INTEGRATED FLOOD HAZARD MANAGEMENT PLAN

SQUAMISH

IFHMP Open House and Online Survey Summary Report

July 2017

Prepared by:

KERR WOOD LEIDAL
consulting engineers

In association with:

the Arlington Group
planning + architecture inc.

SNC·LAVALIN

CASCADE ENVIRONMENTAL
RESOURCE GROUP LTD

THURBER

Table of Contents

Figures

Tables:

Executive Summary

The final phase of community engagement activities for the District of Squamish Integrated Flood Hazard Management Plan (IFHMP) were held in June-July 2017. An Open House was held at the Squamish Adventure Centre on Monday, June 26, 2017 and was followed by the fourth online questionnaire for the IFHMP, a 15-question survey provided in hard-copy at the Open House and made available online from June 26 through July 17, 2017.

23 members of the public attended the Open House, which was facilitated by District of Squamish staff with assistance from the KWL and Arlington Group project team. The Open House included a presentation, followed by a question and answer session, along with an opportunity for the public to review informative storyboards and speak one-on-one with the project team. Feedback received in the question and answer session and through individual conversations noted by the project team indicated general support for the IFHMP, with some concerns regarding individual properties and a need for ongoing public education programs around emergency management in a flood event.

A total of 57 responses were received for the survey, with 10 collected in hard-copy during the Open House, 1 submitted in hard-copy to the District after the event and another 46 completed online. Most of the questions in the survey sought to gauge the community's agreement with the flood risk mitigation measures proposed by the IFHMP. The majority of responses in all questions were in agreement with the measures or approaches proposed. Ninety percent of respondents also indicated that they believed the IFHMP has done an adequate job of identifying risks, options, and recommended approaches for managing flood risk in Squamish.

1. Introduction

The third Open House for the District of Squamish Integrated Flood Hazard Management Plan (IFHMP) was held at the Squamish Adventure Centre on Monday, June 26, 2017. The Open House was held to provide information and gather public input concerning the Draft IFHMP. It summarized the identified flood hazards for the District of Squamish, the proposed flood mitigation options (both policy-based and structural), the recommended funding and implementation strategies. This report serves to document how the Open House was organized and record comments that were provided by the public during the Open House and through an online questionnaire.

1.1 Open House Agenda

The June 26, 2017 Open House took place from 6:00 pm to 8:00 pm. The facilitation was led by David Roulston, Matt Gunn and Chris Wyckham (District of Squamish), and assisted by David Roche (KWL), and Graham Farstad, Cathy Forbes and Caroline Rouxel (Arlington Group).

Attendees were invited to sign in at the door and indicate the neighbourhood in which they live (Appendix A – Open House Attendance Sheet). They were then provided with a handout of the questionnaire (Appendix B – Questionnaire). In addition to printed copies provided at the Open House, the questionnare was also made available online.

For this third Open House, the District included presentation of the IFHMP followed by a question and answer session. Following the question and answer session, participants were invited to review the storyboards and meet with project team members individually.

Attendees were encouraged to complete and submit a hard-copy of the questionnaire before leaving or complete the questionnaire online by July 14, 2017. Ten completed questionnaires were received at the Open House. The Open House concluded shortly before 8:00 pm.

1.2 Attendance

The Open House sign-in sheet indicated a total attendance of 23 persons. Nearly all participants signed in order to provide a public record. Participants were asked to indicate their residential neighbourhood. As with previous IFHMP Open House sessions, neighbourhoods located within river floodplain areas showed a greater participation rate than those less affected by river flooding. Brackendale was the best-represented neighbourhood at the Open House, representing just under 50% of attendees (Table 1).

Neighbourhood	Number of Attendees	Proportion (%)
Garibaldi Estates	1	4.3%
Garibaldi Highlands	1	4.3%
Brackendale	11	48%
Valleycliffe	4	17%
Hospital Hill	2	9%
Squamish Terminals	1	4.3%
Other/Not Identified	3	13%
TOTAL	**23**	**100%**

Table 1: Open house attendees' neighbourhood of residence.

2. Open House Activities

2.1 Presentation and Q&A Session

A presentation took place in the Adventure Centre Theatre starting at 6:15 pm. The presentation to 20 members of the public was provided by the Municipal Engineer for the IFHMP, David Roulston, supplemented by a PowerPoint highlighting key elements. This presentation covered all key elements of the Squamish IFHMP and was followed by a question and answer session. Questions were raised on a wide variety of aspects of the project and the process. They included what education measures will be taken following adoption of the IFHMP, the location of safe refuge areas, funding for dike improvements, the rationale for the three different controlled densification measures, elaboration of opportunistic measures to be considered, and the role of public consultation including whether it resulted in any changes to recommended actions. Several speakers complimented the District for its comprehensive process. The presentation and question and answer session took approximately one hour.

2.2 Revisited Storyboards

A display of 16 storyboards was provided in the north hallway of the Adventure Centre (see Figure 1). They included a series of key storyboards from the first and second Open Houses. These storyboards provided background information on the IFHMP including the major floods over the past century, documentation of the types of flood hazards facing Squamish from the Squamish, Cheakamus, Cheekeye, Mamquam and Stawamus Rivers as well as storm surges and other coastal events. Proposed mitigation measures for these flood hazards were also identified from the first two Open Houses.

Figure 1: Storyboards displayed around the north hallway of the Squamish Adventure Centre.

2.3 New Storyboards

Six new storyboards were prepared for this Open House. These storyboards provided an updated timeline of the IFHMP process and information of about the community engagement strategy through to the completion of the draft IFHMP. The storyboards also summarized key information from the draft IFHMP, including primary policy-based flood mitigation tools (OCP, Flood Bylaw and Development Permit Area) and predominant structural flood mitigation tools (dike upgrades, building a sea dike and planning for a "Super-Dike"). A summary of implementation and funding mechanisms, organized in terms of policy measures, operational measures, capital investments and further studies was displayed. Images of all the storyboards that were displayed are included in Appendix C – Storyboards.

3. Questionnaire – Open House and Online

3.1 Overview

The survey consisted of 15 questions inviting yes/no answers, multiple-choice responses and open-ended comments. The survey was provided in hard-copy for the Open House and made available online on the District's website. The online survey was advertised as open until July 14 and was closed on July 17. A copy of the survey is provided in Appendix B – Questionnaire and responses are included in Appendix D – Survey Responses.

3.2 Questionnaire Response - Open House and Online

10 survey responses were submitted during the Open House, with 1 additional hard-copy survey submitted to the District after the event and 46 online responses received over the following 3 weeks.

3.3 Response Summary

A total of 57 responses to the survey were received. The questions asked and the responses received are summarized below. Respondents were not required to answer all questions and were free to skip questions they did not wish to answer. As a result, the number of responses to each question varied.

Q1. The updated Official Community Plan (OCP) will carefully control but not eliminate growth in areas of higher flood risk. It also says how much risk the community is willing to accept, and encourages growth in areas of lower flood risk. Do you think the OCP updates are a good approach for managing flood risk in Squamish?

A total of 57 responses were received for Question 1. 44 respondents (77%) agreed that the OCP updates are a good approach for managing flood risk. 14 comments were received, with several commenters reinforcing the need for the OCP policies to be clear and consistently enforced for the OCP to be an effective mechanism to manage flood risk. Other comments expressed concerns about limitations on building in certain areas.

Q2. A new Floodplain Bylaw will establish building regulations for new buildings including minimum elevations for future and minimum distances from creeks, rivers, and dikes. Do you think the new Floodplain Bylaw is a good approach for managing flood risk in Squamish?

A total of 48 responses were received for Question 2. 40 respondents (83%) agreed that the new Floodplain Bylaw is a good approach for managing flood risk in Squamish. Of the ten comments received, six related to the need for the bylaw to be realistically balanced with maintaining reasonable costs for developers and builders.

Q3. A new Development Permit Area (DPA) will require future developments to leave space to let water pass safely through the community to avoid transferring risk or increasing flood levels over time. No development will be allowed outside the District's dikes ("Primary Floodways"). Future development in designated dike-protected corridors called "Secondary Floodways" will have to meet specific conditions

to avoid making the consequences of a flood worse for others. Do you think the new DPA is a good approach for managing flood risk in Squamish?

46 respondents answered Question 3, with 39 agreeing (85%) that the new DPA is a good approach to managing flood risk in Squamish. The eight comments received largely reinforced agreement with the DPA. Some comments expressed concern about the effect of this type of regulation on construction costs and subsequently housing affordability, as well as decisions to allow housing to be built on the east side of Loggers Lane.

Q4. The IFHMP recommends a balanced approach to diking that considers different needs in different parts of the community. The IFHMP recommends: Building a new sea dike to protect Downtown Squamish from coastal floods that will get worse as climate change causes sea levels to rise. Making the dikes that protect the heart of the community (Brackendale, Eagle Run / Highway 99, Garibaldi Estates, North Yards, Industrial Park, Dentville, and Downtown Squamish) higher, wider and stronger. These improvements will reduce the likelihood of dike failures that could cause up to $450 million in damages and displace 60% of the community's population Maintaining the Provincial standards for dike protection for the Valleycliffe neighbourhood. Avoiding building new dikes in rural and relatively remote areas like the Paradise Valley. Do you agree with the IFHMP approach to dike protection for managing flood risk in Squamish?

Of the 45 responses received for Question 4, 41 agreed (91%) with the IFHMP approach to dike protection for managing flood risk in Squamish. The ten comments received mainly focused on concerns that the design standard for the dikes are excessive and objections to spending taxpayer money on building dikes. One comment suggested that the extra cost to build dikes should be recognized in the same manner as the costs of sewer and water when building on the hillsides.

Q5. The IFHMP recommends a prioritized list of dike upgrades. Some upgrades will be expensive and may take several decades to build. Building and paying for the upgrades may be a challenge, so the District must start planning immediately. The District can raise the necessary funds in different ways. Please tell us which funding approaches you agree with for flood risk management in Squamish (check all that apply):

Answer Choices	**Responses (# and %)**
Grants from the federal and provincial governments	39 (85%)
Cost-sharing agreements between the District and federal/provincial governments	37 (80%)
Taxes that apply to everyone in the District (since everyone uses services in the floodplain)	24 (52%)
Taxes or fees that only apply to people who own property in dike-protected areas	10 (22%)
Fees charged to developers who will profit from new developments located in the floodplain	39 (85%)

Table 2: Choices and responses to Question 5.

There were 46 responses to Question 5. Three approaches received support from 80% or more respondents. The most popular funding approaches to flood risk management was to use grants from

the federal and provincial governments, take advantage of cost sharing programs, and to charge fees to developers who will profit from new developments located in the floodplain.

Q6. The IFHMP recommends site-specific requirements for new developments. They include new Flood Construction Levels, setbacks from creeks and rivers, erosion protection for foundations and floodproofing fill, and a restrictive covenant on property title. These 'on-site' measures are designed to reduce the consequences of flooding for new development. Do you agree with these on-site measures for managing flood risk in Squamish?

Of the 45 responses received for Question 6, 40 (or 89%) agreed with the proposed on-site measures for managing flood risk in Squamish. The nine comments received demonstrated a variety of general views, including a call for fewer restrictions on landowners, a need to manage these on-site measures and ensure clarity and minimise additional cost to developers, and to ensure these measures don't transfer risk to existing developments or properties.

Q7. Downtown Squamish is a very important business hub for the community. The District has historically allowed non-residential development (e.g., stores, restaurants and warehouses) to build at ground level (below the flood construction level) within the downtown area. The IFHMP continues the historical flood construction level exemption for non-residential development. However, new developments will need to use flood-resistant building materials and a restrictive covenant will be required on title to ensure that future owners understand the risks. Do you agree with this approach for non-residential development?

Of the 46 responses received for Question 7, 39 (85%) agreed with the proposed approach for managing flood risk in non-residential development in Downtown Squamish. Nine comments were received that included concerns around compliance, upgrades and the impact on small business.

Q8. The IFHMP recommends that densification (i.e., rezoning) be controlled at three different levels: Properties located in Restricted Densification Areas (coloured red) should not be rezoned for additional density. Growth may still occur through infill development. Rezoning that concentrates the density allowed under existing zoning into a smaller part of the lot is also acceptable. Properties located in Conditional Densification Areas (coloured yellow) can be rezoned for additional density if the development proposal complies with a list of conditions established by the IFHMP. Properties located in Limited Densification Areas (coloured brown) may be rezoned up to a maximum density of 29 units per hectare (RS-2 Duplex Zoning). Development proposals must also meet all requirements for Conditional Densification Areas. The intention of this recommendation is to limit an increase in flood risk over time, while supporting growth that enhances the ongoing livability of Squamish. Do you agree with this approach?

44 respondents provided answers to Question 8. Nearly all agreed (37 or 84%) agreed with the controlled densification approach to growth in Squamish. A total of ten comments were received, several of which reinforced agreement with this approach. Others expressed concern about how to balance these needs with smart growth principles and pointed out potential discrepancies in the decision to control densification in some areas but not others, for example in Loggers Lane.

Q9. Do you think that the IFHMP has done an adequate job of identifying risks, options, and recommended approaches for managing flood risk in Squamish?

Ninety percent (37 out of 41) of responses to Question 9 agreed that the IFHMP has done an adequate job of identifying risks, options and recommended approaches for managing flood risk in Squamish. Seven comments displayed a range of views, from agreements that the plan is very detailed to a belief that the approaches are too risk averse.

Q10. Do you have any comments about the proposed mitigation plan for the following areas: (check applicable area)

Answer Choices	**Comment Summary**
Downtown Squamish/ Dentville 2 responses	- Concerns about dike breaches - Concerns about storm water management in the Downtown area once the sea dike is built
Garibaldi Estates/Eagle Run/Brackendale 5 responses	- Concerns about dike breaches - Reinforcement of the need for planning in the Brackendale due to the risks faced by the area - A request for no rezoning changes for properties adjacent to the Brackendale dikes, to better protect the inner-community
Paradise Valley	No comments
Valleycliffe 1 response	- Call to prioritize flood protection measures in Valleycliffe due to the growing population in the area and the limited access to the community
Other area (specify) 6 responses	- Question about the level of protection for the Scott Crescent development and Waterfront Landing - General comment stating that the proposed mitigation plan should ensure that existing structures do not become subject to increased risk - Three comments questioning why housing is being supported in the Loggers Lane area

Table 3: Answer choices and comment summary of Question 10.

Q11. Please provide any other general comments you may have about the IFHMP.

15 general comments were received for Question 15 and can be classified into 5 main categories, in no particular order:

1. Praise for the IFHMP and the community engagement process.
2. Specific requests for more information, including evacuation plans.
3. Questions about the IFHMP including how it will be kept current through its duration and how it will be realistically and incrementally implemented.
4. General suggestions for further considerations, including looking at international examples for flood hazard management and supporting the natural courses of the Squamish waterways.
5. Concerns that the plan is too risk averse and will have undesirable cost impacts and effects on housing supply and local businesses.

Q12. Where do you live?

39 responses were given to this question. The largest number live in Brackendale, followed by Garabaldi Highlands and Valleycliffe/Plateau. This includes both Open House and online responses.

Answer Choices	**Responses**
Downtown Squamish	3
Dentville	3
Finch Drive/Loggers Lane	1
North Yards	4
Garibaldi Estates/Eagle Run	1
Tantalus/Newport Ridge	2
Garibaldi Highlands	5
Brackendale	12
Valleycliffe/Plateau	5
Hospital Hill	4
Paradise Valley	0
Other location in Squamish (specify)	0
Outside Squamish (specify)	1
Total	**39**

Table 4: Answer choices and responses to Question 12.

Q13. Do you own property in the floodplain?

Of the 43 responses received for Question 13, 20 stated they owned property in the floodplain, 17 did not own property in the floodplain and 6 were not sure.

Questions 14 and 15 asked for contact information and specific questions that respondents wished to have answered.

15 respondents provided contact details to be added to the District's contact database and will be included in future updates. Two specific questions were received, one asking for clarification of the Restricted Densification Area adjacent to Judd Creek and another inquiring about how to protect a home from flood risk and who to contact for help in the event of a flood. These questions and the appropriate contact details were supplied to District staff for follow up.

3.4 Response Analysis

Questions 1 through 8 in the questionnaire sought to gauge the community's agreement with the IFHMP's identification and determination of the level of flood risk to the community, the measures and mechanisms proposed by the IFHMP to mitigate flood risks, and the types of funding approaches that could be used to pay for required flood risk management measures. A majority of responses to all these questions were in agreement with the measures or approaches proposed.

The comments received in this block of questions represented a balance of respondents reinforcing their support, with certain caveats, and respondents justifying their disagreement with the measures and approaches proposed. Comments regarding policy measures tended to cite concerns that the regulations would not be consistently enforced, or that the measures would impose excessive limitations to development. Comments regarding the structural diking measures tended to express concerns with the proposed design standards, suggesting that they are too extensive and would be too costly.

In terms of costing and funding mechanisms, responses to Question 5, as well as general comments received in other questions, indicated that the community was in favour of flood hazard management measures being funded by grants from the federal and provincial governments, or paid for through fees charged to developers who will profit from new developments located in the floodplain, rather than being funded by local taxpayers.

Question nine asked whether the respondents agreed that the IFHMP adequately identified the risks, options and recommended approaches for managing flood risk in Squamish. The majority of respondents (90%) replied positively to this question, indicating that the IFHMP has been generally well received in its level of risk management and approach to risk mitigation.

Respondents were offered opportunity to provide directed comments about the proposed mitigation plan for select areas. The comments received reflected general concerns and minimal scrutiny of specific technical recommendations. The comments received reinforced the importance of ongoing community education and information sharing around the flood risks faced by individual neighbourhoods.

The final five questions asked allowed for general comments to be made and asked for information on the respondents, including where they live and whether they own property in the flood plain. An opportunity to provide contact information and specific questions that the respondent would like answered was also provided. The information collected showed that the largest percentage of respondents came from the Brackendale area and just under 50% of respondents own property in the floodplain.

It should be noted that the attendance at the Open House and participation in the online survey represented a small proportion of the Squamish community or those neighbourhoods subject to flood hazards. However, much of the information at this final Open House had been previously made available on the District of Squamish website or through the Official Community Plan updating process. Previous consultation had also taken place at two other Open Houses, numerous Council meetings, meetings with the Squamish Nation and meetings with highly affected landowners. The responses received represent the views of interested members of the community and indicate their general support for the IFHMP.

Integrated Flood Hazard Management Plan
Public Open House
June 26th, 2017
Sign-in Sheet

Name	Neighbourhood
	Govt Rd.
	Squamish Terminals Ltd.
	1840 Garden Pl. Sq.
	Brackendale
	Garibaldi Estates
	BRACKENDALE.
	Crumpit Woods
	Brackendale
	Brackendale
	Brackendale
	BRACKENDALE
	Highlands.
	Crumpit Woods
	Brackendale
	Hospital Hill (safest place!)
	Brackendale

	Born, Germany
	Brackendale
	Crumpit Woods.

Squamish Integrated Flood Hazard Management Plan (IFHMP) Questionnaire

Introduction

The Squamish community faces an unusually broad range of flood-related hazards. The District has responded by developing a detailed flood management plan that provides the community with policy, planning and structural protection tools. In 2014, the District began an extensive update to its 1994 Flood Hazard Management Plan. A new Integrated Flood Hazard Management Plan (IFHMP) has been developed to better respond to the changes in the Squamish community.

The IFHMP recommends over 100 specific tools for mitigating flood risk. Recommendations address land use, new building regulations, dike upgrades, river management, emergency response, public education, and flood insurance. Some tools apply to the entire community, such as updates to the OCP and adopting a new Floodplain Bylaw. Other tools apply to specific Flood Hazard Areas.

Some IFHMP recommendations should be implemented immediately. Others will take decades to plan and build. Some of the most important recommendations will require significant long-term financial commitments.

To help us plan and prioritize actions for the future, we want to hear your thoughts on some of the key flood mitigation tools proposed by the IFHMP.

Questionnaire

The IFHMP recommends three key policy tools (Official Community Plan update, new Development Permit Area, new Floodplain Bylaw) that will help the District reduce flood risk. District staff will consider these new policies when evaluating applications for new development throughout the community. The three following questions invite your thoughts on these tools.

1 The updated Official Community Plan (OCP) will carefully control but not eliminate growth in areas of higher flood risk. It also says how much risk the community is willing to accept, and encourages growth in areas of lower flood risk.

Do you think the OCP updates are a good approach for managing flood risk in Squamish?

- ◯ Yes
- ◯ No

Comments

2 A new Floodplain Bylaw will establish building regulations for new buildings including minimum elevations for future and minimum distances from creeks, rivers, and dikes.

Do you think the new Floodplain Bylaw is a good approach for managing flood risk in Squamish?

- ◯ Yes
- ◯ No

Comments

---

3 A new Development Permit Area (DPA) will require future developments to leave space to let water pass safely through the community to avoid transferring risk or increasing flood levels over time. No development will be allowed outside the District's dikes ("Primary Floodways"). Future development in designated dike-protected corridors called "Secondary Floodways" will have to meet specific conditions to avoid making the consequences of a flood worse for others.

Do you think the new DPA is a good approach for managing flood risk in Squamish?

- ◯ Yes
- ◯ No

Comments

Dikes can greatly reduce the potential for flooding. However, they can also promote more development in high-risk areas, which increases the consequences of a dike failure. Dikes can also create a false sense of safety, and people may forget they live in a floodplain.

4

The IFHMP recommends a balanced approach to diking that considers different needs in different parts of the community. The IFHMP recommends:

- Building a new sea dike to protect Downtown Squamish from coastal floods that will get worse as climate change causes sea levels to rise.
- Making the dikes that protect the heart of the community (Brackendale, Eagle Run / Highway 99, Garibaldi Estates, North Yards, Industrial Park, Dentville, and Downtown Squamish) higher, wider and stronger. These improvements will reduce the likelihood of dike failures that could cause up to $450 million in damages and displace 60% of the community's population
- Maintaining the Provincial standards for dike protection for the Valleycliffe neighbourhood.
- Avoiding building new dikes in rural and relatively remote areas like the Paradise Valley.

Do you agree with the IFHMP approach to dike protection for managing flood risk in Squamish?

◯ Yes

◯ No

Comments

5 The IFHMP recommends a prioritized list of dike upgrades. Some upgrades will be expensive and may take several decades to build. Building and paying for the upgrades may be a challenge, so the District must start planning immediately. The District can raise the necessary funds in different ways.

Please tell us which funding approaches you agree with for flood risk management in Squamish (check all that apply):

- [ ] Grants from the federal and provincial governments
- [ ] Cost-sharing agreements between the District and federal / provincial governments
- [ ] Taxes that apply to everyone in the District (since everyone uses services in the floodplain)
- [ ] Taxes or fees that only apply to people who own property in dike-protected areas
- [ ] Fees charged to developers who will profit from new developments located in the floodplain

---

6 The IFHMP recommends site-specific requirements for new developments. They include new Flood Construction Levels, setbacks from creeks and rivers, erosion protection for foundations and floodproofing fill, and a restrictive covenant on property title. These 'on-site' measures are designed to reduce the consequences of flooding for new development.

Do you agree with these on-site measures for managing flood risk in Squamish?

- ◯ Yes
- ◯ No

Comments

---

7 Downtown Squamish is a very important business hub for the community. The District has historically allowed non-residential development (e.g., stores, restaurants and warehouses) to build at ground level (below the flood construction level) within the downtown area. The IFHMP continues the historical flood construction level exemption for non-residential development. However, new developments will need to use flood-resistant building materials and a restrictive covenant will be required on title to ensure that future owners understand the risks.

Do you agree with this approach for non-residential development?

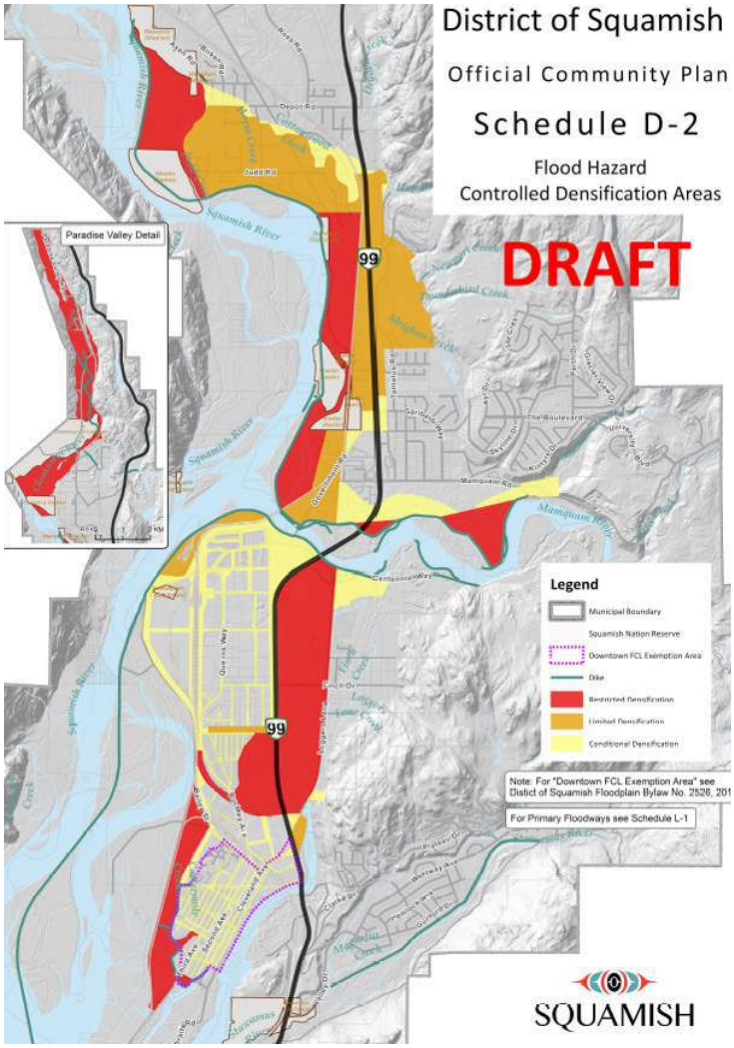
- ◯ Yes
- ◯ No

Comments

8 The IFHMP recommends that densification (i.e., rezoning) be controlled at three different levels:

- Properties located in **Restricted Densification Areas** (coloured red) should not be rezoned for additional density. Growth may still occur through infill development. Rezoning that concentrates the density allowed under existing zoning into a smaller part of the lot is also acceptable.
- Properties located in **Conditional Densification Areas** (coloured yellow) can be rezoned for additional density if the development proposal complies with a list of conditions established by the IFHMP.
- Properties located in **Limited Densification Areas** (coloured brown) may be rezoned up to a maximum density of 29 units per hectare (RS-2 Duplex Zoning). Development proposals must also meet all requirements for Conditional Densification Areas.

The intention of this recommendation is to limit an increase in flood risk over time, while supporting growth that enhances the ongoing livability of Squamish.



Do you agree with this approach?

- ◯ Yes
- ◯ No

Comments

9 **Do you think that the IFHMP has done an adequate job of identifying risks, options, and recommended approaches for managing flood risk in Squamish?**

- ◯ Yes
- ◯ No

Comments

---

10 **Do you have any comments about the proposed mitigation plan for the following areas: (Check applicable area)**

- ☐ Downtown Squamish/ Dentville
- ☐ Garibaldi Estates/Eagle Run/Brackendale
- ☐ Paradise Valley
- ☐ Valleycliffe
- ☐ Other area (specify)

Comments

---

11 **Please provide any other general comments you may have about the IFHMP.**

Comments

Please tell us a little about yourself.

12 **Where do you live?**

- ☐ Downtown Squamish
- ☐ Dentville
- ☐ Finch Drive/Loggers Lane
- ☐ North Yards
- ☐ Garibaldi Estates/Eagle Run
- ☐ Tantalus/Newport Ridge
- ☐ Garibaldi Highlands
- ☐ Brackendale
- ☐ Valleycliffe/Plateau
- ☐ Hospital Hill
- ☐ Paradise Valley
- ☐ Other location in Squamish (specify) _____
- ☐ Outside Squamish (specify) _____

---

13 **Do you own property in the floodplain?**

- ○ Yes
- ○ No
- ○ I own property in Squamish but am not sure if it is in the floodplain.

14 **I would like to learn more. My email address is:**

15 **Please have someone contact me about the following (I understand I may not receive an immediate reply):**

Thank you for completing the IFHMP Questionnaire!

Squamish Integrated Flood Hazard Management Plan

SQUAMISH

Squamish IFHMP

In 1994, the District of Squamish completed its first Flood Hazard Management Plan (FHMP) to manage and mitigate the flood risk for the District.

A generation after its adoption, the FHMP now needs to be revisited and updated. The update process will take into account:

- Growing population
- Legislative and regulatory changes
- New professional standards
- Provincial guidance
- Flood hazard assessment best practices
- Climate change

WHAT IS AN INTEGRATED FLOOD HAZARD MANAGEMENT PLAN?

- The 1994 Flood Hazard Management Plan for Squamish is being updated.
- The new plan will be called the Integrated Flood Hazard Management Plan (IFHMP).
- The IFHMP will guide development and land use in Squamish for years to come. The IFHMP process provides an opportunity for Squamish to maintain its commitment to livability and sustainability by incorporating the latest flood management guidelines, new engineering modeling tools and techniques, and best planning practices.
- An effective IFHMP will depend on community engagement and public support.
- A financially-responsible budget, reflecting the size of the community, will further support the implementation of the IFHMP.

WHAT MAKES UP AN IFHMP?

Phase 1: Flood Mitigation Background Analysis

This first step is designed to summarize the existing information surrounding Squamish's:

- Hydrology
- Geohazards
- Anticipated climate change
- Future coastal water levels
- Extent and condition of existing flood protection
- Existing policy tools that manage flood hazards

Phase 2: Coastal Flood Hazard Mitigation Options

Several coastal flood defence options have been developed and are presented at this first Open House for your input on the options, risks, consequences, and potential mitigation measures.

Phase 3: River Floodplain Modelling and Risk Analysis

Technical risk assessments will be conducted on the Squamish and Mamquam Rivers followed by the Cheakamus, Cheekeye and Stawamus Rivers. Results will be presented at the second Open House in the fall of 2015.

Phase 4: Integrated Flood Hazard Management Plan

The final phase of the IFHMP involves the preparation of the Integrated Flood Hazard Management Plan, which will recommend both technical and policy solutions. The Draft IFHMP will be presented at the third Open House – Winter 2015/16 – and to Council in the winter of 2016.

IFHMP Timeline

SQUAMISH

PROJECT TEAM

KERR WOOD LEIDAL consulting engineers

CASCADE ENVIRONMENTAL RESOURCE GROUP LTD

the Arlington Group

SNC·LAVALIN

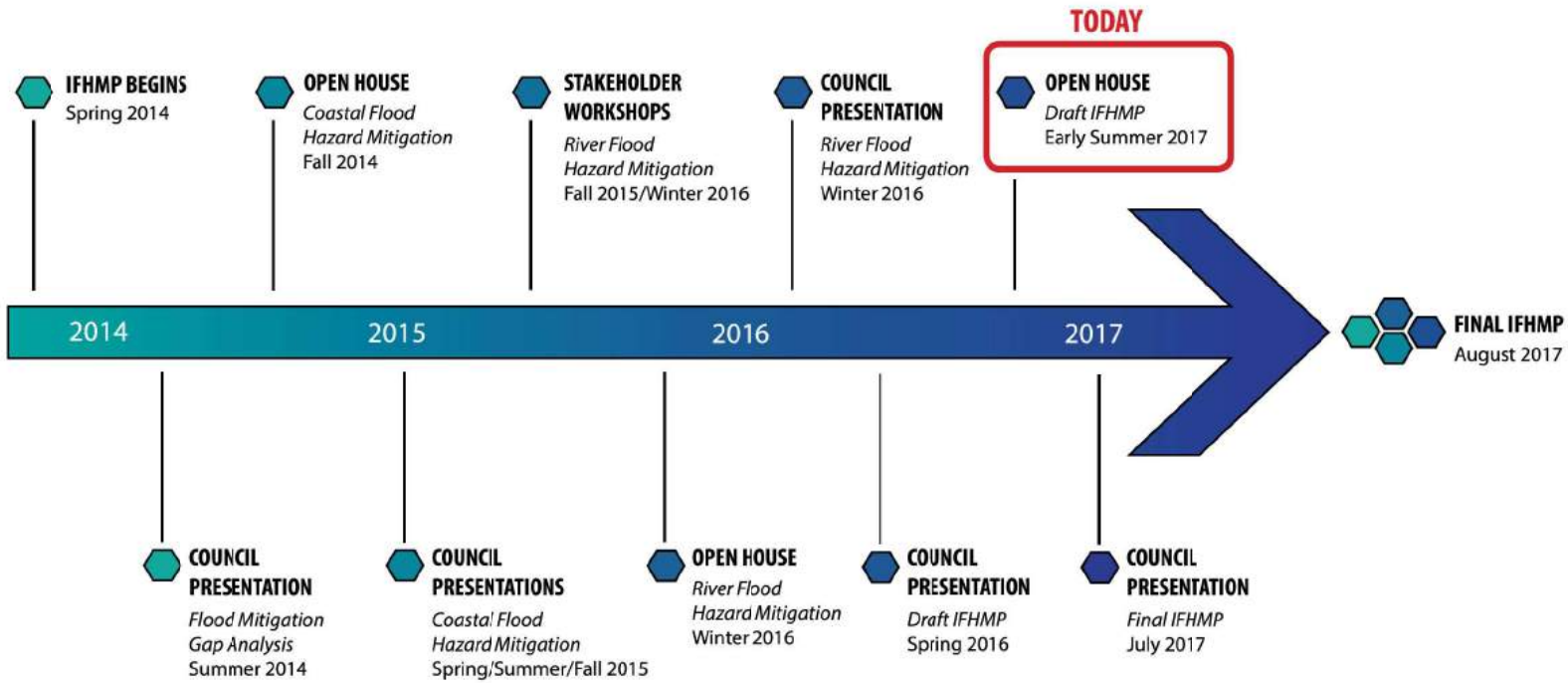
THURBER ENGINEERING LTD.

STAKEHOLDERS

PUBLIC

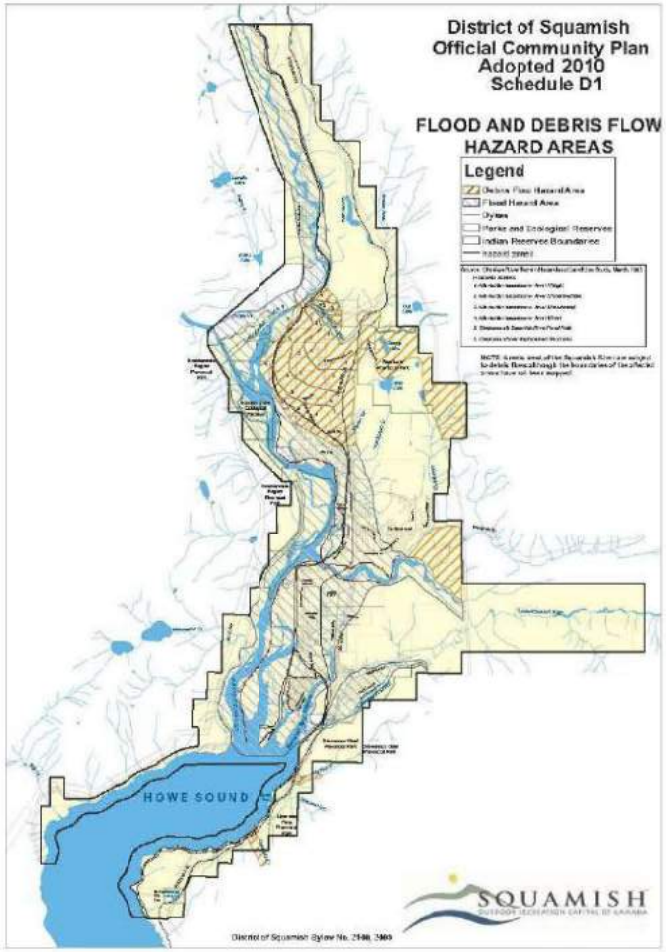
TECHNICAL WORKING GROUP & SḴWX̱WÚ7MESH ÚXWUMIXW (SQUAMISH NATION)

Integrated Flood Hazard Management Plan (IFHMP)
Public Consultation Schedule



Keep up to date and provide feedback on the IFHMP at www.squamish.ca/floodhazard

Natural Hazards in Squamish



Where the Rivers Meet the Sea

The District of Squamish is located at the head of Howe Sound where 5 rivers converge. These mountain rivers, fed by glaciers, snowmelt and precipitation, descend from their steep mountain tops carrying water, sediment, and on occasion, rocks and other debris. When these fast flowing rivers reach the gently sloping valley, they tend to slow down and spread out, and leave sediment behind. The terms alluvial fan and floodplain are used to describe the riparian areas along these lower river reaches.

Sḵwx̱wú7mesh Úxwumixw Oral History - The Flood

The oral history of the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) has a legend called the Flood. According to the legend, when the people began to forget their old ways and failed to listen to their elders, the game began to disappear and then the fish and the berries. People became hungry and began to quarrel. Still they wouldn't listen to their elders and change their ways. Then the rains came. The waters rose and the people had to anchor their canoes to Nch'kay' (Mt. Garibaldi). When the waters receded, the people who survived came to their senses and listened to their elders. Then the game and the fish and the berries returned in abundance.

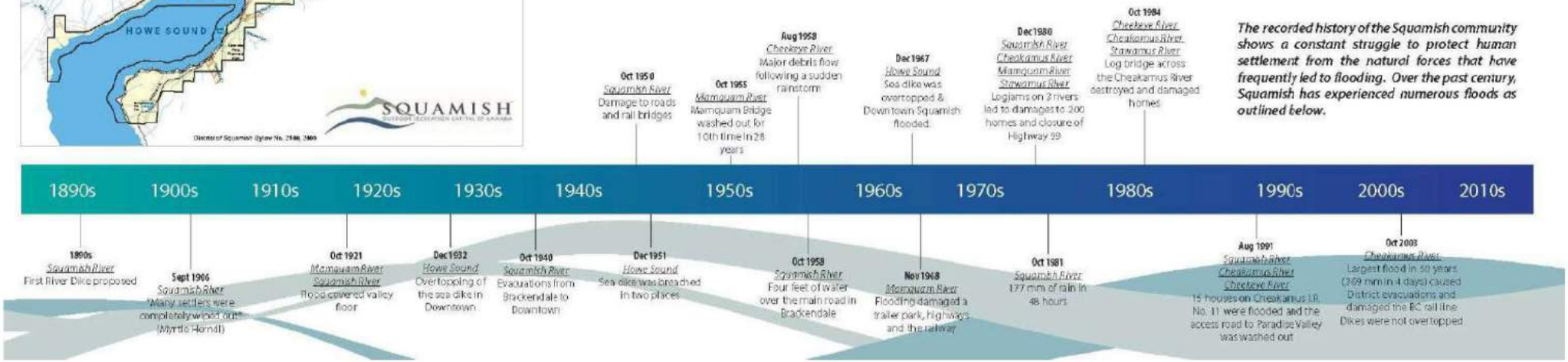
Lessons from the Past

Several conclusions can be drawn from the flood history in Squamish:

1. **All the rivers in Squamish pose a risk of flooding. All have caused multiple and damaging floods in the past.**
2. **Damaging floods have also occurred as a result of coastal inundation.**
3. **The flood risk in Squamish has strong seasonal variations. Most flooding has taken place between October and December. Major floods have also taken place in August.**
4. **Contrary to other B.C. communities, the freshet (typically in late May, June and early July) has not been a major cause of flooding on local rivers.**
5. **The frequency of flood damages over the past 30 years has decreased compared to earlier time periods. This is attributed to investments in structural flood protection (i.e. dikes).**
6. **Extreme precipitation (rain and snow) has occurred on at least 5 occasions since 1980. These continue to test the limits of flood protection structures.**

In addition to the 5 major rivers and their tributaries, the District's land area also includes numerous small, steep creeks that can present flood, debris flow, sedimentation, and erosion hazards.

The recorded history of the Squamish community shows a constant struggle to protect human settlement from the natural forces that have frequently led to flooding. Over the past century, Squamish has experienced numerous floods as outlined below.



Coastal Flood Hazard

Coastal Flood Hazard

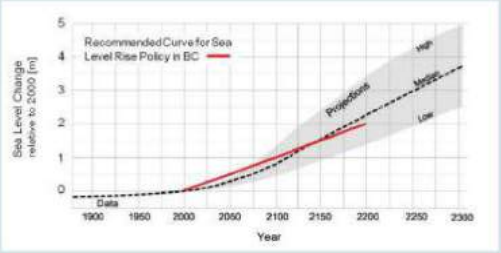
Coastal flood hazards in Squamish are affected by the combination of:

- tides
- storm surge
- local wind and wave effects
- wave imapcts on the shoreline

Engineering assessments have concluded that large tsunamis are unlikely to affect Squamish. Tsunami hazards are beyond the scope of the IFHMP.

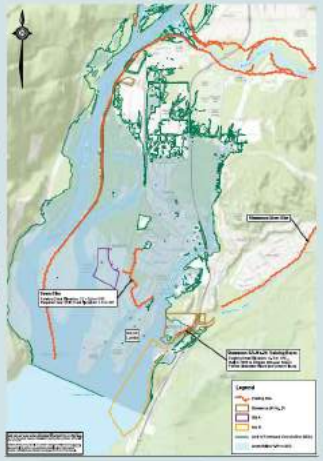
Sea Level Rise

One of the most important climate change impacts is sea level rise due to warmer ocean temperatures and melting of ice. Provincial Guidance anticpiates sea level rise by 1.0 metre by the year 2100 and 2.0 metres by the year 2200. This is illustrated on the graph below.



Squamish at Risk

The District`s Howe Sound coastline extends from Watts Point to Woodfibre. The foreshore is relatively steep and undeveloped except at Woodfibre and from Crescent Slough to Stawamus I.R. No. 24. In this area, river estuaries and sloughs allow coastal hazards to penetrate deep into the community.



Coastal Flood Risk Mitigation

In October 2015, District Council adopted a coastal flood risk mitigation strategy.

Connected Floodplain Areas

"Connected" floodplain areas (such as the downtown Squamish peninsula) encompass many different properties and land uses. Effective risk reduction requires unified and consistent approach. Key strategies for connected coastal floodplain areas are described below.

- **Protect** existing and proposed development against coastal floods including Sea Level Rise to Year 2100
- **Accommodate** coastal flood hazards through land use restrictions, designated floodways, appropriate FCLs, and restrictive covenants.
- **Retreat** critical facilities out of the coastal floodplain as they reach the end of their development life cycle

Unconnected Floodplain Areas

"Unconnected" floodplain areas are also vulnerable to coastal flood hazards. Flooding in one area is not "connected" to flooding in another area, so each site can define its own independent approach for reducing flood risk. Examples of unconnected coastal floodplain areas:

- Scott Crescent Development
- Waterfront Landing
- Stawamus I.R. No. 24
- Site A
- Site B
- Squamish Terminals and
- Woodfibre

Mitigation Options Include the Following Examples

Avoid/Retreat

- Reclaim area to natural state as community amenity
- Possible locations - intertidal areas, Squamish Estuary

Accomodate

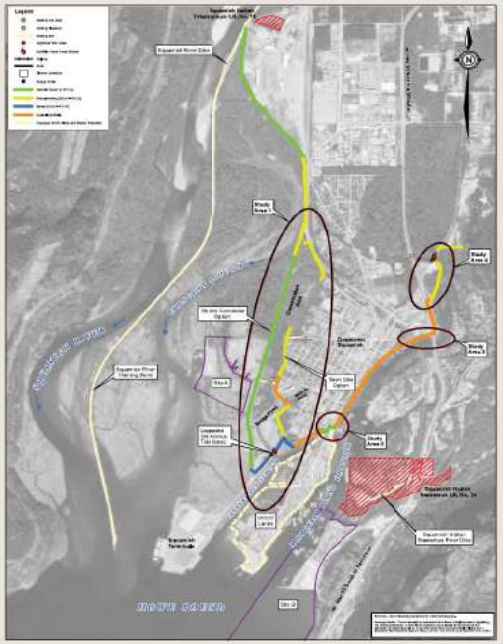
- Raise elevation of habitable space above flood levels
- Use flood resistant building materials below the FCL
- Allow water dependant industrial uses (e.g. log sort)

Protect

- Raise land elevation with structural fill
- Construct offshore defenses (e.g. breakwaters)
- Construct perimeter cefences (e.g. sea dike or seawall).

Future Sea Dike Alignment

District Council approved the future sea dike but some questions must still be addressed in special "study areas".



Different colours in the figure show different types of shoreline treatment:

- Natural or Beach Slopes *(Green)*
- Riprap *(Blue)*
- Bioengineered *(Yellow)*
- Seawall *(Orange)*

Special Study Areas

Special Study Area #1 will determine whether the dike should follow the CN Rail tracks or the existing Town Dike.

- If the District proceeds with the 7th Ave Connector the dike should be incorporated into the truck route.
- If the 7th Ave Connector does not proceed, the Town Dike alignment may be more favourable.

Special Study Area #2 will decide how the dike should tie in with SODC and Squamish Yacht Club boat ramp.

Special Study Area #3 will accommodate bike and foot traffic flow between the railway bridge and Highway 99.

Special Study Area #4 will integrate the sea dike with Rose Park, the proposed Sea to Sky Forestry Centre, and a possible future pump station at Loggers Lane.

Balancing FCLs and Overtopping

If the sea dike is built too low, waves will overtop the dike into downtown. The District of Sechelt has this problem at Trail Bay.

In Squamish, too much overtopping would overwhelm the stormwater system. But, If the sea dike is built too high, it will trap more water during a river dike breach and increase MBEs.

The District selected an overtopping rates of 10 L/s per metre of dike. Higher overtopping rates are unsafe.

Sea Dike Crest Elevations

Different types of shorelines are proposed in different areas.

- Natural beach shoreline is preferred.
- Areas with less space need riprap or bioengineering.
- A seawall is required along Mamquam Blind Channel.

The preliminary elevation for the sea dike crest is 4.7 m above mean sea level. This is on average about 2-3 m above natural ground in Downtown Squamish.

Sea Dike Implementation

The IFHMP recommends phased implementation as per the table below:

ACTION	TIMING
Raise to 3.3 m elevation with standard cross-section	Immediate
Raise to Year 2100 elevation with ongoing redevelopment	Ongoing
Raise to minimum elevation 4.0 m at final dike width.	As funding permits
Raise to Year 2100 (1 m SLR) crest elevation	When justified by sea level rise

The first section of sea dike is already under construction as part of the Mireau development on Mamquam Blind Channel.

Upper Squamish/Mamquam Flood Hazard

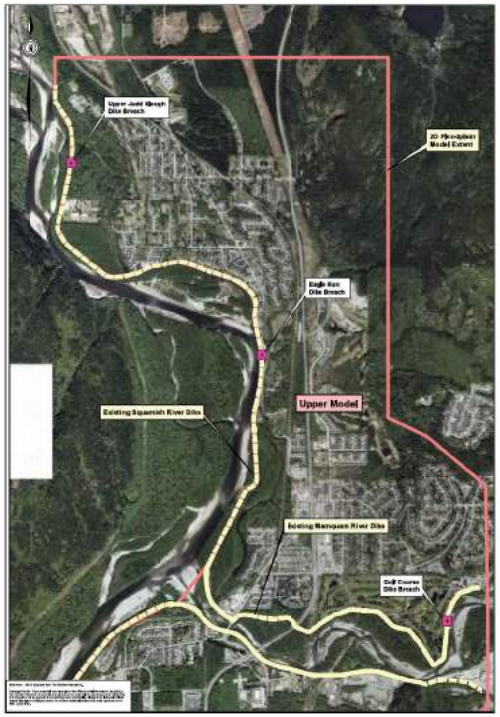
The Mamquam River naturally divides the Squamish River Floodplain into "upper" and "lower" areas. The Upper and Lower floodplain areas were modeled separately.

IFHMP modeling incorporates state of the art technology, updated hydrology, new data and climate change considerations.

Dike Breach Modeling

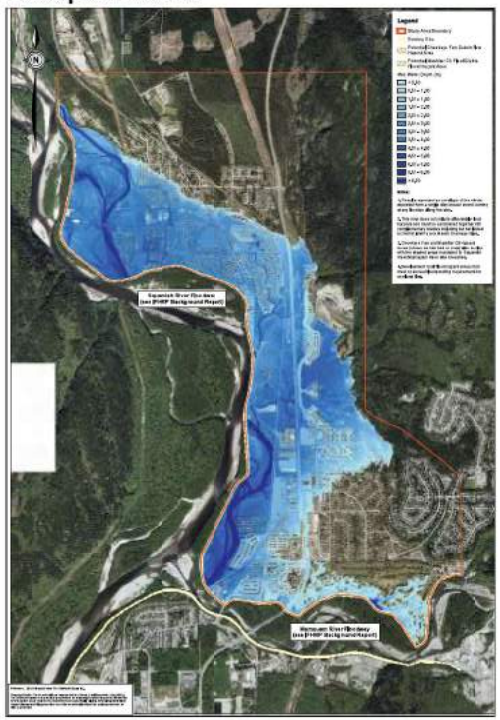
A dike breach could occur at any location. The IFHMP modelled three dike breaches: at Judd Slough, Eagle Run, and the Golf Course.

Modeled Dike Breach Locations



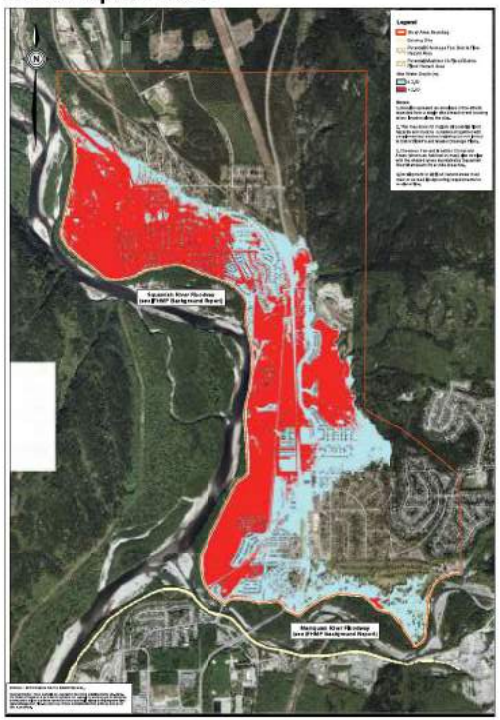
Results from these three simulations were generalized to show "worst case" results for all parts of the floodplain, assuming that the dike breach could happen anywhere. The maps on this board are planning tools and do not represent any specific dike breach scenario.

Floodplain Extent



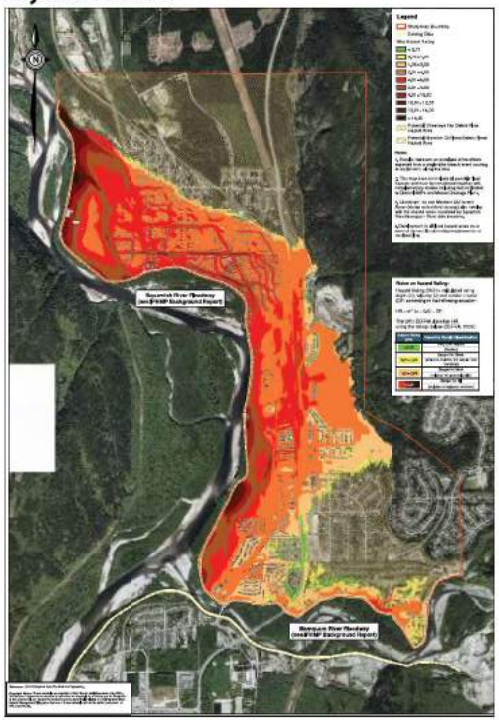
This map shows the maximum extent of flooding expected if a dike breach occurs during the 1:200 year river flood. It also shows water depth above assumed Year 2100 ground level. Darker blue (deeper water) reveals old river levels, channels and local creeks cut off from the river by diking.

Flood Depth > 2.5 m



The red areas on this map show where flood depths would exceed 2.5 m. Provincial guidance recommends 2.5 m flood depth as a basis for identifying particularly high-hazard areas. The areas shown in red were used to help define the limited densification areas shown on board 9.

Physical Hazard



Flooding can be dangerous when water gets deep or flows quickly. It is most dangerous where both happen together. **Hazard Rating** is a measure of how dangerous conditions could get during a dike breach. Darker colours are very dangerous, even for properly trained and equipped emergency personnel.

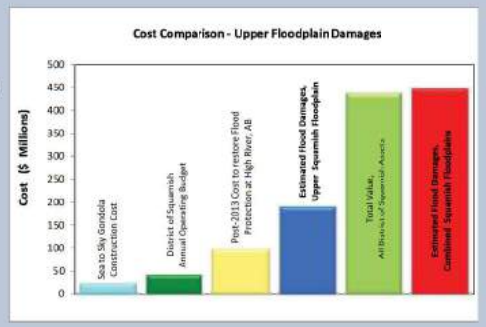
Economic Damages of a Dike Breach

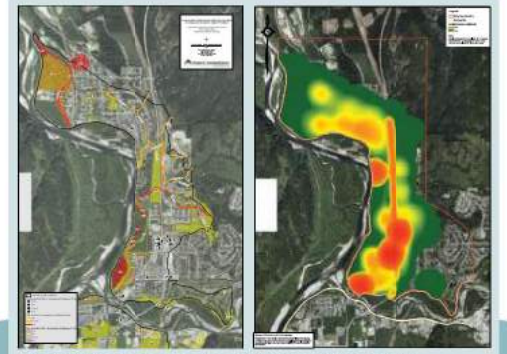
The IFHMP used HAZUS software and Geographic Information Systems (GIS) data to estimate the economic damages resulting from a dike breach flood.

For the upper floodplain:

- Ecomomic losses would total $190 Million (in 2014 dollars)
- 7,000 people could be displaced
- 21,000 tons of debris could be produced.

The HAZUS study cannot account for all possible losses, and is considered a low estimate of damage.





The IFHMP alsc assessed social and environmental consequences, see the River Flood Risk Mitigation report.

Lower Squamish/Mamquam Flood Hazard

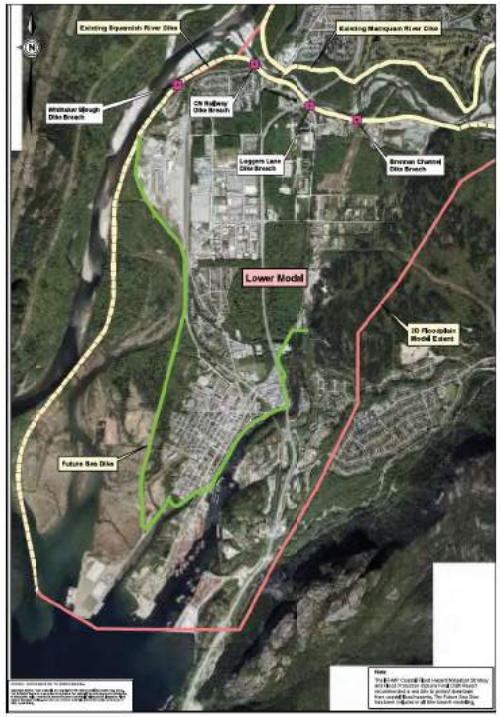
The Mamquam River naturally divides the Squamish River Floodplain into "upper" and "lower" areas. The Upper and Lower floodplain areas were modeled separately.

IFHMP modeling incorporates state of the art technology, updated hydrology, new data and climate change considerations.

Dike Breach Modeling

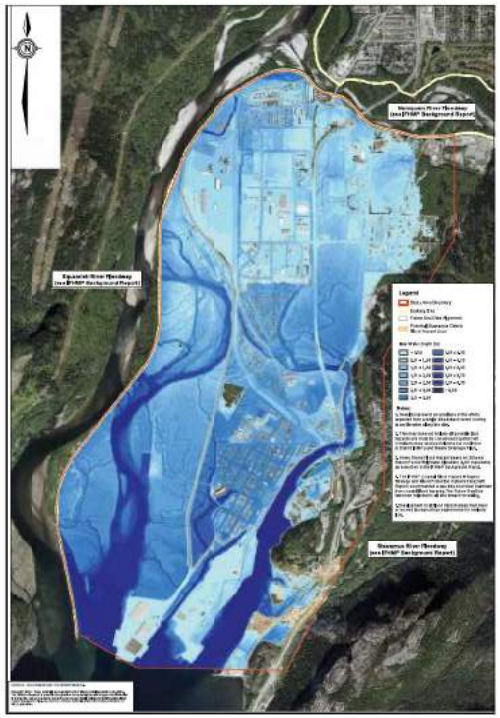
A dike breach could occur at any location. The IFHMP modelled four dike breaches: at Whittaker Slough, CN Railway, Loggers Lane, and the Brennan Channel.

Modeled Dike Breach Locations



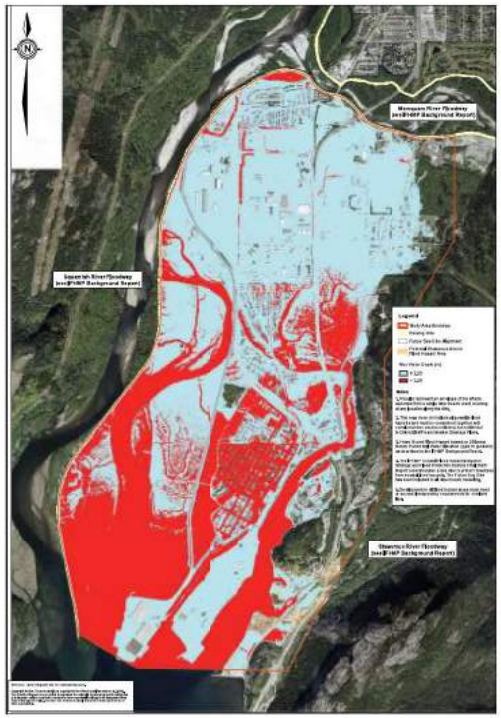
Results from these three simulations were generalized to show "worst case" results for all parts of the floodplain, assuming that the dike breach could happen anywhere. The maps on this board are planning tools and do not represent any specific dike breach scenario.

Floodplain Extent



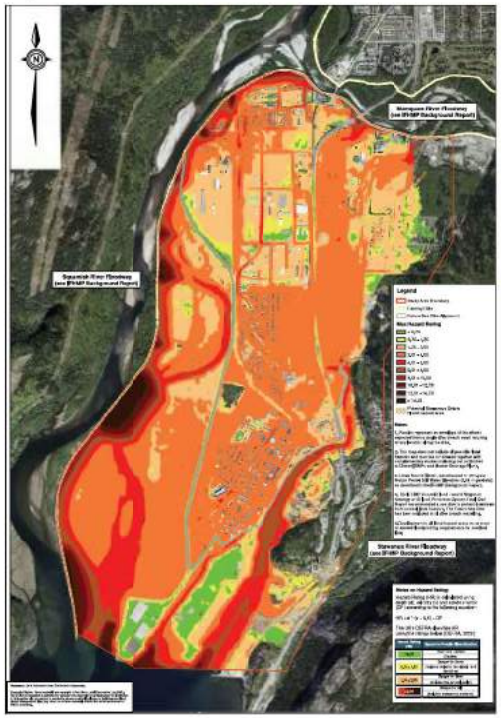
This map shows the maximum extent of flooding expected if a dike breach occurs during the 1:200 year river flood. It also shows water depth above assumed Year 2100 ground level. Darker blue (deeper water) reveals old river levels, channels and local creeks cut off from the river by diking.

Flood Depth > 2.5 m



The red areas on this map show where flood depths would exceed 2.5 m. Provincial guidance recommends 2.5 m flood depth as a basis for identifying particularly high-hazard areas. The areas shown in red were used to help define the limited densification areas shown on board 9.

Physical Hazard



Flooding can be dangerous when water gets deep or flows quickly. It is most dangerous where both happen together. **Hazard Rating** is a measure of how dangerous conditions could get during a dike breach. Darker colours are very dangerous, even for properly trained and equipped emergency personnel.

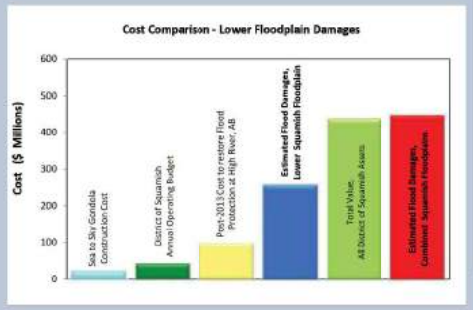
Economic Damages of a Dike Breach

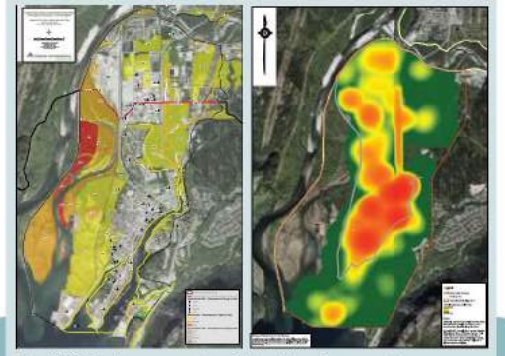
The IFHMP used HAZUS software and Geographic Information Systems (GIS) data to estimate the economic damages resulting from a dike breach flood.

For the lower floodplain:

- Ecomomic losses would total $257 Million (in 2014 dollars)
- 3,400 people could be displaced
- 17,000 tons of debris could be produced.

The HAZUS study cannot account for all possible losses, and is considered a low estimate of damage.





The IFHMP also assessed social and environmental consequences, see the River Flood Risk Mitigation report.

Stawamus River Flood Risk

The Stawamus River drains a heavily-forested glacially-carved watershed that extends from Sky Pilot Mountain to Howe Sound. The river flows through Valleycliffe and Stawamus I.R. No. 24.

Hazard Overview

The primary hazard on Stawamus River is flooding and the possibility of lateral erosion in the higher-elevation areas (e.g. Valleycliffe) and deposition in the lower reaches and estuary.

The Stawamus River is a steep mountain river with typically high rates of wood and sediment transport. Over time, gravel deposited on Mamquam Blind Channel can affect navigation.

Landslide dam-breach debris floods may be possible in the Stawamus River watershed. These events typically have much larger peak discharges and carry much more wood and sediment than a comparable return period 'clear water' flood.

Finally, the Stawamus River estuary is also subject to coastal backwater flooding from Howe Sound.

Areas at Risk

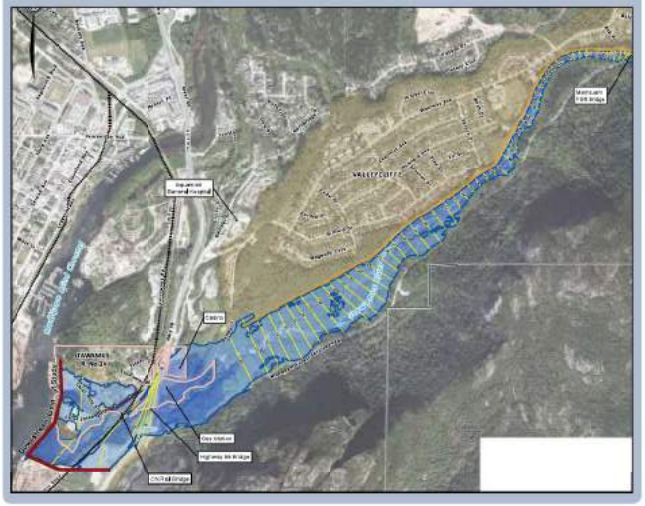
Areas at risk of flooding from Stawamus River include:

- the Valleycliffe neighborhood, including residential and commercial properties as well as Valleycliffe Elementary School,
- low-lying areas surrounding the of Little Stawamus Creek confluence, and
- low-lying areas of Squamish Nation I.R. No. 24.

Key infrastructure includes Highway 99, Valley Drive and the CN Rail mainline and the Mamcuam Forest Service Road. The Squamish Nation gas station and Chances Squamish (casino) are located adjacent to the river immediately upstream of the Highway 99 Bridge.

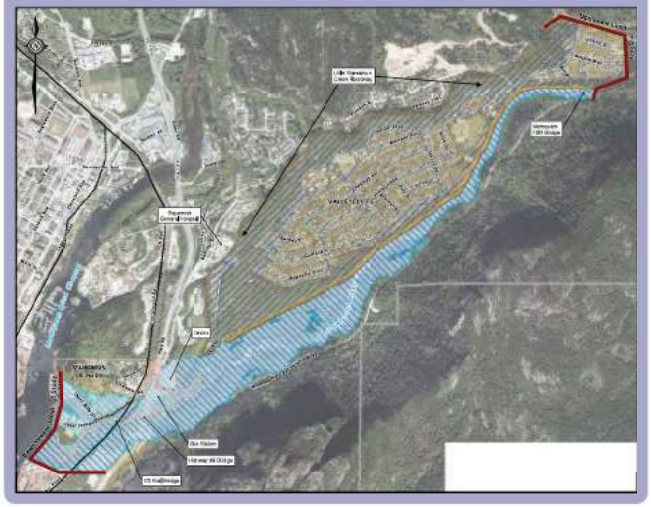
Flood Extents

This map shows the Stawamus River 1:200 year debris flood hazard area. The floodplain consists of the valley corridor generally between the Stawamus River and Little Stawamus Creek. The area at risk extends along the right bank of the Stawamus River from approximately the Mamquam Forest Service Road Bridge to approximately 50 metres upstream of Little Stawamus Creek and about 600 metres upstream from Highway 99.



Land Use Planning - Valleycliffe

The focus for Stawamus River flood risk management is to contain the flood hazard area outside the existing dike. Development under existing zoning should accommodate overland flow by elevating buildings to the FCL and ensuring the street network can serve as secondary floodways in the event of a bridge blockage. These measures are recommended as precautionary and are not expected to be onerous for developers.



Structural Flood Protection Works

- Future studies should consider whether the existing dike crest contains the modelled flood profile along most of its length.
- Upgrades to erosion protection works are recommended.
- Upgrade or extend at the upstream end of the Stawamus River dike could help mitigate debris flood hazards and further reduce the potential for overland flow through Valleycliffe.

Strategy Overview

Protect	is recommended as the primary flood mitigation strategy for the Valleycliffe flood hazard area.
Accept	rather than protect against avulsion and overland flow hazards.
Accommodate	overland flood hazards through floodproofing and internal floodways. Accommodate measures are particularly important in the undiked area between the main Valleycliffe community and Stawamus I.R. No. 24.

Retreat and **Avoid** strategies are not recommended for the Valleycliffe area, except as related to the protection and preservation of secondary floodways. Valleycliffe is an example of an area that can accommodate growth.

Stawamus I.R. No 24

The Squamish Nation is responsible for identifying and implementing appropriate flood risk mitigation strategies and tools on all reserve lands. The reserve is subject to coastal floods as well as floods and debris floods on the Stawamus River.

In parallel with the District's IFHMP, the Squamish Nation is developing a long-term vision for Stawamus I.R. No. 24 that will integrate development, flood protection and environmental objectives.

The IFHMP project team expects that the final vision will likely incorporate elements of all flood risk mitigation strategies: protect, accommodate, Avoid, and Retreat of specific buildings in the highest hazard areas.

Consequences of Flooding: Valleycliffe

- Flooding of Valley Drive and the Mamquam Forest Service Road could isolate some areas.
- Erosion could threaten the District's backup water intake or damage a water main.
- Dikes confine 1:200 year flow but bridge blockages could cause an avulsion through Valleycliffe.
- An avulsion could damage buildings and create hazards to people.

Consequences of Flooding: I.R. No. 24

- Sediment deposition could limit channel capacity.
- Several buildings (including homes), the heritage Shaker Church, and a community wastewater treatment system are located in the flood hazard area.
- Bridge blockages at Highway 99 and CN Rail are possible and would exacerbate flood hazards.
- Highway 99 and CN Rail could be closed to traffic if water overtops highway or railway.
- Entire Sea to Sky corridor cut off from Metro Vancouver.

Bridges and Access Roads

- Valley Drive east of Highway 99 floods regularly. The District can raise the low point, but it should remain below Highway 99.
- A short length of the Mamquam FSR may also be flooded. The District should work with other stakeholders to raise the road.
- The old concrete bridge abutments remain in place below the new Highway 99 bridge deck (top photo). This constricts the channel and increases the potential for woody debris to be trapped by the bridge.
- The CN Rail bridge opening has limited hydraulic capacity (photo) and could be overtopped during a major flood.

The District should work with partners and stakeholders to identify opportunities to address these issues.

Cheakamus River Flood Risk

The Cheakamus River flows through the District from Culliton Creek to the Squamish River at the edge of the Cheekeye Fan. BC Hydro operates a dam at Daisy Lake that diverts water through a tunnel from Cheakamus River to Squamish River.

Hazard Overview

Hazards on the Cheakamus River include normal "clear-water" floods. The 2003 flood was a clear-water flood.

Debris flows on Culliton Creek or the Cheekeye River can reach the Cheakamus River. Small Cheekeye River debris flows partially blocked the Cheakamus River in 2009 (see photo) and 2013.

If a large debris flow blocks the river, the river will back up, spill over, and wash out the blockage. The debris flood that results release a higher peak flow and more sediment than a "clear water" flood. (Photo: Britannia Creek, 1991)

The Cheekeye River can also produce much larger debris flows. Debris flows can occur with little warning. When they "run out" into developed areas, they can buildings and kill people. (Alberta Creek, 1983)

The District is studying debris flow mitigation on the Cheekeye Fan separately from the IFHMP.

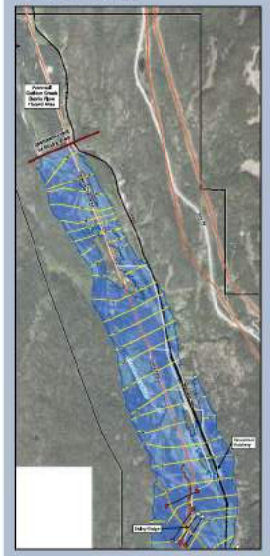
Areas at Risk

Areas at risk of flooding from the Cheakamus River include:

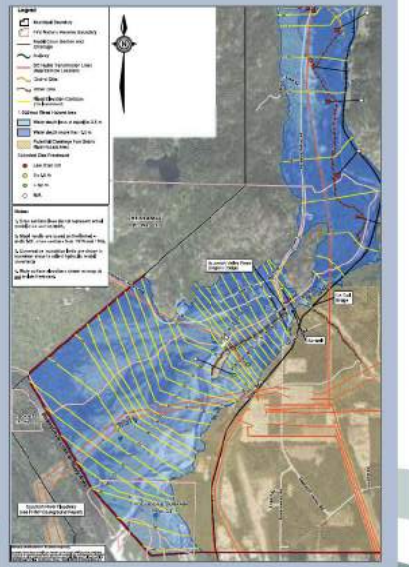
- Paradise Valley, including the Cheakamus Centre and the Bailey Bridge
- Squamish Nation communities at Cheekeye and Moodyville on Cheakamus I.R. No. 11
- The edge of the Cheekeye Fan near the Cheekeye River confluence, including Sunwolf and Fergie's Bridge

Fergie's Bridge and the Bailey Bridge are important links in the only road access to the community. The access route may be vulnerable to flooding.

Flood Extents



These maps show "clear-water" 1:200-year flood hazard areas. The conservative results acceptable for the IFHMP, which must account for other uncertainties like future development patterns and debris floods.



Protect Access

- Review the existing and desired level of flood resilience for emergency response routes. Develop a plan for long-term upgrades.
- Work with community partners to take advantage of opportunities to raise Paradise Valley Road.
- Work with Squamish Nation to incorporate the planned Cheekeye dike into a long-term flood resilience strategy at Fergies Bridge.

- Evaluate dike upgrading options for all river training structures as part of any upgrading plan for the Bailey Bridge

Accommodate Development

- Continue to require restrictive covenants.
- Designate flood hazard areas and minimum Flood Construction Levels based on 1:200 year flood extents.
- Maintain riparian (environmental) and flood protection building setbacks

Limit Diking

- No new District dikes to support new development.
- Ensure new private dikes do not create a transfer of risk.
- Accept responsibility for all river training structures at the Bailey Bridge and incorporate into dike maintenance operations.
- Support landowners who are upgrading or repairing private dikes by sharing emergency response protocols, flood hazard management information, and dike maintenance experience.

Other Measures

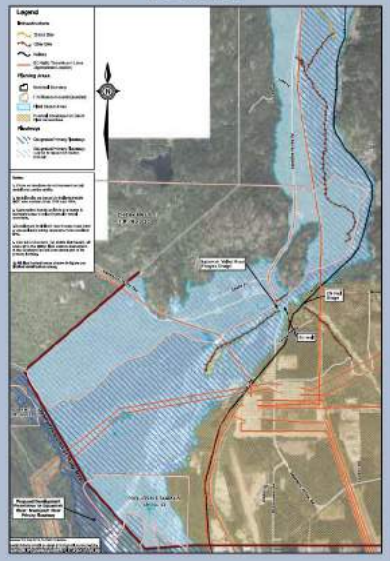
- Develop evacuation plans, signage and safe refuge areas. Share with the community through outreach and signage.
- Work with BC Hydro and the BC River Forecast Centre to maintain and enhance flood warning systems
- Complete comprehensive debris flow / debris flood hazards and mitigation studies for Cheekeye River and Culliton Creek.

Land Use Planning

Strategy Overview

Avoid	further densification of the floodplain by restricting infill development to today's zoning levels. This will help to keep the low density feel of the area.
Accomodate	flood hazards by establishing new FCLs and maximizing building setbacks to give the river space to move.
Protect	key access routes, but preserve the river corridor. Do not build new District dikes to support new development. Help private dike owners make sustainable decisions.

Cheakamus River flood risk management focuses on maintaining the natural system by limiting densification through rezoning in all flood hazard areas. Development under existing zoning should be raised to the FCL and minimize footprint areas within the floodway.



Potential Consequences of Flooding

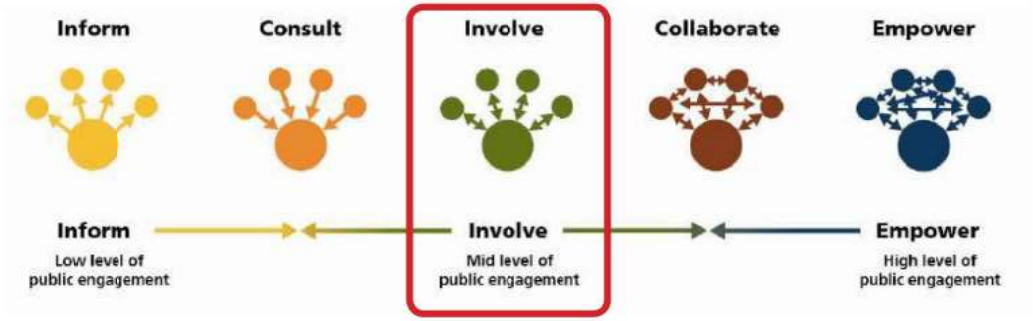
- Private dikes overtop and probably fail.
- Damage to buildings and hazards to people may increase in a debris flood.
- Paradise Valley Road is cut off, creating evacuation and emergency response challenges.
- Fergie's Bridge and the Bailey Bridge are considered particularly high risk structures.
- "Backdoor flow" into Cheekeye community during large events.
- Damage and service interruption for BC Hydro, CN Rail, Cheakamus Centre, Sunwolf and other local businesses.
- Erosion of reserve land is of particular concern for the Squamish Nation.

Community Engagement

Developing a Flood Mitigation Strategy involves challenging tradeoffs and difficult decisions. Recognizing this, in October 2015, Council approved a public engagement plan targeted at the 'Involve' level.

At the 'Involve' level of engagement, the District committed to:

- **Listen to the public's concerns and values.**
- **Consider their input when developing and choosing alternatives.**
- **Provide feedback on how public input influenced the decision process.**

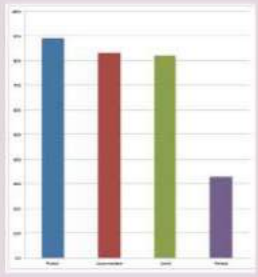


Month	Community Engagment Activity
October 2014	Open House #1 Online Survey #1
November 2015	Highly Affected Stakeholders Workshop Squamish Nation Workshop Community Stakeholders Workshop Online Survey #2
December 2015	IFHMP Project Team Workshops
February 2016	Open House #2 Community Stakeholders Workshop Technical Working Group Meeting District Council Presentation
March 2016	Squamish Nation Chiefs and Council Presentation Stakeholder follow-up discussions Online Survey #3
April - July 2016	Council meetings & Commitees of the whole District Staff Meetings
June 2017	Open House #3
Summer 2017	*Online Survey #4* *Final presentation to Chiefs and Council*

Open House & Online Survey #1 October 2014

The first Open House was held in Squamish on October 23, 2014. The Open House provided general information on flood risks in Squamish and collected feedback on long-term coastal flood protection options. Approximately 70 members of the community attended this event. Following the Open House, an online survey was prepared to gain public input on risk tolerance, evaluation criteria and competing priorities. 117 responses were received.

Overall, the results indicate strong support for protect (89%), accommodate (83%) and avoid (82%) strategies. Retreat did not receive the same level of support (33%).



95% considered reducing the risk of injury or death to be the most important objective.

91% supported using all practical approaches to mitigate flood risk.

82% supported discouraging development in high risk flood plain areas.

The online survey questions **simplified very complex issues**. This was done to help respondents gain an appreciation of the **difficult decisions facing the District**. The survey asked the public to rate difficult decisions between competing objectives, with results showing clear preferences between four objectives, as shown below:

Protecting the environment

Avoiding social, cultural and community impacts
Minimizing costs to taxpayers

Providing development opportunities

Stakeholder Feedback

Over the course of the IFHMP, District staff organized several meetings with key stakeholder groups. Meetings included the following groups and dates:

- Squamish Estuary Management Committee – February 19, 2015
- Highly-Affected Landowners – November 16, 2015
- Residents and Community Stakeholders – November 23, 2015
- Cheakamus River / Paradise Valley Stakeholders – February 1, 2016

Generally, all groups supported improving diking infrastructure and adopting a higher standard of protection. The majority of stakeholders also supported accommodating flood hazard through the use of flood construction levels and allowing passage of floodwaters during a dike breach. There was support for limiting development in the highest hazard areas by the Stakeholders Group while the Highly Affected Landowners Group preferred to see the lands developed using dike protection and flood construction levels for mitigation.

Open House & Online Survey #2 February/March 2016

A second Open House was held on February 24, 2016. The Open House provided information on river flood hazards and mitigation opportunities. It also asked attendees to provide feedback on what they considered to be an acceptable level of flood risk. Approximately 35 people attended the event.

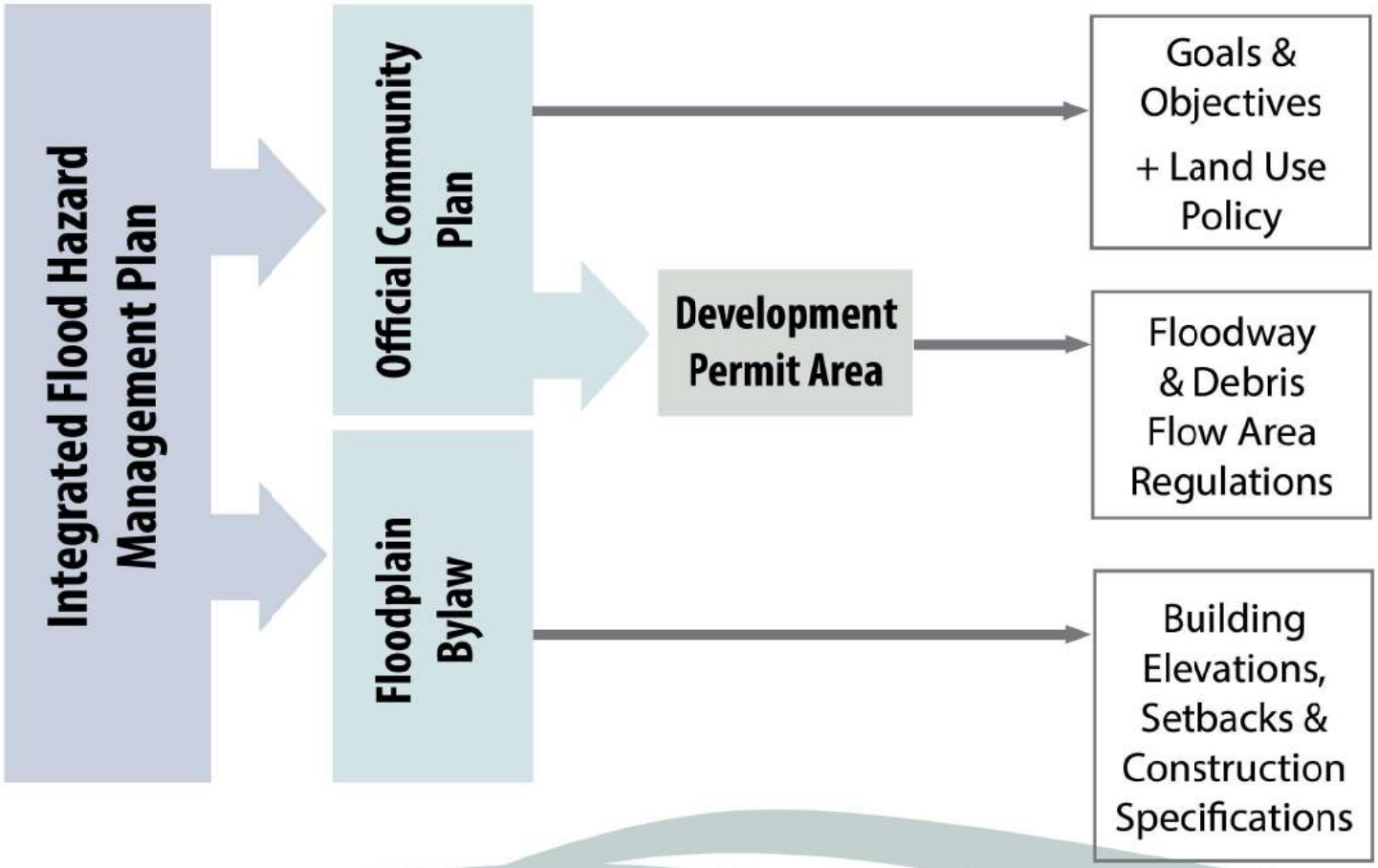
Following the Open House, an online survey was prepared to gain public input on strategies and tools proposed by the IFHMP to help manage river flood risks. Some questions related to general flood hazard management in Squamish. Other questions were specific to each neighbourhood.

There were 38 responses to Survey #2, including 11 received from Open House #2. The response rate to the technical questions was low, which suggests that some people were not comfortable commenting on these very complex issues.

Flood Risk Mitigation Policies

The IFHMP recommends a range of policy measures that set out the goals, objectives and requirements for the community's flood risk management program. The most important land use planning tools focus on the need for updates to the District's flood risk mitigation policies.

The IFHMP project team has worked closely with District Staff to prepare policy updates for the three main policy documents, including the Official Community Plan, the Floodplain Bylaw and a new Development Permit Area.



OCP Smart Growth & Areas for Densification

The OCP sets out the District's vision for the future and guides the growth of the community. The District's Official Community Plan supports smart growth principles, like sustainable design and land use practices. Smart Growth should be updated to incorporate the mitigation of flood risk. Examples include:

- Directing growth away from areas subject to high flood risk.
- Buildings with ground level parking and storage and living areas above the Flood Construction Levels (FCLs).

Areas of Squamish with no flood risk which are suitable for densification from a hazard perspective include:

- Garibaldi Highlands, Quest University and part of Garibaldi Estates

Areas in the floodplain with lower risk and where densification is possible include:

- Valleycliffe, Downtown, Dentville, East of Brennan Park, and Squamish Industrial Park

All other areas will include infill development opportunities.

Floodplain Bylaw

A new Floodplain Bylaw incorporates most of the recommended flood protection measures in a single comprehensive framework with:

- Maps showing FCLs for different areas subject to flood hazard areas
- Available floodproofing measures
- Setbacks from watercourses and dikes
- Permissible use of space below the FCL
- Exemptions for maintenance, repair and additions
- Location of electrical panels and HVAC
- Conditions where a Qualified Professional may be required

The *Local Government Act* limits what regulations a Floodplain Bylaw can establish. For instance a Floodplain Bylaw can not impose development conditions within a primary floodway (main river corridor). The IFHMP recommends a new Development Permit Area for this purpose.

Development Permit Area

A new Development Permit Area (DPA) for flood hazard areas and debris flow natural hazard areas was recommended to clarify requirements for developers and help guide District review of development applications. The DPA captures any important IFHMP policy recommendations that can't be implemented through the OCP or Floodplain Bylaw.

One of the most important regulations of the DPA is to restrict development in primary floodways (with exceptions for the Cheakamus River) and impose regulations for development within secondary floodways (areas within dike-protected corridors critical for conveying floodwaters in the event of a dike breach).

Structural Flood Protection Tools

The IFHMP recommends a range of tools and mitigation measures relating to the planning, design, construction, operation, maintenance, repair, and upgrading of structural flood protection works.

Some of these measures will be implemented through the District's existing dike operations and maintenance program. Other recommended measures will require considerable planning and preparation effort, and may have indeterminate timelines for actual implementation.

1. Fixing Dike Deficiencies/Bringing Existing Dikes to Provincial Standards

The District has spent over $4M on dike upgrades since 2012. Some sections are still too low or too narrow, have substandard bank protection, allow too much seepage, or lack formal land tenure. Addressing these issues is a high priority for the District.

Existing deficiencies include:

- Dike below 1:200 year level
- Lack of land tenure
- No access
- Oversteepened slopes
- Too narrow
- Missing erosion protection
- Overgrown vegetation

Other infrastructure in areas like Eagle Run (below) make upgrades more challenging.

The District will support landowners who are upgrading or repairing private dikes by sharing emergency response protocols, flood hazard management information, and dike maintenance experience. The District will also ensure new private dikes do not create a transfer of risk.

2. Building a Sea Dike

The most important tool for coastal flood risk mitigation is a new District sea dike. The District's sea dike does not meet provincial standards, and Downtown Squamish is presently at risk from coastal floods.

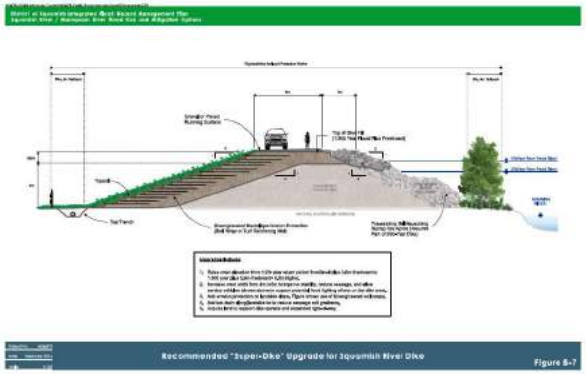
By Year 2100, the sea dike will need to be much longer, higher, and more reliable than it is now. The sea dike will need to start at the Squamish River dike near North Yards, wrap around downtown, and tie into high ground north of Mamquam Blind Channel.

The preliminary crest elevation is 4.7 m geodetic for the majority of the sea dike, but increases to 4.8 m at the north end of Crescent Slough. Some work on the sea dike should start immediately to protect downtown against present-day coastal floods. However, the full height of the Year 2100 sea dike won't be needed right away. As long as the lower part of the sea dike is built wide enough, the upper part can be added later (once we know more about the rate of sea level rise).

Phasing construction in this way makes the sea dike more affordable by spreading costs over a longer period of time. Regardless of whether the sea dike is built all at once or in phases, by the District or by developers, the District should start planning now to make sure that land and funding for the sea dike is available when it is needed.

3. Long-Term Planning: "Super Dike"

The "super dike" recommendation adopts a higher standard of protection for the Squamish River dike. Significant residential and commercial development in this area equates to higher consequences of a dike breach, justifying a higher design standard for the Squamish River dike. The District should start planning now to make the dike higher, wider, and more robust. It will likely take decades to implement the new "super dike" standard.



- The "super-dike" will increase protection from 1:200yr to 1:500 year level.
- Increasing it to 4m-6m wide will reduce seepage that can lead to failure.
- Adding erosion protection on land side will prevent complete failure if overtopped.
- Improved erosion protection will prevent undermining or debris damaging the dike.

Implementation and Funding

The IFHMP makes over 100 recommendations for flood hazard management throughout the District.

The recommended tools can be categorised into four main types.

CATEGORY	EXAMPLE	PRIORITY	FUNDING
Policy Measures deal with goals, objectives and requirements	An updated OCP, the new Floodplain Bylaw and a new Development Permit Area	Most policy measures are Priority 1 IFHMP recommendations.	District Operating Budget. Staff effort may be supplemented by consultants.
Operational Measures affect how the District fulfills its responsibilities	Improving access for dike inspections, undertaking maintenance and repairs and communicating flood risk information to the public.	Most operational measures fall under IFHMP Priorities 1, 2, or 4.	District Operating Budget. The District may receive some funding assistance for Local Authority Emergency Planning through Emergency Management BC.
Capital Investments are construction projects that require large financial investments	The design and construction of a new sea dike and upgrades to the river dikes.	Due to the high costs, only the most important capital investments are assigned IFHMP Priority 1. Most are Priority 2 or 3.	Senior government support through funding grants and cost-sharing programs. The District may fund its share through the annual budget (through general revenues or grants), developer-driven Community Amenity Contributions, and local area levies.
Further Studies will provide more data and analysis to guide future updates	Further technical studies that focus on filling the remaining data and knowledge gaps identified by the IFHMP.	Generally assigned IFHMP Priority 2 so that results will be available to support the next IFHMP update.	A variety of potential sources including general revenues, senior government funding programs, other stakeholders and developers.

Some of the IFHMP recommendations should be implemented immediately. Others will take decades to plan and build.

- **Priority 1** measures should be implemented immediately or at the earliest possible opportunity.
- **Priority 2** measures should be considered in planning decisions and implemented before the next IFHMP update.
- **Priority 3** measures should be considered in planning decisions, but implementation will likely be after the next IFHMP update.
- **Priority 4** measures should be implemented if and when opportunities arise. Priority 4 measures are not strict requirements, but add value to planning, development and other decisions.

Share Your Views

To help us plan and prioritize actions for the future, we want to hear your thoughts on some of the key flood mitigation tools proposed by the IFHMP.

Please indicate whether you agree or disagree with the specific IFHMP recommendations below:	YES	NO	COMMENTS
1. The updated Official Community Plan (OCP) will carefully control but not eliminate growth in areas of higher flood risk. It also says how much risk the community is willing to accept, and encourages growth in areas of lower flood risk. **Do you think the OCP updates are a good approach for managing flood risk in Squamish?**			
2. A new Floodplain Bylaw will establish minimum elevations for new development within the floodplains. It will also require new development to be set back a safe distance from creeks, rivers, and dikes. **Do you think the new Floodplain Bylaw is a good approach for managing flood risk in Squamish?**			
3. A new Development Permit Area (DPA) will require future developments to leave space to let water pass safely through the community. No development will be allowed outside the District's dikes. Future development in designated corridors called "floodways" will have to meet specific conditions to avoid making the consequences of a flood worse for others. **Do you think the new DPA is a good approach for managing flood risk in Squamish?**			
4. Dikes can greatly reduce the potential for flooding. However, they can also promote more development in high-risk areas, which increases the consequences of a dike failure. Dikes can also create a false sense of safety, and people may forget they live in a floodplain. The IFHMP recommends a balanced approach to diking that considers different needs in different parts of the community. The IFHMP recommends: • Building a new sea dike to protect Downtown Squamish from coastal floods that will get worse as climate change causes sea levels to rise • Making the dikes that protect the heart of the community (Brackendale, Eagle Run / Highway 99, Garibaldi Estates, North Yards, Industrial Park, Dentville, and Downtown Squamish) higher, wider and stronger. These improvements will reduce the likelihood of dike failures that could cause up to $450 million in damages and displace 60% of the community's population • Maintaining the current standard of dike protection for the Valleycliffe neighbourhood. • Avoiding new dikes in rural and relatively remote areas like the Paradise Valley. **Do you agree with the IFHMP approach to dike protection for managing flood risk in Squamish?**			
5. The IFHMP recommends site-specific requirements for new development. They include new Flood Construction Levels, setbacks from creeks and rivers, erosion protection for foundations and floodproofing fill, and a restrictive covenant on property title. These on-site measures are designed to reduce the consequences of flooding for new development. **Do you agree with these on-site measures for managing flood risk in Squamish?**			
6. Downtown Squamish is a very important business hub for the community. The District has historically allowed non-residential development (e.g., stores, restaurants and warehouses) to build at ground level within the downtown area. The IFHMP continues the historical exemption for non-residential development. However, new developments will need to use flood-resistant building materials and a restrictive covenant will be required on title to ensure that future owners understand the risks. **Do you agree with this approach for non-residential development?**			
7. Some parts of the District have historically developed in very high risk locations. The IFHMP recommends that the District identify key areas where it would be appropriate to "Build Back Better" after a disaster. **Do you agree with this approach for managing flood risk in Squamish?**			
8. **Do you think that the IFHMP has done an adequate job of identifying risks, options, and recommended approaches for managing flood risk in Squamish?**			

9. The IFHMP recommends a prioritized list of dike upgrades. Some upgrades will be expensive and may take several decades to build. Building and paying for the upgrades may be a challenge, so the District must start planning immediately. The District can raise the necessary funds in different ways.

Please tell us which funding approaches you agree with for flood risk management in Squamish (check all that apply):

Grants from the federal and provincial governments	
Cost-sharing agreements between the District and federal / provincial governments	
Taxes that apply to everyone in the District (since everyone uses services in the floodplain)	
Taxes or fees that only apply to people who own property in dike-protected areas	
Fees charged to developers who will profit from new developments located in the floodplain	

10. **Do you have any comments about the proposed mitigation plan for the following areas:**

AREA	COMMENT
Downtown Squamish/Dentville	
Garibaldi Estates/Eagle Run/ Brackendale	
Paradise Valley	
Valleycliffe	
Other Area (specify)	