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HIGHWOOD RIVER HAZARD STUDY

Flood Risk Inventory and Assessment Report

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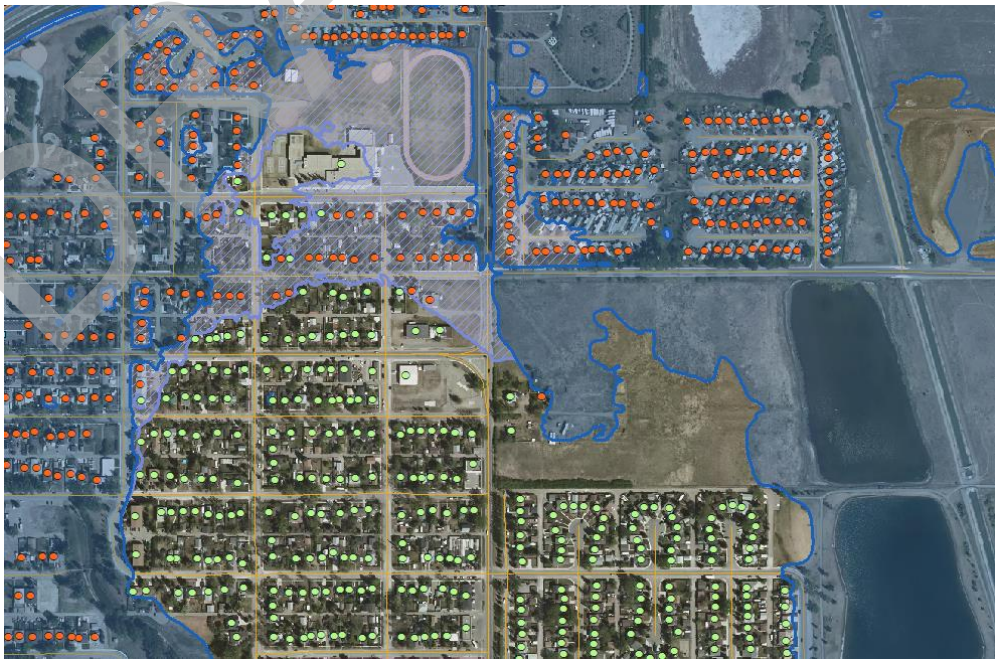

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REPORT

Golder Associates

Executive Summary

Golder Associates Ltd. (Golder) was commissioned by Alberta Environment and Parks (AEP) to undertake the Highwood River Hazard Study (the study) along the Highwood River and Little Bow River reaches. The Highwood River hydraulic model study reach extends from a location upstream of Longview to the Highwood River mouth. There are two major tributaries (i.e., Stimson Creek and Sheep River) along the Highwood River study reach. The Little Bow River study reach extends from the Highwood River floodplain areas south of the Town of High River (High River) to a location approximately 3 km downstream of Highway 2. The upstream end of the Little Bow River study reach is located at the 5th Avenue SE in High River. The Little Bow River generally flows in a southeastern direction.

This report documents the methodology and results of the flood risk assessment and inventory component. A summary of the work supporting the infrastructure inventory and categorization and flood risk statistic assessment is provided. Flood risks in the study area are identified based on the open water flood inundation extents and design flood hazard area information with basic spatial inventory information on land parcels, infrastructure, and population under various flood scenarios. Statistics are presented for open water flood inundation areas, and the design flood hazard area.

The main results of the flood risk assessment for the open water floods in the study area are summarized below:

- The area affected by direct flood inundation in the study area remains low by floods with return periods of 100 years or lower. It increases modestly between the 100-year and 200-year floods and then increases greatly between the 200-year and 350-year floods.
- The area potentially affected by flood control structure failure remains low by floods with return periods of 10 years or lower. It increases greatly between the 10-year and 20-year floods and then increases steadily from the 20-year to the 200-year floods.
- In the Town of High River, the areas affected by direct inundation increase between the 100-year and the 200-year floods, when the neighbourhoods of Lineham Acres and Highwood Village are affected by direct flooding. They again increase greatly between the 200-year and 350-year floods when areas between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates are affected by direct flooding.
- In the Town of High River, a large increase in areas affected by potential flood control structure failure occurs between the 10-year and the 20-year floods when parts of High River between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates are affected by potential flood control structure failure inundation.
- No critical, non-residential buildings (i.e., hospitals, schools, or water treatment facilities) are affected by floods with return periods of 10 years or lower. No critical, non-residential buildings are affected by direct inundation by floods with return periods of 50 years or lower.

- The length of affected roads remains low with return periods of 10 years or lower, and then increases steadily from the 20-year flood to the 1,000-year flood. Some of the major roads that would be affected by floods in the study area include the following:
  - Macleod Trail Southwest at the access to Beachwood Estates would be affected by floods with return periods of 5 years and higher.
  - Centre Street North would be affected by floods with return periods of 5 years and higher between 1st Avenue Northeast and 4th Avenue North.
  - Highway 2A north of the Highwood River, 7th Street Northwest and High Country Drive Northwest would be affected by floods with return periods of 200 years and higher.
  - Highway 2 at the Little Bow River crossing south of High River would be affected by floods with return periods of 75 years and higher.
  - Highway 2 at the Highwood River crossing between Aldersyde and High River would be affected by floods with return periods of 100 years and higher.
- No railroads would be affected by flood inundation return periods of 200 years or lower. The CP Aldersyde spur would be affected by floods with return periods of 350-years and higher. At the 750-year and 1,000-year flood, the CP mainline (Calgary-Lethbridge) would be affected around the Highwood River crossing.

The main results of the flood risk assessment for the design flood in the study area are summarized below:

- There are 75 residential buildings and 3 non-residential buildings located in the floodway.
- There are six (6) residential and two (2) non-residential buildings located in the high hazard flood fringe.
- There are 2,004 residential and 210 non-residential buildings located in the protected flood fringe.
- There are seven (7) residential and zero (0) non-residential buildings located in the flood fringe zone.
- A total population of 166 is located in the floodway, six (6) in the high hazard flood fringe, 6,580 in the protected flood fringe and 12 in the flood fringe.
- The water treatment plant in Longview would be affected by the design flood. The Longview plant is located in the high hazard flood fringe zone.

Some of the major roads that would be affected in the study area are Centre Street (Highway 2A), Macleod Trail Southwest and 530th Avenue East in High River as well as 104th Street East at the Little Bow River crossing south of High River.

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This component of the Highwood River Hazard Study was led by Mr. Peter Thiede. Overall project management was provided by Dr. Hua Zhang with direction by Dr. Dejiang Long. The flood risk inventory and assessment were conducted by Mr. Peter Thiede and Mr. Brian Pendergast.

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1.0 INTRODUCTION

1.1 Study Objectives

Alberta Environment and Parks (AEP) commissioned Golder Associates Ltd. (Golder) in September 2015 to undertake the Highwood River Hazard Study (the study). The primary purpose is to assess and identify river and flood hazards along the study reaches of Highwood River and Little Bow River. The study is conducted under the provincial Flood Hazard Identification Program (FHIP), the goals of which include enhancement of public safety and reduction of future flood damages through the identification of river and flood hazards. Project stakeholders include the Government of Alberta, Foothills County, Town of High River (High River), Village of Longview, and the public. The study includes multiple components and deliverables.

This report summarizes the work of the flood risk assessment and inventory component of the study. A summary of the work supporting the infrastructure inventory and categorization and flood risk statistic assessment is provided. Flood risks in the study area are identified based on the open water flood inundation extents and design flood hazard area information with basic spatial inventory information on land parcels, infrastructure, and population under various flood scenarios. Statistics are presented for open water flood inundation areas, and the design flood hazard area.

1.2 Study Area and Reaches

The study area includes approximately 93 km of the Highwood River reach and approximately 14 km of the Little Bow River reach. The Highwood River study reach extends from a location upstream of Longview to its confluence with the Bow River. There are two major tributaries along the Highwood River study reach (i.e., Stimson Creek and Sheep River). The Little Bow River study reach extends from the overland flow area south of High River to a location approximately 2 km downstream of Highway 2 (see Figure 1).

The study area includes Village of Longview, High River, and Municipal District of Foothills.

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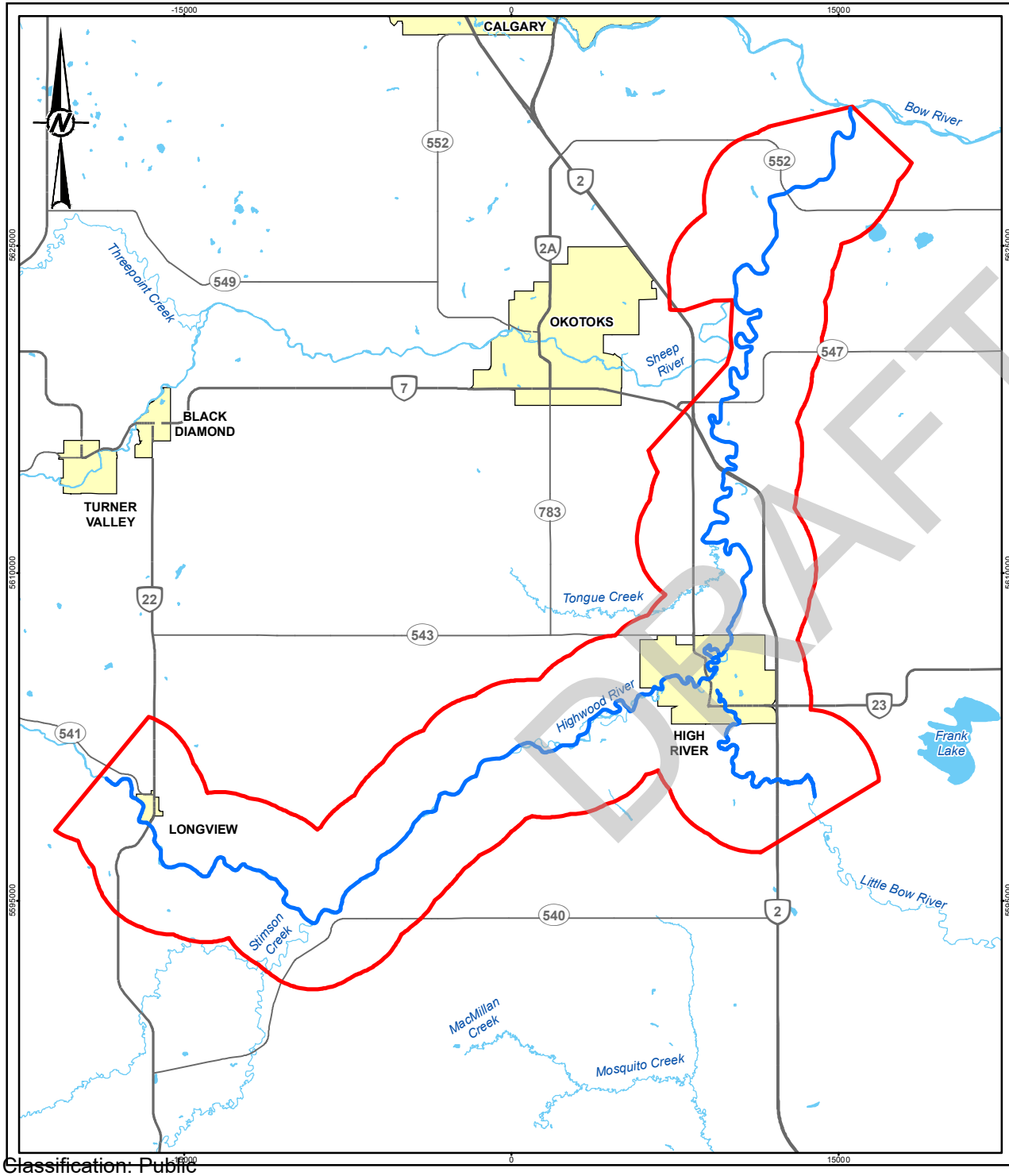

LEGEND

- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- POPULATED PLACE
- STUDY REACH
- RIVER HAZARD STUDY AREA

0 5 10

1:275,000 KILOMETRES

REFERENCE(S)

POPULATED PLACES AND HYDROGRAPHY OBTAINED FROM ALTALIS, © GOVERNMENT OF ALBERTA 2018. ALL RIGHTS RESERVED.
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CLIENT
ALBERTA ENVIRONMENT AND PARKS

PROJECT
HIGHWOOD RIVER HAZARD STUDY

TITLE
STUDY AREA

CONSULTANT
Golder Associates

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DESIGNED	JC
PREPARED	PT
REVIEWED	HZ
APPROVED	HZ

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2.0 AVAILABLE SPATIAL DATA

2.1 Data Sources

Readily available spatial data for the flood risk inventory included road and railroad data obtained from AltaLIS (the distributor of provincial spatial data). Cadastral data was provided by AEP.

2.2 Cadastral Data

Cadastral data (i.e., boundaries of registered land parcels) was provided to Golder in November 2017.

2.3 Roads, and Railroads

Road and railroad data for the study area was obtained from AltaLIS in July 2018.

2.4 Other Infrastructure Data

2.4.1 Data Sources

Infrastructure features such as hospitals, schools and water treatment facilities were interpreted from aerial imagery (see Section 3.2). Hospitals, and water treatment facilities included in the flood risk inventory are detailed in the following sections.

2.4.2 Hospitals

The flood risk inventory includes High River General Hospital which is located within the study area.

2.4.3 Water Treatment Facilities

The flood risk inventory includes the High River Treatment Plant, the Longview Water Treatment Plant, the Foothills Regional Services Commission Sewage Treatment Site, and the Longview Wastewater Lagoon.

2.5 Census Data

Population statistics were obtained from the Statistics Canada 2016 census dissemination blocks (Statistics Canada 2017). The census tallies the number of people whose usual place of residence is in the area. Dissemination blocks are the smallest geographic area for which population counts are disseminated in Canada.

3.0 INTERPRETED SPATIAL DATA

3.1 Interpretation Method

Additional data for roads, railroads and other infrastructure was created by interpreting aerial imagery as required.

Cadastral data was converted from polygons to points (centroids), large infrastructure features (e.g., hospitals) were reduced to single points, and census data was assigned to building points to allow for more efficient tallying of affected features.

The interpretation method is further described in the following sections.

3.2 Aerial Imagery Interpretation

Aerial imagery for the study area was collected by GeodesyGroup Inc. on May 6, 2016 (Golder 2017). The imagery has a 0.30 m Ground Sampling Distance (GSD) resolution and was provided as 4-band orthophotos.

The imagery was used to derive building points where no other spatial data was provided. It was also used to check and update roads throughout the study area.

3.3 Cadastral Data

The polygon datasets representing the land parcels were converted to points (centroid) for further analysis.

3.4 Other Infrastructure Data

All hospitals and water treatment facilities in the study area were reduced to single points for the flood risk assessment.

Considering the size and importance of these features, manual checks were performed to determine whether they are affected by flood events, instead of relying on a point-based overlay analysis (see Section 4.2).

3.5 Census Data

To more accurately estimate the population affected by each flood event, the population count for each dissemination block was evenly distributed between all residential buildings that fall into the block. Where multifamily buildings existed, it was assumed that their average number of residents would be ten times that of the single family homes within the block. Retirement homes were treated as multifamily buildings. Spot checks showed reasonable estimates of residents per building.

Distributing the population numbers to the residential buildings ensures that residents are only counted as affected when their building falls within the inundation extent.

4.0 FLOOD RISK ASSESSMENT AND INVENTORY

4.1 Approach

After the spatial data was compiled, features affected by floods were identified by overlaying flood polygon datasets with the parcel, building, or infrastructure datasets. Features falling within a flood extent were flagged as being affected or potentially affected by the flood event.

Flood statistics were then generated by tallying all affected features for the following categories:

- land parcels;
- residential buildings;
- non-residential buildings;
- major transportation infrastructure; and
- population (based on residential buildings).

The following sections provide further information on the analysis methodology and the results of the assessment.

4.2 Method

Using the inventory datasets developed and described in Sections 2 and 3, flood statistics were generated for the various flood events and flood scenarios considered in this study.

The method to generate these flood statistics involved the following four steps:

- Flood polygons for the 2-, 5-, 10-, 20-, 35-, 50-, 75-, 100-, 200-, 350-, 500-, 750-, and 1,000-year flood scenarios and the design flood scenario were generated as part of the open water flood inundation and flood hazard mapping work undertaken in this study (Golder 2022a and 2022b).
- For each flood scenario, the flood polygons were compared to the inventory dataset in GIS. Land parcels, buildings, and infrastructure were classified as being “affected” if they were located within a mapped flood extent (centroid for parcels). Road and railroad lengths affected by a flooding were also calculated.
- The population affected in each flood scenario was calculated by tallying the number of residents assigned to each affected residential building (see Section 4.3.6).
- The flood statistics for each category were summarized in a series of Microsoft Excel tables.

A manual check using aerial imagery was performed for non-residential buildings classified as hospital and water treatment facilities. As these large facilities are represented by single points in the flood risk inventory dataset, the result of the GIS-based overlay analysis may show the structure as not affected, even though some of the actual building footprint is located within the flood extent. The flood statistics were changed accordingly to include buildings which footprints would be affected.

Flood statistics were calculated separately for two areas of flooding based on flood inundation mapping (Golder 2022a) and four areas of flooding based on design flood hazard mapping (Golder 2022b), as summarized below:

- Direct flood inundation areas: These are areas expected to be inundated for various flood scenarios and have a direct overland connection to the main river/creek channels.
- Flood control structure failure inundation areas: These are areas that would be flooded if the flood control structure protecting the area would fail.
- Floodway areas: The floodway generally includes areas where the water depth is 1 m deep or greater and the local velocity is 1 m/s or faster. Typically, the floodway includes the river channel and adjacent overbank areas. Previously mapped floodways do not typically become larger when a flood hazard map is updated, except for the main channel shifted outside of the previous floodway.
- Flood Fringe areas: The flood fringe is the portion of the design flood hazard area outside the floodway. The flood fringe is divided into three zones:
  - Flood Fringe: Inundated areas outside of the floodway that are shallower and flow velocities are slower.
  - High Hazard Flood Fringe: Areas of deeper or faster-moving water outside of the floodway.
  - Protected Flood Fringe: Low lying areas behind dedicated flood control structures that are at risk of flooding if the structures would fail.

All results are reported by local authority and aggregate total. The local authorities include:

- Village of Longview
- Town of High River
- Foothills County

4.3 Open Water Flood Inundation Scenarios

4.3.1 General

Flood inundation extents were delineated for thirteen (13) open water flood events (Golder 2022a). Flood statistics for direct and flood control structure failure inundation areas were calculated for each flood event, and the results are presented in the following sections.

4.3.2 Land Parcels

A summary of land parcels affected by direct inundation is presented in Table 1, including total number, as well as a breakdown of parcels affected in each local authority. A summary of land parcels potentially affected by flood control structure failure is presented in Table 2, including total number, as well as a breakdown of parcels affected in each local authority. Figure 2 shows the affected parcels per flood scenario.

Table 1: Affected Land Parcels – Direct Inundation for Open Water Flood Inundation Scenarios

Scenario	Village of Longview	Town of High River	Foothills County	Total
2-Year	0	21	19	**40**
5-Year	0	45	31	**76**
10-Year	0	62	53	**115**
20-Year	0	83	87	**170**
35-Year	0	101	115	**216**
50-Year	0	108	142	**250**
75-Year	0	119	193	**312**
100-Year	0	133	212	**345**

Table 1: Affected Land Parcels – Direct Inundation for Open Water Flood Inundation Scenarios

Scenario	Village of Longview	Town of High River	Foothills County	Total
200-Year	0	797	253	**1,050**
350-Year	0	3,424	289	**3,713**
500-Year	0	4,223	301	**4,524**
750-Year	0	5,071	313	**5,384**
1,000-Year	0	5,350	323	**5,673**

Table 2: Affected Land Parcels – Flood Control Structure Failure for Open Water Flood Inundation Scenarios

Scenario	Village of Longview	Town of High River	Foothills County	Total
2-Year	0	10	0	**10**
5-Year	0	30	0	**30**
10-Year	0	2,036	13	**2,049**
20-Year	0	2,266	12	**2,278**
35-Year	0	2,402	12	**2,414**
50-Year	0	3,031	10	**3,041**
75-Year	0	3,434	7	**3,441**
100-Year	0	3,565	3	**3,568**
200-Year	0	1,475	0	**1,475**
350-Year	0	915	0	**915**
500-Year	0	305	0	**305**
750-Year	0	125	0	**125**
1,000-Year	0	10	0	**10**

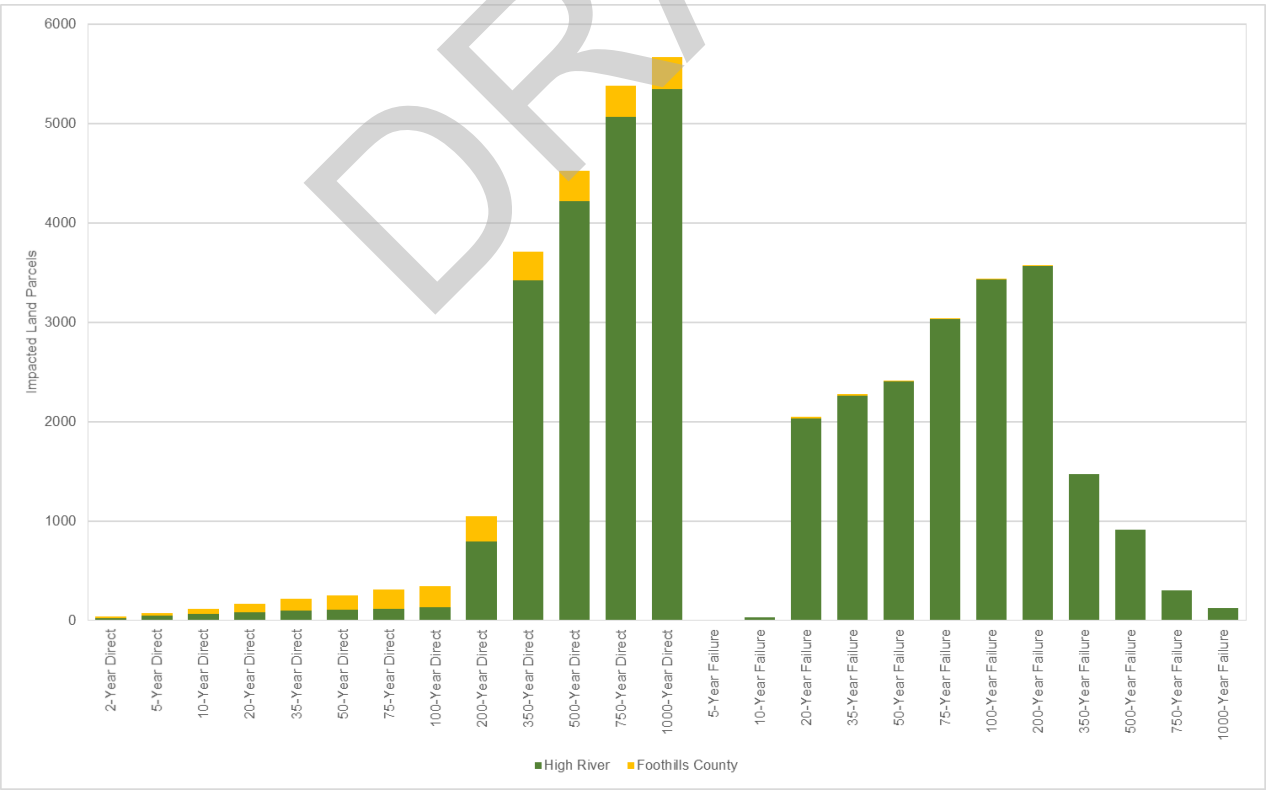

Figure 2: Affected Land Parcels for the Open Water Flood Inundation Scenarios

The total number of land parcels in the study area affected by direct flood inundation remains low for floods with return periods of 100 years or lower. It increases modestly between the 100-year and 200-year floods and then increases significantly between the 200-year and 350-year floods. It then increases steadily from the 350-year flood to the 1,000-year flood.

The number of land parcels potentially affected by flood control structure failure remains low for floods with return periods of 10 years or lower. It increases significantly between the 10-year and 20-year floods and then increases steadily from the 20-year to the 200-year floods. It then decreases steadily up to the 1,000-year flood, as areas previously categorized as flood control structure failure experience direct inundation.

The number of parcels affected in the Village of Longview remains zero for all flood scenarios.

For the Town of High River, the areas affected by direct inundation increase between the 100-year and the 200-year floods, when the neighbourhoods of Lineham Acres and Highwood Village are affected by direct flooding instead of potential flood control structure failure inundation. They again increase greatly between the 200-year and 350-year floods when areas between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates are affected by direct flooding instead of potential flood control structure failure inundation. A large increase in areas affected by potential flood control structure failure occurs between the 10-year and the 20-year floods when parts of High River between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates are affected by potential flood control structure failure inundation.

For Foothills County, the number of parcels affected by direct inundation increases steadily from the 2-year flood to the 1,000-year flood. The number parcels affected by flood control structure failure remains low at all scenarios, reaching its maximum at the 10-year flood.

For the 100-year flood, a total 345 land parcels would be directly inundated in the study area and 3,568 would be potentially inundated in the case of flood control structure failure. In comparison, a total of 5,673 land parcels would be directly inundated in the study area for the 1,000-year flood and 10 would be potentially inundated in the case of flood control structure failure.

4.3.3 Residential Buildings

A summary of affected residential buildings for each local authority is presented in Tables 3 and 4, including total number, as well as a breakdown of residential buildings affected by direct inundation and potential flood control structure failure inundation. Figures 3 to 4 show affected residential and non-residential buildings for each flood scenario (see section 4.3.4 for non-residential buildings).

The total number of residential buildings in the study area affected by direct flood inundation remains low for floods with return periods of 100 years or lower. It increases modestly between the 100-year and 200-year floods and then increases significantly between the 200-year and 350-year floods. It then increases steadily from the 350-year flood to the 1,000-year flood.

The number of residential buildings potentially affected by flood control structure failure remains low for floods with return periods of 10 years or lower. It increases significantly between the 10-year and 20-year floods and then increases steadily from the 20-year to the 200-year floods. It then decreases steadily up to the 1,000-year flood, as areas previously categorized as flood control structure failure experience direct inundation.

The number of residential buildings affected in the Village of Longview remains zero for all flood scenarios. Therefore, no tables or figures are provided for Longview.

For the Town of High River, the areas affected by direct inundation increase between the 100-year and the 200-year floods, when the neighbourhoods of Lineham Acres and Highwood Village are affected by direct flooding instead of potential flood control structure failure inundation. They again increase greatly between the 200-year and 350-year floods when areas between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates are affected by direct flooding. A large increase in areas affected by potential flood control structure failure occurs between the 10-year and the 20-year floods when parts of High River between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates are affected by potential flood control structure failure inundation.

For Foothills County, the number of residential buildings affected by direct inundation increases steadily from the 2-year flood to the 1,000-year flood. The of number residential buildings affected by flood control structure failure remains low at all scenarios, reaching its maximum at the 100-year and 200-year floods.

For the 100-year flood, a total 63 residential buildings would be directly inundated in the study area and 2,004 would be potentially inundated in the case of flood control structure failure. In comparison, a total of 3,206 residential buildings would be directly inundated in the study area for the 1,000-year flood and 106 would be potentially inundated in the case of flood control structure failure.

Table 3: Affected Residential Buildings at Town of High River for Open Water Flood Inundation Scenarios

Flood Event	2-Year	5-Year	10-Year	20-Year	35-Year	50-Year	75-Year	100-Year	200-Year	350-Year	500-Year	750-Year	1,000-Year
Total	**0**	**0**	**0**	**1,191**	**1,270**	**1,356**	**1,698**	**2,019**	**2,467**	**2,843**	**3,031**	**3,192**	**3,220**
Single Family	0	0	0	1,164	1,242	1,327	1,664	1,983	2,420	2,792	2,980	3,141	3,214
Multifamily	0	0	0	27	28	29	33	35	42	45	45	45	0
Retirement Home	0	0	0	0	0	0	1	1	5	6	6	6	6
Direct Inundation	**0**	**0**	**0**	**0**	**3**	**5**	**12**	**21**	**312**	**1,902**	**2,375**	**2,931**	**3,114**
Single Family	0	0	0	0	3	5	12	21	311	1,857	2,329	2,883	3,110
Multifamily	0	0	0	0	0	0	0	0	0	43	44	45	0
Retirement Home	0	0	0	0	0	0	0	0	1	2	2	3	4
Flood Control Structure Failure	**0**	**0**	**0**	**1,191**	**1,267**	**1,351**	**1,686**	**1,998**	**2,155**	**941**	**656**	**261**	**106**
Single Family	0	0	0	1,164	1,239	1,322	1,652	1,962	2,109	935	651	258	104
Multifamily	0	0	0	27	28	29	33	35	42	2	1	0	0
Retirement Home	0	0	0	0	0	0	1	1	4	4	4	3	2

Table 4: Affected Residential Buildings at Foothills County for Open Water Flood Inundation Scenarios

Flood Event	2-Year	5-Year	10-Year	20-Year	35-Year	50-Year	75-Year	100-Year	200-Year	350-Year	500-Year	750-Year	1,000-Year
Total	**0**	**0**	**1**	**5**	**12**	**18**	**35**	**48**	**70**	**77**	**83**	**90**	**92**
Single Family	0	0	1	5	12	18	35	48	70	77	83	90	92
Multifamily	0	0	0	0	0	0	0	0	0	0	0	0	0
Retirement Home	0	0	0	0	0	0	0	0	0	0	0	0	0
Direct Inundation	**0**	**0**	**1**	**3**	**9**	**15**	**30**	**42**	**64**	**74**	**80**	**89**	**92**
Single Family	0	0	1	3	9	15	30	42	64	74	80	89	92
Multifamily	0	0	0	0	0	0	0	0	0	0	0	0	0
Retirement Home	0	0	0	0	0	0	0	0	0	0	0	0	0
Flood Control Structure Failure	0	0	0	2	3	3	5	6	6	3	3	1	0
Single Family	0	0	0	2	3	3	5	6	6	3	3	1	0
Multifamily	0	0	0	0	0	0	0	0	0	0	0	0	0
Retirement Home	0	0	0	0	0	0	0	0	0	0	0	0	0

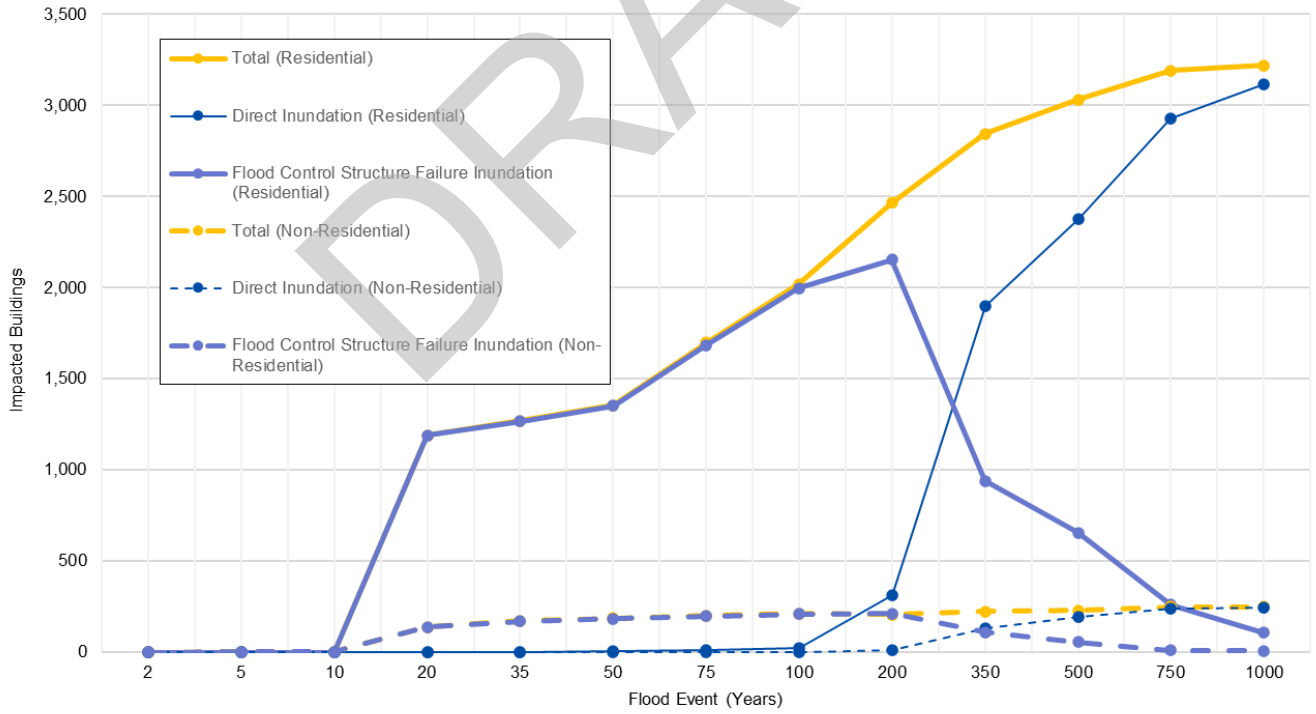

Figure 3: Affected Buildings at Town of High River for Open Water Flood Inundation Scenarios

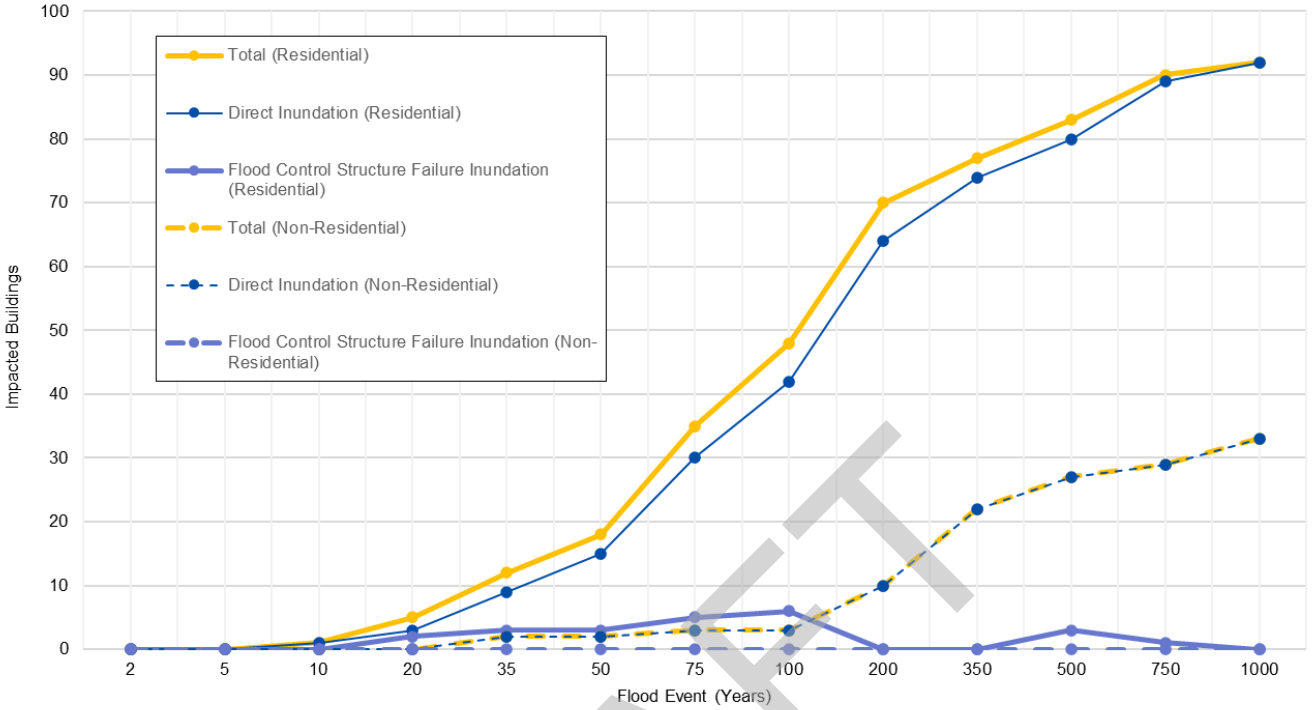

Figure 4: Affected Buildings at Foothills County for Open Water Flood Inundation Scenarios

4.3.4 Non-Residential Buildings

4.3.4.1 Summary

A summary of affected non-residential buildings for each local authority is presented in Tables 5 and 6, including total number, as well as a breakdown of non-residential buildings affected by direct inundation and potential flood control structure failure inundation. Figures 3 and 4 show affected buildings for each flood scenario, including non-residential buildings.

The total number of non-residential buildings in the study area affected by direct flood inundation remains low for floods with return periods of 100 years or lower. It increases modestly between the 100-year and 200-year floods and then increases significantly between the 200-year and 350-year floods. It then increases steadily from the 350-year flood to the 750-year flood.

The number of non-residential buildings potentially affected by flood control structure failure remains low for floods with return periods of 10 years or lower. It increases significantly between the 10-year and 20-year floods and then increases steadily from the 20-year to the 200-year floods. It then decreases steadily up to the 1,000-year flood, as areas previously categorized as flood control structure failure experience direct inundation.

There is one non-residential buildings affected in the Village of Longview, the water treatment plant, starting from the 75-year flood. No tables or figures are provided for Longview.

For the Town of High River, the areas affected by direct inundation increase between the 100-year and the 200-year floods, when the neighbourhoods of Lineham Acres and Highwood Village are affected by direct flooding. They again increase greatly between the 200-year and 350-year floods when areas between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake

Estates, Sunshine Meadows and Hampton Hills Estates are affected by direct flooding. A large increase in areas affected by potential flood control structure failure occurs between the 10-year and the 20-year floods when parts of High River between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates are affected by potential flood control structure failure inundation.

For Foothills County, the number of non-residential buildings affected by direct inundation increases steadily from the 35-year flood to the 1,000-year flood. The number of non-residential buildings affected by flood control structure failure remains zero for all scenarios.

At the 100-year flood, five (5) non-residential buildings would be directly inundated and 211 would be potentially inundated in the case of flood control structure failure. No schools would be directly inundated, and four (4) would be potentially inundated in the case of flood control structure failure. In comparison, 277 non-residential buildings, five (5) of them are schools, would be directly inundated during the 1,000-year flood.

No critical, non-residential buildings (i.e., hospitals, schools, or water treatment facilities) are affected for floods with return periods of 10 years or lower. No critical, non-residential buildings are affected by direct inundation for floods with return periods of 50 years or lower. The following sections provide additional information on the other more critical non-residential building infrastructure.

Table 5: Affected Non-Residential Buildings at Town of High River for Open Water Flood Inundation Scenarios

Flood Event	2-Year	5-Year	10-Year	20-Year	35-Year	50-Year	75-Year	100-Year	200-Year	350-Year	500-Year	750-Year	1,000-Year
Total	**0**	**0**	**1**	**139**	**172**	**186**	**200**	**212**	**207**	**225**	**230**	**250**	**250**
Commercial	0	0	0	131	163	173	182	191	201	217	222	224	224
Industrial	0	0	0	0	0	0	0	0	0	0	0	0	0
Government Building	0	0	0	0	0	0	0	0	0	0	0	0	0
Hospital	0	0	0	1	1	1	1	1	1	1	1	1	1
School	0	0	0	2	2	2	3	4	4	6	6	6	6
Water Treatment Facility	0	0	0	1	1	1	1	1	1	1	1	1	1
Other Non-Residential	0	0	1	4	5	9	13	15	0	0	0	18	18
Direct Inundation	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**11**	**132**	**193**	**239**	**243**
Commercial	0	0	0	1	1	1	1	1	10	121	177	218	221
Industrial	0	0	0	0	0	0	0	0	0	0	0	0	0
Government Building	0	0	0	0	0	0	0	0	0	0	0	0	0
Hospital	0	0	0	0	0	0	0	0	0	1	1	1	1
School	0	0	0	0	0	0	0	0	0	4	4	5	5
Water Treatment Facility	0	0	0	0	0	0	0	0	0	1	1	1	1
Other Non-Residential	0	0	0	0	0	0	0	0	1	5	10	14	15
Flood Control Structure Failure	**0**	**0**	**1**	**138**	**171**	**185**	**199**	**211**	**212**	**110**	**55**	**11**	**7**
Commercial	0	0	0	130	162	172	181	190	191	96	45	6	3
Industrial	0	0	0	0	0	0	0	0	0	0	0	0	0
Government Building	0	0	0	0	0	0	0	0	0	0	0	0	0
Hospital	0	0	0	1	1	1	1	1	1	0	0	0	0
School	0	0	0	2	2	2	3	4	4	2	2	1	1
Water Treatment Facility	0	1	1	1	1	1	1	1	1	0	0	0	0
Other Non-Residential	0	0	1	4	5	9	13	15	15	12	8	4	3

Table 6: Affected Non-Residential Buildings at Foothills County for Open Water Flood Inundation Scenarios

Flood Event	2-Year	5-Year	10-Year	20-Year	35-Year	50-Year	75-Year	100-Year	200-Year	350-Year	500-Year	750-Year	1,000-Year
Total	**0**	**0**	**0**	**0**	**2**	**2**	**3**	**3**	**10**	**22**	**27**	**29**	**33**
Commercial	0	0	0	0	2	2	3	3	10	22	27	29	33
Industrial	0	0	0	0	0	0	0	0	0	0	0	0	0
Government Building	0	0	0	0	0	0	0	0	0	0	0	0	0
Hospital	0	0	0	0	0	0	0	0	0	0	0	0	0
School	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Treatment Facility	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Non-Residential	0	0	0	0	0	0	0	0	0	0	0	0	0
Direct Inundation	**0**	**0**	**0**	**0**	**2**	**2**	**3**	**3**	**10**	**22**	**27**	**29**	**33**
Commercial	0	0	0	0	2	2	3	3	10	22	27	29	33
Industrial	0	0	0	0	0	0	0	0	0	0	0	0	0
Government Building	0	0	0	0	0	0	0	0	0	0	0	0	0
Hospital	0	0	0	0	0	0	0	0	0	0	0	0	0
School	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Treatment Facility	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Non-Residential	0	0	0	0	0	0	0	0	0	0	0	0	0
Flood Control Structure Failure	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Commercial	0	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0	0
Government Building	0	0	0	0	0	0	0	0	0	0	0	0	0
Hospital	0	0	0	0	0	0	0	0	0	0	0	0	0
School	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Treatment Facility	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Non-Residential	0	0	0	0	0	0	0	0	0	0	0	0	0

4.3.4.2 Hospitals

The High River General Hospital would be potentially inundated in case of flood control structure failure during the floods with return periods of 20 years or higher, and would be affected by direct inundation during the floods with return periods of 350 years or higher.

4.3.4.3 Water Treatment Facilities

The Longview Water Treatment Plant would be affected by direct inundation due to floods with return periods of 75 years or higher. The High River Water Treatment Plant would be potentially inundated in the case of flood control structure failure due to floods with return periods of 5 years or higher and would be affected by direct inundation due to floods with return periods of 350 years or higher.

The Foothills Regional Services Commission Sewage Treatment Site (wastewater treatment for Cargill Foods and High River) itself would not be affected by any of the open water flood events. However, access would potentially be cut off due to floods with return periods of 75 years or higher.

The Longview Waster Water Lagoon would not be affected by any open water flood events.

4.3.5 Major Transportation Infrastructure

4.3.5.1 Roads

A summary of roads affected by direct inundation is presented in Table 7, including total length, as well as a breakdown of roads affected in each local authority. A summary of roads potentially affected by flood control structure failure is presented in Table 8, including total length, as well as a breakdown of roads affected in each local authority. Figure 5 shows the affected roads for each flood scenario.

Table 7: Lengths of Affected Roads – Direct Inundation for Open Water Flood Inundation Scenarios

Flood Event	Affected Length (km)			
	Village of Longview	Town of High River	Foothills County	Total
2-Year	0.0	0.1	0.8	**0.9**
5-Year	0.0	1.0	2.0	**2.9**
10-Year	0.0	1.5	5.3	**6.8**
20-Year	0.0	2.5	9.7	**12.2**
35-Year	0.0	3.2	15.7	**18.9**
50-Year	0.0	3.6	19.5	**23.2**
75-Year	0.1	4.7	30.2	**35.0**
100-Year	0.1	5.1	40.4	**45.6**
200-Year	0.1	13.1	57.5	**70.8**
350-Year	0.2	75.9	65.3	**141.3**
500-Year	0.2	85.5	70.1	**155.8**
750-Year	0.3	93.1	75.5	**168.8**
1,000-Year	0.3	95.3	78.9	**174.5**

Table 8: Lengths of Affected Roads – Flood Control Structure Failure for Open Water Flood Inundation Scenarios

Flood Event	Affected Length (km)			
	Village of Longview	Town of High River	Foothills County	Total
2-Year	0.0	0.4	0.0	**0.4**
5-Year	0.0	0.5	0.0	**0.5**
10-Year	0.0	43.0	1.9	**44.9**
20-Year	0.0	48.7	2.1	**50.8**
35-Year	0.0	52.5	2.2	**54.6**
50-Year	0.0	62.6	2.1	**64.7**
75-Year	0.0	67.9	1.6	**69.6**
100-Year	0.0	67.9	1.2	**69.2**
200-Year	0.0	14.1	1.0	**15.2**
350-Year	0.0	7.6	0.9	**8.4**
500-Year	0.0	3.1	0.8	**3.9**
750-Year	0.0	2.6	0.7	**3.3**
1,000-Year	0.0	0.4	0.0	**0.4**

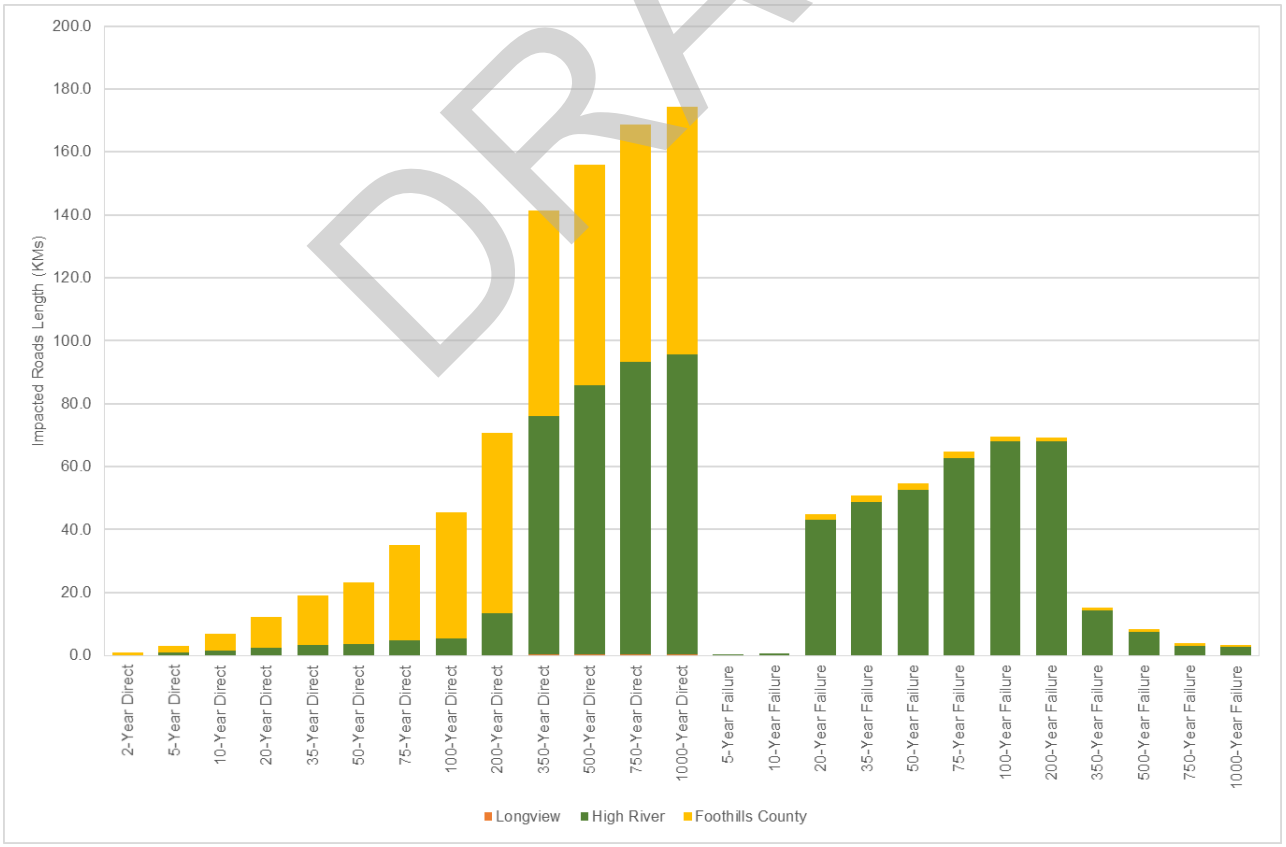

Figure 5: Lengths of Affected Roads for Open Water Flood Inundation Scenarios

The length of roads affected by direct flood inundation and the total length of affected roads remains low between the 2-year flood and the 10-year flood. It then increases steadily from the 20-year food to the 1,000-year floods The length of roads affected by flood control structure failure increases steadily from the 20-year flood to the 200-year flood and then decreases as flood control structure failure inundation is replaced by direct inundation.

The length of roads affected in the Village of Longview remains low for all flood scenarios.

For the Town of High River, the length of roads affected by direct inundation increase modestly between the 100-year and the 200-year floods, when the neighbourhoods of Lineham Acres and Highwood Village are affected by direct flooding. It again increases significantly between the 200-year and 350-year floods when areas between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates are affected by direct flooding. A large increase in length of roads affected by potential flood control structure failure occurs between the 5-year and the 10-year floods when low-lying parts of High River between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates are affected by potential flood control structure failure inundation.

For Foothills County, the length of roads affected by direct inundation increases steadily from the 2-year flood to the 1,000-year flood. The length of roads affected by flood control structure failure remains low for all scenarios.

Details on direct inundation of major roads within High River are provided below:

- 530th Avenue East and 56th Street East would be affected by floods with return periods of 5 years and higher.
- Macleod Trail Southwest at the access to Beachwood Estates would be affected by floods with return periods of 5 years and higher.
- Centre Street North would be affected by floods with return periods of 5 years and higher between 1st Avenue Northeast and 4th Avenue North.
- 12th Avenue Southwest and Railway Street South would be affected by potential flood control structure failure inundation at return periods of 20 years and higher.
- Macleod Trail Southwest north of 4th Avenue Southwest, Centre Street South north of 12th Avenue Southeast, 5th Street Northeast, 12th Avenue Southeast east of 10th Street Southeast, 12th Avenue Southeast west of 5th Street Southeast, and 10th Street Southeast, 2nd Avenue Southeast east of 5th Street Southeast, Sunshine Trail Southeast, 21st Street Southeast, 112 Street East and 7th Street Northwest would be affected by potential flood control structure failure inundation by floods with return periods 20 years and higher.
- Highway 2A north of High Country Drive Northwest would be affected by potential flood control structure failure inundation by floods return periods 35 years and higher.
- Highway 2A north of the Highwood River, 7th Street Northwest and High Country Drive Northwest would be affected by floods with return periods of 200 years and higher.
- Centre Street South, Railway Street South, 12th Avenue Southwest, McLeod Trail Southwest, 12th Avenue Southeast, 2nd Avenue Southeast, 9th Avenue Southeast, 21st Street Southeast, 112 Street East and 10th Street Southeast would be affected by floods with return periods of 350 years and higher.

In addition, the following roads in Foothills County would be affected by direct inundation:

- 104th Street East around the Little Bow River crossing would be affected by floods with return periods of 50 years and higher.
- Highway 2 around the Little Bow River crossing would be affected by floods with return periods of 75 years and higher.
- 498th Avenue East around the Highwood River crossing would be affected by floods with return periods of 200 years and higher.
- Highway 2 around the Highwood River crossing would be affected by floods with return periods of 100 years and higher.

At the 100-year flood, about 45.6 km of roads would be directly inundated and 69.2 km would be potentially inundated in the case of flood control structure failure. In comparison, 174.5 km of roads would be directly inundated for the 1,000-year flood.

4.3.5.2 Bridges/Culverts

A summary of bridge/culvert clearances during floods is presented in Table 9.

Table 9: Bridge/Culvert Clearances for Open Water Flood Inundation Scenarios

River	Name	Minimum Low Chord/ Road Surface Elevation (m)	2-Year		5-Year		10-Year		20-Year		35-Year		50-Year		75-Year		100-Year		200-Year		350-Year		500-Year		750-Year		1,000-Year	
			Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)
Highwood River	Highway 22 Bridge	1198.4	1182.5	15.9	1183.3	15.1	1183.9	14.5	1184.8	13.6	1185.6	12.8	1185.8	12.6	1186.9	11.5	1187.9	10.5	1190.1	8.4	1191.9	6.5	1193.1	5.3	1194.5	3.9	1195.7	2.7
Highwood River	Center Street Bridge	1037.2	1036.3	1.0	1036.9	0.3	1037.1	0.1	1037.3	-0.1	1037.4	-0.2	1037.6	-0.3	1037.8	-0.6	1038.0	-0.8	1038.5	-1.3	1038.9	-1.7	1039.2	-2.0	1039.3	-2.1	1039.4	-2.2
Highwood River	Highway 543 Bridge	1034.5	1030.6	3.9	1031.6	3.0	1032.1	2.4	1032.9	1.6	1033.5	1.0	1033.9	0.6	1034.6	-0.1	1035.0	-0.5	1035.9	-1.4	1036.2	-1.7	1036.4	-1.8	1036.4	-1.9	1036.4	-1.9
Highwood River	Train Bridge	1030.8	1026.3	4.5	1027.2	3.6	1027.8	3.0	1028.5	2.3	1029.1	1.8	1029.4	1.4	1030.1	0.7	1031.1	-0.3	1032.3	-1.5	1033.0	-2.2	1033.4	-2.6	1033.6	-2.8	1033.8	-3.0
Highwood River	Highway 2 Bridge (South Bound)	1028.0	1025.0	3.0	1025.8	2.2	1026.3	1.7	1027.0	1.0	1027.5	0.5	1027.9	0.1	1028.7	-0.7	1030.1	-2.1	1031.1	-3.0	1031.3	-3.3	1031.6	-3.6	1031.8	-3.8	1032.0	-4.0
Highwood River	Highway 2 Bridge (North Bound)	1029.3	1025.0	4.3	1025.7	3.6	1026.2	3.1	1026.9	2.4	1027.5	1.8	1027.8	1.5	1028.6	0.7	1029.2	0.1	1030.5	-1.2	1030.8	-1.5	1031.2	-1.9	1031.6	-2.3	1031.8	-2.5
Highwood River	Highway 547 Bridge	1023.6	1015.9	7.7	1016.6	7.0	1017.0	6.6	1017.7	5.9	1018.2	5.4	1018.6	5.0	1019.4	4.2	1020.1	3.5	1021.7	1.9	1023.0	0.6	1023.8	-0.2	1024.6	-1.0	1024.9	-1.3
Highwood River	Highway 552 Bridge	976.7	963.0	13.7	963.9	12.8	964.4	12.3	965.2	11.5	965.8	10.9	966.2	10.5	967.0	9.7	967.5	9.2	969.0	7.7	970.2	6.5	971.5	5.2	972.2	4.5	972.8	3.9
Little Bow River	12th Avenue Culvert	1032.6	1031.8	0.8	1031.8	0.8	1031.8	0.8	1031.8	0.8	1031.8	0.8	1031.8	0.8	1031.8	0.8	1031.8	0.8	1031.9	0.7	1034.6	-2.0	1035.4	-2.8	1036.1	-3.5	1036.5	-3.9
Little Bow River	5th Street SE Bridge	1033.7	1031.8	1.9	1031.8	1.9	1031.8	1.9	1031.8	1.9	1031.8	1.9	1031.8	1.9	1031.8	1.9	1031.8	1.9	1031.9	1.8	1034.3	-0.6	1035.3	-1.6	1035.8	-2.1	1036.2	-2.5
Little Bow River	Culvert to Residence in NE 36-18-29-4	1030.8	1029.8	1.0	1029.8	1.0	1029.8	1.0	1029.8	1.0	1029.8	1.0	1029.8	1.0	1030.2	0.6	1030.5	0.3	1031.5	-0.7	1033.8	-3.0	1034.4	-3.6	1035.0	-4.2	1035.3	-4.5
Little Bow River	Culvert to Residence in NE 36-18-29-4	1030.5	1029.3	1.2	1029.3	1.2	1029.3	1.2	1029.3	1.2	1029.4	1.1	1029.6	0.9	1030.2	0.3	1030.5	0.0	1031.5	-1.0	1033.0	-2.5	1033.3	-2.8	1033.7	-3.2	1034.1	-3.6
Little Bow River	Hifab Culvert	1026.1	1024.9	1.2	1024.9	1.2	1025.3	0.8	1026.2	-0.1	1026.7	-0.6	1027.0	-0.9	1027.6	-1.5	1027.9	-1.8	1028.7	-2.6	1029.5	-3.4	1029.8	-3.7	1030.2	-4.1	1030.6	-4.5
Little Bow River	104th Street E (Range Road 290) Bridge	1026.1	1023.9	2.2	1023.9	2.2	1024.9	1.2	1025.8	0.3	1026.4	-0.3	1026.5	-0.4	1026.7	-0.6	1026.9	-0.8	1027.2	-1.1	1027.4	-1.3	1027.6	-1.5	1027.9	-1.8	1028.2	-2.1
Little Bow River	Highway 2 West Bridge	1024.1	1018.5	5.6	1018.5	5.6	1019.6	4.5	1021.0	3.1	1021.9	2.2	1022.4	1.7	1023.6	0.5	1023.9	0.2	1024.5	-0.4	1025.1	-1.0	1025.5	-1.4	1026.0	-1.9	1026.4	-2.3
Little Bow River	Highway 2 East Bridge	1024.1	1018.5	5.6	1018.5	5.6	1019.6	4.5	1020.9	3.2	1021.7	2.4	1022.2	1.9	1023.2	0.9	1023.5	0.6	1024.0	0.1	1024.6	-0.5	1024.9	-0.8	1025.4	-1.3	1025.8	-1.7

Note: The clearances are the elevation differences between bridge low chord or culvert road surface elevations and simulated water levels. A negative value indicates the water depth above the low chord for a bridge or above the road surface for a culvert.

4.3.5.3 Railroads

A summary of railroads affected by direct inundation is presented in Table 10, including total length, as well as a breakdown of railroads affected in each local authority. Figure 6 shows the affected railroads for each flood scenario.

No railroads are affected by any flood scenarios in the Village of Longview and the Town of High River.

For Foothills County, no railroads are affected by flood inundation until the 200-year flood. Starting at the 350-year flood, the CP Aldersyde spur (access to Cargill Foods) would be affected north of 446th Avenue East. At the 750-year and 1000-year floods, the CP mainline (Calgary-Lethbridge) would be affected around the Highwood River crossing between 434th Avenue East and 442nd Avenue East.

At the 100-year flood, no railroads would be inundated. About 4 km of railroads would be directly inundated at the 1,000-year flood.

Table 10: Lengths of Affected Railroads for Open Water Flood Inundation Scenarios

Flood Event	Affected Railroad Length (km)			
	Village of Longview	Town of High River	Foothills County	Total
2-Year	0.0	0.0	0.0	**0.0**
5-Year	0.0	0.0	0.0	**0.0**
10-Year	0.0	0.0	0.0	**0.0**
20-Year	0.0	0.0	0.0	**0.0**
35-Year	0.0	0.0	0.0	**0.0**
50-Year	0.0	0.0	0.0	**0.0**
75-Year	0.0	0.0	0.0	**0.0**
100-Year	0.0	0.0	0.0	**0.0**
200-Year	0.0	0.0	0.0	**0.0**
350-Year	0.0	0.0	2.1	**2.1**
500-Year	0.0	0.0	2.9	**2.9**
750-Year	0.0	0.0	3.5	**3.5**
1,000-Year	0.0	0.0	4.0	**4.0**

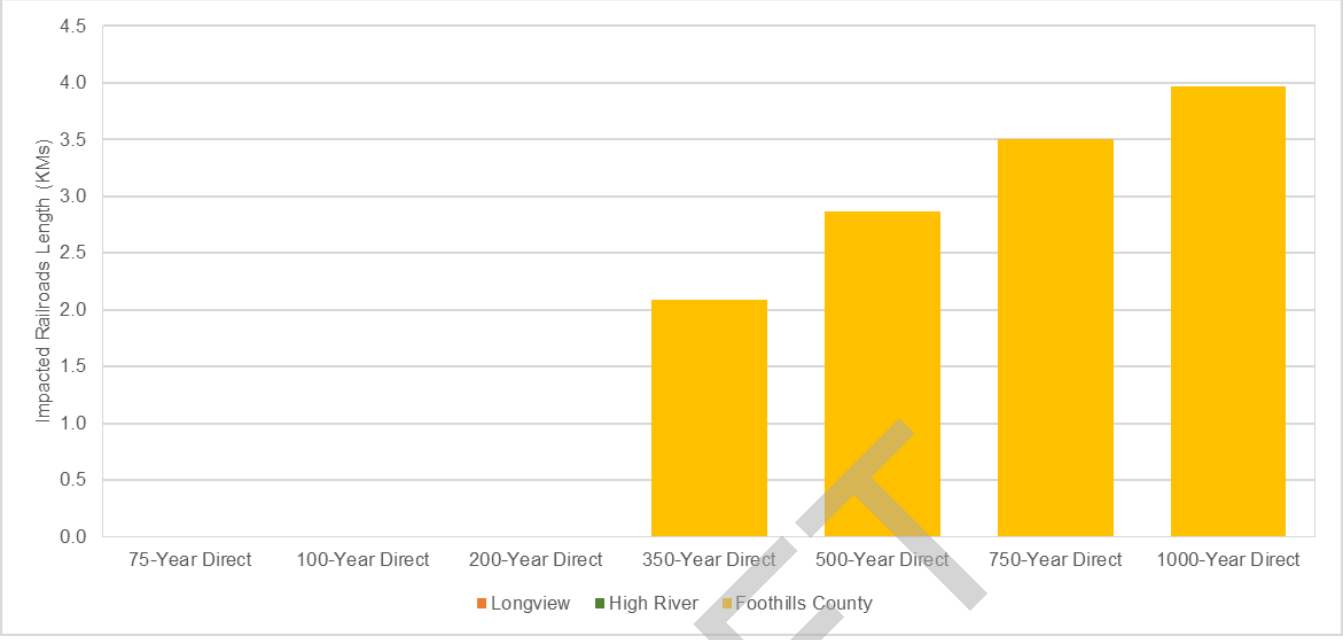

Figure 6: Lengths of Affected Railroads for Open Water Flood Inundation Scenarios

4.3.6 Population

Each residential building in the study area (including single family, multifamily, and retirement homes) was assigned a number of residents based on the population count of the census block they are located in (see Section 2.5). The population affected by a flood scenario was estimated based on a tally of the residents of all affected residential buildings.

A summary of the population affected by direct inundation is presented in Table 11, including total numbers, as well as a breakdown of population affected in each local authority. A summary of the population potentially affected by flood control structure failure is presented in Table 12, including total population, as well as a breakdown of population affected in each local authority. Figure 7 shows the affected population per flood scenario.

Table 11: Affected Population – Direct Inundation for Open Water Flood Inundation Scenarios

Scenario	Village of Longview	Town of High River	Foothills County	Total
2-Year	0	0	0	**0**
5-Year	0	0	0	**0**
10-Year	0	0	2	**2**
20-Year	0	0	6	**6**
35-Year	0	4	20	**24**
50-Year	0	9	32	**41**
75-Year	0	25	57	**82**
100-Year	0	49	81	**130**
200-Year	0	1,020	126	**1,145**
350-Year	0	6,717	147	**6,864**
500-Year	0	8,271	156	**8,427**
750-Year	0	9,885	177	**10,062**
1,000-Year	0	10,549	183	**10,732**

Table 12: Affected Population – Flood Control Structure Failure for Open Water Flood Inundation Scenarios

Scenario	Village of Longview	Town of High River	Foothills County	Total
2-Year	0	0	0	**0**
5-Year	0	0	0	**0**
10-Year	0	0	0	**0**
20-Year	0	4,205	4	**4,209**
35-Year	0	4,459	6	**4,465**
50-Year	0	4,691	6	**4,697**
75-Year	0	5,681	10	**5,691**
100-Year	0	6,568	12	**6,580**
200-Year	0	7,177	13	**7,191**
350-Year	0	2,820	7	**2,827**
500-Year	0	1,885	7	**1,892**
750-Year	0	772	2	**774**
1,000-Year	0	347	0	**347**

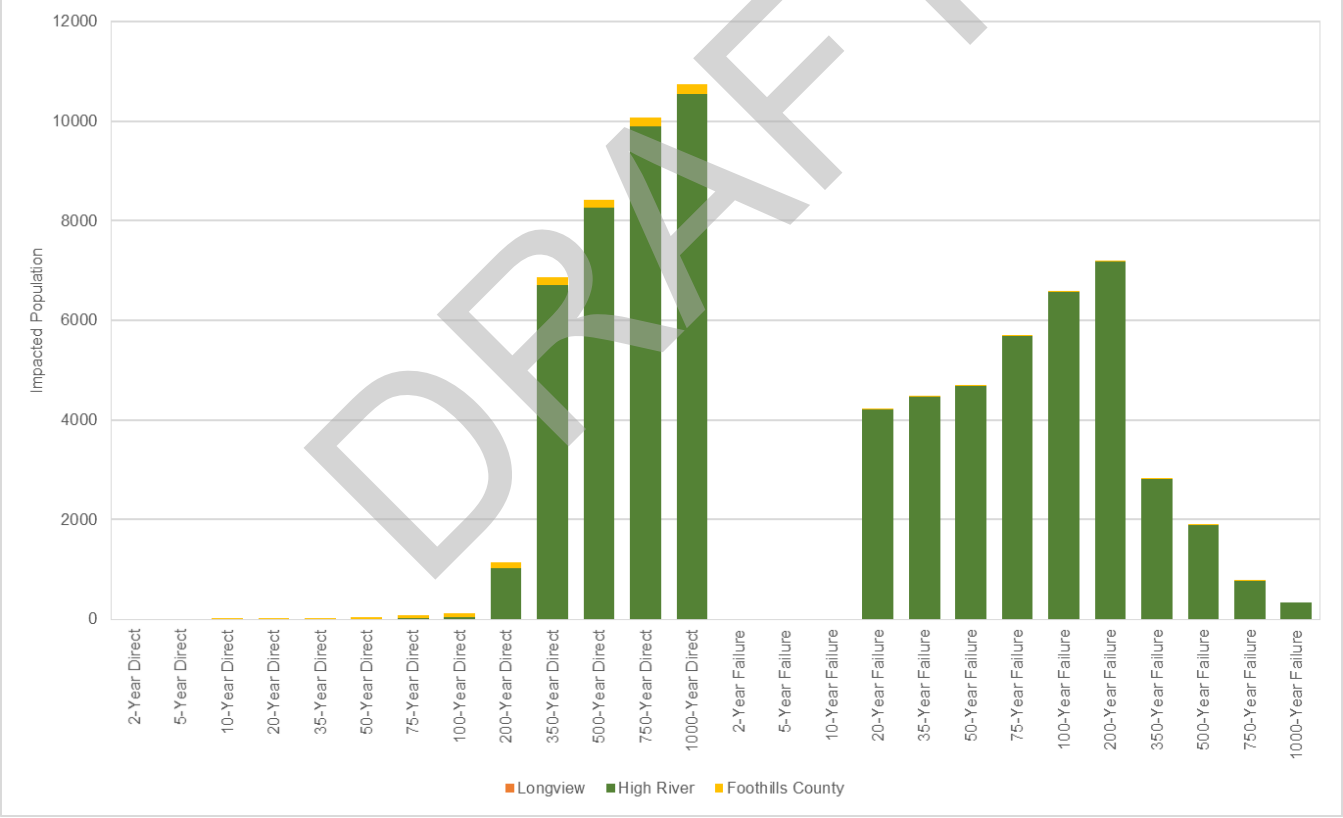

Figure 7: Affected Population for Open Water Flood Inundation Scenarios

The population affected by direct flood inundation remains low until the 100-year flood. It increases modestly between the 100-year and 200-year floods and then increases significantly between the 200-year and 350-year floods. It then increases steadily from the 350-year flood to the 1,000-year flood.

The population potentially affected by flood control structure failure remains low for floods with return periods of 10 years or lower . It strongly increases between the 10-year and 20-year floods and then increases steadily from the 20-year to the 200-year floods. It then decreases steadily up to the 1,000-year flood, as areas previously categorized as flood control structure failure experience direct inundation.

The population affected in the Village of Longview remains zero for all flood scenarios.

For the Town of High River, the population affected by direct inundation increases between the 100-year and the 200-year floods, when the neighbourhoods of Lineham Acres and Highwood Village are affected by direct flooding. The affected population again strongly increases between the 200-year and 350-year floods when areas between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates are affected by direct flooding. A large increase in the population affected by potential flood control structure failure occurs between the 10-year and the 20-year floods when parts of High River between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates are affected by potential flood control structure failure inundation.

For Foothills County, the population affected by direct inundation increases steadily from the 2-year flood to the 1,000-year flood. The population affected by flood control structure failure remains low at all scenarios, reaching its maximum at the 200-year flood.

For the 100-year flood, a population of 130 would be affected by direct inundation in the study area and a population of 6,580 would be potentially affected by flood control structure failure. In comparison, a population of 10,732 would be affected by direct inundation in the study area for the 1,000 year flood and a population of 347 would be potentially affected by flood control structure failure.

4.4 Design Flood Hazard Scenario

4.4.1 General

Flood statistics were generated for the design flood scenario using the flood hazard maps prepared as part of this study (Golder 2022b), and the results are presented in the following sections.

Neighbourhoods in High River affected by the design flood would include Downtown, Central, McLaughlin Meadows, Lineham Acres, Highwood Village, Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates. The land parcels, residential and non-residential buildings and population located within these areas would be affected by the design flood.

4.4.2 Land Parcels

A summary of affected land parcels is presented in Table 13, including the numbers for each local authority, as well as a breakdown of parcels located in the floodway, flood fringe, high hazard flood fringe and protected flood fringe.

Table 13: Affected Land Parcels for the Design Flood Hazard Scenario

Scenario	Village of Longview	Town of High River	Foothills County	Total
Floodway	0	162	144	**306**
Flood Fringe	0	11	48	**59**
High Hazard Flood Fringe	0	3	26	**29**
Protected Flood Fringe	0	3,403	7	**3,410**

For the design flood, there are 306 land parcels located in the floodway, 29 in the high hazard flood fringe, 3,410 in the protected flood fringe and 59 in the flood fringe.

4.4.3 Residential Buildings

A summary of affected residential buildings for each local authority is presented in Tables 14 and 15, including total number, as well as a breakdown of residential buildings located in the floodway, flood fringe, high hazard flood fringe and protected flood fringe.

The number of residential buildings affected in the Village of Longview is zero for the design flood scenario. Therefore, no table is provided for Longview.

Table 14: Affected Residential Buildings at Town of High River for the Design Flood Hazard Scenario

Residential Category	Floodway	High Hazard Flood Fringe	Protected Flood Fringe	Flood Fringe
Multifamily	0	0	35	0
Single Family	32	0	1,962	0
Retirement Home	0	0	1	0
Total	**32**	**0**	**1,998**	**0**

Table 15: Affected Residential Buildings at Foothills County for the Design Flood Hazard Scenario

Residential Category	Floodway	High Hazard Flood Fringe	Protected Flood Fringe	Flood Fringe
Multifamily	0	0	0	0
Single Family	43	6	6	7
Retirement Home	0	0	0	0
Total	**43**	**6**	**6**	**7**

For the design flood, there are 75 residential buildings located in the floodway, six(6) in the high hazard flood fringe, 2,004 in the protected flood fringe and seven (7) in the flood fringe.

4.4.4 Non-Residential Buildings

4.4.4.1 Summary

A summary of affected non-residential buildings for each local authority is presented in Tables 16 to 18, including total number, as well as a breakdown of non-residential buildings located in the floodway, flood fringe, high hazard flood fringe and protected flood fringe.

Table 16: Affected Non-Residential Buildings at Village of Longview for the Design Flood Hazard Scenario

Non-Residential Category	Floodway	High Hazard Flood Fringe	Protected Flood Fringe	Flood Fringe
Commercial	0	0	0	0
Industrial	0	0	0	0
Government Building	0	0	0	0
Hospital	0	0	0	0
School	0	0	0	0
Water Treatment Facility	0	1	0	0
Other Non-Residential	0	0	0	0
Total	**0**	**1**	**0**	**0**

Table 17: Affected Non-Residential Buildings at Town of High River for the Design Flood Hazard Scenario

Non-Residential Category	Floodway	High Hazard Flood Fringe	Protected Flood Fringe	Flood Fringe
Commercial	1	0	190	0
Industrial	0	0	0	0
Government Building	0	0	0	0
Hospital	0	0	1	0
School	0	0	4	0
Water Treatment Facility	0	0	0	0
Other Non-Residential	0	0	15	0
Total	**1**	**0**	**210**	**0**

Table 18: Affected Non-Residential Buildings at Foothills County for the Design Flood Hazard Scenario

Non-Residential Category	Floodway	High Hazard Flood Fringe	Protected Flood Fringe	Flood Fringe
Commercial	2	1	0	0
Industrial	0	0	0	0
Government Building	0	0	0	0
Hospital	0	0	0	0
School	0	0	0	0
Water Treatment Facility	0	0	0	0
Other Non-Residential	0	0	0	0
Total	**2**	**1**	**0**	**0**

For the design flood, there are three (3) non-residential buildings located in the floodway, two (2) in the high hazard flood fringe, 210 in the protected flood fringe and zero (0) in the flood fringe.

Four (4) schools would be affected by the design flood (all located in the protected flood fringe). The following sections provide additional information on other critical non-residential building infrastructure.

4.4.4.2 Hospitals

The High River General Hospital is located in the protected flood fringe zone.

4.4.4.3 Water Treatment Facilities

The Longview Water Treatment Plant is located in the high hazard flood fringe zone.

None of the wastewater treatment facilities in the study area would be affected by the design flood.

4.4.5 Major Transportation Infrastructure

4.4.5.1 Roads

A summary of affected roads is presented in Table 19, including total length, the length for each local authority, as well as a breakdown of roads located in the floodway, flood fringe, high hazard flood fringe and protected flood fringe respectively.

Table 19: Lengths of Affected Roads for the Design Flood Hazard Scenario

Scenario	Affected Road Length (km)			
	Village of Longview	Town of High River	Foothills County	Total
Floodway	0.0	4.6	20.0	**24.6**
Flood Fringe	0.0	1.0	16.8	**17.8**
High Hazard Flood Fringe	0.0	0.0	5.1	**5.1**
Protected Flood Fringe	0.0	67.9	1.5	**69.4**

Details on inundation of major roads within High River during the design flood are provided below:

- Riverside Drive Northwest, High Country Drive Northwest, 7th Street Northwest, Highway 2A north of High Country Driver Northwest, Macleod Trail Southwest east of Highwood Trail Southwest, Highwood Trail Southwest, 12th Avenue Southwest, Centre Street South, Railway Street South, 10th Street Southeast, 12th Avenue Southeast, Sunshine Trail Southeast, 2nd Avenue Southeast, 21st Street Southeast, and 112 Street East are located in the protected flood fringe.
- 40th Street East, 538th Avenue East, 530th Avenue East, 72nd Street East south of the intersection with 12th Avenue Southwest, Macleod Trail Southwest west of Highwood Trail Southwest and Centre Street North (Highway 2A) north of the river crossing are located in the floodway.

In addition, the following roads in Foothills County would be affected by the design flood:

- Highway 2A around the Little Bow River crossing is located in the high hazard flood fringe.
- 104th Street East around the Little Bow River crossing is located in the floodway.

For the design flood, a total length of 24.6 km of roads is located in the floodway, 5.1 km in the high hazard flood fringe, 69.4 km in the protected flood fringe, and 17.8 km in the flood fringe.

4.4.5.2 Bridges/Culverts

A summary of bridge/culvert clearances for the design flood hazard scenario in Table 20.

Table 20: Bridge/Culvert Clearances for the Design Flood Hazard Scenario

River	Name	Minimum Low Chord / Road Surface Elevation (m)	Water Level (m)	Clearance[(a)] (m)
Highwood River	Highway 22 Bridge	1198.4	1187.9	10.5
Highwood River	Center Street Bridge	1037.2	1038.0	-0.8
Highwood River	Highway 543 Bridge	1034.5	1035.0	-0.5
Highwood River	Train Bridge	1030.8	1031.1	-0.3
Highwood River	Highway 2 Bridge (South Bound)	1028.0	1030.1	-2.1
Highwood River	Highway 2 Bridge (North Bound)	1029.3	1029.2	0.1
Highwood River	Highway 547 Bridge	1023.6	1020.1	3.5
Highwood River	Highway 552 Bridge	976.7	967.5	9.2
Little Bow River	12th Avenue Culvert	1032.6	1031.8	0.8
Little Bow River	5th Street SE Bridge	1033.7	1031.8	1.9
Little Bow River	Culvert to Residence in NE 36-18-29-4	1030.8	1030.5	0.3
Little Bow River	Culvert to Residence in NE 36-18-29-4	1030.5	1030.5	0.0
Little Bow River	Hifab Culvert	1026.1	1027.9	-1.8
Little Bow River	104th Street E (Range Road 290) Bridge	1026.1	1026.9	-0.8
Little Bow River	Highway 2 West Bridge	1024.1	1023.9	0.2
Little Bow River	Highway 2 East Bridge	1024.1	1023.5	0.6

(a) The clearances for the 100-year design flood event are the elevation differences between bridge low chord or culvert road surface elevations and simulated water levels. A negative value indicates the water depth above the low chord for a bridge or above the road surface for a culvert.

4.4.5.3 Railroads

None of the railroads in the study area would be affected by the design flood.

4.4.6 Population

A summary of affected population is presented in Table 21, including total number, the number for each local authority, as well as a breakdown of population in areas located in the floodway, flood fringe, high hazard flood fringe and protected flood fringe.

Table 21: Affected Population for the Design Flood Hazard Scenario

Scenario	Village of Longview	Town of High River	Foothills County	Total
Floodway	0	72	94	**166**
Flood Fringe	0	0	12	**12**
High Hazard Flood Fringe	0	0	6	**6**
Protected Flood Fringe	0	6,568	12	**6,580**

For the design flood, there is a population of 166 located in the floodway, six (6) in the high hazard flood fringe, 6,580 in the protected flood fringe and 12 in the flood fringe.

5.0 CONCLUSIONS

The main results of the flood risk assessment for the open water floods in the study area are summarized below:

- The area affected by direct flood inundation in the study area remains low for floods with return periods of 100 years or lower. It increases modestly between the 100-year and 200-year floods and then increases greatly between the 200-year and 350-year floods.
- The area potentially affected by flood control structure failure remains low for floods with return periods of 10 years or lower. It increases greatly between the 10-year and 20-year floods and then increases steadily from the 20-year to the 200-year floods.
- In the Town of High River, the areas affected by direct inundation increase between the 100-year and the 200-year floods, when the neighbourhoods of Lineham Acres and Highwood Village are affected by direct flooding. They increase greatly between the 200-year and 350-year floods when areas between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates are affected by direct flooding.
- In the Town of High River, a large increase in areas affected by potential flood control structure failure occurs between the 10-year and the 20-year floods when parts of High River between Highwood River and 12th Avenue (Downtown, Central and McLaughlin Meadows) as well as the neighbourhoods of Emerson Lake Estates, Sunshine Meadows and Hampton Hills Estates are affected by potential flood control structure failure inundation.
- No critical, non-residential buildings (i.e., hospitals, schools, or water treatment facilities) are affected by floods with return periods of 10 years or lower. No critical, non-residential buildings are affected by direct inundation by floods with return periods of 50 years or lower .
- The length of affected roads remains low for floods with return periods of 10 years or lower, and then increases steadily from the 20-year flood to the 1,000-year flood. Some of the major roads that would be affected by floods in the study area include the following:
  - Macleod Trail Southwest at the access to Beachwood Estates would be affected by floods with return periods of 5 years and higher.
  - Centre Street North would be affected by floods with return periods of 5 years and higher between 1st Avenue Northeast and 4th Avenue North.
  - Highway 2A north of the Highwood River, 7th treet Northwest and High Country Drive Northwest would be affected by floods with return periods of 200 years and higher.
  - Highway 2 at the Little Bow River crossing south of High River would be affected by floods with return periods of 75 years and higher.
  - Highway 2 at the Highwood River crossing between Aldersyde and High River would be affected by floods with return periods of 100 years and higher.

- No railroads would be affected by flood inundation by floods with return periods of 200 years or lower. The CP Aldersyde spur would be affected by floods with return periods of 350-years and higher. At the 750-year and 1,000-year flood, the CP mainline (Calgary-Lethbridge) would be affected around the Highwood River crossing.

The main results of the flood risk assessment for the design flood in the study area are summarized below:

- There are 75 residential buildings and three (3) non-residential buildings located in the floodway.
- There are six (6) residential and two (2) non-residential buildings located in the high hazard flood fringe.
- There are 2,004 residential and 210 non-residential buildings located in the protected flood fringe.
- There are seven (7) residential and zero (0) non-residential buildings located in the flood fringe zone.
- A total population of 166 is located in the floodway, six (6) in the high hazard flood fringe, 6,580 in the protected flood fringe and 12 in the flood fringe.
- The water treatment plant in Longview would be affected by the design flood. The Longview plant is located in the high hazard flood fringe zone.
- Some of the major roads that would be affected in the study area are Centre Street (Highway 2A), Macleod Trail Southwest and 530th Avenue East in High River as well as 104th Street East at the Little Bow River crossing south of High River.

Report Signature Page

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