

Mackay Island NWR Marsh Loss Information

The refuge has been concerned about marsh loss for some time. Marshes transitioning to open water have been observed refuge-wide and is most prevalent along Corey' Ditch, within the Great Marsh, and the shoreline boundary along the Currituck Sound.

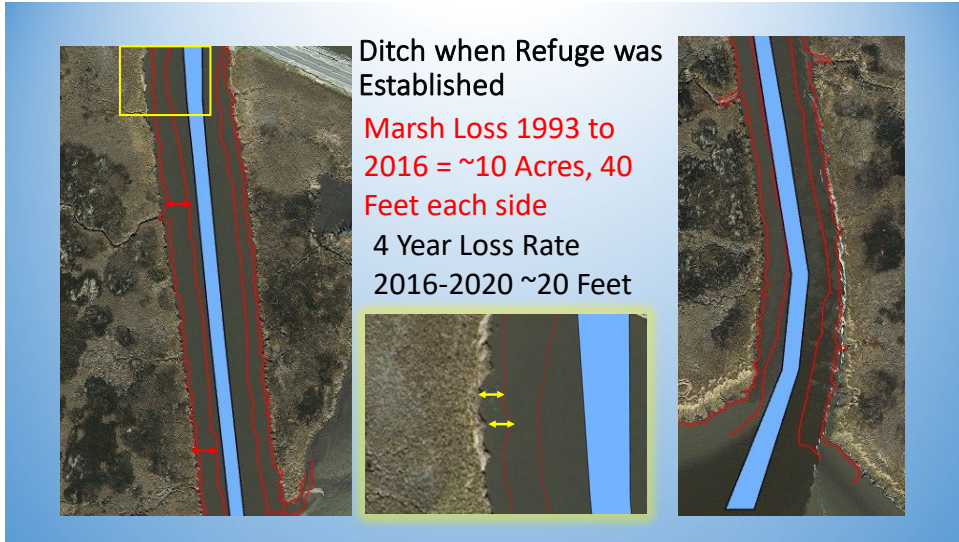


Figure 1. Marsh Loss along Corey's Ditch: Width of the Ditch in 1958 (Light Blue). Area of marsh loss between 1993 and 2016 (red lines/arrows). Area of marsh loss between 2016 and 2020 (yellow arrows). Note: Measurements taken here are from aerial imagery. Five to eight feet of soil under the vegetation along each side of the ditch has already been scoured/removed by the velocity of water in the ditch, meaning the ditch is already 10 to 16 feet wider than shown on the most recent aerial imagery. Marsh loss rates along the ditch are accelerating.

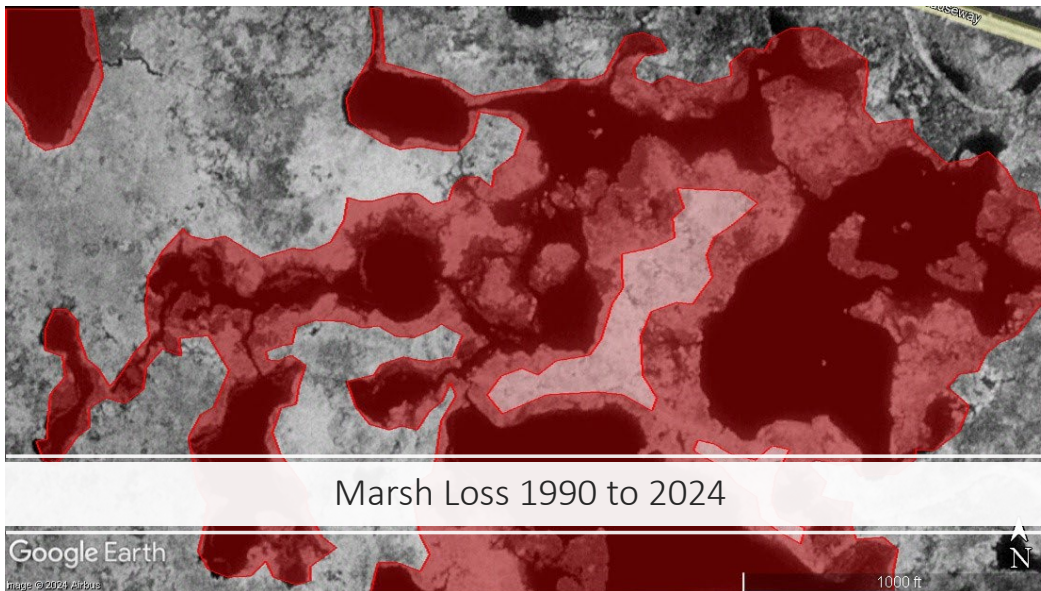


Figure 2. Marsh Loss within the Great Marsh: The area covered in red shows the marshes lost from 1990 to 2024 in a small section of the Great Marsh along the causeway. Marsh loss rates in the interior portions of the marsh are accelerating.

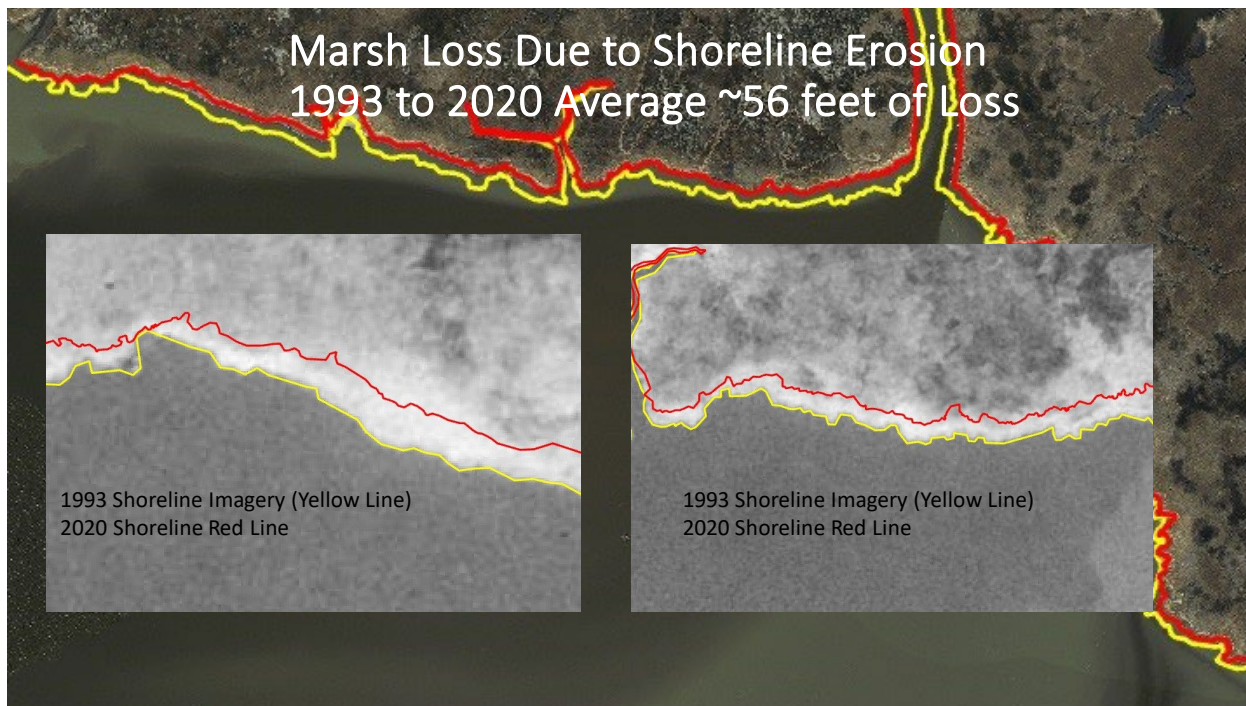


Figure 3. Shoreline Marsh Loss along the Currituck Sound. Changes from the 1993 and 2020 imagery show an average marsh loss of 56 feet.

Sediment is a naturally occurring material that is broken down by processes of weathering and erosion, and is subsequently transported by the action of wind, water, or ice or by the force of gravity acting on the particles. It is most often transported by water.

Under calm conditions, sediment will settle out of the water, allowing sunlight to penetrate deeper into the water. Unfortunately, the waters around Knotts Island are seldom calm, so sediment rarely settles out. The water maintains “chocolate milk” coloration that significantly limits the depth sunlight can penetrate.

Sediment enters our Sounds and Bays from a variety of sources. The most common sources are run-off from construction and agriculture, erosion, and the loss of our marshes. Once sediments enter the waters around Knotts Island they are likely to stay due to a “bath tub effect” where north winds move them south and south winds move them north. This constant back and forth not only keeps sediments suspended, but also prevents them from leaving.

Natural sediment transfer can maintain and build shorelines as well as repair and build natural marshes, but manmade structures can impede these natural forces.



Figure 4. Shoreline Sediment Transfer. Shoreline sediment deposited 1,300 yards west of Corey's ditch (Yellow Arrow) showing a gradual shoreline. No shoreline sediment being deposited near the mouth of Corey's ditch (Red Arrow) showing a vertical shoreline.

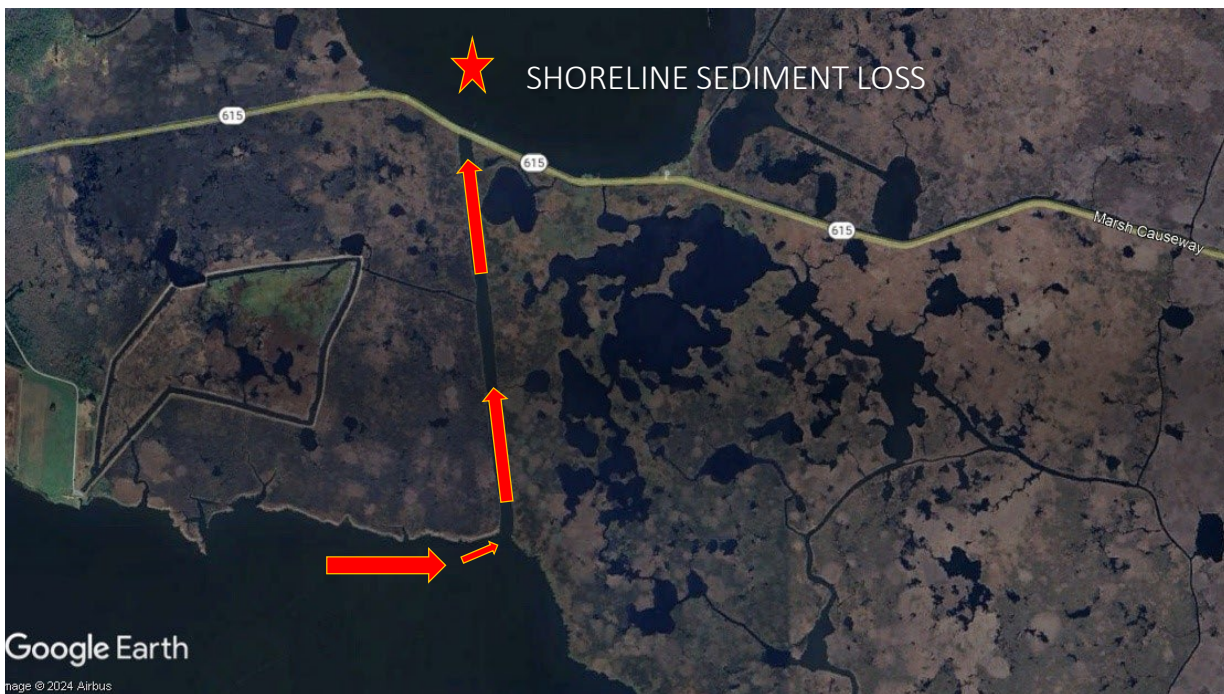


Figure 5. Shoreline Sediment Loss from south shore of Great Marsh. Due in part to the high water velocities within Corey's ditch, sediments are being deposited north of the bridge into Barley's Bay. Note: During low water events you can see the sediment deposits in Barley's Bay when looking north of the bridge.

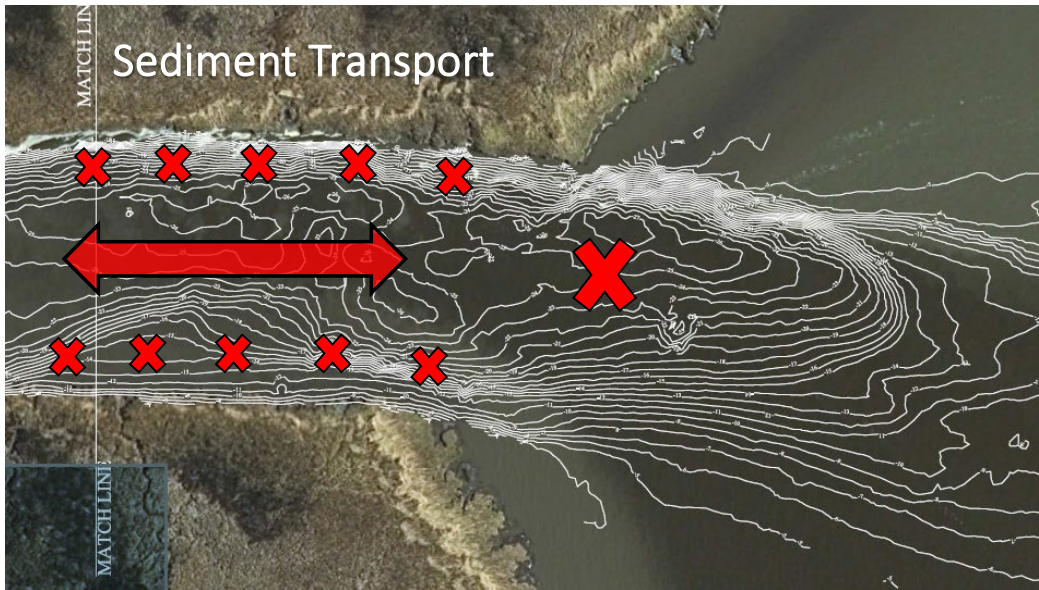


Figure 6. Sediment transport. The velocity of water accelerates within Corey's Ditch. This accelerated water area extends into the Currituck Sound and Barleys Bay moving available sediment back and forth through the ditch. Available sediment here includes suspended sediments already in the Sound in addition to new sediments scoured from the bottom and sides of the ditch.

Recent, research looking at marsh elevation data ([Moorman et al. 2024](#)) at 20 coastal sites in the south Atlantic geography showed that only 6 of these sites were gaining elevation at rates greater than or equal to the elevations needed to keep up with rising water levels. Local results show that Currituck National Wildlife Refuge is gaining elevation at 1.6 mm/year and Mackay Island NWR has a 1.2 mm/year deficit.



Figure 7. Local Coastal Wetland Elevation Monitoring stations at Mackay Island and Currituck NWR's. Currituck NWR is gaining 1.6 mm/year while Mackay Island is showing a 1.2 mm/year deficit.

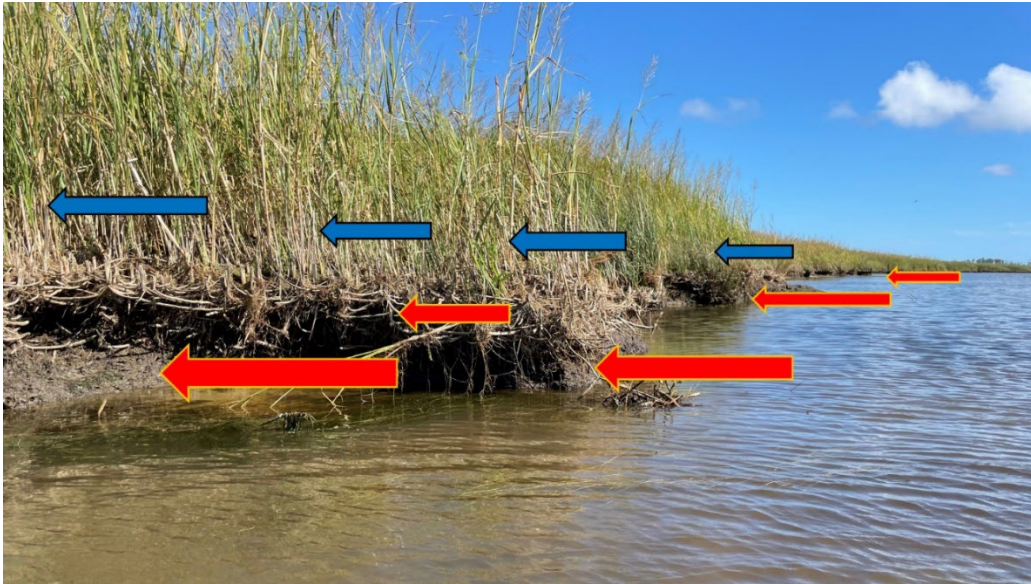


Figure 8. Marshes are very resilient to the effects of flooding and wave energy. Currently there is a delay in water levels going over the marsh at the southern end of Corey's ditch. Water levels below the marsh increases shoreline erosion by increasing the length of time wave energy can undercut the marsh (Red Arrows). When water levels overtop the marsh (Blue Arrows) they can carry sediment into the marsh, building elevation, cleaning the water, and reduce the negative effects of wave energy.

In 2024 the US Geological Survey (USGS) used a remote sensing tool known as unvegetated-vegetated ratio (UVVR) and data from coastal marsh elevation sites to help visualize what is happening to our marshes. The results can be browsed at <https://storymaps.arcgis.com/stories/f9932a1d8310447886e5fce797efcb20>.

Expanding on this analysis, the refuge took advantage of an opportunity to have USGS conduct a high resolution unvegetated-vegetated ratio (UVVR) analysis for the marshes near Knotts Island. USGS used these data to estimate marsh lifespan. Results show the Great Marsh could be gone within the next 25 years, with most of the remaining marshes around Knotts Island gone in the next 50-100 years.

<https://usgs.maps.arcgis.com/apps/instant/sidebar/index.html?appid=ba735480d28844399ee9ab24f2991f19>

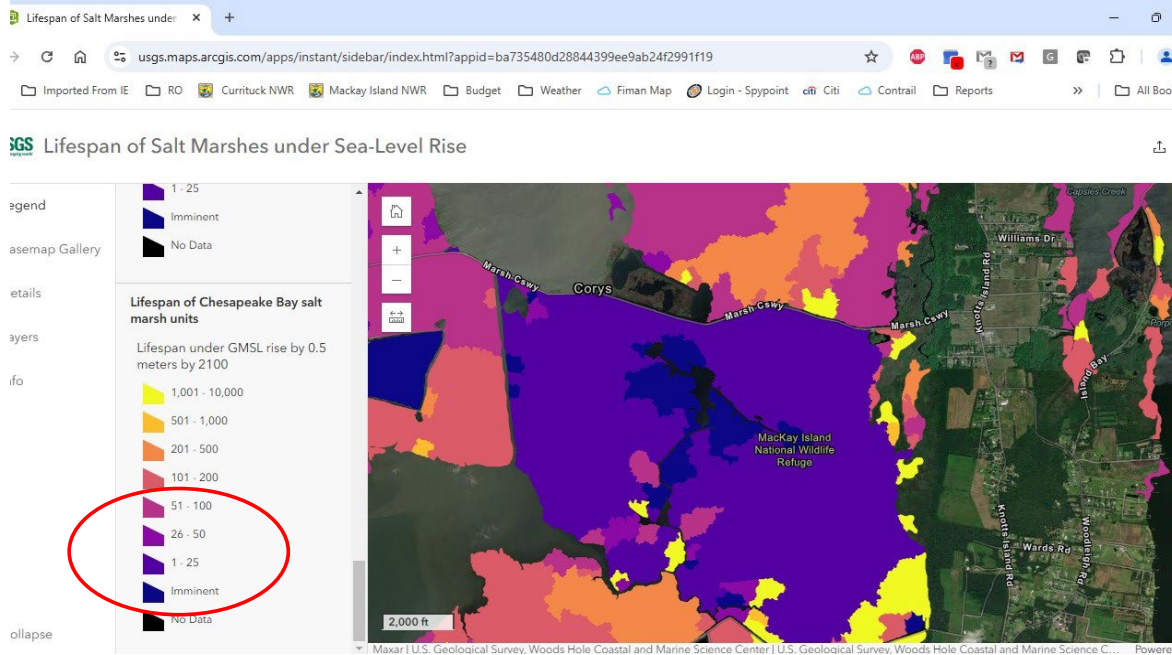


Figure 9. Remaining life span for marshes around Knotts Island. The remaining life expectancy for the Great Marsh is 25 years. Most of the marshes around Knotts Island have a remaining life expectancy of 50-100 years.

Loss of the Mackay Island NWR marshes will release ~800,000,000 cubic feet of additional sediment into the waters around Knotts Island, severely limiting sunlight penetration, and increasing the vulnerability of the Marsh Causeway and Knotts Island properties to coastal storms.



Figure 10. View of Knotts Island if the Mackay NWR marshes are gone. To ensure access to and from Knotts Island, NCDOT will likely need to raise and rock the entire length of the causeway to combat waves over topping the road (yellow line). The entire west facing shoreline of Knotts Island will need shoreline protection to eliminate erosion of the island (Red line).