social and political capital, but this time is earned back during implementation.

Maintaining or creating room for the river in Alberta would involve using both the natural landscape and built infrastructure to channel high flows around infrastructure (diversion), create a larger river cross section to allow high flows to pass (conveyance), detain high flows temporarily (storage), and offer local protection where needed. Contributors to the pilot strongly urged that: Alberta protect the health of the province’s watersheds, remembering that “the protection of the aquatic environment is an underlying principle for managing natural resources in Alberta”;<sup>1</sup> mitigation activities be grounded in respecting our rivers and their many values; and the environmental, social, and economic trade-offs for mitigation options be thoroughly understood.

For a program like this to be successful, the GoA and those in the basin must first define what flood levels they are mitigating to and at what costs, and what risks (frequencies and consequences) they are willing to accept.

Calgary was the largest municipality hit by the 2013 flood. Since then, the City has moved forward with numerous studies, policy initiatives, and new mitigation activity along both the Bow and Elbow rivers.

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<sup>1</sup> Alberta Environment. 1999. *Framework for Water Management Planning*, p. 19.

Other opportunities were identified in this pilot, some of which can be acted on relatively quickly while others will take time to implement. Larger mitigation options on the Elbow are being further studied, including SR1 (off-stream storage in Springbank), MC1 (dry dam on the Elbow River near McLean Creek), and the Calgary tunnel (diversion from the Elbow River to the Bow River). At the same time, work needs to continue on smaller projects and possible relocation opportunities, while ensuring efforts are made to protect riparian areas, fish habitat, and other natural features that are important to aquatic ecosystem health. Likewise, for the Bow River, while many mitigation options have been identified and implemented, renewed effort is needed to ensure that key initiatives do not flag. These include stronger impetus for relocation, prevention of future floodplain development, and negotiation of a long-term watershed agreement between the GoA and TransAlta regarding the management of upstream reservoirs.

Twenty possible “no regrets” opportunities across the Bow Basin were identified in two main categories: policies and decisions, and projects or actions. Opportunities related to policies and decision making are broader in scope and could take longer to implement; e.g., strengthening and enforcing policy and regulation to minimize new development in the floodplain. Potential “no regrets” projects or actions are specific and could be advanced in the near term, such as revising the Southwest Calgary Ring Road Bridge design to leave room for the Elbow River and Fish Creek.

Contributors to the pilot project felt there was value in adapting and applying the *Room for the River* concept to flood mitigation efforts in Alberta. They stressed, however, that these efforts should build on work and study already done to date, be applied through an integrated watershed management approach, including the headwaters and tributaries, and should integrate drought, water quality, and ecosystem and flood risk concerns. An Alberta *Room for the River*-type program could define specific objectives against the following key elements:

- Safety and Security = managing flood risk
- Water Supply = managing drought risk
- Water Quality = managing minimum flows for healthy aquatic ecosystems, biodiversity, drinking water, and recreation.

Raising individual and community awareness and understanding about watershed functions and the effects of flooding will be a crucial part of any program. The various jurisdictions with responsibilities for flood mitigation need to effectively share and communicate knowledge, data, and other scientific findings. Sharing of such information will help improve cross-jurisdictional coordination and collaboration on watershed planning and emergency planning. And, perhaps most importantly, a successful program of this nature would need long-term political, local, and financial support and accountability.

This pilot garnered great interest in the water community in the Bow River Basin. Since the flooding in 2013, there has been an elevated level of awareness and discussion about water management in many parts of the province. This has been particularly noticeable in the Bow River Basin, due in part to the excellent work of the Bow River Basin Council. The approach and purpose tested in this pilot offer a way to harness public momentum and interest in water management, build on the deep expertise and experience of those in the water community, and provide a long-term program for thoughtful and effective water management and flood mitigation throughout Alberta.

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## 1. Introduction

Albertans value and respect the role that water plays in their day-to-day lives. Access to water is fundamental to human settlements and is the basis for our economic activity and quality of life. Although droughts have been more common in Alberta's recent history, floods are not rare. With the 1995 and 2005 flood events still memorable, the June 2013 floods were devastating, affecting families, homes, businesses, property, infrastructure, and landscapes. Following emergency responses by various authorities and volunteer agencies, the Government of Alberta (GoA) established the Flood Recovery Task Force and, subsequently, the Resilience and Mitigation (RAM) Branch in Alberta Environment and Sustainable Resource Development (ESRD).

All flood-prone basins in the province are being examined for mitigation opportunities, with much of the initial attention on the Bow River Basin (the Bow, Elbow, Highwood and Sheep river systems). Diverse options have been examined at the municipal and provincial levels through basin modelling and the development of engineering concepts. This resulted in three large infrastructure measures being selected for further study: the Springbank off-stream storage reservoir, a diversion tunnel from the Elbow to the Bow River, and the McLean Creek dry dam. As well, berming and other local protection measures have been built or are planned in many locations, and flood policy and regulatory options are being reviewed in a number of jurisdictions. This pilot does not replicate the extensive work done to date; rather it is intended to build on existing work by continuing the flood mitigation discussion and highlighting the complexity of a system that requires layers of mitigation.

A project completed in early 2014 for the Task Force<sup>2</sup> focused on the Bow River Basin by identifying seven broad flood mitigation approaches and assessing many specific flood mitigation options for the basin. The project aligned with many of the principles and key elements contained in *Respecting Our Rivers*, the pamphlet published by the GoA that described the Province's approach to flood mitigation.<sup>3</sup> The mitigation approaches are summarized in Table 1.

**Table 1: Flood Mitigation Approaches**

<b>Approach</b>	<b>Brief description</b>
<b>Relocation</b>	Reduce risk to people and property by removing infrastructure from the flood plain and restricting future development
<b>Dry dams</b>	Build detention facilities that temporarily detain high flows but allow normal flows to pass without hindrance and do not permanently retain water
<b>Diversions*</b>	Divert high flows around high risk areas; diversion channels could include new overland routes, existing overland routes, and subsurface tunnels
<b>Wetland storage</b>	Use natural storage function of wetlands to temporarily detain high flows
<b>Natural river functions</b>	Restore natural river functions to slow and attenuate high river flows; this includes wetlands, healthy riparian areas, bio-engineered bank protection, re-widening the floodway, natural channel design, meander belts, and maintaining active flood plains
<b>Change existing operations</b>	Draw down spring reservoir levels, delay filling, and/or raise full supply level capacities of existing reservoirs to capture high flows
<b>Land management</b>	Implement best land management practices in upstream areas (headwaters) to

<sup>2</sup> See <http://albertawater.com/work/research-projects/resilience-and-mitigation-branch> for more information.

<sup>3</sup> Online at <https://pabappsuat.alberta.ca/albertacode/images/respecting-our-rivers.pdf>.

Approach	Brief description
	slow the water from reaching infrastructure; this includes wetland restoration, timber harvest best management practices, wildfire management, timber disease and pest management, off highway vehicle trail management, reducing fragmentation and linear disturbances

\* This term refers to the common definition of diversion as “relocated stream flow” rather than a diversion of water for a licensed off-stream use.

Both this project and the *Respecting Our Rivers* document reaffirm that a systemic, watershed-based approach to flood mitigation is essential. Mitigation options implemented in one part of the complex and interrelated Bow River and tributary system can have major, even catastrophic, consequences in other parts of the system. Mitigation activities in the upstream reaches may have a cumulative effect on downstream communities and infrastructure. Diverting flow away from one community may transfer unacceptable risk to another. All mitigation options will affect the watershed; the options chosen must function to build the health and natural resiliency of the watershed and allow for sound water management under flood, drought, and normal conditions.

In the 18 months since the 2013 floods, various mitigation options for the Bow River Basin have been identified, studied, and implemented by the GoA, municipalities, non-government organizations, and others. With a number of options still under consideration, the GoA announced in the fall of 2014 that it wanted to look more closely at the approach taken by the Netherlands to manage flooding in the Rhine River branches, called the *Room for the River* program. The advice drawn from that discussion and analysis is documented in this report.

### 1.1 Purpose and Context

In response to serious flood threat and severe impacts on people and property, the Netherlands initiated its *Room for the River* program in the later 1990s (see Section 2.1 for more details). Their experience offers a chance for Alberta to learn from others when it comes to identifying, choosing, and implementing suitable flood mitigation measures.

The objective of this pilot project was to build on what has already been identified, studied, and implemented in the Bow River Basin, to ensure that the Dutch *Room for the River* approach and measures have been considered and applied as appropriate in the basin to reduce flood hazard and improve the overall environmental quality of the rivers.

A secondary objective was to develop and pilot a systematic framework and process for identifying specific *Room for the River* options. If valuable, the framework and process could be replicated in other basins throughout the province. A key to success was working with water managers, watershed managers, and experts who know the rivers best (see Appendix A for a list of contributors to this pilot). Many of these organizations and individuals have not only been directly involved in managing water in the Bow River Basin, they also actively participated in previous collaborations to model and identify Bow River water management opportunities for both drought and flood mitigation.<sup>4</sup>

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<sup>4</sup> For more information on these projects, visit the Water Portal at <http://albertawater.com/work/research-projects/ssrb-adaption>.

The pilot project targeted three outcomes:

1. Provide specific advice to the GoA, including:
  - A scan of specific, actionable opportunities to further implement *Room for the River* measures along the Bow and Elbow main stems above and within Calgary.
  - Recognition of what has already been done along the Bow and Elbow rivers to create room for the river.
  - Identification of possible practical and implementable “no regrets” opportunities.<sup>5</sup>
  - Suggestions on a potential broader program, process and engagement.
2. Elevate understanding among the water community in the Bow River Basin of the *Room for the River* program, measures, and associated opportunities in Alberta.
3. Produce a tested framework and process for applying *Room for the River* measures to all watersheds in Alberta.

## 1.2 Scope of the Pilot Project

To ensure appropriate focus and timely completion, careful consideration was given to what was in scope and out of scope for this initial pilot. As mentioned earlier, the pilot was intended to build on prior work and decisions, not replicate them, and the scope of the project was set accordingly. The scope parameters are shown in Table 2.

**Table 2: Scope of the Bow *Room for the River* Pilot Project**

	In Scope	Out of Scope
<b>Geography</b>	<ul style="list-style-type: none"> <li>• Main stems of the Bow and Elbow rivers from above Ghost Dam and the confluence with Quirk Creek to the southern boundary of the city of Calgary</li> </ul>	<ul style="list-style-type: none"> <li>• Tributaries to the Bow or Elbow</li> <li>• The Bow below Calgary</li> <li>• The Highwood and Sheep rivers</li> </ul>
<b>Options and Opportunities</b>	<ul style="list-style-type: none"> <li>• Infrastructure options, operational changes, and natural functions for flood mitigation</li> <li>• Basin scale and local scale options</li> <li>• Primarily surface water quantity, but water quality and groundwater comments will be captured</li> </ul>	<ul style="list-style-type: none"> <li>• Specific Disaster Recovery Program and individual landowner-related decisions</li> <li>• Comprehensive water and risk management discussion</li> </ul>
<b>Impacts</b>	<ul style="list-style-type: none"> <li>• Upstream, downstream, and system-wide impacts</li> <li>• High-flow, low-flow, and “normal-flow” impacts (watershed management)</li> <li>• Identification of potential complexities and dependencies</li> </ul>	<ul style="list-style-type: none"> <li>• Detailed engineering or feasibility and constructability analysis</li> <li>• Detailed environmental, social, or economic impacts</li> </ul>
<b>Findings</b>	<ul style="list-style-type: none"> <li>• Advice on where <i>Room for the River</i> measures have already been applied and a scan of further opportunities</li> <li>• Specific, actionable quick wins</li> </ul>	<ul style="list-style-type: none"> <li>• Comprehensive, triple bottom line evaluation of options</li> <li>• A detailed prioritization study</li> </ul>

<sup>5</sup> “No regrets” opportunities are those mitigation measures that should be beneficial under any and all river conditions; i.e., they have a net positive effect for flood mitigation, with little to no negative consequence.

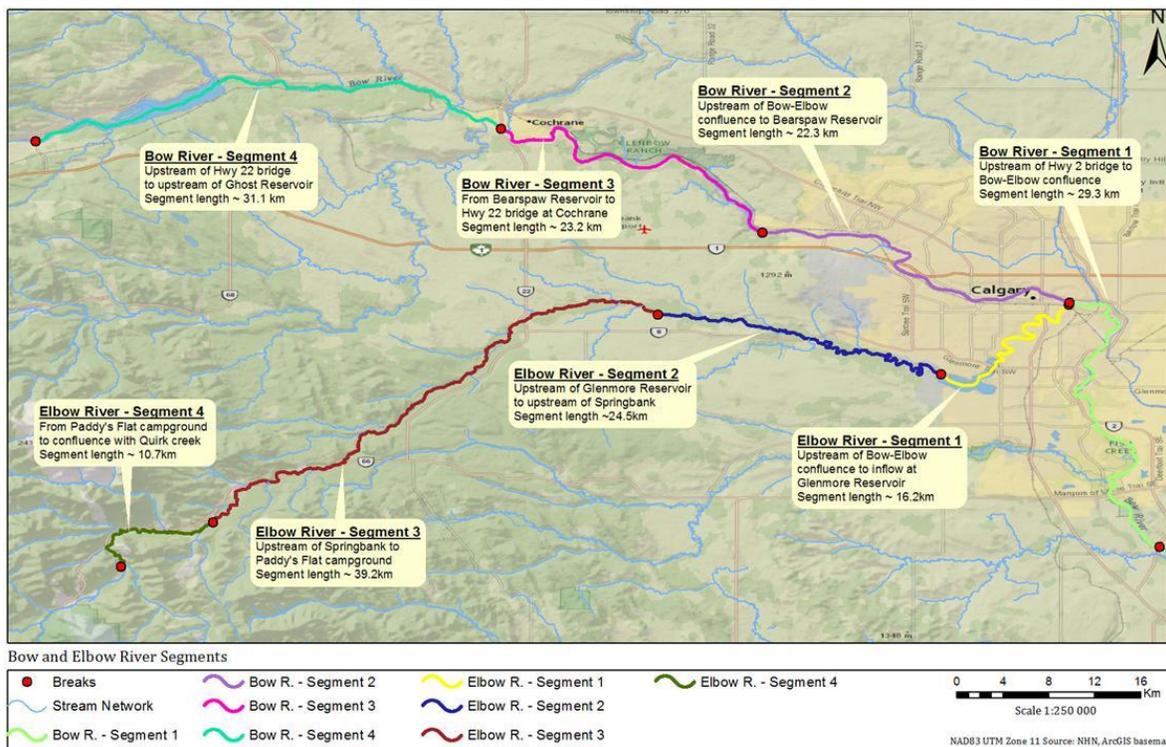
### 1.3 Process and Approach

A simple, systematic framework was developed for applying *Room for the River* measures to the Bow River Basin. For each segment of the basin and for each measure (described in more detail in Section 3.1), four questions were asked:

1. Is the measure applicable and relevant for this river segment and, if so, how?
2. Where has this measure already been applied and has it been effective?
3. What options are still being implemented, are planned, or have been proposed?
4. How could this measure be implemented?

If the answer to the first question was “no,” subsequent questions were not pursued.

The pilot study area was divided into eight river segments – four in the Bow and four in the Elbow – to enable manageable discussion of the examples and opportunities. These river systems are complex with many interdependencies; breaking them into segments does not imply that any one segment is independent of or more important than any other. The segments were delineated primarily by looking for common river morphology and considering the location of infrastructure. The intent was to reflect the diversity of the systems while maintaining a reasonable number of segments to enable productive discussion. Figure 1 illustrates the geographic scope of the entire project; maps of each river segment appear in Section 3.1.



**Figure 1: Geographic Scope of the Pilot Project in the Bow River Basin**

To complete the initial scan for each river segment, project staff first researched and reviewed existing materials (recent flood and engineering studies from municipalities, the Province, and groups involved

in the watershed) and interviewed knowledgeable and experienced representatives from select municipalities, non-government organizations (including Watershed Planning and Advisory Councils and Watershed Stewardship Groups), and others. Once this information was compiled and details added to the framework for each segment, the project team held a one-day multi-stakeholder technical session in Calgary in November 2014 to engage water managers, watershed managers, and experts. Representatives from the Dutch *Room for the River* program participated in the session to share their experience and bring additional expertise to the discussion. The compiled findings from the research, interviews, and working session were presented to the Bow River Basin Council in early December to obtain broader input. This document – the pilot project’s final report – with advice on *Room for the River* implementation and further options in the Bow River Basin was prepared and submitted to the GoA in mid-December. The entire process was facilitated by Alberta WaterSMART with Deltares as expert advisors on the *Room for the River* program.

## 2. Room for the River Management Approach

### 2.1 The Dutch Approach

*Room for the River* is a program designed and implemented by the Government of the Netherlands. It followed a transition in river management policy away from the historic approach of managing flood risk by raising embankments and toward a new approach of creating room for conveyance throughout the river system.

In 1996, the Flood Protection Law (now Water Law) was introduced. It set specific protection levels and required five-year reviews and reports to Parliament on the Rhine design parameters and flood infrastructure. In 2001, the levels from two recent flood events resulted in the design discharge for the Rhine branches being increased from 15,000 m<sup>3</sup>/s to 16,000 m<sup>3</sup>/s. At the same time, a new policy was introduced, adding two key components: the preference for no further dike heightening (i.e., that dike heightening be considered only as a last resort), and a secondary program objective of enhancing natural and cultural landscape values (i.e., “spatial quality”). Thus the specific goals of the current Dutch program are to:

1. Safely cope with a 1:1,250 year discharge of 16,000 m<sup>3</sup>/s without flooding, and
2. Enhance the overall spatial quality of the river landscape.

The Dutch process followed five main steps:

1. Define the problem with specific objectives and clear constraints, considering the geo-ecological functioning of the system and the long-term consequences of current policy.
2. Develop an inventory of potential projects that could be considered to help achieve the specific program objectives.
3. Determine the expected hydraulic impact, cost-effectiveness, and attractiveness of all potential projects and build the Planning Kit (see below), communicating all this data.
4. Working collaboratively with many participants and using the Planning Kit, select the suitable ideas against the objectives for the region; that is, which projects together can achieve the pre-defined goal within the budget constraints?
5. Implement the selected projects locally under national supervision with transparency and extensive engagement throughout.

Sharing knowledge with stakeholders has been a fundamental part of the program in the Netherlands. All results from the early research that went into the problem definition were captured in an understandable way in a single volume that was very explicit about the uncertainties.

The Planning Kit tool (“Blokkendoos”) is a simple, interactive, visual tool showing the hydraulic effect and cost data needed for any user to examine and select sets of individual mitigation measures. This tool allows the user to select various measures throughout the Rhine branches to try to collectively meet the safety objective within a pre-set budget. The tool created a common base of knowledge, allowed users to test their own ideas, and provided a sense of empowerment to affected communities.

The second objective – spatial quality – reflected a balance of functionality (for everyday use), sustainability (geo-ecologically robust), and attractiveness (culturally meaningful and aesthetic). An independent Spatial Quality team (the Q team) was struck to provide advice and to peer review spatial quality for all projects that went ahead.

Nine broad mitigation measures were identified under the *Room for the River* program (Table 3).

**Table 3: Room for the River Measures: Dutch Definitions**

<b>Room for the River Measures</b> (as described by the Dutch program*)
1. Dike relocation: Relocating a dike inland widens the floodplain and increases room for the river.
2. Depoldering: The dike on the river-side of a polder <sup>6</sup> is lowered and relocated inland. This creates space for excess flows in extreme high water situations.
3. High-water channel: A high-water channel is a diked area branching off from the main river to discharge some of the water via a separate route.
4. Lowering floodplains: Lowering or excavating part of the floodplain increases the room for the river in high water situations.
5. Lowering groynes <sup>7</sup> : At high water levels, groynes may obstruct the flow in the river. Lowering groynes speeds up the rate of flow.
6. Removing obstacles: If possible, removing or modifying obstacles in the river bed will increase the rate of flow.
7. Water storage: Provide temporary water storage in extreme situations where the storm surge barrier is closed and there are high river discharges to the sea.
8. Deepening summer bed: Excavating or deepening the surface of the river bed creates more room for the river.
9. Dike reinforcement: Dikes are reinforced at given locations where river widening is not feasible.

\* Source: Room for the River Summary Brochure; March 2012.

Measure 8, essentially dredging, was commonly used in the past in the Netherlands to reduce sediment build-up in navigation channels. Their experience has shown that it has limited effect as the river typically quickly re-deposits sediment in dredged areas, which reduces the benefit or necessitates repeated dredging. Measure 7, water storage, is recognized as having very limited opportunities in the Netherlands. Some opportunities may exist upstream in Germany but those options have not advanced to date. A further limiting factor on potential storage infrastructure is the consequence of infrastructure failure; in the Netherlands, infrastructure failure would be catastrophic given the population density and location. In addition to the risk of catastrophic failure, large infrastructure also means that the burden of a reservoir is borne in a different area from the area that receives the benefits. For these reasons, water storage that uses natural low-lying areas such as polders is much preferred over storage that requires dam infrastructure.

Land required for any of the *Room for the River* measures has usually been handled in one of three ways:

- It was bought by the Government then resold with different conditions on use,
- It was bought by the Government and converted to public land, or
- A compensation arrangement was made with the current landowner for intermittent flooding.

Fisheries and habitat values are important throughout the floodplain area, the main channels, and side channels. Through the spatial planning team, the program has tried to restore aquatic and semi-aquatic spaces, although this is a particular challenge during low-flow periods.

<sup>6</sup> A polder is a low-lying tract of land enclosed by dikes that forms an artificial hydrological entity that has no connection with outside water other than through manually operated devices. (adapted from Wikipedia, <http://en.wikipedia.org/wiki/Polder>)

<sup>7</sup> A groyne is a rigid hydraulic structure built from a river bank. It directs high velocity flows away from the banks, mitigates erosion, and keeps navigation channels open. Groynes are generally placed in groups.

A critical point when considering which measures are most appropriate is the nature of the hydraulic effect of managed water. Simply, water storage should reduce the water level downstream; creating a larger cross section (that is, making room for the river) should reduce the water level locally and upstream. These concepts are often poorly understood.

Rijkswaterstaat, the National Water Authority in the Netherlands, has administered the *Room for the River* program for about 14 years. Of the 700 projects identified in that time, 39 are expected to be implemented by 2015 within a budget of €2.3 billion (about Cdn\$3.3 billion). The expected effect is that 4400 hectares of surface area (about 10% of the system) will be “returned” to the river floodplain. In so doing, the peak flow levels will be reduced so that water level is lowered by 30 cm on average along all three river branches, creating the conveyance capacity for the specified target of 16,000 m<sup>3</sup>/s. Additional information on the *Room for the River* program is available online in English at <http://www.ruimtevoorderivier.nl/english/>.

## 2.2 The Southern Alberta Context

Numerous differences in geography and hydrology exist between the Netherlands and Southern Alberta (Table 4) that must be recognized when potential *Room for the River* measures are being contemplated in this province. Furthermore, the Dutch measures are essentially engineered structural changes, whereas Alberta has indicated the importance of capitalizing on natural river and watershed functions for flood mitigation, as highlighted in the *Respecting Our Rivers* document. These differences do not negate the opportunity to learn from the Dutch program and measures, rather they were recognized as important context throughout the pilot discussions.

**Table 4: Differences between River Systems in the Netherlands and Alberta**

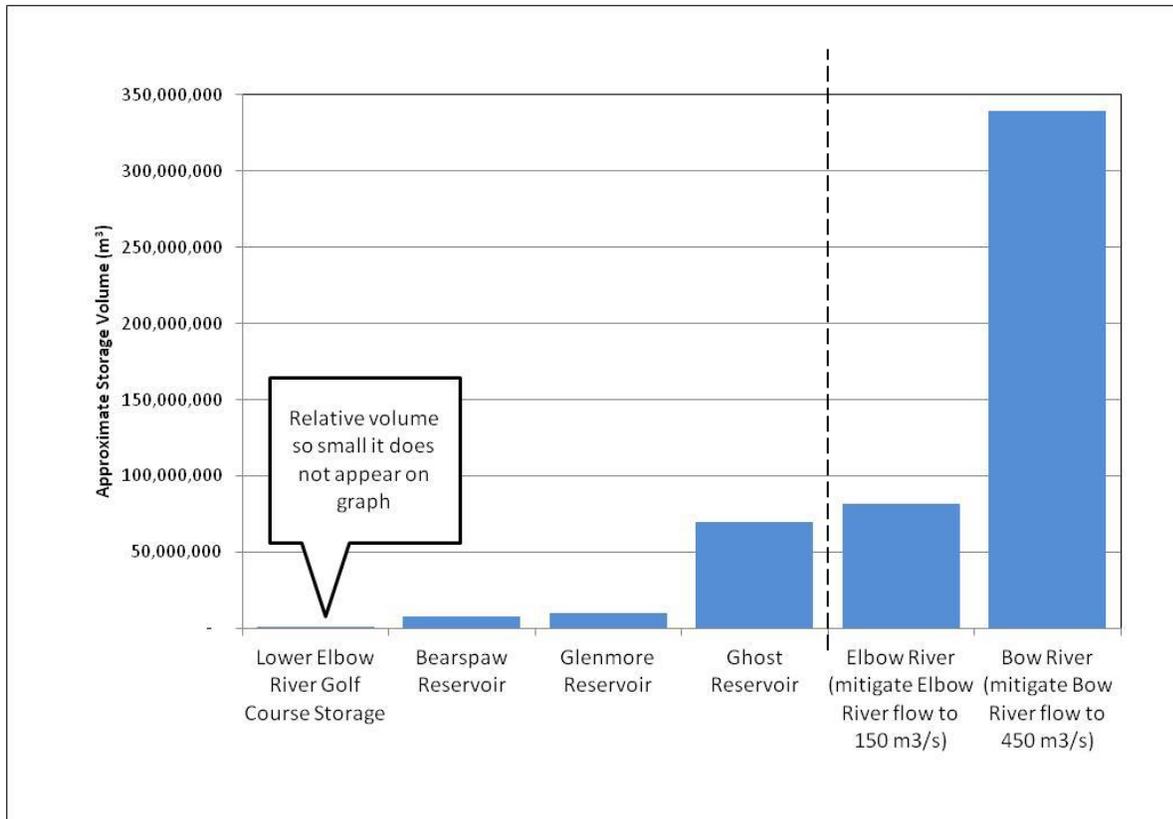
Hydrology of the Netherlands	Hydrology of Southern Alberta
The Netherlands is in the coastal region, partly below sea level	Southern Alberta comprises mountains, foothills, and prairies
The Netherlands has a temperate humid, maritime climate	Alberta has a relatively cold, dry, continental climate
The Netherlands’ rivers branch through static channels through flat terrain with a leveed floodplain	Southern Alberta’s rivers course down steep slopes and move and converge through foothills and onto the prairie
The Rhine flood events see gradual peaks of up to ~16,000 m <sup>3</sup> /s over more than a week	The Elbow and Bow see flashy peaks of ~1,300 m <sup>3</sup> /s and ~2,000 m <sup>3</sup> /s, respectively, in two to three days
The Netherlands has issues with sedimentation of fine material (siltation) but few other water quality concerns	Southern Alberta has issues with transport of fine and coarse material and debris, and complex water quality concerns
Development has encroached on the river throughout the country; <i>Room for the River</i> is lowering the flood level by removing the “straitjacket”	Southern Alberta has a mix of development near and on the river and stretches that are free of development; Alberta is about mitigating flood while respecting our rivers’ natural characteristics
One of the primary purposes of the Rhine River is navigation for transport vessels upstream into Germany; water supply is not a limiting factor	The rivers are managed for water supply in a closed basin; all rivers have multiple functions and uses, including a healthy and thriving recreational cold water fishery
Salt water is a concern	Groundwater plays a key role
The Netherlands is dealing with increasing river discharge where timing is less of an issue and trans-boundary upstream retention is difficult	Southern Alberta is dealing with natural variability where timing is crucial and upstream retention within the same jurisdiction may be possible

With these differences in mind, *Room for the River* measures can be adapted to fit the Alberta context and perhaps categorized to reflect how mitigation is often discussed in Alberta: diversion, conveyance, detention, other, and last resort. Examples in place or being considered on the Bow and Elbow main stems are included with the adapted measures in Table 5.

**Table 5: Room for the River Measures in the Alberta Context**

Measure	How it might be defined in the Alberta context	Examples on the Bow and Elbow main stems
<b>DIVERSION</b>		
1. High-water channels	<ul style="list-style-type: none"> <li>• Create flood bypasses through the floodplain</li> </ul>	<ul style="list-style-type: none"> <li>• Building a Calgary tunnel diversion</li> <li>• Designated overland flooding route through Erlton</li> <li>• Gravel removal in side channels</li> </ul>
<b>CONVEYANCE</b>		
2. Dike relocation	<ul style="list-style-type: none"> <li>• Relocate permanent or temporary barriers, possibly in combination with relocation</li> </ul>	<ul style="list-style-type: none"> <li>• Revisiting Bragg Creek buyouts</li> </ul>
3. Lowering floodplains	<ul style="list-style-type: none"> <li>• Remove material from floodplain</li> <li>• Change policy on allowing fill in floodplains</li> </ul>	
4. Removing obstacles	<ul style="list-style-type: none"> <li>• Set development back from the river (flood way, fringe, plain)</li> <li>• Reduce the size and location of infrastructure in the floodplain; e.g., roads, bridge abutments</li> <li>• Minimize obstacles in the riverbed</li> </ul>	<ul style="list-style-type: none"> <li>• Conservation easements on the Bow and Elbow</li> <li>• Relocation of floodplain development</li> <li>• Revision to SWCRR Elbow overpass plan</li> <li>• Design of bridges e.g., the Peace Bridge</li> <li>• Removal or lowering of gravel/cobble bars</li> </ul>
<b>DETENTION</b>		
5. Water storage	<ul style="list-style-type: none"> <li>• Adjust operations of existing infrastructure</li> <li>• Dredge reservoirs</li> <li>• Construct detention sites (on-stream, off-stream, wetlands, ponds)</li> <li>• Prevent destruction of naturally occurring detention sites</li> <li>• Designate agricultural and park lands in the floodplain as flood zones</li> <li>• Restore riparian zones for absorption</li> </ul>	<ul style="list-style-type: none"> <li>• Upgrading Glenmore Reservoir infrastructure</li> <li>• Contouring upstream end of Ghost Reservoir</li> <li>• Building off-stream storage in Springbank (SR1)</li> <li>• Design light infrastructure spaces (e.g., golf courses) to temporarily flood</li> <li>• Restoring riparian banks near Cochrane</li> <li>• Retaining wetlands, log jams in the headwaters</li> <li>• Possibly, already identified WRRP projects</li> </ul>
<b>OTHER MEASURES</b>		
	<ul style="list-style-type: none"> <li>• Flood proof infrastructure in floodplains</li> <li>• Restore riparian zones for bank stabilization</li> <li>• Enforce land use controls in upper watershed</li> </ul>	<ul style="list-style-type: none"> <li>• Building flood proofing in Erlton</li> <li>• Design and location of ATV facilities in the headwaters</li> </ul>
<b>LAST RESORT MEASURES</b>		
	<ul style="list-style-type: none"> <li>• Reinforce barriers (permanent or temporary) at given locations where river widening is not feasible</li> <li>• Dredge river beds</li> </ul>	<ul style="list-style-type: none"> <li>• Strengthening Sunnyside berm</li> <li>• Armouring Stampede banks</li> <li>• Raising berm at Redwood Meadows</li> </ul>

As potential mitigation measures are examined, an important consideration is the relative scale of mitigation options compared to each other and to the mitigation objectives set for a particular river. In Figure 2, for example, the two columns on the right show the approximate storage volumes that would have needed to be held back in the 2013 flood on the Bow and Elbow rivers to mitigate flows to illustrative targets. The remaining four columns show the approximate volumes of various storage options in the watershed. The chart demonstrates the relative contribution each option might make toward achieving the most stringent overall mitigation targets. This chart should not be read as dismissing the role that storage can play in mitigation, but instead highlights the need to look to a series of mitigation measures working together toward a reasonable mitigation target.



**Figure 2: Illustrative Relative Volumes - Bow River Basin Reservoirs and 2013 Flood Event**

Source: City of Calgary, 2014. Values provided by City of Calgary and TransAlta; volumes are approximate for comparison purposes.

In Figure 2 the flood volumes are calculated as volumes above “normal” flows for the Bow and Elbow rivers over the flood duration. Glenmore Reservoir storage volume is from the recent City of Calgary bathymetry survey. The “storage area” available at the Calgary Golf and Country Club along the Elbow River assumes a two-metre deep retention facility on the floodplain portion of the golf course.

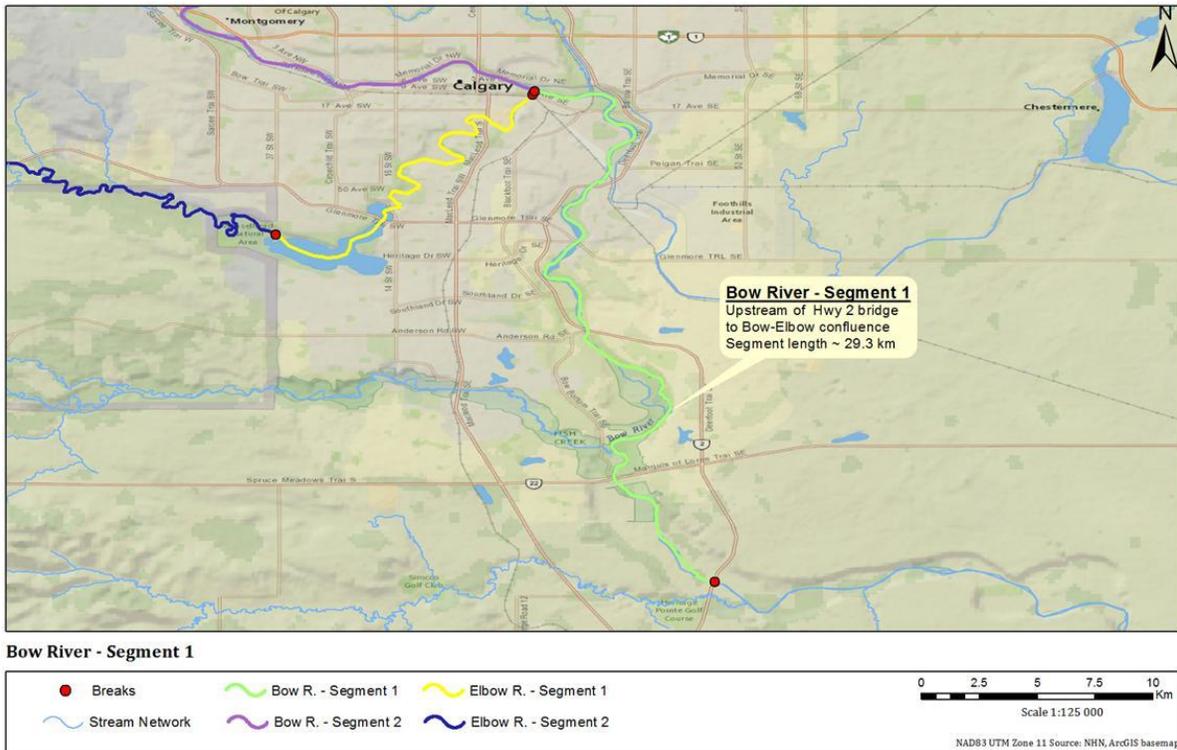
### 3. Advice to Government of Alberta from the *Room for the River* Pilot in the Bow River Basin

#### 3.1 Initial Scan of the Bow and Elbow River Pilot Study Area

When the initial scan was begun in late 2014, various flood mitigation options continued to be under consideration by the GoA whereas others had already been assessed as not warranting further study at this time. This report is not suggesting that options previously not recommended for further study be re-opened. Where relevant, references to these decisions are shown in the tables for each river segment in the column “What options remain?”

##### 3.1.1 Bow River Segment 1

This segment of the Bow River (Figure 3) extends from upstream of the Highway 2 Bridge to the confluence with the Elbow, a distance of approximately 29 km. This segment did not experience as much damage in the 2013 flood as other areas. A number of broad policy instruments are already in place or are being developed for this segment, primarily through the City of Calgary. Discussion focused on looking at opportunities to attenuate the flow upstream as well as minimizing future encroachment in the segment’s floodplain.



**Figure 3: Bow River – Segment 1**

Table 6 shows the initial scan of specific opportunities to further implement *Room for the River* measures along this river segment, as well as actions that have already been taken.

**Table 6: Initial Scan of Room for the River Opportunities for Bow River – Segment 1**

Measure	Apply?	What has already been done?	What options remain?
<b>DIVERSION</b>			
1. High-water channel	Maybe		<ul style="list-style-type: none"> <li>• Use Western Headworks Canal as diversion channel (not recommended by City Expert Panel)</li> <li>• Create a small bypass channel through the Inglewood golf course</li> </ul>
<b>CONVEYANCE</b>			
2. Dike relocation	Yes		<ul style="list-style-type: none"> <li>• Buyouts in targeted locations to enable relocation of current or planned barriers</li> </ul>
3. Lowering floodplains	Maybe		
4. Removing obstacles	Yes	<ul style="list-style-type: none"> <li>• Many setbacks already in effect along the river from Harvie Passage down</li> <li>• The wide-span bridge on 37<sup>th</sup> Street SW over Fish Creek is an example of a bridge designed to allow room for the river</li> <li>• Reduced floodplain development through the City of Calgary’s Environmental Reserve Setback Policy; e.g., Quarry Park development has a 60m setback</li> <li>• Removed grandfathering of flood fringe development requirements through Phase 1 review of the City of Calgary’s Land Use Bylaw and Municipal Development Plan (MDP)</li> </ul>	<ul style="list-style-type: none"> <li>• Where appropriate, as identified by the City of Calgary’s morphology study, remove or lower select gravel/cobble bars in the Bow main stem to remove resistance</li> <li>• Continue to reduce floodplain development through the City of Calgary’s Environmental Reserve Setback Policy. The City of Calgary and the GoA could explore a more flexible approach in how much setback is taken, accounting for topography.</li> <li>• Reduce floodplain development through the City of Calgary’s Riparian Strategy and associated education, mapping, and designation</li> <li>• Encourage the “right kind” of development in the floodplain and flood fringe (e.g., parks)</li> <li>• Minimize development in the floodplain through the Land Use Bylaw/MDP Phase 1 and 2 update</li> <li>• Prohibit new development in the flood fringe, and existing development to be flood proofed</li> <li>• Minimize stormwater infrastructure (i.e., ponds) in the floodplain</li> <li>• Should it be closed, return Fish Creek Wastewater Treatment Plant (WWTP) location to the river</li> <li>• Identify aging infrastructure along the river in areas that could be returned to the river when the infrastructure is removed; e.g., Highway 22X gravel pit; Remington LaFarge site</li> <li>• Look for more flood mitigation opportunities in new developments; e.g., Quarry Park</li> <li>• Redesign Harvie Passage to fail in high-flow event thus removing any incremental flooding it may cause upstream, e.g., in Inglewood</li> <li>• Modify Cushing Bridge (17<sup>th</sup> Ave.) abutment to</li> </ul>

Measure	Apply?	What has already been done?	What options remain?
			allow higher conveyance • Review grandfathered development along the lower Bow in Calgary
<b>DETENTION</b>			
5. Water storage	Yes	• Wetland conservation through the City of Calgary's Wetlands Conservation Policy; e.g., wetland area in Quarry Park • Cranston stormwater detention	• Urban stormwater ponds through the City of Calgary's Stormwater Management Strategy • Promote wetland preservation and enhancement through the City of Calgary's Wetlands Conservation Policy • Improve riparian health and absorption using the City of Calgary's Bioengineering Design Guidelines
<b>OTHER MEASURES</b>			
	Yes	• Riparian maintenance through the City of Calgary's Riparian Strategy	• Graduated flood protection level requirements • Improve riparian health and bank stabilization using the City of Calgary's Bioengineering Design Guidelines
<b>LAST RESORT MEASURES</b>			
	Maybe	• Raise the ground under riverside redevelopments; e.g.; Quarry Park	• City of Calgary River Flood Protection Conceptual Design Study currently studying flood barriers in key locations; e.g., Heritage Drive , Glenmore Trail, Bonnybrook WWTP • Update temporary flood barrier plans to protect against higher flood levels

Additional commentary:

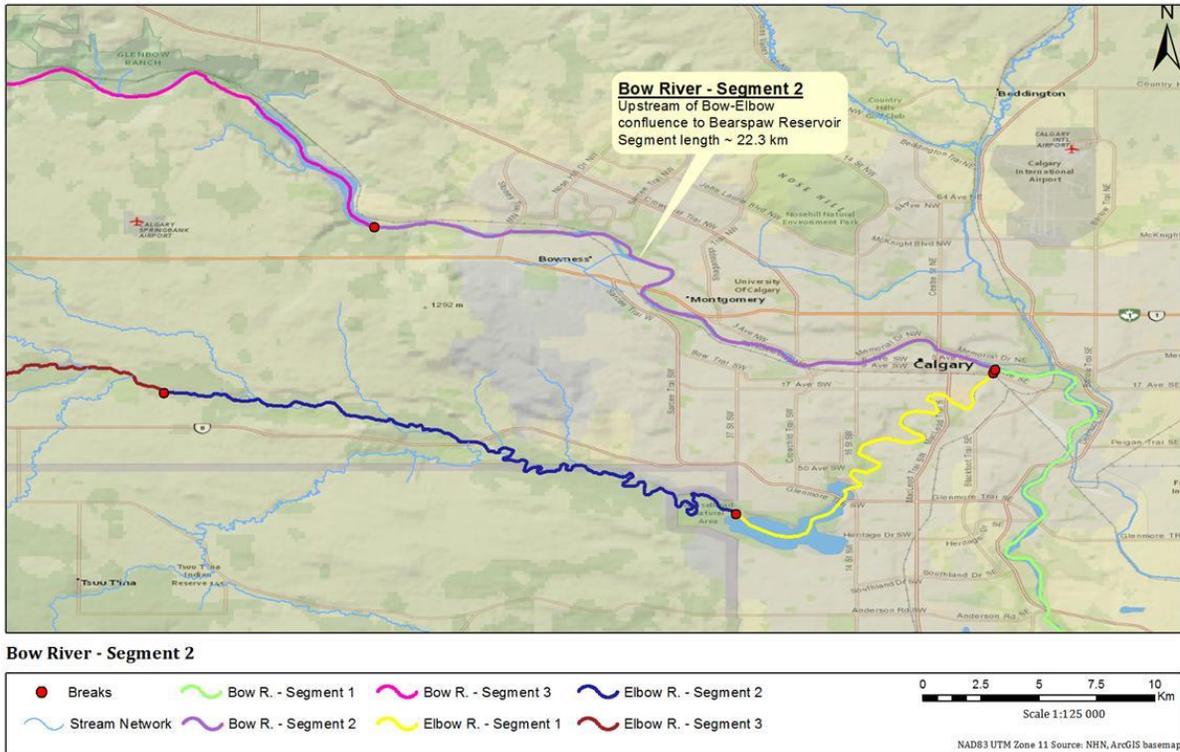
- Many riparian setbacks already exist in this lower segment of the Bow and infrastructure is generally less dense in the floodplain. Nevertheless, flood mitigation considerations should be incorporated into any new developments. Buyouts and relocation incentives offer some potential for making room for the river. In addition, perhaps a more flexible approach to setbacks can be taken that accounts more for topography. Currently only specific and limited setbacks are taken.
- The City of Calgary will be launching a riparian program in early 2015 to begin integrating the bylaw with mapping and to designate different riparian management zones.
- The City's river morphology study, expected to be complete by the end of 2015, will recommend if any gravel or cobble bars should be lowered or removed to reduce flood-related risk along the Bow and Elbow rivers (i.e., to lower flood water levels). Such removal can carry temporary risk to riverine ecology.
- Areas below dams tend to be gravel-starved, so if gravel is removed from one section of a river, consideration should be given to putting it back in the river at a place where it would be

useful. Roosting areas for ducks and geese can also be disrupted by the removal or lowering of gravel bars. This comment applies to many segments of the pilot study.

- Potential remains for future development in some low-lying areas, and consideration should be given to not grandfather developments that are currently in the process of permitting or construction.
- The City's River Flood Protection Conceptual Design Study will include permanent and temporary barrier options throughout the Bow and Elbow floodplains; the results of this study will help determine if and where to create new flood barriers or raise existing flood barriers in key city locations.
- The concept of using the Western Headworks Canal as a diversion channel was not recommended by the City Expert Panel. This was in part due to the capacity of this canal being  $\sim 30\text{m}^3/\text{s}$ , about 1.2% of the 2013 flood peak flow ( $2,400\text{m}^3/\text{s}$ ); therefore it would not convey a great deal of flow from the Bow, and it would cause a lot of damage to the channel itself as well as to downstream infrastructure including Chestermere Lake and the Western Irrigation District canals. In addition, the canals would still be managing considerable urban and agricultural stormwater flow in the region.
- Outreach and information to clarify, for example, what a 1:100 return period event is, would help people better understand flood risks (i.e., what is the chance of a 1:100 year return period event occurring during the 40 years that someone owns a specific home).
- Public education on personal flood preparedness can help to reduce the impacts of flood events, improve emergency response times, and improve recovery.

### 3.1.2 Bow River Segment 2

This segment of the Bow River (Figure 4) extends from upstream of the Bow-Elbow confluence to the Bearspaw Reservoir, and is approximately 22 km long. This stretch of river passes through the heart of the city of Calgary. It encompasses several city parks, the Bearspaw Water Treatment Plant, and large sections of residential properties, curves around the downtown area and runs adjacent to the Calgary Zoo. Several islands are found in this segment, including three with significant development on them – Prince’s Island Park, St. Patrick’s Island, and St. George’s Island. Discussion focused on opportunities to remove obstacles in the floodplain, which may cause local and upstream flooding.



**Figure 4: Bow River – Segment 2**

Table 7 shows the initial scan of specific opportunities to further implement *Room for the River* measures along this river segment, as well as actions that have already been taken.

**Table 7: Initial Scan of *Room for the River* Opportunities for Bow River – Segment 2**

Measure	Apply?	What has already been done?	What options remain?
<b>DIVERSION</b>			
1. High-water channel	Maybe		
<b>CONVEYANCE</b>			
2. Dike relocation	Yes		<ul style="list-style-type: none"> <li>Buyouts in targeted locations to enable relocation of current or planned barriers</li> </ul>
3. Lowering floodplains	Maybe		<ul style="list-style-type: none"> <li>Where appropriate, as identified by the City of Calgary’s morphology study, complete targeted removal or lowering of gravel/cobble bars in the Bow main stem to remove resistance (e.g., above the 10<sup>th</sup> Street Bridge) for larger return period events (possibly 1:5 year event and greater)</li> <li>If appropriate, remove islands to increase flow capacity in the river; e.g., Prince’s Island Park, St. Patrick’s Island, St. George’s Island (Calgary Zoo Island)</li> </ul>
4. Removing obstacles	Yes	<ul style="list-style-type: none"> <li>Peace Bridge designed to let pass 1:100 year return period flood</li> <li>The new St. Patrick’s Island Bridge designed to be a free-span structure across the river channel</li> <li>The wide-span Stoney Trail Northwest Bridge is an example of a bridge designed to allow room for the river</li> <li>Removed grandfathering of flood fringe development requirements through Phase 1 review of the City of Calgary’s Land Use Bylaw and MDP</li> </ul>	<ul style="list-style-type: none"> <li>Minimize development in the floodplain through Phase 2 review of the City of Calgary’s Land Use Bylaw and MDP</li> <li>Reduce floodplain development through the City of Calgary’s Environmental Reserve Setback Policy</li> <li>Reduce floodplain development through the City of Calgary’s Riparian Strategy</li> <li>Minimize stormwater infrastructure in the floodplain</li> <li>Develop common goals with landowners in the river valley to promote land use that aligns with <i>Room for the River</i>; e.g., Western Sky Land Trust Project</li> <li>Modify Bowness Road Bridge (and possible TransCanada Bridge below) to remove constriction</li> </ul>
<b>DETENTION</b>			
5. Water Storage	Maybe	<ul style="list-style-type: none"> <li>Riparian maintenance through the City of Calgary’s Riparian Strategy</li> </ul>	<ul style="list-style-type: none"> <li>Improve riparian health and absorption through the City of Calgary’s Riparian Strategy</li> <li>Design light infrastructure spaces (e.g., parks, pathways, golf courses) to carry or temporarily store floodwater</li> <li>Urban stormwater ponds through the City of</li> </ul>

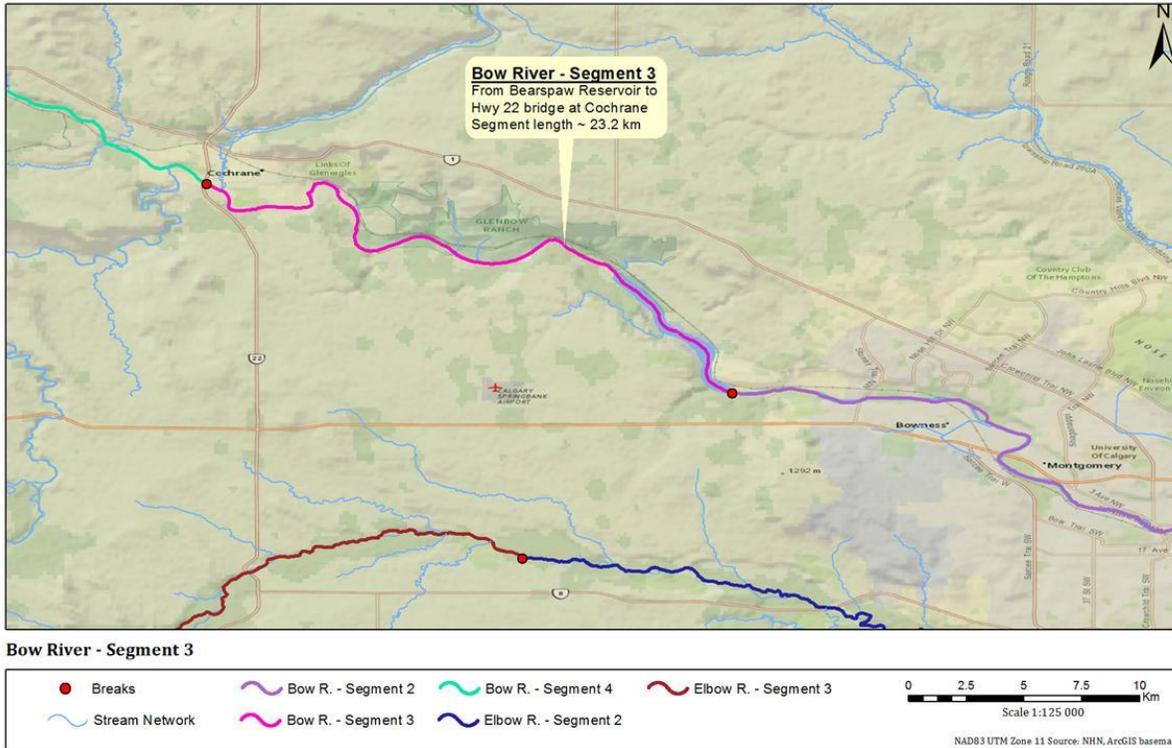
Measure	Apply?	What has already been done?	What options remain?
			Calgary's Stormwater Management Strategy <ul style="list-style-type: none"> <li>Promote wetland preservation and enhancement through City of Calgary's Wetlands Conservation Policy</li> </ul>
<b>OTHER MEASURES</b>			
	Yes		<ul style="list-style-type: none"> <li>Graduated flood protection level requirements</li> <li>Self-insuring new homes in the floodplain</li> <li>Improve riparian health and bank stabilization using the City of Calgary's Bioengineering Design Guidelines</li> <li>Dredge the main stem river bed in selected locations to increase flow capacity</li> </ul>
<b>LAST RESORT MEASURES</b>			
	Yes	<ul style="list-style-type: none"> <li>Raising the ground under riverside redevelopments (e.g. East Village) to reduce need for river flood barriers</li> </ul>	<ul style="list-style-type: none"> <li>City of Calgary River Flood Protection Conceptual Design Study currently studying flood barriers in key locations; e.g., Sunnyside berm, Bowness berm, automated barrier at Centre St. Bridge</li> <li>Update temporary flood barrier plans to protect against higher flood levels</li> </ul>

Additional commentary:

- Permanent barriers along this segment are more feasible than along the Elbow but still present a challenge because they would need to be about two metres high.
- Constructing dikes (berms) may be the most cost-effective approach to mitigating flood damages for some communities (e.g., Bowness).
- There are stormwater and groundwater issues in this area.
- Gravel/cobble bars can impede water flow, so their strategic removal or relocation within the riverbed might be a "no regrets" measure that could be quickly implemented. This should be very selective and possibly limited to areas that resulted from artificial encroachments.
- Buyouts were supported as a means for creating more room for the river in this segment. To avoid engineered infrastructure, much larger scale buyouts and removing large numbers of the structures would be required in this segment (e.g., Bowness). Conservation easements could be used in conjunction with buyouts to prevent future development in the floodplain. Likely the only feasible alternative to buyouts in this area is upstream infrastructure that carries risk of failure.
- Light infrastructure areas, such as golf courses and some parkland, could be deliberately allowed to flood under certain circumstances, but appropriate and equitable guidelines and agreements would need to be in place.
- Removing islands (e.g., Prince's Island Park, St. Patrick's Island, St. George's Island) would have considerable ecological and economic consequences, including reductions in riparian and fish habitat and loss of recreational areas and attractions.
- Public education on personal flood preparedness can help to reduce the impacts of flood events, improve emergency response times and improve recovery.

### 3.1.3 Bow River Segment 3

Segment 3 of the Bow River is shown in Figure 5. It extends for approximately 23 km between Bears paw Reservoir at the western edge of the city of Calgary and the Highway 22 Bridge in Cochrane. This area currently has little development except in the town of Cochrane although there are some residences along the banks of Bears paw Reservoir. Discussion focused on maintaining the room the river now has in this segment by minimizing future obstacles in the floodplain.



**Figure 5: Bow River – Segment 3**

Table 8 shows the initial scan of specific opportunities to further implement *Room for the River* measures along this river segment, as well as actions that have already been taken.

**Table 8: Initial Scan of Room for the River Opportunities for Bow River – Segment 3**

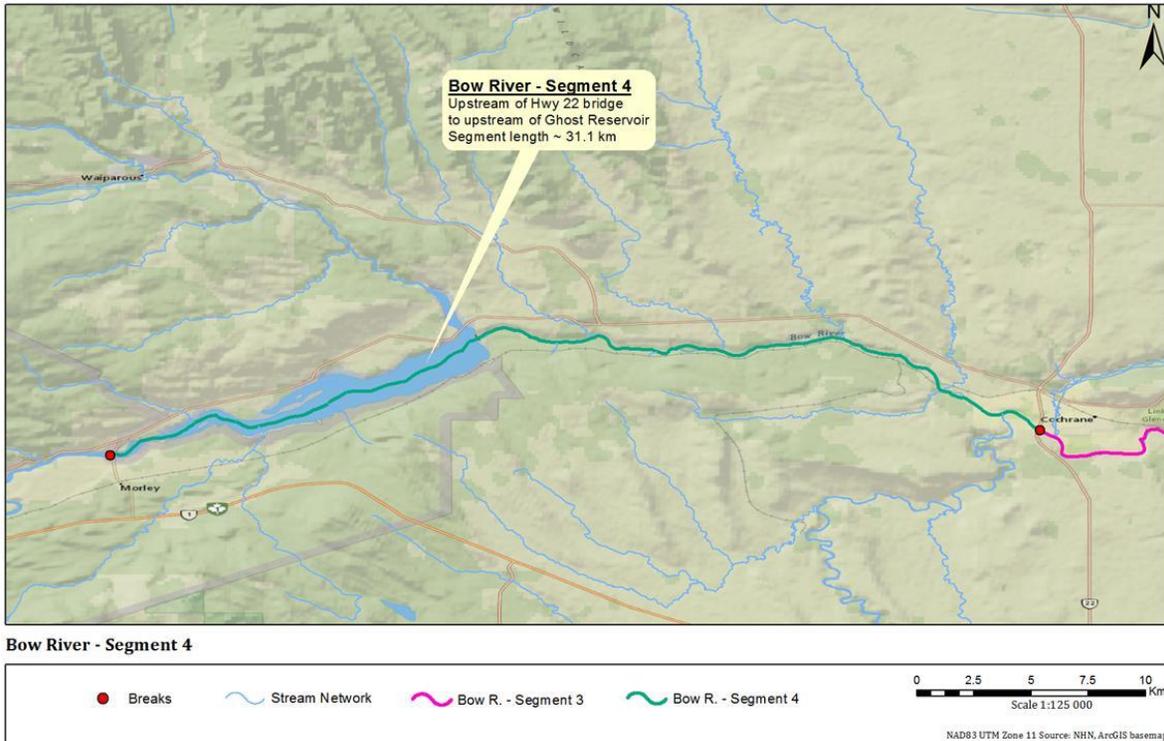
Measure	Apply?	What has already been done?	What options remain?
<b>DIVERSION</b>			
1. High-water channel	No		
<b>CONVEYANCE</b>			
2. Dike relocation	Maybe		<ul style="list-style-type: none"> <li>Relocate the berms near the CP railway</li> </ul>
3. Lowering floodplains	No		
4. Removing obstacles	Yes		<ul style="list-style-type: none"> <li>Minimize development in the floodplain; develop away from the river</li> <li>Limit development in the floodplain in the Cochrane area</li> <li>Minimize stormwater and water treatment infrastructure in the floodplain; if needed, build to minimize impact on river conveyance</li> <li>Design multi-use facilities throughout the watershed (e.g., bike paths in Glenbow Ranch park) to minimize impact on flow</li> <li>Assess the need to remove or lower select grave/cobble bars in the Bow main stem to remove resistance.</li> <li>Develop common goals with the landowners in the river valley to promote land use that aligns with <i>Room for the River</i>; e.g. Western Sky Land Trust Project</li> </ul>
<b>DETENTION</b>			
5. Water storage	Maybe	<ul style="list-style-type: none"> <li>Riparian health initiative to improve riparian absorption along the Glenbow Ranch</li> </ul>	<ul style="list-style-type: none"> <li>Enforce no net change in discharge on new developments above the floodplain; e.g. on the plateau above Glenbow Ranch</li> <li>Preserve Glenbow Lake wetland complex</li> <li>Dredge Bearspaw Reservoir to maximize freeboard for flood mitigation (limited benefit due to small size of reservoir)</li> <li>Allow low-lying open areas to temporarily flood (e.g., Glenbow Ranch Park or further west); may require diversion infrastructure for off-stream storage (dry dams on Bow not recommended for further study by GoA)</li> </ul>
<b>OTHER MEASURES</b>			
	Maybe	<ul style="list-style-type: none"> <li>Riparian bank restoration projects near Cochrane</li> </ul>	<ul style="list-style-type: none"> <li>Improve riparian health and function for bank stabilization</li> <li>Do not allow gravel mining in riparian areas</li> </ul>
<b>LAST RESORT MEASURES</b>			
	No		

Additional commentary:

- Much of the north side of the river in this segment is established as a provincial park but it is under growth pressure, particularly on the higher plateau above Glenbow Ranch Provincial Park and on the south side of the river, from both population and industrial activity. Of particular note is the important wetland complex that is under immediate threat in the Glenbow Lake area. As development occurs, there is a risk of losing absorptive capacity as areas are paved or otherwise made impermeable causing additional and more rapid runoff to the river system. The existing room for the river should be maintained to provide future flood mitigation.
- We need to better understand the role of groundwater in flooding and how development affects infiltration.
- It was suggested that there should be no armouring, dikes, or on-stream storage along the natural river portions of this segment. There may be some small opportunities for off-stream storage. The new Wetland Policy could offer some synergies with respect to storage and these can be explored.
- It was noted that removing gravel from the riverbed and floodplain probably should not, in general, be encouraged. However, some cobble/gravel bars may form in response to the choking caused by the bridge abutments in Cochrane that impede the natural river flow.
- The current gravel pits around Cochrane are high and set relatively far back from the river. Future gravel pit operations could perhaps be built in a manner to temporarily store some flood water, recognizing that the storage volumes of these gravel pits would be very limited. That said, the general sense is that gravel pits should not be operated close to the river.

### 3.1.4 Bow River Segment 4

Segment 4 of the Bow River (Figure 6) extends for approximately 31 km from upstream of the Highway 22 Bridge in Cochrane to upstream of Ghost Reservoir. From the Ghost Reservoir downstream to Cochrane, the river banks are sparsely settled although there is a gas processing plant adjacent to the river. The town of Cochrane did not suffer serious damage in the 2013 flood, but if the heaviest rainfall had been only 50 kilometres north, there could have been some risk to the town infrastructure from the Bow River. Discussion focused on maintaining the room the river currently has in this segment and advancing water storage opportunities using existing infrastructure.



**Figure 6: Bow River – Segment 4**

Table 9 shows the initial scan of specific opportunities to further implement *Room for the River* measures along this river segment, as well as actions that have already been taken.

**Table 9: Initial Scan of Room for the River Opportunities for Bow River – Segment 4**

Measure	Apply?	What has already been done?	What options remain?
<b>DIVERSION</b>			
1. High-water channel	Maybe		<ul style="list-style-type: none"> <li>Potentially broaden the river channel (natural channel design should be considered)</li> </ul>
<b>CONVEYANCE</b>			
2. Dike relocation	Maybe		<ul style="list-style-type: none"> <li>Relocate the berms near the CP railway</li> </ul>
3. Lowering flood plains	Maybe		
4. Removing obstacles	Yes		<ul style="list-style-type: none"> <li>Limit any further development in the floodplain; e.g., development on or near Ghost Reservoir</li> <li>Minimize new berms and hard bank armouring</li> <li>Implement and enforce wetland policy and riparian policy (for County) to reduce development in the floodplain and promote wetland maintenance</li> <li>Locate new energy industry infrastructure outside the floodplain and/or design it to have minimal impact on flow regulation functions</li> <li>Develop common goals with landowners in the river valley to promote land use that aligns with <i>Room for the River</i>; e.g. Western Sky Land Trust Project</li> </ul>
<b>DETENTION</b>			
5. Water storage	Yes		<ul style="list-style-type: none"> <li>Increase flood mitigation through operational changes to Ghost Reservoir, perhaps coupled with new off-stream storage to address drought risk</li> <li>Expand flood mitigation capacity of Ghost Reservoir through sediment removal (study underway)</li> <li>Expand flood mitigation capacity of Ghost Reservoir through upper reservoir bottom contouring to resolve fish stranding limitations</li> <li>Improve riparian health and absorption through Rocky View County’s Riparian Protection Land Use Bylaws</li> <li>Implement and enforce wetland policy and riparian policy (for County) to reduce development in the floodplain and promote wetland maintenance</li> <li>Increase emphasis on avoidance of wetland loss under the Alberta Wetland Policy in targeted areas; e.g., south of Bow River below Ghost Dam</li> <li>Do not remove beaver dams and log jams unless they increase flood risk</li> <li>Build weir infrastructure to temporarily flood open spaces; e.g., east of Wildcat Hills gas plant (on-stream</li> </ul>

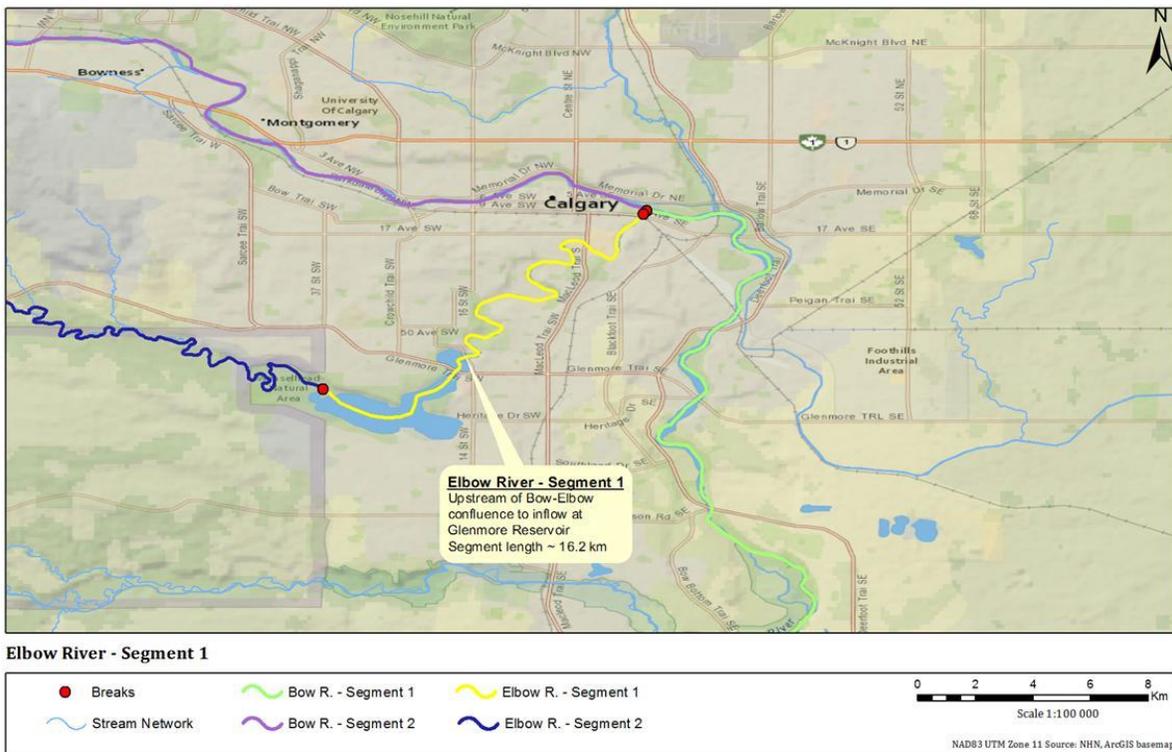
Measure	Apply?	What has already been done?	What options remain?
			<p>dry dams on Bow not recommended for further study by GoA)</p> <ul style="list-style-type: none"> <li>Assess the feasibility of temporary off-stream flooding upstream of Cochrane (dry dams on Bow not recommended for further study by GoA)</li> </ul>
<b>OTHER MEASURES</b>			
	Maybe		<ul style="list-style-type: none"> <li>Improve riparian health and function for bank stabilization through Rocky View County's Riparian Protection Land Use Bylaws</li> <li>Ensure Crown land areas continue to be protected and retained</li> </ul>
<b>LAST RESORT MEASURES</b>			
	No		

Additional commentary:

- Discussion of this segment looked at avoiding the need for berms and other flood mitigation infrastructure, and preventing development in the floodplain and near Ghost Reservoir.
- Other industrial development could also be located away from the river.
- Ghost Reservoir could be given a stronger mandate for flood prevention (with appropriate compensation).
- Ghost Reservoir mitigation should be coupled with enhanced riparian and land cover upstream of the reservoir to decrease sediment loading into the water body.

### 3.1.5 Elbow River Segment 1

This segment of the Elbow River (Figure 7) flows for about 16 km through Calgary, upstream of the Bow-Elbow confluence to the Glenmore Reservoir inflow. This segment is a naturally meandering portion of the river with several subsurface ancient riverbeds now buried under the city. It has been heavily developed with residential and commercial infrastructure all along its length through the city. The area around this segment of the river was heavily damaged in the 2013 flood event, due in part to obstacles that created severe local flooding in the relatively heavily developed areas encroaching on the flood way and flood fringe. It is believed that flood flows from the Elbow were involved in much of the flooding of the downtown areas, well away from this river. Residences and businesses near this stretch of the Elbow were evacuated and some areas are not yet back to normal operations. Discussion focused on opportunities to remove obstacles in the floodplain.



**Figure 7: Elbow River – Segment 1**

Table 10 shows the initial scan of specific opportunities to further implement *Room for the River* measures along this river segment, as well as actions that have already been taken.

**Table 10: Initial Scan of Room for the River Opportunities for Elbow River – Segment 1**

Measure	Apply?	What has already been done?	What options remain?
<b>DIVERSION</b>			
1. High-water channel	Yes	<ul style="list-style-type: none"> <li>Designated overland flooding route through Erlton</li> </ul>	<ul style="list-style-type: none"> <li>Elbow to Bow diversion tunnel (Calgary Glenmore Reservoir Diversion Tunnel is being further studied)</li> <li>Build a conveyance channel through Mission and the Beltline</li> </ul>
<b>CONVEYANCE</b>			
2. Dike relocation	Maybe		<ul style="list-style-type: none"> <li>Buyouts in targeted locations to enable relocation of current or planned barriers</li> </ul>
3. Lowering flood plains	Maybe		<ul style="list-style-type: none"> <li>Possibly lowering parkland already located in the floodplain</li> </ul>
4. Removing obstacles	Yes	<ul style="list-style-type: none"> <li>The Sandy Beach Bridge, Rideau Park Bridge and Riverdale Avenue Bridges have been redesigned to allow larger river flows</li> <li>Redevelopment restrictions are in place for the floodway and fringe (Land Use Bylaw/MDP Phase 1 update)</li> <li>Residential buyouts in the floodplain - 16 properties have been bought out by the Province</li> <li>Reducing floodplain development through the City of Calgary's Riparian Strategy</li> <li>The Calgary Golf and Country Club has remained set back from the river with the Audubon Certification</li> </ul>	<ul style="list-style-type: none"> <li>Look for opportunities to modify bridges to remove restrictions on the river (many utility tie-ins); e.g. 9<sup>th</sup> Ave. Bridge and rail bridge into Inglewood</li> <li>Remove or modify obstacles; e.g., the Stampede horse barns located in the floodway are designed to flood</li> <li>Apply mandatory riparian setbacks to all new development following the City of Calgary's Riparian Strategy</li> <li>Reduce floodplain development through the City of Calgary's Environmental Reserve Setback Policy</li> <li>Where appropriate, as identified by the City of Calgary's morphology study, remove or lower gravel/cobble bars in the river to increase channel conveyance capacity for specific flood events (i.e., for 1:5 year return period event and above); possible example is gravel bars at the second pier of the Mission Bridge</li> <li>Continue with appropriately designed residential buyouts</li> </ul>
<b>DETENTION</b>			
5. Water storage	Yes	<ul style="list-style-type: none"> <li>Urban stormwater ponds through the City of Calgary's Stormwater Management Strategy</li> <li>Preservation and promotion for wetlands through the City of Calgary's Wetlands Conservation</li> </ul>	<ul style="list-style-type: none"> <li>Increase storage in Glenmore Reservoir through infrastructure changes; e.g., gates to replace stop logs</li> <li>Increase storage in Glenmore Reservoir through a large scale infrastructure project (not recommended as the area does not allow for large increases in storage even if</li> </ul>

Measure	Apply?	What has already been done?	What options remain?
		Policy • Sandy Beach Community Association riparian re-establishment	surrounding communities were to be relocated) • Dredge the Glenmore Reservoir to increase live storage for flood mitigation (not recommended by the City of Calgary as it would provide very little storage at great expense and create environmental problems) • Design light infrastructure spaces (e.g., parks, pathways, golf courses) to carry or temporarily store floodwater
<b>OTHER MEASURES</b>			
	Yes	• Allowing building in the floodplain areas but requiring buildings to be resistant to flooding; e.g., community of Erlton • Riparian maintenance through the City of Calgary's Riparian Strategy	• Graduated flood protection level requirements • Self-insuring new homes at flood risk • Limit development in areas identified to be alluvial floodplain • Improve riparian health and bank stabilization using the City of Calgary's Bioengineering Design Guidelines • Raising the ground level at Stampede Park
<b>LAST RESORT MEASURES</b>			
	Yes	• Bank armouring through riprap, modified riprap or enhanced riparian zones; e.g.; bio-engineering banks of riprap with vegetation (willows, cottonwoods, etc.) near the Talisman Centre	• Barrier at 4 <sup>th</sup> Street to protect downtown core • City of Calgary River Flood Protection Conceptual Design Study currently studying permanent and temporary flood barrier options in key locations throughout the city • Update temporary flood barrier plans to protect against higher flood levels

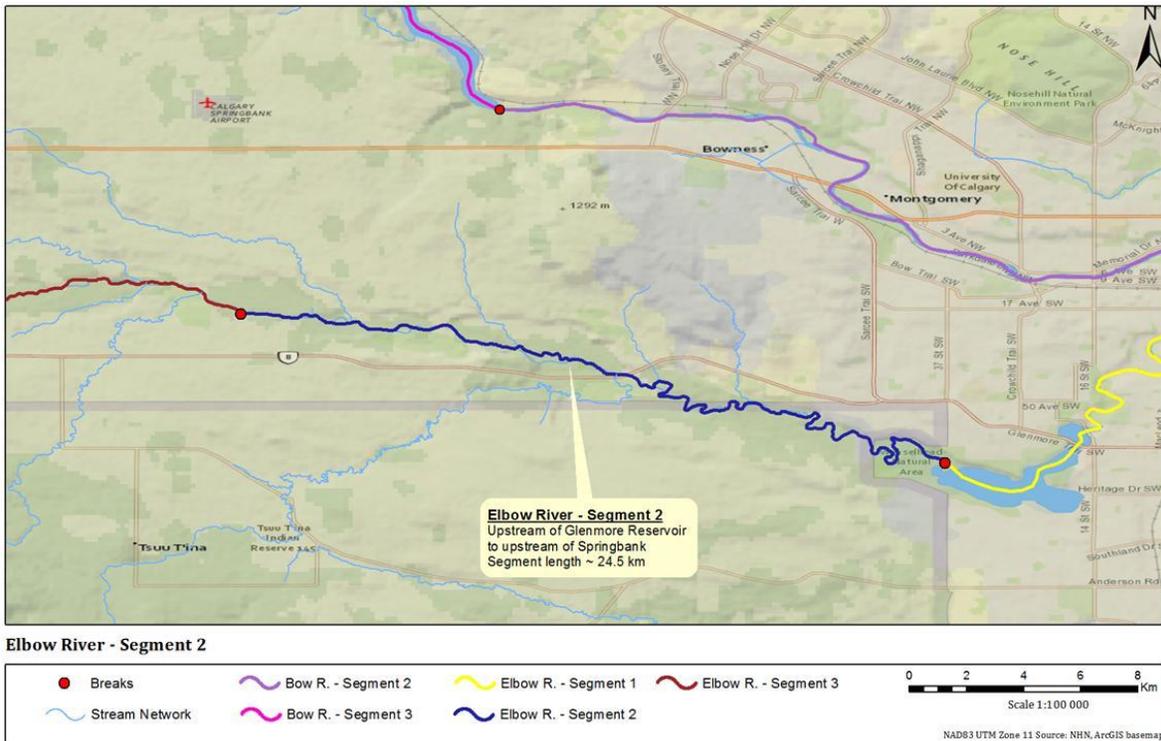
Additional commentary:

- Considerable development in this segment is near the river and there is little room for mitigation. The question was asked whether there is sufficient room left for the river in this segment. Relocations and buyouts in key locations continue to be raised as important. It was suggested that when a property goes on the market in a flood-risk area, the GoA could buy it at fair market value, remove the buildings, and use those properties as flood inundation areas. Furthermore, the buyout program could be extended from the flood way only to also include flood fringe properties.
- In addition to looking ahead at ways to mitigate impacts through flood-resistant construction, new infrastructure and buildings must be maintained to reduce damage from future flood events. Proper design targets and consistent standards need to be in place through building codes and other regulatory mechanisms. Assuming increased climate variability, current standards may well be out of date.

- There could be opportunities to work with partners such as golf courses, which might play a more significant role during flooding to hold back water then be repaired after an event with some compensation; however the storage volumes would be quite limited.
- It is worth exploring how flood mitigation measures could be made to have multiple uses and be aesthetically pleasing.

### 3.1.6 Elbow River Segment 2

This segment of the Elbow River (Figure 8) extends for approximately 24 km from upstream of Glenmore Reservoir to upstream of the Springbank community. This segment includes a meandering and braided river system as it approaches the lower end of the river before entering Glenmore Reservoir. Several golf courses, rural subdivisions, acreages, and expanding development from Calgary are located along this segment. The region is subject to considerable development pressure as an attractive, scenic, and close-in option for high end homes. Discussion focused on removing obstacles in the floodplain and looking for opportunities to create local, temporary storage or side channels.



**Figure 8: Elbow River – Segment 2**

Table 11 shows the initial scan of specific opportunities to further implement *Room for the River* measures along this river segment, as well as actions that have already been taken.

**Table 11: Initial Scan of *Room for the River* Opportunities for Elbow River – Segment 2**

Measure	Apply?	What has already been done?	What options remain?
<b>DIVERSION</b>			
1. High-water channel	Maybe		<ul style="list-style-type: none"> <li>• Create or expand secondary channels in natural drainage locations; e.g. a diversion from the Elbow into Fish Creek (not recommended for further study by GoA)</li> </ul>
<b>CONVEYANCE</b>			
2. Dike relocation	Yes		<ul style="list-style-type: none"> <li>• Move berms protecting golf courses back from the river and allow golf courses to flood</li> </ul>
3. Lowering flood plains	Maybe		<ul style="list-style-type: none"> <li>• Work with the extraction industry to target gravel mining in beneficial areas</li> </ul>
4. Removing obstacles	Yes	<ul style="list-style-type: none"> <li>• Continued enforcement of Rocky View County building codes to minimize obstacles and damage in the floodplain</li> <li>• Reducing floodplain development through City of Calgary’s Environmental Reserve Setback Policy</li> <li>• Reducing floodplain development through the City of Calgary’s Riparian Strategy</li> <li>• Setting back the new Gardner development south of the Elbow</li> </ul>	<ul style="list-style-type: none"> <li>• Modify the twin bridges on Highway 8 to make them wider span</li> <li>• Re-evaluate the SW Calgary Ring Road plan to include wide-span bridges over the Elbow that will maintain the river’s current room</li> <li>• Apply mandatory riparian setbacks to all new development through the City of Calgary’s Riparian Strategy</li> <li>• Where appropriate remove or lower gravel/cobble bars and impediments to increase conveyance capacity of river for specific return period flood events; i.e., &gt; 1:5 year return period</li> <li>• Develop common goals with landowners in the river valley to promote land use that aligns with <i>Room for the River</i>; e.g., Western Sky Land Trust Project</li> <li>• Allow golf courses to flood when needed by removing berms and being compensated for damages caused by the occasional flood; e.g., Elbow Springs Golf Course</li> <li>• Review and remedy poorly done bank protection or reclamation</li> </ul>
<b>DETENTION</b>			
5. Water storage	Yes	<ul style="list-style-type: none"> <li>• Mitigation using urban stormwater ponds through the City of Calgary’s Stormwater Management Strategy</li> <li>• Preserving and enhancing</li> </ul>	<ul style="list-style-type: none"> <li>• Identify areas that would be used for passive or active storage; e.g., parks</li> <li>• Promote further wetlands retention opportunities through the City of Calgary’s Wetlands Conservation Policy</li> <li>• Use root wads and log jams to slow water</li> </ul>

Measure	Apply?	What has already been done?	What options remain?
		wetlands through the City of Calgary's Wetlands Conservation Policy <ul style="list-style-type: none"> <li>Riparian zone maintenance through the City of Calgary's Riparian Strategy</li> <li>Preserving riparian absorption by restricting cattle in the riparian area; e.g., Alberta Agriculture Growing Forward program</li> </ul>	<ul style="list-style-type: none"> <li>Potential local high flow retention on Millbrook Creek in new Gardner development south of the Elbow</li> <li>Improve riparian health and absorption through the Rocky View County Riparian Protection Land Use Bylaws</li> <li>Improve wetland retention using Rocky View County's Wetland Conservation policies</li> <li>Evaluate the SW Calgary Ring Road plan as dry dam to co-function as in-stream storage in case of imminent flooding</li> </ul>
<b>OTHER MEASURES</b>			
	Yes		<ul style="list-style-type: none"> <li>Improve riparian health and bank stabilization; e.g., softening the area that was channelized around Highway 8</li> </ul>
<b>LAST RESORT MEASURES</b>			
	Maybe	<ul style="list-style-type: none"> <li>Raise the ground under riverside redevelopments; e.g., Discovery Ridge</li> </ul>	<ul style="list-style-type: none"> <li>City of Calgary River Flood Protection Conceptual Design Study currently studying flood barriers to protect communities upstream of Glenmore Reservoir</li> <li>Update temporary flood barrier plans to protect against higher flood levels</li> </ul>

Additional commentary:

- Using aquifers for natural underground water storage would likely have limited benefit as the rates of injection would only be a very small percentage of the flood flow rate.
- Root wads, log jams, and riparian absorption would have limited impact on slowing water, especially in very high-flow events.
- The break between river segments 2 and 3 should perhaps be revised as it currently divides the Springbank community.
- There are many examples of bank protection or enhancements that have resulted in the river being narrowed and having steeper sides. This channelizing could be softened by revisiting and restoring poorly-done bank projects, including the unregistered ones that have not been listed.

### 3.1.7 Elbow River Segment 3

Segment 3 of the Elbow River (Figure 9) runs for approximately 39 km from upstream of Springbank to Paddy's Flat campground. It passes through Bragg Creek and Redwood Meadows, both of which were damaged in the 2013 flood. The river system is largely natural apart from some acreages, rural residences, and small businesses until the river nears Bragg Creek and Redwood Meadows. Upstream of Bragg Creek the river is a focal point for year-round recreational activity for many Southern Alberta residents due to its proximity and relatively wild beauty and natural setting. Several campgrounds and recreational sites exist in or near the floodplain. Discussion focused on mitigating local risk by removing obstacles in the floodplain and creating upstream storage to mitigate flood damage in Calgary.

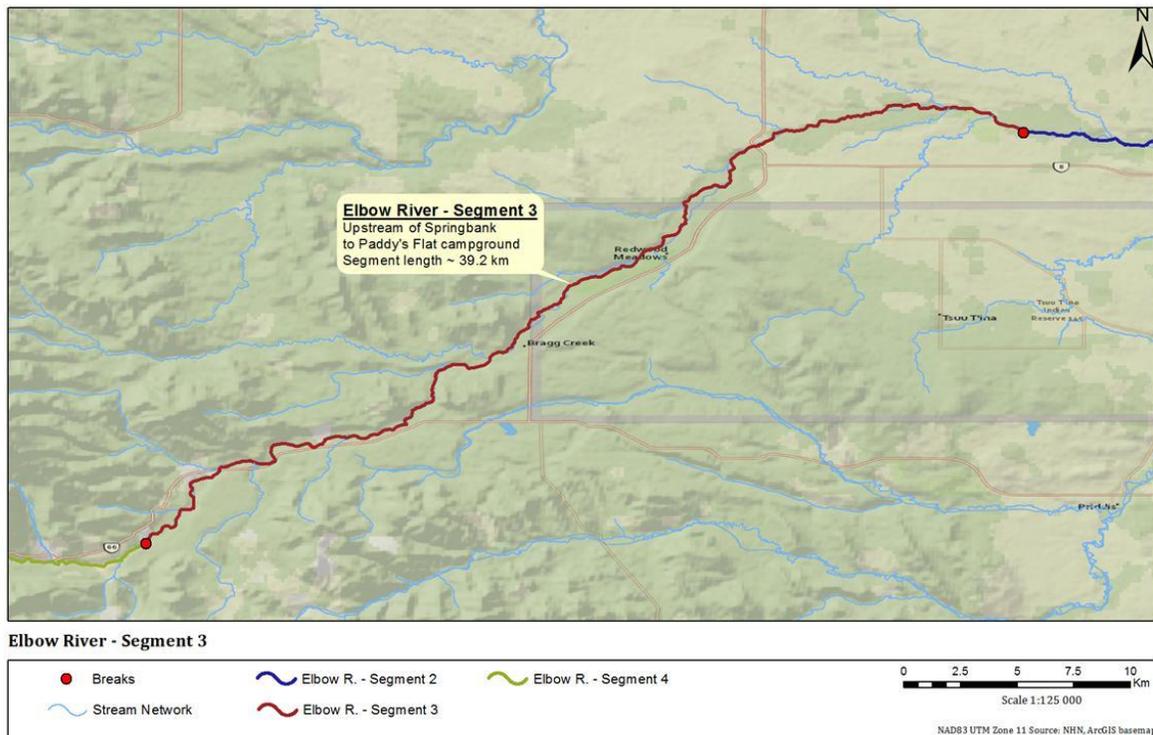


Figure 9: Elbow River – Segment 3

Table 12 shows the initial scan of specific opportunities to further implement *Room for the River* measures along this river segment, as well as actions that have already been taken.

**Table 12: Initial Scan of *Room for the River* Opportunities for Elbow River – Segment 3**

Measure	Apply?	What has already been done?	What options remain?
<b>DIVERSION</b>			
1. High-water channel	Maybe		<ul style="list-style-type: none"> <li>• Create or expand secondary channels in natural drainage locations; e.g., a diversion from the Elbow into Priddis Creek (not recommended for further study by GoA)</li> </ul>
<b>CONVEYANCE</b>			
2. Dike relocation	Yes	<ul style="list-style-type: none"> <li>• Modifications to Redwood Meadows berm</li> </ul>	<ul style="list-style-type: none"> <li>• Low density areas are heavily bermed; relocating berms in conjunction with buyouts should be examined</li> <li>• Relocate Redwood Meadows berm, recognizing land ownership implications</li> </ul>
3. Lowering flood plains	Maybe		<ul style="list-style-type: none"> <li>• Redesign or removal of the bedrock in the Elbow River around and/or through the town of Bragg Creek</li> </ul>
4. Removing obstacles	Yes	<ul style="list-style-type: none"> <li>• Continued enforcement of Rocky View County building codes to minimize obstacles and damage in the floodplain</li> <li>• Centennial Trail was moved up and out of the floodplain</li> <li>• Allen Bill pond is not being rebuilt</li> </ul>	<ul style="list-style-type: none"> <li>• Strictly implement the Rocky View County Plan which identifies growth and no-growth areas</li> <li>• Strictly apply riparian setbacks to all new development, no exceptions</li> <li>• Consider buyouts in the flood fringe in Bragg Creek (low density)</li> <li>• Use Bragg Creek as a pilot for implementing <i>Room for the River</i> in mitigation planning</li> <li>• Where appropriate, remove or lower the gravel/cobble bars in the Elbow above Bragg Creek (benefits need to be studied as this may only lower flood water levels a short distance upstream)</li> <li>• If appropriate, remove the groynes just upstream of Highway 22 Bridge to increase channel conveyance capacity (these groynes may protect the bridge abutments or a buried pipeline)</li> <li>• Widen the span of the Highway 22 Bridge north of Highway 8</li> <li>• Encourage the removal of Redwood Meadows and the berm instead of a lease renewal (very preliminary concept)</li> <li>• Develop common goals with landowners in the river valley to promote land use that aligns with <i>Room for the River</i>; e.g. Western Sky Land Trust Project</li> </ul>

Measure	Apply?	What has already been done?	What options remain?
<b>DETENTION</b>			
5. Water storage	Yes		<ul style="list-style-type: none"> <li>• Construct a dry dam above Bragg Creek (MC1 – currently being further studied)</li> <li>• Construct an off-stream reservoir for high flow storage in Springbank (SR1 – currently being further studied)</li> <li>• Improve riparian health and absorption through the Rocky View County Riparian Protection Land Use Bylaws</li> <li>• Improve wetland retention using Rocky View County’s Wetland Conservation policies</li> </ul>
<b>OTHER MEASURES</b>			
	Yes	<ul style="list-style-type: none"> <li>• The water treatment plant in Bragg Creek is located to withstand 1:100 predicted flood flows but is not designed to withstand high level floods at or within its walls</li> </ul>	<ul style="list-style-type: none"> <li>• Retrofit basements behind the dike to protect from seepage and groundwater flooding</li> <li>• Do not allow basements in new developments</li> <li>• Look for opportunities to widen the river course by removing obstacles in the Elbow upstream of Bragg Creek</li> <li>• Improve riparian health downstream of Bragg Creek before Calgary, east of Highway 22 before 101<sup>st</sup> Street</li> </ul>
<b>LAST RESORT MEASURES</b>			
	Maybe	<ul style="list-style-type: none"> <li>• Existing dike upstream of Bragg Creek was built to 1:20 year flood</li> <li>• Mountain River Estates has armoured banks and reconstructed intake</li> <li>• Riprap at Highway 22 Bridge north of Highway 8</li> </ul>	<ul style="list-style-type: none"> <li>• Berm and armour banks along the Elbow by Bragg Creek as suggested by the AMEC report (this was considered to address only parts of the flood mitigation solution)</li> </ul>

Additional commentary:

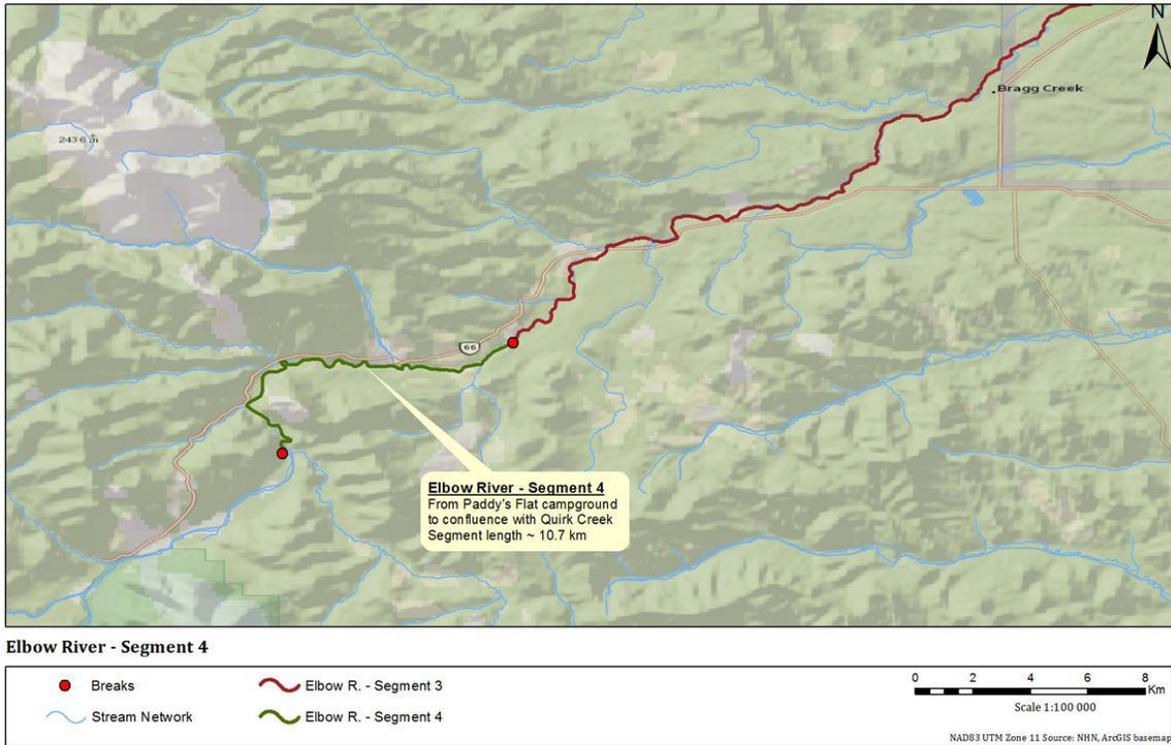
- Post-2000 buildings in Bragg Creek were largely undamaged by the 2013 flood, demonstrating the effectiveness of the County’s municipal development initiatives and permitting requirements.
- Relocating the Redwood Meadows berm would likely require a separate process as it is located on First Nations land.
- A groyne is a type of river training structure that is used to force local river flow in a specific direction. In the Alberta context, groynes are used primarily for erosion protection along a river bank; they modify the local direction of flow and local flow velocity but generally have minimal, if any, impact on flow rate. Any groyne structure creates an obstruction, or obstacle, in the river channel and tends to increase local upstream water levels. That is why the Dutch

are trying to remove and/or lower groynes along their river channels. Groynes would rarely be used in an engineered application to try and reduce water levels during a flood and they would have little value in terms of mitigating downstream flood impacts on the Bow River.

- Groynes can be designed to be more “fish friendly.” When banks are heavily armoured, groynes are often put in because fish do not like channelization and groynes act to reduce velocity directly downstream of the structure (similar to a large boulder) and thus may benefit fish in homogeneous stream channels. Generally, when considering impacts on fish, the best option is to leave natural stretches of the river alone.
- With respect to the groynes just upstream of the Highway 22 Bridge, it was noted that these groynes are protecting an exposed gas pipeline until it can be reburied and were meant as a temporary solution.
- The larger infrastructure measures being studied in this segment (SR1 and MC1) place the burden on this segment (primarily ranchers’ homes and their land) while the benefits are realized downstream (largely in Calgary). This imbalance is not typically favoured under the program in the Netherlands. In addition, the program in the Netherlands prefers to avoid large mitigation infrastructure because of its associated risk of catastrophic failure.
- Compensation for land required for larger mitigation measures has been approached in three different ways in the Netherlands: bought by the Government then resold with different conditions on use; bought by the Government and converted to public land; or a compensation arrangement was made with the current landowner. Compensation for SR1 may need to address many affected parties, not only the directly affected landowners.
- A diversion from the Elbow River into Priddis Creek was discussed in 2013 and not recommended for further study by the GoA. Concerns raised in that discussion included that the area already took large flows in 2013; additional diverted flow could further overwhelm the natural capacity and ecosystem as a new oversized channel would likely be created; there would be direct effects on nearly 500 landowners, water supply for local communities, infrastructure (roads, culverts, homes, recreation facilities, etc.), drainage, and groundwater; and the question of whether this option was simply transferring flood risk from one community to another.
- More science and data are needed to better understand the hydraulics of these river segments and the full impact any one of these mitigation measures may have – locally, upstream, and downstream. Specific examples suggested as needing additional science include the SR1 project and opportunities for secondary channels in natural drainage locations.
- From a broader watershed management perspective, it is important to consider the relative value of single purpose infrastructure; for example, the dry reservoir at SR1 might provide room for the river, but may not satisfy the broader needs of watershed management in times of drought as well as flood.
- Although several Flood Recovery Erosion Control projects were applied for and received preliminary approval, such as mitigation on the northwestern bank of the Elbow as well as through the extensive breakthroughs on the Herron property, these projects have not yet been granted the go-ahead from ESRD and hence, have not yet been addressed.

### 3.1.8 Elbow River Segment 4

Segment 4 of the Elbow River (Figure 10) extends from Paddy’s Flat campground up to the confluence with Quirk Creek, a distance of about 11 km. This segment is primarily natural with a naturally functioning river. Discussion focused on maintaining the room the river currently has in this segment and exploring opportunities for upstream retention, both small and potentially larger scale.



**Figure 10: Elbow River – Segment 4**

Table 13 shows the initial scan of specific opportunities to further implement *Room for the River* measures along this river segment, as well as actions that have already been taken.

**Table 13: Initial Scan of *Room for the River* Opportunities for Elbow River – Segment 4**

Measure	Apply?	What has already been done?	What options remain?
<b>DIVERSION</b>			
1. High-water channel	No		
<b>CONVEYANCE</b>			
2. Dike relocation	No		

Measure	Apply?	What has already been done?	What options remain?
3. Lowering flood plains	No		
4. Removing obstacles	Yes		<ul style="list-style-type: none"> <li>• Revisit building of campgrounds, boat launches, and access in the floodplain; either relocate amenities or build to have least impact on natural stream functions</li> <li>• Implement and enforce wetland policy and riparian policy to avoid development in the floodplain and promote wetland maintenance</li> <li>• Modify or remove structures that constrain flow during flood events, such as buildings, pathways, and bridges; e.g., review past and present infrastructure, and plan how to improve future design</li> <li>• Apply mandatory riparian setbacks to all new development following Rocky View County's Riparian setback policy, to potentially achieve a consistent approach throughout the watershed regardless of jurisdiction</li> <li>• Develop common goals with landowners in the river valley to promote land use that aligns with <i>Room for the River</i>; e.g. Western Sky Land Trust Project</li> </ul>
<b>DETENTION</b>			
5. Water storage	Yes		<ul style="list-style-type: none"> <li>• Identify areas that could be used for storage, following the example of the dry dam structures and removal of floodplain infrastructure in Ohio (not recommended for further study by GoA in this reach; MC1, which is still under consideration, is located in Elbow Segment 3)</li> <li>• Reduce and optimize location and design of multi-use facilities throughout the watershed (e.g., ATV trails) to minimize impact on flow regulation functions</li> <li>• Improve and retain wetlands by following Rocky View County's Wetland Conservation policies</li> <li>• Improve riparian health and absorption by following the Rocky View County Riparian setback policy</li> </ul>
<b>OTHER MEASURES</b>			
	Maybe		<ul style="list-style-type: none"> <li>• Improve riparian health and bank stabilization through Rocky View County's Riparian Protection Land Use Bylaws</li> <li>• Ensure Crown land continues to be protected and retained</li> <li>• Improve riparian health and bank stabilization; e.g., woody vegetation at stream crossings</li> <li>• Do not remove beaver dams and log jams unless they increase flood risk and/or engineer or promote log jams to provide upstream retention of water</li> </ul>
<b>LAST RESORT MEASURES</b>			
	No		

Additional commentary:

- This river segment is recognized as being quite dynamic as seen by its movement after the 2013 floods. Maintaining room for it to move was stressed as a priority for local benefit as well as for its role in attenuating flood flows as they move downstream.
- Engineering log jams to provide upstream retention of water can lead to downstream problems in the event of failures and can pose a barrier to fish movement.
- Land use controls in the headwaters, such as protecting and enhancing wetlands, improving logging practices, and better managing ATV routes can provide flood mitigation benefits as well as improve water quality and riparian health.
- Dry dam structures and removal of floodplain infrastructure are paired techniques in Ohio's flood mitigation. Dry dams have been discussed extensively in Alberta since June 2013 highlighting: the differences between the Ohio and Alberta locations; the burden of new dam infrastructure from an operations, maintenance and reliability perspective; and the impact of a dry dam on sensitive headwaters with vital fisheries, ecosystems and habitat values and where unimpeded material transport is important.
- One area for consideration is the need for a consistent approach for river mitigation in jurisdictions throughout the watershed for land uses, setbacks, or barrier removal, rather than identifying opportunities for one municipality only. The GoA would need to be involved in this work and the approach would apply irrespective of jurisdiction.

### **3.2 “No regrets” Opportunities**

Having considered examples and opportunities within each river segment in the pilot study area, it was then possible to look across the system for potential “no regrets” opportunities, recognizing that it is difficult to achieve truly no regrets because there are trade-offs with every action. With input from the expert contributors, some practical and implementable “no regrets” opportunities were identified in two main categories: policies and decisions, and projects or actions. All these potential opportunities are consistent with the principle that the “straitjacket” for the rivers should not be tightened; that is, at a minimum these opportunities should not further constrain the Bow and Elbow rivers and where room for the river now exists, it should be maintained. Furthermore, to the extent possible, “no regrets” opportunities should not preclude future options for flood mitigation.

Some of these “no regrets” opportunities are basin-wide, others are common to several segments in the pilot, and others are specific to one river segment. Opportunities in the first category typically relate to policies, regulations and decision making, are broader in scope, and could take longer to implement. Opportunities in the second category are typically more specific projects or actions that could be advanced in the near term.

### 3.2.1 Possible “No regrets” Opportunities: Policies and Decisions

No priority is assigned to the possible “no regrets” opportunities shown in Table 14.

**Table 14: Possible “No regrets” Opportunities: Policies and Decisions**

Opportunity	Segment	Implementing the Opportunity
Map inundation and/or hazard across the whole basin to provide a base of knowledge for development, mitigation and recovery decisions, and enforcement	Basin-wide	Continue to fully fund the ESRD hydrology studies and flood hazard mapping projects currently underway, with the Bow River watershed as a first priority.  Integrate all government efforts and funding for mapping to benefit all and to be accessible by all, and include both rural and urban areas.
Document damage to infrastructure to retain institutional memory on flood impacts to inform future building and mitigation	Basin-wide	Document the cost of damages and lost business production caused by the 2013 flood, including insurance claims, provincial compensation, buyouts and other costs to repair damages to all infrastructure, berms, bridges, roads, etc. throughout the region.  Collect digital pictures and footage from media and others and compile into an online database for long-term public access.
Strengthen and enforce policy and regulation to halt or minimize new development in floodplains	Basin-wide	Have Alberta Municipal Affairs put in place clear province-wide guidance to more rigorously limit inappropriate new developments in the floodplain in all municipalities. As new mapping changes the floodplain parameters, areas may require more specific policy.
Ensure projects are rebuilding more robustly than before; e.g., new Glenmore Dam gates higher than original stop logs	Basin-wide	Research and apply best management practices (BMP) and/or best available technology (BAT) criteria to flood-related project applications for provincial funding or shared funding.
Revisit standards and incentives to promote building roads and bridges to leave more room for the river	Basin-wide	Consider a higher provincial standard for new infrastructure construction in the floodplain.  All projects applying for provincial funds or shared funding for transportation infrastructure should be assessed against stringent floodplain standards and criteria in order to receive funding and to proceed.
Establish more stringent guidelines for new pipeline and utility construction in or across floodplains	Basin-wide	The Alberta Energy Regulator and other responsible agencies (e.g., the National Energy Board) consult with private sector pipeline and construction companies to establish world class standards for all pipeline crossings of rivers and other water bodies.
Establish basin wide guidelines for “as needed” flooding of light infrastructure areas	Basin-wide	In collaboration with affected municipalities and parties, develop and apply guidelines for agreements related to use of such lands for periodic flooding, including compensation or restoration costs.
Stop the removal of log jams in the headwaters (where it is not close to flood risk) to maintain natural retention	Bow 4 Elbow 4	In collaboration with local municipalities, forest products companies, and other commercial and recreational users of the headwaters, establish clear

Opportunity	Segment	Implementing the Opportunity
		guidelines for dealing with log jams, beaver dams, and other natural flow blockages throughout the Bow watershed (with consideration given to potential flood or erosion risks) and apply through the South Saskatchewan Regional Plan (SSRP).
Strengthen and enforce land use BMPs to maintain the flow regulation and retention in the catchment	Basin-wide	Refine and establish BMPs for recreational and commercial/industrial land use and, as above, apply clear guidelines for treatment of natural streamflow impediments using the SSRP.
Improve monitoring of precipitation and river flow measurements as well as the methods and timeliness of public communications related to possible flood warnings	Basin-wide	Monitoring of precipitation and river flow is improving but information on appropriate emergency response needs to be shared by the data collectors with the public in an effective and timely manner. Timely communications among the US National Weather Service, Environment Canada, and provincial forecasting services as well as data from standardized and trained local citizenry measurements (such as is well-established throughout the US) can enhance early warning systems and provide real-time information during an emergency event.

### 3.2.2 Possible “No regrets” Opportunities: Specific Projects and Actions

No priority is assigned to the “no regrets” opportunities shown in Table 15.

**Table 15: Possible “No regrets” Opportunities: Specific Projects and Actions**

Opportunity	Segment	Implementing the Opportunity
Revise SWCRR plans to include a wide span bridge, preserving the room for the Elbow River	Elbow 2	As a first step, evaluate what changes can be made under the current agreement to widen the spans of the SWCRR Elbow River Bridge and the Fish Creek Bridge, and ensure that triple bottom line accounting is incorporated in any plan revisions.  Consider alternatives to optimize room for the river considerations at this location.
Secure long-term watershed agreement with TransAlta revising Ghost Dam operations for flood and drought mitigation and other basin interests	Bow 4	Such an agreement has the support of many key stakeholders in the Bow River Basin. That said, there are trade-offs between the local impacts on land owners and business operators and flood protection in Calgary.  A memorandum of understanding or preliminary agreement subject to further modelling, review, and consultation with stakeholders can and should be developed and in place prior to April 2015. This should be done in parallel with the broader public discussion already announced by the GoA.
Remove gravel above the 10 <sup>th</sup> Street Bridge as an example of targeted, science-based removal of flow obstacles	Bow 2	This measure is based on unnatural obstructions that cannot be removed and which then create unnatural obstacles to flood flow in certain instances. Provincial

Opportunity	Segment	Implementing the Opportunity
		<p>approvals and support should be put in place to assure rapid approvals from the federal Department of Fisheries and Oceans and other agencies. Because areas below dams tend to be gravel-starved, consideration could be given to putting any gravel removed through this measure back in the river at a place where it would be useful.</p> <p>Other similar obstacles throughout the basin should be evaluated and prioritized for removal in other river segments.</p>
<p>Increase emphasis on avoidance of wetland loss and encourage wetland restoration in targeted areas; e.g., south of Bow River below Ghost Dam</p>	<p>Bow 3 Bow 4</p>	<p>The Alberta Wetlands Policy establishes a clear priority for avoiding wetlands. This priority can be strongly favoured by ESRD in areas where flood and drought issues may be affected by wetland loss.</p> <p>Engage Ducks Unlimited Canada to investigate wetland restoration opportunities in targeted areas in collaboration with local Watershed Stewardship Groups.</p> <p>Preserve Glenbow Lake wetland complex that is under immediate threat from development</p>
<p>Revisit buyouts to secure properties that could make room for the river: past applications (e.g., Bragg Creek) and future market purchases (e.g., like Calgary Stampede did)</p>	<p>Bow 1 Bow 2 Elbow 1 Elbow 3</p>	<p>Initiate a review of unsuccessful buyout applications from 2013/2014.</p> <p>Extend buyout offer to selected floodplain residents, not just those in the flood way.</p> <p>Develop a long-term purchase program budget and process that enables buyouts whenever flood zone residential properties come on the market to gradually make more room for the river in high hazard areas.</p>
<p>Pilot a community (e.g., Bragg Creek) through RftR planning process to identify effective mitigation measures</p>	<p>Elbow 3</p>	<p>Apply a local version of the Dutch five-step process for flood mitigation selection to a flood-affected community; e.g., Bragg Creek. A somewhat larger region may need to be involved to enable RftR measures to be effective rather than focusing on a single small stretch of river. In either case, it is important to discuss with upstream and downstream stakeholders rather than in isolation.</p>
<p>Run a community through an education and mini RftR process (Dutch tool and communication techniques with tangible outcomes)</p>	<p>Elbow 3</p>	<p>Apply a local version of the Dutch communication and education techniques to raise the understanding of flood mitigation to a flood-affected community, e.g. Bowness.</p>
<p>Build the critical barriers already identified; e.g., Bonnybrook WWTP, automated gates at Centre Street Bridge</p>	<p>Bow 2</p>	<p>Protect high value areas in the flood way and flood fringe that cannot feasibly be removed should be a high priority. Work with municipalities to identify and categorize vulnerability and risk, then prioritize. Establish multi-year budgets and design, build, and operate the required infrastructure.</p>

Opportunity	Segment	Implementing the Opportunity
Fund the already identified Watershed Resiliency and Restoration Program projects to achieve the RftR objectives and measures	Basin-wide	Focus funds within the ESRD program to strengthen all flood- and forecast-related areas and focus on flood hazard regions and locations as a first priority.
Engage recreational users and all landowners, both urban and rural, in the Bow and Elbow river valleys regarding land characteristics, land use, and potential opportunities for restoration, enhancement and preservation.	Basin-wide	<p>Support the conservation approaches already underway. GIS mapping of all land parcels, tenureship and prioritized conservation has been completed for the Bow and Elbow rivers. Western Sky, based on previous success of this program along the lower Bow River, is now undertaking two-year outreach with roughly 250 landowners along these rivers.</p> <p>Support the education and awareness building efforts already underway, many through the resident Watershed Stewardship Groups.</p> <p>Outreach to urban dwellers should include information on low impact development and permeability, the importance of flood preparedness, and the need for everyone to be informed and take responsibility for their own decisions and actions.</p>

### 3.3 Suggestions on a Potential Broader Program, Process, and Engagement

#### 3.3.1 How a *Room for the River*-type Program Might Look in Alberta

The initial research on the Dutch experience and input from contributors led to the identification of several key features that should be part of a *Room for the River*-type program in Alberta. These are described below and all components are viewed as important.

#### **An integrated watershed and river management approach should be the basis of a program for Alberta.**

The program in the Netherlands offers a good example from which to learn, bearing in mind that important climatic, geographic, hydrologic, physiographic, and demographic differences exist between Alberta and the Netherlands. The Dutch experience relies heavily on engineered structural changes, while Alberta has committed, as reflected in the GoA's document *Respecting our Rivers*, to a broader approach that includes promoting natural river functions for flood mitigation wherever possible. Contributors to this pilot project stressed there is no single solution. An integrated watershed management approach, including the headwaters, the tributaries, and all downstream reaches, should be the path forward for Alberta, using all available tools (useful and accurate data and models, municipal and provincial regulations and guidelines, conservation easements, best management practices, triple bottom line analysis, and others). This includes determining the potential effects that actions in one area might have upstream, downstream, and across the entire watershed.

**An Alberta program must have a clearly stated purpose and objectives and well-defined design parameters.**

Are we trying to reduce the probability of a flood occurring? Reduce the risk to people when a flood does occur? Improve watershed health so flood hazards are better absorbed?

In defining the program objectives, it is critical to distinguish between flood hazard and flood risk: hazard refers to the potential of floods to cause harm, while risk reflects the probability that actual harm occurs to people, their property, and infrastructure. As long as people stay out of the way of a hazard, there is no risk.

This stems directly from the Dutch program where the first thing they did was define and then communicate what level of flood protection they wanted to achieve and how they planned to work with stakeholders to achieve it. For Alberta, the starting point should be GoA leading work to define clear objectives for both flood and drought mitigation so that potential actions can be evaluated in a systematic way against those objectives. Without such objectives, piecemeal actions will be taken, designed to different levels of flood protection, with no indication of how they might complement each other. The Bow River Basin Flood Mitigation and Watershed Management Project<sup>8</sup> took a step toward this when it collaboratively modelled and assessed a long list of mitigation options, both individually and in combination, against a suite of target flow rates for the Bow and Elbow rivers.

**The objectives for a program of this nature need to be organized and defined in a manner that is tangible and understandable to the basin residents.**

Two potential frameworks were suggested through the course of this pilot:

Potential Framework 1 is simple and easy to communicate:

1. Diversion – channel high flows around infrastructure
2. Conveyance – create a larger river cross section to allow high flows to pass
3. Storage – detain high flows temporarily
4. Other
5. Last Resort Measures – protect infrastructure from high flows

Potential Framework 2 is slightly more technical, highlighting the hydraulic aspects of the measures:

1. Increase natural retention in the headwaters to reduce flood peaks.
2. Maintain breadth in the upstream floodplain to attenuate flood peaks by lowering and widening the flow distribution curve, and thus lowering the downstream risk.
3. Create conveyance capacity through the floodplain to minimize risk.
4. Create upstream storage to reduce flood peaks and lower the downstream risk.

**With integrated water management as the premise, this type of program should consider all concerns and issues of water management, while remaining focused on flood mitigation.**

Given the complex dynamics of the basins, a flood mitigation program should not be pursued in isolation from other water management considerations in the basin. To that end, integrated water management would include:

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<sup>8</sup> See <http://albertawater.com/work/research-projects/resilience-and-mitigation-branch> for more information.

- Safety and Security = managing flood risk
- Water Supply = managing drought risk
- Water Quality = managing minimum flows for healthy aquatic ecosystems, biodiversity, drinking water, and recreation

Each of these could be established as parallel but interdependent efforts, each with specific objectives and a manageable scope. An effective and resilient flood mitigation program must always be considered in the larger context, seeking as much synergy with the other objectives as possible. Most importantly, there must be a line of sight across the objectives for each effort to ensure a comprehensive, integrated set of water management goal for the basin.

**The name of an Alberta program would likely differ from the program in the Netherlands given the different context and expected objectives.**

With the Netherlands' primary focus on increasing conveyance capacity, using the word "room" is highly appropriate. The purpose, objectives, and goals should inform the program name in Alberta; the name might include the words "respect", "retain", or "make room for" the rivers, for example.

**Sufficient science, data, modelling, study and open communication are required to enable informed and timely flood mitigation decisions.**

Science-based tools including wetland and groundwater inventories, cumulative effects studies, mapping, and associated engineering and ecological studies should be part of the program planning and design phase. Data are needed in specific areas to determine solutions that make sense locally. In the headwaters, for example, data are not available to show the extent to which land use and land management changes might mitigate a flood event.

Flood maps need to be updated and better flood modelling, monitoring, forecasting, and improved communication and warning systems are also needed. Evaluation of costs and benefits, along with social implications of proposed measures, need to be completed prior to moving forward. Economic analysis of potential engineered solutions should cover the full length of time that infrastructure or management practices might have an impact. Long term operating and maintenance costs can have considerable financial implications over a 50- to 100-year time span. As important is a thorough evaluation of the potential "side-effects" or unintended consequences over such long planning horizons.

Such information is the basis for determining risk, developing policy, and designing mitigation projects. Outside of the City of Calgary, there is limited hydraulic data. This makes it very difficult to specifically and locally assess the potential benefits (in terms of water level reduction) that might be realized by implementing the potential *Room for the River* measures identified in the individual river reaches.

This element will take some time to complete, but first requires a commitment to do it. Backed by sound science, the need for policy or legislation that, for example, stops or minimizes development in the floodplain, becomes clear and convincing, and policy development itself becomes more straightforward. Alberta-focused work would also enable the GoA to apply what has been learned elsewhere to our own unique circumstances.

**The planning timeline should be extended, while recognizing that some actions can and should be implemented quickly.**

The Dutch experience demonstrates how long it takes to raise awareness and change mindsets about flooding and mitigation, build social and political capital, and work through a thorough assessment of the hydraulic impact and true costs and benefits of potential mitigation options. As part of a solid and ongoing process, long-term (perhaps 25-50 years) watershed management plans should be developed that provide for periodic progress reports on mitigation activity. Progress reports could be done every five years perhaps with Watershed Planning and Advisory Councils (WPACs) and Watershed Stewardship Groups providing an appropriate venue for this type of engagement and activity.

Clearly it takes time to do the planning and analysis needed to establish a solid scientific and economic foundation for decisions that are likely to involve significant public funds over the long term. In the Netherlands, the program has been running for 14 years and began with a firm policy direction and budget commitment. This important work should not be rushed. Alberta cannot reasonably expect to distill three decades of Dutch experience, including redefining their risk levels, to “no regrets” or “quick wins.” It is reasonable and often necessary to develop long-term plans with many short-term objectives and actions built in. There is some urgency to act so that people do not become complacent and forget the importance of being prepared for the next flood event. Many effective mitigation options are known and can be implemented quickly (such as an agreement to modify upstream reservoir operations on the Bow River), while others, such as moving people and infrastructure out of the floodplain, will take longer.

It behooves Alberta to put appropriate policies and plans in place in a timely manner so when the next flood comes, a rapid and effective response will be possible. Contributors to the pilot were keen to see action on options that could be implemented in the next year.

**An Alberta program needs to take into account land tenureship.**

The suite of potential mitigation activities will vary dramatically across a basin, and land tenure may well influence what options are feasible and what can be implemented. Land tenure in the Bow River Basin includes Crown land, large tracts of First Nations land, private rural landholdings, provincial grazing leases, and urban centres. Other basins are likely to have a similar diversity of tenure and different approaches will be needed for each, ranging from voluntary incentive-based tools to mandatory government-led mitigation projects.

**3.3.2 How the Process Might Move from Scan to Prioritize to Implement**

Contributors were enthusiastic and offered many useful insights and comments about a potential process. They recognized that substantial effort has been exerted since the 2013 flood and that the evaluations and comments collected during consultations since the flood should inform any potential *Room for the River*-type program and process. The next steps will be critical to maintain momentum and advance the work.

An important aspect to long-term success of such a program in Alberta will be changing the way people think about living beside a river, both in terms of risk and responsibility. **Raising awareness and**

**understanding about watershed functions and how flooding affects a community and individuals** would be a good place to start, using materials developed specifically for the watershed.

**Connection to other activities needs to be well navigated;** for example, Bill 27 only deals with development in the floodway. The GoA needs to quickly provide guidance to municipalities to address continuing development and construction in the flood fringe so that municipalities can shift away from business-as-usual. It is relatively straightforward to impose land use controls in greenfield development but very complex in redevelopment where social, economic, and other functions are already in place. If further room is given to a river, what is flood fringe today can be floodway tomorrow. Our rivers are migratory. That is one of the essential elements that nature demands and an important characteristic that makes our rivers beautiful. Further, developing a consistent approach to setbacks throughout the watershed, regardless of jurisdiction, should perhaps be contemplated. A consistent approach for flood mitigation across jurisdictions throughout the watershed would need to work in concert with municipal programs and standards. More broadly, alignment between a *Room for the River*-type program and the flood mitigation objectives that exist in documents such as *Respecting Our Rivers* would need to be clearly established and communicated. Finally, Alberta is already committed to meeting other water management objectives that differ from the Dutch situation. The Bow River Basin is closed to new water licences, it supports an extensive irrigated food production industry, it contains many valued environmental and recreational resources including a world renowned sport fishery, and is not used for any appreciable commercial navigation. Any flood mitigation efforts should ensure that existing objectives continue to be met.

More broadly, **communication of knowledge, data, and other scientific findings between jurisdictions needs to improve.** These same jurisdictions also need to communicate and collaborate on watershed planning and emergency planning, which could be facilitated through an initial desk-top modelling simulation exercise and regular sessions every few years to ensure progress is made on weaknesses or failure points.

It was recognized that **selecting the scale of the study area is a challenge.** While there is a desire to have manageable river segments to consider measures for each reach, it is important to remember that the river is an integrated holistic system. This issue can be addressed by applying an integrated and open model to assess interdependencies within the entire river system from headwaters to confluence and beyond.

It was noted that evaluation of options must be comprehensive and take a triple bottom line approach that considers environmental, social, and economic impacts. The next phase – **prioritization of opportunities – must be systematic, based on facts and data, objective-driven, and transparent.**

Well defined and managed collaborative governance would be fundamental to the success of such a prioritization exercise. Given the many complexities and interdependencies within the water management system, **the roles, responsibilities, and decision-making authority of all involved parties** would need to be clearly defined and communicated. This would be especially important to the many municipalities whose residents are directly affected by the resulting decisions, as well as irrigation districts, livestock operations, and other water users.

Having been through a thorough prioritization process, the Dutch are now in a position of having **well-studied options available to them for implementation if and when the need arises**. This body of knowledge and options allows them to plan well ahead into the future as well as leverage windows of opportunity for implementation when the public will, political will, and budgets are available.

The program in the Netherlands has been and continues to be **supported by long-term funding and national level policy**. This has been fundamental to the program's ability to invest in the necessary research, education, and broad engagement, as well as take a leadership role in driving challenging social change. In Alberta, a continuing dialogue involving public, technical, and policy experts will be needed to further develop this approach, and financial implications should be clearly defined.

### **3.3.3 What Engagement Might be Appropriate**

**Many individuals and organizations should be engaged in any new Alberta program and its corresponding discussion.** Municipalities and the GoA in particular need to work very closely together to identify and decide on appropriate mitigation strategies.

The importance of communication and raising awareness with the general public and flood-affected communities is recognized as a key driver in the success of the program in the Netherlands. Significant effort was put into creating their Volume 1 document that summarized the research and debate that went into the development of the very specific objectives for the program. This **early communication elevated the common understanding of flood dynamics**, creating the necessary platform for an informed and productive selection of specific mitigation measures.

Further public engagement, building on that done in 2013-14 in Alberta, could occur that lays out options with the latest engineering and cost-benefit analyses, then people could work through an **exercise to examine trade-offs within a specified budget**. This is similar to the Dutch process and could give people a better understanding of the trade-offs involved in flood mitigation and broader water management decisions. An Alberta tool similar to the Dutch Planning Kit is already partially developed: an interactive river balance model has been completed with several dozen mitigation options available for testing against flow rate, interdependencies of alternatives and, in some cases, estimated flood inundation extents. What remains to be completed is a more refined interface for the public along with more specific costs, operating parameters and hydraulic impacts for some of the options.

### **3.4 Lessons from the Pilot Project**

This initial pilot was an excellent learning experience from both a planning and delivery perspective. If such a process were to be extended to other basins and over time, these lessons can provide valuable guidance.

#### **Take the time to get the right people in the room for the technical working session.**

Interest in this pilot project was high throughout the water community. The technical working group that provided input on November 14 already functioned very well at a high level. Representatives came from a diversity of organizations, bringing solid technical expertise and experience in water management issues. The facilitators spent considerable time in the initial

stages meeting individually with key participants and influencers to explain the approach, expected outcomes, and scope of the pilot. This early communication effort was invaluable in securing the engagement of critical participants and in gathering material and insight to bring to the full working group for discussion.

Because many of the working group members already knew and had worked with each other, they had a high degree of trust and cooperation. This collaboration was critical to the pilot's success and the same core group should be used again for any further work on the Bow River Basin. Although there was comfort within the group, application of the Chatham House Rule<sup>9</sup> was a valuable addition to the process.

**Early presentations to key municipal groups are vital.**

Presentations in advance of the working session to key municipal groups such as the City of Calgary and the MD of Rocky View gave participants more detailed information and enabled them to come better prepared to the working group session. By also giving them a chance to ask questions and provide comments, the facilitators could clarify aspects of the pilot and refine materials if needed.

**Establish different forums through which different participant types can provide input.**

Beyond the technical working session, the project team worked with the WPAC – the Bow River Basin Council – to facilitate a separate opportunity to share the work to date and gather input from a broader, public group.

**Invest in doing the preliminary work (interviews, literature searches, and other methods) to collect and circulate information prior to the technical working session to help contributors prepare.**

This advance work creates a draft scan of what is already being done in the basin and where future options exist. With this provided in advance, contributors could focus at the working session and drill down into details and specifics as appropriate. It made more efficient use of time and enabled a much more productive discussion.

**Clearly reference the relevant studies and decisions already made.**

Extensive flood mitigation studies, workshops, and decisions have occurred since the June 2013 floods. The project team was diligent in bringing this foundational material into the pilot to ensure the project and the associated discussion built on and did not replicate previous work or revisit prior decisions. Communicating and managing this element took considerable effort, required constant attention, and will need careful management if this pilot is expanded to other river basins in the province.

**Be consistent and clear on the scope of the work.**

Such a project could potentially become very large and unwieldy. Deciding early on what is in and out of scope is essential to keep the work manageable and prevent discussions from getting off topic. Once those parameters are set, they should be consistently and clearly communicated in written work, presentations, and discussions with participants.

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<sup>9</sup> When a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed.

**Provide a relevant and reasonable set of maps and data and ensure they are presented at a scale that is useful.**

For a project like this, the volume of maps and data can be substantial and potentially overwhelming. It is important to take time in advance to select materials that are most useful and relevant. Slides should also be shown with appropriate audiovisual equipment to ensure they are legible.

**Allow the program measures and approach to be flexible to the needs of each basin.**

It was important to adapt the measures and language used in the Netherlands to reflect the nature and opportunities of the pilot study area. Interestingly, the measures that generated greatest discussion in this pilot (including retaining existing room for the river, building new upstream detention, removing obstacles, and local flood protection) were applied differently from those being implemented in the Netherlands (including relocation of dikes, depoldering, removing obstacles, and lowering the floodplain).

**Make sure participants and others understand this was a *pilot* project. Much more work remains to be done within a much larger and more complex discussion.**

This project was valuable and helped advance the thinking about flood mitigation on the main stems in the Bow River Basin, and it provides a sound basis for further actions, perhaps for more comparative analyses and longer term prioritization within these river segments. The pilot has also provided some good lessons for expanding the program to other river systems in Alberta. If further work is intended, a plan should be developed for how the program will be rolled out across the province and what resources will be dedicated.

The pilot provided a basis for decision making that has gone beyond mere consultation with potentially affected parties, into the realm of involvement and enabling water managers, participants, municipalities, and the water community to help set the agenda and develop practical mitigation actions, while understanding the implications that may flow from these actions.

Overall, contributors expressed strong support for the pilot and appreciated that it was tapping into the knowledge base resident in the basin. Input from the Dutch experts was appreciated and valued – both the experience they brought and as a challenging voice asking tough questions in the Bow River Basin. The GoA was urged to consider creating appropriate communications to share information with municipalities to let them know what is happening and how to provide input.

#### 4. Closing Comments

Contributors to the pilot strongly urged that Alberta protect its wild rivers and the health of the province's watersheds, that mitigation activities be grounded in respecting our rivers and their many values, and that the environmental, social, and economic trade-offs of the larger mitigation options be thoroughly understood. Adapting the *Room for the River* program and measures for Alberta offers a well-tested approach for driving productive, watershed-based assessment of mitigation, recognizing the differences in geography, hydrology, climate, geomorphology, and demographics between Alberta and the Netherlands. Any program that is developed and implemented here should take an integrated watershed management approach, dealing with flood and drought conditions, and using all available tools.

The initial scan of options was a useful starting point for the pilot and any subsequent program as it enabled a broad, systematic discussion of the pilot study area. It captured many different types of possible mitigation opportunities, emphasizing the importance of a system approach to flood mitigation as well as the need for thorough and data driven assessment to support prioritization. It helped the discussion move to identifying potential "no regrets" opportunities that could be advanced in the short term. Many lessons can be drawn from the program in the Netherlands on the nature of information, tools, engagement, and support needed to move successfully through this process.

Many mitigation options for the Bow River Basin main stems have been identified and are being implemented, but momentum needs to be maintained to advance work in other areas, particularly on specific projects and actions that are already known to be useful mitigation options. At the same time, work needs to continue on smaller projects and possible relocation opportunities, while ensuring efforts are made to protect riparian areas, fish habitat, and other natural features that are important to aquatic ecosystem health.

If a *Room for the River*-type program were to be developed in Alberta, the objectives, scope, and governance must be clearly defined and communicated. The program should have a name appropriate for the Alberta context. Objectives should be defined for safety and security, water supply, and water quality. It will be essential to raise individual and community awareness and understanding about watershed functions and the effects of flooding. And, perhaps most importantly, the program would need long term political, local, and financial support and accountability.

As noted earlier, this pilot garnered great interest from the water community in the Bow River Basin. Since the flooding in 2013, there has been an elevated level of awareness and discussion about water management in many parts of the province. The approach and purpose tested in this pilot offer a way to harness the public momentum and interest in water management, to build on the deep expertise and experience of those in the water community, and provide a long-term program for thoughtful and effective water management and flood mitigation throughout Alberta.

## Acronyms

ATV	All-terrain vehicle
BAT	Best Available Technology
BMPs	Best Management Practices
ESRD	(Alberta) Environment and Sustainable Resources Development
GoA	Government of Alberta
MDP	Municipal Development Plan
RAM	Resilience and Mitigation (Branch, of ESRD)
RftR	Room for the River
SSRP	South Saskatchewan Regional Plan
SWCRR	Southwest Calgary Ring Road
WPAC	Watershed Planning and Advisory Council
WWTP	Wastewater Treatment Plant

## **Appendix A: Contributors to the *Room for the River* Pilot in the Bow River Basin**

Many thanks to the following organizations who contributed their knowledge, time and expertise to the *Room for the River* Pilot in the Bow River Basin. In some cases, more than one representative from the organization was involved.

Alberta Agriculture and Rural Development  
Alberta Environment and Sustainable Resource Development  
(Fisheries, Forecasting, Bow River Operations, Resilience and Mitigation, and Parks Branches)  
Alberta Wilderness Association  
Bow River Basin Council  
Bow River Irrigation District  
Calgary River Valleys  
City of Calgary  
Cochrane Environmental Action Committee  
Cows and Fish: The Alberta Riparian Habitat Management Society  
Ducks Unlimited Canada  
Elbow Public Advisory Committee  
Elbow River Watershed Partnership  
Fisheries and Oceans Canada  
Highwood Management Plan – Public Advisory Committee  
Kananaskis Improvement District  
Municipal District of Bighorn  
Municipal District of Foothills  
Rocky View County  
Spray Lakes Sawmills  
Town of High River  
TransAlta  
Trout Unlimited Canada  
Western Irrigation District  
Western Sky Land Trust

Alberta WaterSMART and Deltares contributed through their contracted roles as project facilitators and content experts.

## **Addendum**

This addendum reflects the feedback received in response to the *Room for the River Pilot in the Bow River Basin – Advice to the Government of Alberta* report issued December 19, 2014. The *Room for the River Pilot* report was distributed online through the Alberta WaterPortal and the BRBC website and received further public attention from presentations, newspaper articles and radio interviews.

Public feedback on the report was welcomed until January 31, 2015. Feedback was received in writing through the Alberta WaterPortal, direct emails, verbally through one on one discussions and public meetings, and through publicity sources such as newspapers. This addendum summarizes the feedback received, without attribution, in bullet point form. The content found in this addendum does not necessarily reflect the views of other participants or the project team.

This addendum will be forwarded to the Government of Alberta (GoA) as advice as per the original *Room for the River Pilot in the Bow River Basin* objective. Furthermore, all feedback has been captured in its raw form and will also be submitted to the GoA. Content in this addendum has been ordered to reflect the organization of the original *Room for the River* report. Words in quotations reflect the language used by the responder. Feedback in its raw form will only be viewed by the authors of this report and the GoA.

## **1. Introduction**

- In Table 1 “Flood Mitigation Approaches” it was suggested that the traditional wet reservoir approach should be added. It was suggested that because water supply and flows are seasonal the utility of storage to balance flows, maintain environmental objectives and prevent flooding make it a potential alternative. The water supply environmental aspects of the Bow system make wet storage more valuable than in the Dutch context.

### **1.2 Scope of the Pilot Project**

- It was suggested that tributaries and headwaters should be included in the scope as this is where natural detention can be increased.
- It was noted that climate adaptability should have featured more prominently in the report.

### **1.3 Process and Approach**

- It was recommended that the author look at communities in the Western United States and Canada with similar topography, climate, and regional economics as a basis for this study.
- It was suggested that it will likely be a combination of both structural and non-structural solutions that would lead to optimum flood protection with minimal costs.
- It was suggested that solutions that have a far reaching impact and that take years or decades to fully realize, refine and operate should be emphasized.
- It was noted that the report appears to be a collection of thoughts – not analyzed, prioritized nor summarized. Additionally, the report does not link well to some intercity issues on both Bow and Elbow rivers.
- It was suggested that it would be beneficial to have cost benefit analysis as well as hydraulic modelling done for all of the proposed Room for the River measures before the initial scan is issued to the public.
- It was noted that an overall analysis of the river should be conducted and that the river should not only be analysed in separate segments; analyzing segments is fine for local solutions but the effect of the overall situation should be considered. For example, raising the dikes in Redwood Meadows will help protect the community but will likely cause more erosion downstream. The degree to which upstream river segments affect downstream segments should be quantified.
- It was suggested that clear, specific objectives should be agreed on and communicated.
- It was recommended that any reference to First Nations lands or waters should be prefaced by direct consultation and meaningful discussion with the impacted populations.

## **2. Room for the River Management Approach**

### **2.1 The Dutch Approach**

- It was noted that in the Dutch context, even with more than a decade of program development, the program continues to re-assess and refined design targets – this indicated the importance of consultation, process, documentation, and decision making structures (governance) from the start.
- It was noted that there is potentially a need to elucidate the role of private, government required, or voluntary insurance in the Dutch context since insurance can significantly affect the cost-benefit profile of various mitigation options.

## 2.2 The Southern Alberta Context

- It was recommended that the report consider the multiple jurisdictions in Alberta who have decision making power over the river systems as compared to the Netherlands. In Alberta there are federal, provincial and municipal jurisdictions which overlap. Due to this jurisdictional overlap it was suggested that single family housing, which may fall within multiple jurisdictions, can be negatively impacted in favour of other infrastructure. It was suggested that too much emphasis is placed on the protection of areas such as the Stampede grounds, city owned revenue properties and critical infrastructure and new developments in relation to protection of single family housing.
- It was noted that the report refers to several City of Calgary documents such as guidelines, strategies, conceptual design studies, etc. These should be enforced consistently and should not act as a “distraction” from the significant steps necessary to mitigate, protect and make room for the river.
- It was suggested that the list of differences between the river systems in the Netherlands and Alberta, as seen in Table 4, indicates that using the proposed measures from the Netherlands would probably not apply to Alberta.
- A number of changes were suggested to Table 5 “Room for the River Measures in the Alberta Context”:
  - Add the McLean Creek Dry Dam (MC1).
  - Move dredging from “last resort measures” into “conveyance”.
  - The original wording of “detention and other measures” is too weak and that ATVs and associated facilities are not the only problem. It was suggested that more discussion is required regarding clearcut logging in the upper watershed, especially around the wetlands; it was noted that this should be stopped in favour of more selective patch-cut approach.
- It was suggested that reinforcement of dikes and berms should not be characterized as “last resort”. Dikes and berms should be built and / or reinforced wherever doing so is the best option. The term “last resort” has a pejorative connotation that is not appropriate for Alberta.
- It was noted that there is support surrounding the idea that a number of steps can be taken that together achieve the level of protection and risk tolerance appropriate for areas to be defended. Where possible, upstream steps should be preferred to downstream steps. The cumulative impact of these steps must be considered when assessing residual flood risk. Land protected by upstream dams and other watershed management techniques might not require a berm. Houses behind an adequate berm might not need any additional protection. Additionally, it must be noted that if the river overtops a berm designed for a 1:100 return period then houses with their own 1:100 protection will not be protected.
- It was suggested that it should be plainly indicated that storage of around 100 M cubic metres is needed on Elbow to attenuate a 1:100 flood to a 1:10 flood. About 6 times this volume is needed on the Bow. These are very large volumes and exceed the practical amounts of storage available from ad hoc log jams, wetlands, or floodplain lowering schemes.
- It was suggested that land use should be considered in the project scope and that more emphasis could have been placed on maintaining the pristine upper catchments and limiting land use changes that could increase risk. We should be looking at the whole landscape for flood mitigation, not just the river that receives its water from the landscape. For example:

- If all motorized traffic was confined to trails designed to divert overland flow into vegetated areas rather than funnel it downstream;
- If logging ground rules required much more canopy retention to shade the spring snowpack and prescribed lower re-stocking densities so that regrowth is spaced, rather than closed-canopy;
- If beavers were protected from trapping or even supplemented by releasing problematic beavers from elsewhere;
- If permanent roads were built with bridges designed to function as small “dry dams” rather than with culverts that blow out in high water – then water would drain much more slowly to the larger rivers.

### **3. Advice to Government of Alberta from the *Room for the River* Pilot in the Bow River Basin**

#### **3.1 Initial Scan of the Bow and Elbow River Pilot Study Areas**

##### **3.1.1 Bow River Segment 1**

Suggestions regarding Table 6 “Initial Scan of *Room for the River* Opportunities for Bow River – Segment 1”:

- It was suggested that Cranston should not be referenced as a good example for water storage (stormwater detention). Many people associate it with development that is too close to the river.
- There were many suggestions that development in the East Village and construction of the new Calgary Public Library should be stopped.
- It was questioned why the East Village and other downtown infrastructure was not listed as potential obstacles to be moved.
- There was concern expressed regarding references in the *Room for the River* report related to raising floodplain lands before redevelopment in the East Village and Inglewood. It was noted that this appears to be inconsistent with the *Room for the River* approach.
- Additional points were suggested under “other measures”:
  - Flood awareness campaigns / public education.
  - Expanded or enhanced emergency response capacity.
  - Flood proofing and hardening of critical infrastructure.
  - Groundwater protection policy, mapping and / or infrastructure.

##### **3.1.2 Bow River Segment 2**

Suggestions regarding Table 7 “Initial Scan of *Room for the River* Opportunities for Bow River – Segment 2”:

- It was suggested that the statement “Minimize stormwater infrastructure in the floodplain” that appeared in the original *Room for the River* Pilot report is inappropriate for Sunnyside, where a significant cause of the flooding was due to inadequate stormwater infrastructure.
- It was recommended that engineering and feasibility studies should be conducted to determine whether certain components of existing storm sewer systems can be re-routed to non-flood plain areas.
- There was some support for buyouts in Bowness.

- It was suggested that other measures should include groundwater protection policy, mapping and / or infrastructure.

### **3.1.3 Bow River Segment 3**

Suggestions regarding Table 8 “Initial Scan of *Room for the River* Opportunities for Bow River – Segment 3”:

- It was suggested that other measures should include groundwater protection policy, mapping and / or infrastructure.

### **3.1.4 Bow River Segment 4**

Suggestions regarding Table 9 “Initial Scan of *Room for the River* Opportunities for Bow River – Segment 4”:

- It was proposed that in order to ensure the long-term sustainability of reservoirs along the Bow River system, sedimentation must be measured and addressed in a transparent and accountable manner. Data, results and the interpretation from the bathymetric study on the Ghost Reservoir must be publicly available. The operations of not only the Ghost reservoir, but all TransAlta reservoirs, must be re-considered in a different light. TransAlta should be required to submit bathymetric studies and maps to the Alberta Government on a regular basis and such information should be made publicly available.
- It was suggested that a natural way by which sediment infilling in the Ghost Reservoir can be reduced is to ensure that land-use in the Ghost River Watershed does not exacerbate soil erosion and run-off. A balance must be found between resource extraction, land-use, and protection of forest ecosystems not only in the Ghost River watershed, but all the upper watersheds of the Eastern Slopes.
- It was noted that if the Provincial government intends to take steps towards enhancing natural river and watershed functions for flood mitigation then the recommendations in the *Room for the River* Report for the Bow River Segment 4 should be followed. These recommendations outline long-term sustainable measures to enhance resiliency during flood and drought periods.
- It was suggested that other measures should include groundwater protection policy, mapping and / or infrastructure.

### **3.1.5 Elbow River Segment 1**

Suggestions regarding Table 10 “Initial Scan of *Room for the River* Opportunities for Elbow River – Segment 1”:

- It was suggested that a moratorium be implemented on all development on the river banks that will reduce the room for the river until a master plan for flood protection is in place and the potential impact of additional development is understood.
- It was suggested that the river should be channelled in areas such as 4th Street and downtown instead of berming.
- There were many concerns expressed regarding the suggestion of further buyouts.
- Strategic buyouts were recommended in order to make room for the river in an effective manner following a transparent strategy. There should be a restriction on future development if the purchase is consistent with a plan to make the remaining community safer.

- There was support for buyouts in Roxboro and Elbow Park.
- It was recommended to stop berming the Stampede grounds and to not raise these lands.
- It was suggested that the river should be dredged to increase conveyance.
- A respondent noted that in the Room for the River report deepening river channels did not get much comment. It was suggested that in the Elbow Segment 1, it would seem that deepening the river channel combined with berming could have a material impact on flood mitigation in Calgary communities.
- It was noted that “Relocation of current or planned barriers” should only be done only if the new barriers are a viable option considering all affected parties.
- Clarification was requested regarding “Self-insuring new homes at flood risk”.
- It was noted that in the Room for the River report dredging the Glenmore Reservoir is referenced as having “great expense” and was dismissed. Regarding this concept, questions were raised about the expense and how it compares to other alternatives. Respondents felt that more definition of the cost and impact should be available before dismissing dredging the Glenmore Reservoir.
- It is recommended that dredging the Glenmore Reservoir should be considered and studied further by an independent firm.
- It was noted that in other jurisdictions the reservoir intake has been lowered, albeit due to drought, this could be a future consideration by the City of Calgary. Further study on this option, together with the changes at the top of the dam, should be considered to determine the maximum protection the Glenmore reservoir can offer in the event of a flood.
- It was noted that other measures should include groundwater protection policy, mapping and / or infrastructure.
- It was questioned why the community of Mission was not listed as potential obstacles to be moved.

### 3.1.6 Elbow River Segment 2

Suggestions regarding Table 11 “Initial Scan of *Room for the River* Opportunities for Elbow River – Segment 2”:

- It was noted that Table 11 addresses some low volume storage options, such as Millbrook Creek and wetlands, however Figure 2 “Illustrative Relative Volumes – Bow River Basin Reservoirs and 2013 Flood Event” suggests these are unlikely to have appreciable impact. These projects are still likely to have habitat and water supply benefits however flood benefits may be insignificant.

### 3.1.7 Elbow River Segment 3

Suggestions regarding Table 12 “Initial Scan of *Room for the River* Opportunities for Elbow River – Segment 3”:

- There were many concerns regarding the option to “Encourage the removal of Redwood Meadows and the berm instead of lease renewal (very preliminary concept)” on page 31 in the Room for the River report. It was noted that the Redwood berm protects not only the community but also highway 22 and the high-pressure gas pipeline that runs along the right-of-way on the west side of the highway. It was also noted that if the option to remove

Redwood Meadows is to remain on the list other communities along the river should also be suggested for removal.

- It was proposed that a sensible and cost-effective mitigation measure is to invest in additional improvements to the berm along the Redwood Meadows community as well as to the north and south of the existing infrastructure. To do so, the province also needs to coordinate with the federal government to remove some of the roadblocks encountered during the planning for the north berm re-construction in the spring of 2014.
- A responder noted the original report incorrectly stated that the community of Redwood Meadows suffered from flood damage in 2013. In fact, the damage to Redwood Meadows was limited to severe erosion of the flood containment berm while the community itself only suffered from rising groundwater levels. Recent upgrades to the berm were designed to protect the community from the river flow rates experienced in 2013.
- It was suggested that there are two potential options in Bragg Creek in the flood plain:
  - One is to do nothing and have people flood proof their homes and businesses and help them pay for it. In essence this will make the entire flood plan available for the river.
  - A second choice is to channelize the river between dykes on either side of the river. Some properties would still have to be expropriated to provide the land for the dykes. Although this seems like a clear choice the design of this dyke system must force all the water in the river at peak flows into a very narrow space. The water will be moving at high velocity and it will not have the room it had in 2013. However, channelizing the river between two dykes presents a number of challenges including catastrophic breach of the dyke and non-river water trapped behind the dykes. There seems to be political and popular support for damming the Elbow River at McLean Creek. The respondent was not confident that such a dam can be 100% guaranteed to not unleash a flood through the Hamlet.

The respondent did not feel that the Room for the River approach offered a solution for Bragg Creek and felt the time used to study the issue could be used to move forward with solutions, mainly dyking.

- There was support for buyouts in Bragg Creek.

## **Comments referring to multiple segments**

### **McLean Dam (MC1) and Springbank Diversion (SR1)**

- It was noted by many respondents that the Dutch Room for the River the approach makes reference to the consequence of infrastructure failure and thus does not recommend large infrastructure solutions.
- Respondents commented that both MC1 and SR1 are large infrastructure solutions and that smaller more ecological based solutions may be favourable wherever possible.
- Many respondents noted that engineered structures such as dams and dykes should be considered temporary and potentially dangerous measures of flood defence.
- There were many requests for immediate release of the cost-benefit analyses for large flood projects as well as preliminary environmental analyses for MC1 and SR1 before final decisions are made regarding whether to proceed with these projects.

- There was agreement expressed with the statement “Compensation for SR1 may need to address many affected parties, not only the directly affected landowners” on page 33 in the Room for the River report.
- There was a perception among some respondents that the current approach of comparing large infrastructures costs of SR1 versus MC1 is misleading. Full cost comparison (financial, environmental, social and community) should be a core principle of a Room for the River approach in Alberta.
- One respondent perceived that the following costs are missing from the SR1 costs:
  - The money already spent for flood protection upgrades to Redwood Meadows;
  - The money already spent for flood repair to Bragg Creek, and for resident compensation;
  - The upcoming, approved , money to be spent for berm construction at the Tsuu Tina golf course adjacent to Redwood Meadows, and
  - The cost of private land acquisition.
- It was noted that the Room for the River report does not explore the risk and consequences of catastrophic failure of infrastructure for projects such as SR1 and MC1. It is recommended that significant infrastructure projects should be required to outline the catastrophic failure scenario and the available mitigation possibilities.
- It is recommended that infrastructure should be designed, built and operated to be reliable.
- It was recommended that those who benefit directly from the SR1 should pay an annual premium for the protection provided to them by SR1.
- Respondents opposed to SR1 stated the following concerns:
  - Risk of catastrophic failure;
  - Ecological damage;
  - Cost;
  - Negative impact to the community of Springbank due to degradation of ranch and farm land;
  - Flood concerns to upstream communities of Redwood Meadows and Bragg Creek are not addressed, and
  - Risk to drinking water quality degradation and well contamination.
- Respondents in favour of SR1 offered the following reasons:
  - Passes though already disturbed areas, and
  - Grazing could still occur in most years in the diversion area.
- Respondents opposed to MC1 stated the following concerns:
  - Risk of catastrophic failure;
  - Ecological damage – both upstream and downstream, and
  - Cost.
- Respondents in favour of MC1 offered the following reasons:
  - No land costs, therefore it should be less costly than the Springbank diversion;
  - Protection will be offered to Redwood Meadows and Bragg Creek as well as the City of Calgary;
  - Potential for recreation, and
  - It is situated up in the foothills area and there is room to install measures to safeguard against failure.

- One respondent noted that the Province of Alberta needs to explore alternatives which use natural ecological functions and create more biodiversity and habitat rather than destroy it as the Elbow McLean Creek Dam proposal would.
- It was suggested that consideration should be given to constructing smaller versions of both SR1 and MC1; a respondent felt there is an advantage in having two water control projects as a way of mitigating the effects of “catastrophic failure” at one of these sites.

### **Buyouts**

- It was noted that the incorporation of cost benefit analysis in determining buyout versus mitigation was always intended to be part of a rational risk management approach on floodplains but does not seem to have been implemented.
- It was suggested that commercial buyouts as well as residential buyouts should be considered in Calgary.
- Successful buyouts were cited as being a very important step moving forward. It was noted that the most important part of the report is the discussion / mention of a continuing relocation and buyout program. Not only should this be left in the report, but it needs to be emphasized.
- Some successful buyout programs were mentioned including: Mississippi in 1993, Grand Forks, North Dakota in 1997, Baker County, Georgia in 1994, Iowa, Charlotte Mecklenburg, Shepherdsville, Kentucky in 1998, and the US Federal Emergency Management Agency (FEMA). It was noted that the analysis of Shepherdsville’s buyout project shows an average return on investment to be 245 percent; meaning that an estimated savings of \$2.45 in property damages for each dollar invested has been realized since the project’s implementation.
- Many respondents opposed the suggestion in the Room for the River report that future buyouts of properties in the flood way or flood plain merit further consideration. Respondents noted that the flood of 2013 damaged most of the homes in Rideau, Roxboro, Erlton, East Elbow Park, Riverdale and many homes in Elbow Park proper. The flood did not stop at the edge of the flood fringe. So a buyout plan limited to the flood way or flood fringe would still leave huge sections of these communities under water.
- It was suggested that what would be fair to homeowners in the case of buyouts would be to include grandfathering and / or exemption clauses for properties that were developed prior to the 2013 flood; while regulating that future development is approached with flood mitigation in mind should approval be given.
- Many respondents expressed dissatisfaction with the 2013/14 buyout program and unease that future buyout programs will follow the same trend.

### **Other**

- It was recommended that if the revision of flood danger mapping for the worst case scenario has not been properly completed it should be completed immediately.
- It was recommended that consideration should be given to restrictions on municipalities to ensure they do not reduce the room for the river, increasing risk, liability and cost to both the government and individuals in existing developments. Areas that were specifically noted to restrict or stop development:
  - The East Village which will narrow the channel for the Bow;

- Major development and roads in the West Village narrowing the channel and directing water elsewhere;
  - High rise developments downtown; and
  - Development aimed to harden the north river bank of the Elbow.
- It was suggested that the present negotiations with respect to monitoring, operation and control of the Ghost Reservoir should be expanded to all reservoirs and river basins in Alberta.
- It was recommended that engineering studies should be conducted to improve reservoir and river capacities to prevent undesirable flooding.
- It was noted, with gratitude, that the report and the Netherlands did not adopt rescue as an option for managing flood risk. If a strategy fails people certainly need to be rescued but rescue cannot be the primary plan.
- It was noted that if berming is the only protection available in the short term and if the City berms to protect its interests we must have a corresponding right to berm and the support of municipal, provincial and federal resources to do so. To date, the City of Calgary has prevented communities from collaborating to construct effective protective berms.
- It was noted that Room for the River will require changes to the Municipal Government Act (MGA) and the functioning of the Municipal Government Board (MGB). At this time, municipal governments do not have the final authority to prohibit not only riparian development, which they consider unsafe or inappropriate, but also developments affecting wetlands and other key environmental attributes.
- It was suggested that by managing stormwater, protecting wetlands and healthy forests in the headwaters, and maximizing the width and effectiveness of the floodplain, the need for major infrastructure projects can be evaluated as one of the many tools outlined in Room for the River to mitigate flood, not as the only solution.
- There was support for the idea that riparian and wetland areas must be central to the strategy while working towards removing vulnerable infrastructure from flood prone areas.
- It was suggested that special policy areas should be considered in the policy discussion surrounding floodway development regulations. Special policy areas would exist within flood hazard areas, however regulation would take into account upstream and / or local mitigation. As such, regulations may be favourable to homeowners within the area. Such an approach would demonstrate to homeowners that the Provincial Government puts the priority of sustainable communities through the protection of people and property at the forefront, versus an approach that stifles community growth.
- It was suggested that timber harvesting should be decreased. The Room for the River report does not specifically discuss the risks currently posed by the presence of industrialized logging in our upper watersheds. A healthy forest ecosystem — which includes wetlands — provides a natural defense against flood and drought periods. Yet timber harvest in our Eastern slopes is allowed to proceed at rapid pace, even though the clearcut methods used can result in compromised wetlands, increased stream flows and peak instantaneous discharge, exacerbated soil erosion, and enhanced sediment loading of our rivers and reservoirs.

### **3.2 “No regrets” Opportunities**

- It was noted that a comprehensive review of the watershed is welcome as long as it proceeds in a way that does not unduly delay the implementation of truly “no regrets” projects.
- It was suggested that the term “no regrets” be replaced by more suitable language. All the flood mitigation options involve making investments and tradeoffs. There are few that can be truly characterized as “no regrets”.

#### **3.2.1 Possible “No regrets” Opportunities: Policies and Decisions**

Suggestions regarding Table 14 “Possible “No regrets” Opportunities: Policies and Decisions”:

- There was support for statement 2 “Document damage to infrastructure to retain institutional memory on flood impacts to inform future building and mitigation” – it was suggested that the passage of time or the current financial pressures on all levels of government elevate the risk of ignoring upstream mitigation.
- The wording of statement 3 “Strengthen and enforce policy and regulation to halt or minimize new development in floodplains” was perceived to be much too weak, it was suggested that it should be replaced with “...to rigorously limit inappropriate...”.
- It was suggested that statement 3 makes sense if applied only to land that will not be defended, but it should not be used to prevent the renewal of existing communities that will be defended.
- It was suggested that statement 9 “Strengthen and enforce land use BMPs to maintain the flow regulation and retention in the catchment” should have a specific action and language that is more precise.

#### **3.2.2 Possible “No regrets” Opportunities: Specific Projects and Actions**

Suggestions regarding Table 15 “Possible “No regrets” Opportunities: Specific Projects and Actions”:

- Regarding statement 5 on page 39 of the Room for the River Report “Revisit buyouts to secure properties that could make room for the river: past applications (e.g., Bragg Creek) and future market purchases (e.g., like Calgary Stampede did)” it was suggested that clarification is needed regarding what is meant by “Develop a long-range purchase program budget and process that enables buyouts whenever flood zone residential properties come on the market to gradually make more room for the river in high hazard areas.”
- In relation to statement 4 – “Increase emphasis on avoidance of wetland loss and encourage wetland restoration in targeted areas” – it was suggested that any land use which puts existing wetlands in jeopardy must be reconsidered in light of the 2013 flood. At present, Alberta protects wetlands in the White Zone, but no mechanism exists to protect wetlands in the Green Zone. Wetlands in the Green Zone are “in trouble” due to unregulated recreation and industrialized forestry.

### **3.3 Suggestions on a Potential Broader Program, Process, and Engagement**

#### **3.3.1 How a *Room for the River*-type Program Might Look in Alberta**

- It was suggested that a Root Cause Analysis (RCA) should be conducted into the June 2013 flooding in Alberta.

- It was recommended that the June 19 to 22, 2013 rain storm should be clearly defined as a “cold low” long intensity rainstorm and not a flash flood.
- It was recommended that a proper design criteria review should be conducted to determine the appropriate return rate and risk tolerance – the current 1:100 level of protection is too low. The following additional comments regarding return period were noted:
  - The Dutch service level of 1:1250 year return is very high – it is unlikely to be economically achievable in the Bow Basin.
  - In the Alberta or Bow contexts it may not be possible to achieve uniform service level at reasonable costs, based on the configuration of the catchments and existing systems within them.
  - A 1 in 250 return period is appropriate to determine flood hazard areas and account for some of the uncertainties, and that the use of 1 in 500 is appropriate for evaluating risk to critical infrastructure like water and wastewater plants with associated intakes and outfall.
- It was recommended that the Dutch model, which favours a multi-layered approach to flood mitigation as opposed to a single large scale solution, should be followed.
- It was noted that the report discusses long-term political financial support as well as accountability. Perhaps it could suggest a governance structure, or at least identify the governance structure utilized in the Dutch context to ensure delivery of the room for the river program.
- It was suggested that an in-depth study of the Sheep River, Three Point Creek and Okotoks river system should be conducted to understand why Okotoks did not flood.
- On page 43 the report indicates that an Alberta program needs to take into account land tenureship; some reviewers were in agreement with this.

### **3.3.2 How the Process Might Move from Scan to Prioritize to Implement**

- It was noted that there is support for a continued process of engagement in a longer process of planning and educating to favour a Room for the River approach.
- It was noted that there are multiple references to environmental impacts, but social or community impacts do not seem receive the same attention. It was suggested that the Room for the River approach should have some basic tenet that pushes the consideration of social and community impacts as critical components of the approach. Projects that benefit more citizens should get preference over ones where fewer citizens benefit.
- It was suggested that methodology to evaluate riparian ecosystem function is required in order to be able to compare these functions with flood mitigation objectives and benefits.
- It was suggested that land should be identified as “to be defended” versus “may be flooded”.
- It was suggested that a study of groundwater impacts should be carried out, especially in complex areas like Sunnyside, where hill runoff, high river levels, rainfall and sewer back-up all interact.
- It was recommended that a hydraulic flood model should be developed; most effective strategies can only be identified after hydrological modelling has identified specific choke points.
- It was suggested that cost benefit analysis should be incorporated in determining what properties are bought out versus which properties are mitigated.

- It was asked that the GoA recognizes that engineering structures such as dams and dykes are, at best, temporary and potentially very dangerous measures to deal with floods.

### **3.3.3 What Engagement Might be Appropriate**

- It was demanded that the community and stakeholders should be involved in projects such as the Room for the River program. This should include landowners, ranchers, and First Nations who have lived on this land for centuries and have a wealth of knowledge of the river.
- It was noted that the report could more strongly stress the need for excellent technical resources, hydraulic models, maps, scientific studies, risk evaluation tools and state of the art translation of these into visual and teaching tools to engage meaningful public and stakeholder engagement.
- It was noted that the Dutch had the advantage of an already somewhat confined river and social licence to improve the situation through working along and in the river / flood plain somewhat in a “no matter what the costs” (social, environmental and economical) manner, notwithstanding their significant efforts in education and consultation. No matter what the government position in Alberta, there will be no agreement among the many stakeholders, that our government should tackle the issue in same fashion as the Dutch. There are groups who will oppose any efforts to confine or direct river flow given their understanding of the river and its “value”; a contrast to other groups who represent and fear the economic impacts of urban river flooding. These agendas and opinions will not, and have not, changed quickly. The best option is to slowly move people out of the flood plains through provincial and municipal legislation.

## **4. Closing Comments**

- It was recommended that the conclusion should emphasize that a long, thorough, engagement-rich process and governance or decision making structure will be critical to ensuring the social and political capital to realize a program.
- Disappointment was expressed regarding the report to the extent that it gives credence to old behaviours that will continue to contribute to flooding, the cost of which is borne by individuals. We recommend significant changes to the Municipal Government Act to require Environmental Impact Assessments and accountability for increasing the risk to existing communities.
- It was noted that more policy without recognition that mitigation needs to be implemented (Springbank off-stream reservoir) does not make any logical sense and “screams” of lack of forethought.
- It was recommended that the government should proceed with the ecologically-based ideas in the Room for the River Bow-Elbow program. These recommendations emphasize restoring natural flood and drought buffering wetlands and river-side vegetation, strategically moving back vulnerable buildings and other infrastructure from rivers, and avoiding reliance on berming river edges and on costly dams subject to catastrophic failure.
- It was noted that the GoA is encouraged to continue with this process for the entire watershed; undertake advice from the Room for the River Pilot project; and to develop a funding mechanism that provides steady and adequate resources for those organisations with mandates that align with and support the report’s advice.

- It was recommended that the Room for the River Bow-Elbow Pilot project idea should be supported, including expanded buyouts of properties in high hazard areas. The pilot will help make more room in the flood plain to disperse flood waters in lower density areas, restore flood and drought resilient wetlands and river-side vegetation, and minimize reliance on ecologically harmful river berms and dams.
- It was noted that some respondents do not support the Room for the River model.
- It was noted that this pilot will help make more room in the flood plain to disperse flood waters in lower density areas, restore flood and drought resilient wetlands and river-side vegetation, and minimize reliance on ecologically harmful river berms and dams.
- It was noted that in the Netherlands they have been working on Room for the River for many years, and on flood mitigation in general for hundreds of years before that. As Albertans we should take the time to study all the options before us and consider the impacts on people and the environment before going ahead with huge projects that may or may not prove to be suitable in Alberta.