NORTH CAROLINA
Department of Transportation









Ferry Life-Cycle Plan for Terminal Structure Repairs and Replacements

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December 7, 2017

FERRY DIVISION/LIFE-CYCLE PLAN FOR TERMINAL STRUCTURE REPAIRS AND REPLACEMENTS

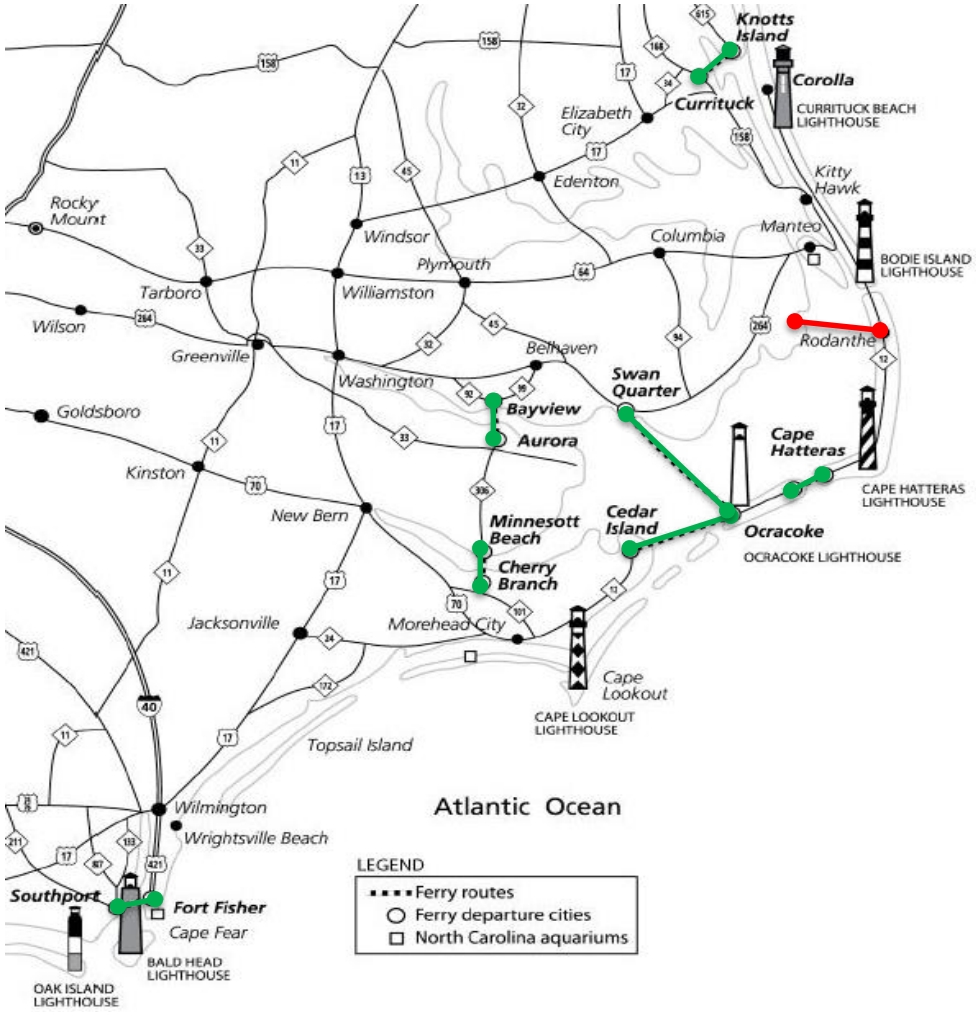
SECTION 34.28C.(a) Development of Plan. – The Ferry Division of the Department of Transportation shall develop a detailed life-cycle plan for the repair and replacement of terminal structures, including ramps and gantries. The plan required under this section shall include a cost-benefit analysis of repairing terminal structures versus replacing terminal structures.

SECTION 34.28C.(b) Submission of Plan. – The Ferry Division shall submit the report required under subsection (a) of this section to the Joint Legislative Transportation Oversight Committee by November 1, 2017.

This study was compiled for the NCDOT Ferry Division by Hardesty & Hanover under the Structures Management Unit's On Call Limited Services Contract.

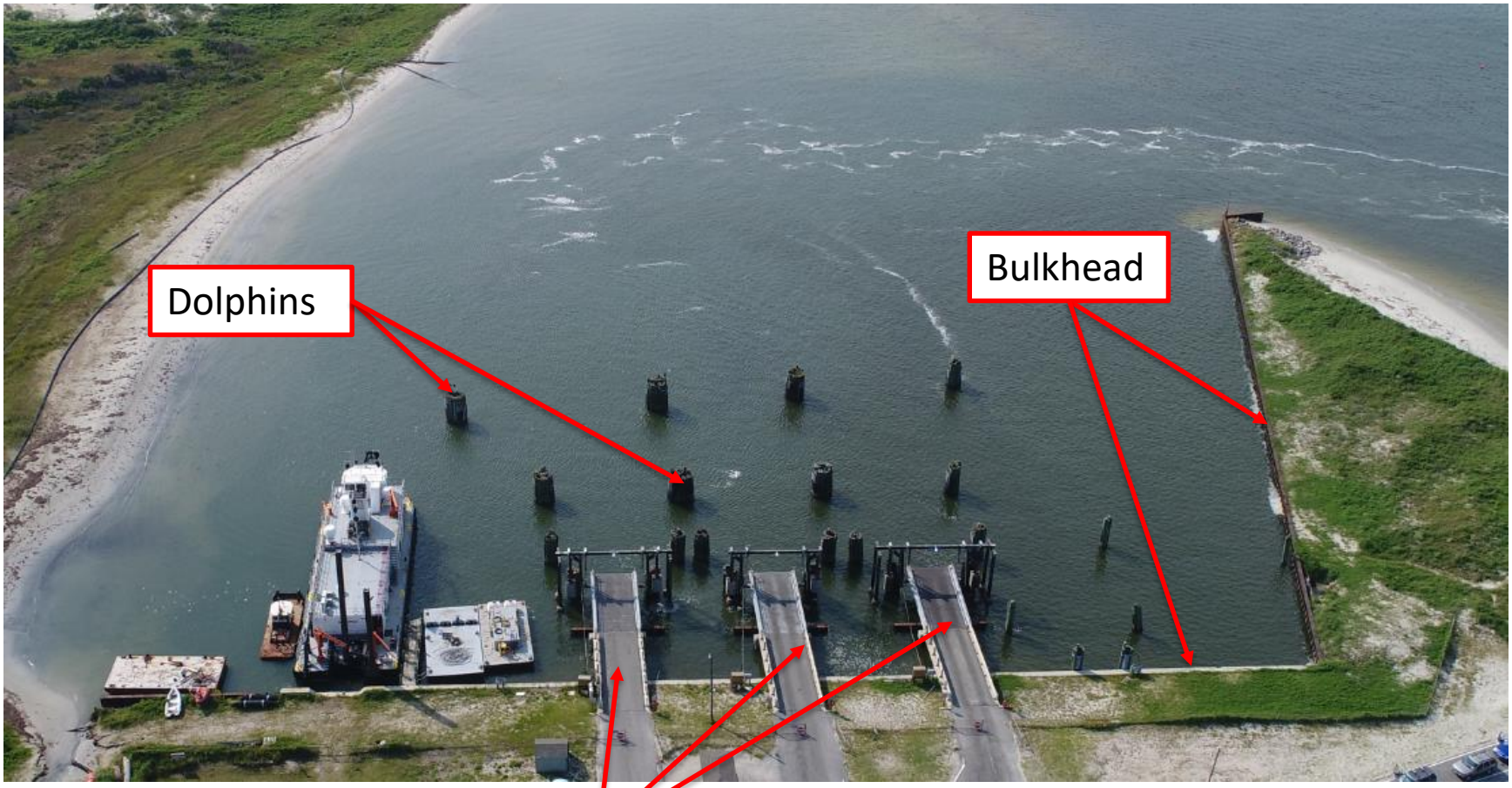
North Carolina Ferry Division

- **7 Ferry Routes**
  - **Currituck – Knotts Island**
    - 1 Ramp & Gantry on Currituck side
    - 1 Ramp & Gantry on Knotts Island side
  - **Swan Quarter - Ocracoke**
    - 2 Ramps & Gantries on Swan Quarter side
    - 1 Ramp & Gantry on Ocracoke side
  - **Hatteras – Southdock (Northern End of Ocracoke Island)**
    - 3 Ramps & Gantries on Hatteras side
    - 3 Ramps & Gantries on Southdock side
  - **Ocracoke – Cedar Island**
    - 1 Ramp & Gantry on Ocracoke side
    - 2 Ramps & Gantries on Cedar Island side
  - **Bayview – Aurora**
    - 1 Ramp & Gantry on Bayview side
    - 1 Ramp & Gantry on Aurora side
  - **Minnesott Beach – Cherry Branch**
    - 2 Ramps & Gantries on Minnesott Beach side
    - 2 Ramps & Gantries on Cherry Branch side
  - **Southport - Fort Fisher**
    - 1 Ramp & Gantry on Southport side
    - 1 Ramp & Gantry on Fort Fisher side
- **1 Emergency Route**
  - **Stumpy Point – Rodanthe**
    - 1 Ramp & Gantry on Stumpy Point side
    - 1 Ramp & Gantry on Rodanthe side

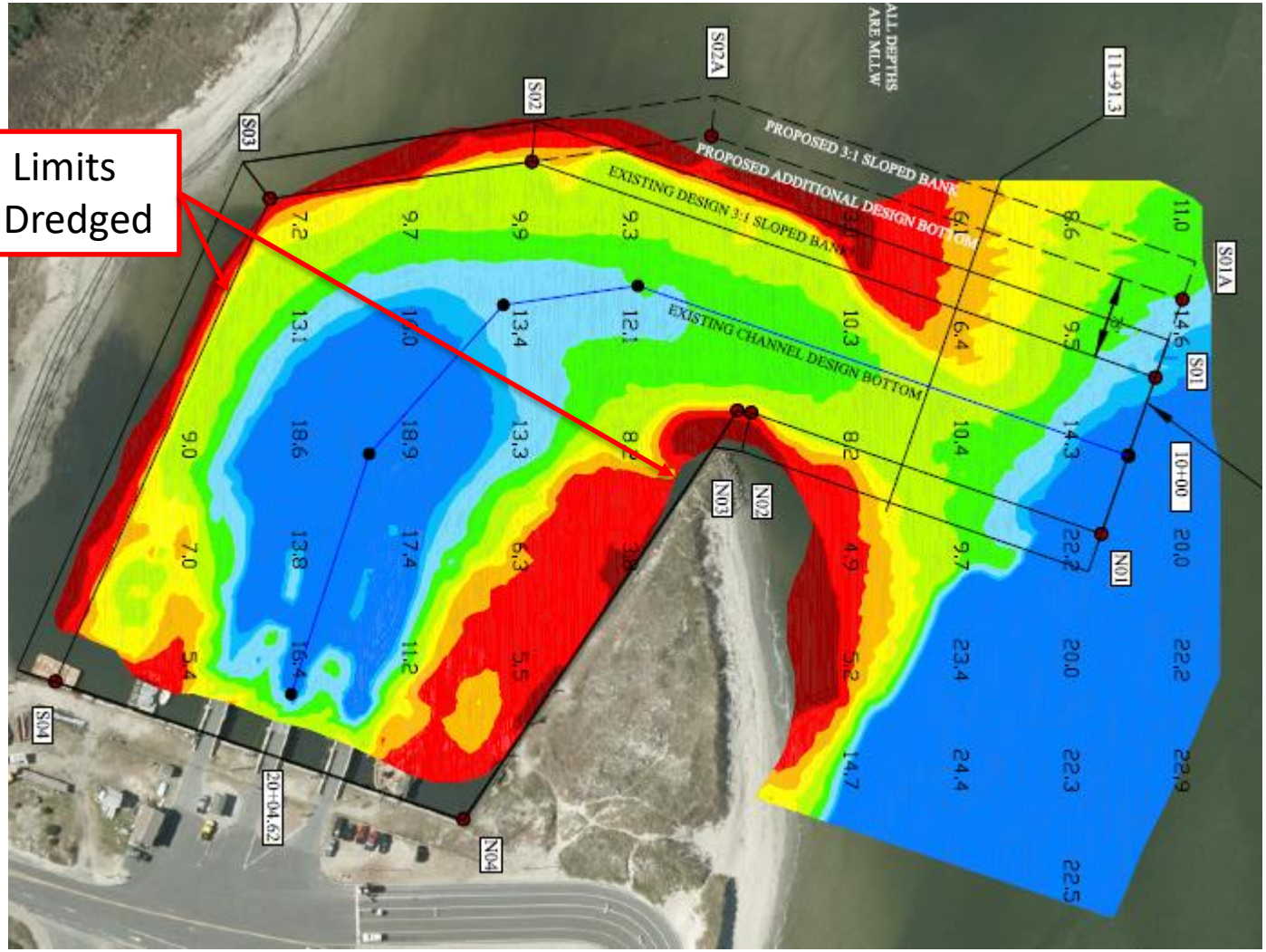


Total of 24 Ramps & Gantries

Terminal Structures Types



Terminal Structures Types



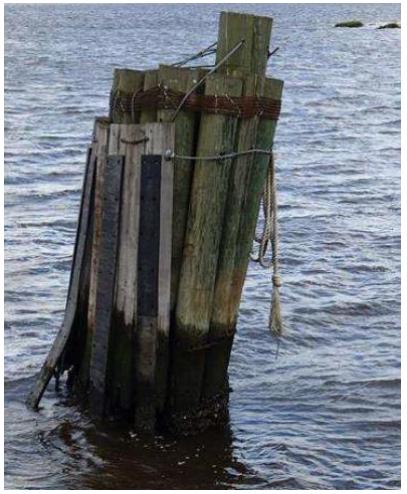
Detailed View of Typical Ramp & Gantry

The Good and The Bad

Piles

Floor Beams underneath

Dolphin



The Good and The Bad

Counterweight

Steel Connections

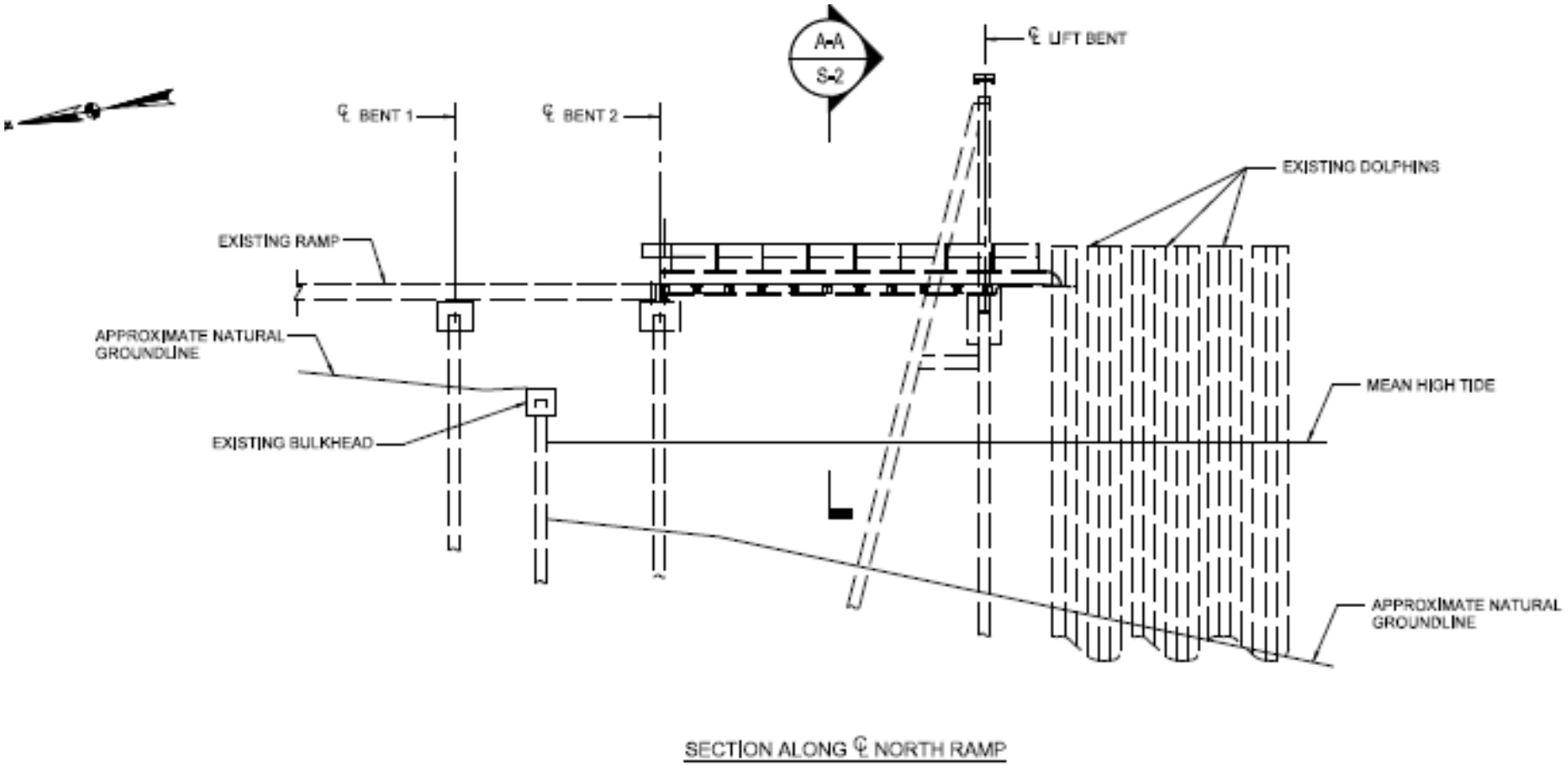
Connection Hardware

Ramp & Gantry Report Card

Structure Number	Location	Items	Year Built	Asset Age (Years)	Design Life (DL) of Ramp	Remaining Years According to DL	NBIS Sufficiency Rating	Structurally Deficient
260032	Currituck	Fixed approach, Bulkhead, Pier, Ramp, Dolphins, Dredging	2005	12	48	36	56.59	
260019	Knotts Island	Fixed approach, Ramp, Dolphins, Dredging	2005	12	48	36	49	
470120	Swan Quarter	2 Fixed Approaches, 2 Piers, 2 Ramps, Dolphins, Dredging	2001	16	48	32	58.38	
470110			2001	16	48	32	54.69	
060322	Bayview	Fixed approach, Bulkhead, Pier, Ramp, Dolphins, Dredging	1994	23	48	25	42.84	Yes
060321	Aurora	Fixed Approach, Bulkhead, Ramp, Dolphins, Dredging	1994	23	48	25	41.49	Yes
680078	Minnesott Beach	Bulkhead, 2 Ramps, Dolphins	1996	21	48	27	40.45	
680076			2014	3	48	45	47.56	
640050	Fort Fisher	Fixed Approach, Ramp, Dolphins, Dredging	1964	53	36	-17	61.53	
090209	Southport	Fixed Approach, Pier, Ramp, Dolphins, Dredging	1964	53	36	-17	61	
240271	Cherry Branch	Bulkhead, 2 Ramps, Dolphins, Dredging	2014	3	48	45	56.78	
240214			1970	47	48	1	39.99	
150099	Cedar Island	Bulkhead, 2 Piers, 2 Ramps, Dolphins, Dredging	1990	27	36	9	50.4	
150100			1990	27	36	9	42	
470114	Ocracoke	2 Fixed Approaches, Pier, 2 Ramps	1997	20	36	16	42.87	
470115			1997	20	36	16	42.87	
470116	Southdock	3 Fixed Approaches, Bulkhead, Pier, 3 Ramps, Dolphins, Dredging	1992	25	36	11	53	Yes
470113			1998	19	36	17	48.92	
470112			1998	19	36	17	53	Yes
270044	Hatteras	Bulkhead, 3 Ramps, Dolphins	1991	26	36	10	38.45	
270045			1991	26	36	10	41.45	
270046			1991	26	36	10	38.45	
270053	Rodanthe	Bulkhead, Ramp, Dolphins	2001	16	36	20	67.08	
270066	Stumpy Point	Bulkhead, 2 Piers, Ramp, Dolphins, Dredging	2000	17	48	31	65.44	
-	Shipyard	Syncro Lift, Dolphins			-	-		

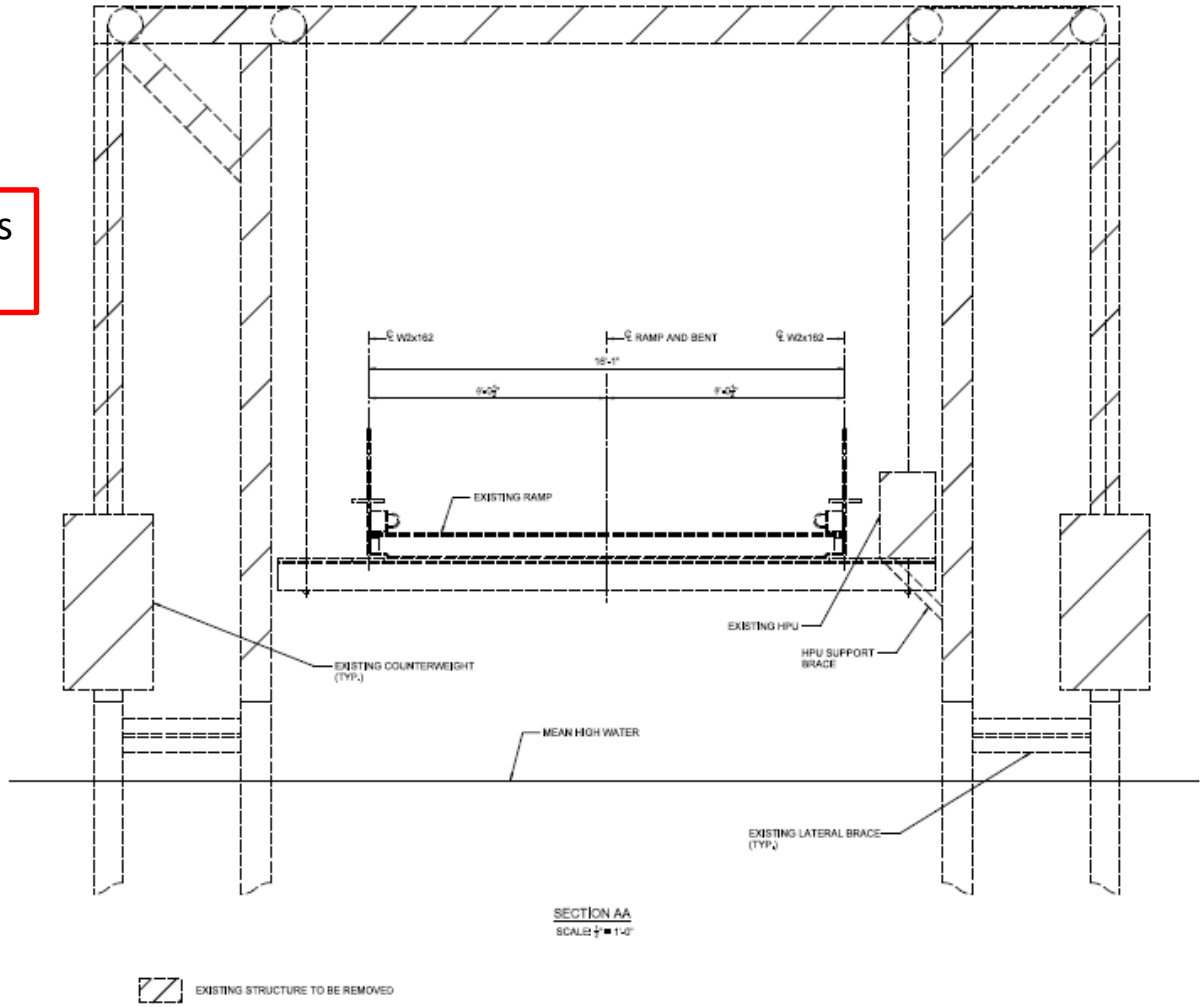
Traditional Ramp & Gantry Design

Traditional Ramp & Gantry Design



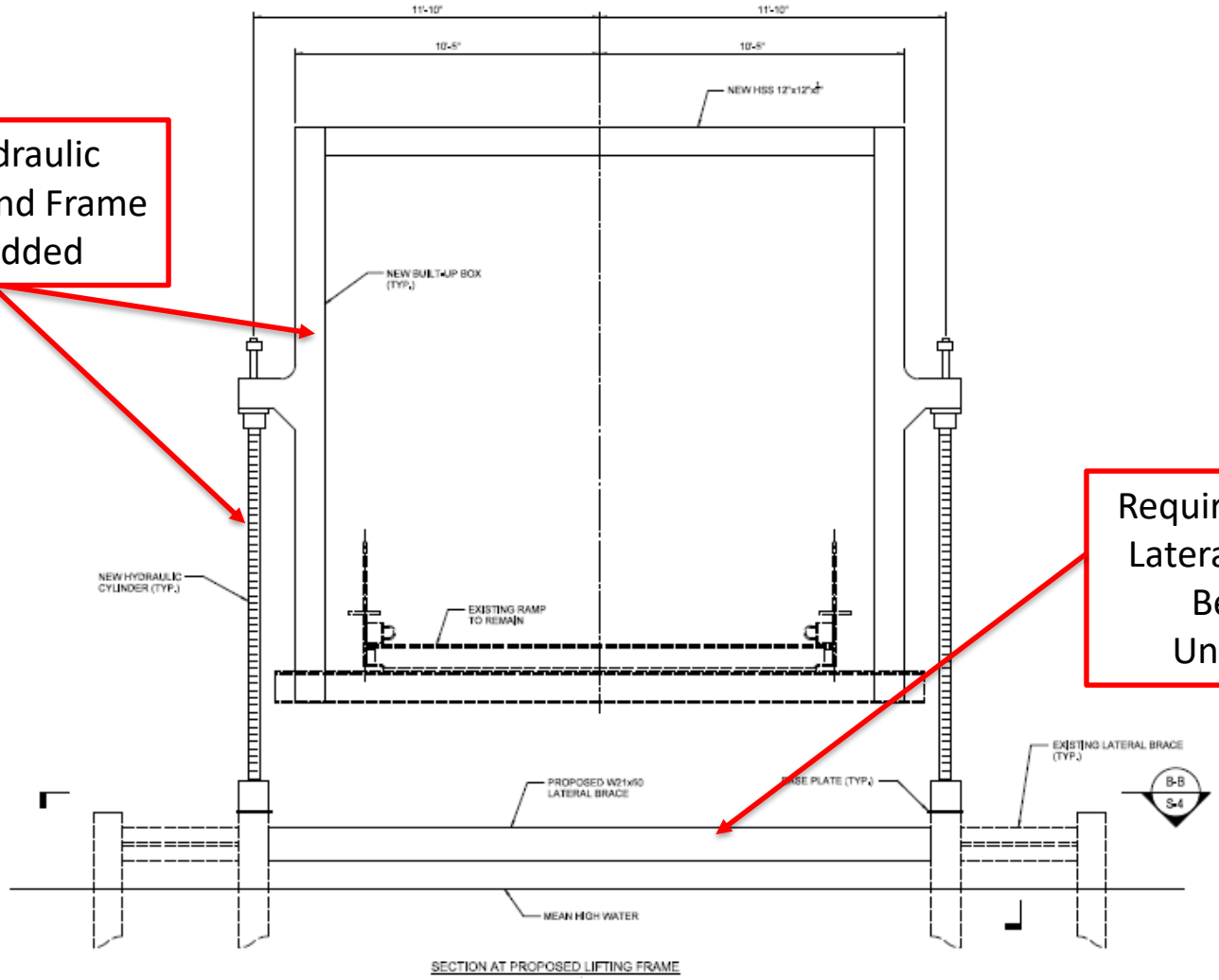
Traditional Ramp & Gantry Design

Hatched Sections To Be Removed



New Ramp & Gantry Design (For Spans < 40')

New Hydraulic Cylinders and Frame To Be Added

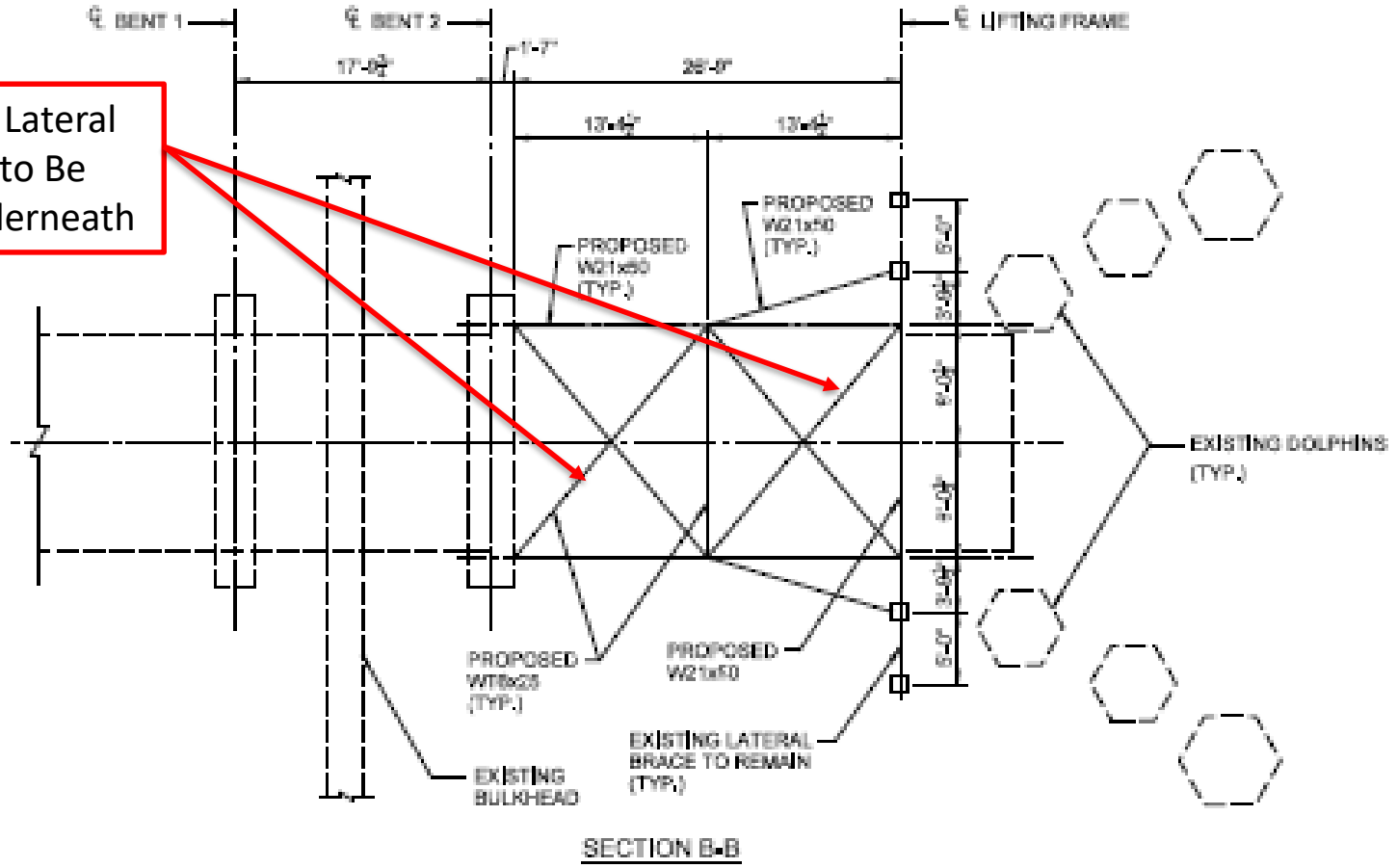


SECTION AT PROPOSED LIFTING FRAME

Requires Proposed Lateral Bracing to Be Added Underneath

New Ramp & Gantry Design (For Spans < 40')

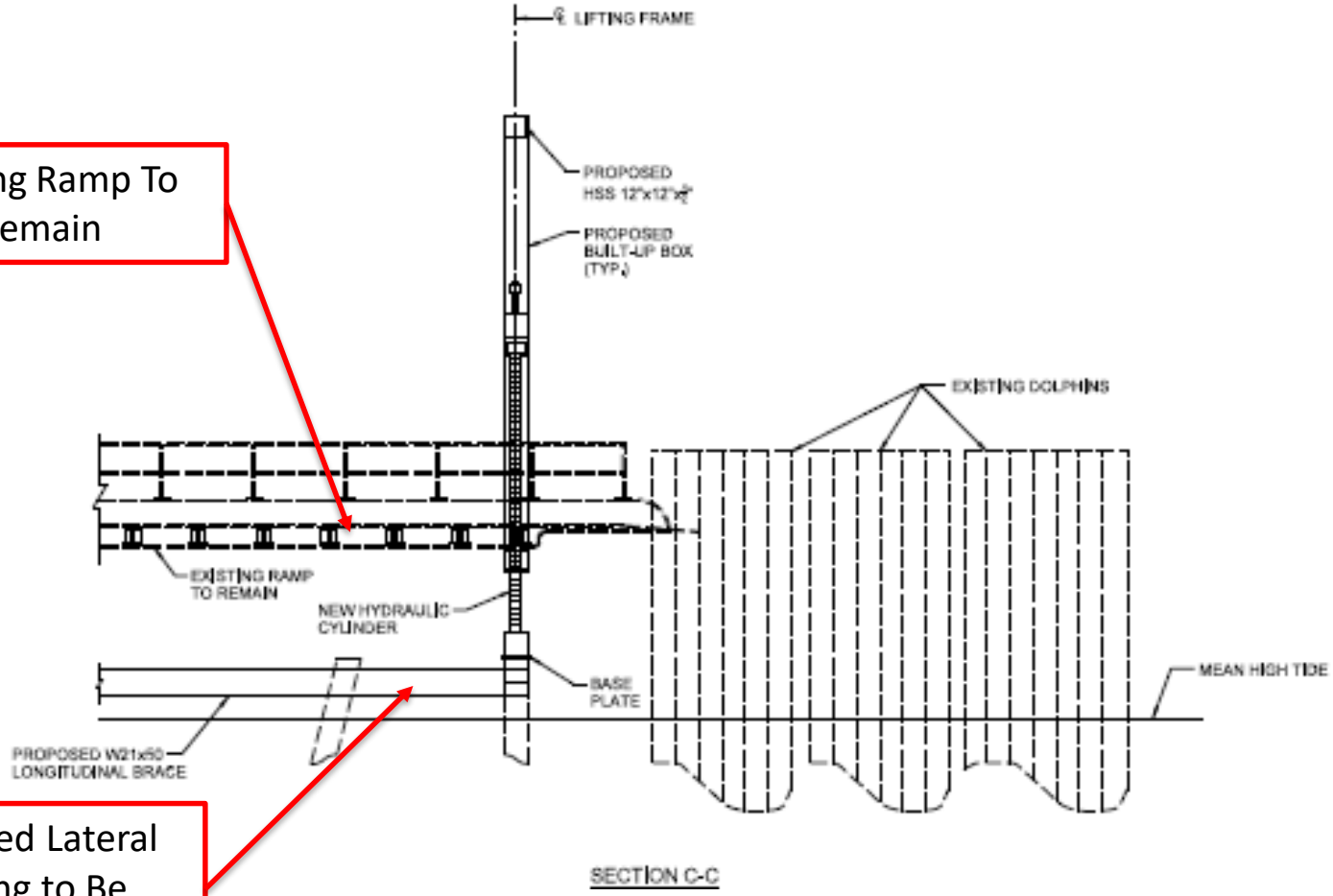
Proposed Lateral Bracing to Be Added Underneath



SECTION B-B

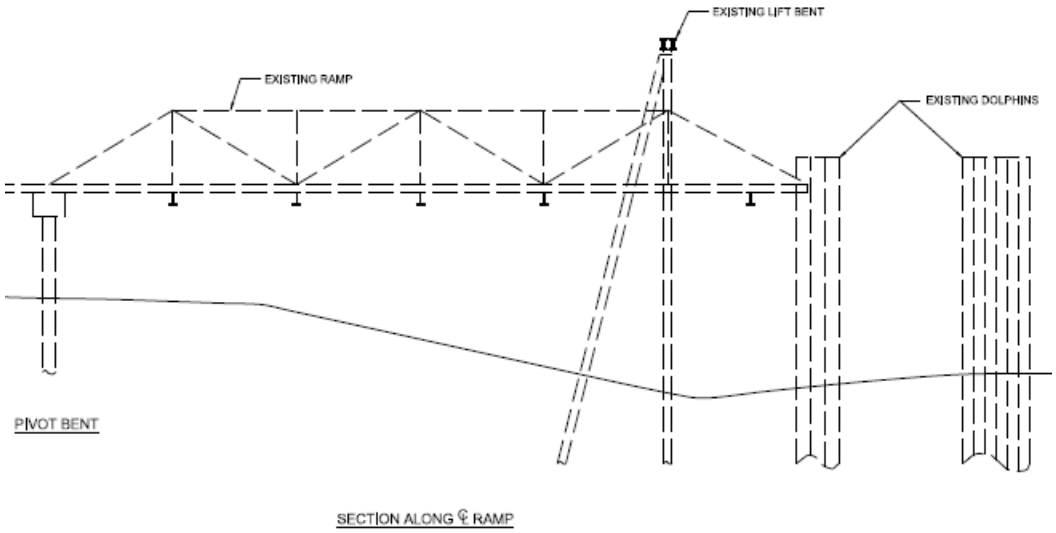
New Ramp & Gantry Design (For Spans ±75')

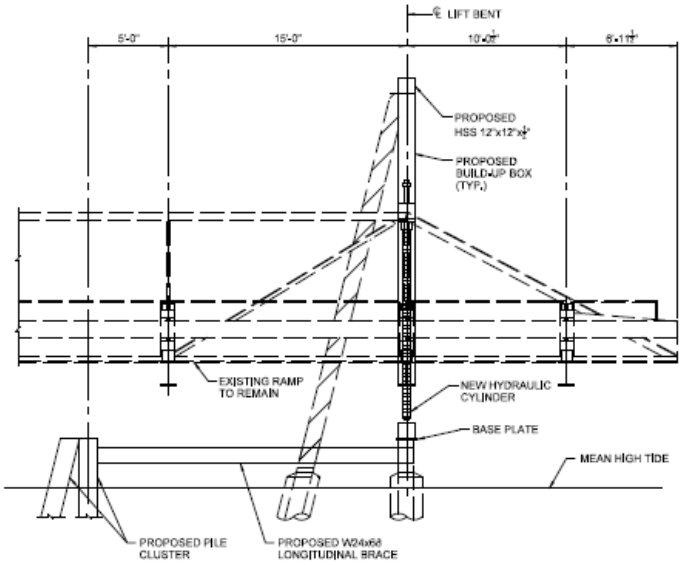
Existing Ramp To Remain



Proposed Lateral Bracing to Be Added Underneath

New Ramp & Gantry Design (For Spans ±75')





- South Port & Fort Fisher Design Is A Similar Design
- Difference due to Movable Span is 75' in length here versus (approximately) 25'at all other locations
- South Port & Fort Fisher Ramps are the first two ramps we will convert to this new configuration ($3M non-recurring funds received in FY2017-18 budget)

Advantages of Proposed Simplified Under Deck Hydraulic Operating System

- Eliminates majority of moving parts that generate majority of annual maintenance needs (i.e.: sheaves, wire rope, counter weight system, etc.)
- Less moving parts equates to reduced opportunities for mechanical failures due to all the inter-related systems, therefore new system will inherently be much more reliable and less prone to breakdowns and/or failures.
- In comparison the maintenance of the new system will be 35% - 40% less than the maintenance required for the existing system we currently have.

Summary of Study Options

- Option #1: Immediate Replacement of all existing ramps with an under deck hydraulic system.

- Option #2: This option retrofits all existing ramps to a simplified under deck hydraulic operating system with a subsequent total replacement when the ramps have reached the end of their useful life.

- Option #3: This option continues the rehabilitation of the 24 NCDOT ferry ramps to extend the design life of each to match that of the precast pre-stressed core slabbed approaches (84 years).

Option #1: Immediate Replacement Option

- Immediate Replacement of all existing ramps with an under deck hydraulic system. The "perfect world" option.
- Of three options considered this option:
  - Most Expensive Option to DOT Through 2038 & 2nd Most Expensive through 2078
  - The Initial 3 year funding needs are by far the highest. 35% of the costs associated occur in first three years
  - Takes Roughly 25 years of decreased maintenance & rehab costs to offset up-front costs for full replacement
  - Annual Maintenance Costs = 21% of the total
  - Rehabilitation/Replacement Costs = 42% of the total
  - Provides safest, most reliable option while at the same time resulting in the lowest annual maintenance costs

Option #2: Design Life Replacement Option

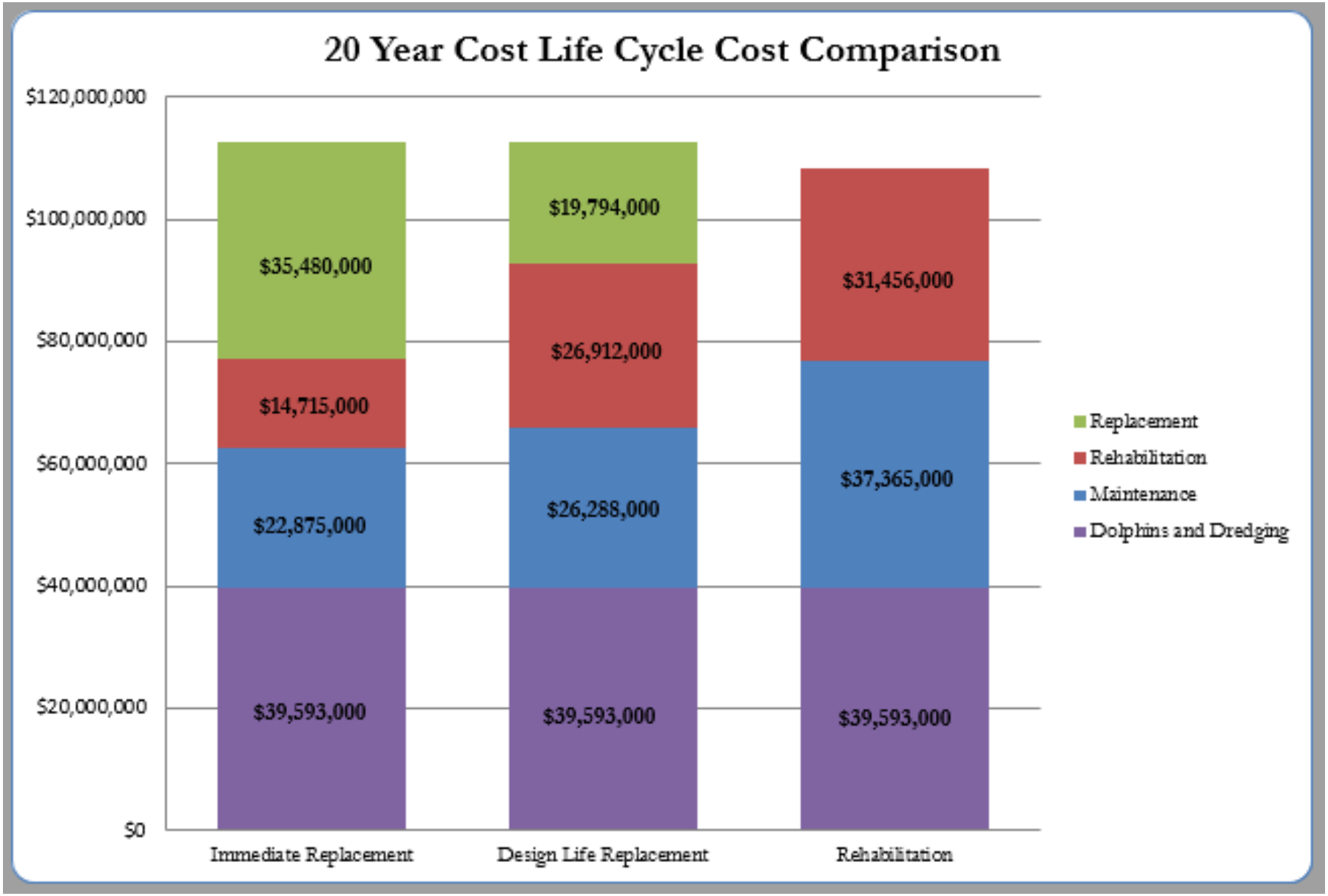
- This option retrofits all existing ramps to a simplified under deck hydraulic operating system with a subsequent total replacement when the ramps have reached the end of their useful life.
- Of three options considered this option:
  - 2nd Least Expensive Option to DOT Through 2038 & Least Expensive Option Through 2078
  - Allows for an immediate reduction in annual maintenance costs without having to invest the full amount needed for comprehensive replacements (in first 3 years) -$24.9M less expensive than Option #1 in first 3 years.
  - Annual Maintenance Costs = 23% of the total
  - Rehabilitation/Replacement Costs = 40% of the total
  - Best Compromise in regards to reduction in annual maintenance costs and noticeably smaller initial investment for rehab/replacement

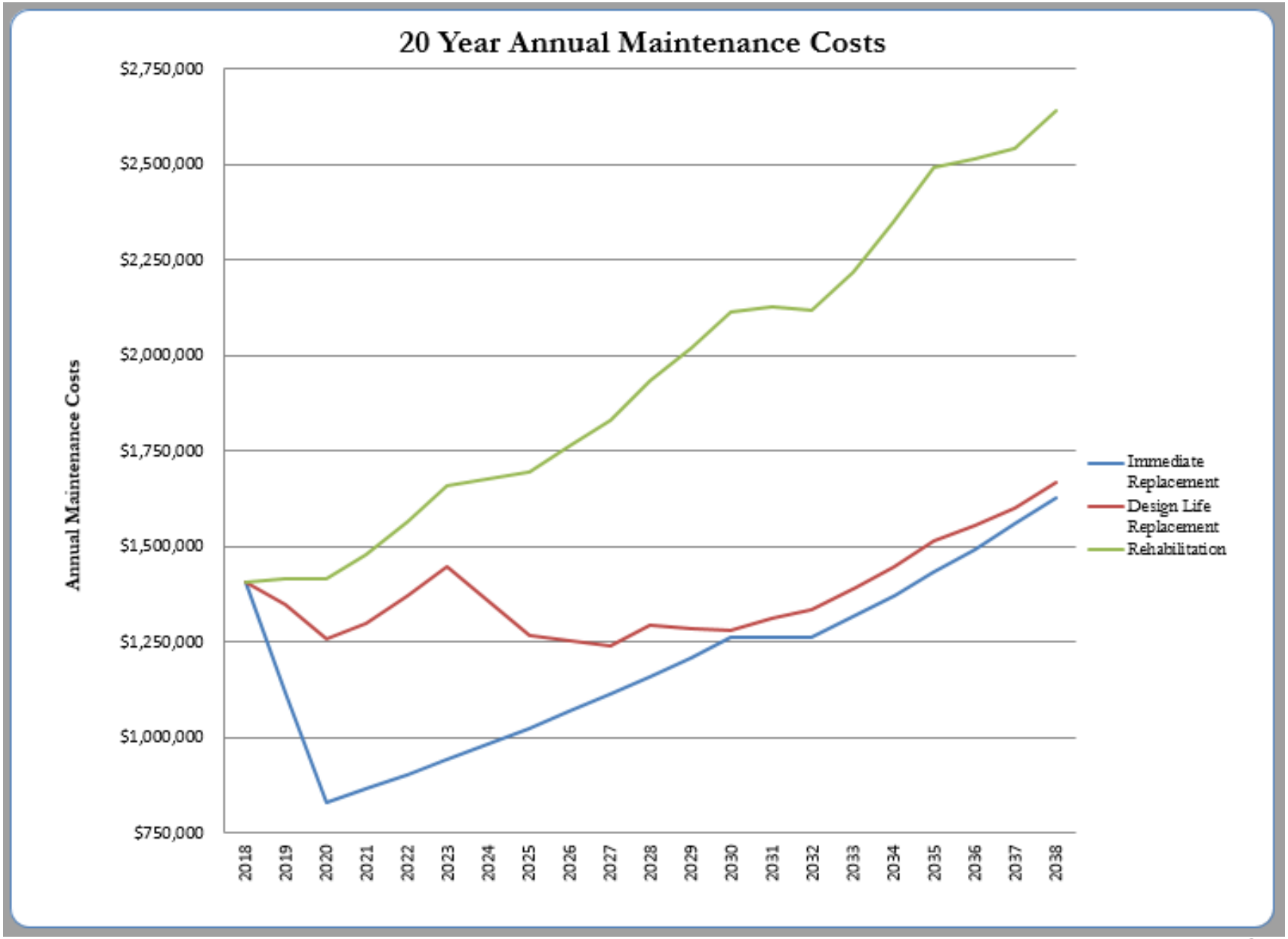
Option #3: Rehabilitation Option

- This option continues the rehabilitation of the 24 NCDOT ferry ramps to extend the design life of each to match that of the precast pre-stressed core slabbed approaches (84 years).
- *This system does not include the conversion to the simplified underdeck hydraulic system like options #1 and #2 as it relies on a replace in kind approach for the continued maintenance and repair.*
- *Pushes the replacement of all structures past the 60 years study period. As such NCDOT will eventually be dealing with 70+ year old movable structures that have a high probability of operational difficulties, costly maintenance needs, and structural deficiencies.*
- Of three options considered this option:
  - Least Expensive Option to DOT Through 2038
  - Most Expensive Option Through 2078
  - Annual Maintenance Costs = 35% of the total
  - Rehabilitation Costs = 29% of the total

Comparison of Ramp Treatments

Ramp & Gantry Approach	Cost per Location	Average 2017 Cost per R&G
Replacement to New System	$1.2M - $3.8M	$2.2M
Retrofit Replacement to New System	$0.5M - $2.15M	$1.2M
Rehabilitation of Current System	$0.375M - $1.375M	$0.7M


20 Year Cost Life Cycle Cost Comparison
$120,000,000
$100,000,000
$80,000,000
$60,000,000
$40,000,000
$20,000,000
$0
$35,480,000
$14,715,000
$22,875,000
$39,593,000
$19,794,000
$26,912,000
$26,288,000
$39,593,000
$31,456,000
$37,365,000
$39,593,000
Immediate Replacement
Design Life Replacement
Rehabilitation
Replacement
Rehabilitation
Maintenance
Dolphins and Dredging


20 Year Annual Maintenance Costs
Annual Maintenance Costs
$2,750,000
$2,500,000
$2,250,000
$2,000,000
$1,750,000
$1,500,000
$1,250,000
$1,000,000
$750,000
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
Immediate Replacement
Design Life Replacement
Rehabilitation

Recommended Ramp & Gantry Replacement Order

PROPOSED SEQUENCE OF WORK

It is understood that short-term funding for the retrofit and/or replacement of the various ferry ramps will need to happen in a systematic and staggered approach. With this in mind, the following sequence of work was developed to assist the NCDOT in prioritizing and planning for the proposed upgrades to the existing ferry system:

1. Southport = Retrofit ramp to under deck system
2. Fort Fisher = Retrofit ramp to under deck system
3. Ocracoke = Full replacement of both ramps with conversion to under deck system
4. Bayview = Retrofit ramp to under deck system
5. Minnesott Beach – East Ramp = Retrofit ramp to under deck system
6. Cherry Branch – South Ramp = Full replacement of ramp with conversion to under deck system
7. Aurora = Retrofit ramp to under deck system
8. Southdock = Full replacement of all three ramps with conversion to under deck system
9. Cedar Island = Full replacement of both ramps with conversion to under deck system
10. Swan Quarter = Retrofit of both ramps to under deck system
11. Minnesott Beach – West Ramp = Retrofit of ramp to under deck system
12. Currituck = Retrofit of ramp to under deck system
13. Knotts Island = Retrofit of ramp to under deck system
14. Stumpy Point = Retrofit of ramp to under deck system
15. Rodanthe = Full replacement of ramp with conversion to under deck system
16. Hatteras = Full replacement of all three ramps with conversion to under deck system
17. Cherry Branch – North Ramp = Retrofit of ramp to under deck system

Cost Comparison of Options

	Costing Categories	Total Needs thru 2038	Annual Needs thru 2038	Actual Amount Spent in FY16-17	Annual Additional Funds Needed to Substain Option
Option #1 Immediate Replacement	Annual Maintenance	$22,874,810	$1,089,277	$54,965	$1,034,312
	Replacement Costs	$50,195,037	$2,390,240		$2,390,240
	Dolphins & Dredging	$39,593,184	$1,885,390	$633,124	$1,252,266
	Total Needs	$112,663,031	$5,364,906	$688,089	$4,676,817
Option #2 Design Life Replacement	Annual Maintenance	$26,288,206	$1,251,819	$54,965	$1,196,854
	Replacement/Retrofit Costs	$46,705,403	$2,224,067		$2,224,067
	Dolphins & Dredging	$39,593,184	$1,885,390	$633,124	$1,252,266
	Total Needs	$112,586,793	$5,361,276	$688,089	$4,673,187
Option #3 Rehabilitation	Annual Maintenance	$37,365,278	$1,779,299	$54,965	$1,724,334
	Rehabilitation Costs	$31,455,777	$1,497,894		$1,497,894
	Dolphins & Dredging	$39,593,184	$1,885,390	$633,124	$1,252,266
	Total Needs	$108,414,239	$5,162,583	$688,089	$4,474,494

Comparison of Years 1 thru 3 Costs

	Costing Categories	Total Needs For First 3 Years
Option #1 Immediate Replacement	Annual Maintenance	$2,250,000
	Replacement Costs	$35,600,000
	Dolphins & Dredging	$2,450,000
	Total Needs	$40,300,000
Option #2 Design Life Replacement	Annual Maintenance	$3,430,000
	Replacement/Retrofit Costs	$10,700,000
	Dolphins & Dredging	$2,450,000
	Total Needs	$16,580,000
Option #3 Rehabilitation	Annual Maintenance	$3,500,000
	Rehabilitation Costs	$5,680,000
	Dolphins & Dredging	$2,450,000
	Total Needs	$11,630,000

Historical Funding Sources

- Prior to STI ramps & gantry replacements were funded as a part of the Bridge Replacement Program
- Prompt Actions and Emergency Repairs were funded from the Moveable Bridge Repair Funds.
- Bulkheads, dolphins, and dredging were generally funded through Ferry Division Maintenance and Operations funds. There was one project funded pre-STI for replacing all the dolphins at Southport and Fort Fisher. This project was completed in July of 2017 for approximately $925K.
- Ferry Boat Discretionary Funds: Federal funds – these funds went away with MAP-21

Current Funding Sources

- Under STI Terminal Assets: are only eligible if related to a capacity expansion project.
- Ferry Boat Program: FAST Act funding (Federal). Requires 80/20 Federal/State match. Funds allocated to NC roughly $1.6M per year. These funds are currently programmed to go toward vessel projects for the next several years.
- Current work on bulkheads, dolphins, and dredging are funded through Ferry Division's Maintenance and Operations budget. As shown current funding is insufficient to address the identified needs across the system.
- $3M in funds (non-recurring) were allocated in FY17-18 budget in order to address the retrofit of the Southport & Fort Fisher ramps to the new configuration.
- There are no recurring funds identified at this time for scheduled replacement/retrofits of any of the remaining terminal locations.

Summary

- Ferry Division would like to move forward with Option #2 as a preferred asset management plan for terminal assets
- This plan would greatly reduce maintenance costs, decrease downtime, and improve system reliability with the new ramp & gantry design that would be implemented through a mixed approach of replacements and retrofits.
- In regards to funding this would require:
  - Annual Operations & Maintenance Increase of:
    - Ramp & Gantry Annual Maintenance = $1.2M*
    - Dolphin/Bulkhead & Dredging Maintenance = $1.23M*
  - A Recurring Fund Created for:
    - Ramp & Gantry Replacements and Retrofits = $ 2.25M*
  - Total Annual Funds Increase = $4.68M*

*Based on annualized costs based over 20 years

Questions?

NORTH CAROLINA FERRY SYSTEM