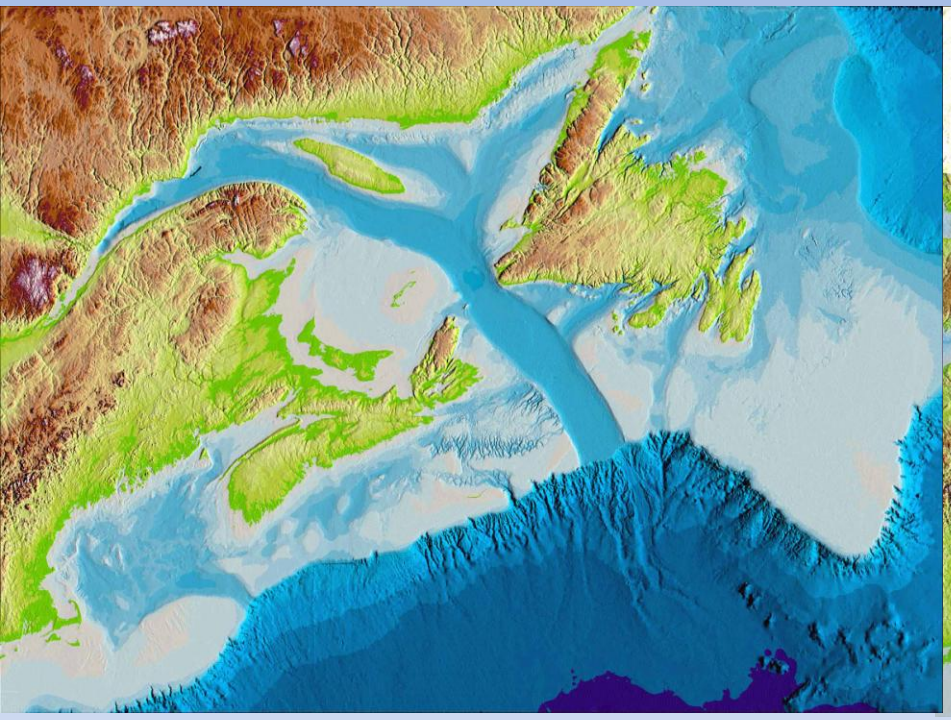
Coastal Change on PEI

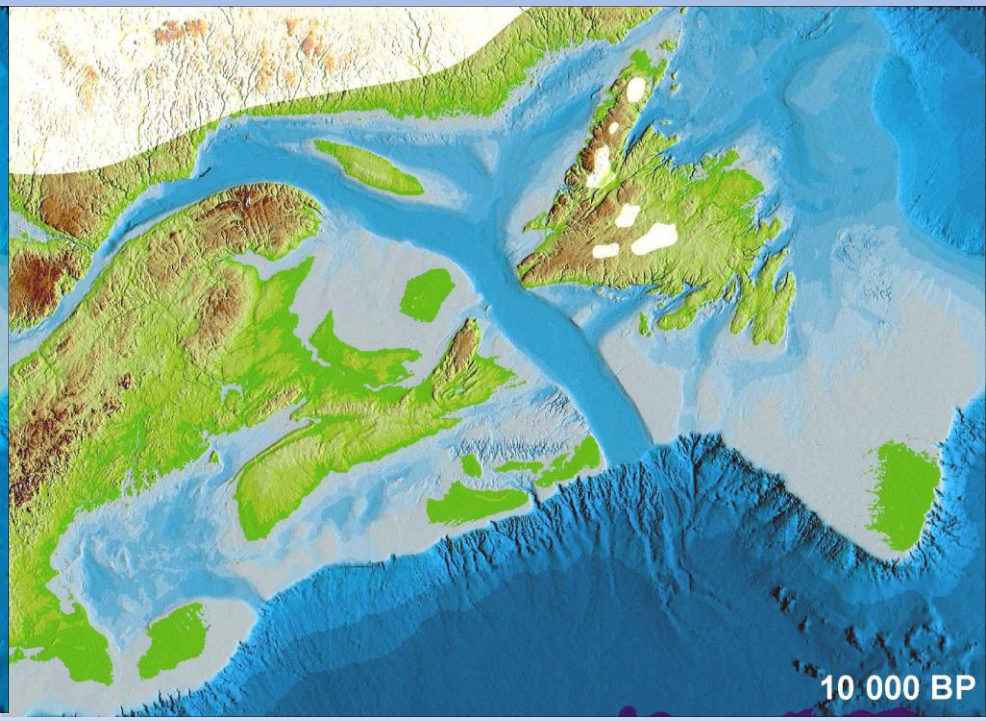
Using Local Knowledge
May 24, 2012
Winter River – Tracadie Bay Watershed Association

What is Coastal Change?

- Coastal Erosion is a natural process which has been ongoing for thousands of years.
- Sediment or rocks are washed away by the ocean and re-shapes our coastline
- Sea water hitting our cliffs, dunes and marshlands does considerable damage.
- Ecological impacts
- Fresh water inundation

Coastal Change is Not New





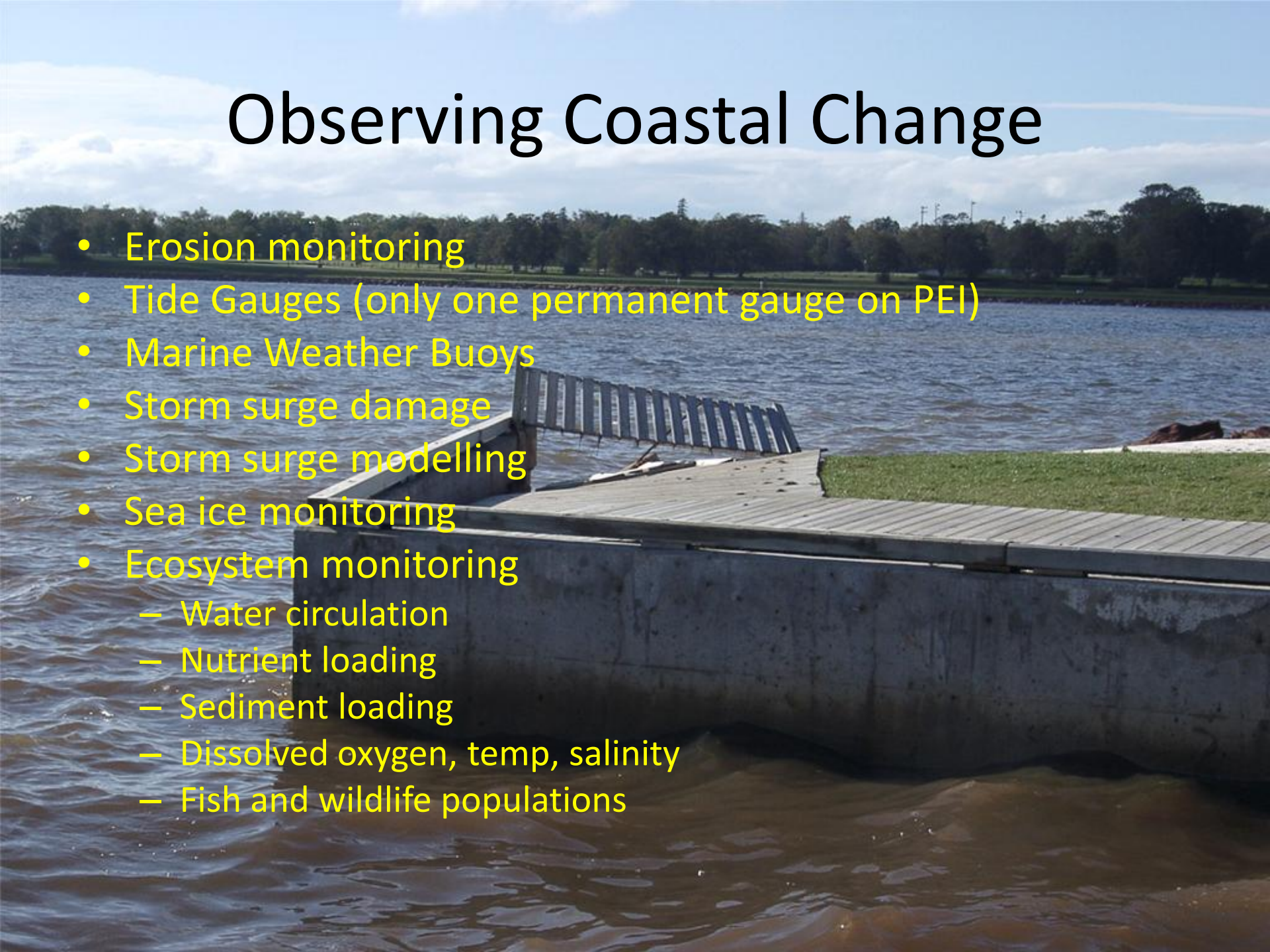
Atlantic Canada – Present day
-From D. Forbes, 2009

Atlantic Canada – 10,000 years ago – PEI Not an Island
- From D. Forbes, 2009.

What are the Agents of Coastal Change?

- Wave Action including overwash
- Sea Level Rise
- Storms and Storm Surges
- Rising Temperatures = Less ice along the shore
- More freeze and thaw cycles
- Overland runoff
- Human activities
  - Infrastructure construction, other human activities (walking / driving on dunes etc.

Observing Coastal Change



- Erosion monitoring
- Tide Gauges (only one permanent gauge on PEI)
- Marine Weather Buoys
- Storm surge damage
- Storm surge modelling
- Sea ice monitoring
- Ecosystem monitoring
  - Water circulation
  - Nutrient loading
  - Sediment loading
  - Dissolved oxygen, temp, salinity
  - Fish and wildlife populations

Coastal Change and Wildlife

- Marine and ocean species
- Birds and mammals
- Plants
- Fresh water species

Shellfish Closures related to Climate Change events

NOTICE

The Regional Director General for the Gulf Region, Department of Fisheries and Oceans, hereby gives notice that Contaminated Fisheries Prohibition Order No. GSN-2012-006 (closing the area listed below) is hereby revoked:

All the waters of North Rustico Harbour and the lower portion of the Hunter River inside a line drawn from a point on land at grid reference 477629E 5144895N; thence to a point on the water at grid reference 478409E 5144200N; thence to a point on land at grid reference 478022E 5143664N and thence to a line drawn at grid reference 476886E 5142711N to grid reference 476063E 5143075N. (Refer to map North Rustico 11L/6).

Souris West, PEI

Local Knowledge - Newspaper Records

Holding back the tide

The Friends of Covehead Brackley Bay has a new low-cost shoreline erosion reduction demo site and is producing a how-to CD and booklet for the public

By Mary MacKay
THE GUARDIAN

The little Dutch boy is infamous for his legendary feat of trying to hold back the sea by sticking his finger in a dyke.

Now a local organization is taking on the immense challenge of staving off the sea's effects on Prince Edward Island's shores and will be sharing that knowledge with all who want it.

The Friends of Covehead Brackley Bay (FCBB) has put together a demonstration site of two low-cost shoreline erosion reduction methods on Covehead Bay. The group is also putting together a how-to booklet and CD to guide people through the steps.

"We were looking for erosion methods that could be done locally using available local materials but we really didn't find anything that was low cost and that would be applicable to local shoreline residents," says Wanson Hemphill, coordinator of FCBB.

"That led me to try to come up with a simple system that we could use to demonstrate in a (visible) way what might work using local materials. That's what led to the demo."

At one time, before P.E.I.'s buffer zone rules came into place in 2008, people used to dump trees and brush over a bank and that would help reduce the soil from getting away.

"But when the buffer zone came into place there's rules now that you can't do that," said Hemphill.

What landowners can do, with the proper permits from the provincial government, is use one of a number of shoreline erosion reduction methods, including rock gabion baskets, concrete retaining walls or large granite rocks.

"We know we have some (methods) on P.E.I. that are working — gabions, for example," he said. "And we know that the giant rocks from New Brunswick and Nova Scotia that they bring over here work. But it's so very expensive that the average homeowner can't afford to do it. So what does the average homeowner do?"

So this summer Hemphill and two UPEI students, Marcie Savage and Jennifer O'Neill, spent some of their FCBB working time researching the subject to see exactly what could be done on a more limited budget.

Two plans of erosion reduction action were drawn up. One method uses a sand/gravel/cement mixture in recycled feedbags that are placed in trenches at the bottom of the bank, which in this case is referred to as the toe.

"The toe is the bottom part of the bank and that's where it erodes. It doesn't erode at the top, even though it appears to be. And when there's nothing left underneath for the top to sit on it falls down," Hemphill explains.

To make sure the water action would not undermine the structure, the FCBB workers dug a linear trench until they hit solid rock, which was 18 inches in this case.

"That's how deep we had to go in order to get it down low enough so the water wouldn't come underneath it. You have to do this. If you just set it on top of the ground it doesn't work," Hemphill says.

"It depends on the wave action how deep you go. We just happened to hit solid rock but we were thinking of going down 24 inches if we could."

The bags of cement/sand/gravel mix were placed in the trench as a base and added more in

$930, including $720 for labour at $12 an hour.

"We did it for a lot cheaper than that because we were using available labour and donated resources," Hemphill says.

The other low-cost shoreline erosion reduction method utilized squared stones recycled from an old basement foundation.

The rocks, which were donated to the FCBB, were placed in a trench at the toe and covered with a cement base.

Rocks were then placed in alternating rows to a height above the high tide mark.

The cost for this rock barrier method for nine feet was $288; that total includes $144 labour.

The Shell Foundation is funding the production of CDs and booklets that will provide people with an overview of shoreline erosion on P.E.I. and information about various erosion

Wanson Hemphill, co-ordinator of the Friends of Covehead Brackley Bay, shows the new site on Covehead Bay that demonstrates two low-cost methods for shoreline erosion reduction.

GUARDIAN PHOTO BY MARY MACKAY

Sea carves new island from P.E.I. shore – July 19, 2010

The new channel is about 100 metres wide. (Pat Martel/CBC)

A wild storm over the winter cut through Blooming Point in P.E.I. National Park and created a new Island.

The sea carved a channel about 100 metres wide through the five-kilometre stretch of sand dunes, cutting it roughly in half. The area has some of the highest sand dunes on P.E.I., rising as much as 20 metres.

Blooming Point almost closed off the mouth of Tracadie Bay, protecting the boats and the mussel buoys. Local fishermen were the first to discover the channel. They are not yet certain how it might affect the local industry.

"It's good for the bay. It's going to allow a lot more water flow, that's good for the mussel industry," Randall Clow, captain of the fishing boat Skippy, told CBC News last week.

"But if the sea ice comes in, that can cause a lot of damage, so we'll have to wait and see."

One immediate effect of the new channel is it makes access to the Gulf of St. Lawrence from Tracadie Bay easier for some fishermen. As the first to navigate the channel, by tradition Clow can name it. Unofficially, he is thinking of Randall's Run.

Blooming Point is not accessible by road. The only way to the area was by boat or by a long hike along the beach. April Laviguer has visited the secluded beach for years.

"Last summer, we were over here, it was pure sand and you could walk across it, and now there's what, 17 feet of water," she said.

Her friend Raymond Bain worries where the erosion might stop now that it has started.

"We're just going to lose more and more of them all the time and eventually, some day there'd be nothing left," he said.

DFO said it was not aware of the new channel, but will monitor it to make sure sand from the blowout doesn't clog up the regular channel. As well, the department says it will be watching to see if winter ice does come into the bay, and creates a problem for mussel farmers.

Cottage Battered by Storm - 2002

Figure 2. Cottage destroyed in the November 2001 storm. The owner was quoted in The Guardian "when the waves came crashing through the front windows, it was time to get out"

Forbes and Manson, 2002

Local Knowledge of Coastal Change

- Started fishing at age 14 in 1938
- Remembers a lobster cannery on the east side of the bridge in Victoria which is now under water.
- There was another lobster cannery and lime kilns in the same area, also now under water.
- Recalls playing on a farm field owned by John C. MacDonald between the house and the shore. The foundation of this house is now on the beach.
- There was also a road running between the MacDonald house and the beach. This road is now under water.
- He has also observed a lot of erosion on Paul's Bluff which is just to the West of Victoria.
- He remembers a lady who lived in Victoria who moved to Crapaud telling about salt spray from Northumberland Strait having to be washed off the windows on her house after a hurricane.

Jimmy Boulter, Victoria

Local Knowledge of Coastal Change – North Rustico

- The lighthouse fell over the cliff after a storm when his father was 5 years old (1893)
- The lighthouse was moved several hundred feet to it's current location.
- When his father was 10 years old (1898) Rustico Harbour was actually an island and boats used to come in where Breakwater Drive is currently located.
- Several bad storms have caused flooding in the area over the years.
- The Dec. 21, 2010 storm resulted in water in their basement just below the floor boards.
- The Dec. 21, 2010 storm did flood the Seagull's Nest Gift Shop across the street and water was 12 inches above the floor.

Vance and Emard Court, Rustico Harbour

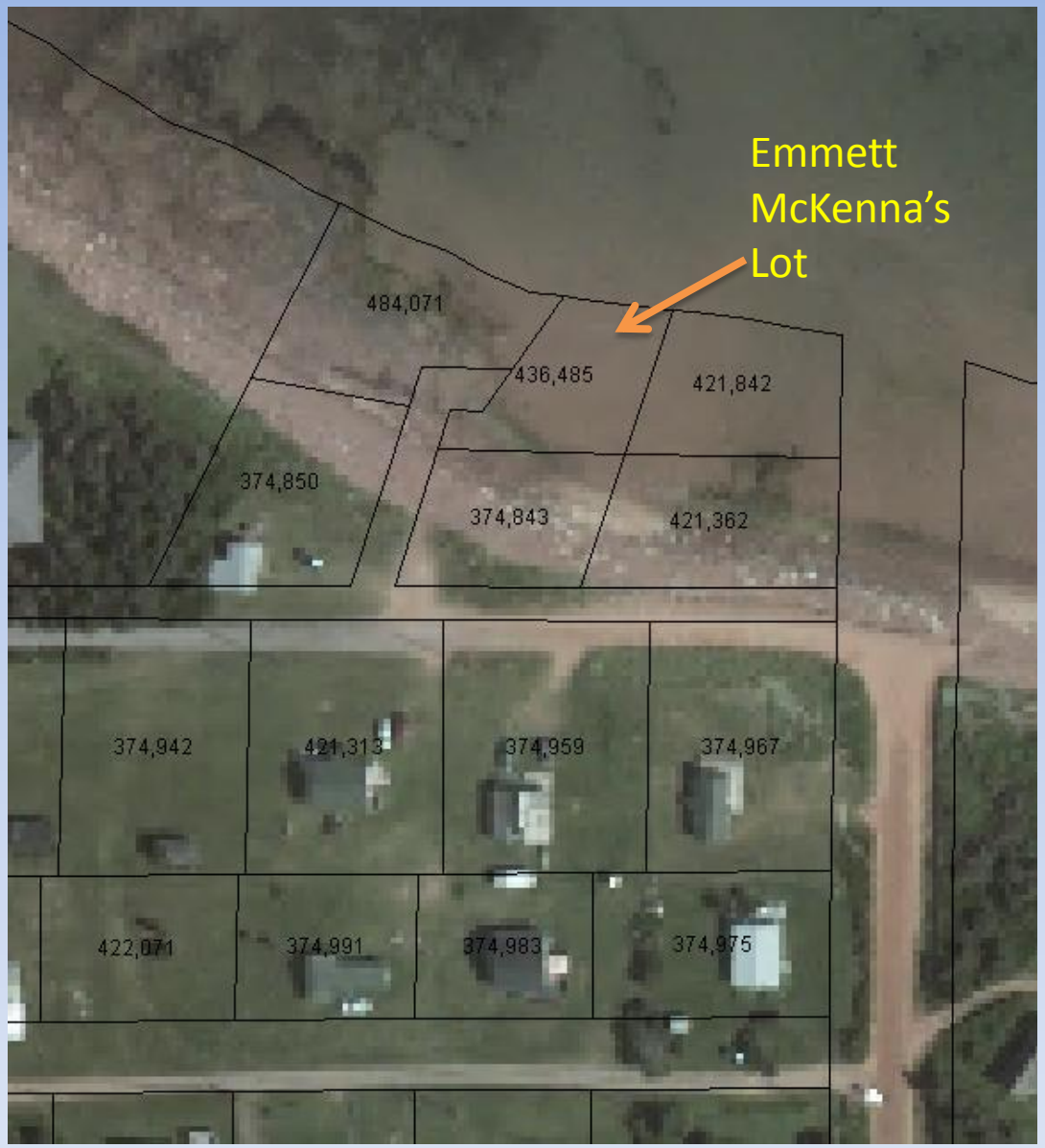
Local Knowledge of Climate Change

- Her house has been flooded due to storm surges on 4 occasions since she has lived there.
- The events occurred on
  - Jan. 21, 2000
  - Sept. 29, 2003 – Juan
  - Dec. 29, 2009
  - Jan. 2 / 3, 2010
- In all four storm surges she lost all of her electrical appliances and her floors have warped.
- In all four storms the water reached the level of the top of her mattress
- She had to be rescued by the fire dept in the Jan, 2010 event

Lillian Elliott of Victoria
Guardian photo by Nigel Armstrong

Local Knowledge Pigot's Point – Savage Harbour 1960-2010

- The McKenna's purchased a cottage lot as shown on the map in 1962
- At the time there was a large sand dune, 50 feet high on the shore side of their cottage.
- A storm in the early 1970's had waves high enough to reach their cottage and twist it around.
- Another storm in 1978 resulted in their neighbour's cottage (Larkins) going air borne.
- They lost 60 to 70 feet of bank during the 1978 storm and their cottage (mobile) was left hinged hanging over the shore.
- The large sand dune was completely gone by the end of the 1970's.
- Over 200 metres of bank have been lost to the Gulf in this area since 1962.



Emmett McKenna paying taxes on a lot now in the Gulf of St. Lawrence. Four other lots also in the Gulf

Pigot's Pt – Rectified Aerial Photos

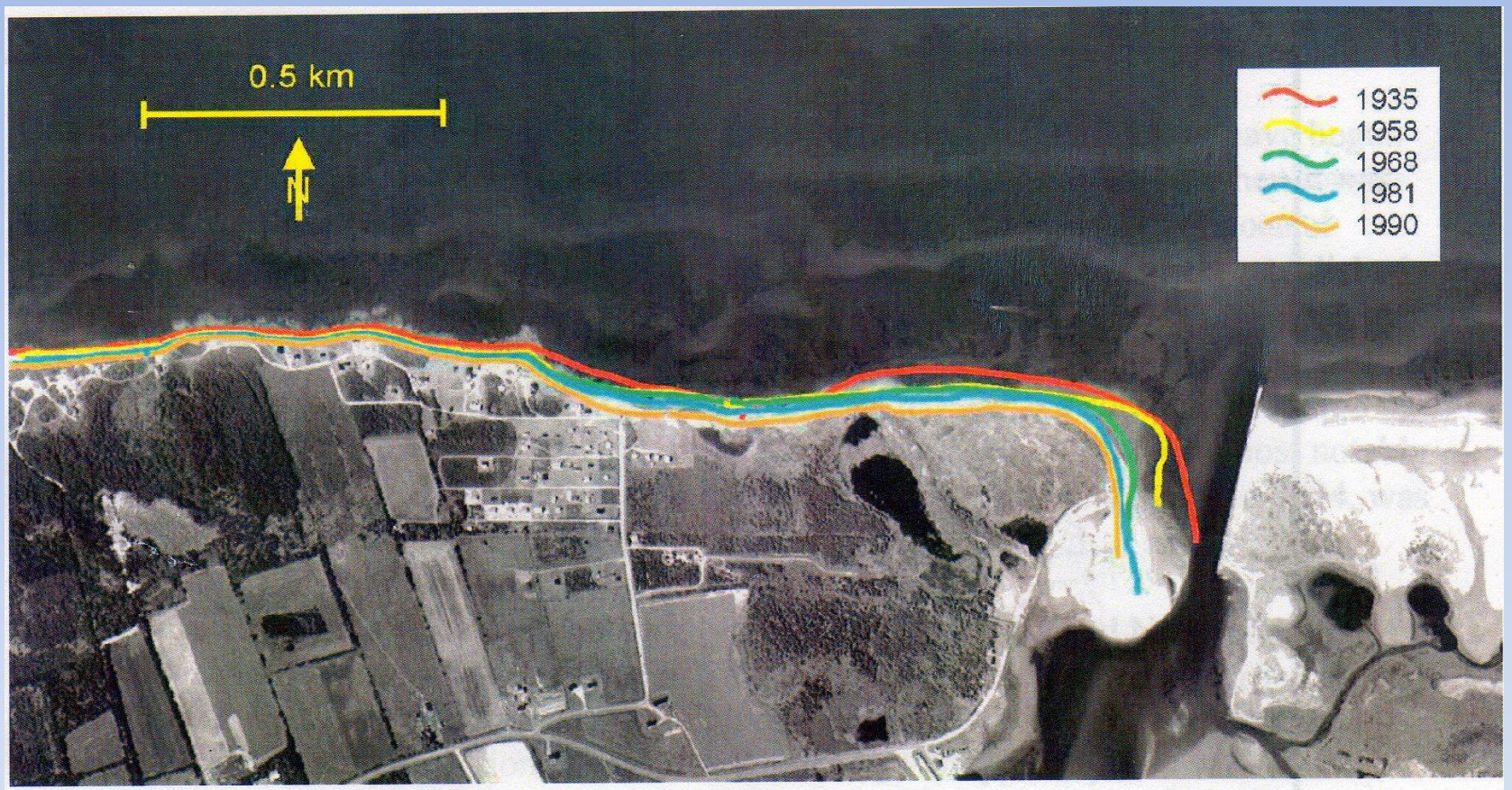


Figure 1. Rectified airphoto showing Pigots Point and Savage Harbour entrance in 1990 (part of 90404-57), with cliff-edge vectors for 1935, 1958, 1968, 1981, and 1990.

Forbes and Manson, 2002

Coastal Erosion at Savage Harbour – Surfside Lane under attack

Sept. 13, 2010

Dec. 22, 2010

Oct 5, 2011

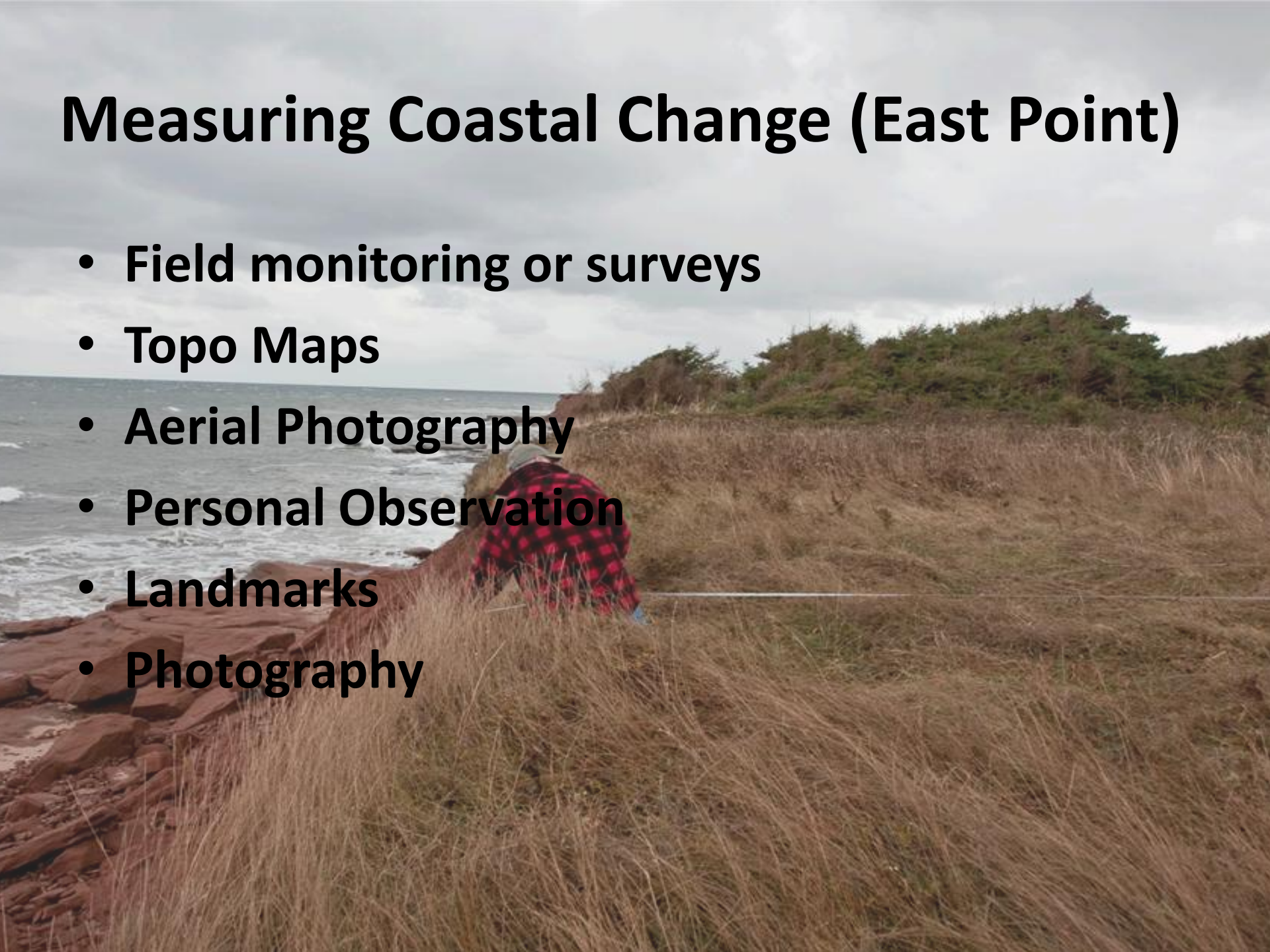
April 11, 2012

Savage Harbour – Cottage Road – April 11, 2012

From Beach

From Cottage Road

Measuring Coastal Change (East Point)

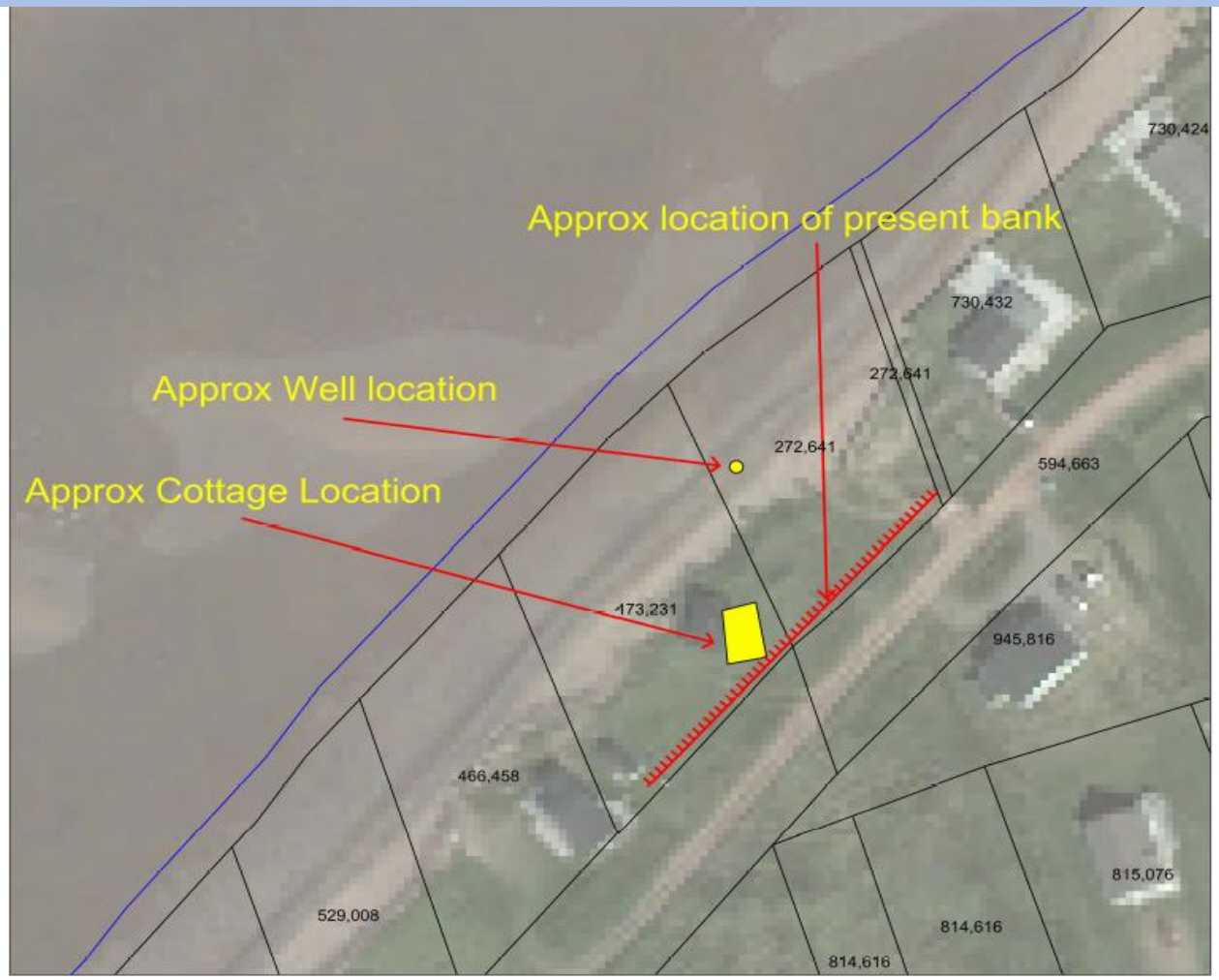


- Field monitoring or surveys
- Topo Maps
- Aerial Photography
- Personal Observation
- Landmarks
- Photography

Summerside Rifle Range 1914-2000 shoreline change

Maximeville

Lots now part of Northumberland Strait



Catastrophic Storm Overwash Event – Greenwich Dunes - 1923

- Greenwich Dunes are part of the PEI National Park
- Dunes are a barrier spit-beach dune complex
- Complete destruction of all foredunes from a major storm in Oct, 1923
- Catastrophic overwash of the dunes for a 10km distance
- Some of the overwash damage extended inland 600 m.

From - S. Matthew, R.G.D. Davidson-Arnott, J. Ollerhead, 2010

Brackley Beach – Dune Erosion

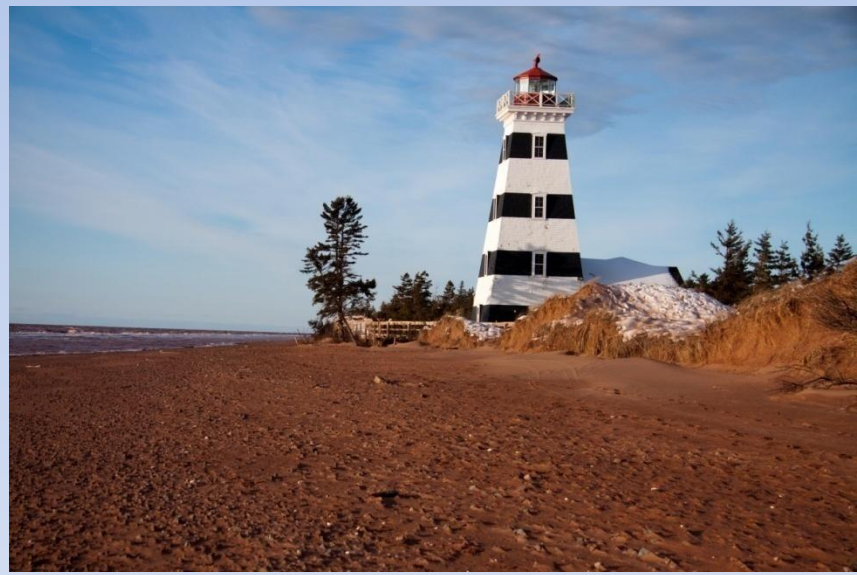
Jacques Cartier Park
Erosion Rates 2004-2011 (7 years)

Survey Map Sheet	# of Points 2004-2011	Average Rate for Measurement Period in m	Annual Rate in m
1 – South park area	2	13.6	1.9
2- North park area	5	16.2	3.7
3- North to beach access to Rt. 12	4	9.9	1.4
4- Northern most part of study area	3	11.3	1.6
		Average for all Map Sheets in m	2.1

Examples of Coastal Change

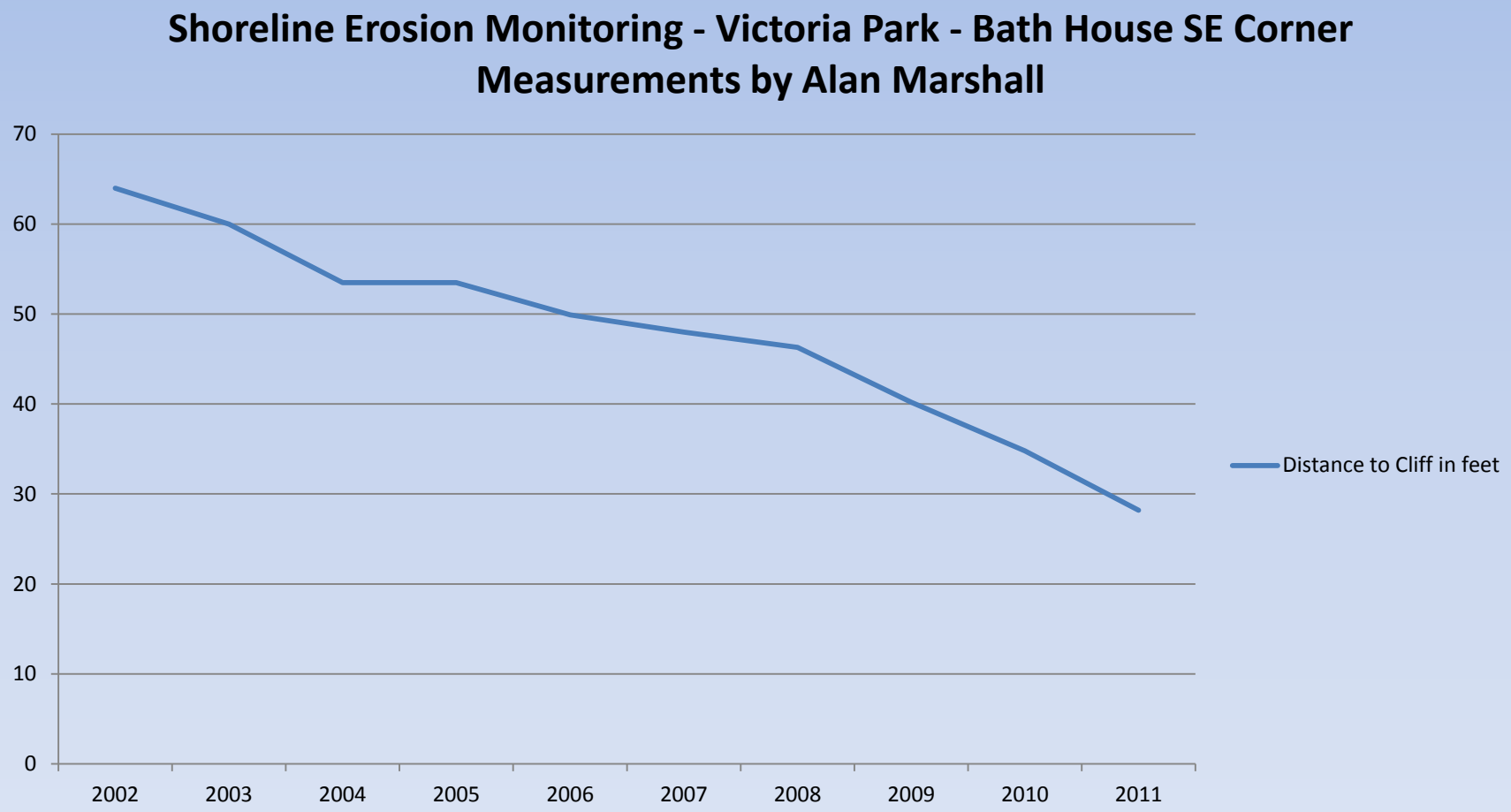
West Point Lighthouse

Jan. 25, 2010

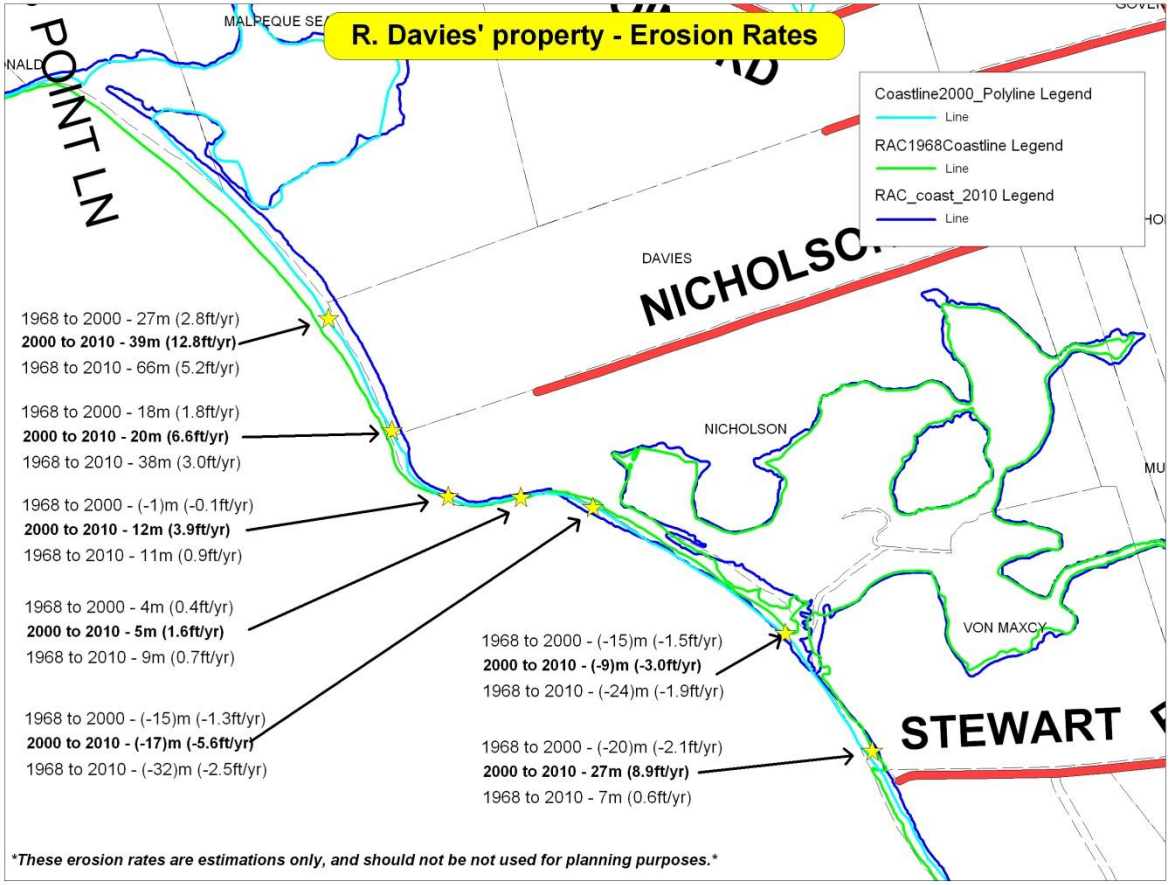


Dec. 30, 2010

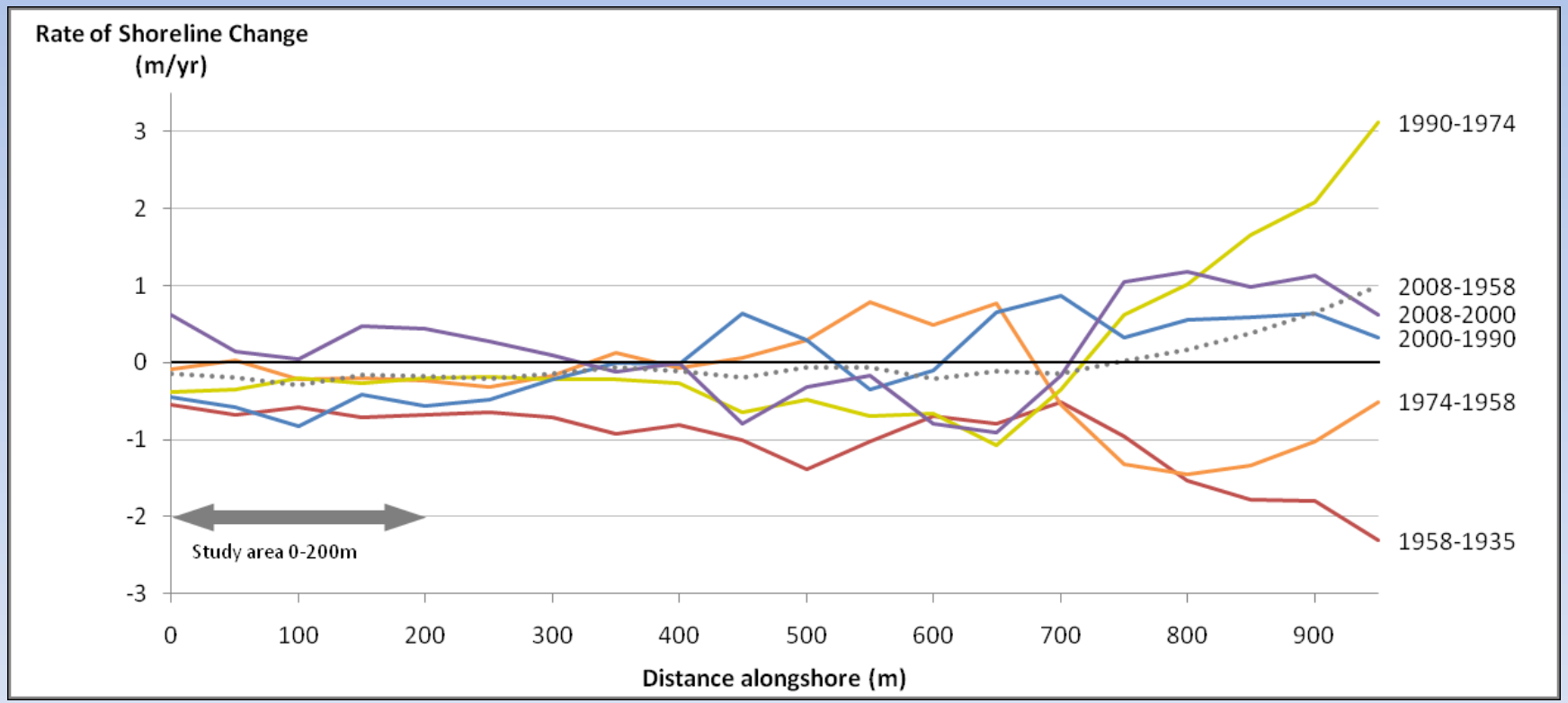
Local Shoreline Monitoring – Victoria, PEI – Using Measuring Tape



Using Orthorectified Aerial Photos
Davies Property – Belle River

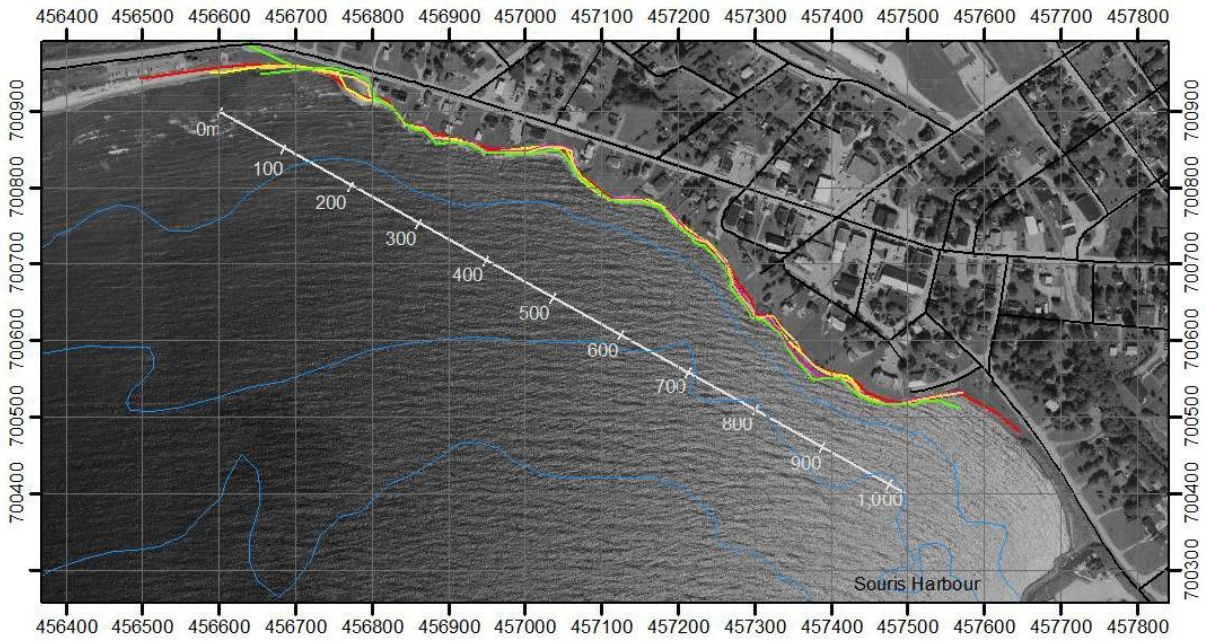


Souris Causeway Shoreline Change Using aerial photos



From Coldwater Consulting Report – April 2011

Souris Cliffs – Shoreline Change



Legend

- 1935
- 1958
- 1974
- 1990
- 2000

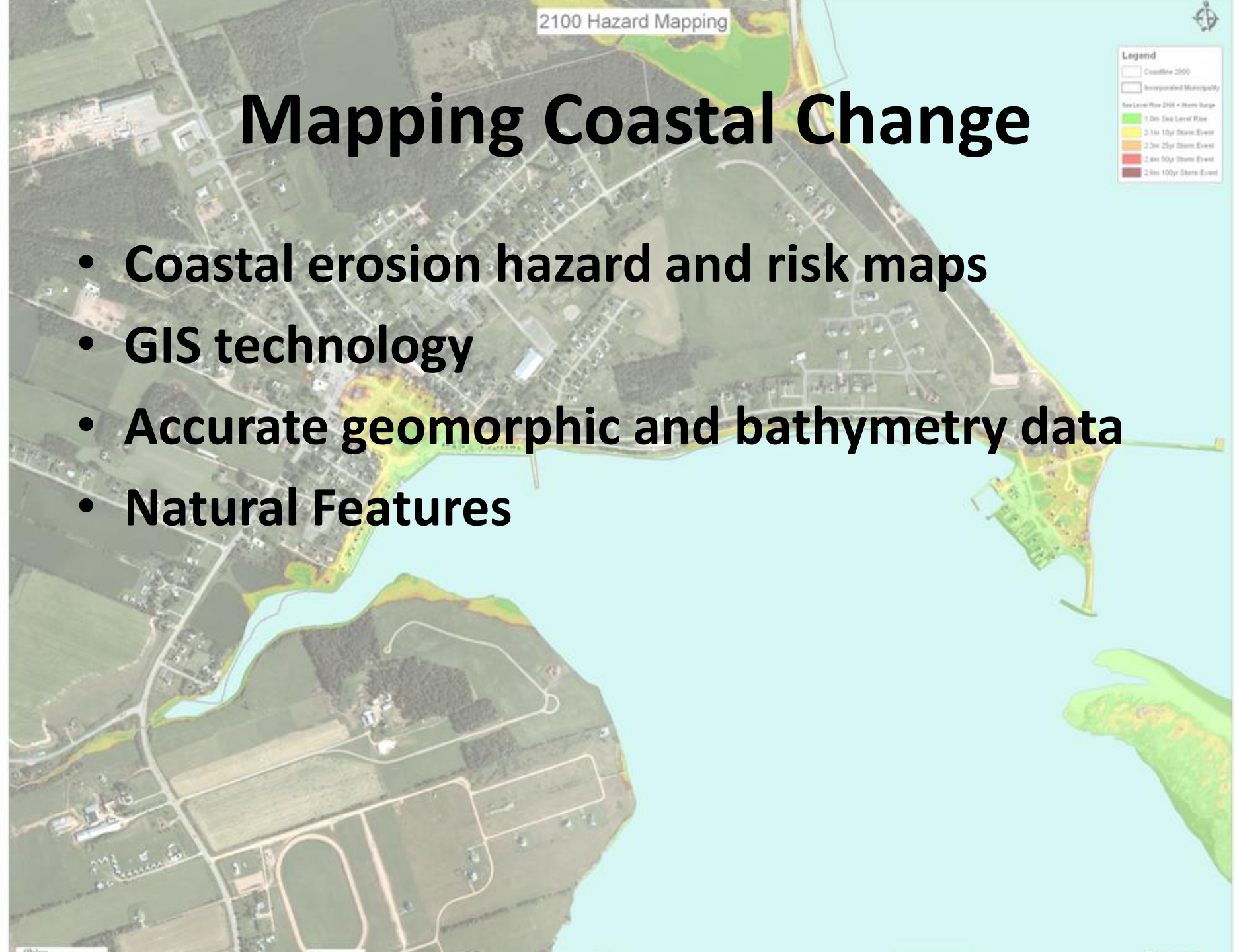
Air photo analysis of shoreline change

Image: 2000 Air photo (FL17P91)
Projection:
NAD_1983_CSRS_Prince_Edward_Island
Double_Stereographic

N
W E
S

Types of Coastal Change Storm-Induced

- Coastal Cliff erosion (ie 8 m in one storm)
- Beach erosion
- Dune erosion
- Overwash
- Inundation and Island Breaching
- Marsh Erosion



Mapping Coastal Change

- Coastal erosion hazard and risk maps
- GIS technology
- Accurate geomorphic and bathymetry data
- Natural Features

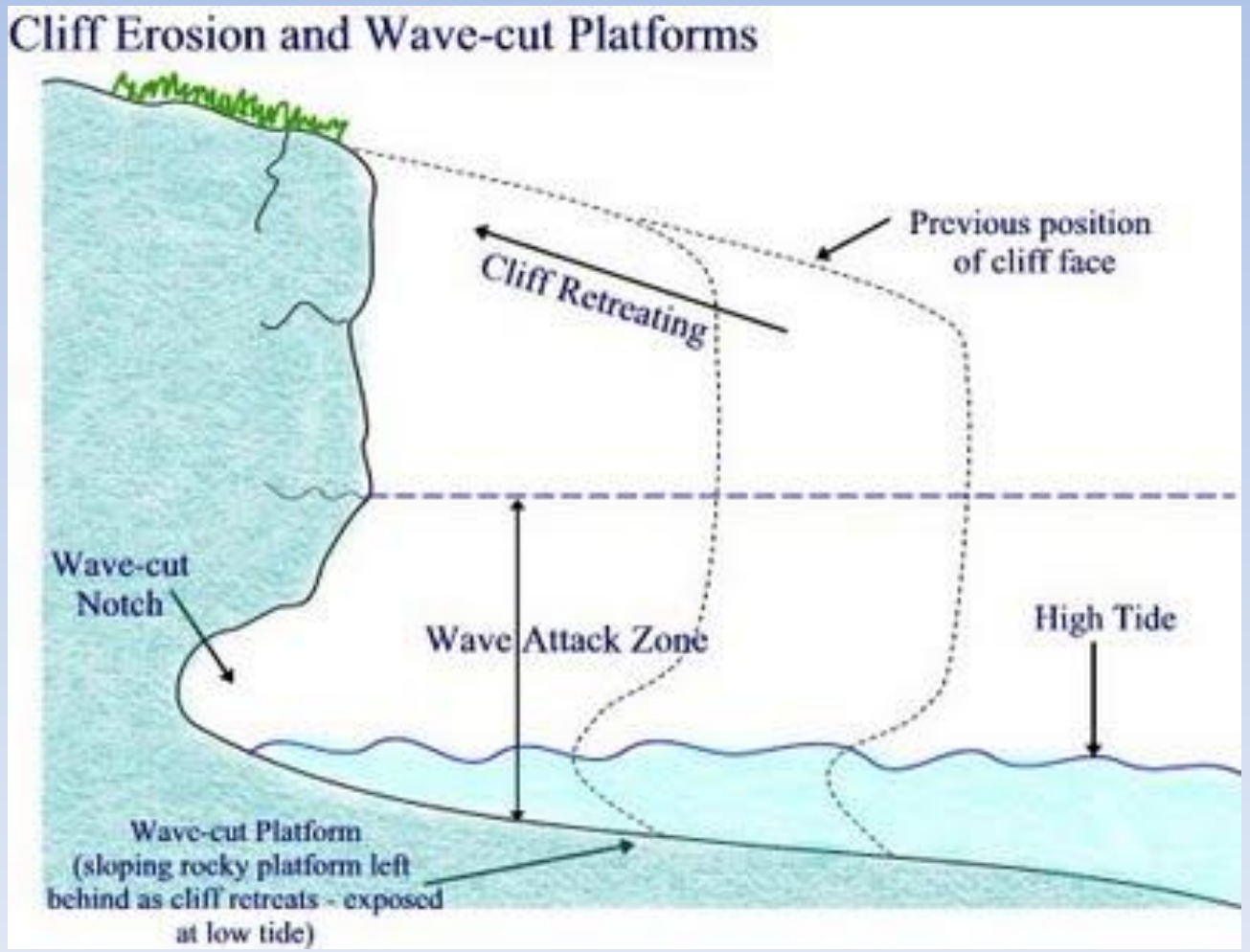
What Can We do to Reduce the Risk of Coastal Erosion

- Hard techniques
  - Sea walls, groynes, rip rap, armour rock
- Soft techniques
  - Beach nourishment, sand fences, saltmarsh creation
- Hybrid techniques
  - Combination of hard and soft methods (such as Panmure Island Causeway)

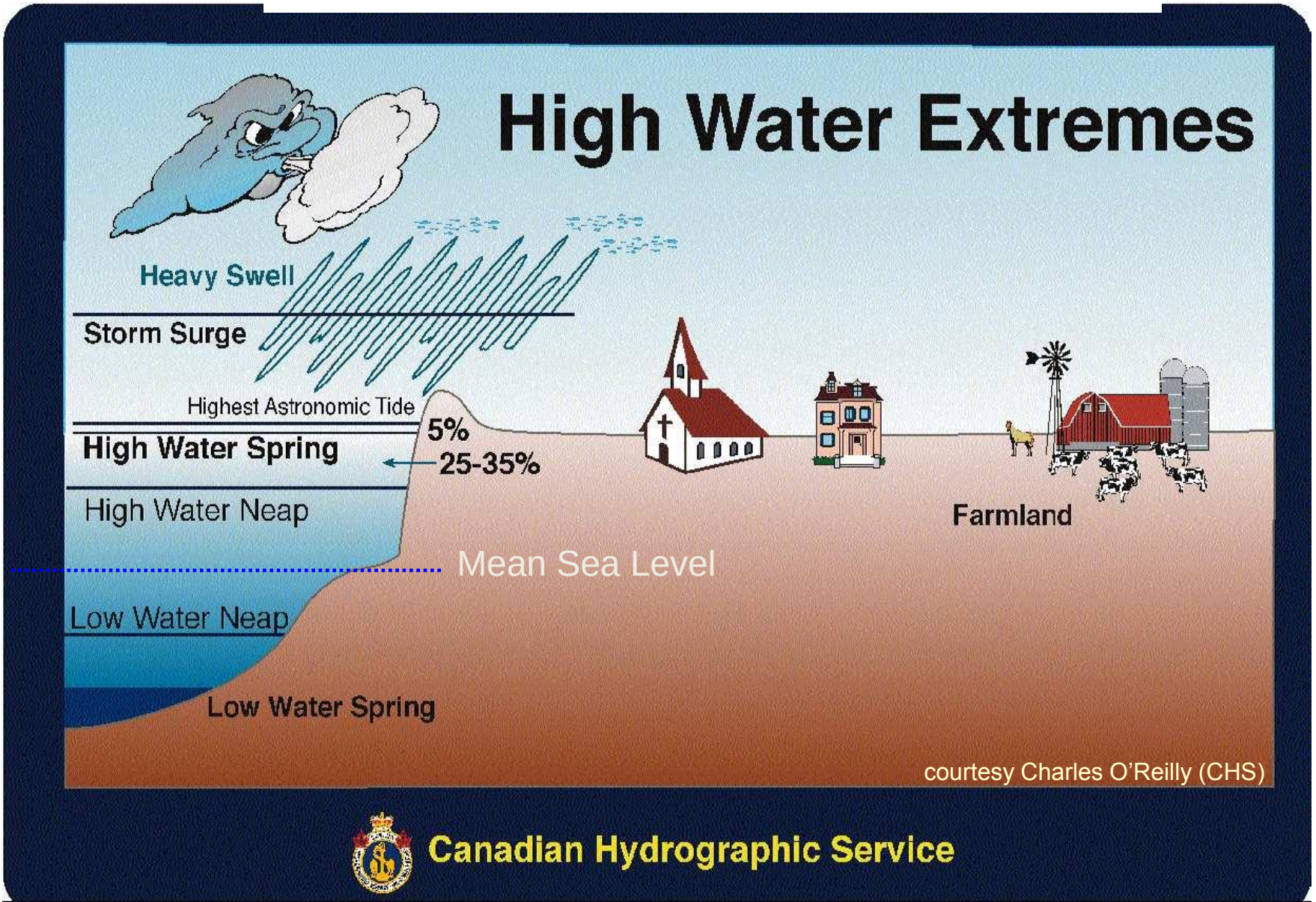
Adapting to Coastal Change

- Planning Techniques
- Research potential future water levels and wave potentials
- Need to understand coastal dynamics
- Regulatory
- Land Management / Land Use
- Structural Methods

Cliff Erosion Diagram



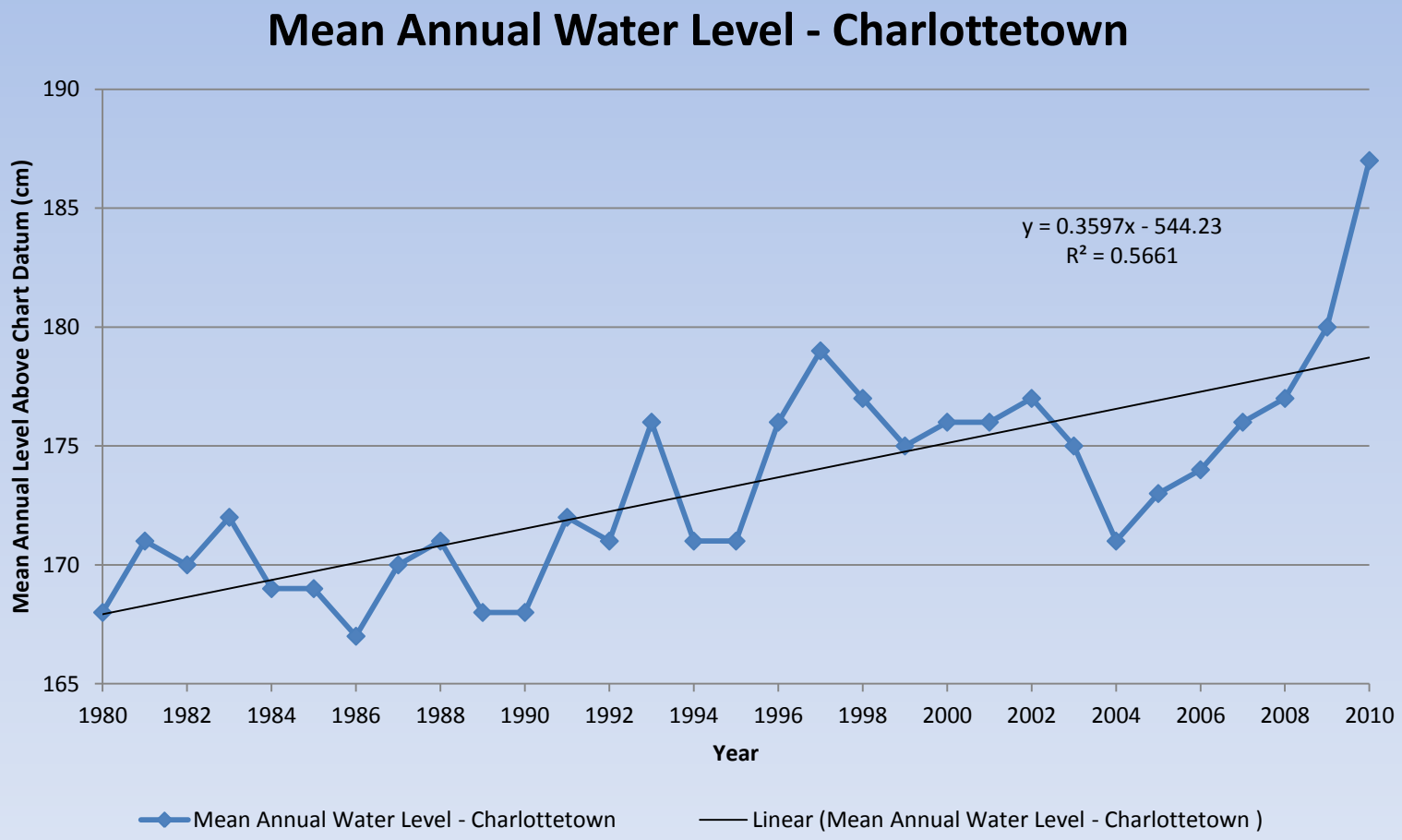
High-water extremes
(high tide, storm surge, wave setup & runup)
are carried on mean sea level



Sea Level Rise Scenarios (Richards & Daigle)
How high will the water go?

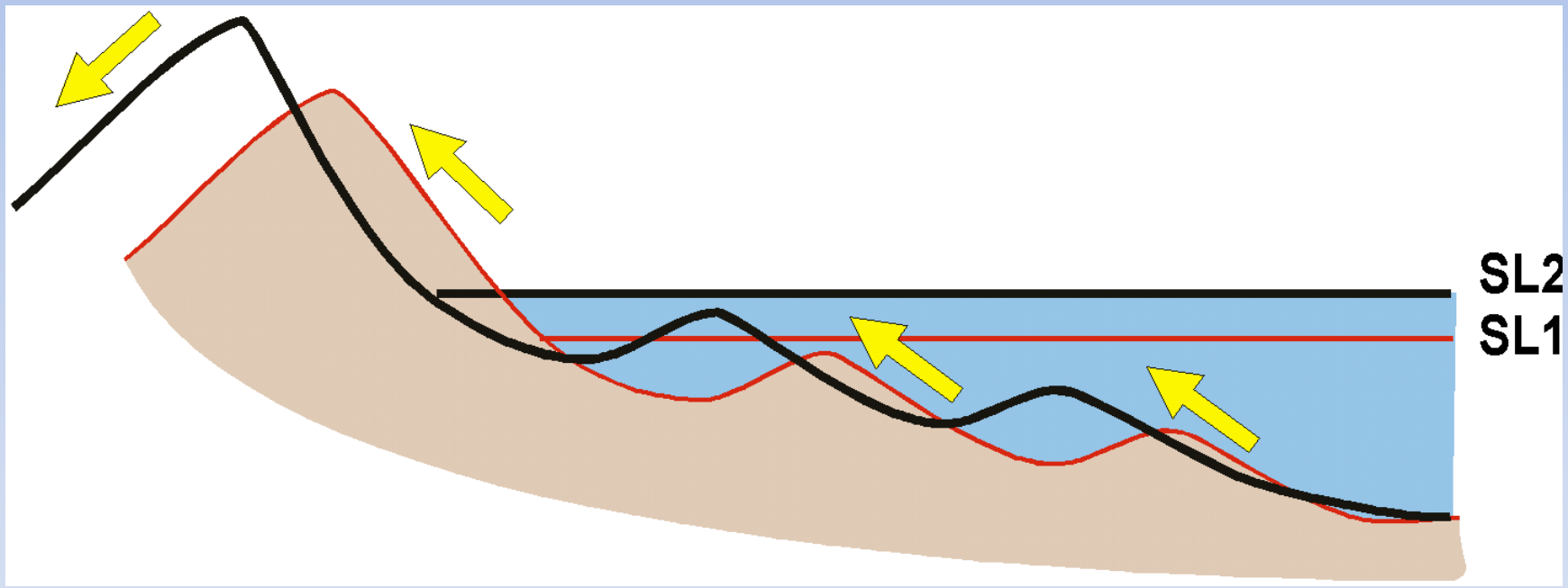
CHS Representative site	HHWLT m (CD)	Sea-Level Rise (2100) + Error Bar (m)	Maximum Storm Surge to Date (m)	Plausible Upper Bound Water Level (m) (CD) by Year 2100
Alberton	1.16	1.56	1.38	4.10
West Point	1.51	1.48	1.77	4.76
Summerside	2.18	1.48	1.53	5.19
Rustico	1.23	1.56	1.38	4.17
Charlottetown	3.01	1.54	1.53	6.08
St Peter's Bay	1.05	1.53	1.38	3.96
North Lake Harbour	1.45	1.58	1.38	4.41
Naufrage	1.25	1.58	1.38	4.21
Georgetown	1.90	1.58	1.38	4.86

Charlottetown – 1980-2010
Rate of Increase 36 cm/century



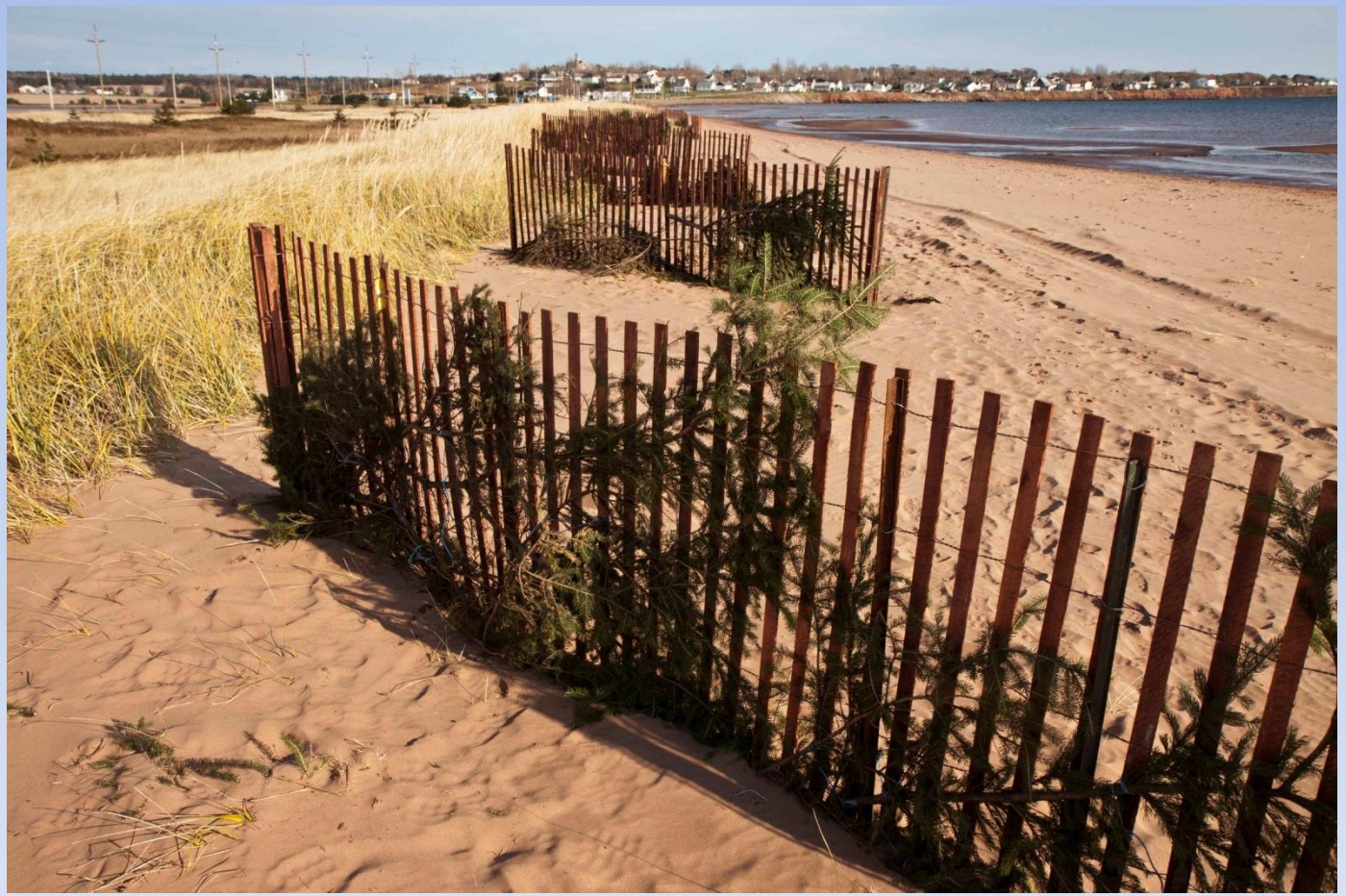
Source: R. J. Daigle Enviro

Schematic Model of the Response of a Sandy Beach and Dune System to Sea Level Rise



From Davidson-Arnott, 2010

Beach Nourishment Technique



Souris Wildlife Federation sand nourishment method to build up sand on the Souris Causeway

Placing Armour Rock at Cymbria – Hard Method - TIR

Springbrook Shoreline Protection – TIR – Oct. 2011 – Hard method

Gabion - Shoreline Protection at Cascumpeque – hard method

Breach of Dunes at Head of Tracadie Bay = More wave energy in the Bay

Winter Bay – Coastline prior to protection

Shoreline Photos from Winter Bay

Winter Bay Shoreline Protection

- Armour rock
- Concrete slabs

Winter Bay Shoreline Protection

Winter Bay – Shoreline Protection Efforts

Winter Bay Shoreline Protection
Various Approaches

Winter Bay – Shoreline Protection Issues

Winter Bay Observations

- Shoreline is under wave attack during surges
- Erosion occurring in non-protected areas
- Many types of protection installed
- Most are not high enough to withstand highest waves – min. 3.5 to 4.0 metres above MSL.
- Several are not installed properly
- Need for a harmonized approach
- Design standards need to be established
- Education of shorefront property owners is req'd

How Can Local People Help?

- Report high water, storm surge and high water events when they happen.
- Report any significant damage to coastline or infrastructure.
- Mark High Water events (spike in a post, stake to mark high water line, spray paint, etc.)
- Volunteer to help maintain and operate a local tide gauge.

Coastal Change Organizations

- Coastal Zone Canada Association
- Southern Gulf of St. Lawrence Coalition
- C-Change (project at Charlottetown)
- UPEI Coastal CURA project
- UPEI Climate Change and Research Group
- Canadian Coastal Science and Engineering Association
- Atlantic Canada Adaptation Solutions Association
- Local Watershed Groups

Thanks for your attention

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