



# Managing Effects of Climate Change At NASA's Wallops Flight Facility

**Carolyn Turner**

NASA Goddard Space Flight Center

Wallops Flight Facility

*Associate Chief – Code 250 Medical and Environmental Management Division*

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"Global Collaboration in Sustainable Environmental and Alternative Energy Strategies"

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# Wallops Island, Virginia - East Coast, USA



**NASA/GSFC  
Greenbelt**

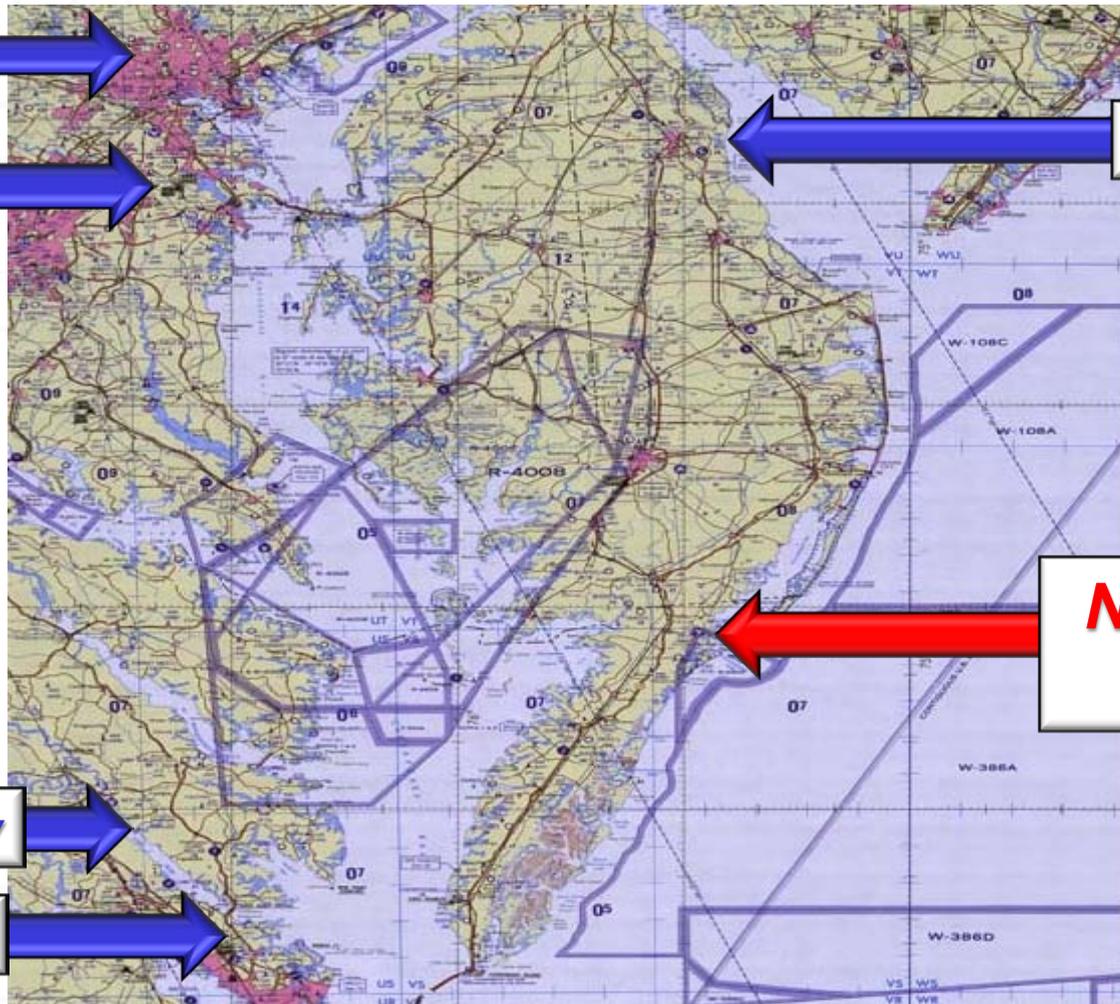
**D.C. Area**

**NASA/Langley**

**Norfolk Area**

**Dover AFB**

**NASA/GSFC  
WFF**





# Wallops Island History



- Established by National Advisory Committee on Aeronautics in 1945 as test site for aerodynamic research
- Over 16,000 launches conducted from Wallops Island during 65 year history
- Wallops mission has evolved to include:
  - Flight program management
  - Technology development
  - Scientific research
  - Orbital Launches





# Wallops 6000 Acre Facility



**Main Base**



**Wallops Island**





# Wallops Mission and Activities



## Mission

Wallops Facility will be a national resource for enabling low-cost aerospace-based science and technology

## Technical Activities

- Research Carriers
  - Sounding Rockets **Wallops Island**
  - Balloons **Wallops Island**
  - Aircraft & UAVs **Wallops Island**
  - Small Orbital Carriers **Wallops Island**
- Engineering Development & Technology Validation
  - Supporting Goddard Spacecraft Instruments and Subsystems
- Earth Science Research
- Mission Operations **Wallops Island**
  - Launch Range
  - Research Airport
  - Orbital Tracking



# U.S. Navy at Wallops



- Surface Combat Systems Center
  - Aegis Combat Training Center
    - Cruiser & destroyer simulators
    - Crew training
    - System development test bed
  - Ship Self-Defense Facility
  - DDG(1000) Engineering Facility
- Naval Air Warfare Center (Patuxent River)
  - Target launch operations
  - Aircraft development testing



# Mid-Atlantic Regional Spaceport (MARS)



**Minotaur I**



**Launch Pad 0-B**





# COTS and CRS Missions



- Taurus II Rocket launches
- NASA's Commercial Orbital Transportation Services (COTS)
- NASA's Commercial Resupply Services (CRS)
- \$40M state and federal investment





# Why is WFF a National Asset?



## Wallops Island – NASA's only owned Launch Range

- Other launch facilities are owned and operated by DOD and are subject to their scheduling and mission priorities
- NASA is a Civilian Agency with scientific mission
- GSFC, WFF's lead Center, is the world leader in climate change research
- WFF's Mission is low-cost, rapid access to space



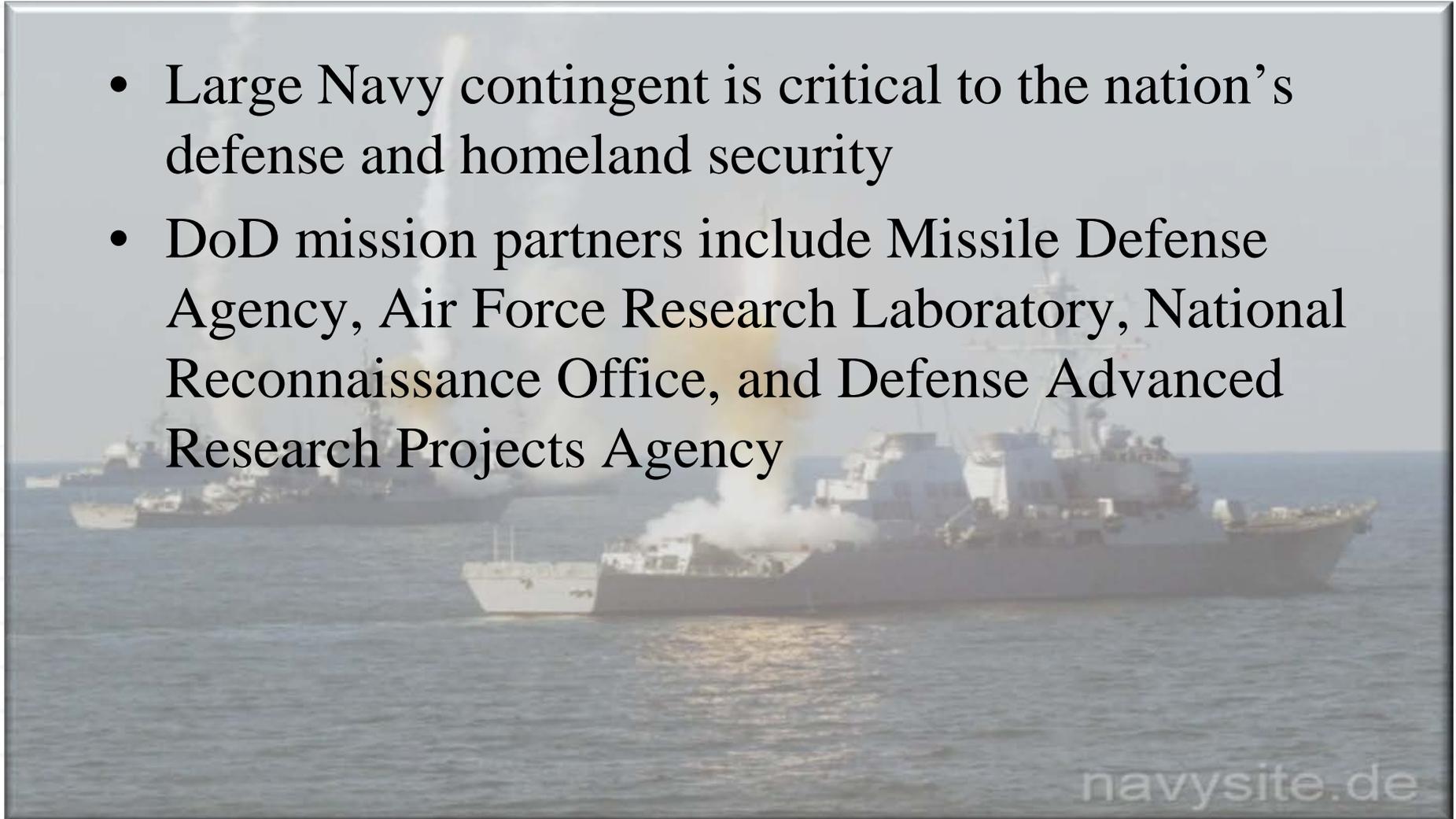


# Why is WFF a National Asset?



## Wallops Island – National Defense

- Large Navy contingent is critical to the nation's defense and homeland security
- DoD mission partners include Missile Defense Agency, Air Force Research Laboratory, National Reconnaissance Office, and Defense Advanced Research Projects Agency



navysite.de



# WFF as an Economic Engine



## Benefits

- In 2008, WFF (NASA, Tenants, & Contractors) employed 1,485 people
- NASA activities generated \$250 Million in local revenue:
  - \$133 Million from Wallops Research Park
  - \$90 Million from Sounding Rocket launches
  - \$6-24 Million from ELV (orbital class) launches
  - \$1 Million from UAS



# \$1.2 Billion in Total Assets



## Current Value of Wallops Island Assets

**NASA: \$170 Million**

**Navy: \$70 Million**

**Plus \$800 Million  
outfitting**

**MARS: \$5 Million**

**Total: \$1.1 Billion**

**Supporting: \$46.5 Million  
in NASA and \$50 Million  
in Navy Programs  
Annually**

## New Launch Range Infrastructure Investment

**Virginia: \$26 Million**

**Federal: \$14 Million**

**Private Sector: \$15 Million**

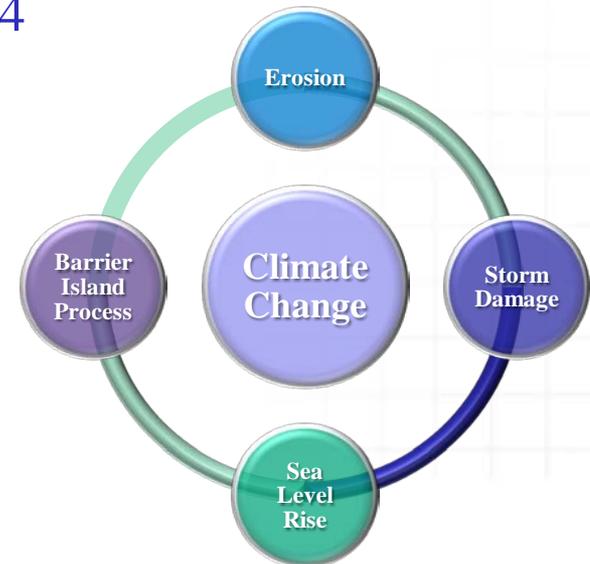
**Total: \$55 Million for  
\$1.9 Billion Program  
(Taurus II CRS)**



# The Challenge



- NASA established presence in the 1940s
- 150 years of “chronic erosion”
- Atlantic Ocean encroaching toward launch pads and infrastructure
- Southern part of Wallops Island retreated approx. 450 M (1350 feet) between 1857 and 1994





# History of Mitigation Efforts

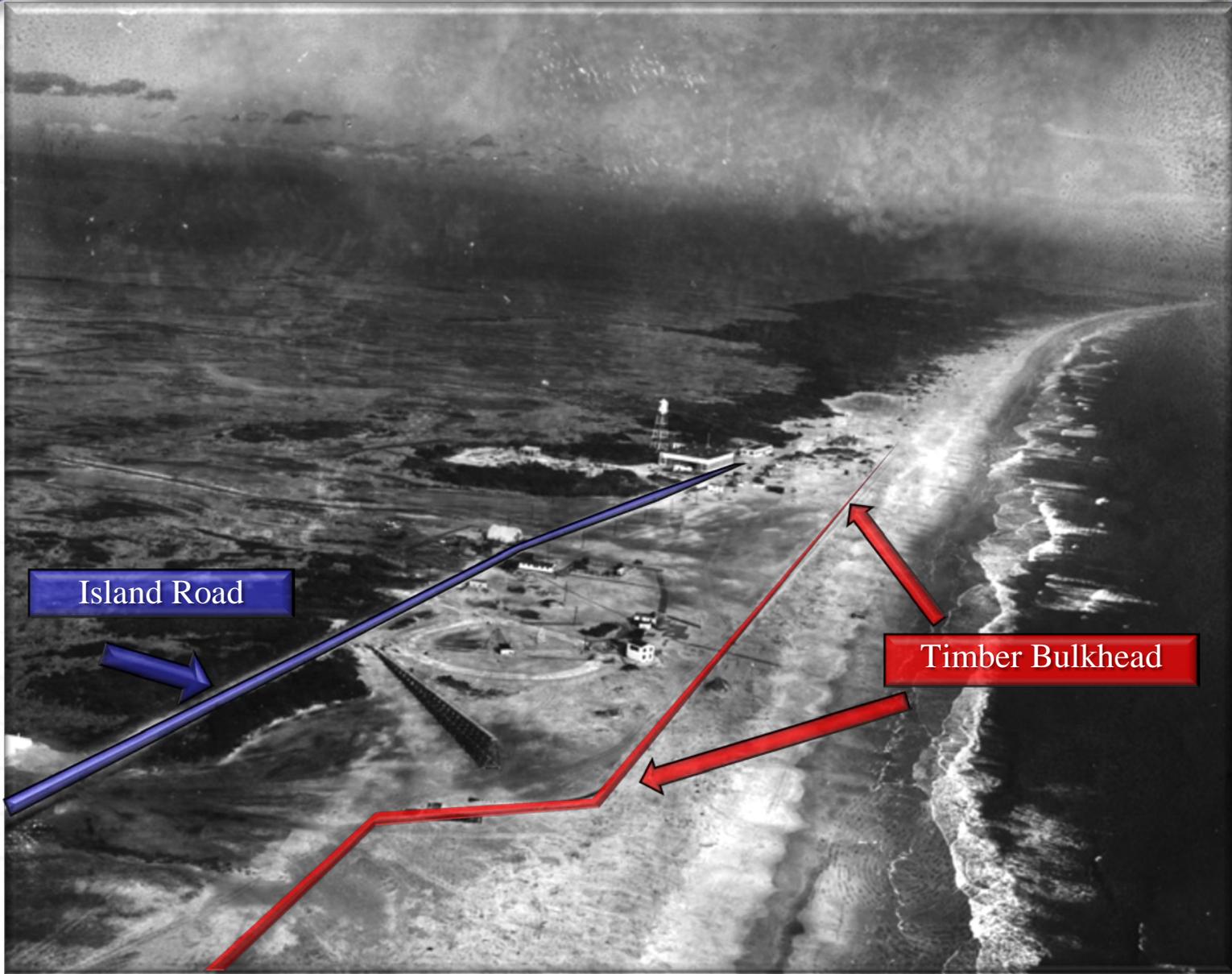


- 1940's** Timber bulkhead
- 1950's** 8 wood groins and bulkheads, concrete aprons, and rock rubble mounds
- 1960's** Groins and seawall extended north
- 1970's** 47 wood groins and seawall modifications (e.g., extended, augmented, and repaired several times)
- 1980's** Experimental designs (e.g., beach prism/beam sand retention units) and seawall modifications
- 1990's** Rock seawall and "failed groins" of the 70's removed
- 2000's** Seawall modifications and geotextile tubes

NACA  
LMAL  
44585



# 1946

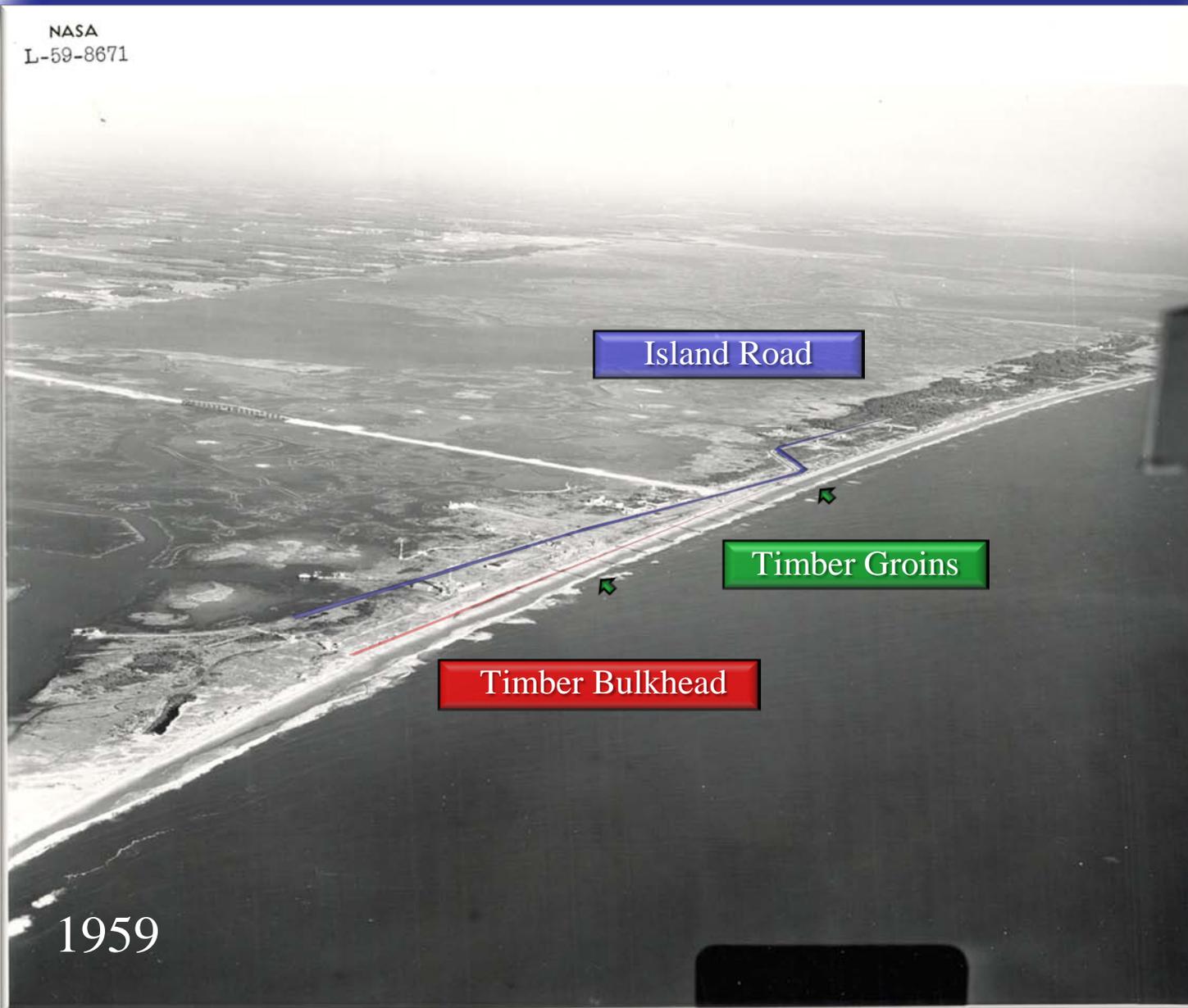




# 1959 – South End



NASA  
L-59-8671



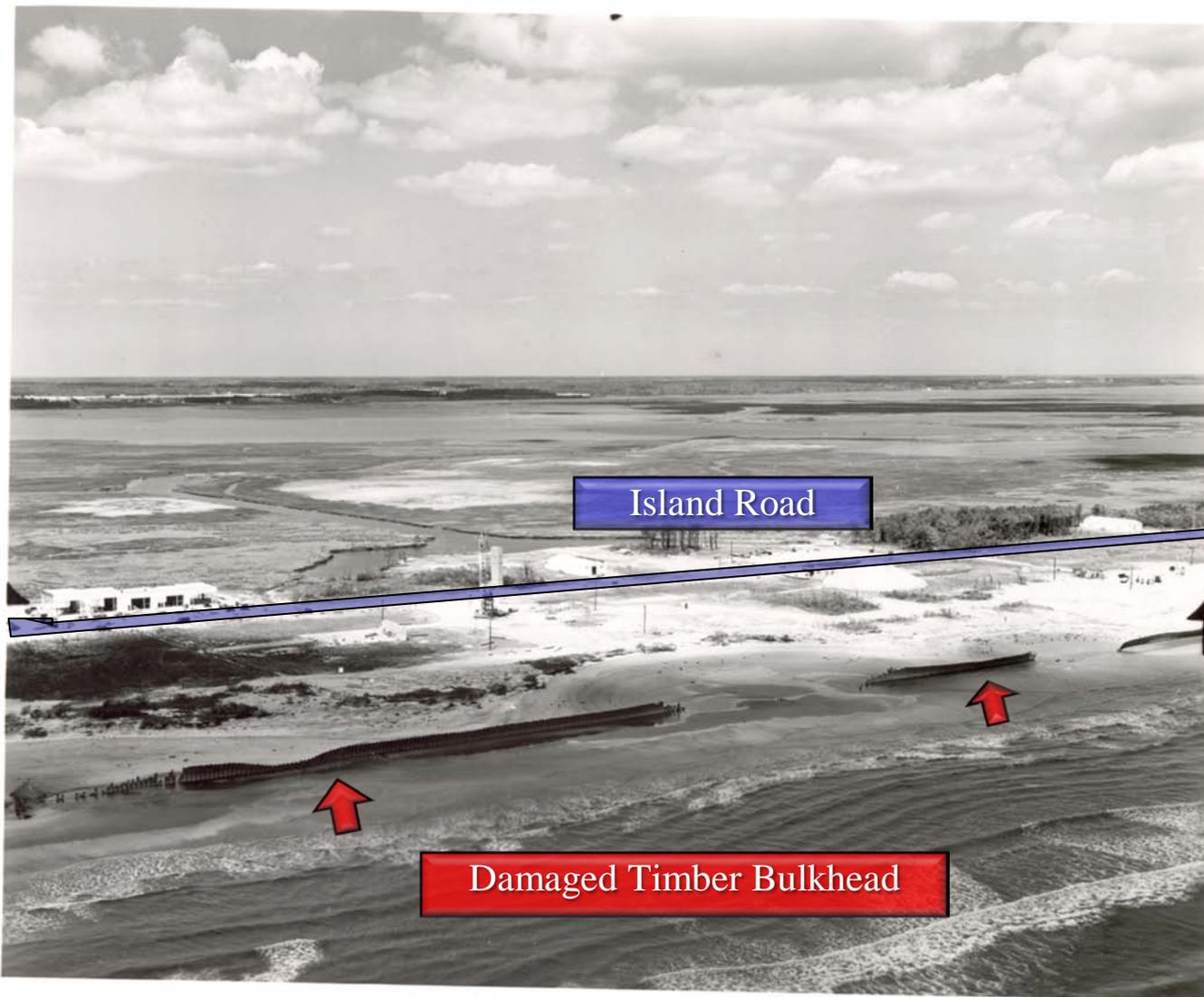
1959



1962



NASA  
L-62-2793



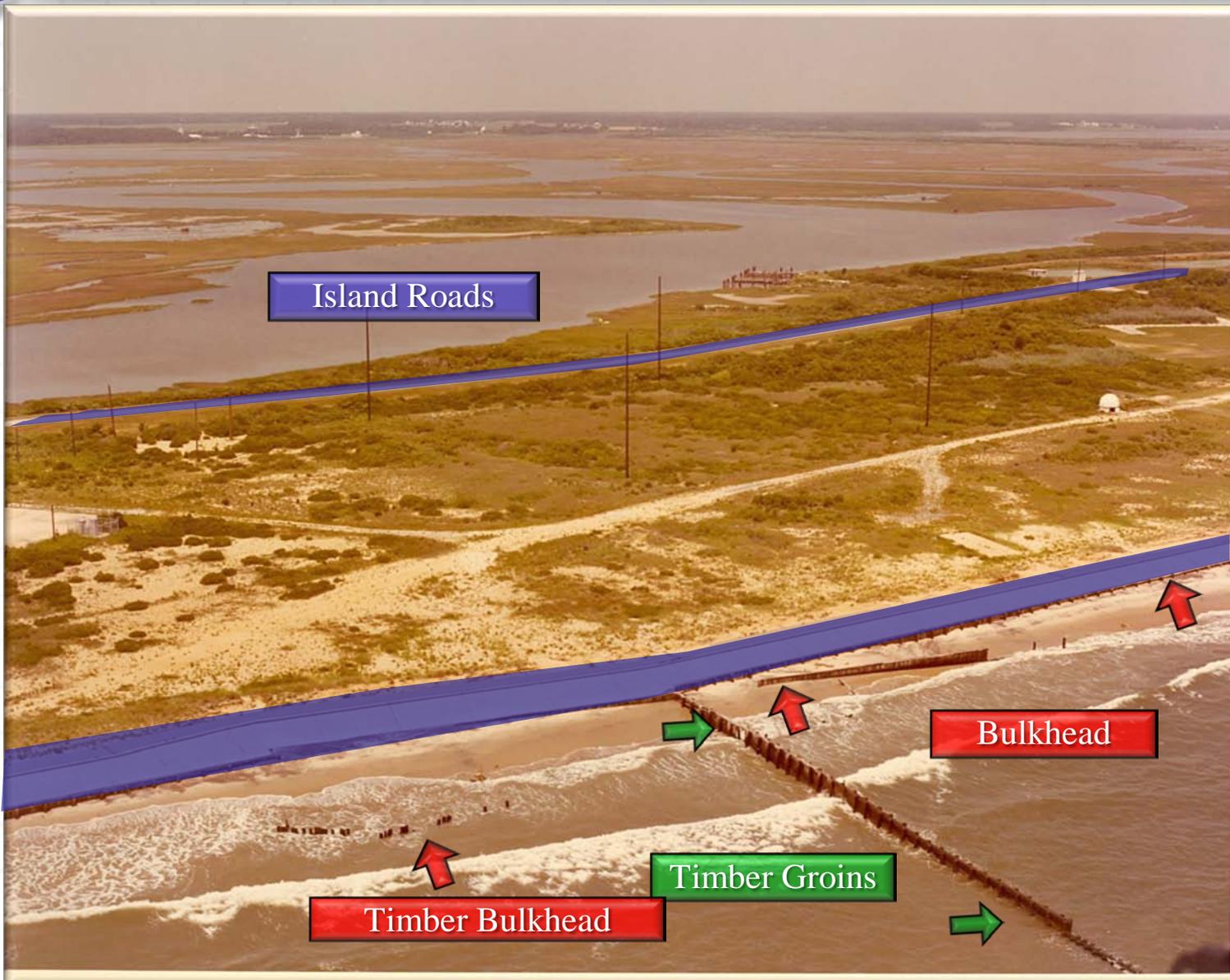


1976





1981



Island Roads

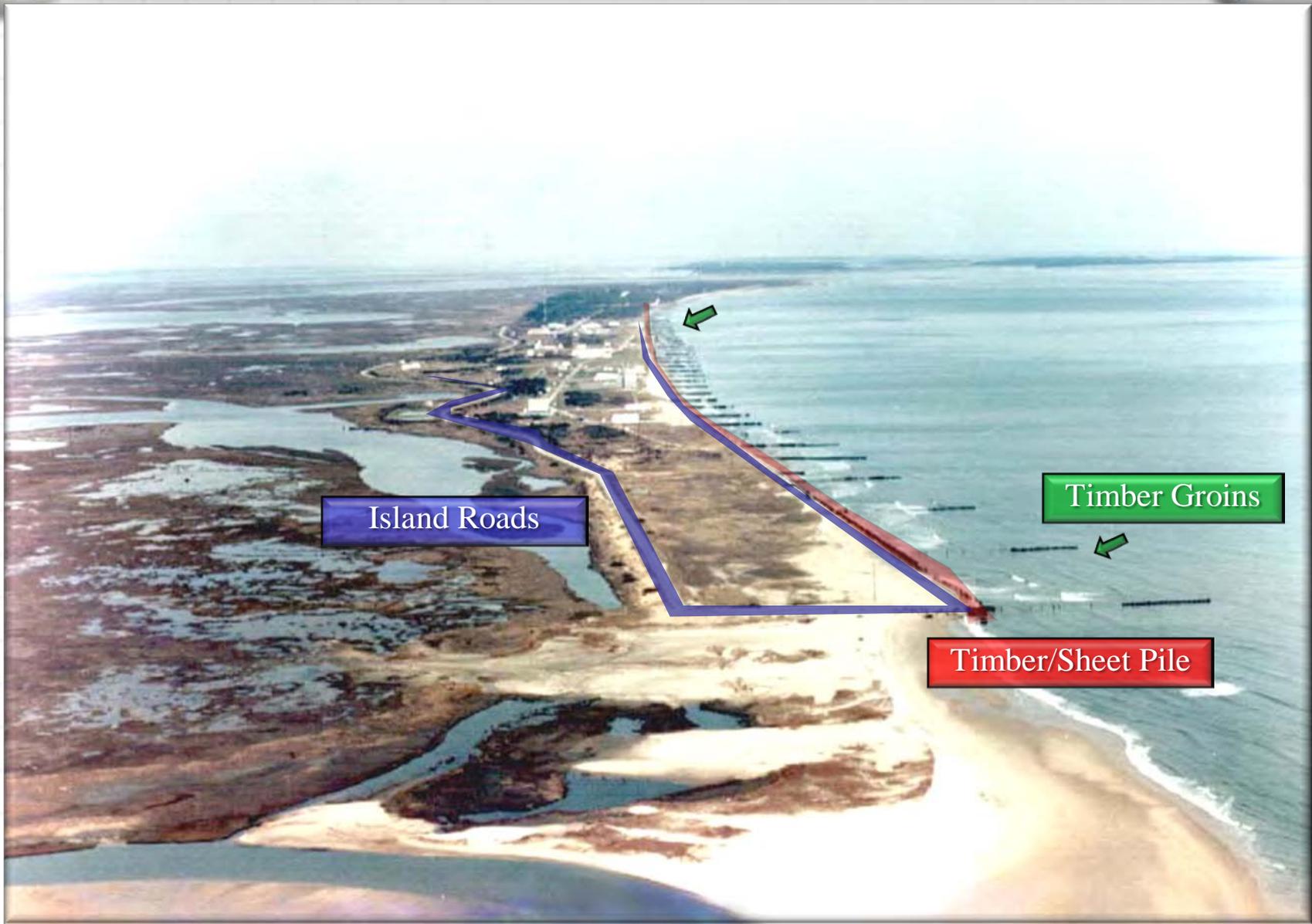
Bulkhead

Timber Bulkhead

Timber Groins



1983



Island Roads

Timber Groins

Timber/Sheet Pile



1987





# 1988 - Experimental "Beach Berms"



Timber Groins

Concrete Prisms

Sheet Pile

Island Road

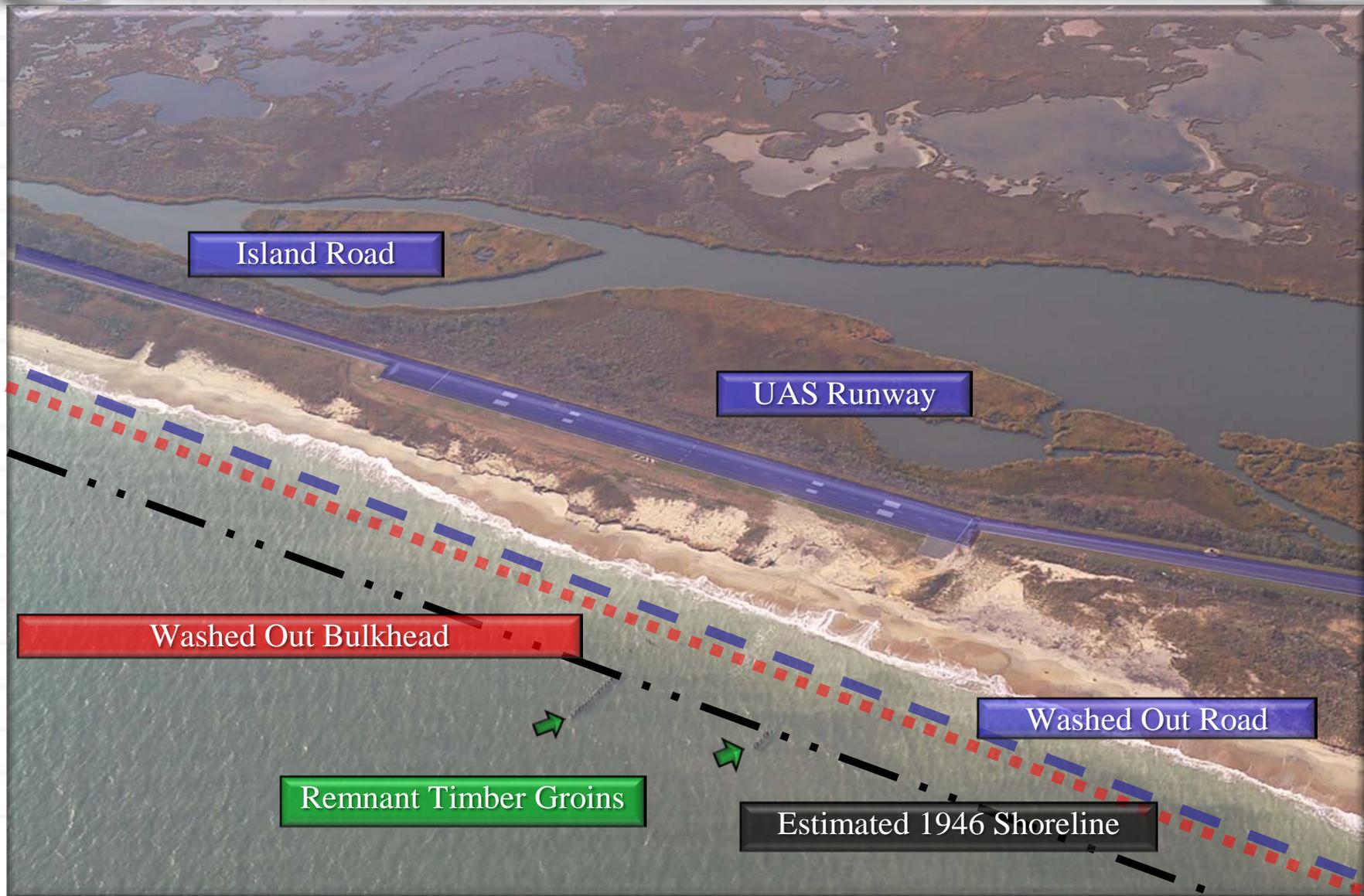


# Mid 1990's to Present - Seawall





# 2005





# What's at Risk?



## \$1.2 Billion in State and Federal Assets



### MARS Pad 0-B

- Located directly adjacent to the Atlantic Ocean



### Seawall

- Never intended to be the primary wearing surface between the Atlantic Ocean and the Launch Range



# Mitigation - Today and into the Future



## Shoreline Restoration and Infrastructure Protection Program

- NASA retained U.S. Army Corps of Engineers (USACE) for design and construction
- 50 year planning horizon
- Goal: reduce damage to Federal and State Infrastructure
- National Environmental Policy Act (NEPA)
  - Programmatic Environmental Impact Statement (EIS)
  - Bureau of Ocean Energy Management, Regulation, and Enforcement and USACE as Cooperating Agencies
  - Final PEIS under Public Review





# Physical Processes



- **Beach Erosion**

- Chronic
- Day in and day out
- Long term retreat
- Continuous wearing
- Permanent loss of beach
- Allows increased storm damage
- Further undermining of seawall

- **Storm Damage**

- Acute
- Short term
- Big changes
- Elevated water levels
- Large waves
- Flooding
- Infrastructure destruction

**THESE PROCESSES ARE ACCELERATED BY SEA LEVEL RISE AND INTENSIFIED STORM AND WAVE EVENTS ATTRIBUTED TO CLIMATE CHANGE.**

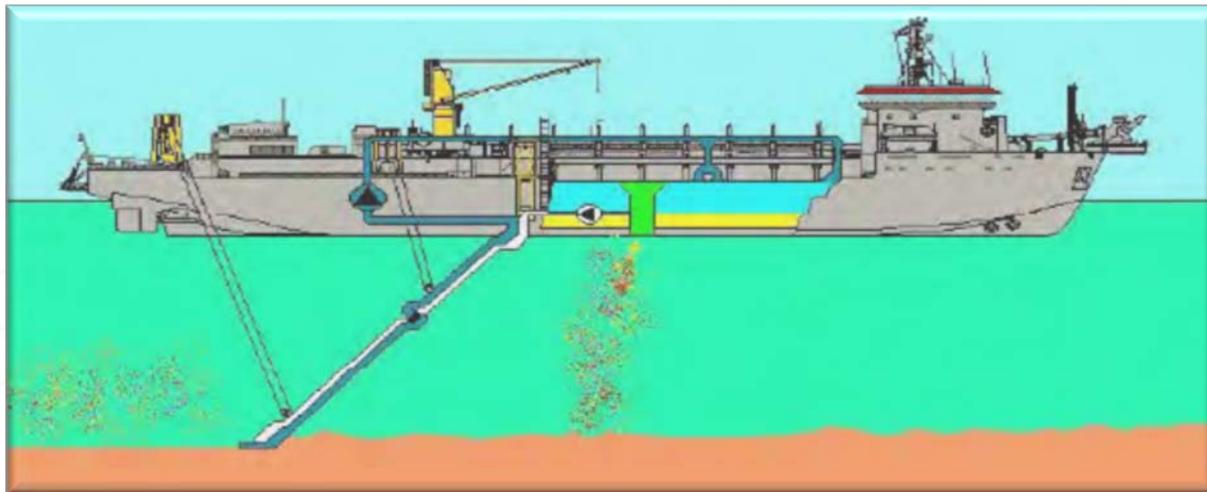


# SRIPP – The Details



- Initial Work

- Rehabilitate existing seawall as needed (Current)
- Build seawall extension (400 meters [~1350 ft ] ) (March 2011 –Nov 2011)
- 2,450,000 m<sup>3</sup> (3,200,000 yds<sup>3</sup> ) sand over 6.8 kilometers (4.25 miles ) provides 30 meters (100 feet) of dry beach in front of seawall (Jan 2012 – Jan 2013)





# SRIPP – The Details



- Beach Fill Renourishment every 5-7 years over 50 Years
  - 616,000 m<sup>3</sup> (800,000 yds<sup>3</sup>) sand
- Long Term Monitoring, Analysis, and Mitigation
- Over \$40M+ Project



(c) Rich Galiano



# Historical Storm Analysis



- 149 Year Storm Dataset
  - Hurricanes – 41 between 1854 and 2003
  - Nor'easters – 39 between 1954 and 2003
- Basis for Design Development
- 2006 Hurricanes “Ernesto” and “Florence” created a loss of asphalt along existing UAV Runway



# Before 2009 Nor'easter Damage - South End



Geotubes

UAS Runway

Timber Groins

Island Road





# After 2009 Nor'easter Damage – South End





# Calculation of Sea-Level Rise



**Total eustatic sea level rise –  
 $0.17 \pm 0.05$  m /100 yr.**

*The future rate of eustatic sea level rise is projected to significantly exceed the historical rate.*

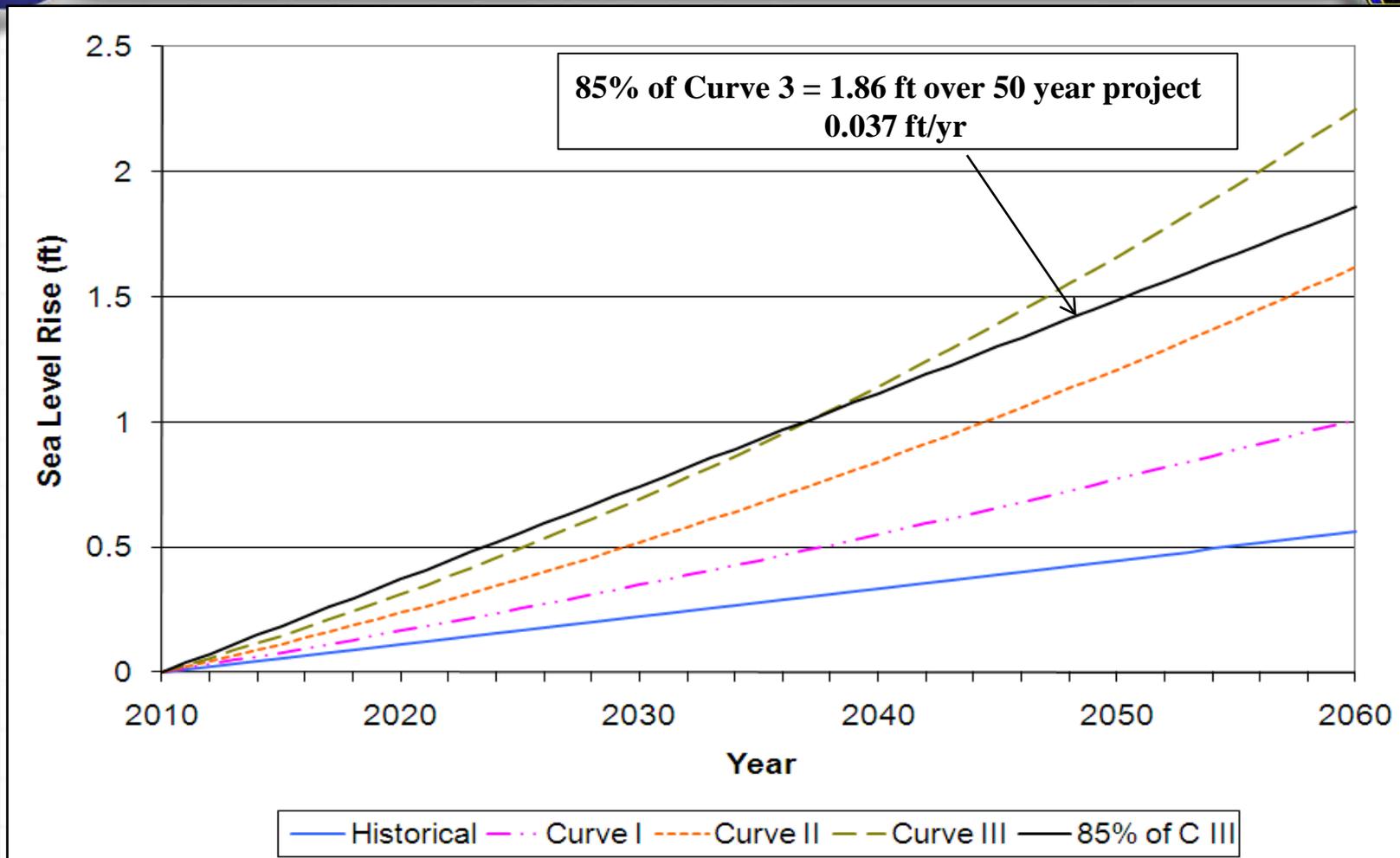
**WFF local sea level rise –  
 $0.34$  m  $\pm$   $0.05$  m/100 yr.**

*Small changes in sea level can be expected to have dramatic effects on shoreline.*

**NOAA Tide Stations used to obtain total SLR rate at Wallops Island, VA.**



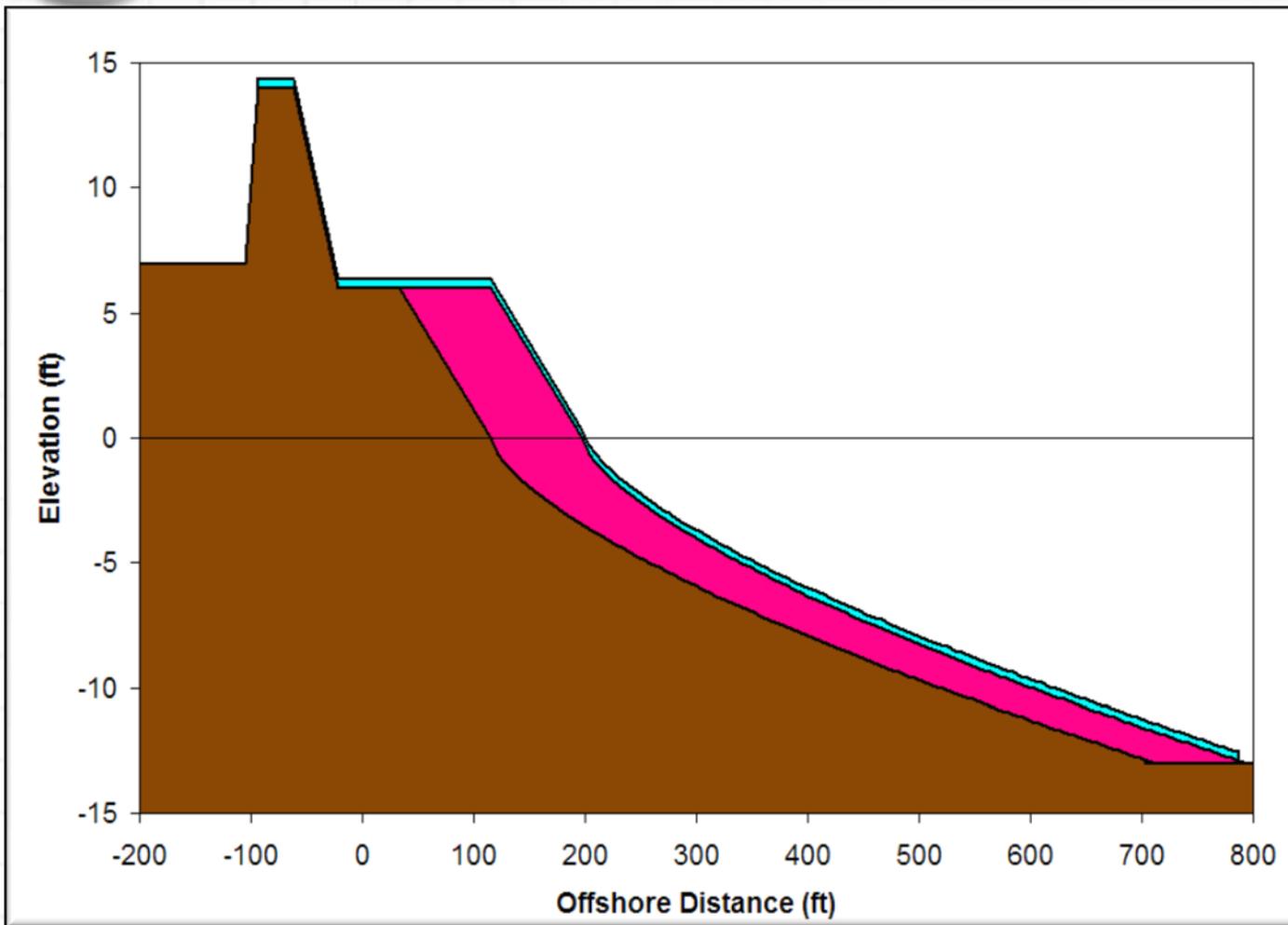
# Projected Wallops Island, VA SLR



Projected Wallops Island, VA SLR, as based upon NRC (1987) curves.



# Beach Re-nourishment



Projected beach fill profile per 5-year re-nourishment cycle.

 Minimum beach fill required to protect WFF assets

 Re-nourishment profile assuming a static sea level  $806,00 \text{ yds}^3$  ( $616,000 \text{ m}^3$ )

 Additional amount of material to compensate for sea level rise  $112,000 \text{ yds}^3$  ( $86,000 \text{ m}^3$ ) or 14%

*Based on monitoring data, the volume of material placed at each re-nourishment cycle can be adjusted to match the amount of sea level rise.*





# Questions?



**Thank you for your interest!**

