



REPORT Municipal District of Foothills Flood Mitigation and Compensation Study

Submitted to MD of Foothills
by IBI Group
August 2017 | #109674



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Executive Summary

Introduction and Context

The area of interest for this study includes land on either side of the Highwood River downstream of the Town of High River, from 498th Avenue to the confluence of the Highwood River with the Bow River. Properties within this area are primarily agricultural and country residential, or acreages.

The June 2013 flood was devastating to properties along the Highwood River, including the Town of High River and the Municipal District (MD) of Foothills. Since that time, a tremendous amount of effort and investment has been spent on recovery and rebuilding of High River, including the construction of mitigation measures (primarily dykes) to protect the town. As a result of these dykes, properties in High River are protected to the 2013 flood level plus one metre freeboard. Residents downstream, however, would now receive higher flows from major flood events due to changes in the flow split between the Highwood and Little Bow basins at the Town of High River and the loss of flood storage within the Town due to the raising of 498 Avenue.

Approximately 150 properties in the MD of Foothills are affected by changes in flood levels and erosion. The impacts of the altered flows were explored in the Scoping Study of Flood Related Areas of Concern on the Highwood River and Little Bow River within the Municipal District of Foothills, prepared by Amec Foster Wheeler and Advisian WorleyParsons Group. The MD is seeking a fair solution to address the impact on these landowners, the inconsistency of protection provided, and the potential liability for future flooding.

Approach Overview

A complete, standalone benefit/cost analysis for properties downstream of the Town of High River to the Bow River confluence was deemed not appropriate for the following reasons:

- only two flood scenarios have been modeled for the study area, precluding the determination of annual average damages, the benefit side of a benefit/cost analysis;
- the benefits and costs for these properties should be considered in the context of the total benefits and costs of the mitigation project for the Town of High River;
- considered in isolation, mitigation measures for individual rural properties rarely produce positive benefit/cost results;
- property-level structural mitigation or flood-proofing does not always effectively eliminate the risk completely or indefinitely;
- aside from buildings, the diversity of land uses makes the accurate estimation of damages (to such things as crops and infrastructure) complex, yet the number of properties is not great enough to apply general estimating techniques. Therefore, the effort is disproportionate to the accuracy and utility of such an estimate, considering the above factors; and
- finally, and most importantly, a benefit/cost approach to mitigation within the study area would not satisfy the objectives of the MD, specifically to negate future liability and risk; inform future owners of the risk; balance landowner and taxpayer interests; address loss of land value; and protect residents and their properties to the same level as that afforded the residents in the Town of High River.

Previous work on the issue has indicated that structural options are not feasible. To meet the objectives of this study, a mitigation method must provide a robust solution that limits future risks. The best solution is to remove and restrict further development within the flood hazard areas, recognizing the affected land's contribution to upstream mitigation.

IBI Group reviewed available precedents locally and internationally. It was determined that the application of a conservation easement to affected areas would be the most effective approach. The landowners would be compensated for the lack of structural protection that was afforded to those upstream, the development restrictions placed on that portion of land, and, for some, the potential loss of land due to erosion. Landowners will still be granted access to the land, but the government will be released from future liability in the event of flooding.

The approach to landowner compensation is not to be misinterpreted as compensation for a pre-existing flood risk, previous damages, or an increase in downstream flows. The lands in question actually now constitute part of the overall flood damage mitigation for High River as they receive and accommodate increased flows due to the construction of protective works. The proposed approach balances the level of protection with the level of compensation for all properties positively or negatively affected by the mitigation works.

Compensation Methods

GIS datasets including the land parcels, improvements, and flood modelling were used to determine the amount of impacted land on each parcel at the new 2013 flow levels. For lands which had residences in the affected area or a residual area that was not suitable for the original use (agriculture or residential), the entire property was considered for buyout.

Land values were estimated using an analysis of MLS bare land sales in the surrounding area dating from January 1, 2014 to May 24, 2017. The price per acre for each property type was plotted against the corresponding acreage and a line of best fit for each graph was created and used to calculate the price per acre of each parcel.

The easement compensation amount was calculated using a "before and after" method. This begins by calculating the price that would be paid for the parcel of land before any land was lost and the price that would be paid for the parcel of land after land is lost to flooding and increased erosion. Subtracting the final price from the initial price of land gives the price that should be paid for the land that is lost for each landowner.

Complete buyouts and improvements have a greater impact on landowners. To account for this, standard methods of additional payments were calculated, as detailed in **Exhibit 4.2**.

Exhibit 4.2: Methods Applied to Estimate Property Values for Recommended Options

Recommended Option	Improvements Flooded?	Method
Buyout	Yes/No	Apply bare land value based on size using "before" value Add value of all buildings (flooded and non-flooded) Add 32% to total if residence is present Or add 20% to total if there is no residence
Easement	No	Apply bare land value based on size using "before and after" method
Easement	Yes	Apply bare land value based on size using "before and after" method Add value of flooded buildings plus 20%

After calculating values to be paid for each owner, an aggregate total for the entire study area was calculated, to be used as an estimate in which the individual variances should reconcile themselves.

Results

The relevant results of this analysis include a total estimated compensation amount by category and a recommended approach for each owner. It is expected that the aggregate totals fairly represent the total cost of achieving the goal of reducing risk and liability within the hazard area, and is broken down in **Exhibit 4.3**.

Exhibit 4.3: Aggregate Compensation Costs by Mitigation Category

Category	Total Cost*
Buyout of Land Only	\$7,176,000
Buyout with Improvements	\$19,127,000
Easements on Land Only	\$1,712,000
Easements with Improvements	\$692,000
* may not sum due to rounding Total:	\$28,706,000

Recommendations

It is recommended that the MD negotiate the easement purchases with individual landowners based on the characteristics of their land and improvements. The compensation amount estimated is believed to fairly represent the total cost of acquiring development restrictions on at-risk lands. However, each property will have characteristics not considered in the general methodology. For example, some structures may be moved to safe ground within the property or other properties that were assumed to have viable residual land may in fact have service or access issues.

The lands that would be covered by a conservation easement in this approach would not necessarily be sterilized. Productive farmland or recreational areas could still be highly functional. Owners of lands with easements would retain usage with development restricted. Lands completely under easement (full buyout) could be resold with the restrictions in place. Finally, having the easement on title ensures awareness and caution for future owners.

1 Introduction

1.1 Background

The June 2013 flood was devastating to properties along the Highwood River, including the Town of High River and the Municipal District (MD) of Foothills. Since that time, a tremendous amount of effort and investment has been spent on recovery and rebuilding of High River, including the construction of mitigation measures (primarily dykes) to protect the town.

In the proximity of the Town of High River, the Highwood River flows adjacent to the Little Bow River Basin. This has allowed for water diversions from the Highwood River at High River to meet irrigation demand for the surrounding rural areas. During a major flood event, water flows at the town would split, with a portion of the water spilling into the Little Bow River. The dykes constructed following the 2013 flood have altered the flow split during major floods, conveying more water within the Highwood River through the town. In addition to the flow split, the raising of 498 Avenue further limits the storage capacity within the Town. Consequently, properties downstream of the town are not protected and many would now experience increased flooding during major events.

The impacts of the altered flows were explored in the Scoping Study of Flood Related Areas of Concern on the Highwood River and Little Bow River within the Municipal District of Foothills, prepared by Amec Foster Wheeler and Advisian WorleyParsons Group. The MD is now seeking recommendations to mitigate these impacts for property owners between High River and the Bow River confluence.

1.2 Purpose

The High River flood mitigation measures have caused increased flow and erosion rates for approximately 115 properties along the Highwood River at certain flood inundation levels. The MD is seeking to compensate these property owners for their role in floodplain management, or provide other appropriate mitigation methods. To these ends, the proposed solution must:

- be defensible;
- negate future liability for the Province of Alberta, the MD of Foothills, and the Town of High River;
- inform future potential buyers of the additional risk to the property;
- balance the rights of the landowner while being fair to the taxpayer; and
- address loss of land value, if any.

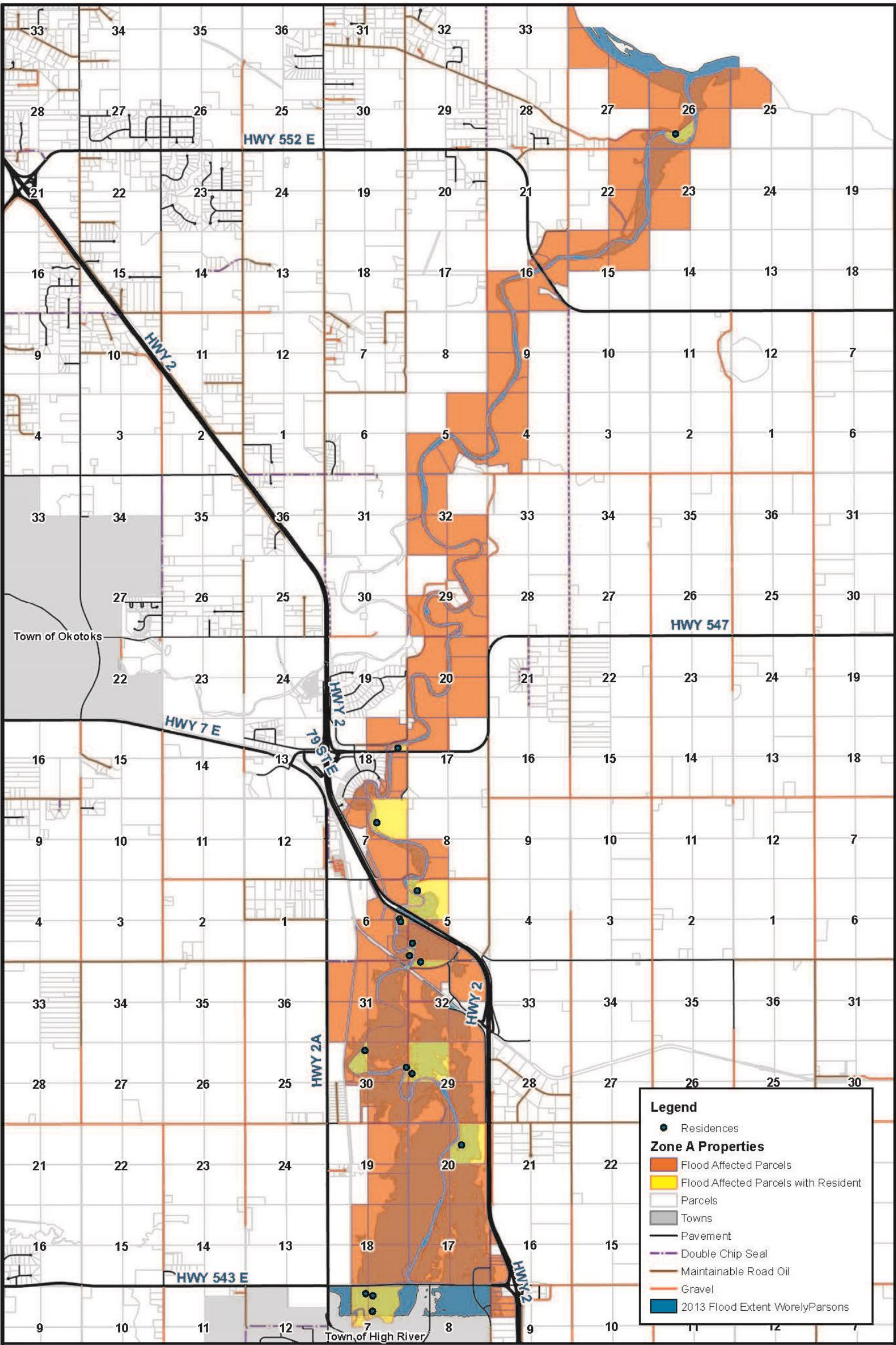
2 Context

2.1 Study Area Land Use

The area of interest for this study includes land on either side of the Highwood River downstream of the Town of High River, from 498th Avenue to the confluence of the Highwood River with the Bow River, as indicated in **Exhibit 2.1**

2.1.1 Current Zoning

The land included in the study area can all be categorized in seven categories under the MD of Foothills' Land Use Bylaws. The majority of the land is Agricultural and Country Residential, with some specialized discretionary uses designated throughout (Municipal District of Foothills No. 31, 2017).



2.1.1.1 Agricultural District

Agricultural districts are intended to preserve land for agricultural purposes and to allow for a broad range of agricultural uses. Certain areas require special consideration due to physical constraints and environmental characteristics.

The minimum lot size for agricultural lots has been designated to be 21 acres.¹ All subdivision applications in the MD currently require an amendment to the Land Use Bylaw due to a clause included in the land use requirements section of each land use district.

2.1.1.2 Residential Districts

The study area includes the Country Residential (CR) and Cluster Residential Districts (CLR). The purpose of these districts is to provide for acreage development (CR) and for smaller parcels clustered in conjunction with a large remnant parcel that will not be further subdivided (CLR). Each residential district has a sub-district "A", for which a development permit is required prior to a building permit being considered.

The density of CR lots is not allowed to exceed 32 per quarter section, or one per five acres of parent parcel. The density of Cluster Residential (CLR) lots must not exceed 40 per quarter section, or one per four acres. The minimum lot size for CR parcels is 2.00 acres (0.81 ha). For CLR, the minimum lot size is 0.80 acres.² Maximum lot sizes are 20.99 acres (8.49 ha) and 1.99 acres (0.81 ha) for CR and CLR parcels respectively.³

2.1.1.3 Recreation

Recreation districts are intended to provide a variety of recreational uses on a site-specific basis consistent with the policies outlined in the Municipal Development Plan. Discretionary uses include, but are not limited to:

- campground (short-term);
- dwelling (single family detached);
- golf course;
- R.V. storage; and
- minor home-based business.

Minimum and maximum lot areas are those areas contained in the title existing on March 11, 2004, or as determined by the Approving Authority and in accordance with an approved area structure plan or outline plan, if applicable.

2.1.1.4 Direct Control Districts

The study area contains four Direct Control Districts: DC2, DC6, DC9, and DC16. These specially designated districts allow for a variety of uses that vary from one parcel to the next. A detailed description of the permitted and discretionary uses in each district can be found in the MD of Foothills Land Use Bylaw 60/2014.

2.1.1.5 Flood Hazard Protection Overlay

In 2014, the MD of Foothills No. 31 updated their Land Use Bylaw to include a Flood Hazard Protection Overlay to discourage new development on lands that are subject to flooding, and achieve the long term goal of decreasing the overall density of development on these lands. The Flood Hazard Protection Overlay includes the provincially defined floodway and flood fringe as well as areas impacted by the June 2013 flood event. The overlay regulations take precedence over the existing land use district.

¹ Or the area contained in the title existing on March 11, 2004, whichever is greater.

² Or the area contained in the title existing on March 11, 2004, whichever is greater.

³ Or the area contained in the title existing on March 11, 2004, whichever is smaller.

The Land Use Bylaw 60/2014 requires that if land is available on the lot that is outside the floodway, that land must be used for any new development. If it can be proven that unflooded land is not available, a development permit must be obtained for all permitted and discretionary uses or activities intended to be carried out within the Flood Protection Overlay, except for detached accessory buildings less than 20.8 m². Before issuing a development permit, the Approving Authority should be satisfied that adequate flood proofing exists, including locating all of the mechanical and electrical equipment within a building above the designated flood level.

Minor renovations and repairs to existing buildings do not require flood proofing. Similar to many other flood regulations across Canada, basements are discouraged in new buildings in the Flood Hazard Protection Overlay unless they are flood proofed, and the storage of chemicals and toxic waste that cannot be readily removed is prohibited on the property.

2.2 Watershed and River Characteristics

The Highwood River Basin is made up of three basic physiographic regions, as described by Northwest Hydraulic Consulting in their High River Flood Risk Mapping Study (1992):

"The western portion lies within the steep eastern slopes of the Rocky Mountains. This gives way to the Foothills region which extends to within a few kilometers of [the Town of High River]. East of this is the Western Alberta Plains region."

The stretch of river downstream of High River closest to the confluence of the Bow River is primarily a straight, entrenched, single-channel river. Slightly upstream from this, closer to the Town of High River, it is still single-channeled, but meanders, and has consequently formed a number of associated oxbow channels. In these two reaches of the river, flood flows are essentially confined to the entrenched channel (Northwest Hydraulic Consultants Ltd., 1992).

Further upstream, between the Town of High River and the intersection of the Highwood River with Hwy 20, the river maintains the same single-channel meandering form, but has lower bank heights. As a result, flood flows are not constrained to the river channel and can easily overflow into the adjacent floodplain or into the Little Bow River Basin located further south.

Pekisko Creek and Stimson Creek are two sub-watersheds located within the MD of Foothills boundary, both of which are located primarily within the Foothills and Southern Alberta Uplands and are significant tributaries to the Highwood River. Together, they contribute approximately 30% of the water to the Highwood River watershed and can therefore contribute to flooding in the constituent rivers and streams.

Downstream of the Hwy 2 bridge crossing, the flows on the Highwood River are significantly influenced by flows on the Sheep River, as the two join up.

2.3 History of Flooding

2.3.1 Flood Frequencies

Flooding of the Highwood River is driven primarily by freshet, rain-on-snow, and heavy rainfall events. The flood events can cause water levels in the river to be 20 to 100 times higher than base flows and to stay elevated through the spring and early summer. Hydrology in the lower segment in the river, below Women's Coulee Canal inlet, is primarily driven by discharge from the upper catchment areas in the Rocky Mountain and Foothill Regions.

Three water monitoring stations are set up in this area:

- 05BL003 Highwood River at High River;
- 05BL004 Highwood River below Little Bow Canal; and
- 05BL009 Highwood River near Aldersyde.

Further downstream, flood hydrology is greatly influenced by the Sheep River, and can be measured at 05BL024 Highwood River near the mouth. This station is located 6.5 km upstream of the confluence of the Highwood River with the Bow River.

Amec Foster Wheeler and Advisian have compiled a list of the eight largest instantaneous peak flows and their flow rates by WSC station. Unfortunately, station 05BL024 only became active beginning in 1970 and experienced various malfunctions in recent years, limiting the amount of data acquired.

Exhibit 2.2: Eight Largest Instantaneous Peak Flow and Flow Rates on the Highwood River Near High River (adapted from Amec Foster Wheeler Environment & Infrastructure and Advisian WorleyParsons Group, 2017)

Highwood Below Little Bow Canal 05BL004 (Area 1,950 km ²)			Highwood Near the Mouth 05BL024 (Area 3950 km ²)		
Year	Peak Flow (m ³ /s)	Flow Rate (m ³ /s/km ²)	Year	Peak Flow (m ³ /s)	Flow Rate (m ³ /s/km ²)
2013	1260 ¹	0.9333	2013	2320 ¹	0.5873
1995	803	0.4118	1995	1120	0.2835
1932	740	0.3795	1932	- ³	-
1942	708 ²	0.3631	1942	-	-
2005	671	0.3441	2005	1340	0.3392
1923	643 ²	0.3297	1923	-	-
1929	595	0.3051	1929	-	-
1953	563	0.2746	1953	-	-

Notes:

¹ Preliminary WSC estimate using slope-area method. Approximately 560 m³/s of the estimated 1820 m³/s upstream flow was split to the Little Bow.

² From Highwood River near Aldersyde (05BL009)

³ No Data Available

2.3.2 2013 Southern Alberta Floods

In June 2013, High River saw the worst flooding in its recorded history. The MD of Foothills declared a state of emergency on June 20 at 9:20am, and anyone who lived near a river, creek, or stream was asked to evacuate. All campgrounds near the water were closed. Earlier that day in High River, at 7:04am, officials from High River declared a local state of emergency because the Highwood River was rising so rapidly and overflowing its banks (Massinon & Fraser, 2014). The entire town of High River was evacuated, forcing 13,000 people to leave their homes for the week following the flood. Despite the town lacking basic services such as sewer, water, and power, 300 people refused to leave and remained in their homes (Varcoe, 2013). Access to emergency centres was limited, and was cut off altogether from some areas.

Following this devastating event, the Town of High River and its residents were determined to fortify the town against future flood events. However, the focus on protecting the Town has resulted in increased low probability flood magnitudes in some areas on the Highwood River downstream of High River. While the majority of the Town of High River has recovered from the flooding in 2013 and is ready to redefine themselves, many of the residents downstream are waiting for an appropriate response from the government.

2.4 Measures Implemented

2.4.1 Structural Mitigation

Over seven kilometers of permanent dykes have been constructed along the Highwood River, in addition to numerous interim dikes designed to provide protection until permanent measures are approved and constructed. Some dykes and mitigation measures that affect the Town of High River and downstream flows are described below.

2.4.1.1 *West Town Dyke, Town Dyke, and Little Bow Canal Dyke*

These three dykes have been designed to protect the south portion of High River from overflow from Baker Creek's right downstream bank, as well as flooding from the main channel of the Highwood River. The construction of these dykes can cause increased low probability flooding downstream because a portion of the flow that was originally diverted down the Little Bow River is now being diverted down the main channel of the Highwood River. During floods of low probability, flow in the Little Bow River is expected to decrease, while flooding along the Highwood River downstream of town is expected to increase due to the diversion and decreased storage capability.

2.4.1.2 *498 Ave E Dyke*

The raising of 498 Avenue E provided added flood protection for the eastern portion of the Town of High River, but in the process caused a loss in flood storage of an estimated 6,100,000 m³. At higher flood probabilities the areas downstream of the Town on the Highwood River are unlikely to be affected by the mitigation measures. However, during lower probability events, there is an increased flood risk to areas along the Highwood River. The raising of 498 Ave E also serves as a key access route to some of the communities it is protecting.

2.4.1.3 *Hoeh Dyke*

The Hoeh Dyke was installed on the Highwood River southwest of the Town of High River as a measure to prevent the Highwood River from changing its course into the Little Bow River further upstream. The Hoeh Dyke has been repaired or altered several times in order to effectively influence the river's flow since it was initially built. Most recently, repairs were completed in 2014 replacing rip-rap along sections of the dike that had been washed away in 2013 in order to maintain the dyke's integrity and prevent erosion of the riverbanks.

2.4.1.4 *Women's Coulee Diversion*

The Women's Coulee Diversion Project is located about eight kilometers southwest of the Town of High River and aims to divert water from the Highwood River into Mosquito Creek and ultimately into the Little Bow River. Downstream users are then able to use this water for irrigation, agriculture, municipal, and industrial purposes. The diversion is maintained and operated by Environment and Sustainable Resource Development, Operations Infrastructure Calgary, who hires a contractor to adjust the gates on a daily basis on their behalf.

From April 1 to September 30 Women's Coulee Diversion has a maximum diversion rate of 1.70 m³/s, with minimal operational flow being 0.85 m³/s. In the winter season, from October 1 to March 31, it has a maximum diversion rate of 0.283 m³/s (Alberta Environment, 2008).

3 Development of Flood Mitigation Options

3.1 Previously Considered Options

In the scoping study submitted to the MD, Amec Foster Wheeler and Advisian WorleyParsons Group (2017) examined each property in the study area and recommended a combination of options based on the lowest cost alternative for each property. They examined multiple alternatives for each property and chose the most cost-effective option for each, providing the MD with an aggregate total for the area. Erosion protection costs were not included as they were considered prohibitive due to their high costs. The following four options were considered in the previous study:

Option 1: Property Buyout

A buyout of the entire property by the government was proposed, based on the assessed value of the property, plus 20% for administrative and reclamation costs.

Option 2: Residence and Ancillary Buildings Buyout

This option involved a buyout of the residential building and any ancillary structures, allowing continued use of the parcel for agriculture or other uses outside the flood hazard area. Other options considered were the buying and relocating of residential buildings outside of the flood plain on the same property.

Option 3: Residential and Ancillary Buildings Flood Protection to 2013 Landscape Scenario Flood Levels

The study considered building berms around all structures located up to the 2013 flood level, plus one meter freeboard, while recognizing some of the gaps in this approach, such as the ability for flood waters to breach or overtop the berms.

Structural flood protection costs for each property were estimated for ring berms to be built around the perimeter of residences and their yards, based on typical costs for similar work done previously as part of the Flood Recovery and Erosion Control program (Amec Foster Wheeler Environment & Infrastructure and Advisian WorleyParsons Group, 2017). In some cases, installation of erosion protection was considered, where infrastructure or land had an increased risk of erosion.

Option 4: Residential and Ancillary Buildings Flood Protection to Existing Conditions (Scenario 28A) Flood Levels

When compared to Option 3, this option proposed protection to higher elevations for properties downstream of High River and lower protection levels for properties on the Little Bow.

3.2 Approach

Flood damage estimates are generally employed to evaluate the level of risk and the economic efficiency of mitigation options using a benefit/cost analysis. For flood mitigation projects, economic evaluation requires a comparison between the events predicted to occur if the project is built and those predicted to occur if the project is not built. This is called the “with and without principle”. For flood control, one cannot directly equate an exchange in the market, however flood control benefits can be estimated by assuming they are equivalent to the flood damage prevented.

For flood mitigation projects the probabilistic approach to benefit/cost estimates is used. Within the defined flood risk area, flood damages are estimated with the application of depth-damage curves applied to the various return flood events (probability). The flood damage probability

distribution is then plotted and the average annual damage (AAD) estimated for project evaluation purposes.

The benefit/cost (B/C) ratio of a project is the ratio of net present value of the benefits (average annual damages) over the net present value of the costs. This value is the indicator of economic efficiency. Where the benefits exceed costs, the ratio would be greater than 1.0, and where benefits are less than costs, then the ratio would be less than 1.0. An efficient project would have a B/C ratio greater than 1.0. At a B/C ratio of 1.0, the project is at a breakeven point.

The benefit/cost approach to disaster mitigation assessments theoretically requires a complete enumeration of all gains/benefits and losses/costs associated with a project. In practice, however, it is not possible to even identify all potential impacts much less quantify and monetize them. IBI Group has developed leading-edge tools and methodologies for the estimation of direct and indirect damages including structure and content damage, residential displacement costs, business interruption losses, and intangible household impacts. Other social, political, and environmental impacts are often best evaluated with a multi-criteria analysis.

The subject properties in this study are impacted by the mitigation works constructed to protect the Town of High River. As such, they should have been considered in the scope of that project. Over \$100 million has been spent to protect the Town of High River to the level of the 2013 flood (1820 m³). We are not aware of any benefit/cost analysis for this project. However, given the scale of destruction in 2013, it is assumed that the downstream damages in the MD of Foothills would be negligible in comparison to the benefit (damages averted) within the Town.

A complete, standalone benefit/cost analysis for properties downstream of the Town of High River to the Bow River confluence was deemed not appropriate for the following reasons:

- only two flood scenarios have been modeled for the study area (2013 flood flow with and without the mitigation in the Town of High River). This precludes the determination of annual average damages, the benefit side of a benefit/cost analysis;
- the benefits and costs for these properties should be considered in the context of the total benefits and costs of the mitigation project for the Town of High River;
- considered in isolation, mitigation measures for individual rural properties rarely produce positive benefit/cost results;
- property-level structural mitigation or flood-proofing does not always effectively eliminate the risk completely or indefinitely;
- aside from buildings, the diversity of land uses makes the accurate estimation of damages (to such things as crops and infrastructure) complex, yet the number of properties is not great enough to apply general estimating techniques. Therefore, the effort is disproportionate to the accuracy and utility of such an estimate, considering the above factors; and
- finally, and most importantly, a benefit/cost approach to mitigation within the study area would not satisfy the objectives of the MD, specifically to negate future liability and risk; inform future owners of the risk; balance landowner and taxpayer interests; address loss of land value; and protect residents and their properties to the same level as that afforded the residents in the Town of High River.

Previous work on the issue has indicated that structural options are not feasible. To meet the objectives of this study, a mitigation method must provide a robust solution that limits future risks. Compensating landowners for damages when a future flood occurs may be cost-effective when only considering current structures. However, it does not account for future development and other increases in risk and liabilities. Furthermore, it does not provide an equitable situation for area landowners. Therefore, the best solution is to remove and restrict further development within the flood hazard areas, recognizing the affected land's contribution to upstream mitigation.

3.2.1 Approach Rationale

The properties in the subject area were not previously considered in mitigation works constructed by the Town of High River. However, they are now part of the floodplain management scheme being implemented. Current regulations do not limit the risk or liability. Isolated structural mitigation, and flood and compensate options are not feasible and do not fully meet the objectives of the MD. Therefore the best solution is to remove and restrict any further development within the flood hazard areas.

The approach to landowner compensation is not to be misinterpreted as compensation for a pre-existing flood risk, previous damages, or an increase in downstream flows. The lands in question actually now constitute part of the overall flood damage mitigation for High River as they receive and accommodate increased flows due to the construction of protective works. The proposed approach balances the level of protection with the level of compensation for all properties positively or negatively affected by the mitigation works.

3.3 Restrictions and Compensation Methods

IBI Group has examined numerous flood compensation models in use in Canada, the USA, the UK, and Australia. A comprehensive review of natural flood mitigation measures was commissioned by the Scottish Government in 2015, which is detailed here, as well as methods used by the Manitoba government to protect its residents from flooding over the years. Select experiences in other international locations were also explored, and can be found in **Appendix A**. The compensation measures have been compiled and summarized from all of these sources.

3.3.1 Overview

The Scottish Government (RPA, RHDHV and Allathan Associates, 2015) examined 61 case studies (relevant case studies are outlined in Appendix A, with a detailed examination of the Manitoba experience in **Appendix B**) and formulated eight compensation methods (a-i below):

- a. Land purchase/sale – Where a public body buys land from the land manager and implements Natural Floodplain Management (NFM) measure on that land.
- b. Land purchase/sale and leaseback – Where a public body buys land from a land manager, implements NFM measure, and then leases the land back to the original owner or another land manager. The lease may restrict the type or timing of land use in order to ensure effective use of the NFM measure.
- c. Land lease to public body – The land manager leases the land to the public body to implement the NFM measure, with the option for the public body to sublease it back to the original land manager for grazing or other productive activities.
- d. Servitude, wayleaves⁴ – A servitude may be attached to a land title to benefit another property. One-off payments may need to be made to enable rights of access, or rights to construct and maintain a NFM structure. A public body may make wayleave payments (usually annually) to a land manager in return for the public body being able to implement and maintain an NFM measure. It may be incident based, i.e., only when the land is flooded. There are three basic types of servitudes: easements, covenants, and profits. Easements give the government the right to enter and use the land for a specific purpose. Covenants obligate a landowner to do something, and profits give someone the right to enter and remove natural resources from the land.

⁴ Wayleave payments are not used in Canada, but were found in some of the case studies examined in the report.

- e. Capital and annual payments (including grants) by Government or Agencies – Where the public body makes a capital and/or annual payment to a land manager so that they use or manage their land in a particular way, to enable implementation of a NFM measure. These payments may make up for loss of income or encourage a particular land use.
- f. Capital and annual payments (including grants) by Trusts or Local initiatives (non-government) – Similar to the above, except payments are granted from non-government sources.
- g. Economic instruments (fiscal, permits, service payments, auctions) – Permits could involve a system of tradable flood permits, where a public body buys permits to flood areas from land managers and the land managers are able to buy and sell their permits to each other. Service payments work under a system where a land manager sells a service such as flood storage or water retention (through planting trees) to the public body or an insurance company, which would recoup money through decreased downstream insurance payouts. 'Flood and Compensate' has been identified as one of the more cost effective economic instruments (Alberta WaterPortal, 2013).
- h. Advice and technical support – Land managers are provided with advice on how to best minimize flood risks or technical support to enable them to continue operating their business, which would otherwise be affected with the implementation of a NFM measure.
- i. Conservation covenants – These are an additional mechanism that is already in place within Scottish law and on selected parcels across Canada. The purpose of a conservation covenant is to protect or preserve particular characteristics within the land. Specific conditions are set out in the Title Conditions (Scotland) Act 2003, section 387:
 - “....for the purpose of preserving, or protecting, for the benefit of the public—*
 - (a) the architectural or historical characteristics of any land; or*
 - (b) any other special characteristics of any land (including, without prejudice to the generality of this paragraph, a special characteristic derived from the flora, fauna or general appearance of the land)”*

For the majority of mechanisms, the responsibility is likely to lie with the governing body to identify potential mechanisms, and to lead the process, a procedure which likely requires some negotiation, especially in the beginning. This process will require a good relationship between the buyer and seller (or the governing body and the landowner). Where productive farms are being considered, it is important to bear in mind that the farm is a business, and that viability is important, not only to the landowner, but to the greater economy. It should also be acknowledged that for catchment-wide plans, a consistent approach for fair compensation is required. A more detailed breakdown of the flood compensation methods can be found in **Appendix C**.

3.3.2 Methods Considered

Based on the information gathered and the case studies examined and the MD's objectives, two main flood compensation options are possible for the Highwood River downstream of High River.

3.3.2.1 Option 1 – Conservation Covenant/Easement

While the lands in the study area are located downstream of the Town of High River, they are still related to the flood mitigation benefits to the town, much like upstream forests and river soils help to prevent or reduce downstream floods. Because they are providing ecosystem regulating

services, the landowners should be recognized with payments for ecosystem services, and should also be provided with advice and guidance on how to be responsible stewards of their land.

In this option, a portion of the land on each parcel is designated as part of the flood hazard area. Compensation for the lands with an easement is due to the lack of protection afforded to others, the development restrictions placed on that portion of land, and, for some, the potential loss of land due to erosion. Landowners will still be granted access to the land, but the government will be released from future liability in the event of flooding.

The compensation would be a single payment at the time the easement is placed on title. The registered easement will reflect the restrictions for future owners and negate future liability for the Province of Alberta, the MD, and the Town of High River. Compensation will account for the potential loss of property value and balance the rights of the landowner while being fair to the taxpayer.

3.3.2.2 Option 2 – Buyout at Market Rate

For properties where an easement would too significantly alter the use of the land, a complete buyout may be considered. This option involves larger up-front costs, but eliminates the risks of flooding to landowners and could ultimately reduce costs in the long term.

It is feasible that much of the costs can be recovered and regional economic activity maintained by selling the land back (with restrictions in place) to the original owners or other parties for uses such as crops that do not require development or infrastructure.

3.3.2.3 Other Options/Variations

In addition to the two main options employed in this study, there are some variations that may be individually considered without altering the intention and approach taken in this study. The purchase of the land outright and then subsequently selling it back with an easement can achieve the same objectives as purchasing an easement from the existing landowner but there are several disadvantages. There are two main purchase and sell options:

1. Purchase the entire parcel from the affected landowner, apply the easement to the flood risk lands, and then resell the entire parcel with the easement in place. This option nets the same result as purchasing an easement from the existing landowner, however it involves more transactional costs and risks. It remains an option for landowners who would rather sell.
2. Purchase only the flood-risk area, apply the easement to the new parcel, and then sell it. This option would require subdivision of each parcel to the maximum extent of the flood area (the new 2013 extents). Remaining parcels would be irregular in shape, potentially at odds with MD bylaws and difficult to price and sell individually if the original landowner was not interested in repurchasing.

Another option related to the purchase of the flood-risk portions of land only is to transfer them to a conservation trust or other authority, rather than reselling. This option may not recover purchase costs and could disrupt economic activity, but would add conservation lands to the MD's assets.

The advantage of purchasing an easement from the existing landowner is that it is the least disruptive, least complicated, and least risky. However, this recommendation is applied in general and individual property negotiations may vary with no major impact on the total anticipated costs.

4 Compensation Methods

4.1 Property Categorization

A Geographic Information System (GIS) was used to help organize, coordinate, and manipulate spatial data provided by the MD.

Parcels with the same owner were examined together to account for the possibility of moving operations to a different location on adjacent land, as well as the possibility of causing injurious affection that may occur when subdividing land.

GIS was also used to create a 10-meter buffer around the areas along the Highwood River susceptible to increased erosion. Any eroded area lying outside of the provided flood models was added to the land lost in the flood model for each parcel.

Each parcel was examined independently by owner to determine the best option for their parcels and improvements, both from the point of view of the landowner and the MD of Foothills.

Factors considered in determining the best course of action are based on the assumption that the measures taken will negate any future liability for the Province of Alberta, the MD of Foothills, or the Town of High River. Furthermore, both the interests of the government and the landowner were taken into account. For example, in most cases where it was deemed that the landowner could remain on their property and carry out operations with minimal disruption, the option to create an easement was chosen over the option to buy out the property.

Unflooded land was considered to be usable for agricultural purposes if it:

- was not isolated or surrounded by inundation;
- maintained access while inundated;
- was a minimum of 21 acres; and
- was a square, rectangle or triangle (for ease of cultivation).

An unflooded area was considered to be usable as a Country Residential parcel if it:

- was not isolated or surrounded by inundation;
- maintained access while inundated;
- was a minimum of 2 acres; and
- was deemed a shape that reasonably allowed for development and use of the parcel as intended within the land use district.

All of the parcels that did not meet the above criteria were over 70% inundated and were considered for buyouts or complete easements because they did not have usable unflooded land remaining. Values for each parcel were calculated based on the size of the parcel before and after flooding and erosion; whether improvements were in flooded areas; and the type of action taken (easement or buyout).

4.2 Determining a Base Price

Assessment values for improvements were taken from the most recent assessment data available, which was 2017 assessment data provided by the MD of Foothills. In some instances, when expropriating property, pre-flood values are used to assess property values, however many flooded properties were eligible for flood assistance from the provincial government, money which was used to rebuild and improve the flooded buildings in the study area. As such, the 2017 assessed values provide a more accurate representation of the actual property values. In rare cases where the 2017 value was not available, the 2015 value was substituted.

To calculate the value of bare land per acre, land values were extrapolated from MLS bare land sales in the surrounding area dating from January 1, 2014 to May 24, 2017. Sales were divided into Country Residential (CR) parcels less than 21 acres, and Agricultural (Ag) parcels greater than 21 acres in order to acquire the price for the bare land in each of these categories. The price per acre was then plotted against the corresponding acreage and a line of best fit for each graph was created and used to calculate the price per acre of each parcel.

CR parcels sell for a much higher price-per-acre than do Ag parcels. This is due primarily to their capacity to be developed, and both CR and Ag parcels decrease in price-per-acre as they increase in size. This is demonstrated in **Exhibit 4.1**. As such, a constant price-per-acre cannot be applied to all land sizes or scenarios. Where land was being bought out in its entirety, the price-per-acre was applied to the full land value. However, it was recognized that in instances where easements are purchased, small areas of land are worth more per acre than larger areas. Therefore the remaining parcel should be valued based on the number of acres remaining after the easement is placed on the land in order to give the land owner a fair assessment of their land. This was done using a “before and after” method, except in instances where the entire parcel was purchased.

The “before and after” method begins by calculating the price that would be paid for the parcel of land before any land was lost and the price that would be paid for the parcel of land after land is lost to flooding and increased erosion. Subtracting the final price from the initial price of land gives the price that should be paid for the land that is lost for each landowner.

4.3 Applying a Standard Method

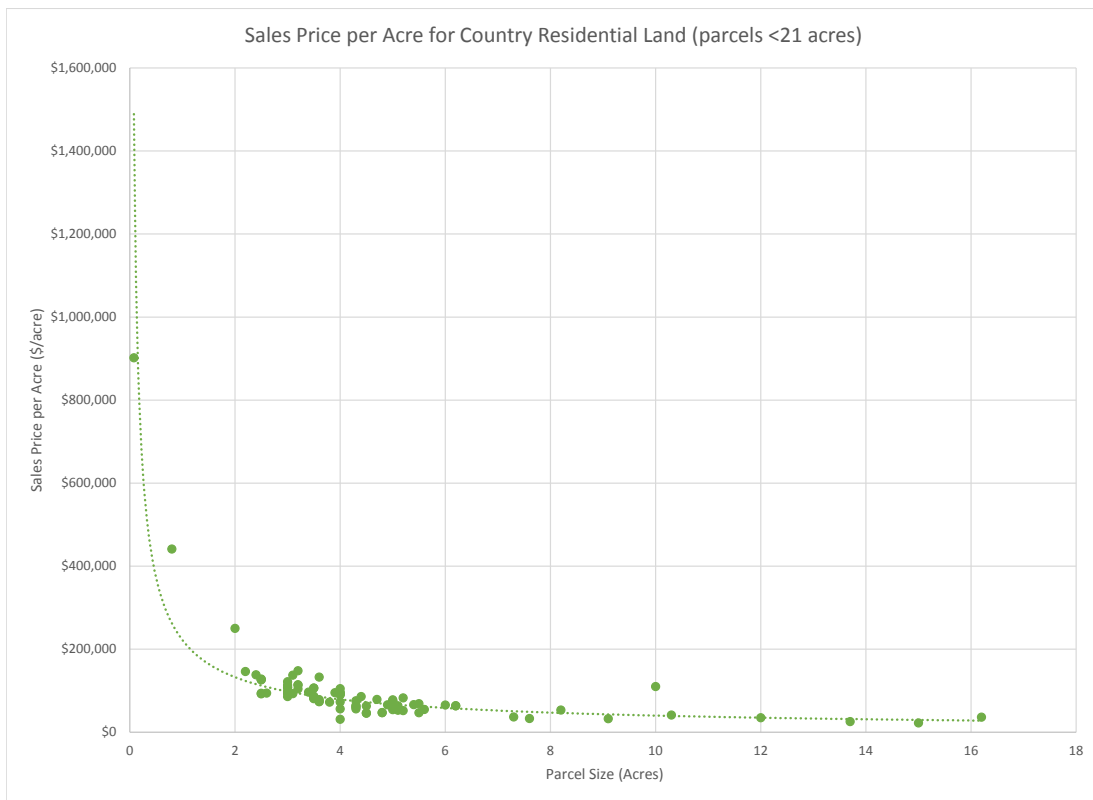
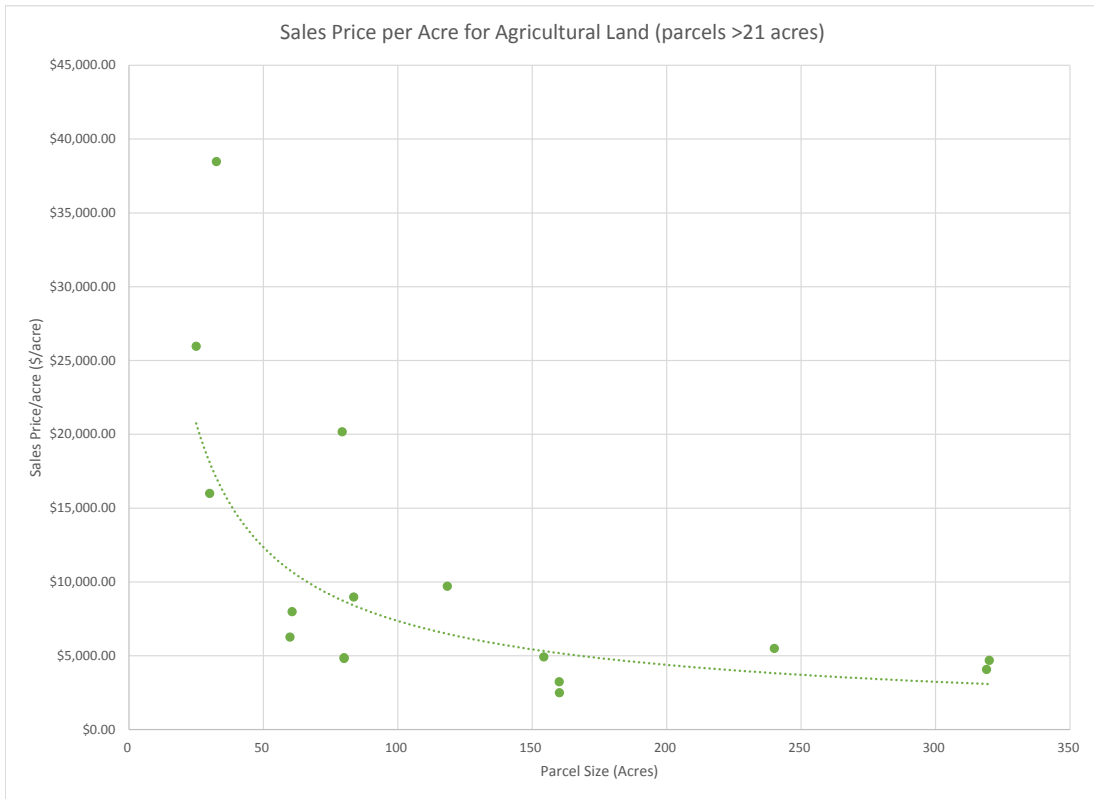
With a few notable exceptions, the properties in the study area could be divided into categories, and a standard methodology be used to estimate the value of the property given the recommended action.

Twenty percent has been added to the assigned base value in certain instances to account for the expectation that expropriation methods will need to be used with some landowners. This will account for damages attributable to disturbance if the owner is required to move, or if payment is required to enable the owner to relocate their residence. This should also cover the value of any special economic advantage arising out of the owner’s occupation of the land, and damages for injurious affection in the event of a partial taking of the owner’s land.

For properties where a buyout has been recommended and a residence is at risk of flooding, a different percentage is applied to the value of the property: five percent to account for damages for relocation and inconvenience, and 27 percent to allow for home-for-a-home provisions, summing to a total of 32 percent for residential buyouts. This method applies only to properties with residences on them because the Expropriation Act of Alberta is only required to provide home-for-a-home provisions for properties where the principal family home is expropriated, along with outbuildings like a shed or garage.

The Act recognizes that market value does not always provide true compensation for the home and that it may be difficult to acquire or construct a home that is equivalent to the home that the family is required to leave. Given the relative scarcity of comparable residential properties in rural Alberta, this is likely to be a fairly difficult task. As such, the home-for-a-home provision is relatively high. The Expropriation Act does not spell out the basis of compensation awarded, but recent expropriation cases have seen the reproduction cost of the existing improvements utilized to quantify the home-for-a-home provision. They must also take into account the value to the owner (Alberta Law Reform Institute, 1973).

Sales Price per Acre



The methods used for each case are summarized in **Exhibit 4.2**.

Exhibit 4.2: Methods Applied to Estimate Property Values for Recommended Options

Recommended Option	Improvements Flooded?	Method
Buyout	Yes/No	Apply bare land value based on size using “before” value Add value of all buildings (flooded and non-flooded) Add 32% to total if residence is present Or add 20% to total if there is no residence
Easement	No	Apply bare land value based on size using “before and after” method
Easement	Yes	Apply bare land value based on size using “before and after” method Add value of flooded buildings plus 20%

After calculating values to be paid for each owner, an aggregate total for the entire study area was determined, to be used as an estimate in which the individual variances should reconcile themselves.

4.4 Results

The relevant results of this analysis include a total estimated compensation amount by category and a recommended approach for each owner. It is expected that the aggregate totals fairly represent the total cost of achieving the goal of reducing risk and liability within the hazard area and is detailed in **Exhibit 4.3**. Illustrated examples of easement and buyout properties are contained in **Appendix D**.

Exhibit 4.3: Aggregate Compensation Costs by Mitigation Category

Category	Total Cost*
Buyout of Land Only	\$7,176,000
Buyout with Improvements	\$25,665,000
Easements on Land Only	\$1,712,000
Easements with Improvements	\$692,000
* may not sum due to rounding Total:	\$35,244,000

5 Summary and Recommendations

Properties in the MD of Foothills along the Highwood River between the Town of High River and the Bow River confluence would be severely impacted by another major flood event. Not only do they receive no benefit from the extensive flood mitigation works through the Town, they are also subject to increased flooding as a result. The MD of Foothills requires a defensible plan that is fair to land owners and taxpayers while negating liability and future risks.

Structural mitigation is generally not feasible for individual rural properties. The current regulations and disaster recovery programs do not adequately reduce future risks and are not equitable to all landowners in the context of the protection afforded to others. The most effective, long term solution is to remove and restrict development in the at-risk areas. Fair payment to affected landowners would not be compensation for increased flooding, it is payment for the service the occasionally flooded land provides as part of the overall floodplain management strategy for the Highwood River.

Average property values were determined from comparable past sales in the region. A flood event equivalent to June 2013 with the High River mitigation in place would have varying impacts on the affected properties. If only a portion of the lands were at risk, a conservation easement was considered. In this case, the property was valued by size before and after removing the at-risk portion. The difference between these values is the estimated payment to the owner for the application of the easement. This approach recognizes that the value per acre varies with parcel size and development potential of the residual lands. For lands that had impacted residences or did not retain a viable parcel size outside the easement area, the value for the original parcel size was used (complete buyout).

It is recommended that the MD negotiate the easement purchases with individual landowners based on the characteristics of their land and improvements. The compensation amount estimated is believed to fairly represent the total cost of acquiring development restrictions on at-risk lands. However, each property will have characteristics not considered in the general methodology. For example, some structures may be moved to safe ground within the property or other properties that were assumed to have viable residual land may in fact have service or access issues.

The lands that would be covered by a conservation easement in this approach would not necessarily be sterilized. Productive farmland or recreational areas could still be highly functional. Owners of lands with easements would retain usage with development restricted. Lands completely under easement (full buyout) could be resold with the restrictions in place. Finally, having the easement on title ensures awareness for future owners.

6 References

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Appendix A – Case Studies

Case Studies

Belford Proactive Flood Solutions – Northumberland, England

Type of Mechanism: Capital grant

Description

Natural Flood Management implemented on a catchment scale in Belford, a small town in NE England, which has flooded several times. The ultimate construction ended up incorporating 35 runoff attenuation features (RAF).

Payment Structure

The scheme was funded by a 200k pound payment from the Environment Agency, compensating farmers via a one-off payment. Payments for farmers were set at 1000 pounds per RAF feature, (plus additional money for consulting and research costs).

Impacts for Land Manager

Only one feature has been identified as needing ongoing maintenance. Aside from this, there has been no evidence to suggest there have been significant impacts for land managers. Newcastle University is monitoring the project and has shown local scale flood peak reductions along with the collection of large amounts of sediment, saving land managers money and preventing loss of land.

Links/References

Runoff attenuation features: a sustainable flood mitigation strategy in the Belford catchment, UK¹

Runoff management during the September 2008 Floods in the Belford catchment, Northumberland²

Crook of Baldoon Nature Reserve Project – Dumfries and Galloway

Type of Mechanism: Land Purchase

Description

The Royal Society for the Protection of Birds (RSPB) Scotland purchased 156 hectares of land at the Crook of Baldoon, in the southwest of Scotland in 2010. In 2012 a further 40 hectares of adjacent farmland was purchased to increase this area. The total area consists of saltmarsh, intensively farmed grassland, and short rotation coppice willow.

Payment Structure

One-off payments for land purchases came from RSPB Scotland, with contributions from a number of charitable trusts and funds.

¹ <http://langcent.ncl.ac.uk/proactive/belford/papers/Nicholsonetal.pdf>

² <https://research.ncl.ac.uk/proactive/belford/papers/j.1753-318X.2010.01078.x.pdf>

Impacts for Land Manager

Because the land was acquired by RSPB, the site is now safeguarded for wildlife in perpetuity. Grazing on the saltmarsh has been reduced and ongoing monitoring has been shown that the physical structure and diversity has improved since the project's inception.

Links/References

Crook of Baldoon Nature Reserve Project. Final Report to Dumfries & Galloway Leader Programme³

Dearne Valley Nature Improvement Area (NIA) – Yorkshire, England

Type of Mechanism: Land purchase and lease transfer plus targeted advisory work

Description

The Dearne Valley NIA site is located on a former coalfield and is made up of a mixture of farmland, wetland, and woodland. Management is undertaken by the Dearne Valley Green Heart (DVGH) partnership, with land being owned by a number of the DVGH partners and private land managers. The aim is to restore, improve and create habitats within the NIA to provide valuable ecological habitats and provide natural flood management opportunities. Some farm land which was previously being used to grow animal fodder was switched to grazing pasture, allowing for more biodiversity benefits.

Payment Structure

Land purchases were negotiated through a one-off payment between buyer and seller. In the case of lease transfers, approximately 90% of the freehold value was paid to the tenant farmers to buy out the tenancies and the new tenant (the RSBC in this case).

Impacts for Land Manager

Once sold, the previous land owner relinquishes all rights to the land. In the case of lease transfers, the land manager had to buy out the current leaseholder, the payment for which would have been provided by the DVGH partnership and other funding sources.

Links/References

Dearne Valley Green Heart⁴

Elgin Flood Alleviation – Moray, Scotland

Type of Mechanism: Land Purchase

Description

Elgin is one of Scotland's oldest towns, lying along the banks of the Lossie River. The Lossie River has a documented history of flooding dating back 250 years. The Elgin Flood Alleviation scheme is the largest flood scheme in Scotland's history, and involves a series of set-back flood embankments, flood walls, bridges, and flood channels, in addition to the demolition of select structures located within the flood plain. It was due for completion in autumn 2015, and had a budget of 86 million pounds. The combination of set-back

³ http://www.dgleader.co.uk/wp-content/uploads/2016/08/Leader_final_report_Crook_of_Baldoon.pdf

⁴ <http://www.barnsleybiodiversity.org.uk/nia.html>

defences and lowered flood plain should provide a current-day standard of 1:200 year protection for the city.

Payment Structure

The project itself was completed with funds from the Scottish Government and Moray Council. Land Managers were compensated by negotiation under the Lands Compensation Act (1973). Land needed for engineering works would have received compensation for its capital value, plus injurious affection, and severance and disturbance.

Impacts for Land Manager

Compensation mechanisms for land purchase mean that the land manager is paid a sum based on the value of their property without taking into account the flood mitigation measures on the property. This project in particular will provide major benefits to the community by providing transportation links, reducing disruption due to flooding and related damage, and protection a large number of business and domestic properties.

Links/References

Moray Council Flood Alleviation Scheme⁵

Long Philip Burn – Selkirk

Type of Mechanism: Capital grant and land manager contributions

Description

The town of Selkirk has a history of flooding, deriving from multiple sources. The Long Philip Burn is a small burn with high energy rising in the hills adjacent to town. The upper reach of the catchment had been degraded due to years of close-cropping from sheep-grazing. Other factors combine to produce flash floods in the area, delivering high volumes of gravel into the system. The mitigation scheme strove to incorporate natural flood management into its design, and has resulted in both major-scale (e.g. river restoration) and minor-scale (e.g. riparian fencing and log-jams) NFM measures. When completed, the measures will reduce flood risk from the 1:2 flood event to above the 1:200 year flood event.

Payment Structure

The total cost of the river restoration and engineered flood defences operating on the lower reaches are approximately 3million pounds. The flood defences on the lower reach are funded through capital grants, with 80% provided by the Scottish Government and 20% by the Scottish Borders Council. The middle reach works, consisting mainly of sediment management, were undertaken entirely on the land of one landowner at a cost of about 70,000 pounds, with an additional compensation payment of 20,000 pounds. They were paid for by the Scottish Borders Council capital grant funding and will cost about 5,000 pounds per year to maintain. The upper reach was owned by two large land owners, managed by tenants. The various NFM measures were funded by the SRDP and land managers/tenants.

⁵ http://www.moray.gov.uk/moray_standard/page_81702.html

Impacts for Land Manager

Land being taken away for flood management was purchased outright at market value with the understanding that it would no longer be useful for farming. In the middle reaches, there was some loss of land for farming, but the offset was the potential environmental improvements and reducing loss of land to river-slope collapse or gravel wash-out onto arable land. The same goes for land in the upper reaches, but the hope is that with maturing riparian planting, there should be an environmental improvement.

Nigg Bay Managed Realignment Scheme – Cromarty Firth, Scotland

Type of Mechanism: Land Purchase, government grants

Description

Nigg Bay was a planned realignment which involved making two 20-meter wide breaches in existing sea defences to allow the top of the tide to flood a 25 ha field. The goal was to create important habitats for wildlife while reducing maintenance requirements for the existing and failing coastal defences.

Payment Structure

The RSPB applied for and received grant funding from the Heritage Lottery Fund (HLF), the Scottish Natural Heritage (SNH), and the Scottish Environmental Protection Agency (SEPA). Land was gradually purchased; there were no additional payments to land managers or anyone else. The site is part of a nature reserve.

Impacts for Land Manager

The RSPB is the land manager and has created 25 ha of new intertidal habitat, partially compensating for past losses in Nigg Bay and potential future losses due to sea level rise and climate change. There will also be benefits for coastal flood management by reducing pressure on sea walls elsewhere in Nigg Bay.

Links/References

Case Study on the Nigg Bay Managed Realignment Scheme (Scotland)⁶

Coastal Realignment at RSPB Nigg Bay Nature Reserve⁷

Land buy-back Scheme – State of Victoria, Australia

Type of Mechanism: Sale and leaseback

Description

Following severe flooding in Australia in early 2011, the Government in the State of Victoria undertook an initiative to buy land and then resell it with flood covenants attached. The covenants may prevent irrigation or require the land to be managed as extensive grassland. The buyback scheme was part of a larger rural flood assistance program, and was made available to properties that were affected the most by the floods in 2011. It was established to buy properties from landowners who wanted to voluntarily sell and relocate somewhere else on their land, or give up their land. The program offered compensation

⁶ https://restorerivers.eu/wiki/images/6/65/Nigg_bay_managed_realignment_scheme.pdf

⁷ https://www.rspb.org.uk/Images/CoastalRealignmentatRSPBNiggBaynaturereserve_tcm9-406978.pdf

for change in land value with a covenant placed over the land to be designated a flood path in the future, and land titles to be reconfigured with no insurance prerequisites. The buyback price was the pre-flood market value.

Payment Structure

One-off payments were offered to landowners in flooded areas for a set period of time.

Impacts for Land Manager

Sale of land was voluntary, and there was possible loss of production either way, whether the landowners decided to keep their land and it continue to be flooded, or they sell it to the government and lose semi-productive land. With a loss of a number of residents, the closest town lost a number of residents and business as well. Those who wished to leave were paid the pre-flooded market value, allowing them to vacate their land quickly and leading to a relatively fast change in land use.

Links/References

Primarily newspaper articles⁸

Urban Water Quality Protection – New York City

Type of Mechanism: Land purchase and leaseback

Description

During the first half of the 20th century, NYC acquired large tracts of land upstream to create reservoirs for their water. Farms were flooded and villages relocated in the process. In 1989, the federal *Safe Drinking Water Act* required a new higher standard of water quality. Engineers projected the cost of new treatment facilities to be over \$5 billion, plus millions annually to operate.

However the new legislation allowed for the protection of watersheds as an alternative. Working cooperatively with the upstream farmers this time, NYC worked with the American Farmland Trust to establish the Watershed Agricultural Council (WAC). The City funded "Whole Farm Plans" and provided \$20 million to purchase agricultural conservation easements in the Catskill/Delaware River watershed. Currently, to apply for a CE, the applicant must have a current and active Whole Farm Plan and have a property at least 50 acres in size.

Payment Structure

Conservation easements are either sold or donated by a landowner from working farms in New York City's Watershed to protect the City's water resources. Once the proposed CE design has been drafted, the easement is appraised to determine its value. This becomes the basis for the offer to the landowner who will then apply to the WAC. The WAC pays for all appraisals and staff required to design a proposed CE. The WAC will then rate and choose an applicant based on a number of criteria.

⁸ <http://www.theage.com.au/victoria/land-buyback-scheme-heads-21m-flood-package-20110426-1dv4r.html>

Impacts for Land Manager

Farmers retained their land, higher standards of agricultural management were implemented, the upstream watershed was protected from intensive use in perpetuity and New York City saved billions of dollars.

Links/References

New York Watershed Agricultural Council⁹

White Cart Water Flood Prevention Scheme – South Glasgow, Scotland

Type of Mechanism: Land purchase and lease back; one-off compensation and compensation in kind

Description

The program consisted of two phases of work, the first of which involved works in the upper catchment, while the second consisted of works to urban defenses. This case study looked specifically at work done in the upper catchment where land was required for flood storage and access during construction and maintenance. The land purchase required for flood storage was a complicated process because it involved 40 land owners. For the vast majority, a one-off payment was provided for the inconvenience of the flooding that would occur once the mechanism was in place. The payment was dependent on land value and use, with the majority of the land being low grade agricultural, used for grazing, with two exceptions. The first was land belonging to a dairy farmer, who received annual payments over the four years during construction. The second was land acquired by the City for flood storage, which was then leased back to the land owner. They also acquired a new area of land for the land owner in exchange.

Payment Structure

A variety of one-off payments, annual payments during construction, compensation and in-kind arrangements; and access rental agreements.

Impacts for Land Manager

Impacts for Land Manager: During construction of the mitigation structures, land managers experiences some loss of production, which was compensated for with one-off payments when the land was not available for grazing. The land may be flooded during high flows, the frequency of which may be determined by rainfall and catchment response, which was taken into account in the one-off payments. The approach for the land compensation proved to be one of the main barriers to this approach.

Links/References

White Cart Water Flood Prevention Scheme¹⁰

⁹ <http://www.nycwatershed.org/>

¹⁰ <http://www.whitecartwaterproject.org/>

Appendix B – The Manitoba Experience

The Manitoba Experience

Background

Winnipeg is located in such a location that it is exposed to a high risk of damage from flooding. Winnipeg already has in place numerous ring dikes around entire communities, and a diversion system that when undertaken, was the second largest earth moving project in the world. Still, in 2001, the average annual damages that could be incurred if no additional protection works were put in place in Winnipeg were calculated to be \$50-\$70 million per year, excluding business losses (KGS Group, 2001).

Existing Flood Protection Facilities (2001)

When KGS Group prepared their report, major control to the City of Winnipeg and surrounding areas was provided by the Red River Floodway, the Portage Diversion, the Shellmouth Dam, and a comprehensive diking system within the City.

Red River Floodway

Construction of the Red River Floodway was completed in 1968 and cost a total of \$62.7 million. It provides protection up to the 1 in 160 year flood level at Redwood Bridge and consists of four major components: the Floodway channel; the Inlet Control Structure; the dikes; and the Outlet Structure. The Inlet Control Structure consists of concrete abutments and a central pier with two large submersible gates.

The gates are usually submerged in the summer months, under about 8 ft of water, allowing water to flow into the Floodway Channel under a certain discharge, and regulating the diversion in flow between the Red River and the Floodway Channel, also maintaining a steady water surface elevation upstream of the structure.

Dikes on either side of the Floodway Inlet Control Structure retain the floodwaters, with the West Dike retaining the floodwaters of the Red River, and the East Dike retaining the waters created by the Floodway Channel.

Portage Diversion

The Portage Diversion was completed in 1970 at a cost of \$20.5 million and is designed to carry flood flows from the Assiniboine River at a point just upstream of Portage la Prairie northward to Lake Manitoba. This diversion provides flood protection to the City of Winnipeg and the City of Portage la Prairie, as well as the area adjoining the Assiniboine River between the two cities.

Shellmouth Dam

The Shellmouth Dam was completed in 1972 at a cost of \$10.8 million, designed to benefit the Cities of Brandon, Portage la Prairie, and Winnipeg. It has the ability to store water, as well as reduce the flow of water due to its horseshoe-shaped design.

Flood Defence Expansion

KGS was retained in 2001 to perform a benefit cost analysis on multiple flood protection schemes. The two main options that were compared were the expansion of the Red River Floodway and the enhancement of Ste. Agathe Detention Structure.

Development of either flood defense would have required access to private property. As outlined by KGS, the following factors should be considered when accessing private property:

- Where land needs to be expropriated compensation must be paid to affected land owners according to the value of their land, plus damages in accordance with the Expropriation Act.
- If private land is to be used for the storage of water on a regular basis, this would be seen as 'taking of land' and would require compensation. Examples of such use are detailed in Section 0.
- According to the Emergency Measures Act, lands may be flooded without any liability during a declared state of emergency, subject to the payment of compensation laid out in the Act.

In order to expand the Red River Floodway, the government would be required to purchase an additional estimated 950 acres of land, costing just over \$6 million in land acquisition costs.

Government Buyouts

Following severe ice jams in 2009, the 63 most flood-prone homes and cottages in the Breezy Point¹ (42 cottages) and St. Peters Road areas were purchased by the government so the homeowners could relocate. The provincial government offered pre-flood market value for the Crown Land leaseholders of vacation homes in Breezy Point in an attempt to decommission the subdivision along the Red River.

The buyouts were part of a voluntary program, but the government made it clear that the cottage owners' leases would not be renewed, and that the offer would not last indefinitely. Negotiations were completed in 2010 and demolition work began in January of 2011 with land returned to its natural state in the summer of 2011. Meanwhile, the RM of St. Andrews offered similar deals for privately held land just south of Breezy Point.²

Flood prevention measures in this area were not a viable option, and as such the Government of Manitoba made the decision to buy back the properties or end the leases and return the land to its natural state. The buyouts in Breezy Point totalled about \$3 million, and those in St. Peters totalled about \$1 million.³

Flood and Compensate

In 2014, the Government of Manitoba made available \$1.15 million in compensation to farmers whose lands were flooded due to a decision to use the Portage Diversion to manage water flow and provide flood protection to a number of Manitoban homes and properties.⁴ Recognizing that this has led to a loss in production for farmers, payments were made to crop and forage producers in the immediate vicinity of the Diversion for lost production and land restoration, making an estimated 2,500 acres eligible for compensation.

¹ https://gov.mb.ca/asset_library/en/spring_outlook/flood_fighting_2015.pdf

² <http://www.interlaketoday.ca/2009/07/24/breezy-point-buyouts-bashed>

³ <http://www.winnipegfreepress.com/local/breezy-point-flood-buyouts-complete-80494842.html>

⁴ <http://news.gov.mb.ca/news/index.html?item=33273>

Appendix C – Detailed Flood Compensation Methods

Detailed Compensation Methods

Land Purchase/Sale and Land Purchase/Sale with Leaseback

Case Studies

Crook of Baldoon, Elgin Flood Alleviation, Nigg Bay, State of Victoria, Upper Garnock, White Cart Water, Dearne Valley NIA, New York Whole Land Management

Concerns

The process of purchasing land can be complicated and time consuming, particularly if it involves a large number of land owners. Two of the most time-consuming activities brought up in the study were identifying the land owners and negotiations.

Low-grade agricultural land was identified as easier to purchase. While higher grade land was still possible to purchase, it required more incentives or additional payments in order to encourage participation. The payments are dependent on the land value and its use, and successful negotiation often requires good background knowledge of agricultural issues and an understanding of how to talk to farmers and landowners.

Although this mechanism requires a significant upfront cost, particularly when large amounts of land are required, there are thought to be minimal long term costs involved. Additionally, land purchase gives overall control of land and its management to the government and ultimately eliminates any ongoing payments.

Determining Payment Rates

A land purchase by a governing body will require a one-off capital payment, based on an independent valuation of the land, taking into account the land capability and productivity. Leaseback rates must take into account that the land use may need to change in response to changing conditions after implementation measures and that the measures are likely to reduce the size of useable land. Additional costs may include legal and valuation fees.

Land Lease to a Public Body

Case Studies

Dearne Valley NIA

Concerns

In cases where there are already tenants on the land and the lease is not up for renewal, the owner will need to negotiate with the current tenant to surrender the lease. In these cases, most often a payment will be needed to “buy out” the tenant’s lease; this payment can be calculated by having the land independently valued and taking into consideration how long the lease has been held and how much longer is left on it. Using an independent assessor is important as this helps the tenant and landowner to feel they are getting fair payment.

If there is no tenant on the land, most times the process is much simpler as only a rental payment will be needed. Long term leases (up to 100 years or more) can be agreed to with this mechanism, which can help secure the land.

Determining Payment Rates

When determining payment rates, market rental value determined by land class needs to be identified for the affected land, taking into account that the implemented measures will likely reduce the size of productive land, and the time during which it is useable. The length of the lease may also be important in determining the rate.

Servitudes

Case Studies

State of Victoria, Westcountry Rivers Trust (Upstream Thinking Initiative), New York Whole Land Management

Concerns

Servitude agreements, such as easements, can work well in combination with other payments and mechanisms to secure the longevity of a project or to ensure that actions implemented on a parcel of land will be maintained for a minimum period of time. Servitude agreements can be restrictive for the land manager and in some cases concerns arise about the re-sale value of the land. These issues can be overcome in some cases by emphasising any additional benefits or having a time limit on the agreement. For more in-depth information about easements, see the section on conservation easements.

Determining Payment Rates

Negotiations need to take place to determine the long-term impact on the land value of the servitude. The extent of the impact and conditions of the servitude should benefit the landowner and relate to the extent of the impacts of the mitigation measures.

Installing a NFM measure or structure on the land may lead to the land manager taking on legal ownership of the structure, which may affect maintenance and long-term effectiveness of the structure. Where annual payments are being considered, there is the possibility that a long term arrangement may result in a total payment that is greater than the value of buying the land to build the structure. The same should be considered where the government is maintaining the structure and paying the landowner for access to their land.

Capital and Annual Payments

Case Studies

Belford Proactive Flood Solutions, Long Philip Burn, Scottish Rural Development Programme, Scottish Water (Sustainable Land Management Incentive Scheme)

Concerns

Capital and annual payments can be an attractive incentive for land managers if they are required to decrease the amount of land or the productivity of their land. It helps to reduce the financial burden or barriers to implementing measures, and can become a secure source of income for the land manager if they are made regularly.

Case studies reviewed in the 2015 study indicated that there are two main methods for providing payments in order to ensure criteria and payments are consistent between applicants:

- A maximum amount is made available per applicant with quotes for work submitted up to this maximum amount; or
- Fixed sums are set for specific measures implemented (a dollar amount per meter of fencing or berm installed).

After payments are made, site inspections are required in order to ensure that measures have been properly carried out. It is important to consider how long annual payments are going to be carried out to know if the funding will be available and if the scheme is sustainable.

Determining Payment Rates

The amount of capital payment will need to compensate for implementation of the NFM measure if necessary, or to compensate for loss of income sure to change in land management, whichever is deemed appropriate. Installing a NFM measure on someone else's land may lead to them taking ownership of it, but this should be considered at the outset, along with who will be maintaining the structure and retaining liability for its performance and insurance. Compensation should be determined accordingly. Otherwise, annual payments should be considered for any loss to size of productive land or time that land may be productive.

Economic Instruments – Flood and Compensate

'Flood and Compensate' is a specific economic instrument that can protect a major population centre, while allowing controlled flooding of designated lands. These measures in turn help minimize losses for the majority of residents in surrounding areas as well. Flood and Compensate can also help minimize costs by reducing the land that needs to be acquired by the government, since whole parcels of land are not purchased from affected residents. Instead, affected residents remain land owners and are only compensated in the event of a flood.

Case Studies

The Manitoba Experience, National Flood Regulations in Scotland

Concerns

The programs ensure that flood waters are dissipated by diverting water to nearby land, and compensation occurs after the flood passes so that economic losses can be calculated. One concern for the governing body is that depending on the frequency of flooding, it may be less costly in the long term to just buy the parcel of land. This may have negative effects if land owners are displaced from their land.

Determining Payment Rates

Because this model provides financial compensation to affected land owners in the event of a flood, the associated costs depend largely on the frequency and severity of the flood and any mitigation measures employed. It also depends on the level of government implementing the measures. In Scotland for instance, the measures are mandated by the national government, while in Manitoba it is the provincial government that protects its citizens with flood and compensate measures.

Conservation Covenants

Conservation covenants are outlined in more detail in the following section.

Determining the Appropriate Method

In determining which type of mechanism is most appropriate, RPA (RPA, RHDHV and Allathan Associates, 2015) recommends taking into account factors such as:

- The effectiveness of the mechanism in ensuring the measure is implemented as initially intended;
- The effectiveness of the mechanism over time;
- Flexibility of the mechanism in terms of its ability to adapt to changing requirements and environmental conditions; and
- Lead time required to set up the mechanism

Furthermore, the effects of the mechanism on the landowners, surrounding residents, and downstream users should be accounted for.

Financial and Legal Implications

When considering the implementation of a structure or mechanism on a parcel of land, certain financial and legal implications will need to be accounted for.

Financial

- Does the measure result in land being taken out of productive use?
- Does the NFM measure limit or change the current land use?
- Does it prohibit the land manager from applying for grants or other aid?
- What sort of payment goes to the land manager as a result of installing the NFM (such as large, one-off payments)?

Legal

- Does the mechanism/measure combination mean that the land manager or public body has a legal responsibility to maintain the land use?
- Is the land manager relying on qualifying for agricultural property relief? And will the land manager have their eligible land area reduced if they are no longer able to actively farm the part now being used for flood relief?
- If the measure includes a flood storage area, what implications does this have for the land manager's ability to obtain insurance and other health and safety responsibilities?

Summary

The measures described above are financial instruments used to compensate landowners for providing natural flood mitigation such as:

- Runoff reduction
- Floodplain storage
- Sediment management
- Wave velocity dissipation
- Bank erosion management

The mitigation measures required must be looked at in conjunction with the method of compensation in order to determine the most appropriate flood compensation model to use.

Conservation Covenants

Introduction

Land conservation agreements are one method that governments use to influence how land owners manage their land. In Canada they are generally referred to as conservation covenants or conservation agreements by the Nature Conservancy Canada; Australia refers to them as conservation covenants, and the USA often calls them conservation easements.

Restrictions and Use

When implementing a Conservation Easement (CE), land use restrictions will generally support the conservation goals of the CE. Beyond these restrictions and any activities outlined in the Management Plan, the landowner is free to manage the land however they wish. The restrictions placed on the land should be carefully considered, taking into account the conservation goals and any future land uses. Some common restrictions on conservation easements relate to:

- Subdivision
- Buildings
- Water drainage
- Disturbing the land
- Fencing
- Public access
- Roads and trails
- Timber harvesting
- Mining and excavations
- Waste management
- Agricultural related limitations

The CE should define and incorporate the intended use of the land and outline the easement area with a legal description and an articulation between geographic areas subject to each easement purpose (if there is more than one).

The primary purposes of the agreement in this case are to conserve watershed functions, conserve land and soils with high agricultural or recreational value, and prevent use of property along newly created flood zones.

Rights Reserved by Grantor

Oftentimes, particularly in the event of agricultural properties, land owners may wish to articulate a scope of agricultural practice that is allowed under the agreement. Commonly reserved rights of the grantor (in this case the land owner) often include:

- Control of access
- Fee simple ownership
- Agricultural practices exclusion

Access and Dispute Resolution

The government should be provided access to the land for the purposes of monitoring and enforcement, constructing a structure if necessary, and post-flood reclamation if such a stipulation is laid out in the agreement. Most CE documents also contain some form of process for dispute resolution in the event that a dispute arises to avoid legal action.

Transfer of Conservation Easement

In the event that the land is sold or the landowning company is dissolved, there needs to be a provision in the easement and their bylaws for transferring the CE in perpetuity. If the CE is to be terminated at a certain point in time, this too should be outlined in the agreement.

Municipal Governments as Qualified Organizations

Municipal or provincial governments use conservation easements in a different way than land trusts do, land trusts generally being comprised of non-profit groups or NGOs. Government conservation easements come about almost exclusively as a results of the proposal for development.

Governments have some significant advantages over other potential qualified organizations. Their statutory documents require them to articulate goals that can be a base for conservation goals. For example, in their Municipal Development Plans, municipalities are required to consider conservation of agricultural operations, but not agricultural land. Despite this, most municipal development plans will at least consider the agricultural land base. Governments are also, for all intents and purposes, perpetual organizations, lending to the sustainability of the long term sustainability of the CE.

Urban Growth Management

One key component of Urban Growth Management (Smart Growth) involves determining lands of particular importance for watershed protection, agriculture, biological diversity, recreation, natural resources, etc. and directing any new residential and intensive commercial development away from these areas.

The State of Oregon had the first aggressive growth management program in 1972, requiring cities to establish boundaries beyond which they would not provide services. In Alberta, the town of Okotoks led the way with their award-winning Sustainable Okotoks Municipal Development Plan, which limited population growth, town boundaries, and water use. The recent repeal of that policy shows the challenges of leaving such a program to political will only.

The State of Maryland went one step further and incorporated conservation easements into their Smart Growth plan. Maryland's *Economic Growth, Resource Protection, and Planning Act* directs state funds for development only to designated "Priority Funding Areas." At the same time their Rural Legacy program provides funding and incentives for CEs on the areas outside designated Priority Funding Areas. These efforts protect critical ecological functions, support wildlife, safeguard fragile water resources and protect productive farmland.

Groundwater Recharge Protection

In Alberta, groundwater is relied on heavily for both human needs (drinking water, industrial use) and ecological functions (water cycling, wetland habitat). Those aquifers are dependent on associated landscapes that capture precipitation and surface water, facilitating critical absorption and recharge. Despite their importance, those wet areas are often seen as barriers to development and economic activity, leading them to be drained and filled, or re-formed to harden them and degrade their infiltration capacity.

Though not currently a primary use, CEs can be used to limit land use activities that impair this groundwater re-charge capability. Land trusts can identify critical recharge areas in the area of focus and target them for conservation. Municipalities can include consideration of groundwater recharge areas in development proposals and approvals, and use CEs to facilitate protection of these critical landscapes within a matrix of developed lands.

Conservation Law in the UK

Under UK Conservation Covenant Law (The Law Commission, 2014), the UK Government has created provisions for payment for eco-system services and agri-environment schemes. Payments for environmental services have become increasingly important in the creation of environmental policy in recent years, and it was suggested that conservation covenants could be used to provide a secure and consistent way of making sure that payments to landowners for ecosystem services produce the desired outcome. Land management practices upstream of a river may contribute to flooding downstream. After some negotiation, affected landowners downstream may agree to adopt different land management practices in return for a lump-sum or yearly payment. In other instances, innovative upstream land management can have positive impacts on downstream users, including water filtration and other positive ecosystem services.

Payments for Ecosystem Services

Introduction

While some ecosystem services, such as timber and food, have a monetary value, others, such as climate and flood control, do not, despite being equally vital to our wellbeing (Smith, et al., 2013). Payments for ecosystem services (PES) is one market-based mechanism which attempts to compensate for this discrepancy. The basic idea behind

PES is that those who provide ecosystem services should be paid for doing so, much like any other service, in an attempt to bring these services into the wider economy, so that those who benefit from these services pay those who provide them. The past 15 years have witnessed a rapid increase in PES programs around the world at national, regional, and local levels (Smith, et al., 2013).

It has been noted that one of the most significant factors leading to the loss and degradation of regulating services on a global level is that decision-makers either lack or choose to ignore information about the value of regulating services when considering development decisions that impact natural ecosystems. Therefore, land is used for a purpose which generally benefits only one group of stakeholders as opposed to the wider population.

For a PES scheme to work, it must be positive from a buyer's perspective in that the payments are less than those associated with any alternative means of securing the desired service. For example it may be less expensive to pay land owners for improved catchment management or flood retention than to pay for additional structural flood mitigation. The scheme must also be attractive to the seller, in that the payment received at least covers the value of any returns foregone as a result of implementing the interventions such as lost agricultural production. PES programs may also come along with regulations or government provisions to help protect and enhance services. The stakeholders may also enter into an agreement voluntarily without requesting payment, solely as land stewards.

Opportunities and Risks

By promoting catchment-based approaches to water management, and acknowledging the benefits that their proper management can provide, consistent goals can be achieved, maximizing the contribution that land owners can make to sustainable development. Land owners can also be compensated for services and earn an income that may have otherwise gone unused, and learn good management practices in the process. A further benefit of some regulating services is that they are complementary (for example, carbon storage and hydrological flow and carbon storage in forests) (Kumar, Verma, Wood, & Negandhi, 2010).

Smith et al. (2013) note some unintended consequences that may arise in the process include:

- Increasing the provision of an ecosystem service in one area will lead to pressure on an ecosystem service in another area (intensified land use to compensate for a decrease in agricultural activities for example).
- The perception that a PES program is unfair based on the assessed potential of the land.
- The introduction of non-native species or other poor management practices after payments have been made.
- Furthermore, Kumar et al. (2010) note that some ecosystem services may be seen as conflicting or rival services. For example, habitat provision or bioremediation and withdrawal of water for irrigation in floodplain wetlands are rival services.

PES in Practice

Payments for ecosystem services must benefit both the buyer and the seller. Different methods of land management will have a significant impact on the delivery of the

ecosystem service, and the downstream benefits to users. When determining the monetary value of the payments for ecosystem services, particularly where agricultural land is used for floodplain regulation:

- The minimum PES payment would cover any private income foregone by the farmer as a result of reduced agricultural production.
- The theoretical maximum payment would be the cumulative value of additional ecosystem services provided to the buyer (which may include flood attenuation, fresh water supply, and wildlife habitat), however these are hard to quantify.
- In practice, the level at which PES payments are set reflects supply and demand for particular ecosystem services and an intermediate point between the above minimum and maximum values.

Payments made for ecosystem services may involve additional provisions for enhanced land management practices, in areas such as:

- Soil management
- Livestock management
- Fertilizer management
- Farm infrastructure
- Manure management

Step-by-Step Approach

Defra has laid out a number of steps in their 2014 best practices guide to ecosystem services, which can be examined in more detail in their report (Smith, et al., 2013).

Phase I: Identify a saleable ecosystem service and prospective buyers and sellers

Identifying a saleable ecosystem service involves affirming three specific questions:

1. Are there specific land or resource management actions that can secure a supply of the ecosystem service over and above that which is currently being offered?
2. Is there a clear demand for this service and is it financially valuable to at least one buyer?
3. Is it clear whose actions have the capacity to increase supply of the ecosystem service?

Some regulating services that may be provided by rivers and wetlands include the following:

a. Water quality regulation

Forests and wetlands can help to stabilize soils and filter pollutants from water. The quantity and quality of water flowing through these watersheds are highly important to agriculture, hydro-power plants, and municipal water supplies, particularly if residents rely on wells for drinking water. The value of water quality regulation is often compared to the cost of constructing and operating a water treatment plant.

b. Waste treatment and processing

Ecosystems play an important role in the removal and treatment of waste introduced into the environment. Aquatic systems have the ability to remove an average of 80 percent of global nitrogen, but the amount is being reduced by the loss of wetlands across the globe (Kumar, Verma, Wood, & Negandhi, 2010). The characteristics of both wastes and the ecosystems that cleanse them vary, natural environments vary in their capabilities to absorb and treat waste.

c. Water-flow regulation

Vegetation has a significant effect on regional rainfall patterns. Vegetation such as trees increase evaporation of water from the Earth's surface, thereby causing increased cloud formation and rainfall. This same vegetation also acts as a sponge, soaking up and storing water when it is abundant, and slowly releasing it during dry periods. This system of capturing, storing, and releasing water reduces the impacts of flood and droughts on surrounding communities (Myers, 1996).

d. Nutrient cycling

Natural ecosystems regulate the flows and concentrations of nutrients (such as nitrogen, phosphorus, and potassium) through a number of complex processes. The continuous recycling of dozens of chemical elements occurring in natural systems supports life on Earth.

e. Natural hazard regulation

Soils have the ability to store large amounts of water and help in reducing the severity and probability of floods and fires. Coral reefs also buffer waves and protect adjacent coastlines from storm damage. Wetlands attenuate floods by absorbing peak runoffs and storm surges. These regulating services contribute to human safety and the protection of man-made infrastructure, although changes humans have made to natural ecosystems have contributed to a significant rise in the number of floods, storms, and major fires across all continents since the 1940s (Millenium Ecosystem Assessment, 2005).

The second step in this phase is identifying the market of buyers and sellers. Buyers can be divided up into three types:

4. Primary buyers: such as private organizations and other individuals who reap benefits directly from improved ecosystem services, and therefore pay directly for them (i.e., reduced flood risk, clean water, or recreational access).
5. Secondary buyers: including organizations that pay on behalf of the public (i.e., water utilities).
6. Tertiary buyers: buyers who purchase improved ecosystem services on behalf of the public (i.e., the government).

Beyond the buyers and sellers, it is also helpful to determine intermediaries (who may be valuable in determining prices and establishing baselines), and knowledge providers (such as scientists and resource management specialists).

Phase II: Establish PES Scheme Principle and Resolve Technical Issues

Establishing the key principles underlying the PES program will likely involve a significant investment of time and effort, in addition to building strong relationships in order to create a mutually beneficial agreement. This step involves such tasks as:

- Determining the geographical area

- Establishing a baseline for accurate monitoring
- Opportunity and risk assessment
- Identifying the right interventions
- Method of payment (input- or output-based payments)
- Methods for monitoring, verifying, evaluation, and review

Phase III: Negotiate and Implement Agreements

Negotiating the PES agreements involves agreeing to:

- Nature of payments
- Level of payments (price paid for ecosystem services)
- Timing of payments

After the above are agreed to, formal agreements are drawn up, outlining the details of the plan. See **Exhibit 4.1** for examples of commonly used valuation tools.

Phase VI: Monitor, Evaluate, and Review Implementation

PES programs need to be monitored in order to ensure that:

- The interventions or ecosystem service outcomes are being delivered as intended
- Interventions are enhancing ecosystem services (if payments are based on inputs)
- There are no adverse trade-offs taking place with other valuable ecosystem services
- Regulatory requirements are being complied with

In order to be effective, the system must be compared to a baseline, measured before any measures are put in place. Effective monitoring should also be cost-effective, accurate, replicable, timely, and free of bias.

Phase V: Consider Opportunities for Multiple-benefit PES

This step involves identifying the co-benefits associated with providing the core ecosystem service initially assessed, and then identifying all co-benefits, regardless of whether there is a market for them or not. If they can be quantified by being bundled or layered together with the other ecosystem service(s).

Exhibit 1: Tools for valuing ecosystem services

Valuation Tool	Description
Replacement Costs	Even where ecosystem services have no market, they may have alternatives or substitutes that can be bought and sold that may be used as a proxy. For example, the costs of building and operating a waste treatment facility as a replacement for the cost of wetland services.
Effects on Production	Because other economic processes often rely on wetland resources as inputs or the support they provide, it is sometimes possible to look at the contributions of wetland goods and services in relation to the output of

	wider production/consumption opportunities in order to assess their value.
Damage Costs Avoided	The loss of ecosystems often incurs costs in terms of damage to or a reduction of other economic activities. The damage costs avoided can be used to represent the economic losses foregone by conserving the ecosystem. For example, floodplains provide important flood attenuation services for nearby infrastructure and settlements. The services can be valued by assessing the costs of damage avoided at certain return periods to surrounding roads, buildings, and other infrastructure.
Mitigative or Avertive Expenditures	Similar to replacement costs, if the natural ecosystem were gone, it would almost always be necessary to take some steps to mitigate the negative side effects. For example, coastal marshes and mangroves stabilize shores, control erosion, and protect from storms and floods. It would be necessary to build flood barriers and other infrastructure to mitigate the degradation of the ecosystem, the cost of which can be used as a proxy for its value.
Hedonic Pricing	Hedonic methods look at the differential in property prices and wages between locations and then isolate the proportion of this difference that can be attributed to the ecosystem service.
Travel Costs	Wetlands, rivers, and lakes often hold a high recreational value, even though there is often no charge to use or view them. The expenditure can be calculated by adding up the costs (transportation, food, equipment, accommodation, time, etc.) that visitors spend to reach the destination, and creating a demand curve. These travel costs are reflective of the value that people place on the recreational aspects of the ecosystem.
Contingent Valuation	Contingent evaluation techniques are often used where no close substitutes are available and the ecosystem has no recreational value. Contingent valuation infers that people are hypothetically willing to pay for the services the ecosystem offers, or are willing to accept compensation for their loss.

Appendix D – Illustrated Examples of Easement and Buyout Methods

