Lower Mainland Flood Management Strategy

INTEGRATING CLIMATE CHANGE IN FLOOD PLANNING AND DECISION MAKING

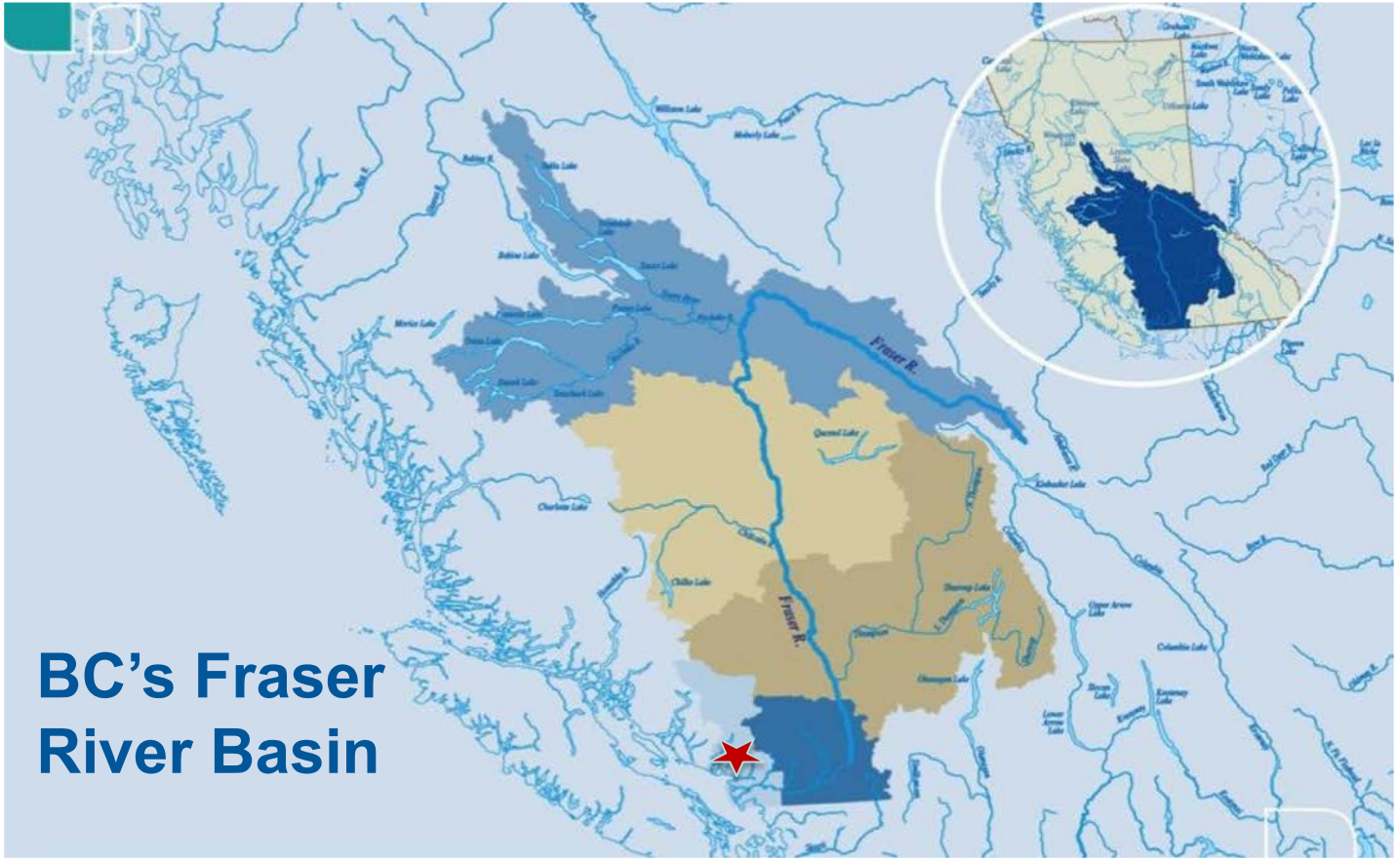
ADAPTATION CANADA 2020 CONFERENCE
February 19, 2020 – Fraser Basin Council

Lower Mainland Flood Management Strategy

Aims to reduce flood risk and increase resilience for communities along the Lower Fraser River and South Coast

Coastal Storm surge (winter flood)

Fraser River freshet (spring flood)


BC's Fraser
River Basin
Fraser R.
Fraser R.

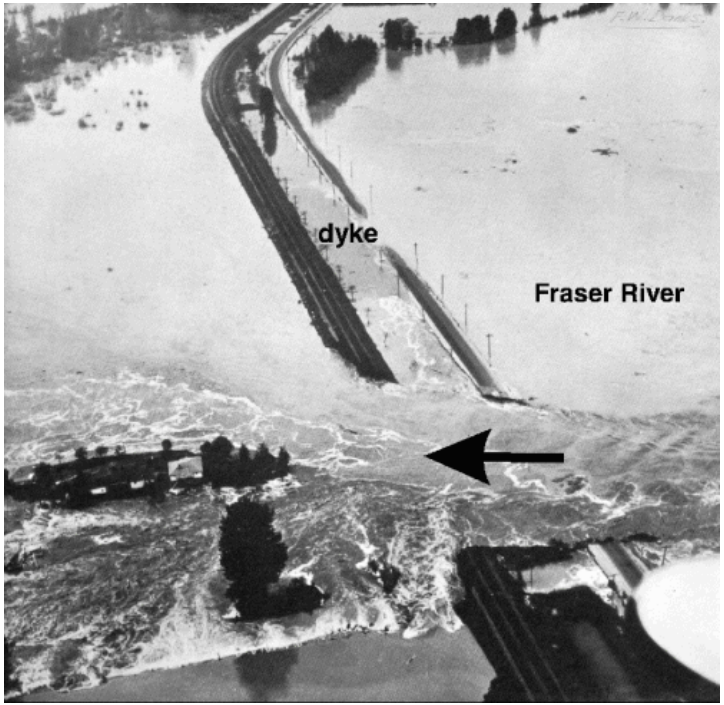
Floods of Recent Record

	Annual Exceedance Probability (AEP)	Estimated Return Period (yrs)	Peak Discharge at Hope (m^3/s)	Duration of peak (weeks)
1894	<0.2%	>500	17,000	-
1948	0.5%	200	15,200	4

Design flood

1894 Fraser River Flood – Chilliwack

1948 Fraser River Flood



CGEN Archive

Vancouver Archives

1948 Fraser River Flood (estimated impacts)

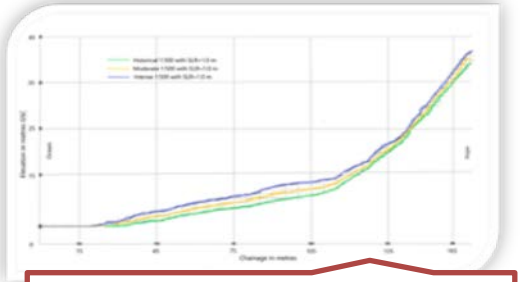
16,000
people
evacuated

22,000
hectares of
farmland
disappeared

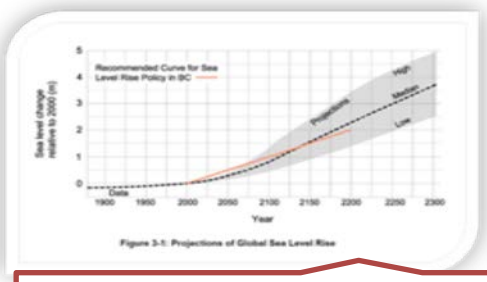
2,000
homes
damaged or
completely
destroyed

$210
million
in total damages

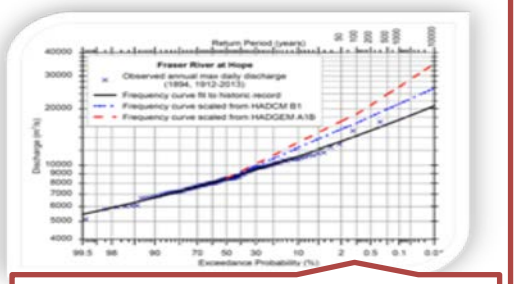
What about Climate Change?



Changing climate is projected to increase magnitude and frequency of Fraser River and coastal flooding



Sea level projected to rise on average by 0.5 m by 2050, 1 m by 2100, 2 m by 2200



Hydrological changes in the Fraser River Basin (snowpack, rate of snowmelt and incidence of rainfall

Regional Assessment of Flood Vulnerabilities

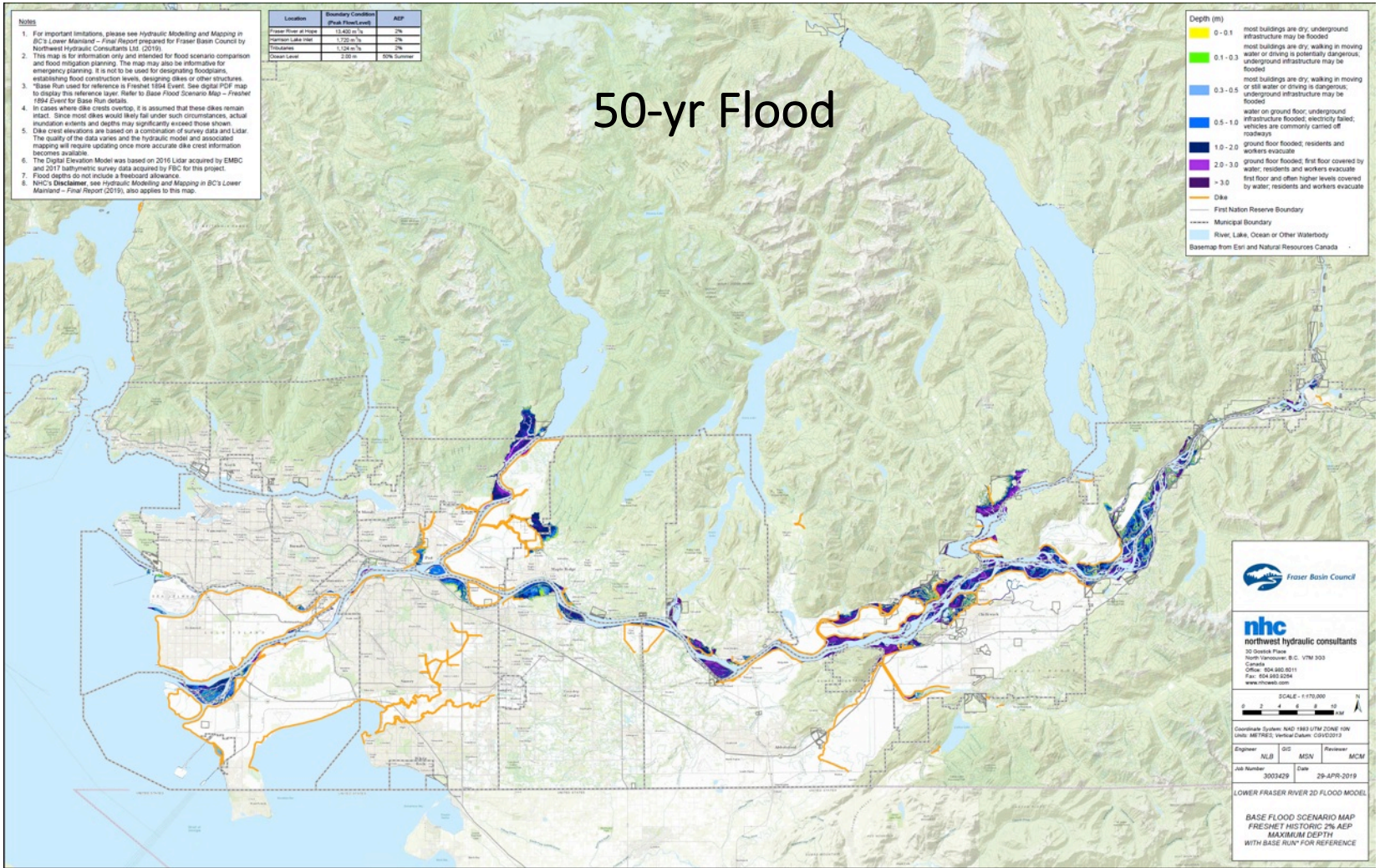
Estimated People Impacted

Flood Scenario	Total population seeking shelter	Number of Municipalities	Number of First Nations	Number of Reserve / Treaty lands
A. Coastal Present Day	238,000	15	4	7
B. Coastal Year 2100	261,000	15	5	9
C. River Present Day	266,000	17	22	43
D. River Year 2100	311,000	17	23	47

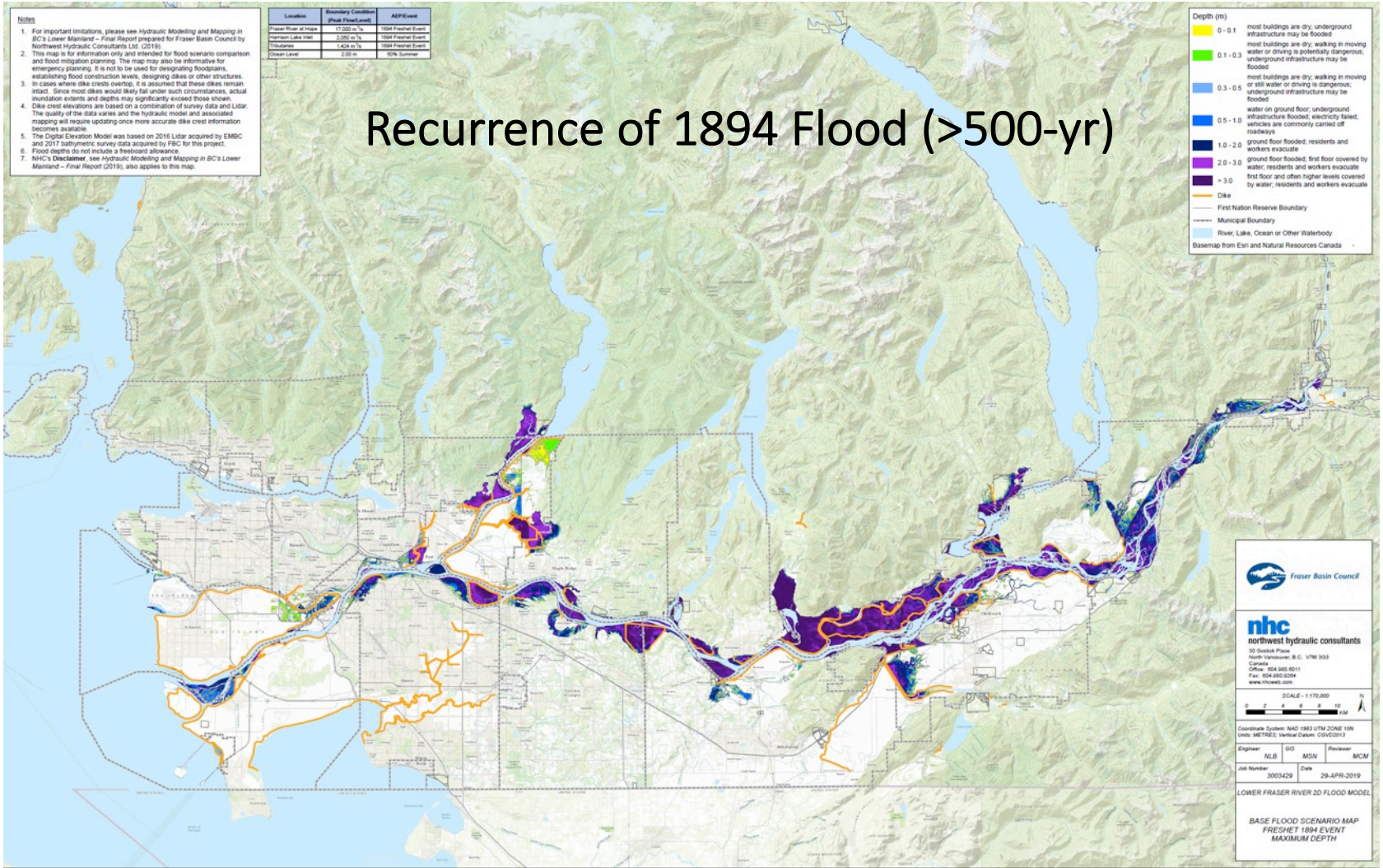
Regional Assessment of Flood Vulnerabilities

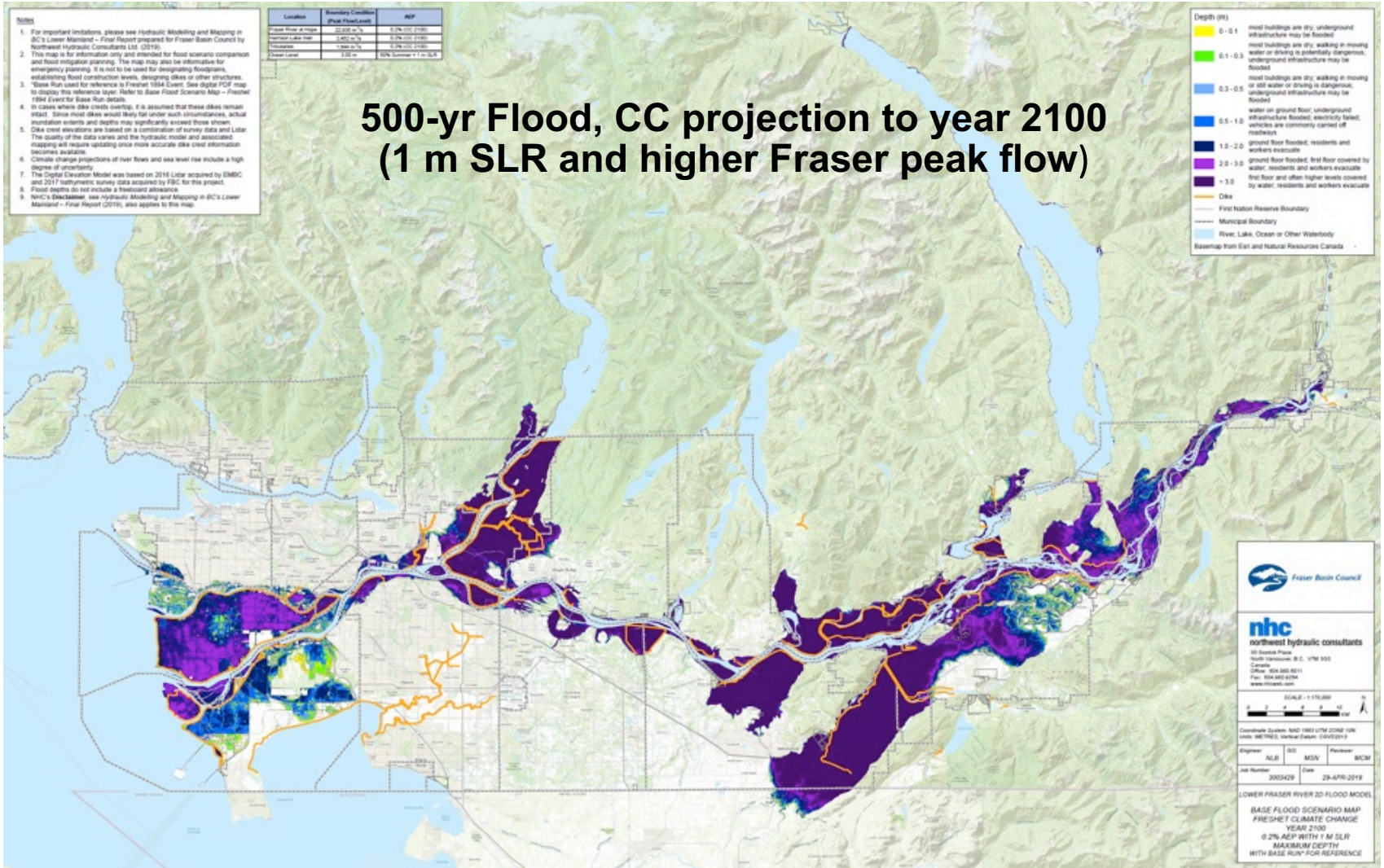
Total Economic Loss Projections

Flood Scenario	Residential	Commercial	Industrial	Public/ Institutional Buildings	Interrupted Cargo Shipments	Infra-structure	Agriculture	Total
A. Coastal Present Day	$5.6 B	$6.3 B	$1.6 B	$720 M	$3.6 B	$1.4 B	$100 M	**$19.3 B**
B. Coastal Year 2100	$7.1 B	$8.6 B	$2.6 B	$910 M	$3.6 B	$1.8 B	$200 M	**$24.7 B**
C. River Present Day	$2.6 B	$3.8 B	$1.6 B	$880 M	$7.7 B	$4.6 B	$1.6 B	**$22.9 B**
D. River Year 2100	$6.6 B	$7.6 B	$2.9 B	$1.2 B	$7.7 B	$5.0 B	$1.6 B	**$32.7 B**


50-yr Flood
Notes
1. For important limitations, please see Hydraulic Modelling and Mapping in BC's Lower Mainland – Final Report prepared for Fraser Basin Council by Northwest Hydraulic Consultants Ltd. (2019).
2. This map is for information only and intended for flood scenario comparison and flood mitigation planning. The map may also be informative for emergency planning. It is not to be used for designating floodplains, establishing flood construction levels, designing dikes or other structures.
3. *Base Run used for reference is Freshet 1894 Event. See digital PDF map to display this reference layer. Refer to Base Flood Scenario Map – Freshet 1894 Event for Base Run details.
4. In cases where dike crests overtop, it is assumed that these dikes remain intact. Since most dikes would likely fail under such circumstances, actual inundation extents and depths may significantly exceed those shown.
5. Dike crest elevations are based on a combination of survey data and Lidar. The quality of the data varies and the hydraulic model and associated mapping will require updating once more accurate dike crest information becomes available.
6. The Digital Elevation Model was based on 2016 Lidar acquired by EMBC and 2017 bathymetric survey data acquired by FBC for this project.
7. Flood depths do not include a freeboard allowance.
8. NHC's Disclaimer, see Hydraulic Modelling and Mapping in BC's Lower Mainland – Final Report (2019), also applies to this map.
Location
Boundary Condition (Peak Flow/Level)
AEP
Fraser River at Hope
13,400 m³/s
2%
Harrison Lake Inlet
1,720 m³/s
2%
Tributaries
1,124 m³/s
2%
Ocean Level
2.00 m
50% Summer
Depth (m)
0 - 0.1 most buildings are dry; underground infrastructure may be flooded
0.1 - 0.3 most buildings are dry; walking in moving water or driving is potentially dangerous; underground infrastructure may be flooded
0.3 - 0.5 most buildings are dry; walking in moving or still water or driving is dangerous; underground infrastructure may be flooded
0.5 - 1.0 water on ground floor; underground infrastructure flooded; electricity failed; vehicles are commonly carried off roadways
1.0 - 2.0 ground floor flooded; residents and workers evacuate
2.0 - 3.0 ground floor flooded; first floor covered by water; residents and workers evacuate
> 3.0 first floor and often higher levels covered by water; residents and workers evacuate
Dike
First Nation Reserve Boundary
Municipal Boundary
River, Lake, Ocean or Other Waterbody
Basemap from Esri and Natural Resources Canada
Fraser Basin Council
nhc
northwest hydraulic consultants
30 Gostick Place
North Vancouver, B.C. V7M 3G3
Canada
Office: 604.980.6011
Fax: 604.980.9264
www.nhcweb.com
SCALE - 1:170,000
0 2 4 6 8 10 KM
N
Coordinate System: NAD 1983 UTM ZONE 10N
Units: METRES; Vertical Datum: CGVD2013
Engineer NLB
GIS MSN
Reviewer MCM
Job Number 3003429
Date 29-APR-2019
LOWER FRASER RIVER 2D FLOOD MODEL
BASE FLOOD SCENARIO MAP
FRESHET HISTORIC 2% AEP
MAXIMUM DEPTH
WITH BASE RUN* FOR REFERENCE

Recurrence of 1894 Flood (>500-yr)




500-yr Flood, CC projection to year 2100
(1 m SLR and higher Fraser peak flow)
Notes
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5. Dike crest elevations are based on a combination of survey data and Lidar. The quality of the data varies and the hydraulic model and associated mapping will require updating once more accurate dike crest information becomes available.
6. Climate change projections of river flows and sea level rise include a high degree of uncertainty.
7. The Digital Elevation Model was based on 2016 Lidar acquired by EMBC and 2017 bathymetric survey data acquired by FBC for this project.
8. Flood depths do not include a freeboard allowance.
9. NHC's Disclaimer, see Hydraulic Modelling and Mapping in BC's Lower Mainland – Final Report (2019), also applies to this map.
Location
Boundary Condition (Peak Flow/Level)
AEP
Fraser River at Hope
22,000 m³/s
0.2% (1/2,000)
Harrison Lake Inlet
2,450 m³/s
0.2% (1/2,000)
Tributaries
1,500 m³/s
0.2% (1/2,000)
Ocean Level
3.00 m
50% Summer + 1 m SLR
Depth (m)
0 - 0.1
most buildings are dry; underground infrastructure may be flooded
0.1 - 0.3
most buildings are dry; walking in moving water or driving is potentially dangerous; underground infrastructure may be flooded
0.3 - 0.5
most buildings are dry; walking in moving or still water or driving is dangerous; underground infrastructure may be flooded
0.5 - 1.0
water on ground floor; underground infrastructure flooded; electricity failed; vehicles are commonly carried off roadways
1.0 - 2.0
ground floor flooded; residents and workers evacuate
2.0 - 3.0
ground floor flooded; first floor covered by water; residents and workers evacuate
+ 3.0
first floor and often higher levels covered by water; residents and workers evacuate
Dike
First Nation Reserve Boundary
Municipal Boundary
River, Lake, Ocean or Other Waterbody
Basemap from Esri and Natural Resources Canada
Fraser Basin Council
nhc
northwest hydraulic consultants
Engineer: NJB
GIS: MSN
Reviewer: MCM
Job Number: 3003429
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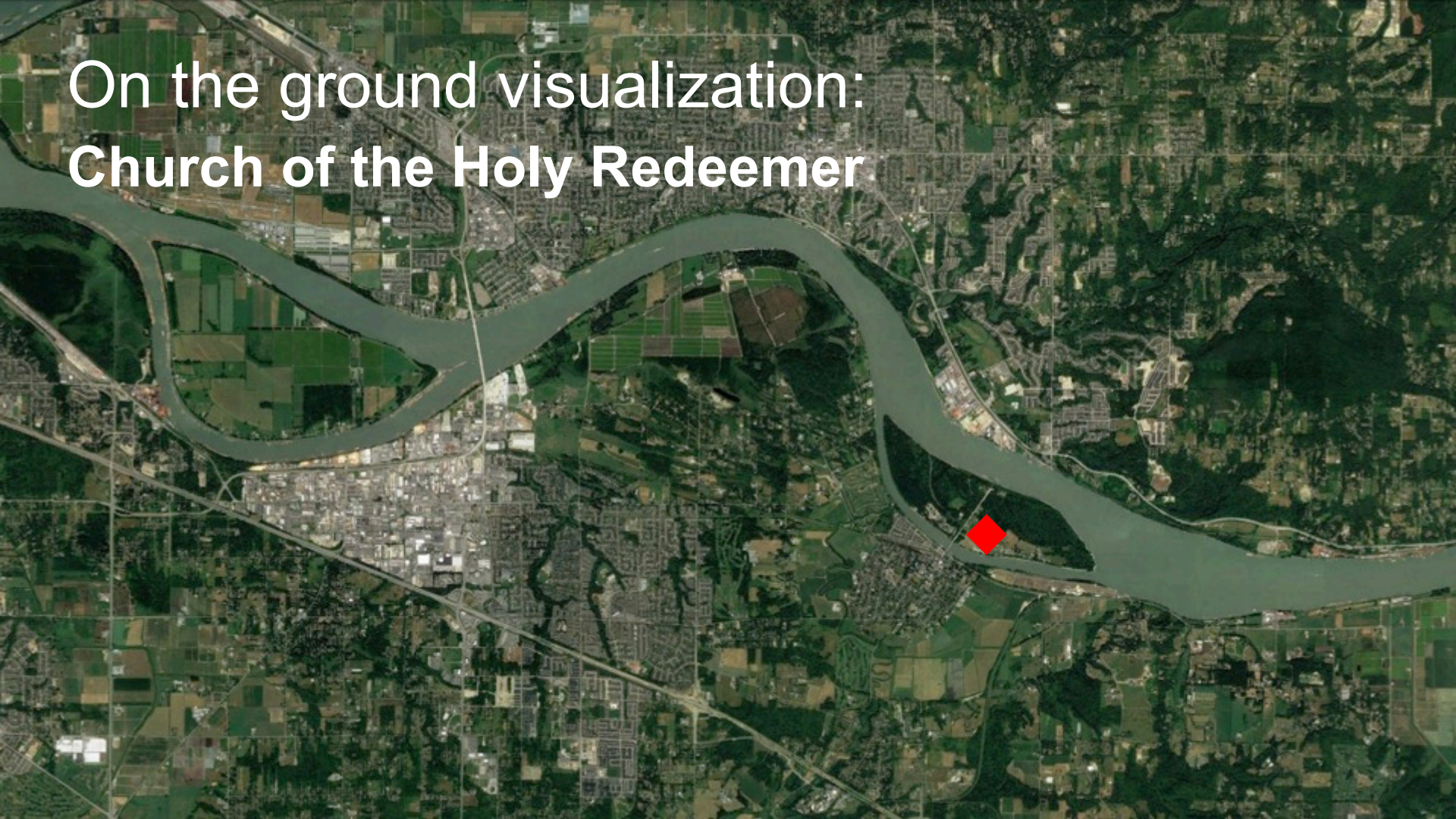
LOWER FRASER RIVER 2D FLOOD MODEL
BASE FLOOD SCENARIO MAP
FRESHET CLIMATE CHANGE
YEAR 2100
0.2% AEP WITH 1 M SLR
MAXIMUM DEPTH
WITH BASE RUN* FOR REFERENCE


On the ground visualization:
Church of the Holy Redeemer

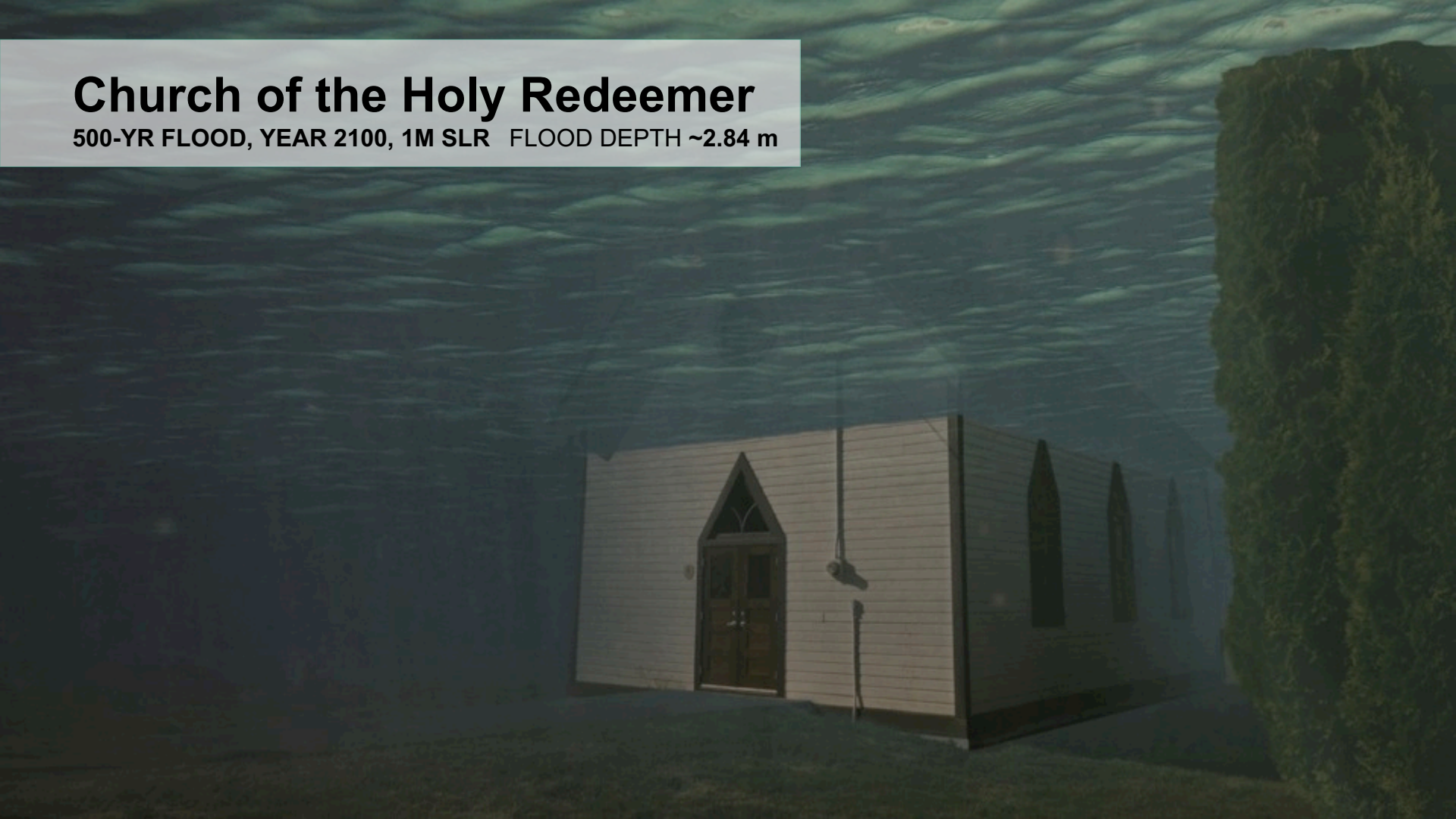
Church of the Holy Redeemer

NO FLOOD SCENARIO FLOOD DEPTH **0.0 m**


Church of the Holy Redeemer
RECURRENCE OF 1894 FLOOD
FLOOD DEPTH ~1.3 m

Church of the Holy Redeemer

500-YR FLOOD, YEAR 2100, 1M SLR FLOOD DEPTH **~2.84 m**




On the ground visualization:
Matsqui Trail


Matsqui Trail
FLOOD DEPTH: 0.00M

Matsqui Trail

SCENARIO: RECURRENCE OF 1894 FRESHET FLOOD

FLOOD DEPTH: ~2.93M


Matsqui Trail
SCENARIO: 500-YEAR FRESHET FLOOD IN 2100
FLOOD DEPTH: ~4.75M

Flood Hazard Modelling and Mapping – Key Findings

Dike raising (to Provincial std) - Flooded area reduced by 37%, flood levels in-channel increased by 30 cm in and around Mission (1894 flood)

Dike setbacks (400m setback for 12km length) - Flood levels in-channel dropped around 15 cm in vicinity of the setback (1894 flood)

Upstream storage (Nechako and Bridge River reservoirs) - Estimated to reduce water levels by 30-40 cm between Hope and Mission (0.5% AEP **(200-yr) flood**)

Gravel removal (2M m3 removed, lowering gravel bars by 2m from Agassiz bridge to Harrison River) - Flood levels in-channel dropped by about 12 cm in the vicinity (1894 flood)

Risk Reduction Options to Consider

- Land use planning and floodplain regulation
- Floodproofing (flood construction levels)
- Dikes, floodwalls and related infrastructure (shoreline dikes, setback dikes, super dikes, pumps, floodgates, etc.)
- Water diversion and upstream storage
- Sediment removal
- Sea barriers (for storm surges)
- Nature-based solutions (living dikes, beach nourishment)
- Other (e.g. emergency response and recovery, insurance, disaster assistance, and more)

Proposed Criteria to Evaluate Options

- Effectiveness at reducing flood risk
- Feasibility (technical and regulatory feasibility)
- Cost relative to benefit (capital, operations and maintenance, life cycle costs)
- First Nations title, rights, interests and consent
- Sustainability benefits and adverse impacts (environmental, social, cultural and economic)
- Regional benefits and/or risk transfer
- Future flexibility / adaptability

Thank you. Questions and Comments?

Fraser Basin Council

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Fraser Basin Council