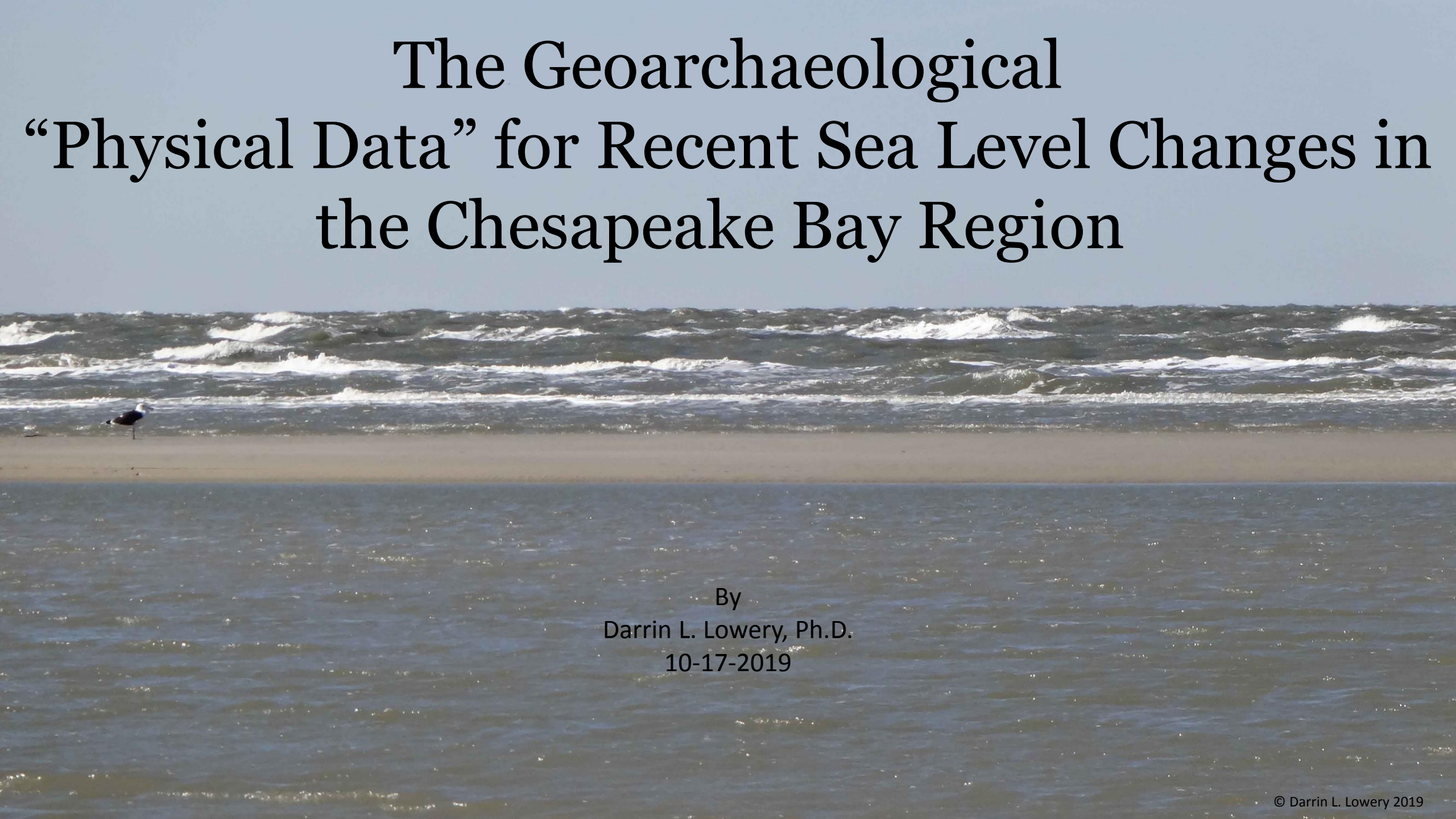
The Geoarchaeological "Physical Data" for Recent Sea Level Changes in the Chesapeake Bay Region



By
Darrin L. Lowery, Ph.D.
10-17-2019

Crisfield, Md., beats back a rising Chesapeake Bay

WASHINGTON POST
October 24, 2013

"WE COULD LOOK LIKE HOLLAND ISLAND ONE DAY."
A Crisfielder referring to the vanishing island 16 miles away whose last house sank in 2010.

IS THIS

THE FUTURE OF

CRISFIELD, MD.?

By David Montgomery

This is what folks are saying today!

Photo by Dave Harp

Photo by Stephen White

Guess what folks were saying a century earlier?

A

Estherville Daily News (Estherville, Iowa)
Thu, Nov 25, 1897 · Page 11

THE WILD WAVES' WORK.

Wearing Away of Islands in Chesapeake Bay.

We often wonder at the miracles of nature, and sometimes doubt if all things that geologists tell can possibly be true. But the changes that are taking place every day meet the marvels of the past, and show that nature is as busy as she ever was in any age or period, says the Baltimore American.

Not many years ago the chain of islands on the eastern side of Chesapeake bay were large and valuable. But they have been getting smaller all the time. Sharps island, once quite a settlement, is now a comparatively small spot in the busy waters. Every year the Chesapeake bay is different. The tides that carry the drainage of many states through her mouth, which is only 12 miles wide, are working changes every hour.

In New York hundreds of thousands of dollars were spent upon a great hotel near the water's edge. Now the water is running under its foundations, and there is a probability that the house will be a total loss. The water of the Hudson undermined one of man's strongest works, and a train pitched into the river. At Atlantic City the tides have robbed some property owners and have made others rich.

But the most striking incident of all in recent history was the obliteration of Cobb's island, just off the coast of eastern Virginia. The dispatches to the American say it is gone. Months ago the hotel went, and so did many of the buildings. Now the life saving station has been swept away, and there is nothing on the island, which used to be filled with health, comfort and beauty. The church is gone. The houses are gone. The shooting boxes are gone. The waters have driven mar away, the life saving crew escaping with their lives. And yet only four years ago an offer of $75,000 was made for the island, and a company of capitalists was prepared to erect upon it a handsome hotel.

B

The Evening Journal (Wilmington, Delaware)
Mon, Jan 21, 1907 · Main Edition · Page 3

CHESAPEAKE BAY BOTTOM SINKING

Islands Are Gradually Disappearing--Coast Line Has Changed

The cable dispatches bringing information that the city of Kingston, in Jamaica, was sinking into the sea has recalled to mind that the face line of the entire Atlantic Coast has changed considerably in the past few years. This fact is noticeable in the Chesapeake Bay particularly, and the pilots who have for years gone up and down the waterway, and are qualified authorities on the subject, say that the islands which have been known in the bay for years are gradually disappearing, due to the sinking of the earth's crust and continual erosion. The pilots also assert that in some parts of the bay the channels have been made deeper in the past ten or twenty years and that this is due to the sinking of the earth along the Atlantic Coast.

Scientists assert that as the coastline of the Atlantic sinks into the ocean there is a proportionate rise in the coast line on the Pacific. This fact has been established beyond doubt.

Island Has Disappeared.

It is figured by persons competent to talk on the subject that in less than 100 years from now beautiful and fertile Kent Island will have sunk into the bay and Hooper's Island, Sharps Island, Barren Island, Taylors Island and Hollands Island and others will have disappeared and nothing of them will remain to remind future generations of these beautiful places.

Cobbs Island, once a famous fishing and gunning place, has disappeared from the surface of the bay, and other islands equally famous years ago have been swallowed up in the great action of nature.

In talking over the matter Provost Philip R. Uhler said that there was no doubt that the entire face of the coast line was sinking into the sea and that the islands in the Chesapeake would meet the same fate.

Dr. Uhler has made a study of the matter and is deeply interested in the action of the sea. He said that Kingston's probable fate was due to the earthquake which had shaken the coral coast line to its very foundations and caused it to disintegrate.

In regard to Sharps Island, as a corroboration that the bottom of the Chesapeake Bay is sinking, is given the following figures: In 1809 the island consisted of 700 acres. In 1906 there are but 50 acres, showing that in 97 years 650 acres of land had been swallowed up in the Chesapeake's great maw.

Cooks Point, at the mouth of the Choptank river, has lost 13 acres to the Chesapeake in 30 years. The crabbers and fishermen on Smiths Island now ply their vocations over the graves of their own ancestors and where at one time there were blooming fields and orchards.

On Western Shore.

The sinking of the western shore of the Chesapeake is more noticeable. It was stated that where once was Fair Haven, a well-known excursion resort of 25 or 30 years ago, there is now a waste of water, showing that the land had sunk out of sight, carrying with it all traces of the old place.

The slow sinking of the Atlantic Coast is a fact well known to American geologists, but the definite measurements or the rate of the subsidence is a matter of scientific interest.

As long ago as 1868 the late Professor George H. Cook, State geologist of New Jersey, investigated this matter thoroughly, collecting numerous observations indicative of the encroachment of the sea on the Atlantic Coast and particularly along the coast of his own State. Subsequent investigations made by the United States Geological Survey have demonstrated that the encroachments of the sea were not of a local character alone, but a condition characteristic of the entire Atlantic seaboard, including the Chesapeake and the other bays along the coast, Long Island and Pamlico Sounds.

C

The Washington Herald (Washington, District of Columbia)
Sun, Aug 2, 1914 · First Edition · Page 25

ISLANDS Disappearing Every Year in Chesapeake

SO accustomed have we become to false rumors of the disappearance of islands or the sinking of portions of a seacoast, at the time of earthquakes or volcanic disturbances, that we are inclined to regard all reports of such phenomena with skepticism. That certain islands and headlands in Chesapeake Bay are being destroyed at a startling rate, not by any catastrophic force of nature but by the ordinary action of waves and currents, is demonstrated in a short report just published by the United States Geological Survey, "Erosion and Sedimentation in Chesapeake Bay around the Mouth of Choptank River."

This report is the result of a comparison of a portion of two separate topographic and hydrographic surveys of Chesapeake Bay made by the United States Coast and Geodetic Survey, one in 1847-48 and a second over a half a century later, in 1900-1901. A third supplementary topographic survey of a part of the area studied was made in 1910 by the author of the report, J. Fred. Hunter, together with C. C. Yates, of the Coast and Geodetic Survey.

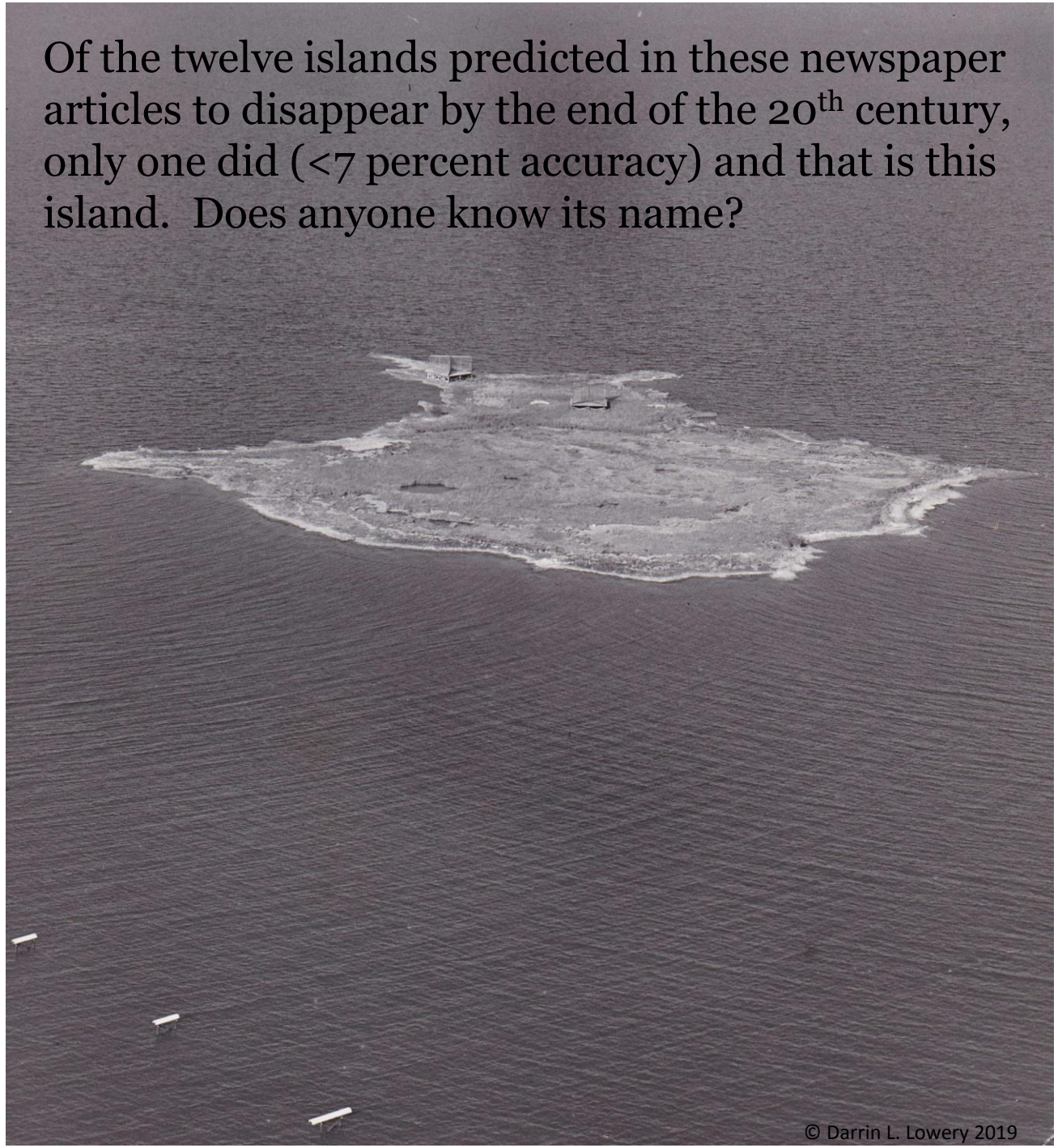
The results of the work are of unusual interest because they give accurate quantitative data on the amount and rate of erosion and sedimentation in a representative area of the bay. The most interesting feature of the study is the rapid destruction of the three islands at the mouth of Choptank River. Of these, Sharps Island, which a generation ago was a summer resort and a favorite hunting ground besides supporting a number of families throughout the year, is today deserted and almost barren of life. Its 428 acres of 1848 had dwindled to 91 by 1900, while at the time of the most recent survey, in 1910, the island contained but 53 acres, its north shore having suffered the phenomenal loss of 110 feet a year during the period from 1900 to 1910.

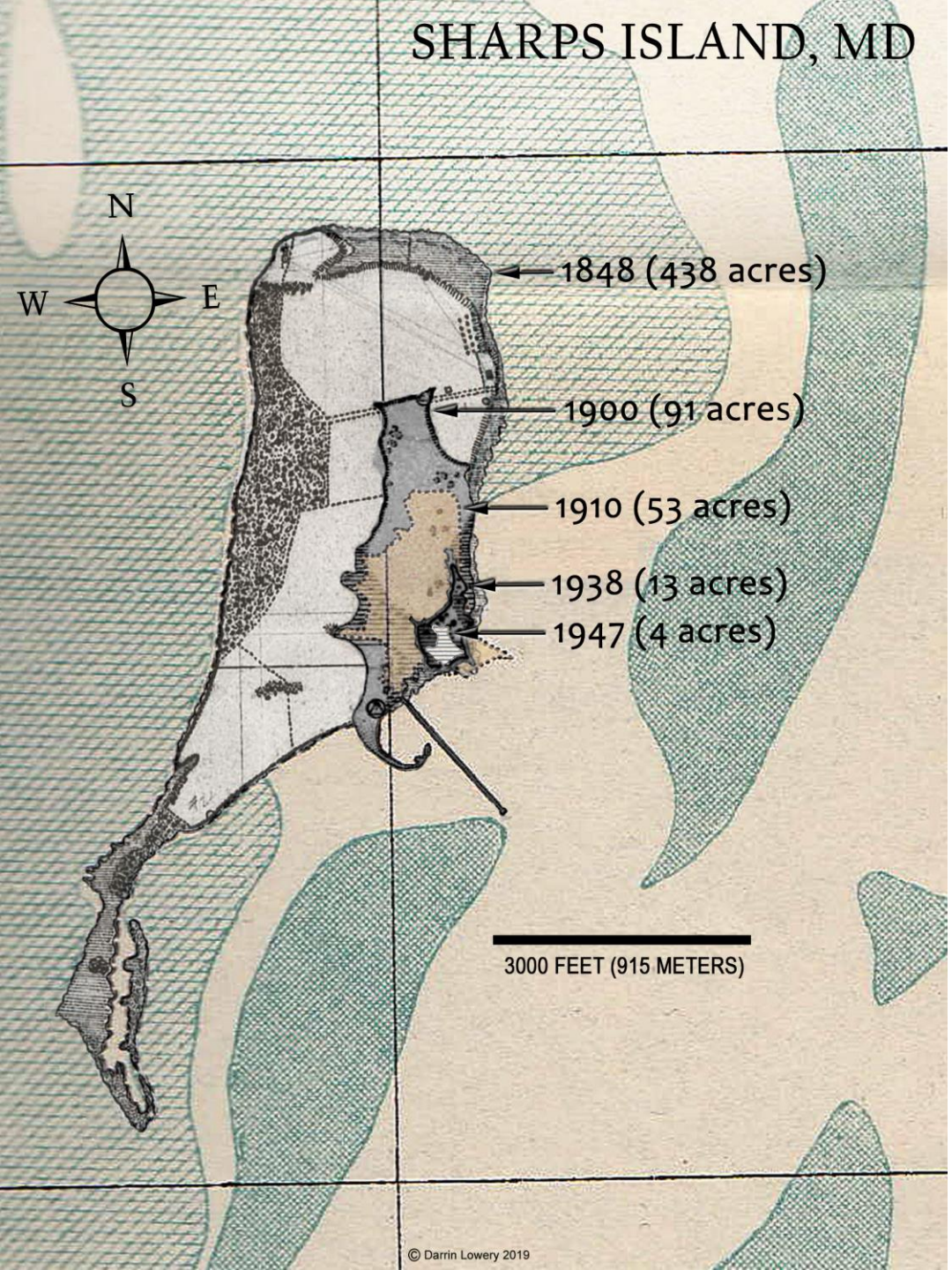
Calculations by Mr. Hunter indicate that the island will be entirely effaced before 1950. James Island, which lies south of Sharps Island, decreased in size from 976 acres in 1848 to 490 acres in 1910, while to the north Tilghman Island, which supports many prosperous farmers and fishermen, was reduced from 2,015 acres in 1847 to 1,686 acres in 1900 and is now surrendering approximately six acres each year to the seas.

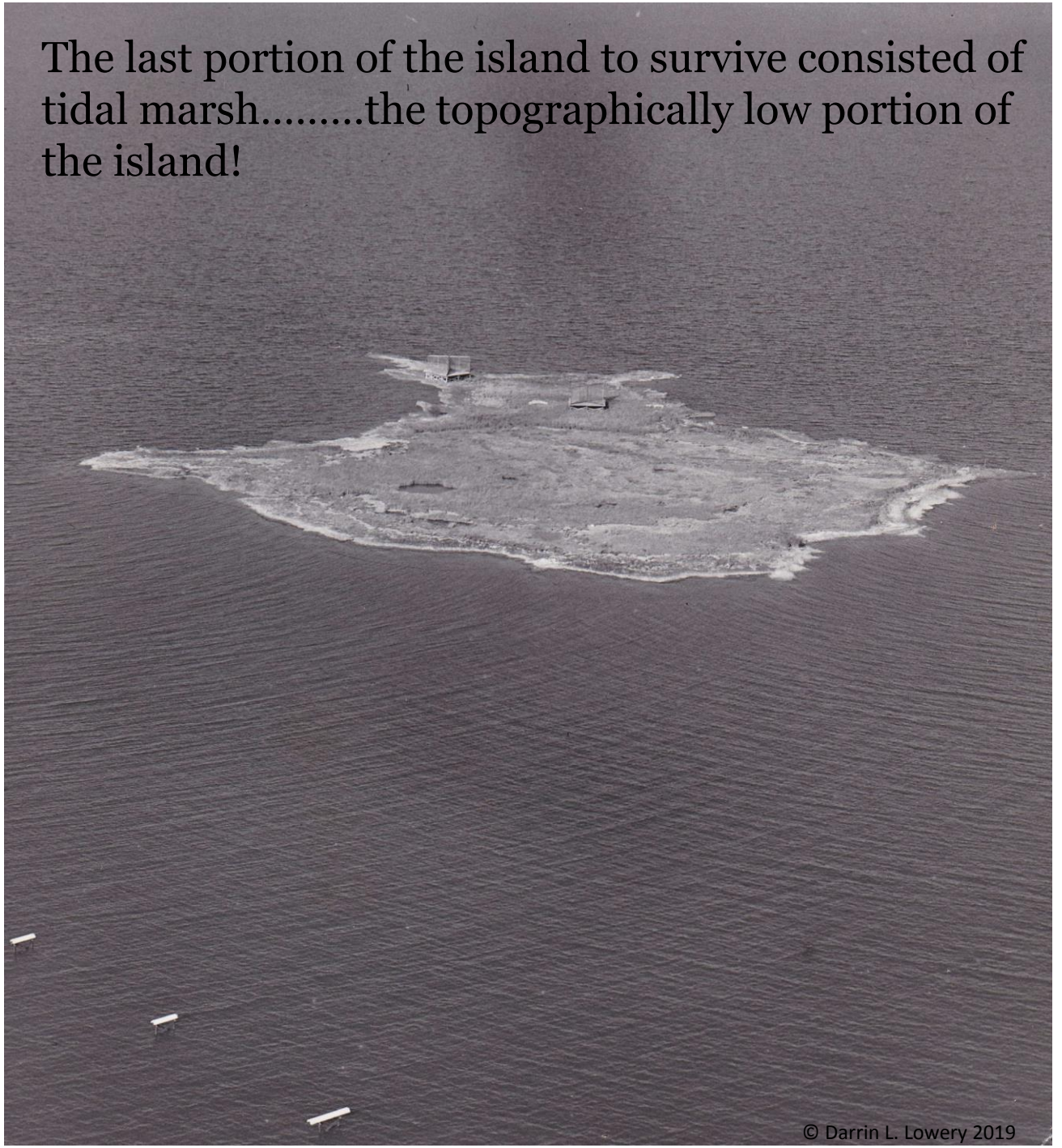
On Sharps Island the site of an artesian well has been transgressed by the waves so that it now presents the unique feature of a well located in the bay. The map of 1901 showed that the only remainder of the north end of the James Island of 1848 was a small island situated on the spot which was formerly an arm of an inlet but which later became filled with marsh material. Then the water in the midst of land in 1848 should become land in the midst of water in 1901 is a remarkable result of the greater resistance of the marsh-built land.

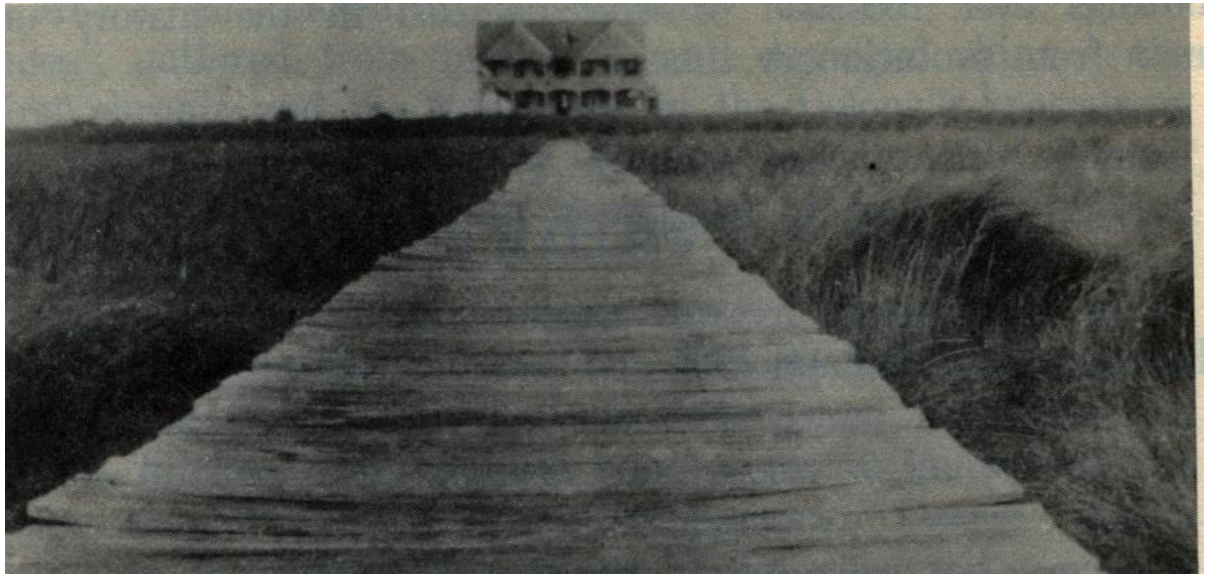
Practically all of the erosion has been on the west and north sides of the islands, which are most open to the attack of the southerly bay currents and the westerly winds and their waves. No building up of land is going on within the area studied, although farther south extensive delta deposits are being laid down.

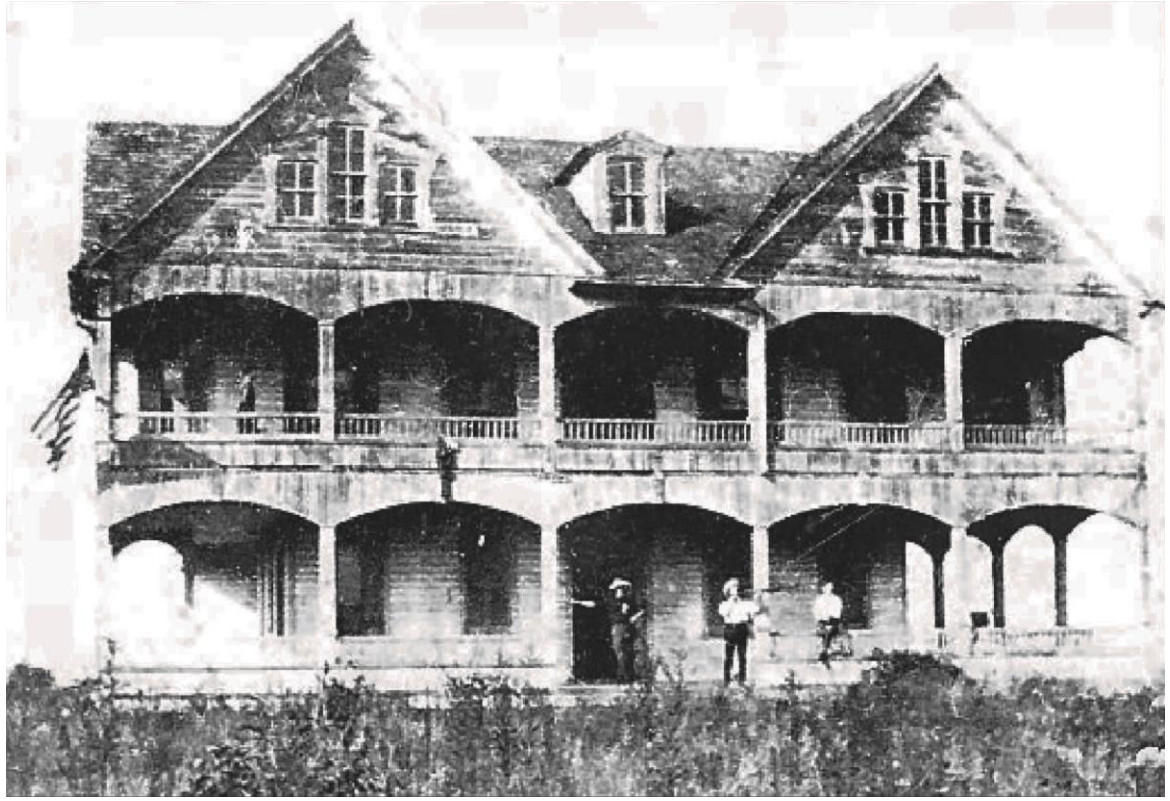
Of the twelve islands predicted in these newspaper articles to disappear by the end of the 20th century, only one did (<7 percent accuracy) and that is this island. Does anyone know its name?




SHARPS ISLAND, MD
N
W
E
S
1848 (438 acres)
1900 (91 acres)
1910 (53 acres)
1938 (13 acres)
1947 (4 acres)
3000 FEET (915 METERS)
© Darrin Lowery 2019


The last portion of the island to survive consisted of tidal marsh.....the topographically low portion of the island!
© Darrin L. Lowery 2019

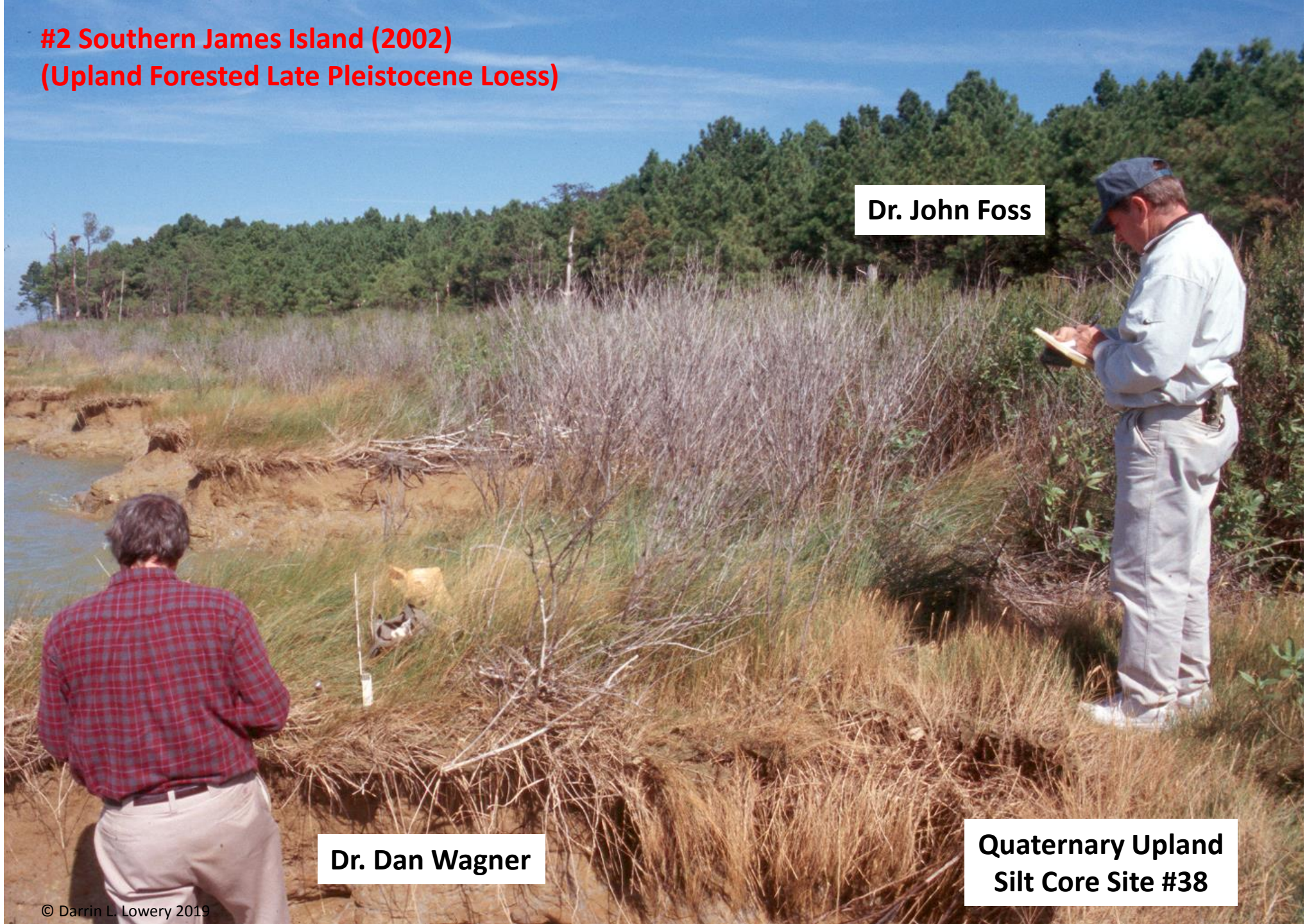




Analogous to the last house on Holland's Island, the hotel on Sharp's Island eroded away! It did NOT "sink"!

#1 Northern James Island

Note that tidal marsh…. the topographically low portion of the island…… is the last to disappear!



The loss of James Island (Upland Silt Core Site #38) is no more evidence of sea level rise……

……..than the loss of Tom Horton's childhood baseball field!

SCALE CONCEPT #1: Shoreline erosion happens on a hourly/daily time scale!

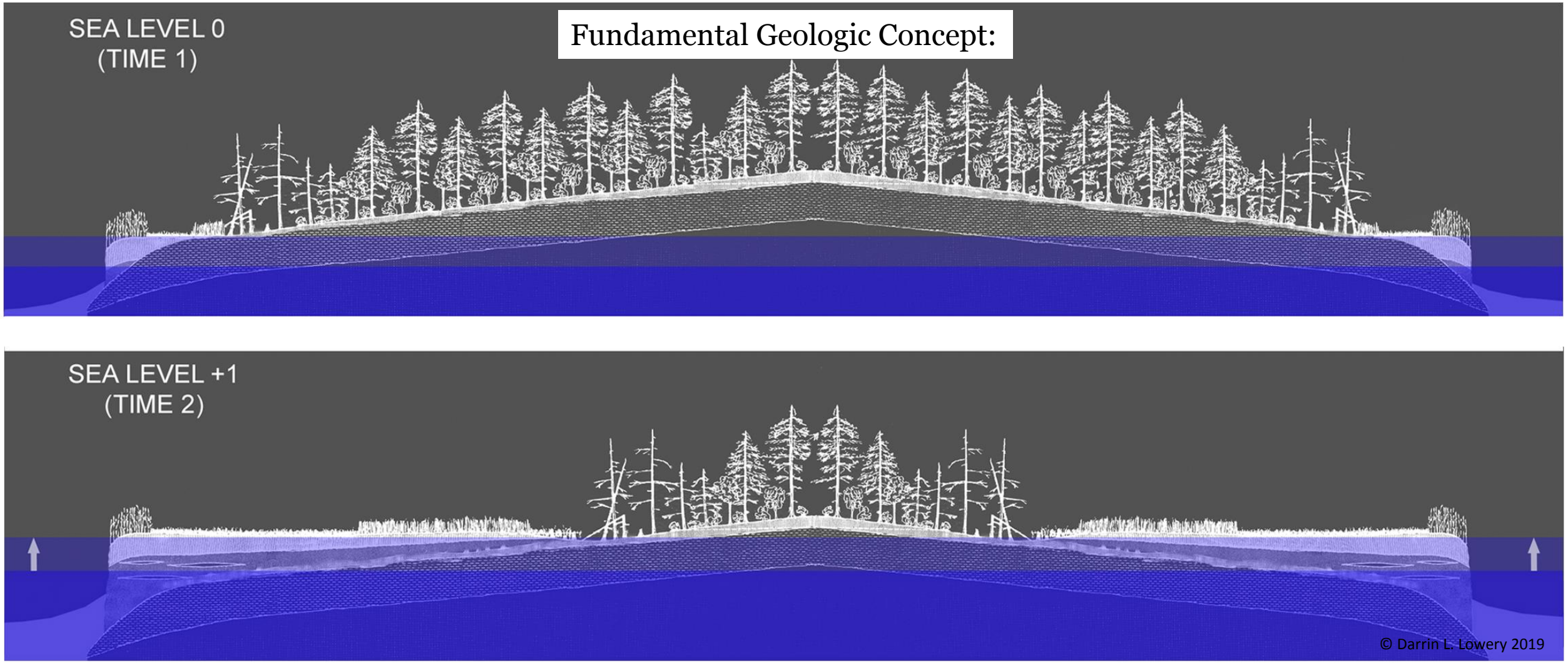
Northwest Taylor's Island
SITE: 18DO359 (4-10-2017)

The photo, which was taken on 4-10-2017, shows an eroded point of land at 18DO359. James Island can be seen in the background. Guess what happens to this point of land 120 days later?

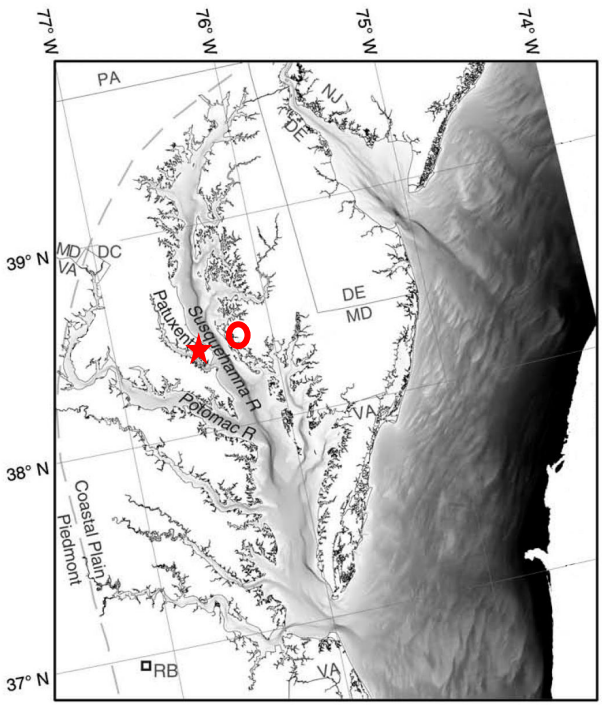
Northwest Taylor's Island
SITE: 18DO359 (8-9-2017)

The photo, which was taken on 8-9-2017, shows the same eroded point of land at 18DO359. The point is now an island. Did sea level rise over this short 120 day period? The answer is a resounding ***NO***!

SCALE CONCEPT #2: Sea level rise happens on a centennial/millennial time scale!

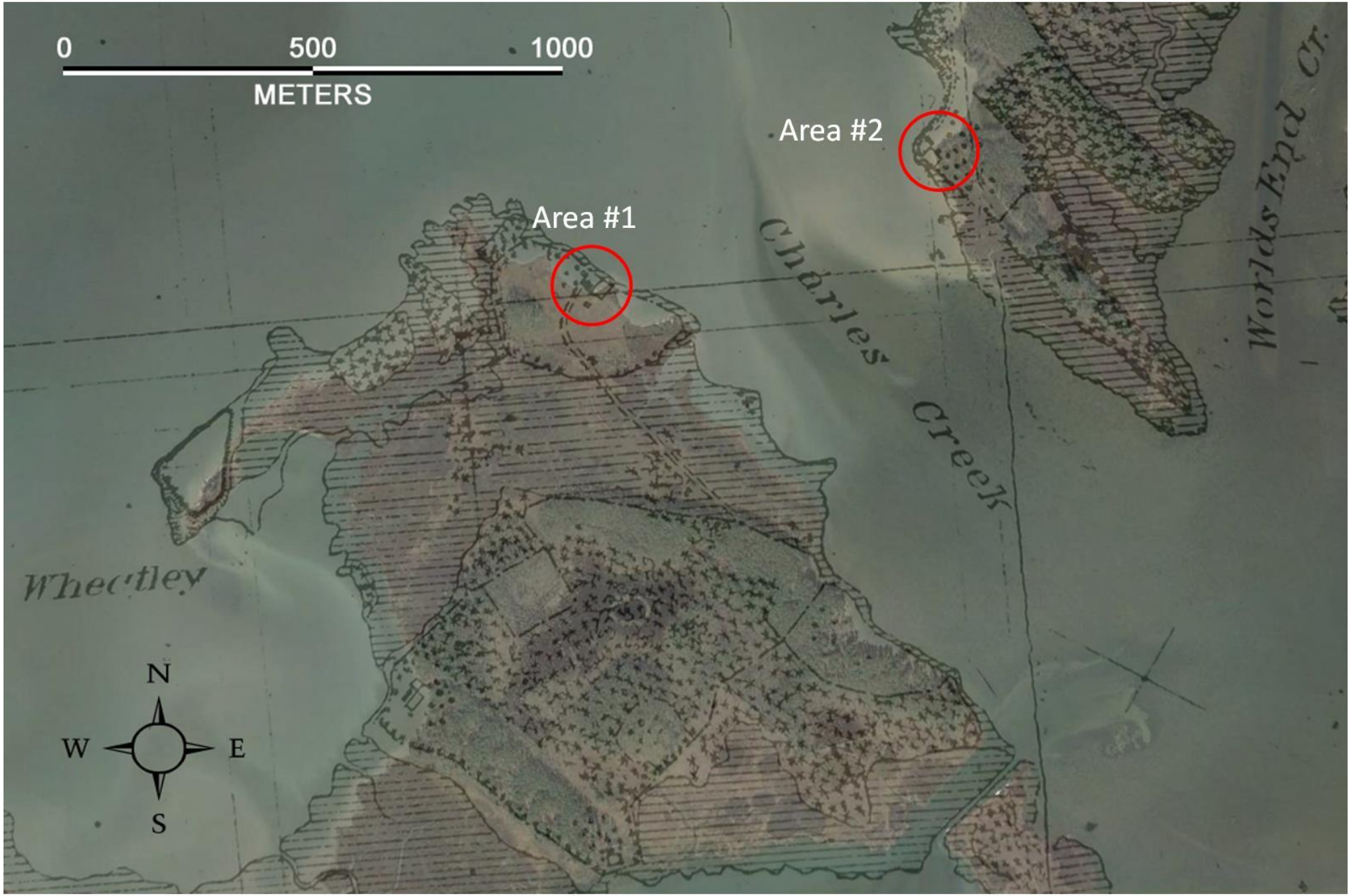


"If you fill up a bath tub with more water (or if the upland surface is collapsing), the amount of dry area decreases and the amount of wet area increases!"



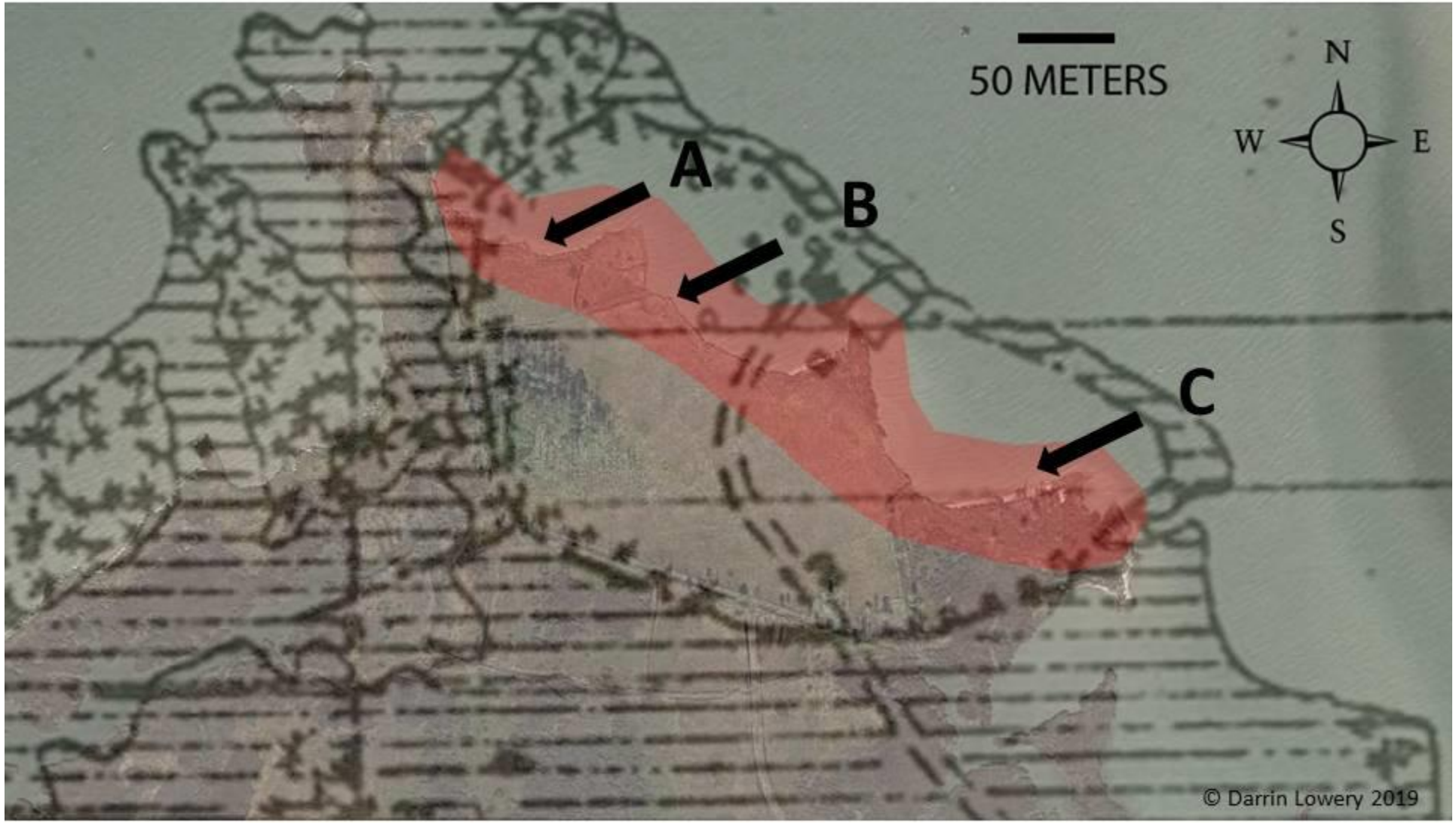
A Section of U.S. Coastal Survey Map T-255 (*Surveyed May-August 1848*)

Eastern Honga River, Dorchester County, Maryland



AREA #1

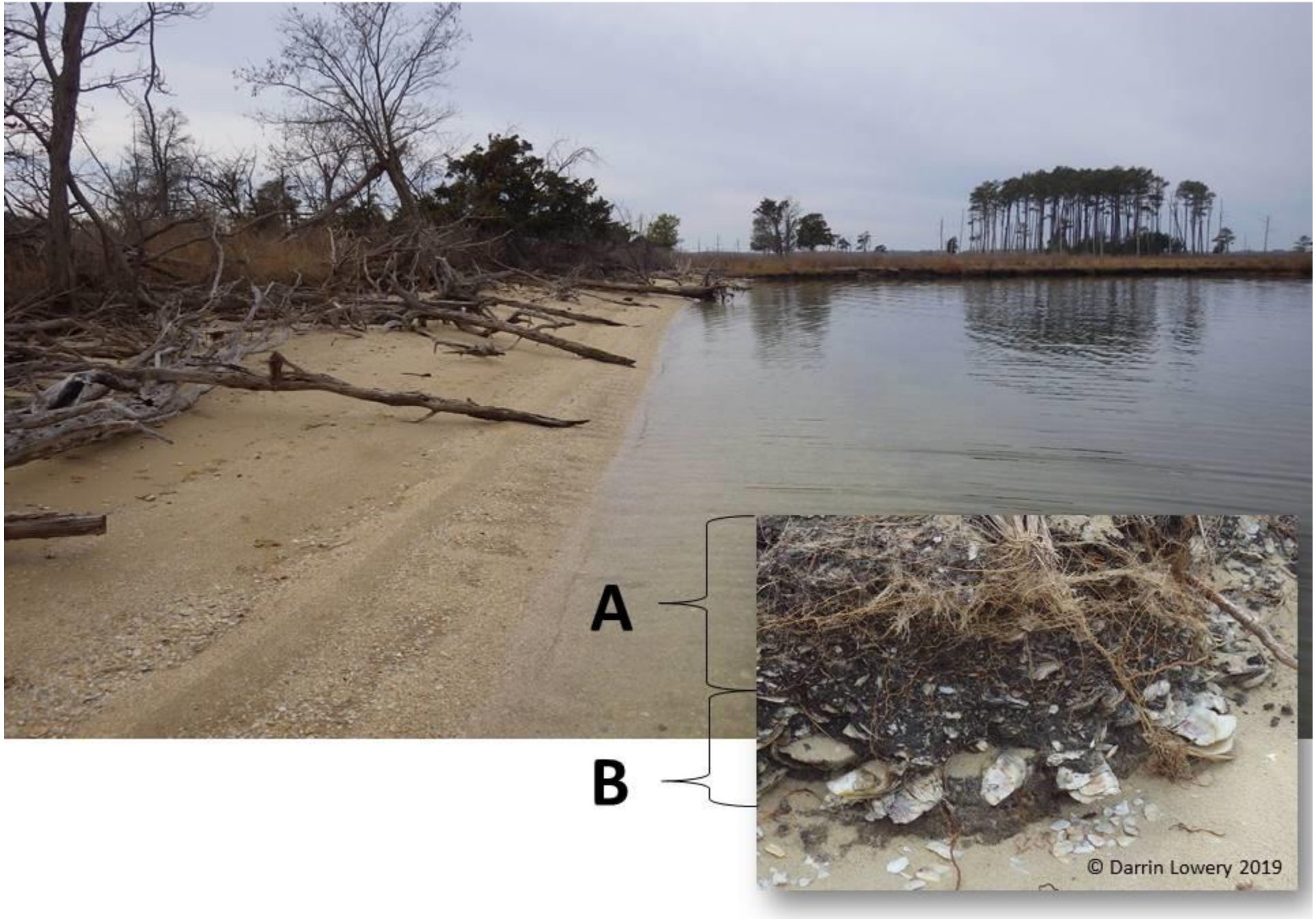
1848 map / 2013 Satellite Image



AREA #1 (A)

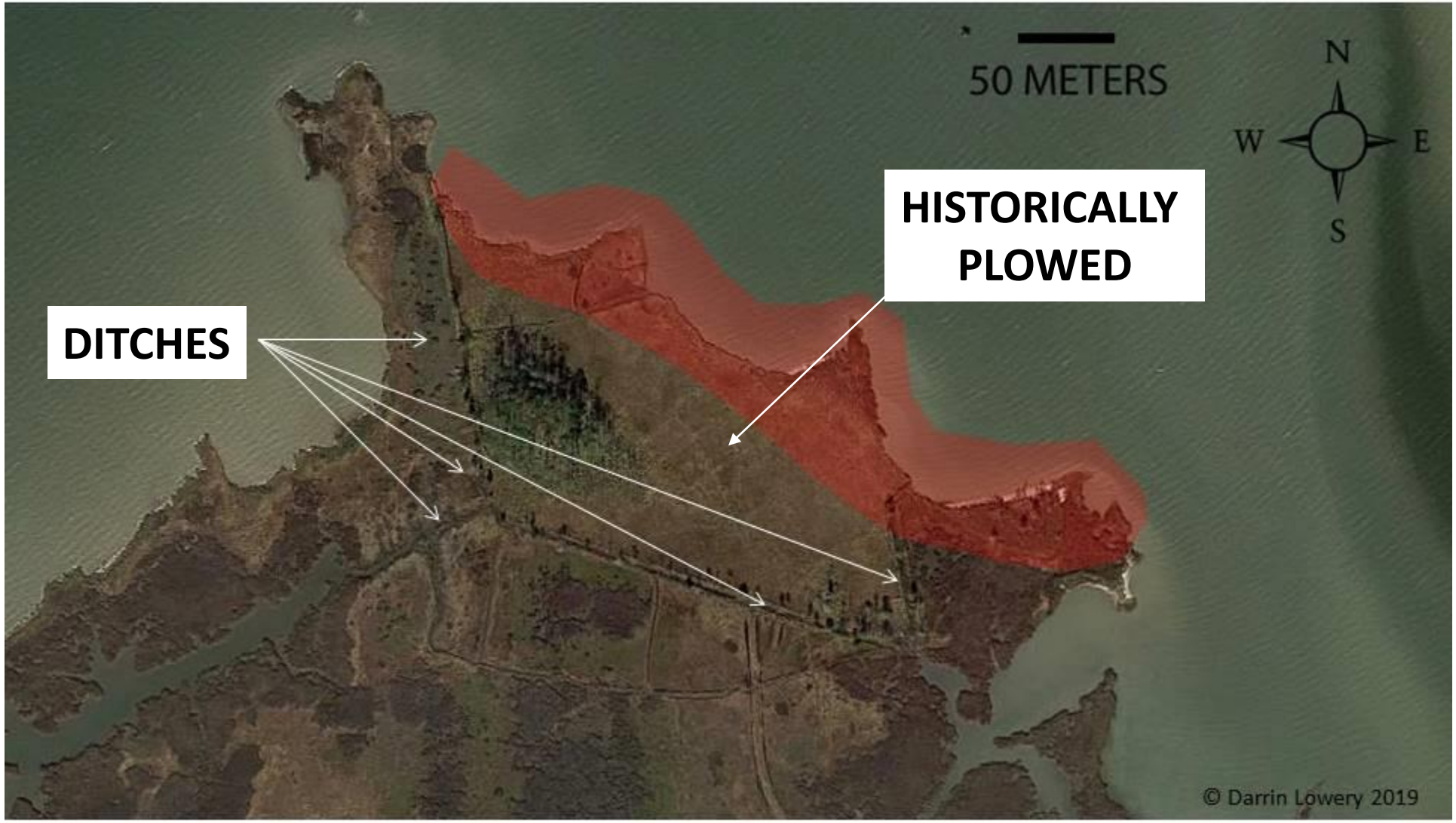
AREA #1 (B)

AREA #1 (C)



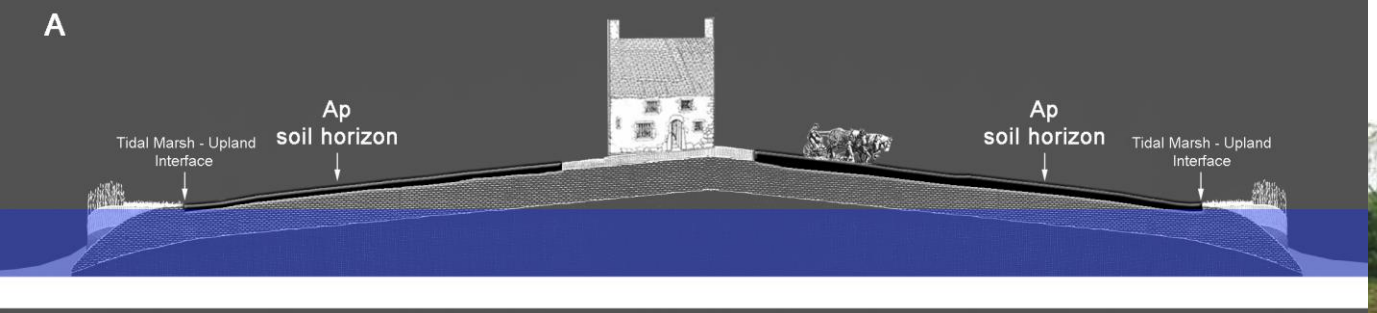
AREA #1

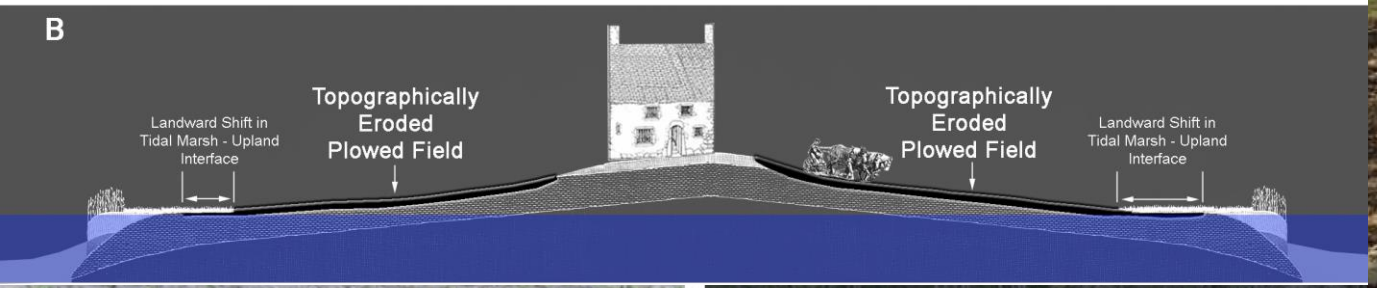
West Worlds End Creek Site (18DO385)

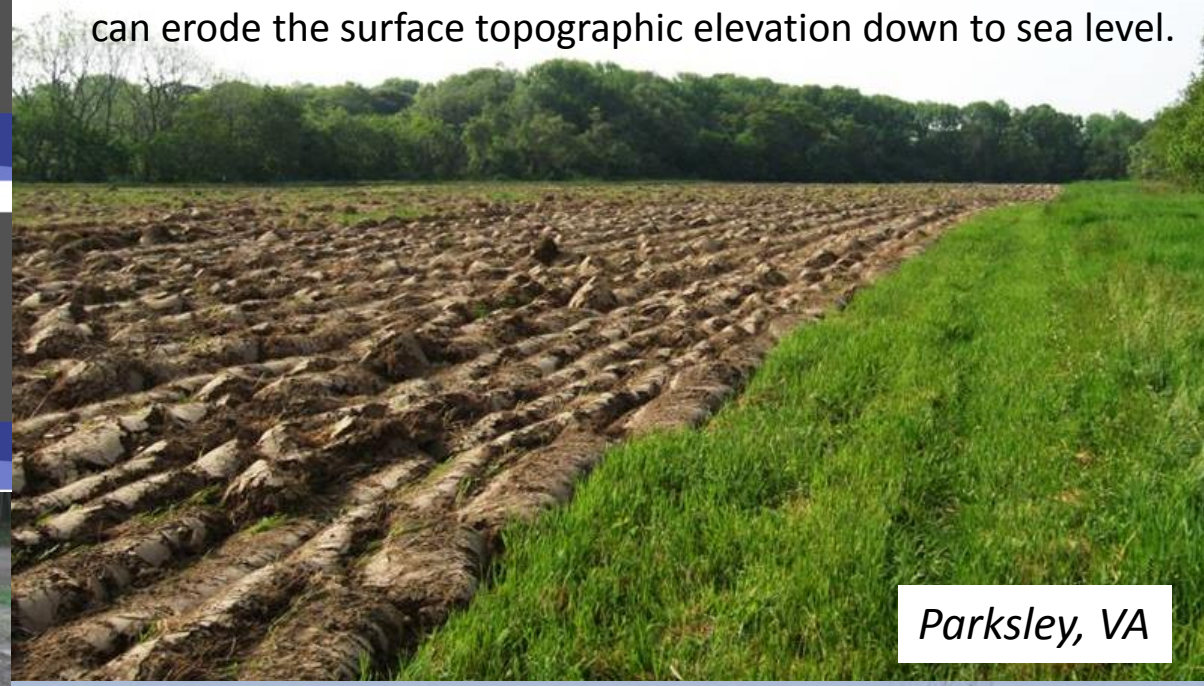


PLOWING….

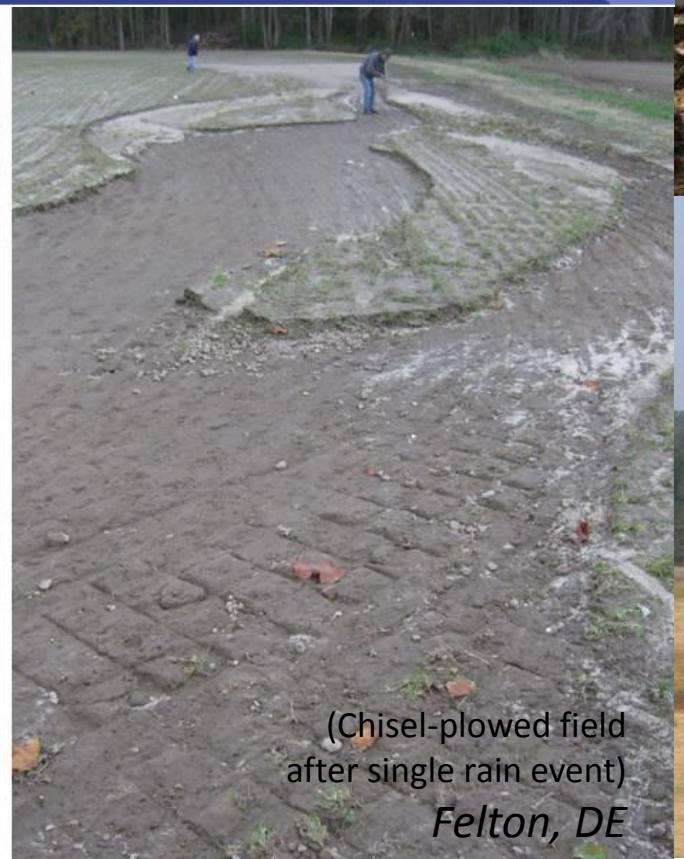
can erode the surface topographic elevation down to sea level.







Parksley, VA



(Chisel-plowed field after single rain event)

Felton, DE

Exmore, VA

DITCHING…

in low lying areas can change the pH, permit regular saltwater intrusion, result in interior hypersaline conditions, and introduce burrowing/ tunneling marine organisms, which can magnify the negative long-term effects of saltwater incursion.

Fairmount, MD

Change pH (acidic)

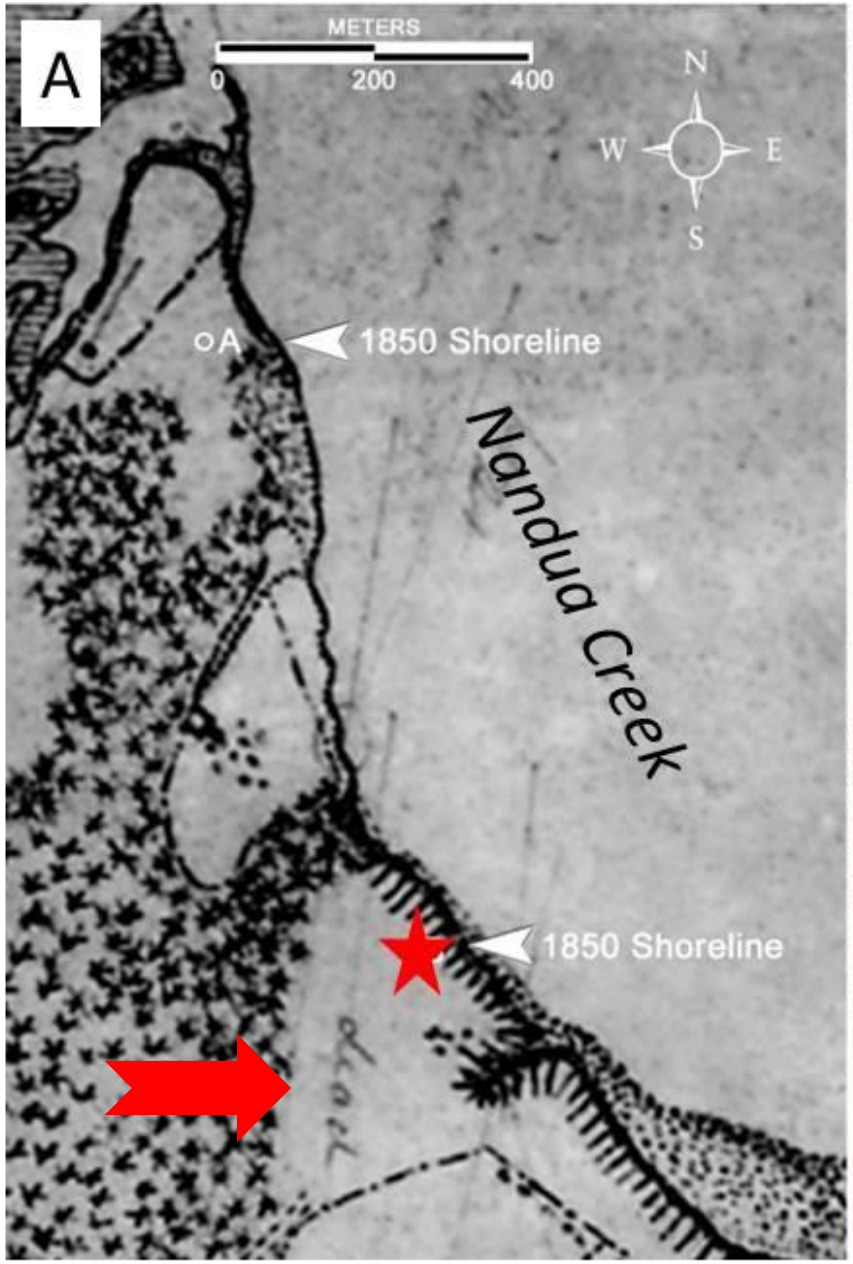
Crocheron, MD

Normal Tide

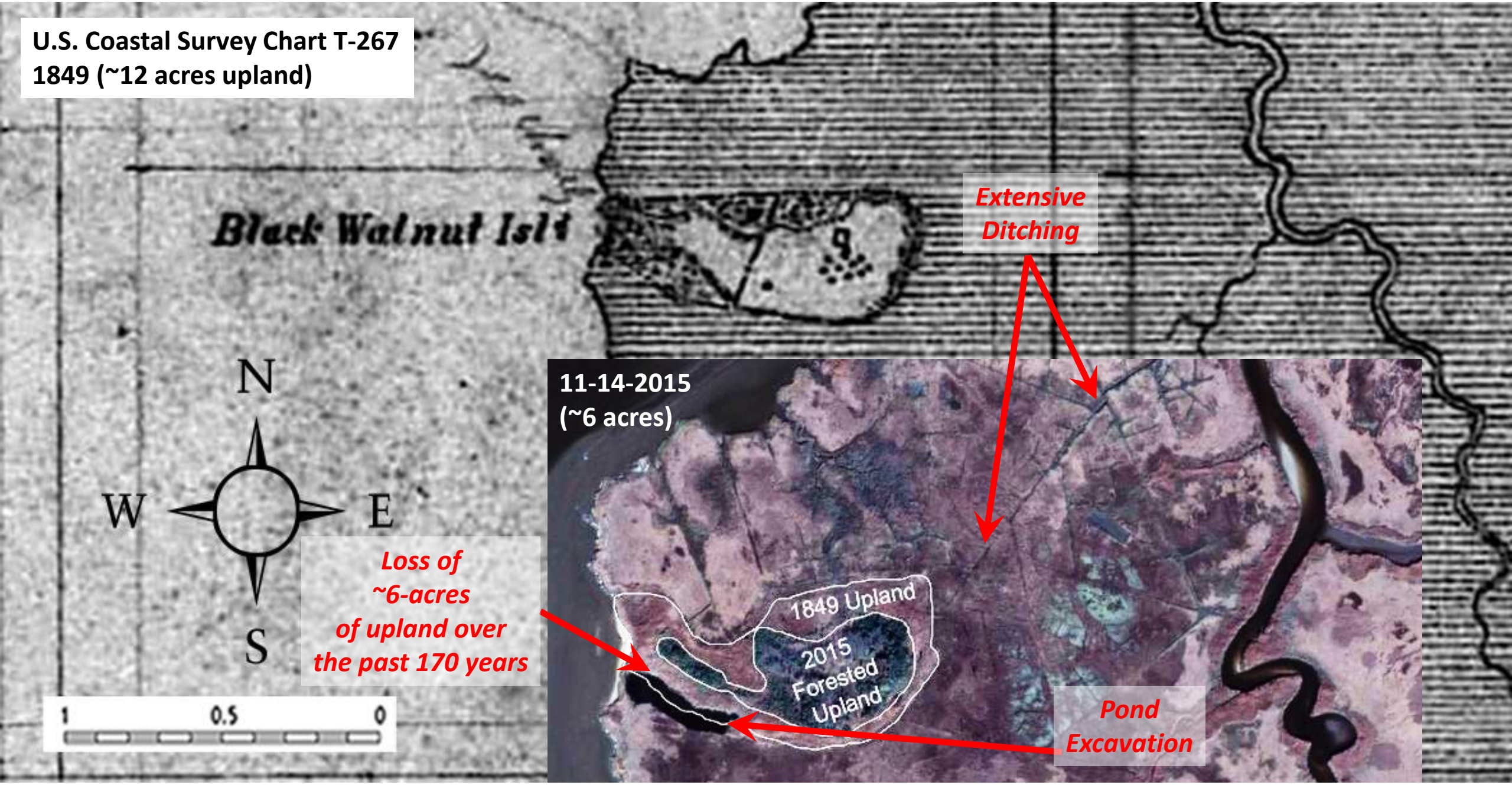
High Tide

ULTIMATELY...

a former tilled field can be transformed into tidal marsh without raising sea level!



Note that the mid-19th century surveyor designated this field as “dead”!


U.S. Coastal Survey Chart T-267
1849 (~12 acres upland)
Black Walnut Islt
N
W
E
S
1
0.5
0
Extensive Ditching
11-14-2015
(~6 acres)
1849 Upland
2015 Forested Upland
Loss of ~6-acres of upland over the past 170 years
Pond Excavation

1848 map / 2013 Satellite Image

A

CEMETERY

B

PLOWED FIELD

C

PLOWED UPLAND - TIDAL MARSH INTERFACE

N

W

E

S

0

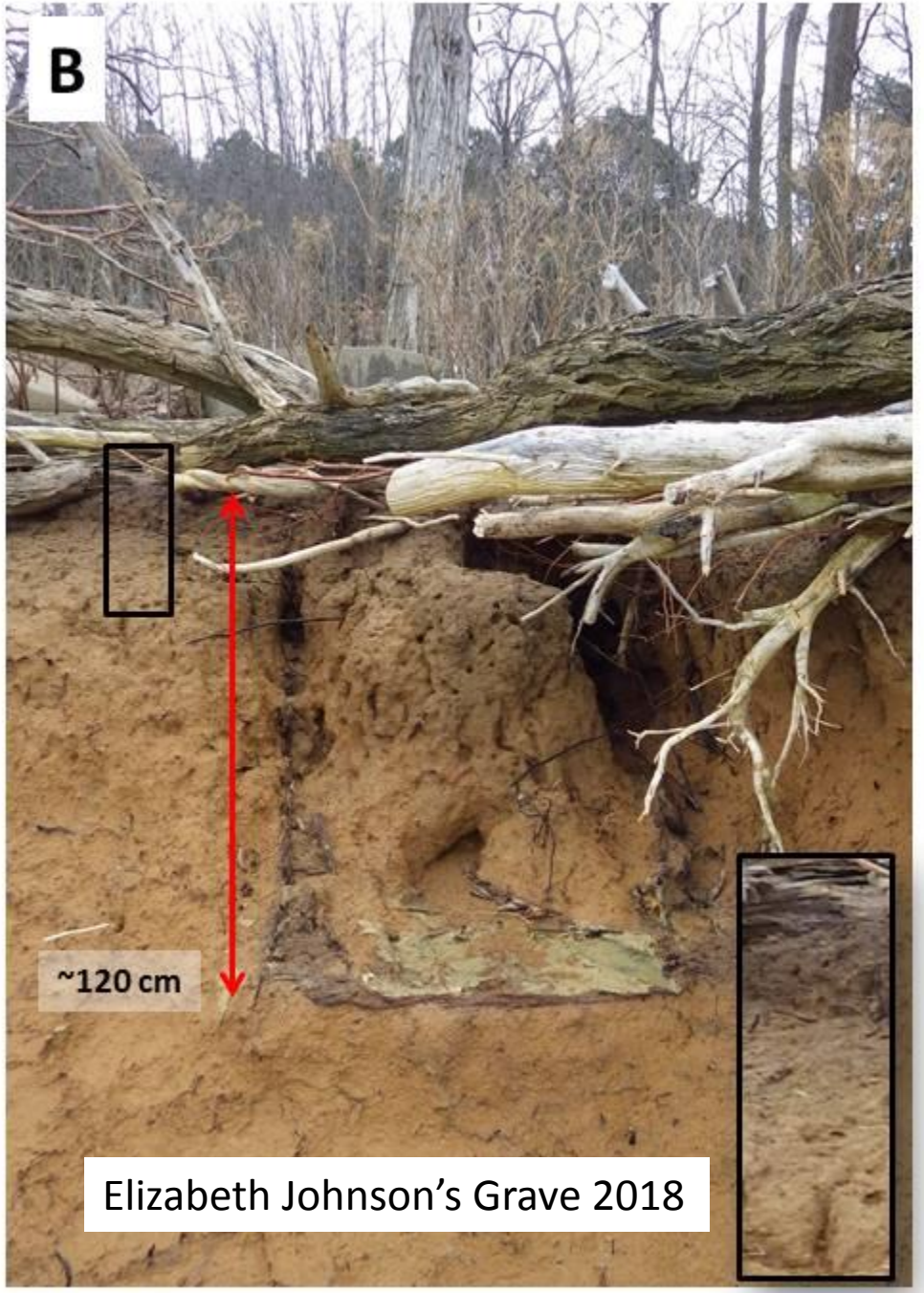
100

METERS

AREA #2 (A)

AREA #2 (A)

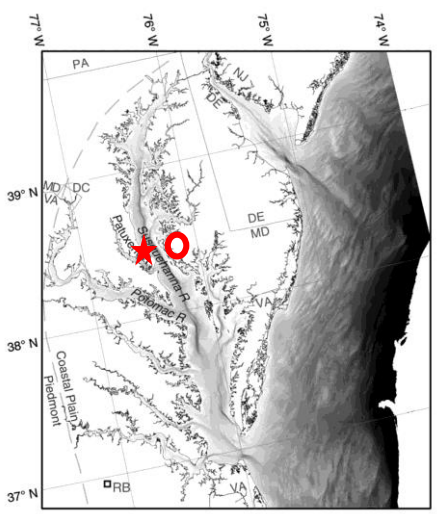
Elizabeth Johnson's Grave 2011



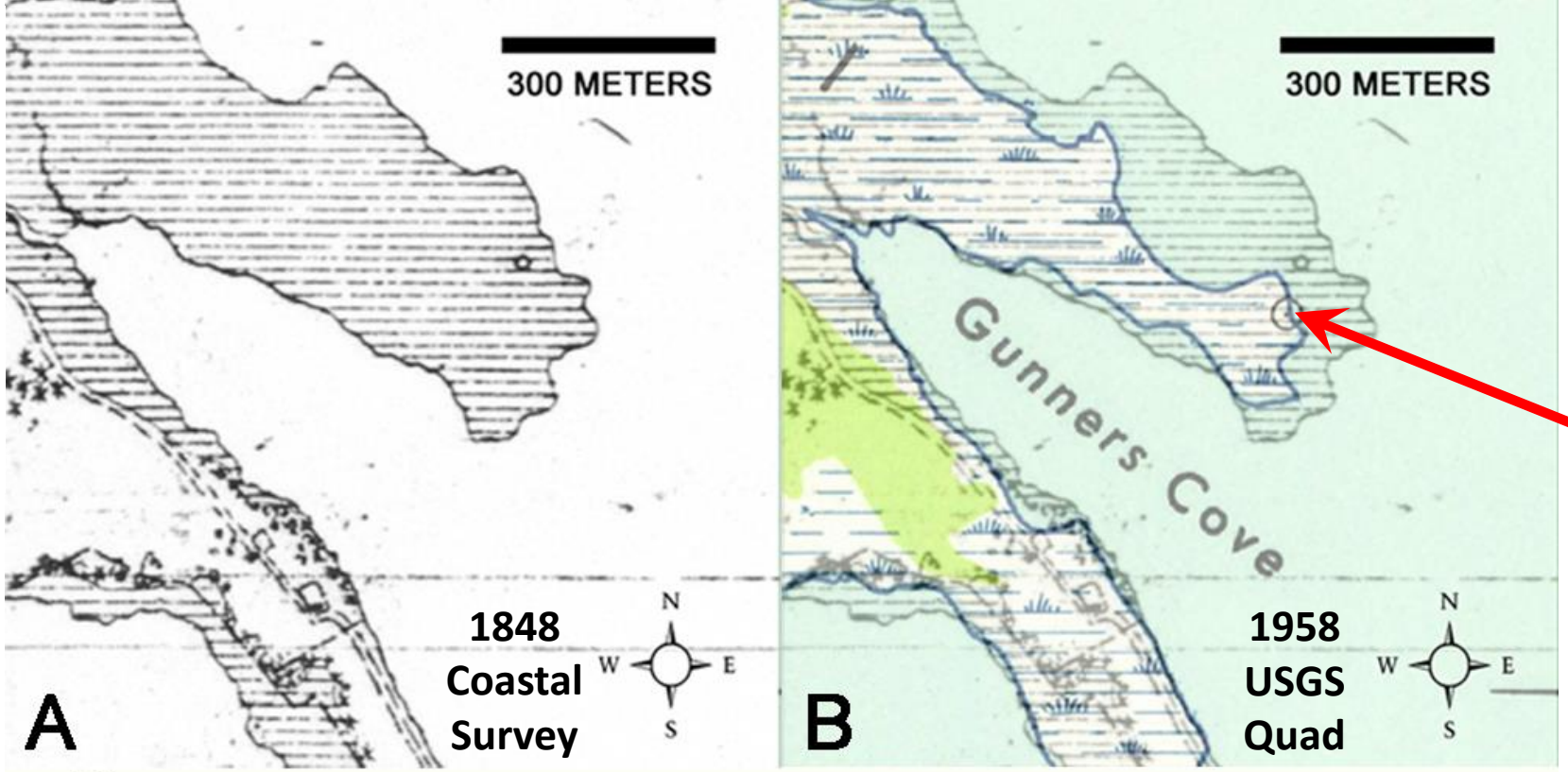
Elizabeth Johnson's Grave 2018

AREA #2 (B)

AREA #2 (C)

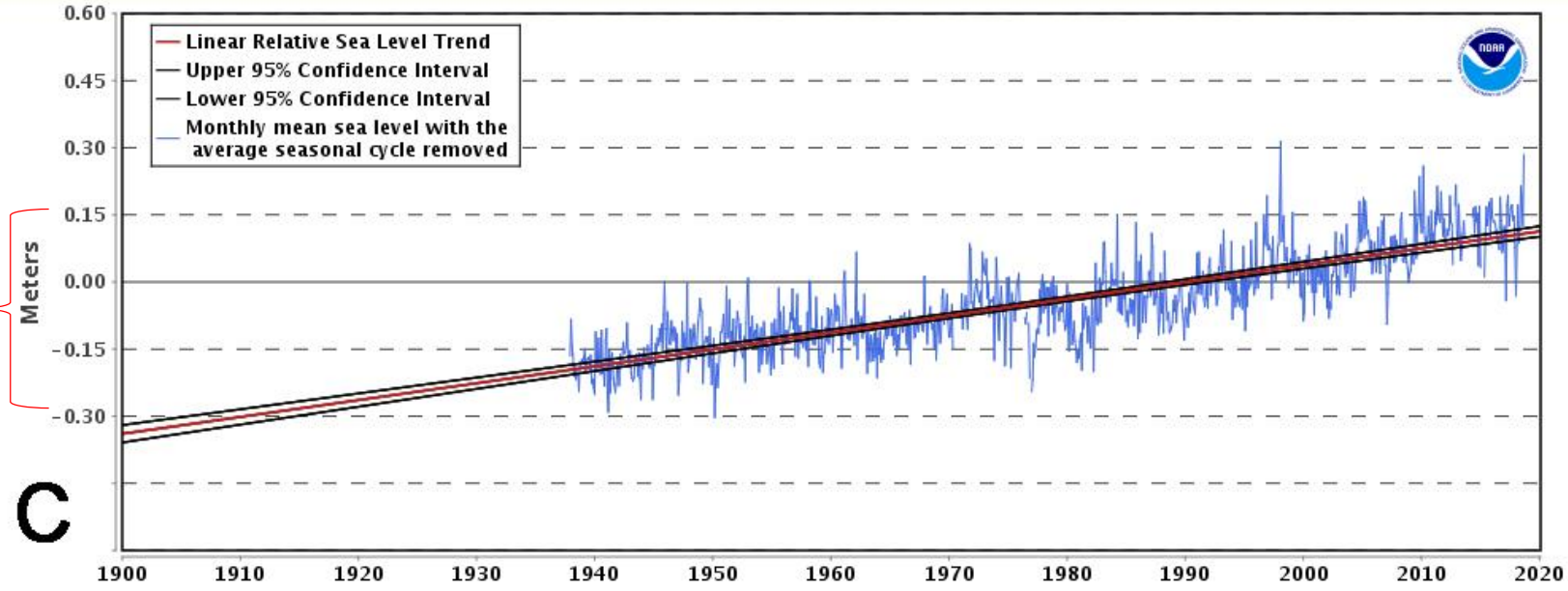


Gunners Cove, Honga River, Dorchester Co., MD

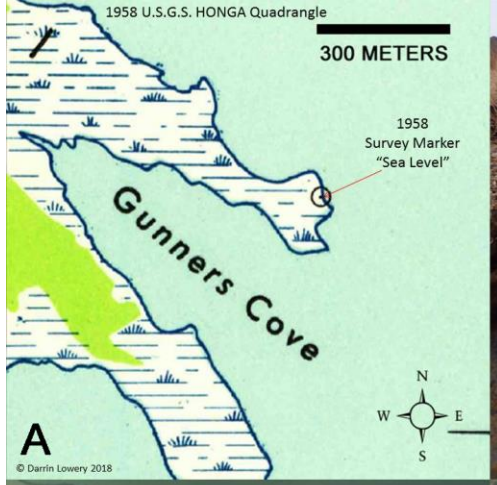


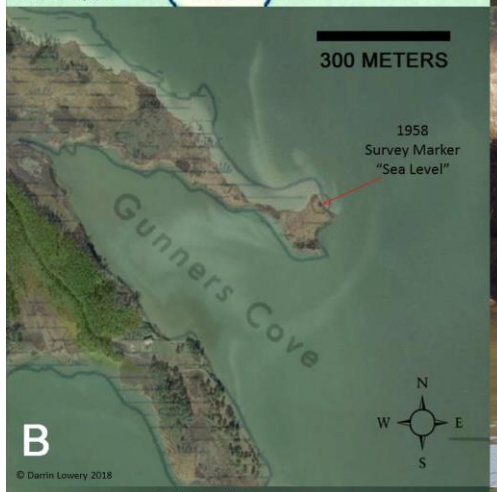
Survey Marker "Sea Level"

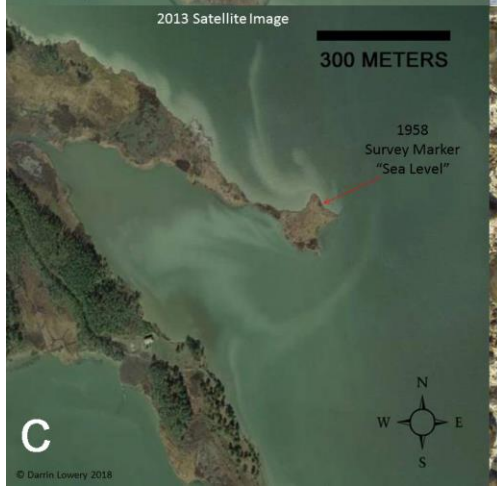
38 cm of modeled rise
(**1.25 feet or ~15 inches**)
100 years

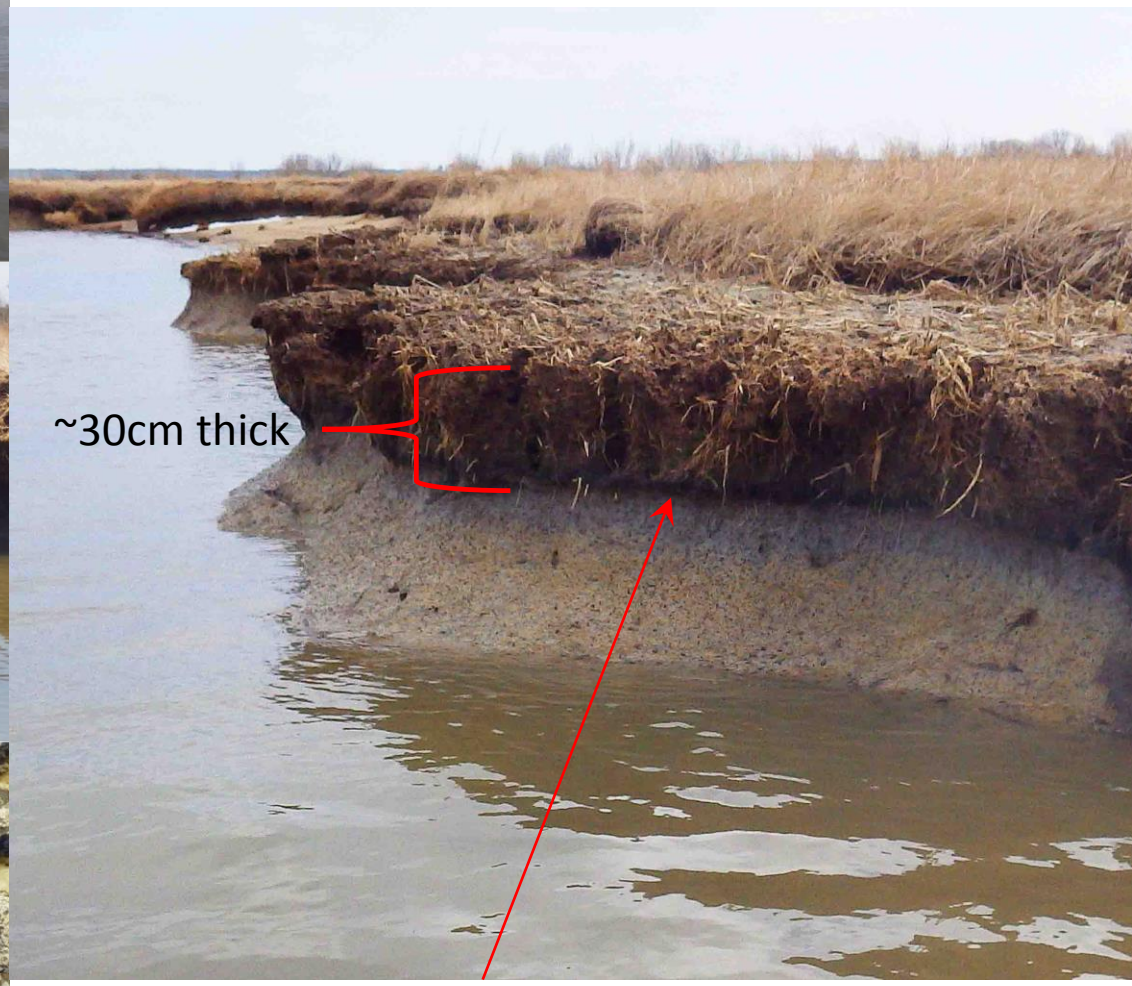


Gunners Cove,
Honga River,
Dorchester Co., MD









Intact Drowned Upland Surface
(No historic alteration or intrusion)

Deal Island, MD (Sea level Change Last 1000 Years in Chesapeake Bay J OF COAST. RES. Kearney 1996)

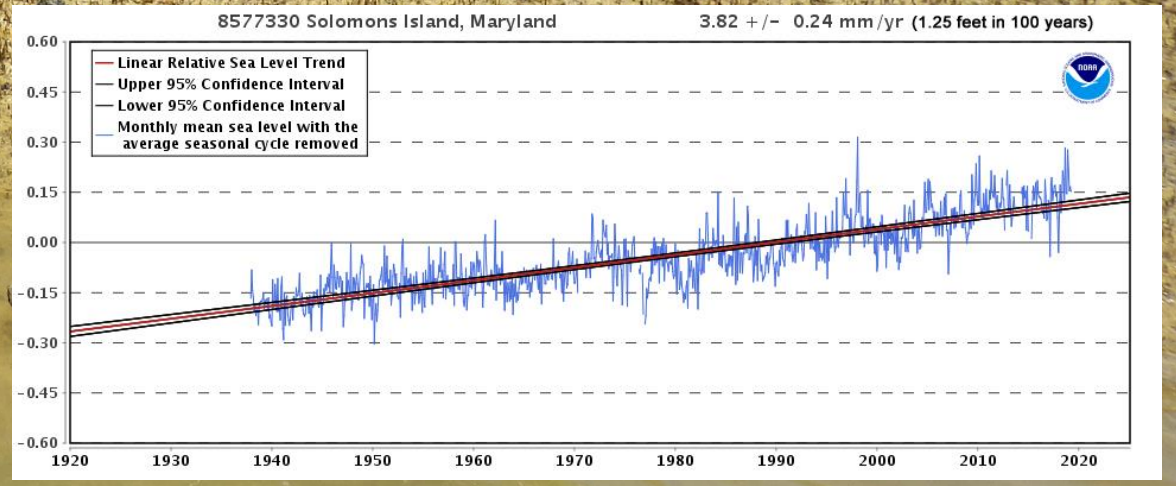
Material:	Lab #:	14C-age BP	Error (+/-)	Calibrated calAD	Error (+/-)	Sample Depth (Drowned Upland)
Basal Tidal Marsh Peat	Beta-21803	880	100	**1134 calAD**	**88**	90cm below marsh surface
Basal Tidal Marsh Peat	Beta-23318	980	70	**1068 calAD**	**72**	83cm below marsh surface
Basal Tidal Marsh Peat	Beta-23319	860	90	**1146 calAD**	**86**	75cm below marsh surface
Basal Tidal Marsh Peat	Beta-23320	560	60	**1363 calAD**	**47**	40cm below marsh surface

~40cm thick

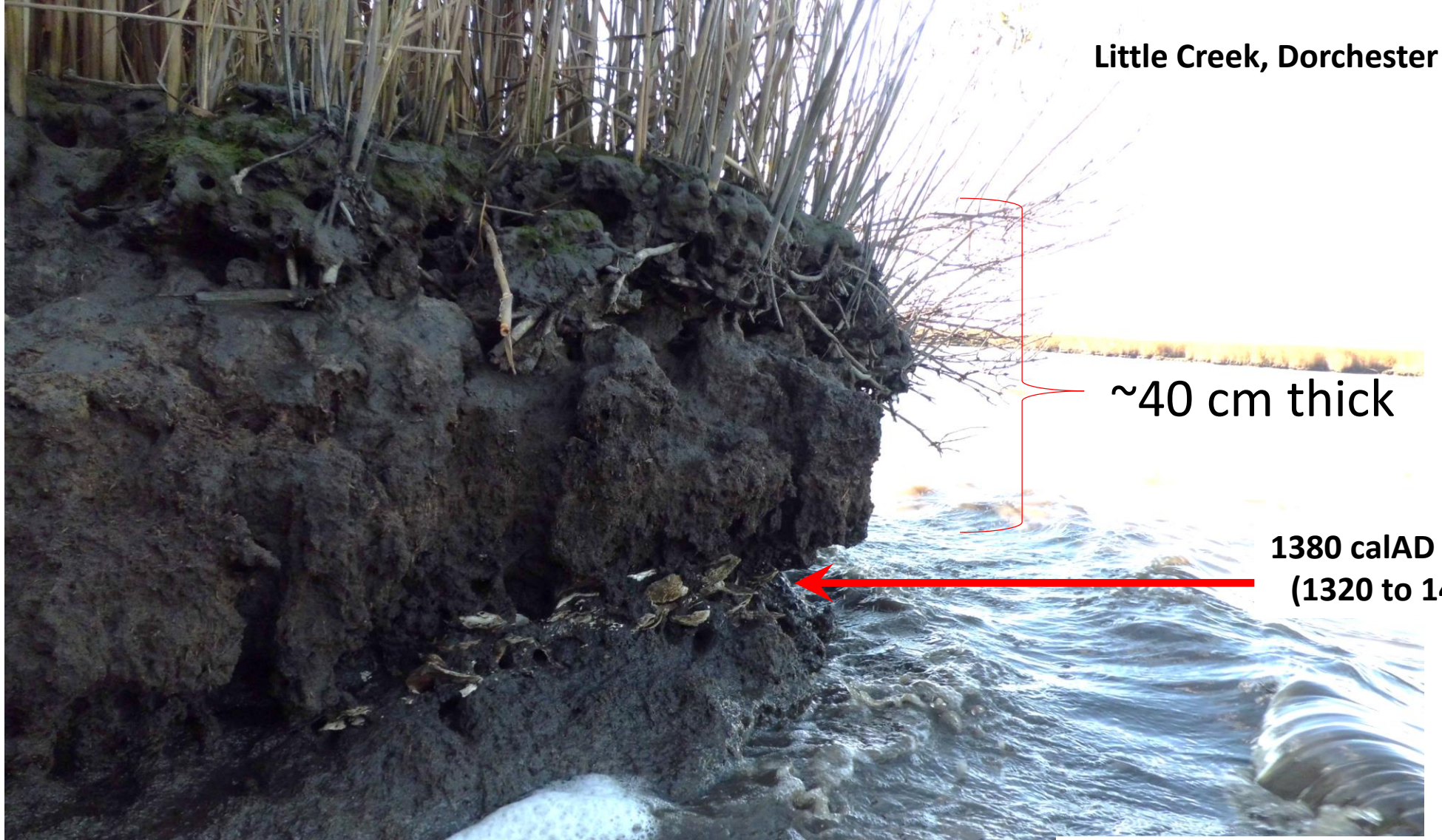
Basal Tidal Marsh Vegetation
1363 calAD +/- 47 years
(1316 to 1410 calAD)

If NOAA's tide-based sea level model for Solomon's Island was correct, the date on the basal tidal marsh should have been "modern", not 14th to 15th century in age!

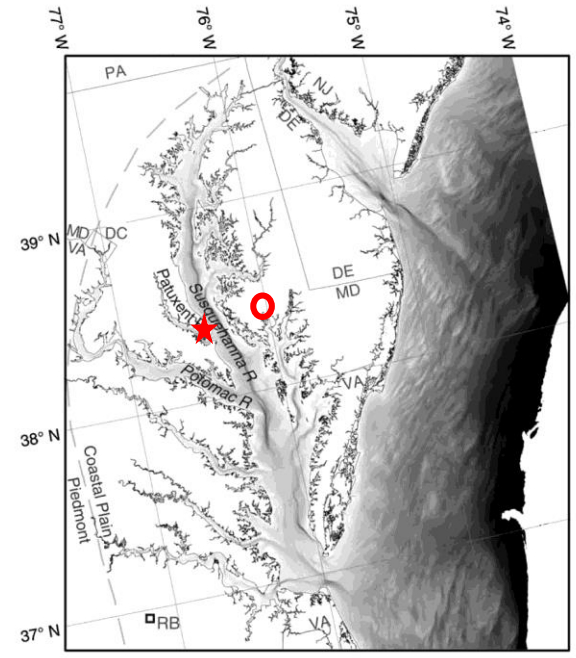
38 cm of modeled rise
(**1.25 feet or ~15 inches**)
100 years



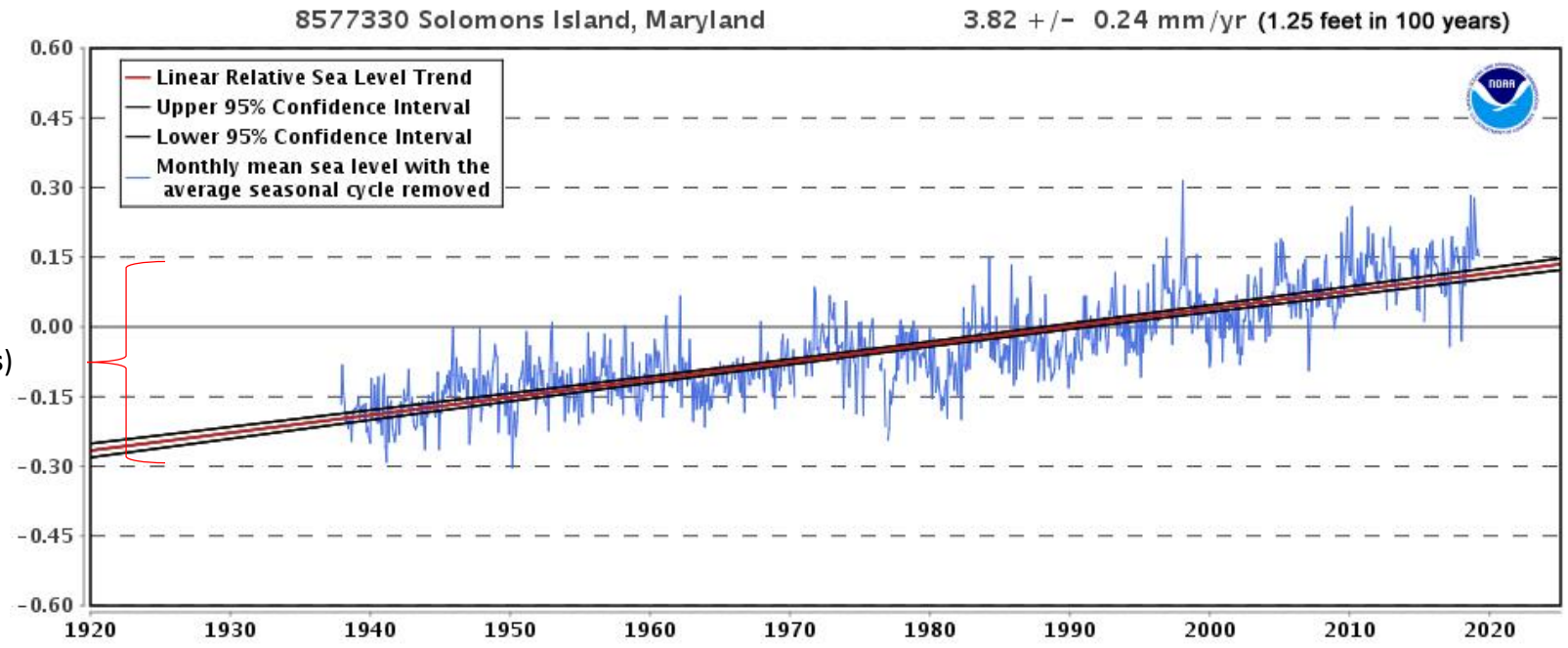
Deal Island, Wicomico County, MD

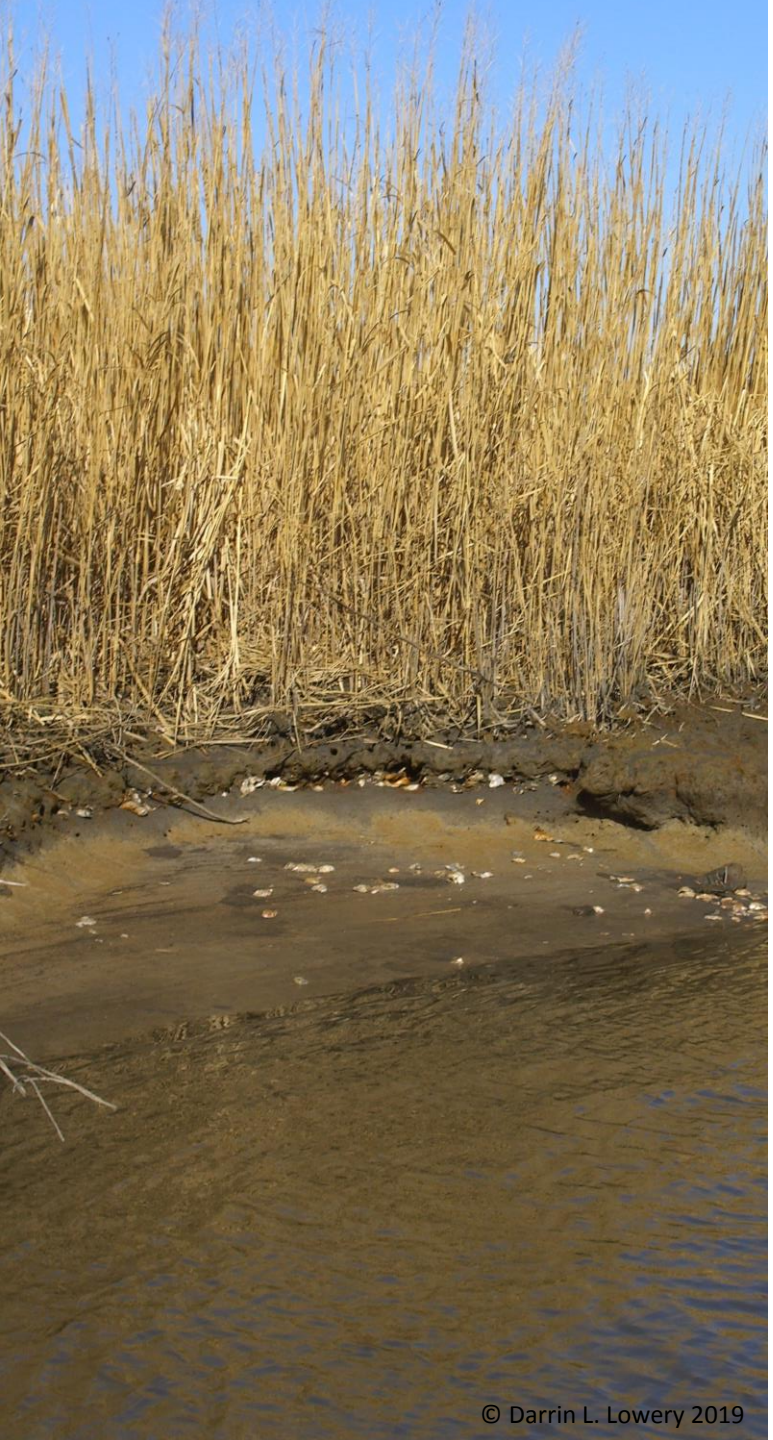


Both the Deal Island initial tidal marsh formation and the Little Creek drowned midden show no historic intrusion. These surfaces have been drowned for a very long time (14th to 15th century).

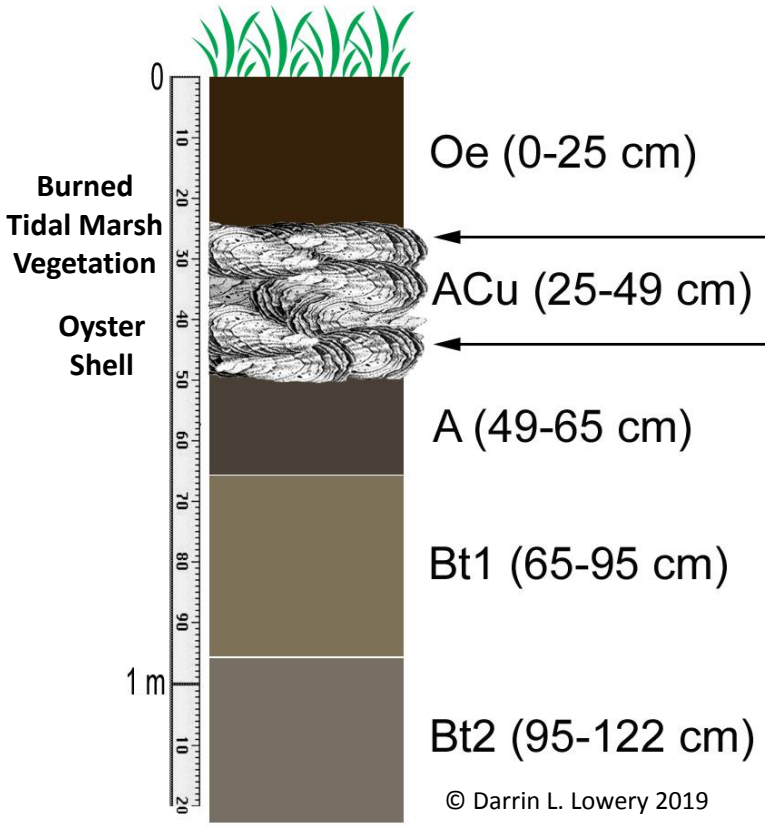


38 cm of modeled rise
(**1.25 feet or ~15 inches**)
100 years





Thorofare Marsh Bend #2 (18DO433)
- Bank Profile -
FISHING BAY, DORCHESTER CO., MD



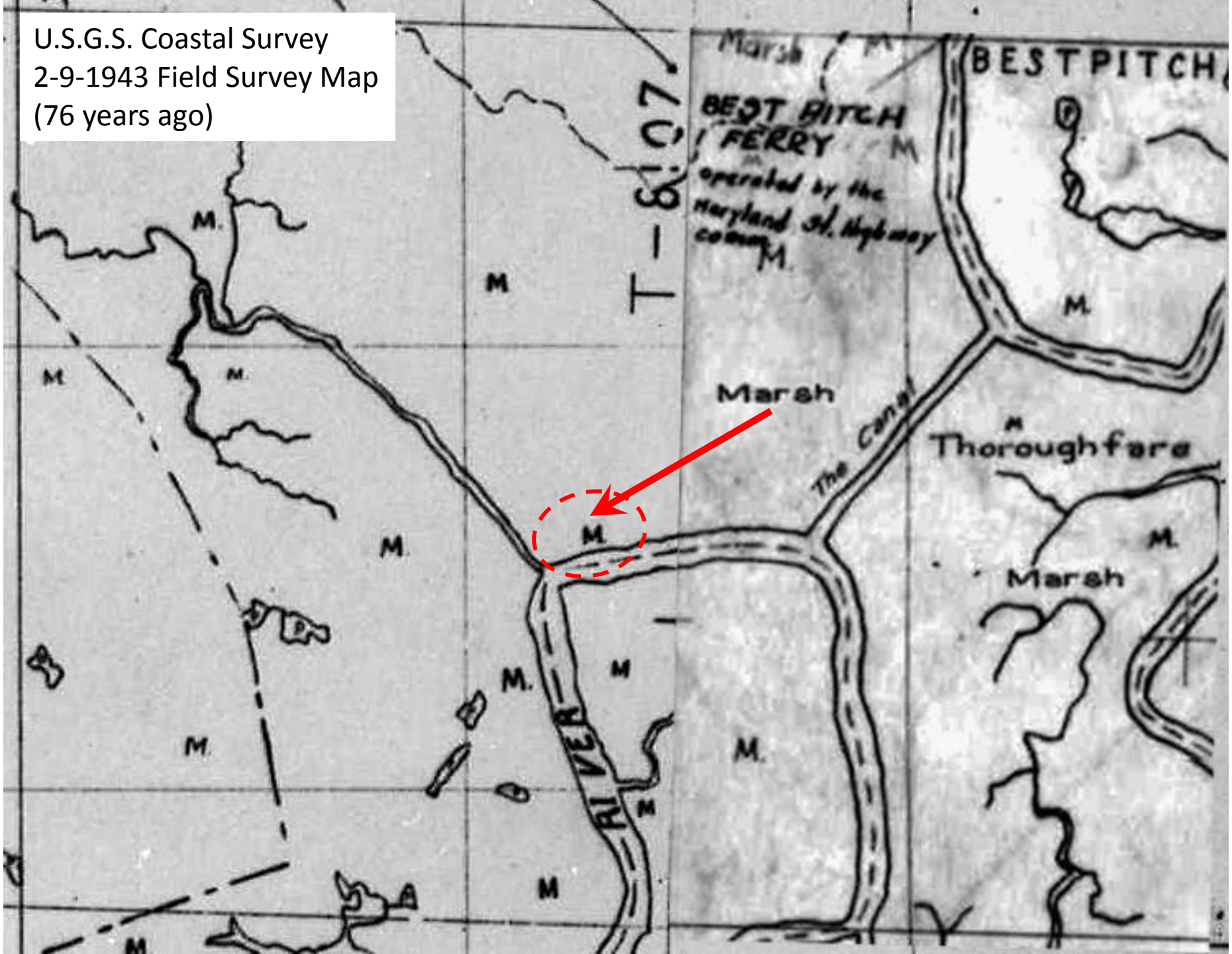
Tidal Marsh Peat Stratum
(25 cm or ~10 inches)

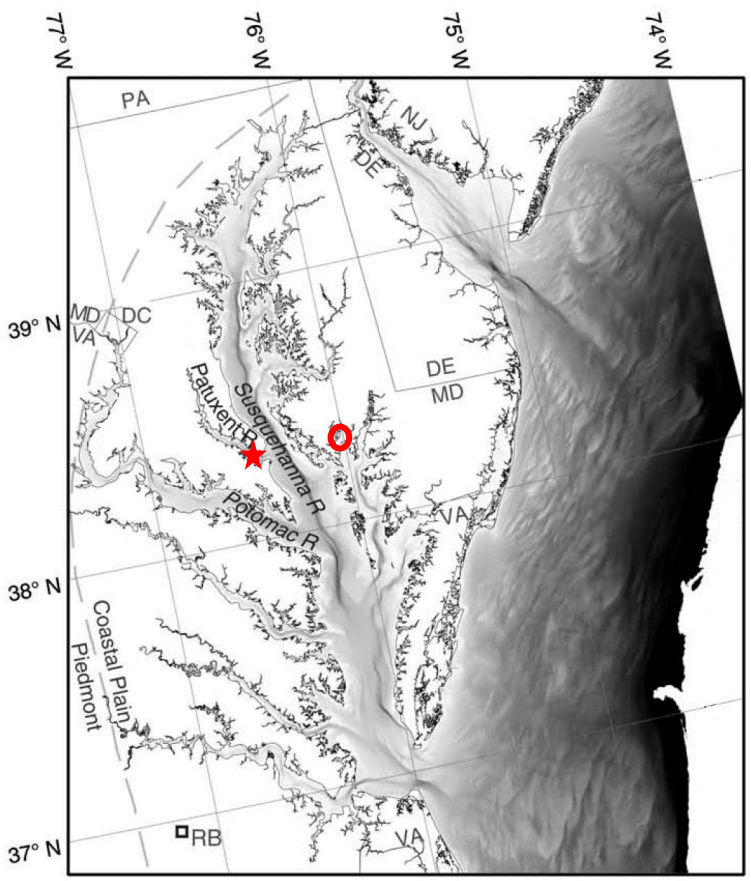
1675 cal AD ± 125 years (OS-81502)

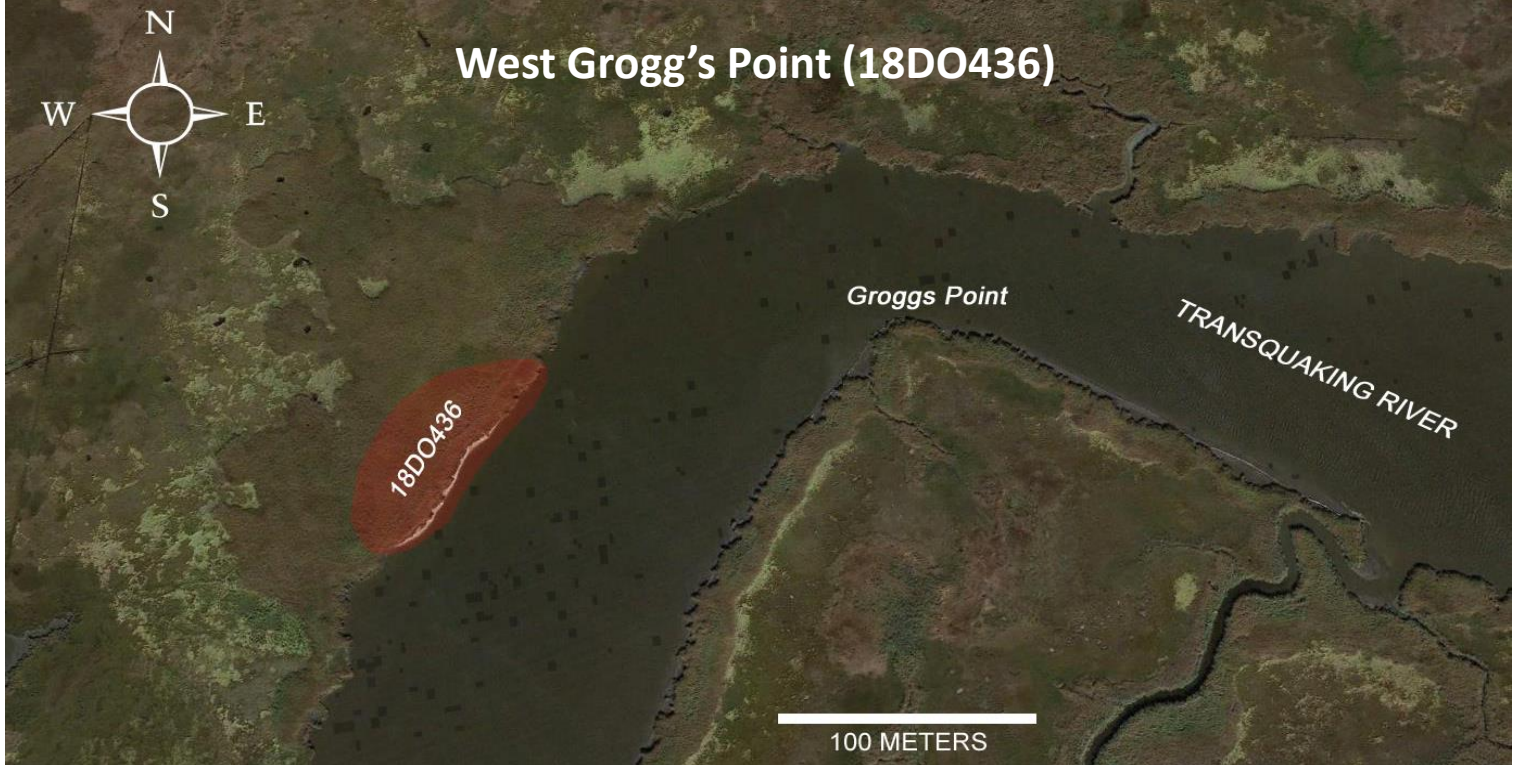
NO HISTORICAL INTRUSION or ALTERATION

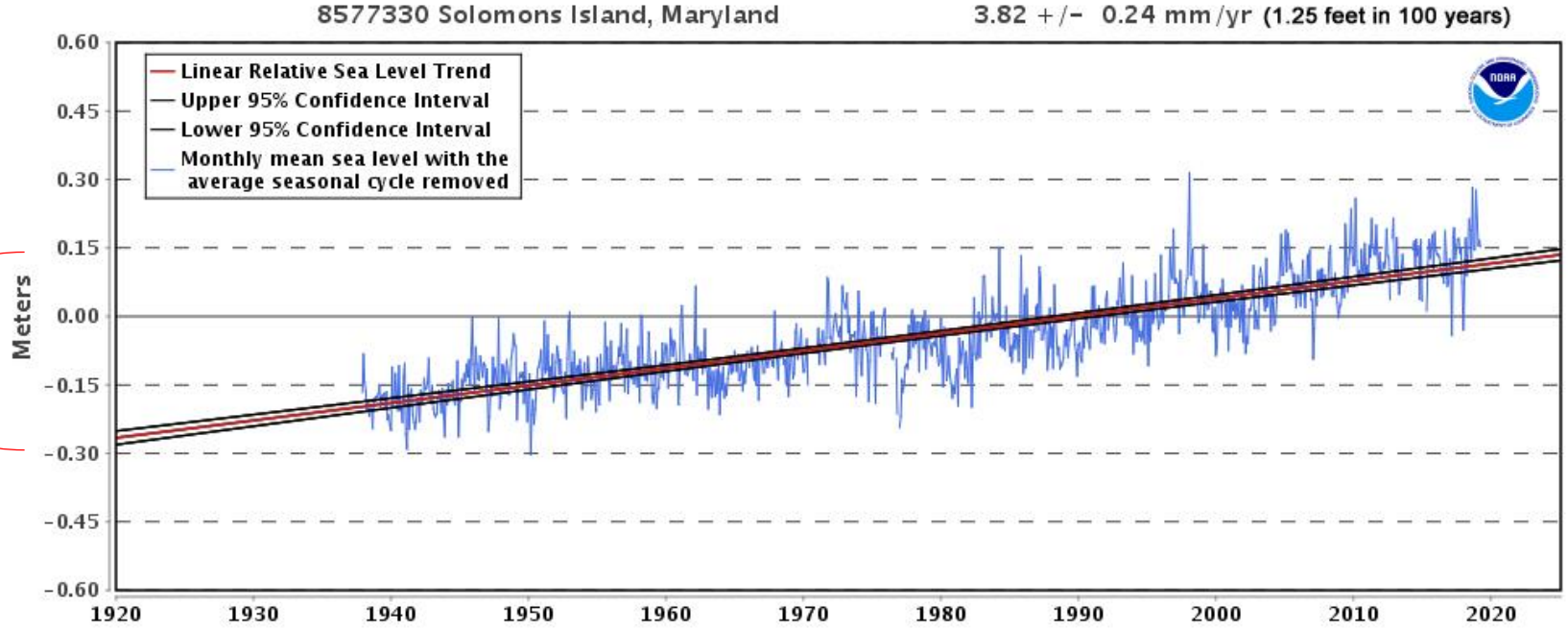
1120 cal AD ± 90 years (D-007532)

Initial intrusion of salt water and onset of tidal marsh peat development over this drowned upland surface occurred sometime between 1550 and 1800 calAD.


U.S.G.S. Coastal Survey
2-9-1943 Field Survey Map
(76 years ago)
BEST PITCH
FERRY
operated by the
Maryland St. Highway
Marsh
The Canal
Thoroughfare
Marsh
RIVER



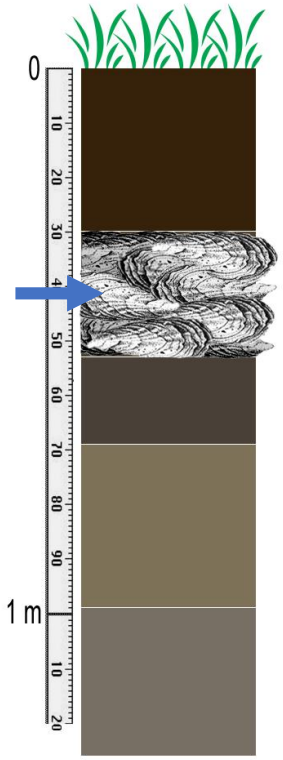




38 cm of modeled rise
(**1.25 feet or ~15 inches**)
100 years

Transquaking River, Dorchester Co. MD

WEST GROGG'S POINT (18DO436)
- Interior Auger Boring -
FISHING BAY, DORCHESTER CO., MD



Oe (0-30 cm)

ACu (30-53 cm)

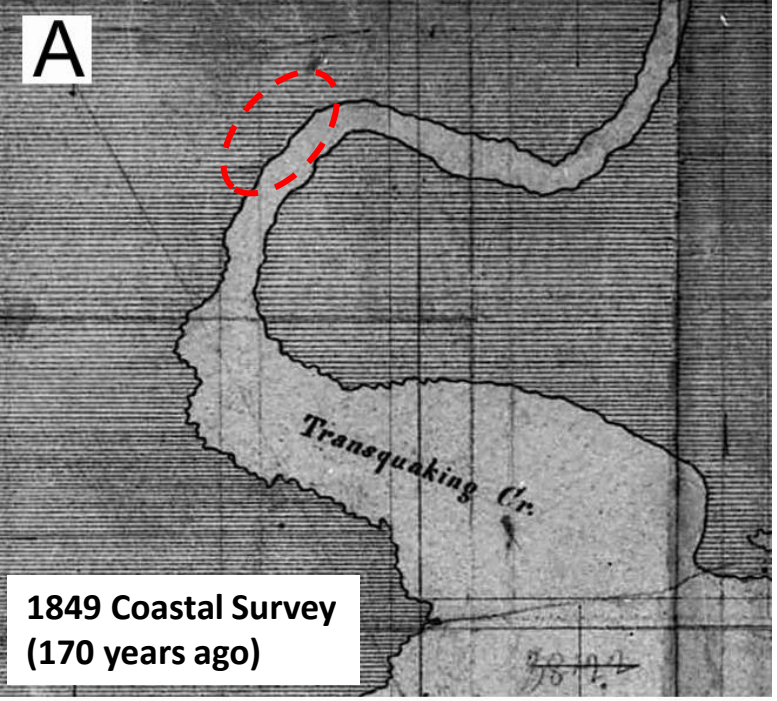
A (53-69 cm)

Bt1 (69-99 cm)

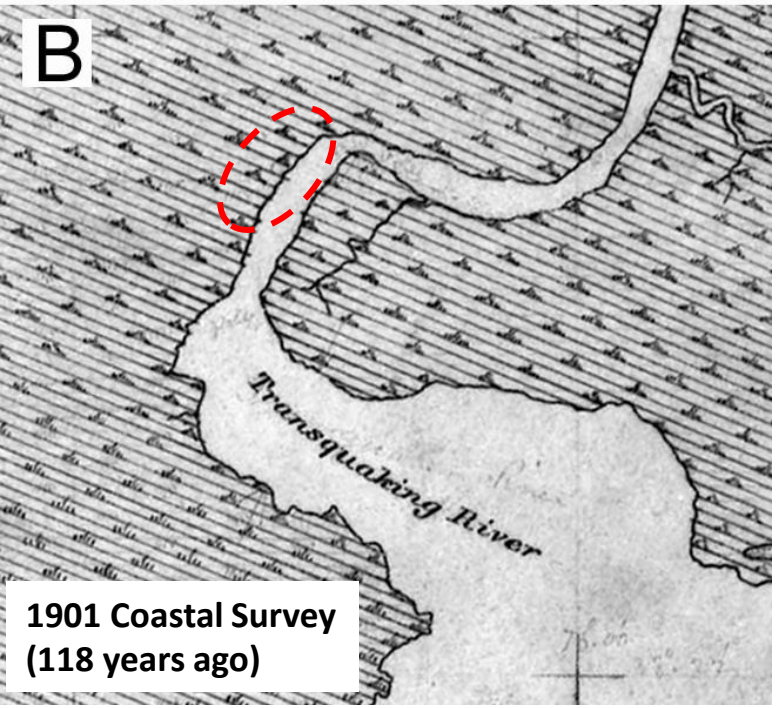
Bt2 (99-125 cm)

Tidal Marsh Peat Stratum
(30 - 17cm or 12 - 7 inches)

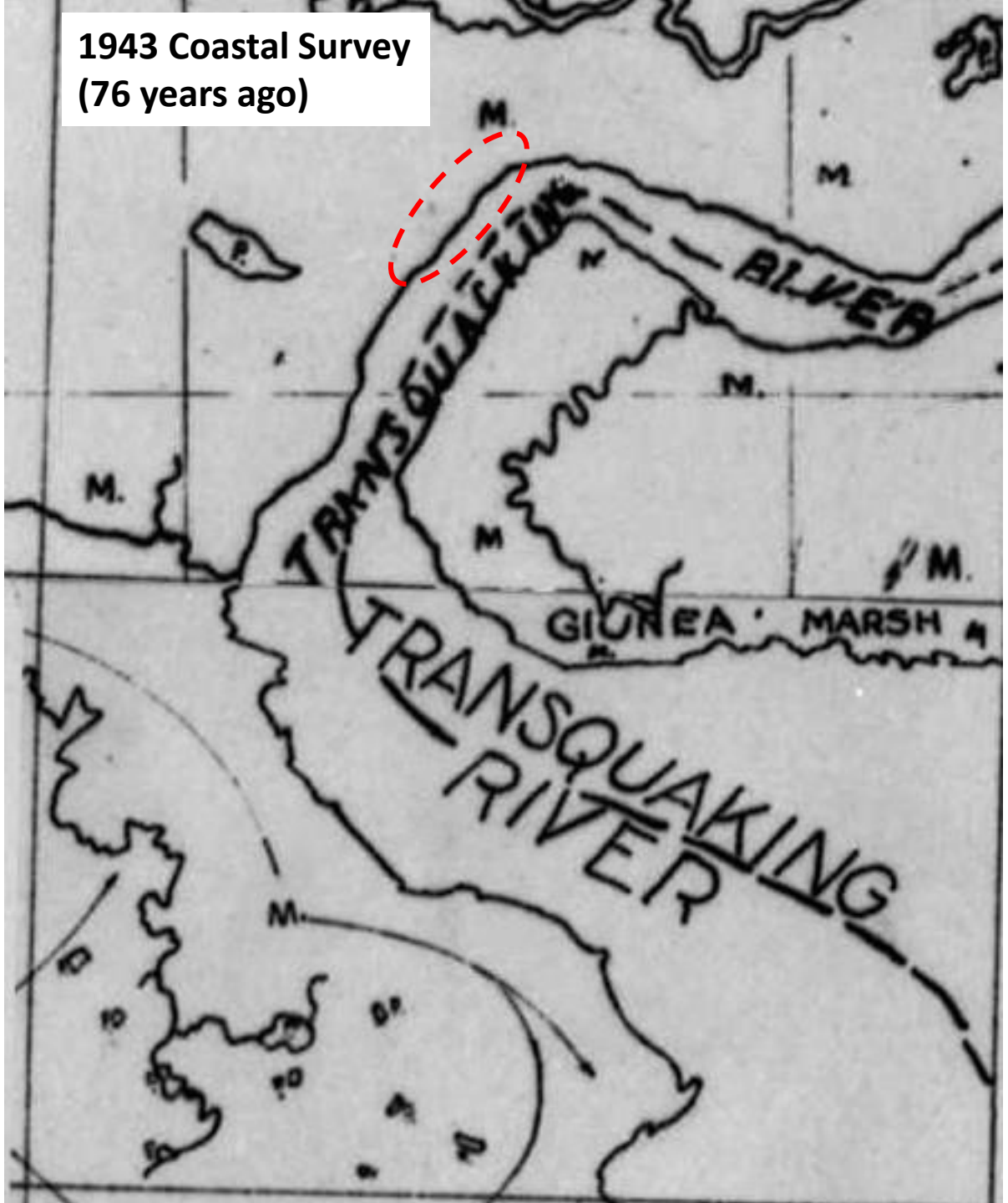
980 - 1170 cal AD (OS-104719)
980 - 1150 cal AD (OS-81510)
930 - 1130 cal AD (OS-92579)
900 - 1070 cal AD (OS-81507)



1849 Coastal Survey
(170 years ago)



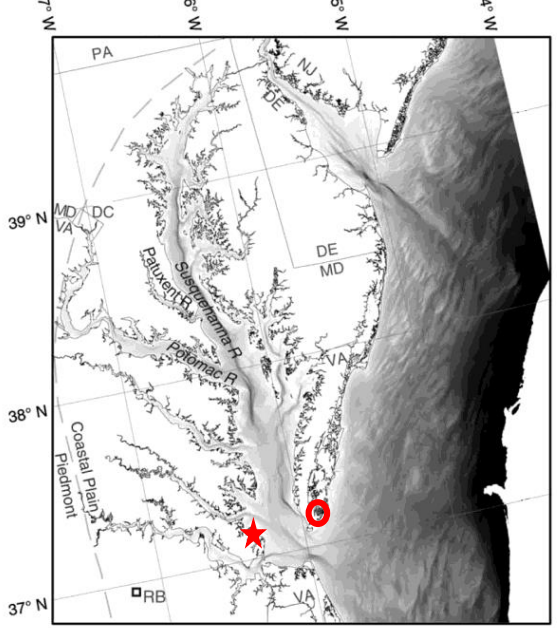
1901 Coastal Survey
(118 years ago)

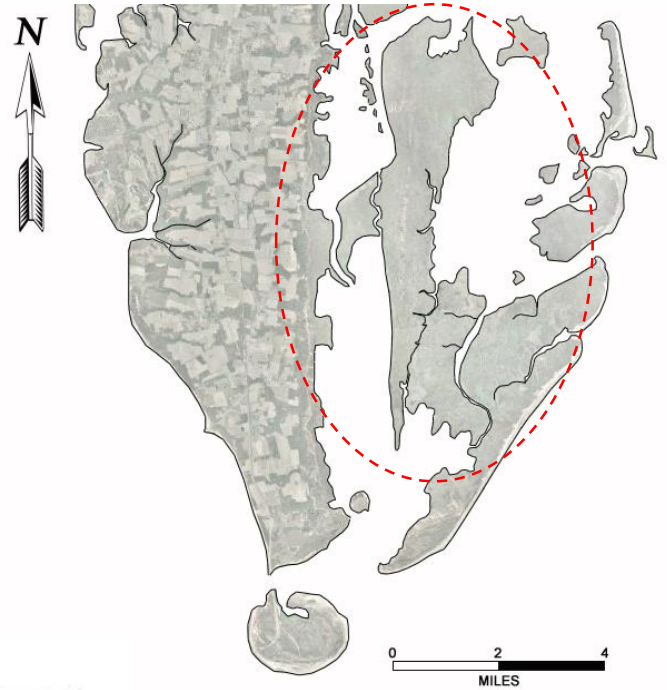


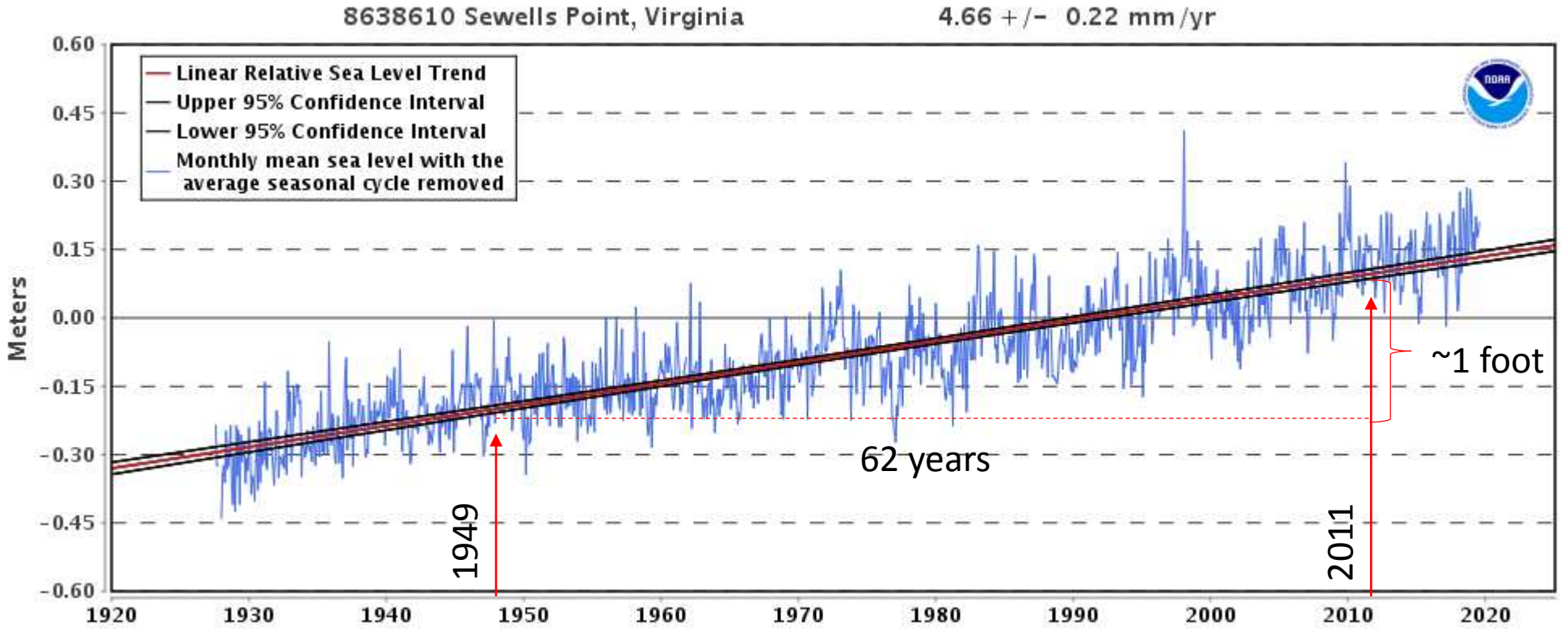
1943 Coastal Survey
(76 years ago)

Tidal salt marsh has been present at this location over the past 170 years!

MOCKHORN ISLAND, VA



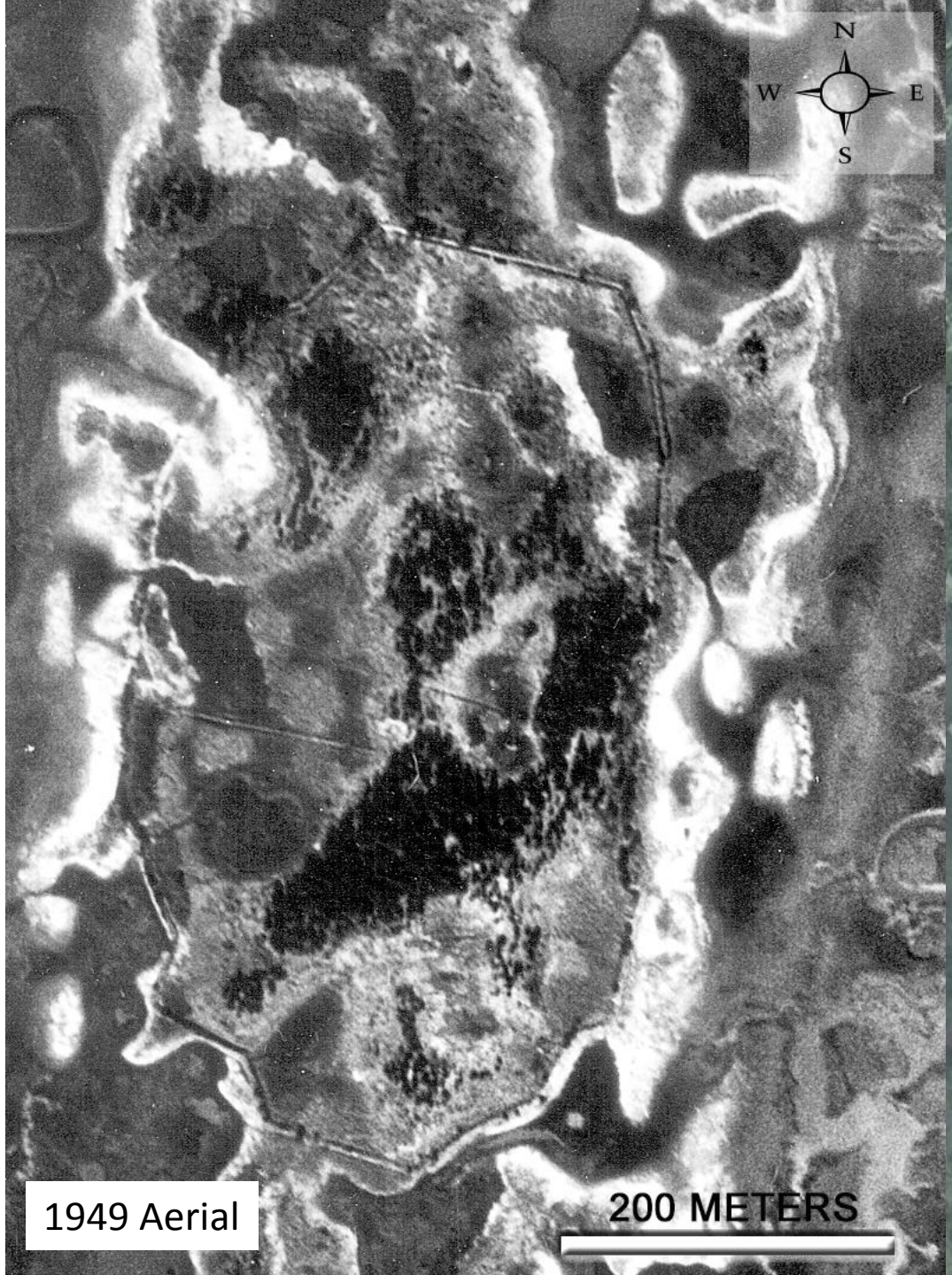




Sea Level Rise
Tide-Based Model
(~46 cm = ~1.5 feet
or ~18 inches
of modeled
rise over the
past 100 years)

62-year period (~28.9 cm or 11.3 inches of modeled rise)

Note that there there has been very little change to the features (i.e., ditches and forested upland) on this landscape over the past 62-years! According to NOAA's tide-based sea level model, the area has been impacted by ~1-foot of sea level rise over the past 62-years.

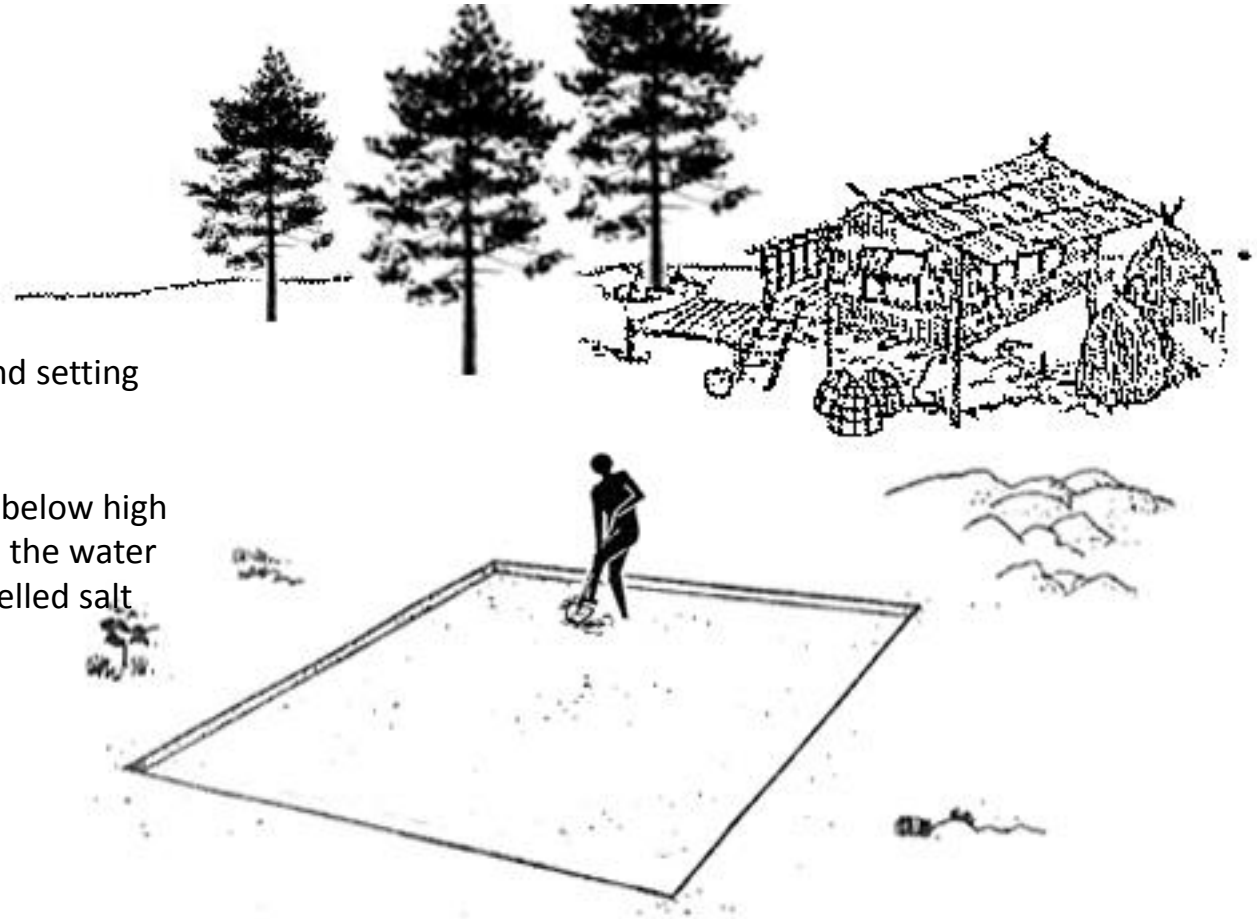


Note these “circular depressions”!

History of Mockhorn Island, Virginia

- The second patent for Mockhorn Island was issued in 1683 to Gen. John Custis, which encompassed 1,400 acres of “Machone Island”.
- On April 4th, 1686, Custis entered into an agreement with Mr. Peter Reverdy to dig three hundred and twelve **salt-evaporation ponds or salters** on the “Island of Mockon”

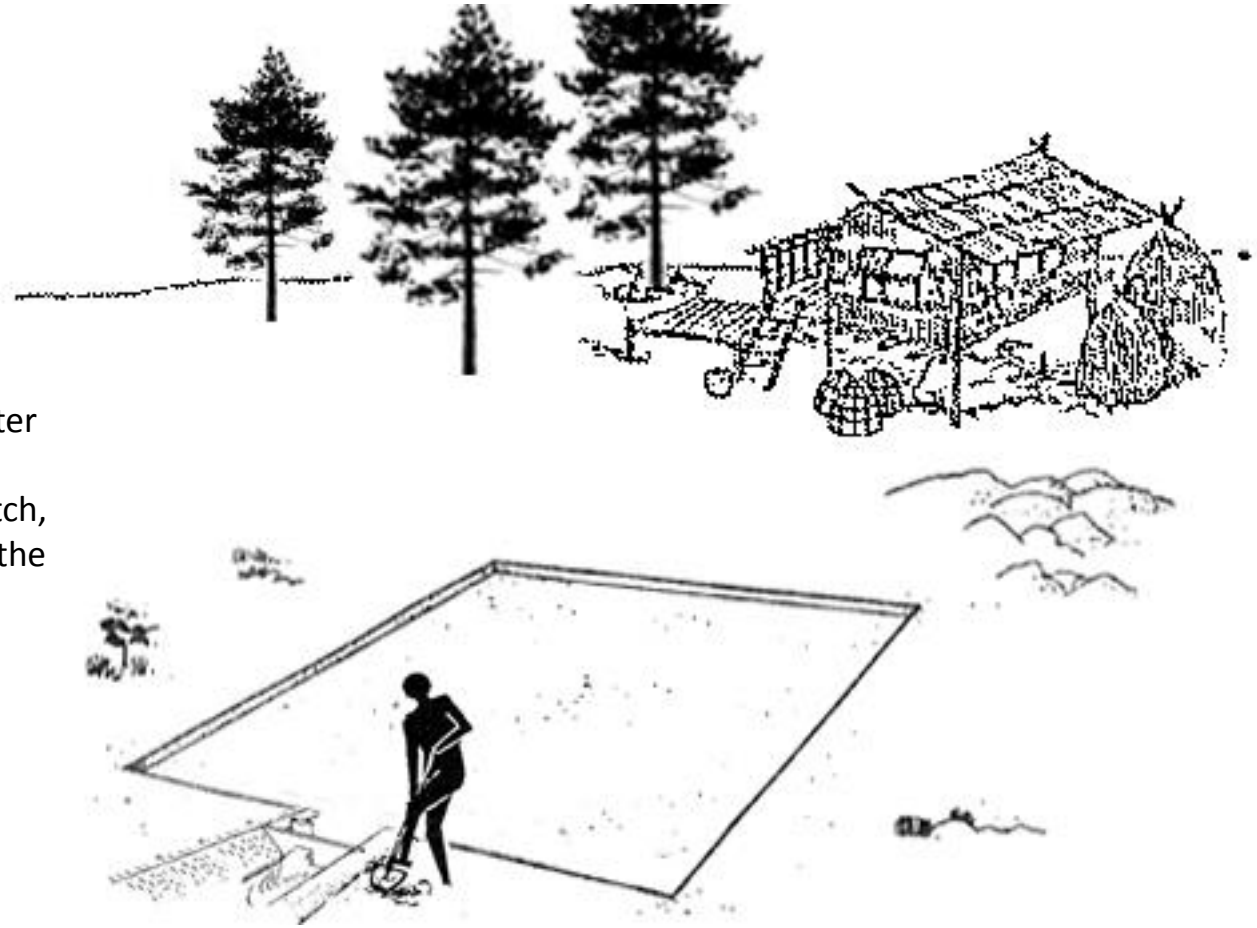
Salt Pond Creation: Stage 1



-Excavate a pond in a marginal upland setting near a high salinity body of water

-Depth **≤4 inches (~10 centimeters)** below high water level (if the pond is too deep, the water may only form a brine and not kernelled salt

Salt Pond Creation: Stage 2



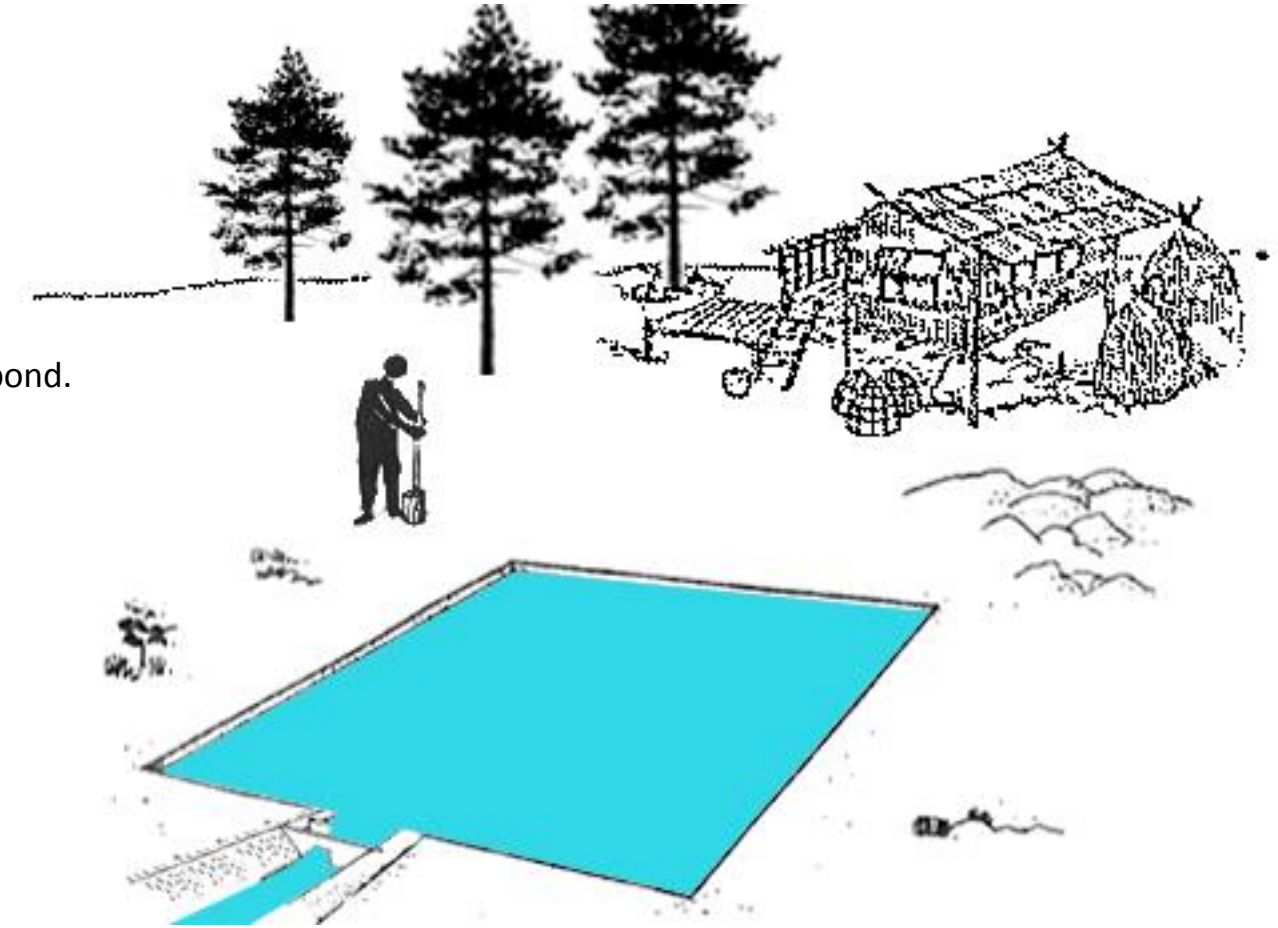
-Excavate a ditch from the pond to the nearby high salinity body of water

-Install a water access gate in the ditch, which isolates the water flow from the pond and the nearby body of water

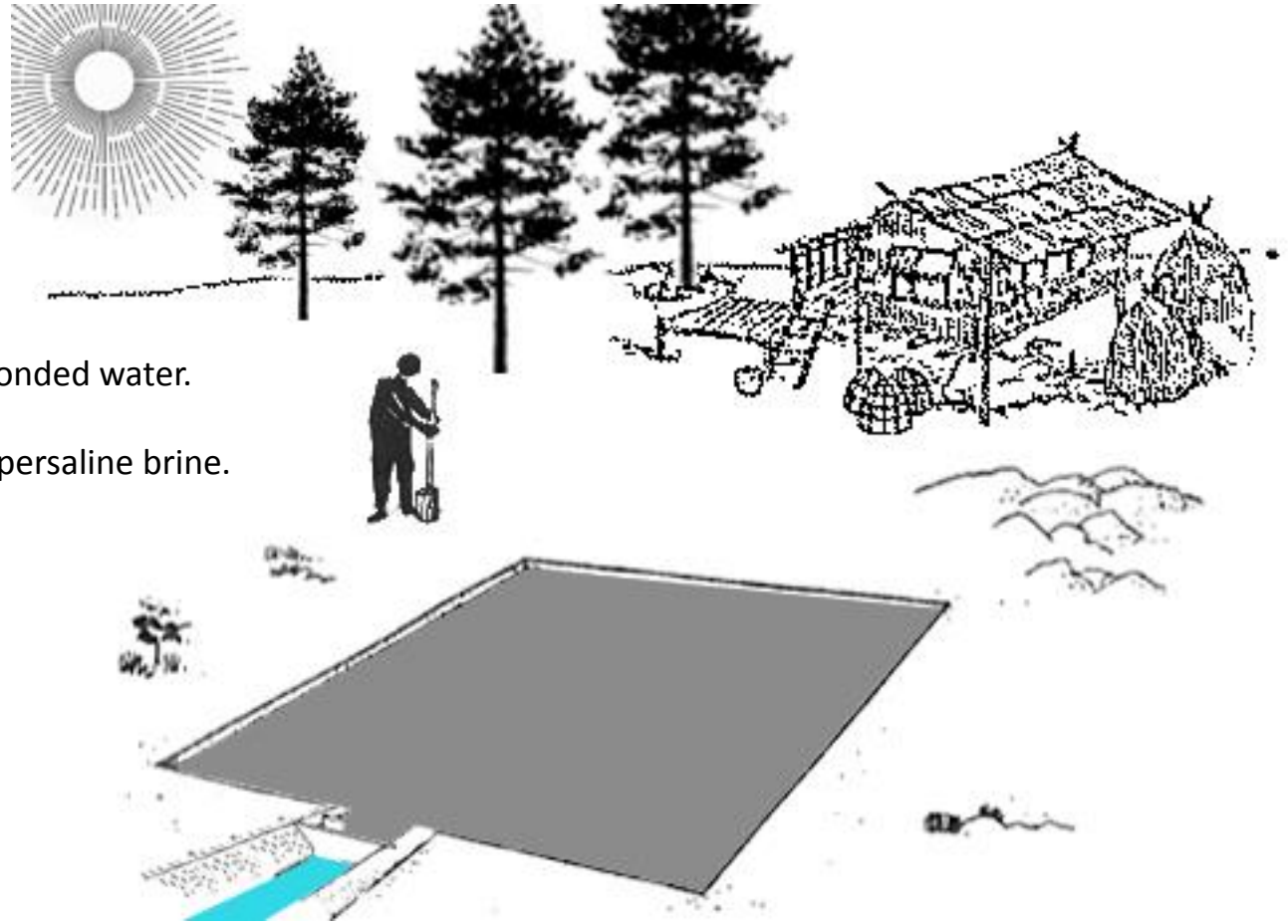
Salt Pond Creation: Stage 3

-Allow the salt water to enter the pond.

- Close the access gate.



Salt Pond Creation: Stage 4

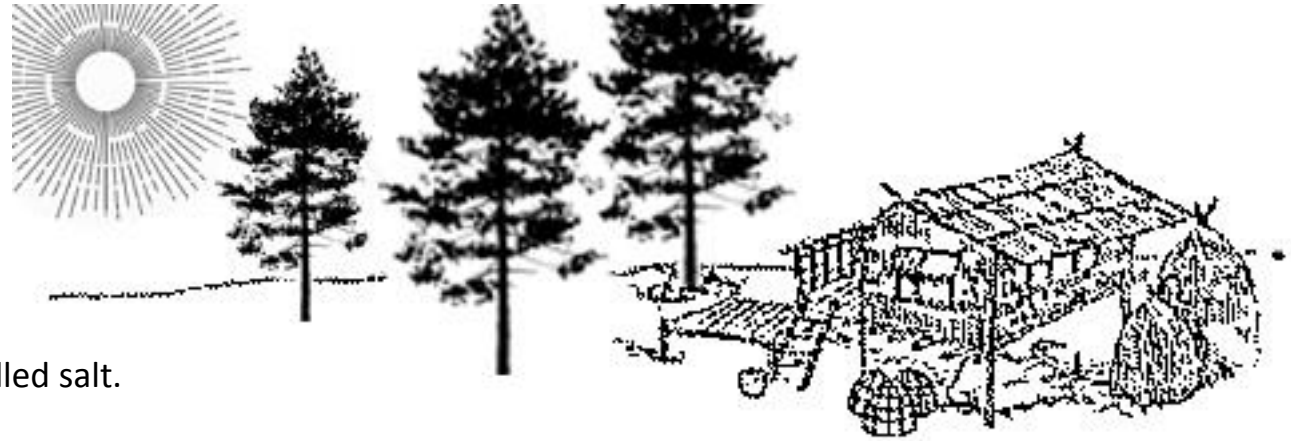


-Allow the sun to evaporate the ponded water.

-The pond will initially become hypersaline brine.

- Kernelled salt will form.

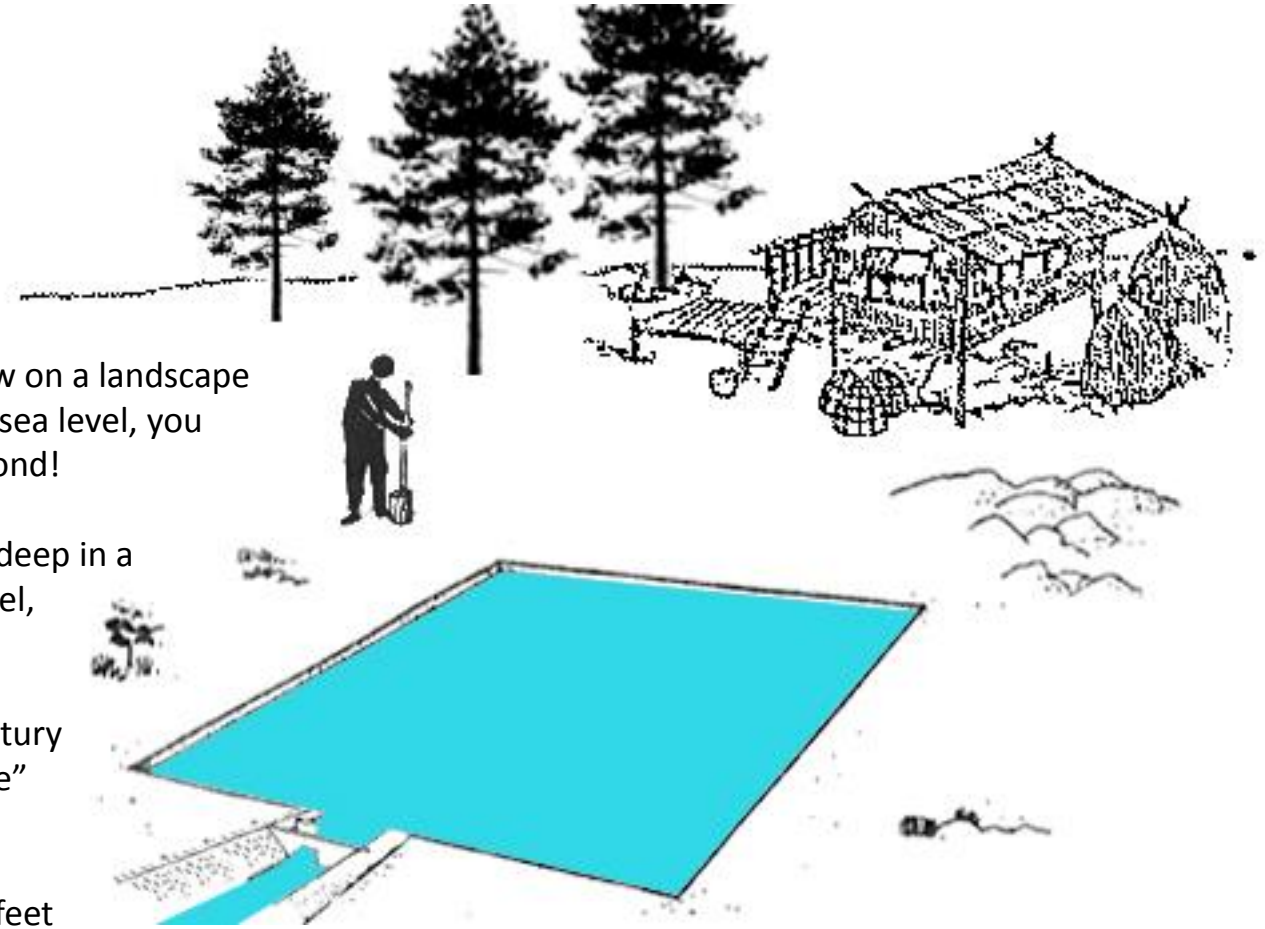
Salt Pond Creation: Stage 4



-Remove and/or collect the kernelled salt.

-Repeat the process!

IMPORTANT GEOARCHAEOLOGICAL BENCHMARKS FOR HISTORIC SEA LEVEL POSITIONS



-If the salt pond was dug too shallow on a landscape or if the landscape was well-above sea level, you would not get sea water into the pond!

-If the salt pond was excavated too deep in a landscape marginally above sea level, kernelled salt would not form.

- So the depth of these late 17th century ponds provide a proxy for “high tide” ~350 years ago.

-If the local sea level has risen ~1.5 feet over the past century, the depths of these late 17th century salt evaporation ponds should be well below modern sea level!

.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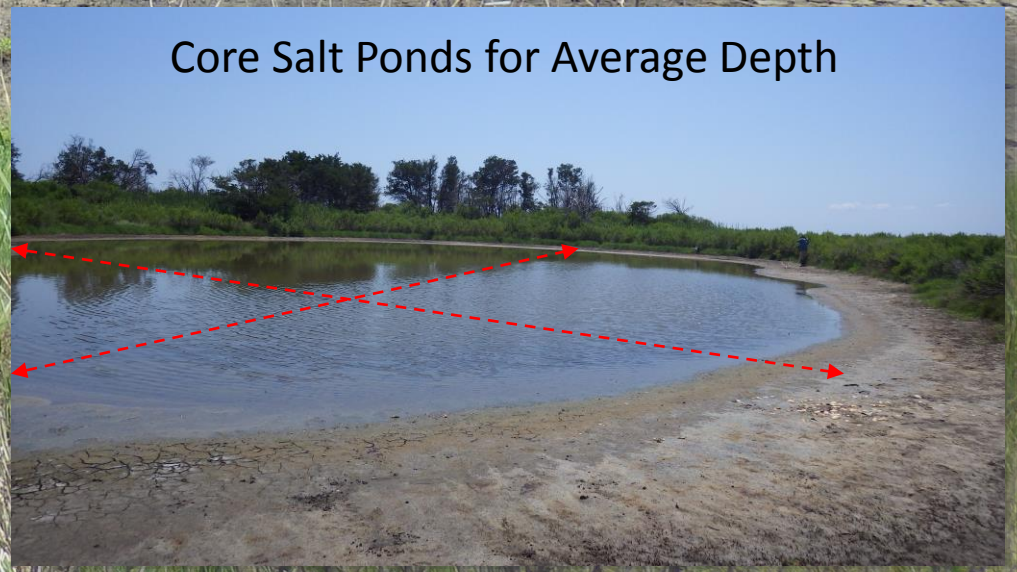
200 METERS
© Darrin L. Lowery 2019

Here's a late 17th/early 18th century salt-evaporation pond being cored to determine the average depth of these ponds.

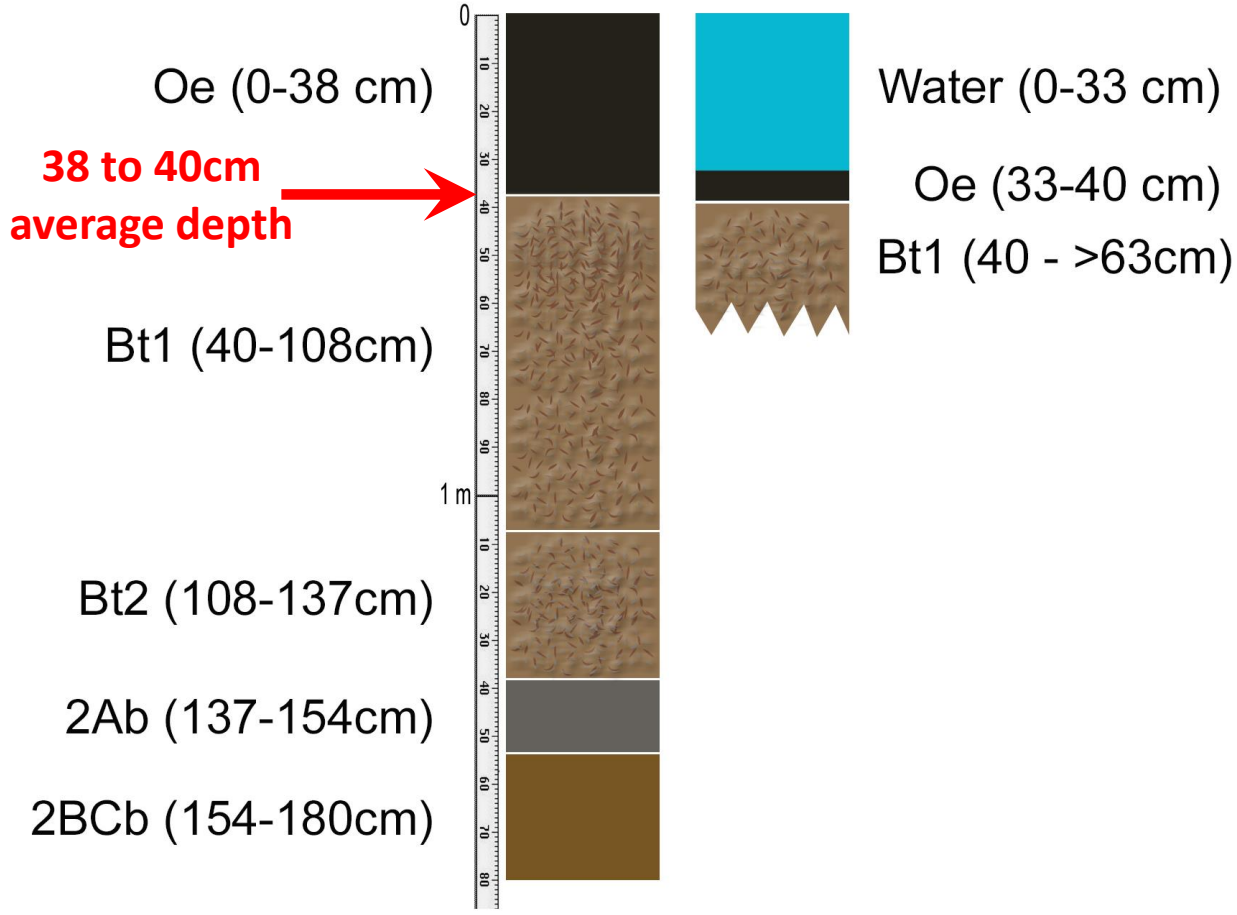
7-28-2019

Dr. Dan Wagner →

Mr. Joseph Clemens (Masters Student)
University of Delaware, Dept. of Earth Sciences

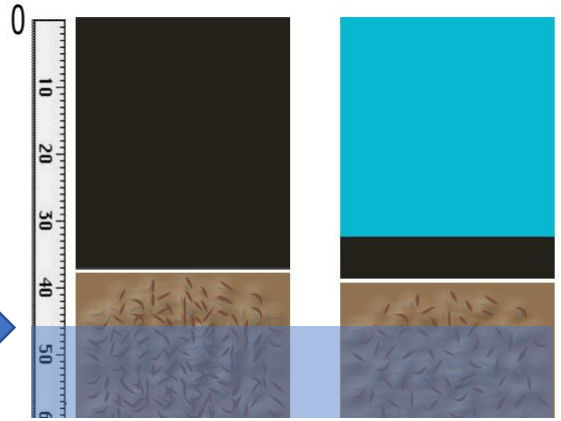


MOCKHORN ISLAND (Salt Ponds) - Interior Auger Borings- NORTHAMPTON CO., VA



IF YOU DROPPED SEA LEVEL TO THE REPORTED -46 cm circa 1919, you wouldn't be able to get sea water into the ponds (only during extreme unpredictable high or storm tide events)!

Oe (0-38 cm)

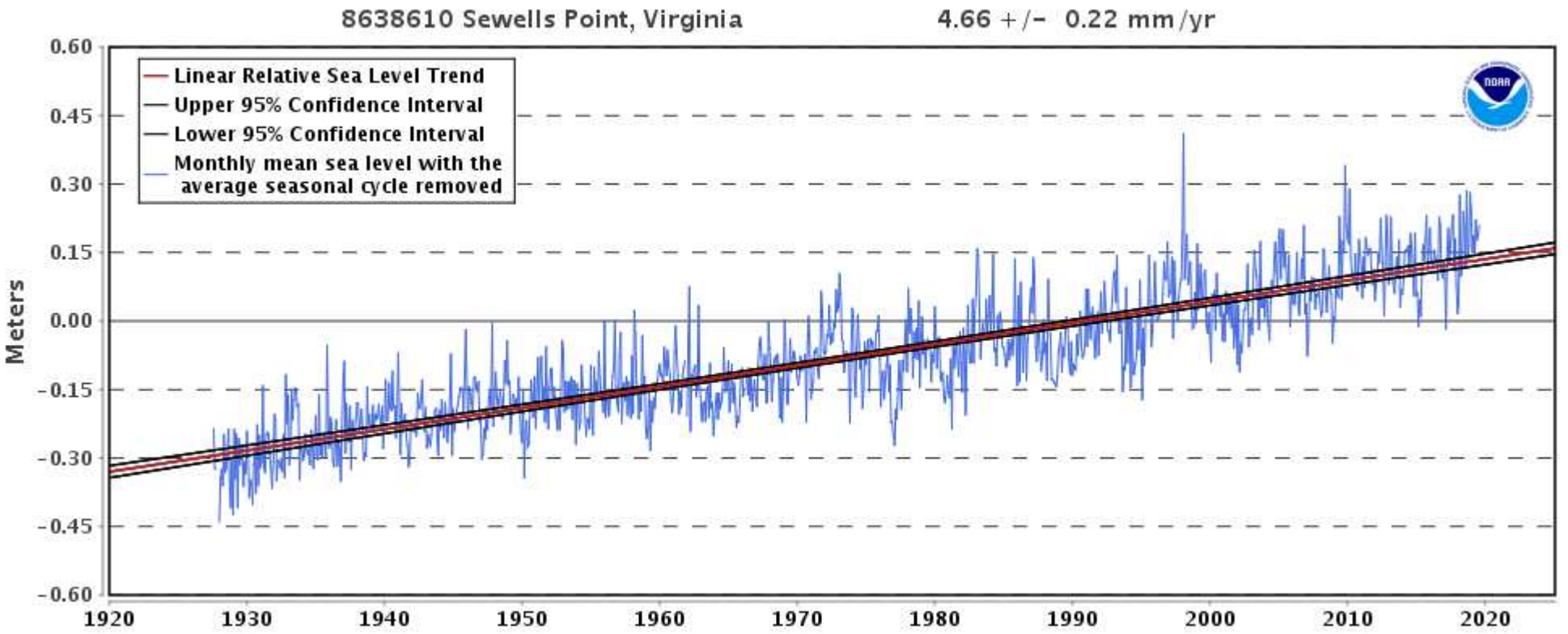


Water (0-33 cm)

Oe (33-40 cm)

Bt1 (40 - >63cm)

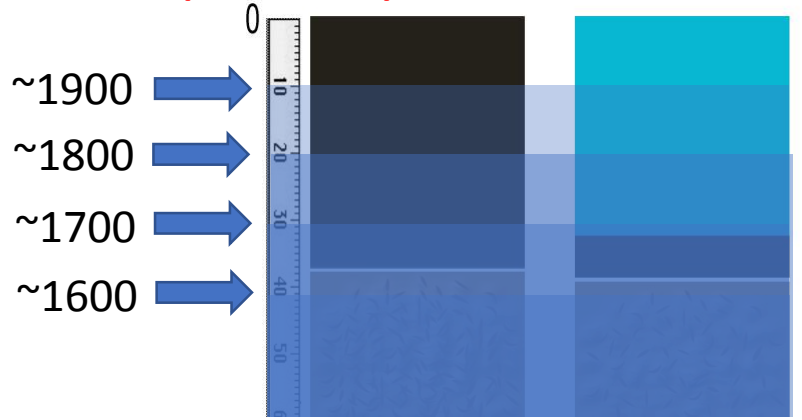
~1919 calAD (46-cm or ~1.5 feet lower, NOAA model)



Sea Level Rise Tide-Based Model (~46 cm or ~1.5 feet of rise over the past 100 years)

The information presented in NOAA's tide-based sea level trend summary is a <u>scientific model</u>! However, it is <u>NOT</u> supported by the real world physical data.

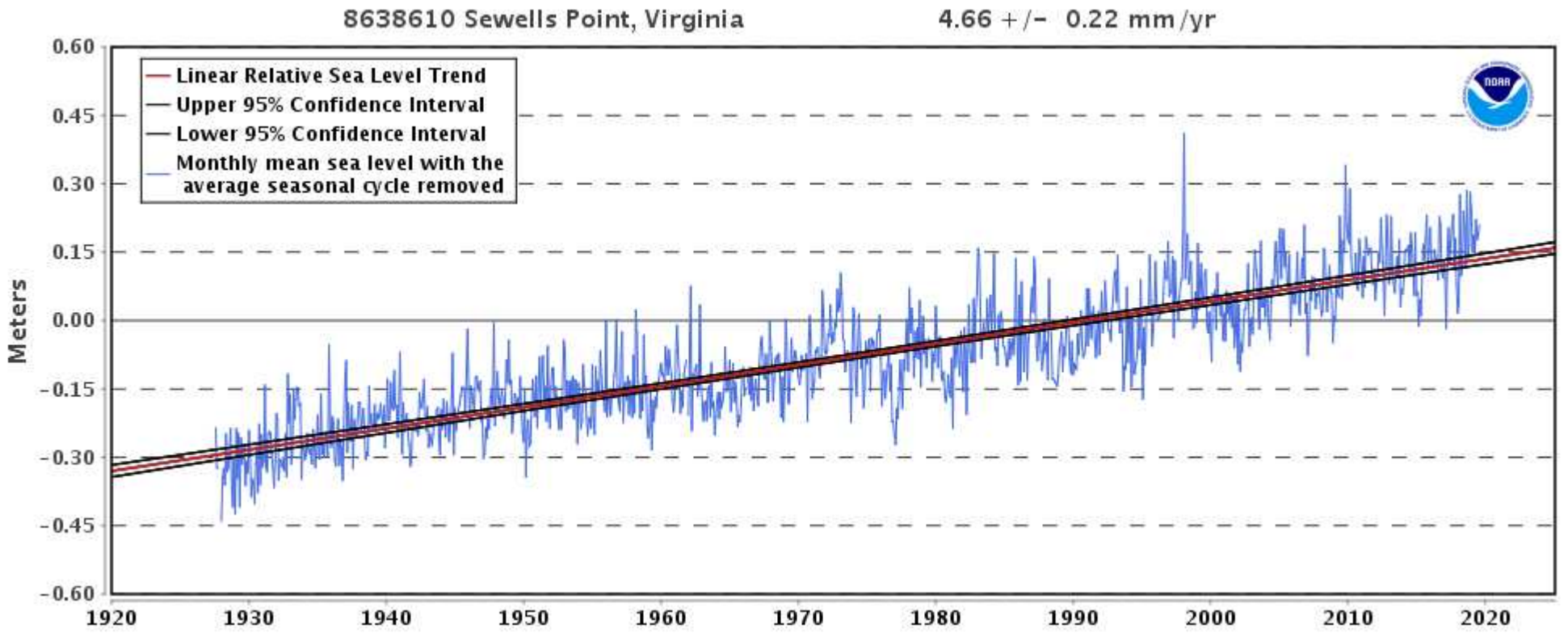
HOWEVER, IF YOU DROPPED SEA LEVEL ABOUT ~10cm PER CENTURY OVER THE PAST 400 YEARS THESE PONDS WOULD REGULARLY AND PREDICTABLY HOLD ~8 TO 10cm (3-4 inches) OF WATER AT HIGH TIDE THREE CENTURIES AGO!



Water (0-33 cm)

Oe (33-40 cm)

Bt1 (40 - >63cm)



Sea Level Rise Tide-Based Model (~46 cm or ~1.5 feet of rise over the past 100 years)

LETTER

NATURE volume 517, pages 481–484 (22 January 2015)

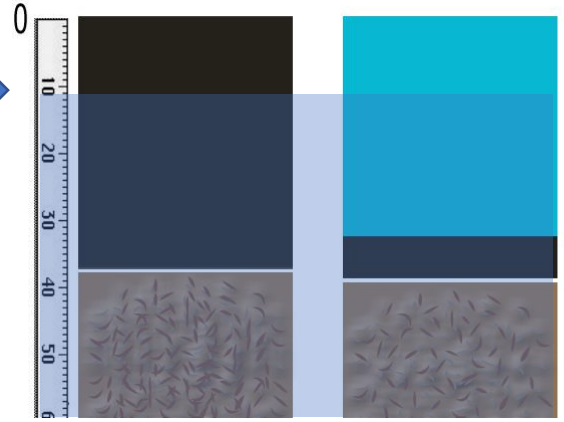
Probabilistic reanalysis of twentieth-century sea-level rise

Carling C. Hay[1,2], Eric Morrow[1,2], Robert E. Kopp[2,3] & Jerry X. Mitrovica[1]

Here we find a rate of GMSL rise from 1901 to 1990 of 1.2 ± 0.2 millimetres per year (90% confidence interval).

The information presented in this article is a scientific model! However, it agrees with the real world physical data.

~1900



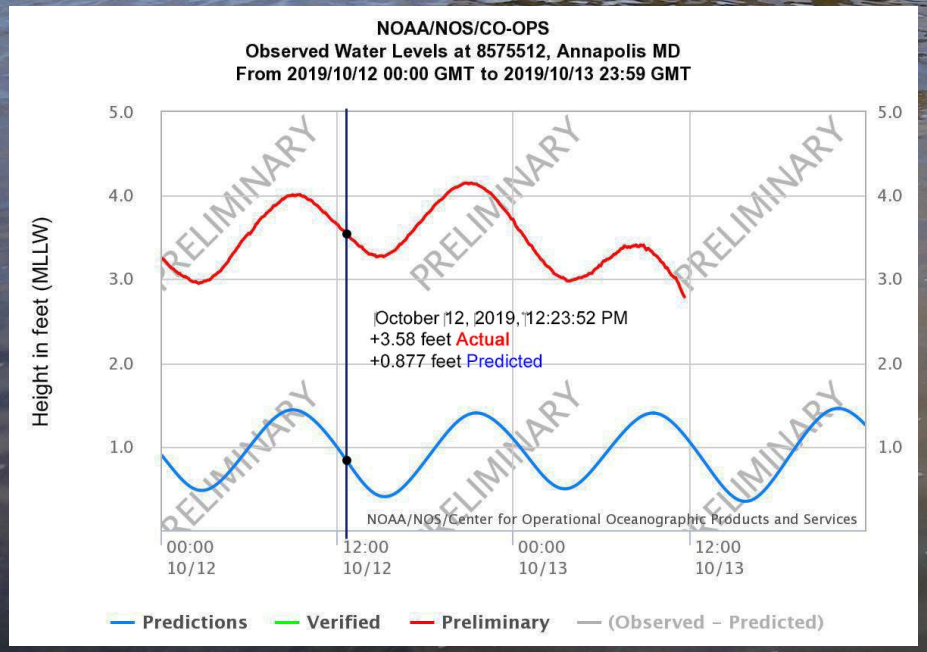
Water (0-33 cm)

Oe (33-40 cm)

Bt1 (40 - >63cm)

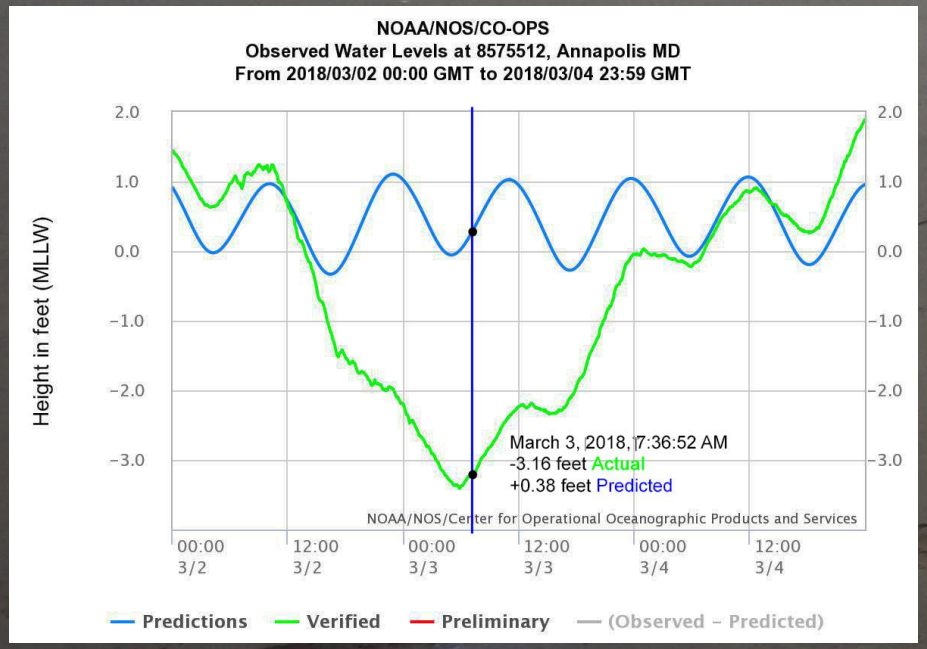
PLEASE REMEMBER THAT…..

For every extreme "high tide"……..



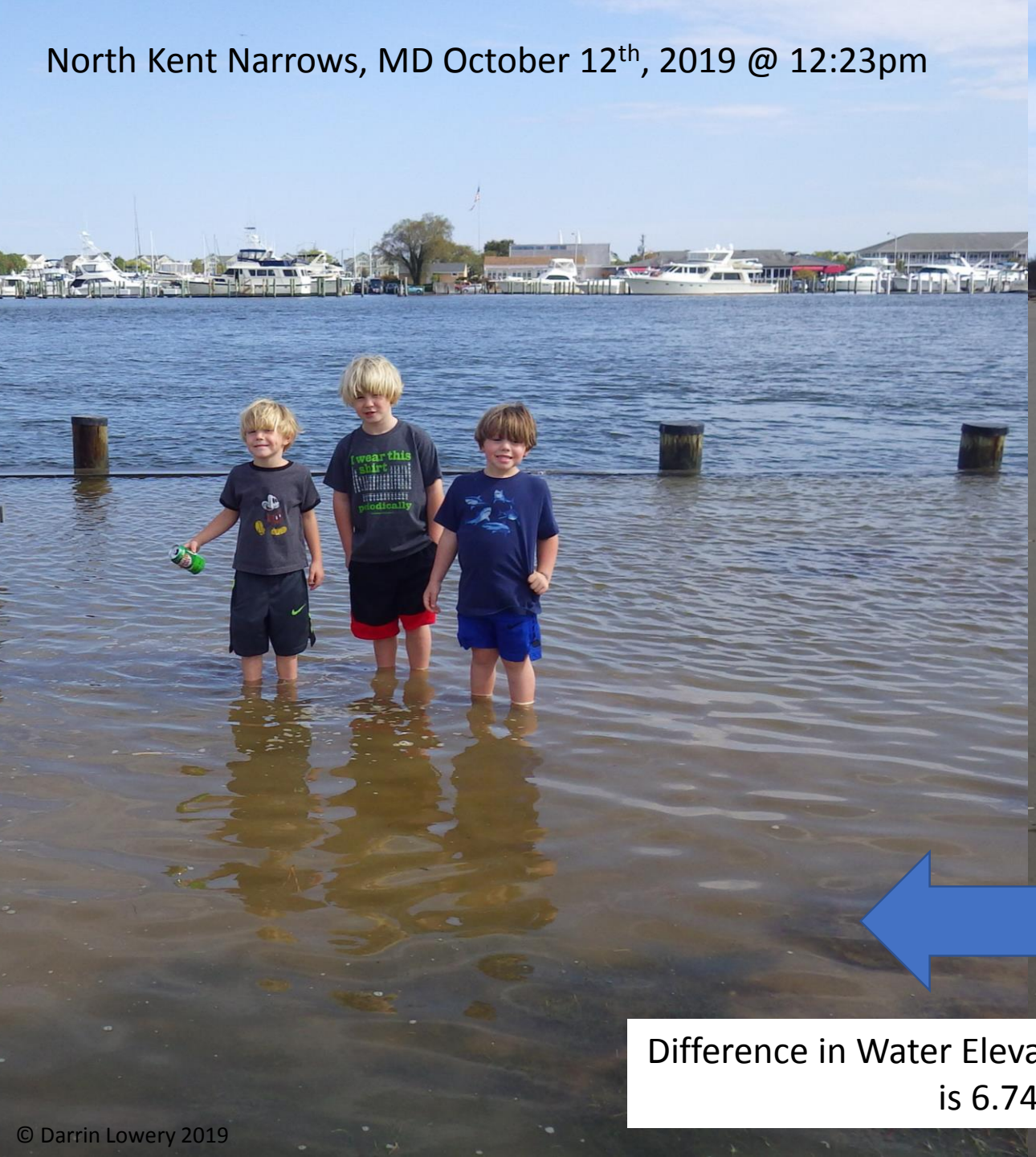
North Kent Narrows, MD October 12th, 2019 @ 12:23pm

….there will be an extreme "low tide"!

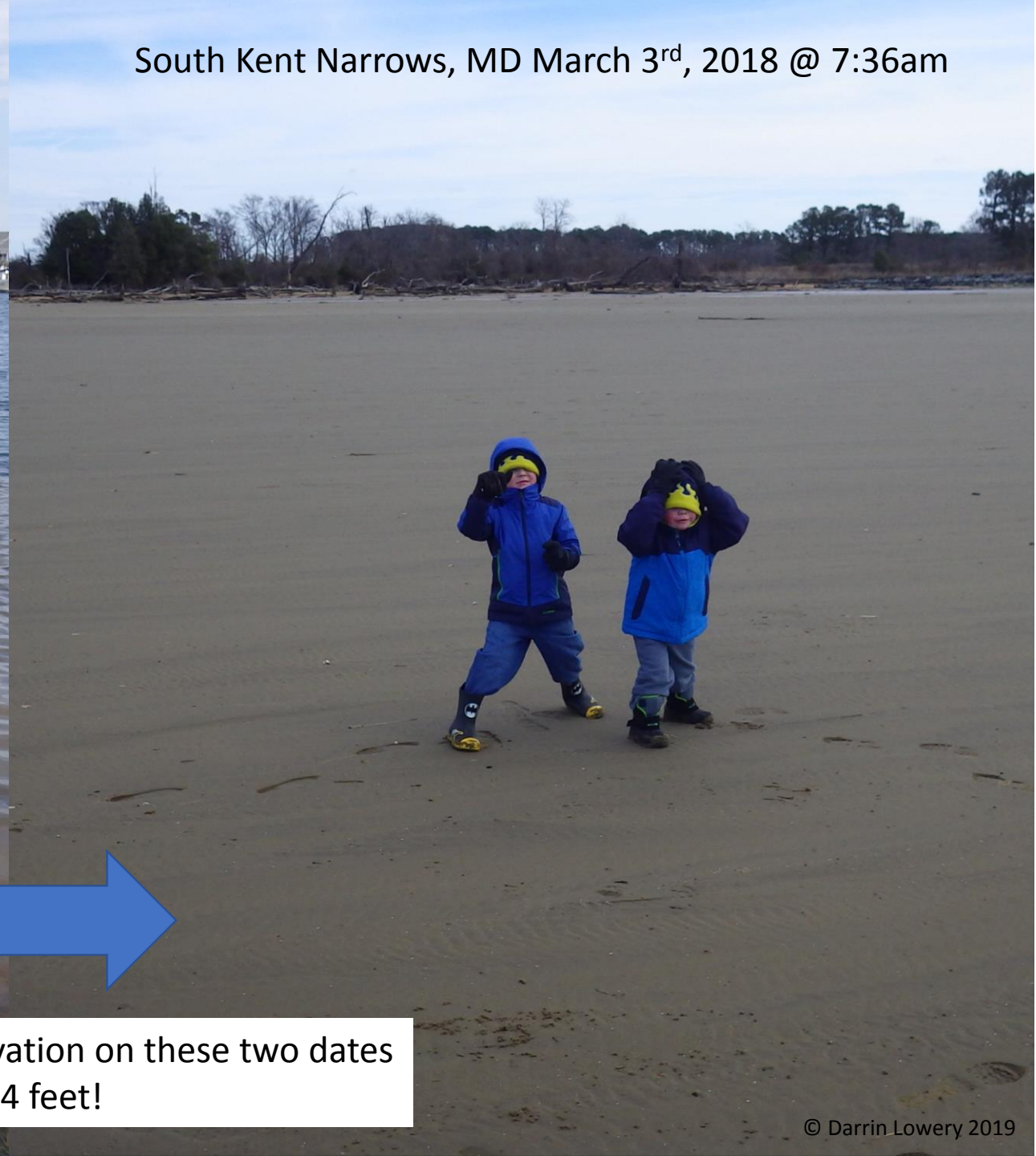


South Kent Narrows, MD March 3rd, 2018 @ 7:36am

North Kent Narrows, MD October 12th, 2019 @ 12:23pm



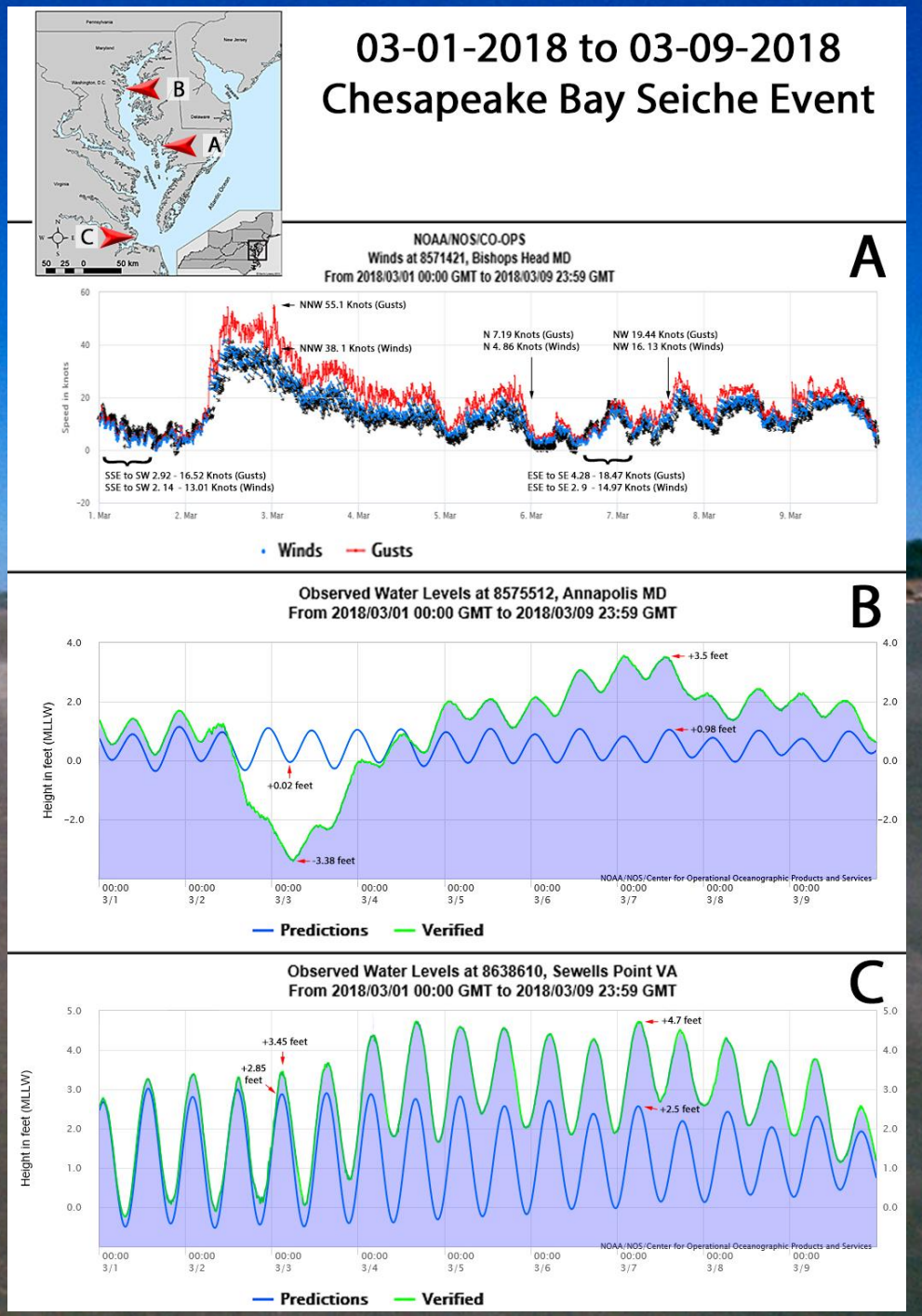
South Kent Narrows, MD March 3rd, 2018 @ 7:36am



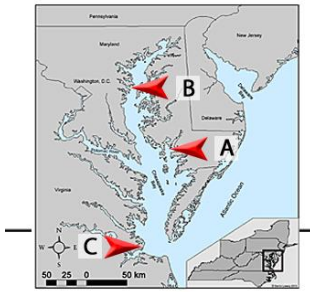
Difference in Water Elevation on these two dates is 6.74 feet!

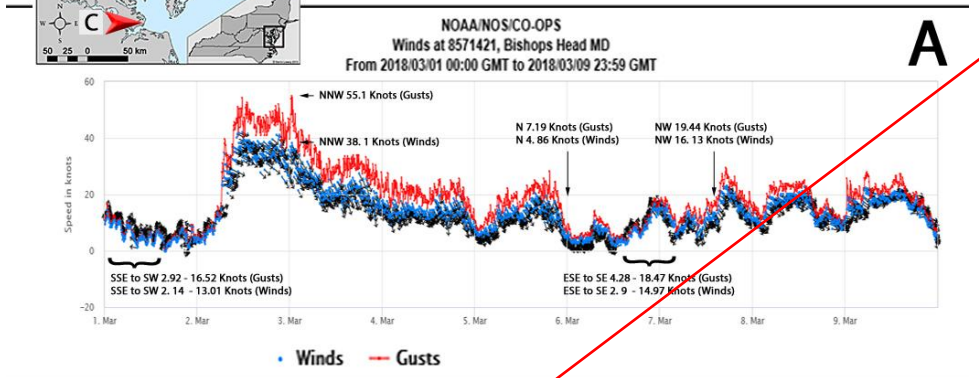
The wind transfer of water tells you nothing about sea level change!

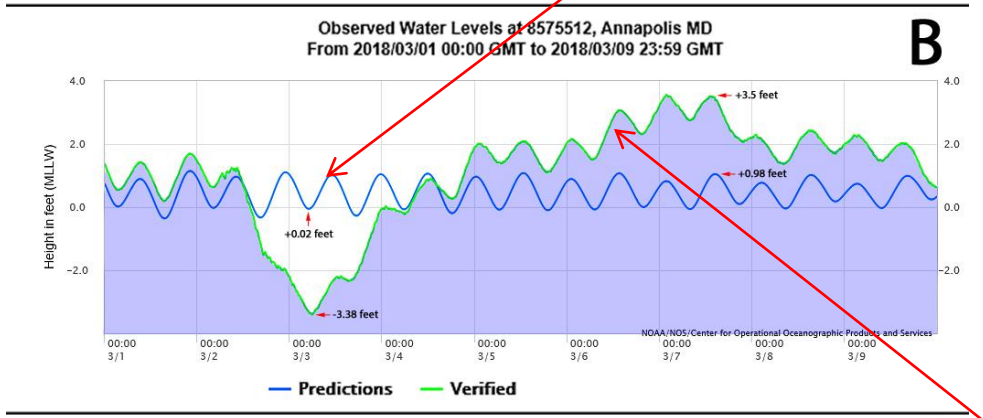
The newspapers and other public media usually <u>only report the high tides</u>….<u>not the low tides</u>!

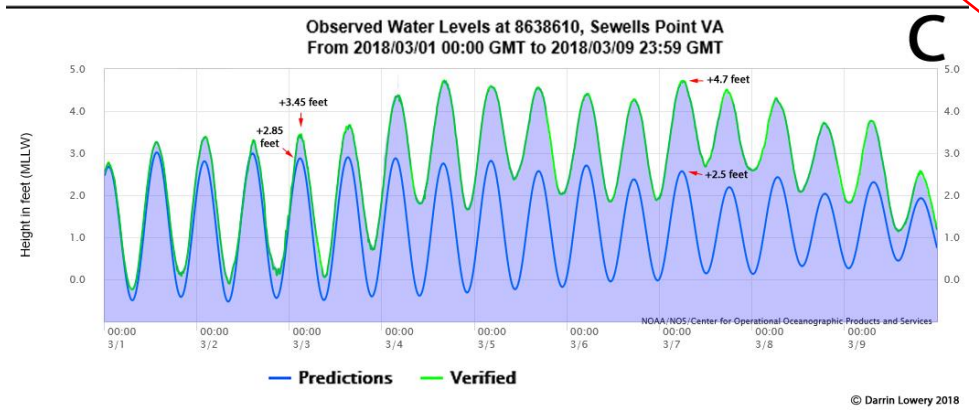


03-01-2018 to 03-09-2018
Chesapeake Bay Seiche Event









Only one regional newspaper reported this extreme low tide event!

Note that three days prior was one of the lowest tides in the upper bay in over two decades!

Images without geologic contexts tell you nothing about sea level changes in the Chesapeake Bay region.

The entrance to the Chesapeake Bay Maritime Museum is NOT evidence that sea level is falling!

Always remember that…..

the <u>Scientific Method</u> requires that hypotheses and theories (i.e., models) be confirmed (i.e., tested) by physical real world data!

Thank you for your time!