

RDOS Park Rill, Horn, and Kearns Creek Floodplain Mapping Project

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Outline



- Background
- Study Objectives
- Hydrologic Analysis
- Channel Assessment
- Riverine and Lake Modelling
- Flood Hazard and FCL Mapping
- Consequence Characterization
- Flood Mitigation Measures

Background – 2018



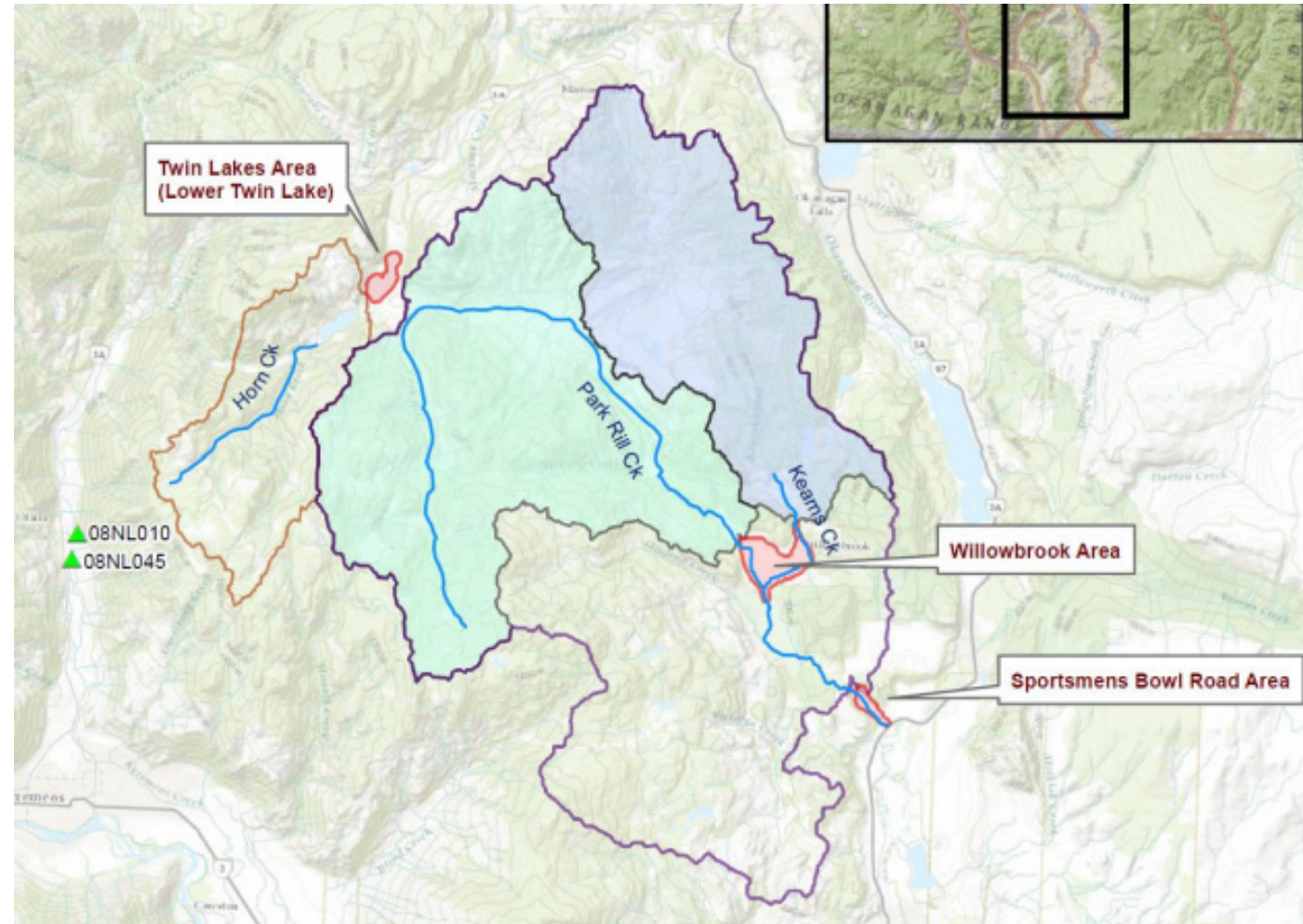
Penticton Herald File Photo



<- May 23, 2018 <https://globalnews.ca/video/4226540/twin-lakes-floods>
50 infantry + 20 engineers, then 70 strathconas + 10 engineers

Study Objectives

- NHC was retained in 2020 to complete the RDOS' Park Rill, Horn, and Kearns Creek Floodplain Mapping Project
- Primary Objectives:
 - Prepare floodplain and flood hazard maps for Lower Twin Lake, Willowbrook and Sportsman Bowl Road
 - Assess consequences of flooding
 - Identify mitigation measures
 - Complete a visual inspection of a 12 km reach of Park Rill Creek



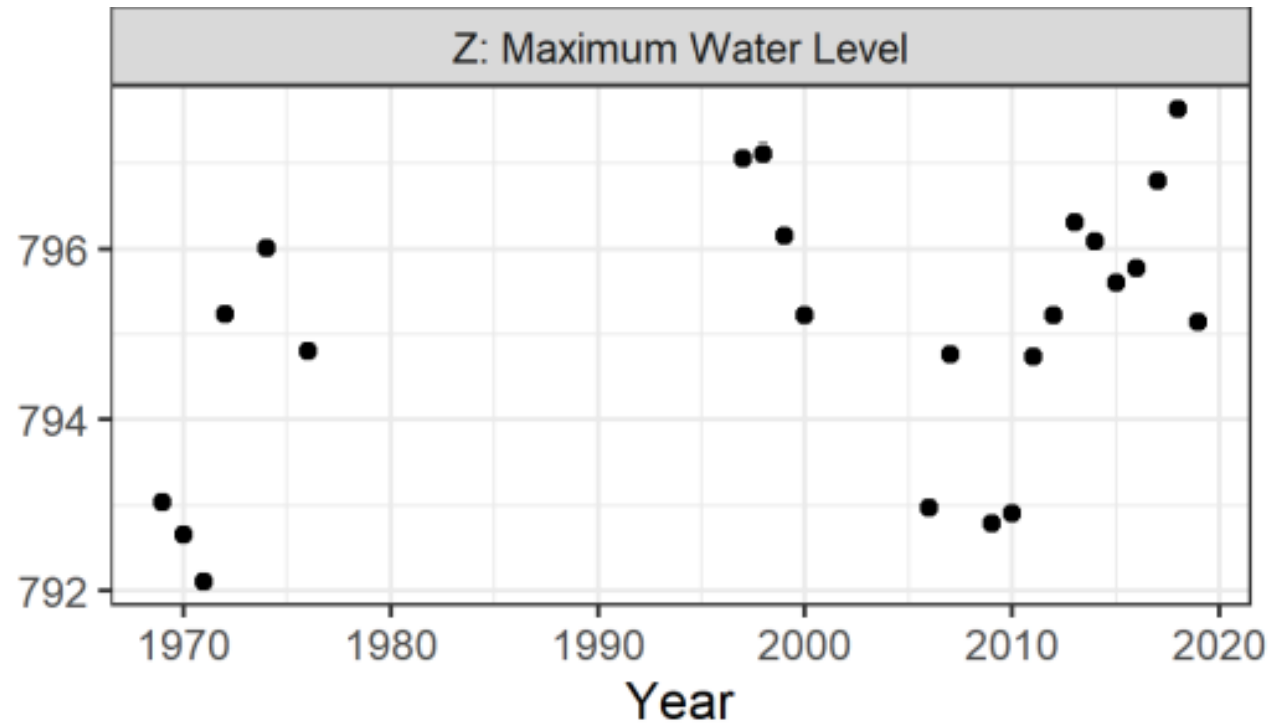
Hydrologic Analysis - Park Rill Creek



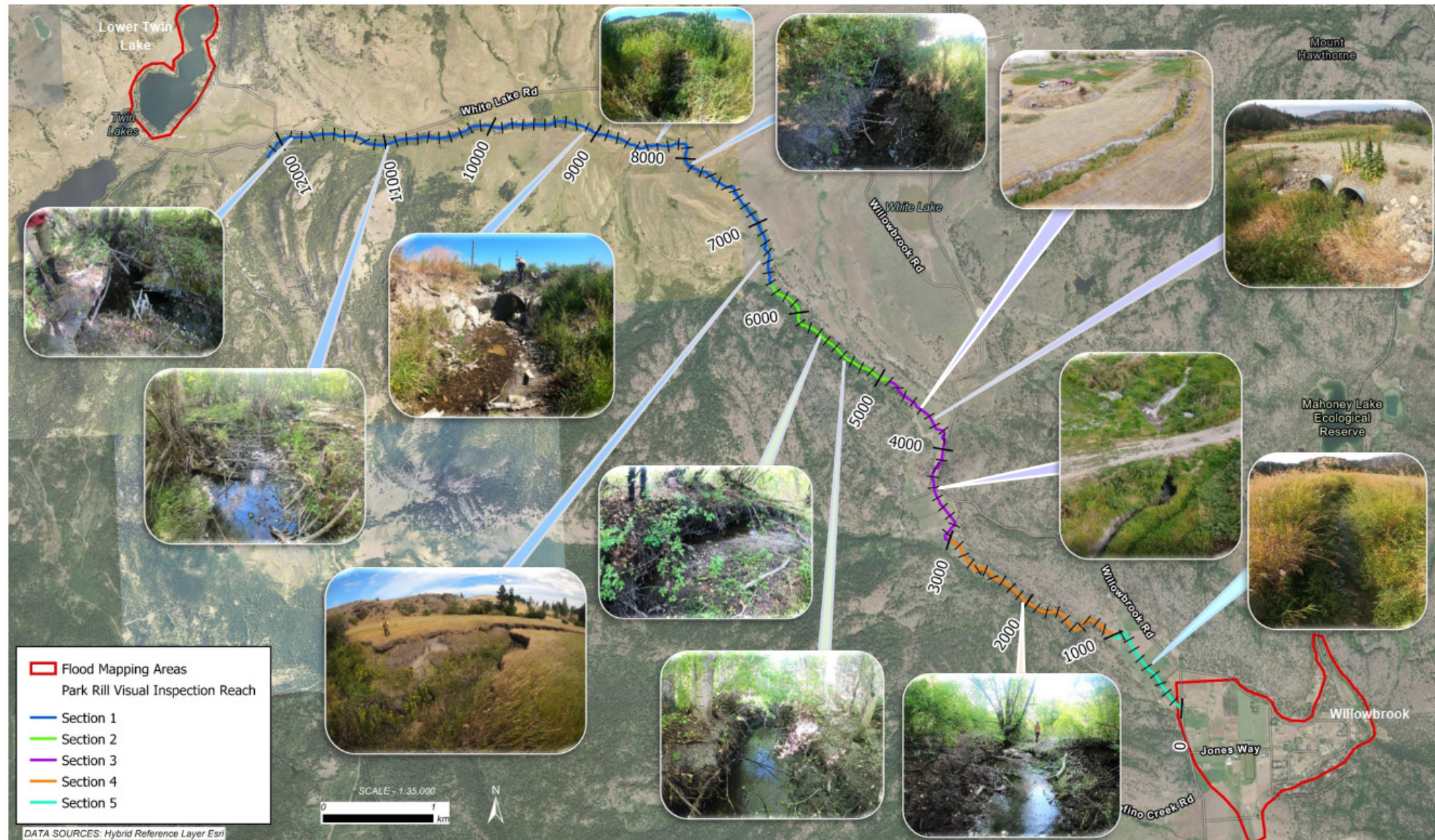
- Hydrologic analysis developed design flows (i.e. 200-year flow) and climate change adjustments as required by EGBC
- Design flows calculated for three locations: Kearns Creek, Park Rill Creek upstream of Willowbrook, and Park Rill Creek upstream of Sportsmen Bowl Road
- Limited historic data on Park Rill Creek – regional analysis used instead
- Climate change factors based on hydrologic modelling completed for the Okanagan Mainstem Mapping (10-13%)
- Long term monitoring would reduce uncertainty in estimates

Hydrologic Analysis – Lower Twin Lake

- Analysis of lake levels on Lower Twin Lake
- Complicated by pumping, sporadic record keeping, autocorrelation
- Naturalized lake levels (no pumping)
- Performed a frequency analysis that is dependent on the pre-freshet water level
- Climate change based on relative increase to inflows (10 to 13%)



Channel Assessment



Lake and River Modelling

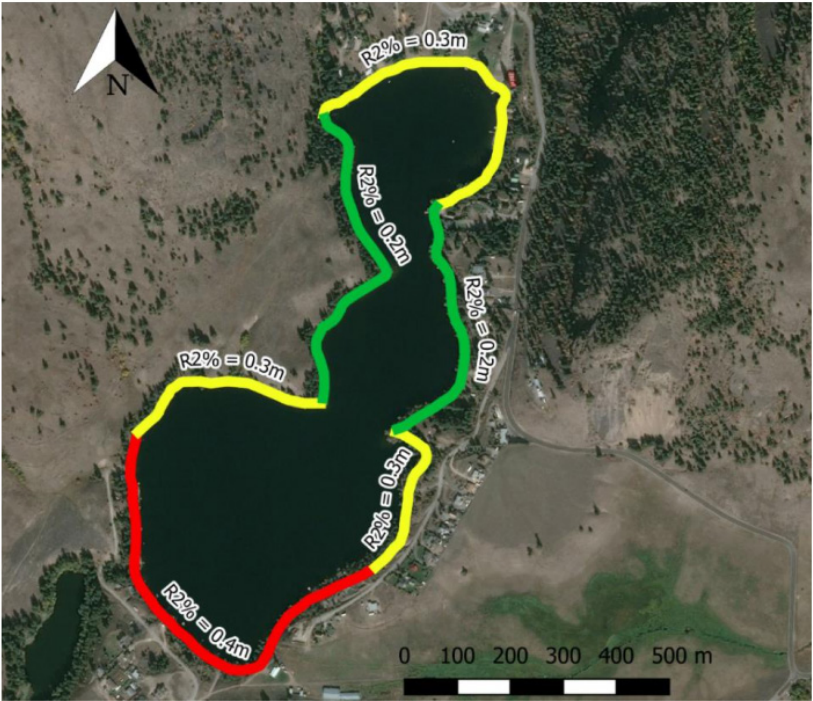


Figure 6.1 Recommended runup values for use in flood mapping

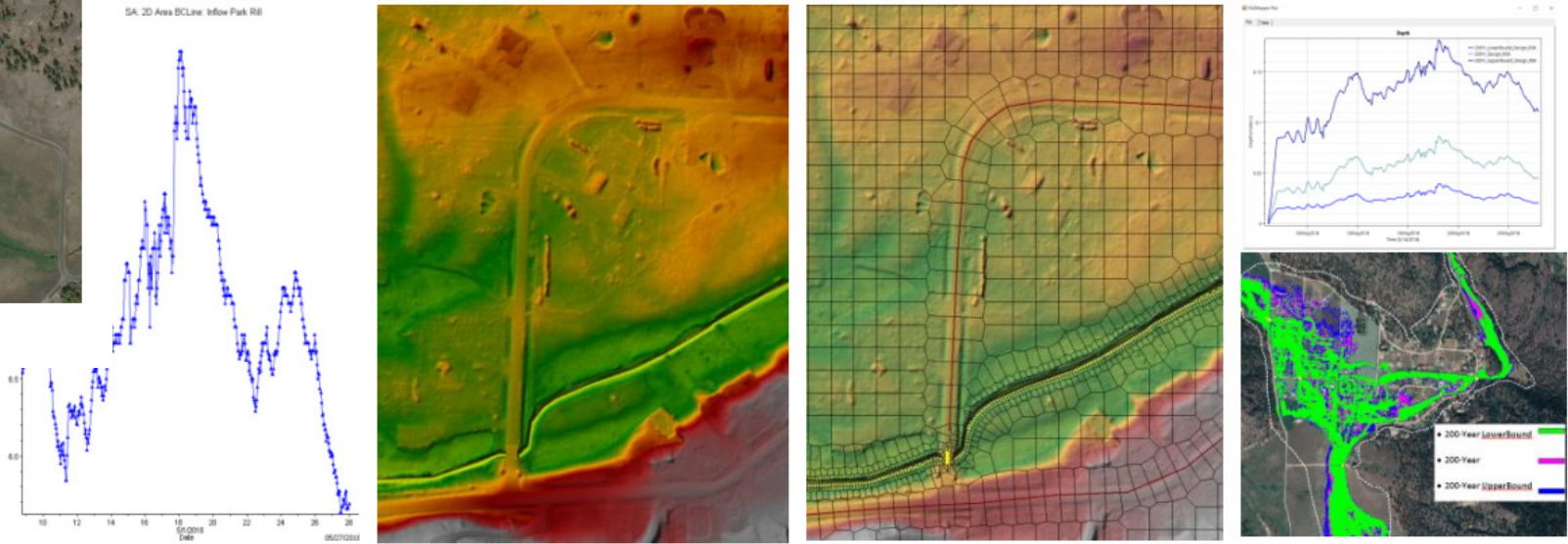
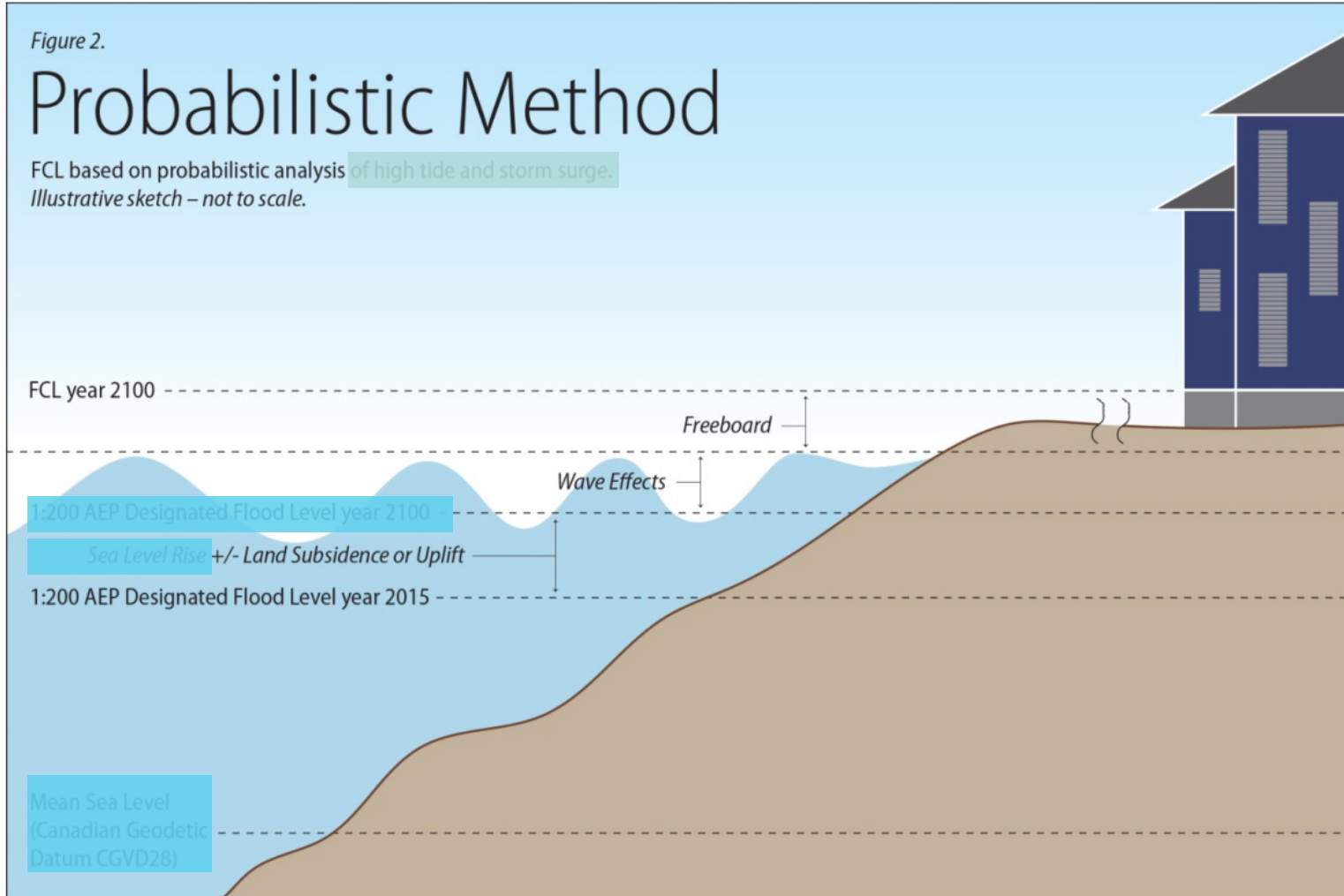
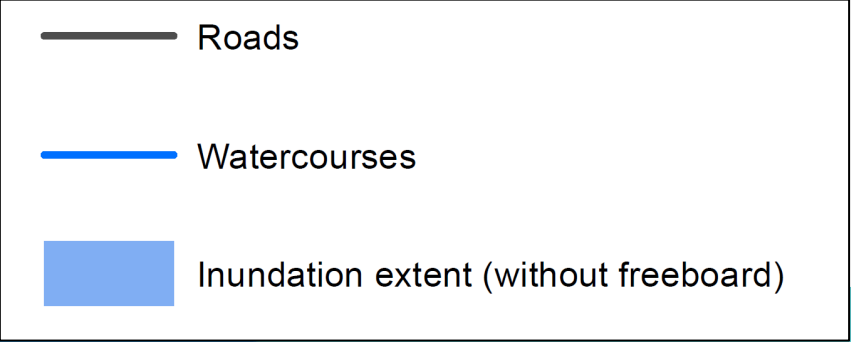
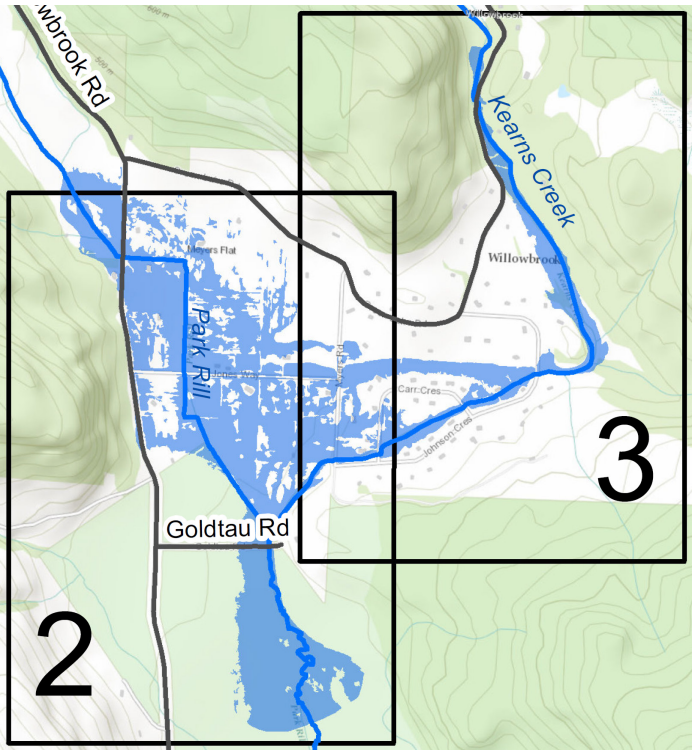
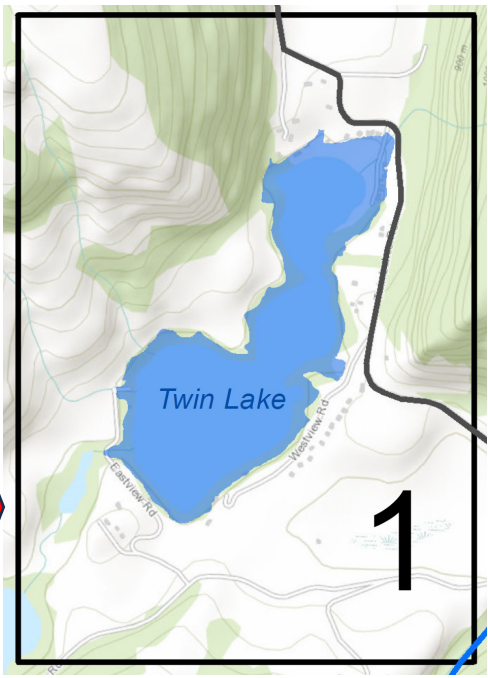
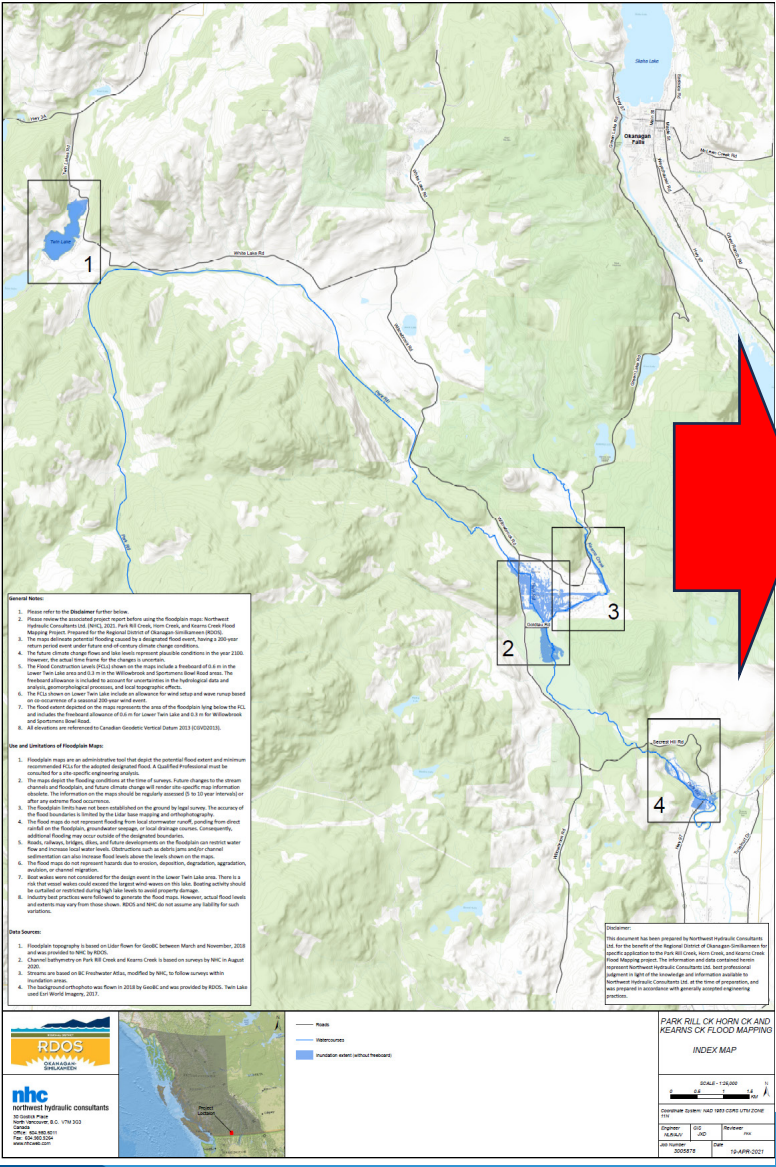


Figure 7.1 Overview of steps undertaken for development of the HEC-RAS 2D models



- Flood Hazard Area Land Use Management Guidelines (amended 2018):
 - 1:200 or 1:500 year Annual Exceedance Probability (AEP) total water level (2100)
 - Allowance for regional uplift, or subsidence to the year 2100;
 - Estimated wave effects associated with the Designated Storm (1:200 or 1:500)
 - Minimum freeboard of 0.6 metres.

Flood Hazard and FCL Mapping



General Notes:

1. Please refer to the **Disclaimer** further below.
2. Please review the associated project report before using the floodplain maps: Northwest Hydraulic Consultants Ltd. (NHC), 2021. Park Rill Creek, Horn Creek, and Kearns Creek Flood Mapping Project. Prepared for the Regional District of Okanagan-Similkameen (RDOS).
3. The maps delineate potential flooding caused by a designated flood event, having a 200-year return period event under future end-of-century climate change conditions.
4. The future climate change flows and lake levels represent plausible conditions in the year 2100. However, the actual time frame for the changes is uncertain.
5. The Flood Construction Levels (FCLs) shown on the maps include a freeboard of 0.6 m in the Lower Twin Lake area and 0.3 m in the Willowbrook and Sportsmens Bowl Road areas. The freeboard allowance is included to account for uncertainties in the hydrological data and analysis, geomorphological processes, and local topographic effects.
6. The FCLs shown on Lower Twin Lake include an allowance for wind setup and wave runup based on co-occurrence of a seasonal 200-year wind event.
7. The flood extent depicted on the maps represents the area of the floodplain lying below the FCL and includes the freeboard allowance of 0.6 m for Lower Twin Lake and 0.3 m for Willowbrook and Sportsmens Bowl Road.
8. All elevations are referenced to Canadian Geodetic Vertical Datum 2013 (CGVD2013).

Data Sources:

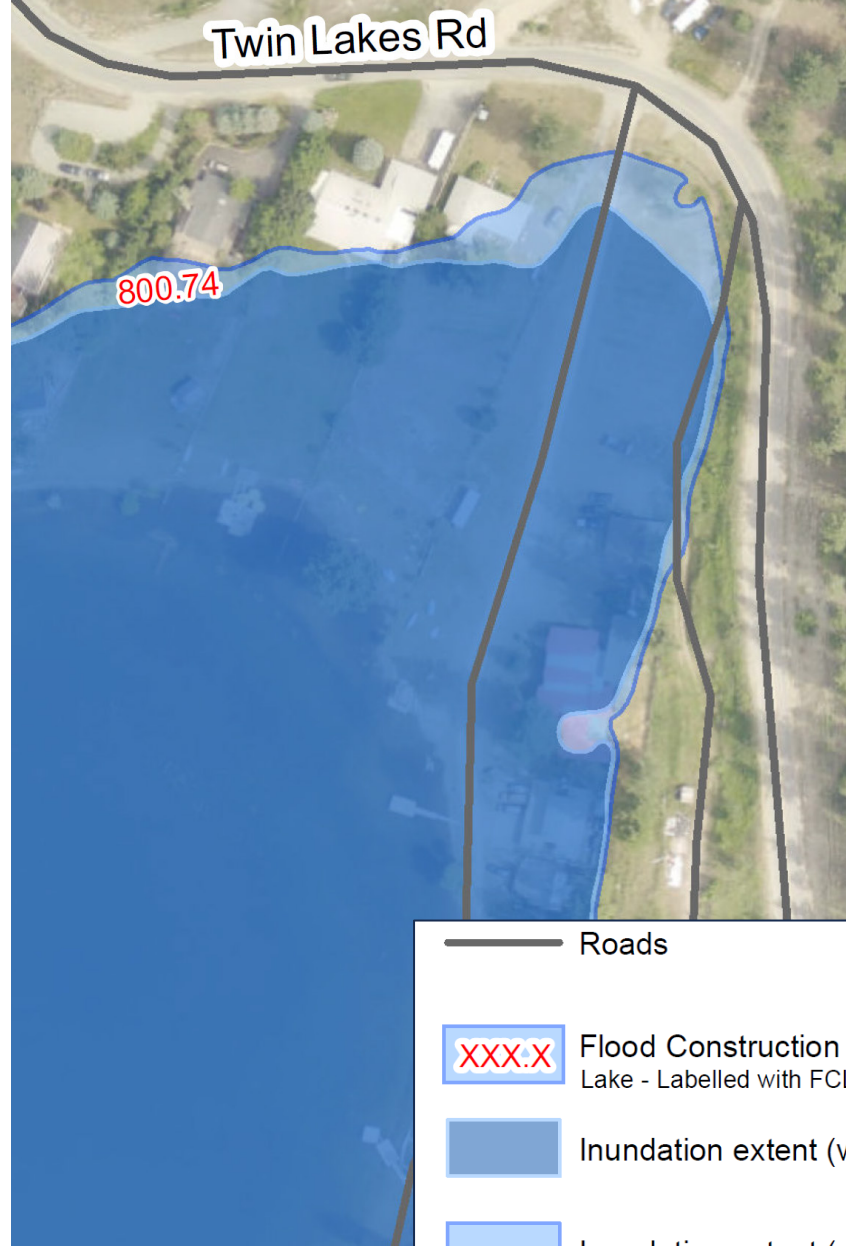
1. Floodplain topography is based on Lidar flown for GeoBC between March and November, 2018 and was provided to NHC by RDOS.
2. Channel bathymetry on Park Rill Creek and Kearns Creek is based on surveys by NHC in August 2020.
3. Streams are based on BC Freshwater Atlas, modified by NHC, to follow surveys within inundation areas.
4. The background orthophoto was flown in 2018 by GeoBC and was provided by RDOS. Twin Lake used Esri World Imagery, 2017.

Use and Limitations of Floodplain Maps:

1. Floodplain maps are an administrative tool that depict the potential flood extent and minimum recommended FCLs for the adopted designated flood. A Qualified Professional must be consulted for a site-specific engineering analysis.
2. The maps depict the flooding conditions at the time of surveys. Future changes to the stream channels and floodplain, and future climate change will render site-specific map information obsolete. The information on the maps should be regularly assessed (5 to 10 year intervals) or after any extreme flood occurrence.
3. The floodplain limits have not been established on the ground by legal survey. The accuracy of the flood boundaries is limited by the Lidar base mapping and orthophotography.
4. The flood maps do not represent flooding from local stormwater runoff, ponding from direct rainfall on the floodplain, groundwater seepage, or local drainage courses. Consequently, additional flooding may occur outside of the designated boundaries.
5. Roads, railways, bridges, dikes, and future developments on the floodplain can restrict water flow and increase local water levels. Obstructions such as debris jams and/or channel sedimentation can also increase flood levels above the levels shown on the maps.
6. The flood maps do not represent hazards due to erosion, deposition, degradation, aggradation, avulsion, or channel migration.
7. Boat wakes were not considered for the design event in the Lower Twin Lake area. There is a risk that vessel wakes could exceed the largest wind-waves on this lake. Boating activity should be curtailed or restricted during high lake levels to avoid property damage.
8. Industry best practices were followed to generate the flood maps. However, actual flood levels and extents may vary from those shown. RDOS and NHC do not assume any liability for such variations.

Disclaimer:

This document has been prepared by Northwest Hydraulic Consultants Ltd. for the benefit of the Regional District of Okanagan-Similkameen for specific application to the Park Rill Creek, Horn Creek, and Kearns Creek Flood Mapping project. The information and data contained herein represent Northwest Hydraulic Consultants Ltd. best professional judgment in light of the knowledge and information available to Northwest Hydraulic Consultants Ltd. at the time of preparation, and was prepared in accordance with generally accepted engineering practices.



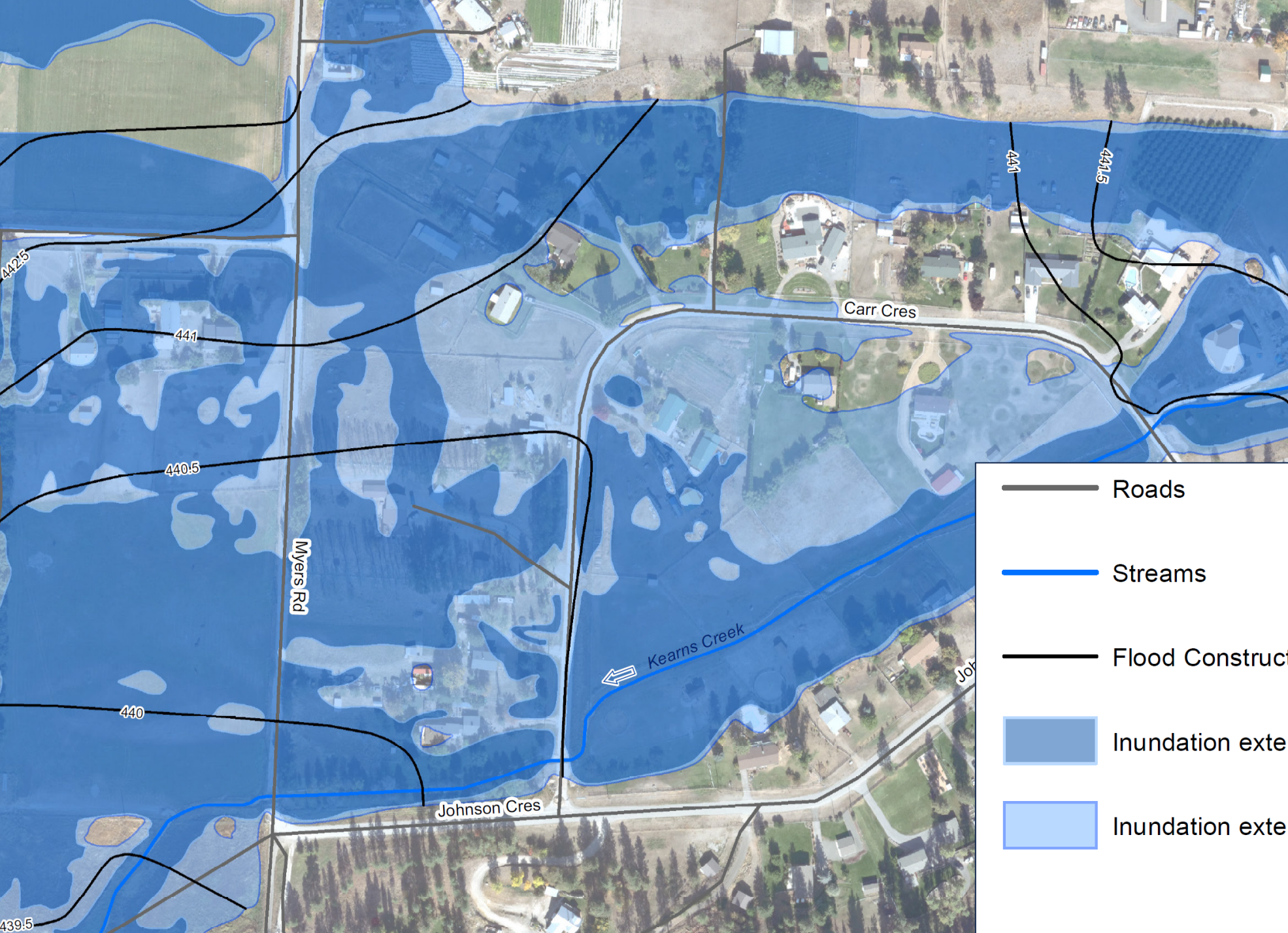
 Roads

 Flood Construction Level (FCL) zone
Lake - Labelled with FCL in Metres

 Inundation extent (without freeboard)

 Inundation extent (with wave run-up and freeboard)

 Boundary between adjacent FCL zones



- Roads
- Streams
- Flood Construction Level (FCL) Isoline (m)
- Inundation extent (without freeboard)
- Inundation extent (with freeboard)

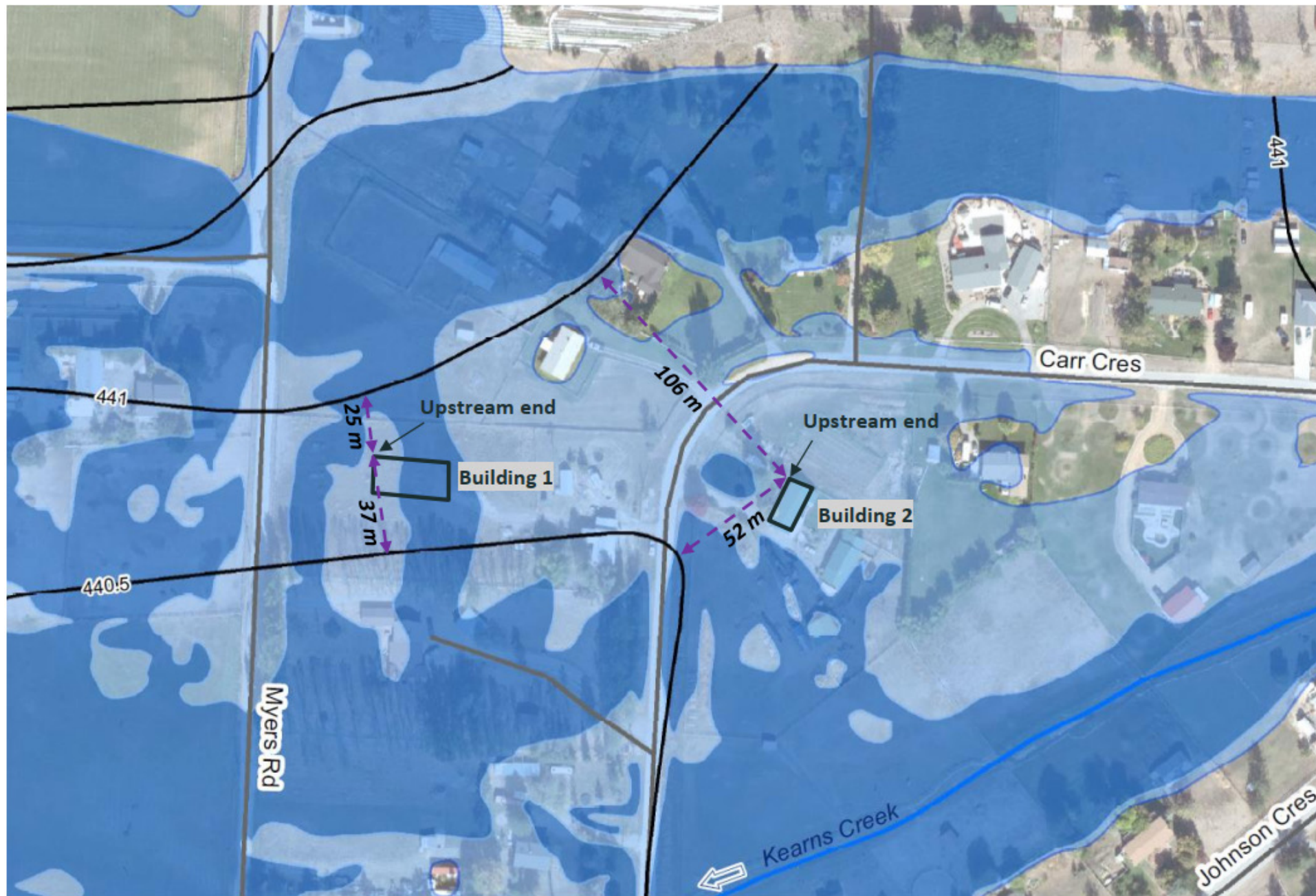


Figure 8.1 Example of FCL calculation for one hypothetical building and one existing building in Willowbrook

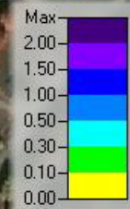
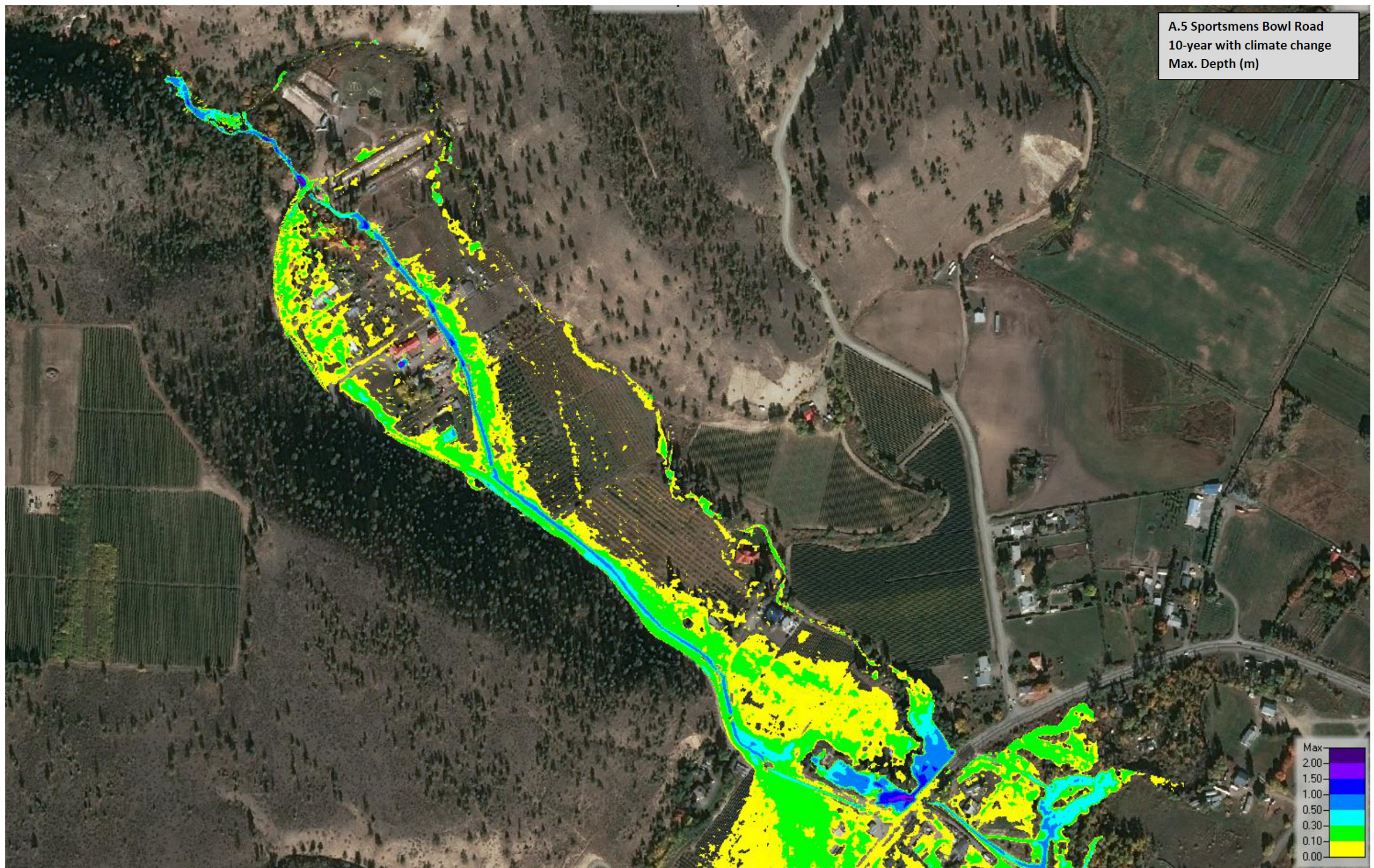
APPENDIX A

DEPTH, VELOCITY, AND HAZARD DIAGRAMS

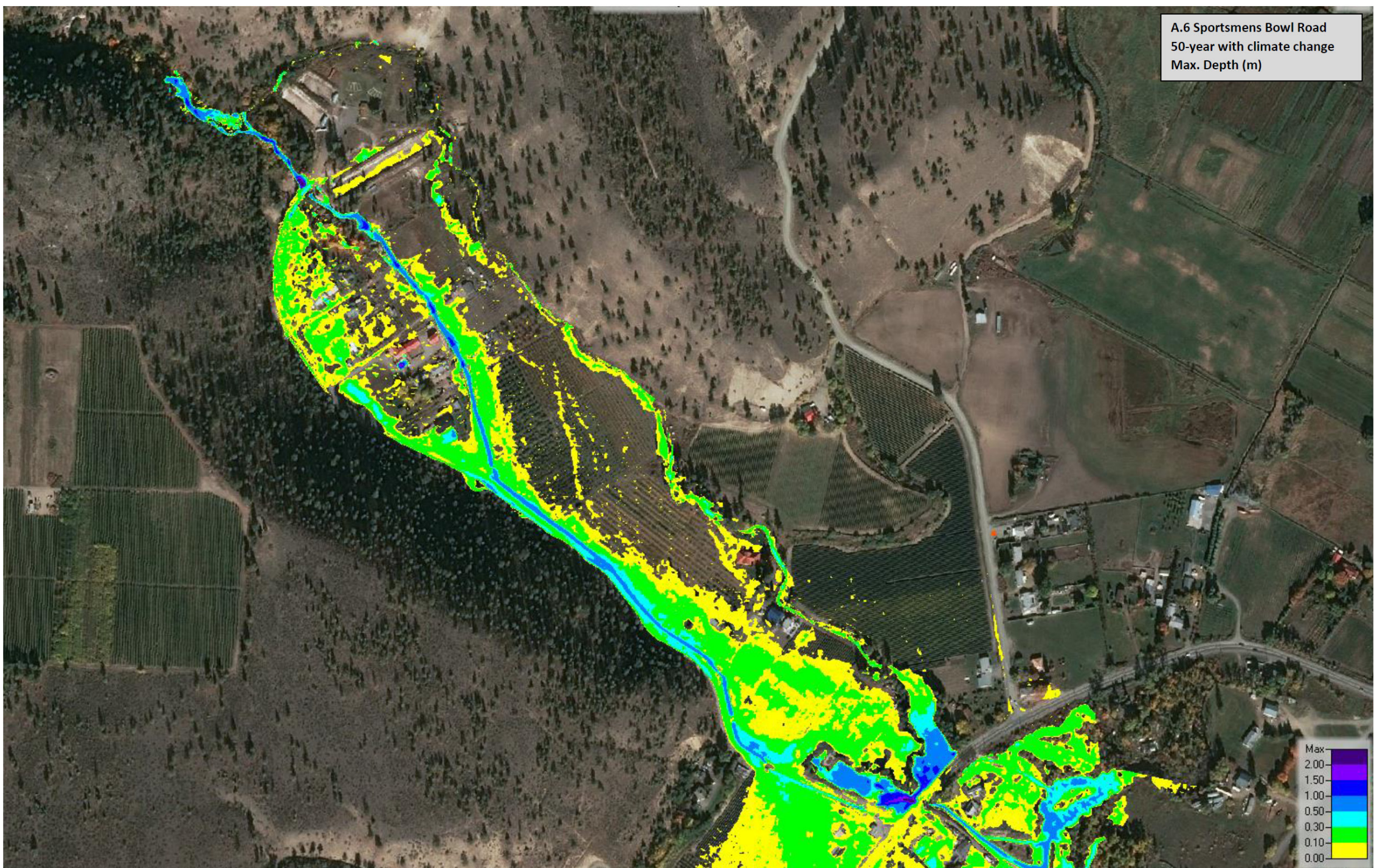


- A.1 Willowbrook 10-year with climate change – Max. Depth
- A.2 Willowbrook 50-year with climate change – Max. Depth
- A.3 Willowbrook 100-year with climate change – Max. Depth
- A.4 Willowbrook 200-year with climate change – Max. Depth
- A.5 Sportsmens Bowl Road 10-year with climate change – Max. Depth
- A.6 Sportsmens Bowl Road 50-year with climate change – Max. Depth
- A.7 Sportsmens Bowl Road 100-year with climate change – Max. Depth
- A.8 Sportsmens Bowl Road 200-year with climate change – Max. Depth
- A.9 Willowbrook 10-year with climate change – Max. Velocity
- A.10 Willowbrook 50-year with climate change – Max. Velocity
- A.11 Willowbrook 100-year with climate change – Max. Velocity
- A.12 Willowbrook 200-year with climate change – Max. Velocity
- A.13 Sportsmens Bowl Road 10-year with climate change – Max. Velocity
- A.14 Sportsmens Bowl Road 50-year with climate change – Max. Velocity
- A.15 Sportsmens Bowl Road 100-year with climate change – Max. Velocity
- A.16 Sportsmens Bowl Road 200-year with climate change – Max. Velocity
- A.17 Willowbrook 200-year with climate change – Max. Hazard
- A.18 Sportsmens Bowl Road 20-year with climate change – Max. Hazard

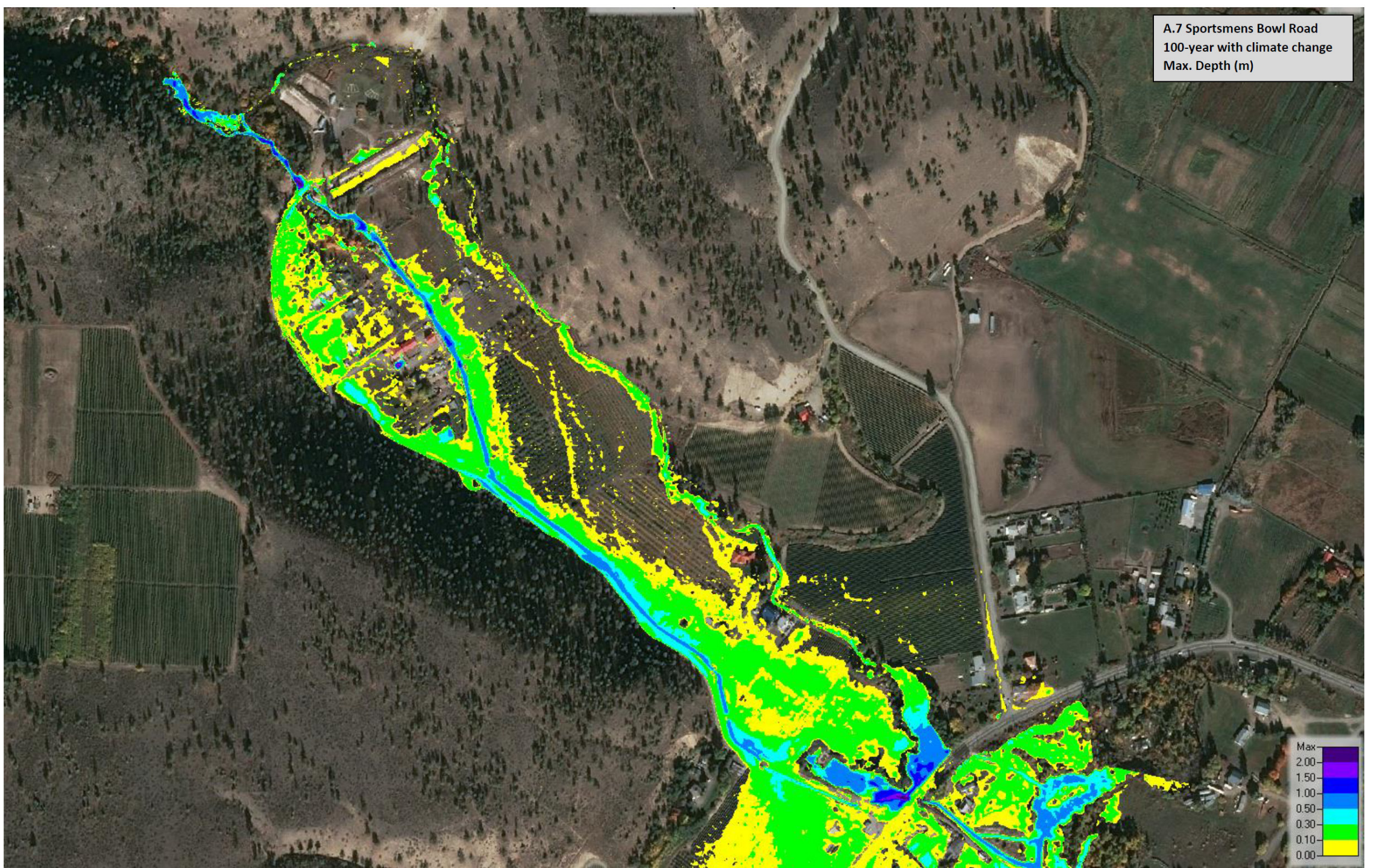
A.5 Sportsmens Bowl Road
10-year with climate change
Max. Depth (m)



A.6 Sportsmens Bowl Road
50-year with climate change
Max. Depth (m)



A.7 Sportsmens Bowl Road
100-year with climate change
Max. Depth (m)



A.8 Sportsmens Bowl Road
200-year with climate change
Max. Depth (m)

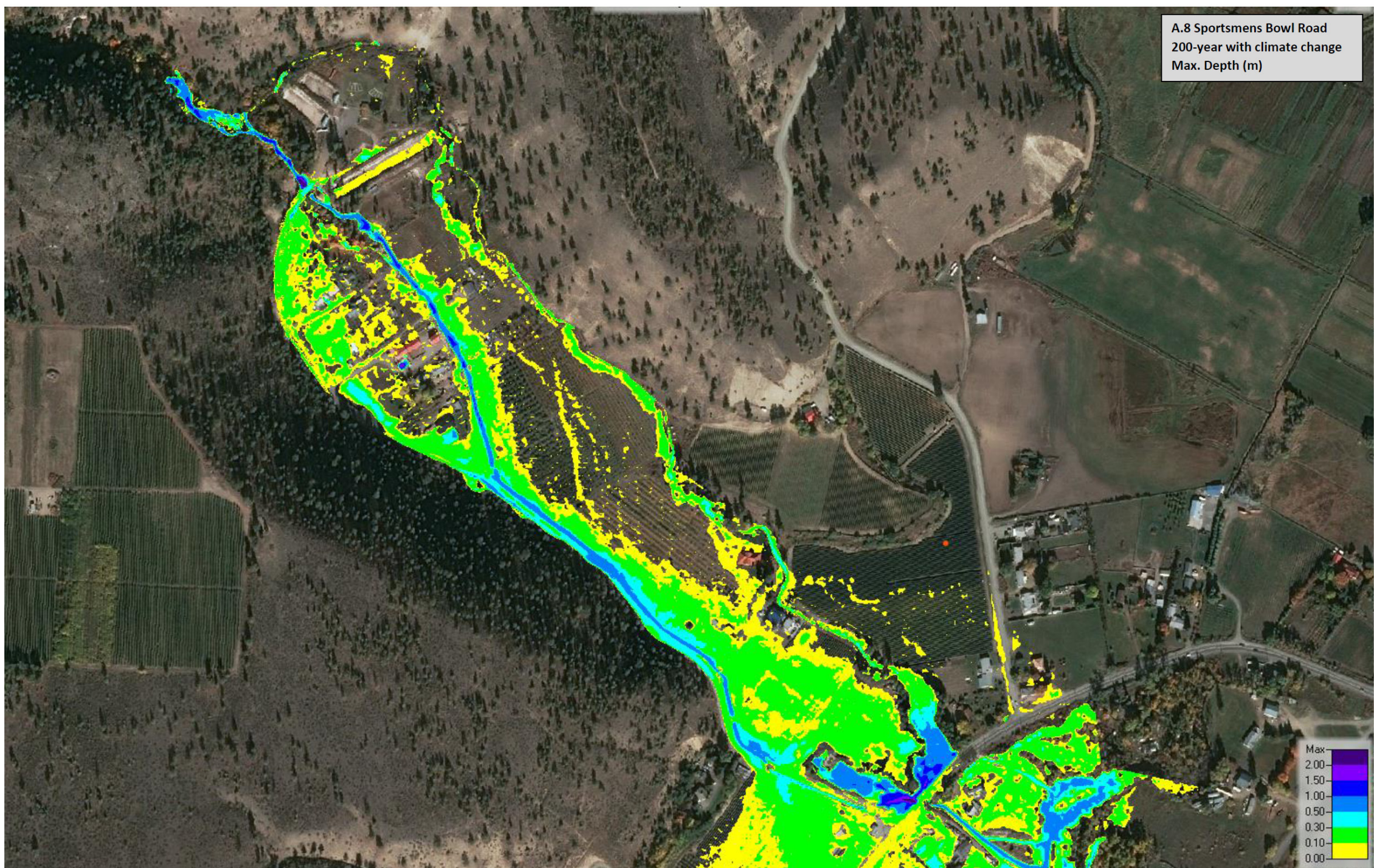
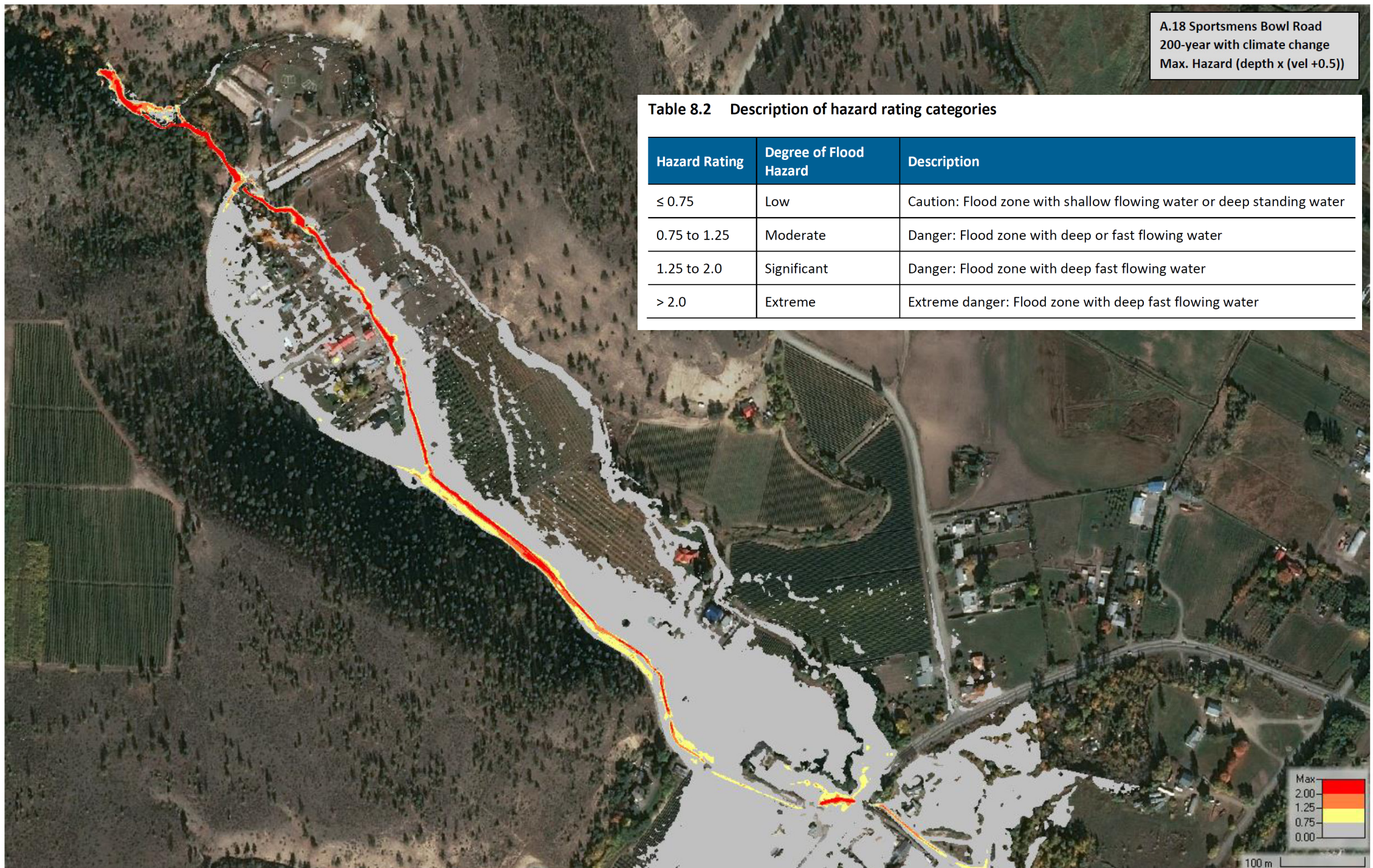


Table 8.2 Description of hazard rating categories

Hazard Rating	Degree of Flood Hazard	Description
≤ 0.75	Low	Caution: Flood zone with shallow flowing water or deep standing water
0.75 to 1.25	Moderate	Danger: Flood zone with deep or fast flowing water
1.25 to 2.0	Significant	Danger: Flood zone with deep fast flowing water
> 2.0	Extreme	Extreme danger: Flood zone with deep fast flowing water



Consequence Characterization



Table 9.9 Lower and upper bound population counts

Study Area	Population Per-building (mean)	Total Population	Population Count – Lower Bound	Population Count – Upper Bound
Lower Twin Lake	2.24	52	38	43
Willowbrook	1.53	164	3	43
Sportsmens Bowl Rd	1.36	27	0	15
Total		243	41	101

Table 9.8 Lower and upper bound building counts

Area	# of Buildings	Building Count – Lower Bound	Upper Count – Lower Bound
Lower Twin Lake	27	17	19
Willowbrook	132	2	28
Sportsmens Bowl Rd	21	0	11
Total	180	19	58

Table 9.10 Length of road inundated per road type (m)

Study Area	Loose	Paved	Rough	Total
Lower Twin Lake	-	340	114	454
Willowbrook	-	254	143	397
Sportsmens Bowl Rd	-	812	59	871
Total	-	1,406	316	1,722



Legend

 Study Area

200-year flood
depth (m)



Flood Impacts

Buildings (depth m)

× 0.0 - 0.0

● 0 - 0.3

● 0.3 - 0.5

● 0.5 - 1

Roads (m inundated)

0 - 100

 100 - 200

Power Poles (depth m)

□ 0 - 0.1

■ 0.1 - 3.0

Flood Mitigation Measures

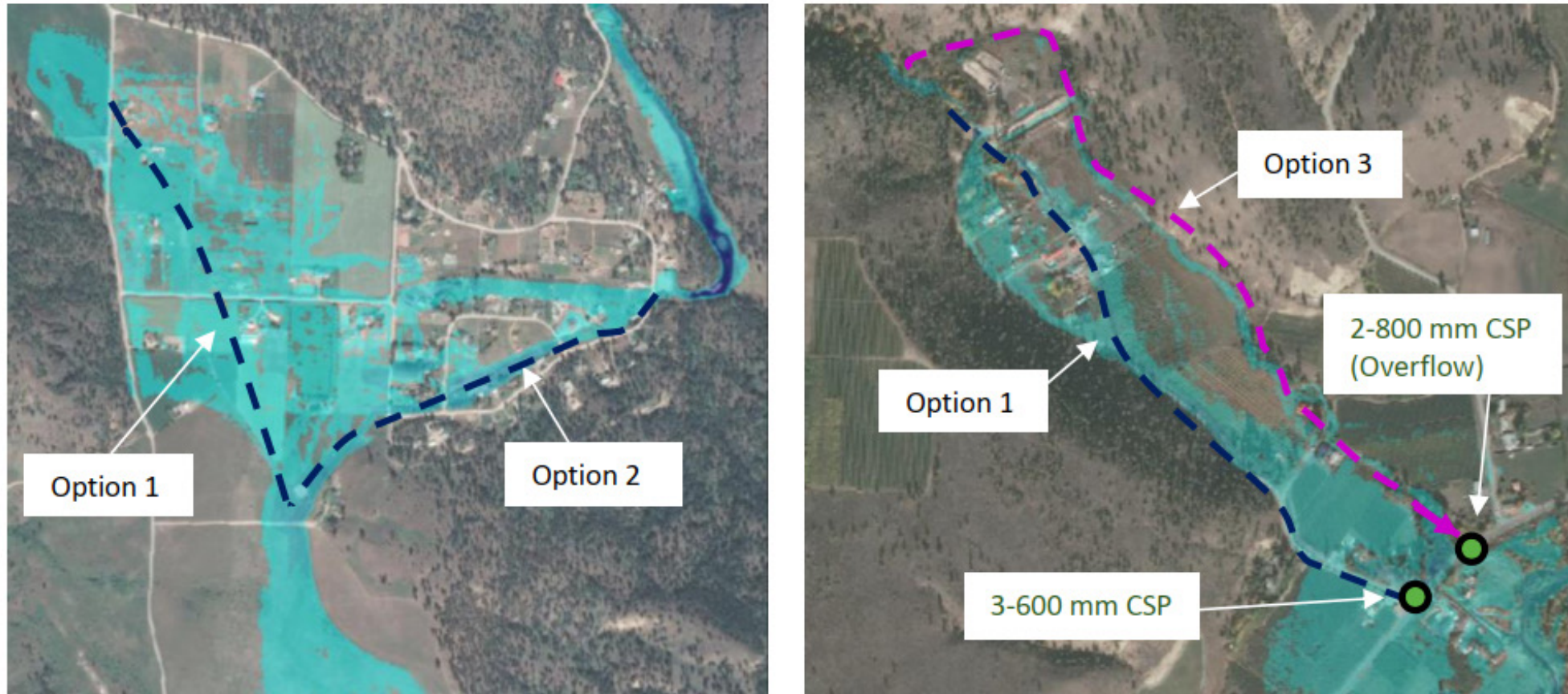


Figure 10.6 Flow conveyance improvement concepts for Willowbrook (left) and Sportsmens Bowl Road (right). Proposed upgrade reaches are shown in blue and diversion alignments in pink