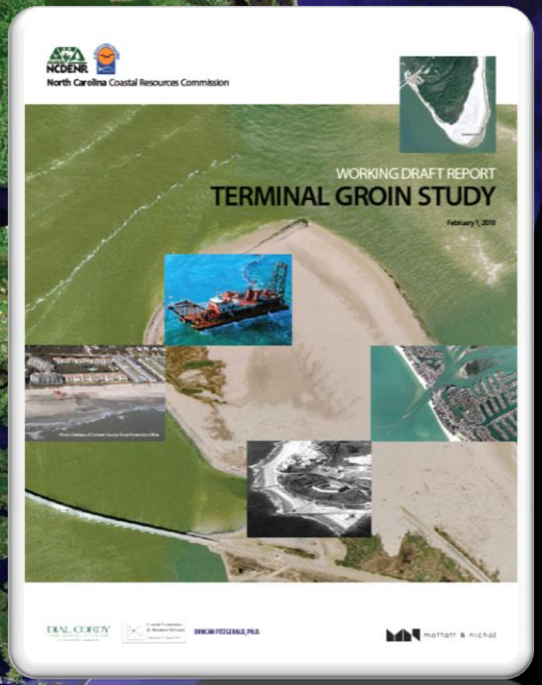
NC Terminal Groin Study:
Feasibility and Advisability of the Use of a Terminal Groin as an Erosion Control Device



DRAFT REPORT PRESENTATION
CRC Meeting
February 17, 2010

MOFFATT & NICHOL

DIAL CORDY AND ASSOCIATES INC
Environmental Consultants

Presentation Outline

- Study Overview
- Discussion of Draft Report
  - Coastal Engineering Analysis and Geological Assessment (Section II & III)
  - Environmental Assessment (IV)
  - Economic Assessment (VI)
  - Construction Techniques, Costs, Locations (V, VII, VIII)
- Next Steps

House Bill 709

SECTION 2:

"The Coastal Resources Commission, in consultation with the Division of Coastal Management, the Division of Land Resources, and the Coastal Resources Advisory Commission, shall conduct a study of the feasibility and advisability of the use of a terminal groin as an erosion control device at the end of a littoral cell or the side of an inlet to limit or control sediment passage into the inlet channel. For the purpose of this study, a littoral cell is defined as any section of coastline that has its own sediment sources and is isolated from adjacent coastal reaches in terms of sediment movement."

Items Identified In House Bill 709

Shall consider:

(1) Scientific data regarding the effectiveness of terminal groins constructed in North Carolina and other states in controlling erosion. Such data will include consideration of the effect of terminal groins on adjacent areas of the coastline.

(2) Scientific data regarding the impact of terminal groins on the environment and natural wildlife habitats.

(3) Information regarding the engineering techniques used to construct terminal groins, including technological advances and techniques that minimize the impact on adjacent shorelines.

Items Identified In House Bill 709

Shall consider:

(4) Information regarding the current and projected economic impact to the State, local governments, and the private sector from erosion caused by shifting inlets, including loss of property, public infrastructure, and tax base.

(5) Information regarding the public and private monetary costs of the construction and maintenance of terminal groins.

(6) Whether the potential use of terminal groins should be limited to navigable, dredged inlet channels.

Items Identified In House Bill 709

Public Input

- In conducting the study, the Commission shall hold at least **three public hearings** where interested parties and members of the general public will have the opportunity to present views and written material regarding the feasibility and advisability of the use of a terminal groin as an erosion control device at the end of a littoral cell or the side of an inlet to limit or control sediment passage into the inlet channel.

Public Hearing Location	Date and Time
Sheraton Atlantic Beach	Oct. 29, 2009 - 5 p.m.
Kill Devil Hills Town Hall	Dec. 16, 2009 - 5 p.m.
North Raleigh Hilton, Raleigh	Jan. 13, 2010 - 4:30 p.m.
New Hanover County Government Complex, Wilmington	Feb. 17, 2010 - 5 p.m.
Sea Trail, Sunset Beach	March 24 or 25, 2010

Items Identified In House Bill 709

Public Input

- DCM Website: http://www.nccoastalmanagement.net
- Email Comments: jim.gregson@ncdenr.gov

Report

- No later than **April 1, 2010**, the Commission shall report its findings and recommendations to the Environmental Review Commission and the General Assembly.

Project Team Members

Project Team Members

- Moffatt & Nichol – Coastal Engineering
- Dial Cordy and Associates, Inc. - Environmental
- Dr. Duncan FitzGerald (Boston University) – Coastal Geology
- Dr. Chris Dumas (UNCW) – Economics

Roles of CRC/CRAC, Science Panel

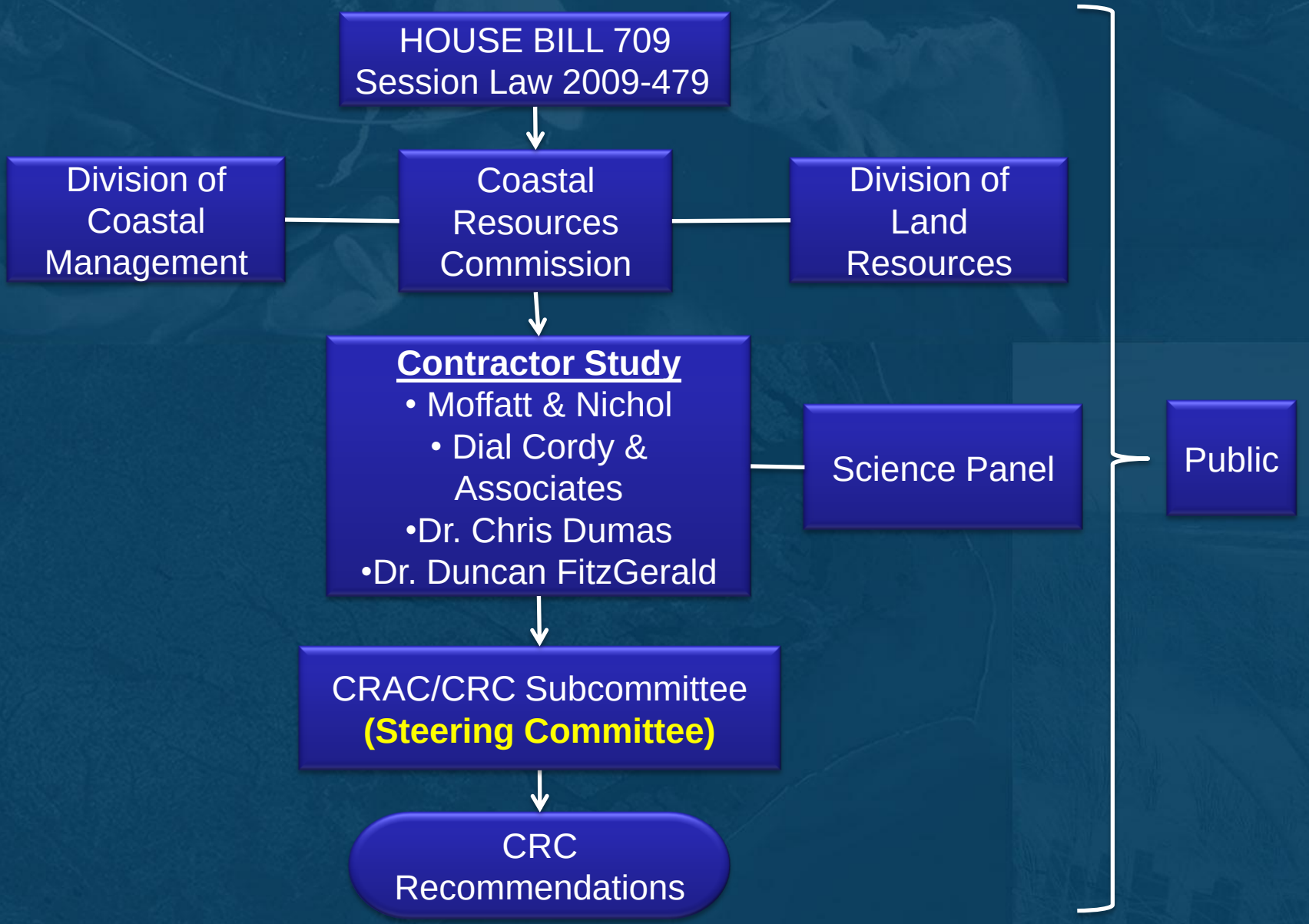
CRC/CRAC

- Provide Guidance to M&N During the Study
- Will Be Responsible for Developing the Policy Conclusions and Recommendations to Be Supplied to the ERC and Ultimately the General Assembly

Science Panel

- Science Panel was involved in the Project Scoping, Approval of Study Methodologies, and in an Advisory Capacity Providing Comments of the Report
- Five Scheduled Meetings
  (Sept. 29, Dec. 1, Jan. 19, Feb. 8, and Mar. 12)

Overall Study Organization



Selected Sites Based on September 29th Science Panel Meeting

North Carolina
- Oregon Inlet
- Fort Macon

Florida
- Amelia Island
- Captiva Island
- John's Pass

Overall Project Work Plan

Task 1 – Coastal Engineering Analyses of Effectiveness and Impacts of Terminal Groins

Task 2 – Environmental Resource Analyses of Potential Effects of Terminal Groins

Task 3 – Construction Techniques to Limit Impacts

Task 4 – Economic Study of Impacts of Shifting Inlets

Task 5 – Initial Construction and Maintenance Costs

Task 6 – Potential Locations Study

Task 7 – Public Input

Task 8 – Draft and Final Report

II & III – Coastal and Geological Assessment

Method/Approach

- Gather and Compile Physical Data
- Shoreline Change
  - GIS Shorelines (DCM, NCDOT, FL DEP) from available pre- and post-terminal groin periods
  - Measure shoreline change along transects every 50 m for 3 miles each side of inlet
  - Calculate pre and post shoreline change rates (cumulative averages and averages over intervals)
- Beach Volume Changes
  - Use available profiles near each site to shoreline change to beach volume relationships
  - Compute beach volume changes based on shoreline change

II & III – Coastal and Geological Assessment

Method/Approach (con't)

- Nourishment
  - Determined nourishment and placement volumes and locations
  - Calculated volume changes pre- and post-structure netting out all nourishment (subtract nourishment volumes)
- Dredging
  - Determined dredging volumes
  - Presented scenarios for amounts of dredge material (excluding sidecaster) that may have otherwise have naturally bypassed the inlet (add back percentage of dredging volumes)
- Geologic setting
  - Review literature for 5 sites
  - Discuss physical and geologic processes as they relate to terminal groins (examine aerial photography, longshore sediment transport behavior, morphological changes, human impacts)

II & III – Coastal and Geological Assessment

ANALYSIS OVERVIEW

Shoreline Change

- Measure differences between historic shoreline positions
- Includes effects of:
  - Sea Level Rise
  - Storms
  - Beach Nourishment / Placement
  - Dredging
  - Structures
  - Long-term Natural Regional Shoreline Processes

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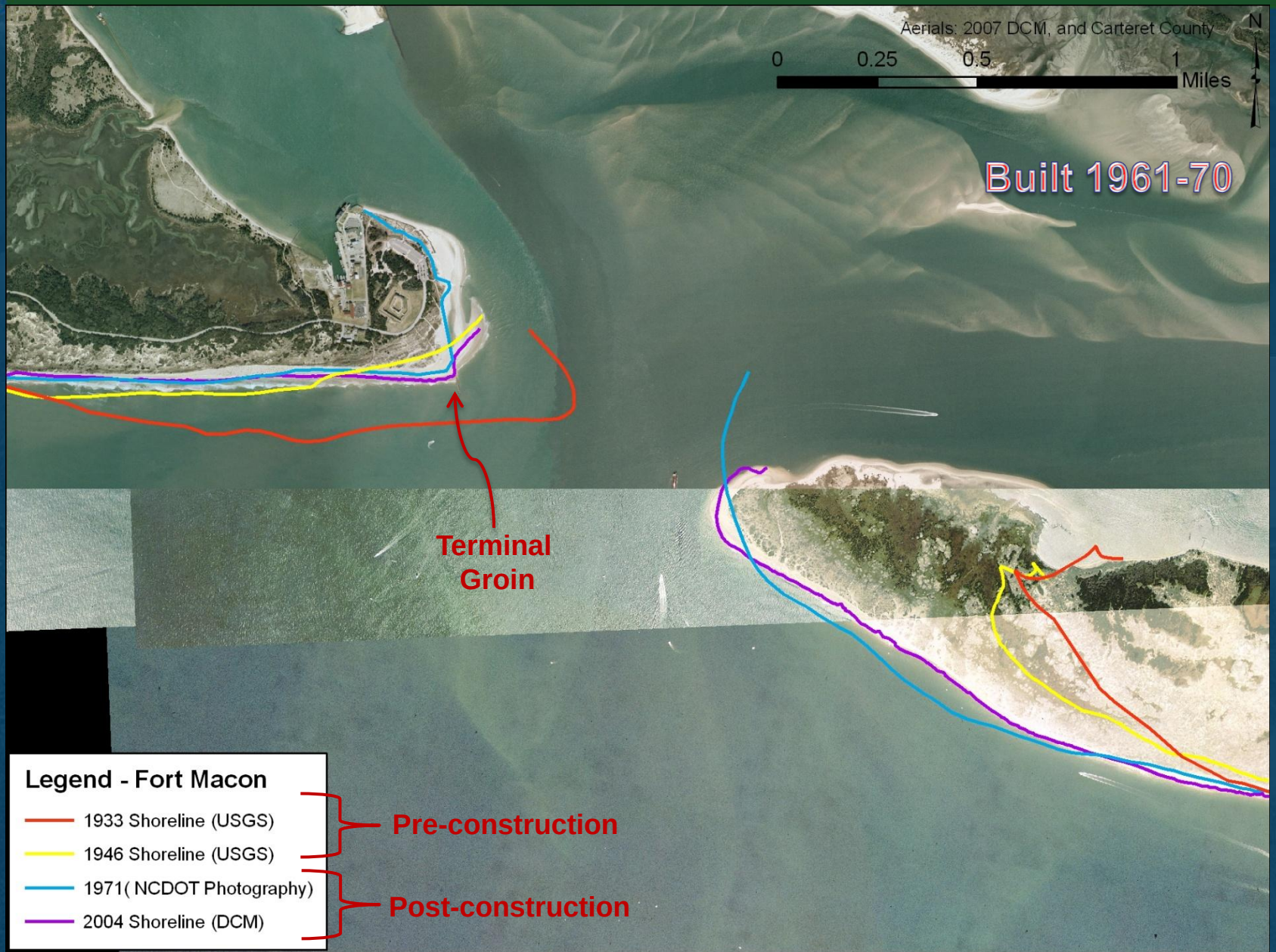
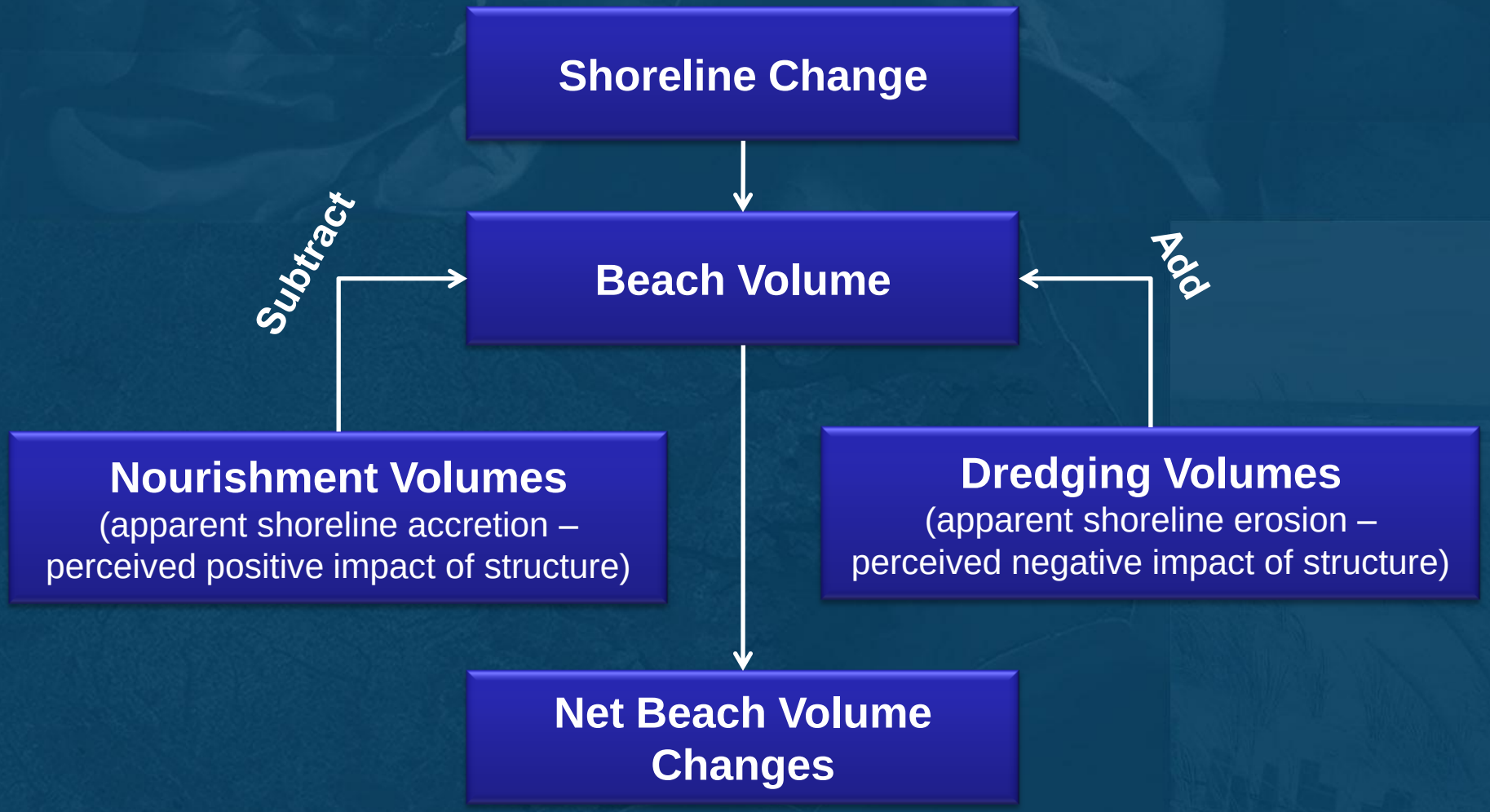
Fort Macon – Shoreline Change

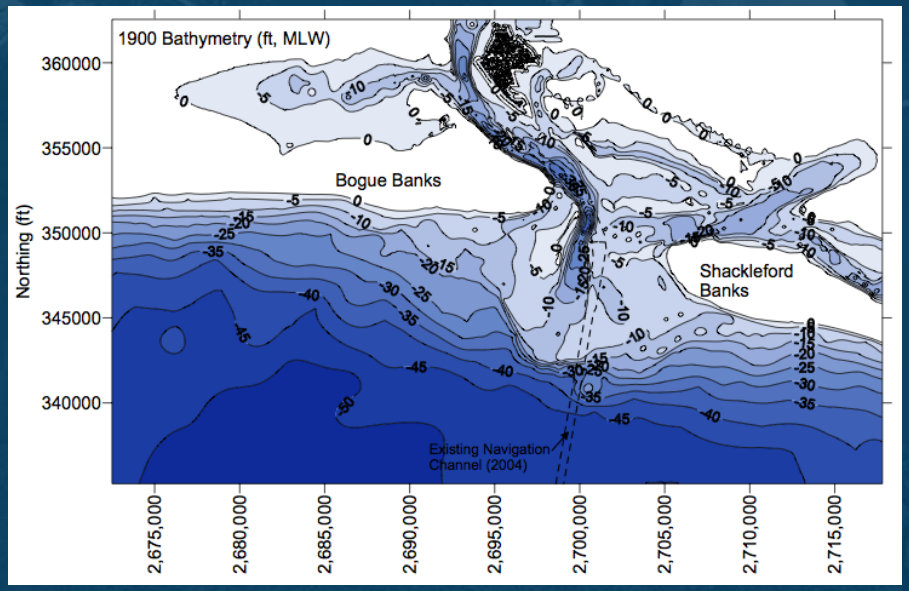


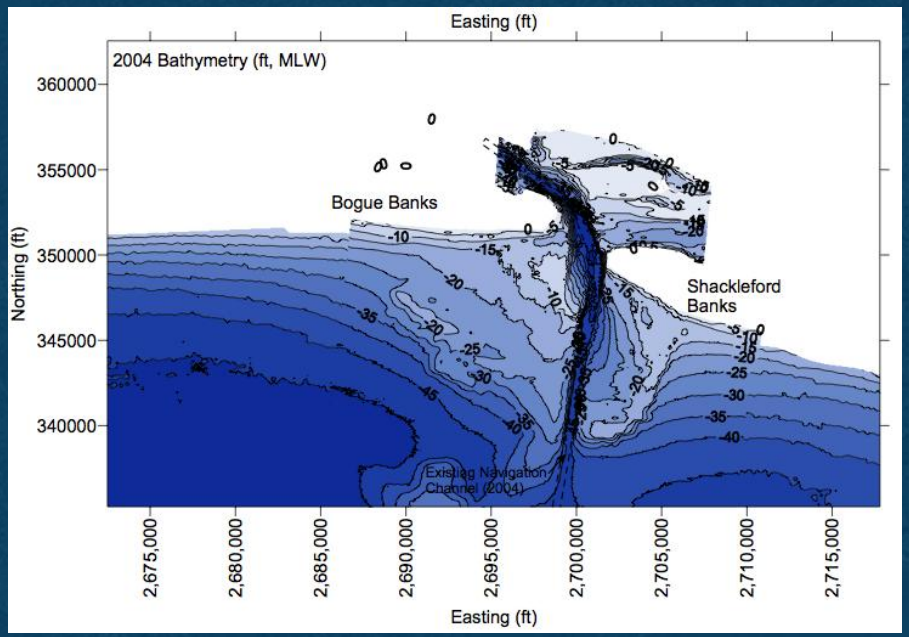
II & III – Coastal and Geological Assessment

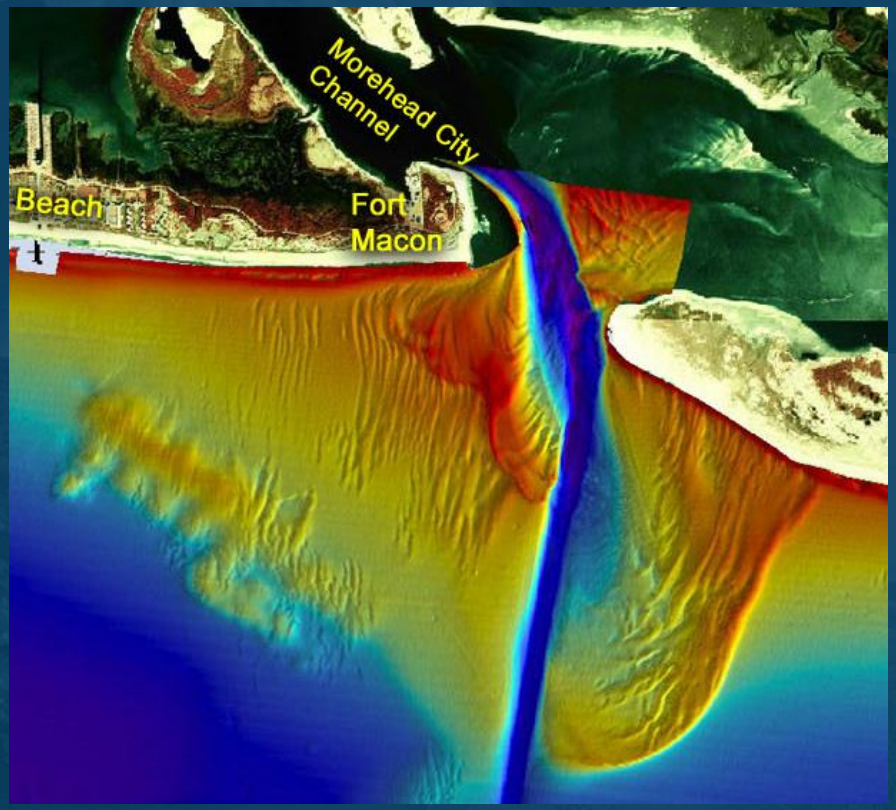
ANALYSIS OVERVIEW



Fort Macon - Geological Setting







Dredging and Tidal Prism Changes…

Resulting Offshore Bar (Terminal Lobe) Changes

II & III – Coastal and Geological Assessment

Summary Results

- Shoreline Change (only based on shorelines)
  - All shorelines on the structure side of the inlet were eroding prior to groin construction
  - Shorelines on opposite side of inlet do not display a clear trend
  - However due to nourishment and dredging activities assessments cannot be made on shorelines alone
- Nourishment and nearshore disposal volumes
  - On structure side of inlets after removing (netting out) all beach nourishment and nearshore disposal, the beach along 3 miles generally display a reduction in eroded volume (except Amelia and one of the Pea Island time periods calculated)
  - Beach volume changes on opposite side of the inlet again do not show a clear trend

II & III – Coastal and Geological Assessment

Summary Results (con't)

- Dredging
  - Deprives natural bypassing the inlet and must be accounted for in understanding the relative impact of Terminal Groins

IV - Environmental Analysis

- Major Emphasis:
  - Analysis of the Effects of Terminal Groins on Available Environmental Data
- Approach:
  - Collected and Analyzed Biological Data and Scientific Literature
    - State and Federal Agencies
    - Non-Profit Organizations
    - Non-Governmental Organizations

IV - Environmental Analysis

Analysis: Evaluated Readily Available Biological Data

- Spatial and Temporal (Pre- and Post-Construction)
- Similar Sites Adjacent to Study Areas (Regional Perspective)
- Graphical Representation (Observations/Year)
- Evaluated Storm and Renourishment Data
- Numerical Description of Population Data

Captiva Island, Florida

IV - Environmental Analysis

Technical Qualifiers

- No New Natural Resource Data Were Collected During This Study.
- Existing Secondary Sources and Raw Data Were Collected To Evaluate Potential Environmental Effects.
- Available Data Were Not Directly Related To Construction of a Terminal Groin.

USACE

IV - Environmental Analysis

Technical Qualifiers cont.

- Beach Nourishment and Terminal Groin Effects Could Not be Separated Based on Available Natural Resource Data.
- Historical Nature of Study Sites Precluded Availability of Pre-Construction Natural Resource Data.
- Prior to Construction and After Construction Data Were Only Available for Two Sites and Limited Resources (i.e. sea turtle and shorebird data).

USACE

IV - Environmental Analysis

Biological Resources Evaluated

- Shorebirds and Waterbirds
  - Observation Data; Nests; Areas Surveyed; Source
- Sea Turtles
  - Nests; False Crawl; Distance; Source
- Benthic Resources
  - Minimal Empirical Data; Past Studies
- Fisheries
  - Minimal Empirical Data; Past Studies
- Habitat Change
  - Scientific Literature; Aerial Photography
- Water quality
  - Minimal Empirical Data; Historical Studies

USFWS

IV - Environmental Analysis

Summary of Findings

- Minimizing Natural Overwash at the End of an Island Limits Natural Barrier Island Processes which Affects Inlet Habitats, thus Affecting Species Use
- Anchoring the End of an Island May Curtail an Inlet's Natural Migration Patterns thereby Minimizing the Formation of Sand Flats
- Fillet Material Should be Compatible to Minimize Effects on Benthic Infauna Recovery and Upper Trophic Levels
- Resources Continue to Use locations where Terminal Groins Exist, However, if Habitat Succession Occurs, Species Suitability May Be Affected
- Available Data and a Limited Time Frame Resulted in Non-Discernable Site Specific Trends

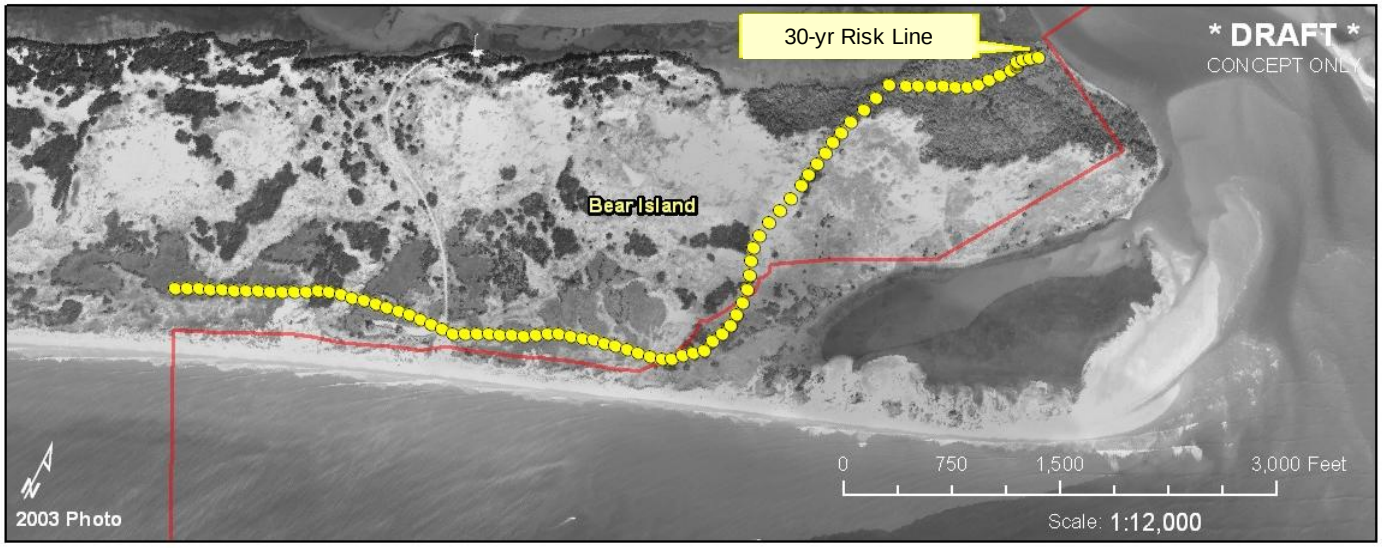
VI – Economic Study

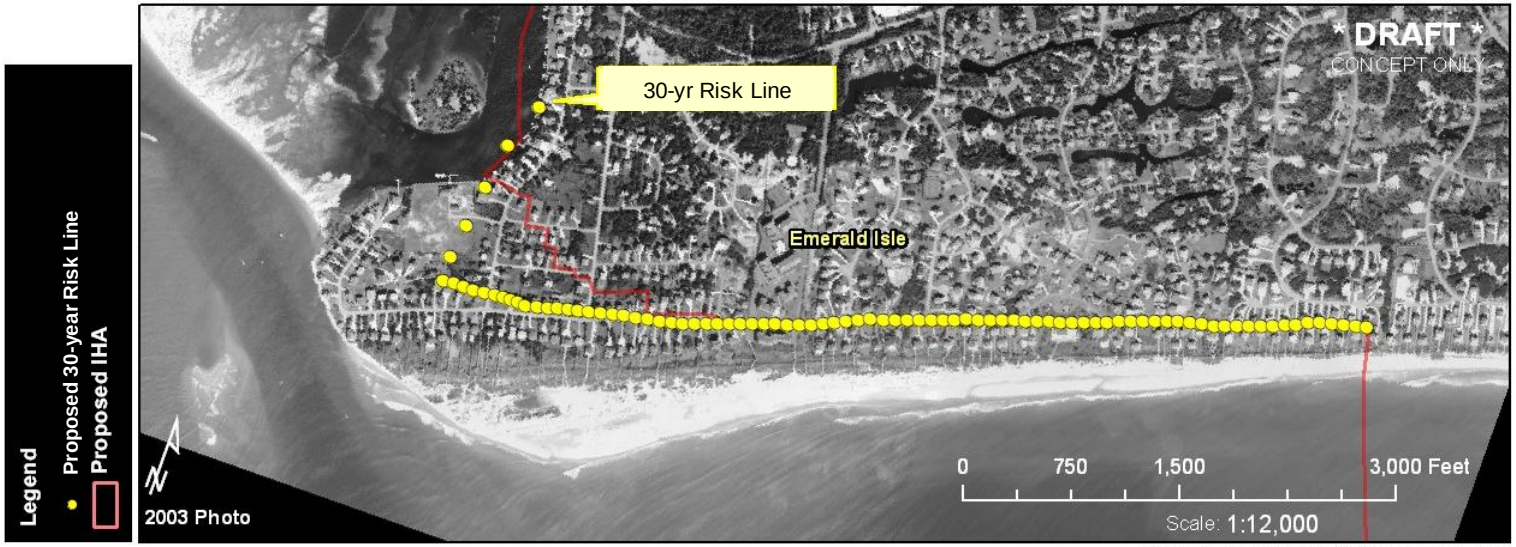
Method/Approach

- Identify Properties and Infrastructure at Risk (Use Proposed 30-yr Risk Lines)
- Assemble Current Property and Infrastructure Location and Value Data – Location (County Parcel Data) – Value (County Appraisals, NCDOT, Utility Companies)
- Add Up Economic Value – Tabulate Each Side of Inlet
- Include Property Loss, Public Infrastructure, and Tax Base Losses
- Discussions on Diminished Market Value, Impact on Second Row, Environmental and Recreational Values

VI – Economic Study

Bogue Inlet





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VI – Economic Study

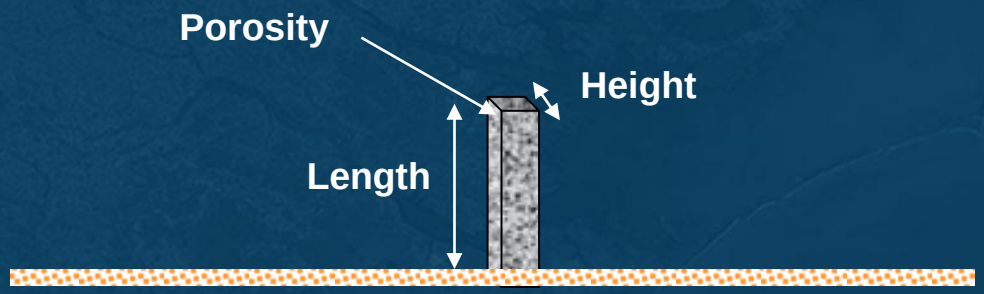
Summary Results

- Economic Impacts Vary Widely By Inlet and Side of Inlet
- Inlets With Higher Development May Have Significant Infrastructure and Property at Risk Over the Next 30 Years
- All Areas Denoted By 30-yr Risk Lines May Not Be Protected By a Terminal Groin Structure
- Additional Factors Such as Recreation, Environmental Economic Value, and Property Transfer Value Can Be Important

V – Construction Techniques

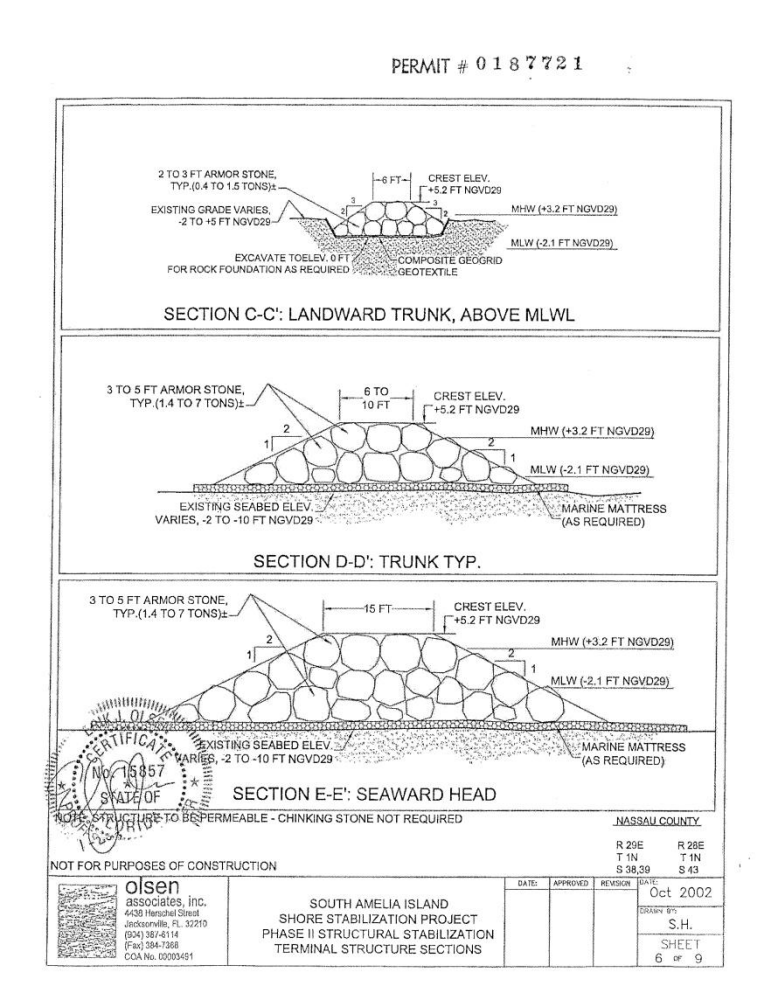
Method/Approach

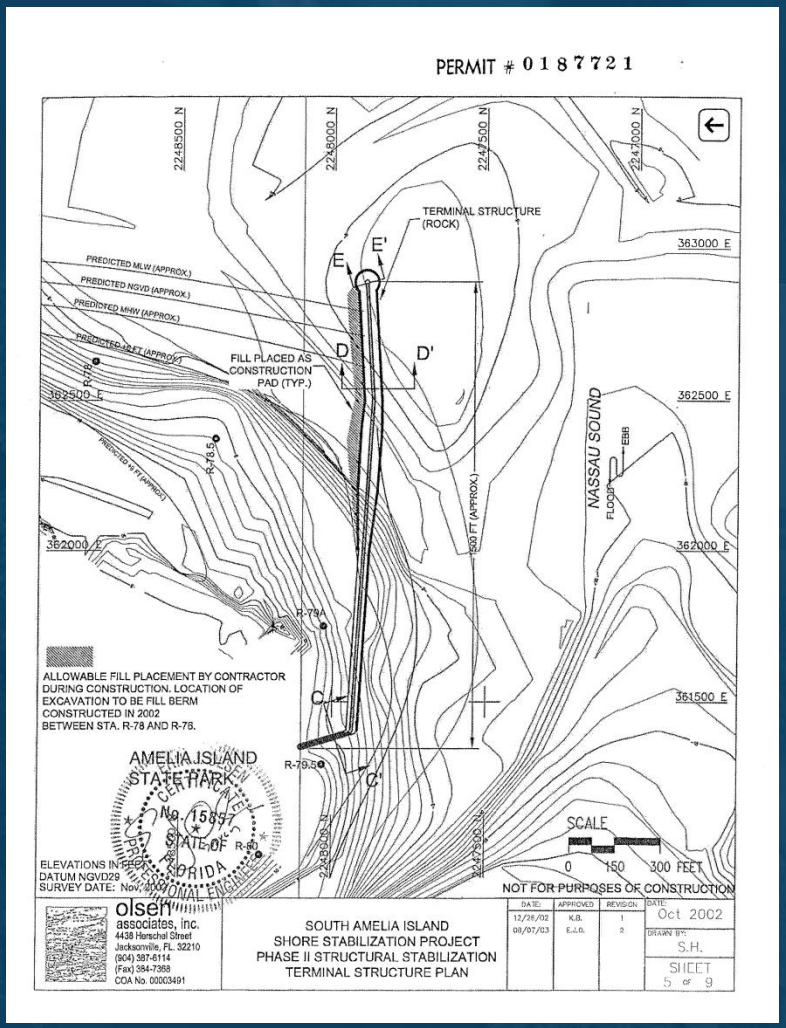
- Literature Review of Techniques Used to Limit Impacts on Adjacent Shorelines:
  - Limits on Groin Height and Length
  - Porosity of Structures (Sediment Transmission)
  - Materials, etc.
- Parametric Study With Available Data for Five Sites



V – Construction Techniques

Amelia Island – Leaky Groin





V – Construction Techniques

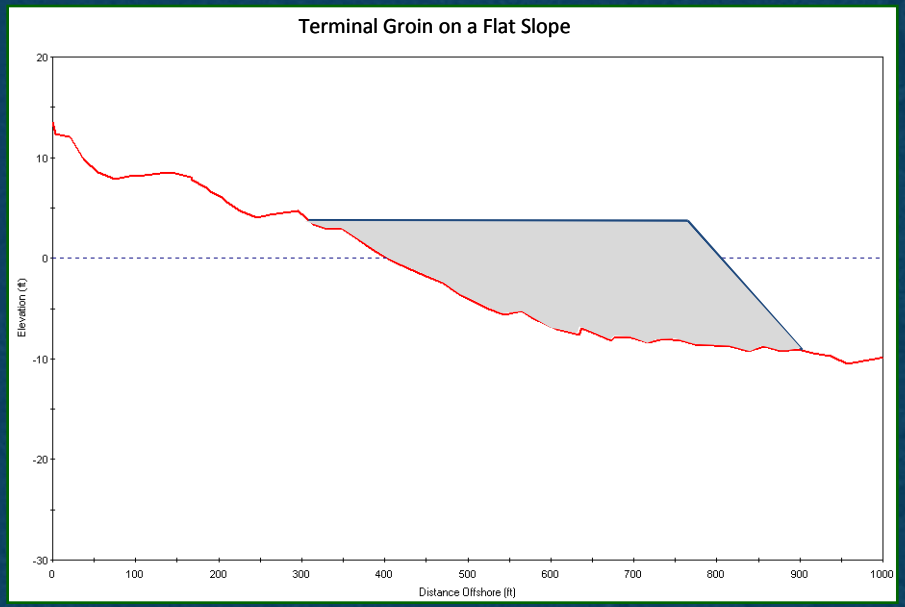
Summary Results

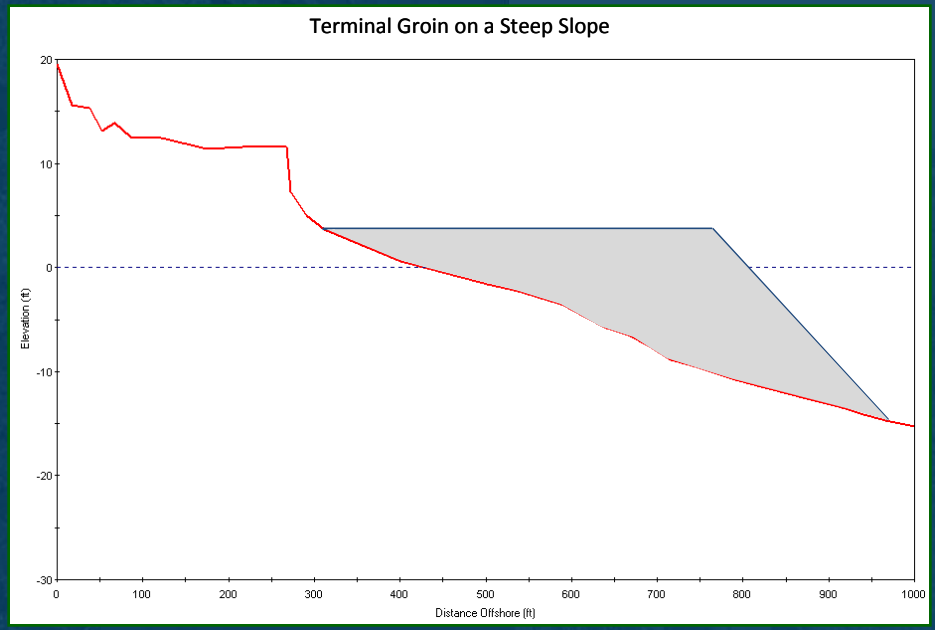
- Longer Length Has More Effect - Threshold
- Higher Elevation Has More Effect – Threshold
- Leaky Groin at Amelia Clearly Allows Material to Pass
- Groin Structure Shape Also Has Influence - Inclined And Notched Structures As Well As Various Planform Shapes (T-shaped, L-shaped, Dogleg, Etc.)
- Material Types Have Also Been Shown To Affect Sediment Transport Rates And Shoreline Behavior. Concrete, Steel, And Timber Sheeting And Pilings Allow For Adjustments In The Field As Well As Removal Of The Structures If Shown To Have An Unacceptable Adverse Impact.

VII – Initial Construction & Maintenance Costs

Method/Approach

- Review Available Cost Data For Existing Terminal Groins Including Public and Private Costs
- Develop Ranges of Potential Costs Based on Typical Expected Terminal Groin Dimensions and Typical North Carolina Offshore Slopes





VII – Initial Construction & Maintenance Costs

Summary Results

- Typical $/ft Costs (Depending on Structure Height and Section)
- Rock: $1200 - $6500/ft; Steel and Concrete: $4000 - $5000/ft
- Timber: $4000 - $5000/ft; Geotextile Tube: $250 - $1000/ft
- Some Materials Not Suitable for Larger Structures in Deeper Water
- Annual Maintenance Costs – Between 5-10% of Initial Cost – 10-15% Including Sea Level Rise and Storms
- Initial Beach Nourishment Costs Should Also Be Included
- Permitting & Design, Monitoring and Removal Costs Should Also Be Included

VIII – Potential Terminal Groin Locations

Method/Approach

- Literature Review of Existing Locations (Inlets – dredged, natural)
- Issues With Respect to Use at Navigable, Dredged Inlets vs. Non-dredged Inlets
- Inlet Behavior
- Assess And Comment On The Locations Of Terminal Groins With Respect To The Inlet Conditions As Well As The Geologic And Hydrodynamic Setting Of Each Of The Five Study Cases

VIII – Potential Terminal Groin Locations

Summary Results

- Most Existing Sites Include Navigable, Dredged Inlets
- Only Inlet Locations Considered for Study
- Five Sites Have Similar Hydrodynamic Conditions As NC Inlets
- Significant Range of Inlet Management Also Covered
- Level of Interventions (Nourishment & Dredging) Along With Terminal Groin Dimensions Determine Relative Scale Effect of Groin
- Nourishment and Some Level of Inlet Management Normally Accompany Terminal Groins

Next Steps

- Final Report (Contractor Study) – March 1, 2010
- Science Panel Meeting – March 12, 2010 – Raleigh
- Steering Committee Meeting – March 18, 2010 – New Bern
- Final CRC Meeting and Public Hearing – March 25, 2010 – Sea Trail/Sunset Beach
- CRC Report to ERC – April 1, 2010