

COASTAL CHANGE MONITORING ON PRINCE EDWARD ISLAND

Coastal Conversations: Session 2



PEI COASTAL ZONES

Island land area = 5,660 km²

104th largest in the world, 23rd largest in Canada

3,295 kilometers of coastline on Prince Edward Island*



**2010 coastline study*

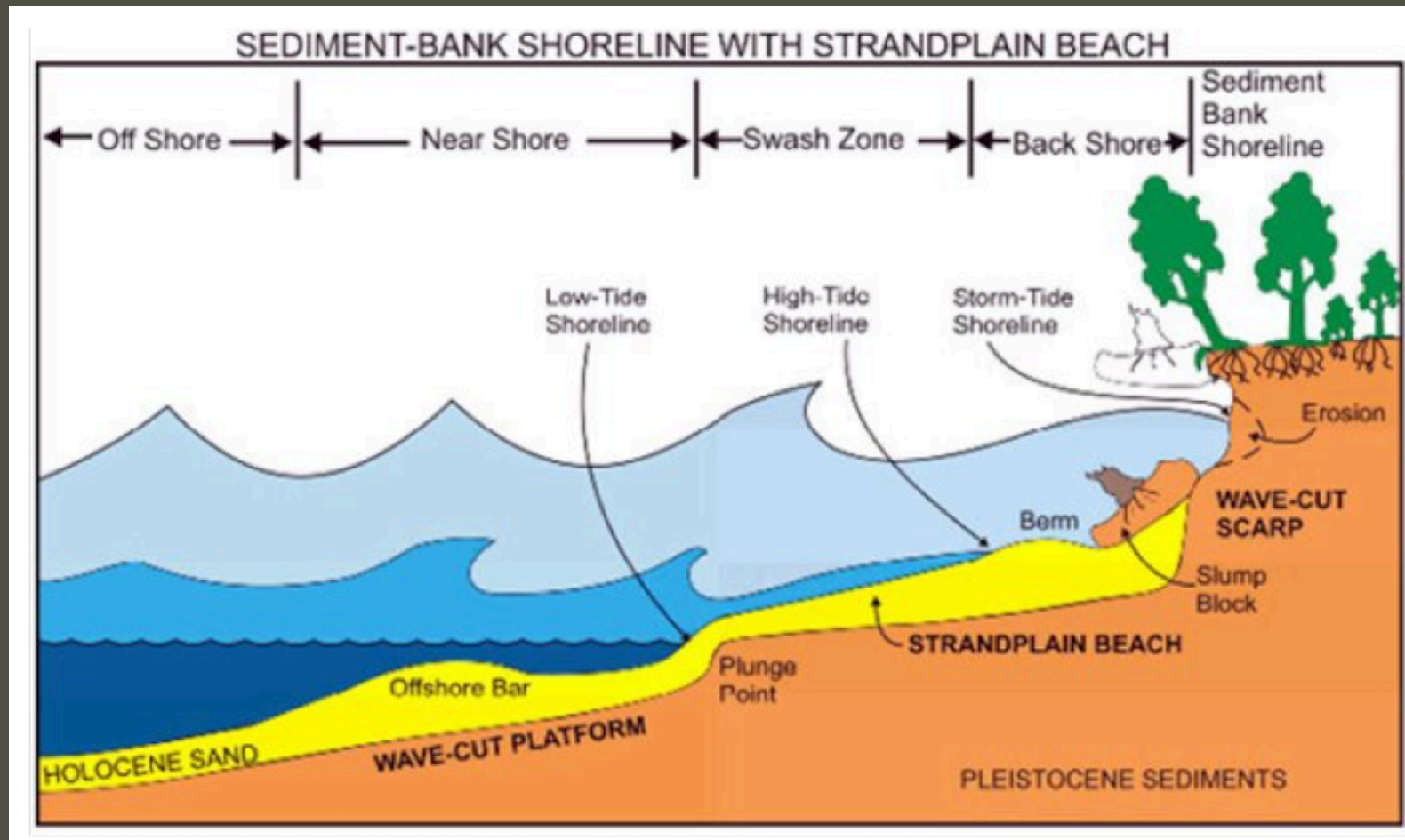
PRINCE EDWARD ISLAND, SENSITIVE TO COASTAL EROSION

- PEI made of Sand and Sandstone
- Sea Level Rise
 - +32cm last 100 years,
 - +2 to +2.7m next 100 years?
- Land Falling
 - 10 to -20 cm per century
- Changing storm environment
- Changing winter ice cover

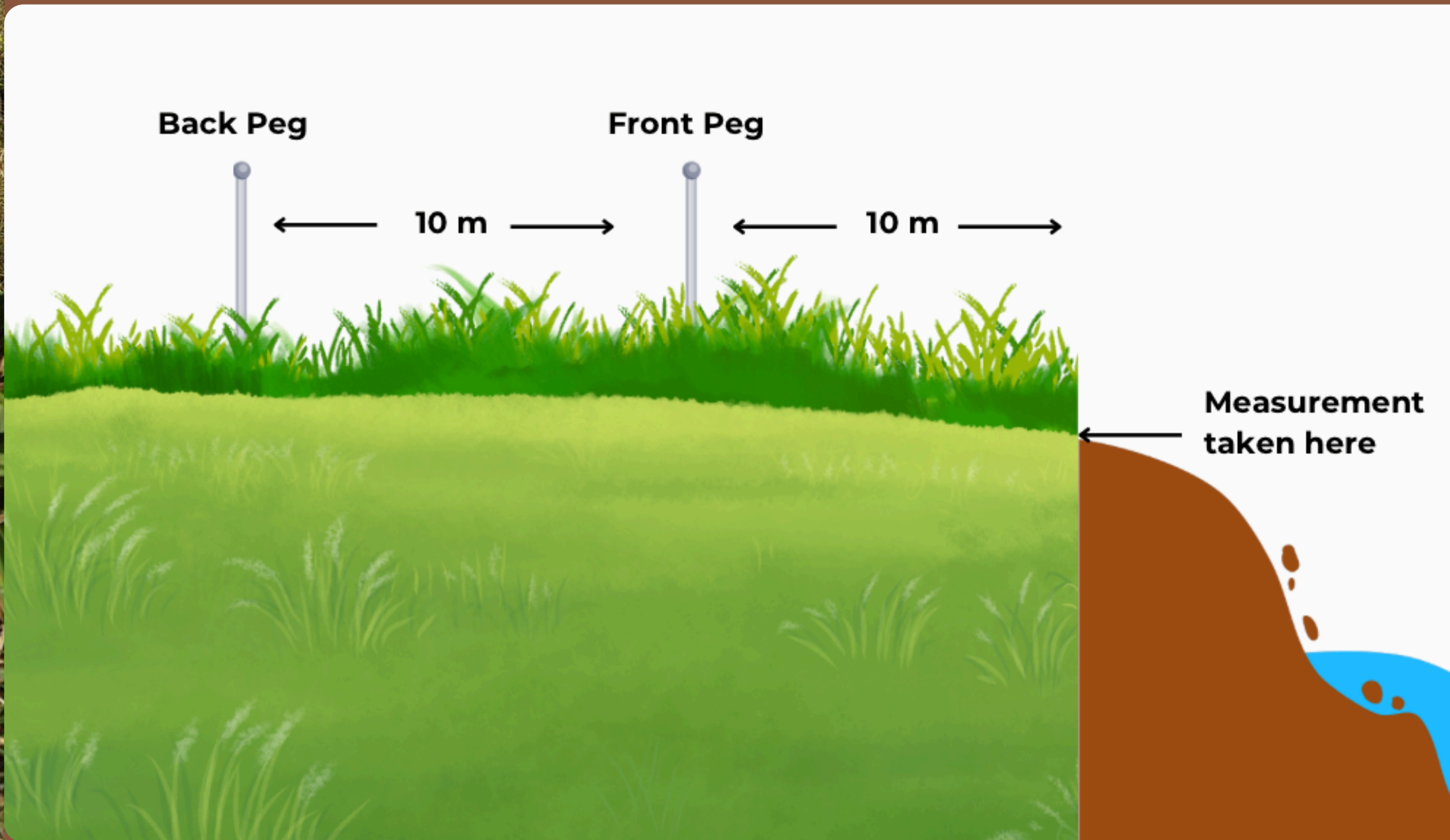


WHAT IS COASTAL EROSION?

Coastal erosion is the **loss or displacement of land**, or the long-term removal of sediment and rocks along the coastline due to the action of **waves, currents, tides, wind-driven water, waterborne ice, or other impacts of storms.**



Erosion Monitoring using Peg Methodology



MONITORING EROSION WITH AN RPAS... WHAT IS AN RPAS?

RPAS – Remotely Piloted Aircraft System

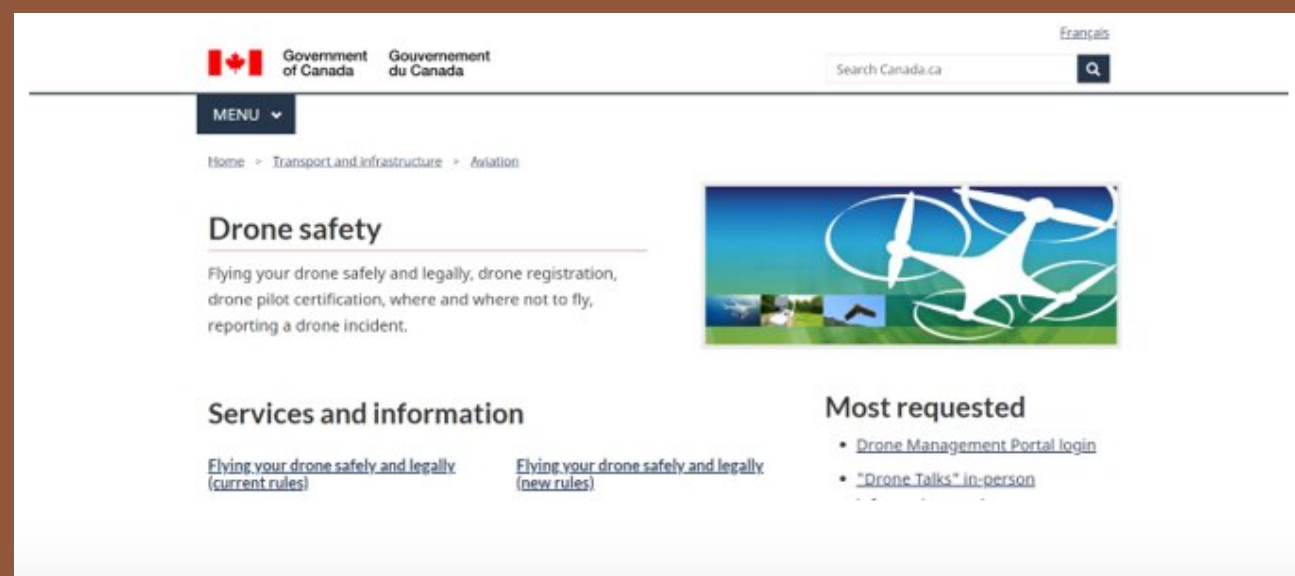
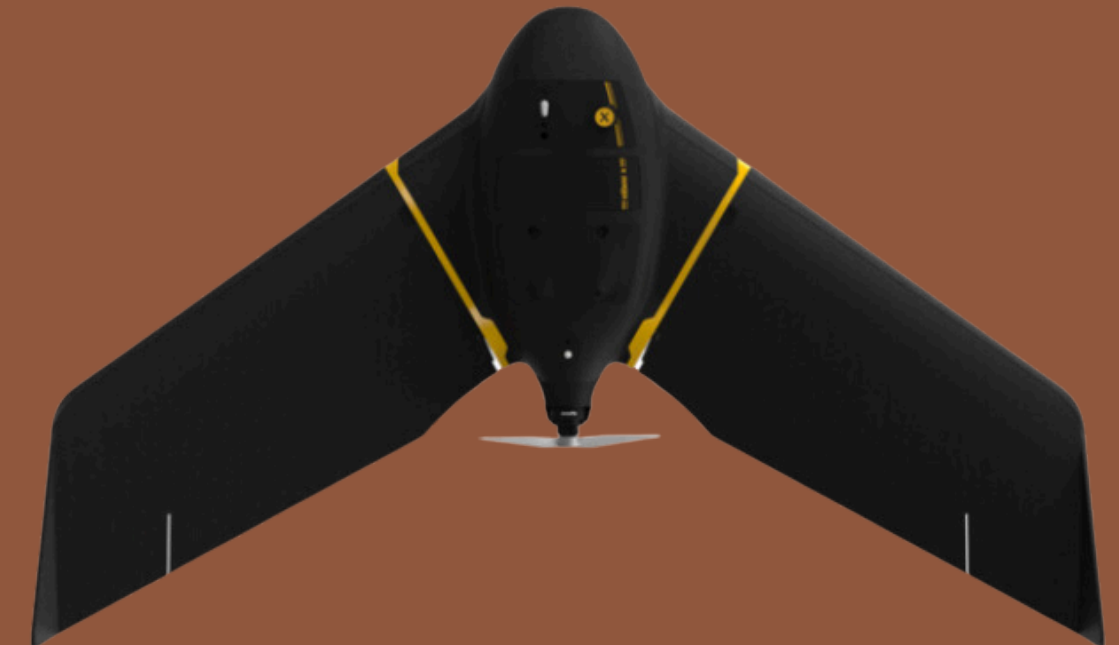
- A set of configurable elements consisting of a remotely piloted aircraft, its control station, the command and control links and any other system elements required during flight operation



Other RPAS names

- Although the official regulations call them RPAS they can also be called a **Drone**, UAV, UAS, or RPV

*As of 2019 you DO need a license to fly an RPAS in Canada, unless the aircraft weighs less than 250 grams



WHY USE AN RPAS?

Cost

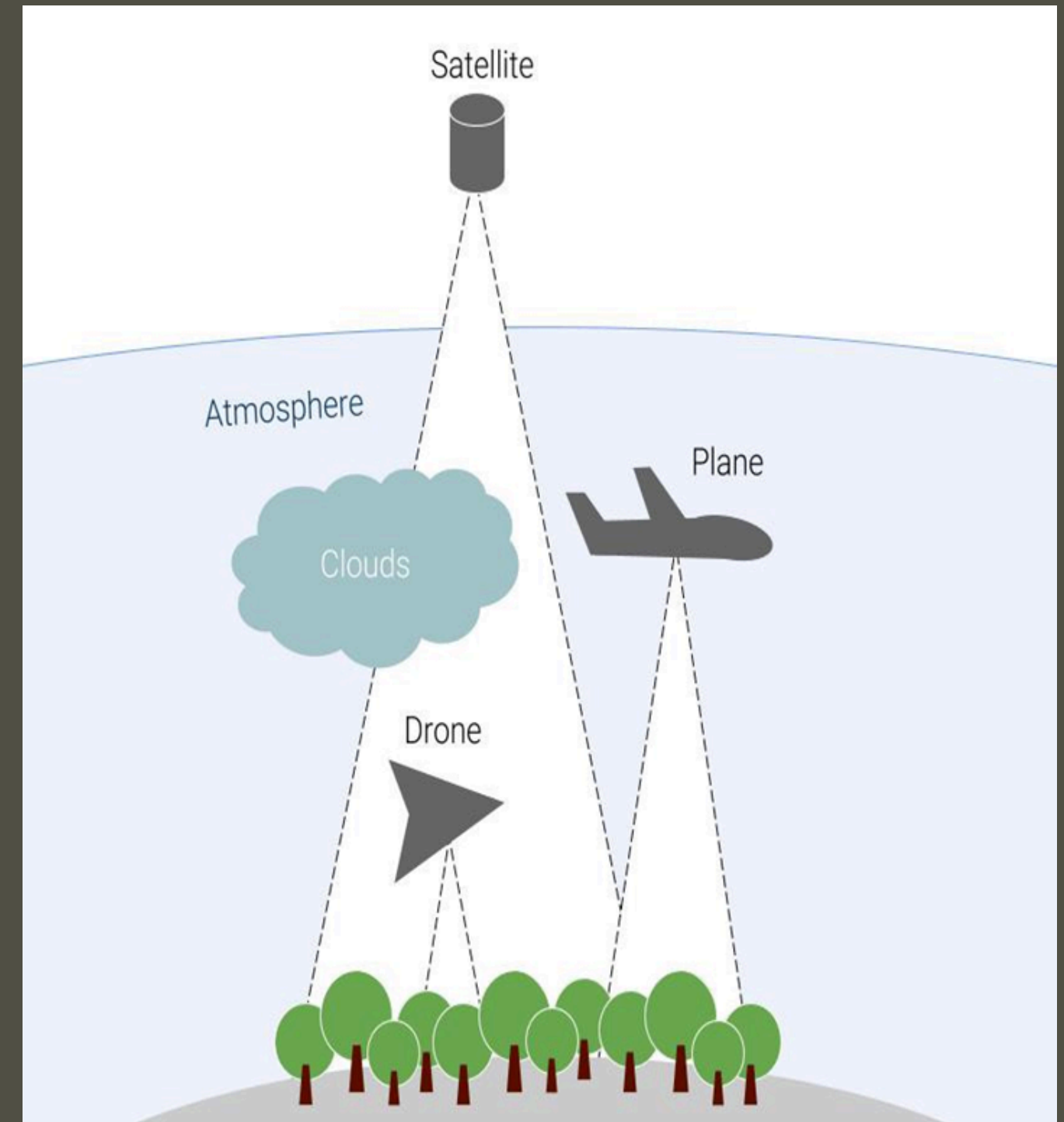
- RPAS solutions can be much less expensive than traditional approaches using satellites or manned aircraft

Speed

- With a bit of planning tasks that used to require hours or days can be done in a fraction of the time
- RPAS can be set up and deployed in a matter of minutes responding to situations that can benefit from immediate aerial overviews

Flexibility

- RPAS can fit a large number of different sensors and accessories to suit different mission needs
- Missions can be flown more frequently and less expensively than other forms of aerial capture



CAPTURING AERIAL IMAGERY USING AN RPAS



MEASURING COASTAL EROSION ON PEI

In the Air- Drone Surveys

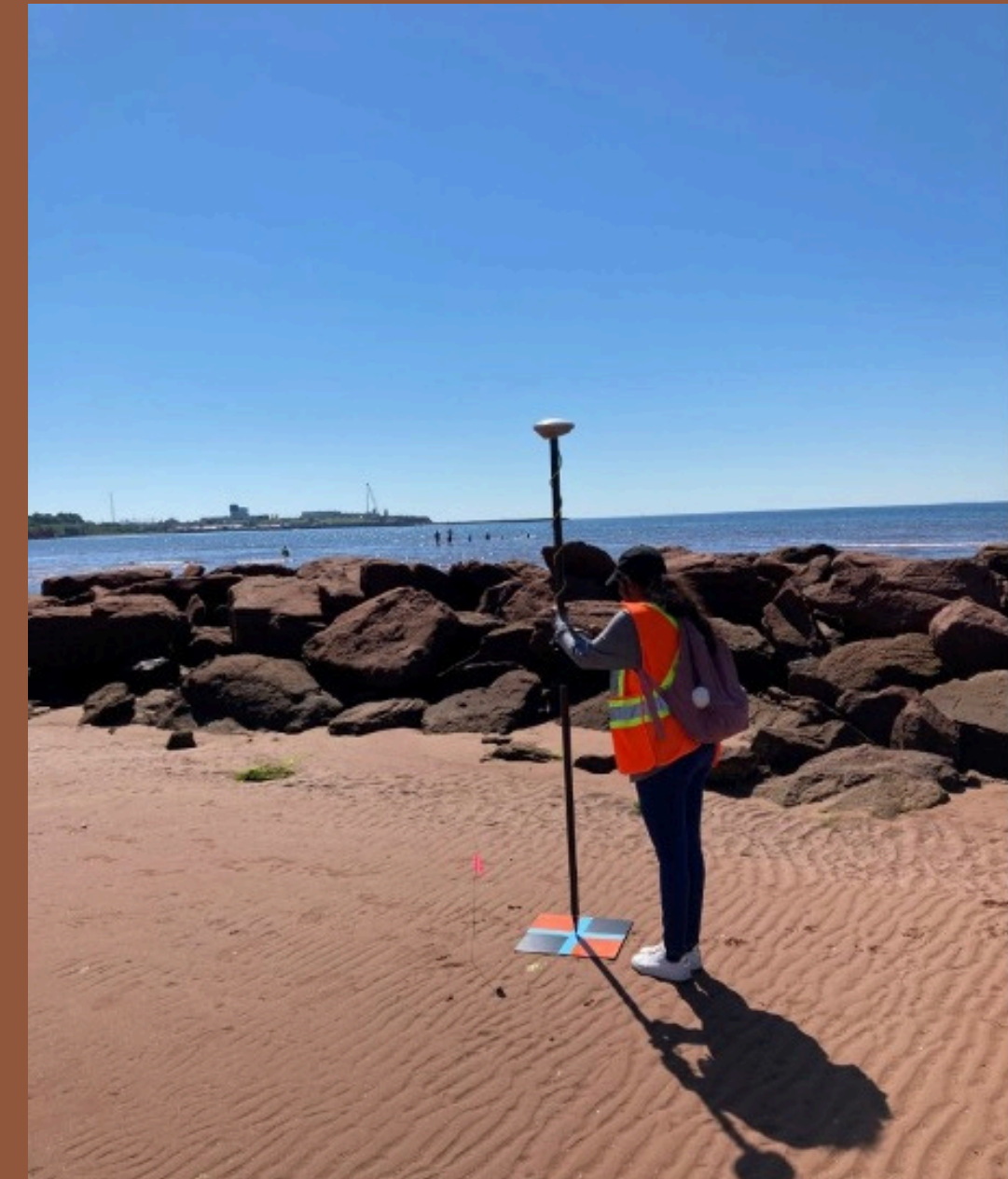
- Since 2016, the UPEI Climate Lab has been flying all erosion monitoring sites with a DJI Phantom quadcopter drone
- We program the flight mission, fly the area comprehensively each year, and can then **compare imagery from year to year to determine erosion rates**
- DJI Phantom 4 RTK has a 20 MegaPixel camera that allows for clear imagery at high altitudes
- Ground Control Points (GCPs) are used to make aerial surveys more accurate (2-5 cm)



METHODS AND MATERIALS

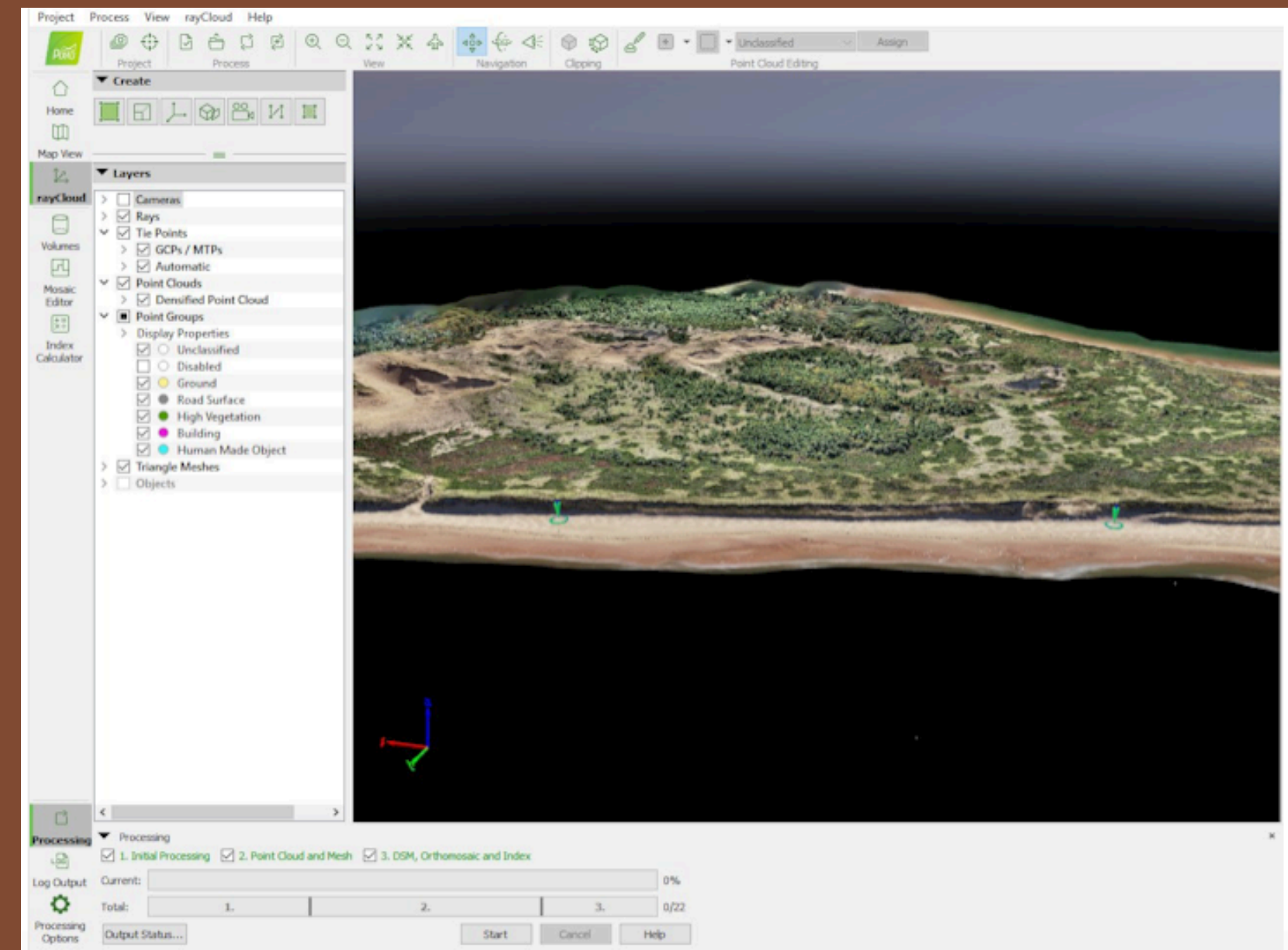
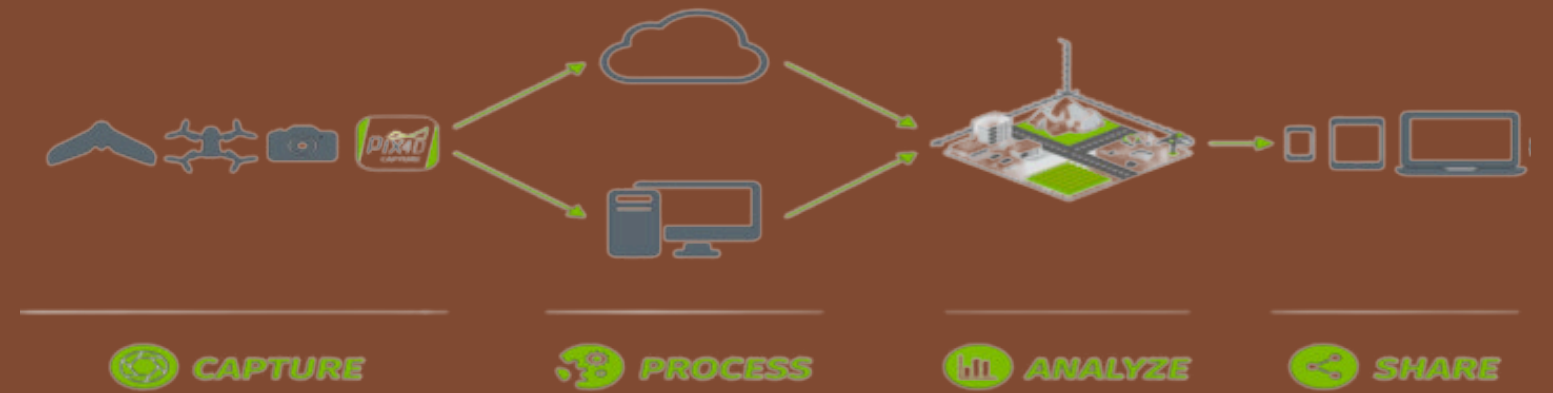
Ground Control Points

- **Ground control points** are often necessary for accurately georeferencing drone imagery
- Ground control points, which are boards with a clear center point (X), are spread throughout the surveyed area
- The coordinates and elevation at the center of each ground control point are then measured with a highly accurate Trimble RTK GPS unit (2 centimeter accuracy)



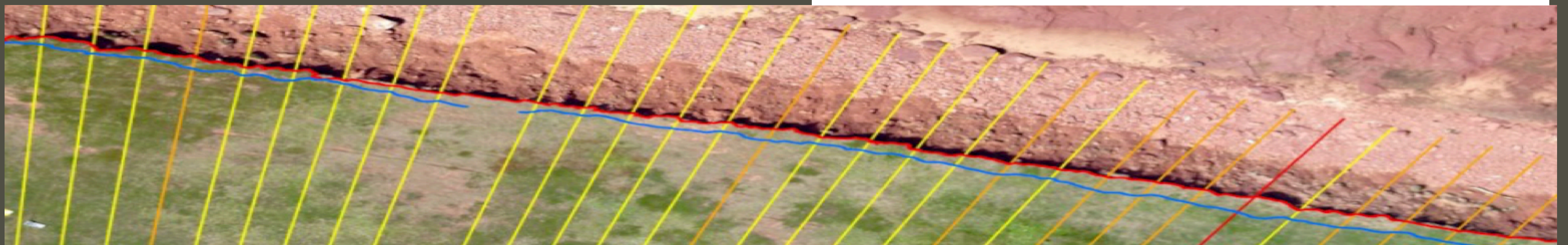
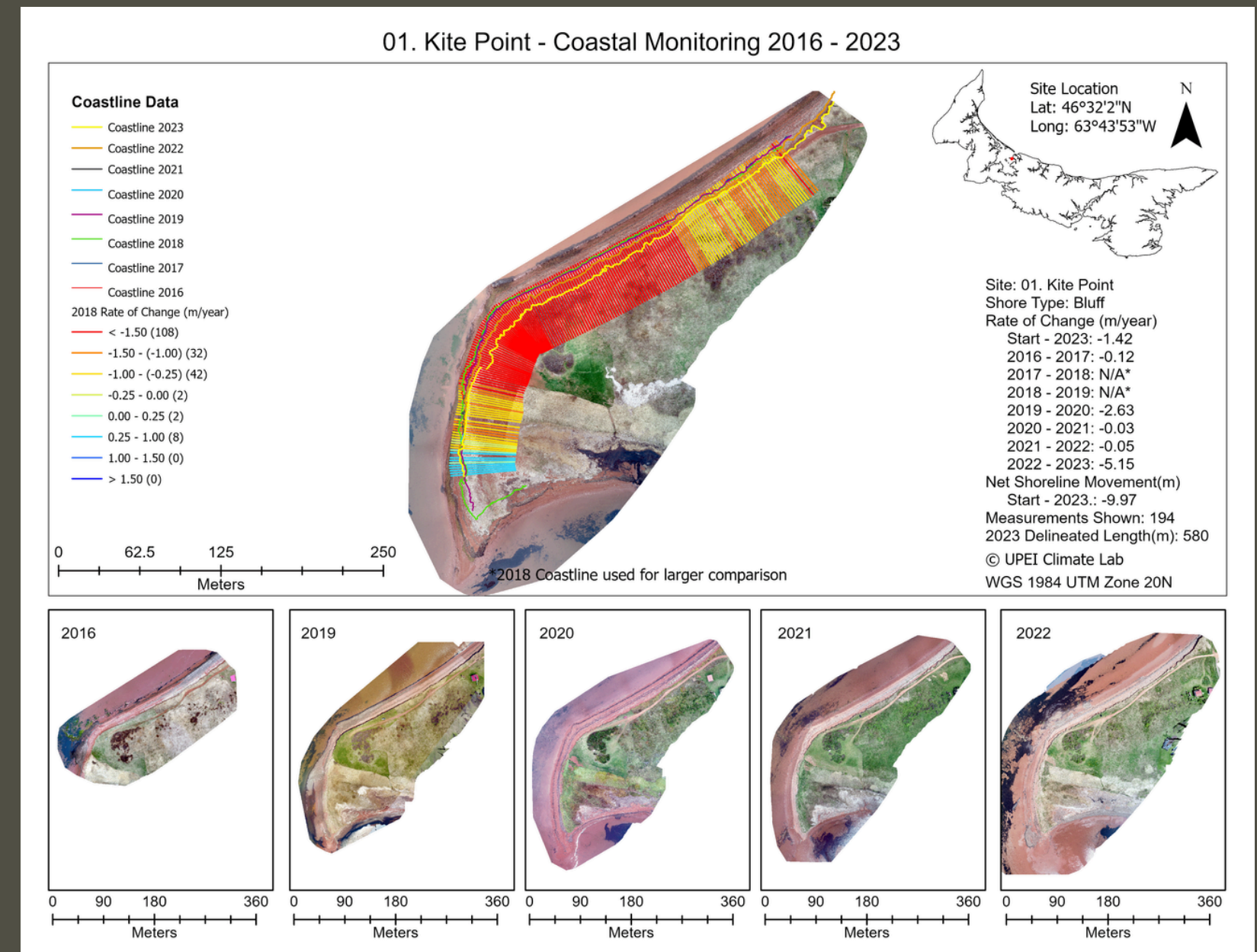
PROCESSING AERIAL IMAGERY USING PHOTOGRAMMETRY

- **Photogrammetry** is the science of using photography in surveying and mapping to measure distance between objects
- Pix4D photogrammetry software is used to create orthomosaics and digital surface models (DSMs)
- Ground Control Points can be added to Pix4D project for increased accuracy
- With sufficient flight overlap and proper settings, complex 3D models of areas can be generated



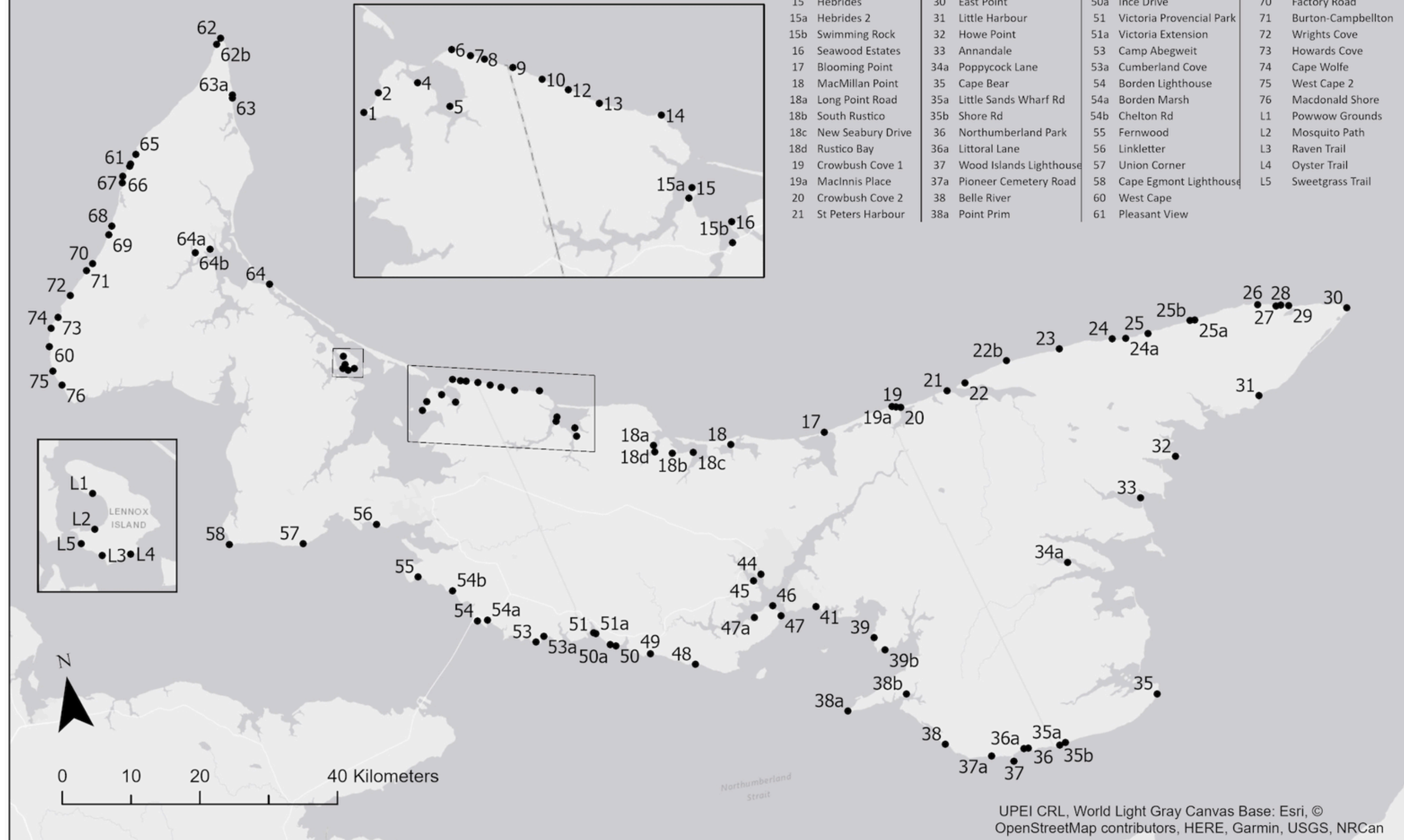
USING DSAS (DIGITAL SHORELINE ANALYSIS SYSTEM)

- DSAS developed by NOAA (National Oceanic and Atmospheric Administration)
- DSAS software is designed to **calculate shoreline change** over time
- **Transects** are cast to intersect shorelines at specified spacing alongshore (every 2 meters)
- Results are displayed on an **Output Map**, which includes **Rate of Change** and **Net Shore Movement**



2024 Coastal Change Monitoring Sites

Site ID	Site Name	Site ID	Site Name	Site ID	Site Name	Site ID	Site Name
1	Kite Point	22	Greenwich	38b	Colonsay Lane	62	North Cape
2	Montgomery Road	22b	Cable Head	39	Cherry Cliff Park	62b	North Cape Turbine
4	Coulson Cottage	23	Goose River	39b	China Point	63	Anglo Tignish
5	Reubens Lane	24	Naufrage Lighthouse	41	Tea Hill	63a	Anglo Tignish 2
6	Twin Shores	24a	Mary Joes Lane	44	Queen Elizabeth Park	64	Conway_Sandhills
7	Darnley Lighthouse	25	Clearspring	45	York Point	64a	Fox Island Field
8	Thunder Cove	25a	Rock Berra Artist Retreat	46	Rocky Point	64b	Sunset Way
9	Seaview 1	25b	Rock Berra	47	Blockhouse Lighthouse	65	Black Pond
10	Seaview 2	26	Campbells Cove	47a	Burdette Lane	66	Cape Gage
12	Phyllis Kennedy Road	27	Lakeville	48	Canoe Cove	67	Ebbsfleet
13	Cousins Shore	28	North Lake 1	49	Argyle Shore	68	Kelly Rd
14	Cape Tryon	29	North Lake 2	50	Hampton	69	Little Miminegash Pond
15	Hebrides	30	East Point	50a	Ince Drive	70	Factory Road
15a	Hebrides 2	31	Little Harbour	51	Victoria Provincial Park	71	Burton-Campbellton
15b	Swimming Rock	32	Howe Point	51a	Victoria Extension	72	Wrights Cove
16	Seawood Estates	33	Annandale	53	Camp Abegweit	73	Howards Cove
17	Blooming Point	34a	Poppycock Lane	53a	Cumberland Cove	74	Cape Wolfe
18	MacMillan Point	35	Cape Bear	54	Borden Lighthouse	75	West Cape 2
18a	Long Point Road	35a	Little Sands Wharf Rd	54a	Borden Marsh	76	Macdonald Shore
18b	South Rustico	35b	Shore Rd	54b	Chelton Rd	L1	Powwow Grounds
18c	New Seabury Drive	36	Northumberland Park	55	Fernwood	L2	Mosquito Path
18d	Rustico Bay	36a	Littoral Lane	56	Linkletter	L3	Raven Trail
19	Crowbush Cove 1	37	Wood Islands Lighthouse	57	Union Corner	L4	Oyster Trail
19a	MacInnis Place	37a	Pioneer Cemetery Road	58	Cape Egmont Lighthouse	L5	Sweetgrass Trail
20	Crowbush Cove 2	38	Belle River	60	West Cape		
21	St Peters Harbour	38a	Point Prim	61	Pleasant View		



2024 RATE OF CHANGE RESULTS

Shore Type	2024 Sites Flown	Sites Delineated	Start-2024 EPR	Start -2024 NSM	2023-2024 EPR	2023-2024 NSM	2023-2024 Measurements	Length Delineated (m)
Bluff	5	5	-0.41	-2.93	0	0	851	2,384.2
Cliff	78	78	-0.38	-1.89	-0.05	-0.06	15,859	46,170.6
Dune	5	5	-1.09	-7.98	0.71	0.75	1,405	8,775.1
Low Plain	6	2	-0.34	-1.72	0	0	425	1,079.9
Wet-land	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Total	94	94	-0.46	-2.74	0.01	0	18,630	58,409.8

DAMAGE FROM POST TROPICAL STORM FIONA



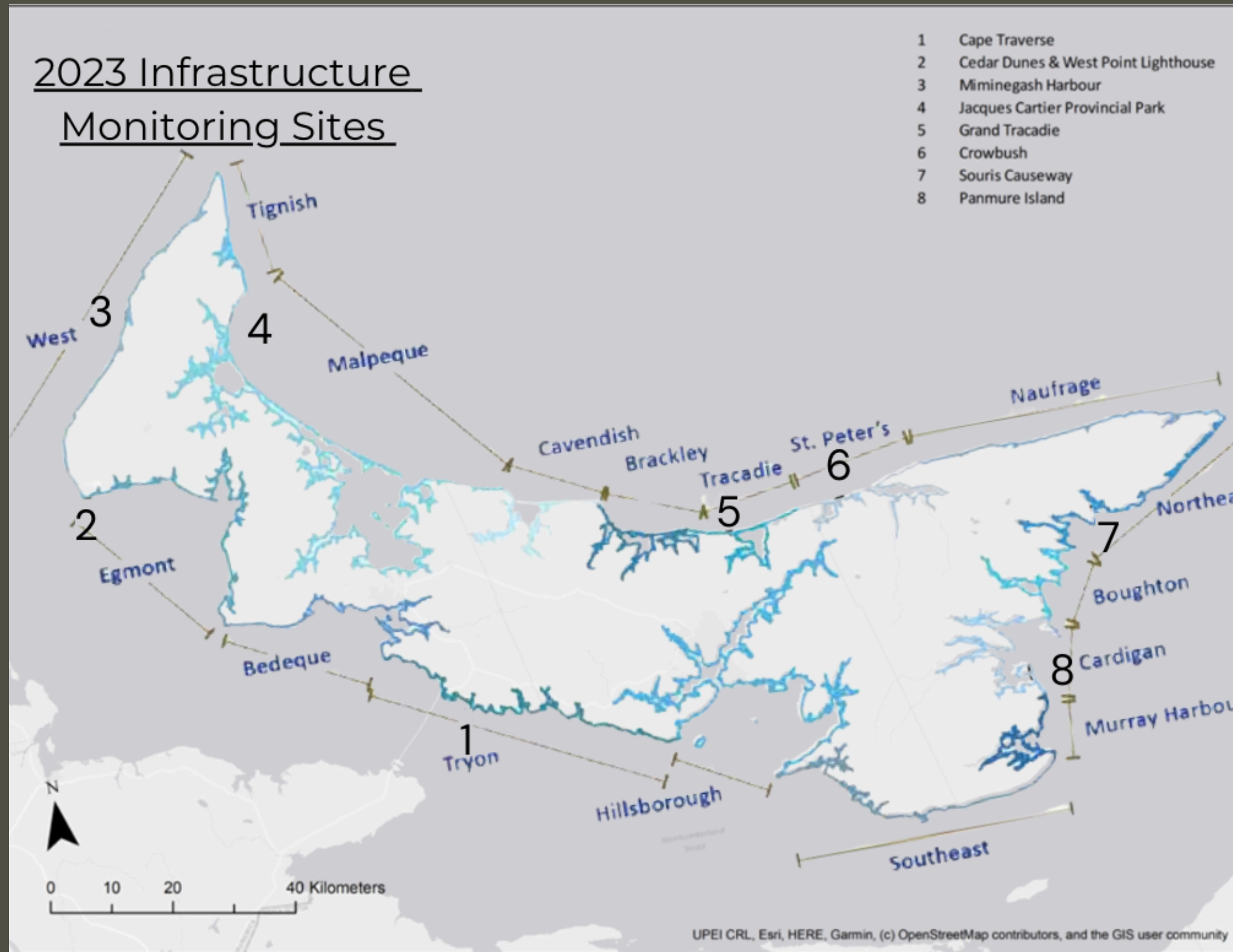
The Hebrides community (McEwens Island) was hit very hard by Fiona, losing a dozen cottages to the storm

DAMAGE FROM POST TROPICAL STORM FIONA



Savage Harbour was hit especially hard by Fiona, with some areas experiencing 17 meters of coastal erosion

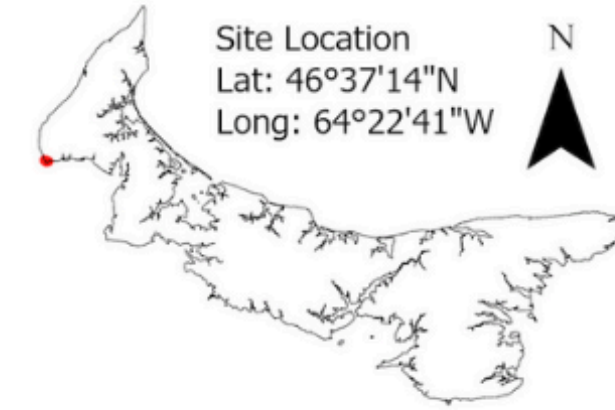
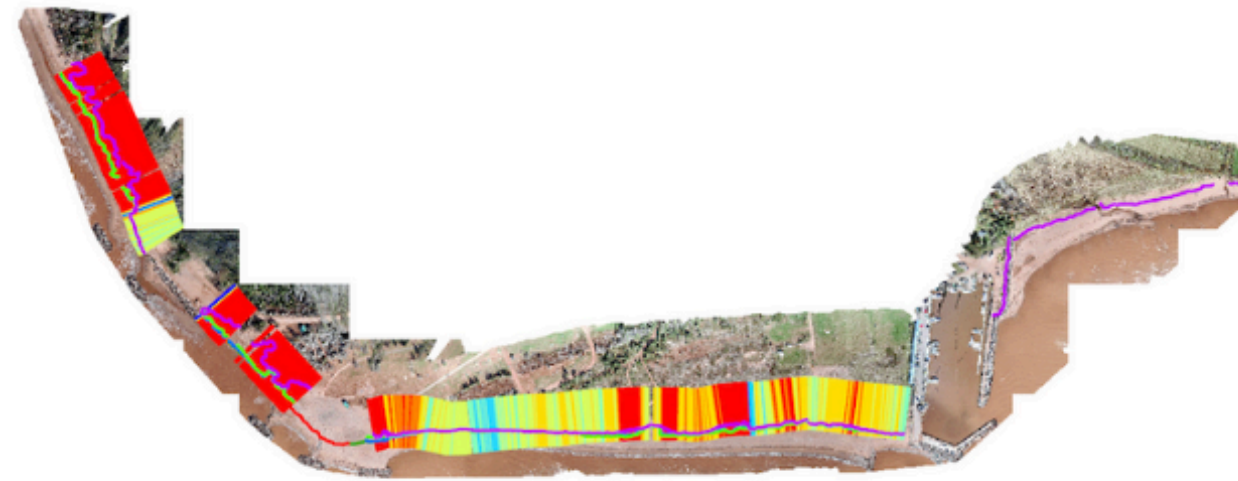
8 INFRASTRUCTURE MONITORING LOCATIONS



Cedar Dunes - Shoreline Monitoring 2020-2022

Coastline Data

- Cedar Dunes Sept. 25, 2020
 - Cedar Dunes June 3, 2021
 - Cedar Dunes Oct. 26, 2021
 - Cedar Dunes June 15, 2022
 - Cedar Dunes Oct. 12, 2022
- Cedar Dunes Rate of Change (m/year)
- < -1.50 (233)
 - -1.50 - (-1.00) (38)
 - -1.00 - (-0.25) (110)
 - -0.25 - 0.00 (125)
 - 0.00 - 0.25 (37)
 - 0.25 - 1.00 (14)
 - 1.00 - 1.50 (1)
 - > 1.50 (2)



Cedar Dunes

Rate of Change (m/year)

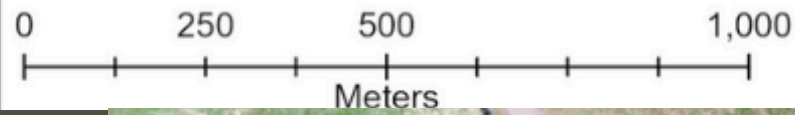
2020 - 2022.2: -2.86

2020 - 2021.1: -0.83
 2021.1 - 2021.2: -0.06
 2021.2 - 2022.1: 0.08
 2022.1 - 2022.2: -16.01

Net Shoreline Movement(m)

2020 - 2022.2: -5.85
 2022.1 - 2022.2: -5.22

Measurements: 560



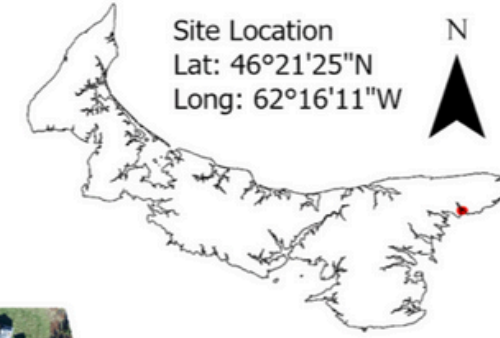
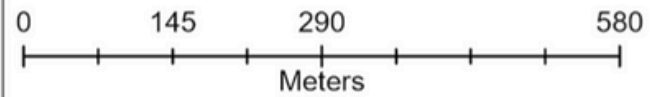
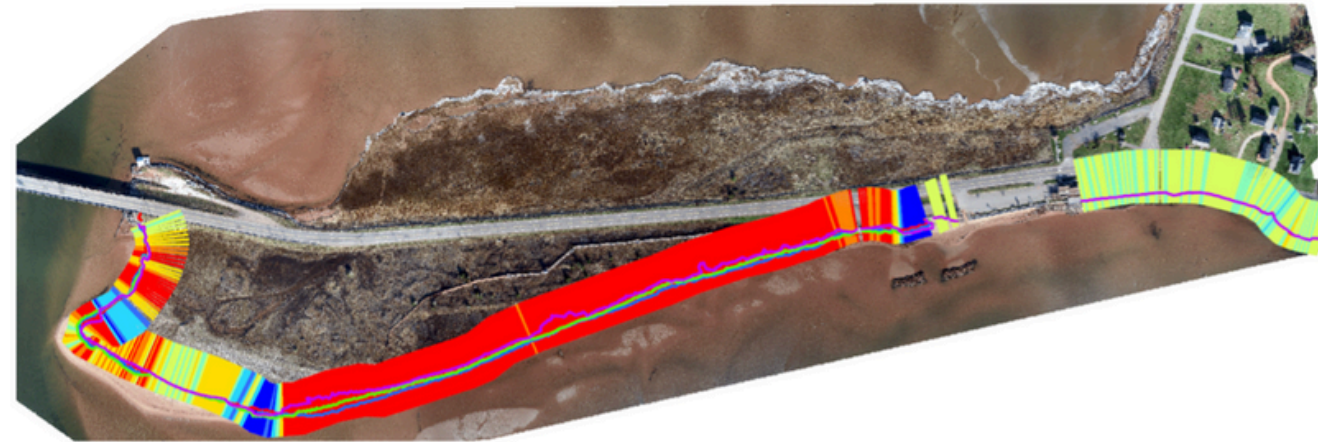
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Souris Causeway - Shoreline Monitoring 2020-2022

Coastline Data

- Souris Causeway Oct. 1, 2020
 - Souris Causeway Nov. 02, 2021
 - Souris Causeway Jul. 21, 2022
 - Souris Causeway Nov. 19, 2022
- Souris Causeway Rate of Change (m/year)
- < -1.50 (332)
 - -1.50 - (-1.00) (36)
 - -1.00 - (-0.25) (58)
 - -0.25 - 0.00 (111)
 - 0.00 - 0.25 (56)
 - 0.25 - 1.00 (19)
 - 1.00 - 1.50 (8)
 - > 1.50 (28)



Site Location
 Lat: 46°21'25"N
 Long: 62°16'11"W

N



Souris Causeway

Rate of Change (m/year):
 2020 - 2022.2: -2.32

2020 - 2021: -0.83
 2021 - 2022.1: -1.21
 2022.1 - 2022.2: -9.55

Net Shoreline Movement(m):
 2020 - 2022.2: -4.93
 2022.1 - 2022.2: -3.16
 Measurements Shown: 648

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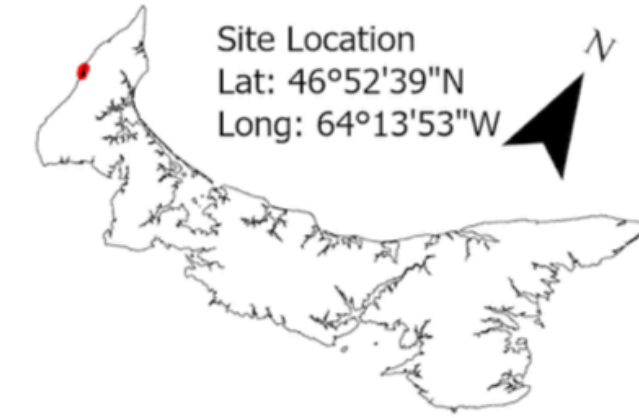
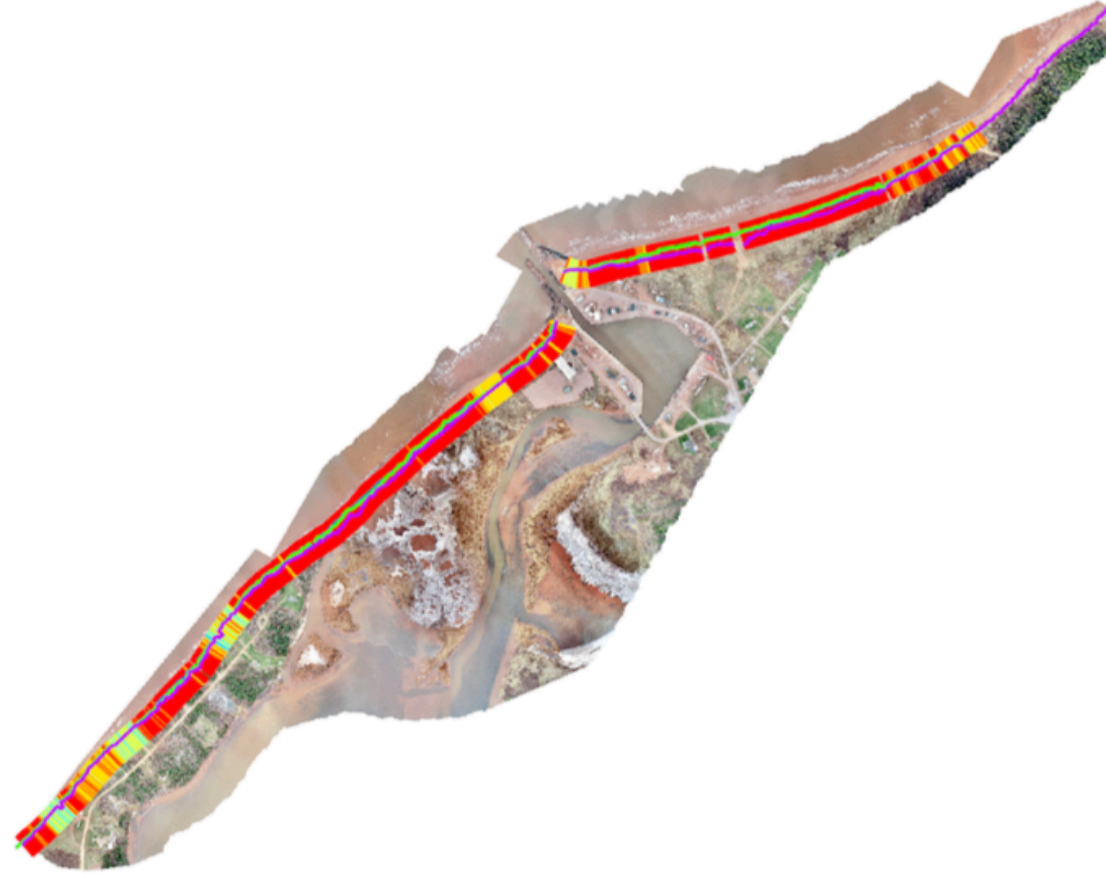
Miminegash Harbour - Shoreline Monitoring 2020-2022

Coastline Data

- Miminegash Oct. 2, 2020
- Miminegash Oct. 21, 2021
- Miminegash July 28, 2021
- Miminegash Aug. 22, 2022
- Miminegash Nov. 25, 2022

Miminegash Rate of Change (m/year)

- < -1.50 (828)
- -1.50 - (-1.00) (109)
- -1.00 - (-0.25) (118)
- -0.25 - 0.00 (53)
- 0.00 - 0.25 (33)
- 0.25 - 1.00 (4)
- 1.00 - 1.50 (0)
- > 1.50 (0)

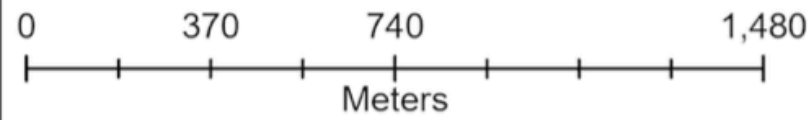


Miminegash Harbour

Rate of Change (m/year)
2020 - 2022.2: -3

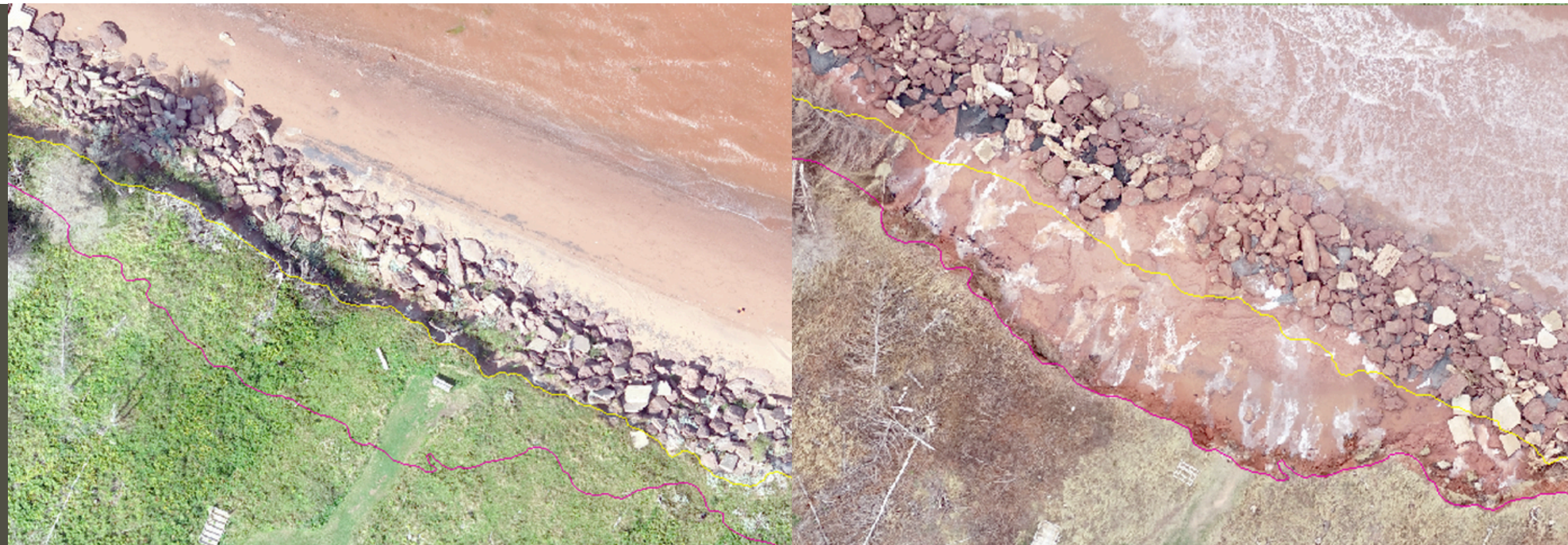
2020 - 2021.1: 0.66
2021.1 - 2021.2: -1.53
2021.2 - 2022.1: 0.11
2022.1 - 2022.2: -25.68

Net Shoreline Movement(m)
2020 - 2022.2: -6.44
2022.1 - 2022.2: -6.68
Measurements: 1145



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Infrastructure Monitoring Locations	End Point Rate (m/year) 2020-2023
Cape Traverse	-0.67
Cedar Dunes and West Point Lighthouse	-2.59
Crowbush	-2.89
Grand Tracadie Beach	-0.65
Jacques Cartier Provincial Park	-2.17
Miminegash Harbour	-2.21
Panmure Island Causeway	-1.37
Souris Causeway	-1.47

EPR is the annual rate of change (m/year) and is calculated through dividing the distance between coastlines by the time elapsed between aerial imagery

Infrastructure Monitoring Locations	Net Shoreline Movement (m) 2020-2023
Cape Traverse	-2.11
Cedar Dunes and West Point Lighthouse	-7.97
Crowbush	-8.78
Grand Tracadie Beach	-2.00
Jacques Cartier Provincial Park	-6.49
Miminegash Harbour	-6.72
Panmure Island Causeway	-4.27
Souris Causeway	-4.26

NSM is the total movement between two shoreline positions

Important Reminder

- We aim to stay off busy beaches during the summer months, but tourists may see people in UPEI attire (and fluorescent vests) around coastal areas doing research
- If we are flying in an area where people are present, we will not fly directly above anyone (as that is against the law!)
- Please keep a distance from cliff edges, as undercutting caused by erosion could lead to unstable areas
- Please stay off the dunes :)



Thank you

