Sea-Level Rise and Flooding Scenarios

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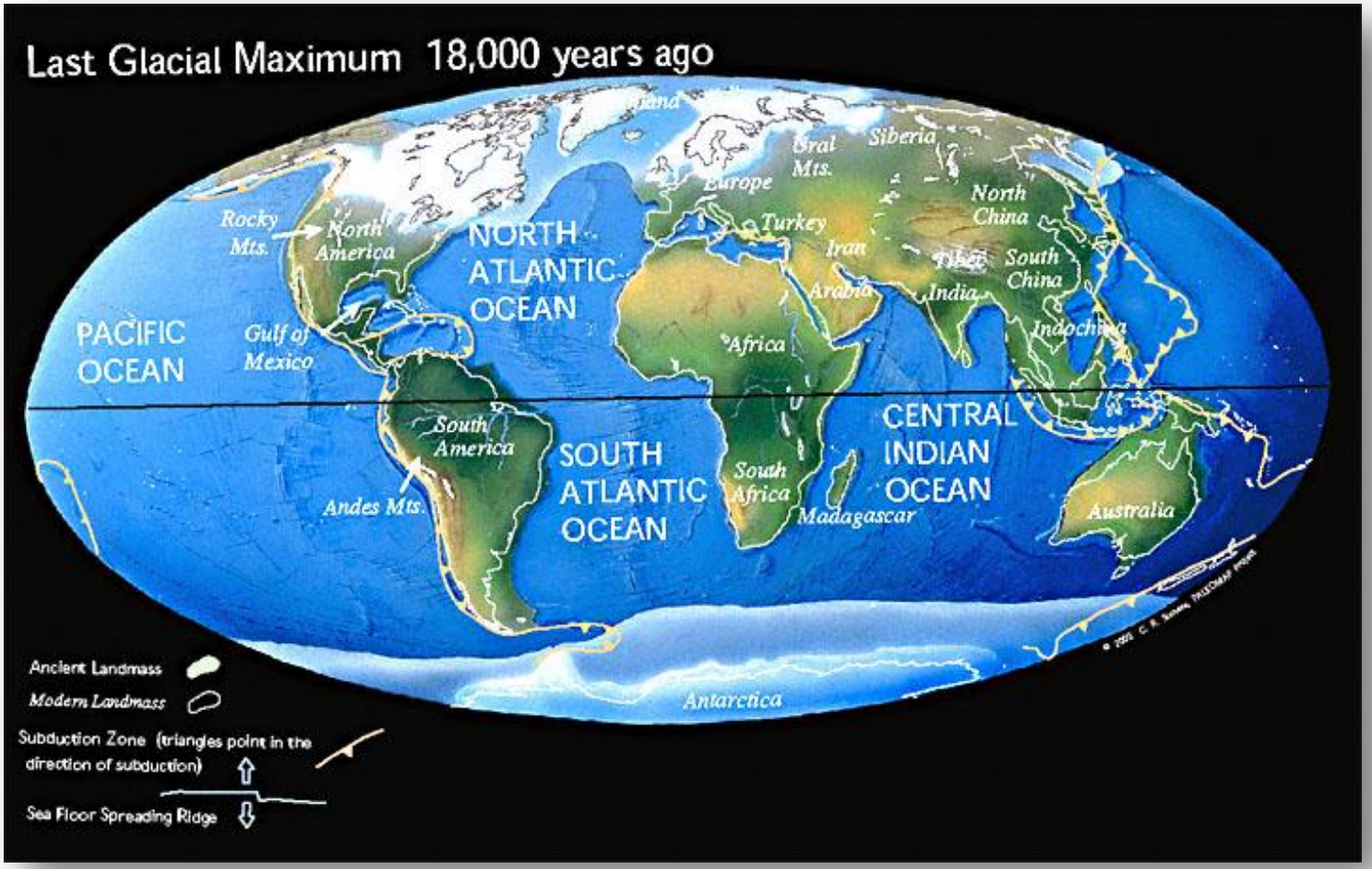
Outline

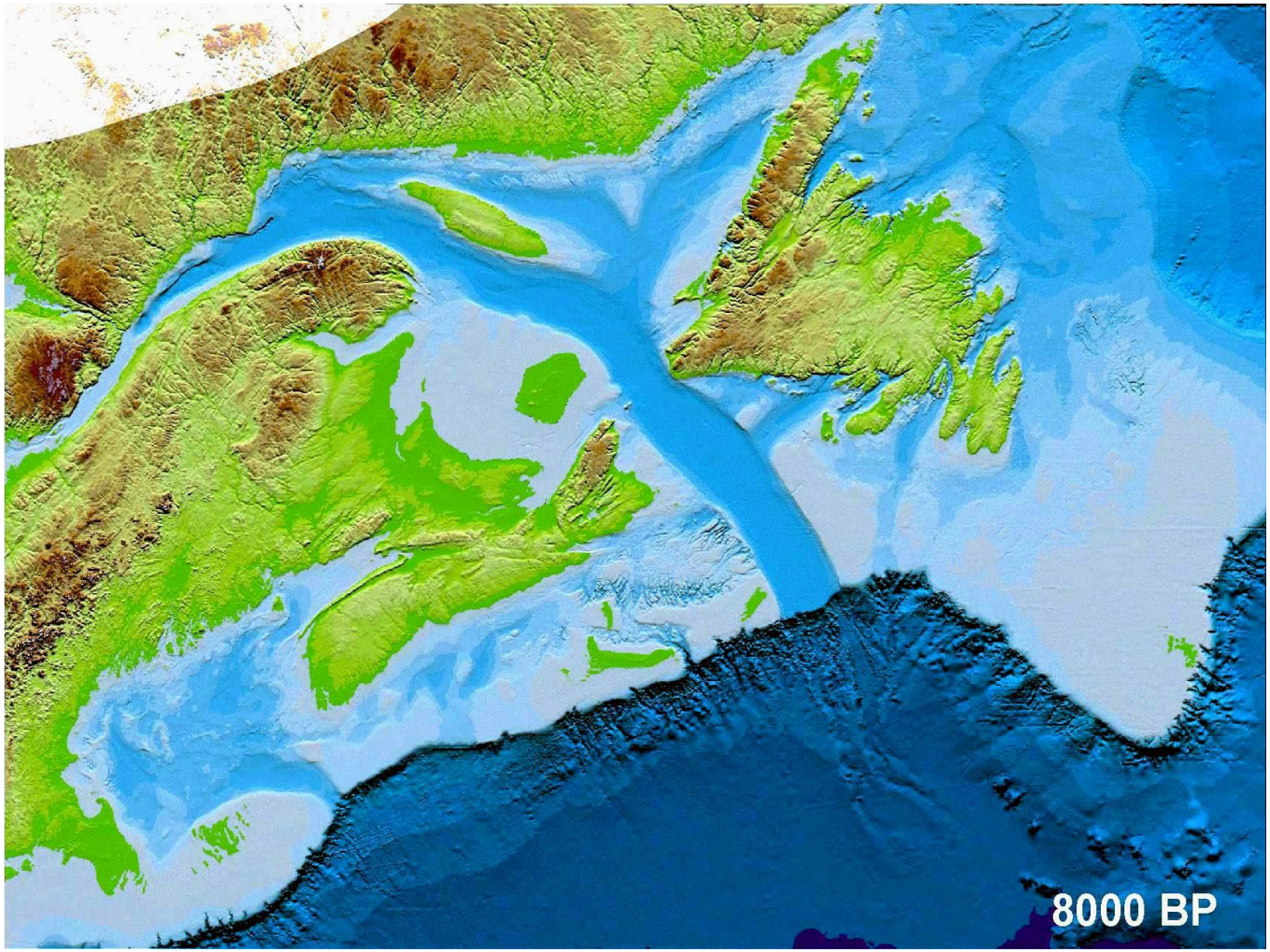
- *Historical Sea-Level Rise*
- *Future Predictions*
- *Storm Surge Scenarios*
- *Coastal Zone Flooding Scenarios*
- *LiDAR Depictions*

Sea-Level rise of 120 m in past 18,000 Years



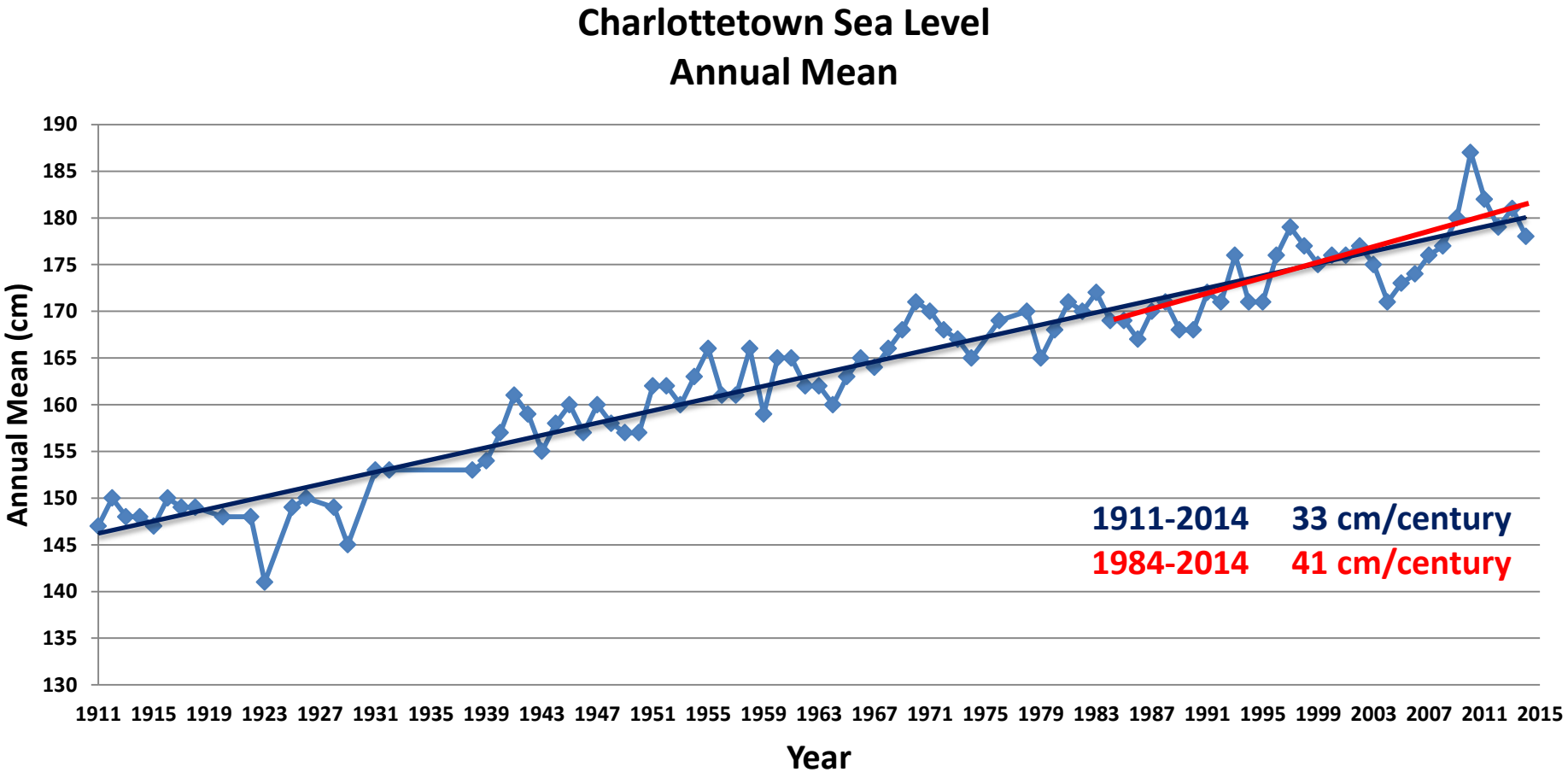
Source: Scotese, C. R., 2001. Atlas of Earth History, Volume 1, Paleogeography, PALEOMAP Project, Arlington, Texas, 52 pp.

8,000 Years Ago …



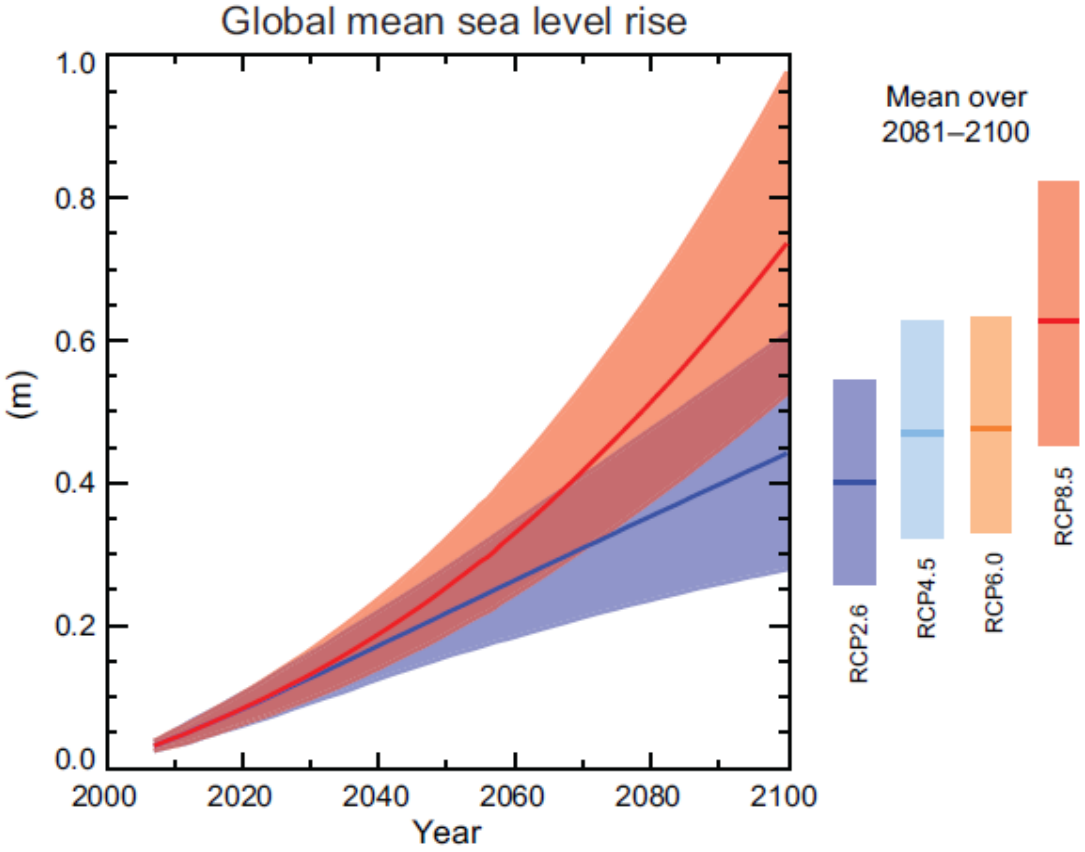
Source: John Shaw, GSC

Charlottetown Sea-Level Trends 1911-2014



Source: R.J. Daigle Enviro

IPCC Global Sea-Level Rise Estimates



Main Global Factors:

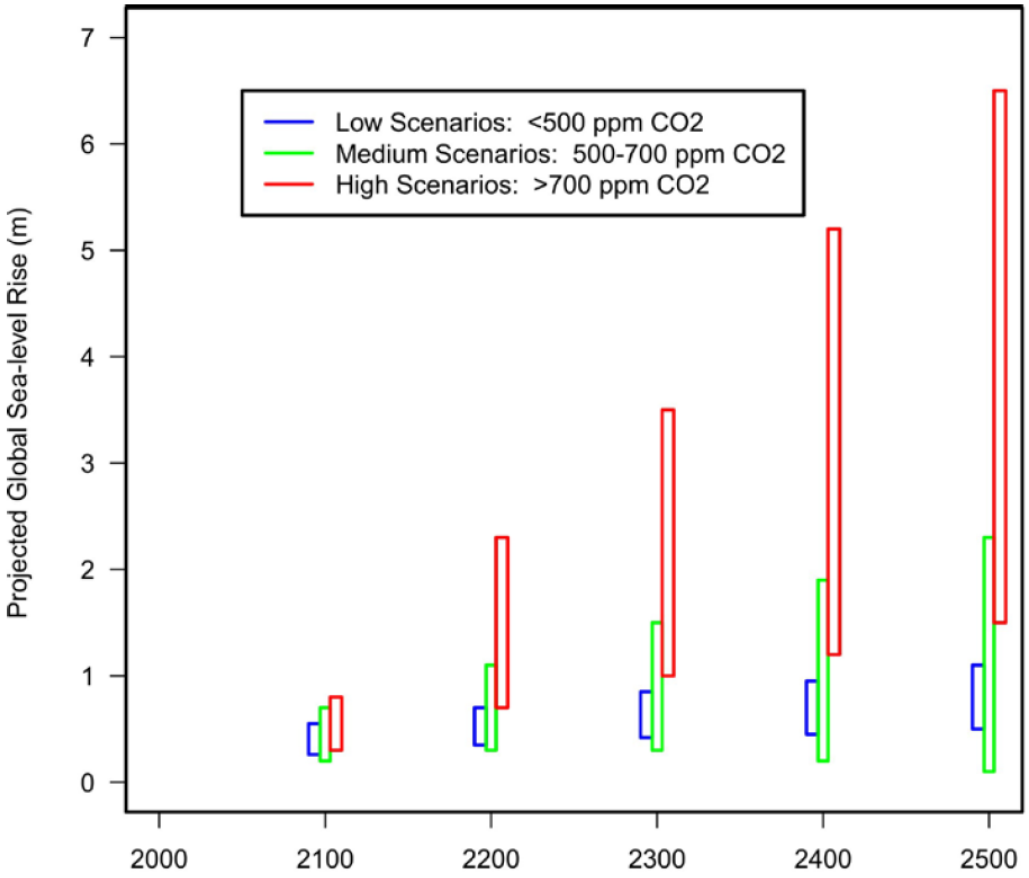
- **Thermal Expansion of Oceans**
- **Ice Sheet (Greenland, Antarctica) and Glacier melting**

Main Regional Factors:

- **Re-distribution of Ice meltwater**
- **Vertical Land Motion**
- **Oceanographic Effect**

Source: IPCC AR5

Long-Term Global Sea-Level Rise Estimates



Source: IPCC AR5

Regional Factor– Redistribution of Ice Cap and Glacier Meltwater

Antarctica

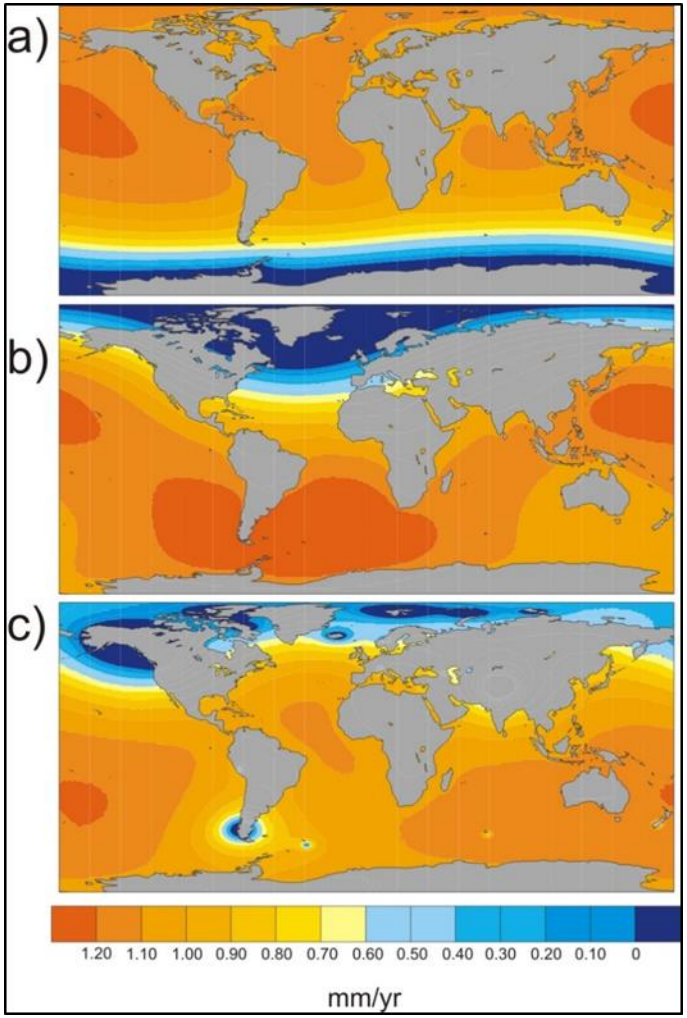
10 cm ≈ 11 cm

Greenland

10 cm ≈ 3 cm

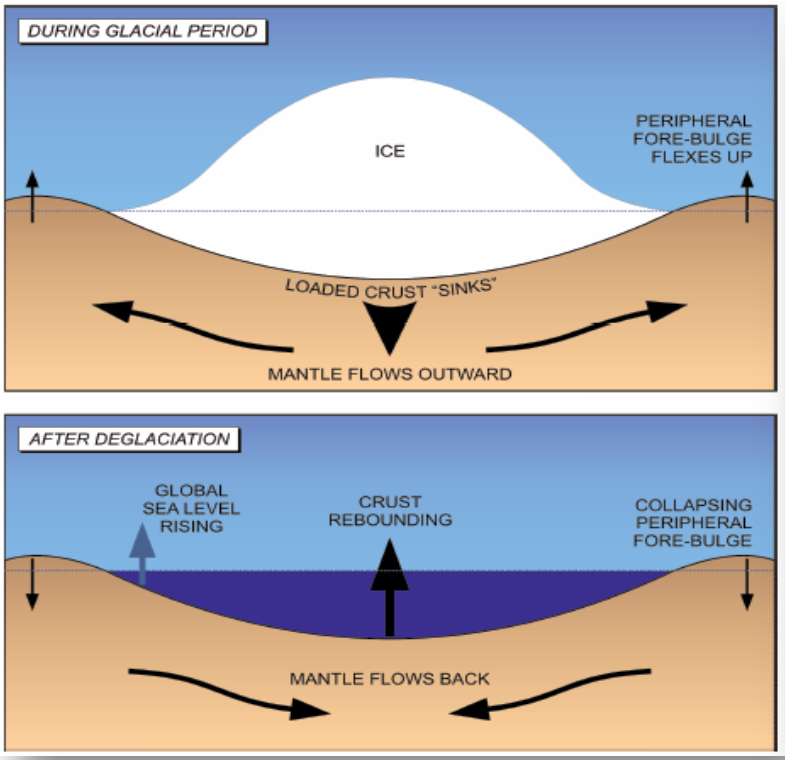
Mountain Glaciers

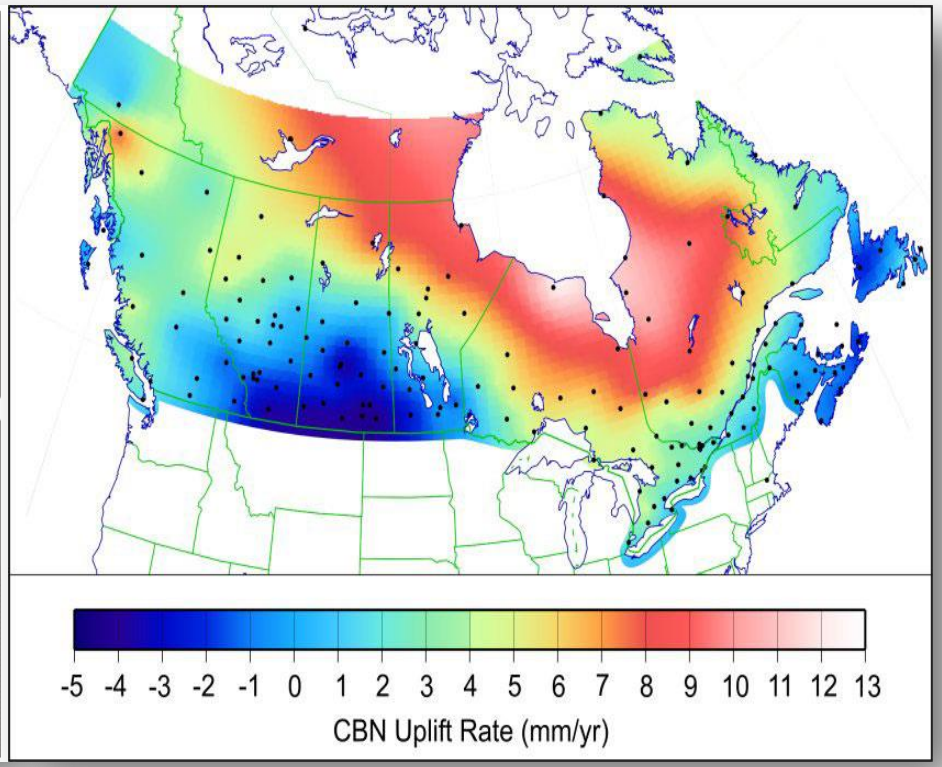
10 cm ≈ 9 cm



Source: IPCC AR5

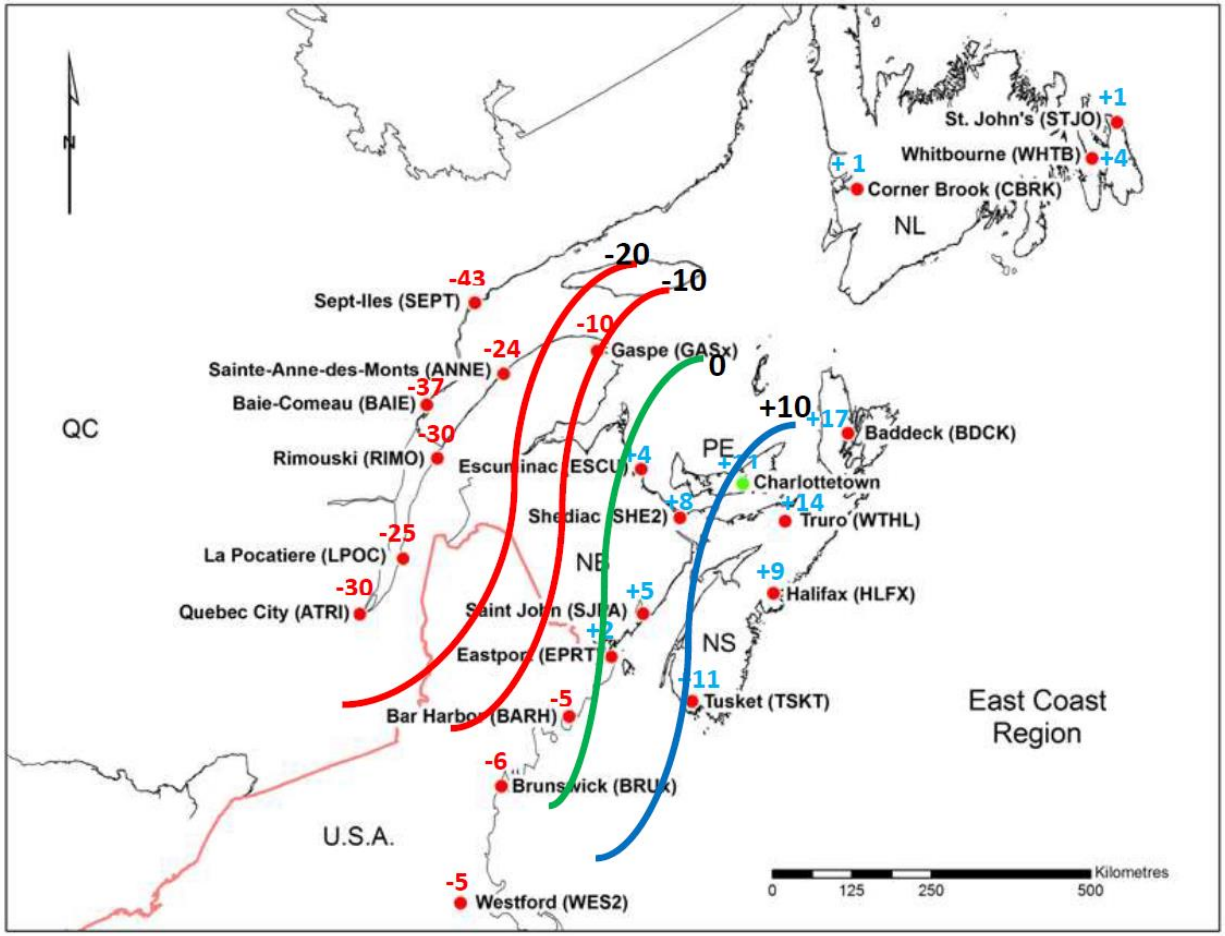
Regional Factor – Vertical Land Motion





Source: (Henton, Craymer, Ferland, Dragert, Mazzotti, & Forbes, 2006)

Regional Factor – Vertical Land Motion



Source: James, et al., 2014

Other Regional Factors

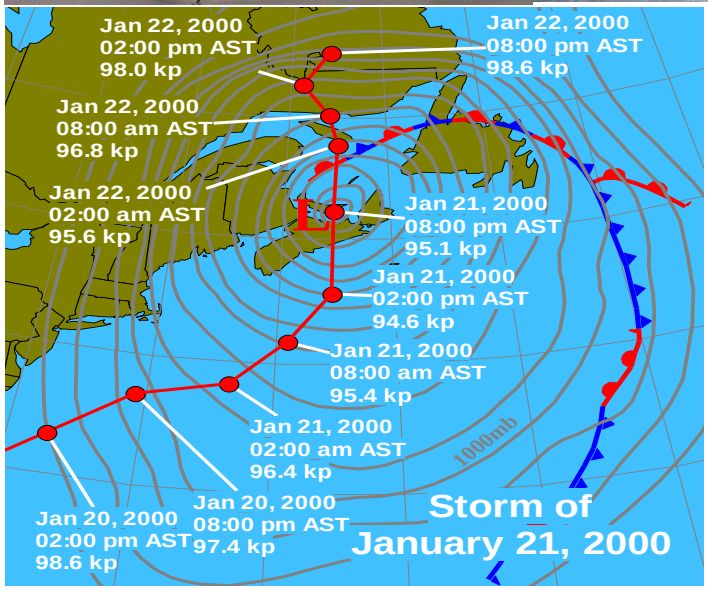
- ***Regional Oceanographic Effects***
  - *Diminution of Gulf Stream (≈ +18 cm)*
  - *Bay of Fundy Tidal Range Increase (≈ +10cm)*

- ***Land Water Storage***
  - *Extraction of Ground Water*
  - *Reservoir Impoundment (Dams)*
  - *Combined Effect Minimal*

Resulting Sea Level Rise Estimates to 2100

- **Campbellton** **63 cm ± 19**
- **Bathurst** **70 cm ± 19**
- **Miramichi** **77 cm ± 19**
- **Bouctouche** **79 cm ± 19**
- **Shediac** **82 cm ± 19**
- **Saint John** **91 cm ± 19**
- **Sackville** **93 cm ± 19**

Baseline Storm – 21 Jan 2000
2-Metre Storm Surge

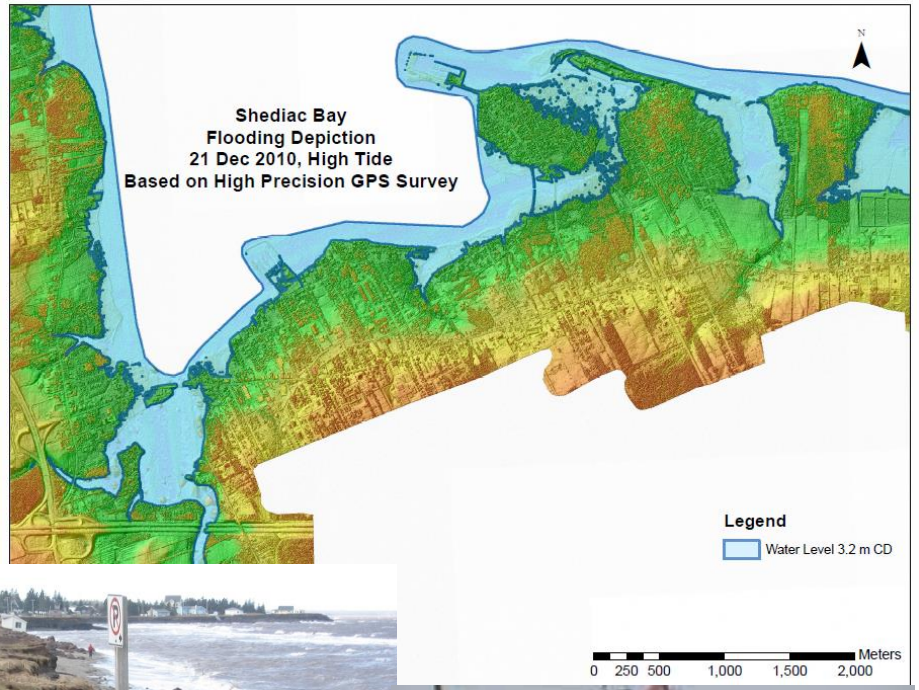


Predicted High Tide – 1.6m
Measured Tide – 3.6 m

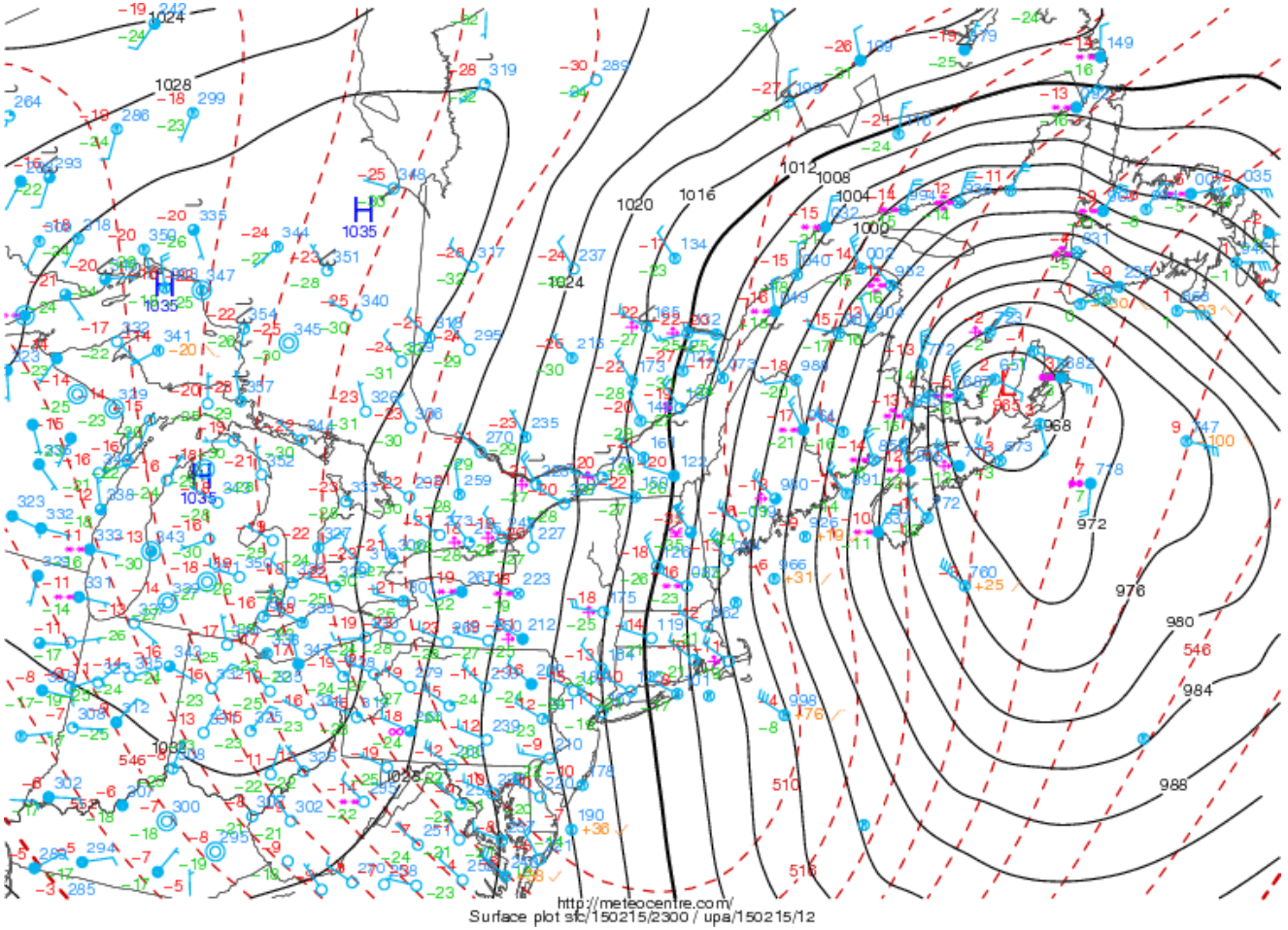
Source: Impacts of Sea-Level and Climate Change on the Coastal Zone of SE NB, Environment Canada 2006

December 21, 2010 Storm Surge

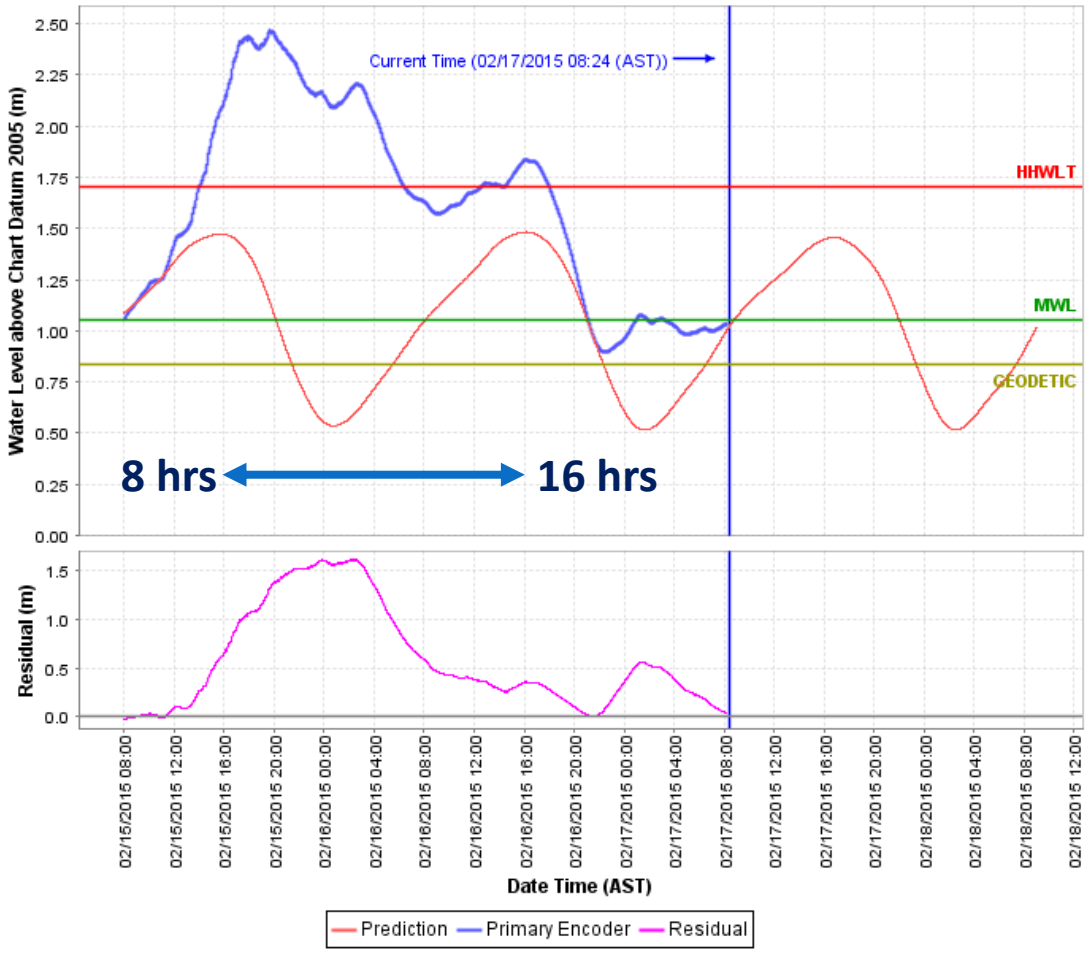
1.7 m Surge
21 Dec 2010



February 15, 2015 Storm – 1.6 m Storm Surge

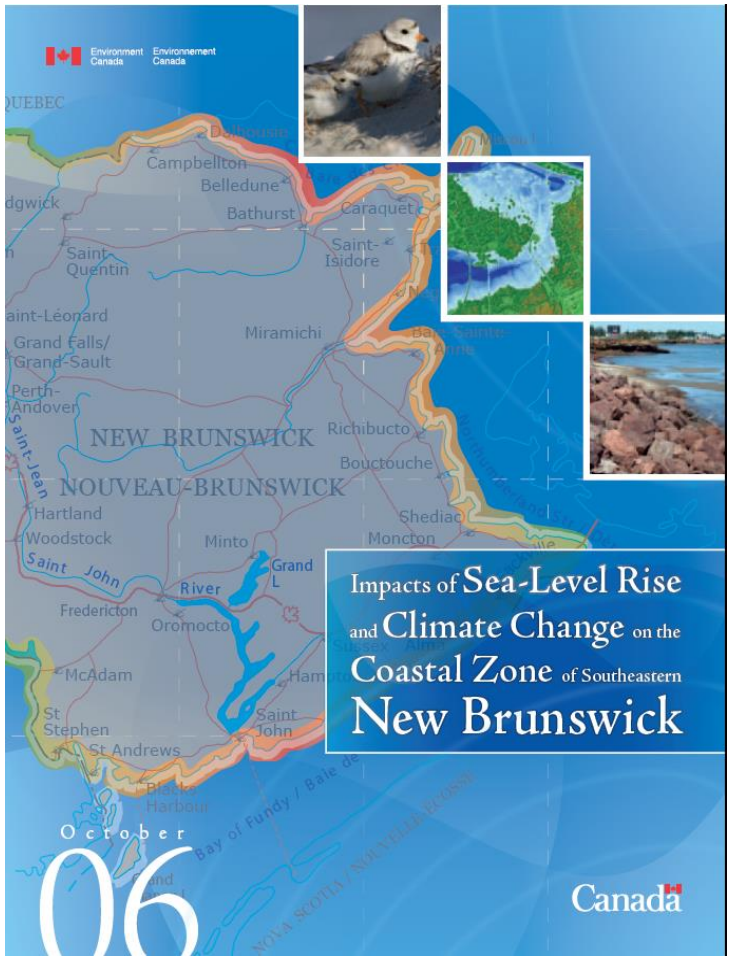


Shediac Water Level Recording Feb 15, 2015



Data Source: Canadian Hydrographic Service

NB Sea Level Rise Project 2003-2006

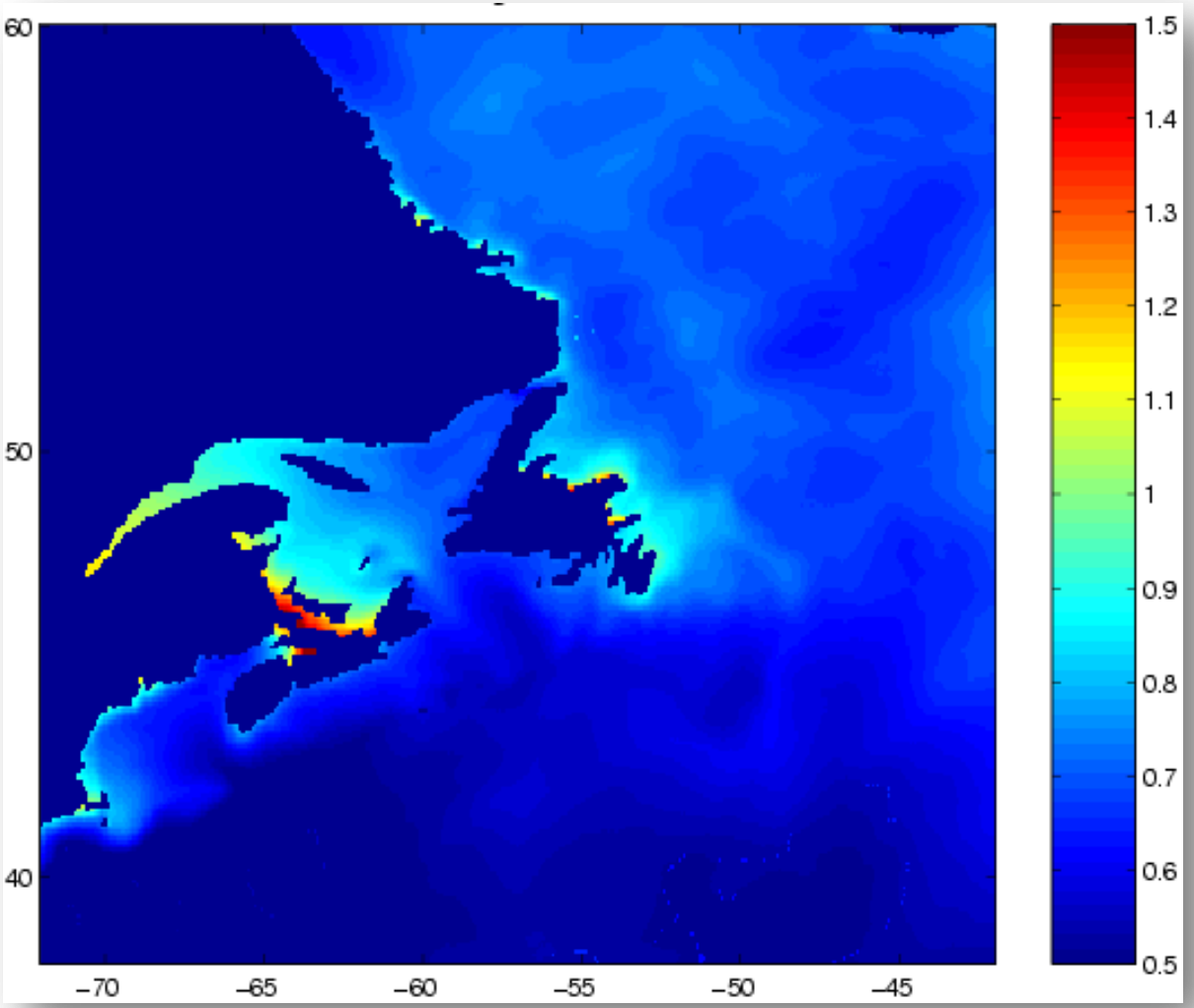


Project Lead: ***Environment Canada***

Research Partners:

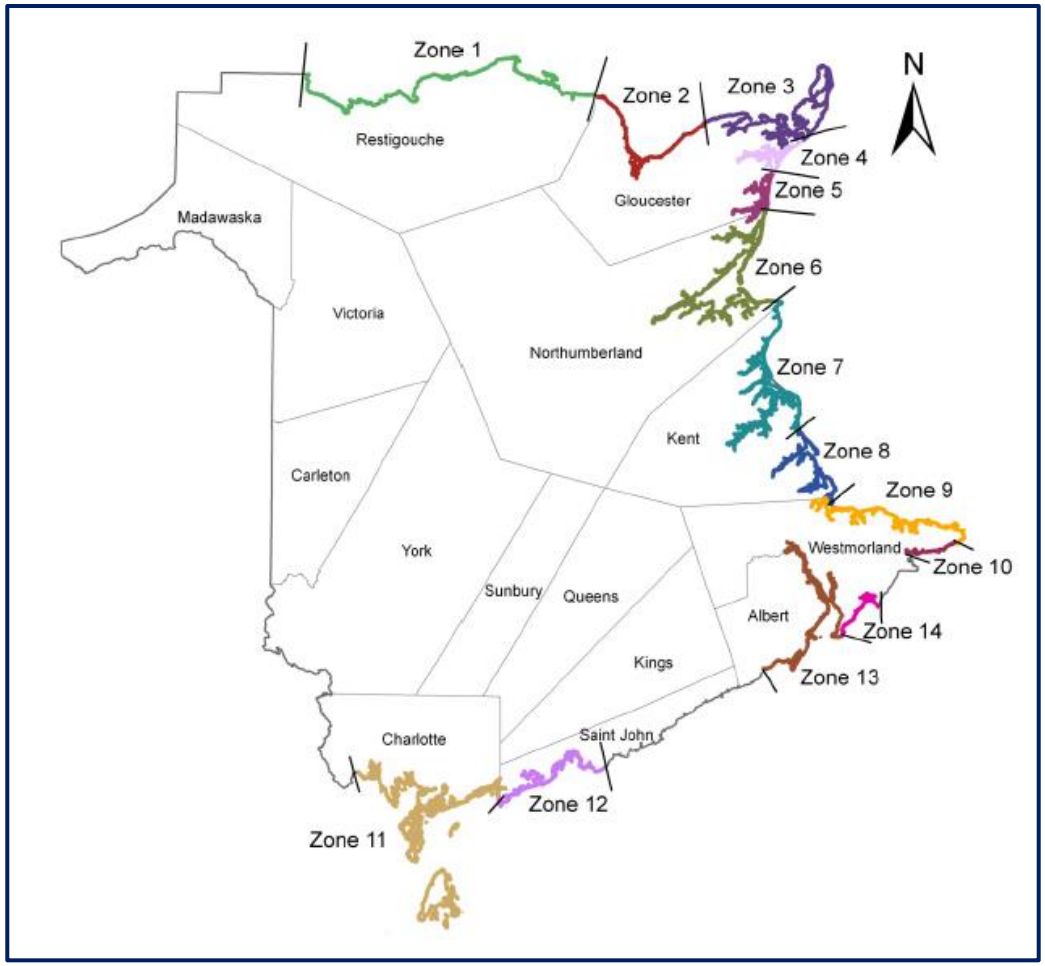
Université de Moncton
University of New Brunswick
Mount Allison University
Dalhousie University
Université Laurentian University
Centre of Geographic Sciences
Université de Sherbrooke
NB Department of Environment
NB Department of Natural Resources
Environment Canada
Natural Resources Canada
Parks Canada Agency
Fisheries and Oceans Canada

Storm Surge 40-Year Return Model



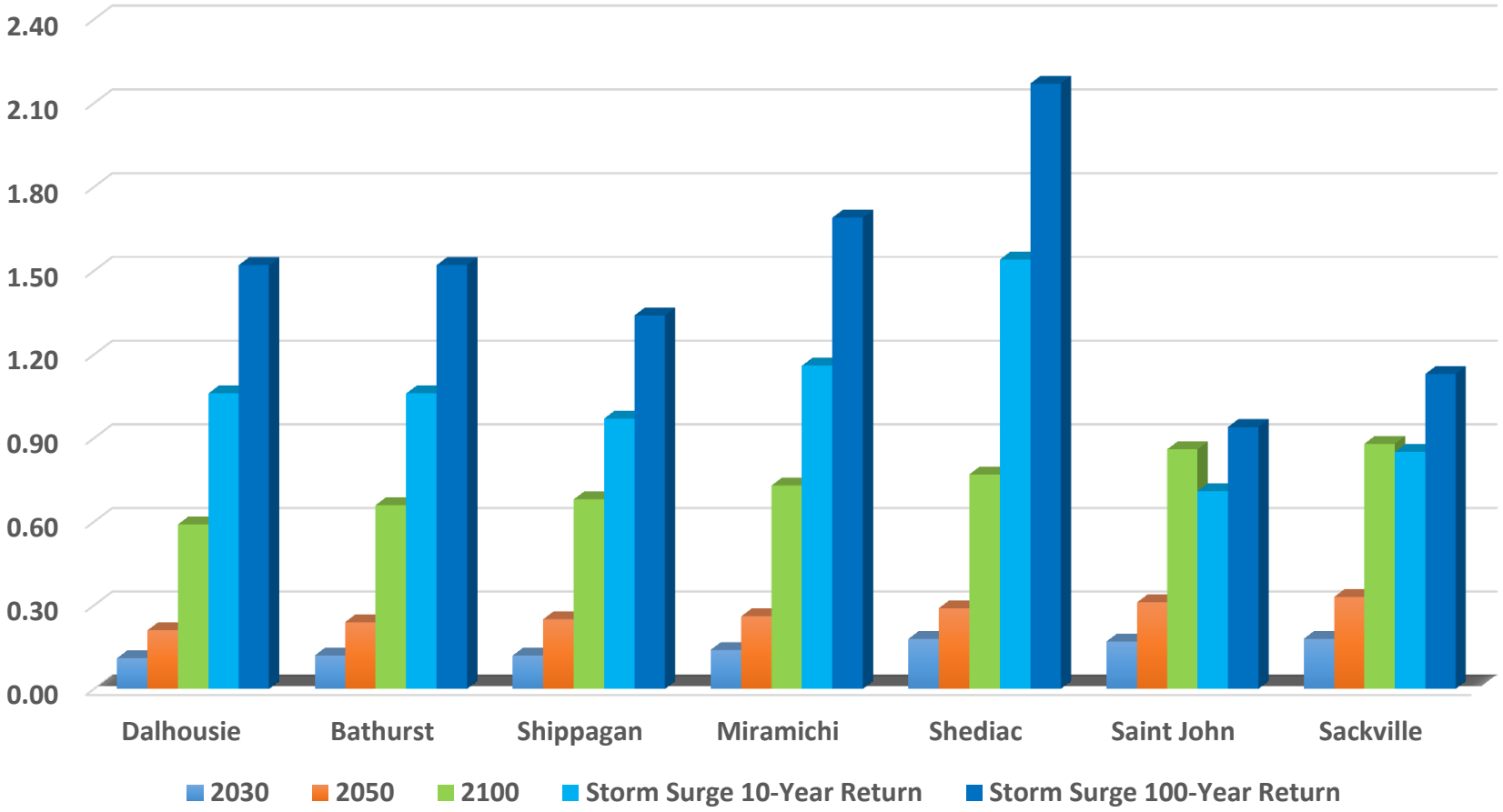
Source: Hal Ritchie, Environment Canada; Natacha Bernier, Keith Thompson, Jeff MacDonald, Jie Ou, Dalhousie University

Flooding Scenario Zones



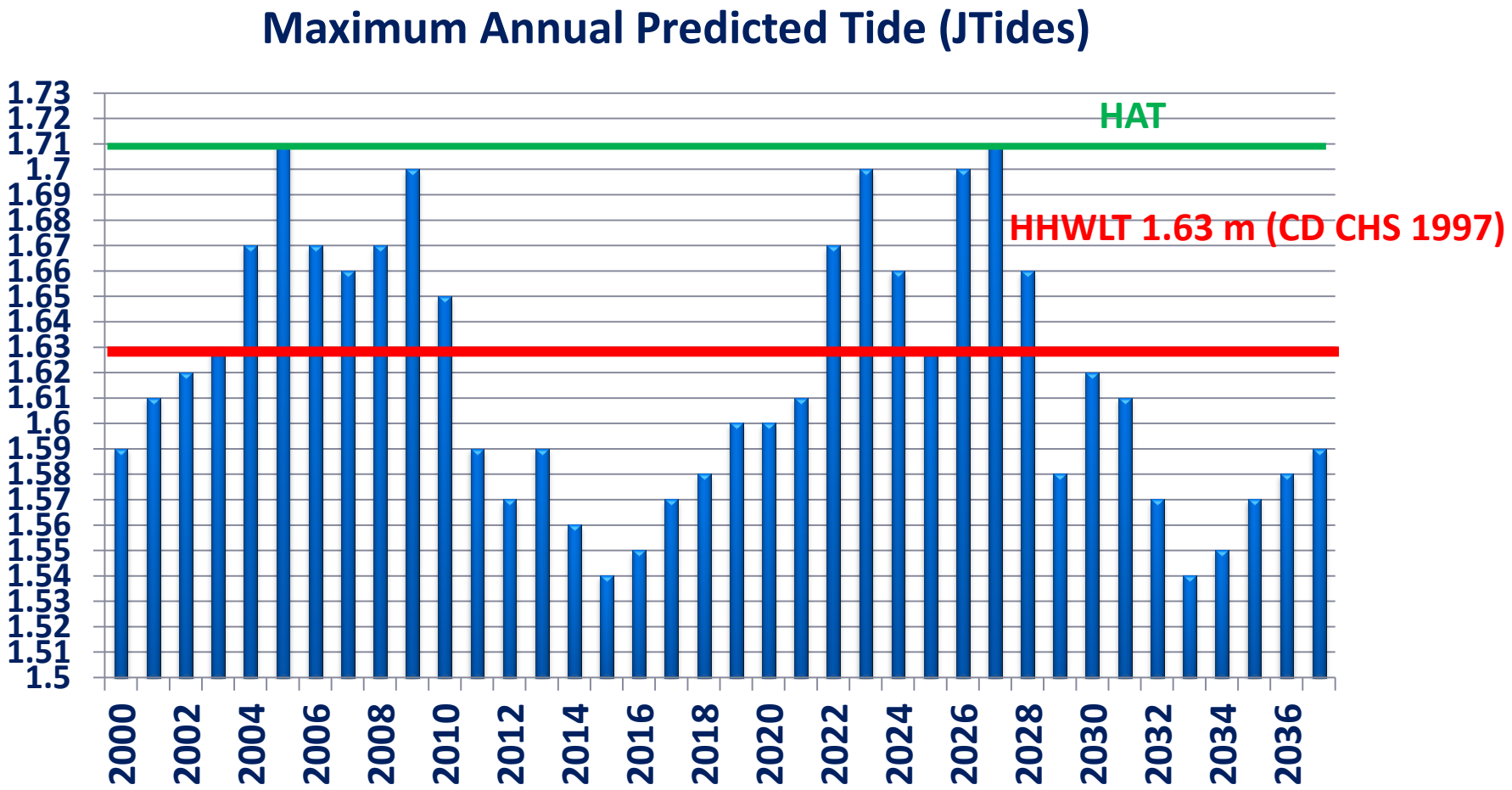
Map Source: NB ELG

Sea-Level Rise and Coastal Flooding



Source: R.J. Daigle Enviro

HHWLT Baseline – Shediac Example

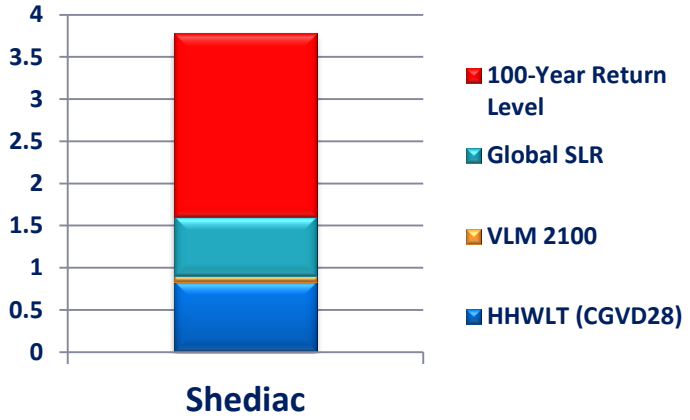


Source: R.J. Daigle Enviro

Flooding Scenarios

Flooding Level =

HHWLT Baseline



+ Adjusted Global Sea-Level Rise Component

+ Vertical Land Movement Component

+ Storm Surge Return Period Component (1-, 2-, 5-, 10-, 25-, 50- and 100-Year)

(for each of Years 2010, 2030, 2050 and 2100)

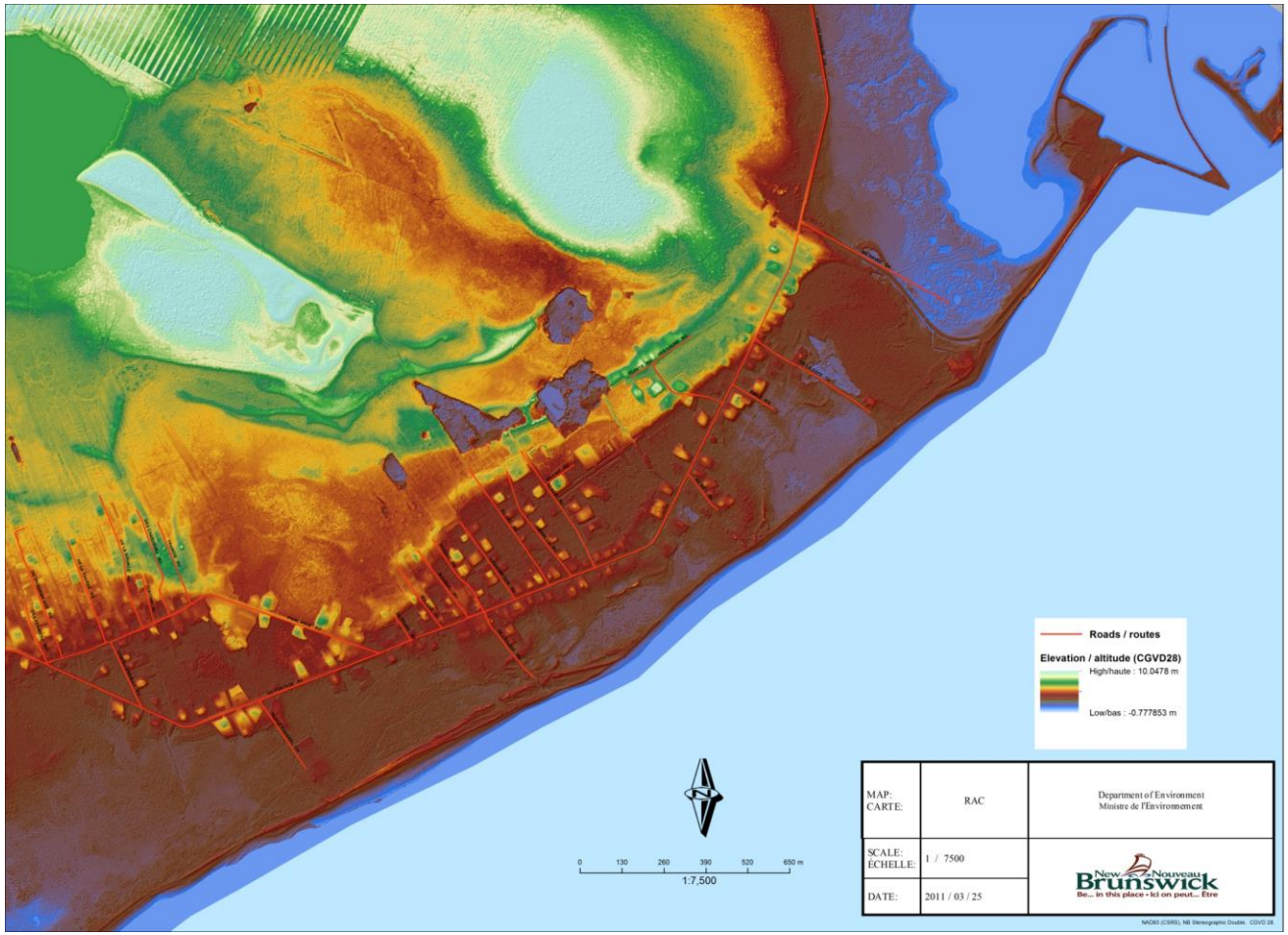
Source: R.J. Daigle Enviro

Zone 9 (Shediac Bay) Flooding Scenarios

Zone 9: Westmorland County - County Line to Cape Spear, HHWLT 0.7 m ± 0.1 (CGVD28)					
Return Period	Surge Residual	Level 2010	Level 2030	Level 2050	Level 2100
1-Year	0.92 ± 0.20	1.62 ± 0.30	1.78 ± 0.37	1.91 ± 0.44	2.39 ± 0.68
2-Year	1.11 ± 0.20	1.81 ± 0.30	1.97 ± 0.37	2.10 ± 0.44	2.58 ± 0.68
5-Year	1.36 ± 0.20	2.06 ± 0.30	2.22 ± 0.37	2.35 ± 0.44	2.83 ± 0.68
10-Year	1.54 ± 0.20	2.24 ± 0.30	2.40 ± 0.37	2.53 ± 0.44	3.01 ± 0.68
25-Year	1.79 ± 0.20	2.49 ± 0.30	2.65 ± 0.37	2.78 ± 0.44	3.26 ± 0.68
50-Year	1.98 ± 0.20	2.68 ± 0.30	2.84 ± 0.37	2.97 ± 0.44	3.45 ± 0.68
100-Year	2.17 ± 0.20	2.87 ± 0.30	3.03 ± 0.37	3.16 ± 0.44	3.64 ± 0.68

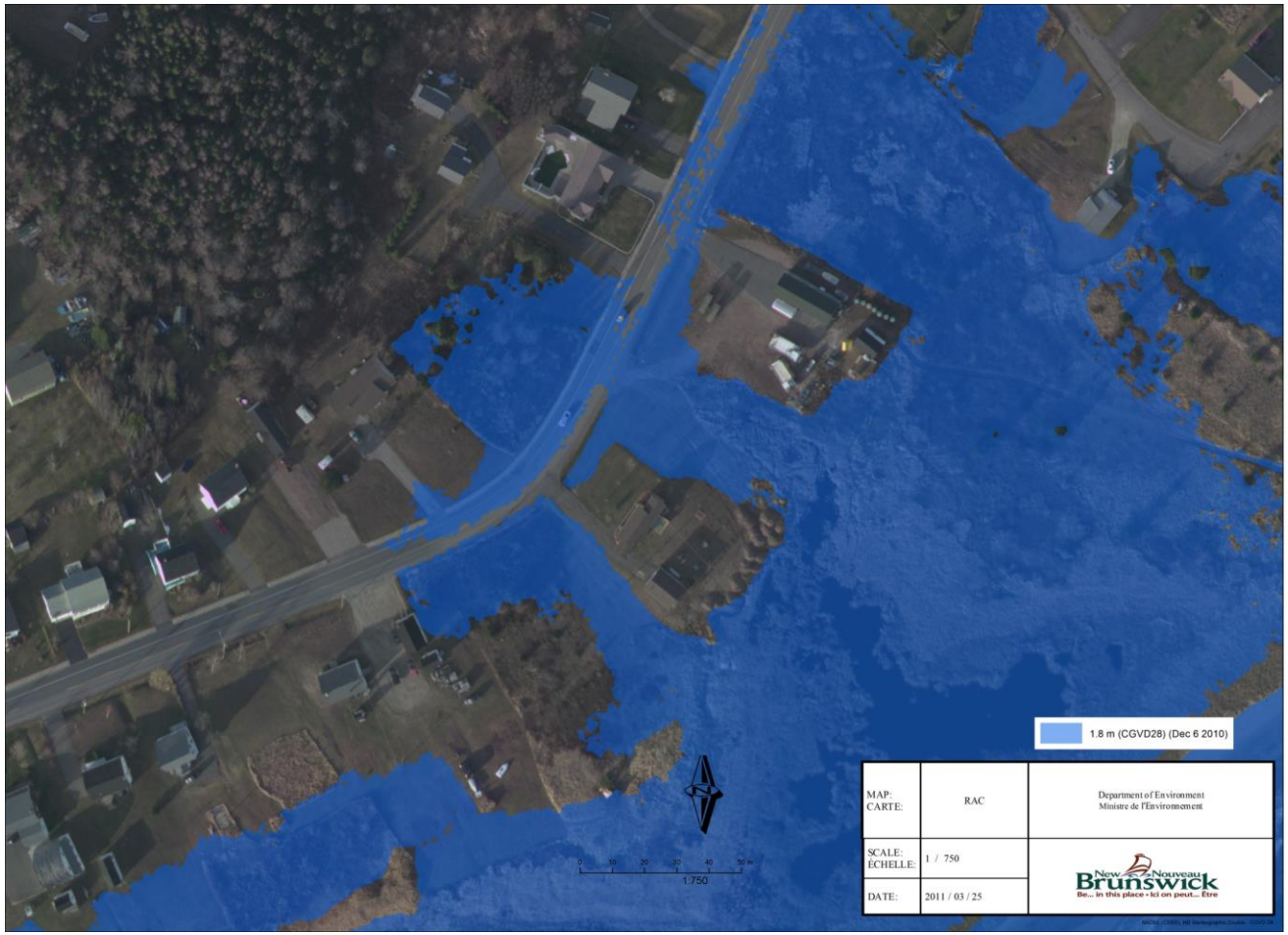
Source: R.J. Daigle Enviro

LiDAR Elevations – Le Goulet



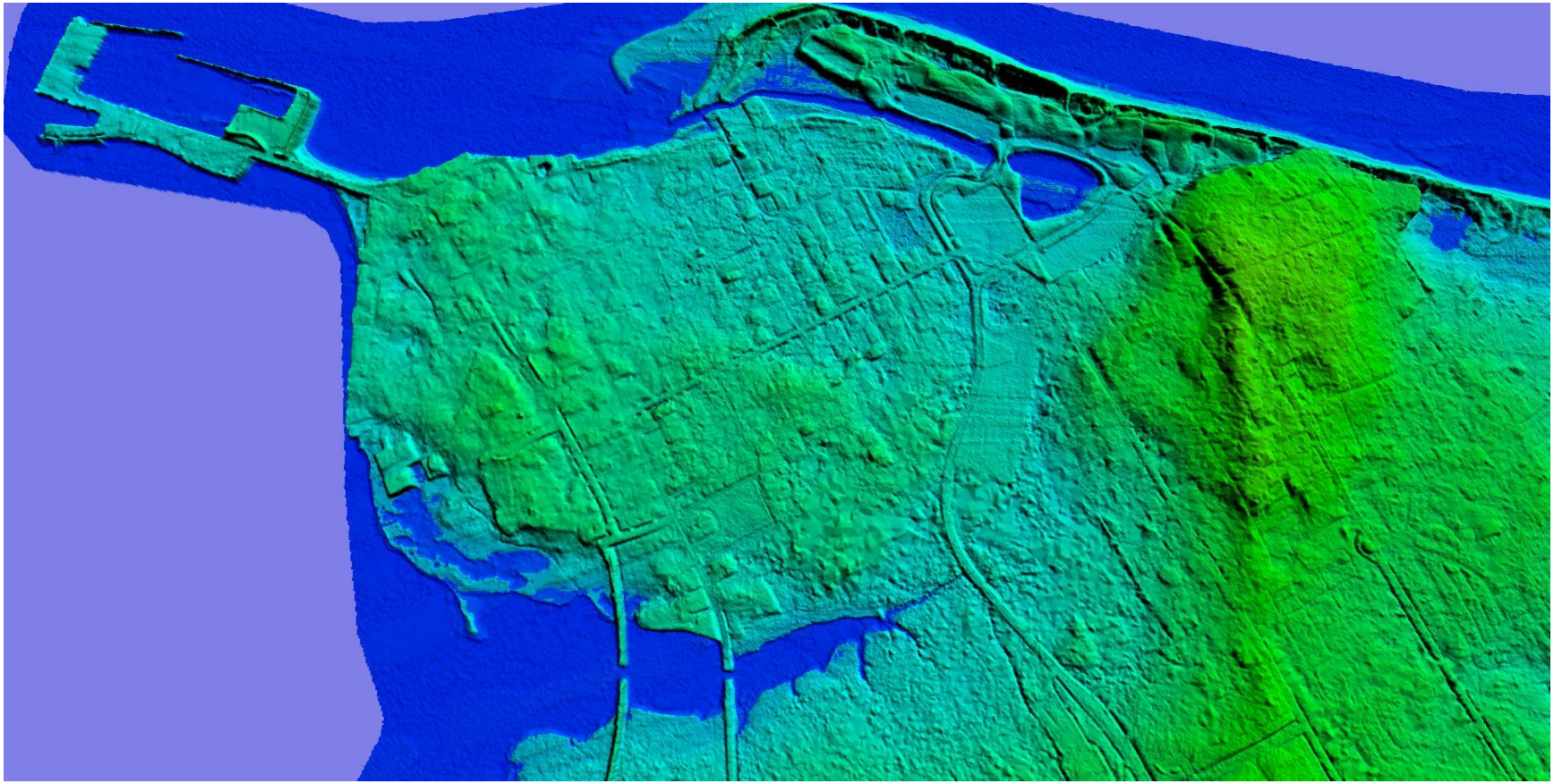
Source: NB ELG

Le Goulet – Dec 6, 2010 Storm Surge



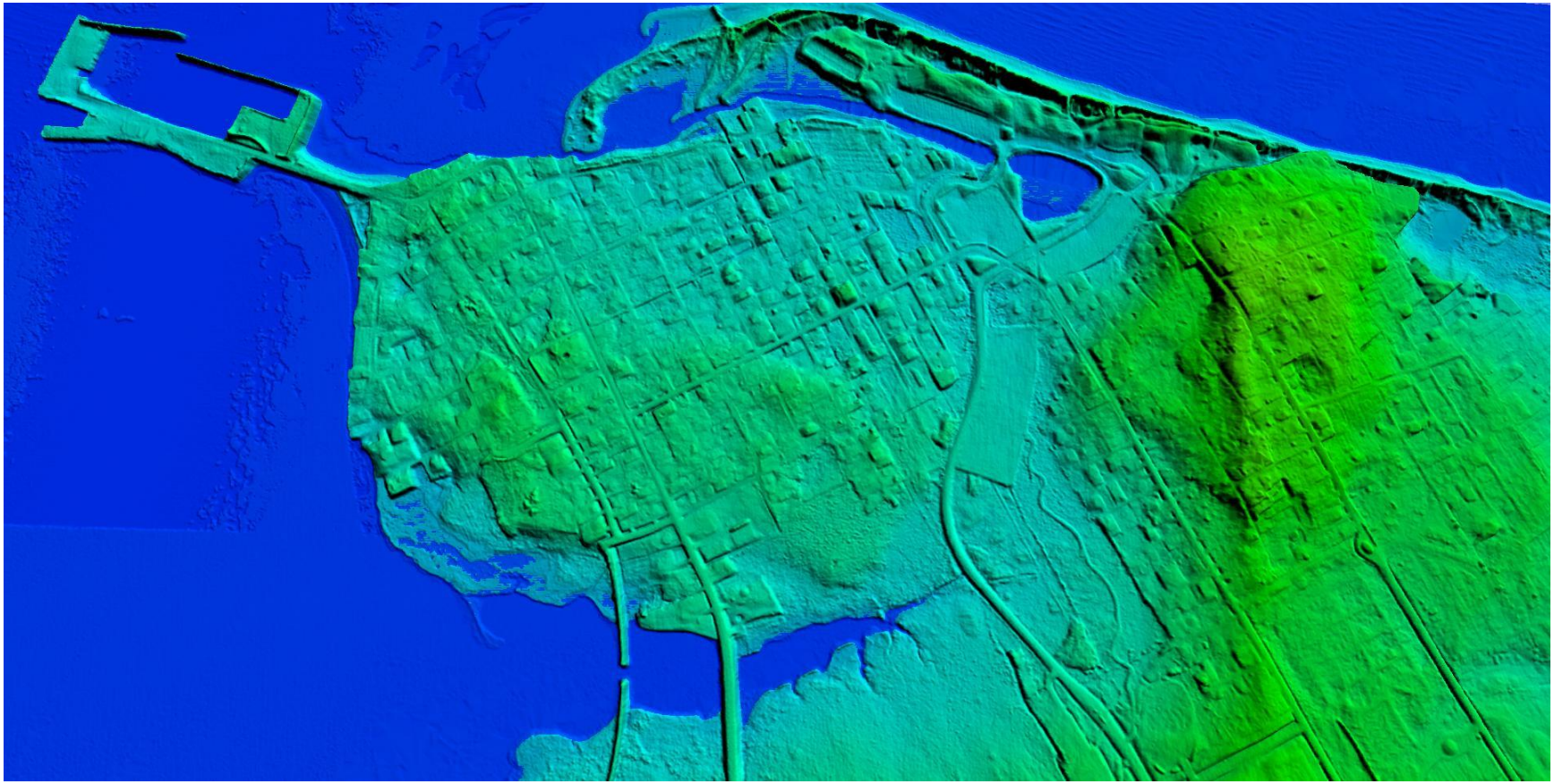
Source: NB ELG

Pointe-du-Chêne 2003 LiDAR DEM



Source: R.J. Daigle Enviro using 2003 EC LiDAR

Pointe-du-Chêne 2013 LiDAR DEM



Source: R.J. Daigle Enviro using 2013 NB ELG LiDAR

Pointe-du-Chêne

Source: R.J. Daigle Enviro using 2013 NB ELG LiDAR and Orthos

Pointe-du-Chêne – Jan 2000 Storm
2003 LiDAR Elevations

Water Level 2.84 m CGVD28

Source: R.J. Daigle Enviro using 2013 NB ELG Orthos and 2003 EC LiDAR

Pointe-du-Chêne – Jan 2000 Storm
2013 LiDAR Elevations

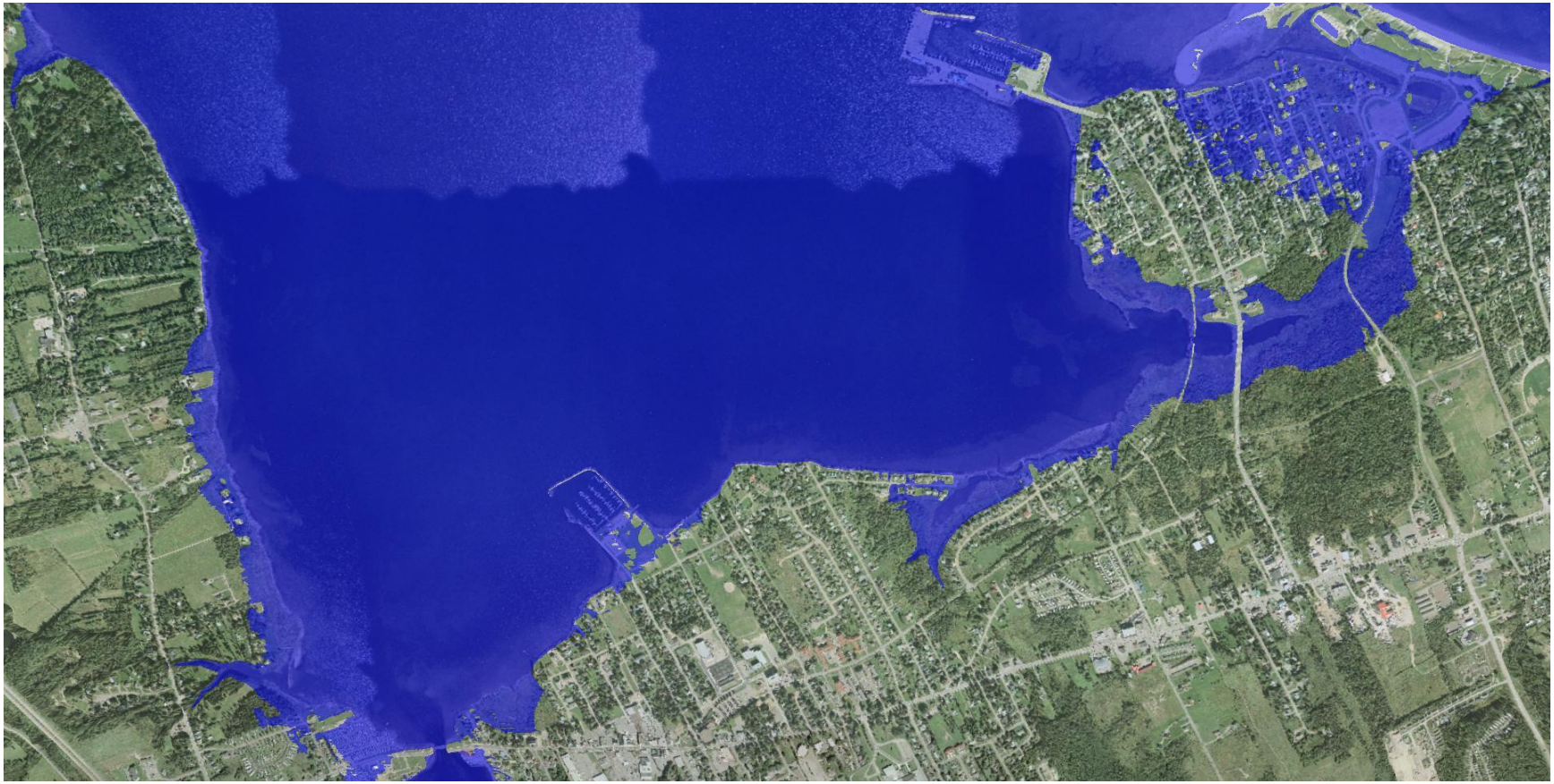
Water Level 2.84 m CGVD28

Source: R.J. Daigle Enviro using 2013 NB ELG LiDAR and Orthos

Shediac Bay

Source: R.J. Daigle Enviro using 2013 NB ELG LiDAR and Orthos

Shediac Bay 25-Year Flooding Scenario 2010



Water Level 2.49 m CGVD28 (21 Dec 2010, 2.4m)

Source: R.J. Daigle Enviro using 2013 NB ELG LiDAR and Orthos

Shediac Bay 25-Year Flooding Scenario 2100

Water Level 3.45 m CGVD28

Source: R.J. Daigle Enviro using 2013 NB ELG LiDAR and Orthos

St Andrews Normal Tides

Source: R.J. Daigle Enviro

St Andrews 25-Year 2010 Scenario

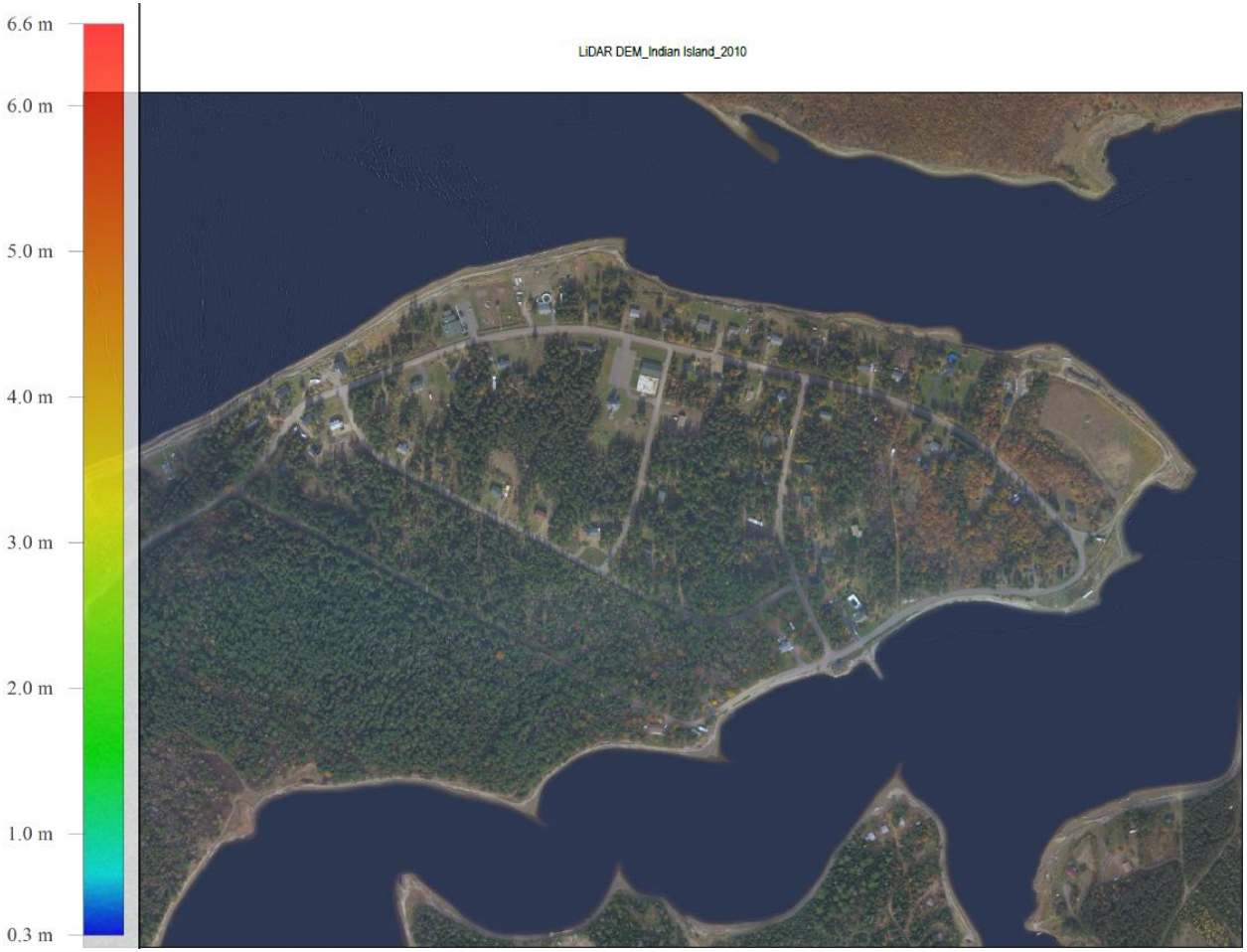
R.J. Daigle Enviro

Source: R.J. Daigle Enviro

St Andrews 25-Year 2100 Scenario

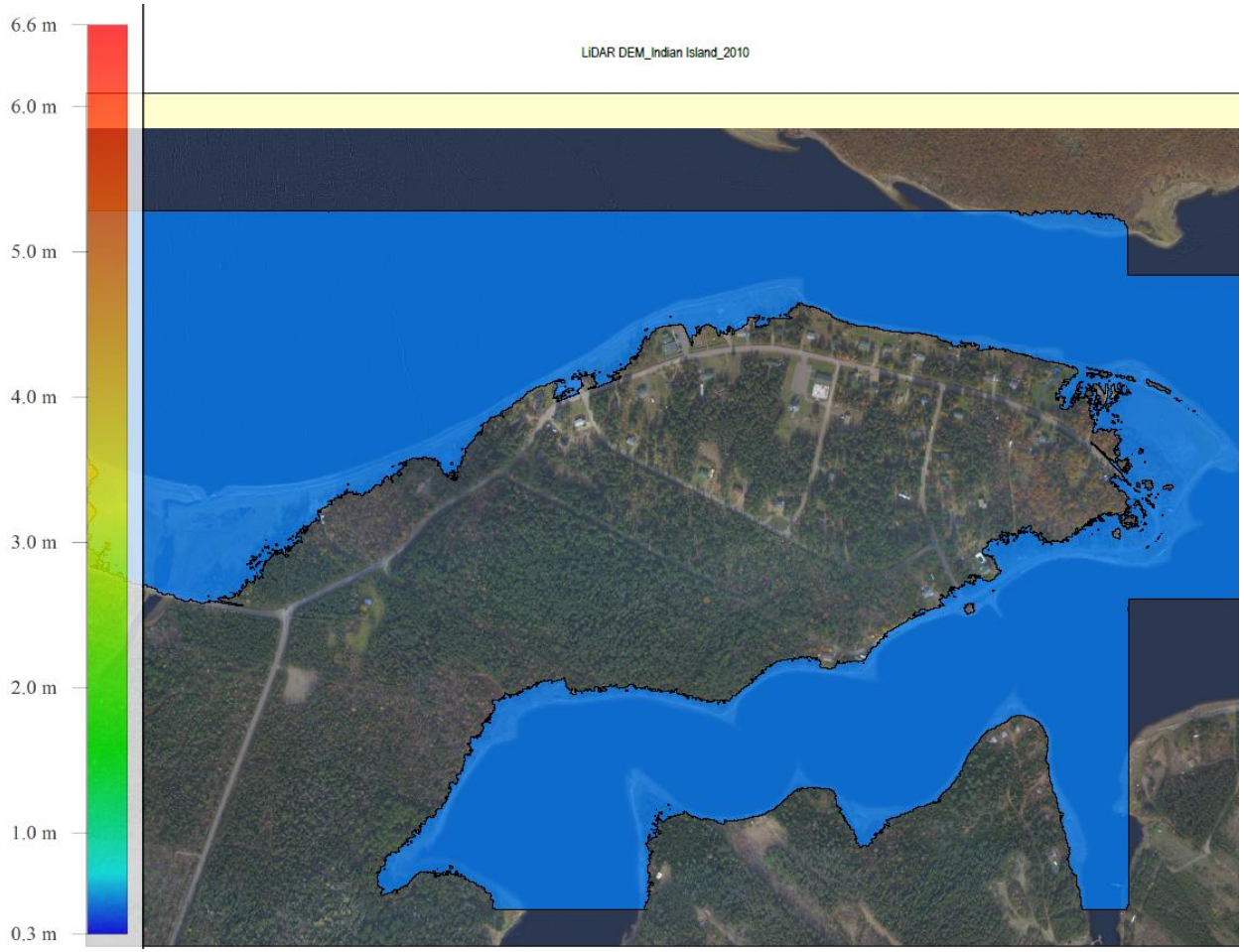
Source: R.J. Daigle Enviro

Indian Island First Nation



Source: R.J. Daigle Enviro

Indian Island First Nation – Dec 2010 Storm Surge Flooding



Source: R.J. Daigle Enviro

Indian Island First Nation – Subsequent Shore Protection

Source: R.J. Daigle Enviro

Indian Island First Nation – Subsequent Protection from Dec 2010 Storm

Source: R.J. Daigle Enviro

Merci!
Thank You!