

A photograph of a coastal landscape. In the foreground, there is a field of tall, dry, yellowish grass. Behind it, a sandy dune with some green shrubs is visible. In the middle ground, a wide, sandy beach stretches across the frame. To the left of the beach is a calm body of water, and to the right is the ocean with white-capped waves breaking. In the background, there are more dunes and a distant shoreline under a clear blue sky with some light clouds.

# Coastal Change on PEI

Using Local Knowledge

April 17<sup>th</sup>, 2012

PEI's Changing Climate



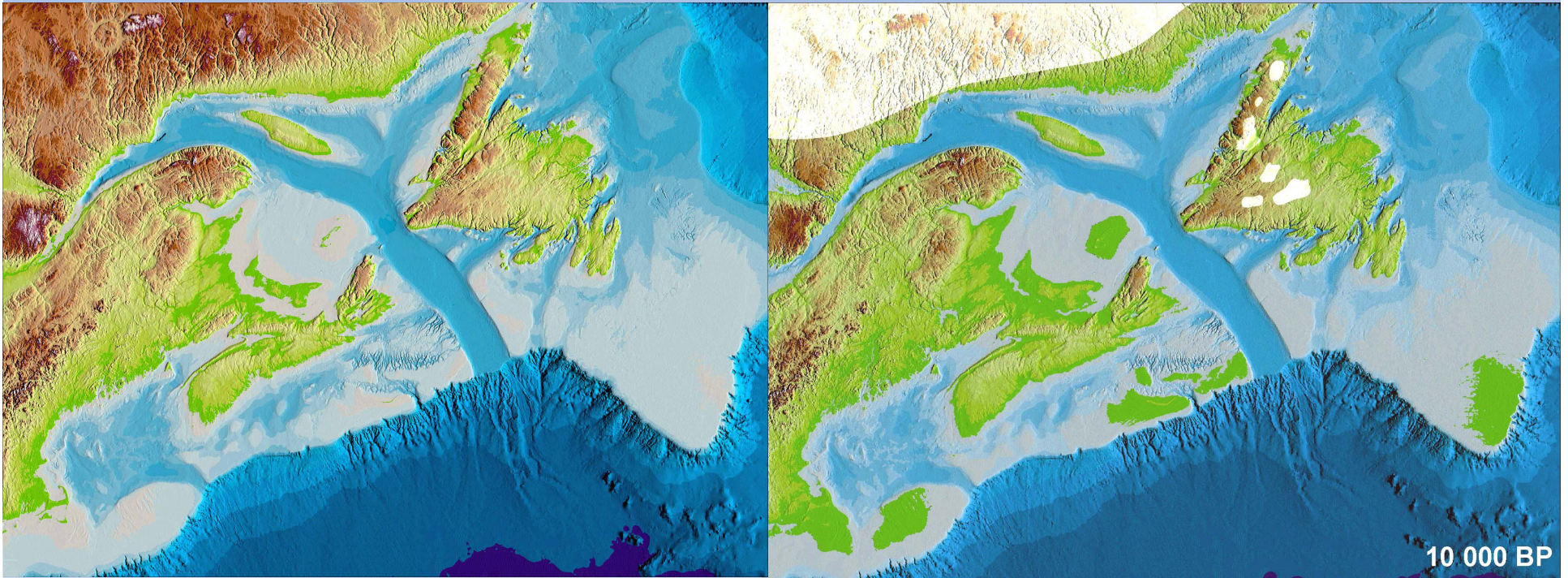
# What is Coastal Change?

- 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?

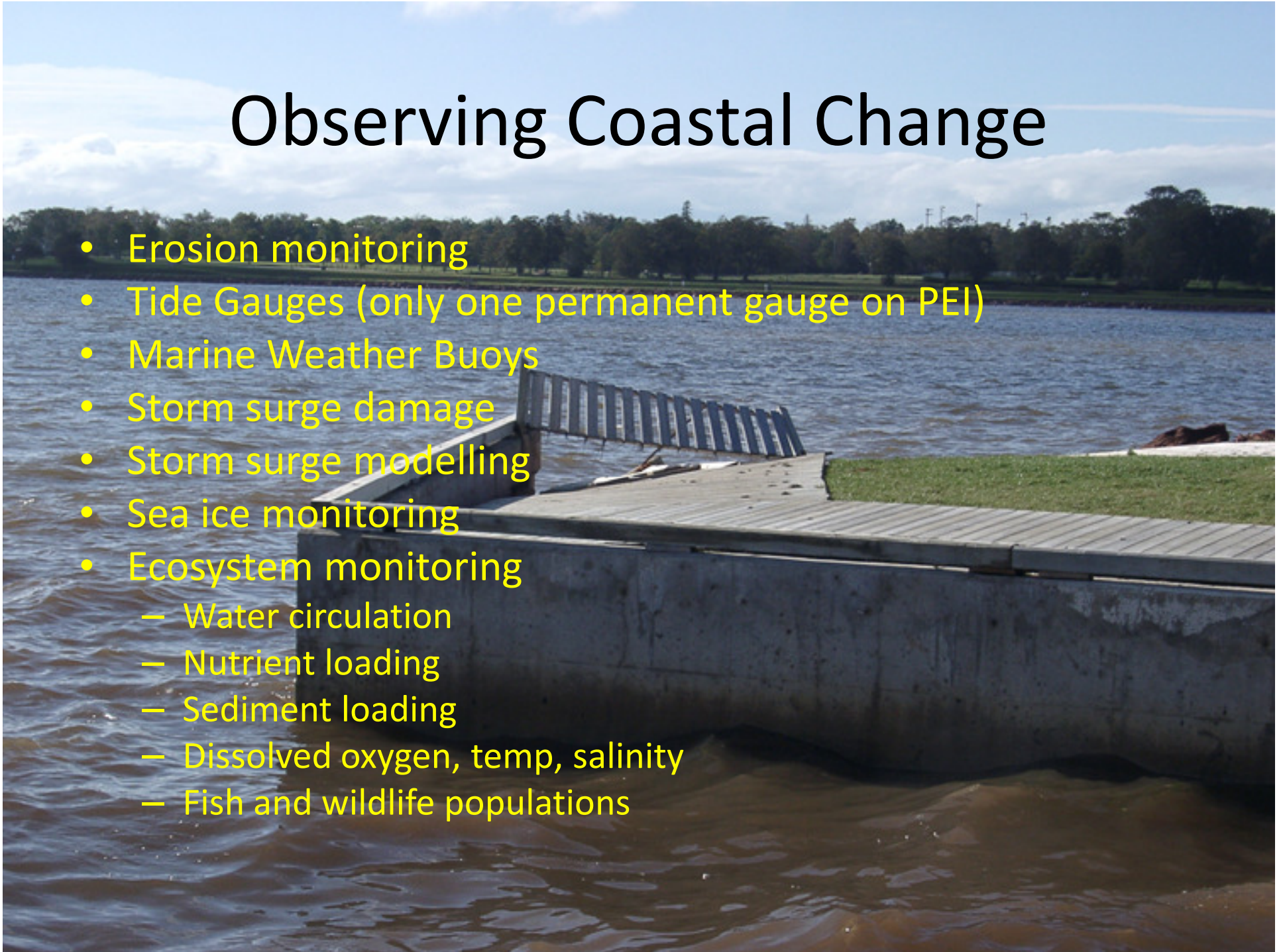
- Wave Action including overwash
- Sea Level Rise
- Storms and Storm Surges
- Rising Temperatures = Less ice along the shore
- More freeze and thaw cycles
- Overland runoff
- Human activities
  - Infrastructure construction, other human activities (walking / driving on dunes etc.





# 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

ALCOHOL GAMING

gaming to p

Finance m but gov

By Ryan R THE GUARDIAN



This car parked along Kensington Road near Joe Ghiz Memorial Park became submerged in flood water following a day of heavy rainfall in Charlottetown. Areas throughout the city were reported flooded due to the heavy rain, including Grafton Street near Holland College and parts of University Avenue. GUARDIAN PHOTO BY NATHAN ROCKFORD

## YOU SAID IT

"... when it's a performance by the man who put hours, weeks, months of hard labour into renovating the old 1846 church — that is, Harmony House co-owner/operator Kris Taylor — playing alongside long-time musical colleague Allan Rankin, the charm is just flowing over the brim." **Todd MacLean**  
See Out and about, C2

## NEW BRUNSWICK

### City councillor acquitted of impaired driving

BATHURST, N.B. — A Bathurst city councillor has been acquitted of impaired driving after a judge ruled the Crown failed to prove its case beyond a reasonable doubt.

Scott Ferguson, who is also a school vice-principal, was charged with operating a motor vehicle while impaired, having care and control of a vehicle while impaired and refusing a breathalyzer.

Provincial court Judge Ronald LeBlanc said Thursday that Ferguson didn't appear in DVD footage of the arrest to be staggering or slurring, contrary to an officer's testimony.

The judge also pointed out that the sergeant responsible for administering the breathalyzer

## Rainstorm floods Charlottetown streets

*Downdrop turns basements, backyards into ponds*

By Nathan Rockford THE GUARDIAN

It was an exceptionally damp day for many Charlottetown residents Thursday as a massive rainstorm flooded the city.

Streets throughout the capital were closed as public works crews worked to clear the water and a number of residents in low-lying areas experienced basement flooding.

"It's nothing unusual for me," said Scott MacDonald, who lives on Spring Street.

"It always floods here," MacDonald said. "The flooding was so bad on Spring Street that at one point Thursday afternoon the neighbourhood kids were swimming in what he describes as a 'pond'."

"They were out playing in it," he said.

"They even had the dog out."

But while he said he has seen his share of flooding over the years he hasn't seen it as bad as Thursday since the early 1990s.

"There was water over the bumper of the neighbour's van," MacDonald described, adding his basement and backyard were heavily affected.

"My backyard was literally a pond."

Superintendent of public works Blair Kinch said he saw areas flooded that he's never seen flood before.

"It was just more rain than the storm sewer could handle," he said, adding crews were out from 2 p.m. until roughly 10 p.m. Thursday working to get things back under control.

In total, nine streets were reported flooded, including Reserve Street, Newland Crescent, Exhibition Drive, Fitzroy Street and University Avenue, Spring Street, Costello Lane, Grafton Street and Kent Street.

That aside, Kinch said he heard no reports of basement flooding but expects the phones will start ringing today.

In the future, he said there's not much the city can do to prevent flooding outside of regularly cleaning the catch basins located throughout Charlottetown.

There are approximately 170 cottage owners in the area. Jamieson and his wife circulated a petition with 80 names on it in an effort to convince government to move on repairs.

"The boardwalk is our lifeline. I've been here for 30 years. We take very nice care of our property. We have a five-star resort sitting next

to it. The provincial government hasn't decided if it's involved in on-bling, says Finance Minister Wes Sheridan. But he said the province has let Atlantic Lottery Corporation (ALC) look at changes to include online gaming. "We're waiting what they come out of the minister said. Although ALC is an estimate of around a million in potential revenue from online gaming, Sheridan said province adopted gambling it would be a regulated and safe site. "This is not about money."

If P.E.I. were involved with on-bling, it wouldn't be the first province to do so. British Columbia has an online casino in Ontario announced intention to get into gaming earlier this year. Sheridan said less than one per cent of

## Facebook users on P.E.I.

LOCAL NEWS A1-5 • National News A5-7 • Opinion/Editorial A8-9 • International News A10, B5 • Sports B1-4 • In Memoriam B7

## Boardwalk to nowhere

*Summer residents of Lakeside livid nothing is being done to restore beach access after storm two years ago destroyed boardwalk and staircase*

By Dave Stewart THE GUARDIAN



Lakeside — An American tourist with a disabled husband looked out over the marram grass Tuesday and called it the boardwalk to nowhere.

Hundreds of summertime residents of the picturesque beachside community are livid over being shut off from access to the beach after a storm destroyed the boardwalk and staircase to the beach in 2008.

Vandals have made things even worse recently, using wood from the boardwalk to start a bonfire.

A Guardian reporter and photographer went out for a look at the damage Tuesday afternoon and were greeted by about a dozen angry residents.

"This is our 41st summer here and this is the first time I've been embarrassed to be associated with Lakeside," said Lyman MacInnis, a summer area resident. "This is an absolute embarrassment."

At present, the boardwalk extends from Lakeside Road over the marram grass. The area reserved for wheelchairs or people who just want to sit and look out to the ocean is roped off and it looks anything but safe. The staircase to the beach is completely gone.

Lakeside resident Eldon Jamieson said the Morell and Area Development Corporation has been in contact with the provincial government since the damage occurred in 2008 but so far nothing has changed.

"We're looking at another summer coming and we're going to have no boardwalk," Jamieson said.

"It's unsightly and it's unacceptable. It's unsafe for residents."

The province should make long-overdue repairs immediately, suggested Gavin Kenny.

There are approximately 170 cottage owners in the area. Jamieson and his wife circulated a petition with 80 names on it in an effort to convince government to move on repairs.

"The boardwalk is our lifeline. I've been here for 30 years. We take very nice care of our property. We have a five-star resort sitting next to it. The provincial government hasn't decided if it's involved in on-bling, says Finance Minister Wes Sheridan. But he said the province has let Atlantic Lottery Corporation (ALC) look at changes to include online gaming. "We're waiting what they come out of the minister said. Although ALC is an estimate of around a million in potential revenue from online gaming, Sheridan said province adopted gambling it would be a regulated and safe site. "This is not about money."

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## Monument to pride at Sherbrooke

The Former Members of the P.E.I. legislature honour former Premier Ian MacInnis buried at Sherbrooke. The public is invited to a monument unveiling opposite the Charlottetown port, on Sunday at 2 p.m.

The ceremony is to ensure all former premiers are recognized at their final resting place.

Former MLA Mario Murphy, a member of the association, research indicates that by the name of Harley that Donald Farquhar, former premier, once owned a farm. This led him to find where all former premiers were buried.

"He found many brothers not recording their names," Murphy said. "Harley took pictures of the monument, which was available."

She said he then sought out former members, which agreed to take on the cost of cleaning and replacing headstones.

## Charlotte of new Monopoly

CANWEST NEWS SERVICE AND THE GUARDIAN

OTTAWA — The company that created the board game Monopoly has named Charlotte, Ont., as the new capital of the game. The company said it chose the city because of its long history of being a capital city.

Twenty-two Canadian cities were officially added to the list of cities included in the game, which includes Ottawa, Montreal, Kelowna, Kananaskis, and many others.

"I do frequent a lot of boardwalks," Weskie said. "It's too bad I can't get up to this beach."

Weskie, who is in a wheelchair, could only lament at not being able to navigate up to the beach.

"Emergency assistance would be delayed if needed on the beach."

Lakeside summer residents Eldon Jamieson and Zita Ryan stand beside what is left of the boardwalk/staircase leading from about 170 cottage lots to the beach at Lakeside. A storm in 2008 destroyed the staircase and vandals have caused damage twice recently. Residents have been attempting to convince the province to fix the damage for the past two years, so far, to no avail. The viewing area for those in wheelchairs, which can be seen in the picture, has been roped off for safety reasons. GUARDIAN PHOTO BY HEATHER TAWEL

This is our 41st summer here and this is the first time I've been embarrassed to be associated with Lakeside. This is an absolute embarrassment.

Lyman MacInnis



# 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

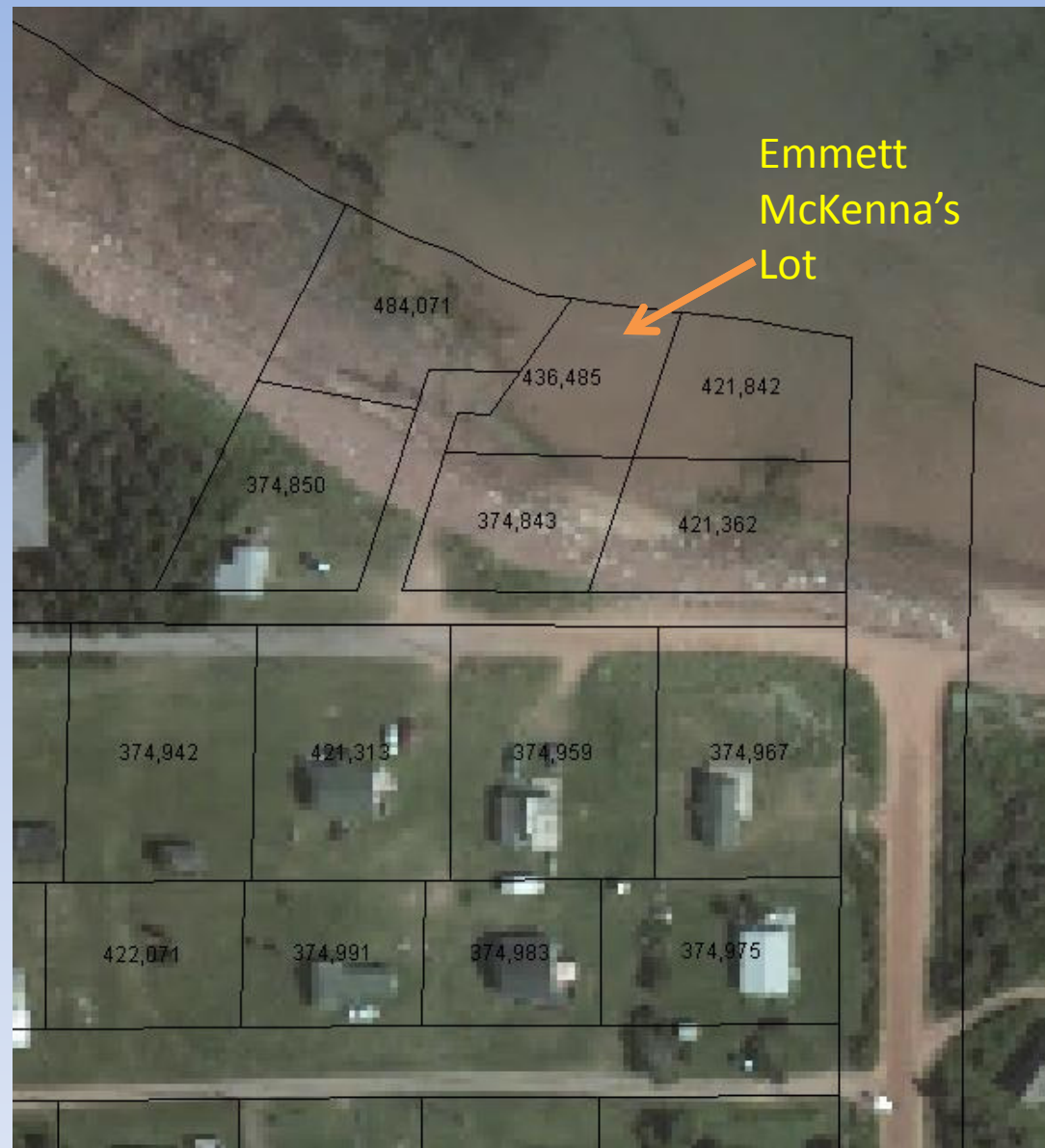


Lillian Elliott of Victoria  
Guardian photo by Nigel Armstrong



## 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

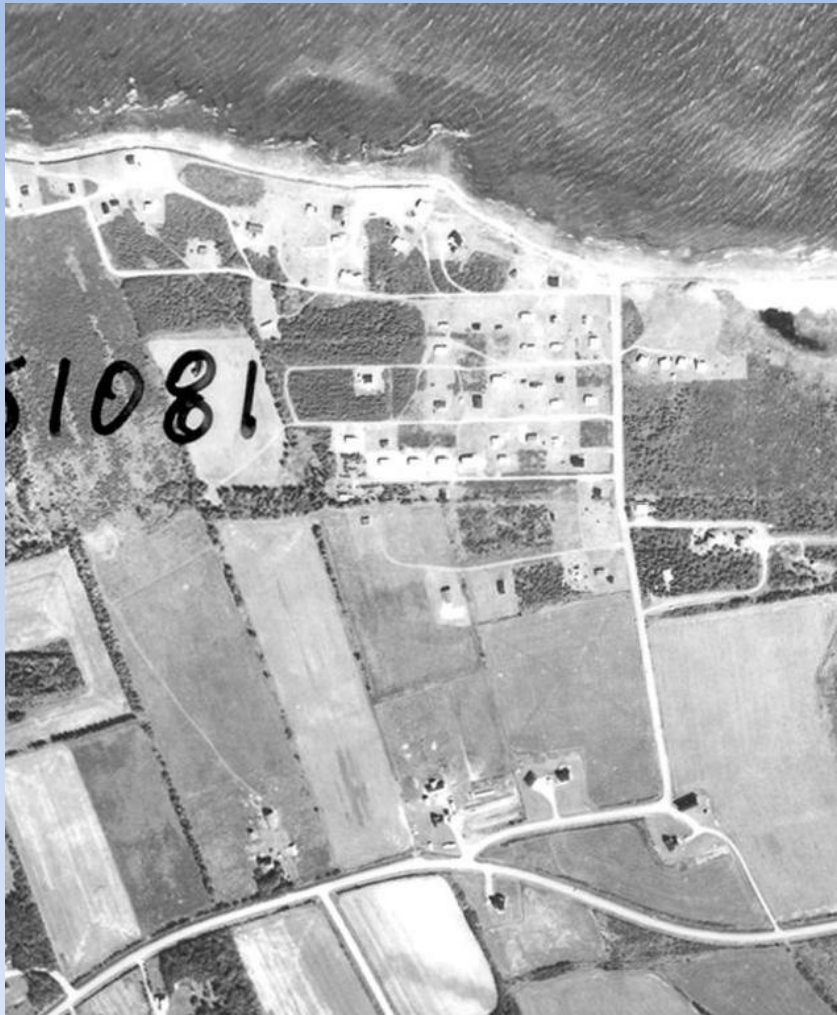


# Pigot's Pt, Cottage Area – 1935, 1974 Aerial Photos





# Pigot's Pt. -Cottage Area – 1990, 2000





# Pigot's Pt – Rectified Aerial Photos

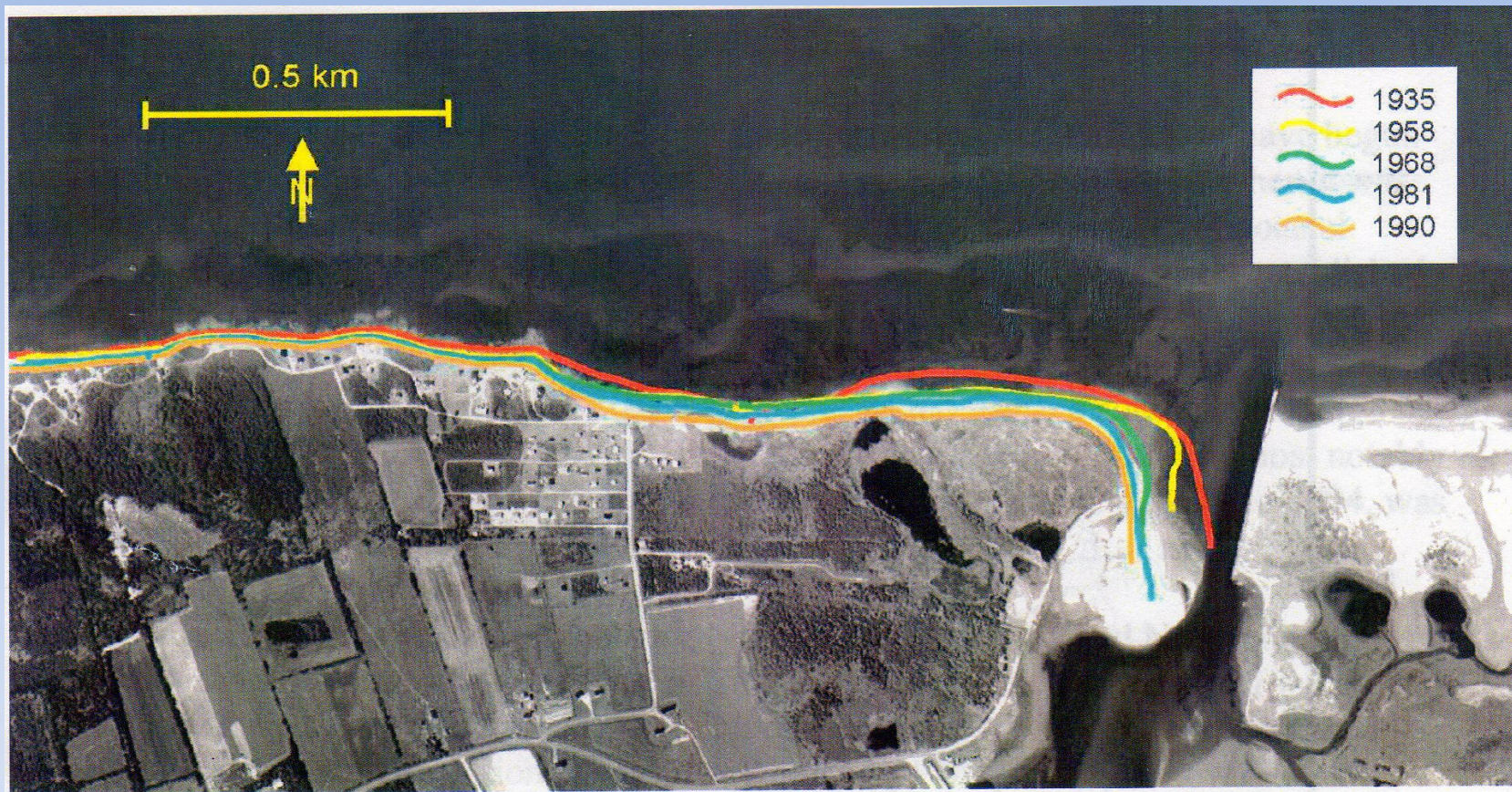


Figure 1. Rectified airphoto showing Pigots Point and Savage Harbour entrance in 1990 (part of 90404-57), with cliff-edge vectors for 1935, 1958, 1968, 1981, and 1990.



# 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**



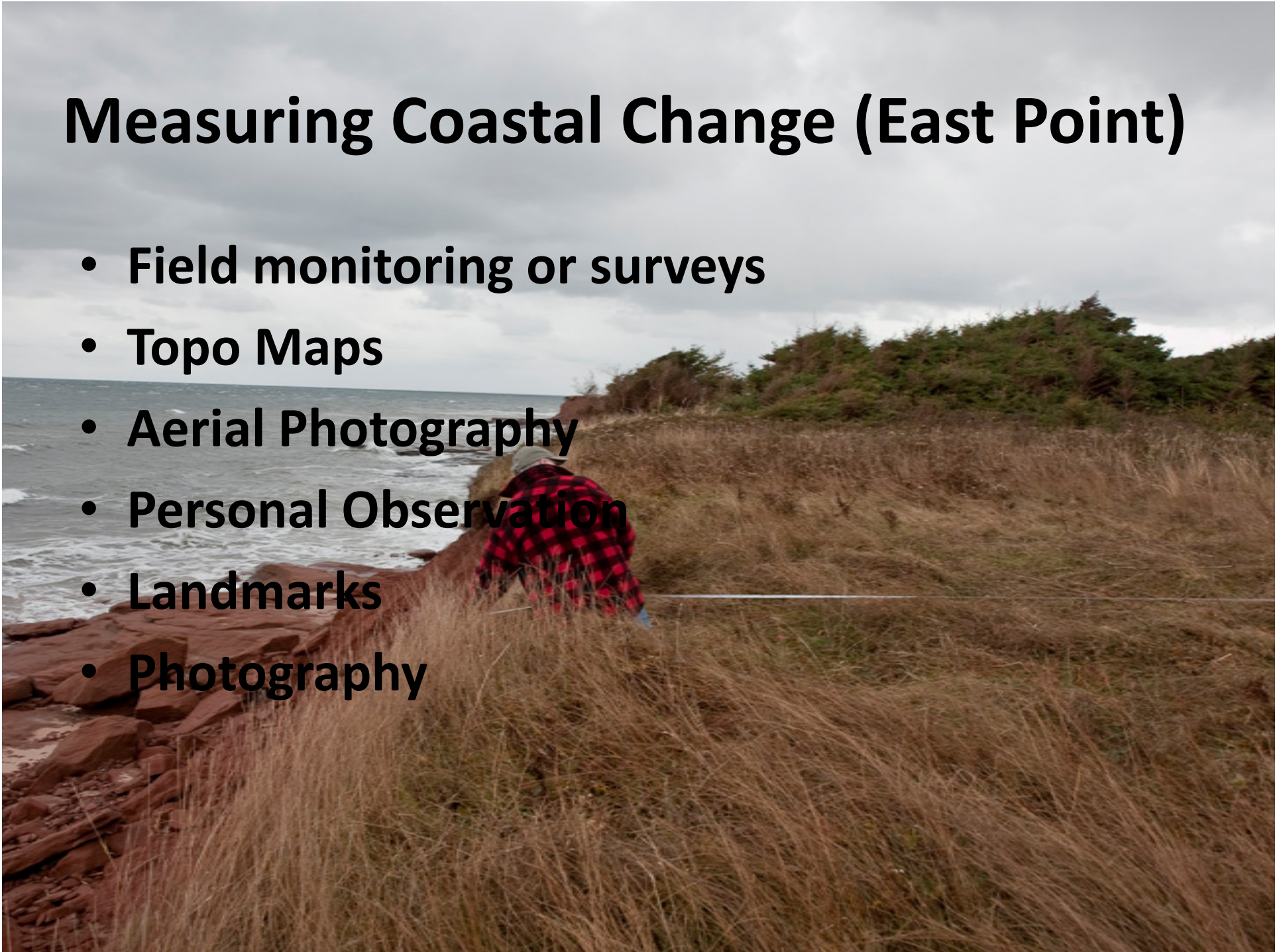
**From Cottage Road**





# Measuring Coastal Change (East Point)

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





# Summerside Rifle Range

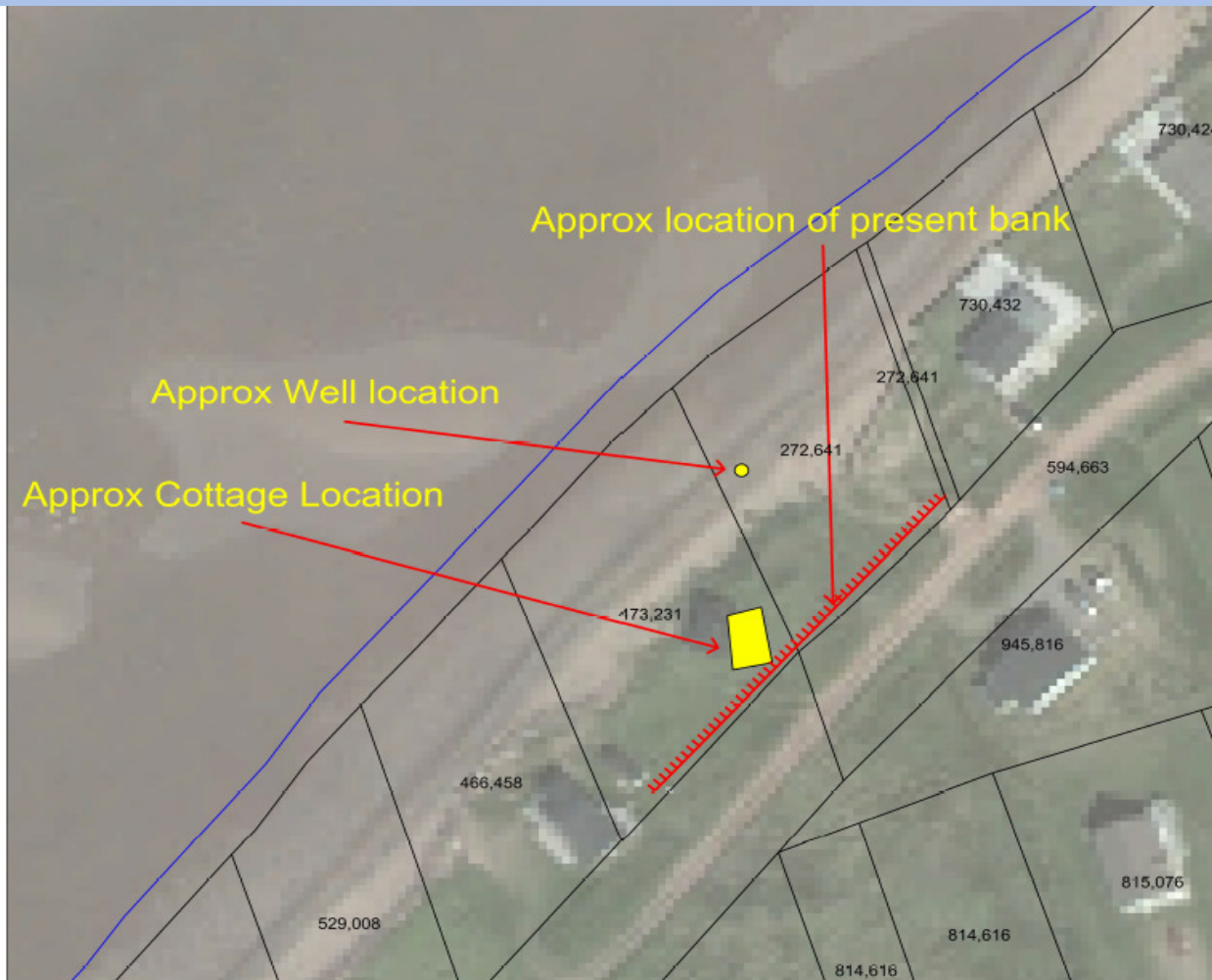
## 1914-2000 shoreline change





# 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



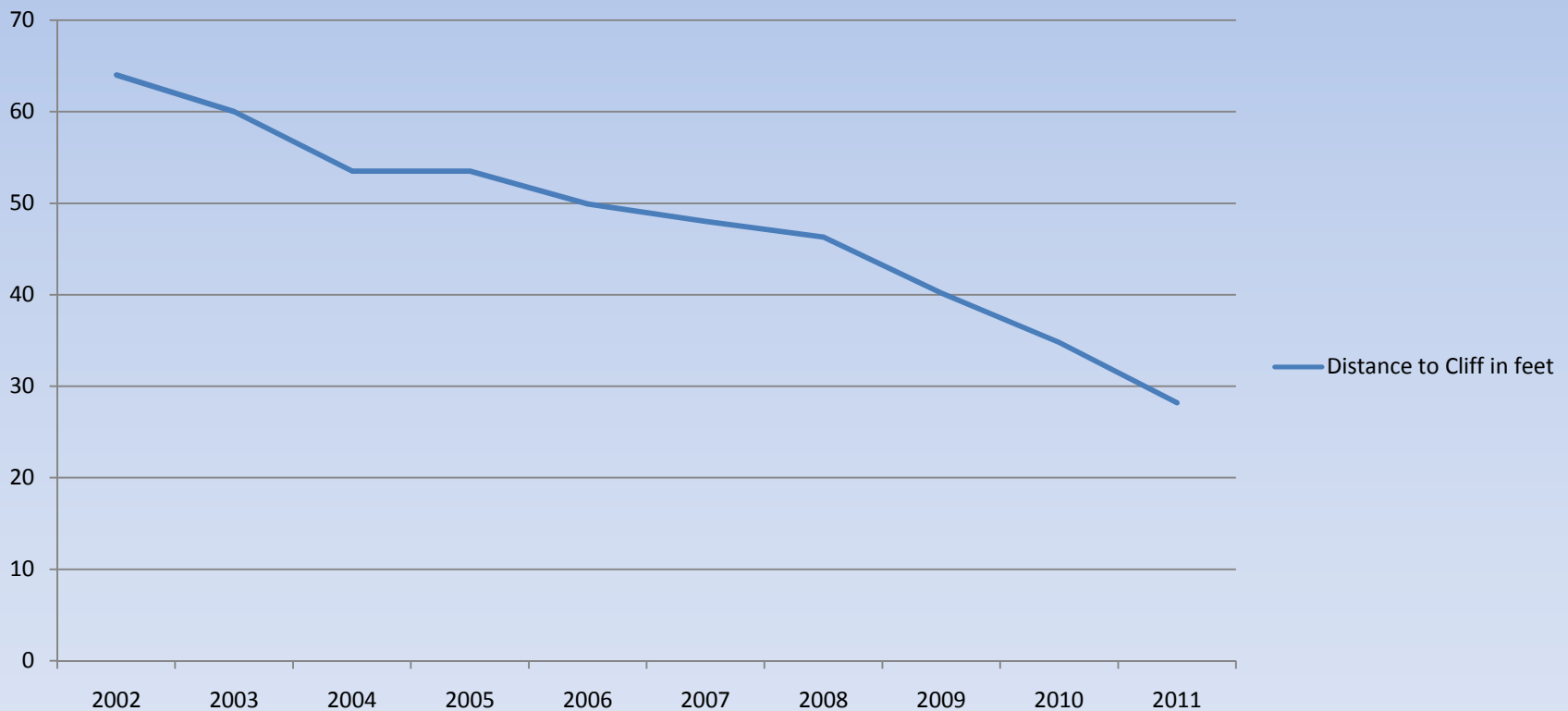
Jan. 25, 2010



Dec. 30, 2010

# Local Shoreline Monitoring – Victoria, PEI – Using Measuring Tape

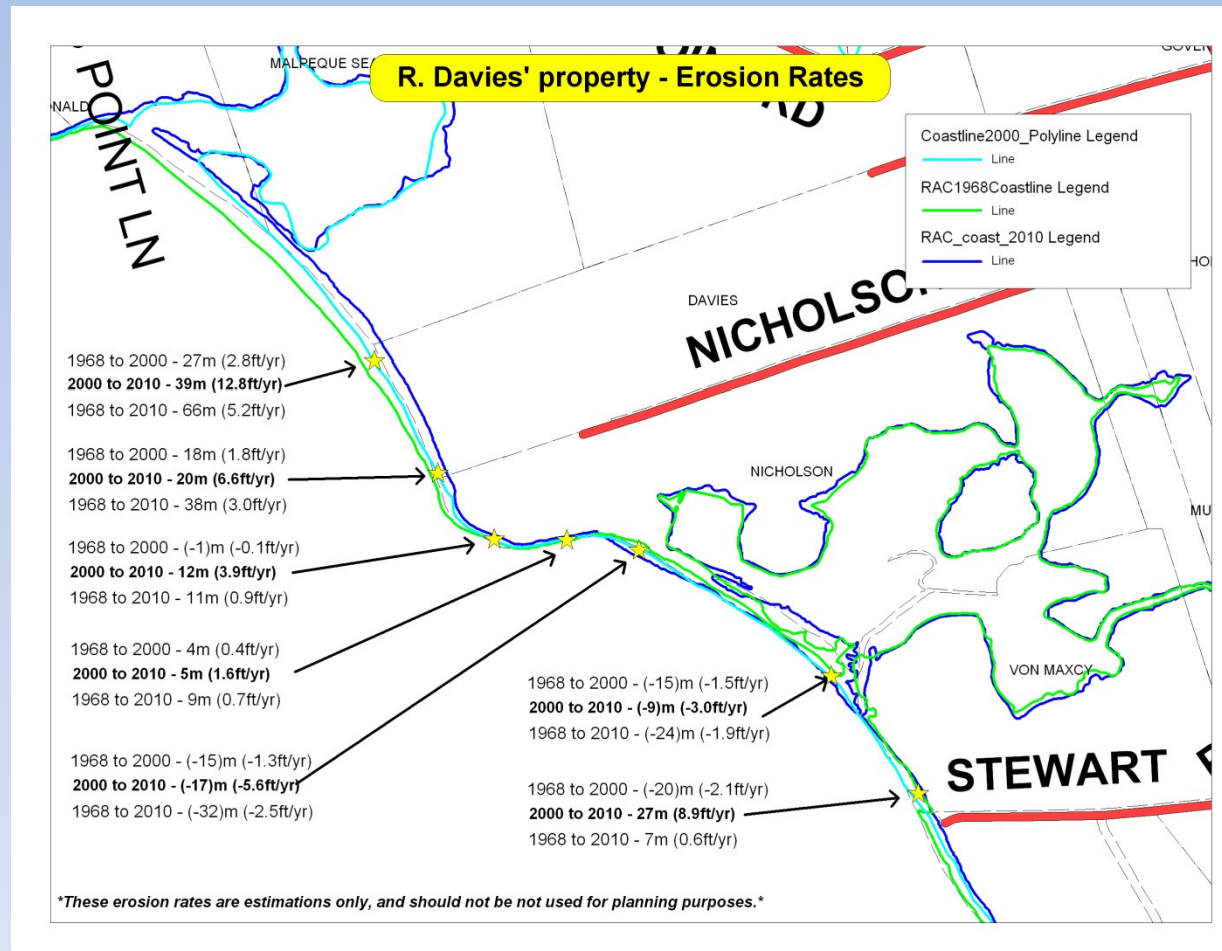
**Shoreline Erosion Monitoring - Victoria Park - Bath House SE Corner  
Measurements by Alan Marshall**



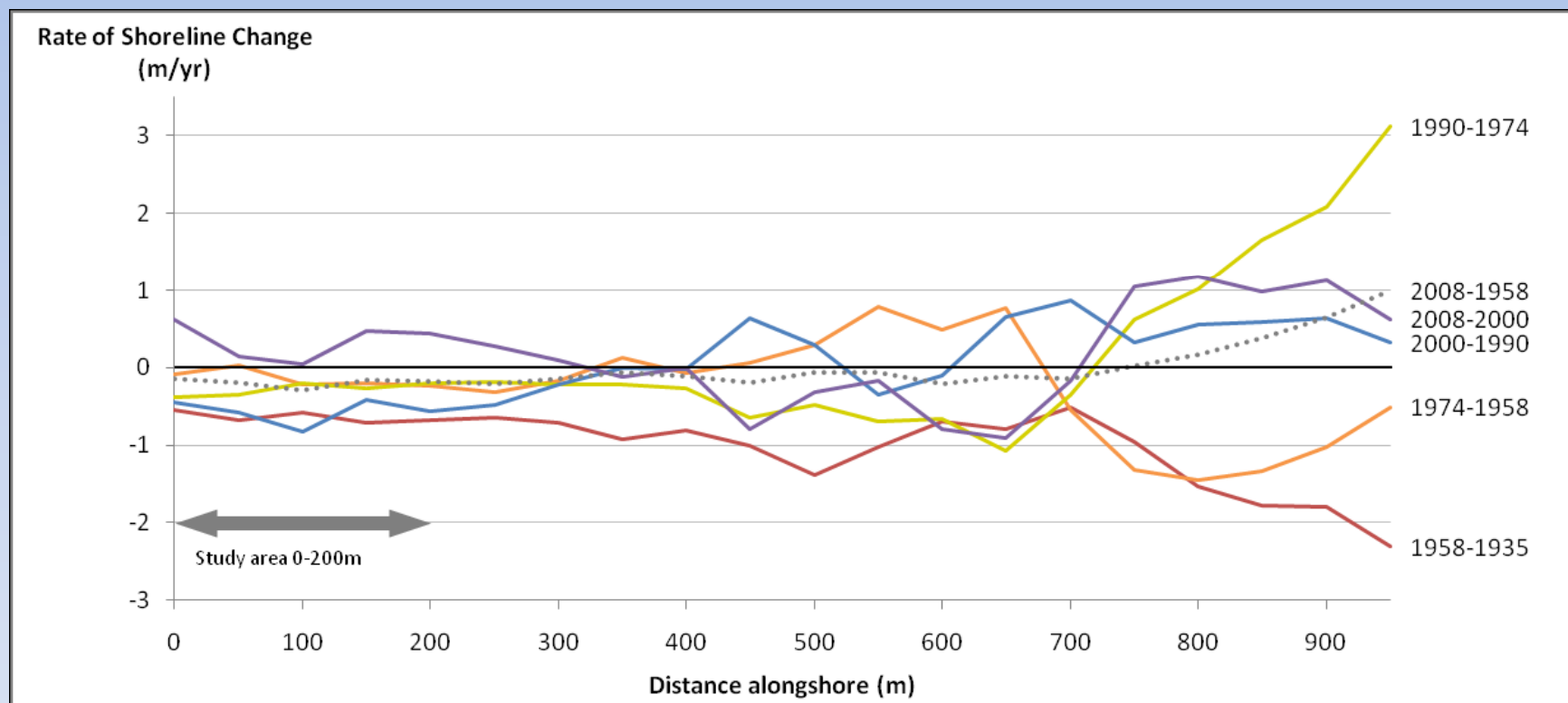


# Using Orthorectified Aerial Photos

## Davies Property – Belle River



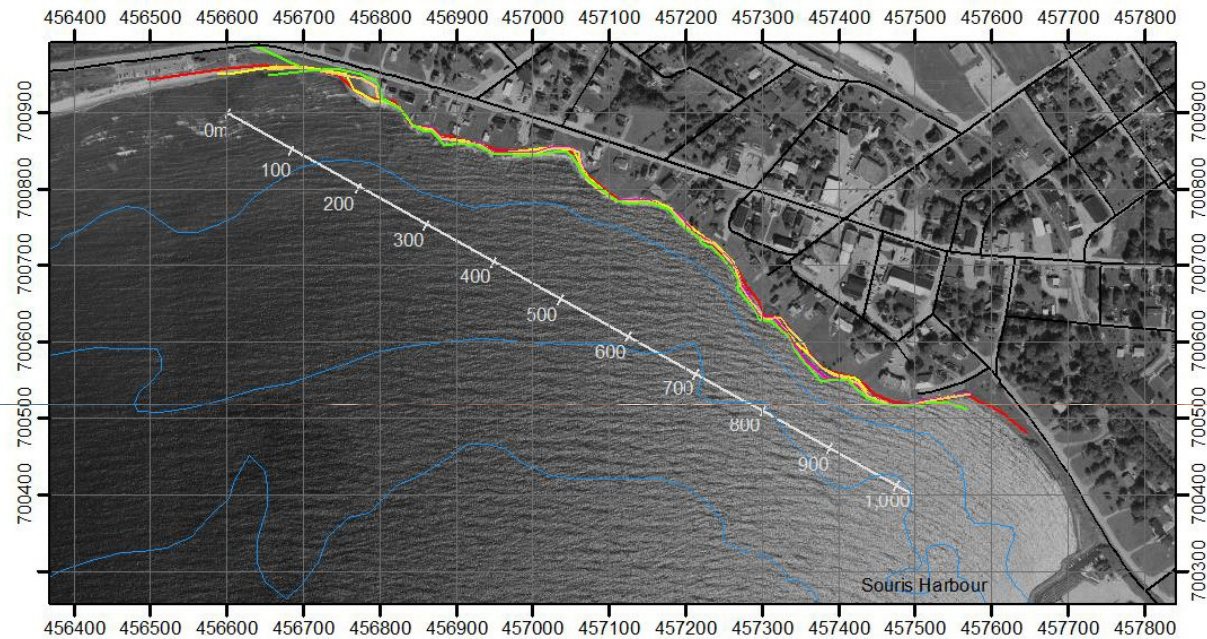
# Souris Causeway Shoreline Change Using aerial photos



From Coldwater Consulting Report – April 2011



# Souris Cliffs – Shoreline Change

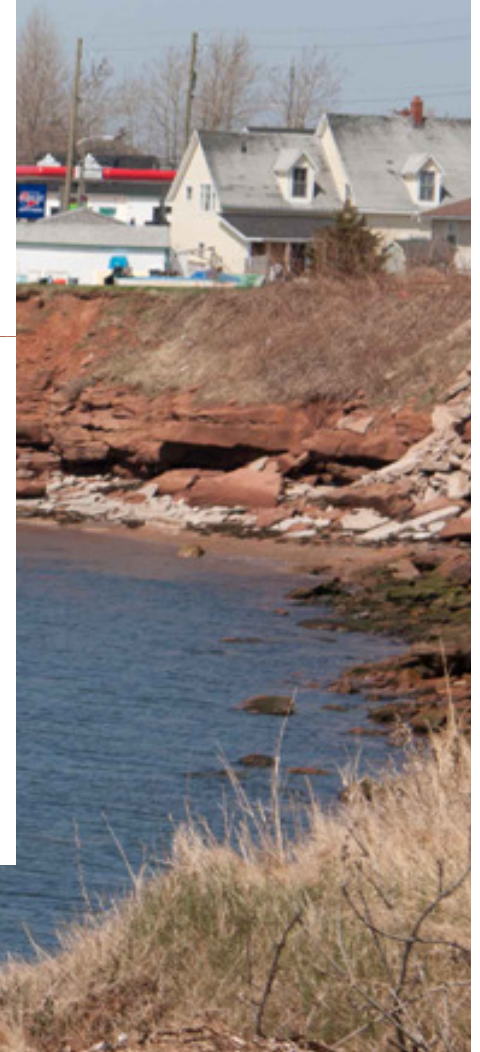
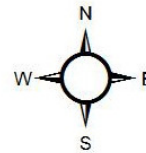


## Legend

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





# Types of Coastal Change

## Storm-Induced

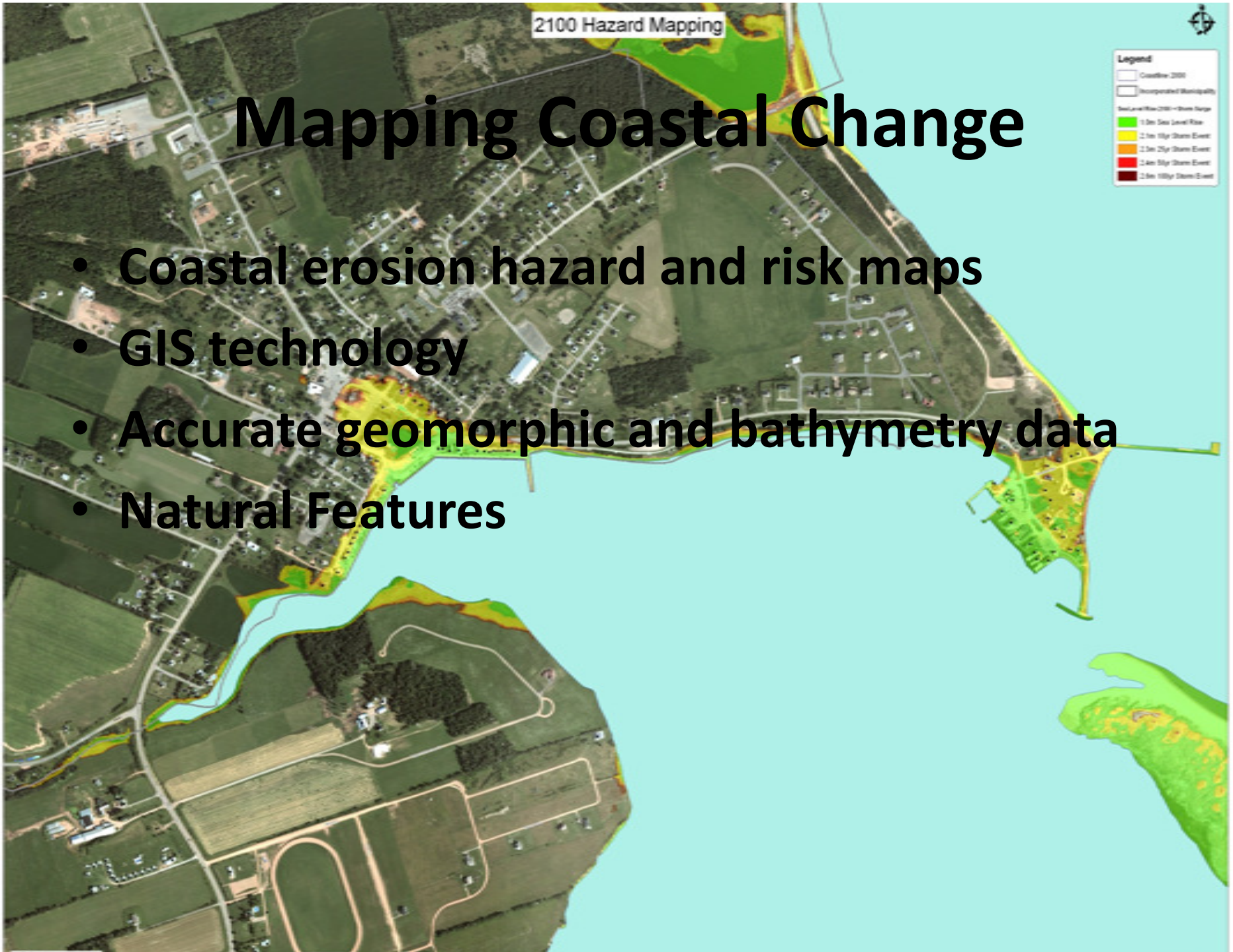
- Coastal Cliff erosion (ie 8 m in one storm)
- Beach erosion
- Dune erosion
- Overwash
- Inundation and Island Breaching
- Marsh Erosion





# 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)

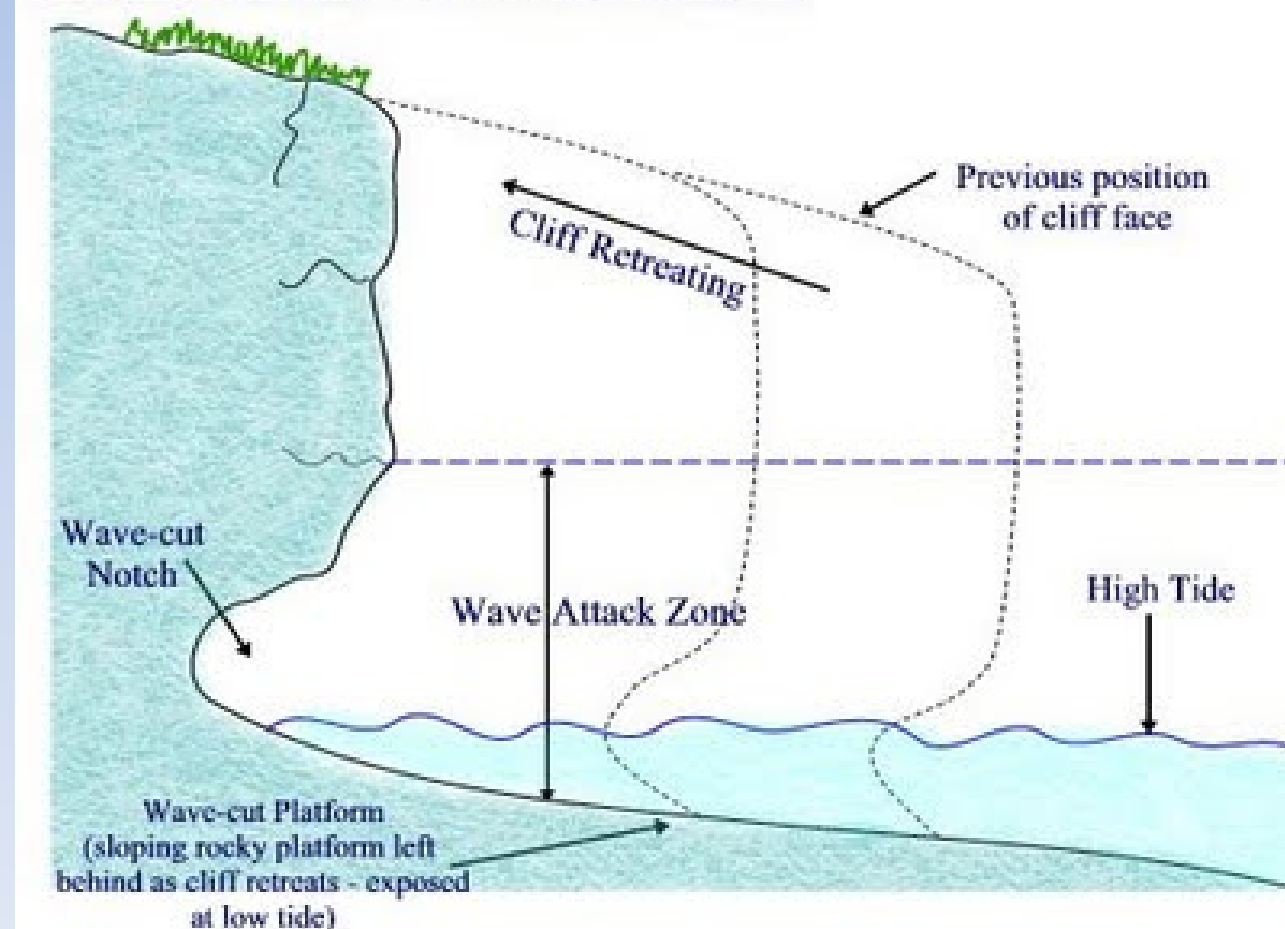


# Adapting to Coastal Change

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

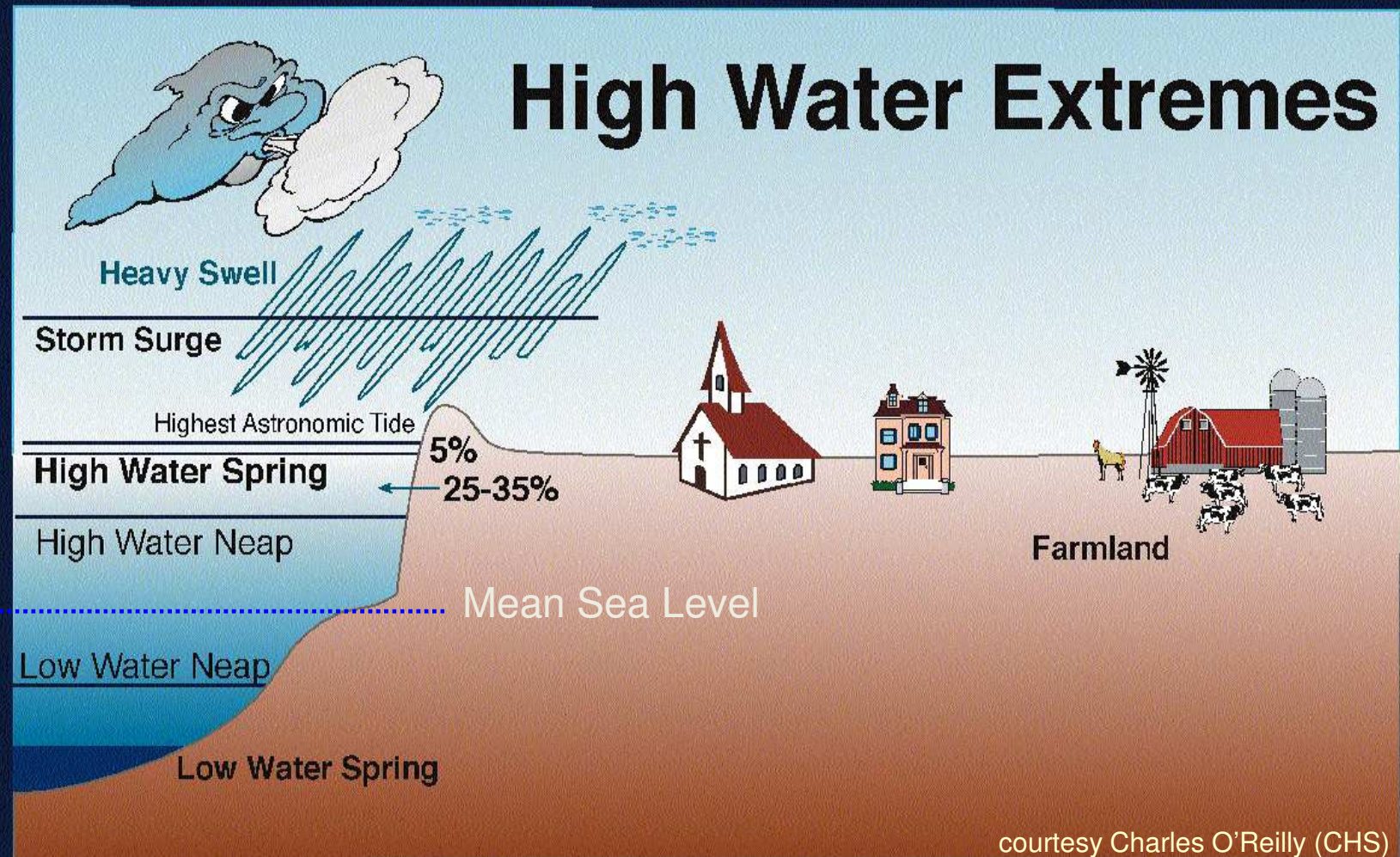
# Cliff Erosion Diagram

Cliff Erosion and Wave-cut Platforms





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



**Canadian Hydrographic Service**

# Sea Level Rise Scenarios (Richards & Daigle)

## How high will the water go?

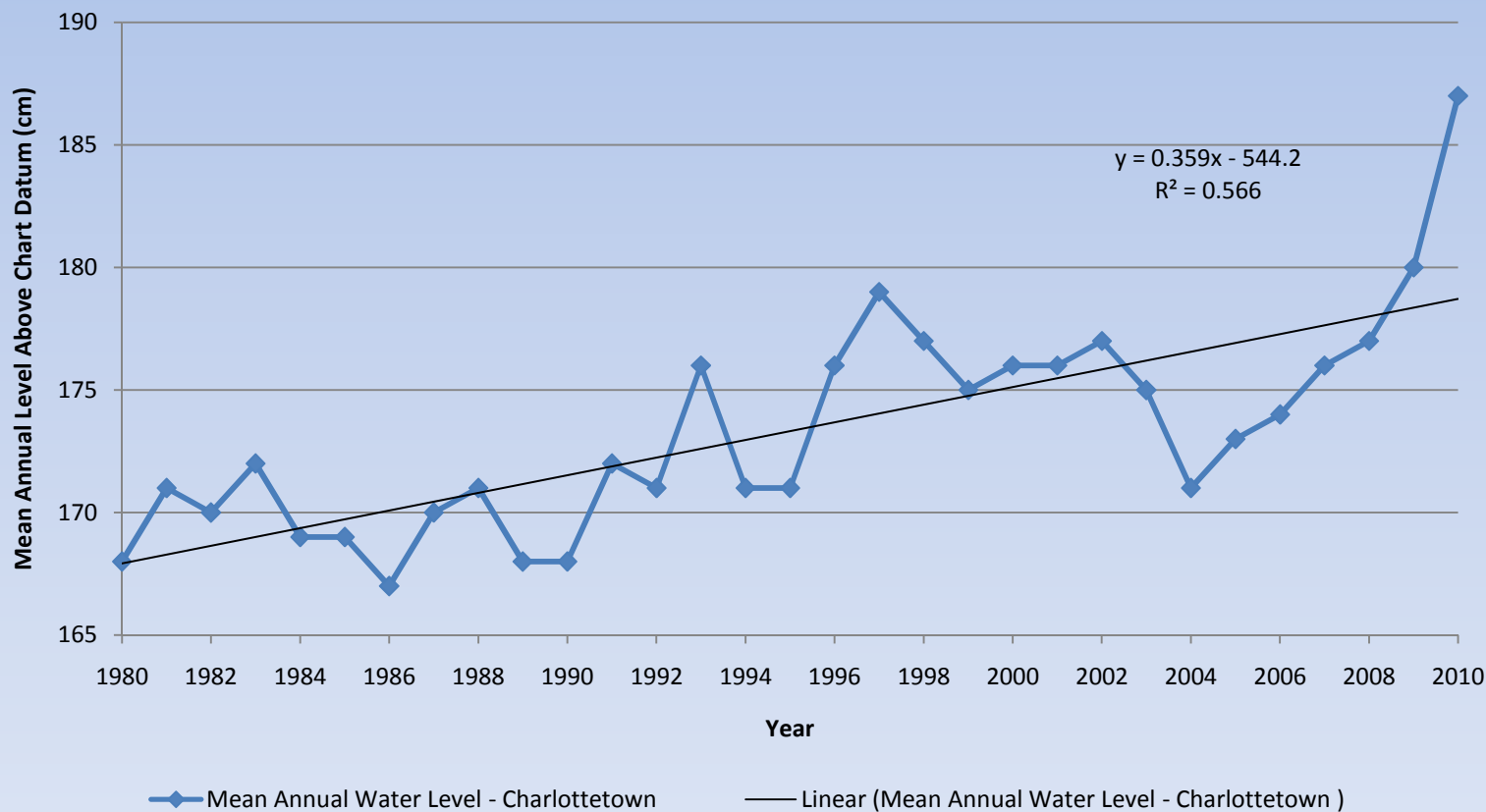
CHS Representative site	HHWLT m (CD)	Sea-Level Rise (2100) + Error Bar (m)	Maximum Storm Surge to Date (m)	Plausible Upper Bound Water Level (m) (CD) by Year 2100
Alberton	1.16	1.56	1.38	4.10
West Point	1.51	1.48	1.77	4.76
Summerside	2.18	1.48	1.53	5.19
Rustico	1.23	1.56	1.38	4.17
Charlottetown	3.01	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***

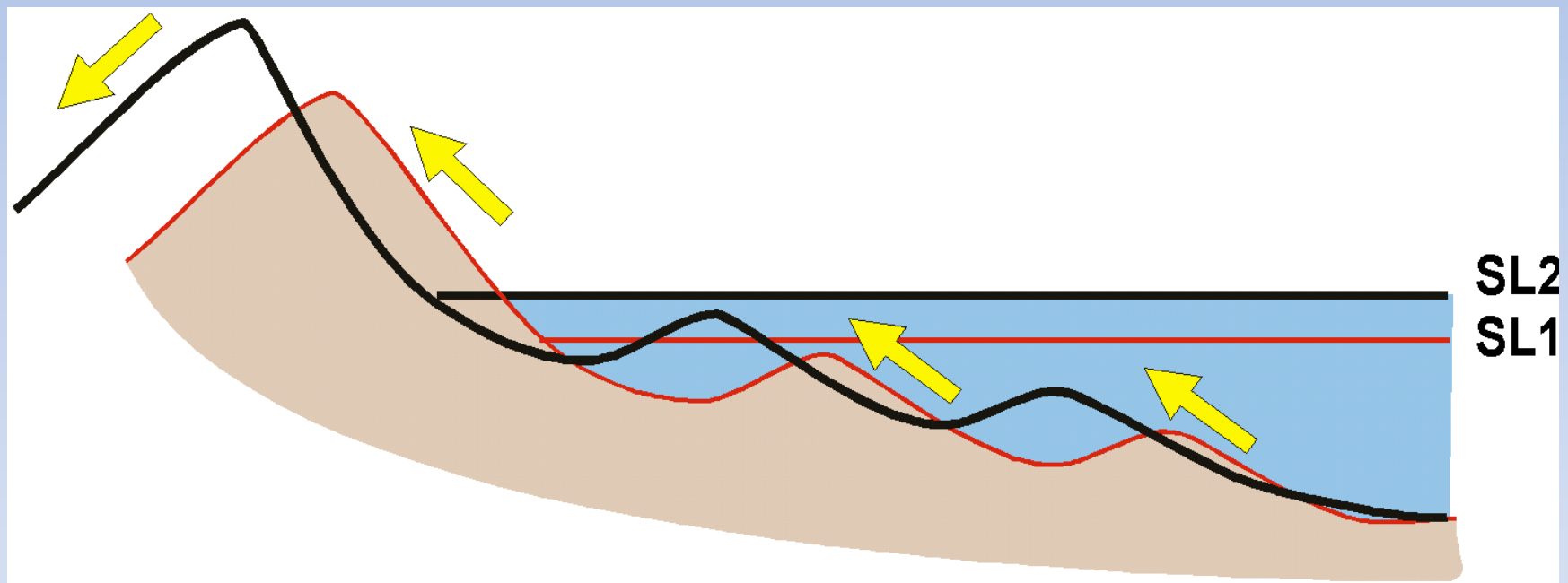
## ***Rate of Increase 36 cm/century***

**Mean Annual Water Level - Charlottetown**



**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





# 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 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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