

Sea Level Rise and Climate Adaptation

Report on the Coastal Floodplain Mapping Project

Presented by Kim Fowler, Manager of Long Range Planning, Energy & Sustainability
June 9, 2020

Responding to a changing environment

Coastal Floodplain Mapping Project

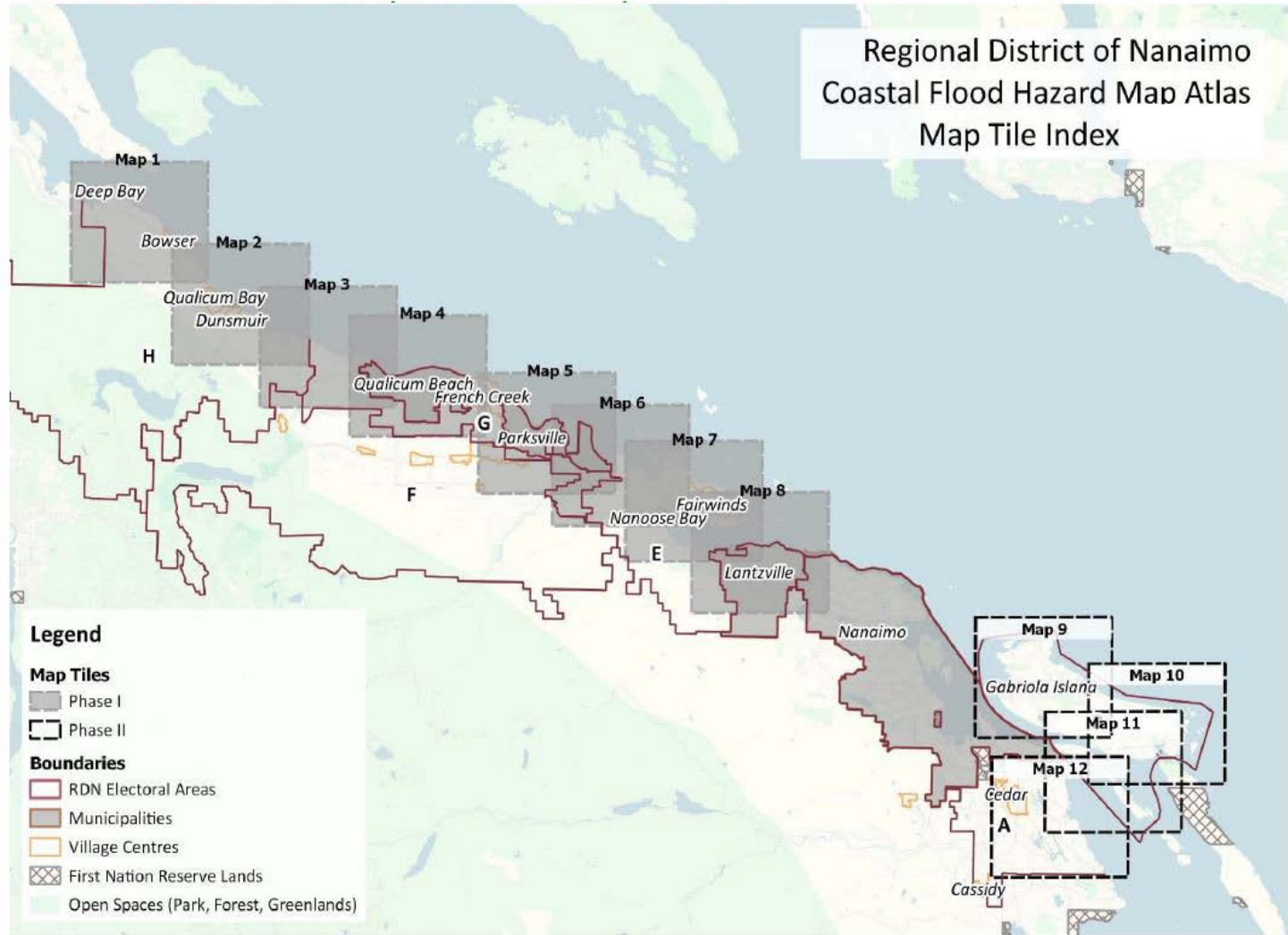
- Regional Growth Strategy Implementation Action
- Gathered data for technical study & prepared coastal flood hazard maps to:
 - better understand coastal flood hazards
 - ensure a standard of public safety into the future
 - use for land use, infrastructure planning & emergency management
 - be use by engineers & development sector to plan coastal projects

What are other coastal communities doing?

A few examples:

- City of Nanaimo - draft Climate Resiliency Strategy
- Town of Qualicum Beach - Waterfront Plan & draft Climate Action Plan
- Cowichan VRD - Natural Hazard Risk Assessment
- Comox VRD - Coastal Flood Mapping Project
- Capital RD – Coastal Flood Adaptation Strategy
- City of Campbell River - Coastal Flood Mapping Project
- City of Surrey - Climate Adaptation Strategy
- City of Vancouver - Vancouver's Changing Shorelines

Study Area: Phase 1 & Phase 2



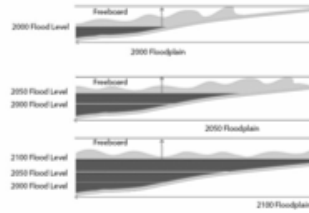
Which flood hazards mapped?



Coastal Storm Surge



Tides



Sea Level Rise



Tsunami



River flooding



Sewer backup

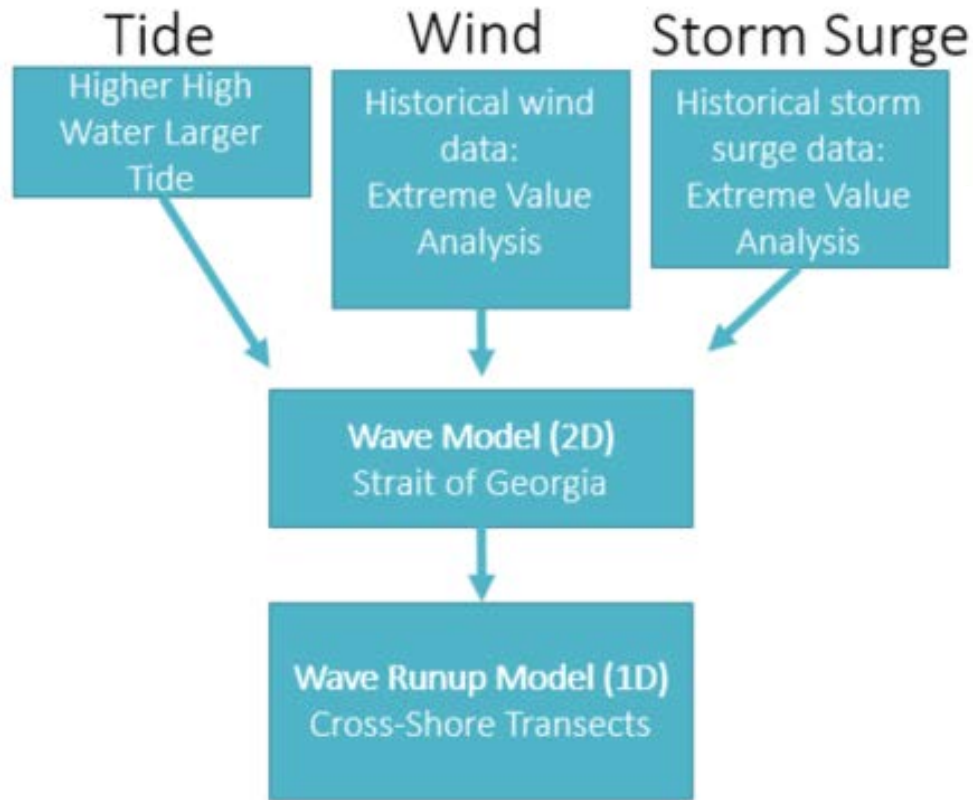


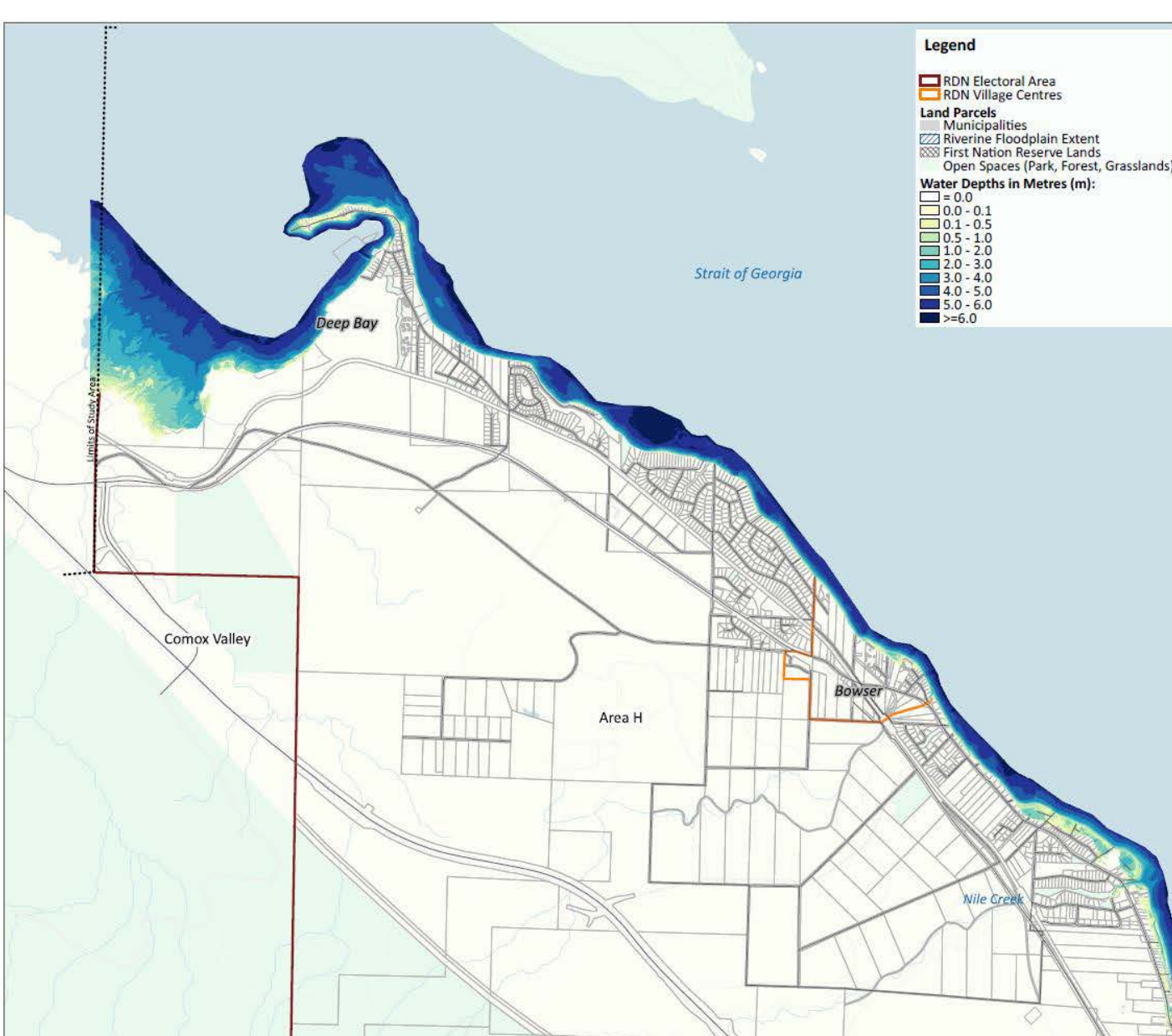
Erosion



Coastal Storm Flood Hazards

Coastal modelling – designated storm approach





Legend

- RDN Electoral Area
- RDN Village Centres
- Land Parcels**
- Municipalities
- Riverine Floodplain Extent
- First Nation Reserve Lands
- Open Spaces (Park, Forest, Grasslands)
- Water Depths in Metres (m):**
- = 0.0
- 0.0 - 0.1
- 0.1 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0
- 5.0 - 6.0
- >=6.0



Notes to User:

- This map is designed to accompany a Floodplain Mapping Report (Ebbwater Consulting Inc. and Cascadia Coast Research Ltd., 2019) and is intended for the purposes set out in that report only. See the main report for further details on the methodology, results and limitations.
- Flood water depths were developed using a 0.5% Annual Exceedance Probability (AEP) flood and a 1 m Relative Sea Level Rise (RSLR).
- The adopted values for sea level rise are based on guidelines from Ausenco Sandwell (2011). These are subject to change and RSLR values may need to be reassessed in future.
- Water depths DO NOT include a freeboard allowance.

Limitations:

- The accuracy of the presented flood depths is limited by available data and modelling approaches. Water elevations were interpolated from 1D cross-shore transects to calculate the flood depth layer. Please refer to report for detailed discussion of limitations.
- The accuracy of the floodplain extent is limited by the accuracy of the base surveys and mapping data. The floodplain limits were not established on the ground by legal survey.
- This map was produced by Ebbwater Consulting Inc. using generally accepted best practice and guidelines for the Province of British Columbia. However, flooding may still occur outside the defined floodplain boundary, and Ebbwater Consulting Inc. and Cascadia Coast Research Ltd. do not assume any liability by reason of the failure to delineate flood areas on this map.
- The water depths shown on this map are to provide an assessment of current and future flooding to help inform decisions on future land use policy. Under the provisions of the Local Government Act 2004, these flood extents only take effect when adopted by bylaw or implemented via another planning tool (such as a development permit area). They therefore do not currently have any legal or planning standing.
- Flood depths in the vicinity of rivers (such as Big Qualicum River, Englishman River, Little Qualicum River and French Creek) are also a function of river flows. This mapping only shows the coastal component, and therefore flood depths may locally be higher. For estuarine areas, the combined effects of coastal and riverine hazards should be assessed. For the Englishman River and the Little Qualicum River, riverine flood maps exist from 1985 and 1997 (BC Ministry of Environment 1985 and 1997), while no flood maps exist for Big Qualicum River and French Creek.
- Base map and parcel layers were provided by different data owners and are subject to differences.

Data Sources:

- Flood Construction Reference Plane (FCRP) values provided by Cascadia Coast Research Ltd.
- Water depths were interpolated from a limited number of transects and are relative to onshore topography.
- Provincial riverine floodplain layer was downloaded from "Floodplain Maps by Region", BC Ministry of Environment 1985 and 1997. Accessed February 19, 2019.
- First Nation Reserve Lands (also known as Indian Reserve Lands) layer was downloaded from DataBC, Province of British Columbia. The other civic boundary layers were provided by the RDN.
- LIDAR data surveyed in 2016 was used to create the Digital Elevation Model (DEM).
- OSM Humanitarian Data Model and CARTO's Positron, created using derivatives of OpenStreetMap data - openstreetmap.org (© OpenStreetMap contributors; cartography license CC BY-SA)

References:

- Ebbwater Consulting Inc. and Cascadia Coast Research Ltd. (2019). Regional District of Nanaimo Coastal Floodplain Mapping. Prepared for the RDN.

Date Created:	March 31 2019	
Coordinate System:	NAD83, UTM 10N	
Vertical Datum:	CGVD 2013	
Paper Size:	ANSI D	
Prepared By:	NS	
Reviewed By:	AC	
Checked By:	TL	

Scale: 1:15,000

0 0.25 0.5 0.75 1 km



ELECTORAL AREA H (1 OF 3)
FLOOD CONSTRUCTION LEVEL REGULATORY MAP
 1.0 m RSLR - Map 1 of 14



Notes to User:

1. This map is designed to accompany a Coastal Floodplain Mapping Report (Ebbwater Consulting Inc. and Cascadia Coast Research Ltd, 2019) and is intended for the purposes set out in that report only. See the main report for further details on the methodology, results and limitations and references.
2. Flood water levels were developed using a 0.5% Annual Exceedance Probability (AEP) flood and 1.0 m Relative Sea Level Rise (RSLR).
3. The adopted values for sea level rise are based on guidelines from Ausenco Sandwell (2011). These are subject to change and RSLR values may need to be reassessed in future.
4. A 0.6 m freeboard allowance has been included in water levels in accordance with Ausenco Sandwell (2011).
5. Flood Construction Levels (FCLs) have been divided into reaches based on similar flood level values (FCL values are given relative to CGVD2013). Simplified reach maps without contours are also available.
6. This map was produced following the Coastal Floodplain Mapping Guidelines (KWL 2011) and Professional Practice Guidelines (APFGBC 2017).
7. The coloured FCL Reach polygons show Floodplain areas as defined by the indicated FCL.
8. The Regional District of Nanaimo (RDN) does not represent that flooding will not occur outside of the indicated FCL Reach and will not exceed the FCLs indicated on the map.
9. Application of the FCLs presented in this map should be done in accordance with relevant policy and regulations by a suitably qualified professional.

Limitations:

1. The accuracy of the presented FCLs is limited by available data and modelling approaches. The FCLs are based on 1D cross shore transects. These have been simplified by merging areas of similar transects into FCL reaches. Please refer to report (Ebbwater Consulting Inc. and Cascadia Coast Research Ltd., 2019) for a detailed discussion of limitations.
2. The accuracy of the floodplain extent is limited by the accuracy of the base mapping data and surveys. The floodplain limits were not established on the ground by legal survey.
3. This map was produced by Ebbwater Consulting Inc. using generally accepted best practice and guidelines for the Province of British Columbia. However, flooding may still occur outside the defined floodplain boundary, and Ebbwater Consulting Inc. and Cascadia Coast Research Ltd. do not assume any liability by reason of the failure to delineate flood areas on this map.
4. The outlines and levels shown on this map are to provide an assessment of current and future flood levels to help inform decisions on future land use policy. Under the provisions of the Local Government Act 2004, these levels only take effect when adopted by bylaw or implemented via another planning tool (such as a development permit area). The required setback from the FCL Reach area is defined in RDN Floodplain Management Bylaw No.1469, 2006.
5. The presented FCLs are limited to estimates of the effects of a coastal storm flood hazard and they do not include effects of riverine flooding. FCLs in estuarine areas (such as Big Qualicum River, Englishman River, Little Qualicum River and French Creek) should be based both on the coastal conditions and river levels. More information on riverine hazard in Englishman River and Little Qualicum River can be found in flood hazard assessments completed by the Province of BC (BC Ministry of Environment 1985 and 1997), however no flood maps exist for other estuarine areas.
6. Base map and parcel layers were provided by different data owners and are subject to differences.

Data Sources:

1. Flood Construction Reference Plane (FCRP) values provided by Cascadia Coast Research Ltd.
2. First Nation Reserve Lands (also known as Indian Reserve Lands) layer was downloaded from DataBC, Province of British Columbia. The other civic boundary layers were provided by the Regional District of Nanaimo.
3. Provincial Riverine Floodplain layer was downloaded from "Floodplain Maps by Region", BC Ministry of Environment 1985 and 1997. Accessed February 19, 2019.
4. LIDAR data surveyed in 2016 was used to create the contours. Contours are 1.0 m CGVD and greater.
5. OSM Humanitarian Data Model and CARTO's Posttron, created using derivatives of OpenStreetMap data - openstreetmap.org (© OpenStreetMap contributors; cartography license CC BY-SA).

References:

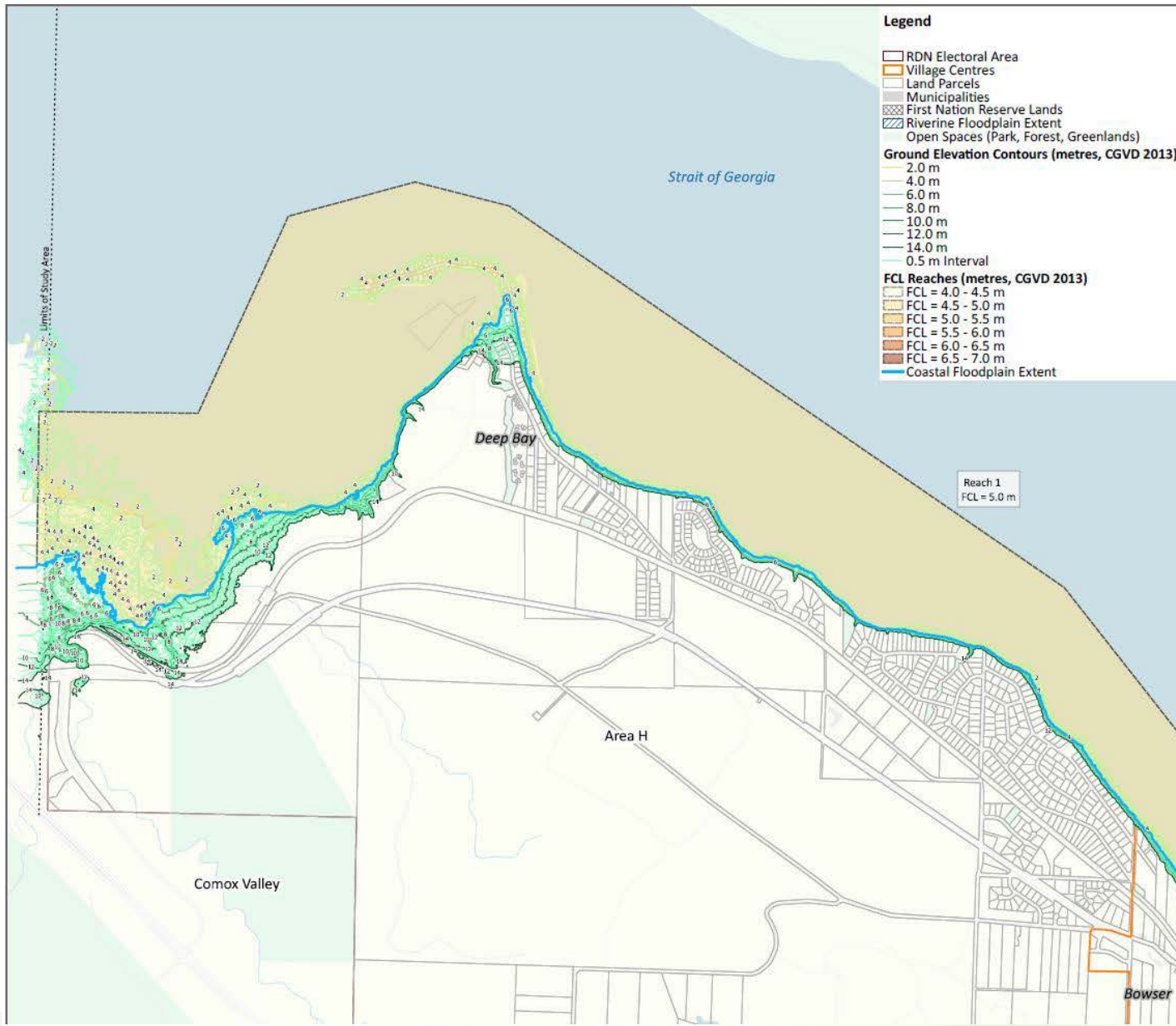
1. Ebbwater Consulting Inc. and Cascadia Coast Research Ltd. (2019). Regional District of Nanaimo Coastal Floodplain Mapping. Prepared for the Regional District of Nanaimo.

Date Created:	31 Mar 2019	
Coordinate System:	NAD83, UTM 10N	
Vertical Datum:	CGVD 2013	
Paper Size:	Sheet ANSI D	
Prepared By:	DW	
Reviewed By:	AC	
Checked By:	TL	

Scale: 1:10,000
 0 0.25 0.5 0.75 km


Legend

- RDN Electoral Area
 - Village Centres
 - Land Parcels
 - Municipalities
 - First Nation Reserve Lands
 - Riverine Floodplain Extent
 - Open Spaces (Park, Forest, Greenlands)
- Ground Elevation Contours (metres, CGVD 2013)**
- 2.0 m
 - 4.0 m
 - 6.0 m
 - 8.0 m
 - 10.0 m
 - 12.0 m
 - 14.0 m
 - 0.5 m Interval
- FCL Reaches (metres, CGVD 2013)**
- FCL = 4.0 - 4.5 m
 - FCL = 4.5 - 5.0 m
 - FCL = 5.0 - 5.5 m
 - FCL = 5.5 - 6.0 m
 - FCL = 6.0 - 6.5 m
 - FCL = 6.5 - 7.0 m
 - Coastal Floodplain Extent

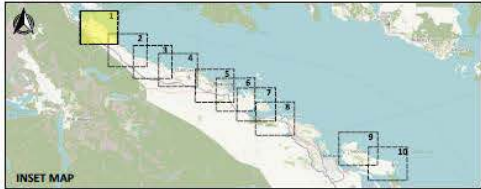


Legend

- RDN Electoral Area
 - Village Centres
 - Land Parcels
 - Municipalities
 - First Nation Reserve Lands
 - Riverine Floodplain Extent
 - Open Spaces (Park, Forest, Greenlands)
- Sea Level Rise Planning Area**
- 0.5 metres Relative Sea Level Rise
 - 1.0 metres Relative Sea Level Rise



ELECTORAL AREA H (1 OF 3)
SEA LEVEL RISE PLANNING AREA MAP
Map 1 of 10





INSET MAP


- Notes to User:**
1. This map is designed to accompany a Coastal Floodplain Mapping Report (Ebbwater Consulting Inc. and Cascadia Coast Research Ltd., 2019) and is intended for the purposes set out in that report only. See the main report for further details on the methodology, results and limitations and references.
 2. Flood water levels were developed using a 0.5% Annual Exceedance Probability (AEP) flood and 0.5 m and 1.0 m Relative Sea Level Rise (RSLR).
 3. The adopted values for sea level rise are based on guidelines from Ausenco Sandwell (2011). These are subject to change and RSLR values may need to be reassessed in future.
 4. A 0.6 m freeboard allowance has been included in water levels in accordance with Ausenco Sandwell (2011).
 5. The Sea Level Rise Planning Areas are based on Flood Construction Levels (FCLs) which were divided into Reaches based on similar flood level values.
 6. The Regional District of Nanaimo does not represent that flooding will not occur outside of the Sea Level Rise Planning Areas indicated on the map.

- Limitations:**
1. The accuracy of the presented FCLs is limited by available data and modelling approaches. The FCLs are based on 10 cross-shore transects. These have been simplified by merging areas of similar transects into FCL reaches. Please refer to report (Ebbwater Consulting Inc. and Cascadia Coast Research Ltd., 2019) for a detailed discussion of limitations.
 2. The accuracy of the floodplain extent is limited by the accuracy of the base mapping data and surveys. The floodplain limits were not established on the ground by legal survey.
 3. This map was produced by Ebbwater Consulting Inc. using generally accepted best practice and guidelines for the Province of British Columbia. However, flooding may still occur outside the defined floodplain boundary, and Ebbwater Consulting Inc. and Cascadia Coast Research Ltd. do not assume any liability by reason of the failure to delineate flood areas on this map.
 4. The areas shown on this map are to provide an assessment of current and future flood hazard to help inform decisions on future land use policy. Under the provisions of the Local Government Act 2004, these areas only take effect when adopted by bylaw or implemented via another planning tool (such as a development permit area). The required setback is defined in RDN Floodplain Management Bylaw No.1469, 2006.
 5. The presented extents are limited to estimates of the effects of a coastal storm flood hazard and they do not include effects of riverine flooding. Flood hazard in estuarine areas (such as Big Qualicum River, Englishman River, Little Qualicum River and French Creek) should be based both on the coastal conditions and river levels. More information on riverine hazard in Englishman River and Little Qualicum River can be found in flood hazard assessments completed by the Province of BC (BC Ministry of Environment 1985 and 1997), however no flood maps exist for other estuarine areas.
 6. Base map and parcel layers were provided by different data owners and are subject to differences.

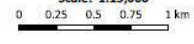
- Data Sources:**
1. Flood Construction Reference Plane (FCRP) values provided by Cascadia Coast Research Ltd.
 2. First Nation Reserve Lands (also known as Indian Reserve Lands) layer was downloaded from DataBC, Province of British Columbia. The other civic boundary layers were provided by the Regional District of Nanaimo.
 3. Provincial Riverine Floodplain layer was downloaded from "Floodplain Maps by Region", BC Ministry of Environment 1985 and 1997, Accessed February 19, 2019.
 4. GDM Humanitarian Data Model and CARTO's Position, created using derivatives of OpenStreetMap data openstreetmap.org (© OpenStreetMap contributors; cartagrapy license CC BY-SA).

- References:**
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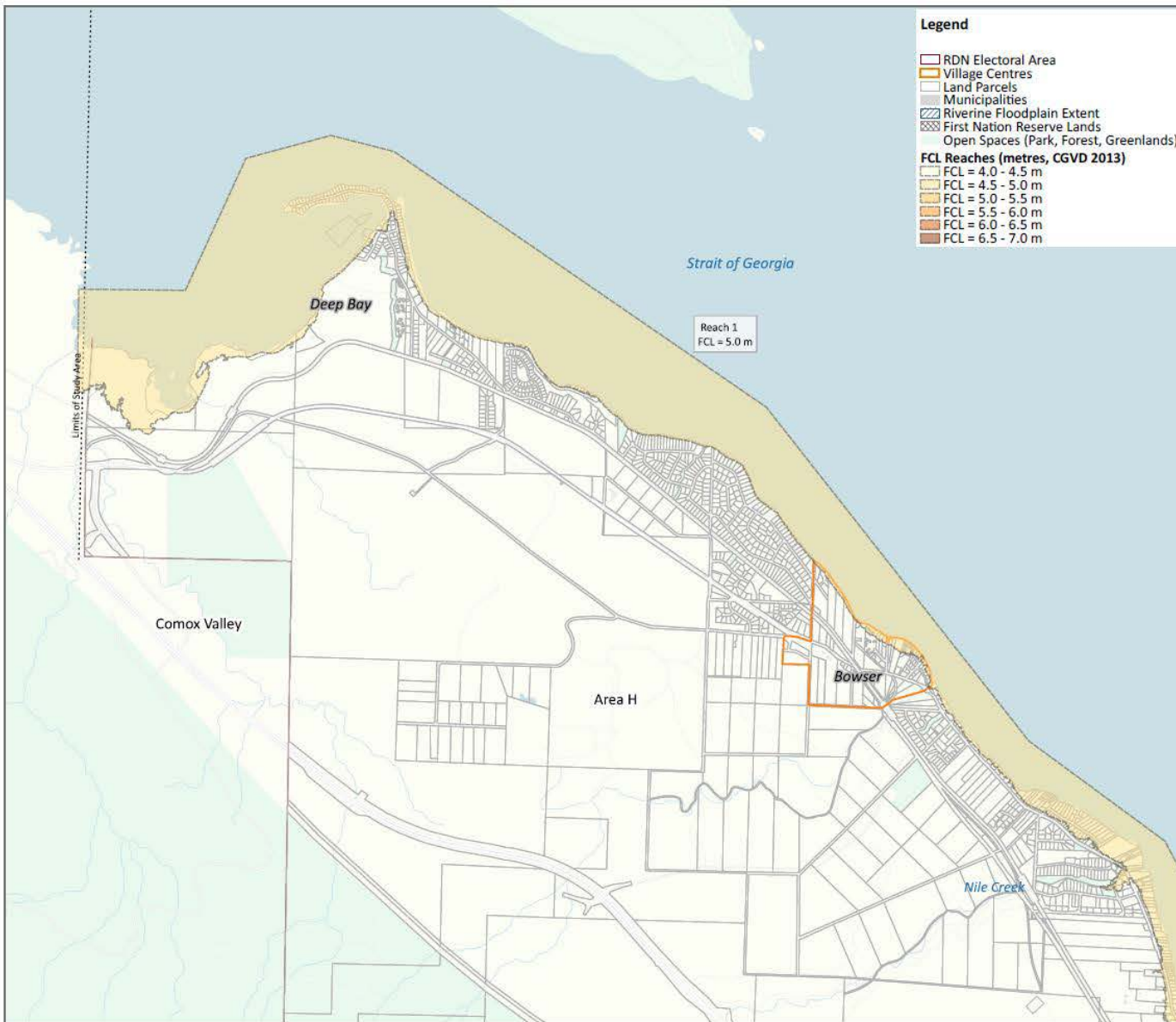
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<p>Prepared By: DW Reviewed By: AC Checked By: TL</p>	



Scale: 1:15,000







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 - Open Spaces (Park, Forest, Greenlands)
- FCL Reaches (metres, CGVD 2013)**
- FCL = 4.0 - 4.5 m
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 - FCL = 6.0 - 6.5 m
 - FCL = 6.5 - 7.0 m

ELECTORAL AREA H (1 OF 3)

FLOOD CONSTRUCTION LEVEL REACH MAP

1.0 m RSL - Map 1 of 10

INSET MAP

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5. Flood Construction Levels (FCLs) have been divided into reaches based on similar flood levels values (FCL values are given relative to CGVD2013).
6. The coloured FCL Reach polygons show floodplain areas as defined by the indicated FCL.
7. The Regional District of Nanaimo (RDN) does not represent that flooding will not occur outside of the indicated FCL Reach and will not exceed the FCLs indicated on the map.
8. Application of the FCLs presented in this map should be done in accordance with relevant policy and regulations by a suitably qualified professional.

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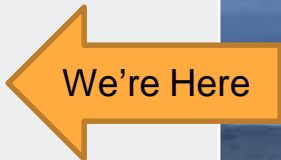
References:

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Date Created: 31 Mar 2019 Coordinate System: NAD83, UTM 10N Vertical Datum: CGVD 2013 Paper Size: Sheet ANS1 D	
Prepared By: DW Reviewed By: AC Checked By: TL	
	Scale: 1:15,000

Where we are...

PHASES	KEY DELIVERABLES
INCEPTION	Backgrounder, Program Plan – complete 2016
RESEARCH	Acquire LiDAR – completed 2017 Develop coastal flood hazard maps – completed 2019 Update land use bylaws – pending approval Update riverine floodplain maps (3) – pending 2020 - 2023 Combined coastal + riverine flood risk assessment – pending 2024
PLAN	Adaptation Strategy - pending
IMPLEMENT	Various departmental implementation projects - pending



Proposed Next Steps

Request the Board direct:

- **the coastal flood hazard maps be communicated to the public**
- **the applicable land use bylaw amendments be reviewed & updated to incorporate the findings of the Coastal Floodplain Mapping Project**