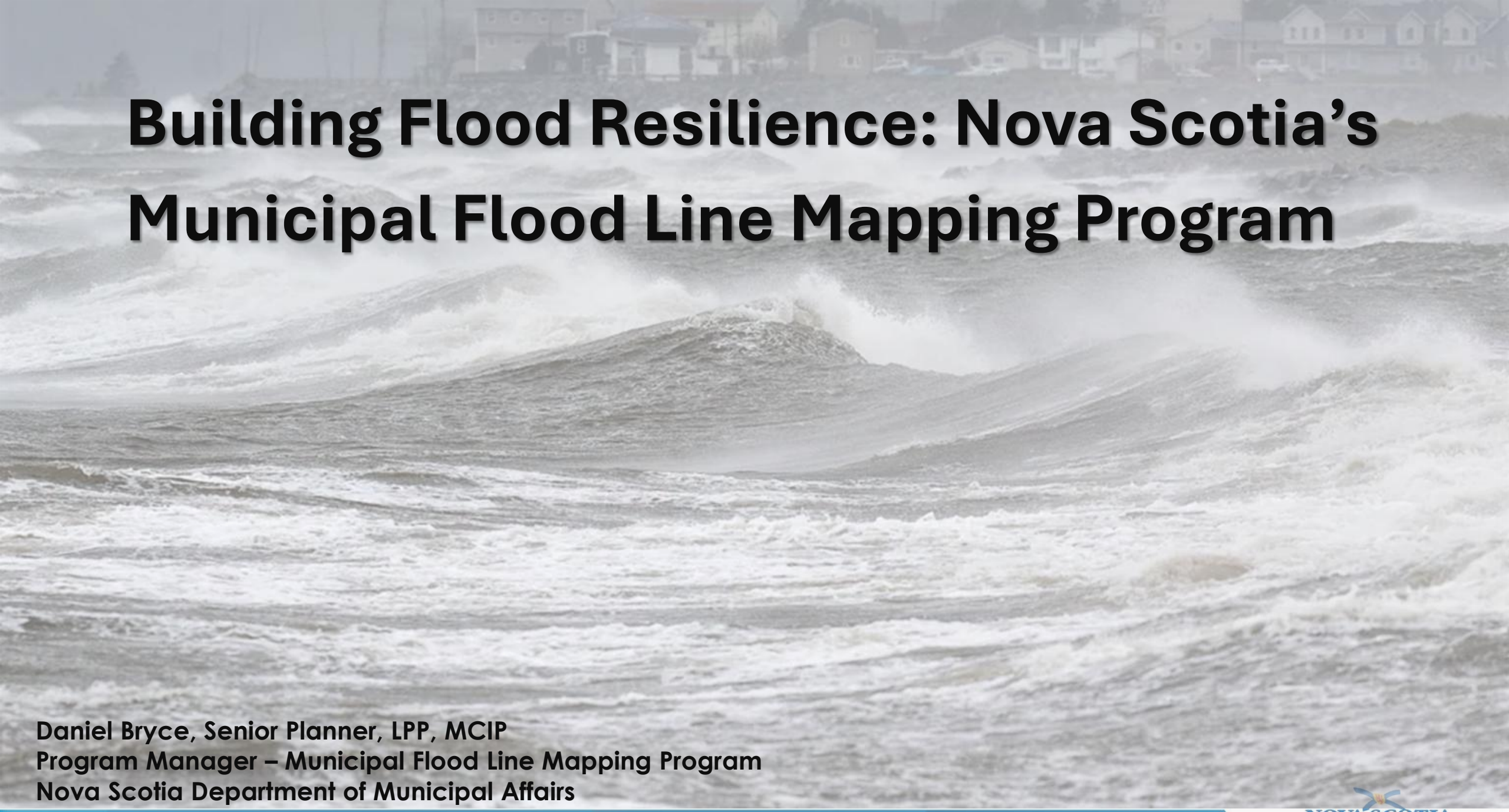
Building Flood Resilience: Nova Scotia's Municipal Flood Line Mapping Program



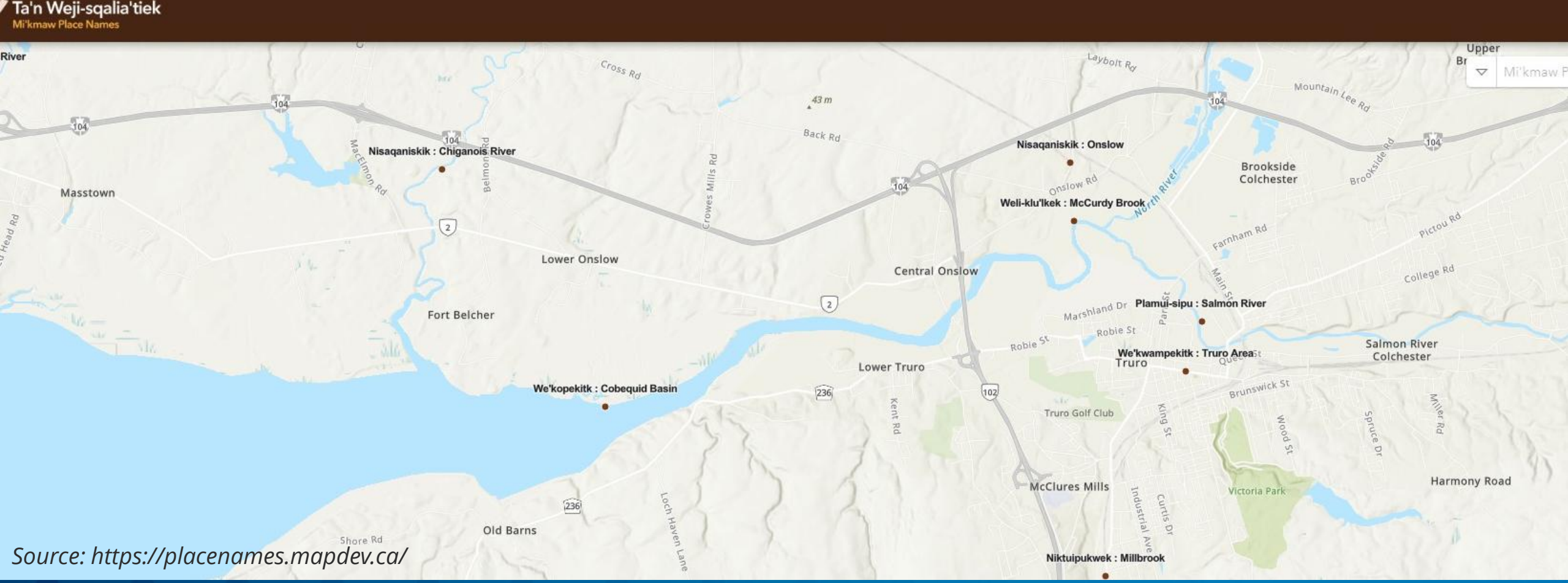
Daniel Bryce, Senior Planner, LPP, MCIP
Program Manager – Municipal Flood Line Mapping Program
Nova Scotia Department of Municipal Affairs

NOVA SCOTIA

Outline

1. Flood hazards in Nova Scotia
2. Regulatory Framework for Flood Hazard areas
3. Municipal Flood Line Mapping (MFLM) Program Overview
4. Land Use Policy Application

NOVA SCOTIA



Source: https://placenames.mapdev.ca/

Mespo'qia'tieg
We are flooded

- We'kwampekitk (meaning end of the waters flow) – Truro
- Wakobetgitk (end of the rushing or flowing water) - Cobequid
- Kejimkujik (swollen waters)
- Stewiake (flowing out in small streams)
- Takumegooch (meeting of the waters) - Tatamagouche
- Whycocomagh - Head of the Waters

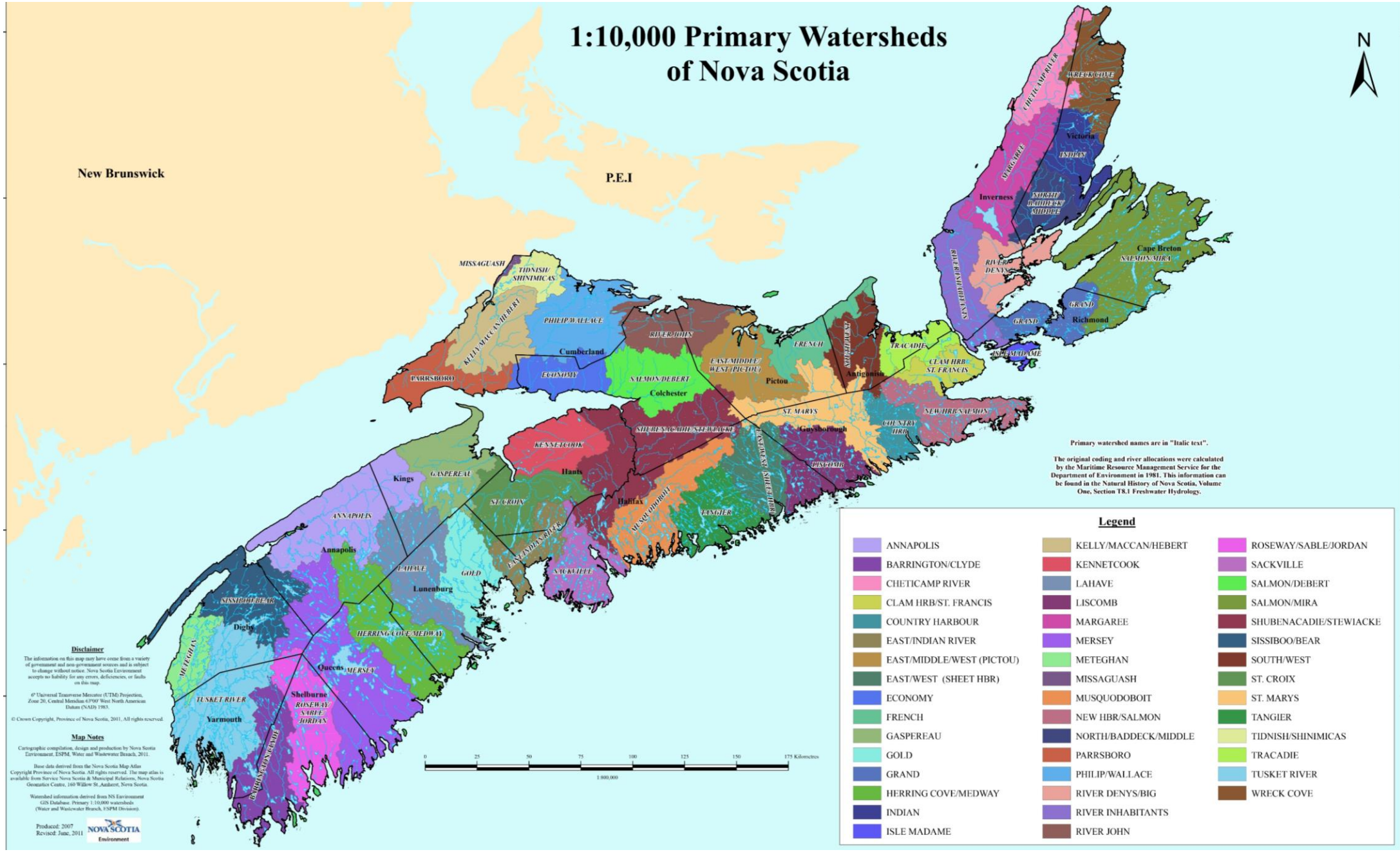
NOVA SCOTIA

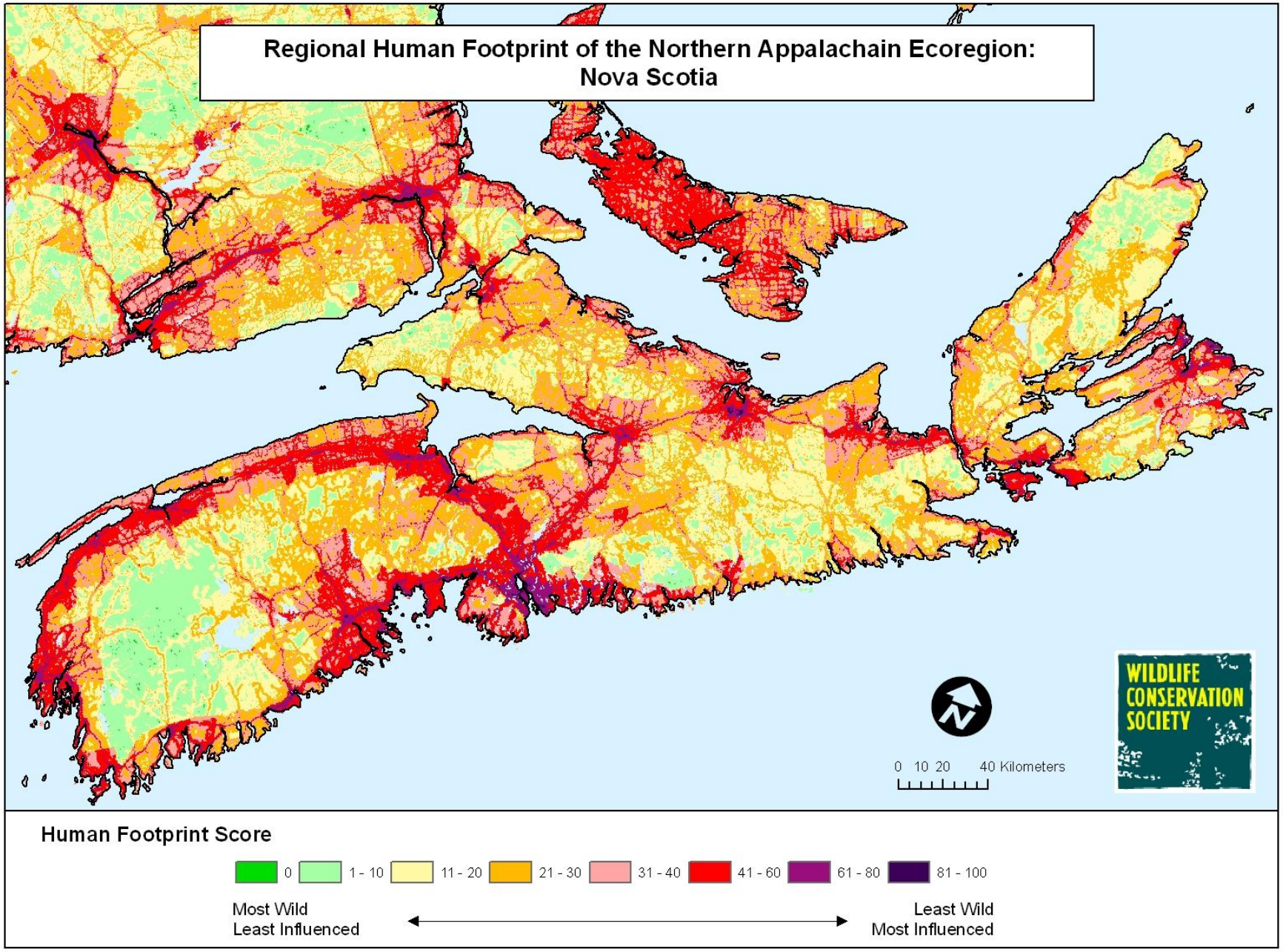
Flood Hazards In Nova Scotia



Image Credit: NOAA

NOVA SCOTIA


1:10,000 Primary Watersheds of Nova Scotia
N
New Brunswick
P.E.I
Primary watershed names are in "Italic text".
The original coding and river allocations were calculated by the Maritime Resource Management Service for the Department of Environment in 1981. This information can be found in the Natural History of Nova Scotia, Volume One, Section T8.1 Freshwater Hydrology.
Legend
ANNAPOLIS
BARRINGTON/CLYDE
CHETICAMP RIVER
CLAM HRB/ST. FRANCIS
COUNTRY HARBOUR
EAST/INDIAN RIVER
EAST/MIDDLE/WEST (PICTOU)
EAST/WEST (SHEET HBR)
ECONOMY
FRENCH
GASPEREAU
GOLD
GRAND
HERRING COVE/MEDWAY
INDIAN
ISLE MADAME
KELLY/MACCAN/HEBERT
KENNETCOOK
LAHAVE
LISCOMB
MARGAREE
MERSEY
METEGHAN
MISSAGUASH
MUSQUODOBOIT
NEW HBR/SALMON
NORTH/BADDECK/MIDDLE
PARRSBORO
PHILIP/WALLACE
RIVER DENYS/BIG
RIVER INHABITANTS
RIVER JOHN
ROSEWAY/SABLE/JORDAN
SACKVILLE
SALMON/DEBERT
SALMON/MIRA
SHUBENACADIE/STEWIACKE
SISSIBOO/BEAR
SOUTH/WEST
ST. CROIX
ST. MARYS
TANGIER
TIDNISH/SHINIMICAS
TRACADIE
TUSKET RIVER
WRECK COVE
Disclaimer
Map Notes
0 25 50 75 100 125 150 175 Kilometres
1:800,000

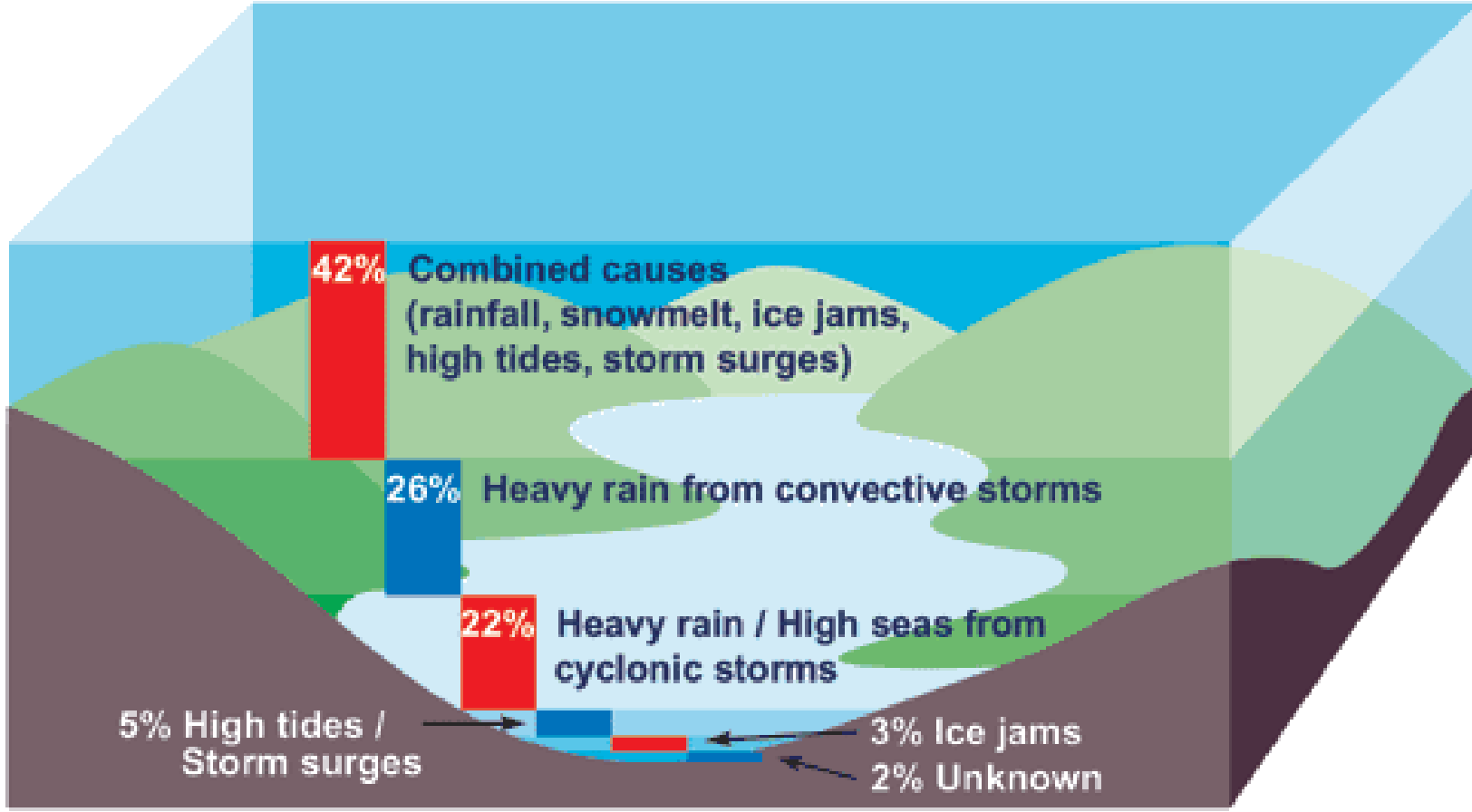


©Wildlife Conservation Society Canada

- >10,000 km's highly variable and irregular coastline
- Predominant settlement pattern is along the coastal portions of the province
- High proportion of infrastructure and road corridors close to ocean
- Many economies and livelihoods intrinsically linked to coastal areas (industry, tourism, fisheries, etc.)

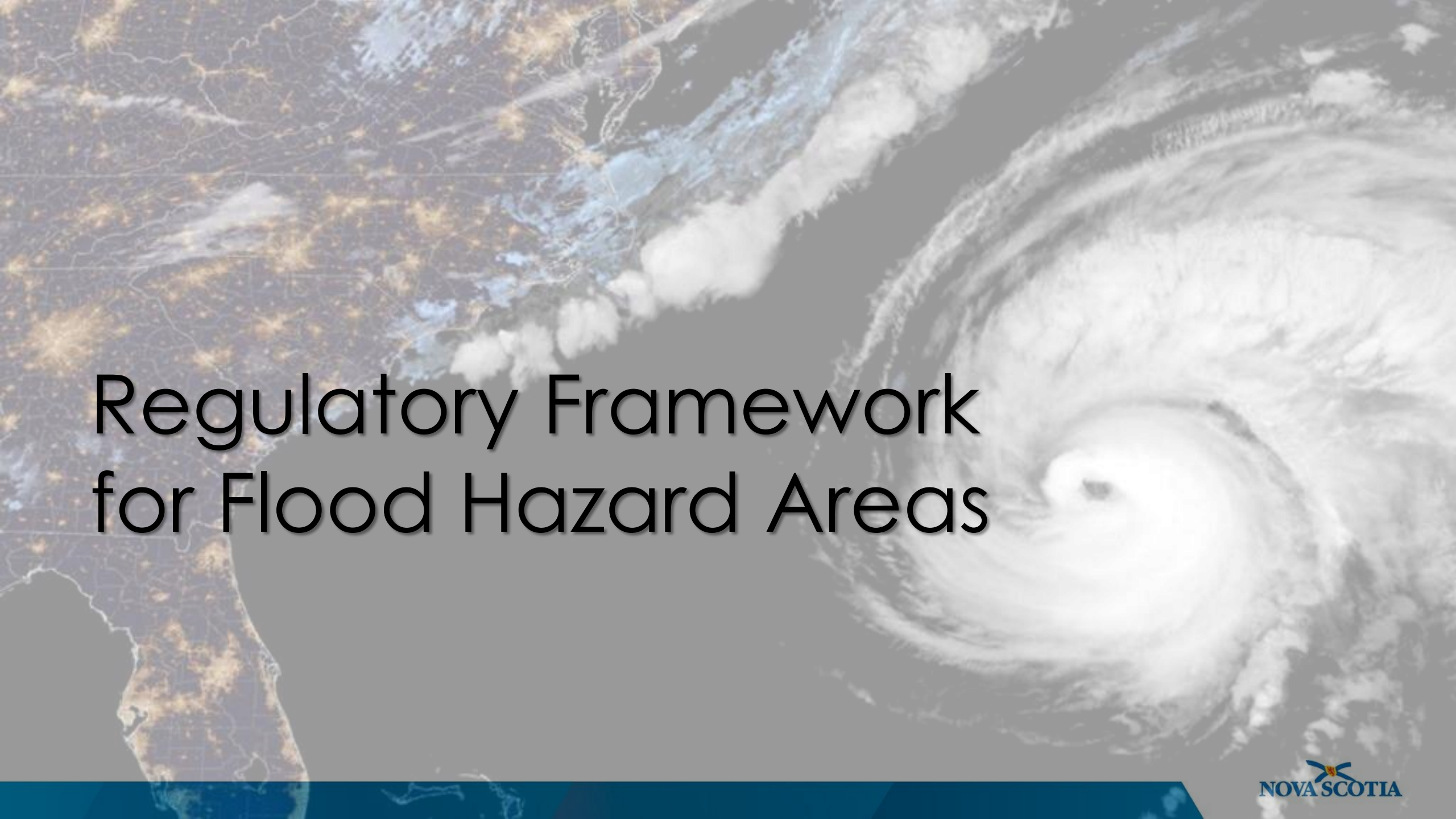
Flooding in Nova Scotia – 1759-1986

- Major tropical storms with heavy rain
- Floods involving snowmelt when a heavy rainfall accompanies annual spring runoff
- Ice jams backing up rivers during winter thaws and spring freshet
- Destructive coastline flooding a consequence of storm surges due to hurricane and cyclonic storms



https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/floods/events-atlantic-provinces.html#NS

NOVA SCOTIA



Regulatory Framework for Flood Hazard Areas

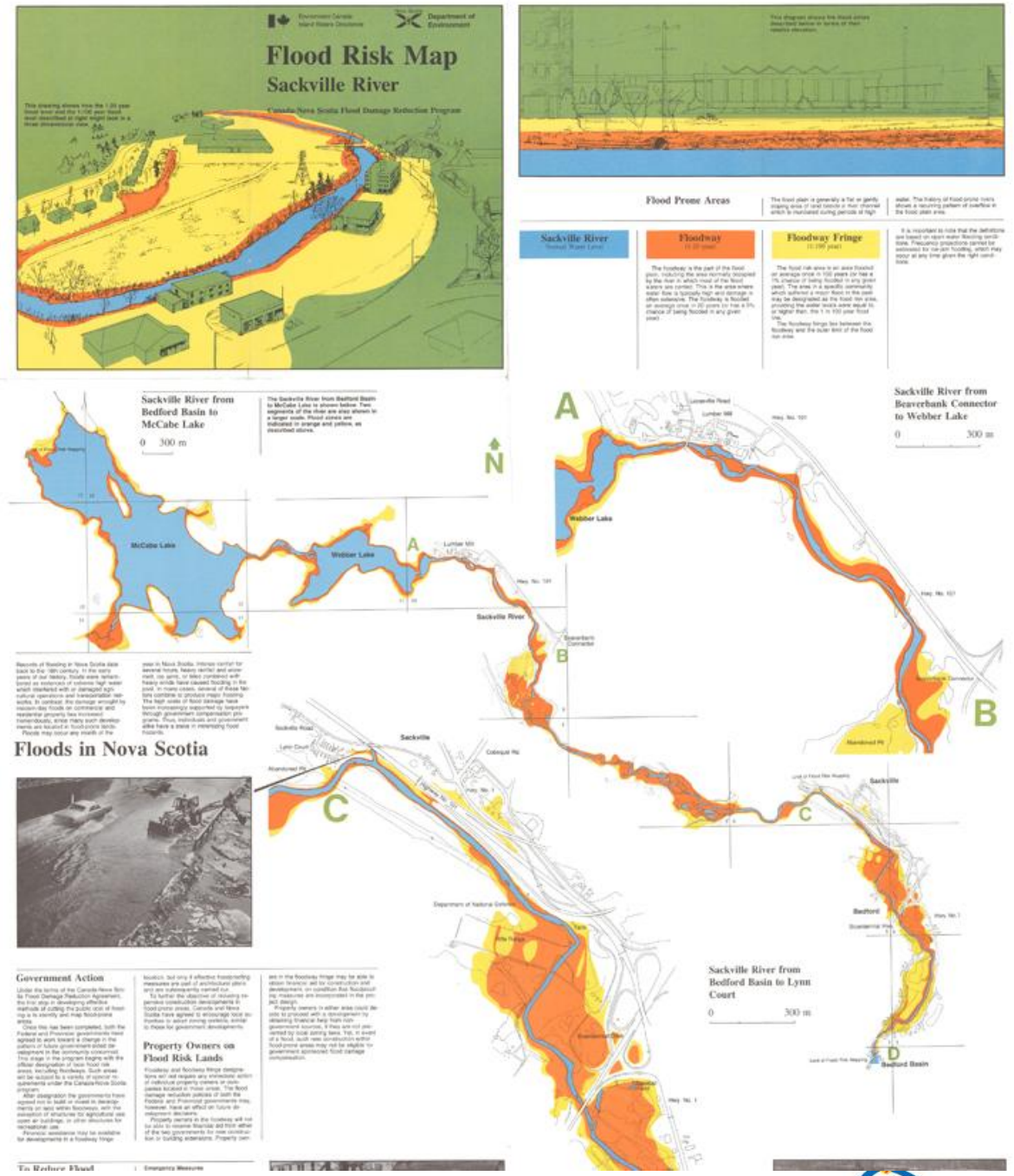
NOVA SCOTIA

1988 Canada-Nova Scotia Flood Damage Reduction Program

Flood Risk areas defined at the 1 in 20 and 1 in 100 events

- East River, Pictou County
- Little Sackville River, Halifax County
- Sackville River, Halifax County
- Salmon and North Rivers, Colchester County
- West and Rights Rivers and Brierly Brook, Antigonish County

Floodway – 1 in 20 = 5% AEP
Floodway Fringe – 1 in 100 = 1% AEP



NOVA SCOTIA

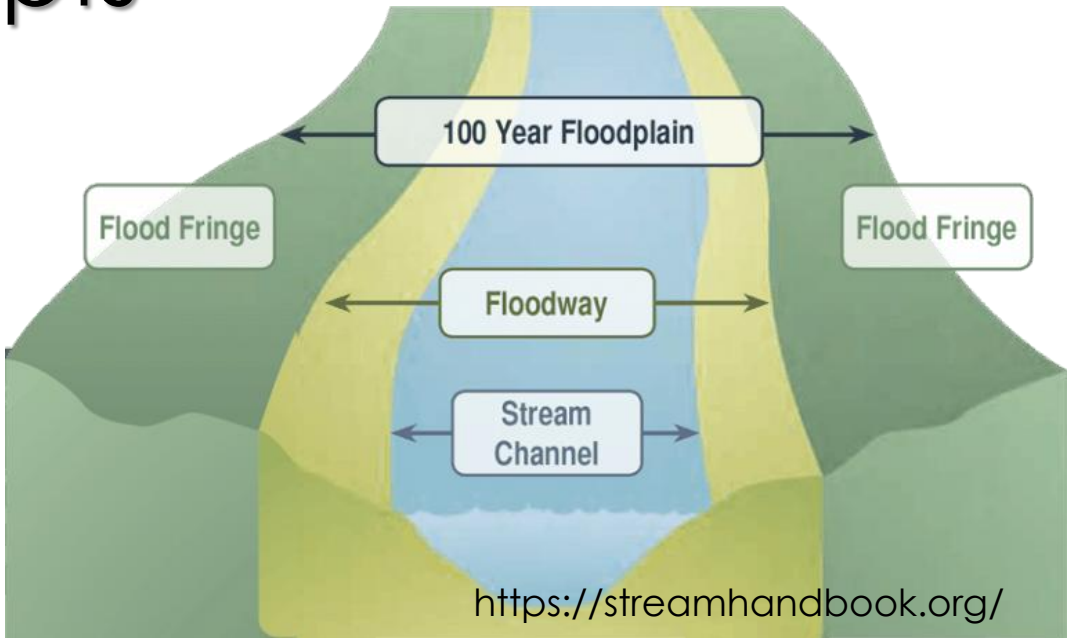
1998

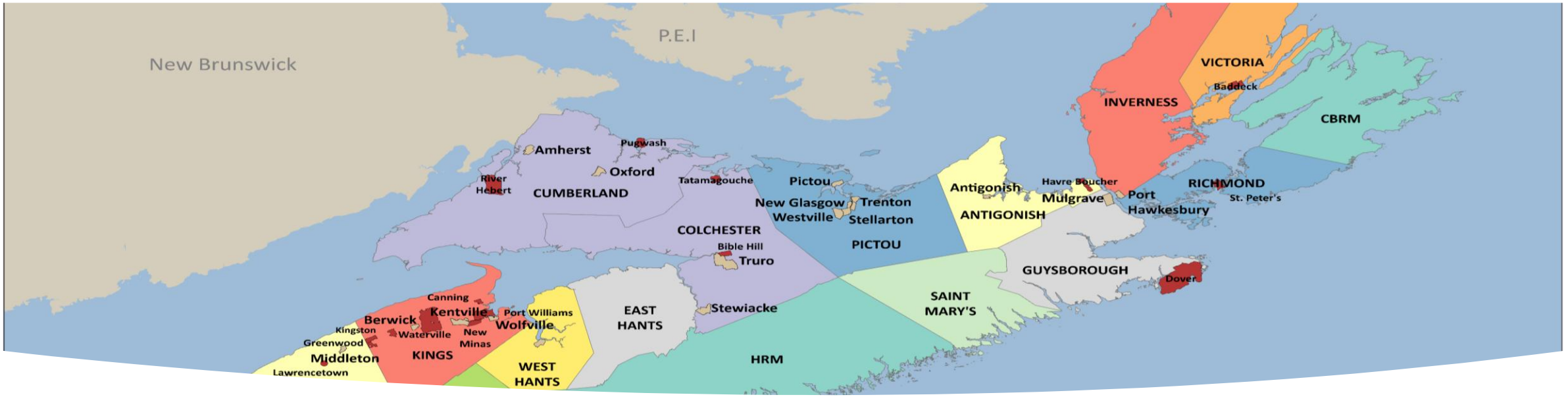
Municipal Government Act	Statements of Provincial Interest	Flood Risk Areas
Enables Municipal Planning Strategies	Requires consideration of public interest	Defines Areas that require regulation

Statement of Provincial Interest on Flood Risk Areas - Excerpts

- 1. Planning documents must identify Flood Risk Areas consistent with the Canada-Nova Scotia Flood Damage Reduction Program mapping…

  …and any locally known floodplain.





Minimum Planning Requirements

- In 2018, the Municipal Government Act (MGA) was amended to **require that all** Municipalities in Nova Scotia have a Municipal Planning Strategy (MPS) for **all parts** of their jurisdiction
- **Every** MPS must be reasonably consistent with the Statements of Provincial Interest (SPI) and municipalities **must** engage abutting municipalities when they make amendments to their MPS that may affect a SPI
- **SPI on Flood Risk Areas requires** municipalities at a minimum to place specific development restrictions where they are aware of flood hazards in the **floodway fringe**

NOVA SCOTIA



Municipal Flood Line Mapping (MFLM) Program

NOVA SCOTIA

Implementation of Flood Mapping Program

- Municipalities have great influence in flood management through land use planning and regulation
- **Goal:** Give municipalities information needed to incorporate results of flood map studies into planning documents
- *Additional benefit:* Provide information to support emergency management preparedness


Truro, NS

Developing Climate Standard and technical specifications for flood mapping

10 Year Program Timeline

2018 – Academics develop climate standard for NS

2019 – Consultants draft technical specifications and guidance on flood mapping and run test cases

2020 – Province reviews Test Cases results and edits draft documents

2021 – Lidar Data Collection is complete

2022 – Municipalities lead more test cases

2023 – MFLM Program officially launched

2025 – 50% of the Primary Watersheds are mapped

March 31, 2028 – End Flood Line Mapping Program

Who has been involved?

Dalhousie University
Saint Mary's University
St. Francis Xavier University

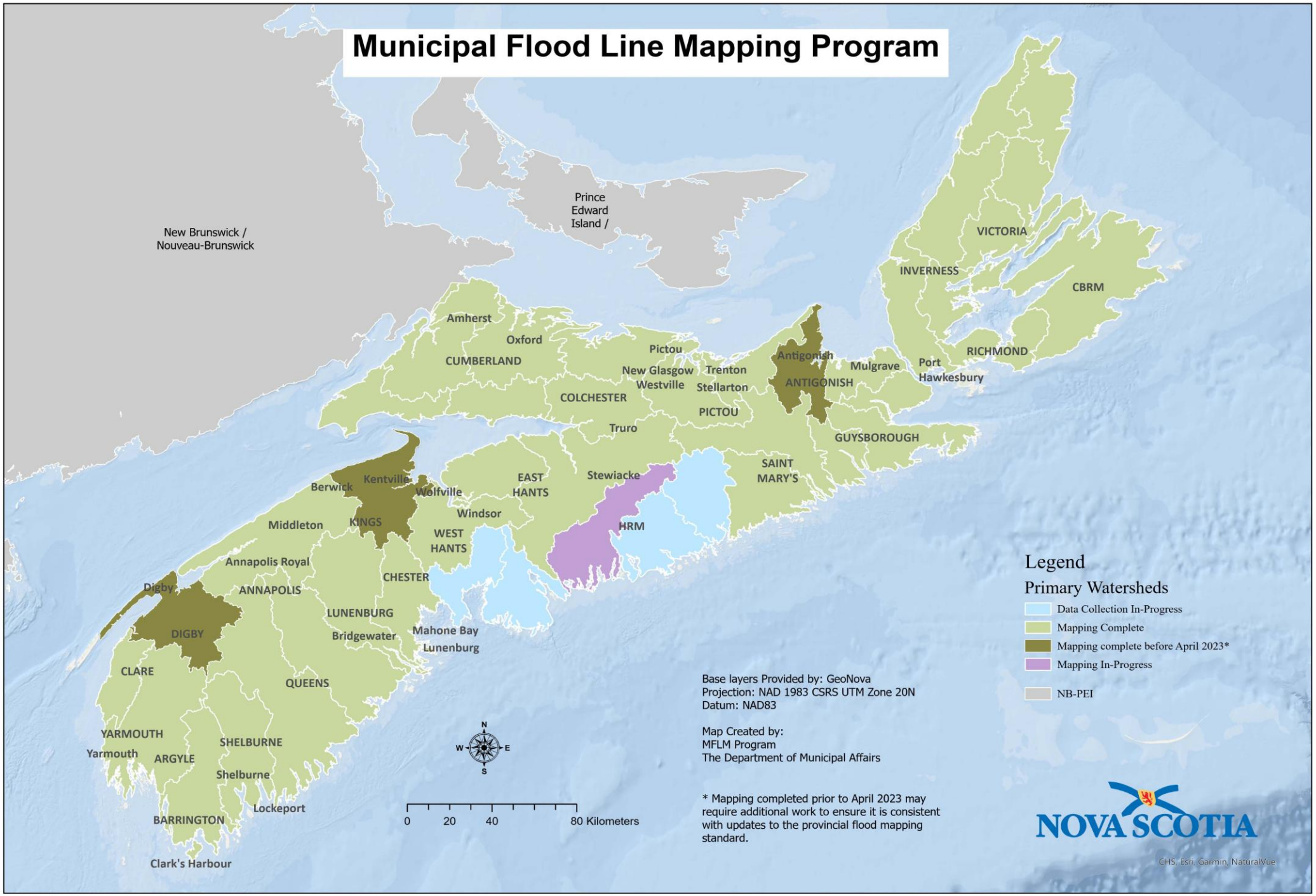
CBCL
Dillon Consulting
WSP
Stantec
3D Wave Design
wood.
Hatch

Nova Scotia Federation of Municipalities
The Confederacy of Mainland Mi'kmaq
UINR
Bluenose Coastal Action Foundation

AGRG Applied Geomatics Research Group
Natural Resources Canada
Ressources naturelles Canada
PICS Pacific Institute for Climate Solutions
CLIMAtlantic
Canada

Nova Scotia

Municipal Flood Line Mapping Program



NOVA SCOTIA

Tiered Mapping Approach



Tier 3

- Rural areas with little or no development
- Small river tributaries or shore direct watersheds
- No fieldwork required (only use existing data)
- General information on potential flood hazards



Tier 2

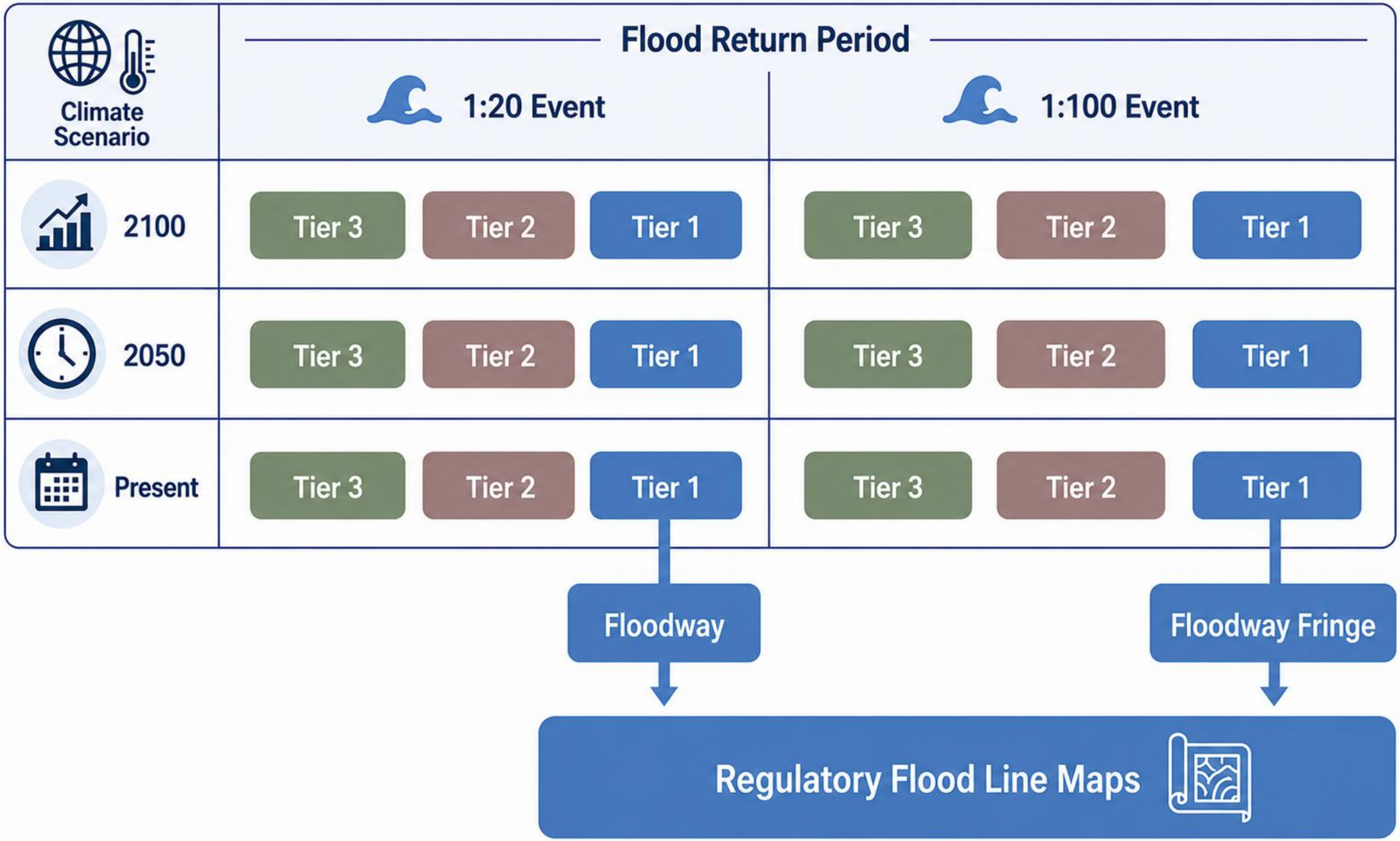
- Important routes or infrastructure located outside of developed areas
- Tributaries and sub-watersheds
- Targeted fieldwork required
- Targeted information on hazards to inform emergency management



Tier 1

- Significant current or potential development
- Primary or secondary watersheds and coastline
- Extensive fieldwork required
- Regulatory hazard maps to inform municipal plans




Climate Scenario
Flood Return Period
1:20 Event
1:100 Event
2100
Tier 3
Tier 2
Tier 1
Tier 3
Tier 2
Tier 1
2050
Tier 3
Tier 2
Tier 1
Tier 3
Tier 2
Tier 1
Present
Tier 3
Tier 2
Tier 1
Tier 3
Tier 2
Tier 1
Floodway
Floodway Fringe
Regulatory Flood Line Maps

Data Collection
Southwest Nova Scotia Watersheds



SOUTHWEST NOVA SCOTIA PRIMARY WATERSHEDS MUNICIPAL FLOOD LINE MAPPING

FIELD PROGRAM REPORT

SURVEYED LOCATIONS

FIGURE 3-2

- Hydraulic Structures (Dillon)
- Coastal Loggers (AGRG)
- Water Level Loggers (Dillon)

Fluvial Bathymetry (Dillon)

- Barrington River
- Chegoggin River
- Clyde River
- Jordan Falls
- Meteghan River
- Roseway River
- Salmon River



SCALE 1:450,000

0 3.75 7.5 15 Kilometers

MAP DRAWING INFORMATION
DATA PROVIDED BY GEOGRAPHICA, DILLON, ENVIRONMENT AND CLIMATE CHANGE CANADA

MAP CREATED BY: JA
MAP CHECKED BY: EC
MAP PROJECTION: NAD 1983 CSRS UTM ZONE 20N

DILLON CONSULTING

PROJECT: 19-8657
STATUS: DRAFT
DATE: 2020-02-21

Data Collection – Annapolis Region riverine flood mapping

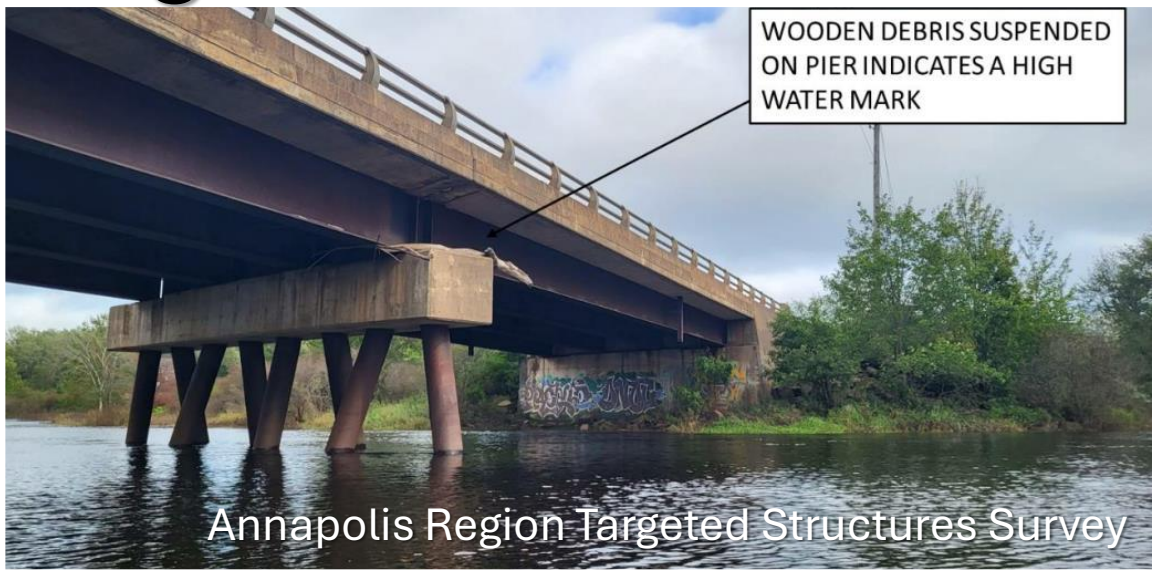
Data Collection

Background Information

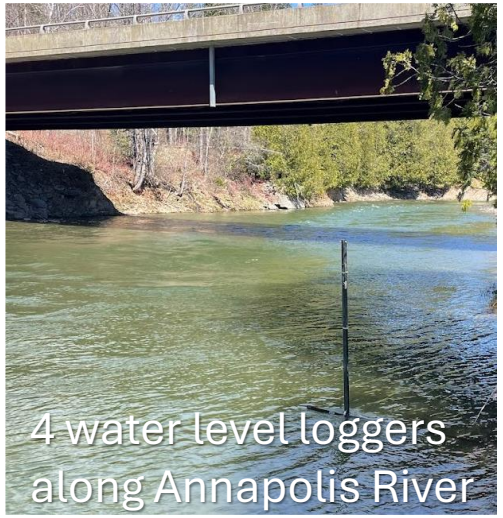
- Historical flooding
- Geospatial data
- Meteorological data
- Hydrometric data

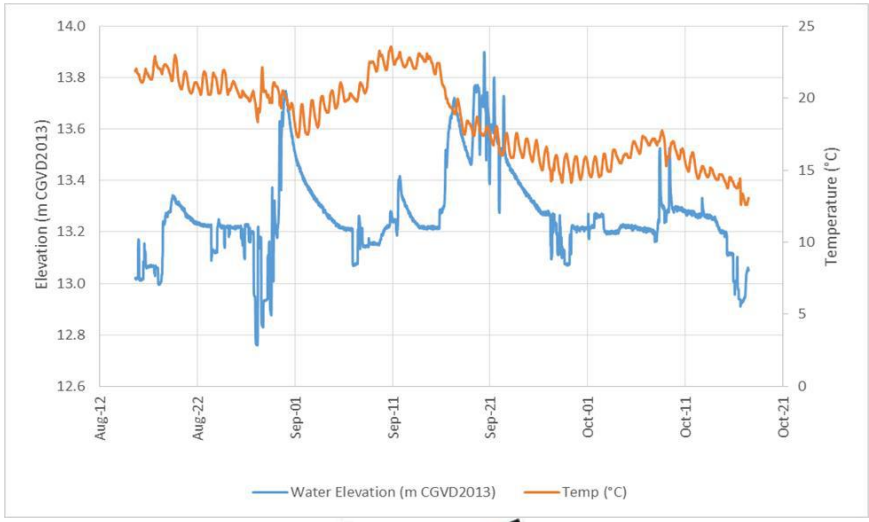
Field data collection

- Hydraulic structures survey
- Channel cross-sections
- Water level monitoring
- Bathymetric data
- Hydrometric data
- Climate data



Annapolis Region Targeted Structures Survey

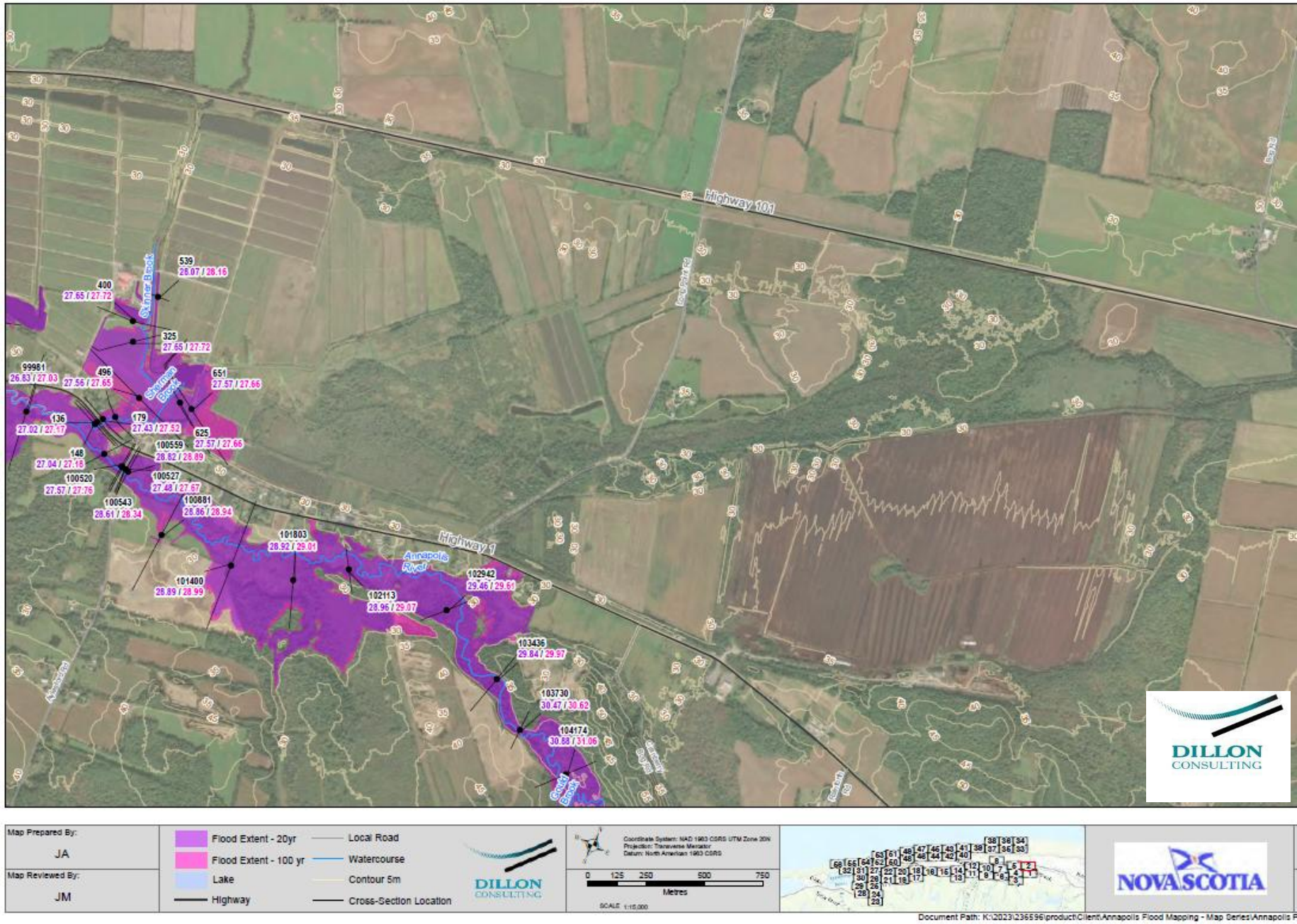

4 water level loggers along Annapolis River



MFLM flood line maps

Flood line maps include:

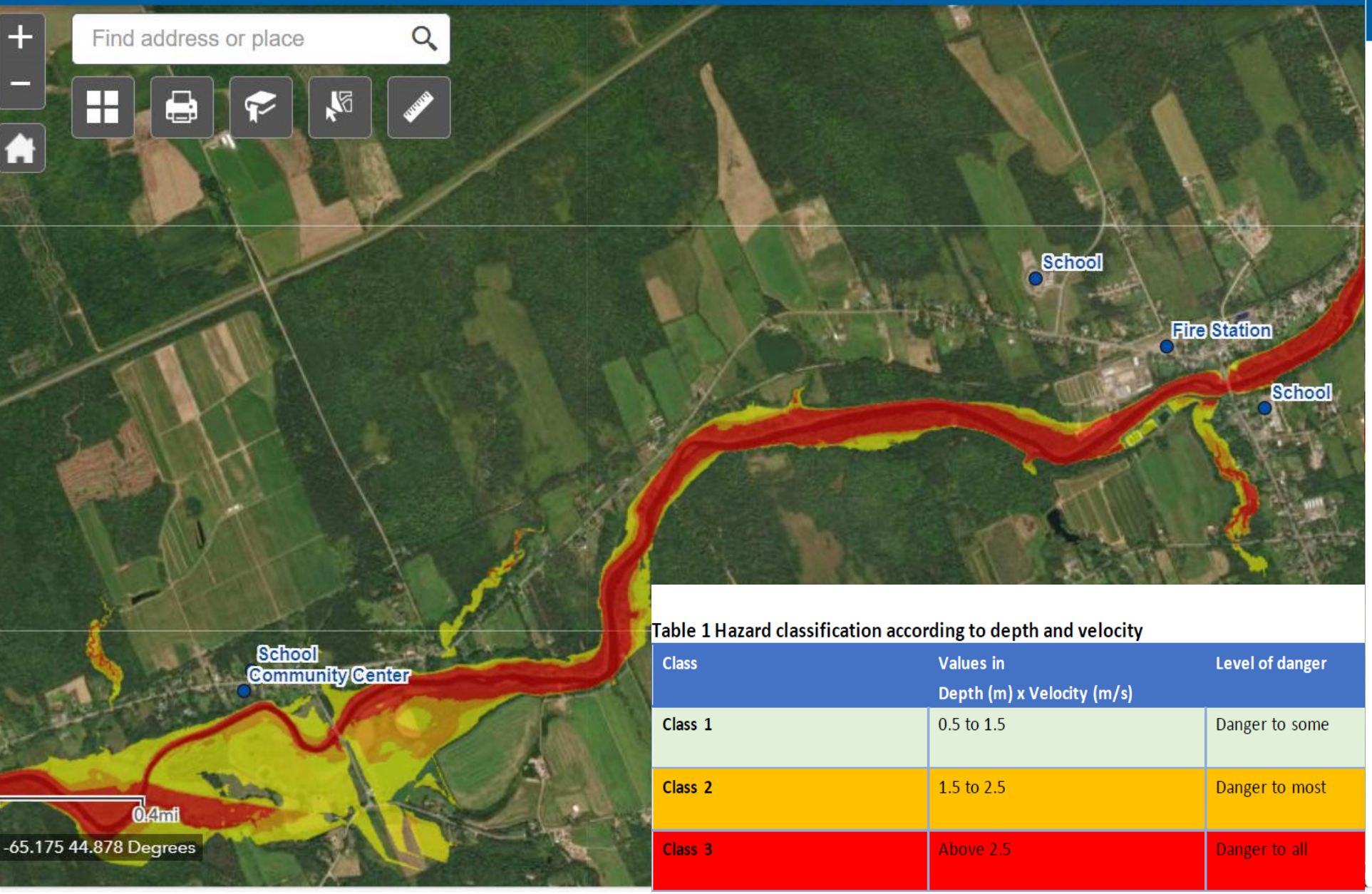
- Flood extents
- Flood depths
- Flood hazard maps (water depth x velocity)



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Annapolis River Primary Watershed - Flood Line Mapping

with ArcGIS Web AppBuilder



Climate Change 2100 Scenarios

Layers

- [x] Cross Sections
- [ ] Annapolis Basin Coastal CC2100 Flooding
- [ ] Bay of Fundy Coastal CC2100
- [x] Hazard Scenario CC2100 100 Yr
  - [x] Hazard Scenario CC2100 100 Yr
    - Danger to Some
    - Danger to Most
    - Danger to All
- [ ] Hazard Scenario CC2100 20 Yr
- [ ] CC2100 Riverine Flood Scenarios

Table 1 Hazard classification according to depth and velocity

Class	Values in Depth (m) x Velocity (m/s)	Level of danger
Class 1	0.5 to 1.5	Danger to some
Class 2	1.5 to 2.5	Danger to most
Class 3	Above 2.5	Danger to all

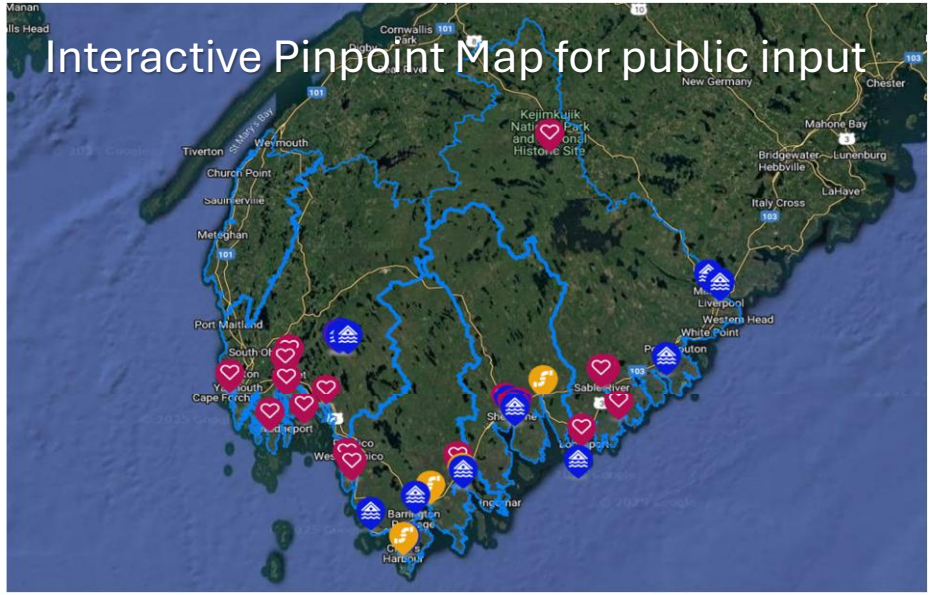
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Review Process

- Municipal/Provincial Review – consistent with project proposal; project spatial extents ensure sufficient data collection and flood mapping coverage
- FHIMP (NRCan) – review Statements of Work, data collection and flood modeling and mapping deliverables meet Federal Standards
- Client Engineer Review: consistency with MFLM technical specifications

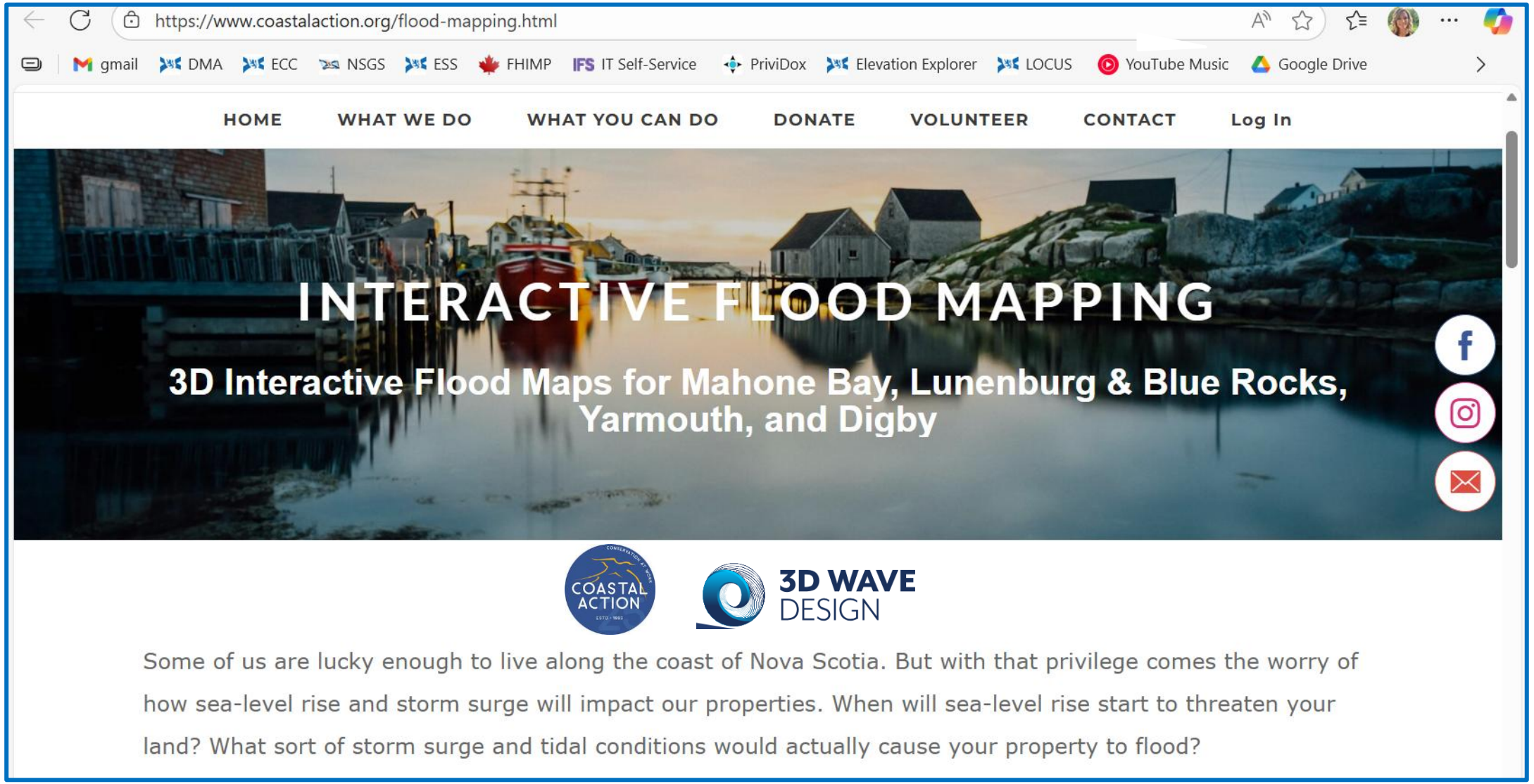
Flood Data and Map Dissemination

- Equip municipalities with flood line data, maps, and tools to communicate flood risk information to the public
- Project specific public engagement



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Interactive Flood Visuals



Interactive Flood Visuals



5% AEP

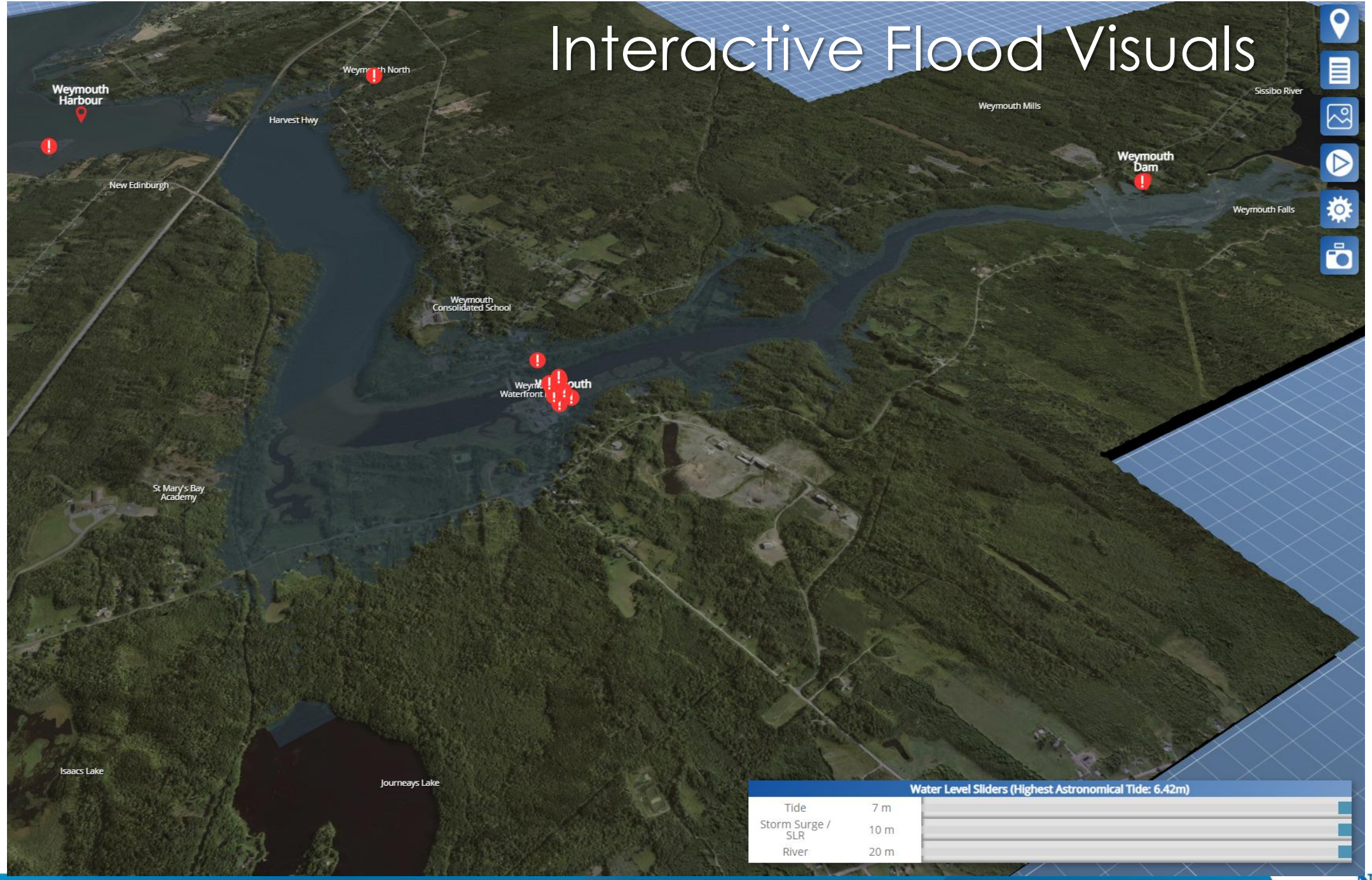


1% AEP



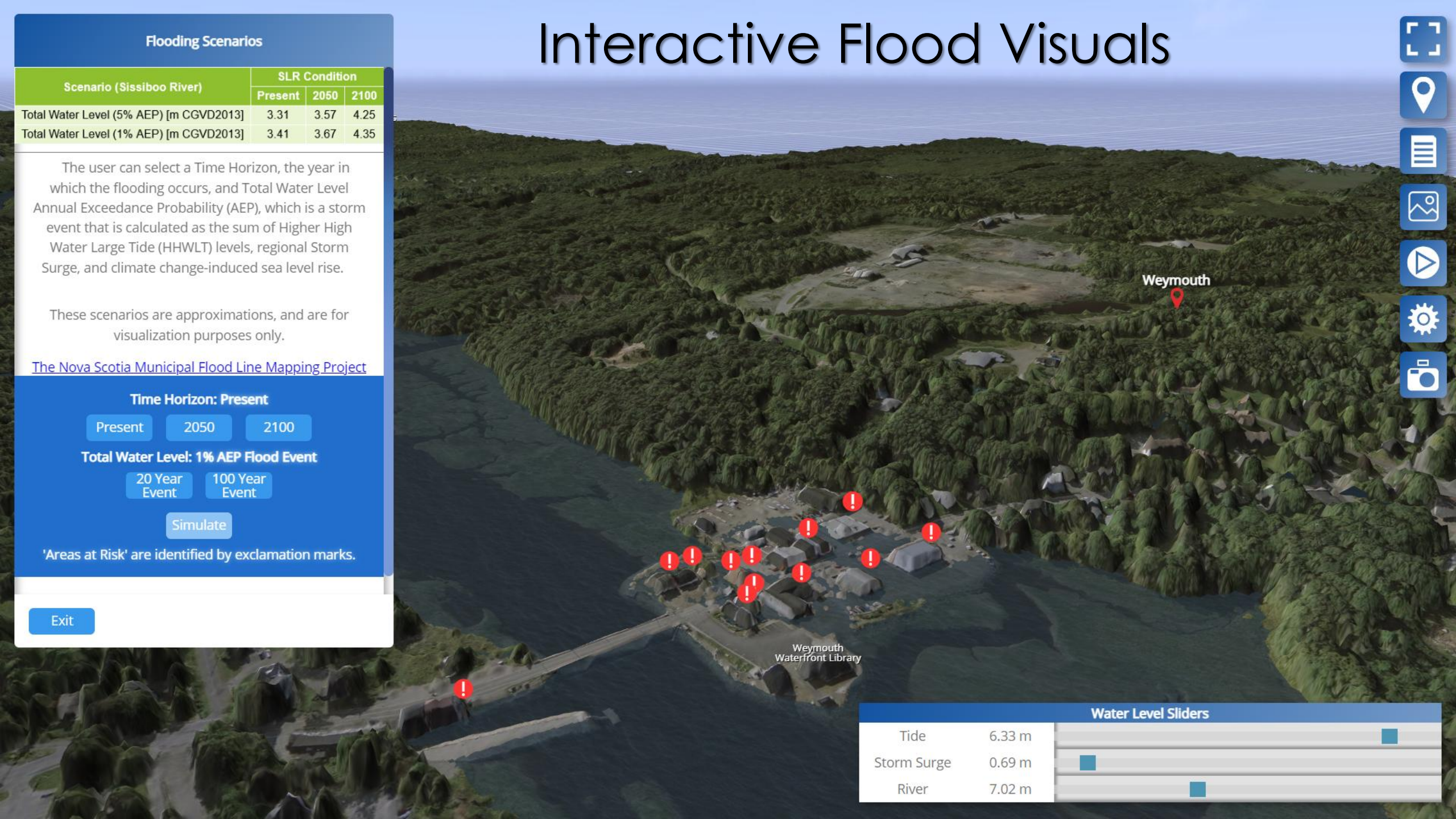
1% AEP + RCP 8.5

Interactive Flood Visuals



NOVA SCOTIA

Interactive Flood Visuals



Flooding Scenarios

Scenario (Sissiboo River)	SLR Condition		
	Present	2050	2100
Total Water Level (5% AEP) [m CGVD2013]	3.31	3.57	4.25
Total Water Level (1% AEP) [m CGVD2013]	3.41	3.67	4.35

The user can select a Time Horizon, the year in which the flooding occurs, and Total Water Level Annual Exceedance Probability (AEP), which is a storm event that is calculated as the sum of Higher High Water Large Tide (HHWLT) levels, regional Storm Surge, and climate change-induced sea level rise.

These scenarios are approximations, and are for visualization purposes only.

The Nova Scotia Municipal Flood Line Mapping Project

Time Horizon: Present

Present | 2050 | 2100

Total Water Level: 1% AEP Flood Event

20 Year Event | 100 Year Event

Simulate

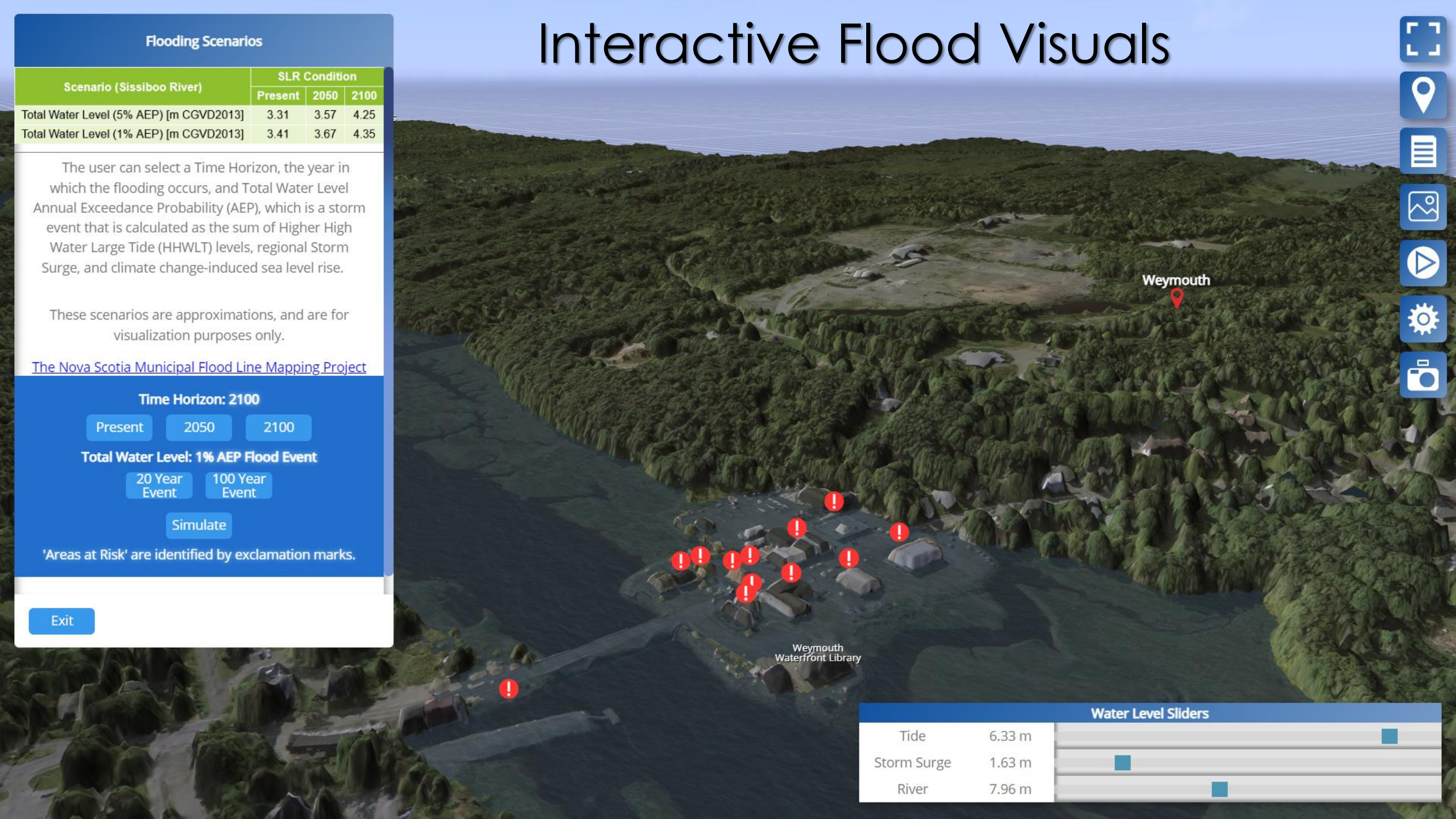
'Areas at Risk' are identified by exclamation marks.

Exit

Water Level Sliders

Tide	6.33 m
Storm Surge	0.69 m
River	7.02 m

Interactive Flood Visuals



Land Use Policy Application

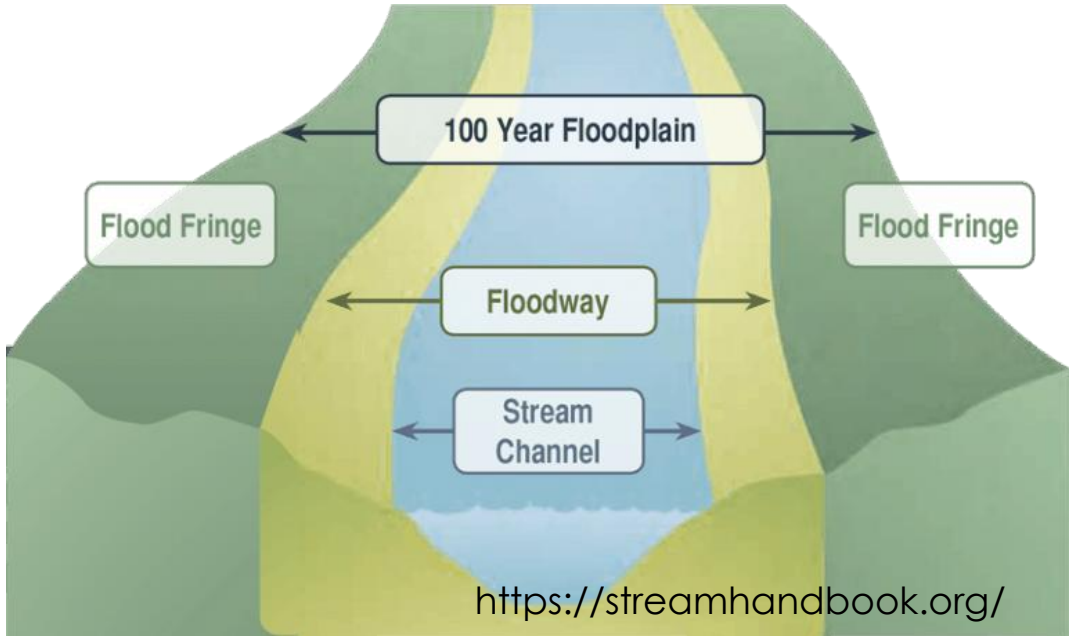


Image Credit: NOAA

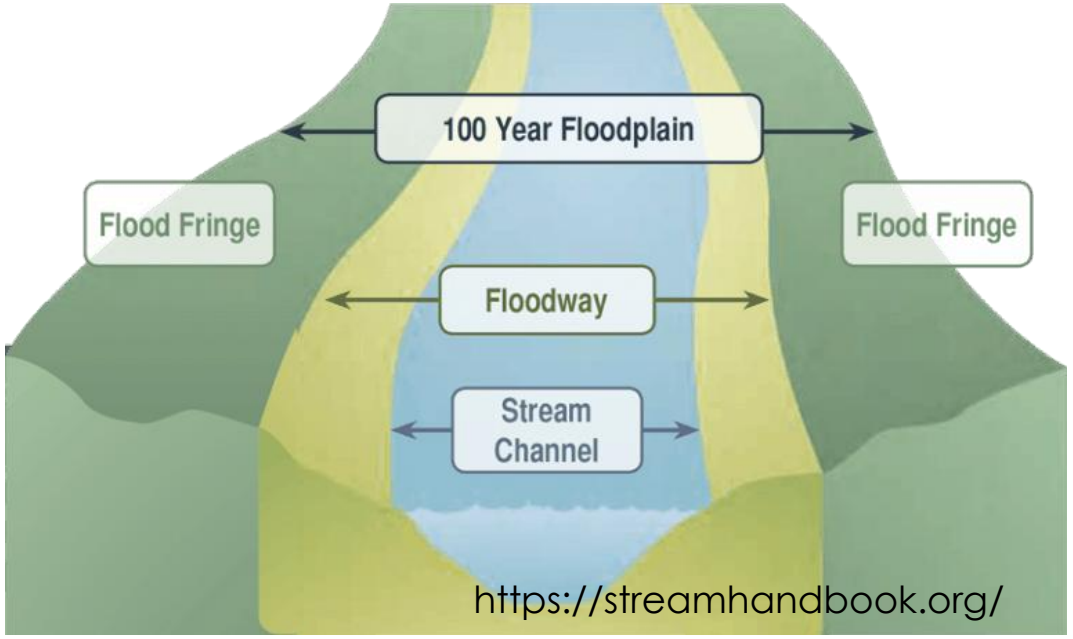
Statement of Provincial Interest on Flood Risk Areas - Excerpts

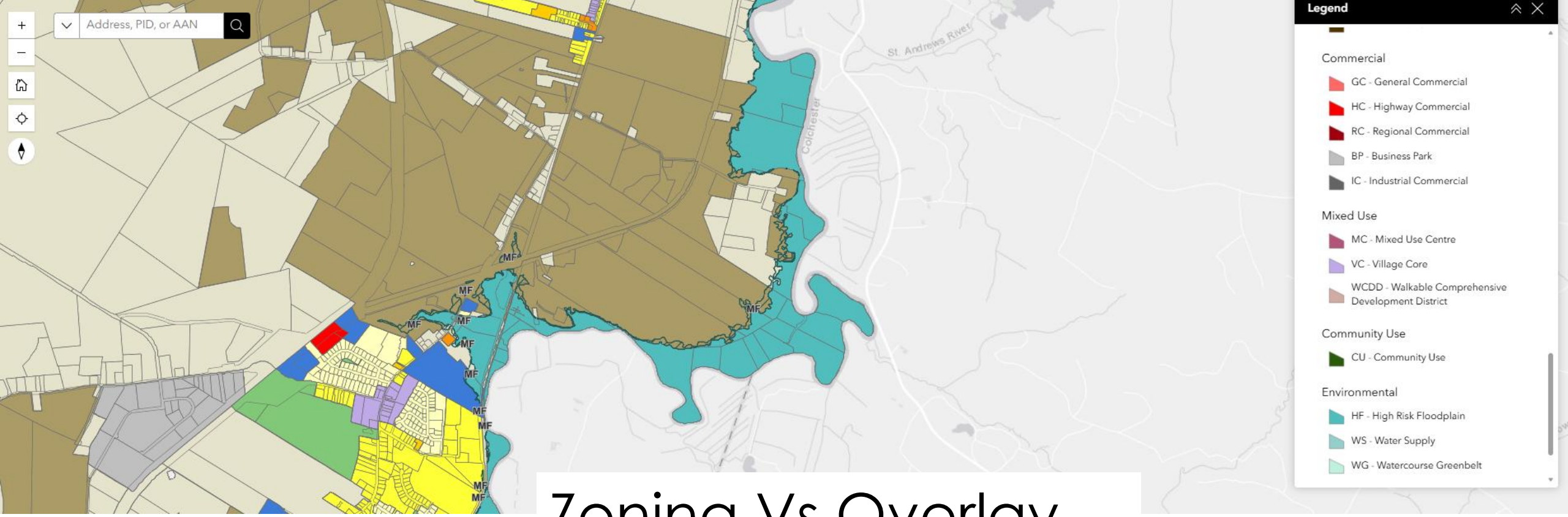
1. Planning documents must identify Flood Risk Areas consistent with … **any locally known floodplain**.

4. For **known floodplains** that have not been mapped under the Canada-Nova Scotia Flood Damage Reduction Program, planning documents should be, at a minimum, reasonably consistent with the provisions applicable to the Floodway Fringe.



- (b) within the **Floodway Fringe**,
  - (i) development, provided it is floodproofed, may be permitted, except for
    - (1) residential institutions such as hospitals, senior citizen homes, homes for special care and similar facilities where flooding could pose a significant threat to the safety of residents if evacuation became necessary, and
    - (2) any use associated with the warehousing or the production of hazardous materials,
  - (ii) the placement of off-site fill must be limited to that required for floodproofing or flood risk management.





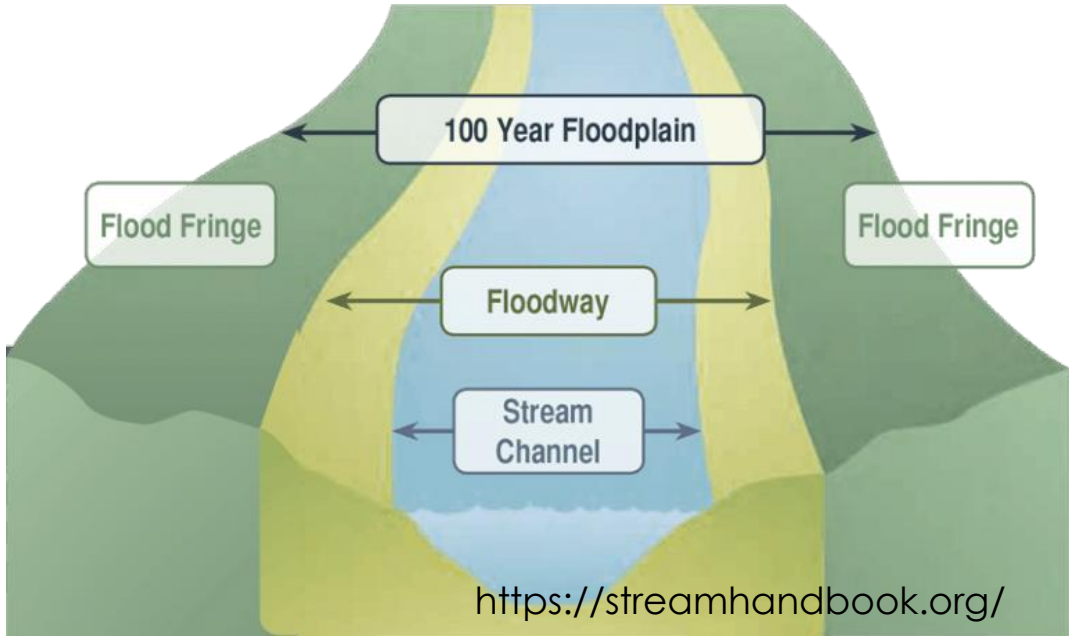
Zoning Vs Overlay



Policy Examples for Flood Hazard Overlay

Policy F1 - It shall be a policy of Council to establish the Floodway Fringe (FF) Overlay and apply it to lands having a 1:100-year flood frequency as determined by the Municipal Flood Line Mapping Program.

Policy F2 - It shall be a policy of Council to apply the regulations and requirements of the underlying zone to any development for lands within the Floodway Fringe (FF) Overlay.

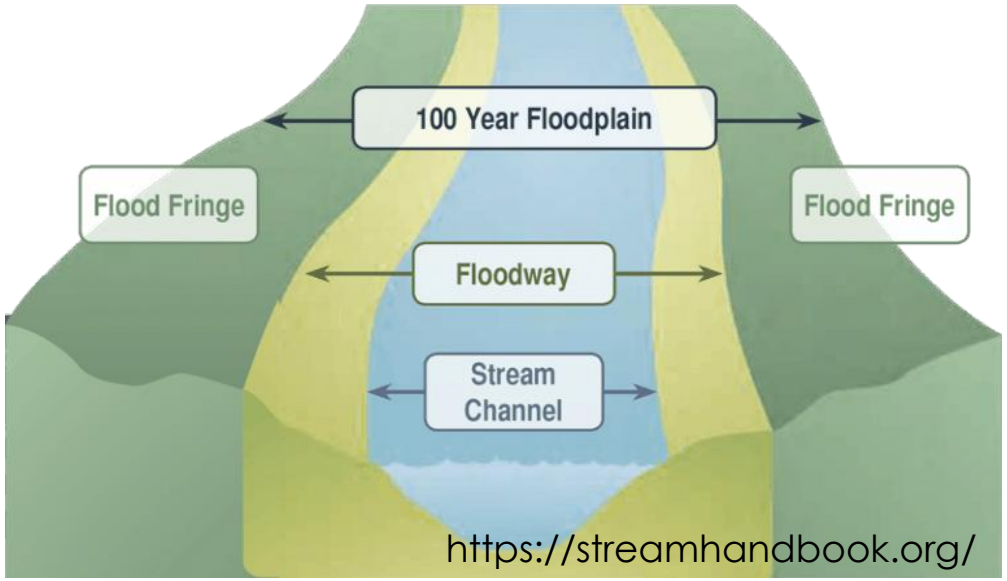


Policy Examples for Flood Hazard Overlay

Policy F3 - It shall be a policy of Council to permit development, provided it is in accordance with the Land Use Bylaw flood proofing requirements, except for:

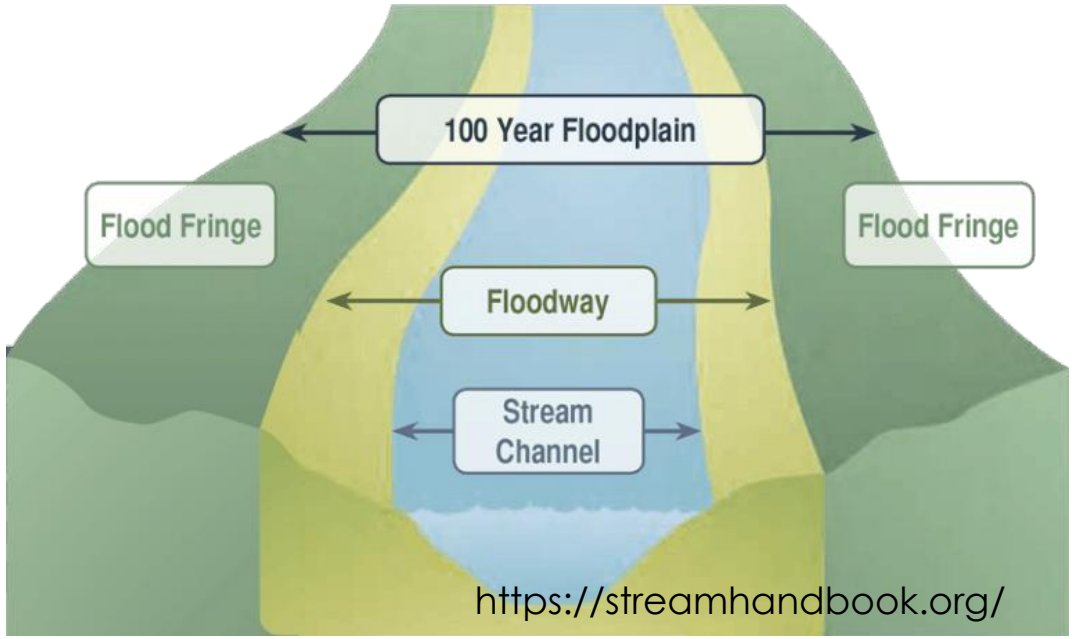
1) residential institutions such as hospitals, senior citizen homes, homes for special care and similar facilities where flooding could pose a significant threat to the safety of residents if evacuation became necessary, and

2) any use associated with the warehousing or the production of hazardous materials



Policy Examples for Flood Hazard Overlay

Policy F4 - It shall be a policy of Council to permit the addition of fill material from outside of the floodplain in the Floodway Fringe (FF) Overlay provided it is only used for flood proofing purposes in accordance with the Land Use By-law flood proofing requirements.



What's next?

- MFLM flood mapping on track for completion in 2027
- Municipalities are expected to treat the flood maps as "known floodplains" and update their MPS and LUB with policy that is reasonably consistent with the Statement of Provincial Interest Regarding Flood Risk Areas
- Evolving climate science, datasets, and modelling tools will continue to be incorporated into MFLM guidelines
- Previous studies areas may be revised using new MFLM technical specifications as funding is available
- Flood mapping data, maps, and reports will provide foundation for more detailed studies, e.g., infrastructure, utilities, coastal urban development
- Focus on dissemination of data and communication tools to municipalities and public in accessible formats



Thank You!

Daniel Bryce, Senior Planner, LPP, MCIP
Program Manager – Municipal Flood Line Mapping Program
Nova Scotia Department of Municipal Affairs
danielbryce@novascotia.ca

NOVA SCOTIA