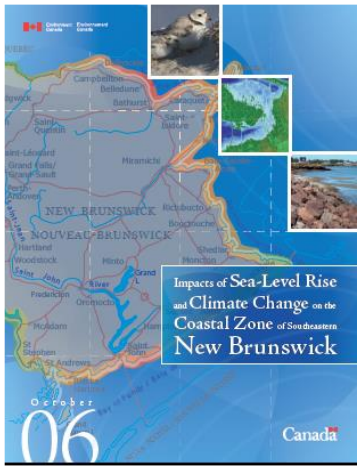


Sea-Level Rise and Flooding Estimates for New Brunswick Coastal Sections

Final Report

January 2012

Updated Sea-Level Rise and Flooding Estimates for New Brunswick Coastal Sections

Based on IPCC 5th Assessment Report

2014

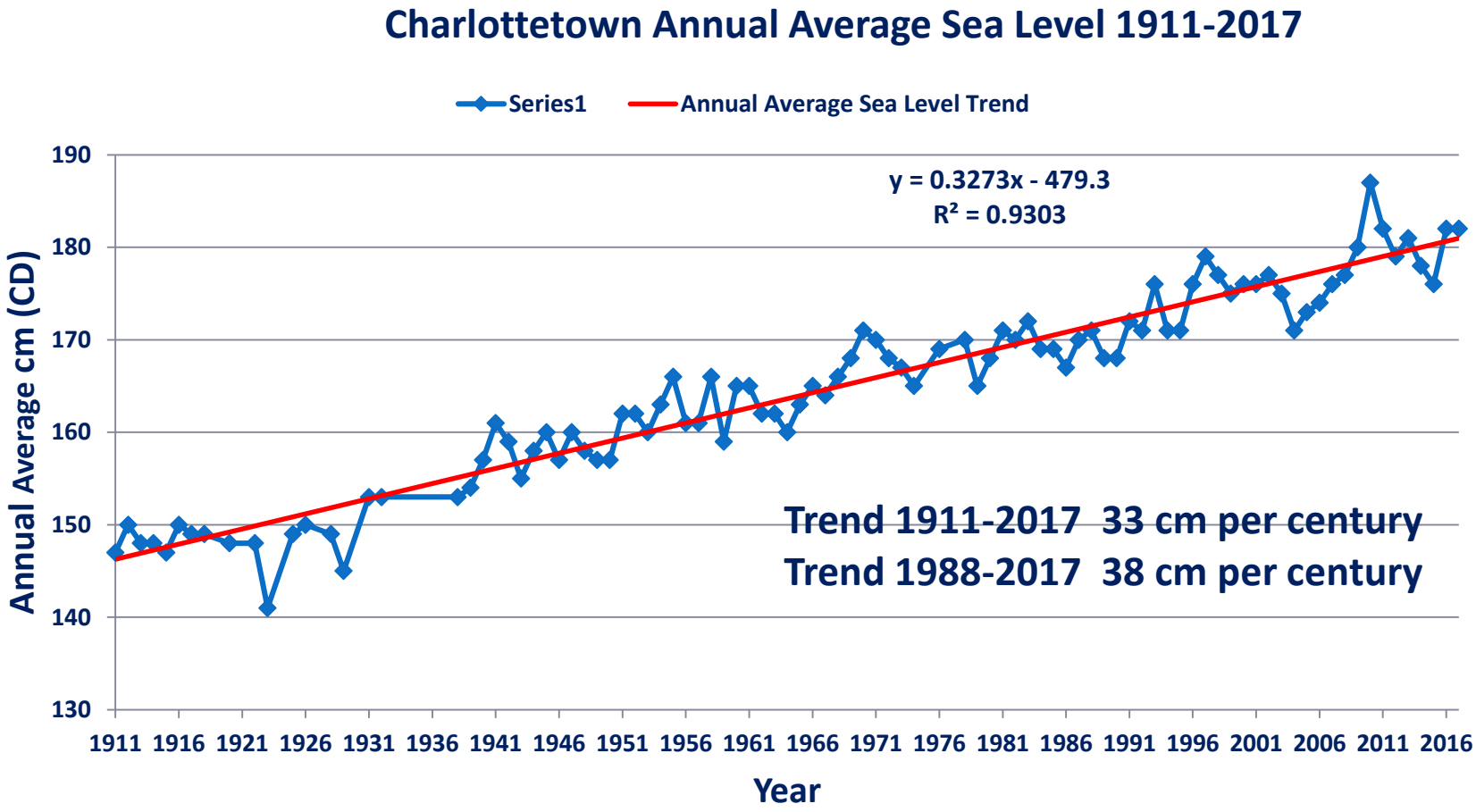
Sea-Level Rise and Flooding Estimates for New Brunswick Coastal Sections 2017

Based on IPCC 5th Assessment Report

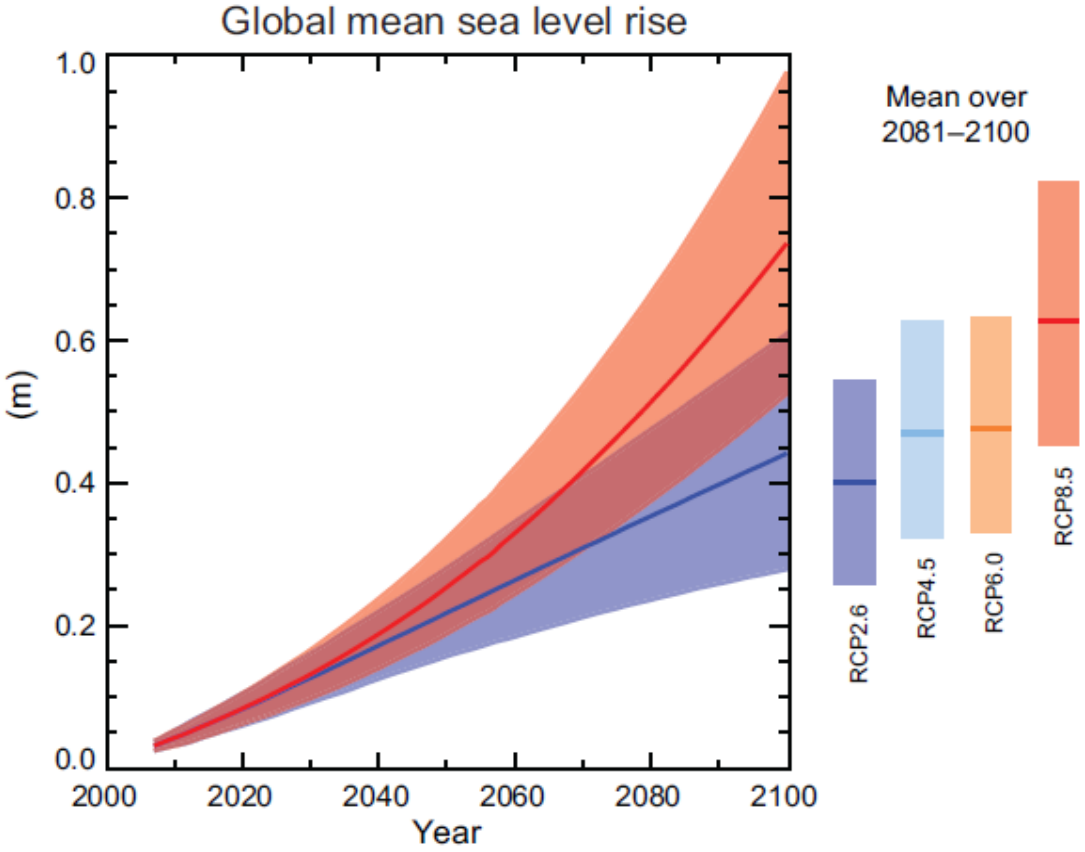
October 2017

Réal Daigle, Meteorologist
Climate Change Consultant
rdenviro1@gmail.com

Charlottetown Annual Average Sea Levels



IPCC Global Sea-Level Rise Estimates



Main Global Factors:

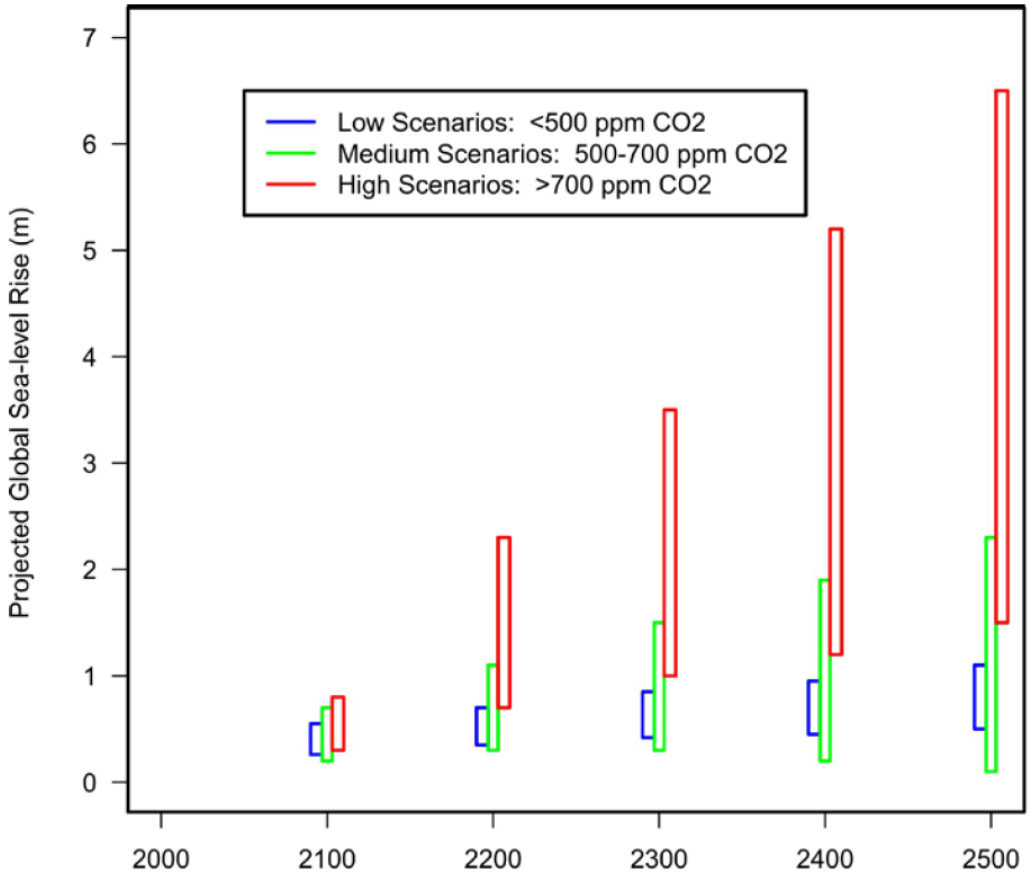
- **Thermal Expansion of Oceans**
- **Ice Sheet (Greenland, Antarctica) and Glacier melting**

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

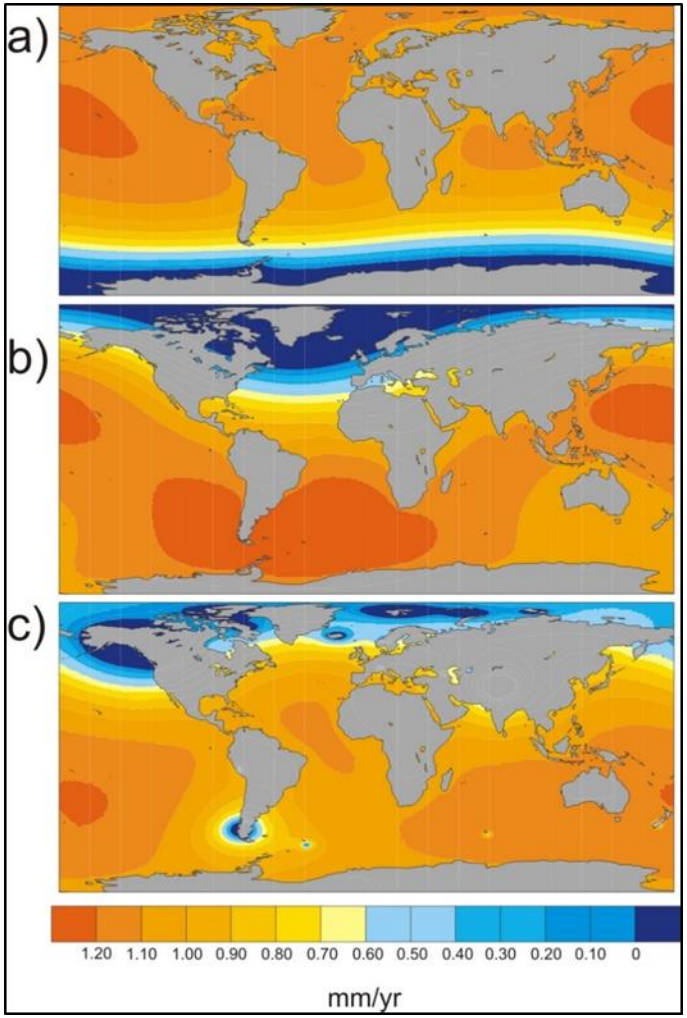
10 cm ≈ 11 cm

Greenland

10 cm ≈ 3 cm

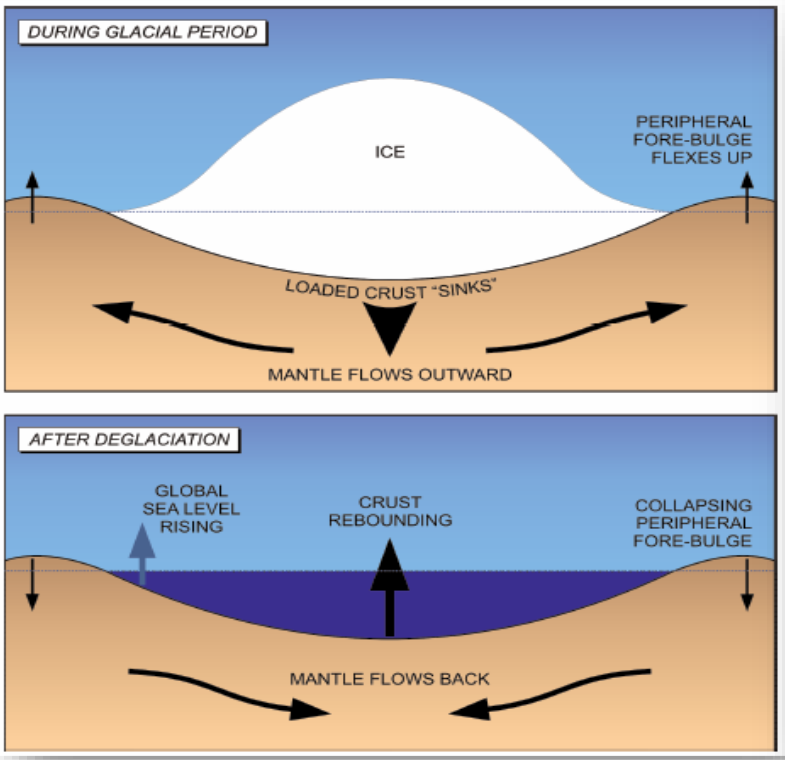
Mountain Glaciers

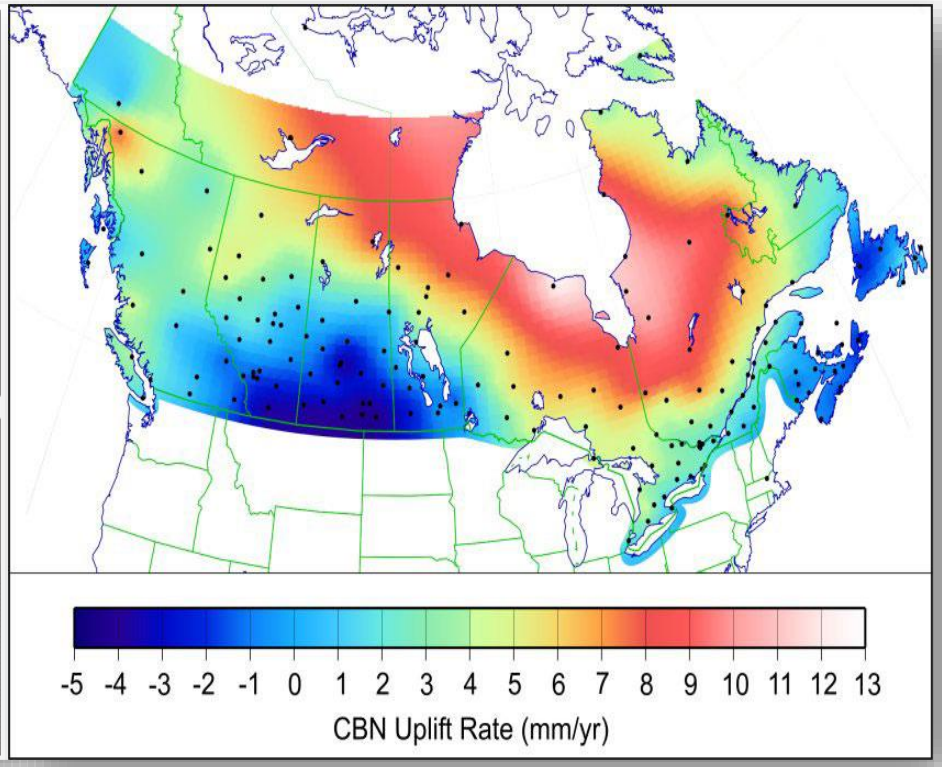
10 cm ≈ 9 cm



Source: IPCC AR5

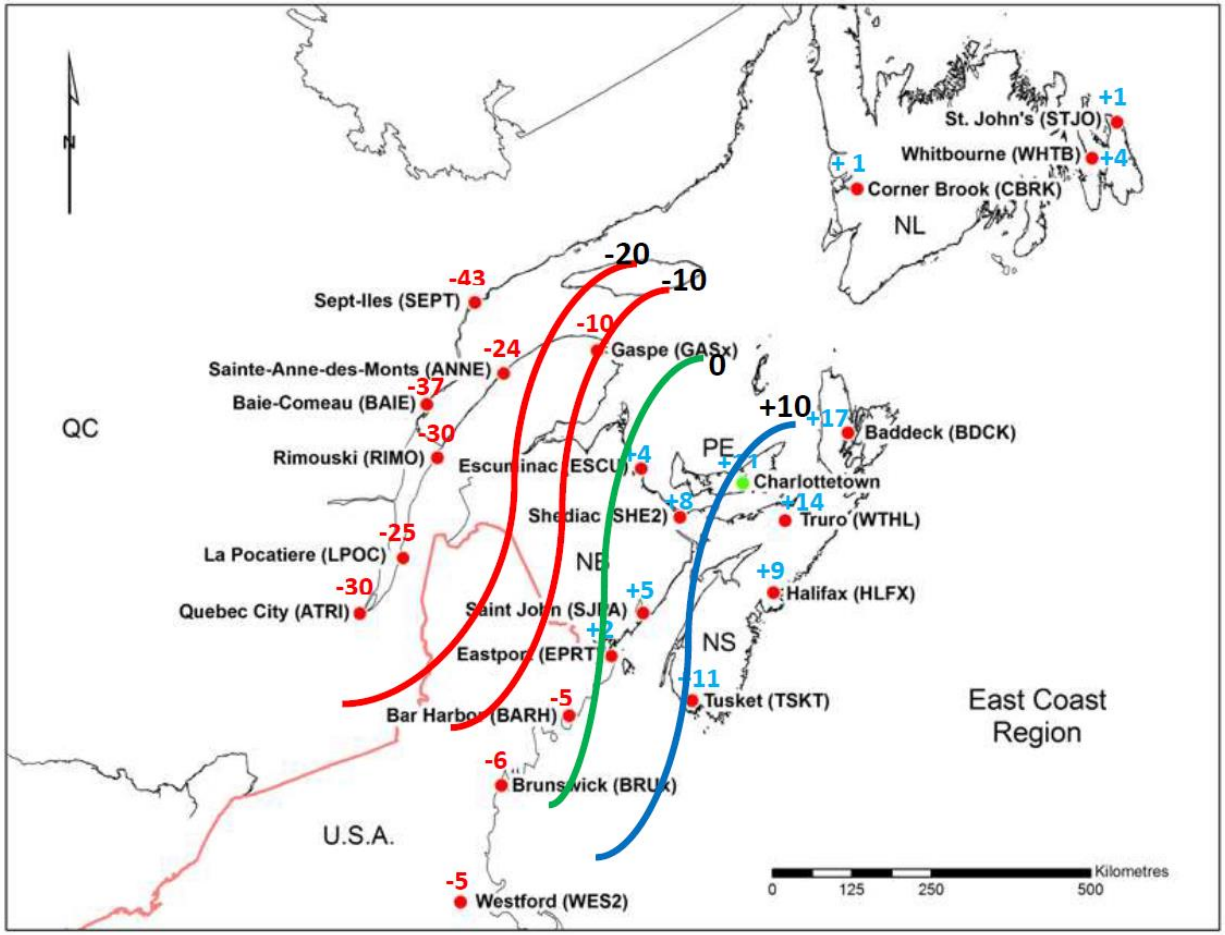
Regional Factor – Vertical Land Motion





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

Regional Factor – Vertical Land Motion



Source: James, et al., 2014

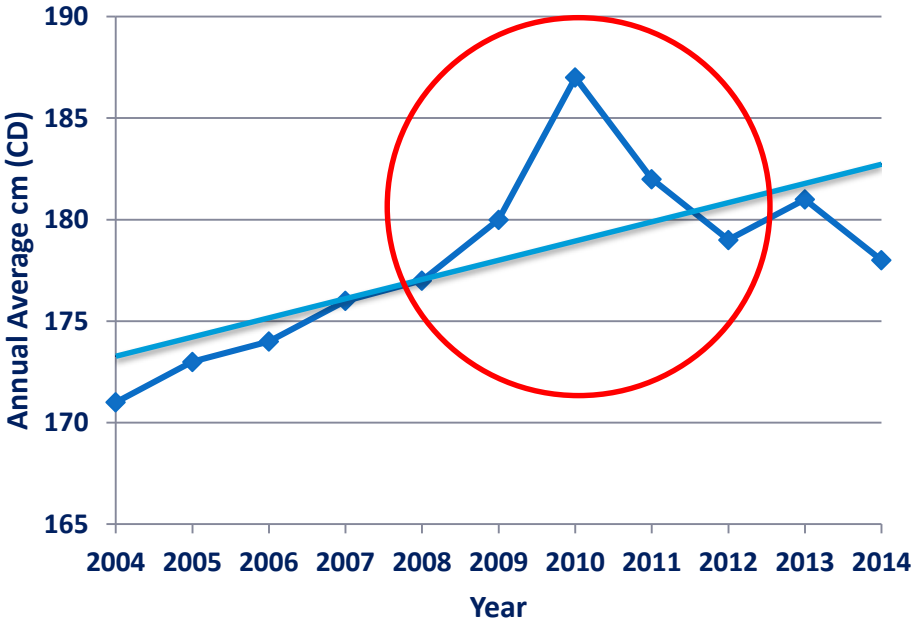
Other Regional Factors

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

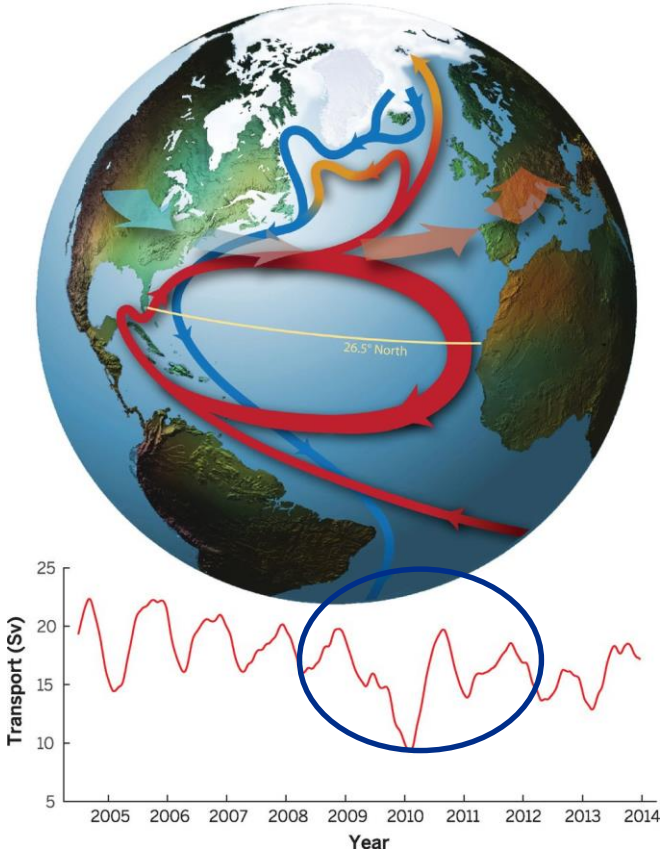
- ***Land Water Storage***
  - *Extraction of Ground Water*
  - *Reservoir Impoundment (Dams)*
  - *Combined Effect Minimal*

Oceanographic Variability

Charlottetown Annual 2004-2014

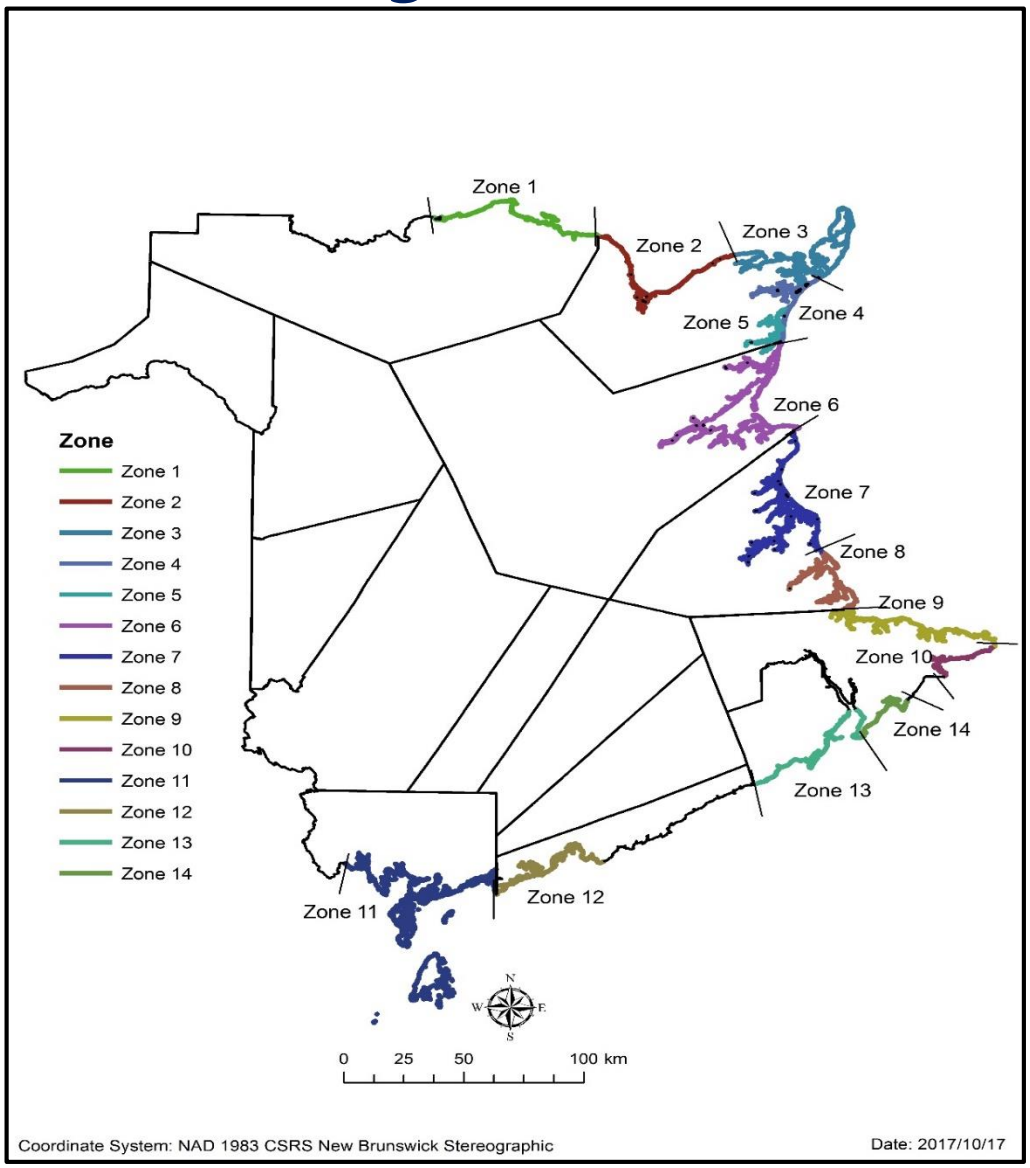


Atlantic Meridional Overturning Circulation



Source: Science 19 Jun 2015: Vol. 348, Issue 6241, 1255575

Flooding Scenario Zones

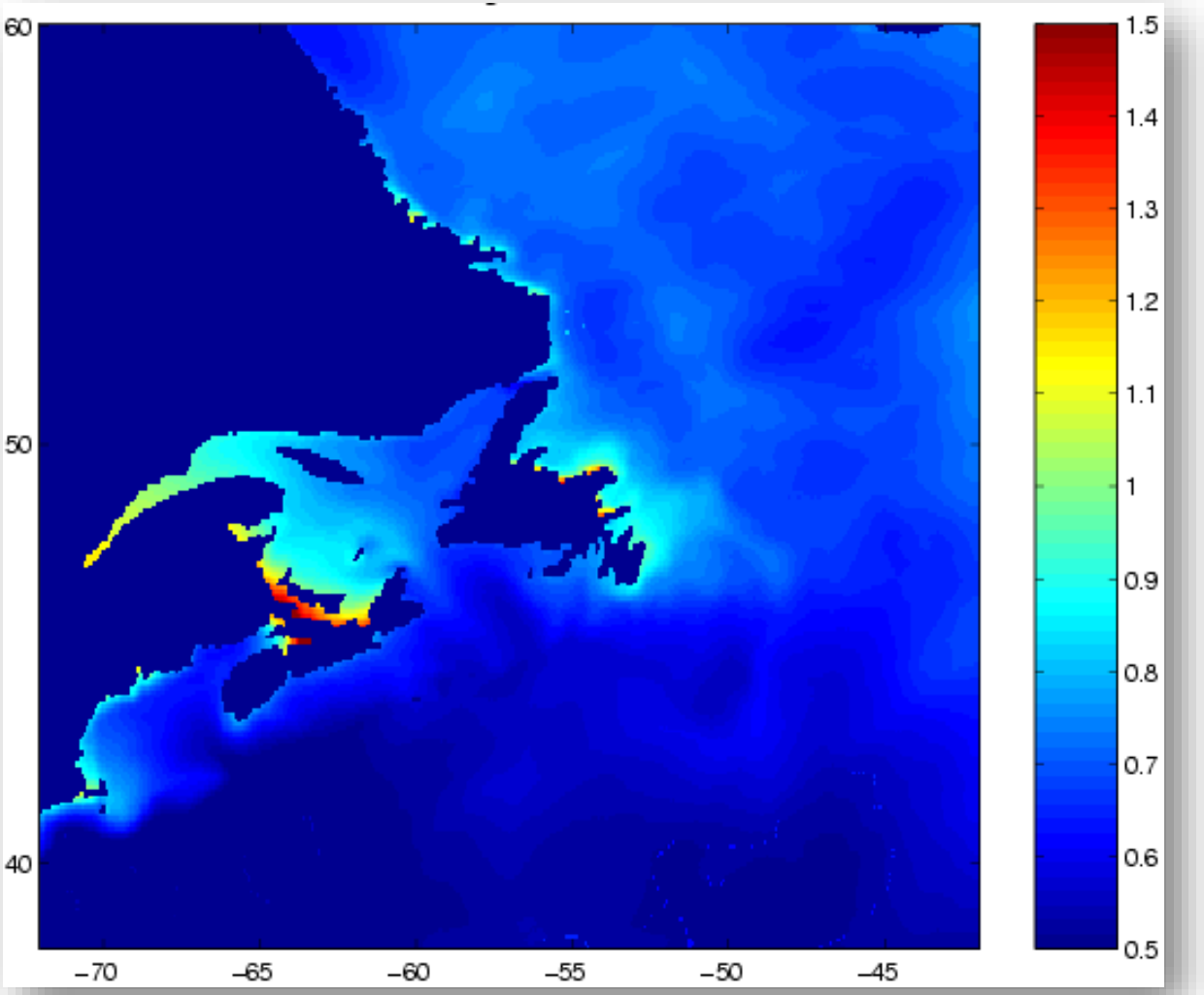


Map Source: NB ELG

Regional Sea-Level Rise Estimates

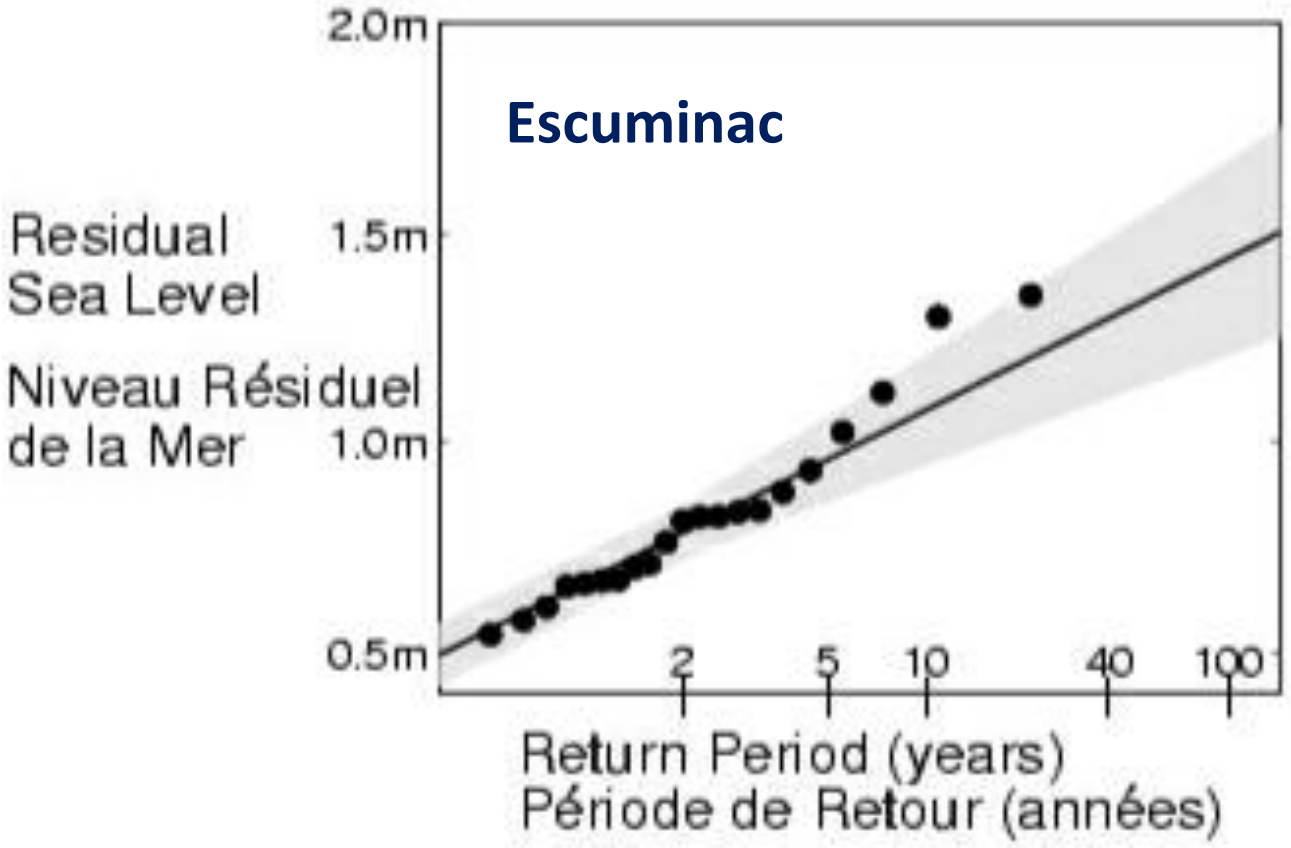
Coastal Section	Total Change 2010-2030 (m)	Total Change 2010-2050 (m)	Total Change 2010-2100 (m)	Total Change 2010-2100 (m) Including additional 0.65 m
Zone 1: Restigouche County	0.11 ± 0.07	0.21 ± 0.14	0.59 ± 0.38	1.24 ± 0.38
Zone 2: Gloucester County - County Line to Grande-Anse (incl.)	0.12 ± 0.07	0.24 ± 0.14	0.66 ± 0.38	1.31 ± 0.38
Zone 3: Gloucester County - Grande-Anse to Pointe-Sauvage	0.12 ± 0.07	0.24 ± 0.14	0.67 ± 0.38	1.32 ± 0.38
Zone 4: Gloucester County - Pointe-Sauvage to Northumberland County Line	0.13 ± 0.07	0.25 ± 0.14	0.69 ± 0.38	1.34 ± 0.38
Zone 5: Gloucester County - Tracadie-Sheila (Tracadie Bay including Val-Comeau)	0.13 ± 0.07	0.25 ± 0.14	0.69 ± 0.38	1.34 ± 0.38
Zone 6: Northumberland County (Miramichi Bay)	0.14 ± 0.07	0.26 ± 0.14	0.73 ± 0.38	1.38 ± 0.38
Zone 7: Kent County - County Line to Saint Édouard-de-Kent (incl.)	0.14 ± 0.07	0.27 ± 0.14	0.75 ± 0.38	1.40 ± 0.38
Zone 8: Kent County - Saint-Édouard-de-Kent to Westmorland County Line	0.15 ± 0.07	0.28 ± 0.14	0.76 ± 0.38	1.41 ± 0.38
Zone 9: Westmorland County - County Line to Cape Spear	0.16 ± 0.07	0.29 ± 0.14	0.77 ± 0.38	1.42 ± 0.38
Zone 10: Westmorland County - Cape Spear to Port Elgin	0.16 ± 0.07	0.30 ± 0.14	0.78 ± 0.38	1.43 ± 0.38

Storm Surge 40-Year Return Model



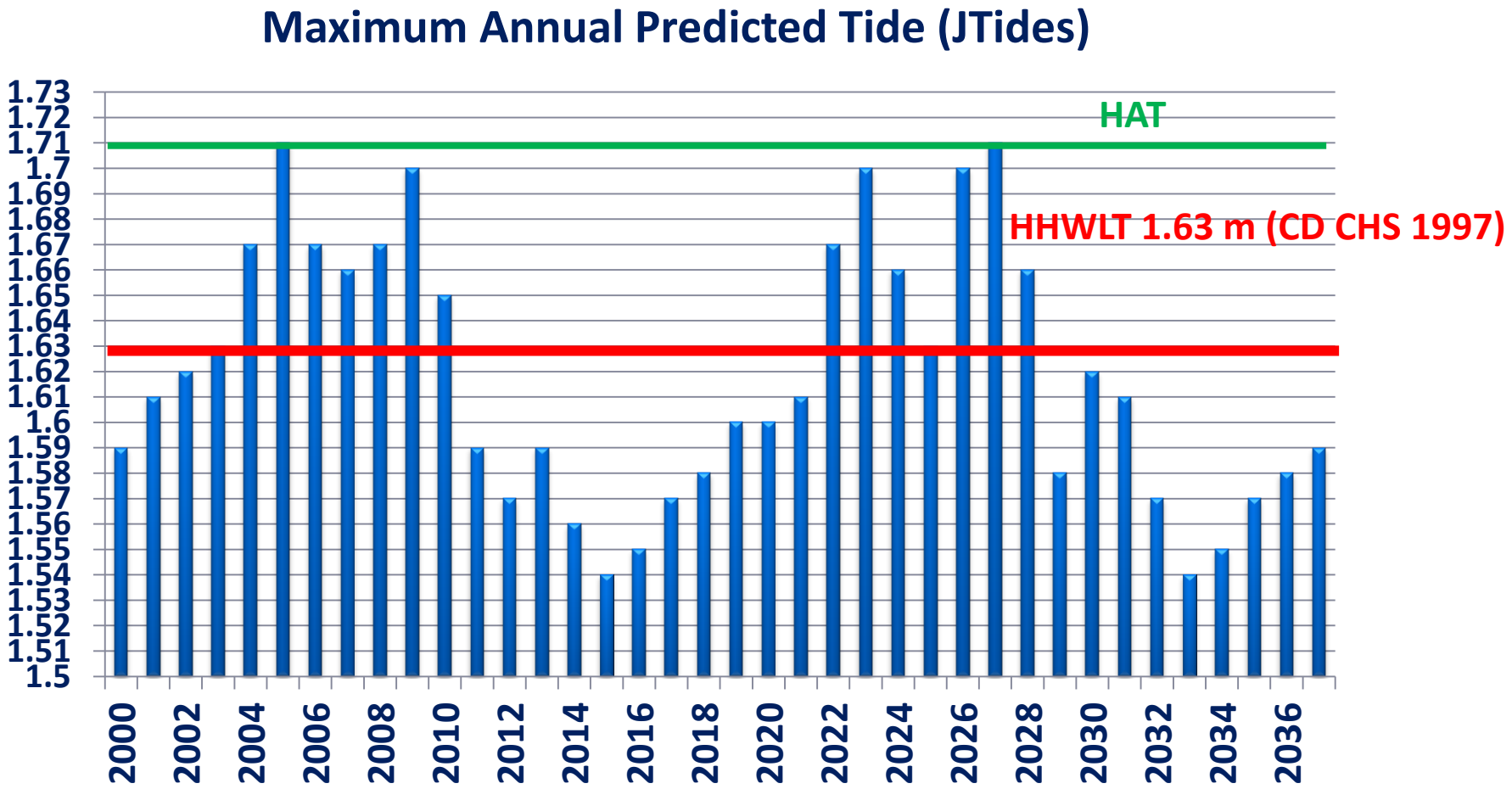
Source: Hal Ritchie, Environment Canada; Natacha Bernier, Keith Thompson, Jeff MacDonald, Jie Ou, Dalhousie University

Storm Surge Return Periods



Source: Bernier, 2005

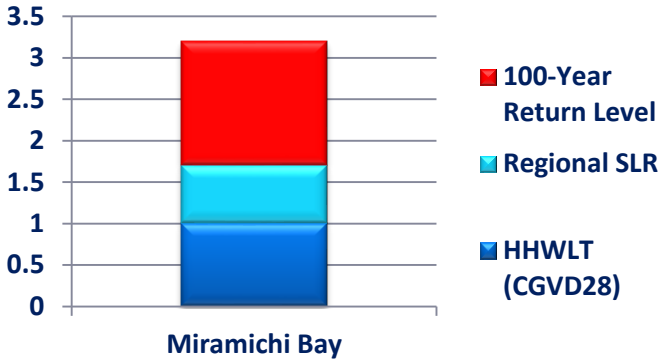
HHWLT Baseline – Shediac Example



Source: R.J. Daigle Enviro

Flooding Scenarios

Flooding Level (Miramichi) =



HHWLT Baseline (1.0 m CGVD28)

+ Regional Sea-Level Rise Component (0.7 m)

+ Storm Surge Return Period Component [(1-, 2-, 5-, 10-, 25-, 50- and 100-Year (1.5 m)]

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

Source: R.J. Daigle Enviro

Zone 6 (Miramichi Bay) Flooding Scenarios

Zone 6: Northumberland County (Miramichi Bay), HHWLT 1.0 m ± 0.1 (CGVD28)

Return Period	Surge Residual	Residual + Uncertainty	Level 2010	Level 2030	Level 2050	Level 2100	Level 2100 + 0.65 m
1-Year	0.61 ± 0.02	0.63	1.6 ± 0.1	1.8 ± 0.2	1.9 ± 0.2	2.4 ± 0.5	3.0 ± 0.5
2-Year	0.74 ± 0.05	0.79	1.8 ± 0.1	1.9 ± 0.2	2.1 ± 0.2	2.5 ± 0.5	3.2 ± 0.5
5-Year	0.91 ± 0.09	1.00	2.0 ± 0.1	2.1 ± 0.2	2.3 ± 0.2	2.7 ± 0.5	3.4 ± 0.5
10-Year	1.04 ± 0.12	1.16	2.2 ± 0.1	2.3 ± 0.2	2.4 ± 0.2	2.9 ± 0.5	3.5 ± 0.5
25-Year	1.21 ± 0.16	1.37	2.4 ± 0.1	2.5 ± 0.2	2.6 ± 0.2	3.1 ± 0.5	3.8 ± 0.5
50-Year	1.34 ± 0.19	1.53	2.5 ± 0.1	2.7 ± 0.2	2.8 ± 0.2	3.3 ± 0.5	3.9 ± 0.5
100-Year	1.47 ± 0.22	1.69	2.7 ± 0.1	2.8 ± 0.2	3.0 ± 0.2	3.4 ± 0.5	4.1 ± 0.5

Zone 6: Northumberland County (Miramichi Bay), HHWLT 0.5 m ± 0.1 (CGVD2013)

Return Period	Surge Residual	Residual + Uncertainty	Level 2010	Level 2030	Level 2050	Level 2100	Level 2100 + 0.65 m
1-Year	0.61 ± 0.02	0.63	1.1 ± 0.1	1.3 ± 0.2	1.4 ± 0.2	1.9 ± 0.5	2.5 ± 0.5
2-Year	0.74 ± 0.05	0.79	1.3 ± 0.1	1.4 ± 0.2	1.6 ± 0.2	2.0 ± 0.5	2.7 ± 0.5
5-Year	0.91 ± 0.09	1.00	1.5 ± 0.1	1.6 ± 0.2	1.8 ± 0.2	2.2 ± 0.5	2.9 ± 0.5
10-Year	1.04 ± 0.12	1.16	1.7 ± 0.1	1.8 ± 0.2	1.9 ± 0.2	2.4 ± 0.5	3.0 ± 0.5
25-Year	1.21 ± 0.16	1.37	1.9 ± 0.1	2.0 ± 0.2	2.1 ± 0.2	2.6 ± 0.5	3.3 ± 0.5
50-Year	1.34 ± 0.19	1.53	2.0 ± 0.1	2.2 ± 0.2	2.3 ± 0.2	2.8 ± 0.5	3.4 ± 0.5
100-Year	1.47 ± 0.22	1.69	2.2 ± 0.1	2.3 ± 0.2	2.5 ± 0.2	2.9 ± 0.5	3.6 ± 0.5

Source: R.J. Daigle Enviro

Merci!
Thank You!