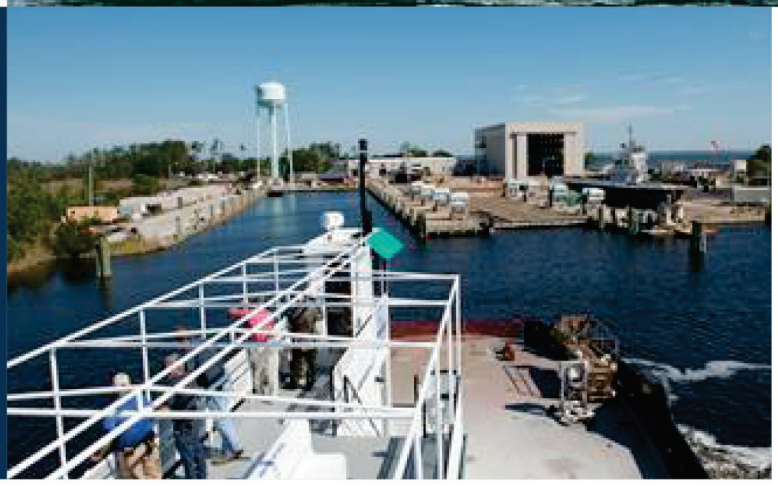

Study Report

Ferry Division Vessel Replacement Study

North Carolina Department of Transportation

Manns Harbor, North Carolina

February
2024

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Executive Summary

Study Scope

As mandated in Section 41.11A.(a) of the North Carolina General Assembly Appropriations Act of 2023 dated September 17, 2023:

> Ferry Vessel Replacement Plan "The Ferry Division of the Department of Transportation shall develop a plan for replacing its fleet. The plan shall identify each vessel owned by the Department of Transportation at the time of publication of the report and, in addition, include all of the following information:
>
> (1) The date each vessel entered service.
> (2) The routes and division served by each vessel.
> (3) An assessment of the condition of each vessel.
> (4) The estimated remaining service life of each vessel.
> (5) A schedule for replacing each vessel that includes all of the following:
> a. A rank order prioritization of vessel replacement that includes the estimated replacement date for each vessel.
> b. The class of vessel each vessel currently in service will be replaced with.
> c. The costs the Ferry Division will incur to replace each vessel.
> (6) Any funds dedicated or identified for replacing vessels, including the amount and source of the funds.
> (7) A list of potential interventions, if any, that could extend the life of each vessel currently in service. This list shall include (i) the cost of the intervention and (ii) the additional extended life the intervention would provide for the vessel."

Goals and Objectives

The goals of this study are to develop a plan that meets the requirements of Section 41.11A.(a) of the Appropriations Act and considers the current operational and maintenance environments of the North Carolina Department of Transportation (NCDOT) Ferry Division's 23 passenger/vehicle vessels that serve communities in coastal North Carolina. Key objectives of this study include the following:

- Apply a disciplined risk-based approach to vessel replacement prioritization.
- Create scenarios for determining future replacement costs of the ferry vessel fleet.
- Identify sources of funding the NCDOT Ferry Division could potentially access to cover some portion of the vessel replacement costs.
- Define a recommended sequence for vessel replacement that provides the best value for the Ferry Division and its stakeholders.

Project Milestones

The Ferry Division shall submit this plan to the chairs of the Joint Legislative Transportation Oversight Committee, the chairs of the House and Senate Transportation Appropriations Committees, and the Fiscal Research Division no later than March 1, 2024.

Approach

The approach to meeting the study objectives centers around the use of a risk-based prioritization framework frequently leveraged by asset intensive organizations to determine capital replacement of its critical assets.

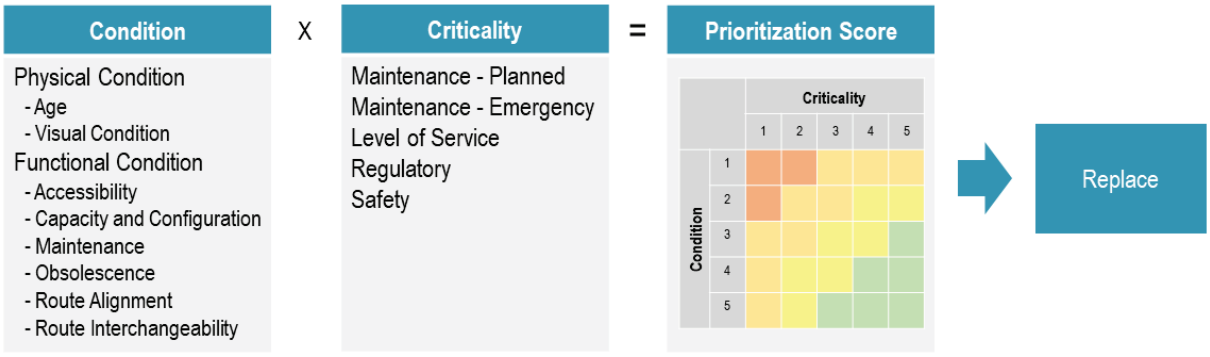

Figure ES 1 Prioritization framework

For the development of this plan, key elements of this approach included the following:

- Analysis of each vessel's age, physical condition, functional condition, and criticality.
- Based on FTA guidance and a review of similar agencies operating passenger ferry service, a useful life of 50 years was used for vessels in the Sound, River, and Hatteras class, while a useful life of 15 years was used for vessels in the Aluminum Ferry class.
- Visual condition assessment of 20 of the 23 vessels with acknowledgement of condition relative to timing of credit dry docking (CDD).
- Review and inclusion of results from previous studies conducted by the Ferry Division for vessel life cycle cost analysis.
- Alignment with Federal Transit Administration (FTA) best practice for determining vessel useful life and recognizing the impact of the North Carolina environmental conditions on vessel useful life.
- Analysis takes into account the current operational environment (e.g., River Class vessel supporting Hatteras-Ocracoke route) with particular attention to the significant impact the Hatteras-Ocracoke route has on vessel condition due to challenging channel conditions.
- Alignment with the concurrent shipyard capacity analysis to consider overall NCDOT and Ferry Division impact.

In addition to the risk-based prioritization framework analysis, eight scenarios for vessel replacement were developed to understand the impact of adjusting the frequency of replacements and the number

of vessels replaced. The frequency of the vessel replacements were every 2, 3, 4, or 5 years and number of vessels replaced per year was either one or two. Detailed financial scenarios were developed using a desktop analysis that considered replacement by vessel class (Sound, River, Hatteras, Aluminum Ferry) and age of vessel (Scenarios 1 through 8), and by outputs of the risk-based prioritization analysis (Scenarios 9 and 10). A comparison of these scenarios was conducted to determine the recommended vessel replacement sequence and associated costs over a 50-year horizon. Given the unique characteristics and relatively young age of the Ocracoke Express, a passenger only vessel in the Aluminum Ferry class, it was included within the financial scenarios based upon its age and anticipated replacement at the end of its useful life. The Ocracoke Express was not assessed in terms of visual condition, functional condition, or criticality, and thus an overall risk-based prioritization score was not given.

Financial Scenario Assumptions

The following financial assumptions were used in the development of the various scenarios.

- Five percent inflation per year based on a number of inputs:
    - United States (U.S.) projected annual inflation rate 2010-2018, International Monetary Fund (IMF) data.
    - Forecasted estimates for 2026-2028 (used for 2029 and beyond)
    - Inflation in shipbuilding industry according to the U.S. Federal Reserve
    - US Steel price index
- The study did not consider North Carolina state economic budget data.
- Each vessel replacement assumes a 5 percent administrative oversight/procurement cost in addition to vessel replacement total.
- Consistent use of a 5-year period from year of funding/start of design to year placed into service.
- The 2023 base cost estimates for acquisition of a new vessel as shown in Table ES-1 were determined through an analysis of past vessel acquisition total costs and discussion with Ferry Division Engineering staff. It is anticipated that the replacement vessel for the River and Hatteras classes will have similar characteristic as described in Section 7.2. These estimates will need to be validated once a confirmed vessel design configuration is determined for the replacement vessels.

Table ES-1 Summary of vessel age and base cost by class

Class	Number of Vessels	Average Age	Base Cost of New Vessel (million dollars, 2023)
Sound	5	28.4	35
River	11	17.3	20
Hatteras	6	34.3	20
Aluminum Ferry	1	2	8
Total/Cumulative	**23**	**24.5**	

*Note: The Total/Cumulative Average Age does not include the Aluminum Ferry class

Lastly, this study stresses the need for identifying additional funding sources, as the Ferry Division faces challenges in vessel replacement due to limited and restricted toll revenue, which amounted to $1.8 million in the recent fiscal year. Despite the revenue being dedicated to capital costs, it falls short of meeting the substantial financial requirement for vessel replacement. The study highlights the Ferry Division's future reliance on federal and state funding opportunities to bridge this gap.

Prioritization and Financial Scenario Results

The results of the risk-based prioritization led to a recommended replacement sequence as detailed in Table ES-2. In general, the lowest score indicates the first vessel to be replaced while the highest score identifies the last vessel to be replaced. After reviewing the initial risk-based results, even though it did not score the lowest, the Silver Lake vessel was identified as the first vessel to be replaced because it is currently the oldest vessel and is already included in the State Transportation Improvement Plan (STIP) for replacement. The remaining vessels in the Sound, River, and Hatteras class were prioritized based on the assessment outlined in Section 5, which considers the vessel's age, visual condition, functional condition, and criticality to the Ferry Division. The Ocracoke Express, part of the Aluminum Ferry class, was not assessed in terms of visual condition, functional condition, or criticality, but was included in the vessel replacement study based upon its age and anticipated replacement at the end of its useful life.

It is important to note these scores reflect a snapshot in time given the evaluation parameters described above and should be frequently reviewed to incorporate changes in vessel condition, operational environment, and maintenance schedules. Therefore, the schedule below is a general guide that will likely change over time.

Table ES-2 Ferry passenger/vehicle vessels by risk-based prioritization – order of replacement

Vessel	Class	Age	Risk-Based Prioritization
Silver Lake*	Sound	55	7.67
Gov. James B. Hunt	Hatteras	39	5.52
Chicamocomico	Hatteras	33	7.60
Hatteras	River	17	8.70
Carteret	Sound	35	8.91
Cedar Island	Sound	29	8.94
Croatoan	River	20	9.08
W. Stanford White	River	20	9.34
Frisco	Hatteras	34	9.42
Kinnakeet	Hatteras	34	9.56
Sea Level	Sound	11	9.72
Cape Point	Hatteras	33	9.93
Ocracoke	Hatteras	33	10.12
Gov. Daniel Russell	River	31	10.27
Neuse	River	25	10.40
Southport	River	27	10.44
Swan Quarter	Sound	12	10.55
Floyd J. Lupton	River	23	12.92
Fort Fisher	River	23	13.76
Rodanthe	River	4	14.24
Avon	River	0	20.37
Salvo	River	0	20.37
Ocracoke Express**	Aluminum Ferry	2	Not scored

*Although it did not score the lowest in terms of prioritization, Silver Lake is listed first as it is already included in the STIP.

**Ocracoke Express was not assessed in terms of visual condition, functional condition, or criticality, and thus an overall risk-based prioritization score was not given. It was included within the financial scenarios based upon its age and anticipated replacement at the end of its useful life.

This risk-based prioritization sequence was then used to create Scenarios 9 and 10 and compared with Scenarios 1 through 8 which were built based on vessel class and age as well as various replacement cycles. As shown in Table ES-3, Scenario 5 provides the lowest total cost for replacement over the 50-year horizon – $991.78 million; however, the financial feasibility of replacing two vessels every 2 years will require close coordination and financial support in the STIP. Scenario 6 and Scenario 10 both replace two vessels every 3 years and have a similar total cost over the 50-year horizon. Of these two, Scenario 10, with a cost of $1.4 billion, was built using the risk-based prioritization framework. The difference between the two scenarios is the order of vessel replacement.

Table ES-3 Vessel replacement scenarios

Scenario	Number of Vessels Replaced in Each Cycle	Schedule Replacement	Total Cost for Complete Fleet Replacement (millions)	Total Federal Cost Share (80%) (millions)	Total Local Match Requirement (20%) (millions)	Final Year of Funding	50-Year Cost Through 2073 (millions)	Number of Vessels Replaced in 50 Years	Percent of Fleet Replacement Over 50 Years	20-Year Cost Through 2043 (millions)	Number of Vessels Replaced in 20 Years	Percent of Fleet Replacement Over 20 Years
Scenario 1	1	2 years	$1,895.17	$1,516.14	$379.03	2069	$1,895.17	23	100%	$479.98	10	43%
Scenario 2	1	3 years	$4,081.94	$3,265.55	$816.39	2092	$1,356.31	17	74%	$341.74	6	26%
Scenario 3	1	4 years	$9,471.75	$7,577.40	$1,894.35	2115	$1,041.98	15	65%	$342.69	5	22%
Scenario 4	1	5 years	$23,125.16	$18,500.13	$4,625.03	2138	$948.25	12	52%	$280.67	4	17%
Scenario 5	2	2 years	$991.78	$793.42	$198.36	2047	$991.78	23	100%	$841.01	20	87%
Scenario 6	2	3 years	$1,388.04	$1,110.43	$277.61	2059	$1,388.04	23	100%	$536.99	12	52%
Scenario 7	2	4 years	$1,993.33	$1,594.67	$398.67	2071	$1,993.33	23	100%	$504.76	10	43%
Scenario 8	2	5 years	$2,316.77	$1,853.42	$463.35	2083	$2,155.13	20	87%	$445.03	8	35%
Scenario 9	1	3 years	$4,878.96	$3,903.17	$975.79	2092	$1,399.19	17	74%	$305.82	6	26%
Scenario 10	2	3 years	$1,412.03	$1,129.63	$282.41	2059	$1,412.03	23	100%	$552.31	13	57%

The best vessel replacement strategy recommended for NCDOT consideration is Scenario 10, with replacement of two vessels every 3 years with vessels identified for replacement determined through the use of a risk-based prioritization framework. Details on the specific costs projected for each of the vessels for Scenario 10 are shown in Table ES-4 with additional discussion provided in Section 7.1.

Table ES-4 Recommended replacement plan - Scenario 10

Vessel	Class	Age (as of 1/2024)	Risk-Based Prioritization	Year of Funding/ Start of Design	Year Placed into Service	Age at Time Placed into Service	Cost at Year of Funding, Including Estimated Overhead Cost (millions)
Silver Lake	Sound	55	7.67	2026	2031	62	$42.54
Gov. James B. Hunt	Hatteras	39	5.52	2026	2031	46	$24.31
Chicamocomico	Hatteras	33	7.6	2029	2034	43	$28.14
Hatteras	River	17	8.7	2029	2034	27	$28.14
Carteret	Sound	35	8.91	2032	2037	48	$57.01
Cedar Island	Sound	29	8.94	2032	2037	42	$57.01
Ocracoke Express	Aluminum Ferry	2	Not Scored	2032	2037	15	$13.42
Croatoan	River	20	9.08	2035	2040	36	$37.71
W. Stanford White	River	20	9.34	2035	2040	36	$37.71
Frisco	Hatteras	34	9.42	2038	2043	53	$43.66
Kinnakeet	Hatteras	34	9.56	2038	2043	53	$43.66
Sea Level	Sound	11	9.72	2041	2046	33	$69.49
Cape Point	Hatteras	33	9.93	2041	2046	55	$69.49
Ocracoke	Hatteras	33	10.12	2044	2049	58	$58.51
Gov. Daniel Russell	River	31	10.27	2044	2049	56	$58.51
Neuse	River	25	10.4	2047	2052	53	$67.73
Southport	River	27	10.44	2047	2052	55	$67.73
Swan Quarter	Sound	12	10.55	2050	2055	43	$137.20
Floyd J. Lupton	River	23	12.92	2050	2055	54	$78.40
Fort Fisher	River	23	13.76	2053	2058	57	$90.76
Rodanthe	River	4	14.24	2053	2058	38	$90.76
Avon	River	0	20.37	2056	2061	37	$105.07
Salvo	River	0	20.37	2056	2061	37	$105.07

Recognizing Funding Adjustments Based on STIP Updates

The recommendations in this vessel replacement study will change over time as funding changes for individual vessels or for overall programs. Inclusion in the approved STIP is the required first step in determining whether a project (vessel replacement) is funded or not. For example, the Rodanthe vessel was funded in the STIP several years ago when it was replaced.

The current STIP was approved in February 2024 by the Federal Highway Administration (FHWA) and North Carolina Board of Transportation and must be updated at least once every 4 years. The current

STIP is for the 10-year period 2024–2033. Of the 98 different funding sources allocated in the STIP, 48 are governed by the state's Strategic Transportation Investments (STI) law passed in 2013. The STI established a strategic mobility formula for allocating available revenue based on a data-driven scoring process and local input. Funding is distributed in three categories: Division Needs, Regional Impact, and Statewide Mobility. Ferry vessel replacements are scored and potentially funded in two of the categories. In this approved STIP, funding has not been allocated to vessel replacement. The vessels identified in the current STIP but not funded are:

- Fort Fisher, River Class Ferry – project estimate of $14 million;
- Silver Lake, Sound Ferry – project estimate of $25.6 million; and
- Hatteras, Passenger Ferry – project estimate of $6.5 million.

There are formula-based and discretionary federal funding sources NCDOT's Ferry Division could leverage to help pay for the vessel replacements. Examples of potential federal funding sources which are eligible are shown in Table ES-5. These sources must also be incorporated into the STIP before they can be spent. Because the vessels in this analysis are passenger and vehicle, their replacement could be partially funded with a variety of federal sources. Most competitive federal grant sources have a 20 percent match requirement. Existing state and federal funding sources are outlined in Section 6 as are potential federally authorized financing programs to address its capital needs.

For Scenario 10, a 20 percent match equals $282.41 as shown in Table ES-3. Scenario 4 with a 5-year, one vessel replacement cycle has the highest estimated match and cost because of the long period of time required to replace all vessels. Additional detail on each of these programs is provided in Section 6.

Table ES-5 Formula and potential federal funding

Program Name	Agency	Fleet Expansion and Applicable Engine Retrofitting
Electric or Low-Emitting Ferry Pilot Program	Federal Transit Administration	☑
Ferry Service for Rural Communities	Federal Transit Administration	☑
Diesel Emissions Reduction Act	Environmental Protection Agency	☑

Intervention Strategies

In addition to recognizing the STIP funding impact, several intervention strategies were identified that could help extend the life of each vessel currently in service. These strategies encompass several key areas aimed at enhancing safety, efficiency, and reliability across the vessel fleet and should be considered in future initiatives.

First, the Ferry Division should continue looking into the implementation and expansion of a Safety Management System (SMS). An SMS would enhance vessel maintenance tracking, trend identification, and repair planning, fostering a proactive approach to safety and maintenance. The Ferry

Division should also continue the transition from central and standalone HVAC systems to mini split units, which are known for their suitability, cost-effectiveness, and reduced maintenance requirements. Propulsion system upgrades are recommended, with a focus on replacing outdated mechanical units with more efficient alternatives to mitigate maintenance demands and enhance performance. Additionally, integrating maintenance history and analysis is advised to glean insights into recurring issues and intervention effectiveness, enabling informed decision-making and resource allocation.

Finally, proactive management of channel depths emerges as a crucial strategy to prevent vessel groundings, especially in challenging routes like the Hatteras to Ocracoke, where shallow waters and difficult channel routing pose heightened risks. By proactively maintaining channel depths, potential delays and operational disruptions are mitigated, underscoring the commitment to passenger safety and service reliability. These multifaceted strategies collectively underscore a holistic approach to enhancing the resilience and operational effectiveness of the ferry fleet, ensuring a safer and more efficient transportation service for all stakeholders.

Next Steps

The vessel replacement study lays the groundwork for the replacement of the Ferry Division's fleet over the next fifty years. Through a risk-based prioritization approach and financial analysis, the study identifies a schedule for replacing each vessel. This proposed schedule, involving the phased replacement of two vessels every three years, ensures the sustained reliability and efficiency of the fleet while maximizing available funding. The study also highlights intervention strategies aimed at prolonging the lifespan and enhancing the performance of existing vessels, reflecting a proactive approach to fleet management and ensuring the continued provision of safe, reliable transportation services for coastal communities across North Carolina.

To further enhance vessel performance and longevity, it is recommended that the Ferry Division expands the application of this risk-based prioritization approach to include activities beyond replacement, such as rehabilitation and maintenance. Developing comprehensive life cycle plans informed by current vessel conditions and historical maintenance records will facilitate precise scheduling of these activities and improve coordination of work logistics. Additionally, adopting a routine vessel inspection program, conducting root cause analyses of historical unplanned maintenance, and implementing identified interventions to extend vessel life beyond planned useful life will be crucial next steps. Finally, exploring innovative procurement strategies, such as scalable vessel procurement contracts, can address constraints in the shipbuilding industry and regulatory requirements, ensuring an efficient and streamlined replacement process.

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01

Introduction

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1 Introduction

The North Carolina Department of Transportation (NCDOT) works to connect the people, products, and places of the state of North Carolina. The Ferry Division is undertaking a vessel replacement study to develop a plan for replacement of its fleet as outlined in Section 41.11A(a)(b) of the special provisions included in the North Carolina 2023 Appropriations Act. This study aims to analyze vessel condition, criticality, replacement cost, and potential funding sources to guide the replacement plan.

1.1 Ferry Division

The NCDOT Ferry Division has served the coastal region for over 70 years and is a critical lifeline for the communities it serves. In 2023, North Carolina ferries carried more than one and a half million passengers and 700,000 vehicles, making it the second largest state-run ferry system in the U.S. with only the State of Washington's system being larger.1

The Ferry Division operates 23 vessels to provide daily passenger/vehicle service on seven regular routes across the Currituck and Pamlico Sounds and the Cape Fear, Neuse, and Pamlico rivers. Twenty-two of the vessels are classified as either Sound, River, or Hatteras. The Ferry Division also operates one passenger-only vessel, the Ocracoke Express, several support vessels, and the most significant maintenance shipyard between Norfolk, Virginia and Charleston, South Carolina.

Although the ferry system has the highest passenger count during the warmer months, spanning mostly from May through September, it is also an essential transportation method year-round for those who live and work in the region. The ferry system in North Carolina operates in the eastern counties of Currituck, Hyde, Carteret, Beaufort, Dare, Pamlico, Craven, Brunswick, and New Hanover. Each route provides valuable connections to and from communities. For example, one route offers Knott's Island school children a route to their school on the mainland, another connects Ocracoke residents to their county seat in Hyde County, and another provides workers at the mining companies in Aurora and the Cherry Point Marine Corps Air Station a direct connection to their homes. While the ferry system operates in and serves these eastern communities, the system is essential statewide as a driver for tourism in North Carolina. Two of the most used routes, Southport–Fort Fisher, and Hatteras–Ocracoke, operate primarily to link tourists to attractions on the Outer Banks and the Cape Fear area.

As a critical lifeline, the ferry system also operates two designated evacuation/emergency routes. These emergency routes provide a critical service during evacuation, recovery, and rebuilding efforts by transporting essential supplies, equipment, emergency response, workers, residents, and volunteers. On the Outer Banks, from the area north of Rodanthe to the sound end of Ocracoke, there is only one road—NC HWY 12—that travels its length. During major storms, this route is typically closed and damaged due to ocean overwash and sand accumulation.

[1] "A Year in Review" https://www.ncdot.gov/divisions/ferry/Pages/default.aspx

In total, three of the seven regular routes shown in Figure 1-1 and Table 1-1 have no alternative roadway route if the ferry system is not in service.

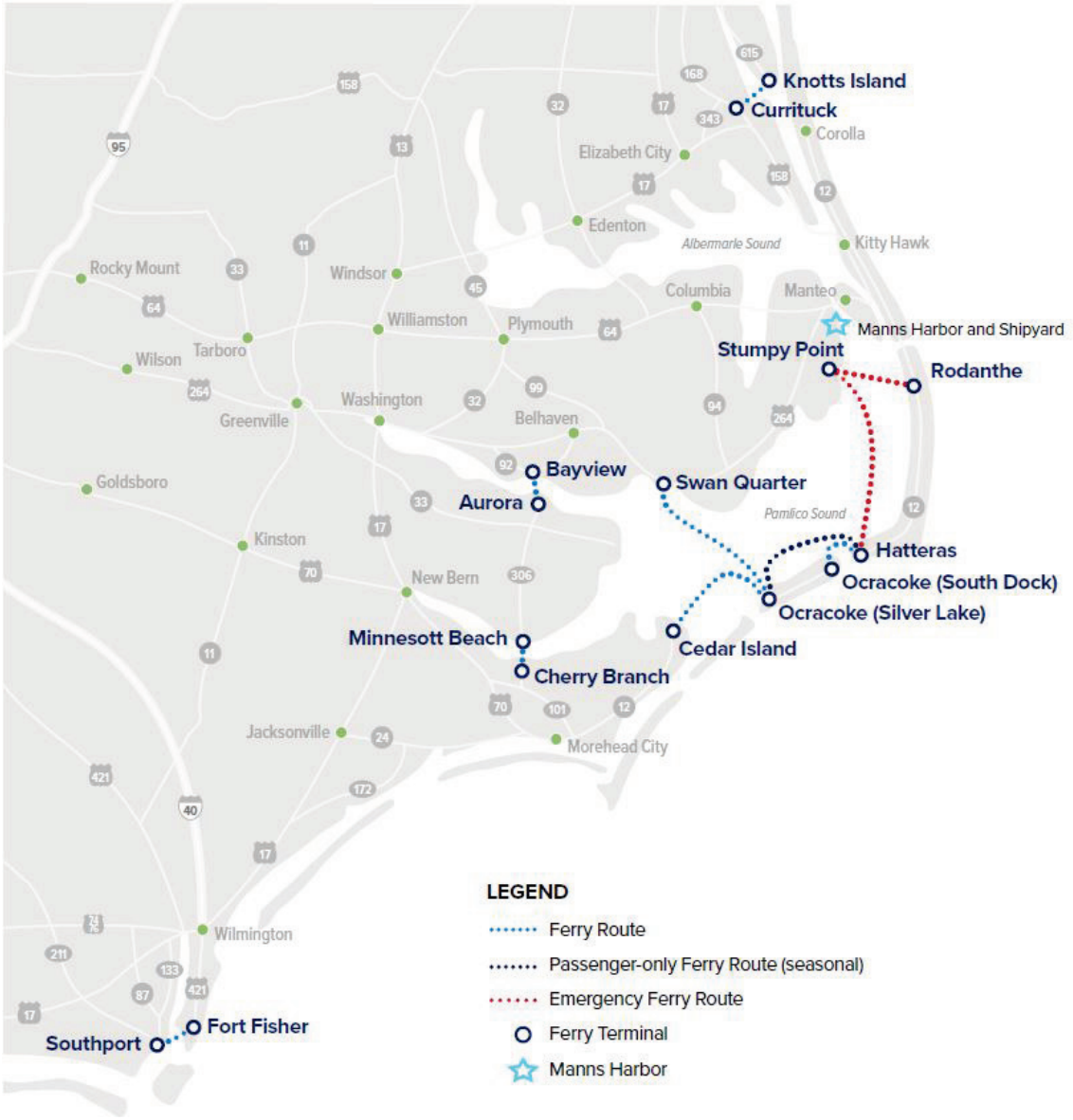

Figure 1-1 NCDOT ferry routes and region (source: Long-Range Plan 2050)

1.1.1 Regularly Operated Routes and Seasonal Passenger Ferry Route

- Aurora-Bayview – Connects the town of Bayview and Aurora across the Pamlico River. This 3.5-mile, 30-minute route has mostly resident passengers since work is the largest trip purpose for travel. River class vessels service this route. There is a driving alternative for this route which has a travel time of around 68 minutes.
- Cedar Island-Ocracoke – Connects Carteret and Hyde counties by connecting Cedar Island and Ocracoke Island along the Pamlico Sound. The route spans 23 miles and is scheduled to take over 2 hours. Sound class vessels operate this route. Most passengers on this route are

visitors to the region and it is busiest in the summer months. There is no driving alternative for this route.

- Cherry Branch–Minnesott Beach – Crosses the Neuse River to connect the towns of Havelock and Minnesott Beach. The route is about 2.5 miles, has a crossing time of about 20 minutes and is serviced by River class vessels. There is a driving alternative for this route which has a travel time of around 63 minutes.
- Currituck–Knotts Island – Traverses from the mainland of North Carolina, Currituck, to Knott's Island, an island shared by North Carolina and Virginia. This 5-mile route has a scheduling travel time of about 45 minutes and is serviced by a Hatteras class vessel. There is a driving alternative for this route which has a travel time of around 58 minutes.
- Hatteras–Ocracoke (Silver Lake) – The passenger-only service connects Hyde and Dare counties across the Hatteras Inlet to the Silver Lake dock on the island. This 22-mile route has a crossing time of about 70 minutes and is busiest in the summer months with tourism. This route is served by the vessel in the Aluminum Ferry class. There is no driving alternative for this route.
- Hatteras–Ocracoke (South Dock) – Connects Hyde and Dare counties across the Hatteras Inlet. This 8.5-mile route has a crossing time of about 1 hour and is busiest in the summer months with tourism. This route is served by vessels in the Hatteras and River classes. There is no driving alternative for this route.
- Southport–Fort Fisher – Connects the city of Southport in the mainland of North Carolina with Fort Fisher across the Cape Fear River. The route is about 3.5 miles long and has a crossing time of 35 minutes. The route is served by vessels in the River class. There is a driving alternative for this route which has a travel time of around 70 minutes.
- Swan Quarter–Ocracoke – Traverses the Pamlico Sound to connect Swan Quarter to Ocracoke Island. The longest route in the Ferry Division, the trajectory is about 27 miles and takes over 2.5 hours. The route is served by Sound class vessels. There is no driving alternative for this route.

Table 1-1 NCDOT ferry route characteristics[2]

NCDOT Route	Crossing Time (minutes)	Drive Time Alternative (minutes)
Aurora–Bayview	30	68
Cedar Island–Ocracoke (Silver Lake)	135	No Alternative
Cherry Branch–Minnesott Beach	20	63
Currituck–Knotts Island	45	58
Hatteras–Ocracoke (Silver Lake) Passenger Ferry	70	No Alternative
Hatteras–Ocracoke (South Dock)	60	No Alternative
Southport–Fort Fisher	35	70
Swan Quarter–Ocracoke (Silver Lake)	160	No Alternative

[2] Long-Range Plan

1.1.2 The Challenges of the Hatteras–Ocracoke Route

The waters off the coast of North Carolina, in particular near the Outer Banks including Hatteras and Ocracoke Islands, are known as the graveyard of the Atlantic. This is due to the changing weather and ocean conditions which have historically caused numerous ship sinkings from early colonial times to the present day. Hurricanes, nor'easters, strong ocean and inlet currents, and other weather conditions create difficult navigation for vessels in this area. The vessels transiting in the Hatteras Inlet are not immune to the strong currents, shoaling, tidal changes, and wind conditions. Due to shoaling and lack of channel maintenance the ferry route from Hatteras village to Ocracoke South Dock shifts constantly with new routes required on a regular basis. Channel maintenance is the responsibility of the US Army Corps of Engineers in the federally designated Hatteras to Ocracoke channels.

For example, the initial route from Hatteras village, across the Hatteras Inlet, to Ocracoke South Dock was an approximate 20-minute trip each way. Due to shoaling, the route was revised to the route identified as the Horseshoe Channel in 2013. This channel as shown in Figure 1-2 extends initially westward from Hatteras towards the mainland into the Pamlico sound, then turns southward and then again eastward to Ocracoke South Dock. This route duration was approximately 60 minutes each way.

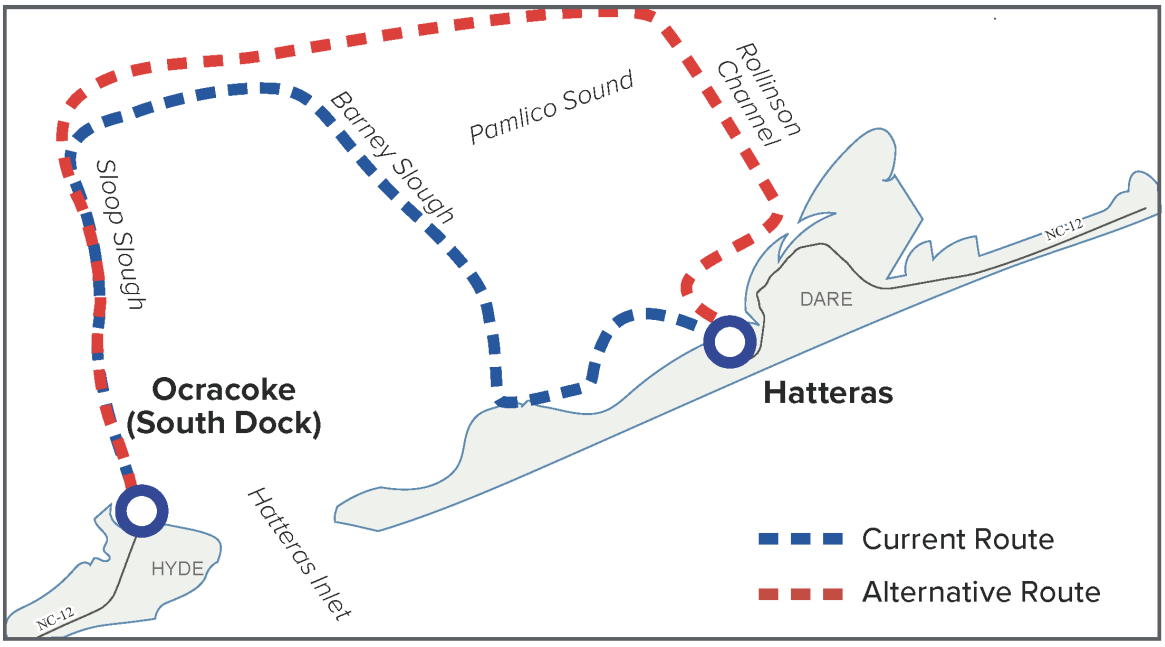

Figure 1-2 Previous Hatteras route and changes

Due to further shoaling, the route was once again revised in 2023, and the route now requires use of the channel known as the Rollison Channel. The vessels must now travel north from the Hatteras terminal before making the westward turn. The vessels then travel west, south, and again east. Additionally, as the vessel is approaching or departing from Ocracoke South Dock, the vessels must execute an "S" turn due to water depth limitations. Route duration is now approximately 80 minutes.

The water depth below keel during the latest route remains less than 2.0 feet for a significant stretch of the route. The changes in the routing and difficulties encountered due to limitations of channel depth, channel routing, and weather considerations create increased risk to the vessels by:

- Increased time underway and wear and tear exposure for hull and machinery.
- Decreased time between voyages resulting in less time for any minor maintenance and repairs when docked.
- Increased operation tempo for crew members resulting in additional stress and fatigue.
- Increased time onboard for crew and passengers, resulting in increased demand for facilities like toilets and passenger spaces.

1.2 Vessel Replacement Program

This vessel replacement study covers criteria for each of the Ferry Division's 23 passenger/vehicle vessels and includes details regarding vessel date of service, route and NCDOT geographic division served; an assessment of vessel condition, remaining useful life, and proposed vessel replacement schedule for current vessels and classes; costs, sources and uses of funding associated with subject replacements; as well as an evaluation of potential interventions and costs to extend the life of each vessel in service.

An updated vessel replacement schedule and program should improve service reliability, safety, and efficiency for the coastal region. The plan will allow the Ferry Division to better manage resources and priorities for replacing vessels and explore potential interventions to extend the lifespan of these critical assets.

The requirements for the Ferry Vessel Replacement Plan are listed in Table 1-2 and fall under Section 41.11A.(a) in the North Carolina special provisions included in the 2023 Appropriations Act as of September 17, 2023.

Table 1-2 Vessel replacement plan report requirements

Requirement	Description	Report Location
1	Date vessel entered service	Section 2.2
2	Route and NCDOT division served by each vessel	Section 2.1
3	Assessment of the condition of each vessel	Sections 3.2, 3.3
4	Estimated remaining service life of each vessel	Section 2.2
5	Schedule for replacing each vessel that includes rank order prioritization, class of vessel, estimated cost to replace each vessel.	Sections 5, 7.1
6	Funds dedicated or identified for replacing vessels, including the source and amount of the funds	Section 6
7	Potential interventions that could extend the useful life of the vessels including the cost of intervention and additional service life that the intervention would provide.	Section 7.3

1.3 Purpose and Structure

This study identifies the objectives, approach, and recommendations for the Vessel Replacement Plan for NCDOT Ferry Division. The sections of the study include:

- Section 2 Vessel Inventory – provides an overview to the Ferry Division's vessels.
- Section 3 Vessel Condition – defines the Ferry Division's approach to assessing vessel condition, both in terms of physical condition and functional condition and the current condition state of each vessel.
- Section 4 Vessel Criticality – defines the Ferry Division's approach to assessing vessel criticality.
- Section 5 Vessel Prioritization – summarizes the Ferry Division's risk-based approach to its replacement program and how it prioritizes vessels.
- Section 6 Funding Strategy and Financial Forecast Scenarios – examines proposed funding and financing sources strategies for replacing vessels, based on the inventory, condition, and life cycle activities. It also includes cost forecasts.
- Section 7 Vessel Replacement Plan – presents a recommended vessel replacement plan, including prioritized list of vessels, estimated time to replace the vessels, what vessels would be replaced with, the estimated cost the Ferry Division would incur to replace each vessel, and proposed intervention strategies that could extend the life of each vessel.
- Section 8 Future Improvements – provides several recommendations to improve the life cycle management of the vessels and leverage risk-based prioritization for future financial forecasting.

02

Vessel Inventory

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2 Vessel Inventory

The Ferry Division maintains an active inventory of its passenger/vehicle vessels, which serves as the foundation for its vessel replacement plan. This not only includes a documented record for each vessel but also key vessel characteristics that serve as direct inputs into the replacement study including age, route information, cost data, configuration and equipment, and maintenance history.

2.1 Ferry Fleet Overview

The Ferry Division owns, operates, and maintains 23 passenger/vehicle vessels which are divided into four classes: Sound, River, Hatteras, and Aluminum Ferry. Some vessels can operate on multiple routes, while others are limited to certain routes based on vessel and/or channel conditions. Specifically, due to channel geometries and weather conditions, vessels within the Sound class can only operate on Sound routes, while vessels within the River and Hatteras class can, for the most part, operate along other routes. The Ferry Division owns and operates a passenger-only vessel, the Ocracoke Express, which operates seasonally between Hatteras and Ocracoke, and is the only vessel in the Aluminum Ferry class. It is important to note the Ocracoke Express was not assessed in terms of visual condition, functional condition, or criticality, but was included within the vessel replacement study based upon its age and anticipated replacement at the end of its useful life.

2.1.1 Sound Class

The Sound class only serves the Cedar Island–Ocracoke and Swan Quarter–Ocracoke routes, through the turbulent waters of the Pamlico Sound. These vessels are the largest of the fleet, with capacity ranging from 46 to 50 vehicles and the ability to transport 300 passengers. The Sound class has a total of five vessels.

Table 2-1 Sound class vessels

Vessel	Route	NCDOT Division	Vehicle Capacity	Passenger Capacity	Length (feet)
Silver Lake	Cedar Island–Ocracoke Swan Quarter–Ocracoke	1/2	50	300	220
Carteret	Cedar Island–Ocracoke Swan Quarter–Ocracoke	1/2	50	300	220
Cedar Island	Cedar Island–Ocracoke Swan Quarter–Ocracoke	1/2	50	300	220
Swan Quarter	Cedar Island–Ocracoke Swan Quarter–Ocracoke	1/2	46	300	220
Sea Level	Cedar Island–Ocracoke Swan Quarter–Ocracoke	1/2	46	300	220

2.1.2 River Class

The River class vessels serve a total of four routes: Hatteras–Ocracoke (South Dock), Cherry Branch–Minnesott Beach, Aurora–Bayview, and Southport–Fort Fisher. The vessels in this class have a capacity of 40 vehicles and 300 passengers. There are eleven vessels in the River class. For the Hatteras–Ocracoke route, River class vessels are used to supplement Hatteras vessel journeys.

Table 2-2 River class vessels

Vessel	Route	NCDOT Division	Vehicle Capacity	Passenger Capacity	Length (feet)
Southport	Southport–Fort Fisher	3	40	300	180
Fort Fisher	Southport–Fort Fisher	3	40	300	180
Gov. Daniel Russell	Cherry Branch–Minnesott Beach	2	40	300	180
Neuse	Cherry Branch–Minnesott Beach	2	40	300	180
Floyd J. Lupton	Cherry Branch–Minnesott Beach	2	40	300	180
Avon	Cherry Branch–Minnesott Beach	2	40	300	184
Salvo	Cherry Branch–Minnesott Beach	2	40	300	184
W. Stanford White	Hatteras–Ocracoke (South Dock)	1	40	300	180
Croatoan	Hatteras–Ocracoke (South Dock)	1	40	300	180
Hatteras	Hatteras–Ocracoke (South Dock)	1	40	300	180
Rodanthe	Hatteras–Ocracoke (South Dock)	1	40	300	184

2.1.3 Hatteras Class

The Hatteras class, the smallest vessels, serve the Hatteras–Ocracoke (South Dock) and the Currituck–Knotts Island routes. The vessels in this class have a capacity of 20 to 30 vehicles and 149 passengers. There are six vessels in the Hatteras Class.

Table 2-3 Hatteras class vessels

Vessel	Route	NCDOT Division	Vehicle Capacity	Passenger Capacity	Length (feet)
Gov. James B. Hunt	Currituck–Knotts Island	1	20	149	159
Kinnakeet	Hatteras–Ocracoke (South Dock)	1	30	149	150
Frisco	Hatteras–Ocracoke (South Dock)	1	30	149	150
Chicamocomico	Hatteras–Ocracoke (South Dock)	1	30	149	150
Cape Point	Hatteras–Ocracoke (South Dock)	1	30	149	150
Ocracoke	Hatteras-Ocracoke (South Dock)	1	30	149	150

2.1.4 Aluminum Ferry Class

The Aluminum Ferry class includes the only passenger-only vessel in the Ferry Division and serves the Hatteras–Ocracoke (Silver Lake) route on a seasonal basis. The Ocracoke Express vessel has a capacity of 127 passengers.

Table 2-4 Aluminum Ferry class vessels

Vessel	Route	NCDOT Division	Vehicle Capacity	Passenger Capacity	Length (feet)
Ocracoke Express	Hatteras–Ocracoke (Silver Lake)	1	N/A	127	92

2.2 Vessel Inventory and Useful Life

The Ferry Division's vessel inventory is summarized in Table 2-5 including the date the vessel entered service, age, and the remaining useful life assuming a 50-year useful life.

A key indicator of vessel health and replacement criteria is the useful life, which is defined by the Federal Transit Administration (FTA) as "the period of time that an asset, either individually or as part of a system, is expected to provide acceptable service under normal operating conditions." In the case of the Ferry Division's vessels, a useful life of 50 years was used for vessels in the Sound, River, and Hatteras class. While the FTA recommends a useful life of 60 years for most vessels (FTA Circular 5010.1e), based on a review of similar agencies operating passenger ferry service and the visual

condition assessment conducted for the Ferry Division's vessels as part of this study, it was recommended that a 50-year useful life be used for all 22 steel vessels.

Within the Ferry Division, due to the variability between the route's environmental impacts, specifically the Hatteras-Ocracoke route as noted in Section 1.1.2, a standard useful life across all vessels may not be appropriate. The Hatteras–Ocracoke route with its on-going and increased shoaling and little channel maintenance has caused the route to be re-routed multiple times. The impacts of the changing weather and ocean conditions including hurricanes, nor'easters, and strong ocean and inlet currents create difficult navigation for vessels in this area. The vessels transiting in the Hatteras Inlet are not immune to the strong currents, shoaling, tidal changes, and wind conditions result in those vessels getting damaged more frequently than vessels on other routes.

Further, using a shorter useful life allows the Ferry Division to mitigate risks and adapt to changing needs and standards, while also optimizing budget constraints and infrastructure investments while meeting public expectations for reliable services. This strategy involves balancing cost considerations with the benefits of early asset replacement, technological upgrades, and improved operational efficiency to ensure effective long-term asset management.

For the Ocracoke Express, the only vessel in the Aluminum Ferry class, a useful life of 15 years was used. Generally, aluminum vessels are known for their durability and resistance to corrosion, which can contribute to a longer useful life. However, due to the operating environment of the Ocracoke Express, frequently exposed to harsh conditions such as rough waters and extreme weather, it is expected that this vessel will experience accelerated wear and tear. This heightened exposure increases the likelihood of fatigue cracking, corrosion, and structural deterioration, warranting a conservative estimate for its useful life.

Table 2-5 Vessel inventory

Class	Vessel	Date Placed Into Service (delivered)	Age (years)	Useful Life (years)	Remaining Useful Life
Sound	Silver Lake	12/15/1968	55	50	Past useful life
	Carteret	6/20/1988	35	50	15
	Cedar Island	12/15/1994	29	50	21
	Swan Quarter	10/17/2011	12	50	38
	Sea Level	3/14/2012	11	50	39
River	Gov. Daniel Russell	4/30/1992	31	50	19
	Southport	11/21/1996	27	50	23
	Neuse	4/10/1998	25	50	25
	Floyd J. Lupton	3/26/2000	23	50	27
	Fort Fisher	5/15/2000	23	50	27
	W. Stanford White	5/26/2003	20	50	30
	Croatoan	8/8/2003	20	50	30
	Hatteras	5/25/2006	17	50	33
	Rodanthe	5/24/2019	4	50	46
	Avon	TBD	TBD	50	TBD
	Salvo	6/8/2023	0	50	50
Hatteras	Gov. James B. Hunt	6/1/1984	39	50	11
	Kinnakeet	5/5/1989	34	50	16
	Frisco	11/16/1989	34	50	16
	Chicamocomico	2/28/1990	33	50	17
	Cape Point	2/28/1990	33	50	17
	Ocracoke	11/9/1990	33	50	17
Aluminum Ferry	Ocracoke Express	10/28/2021	2	15	13

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03

Vessel Condition

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3 Vessel Condition

A major focus and requirement of the vessel replacement plan is to understand the condition of the Ferry Division's vessels. In the context of this study, vessel condition considers two components: physical condition and functional condition. Physical condition considers both the vessel's age and its visual condition. Age serves as a crucial indicator for condition, as older vessels typically experience more wear and tear over time, potentially leading to structural degradation and performance issues. Visual condition plays a vital role in evaluating physical condition, as it allows assessors to identify visible signs of damage, corrosion, and/or deterioration that may impact the vessel's overall health and longevity. In addition to physical condition, functional condition assesses the vessel's operational capabilities and efficiency in fulfilling its intended purposes. A vessel may be in relatively good physical condition but experience functional issues that hinder its operations or compliance with regulatory requirements.

To assess condition, the Ferry Division applied a five-point rating scale to the vessel's age, visual condition, and functional condition. The scores were weighted, and an overall vessel condition score was then assigned to each vessel. The following subsections provide additional detail on the condition criteria and scoring approach, followed by a summary of each vessel's condition in the current fleet.

3.1 Physical Condition Assessment Criteria and Scoring

Physical condition refers to the current state of the vessel's physical infrastructure, taking into account both its age and visual condition. It considers the entire vessel as well as the various components, including the hull, superstructure, mechanical systems, and communications.

3.1.1 Age

First, for age, a score was assigned based on the share of the vessel's useful life elapsed. This was determined by taking the percent of actual age, as of January 2024, compared to the vessel's useful life of 50 years. This was then aligned to the condition rating scale of 1 to 5, as shown in Table 3-1. An age score was assigned to each vessel.

Table 3-1 Age rating scale

Score	Rating	Description
5	Excellent	Vessel's useful life: 0% to <25% of useful life (50 years) has passed.
4	Good	Vessel's useful life: 25% to <50% of useful life (50 years) has passed.
3	Adequate	Vessel's useful life: 50% to <75% of useful life (50 years) has passed.
2	Marginal	Vessel's useful life: 75% to <100% of useful life (50 years) has passed.
1	Poor	Vessel's useful life: >100% of useful life (50 years) has passed.

3.1.2 Visual Condition

Between December 2023 and January 2024, a visual condition assessment was conducted on all steel vessels, based on ten individually assessed categories as outlined in Table 3-2. Each category was given a weight which was used to calculate an overall visual condition score for each vessel. The category weightings were determined based on an engineered view of the relative impact of the components within that category to the overall vessel safety, operational efficiency, and physical integrity. These weightings were reviewed and validated with the Ferry Division engineering staff.

It is important to note the visual condition is highly dependent on the timing of credit dry docking (CDD). Visual condition assessments are done at a point in time, and if vessels have just gone through CDD, it is expected the vessels will score much higher in terms of visual condition, as opposed to vessels that were visually assessed pre-CDD. Visual condition assessments are planned to be conducted more regularly to better track visual condition historically and note changes in visual condition relative to CDD.

Table 3-2 Visual assessment categories

Category	Definition	Weighting
Communication	Assesses the condition of communication equipment including radar, very high frequency (VHF) radios, automatic identification system (AIS), telephone, and intercom systems. Double ended vessels require duplication of equipment.	4%
Electrical	Assesses the condition of electrical cable, switchboards, and electrical generators. Cable insulation, routing and conditions are considered.	4%
Emergency	Assesses the condition and arrangement of life saving equipment, rescue boat and davits, life rafts, and fire-fighting arrangements.	12%
Engine	Assesses the condition and tier level of the propulsion and generator engines. Checks for leaks, hazardous conditions, and vibrations for operating engines.	8%
Interior and Equipment	Assesses the condition of passenger lounge windows, wall panels, and seating areas as well as crew accommodations as applicable. Includes the condition of passenger and crew heads.	5%
HVAC	Assesses the condition, type, and age of the HVAC systems. Central HVAC systems are typically more difficult to maintain/repair and mini-split systems easier and less costly.	5%
Plumbing	Assesses the condition of piping and valves for sea water, sewage, air, and potable water systems.	8%
Propulsion	Assesses the condition of propulsion shaft, seals, and propellers as found.	20%
Steering	Assesses the condition of rudder mechanism, rudder/rudder stock, rudder hydraulics as applicable. Voith Schneider vessels and pod propulsion vessels do not have separate steering machinery.	10%
Structure	Assesses the condition of the structure of the hull, bulwarks, bilges, decks, and accommodations including pilot house. Considers corrosion and coating conditions.	25%

All Sound, River, and Hatteras class vessels were physically examined, except for the Neuse and Hatteras. For these two vessels, a desktop assessment was conducted. The assessment process involved traveling on most operational vessels and examining accessible compartments and

machinery during vessel operation. Criteria for the assessment included evaluating vessel cleanliness, equipment condition, safety measures, and accommodation spaces.

The vessels were primarily assessed visually, but maintenance status relative to past and upcoming shipyard periods was also considered. In addition, the assessment included discussions with Ferry Division personnel, utilization of U.S. Coast Guard (USCG) Port State Information Exchange (PSIX) data, and consideration of vessel age and distance from last/next docking, along with technical information and maintenance history tracked by the Ferry Division.

Appendix A provides a detailed visual breakdown used to assess each vessel. It includes representative photos of the components assessed across all ten categories.

A condition score was assigned to each of the ten categories for each vessel, on a five-point scale, with a 1 being rated in poor condition, and a 5 being rated in excellent condition. Table 3-3 outlines the overarching guidance used to make this assessment for each category.

Table 3-3 Visual assessment rating scale

Score	Rating	Description
5	Excellent	Asset/component is in optimal condition with no signs of wear or deterioration. No immediate maintenance or repairs are required. Expected to perform at or above design standards.
4	Good	Asset/component is in overall good condition but may show minor signs of wear. Routine maintenance is recommended to prevent deterioration. No significant issues affecting performance.
3	Adequate	Asset/component shows noticeable signs of wear or deterioration. Some components may require repair or replacement. Performance may be slightly compromised, but the asset is generally functional.
2	Marginal	Asset/component is in marginal condition with significant signs of wear, deterioration, or damage. Substantial maintenance or repair is needed to restore functionality. Performance is noticeably affected, and there is an increased risk of failure.
1	Poor	Asset/component is in a critical state with severe deterioration or damage. Immediate and extensive maintenance or rehabilitation is required to avoid failure. Asset is at risk of imminent failure, and continued use may pose safety or operational risks.

Once a score was assigned for each of the ten condition categories, a weighted score was calculated based on assigned weightings for each category, as illustrated in Figure 3-1. This resulted in an overall visual condition score for each vessel.

Visual Condition Score	+	Communication Score	x	4%
		Electrical	x	4%
		Emergency	x	12%
		Engine	x	8%
		Interior and Equipment	x	5%
		HVAC	x	5%
		Plumbing	x	8%
		Propulsion	x	20%
		Steering	x	10%
		Structure	x	25%
				= Weighted Score

Figure 3-1 Visual condition weighted score equation

3.1.3 Physical Condition Score

The physical condition score was determined by combining both the age and visual score: the age score, which contributes 40 percent to the overall score, and the visual condition score, which contributes the remaining 60 percent. This formula, illustrated in Figure 3-2, allows for a weighted assessment that considers both the age and visual condition of the vessel when determining its overall physical condition. The weighting split considers the influence of CDD timing on visual condition. While age serves as a key indicator of physical condition, the aging process of vessels can vary significantly depending on factors such as usage patterns and travel routes. Hence, visual condition emerges as a crucial determinant for assessing the overall physical health of a vessel. While a visual condition assessment may be influenced by the timing of CDD, it does provide a thorough examination of all components of the vessel, contrasting with just the consideration of the vessel's overall age. Consequently, visual condition carries slightly more weight than age in the calculation of the overall physical condition score.

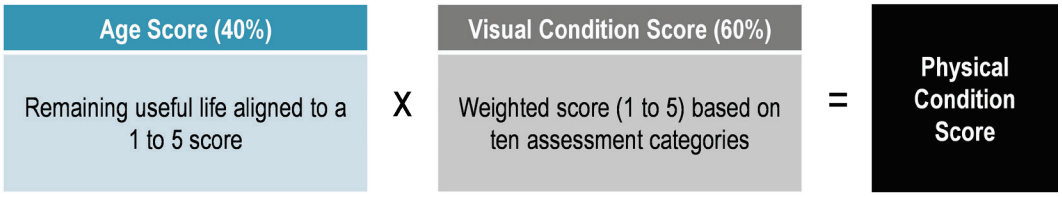

Figure 3-2 Physical condition score equation

The resulting physical condition score falls within a five-point range, from 1 to 5, with each range representing a different level of condition, from excellent to poor. Table 3-4 breaks down this scoring system.

Table 3-4 Physical condition rating scale

Score	Rating	Description
4.50-5.00	Excellent	No visible defects, new or near new condition, may still be under warranty if applicable.
3.50-4.49	Good	Good condition, but no longer new, may be slightly defective or deteriorated, but is overall functional.
2.50-3.49	Adequate	Moderately deteriorated or defective; but has not exceeded useful life.
1.50-2.49	Marginal	Defective or deteriorated in need of replacement; close to exceeding its useful life.
1.00-1.49	Poor	Critically damaged or in need of immediate repair; exceeded useful life.

3.1.4 Vessel Physical Condition

The age for each vessel, as of January 2024, is shown in Figure 3-3. Using the benchmark of 50 years as the standard useful life for all vessels, there is one vessel in the Ferry Division that has exceeded its useful life. The Silver Lake in the Sound Class has been in service for 55 years, 5 years over the standard benchmark utilized as a part of this analysis. Nine of the other 22 vessels have less than 20 years before they reach the end of their useful life.

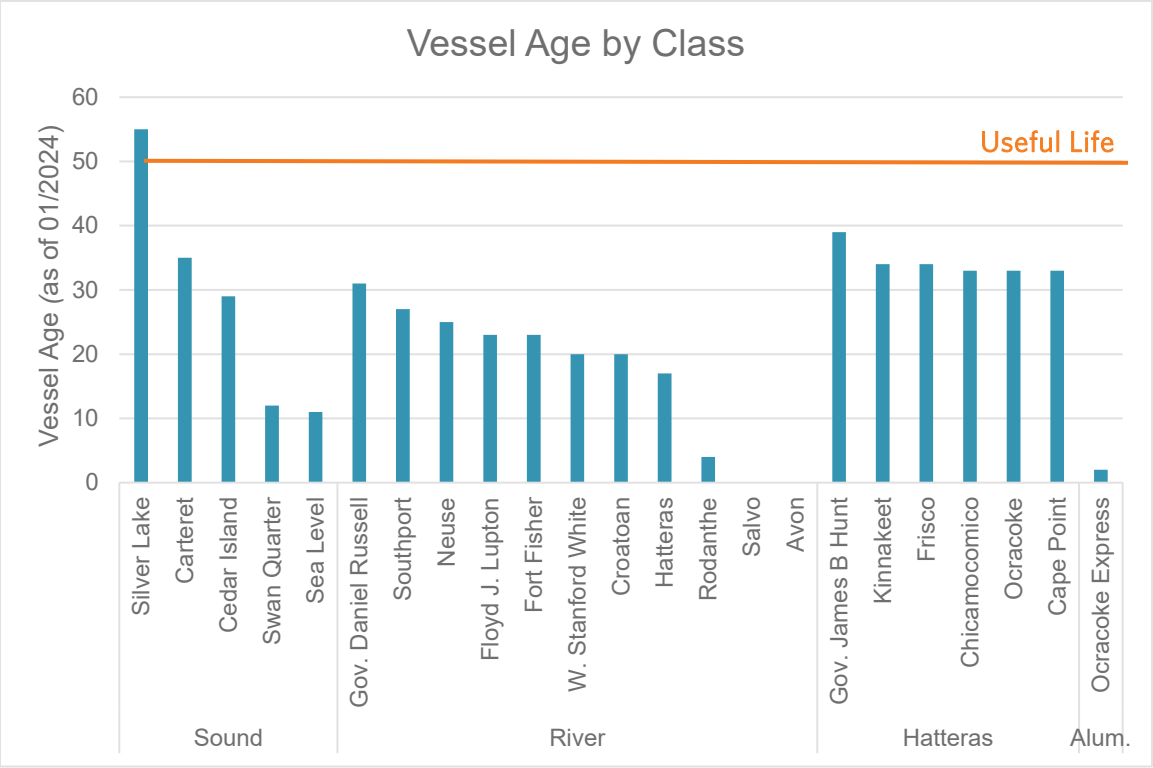

Figure 3-3 Vessel age by class

Table 3-5 summarizes the average age of vessels within each class. The River class has two brand-new vessels and is the youngest fleet which makes the average age of the vessels in the River class significantly lower than the Sound or Hatteras classes.

Table 3-5 Vessel age summary

Class	Average Age	Average % Useful Life Elapsed	Minimum Age	Maximum Age
Sound	28.4	57%	11	55
River	17.3	35%	0	31
Hatteras	34.3	69%	33	39
Aluminum Ferry	2	13%	2	2
Total/Cumulative	**24.5**	**49%**	**0**	**55**

*Note: The Total/Cumulative Average Age does not include the Aluminum Ferry class

As described in Section 3.1.2, a visual condition score was determined for all vessels based on the weighted score within each of the ten visual condition assessment categories. As shown in Figure 3-4, as should be expected, there is a trend between age and visual condition, the older the vessel the more likely it is to have a lower visual condition score.

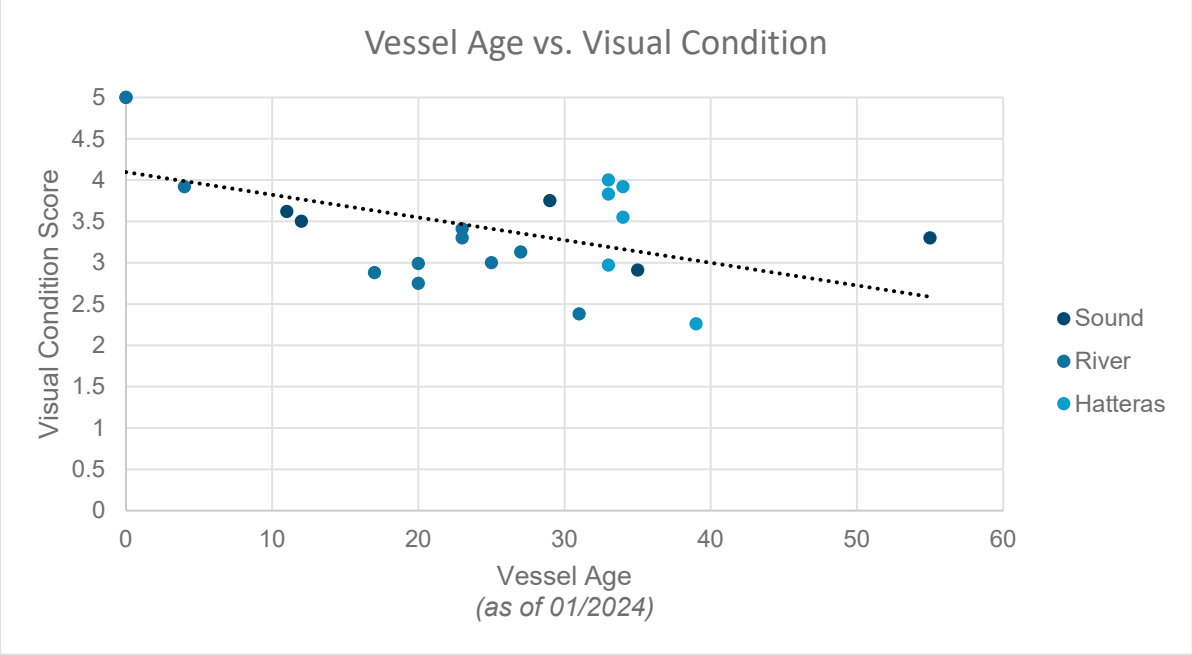

Figure 3-4 Vessel age vs. visual condition
Note: The Aluminum Ferry class was not assessed in terms of visual condition

The overall physical condition rating is comprised of both the age and the visual condition of each vessel. Figure 3-5 summarizes the condition for all vessels analyzed in the study, categorized by vessel class. Most vessels in the Ferry Division were categorized as being in adequate condition, meaning they are moderately deteriorated or defected but not past their useful life. The two vessels in excellent condition are the Avon and Salvo, which are brand new vessels. On the other end of the spectrum, the vessels in marginal condition are the Silver Lake and Gov. James B. Hunt, which means they are critically damaged or in need of immediate repair.

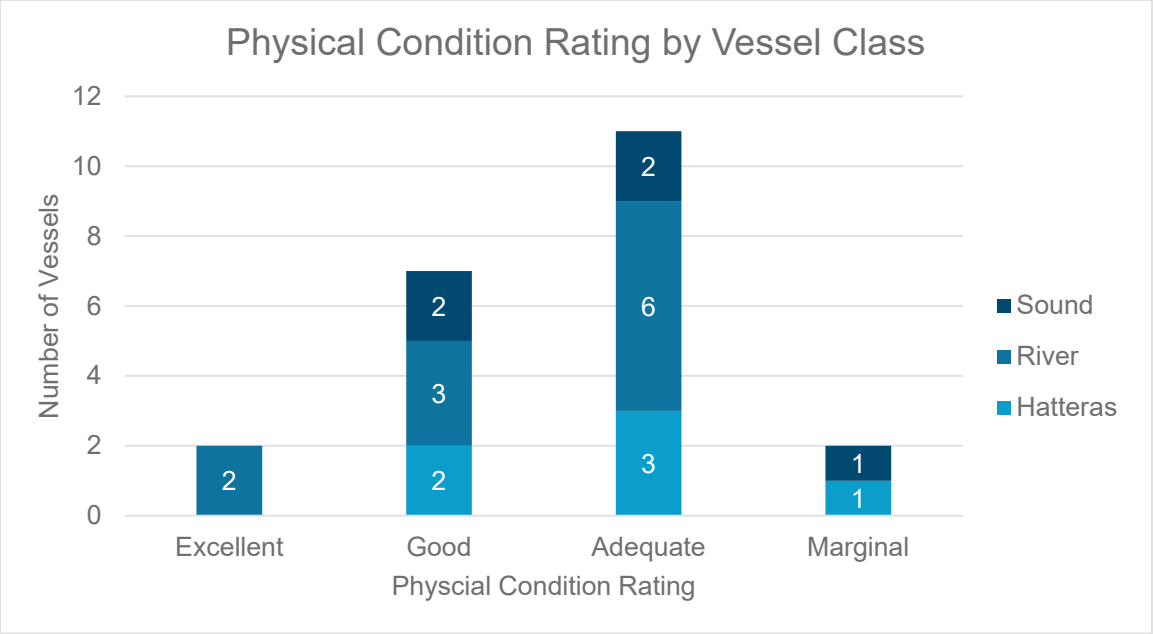

Figure 3-5 Physical condition rating by vessel class

Note: The Aluminum Ferry class was not assessed in terms of physical condition

3.2 Functional Condition Assessment Criteria and Scoring

In addition to physical condition, it is equally important to evaluate the functional condition of the vessels. Functional condition is defined as the ability to meet operational and performance requirements now and in the future, with scoring combined with the asset level physical condition score. Using a combination of both physical and functional assessment helps ensure the Ferry Division considers not only physical needs as part of its ongoing assessment but considers wider planning needs that can be funneled into the vessel replacement planning process. It also helps ensure physical needs are addressed within the wider context of long-term planning to ensure investments are rational and deliver long-term benefits.

Functional condition was determined through a desktop assessment including a review of any existing relevant reports and records with visual assessments incorporated for verification purposes. As with physical condition, objective assessment requires an evaluation based on a set of well-defined and consistently applied criteria that reflect general industry standards as well as unique agency characteristics priorities.

The functional condition score was calculated by a weighted average of six factors presented in Table 3-6. The factor weightings were determined based on a comprehensive understanding of the operational landscape of the Ferry Division, and how various factors impact a vessel's functional purpose and operational effectiveness. These weightings were reviewed and validated with the Ferry Division engineering staff.

Table 3-6 Functional condition assessment factors

Factors	Definition	Weighting
Accessibility	Assesses ease and safety of boarding, disembarking, and navigating the vessel.	15%
Capacity and Configuration	Assesses vessel capacity, layout, and future readiness, including ridership, vehicle use, functions, space, potential upgrades, and compliance.	20%
Maintenance	Assesses the required maintenance needs of a vessel	25%
Obsolescence	Assesses vessel capability, considering modern technology, purpose suitability, sustainability, spare parts availability, and compliance with standards and industry practices.	20%
Route Alignment	Assesses vessel alignment with assigned route, considering environmental factors like depth and salinity.	5%
Route Interchangeability	Assesses the vessel's route versatility by evaluating its suitability for multiple routes	15%

Further details regarding each of the six factors, along with detailed rating guidance is provided in Tables 3-7 through 3-12. Each vessel was scored on a 1 to 5 scale against all factors.

3.2.1 Accessibility

Accessibility assesses how easily, safely, and securely personnel, passengers, and cargo can board, disembark, and navigate the vessel, considering both for current and future needs.

Table 3-7 Accessibility rating scale

Score	Rating	Description
5	Excellent	Vessel and its related equipment exhibit a very high level of accessibility, surpassing expectations for easy, safe, and secure processes in boarding, disembarking, and navigation. Both current and future needs are exceptionally well-addressed, making it a benchmark for accessibility standards.
4	Good	Vessel and its related equipment exhibit a high level of accessibility, making it easy, safe, and secure for personnel, passengers, and cargo to board, disembark, and navigate. Current needs are well-met, and provisions are made for future requirements.
3	Adequate	Vessel and its related equipment meet basic accessibility requirements, providing satisfactory conditions for boarding, disembarking, and navigation. However, there is room for improvement in addressing both current and future needs more comprehensively.
2	Marginal	Vessel and its related equipment have some accessibility features, but improvements are necessary. There are moderate challenges in ensuring easy, safe, and secure processes for boarding, disembarking, and navigation. Current needs are partially met, but future needs may be overlooked.
1	Poor	Vessel and its related equipment demonstrate significant challenges in allowing easy, safe, and secure boarding, disembarking, and navigation for personnel, passengers, and cargo. Current and future needs are inadequately addressed, leading to substantial accessibility issues.

3.2.2 Capacity and Configuration

Capacity and configuration assesses the vessel's capacity and configuration for current and future needs, considering ridership, vehicle utilization, internal and customer functions, space adequacy, potential upgrades, and alignment with NCDOT and USCG standards.

Table 3-8 Capacity and configuration rating scale

Score	Rating	Description
5	Excellent	Vessel and its related equipment can meet both current and expected future demand in all situations (average and peak), adhering to all planning and design standards. Systems are designed to handle peak and average situations, ensuring efficiency in layout and configuration for both passengers and vehicles.
4	Good	Vessel and its related equipment can meet current demand in all situations (average and peak) and is expected to meet future average but not peak. While compliant with most planning and design standards, there may be a need for reasonable expansion. The layout and configuration are reasonably efficient for passengers and vehicles.
3	Adequate	Vessel and its related equipment can meet current demand during average situations but have capacity issues/limitations during peak demand conditions. Anticipated to meet future average demand with some expansion required. While meeting most planning and design standards, there is room for improvement in layout and configuration for passengers and vehicles.
2	Marginal	Vessel and its related equipment can meet current demand during average situations but have more significant capacity issues/ limitations during peak demand conditions. Future demands, average and peak, require substantial expansion. Meeting only a minimal level of planning and design standards, the layout and configuration are considered dated and inefficient for passengers and vehicles.
1	Poor	Vessel and its related equipment cannot meet current demand needs during average or peak situations and have ongoing significant capacity constraints. Major systems demand significant expansion and upgrades, falling short of current planning and design standards. The overall layout and configuration for passengers and vehicles are considered very dated and inefficient.

3.2.3 Maintenance

Maintenance assesses the required maintenance needs of a vessel based on the number of planned and emergency vessel repairs from 2016 to 2023 based on available historical maintenance data (does not include emergency repairs due to grounding, as this is caused due to external factors).

Table 3-9 Maintenance rating scale

Score	Rating	Description
5	Excellent	Vessel has experienced zero to one planned or emergency repairs between 2016 and 2023 (based on historical data).
4	Good	Vessel has experienced two to three planned or emergency repairs between 2016 and 2023 (based on historical data).
3	Adequate	Vessel has experienced four planned or emergency repairs between 2016 and 2023 (based on historical data).
2	Marginal	Vessel has experienced five to six planned or emergency repairs between 2016 and 2023 (based on historical data).
1	Poor	Vessel has experienced seven or more planned or emergency repairs between 2016 and 2023 (based on historical data).

3.2.4 Obsolescence

Obsolescence assesses overall vessel capability to serve its intended function in terms of modern technology, suitability for purpose, spare parts availability, sustainability (e.g., vessel electrification, high-efficiency assets), and technical support. Considers comparison with recent NCDOT and USCG standards and industry best practices for system design and procurement.

Table 3-10 Obsolescence rating scale

Score	Rating	Description
5	Excellent	Vessel and its related equipment embody the best available technology for current use. Every aspect, including supporting subsystems, aligns with the latest designs, NCDOT standards, and industry best practices. Spare parts and technical support are readily accessible.
4	Good	Vessel and its related equipment are recent technology and good fit for current use. Supporting subsystems are configured to reflect recent advancements. Spare parts and technical support are sourced from manufacturers or established third-party suppliers. The configuration aligns with recent designs and standard industry practices.
3	Adequate	Vessel and its related equipment may be somewhat dated but are standard technology and appropriate fit for current use. Supporting subsystems represent standard technology still widely deployed. Spare parts and technical support are available with reasonable lead time, aligning with standard designs and industry practices.
2	Marginal	Vessel and its related equipment are dated, and while are still relevant technology, are limited in functionality. Supporting subsystems meet baseline needs, but technology is nearing or at end of useful life. Procuring spare parts and technical support may pose challenges. The configuration represents older standards and is outdated compared to industry practices.
1	Poor	Vessel and its related equipment are very dated and do not meet current functional needs. The technology is well past its useful life, with no readily available spare parts or technical support. Designs are very outdated compared to industry practices across the Ferry Division.

3.2.5 Route Alignment

Route alignment assesses how well the vessel type/structure is aligned to the assigned route, primarily considering the environment for which the vessel operates based on the depth and salinity of the location.

Table 3-11 Route alignment rating scale

Score	Rating	Description
5	Excellent	Vessel's primary route services Currituck, and the vessel is very well-aligned to the depth and salinity of the route.
4	Good	Vessel's primary route services Cherry Branch and Pamlico River, and the vessel is well-aligned to the depth and salinity of the route.
3	Adequate	Vessel's primary route services Southport, and the vessel is somewhat aligned to the depth and salinity of the route.
2	Marginal	Vessel's primary route services Swan Quarter–Cedar Island–Ocracoke, and the vessel is not well aligned to the depth and salinity of the route.
1	Poor	Vessel's primary route services Hatteras–Ocracoke, and the vessel is poorly aligned to the depth and salinity of the route.

3.2.6 Route Interchangeability

Route interchangeability assesses the vessel's route versatility by evaluating its suitability for multiple routes across all route types (Sound, River, and Hatteras).

Table 3-12 Route interchangeability rating scale

Score	Rating	Description
5	Excellent	Vessel has the capability to operate on more than 75% of the routes operated by the Ferry Division across all route types: Sound, River, and Hatteras.
4	Good	Not applicable – a score of 4 is not assigned for this factor.
3	Adequate	Vessel has the capability to operate on approximately 50% of the routes operated by the Ferry Division across all route types: Sound, River, and Hatteras.
2	Marginal	Not applicable – a score of 2 is not assigned for this factor.
1	Poor	Vessel has the capability to operate on less than 25% of the routes operated by the Ferry Division across all route types: Sound, River, and Hatteras.

3.2.7 Functional Condition Score

Once a score was given for each of the six factors, a weighted score was calculated based on assigned weightings for each factor, as illustrated in Figure 3-6. This resulted in an overall functional condition score for each vessel.

Functional Condition Score +	Accessibility	x	15%
	Capacity and Configuration	x	20%
	Maintenance	x	25%
	Obsolescence	x	20%
	Route Alignment	x	5%
	Route Interchangeability	x	15%
			= Weighted Scores

Figure 3-6 Functional condition weighted score equation

The resulting functional condition score falls within a five-point range, from 1 to 5, with each range representing a different level of condition, from excellent to poor. Table 3-13 breaks down this scoring system. Similar to visual condition, it should be noted that functional condition scores are assigned at a point in time and may change before or after a vessel has gone through a scheduled CDD.

Table 3-13 Functional condition rating scale

Score	Rating	Description
4.50-5.00	Excellent	Vessel fully meets customer, Ferry Division, and/or employee expectations and is aligned with the most modern and up-to-date standards. Represents current best use and practice.
3.50-4.49	Good	Vessel meets reasonable customer, Ferry Division, and/or employee expectations and is aligned with up-to-date standards. Represents current standard use and practice.
2.50-3.49	Adequate	Vessel reasonably meets customer, Ferry Division, and/or employee expectations and is aligned with somewhat recent standards. Represents current acceptable use and practice.
1.50-2.49	Marginal	Vessel marginally meets customer, Ferry Division, and/or employee expectations and is considered dated in terms of recent standards. Represents past acceptable use and practice, but not in line with current.
1.00-1.49	Poor	Vessel does not meet customer, Ferry Division, and/or employee expectations and is considered very dated in terms of recent standards. Does not represent acceptable use and practice.

3.2.8 Vessel Functional Condition

Based on the resulting functional condition scores, most vessels fall within the adequate rating for functional condition, as shown in Figure 3-7, meaning the vessel reasonably meets expectations and is in acceptable use. Five vessels were categorized as being in good functional condition, and three of those five are within the River class. Only one vessel was categorized as being in marginal functional condition, meaning that the vessel represents past acceptable use but does not meet the current standards.

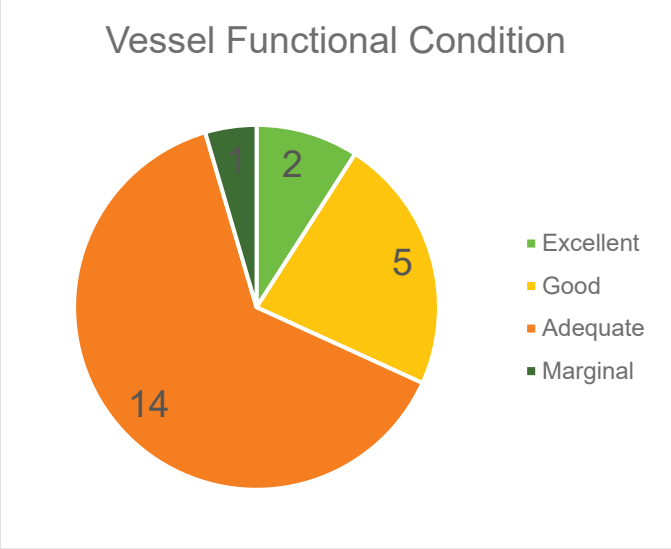

Figure 3-7 Vessel functional condition rating
Note: The Aluminum Ferry class was not assessed in terms of functional condition

The average functional score for each vessel class differed slightly, as shown in Table 3-14. For the functional condition, the Hatteras class had the lowest scoring vessel, the Gov. James B. Hunt, and the River class had the highest scoring vessels, the Avon and Salvo, again attributing to the fact that Avon and Salvo are brand new vessels.

Table 3-14 Functional condition rating and score by vessel class

Class	Average Rating and Score	Minimum Rating and Score	Maximum Rating and Score
Sound	Adequate (3.4)	Adequate (3.2)	Good (3.7)
River	Good (3.6)	Adequate (2.8)	Excellent (4.7)
Hatteras	Adequate (3.1)	Marginal (2.4)	Good (3.5)
Aluminum Ferry	Not scored	Not scored	Not scored
Total/Cumulative	**Adequate (3.4)**	**Marginal (2.4)**	**Excellent (4.7)**

3.3 Vessel Overall Condition

For the vessel replacement plan, a combination of both the physical condition score and the functional condition score was used to develop an overall condition score for each vessel. Figure 3-8 illustrates the approach for calculating the overall condition.

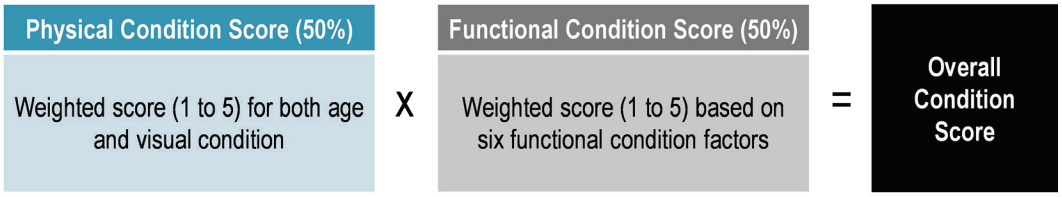

Figure 3-8 Overall condition score equation

Based on the overall condition score, a final condition rating was assigned to each vessel, similar to the rating scale used for both visual and functional condition, as shown in Table 3-15.

Table 3-15 Overall condition score and rating scale

Score	Rating
4.50-5.00	Excellent
3.50-4.49	Good
2.50-3.49	Adequate
1.50-2.49	Marginal
1.00-1.49	Poor

Figure 3-9 summarizes the overall condition for all vessels analyzed in the study, categorized by vessel class. Most vessels in the Ferry Division were categorized as being in adequate condition, meaning the vessels are currently in acceptable use and practice. The newest vessels, the Avon and Salvo, are in excellent condition and the one vessel in marginal condition is the Gov. James B. Hunt vessel. More vessels were categorized in the adequate overall condition rating once functional conditions were incorporated than when the physical condition was analyzed for all vessels.

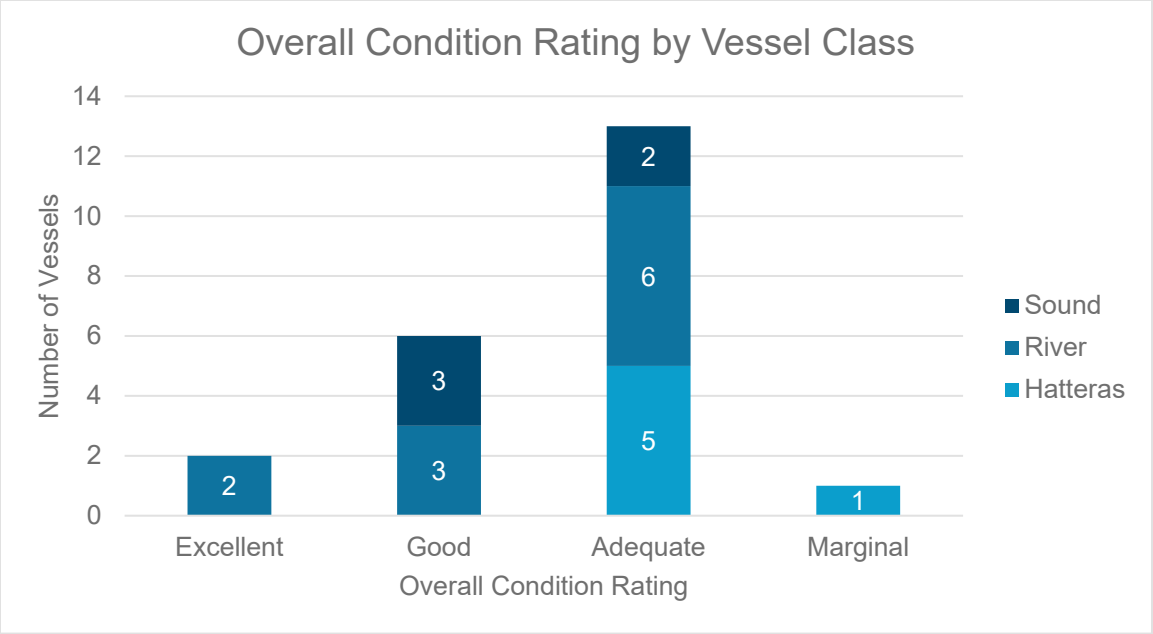

Figure 3-9 Overall condition rating by vessel class

Note: The Aluminum Ferry class was not assessed in terms of overall condition

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04

Vessel Criticality

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4 Vessel Criticality

In addition to vessel condition, this report also considers vessel criticality as part of this vessel replacement plan. Vessel criticality refers to the degree of importance or significance of the asset to the overall function and safety of the ferry program. It involves assessing the impact that the failure, degradation, or inadequate performance of a vessel would have on essential services, public safety, and the Ferry Division's operations. Vessel criticality is a key consideration for prioritizing reactive maintenance, life cycle activities, and investment allocation.

To assess criticality a five-point rating scale was applied across five criticality factors. The scores were weighted, and an overall vessel criticality score then assigned to each vessel. The following subsections provide additional details on the criticality criteria and scoring approach, followed by a summary of the vessels' criticality in the current fleet.

4.1 Vessel Criticality Assessment Criteria and Scoring

Vessel criticality assesses the impact if the vessel were to fail or be non-operational across five factors including planned maintenance, emergency maintenance, level of service, regulatory compliance, and safety. The criticality score was calculated by a weighted average of the five factors as described in Table 4-1. The factor weightings were determined based on the relative impact a vessel failure has on the Ferry Division's operations, staff, passengers, and public perception. These weightings were reviewed and validated with the Ferry Division engineering staff.

Table 4-1 Vessel criticality factors

Factors	Definition	Weighting
Maintenance–Planned	Considers repair time and cost for planned maintenance, impacting staff schedules and operational reinstatement.	30%
Maintenance–Emergency	Considers time and cost for emergency repairs, impacting staff availability and expenses.	20%
Level of Service	Considers impacts on service quality and capacity for timely, responsive service, affecting capacity, punctuality, fleet availability, customer response, and public perception.	20%
Regulatory	Considers impacts on regulatory compliance.	10%
Safety	Considers impacts of potential injuries from vessel failures or normal operations, as well as collateral damage to equipment and property.	20%

Further details regarding each of the five factors, along with detailed rating guidance are provided in Table 4-2 through Table 4-6. Each vessel was scored on a 1 to 5 scale against all factors.

4.1.1 Maintenance–Planned

Maintenance–Planned considers the time and cost of repair for planned maintenance of the vessel. Impacts may include planned staff time to repair/respond and reinstate to normal operations. Based on the average days and cost per planned repair between 2016 and 2022, using available historical maintenance data.

Table 4-2 Maintenance–planned rating scale

Score	Criteria	Maintenance–Planned (30% of aggregate)	Time (50% of planned maintenance score)	Cost (50% of planned maintenance score)
5	Negligible	Repair and response have little to no impact, involving minimal time and cost. It has a negligible effect on normal operations, requiring minimal staff involvement.	Vessel has experienced less than 60 average days per planned repair.	Minimal cost to repair (less than $250K on average per repair) including additional parts/materials, labor, and/or outside contractors.
4	Minor	Planned repairs are required in a reasonable timeframe, with minor time and cost involved. The impact on normal operations is limited, and the staff involvement is manageable.	Vessel has experienced 60 to <120 average days per planned repair.	Minor cost to repair ($250K to <$500K on average per repair) including additional parts/materials, labor, and/or outside contractors.
3	Moderate	Planned repair is necessary within a notable timeframe, incurring moderate time and cost. It involves a moderate impact on normal operations and requires a moderate level of staff involvement.	Vessel has experienced 120 to <180 average days per planned repair.	Moderate cost to repair ($500K to <$1M on average per repair) including additional parts/materials, labor, and/or outside contractors.
2	Major	Planned repair is time-sensitive, demanding considerable resources and staff involvement. It has a major impact on normal operations, requiring significant efforts to mitigate.	Vessel has experienced 180 to <240 average days per planned repair.	Major cost to repair ($1M to <$2M on average per repair) including additional parts/materials, labor (including overtime), and/or outside contractors.
1	Severe	Planned repair involves extensive time, cost, and resources. It results in a severe impact on normal operations, significant staff involvement, and potential disruption of other duties.	Vessel has experienced 240+ average days per planned repair.	Significant cost to repair (over $2M on average per repair) including additional parts/materials, labor (including overtime), and/or outside contractors.

4.1.2 Maintenance–Emergency

Maintenance–Emergency considers the time and cost of repair for emergency maintenance of the vessel. Impacts may include required staff time and cost to repair/respond including staff involved that may be pulled from other duties. Based on the average days and cost per emergency repair between 2020 and 2023, using available historical maintenance data.

Table 4-3 Maintenance–emergency rating scale

Score	Criteria	Maintenance–Emergency (20% of aggregate)	Time (50% of emergency maintenance score)	Cost (50% of emergency maintenance score)
5	Negligible	Emergency repair and response have little to no impact, involving minimal time and cost. It has a negligible effect on normal operations, requiring minimal staff involvement.	Vessel has experienced less than 5 average days per emergency repair.	Minimal cost to repair (less than $10K on average per repair) including additional parts/materials, labor, and/or outside contractors.
4	Minor	Emergency repair and response are required within a reasonable timeframe, with minor time and cost involved. The impact on normal operations is limited, and the staff involvement is manageable.	Vessel has experienced 5 to <10 average days per emergency repair.	Minor cost to repair ($10K to <$20K on average per repair) including additional parts/materials, labor, and/or outside contractors.
3	Moderate	Emergency repair and response are necessary within a notable timeframe, incurring moderate time and cost. It involves a moderate impact on normal operations and requires a moderate level of staff involvement.	Vessel has experienced 10 to <15 average days per emergency repair.	Moderate cost to repair ($20K to <$30K on average per repair) including additional parts/materials, labor, and/or outside contractors.
2	Major	Emergency repair and response are time-sensitive, demanding considerable resources and staff involvement. It has a major impact on normal operations, requiring significant efforts to mitigate.	Vessel has experienced 15 to <24 average days per emergency repair.	Major cost to repair ($30K to <$40K on average per repair) including additional parts/materials, labor (including overtime), and/or outside contractors.
1	Severe	Emergency repair and response require immediate attention, involving extensive time, cost, and resources. It results in a severe impact on normal operations, significant staff involvement, and potential disruption of other duties.	Vessel has experienced 24+ average days per emergency repair.	Significant cost to repair (over $40K on average per repair) including additional parts/materials, labor (including overtime), and/or outside contractors.

4.1.3 Level of Service

Level of service considers the impacts on overall level of service to customer base and the public including ability to provide timely, responsive, and quality service and potential impact on capacity, on-time performance, vehicle/fleet availability, customer response, information availability, public perception, and/or availability of alternative modes of transportation to complete the route (if any).

Table 4-4 Level of service rating scale

Score	Rating	Description
5	Negligible	Failure expected to have only negligible impact in the ability to provide service and would not result in significant service interruption, delays, perception issues or degradation in service; suitable alternative modes of transportation are available to complete the route.
4	Minor	Failure is expected to impact the ability to provide service for a minor period and/or only minorly impact customers. The failure is anticipated to result in minor service interruption, schedule delays (on-time performance), only some perception/communication (information availability) issues, or some degradation in service; alternative modes of transportation are available to complete the route.
3	Moderate	Failure expected to impact ability to provide service for a moderate period and/or moderately impact customers. Failure expected to result in moderate service interruption, schedule delays (on-time performance), and moderate perception/communication; limited and/or somewhat timely alternative modes of transportation are available to complete the route.
2	Major	Failure is expected to impact the ability to provide service for a significant period and/or majorly impact customers. The failure is anticipated to result in service interruption, schedule delays (on-time performance), severe perception/communication (information availability) issues, or other notable degradation in service (comfort or amenities); very limited and/or timely alternative modes of transportation are available to complete the route.
1	Severe	Failure expected to impact ability to provide service for a substantial period and/or severely impact customers. Failure expected to result in significant service interruption, schedule delays (on-time performance), severe perception/communication (information availability) issues, or other degradation in service (comfort or amenities); no alternative modes of transportation are available to complete the route.

4.1.4 Regulatory

Regulatory considers impacts on regulatory compliance including, but not limited to, USCG, FTA, North Carolina State Regulations, etc.

Table 4-5 Regulatory rating scale

Score	Rating	Description
5	Negligible	Failure represents little to no regulatory impact, indicating a low risk to compliance with regulations. The Ferry Division is in good standing with relevant regulatory standards, and the risk of fines and regulatory actions is minimal.
4	Minor	Failure represents minor regulatory impact, highlighting a manageable risk of non-compliance with regulations. While there is a risk of fines and regulatory actions, the potential impact is limited. Proactive steps can be taken to address and rectify compliance issues.
3	Moderate	Failure represents moderate regulatory impact, suggesting a notable risk of non-compliance with key regulations. Failure to meet certain regulatory requirements could lead to fines and potential legal actions. Timely corrective measures are required to address compliance issues.
2	Major	Failure represents major regulatory impact, indicating a risk to compliance with key regulations. Failure to meet certain regulatory standards may result in considerable fines and legal consequences. Immediate corrective actions and investments may be necessary to address compliance gaps.
1	Severe	Failure represents substantial violation, signifying a severe threat to compliance with regulations. Non-compliance poses immediate and serious consequences, potentially leading to significant fines, legal actions, and suspension of operations.

4.1.5 Safety

Safety considers the impact on Ferry Division staff and the public, with the potential for injury resulting from a failure of a vessel or during normal operations of a vessel. This can include safety and health-related issues such as running aground, fires, etc., as well the potential for collateral damage to equipment and/or property due to failures.

Table 4-6 Safety rating scale

Score	Rating	Description
5	Negligible	Failure represents potential for less-than-minor injury (either Ferry Division staff or the public) with low impact. No expected collateral damage. Immediate mitigation or avoidance is likely, and no secondary/downstream hazard affecting staff and/or the public.
4	Minor	Failure represents potential for non-serious minor injury (either Ferry Division staff or the public) with low impact. Likely ability to reasonably mitigate or avoid resulting impact. Some potential for collateral damage. Likely injury represents non-serious minor injury and less-than-minor secondary/ downstream hazard affecting staff and/or the public.
3	Moderate	Failure represents potential for non-serious injury (either Ferry Division staff or the public) with moderate impact. Ability to reasonably mitigate or avoid resulting impact. Potential for collateral damage. Likely injury represents non-serious injury and non-serious secondary/ downstream hazard affecting staff and/or the public.
2	Major	Failure represents potential for serious injury (either Ferry Division staff or the public) with major impact. Limited ability to mitigate or avoid resulting impact. Expected collateral damage. Likely injury represents serious injury and potential for serious secondary/ downstream hazards affecting staff and/or the public.
1	Severe	Failure represents potential for serious injury or fatality (either Ferry Division staff or the public) with severe impact. Very limited ability to mitigate or avoid resulting impact. Expected significant collateral damage. Likely injury represents severe injury or fatality and severe secondary/downstream hazards affecting staff and/or the public.

4.1.6 Criticality Score

Once a score was given for each of the five factors, a weighted score was calculated based on assigned weightings for each factor, as illustrated in Figure 4-1. This resulted in an overall criticality score for each vessel.

Criticality Score	+	Maintenance–Planned	x	30%
		Maintenance–Emergency	x	20%
		Level of Service	x	20%
		Regulatory	x	10%
		Safety	x	20%
				= Weighted Scores

Figure 4-1 Criticality weighted score equation

The resulting criticality score falls within a five-point range, from 1 to 5, with each range representing a different level of criticality, from excellent to poor. Table 4-7 breaks down this scoring system.

Table 4-7 Criticality score rating scale

Score	Rating	Description
4.50-5.00	Negligible	Vessel has minimal impact on the Ferry Division's operations. Failure or degradation of the asset has a low impact on service delivery. Easily replaceable or has minimal consequences if not addressed immediately.
3.50-4.49	Minor	Vessel has some impact on the Ferry Division's operations. Failure may cause some inconvenience or disruption but can be managed without significant consequences. Replacement or repair can be planned without immediate urgency.
2.50-3.49	Moderate	Vessel has a moderate impact on the Ferry Division's operations. Failure may cause noticeable disruptions and affect service delivery. Timely maintenance or replacement is important to prevent significant negative consequences.
1.50-2.49	Major	Vessel has a high impact on the Ferry Division's operations. Failure may result in significant disruptions, affecting multiple aspects of service delivery. Immediate attention and timely maintenance are crucial to prevent major consequences.
1.00-1.49	Severe	Vessel is mission-critical and essential for the Ferry Division's operations. Failure may have severe and widespread consequences, potentially affecting public safety, regulatory compliance, or the organization's core functions. Requires immediate and top-priority attention, and ongoing monitoring and maintenance are essential.

4.2 Vessel Criticality

Table 4-8 summarizes the final vessel criticality ratings. Many vessels in the Ferry Division, a total of 16 of 23, obtained a rating of moderate criticality, meaning that failures in these vessels may cause notable disruptions in service and require timely maintenance but will not majorly impact overall ferry operations.

Table 4-8 Vessel criticality rating summary

Class	Minor	Moderate	Major
Sound	-	5	-
River	5	6	-
Hatteras	-	5	1
Aluminum Ferry	Not scored	Not scored	Not scored
Total/Cumulative	**5**	**16**	**1**

*Note: The Total/Cumulative Average Age does not include the Aluminum Ferry class

There was an almost even split among classes within the Ferry Division for the moderate criticality rating, having five to six ferries from each vessel class. The five vessels that had a minor criticality categorization all fell within the River class. The only ferry that classifies as having major criticality is the Gov. James B. Hunt vessel in the Hatteras class.

05

Vessel Prioritization

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5 Vessel Prioritization

For this vessel replacement plan, a risk-based approach was used to prioritize vessels, considering both condition (probability of the vessel failing) and criticality (impact if the vessel fails). By systematically prioritizing assets based on these factors, the Ferry Division can strategically allocate limited resources to address the most pressing needs first. This approach ensures that maintenance, repair, and replacement efforts are targeted where they are most needed, minimizing disruptions to service delivery and reducing the likelihood of costly failures.

5.1 Prioritization Framework

A risk-based prioritization framework leverages the asset condition and asset criticality scores to get an overall risk-based vessel score, as illustrated in Figure 5-1. For this study, the resulting risk-based score was used specifically to help prioritize vessel replacement; however, the framework can be also used to help prioritize non-replacement activities such as rehabilitation, maintenance, and enhancements.

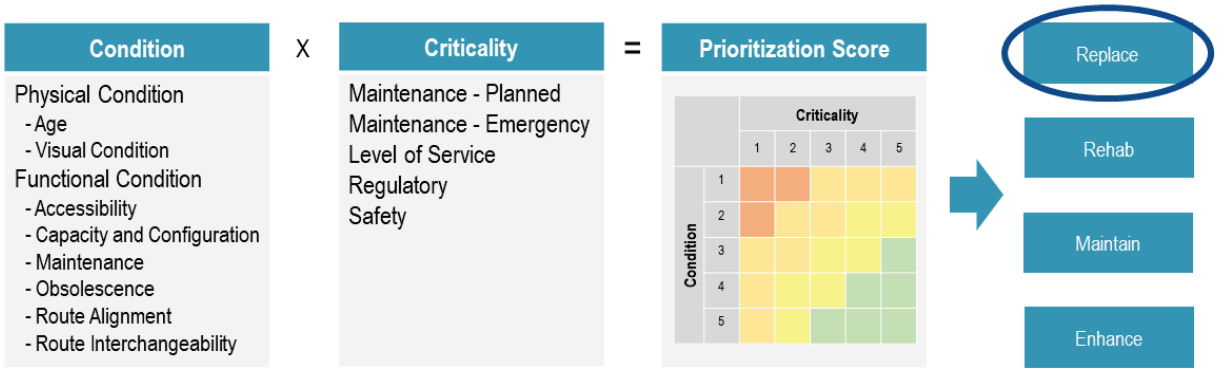

Figure 5-1 Risk-based prioritization framework

The prioritization framework ultimately adds an additional level of rigor to assessing asset state and investing available funds. It also serves as a way for the Ferry Division to create an annual list of prioritized assets. Table 5-1 shows how each overall risk-based prioritization score is defined within the framework.

Table 5-1 Risk-based prioritization rating scale

Priority Rating	Risk-Based Prioritization	Description
Critical	1.00-2.49	Requires intervention from executive management; requires prompt action to implement new agency and/or Ferry Division controls to treat the asset.
High	2.50-6.49	Affects the ability of the Ferry Division and/or department to carry out its mission or day-to-day operations – existing controls may be effective but could require additional action and/or controls to be managed.
Medium	6.50-12.49	Impacts delivery of Ferry Division and/or NCDOT function – existing controls are effective and possible additional actions may need to be implemented.
Low	12.50-25.00	Managed with current practices and procedures - impacts are dealt with by routine operations which should be monitored for effectiveness.

The risk-based prioritization for each vessel was based on current qualitative and quantitative data for vessel condition and criticality and then combined with other observational human input and interpretation for actual prioritization. The resulting prioritization can assist the Ferry Division in vessel asset management along with financial planning and other constraints and limitations of the system (e.g., dry dock capacity for maintenance for vessel). The recommended vessel replacement plan, combining the raw output from the prioritization framework and the financial plan, is outlined in more detail in Section 7.

5.2 Vessel Prioritization

Table 5-2 presents the output scores for each vessel using the risk-based prioritization framework. This table is a summary of the complete set of vessel ratings, presented in Appendix B. With the exception of Silver Lake, which is already scheduled for replacement and has been included in the STIP, the vessels are listed based on their risk-based prioritization, with the vessel having the highest priority for replacement being listed first. It is important to note that since age is not the only factor considered in the risk-based prioritization, some younger vessels may be recommended for replacement before older vessels (that are in better condition and/or are more critical to the Ferry Division's operations). Further, these prioritization scores are point-in-time calculations using the risk-based prioritization framework and will change annually. Details about each vessel's ranking are provided following the table.

Table 5-2 Vessel prioritization summary

Vessel	Class	Age	Risk-Based Prioritization
Silver Lake*	Sound	55	7.67
Gov. James B. Hunt	Hatteras	39	5.52
Chicamocomico	Hatteras	33	7.60
Hatteras	River	17	8.70
Carteret	Sound	35	8.91
Cedar Island	Sound	29	8.94
Croatoan	River	20	9.08
W. Stanford White	River	20	9.34
Frisco	Hatteras	34	9.42
Kinnakeet	Hatteras	34	9.56
Sea Level	Sound	11	9.72
Cape Point	Hatteras	33	9.93
Ocracoke	Hatteras	33	10.12
Gov. Daniel Russell	River	31	10.27
Neuse	River	25	10.40
Southport	River	27	10.44
Swan Quarter	Sound	12	10.55
Floyd J. Lupton	River	23	12.92
Fort Fisher	River	23	13.76
Rodanthe	River	4	14.24
Avon	River	0	20.37
Salvo	River	0	20.37
Ocracoke Express**	Aluminum Ferry	2	Not scored

*Although it did not score the lowest, in terms of prioritization, Silver Lake is listed first as it is already due to be replaced and has been identified in the STIP.

**Ocracoke Express was not assessed in terms of visual condition, functional condition, or criticality, and thus an overall risk-based prioritization score was not given. It was included within the financial scenarios based upon its age and anticipated replacement at the end of its useful life.

5.2.1 Silver Lake

While Silver Lake, the oldest vessel in the fleet, did not have the lowest risk-based score, it is listed at the top of the prioritized list because the vessel is already scheduled for replacement and is included in NCDOT's STIP. Silver Lake scored higher than Gov. James B. Hunt and Chicamocomico in terms of condition and criticality. Specifically, scoring better in terms of capacity and configuration and overall route alignment and interchangeability. Bilge area and piping as well as older machinery are principal factors for the lower visual condition assessment.

5.2.2 Gov. James B. Hunt

The second oldest vessel in the fleet, the Gov. James B. Hunt vessel scored the lowest in terms of visual condition and criticality, specifically scoring poor in terms of capacity and configuration and route interchangeability. Accommodation, HVAC, plumbing and machinery/equipment were noted as

degraded and resulted in lower visual condition assessment. Further, it was noted as a critical vessel in terms of safety considerations and requiring significant maintenance time compared to the other vessels.

5.2.3 Chicamocomico

While several components scored good in terms of visual condition, such as its engine and steering, this vessel did have several components in marginal condition including emergency equipment, HVAC, and interiors. Condition of superstructure and other coatings were degraded. Interior and machinery spaces equally show evidence of degradation and require upgrade, more maintenance than other vessels. Further it was identified as one of the most critical vessels in terms of maintenance, level of service, and safety.

5.2.4 Hatteras

While still considered a young vessel, the risk-based prioritization process ranked the Hatteras high for replacement due to several components being rated in marginal condition and having spent significant time in maintenance or not in service based on historical records. Functionally, Hatteras was considered adequate across all functional condition factors. In addition, while built as a River class vessel, it is being used to transport passengers and vehicles between Hatteras and Ocracoke. This use influences its condition and need for maintenance. Further, the shallow depth, difficult channel routing, and challenging environmental conditions result in both increased trip travel time and contributes to increased susceptibility to damage to propulsion and steering systems, in particular exposed rudders. This accounts for emergency repair operations which disrupts the regularly scheduled maintenance and repair schedules. This results in significant impact and emergent repairs for the vessel. While this impacts the vessel's prioritization score, the resulting score is more a function of the vessel's environment as opposed to the vessel's expected deterioration. Hatteras was not physically examined as part of the condition assessment due to timing and availability; however, a desktop assessment was performed for this vessel.

5.2.5 Carteret

The third oldest vessel in the fleet, Carteret was identified as number five on the prioritized list. Of particular note, this vessel was considered to be in adequate condition across all visual condition categories and functional condition factors. It was also considered moderate in terms of criticality. The fact that it is one of the oldest vessels serves as the main reason this vessel is listed higher on the prioritized list.

5.2.6 Cedar Island

Cedar Island scored quite high in terms of both visual and functional condition despite its age, scoring good in several key component categories including structure, propulsion, emergency, and steering. Criticality was rated as moderate, scoring more critical in the category of emergency maintenance as compared to other vessels.

5.2.7 Croatoan

Croatoan, while younger than Cedar Island, this vessel scored lower in terms of visual and functional condition. It was rated an overall adequate score for visual condition, but several components including emergency, engine, and interior were noted to be in marginal condition. Croatoan was rated as a more critical vessel then Cedar Island; however, specifically scoring much better in terms of emergency maintenance as compared to other vessels (spending only minimal time in maintenance and/or on dry dock).

5.2.8 W. Stanford White

While scoring an adequate score in visual condition, it had one of the lowest visual condition scores for structure which accounts for 25 percent of the overall visual condition score. This vessel also had the most times needing maintenance (separate instances) based on available historical records, and as such scored poor in terms of maintenance functional condition. However, the vessel was operating without issues and seemed to be well suited for the route on which it was operating.

5.2.9 Frisco

Tied with Kinnakeet as the fourth oldest vessel, Frisco scored consistently good in terms of both visual and functional condition. It was rated as moderately critical, mainly due to time spent in maintenance and/or dry dock. At the time of the visual condition assessment, the vessel was being prepared to be sent to an outside shipyard.

5.2.10 Kinnakeet

Tied with Frisco as the fourth oldest vessel, Kinnakeet scored consistently good in terms of both visual and functional condition. It was rated as moderately critical, mainly due to time spent in maintenance and/or dry dock.

5.2.11 Sea Level

The Sea Level is the youngest vessel of the Sound Class; however, it is higher on the prioritization list then other older vessels due to its visual condition score and being considered more critical in terms of time spent in maintenance and/or dry dock. While only minimal, Sea Level did score lower in terms of visual condition compared to its other older vessel counterparts.

5.2.12 Cape Point and Ocracoke

Both Cape Point and Ocracoke are approximately two-thirds through their useful life but overall scored good in terms of visual condition and adequate in terms of functional condition. Both vessels scored consistently in all visual condition categories (structure, propulsion, engine, etc.).

5.2.13 Gov. Daniel Russell and Southport

Both vessels are roughly 50 percent through their useful life and, while Southport was rated adequate in terms of visual condition, Gov. Daniel Russell slipped into marginal condition at the time of this assessment. This was mainly due to structure and propulsion (the two highest weighted components) scoring marginal, while Southport scored adequate. Gov. Daniel Russell did score slightly better in

terms of criticality, as compared to Southport, mainly due to having a better planned maintenance track record.

5.2.14 Neuse

Due to timing and availability, the Neuse was not visually assessed but a desktop analysis was carried out instead. The assessment was based on USCG PSIX matrix of repair history as well as discussions with Ferry Division personnel. It is reported to be in good condition relative to its age.

5.2.15 Swan Quarter

Swan Quarter is roughly a quarter through its useful life and, as expected, scored consistently across visual condition, functional condition, and criticality. While it scored good in terms of major components for visual condition (propulsion, structure, engine, and steering), it is important to note that Swam Quarter only scored marginal for some other components such as HVAC, electrical, and interiors. Swan Quarter was rated as adequate in terms of functional condition, noting some issues with accessibility.

5.2.16 Floyd J. Lupton and Fort Fisher

Both 23 years old and approaching their mid-life point, Floyd J. Lupton and Fort Fisher rated adequate in terms of visual condition (with several components rated in good condition) and good in terms of functional condition. Of note, both vessels scored excellent in terms of route interchangeability (functional condition factor). The Floyd J. Lupton was assessed at two different times in the shipyard; it was noted to be in adequate condition at the early stages of repair and is expected to return to service in good condition. Fort Fisher was inspected within several days of the expiration of its Certificate of Inspection (COI) and would then be out of service until a shipyard slot was available. Generally, it was found in good condition with no significant deficiencies even though it would soon be requiring shipyard work.

5.2.17 Rodanthe

Not including Avon and Salvo, Rodanthe is the youngest vessel. As expected, it scored as one of the highest in terms of visual and functional condition, and overall scored well in terms of criticality, specifically having a good track record in terms of maintenance time and cost, based on historical records. Rodanthe scored excellent in terms of route interchangeability (functional condition factor).

5.2.18 Avon and Salvo

Avon and Salvo are both brand new vessels, and as such scored excellent in terms of visual condition. Functionally, these two vessels scored excellent in all functional condition categories except route interchangeability, due to limitations on being able to operate on only roughly half of all routes. The vessels are the most modern, state of the art vessels in the fleet. Although Salvo seems to be experiencing some mechanical issues, this is fairly common on newly delivered vessels. The major issues for these two vessels are the pod type of propulsion makes the vessels unsuitable for some routes as the pods are subject to damage in waters with shoaling and shifting channels.

5.2.19 Ocracoke Express

The Ocracoke Express is a passenger-only vessel, and given its unique characteristics and relatively young age, it was included within the financial scenarios based upon its age and anticipated replacement at the end of its useful life. It was not assessed in terms of visual condition, functional condition, or criticality, and thus an overall risk-based prioritization score was not given.

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06

Funding Strategy and Financial Forecast Scenarios

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6 Funding Strategy and Financial Forecast Scenarios

Section 41.11A.(a) of the North Carolina General Assembly Appropriations Act of 2023 requires this vessel replacement plan to include the estimated costs the Ferry Division will incur to replace each vessel. In addition, the plan is to include any funds dedicated or identified for replacing vessels, including the amount and source of the funds. This section includes an overview of state and federal funding currently allocated to the Ferry Division and discretionary federal grant and financial programs.

It concludes with ten financial forecast scenarios which align the vessel capital needs and their costs with funding. Scenarios 1 through 8 use vessel age and replacement cycle only while Scenarios 9 and 10 offer options using the risk-based prioritization results outlined earlier in this study. The funding strategy includes prioritizing vessel retrofitting or replacement based on a planned, comprehensive schedule, ensuring a proactive approach to secure federal funding, and arranging for local match. In consideration of the various funding and financing sources outlined.

6.1 State Transportation Funding

State funding comes from appropriations to NCDOT (and subsequently to the Ferry Division), toll revenues collected at designated ferry routes, federal formula and discretionary funds, and through the STIP process. Because the available funding is not sufficient, this section details other potential funding and financing options that could be considered.

As of February 2024, the Ferry Division's spend plan is $72.3 million for operations and maintenance.

6.1.1 State Transportation Improvement Plan

For capital projects, inclusion in the approved STIP is the required first step whether the transportation project is funded or not. In February 2024, the Federal Highway Administration (FHWA) approved the North Carolina Board of Transportation's STIP for 2024–2033.

The current STIP (February 2024) did not allocate available revenue to a ferry vessel replacement. The current STIP includes the following vessels but does not fund them.

- Fort Fisher River Class Ferry – project estimate of $14 million,
- Silver Lake Sound Ferry – project estimate of $25.6 million, and
- Hatteras Passenger Ferry – project estimate of $6.5 million

The current STIP includes a total of 14 Ferry Division projects including six that are completed. While no funding may be allocated to a project, it is required to be in the STIP to be eligible for future federal funding. In addition, of the 98 funding sources in the STIP, 48 are allocated to projects governed by the

state's STI law passed in 2013. STI includes a strategic mobility formula for allocating available revenue based on a data-driven scoring process and local input. Funding is distributed in three categories: Division Needs, Regional Impact and Statewide Mobility. Replacement of state-maintained ferry vessels qualifies as Division Needs and Regional Impact projects. The Ocracoke Express and any other future passenger vessel replacements are not defined as Regional Impact projects. The revenue distribution and factors differ in each category with data elements make up a minimum of 50 percent in the two qualifying categories. A project's benefit/cost can improve when it is funded during the project submission phase through local entity contributions or tolling approved by a local planning organization.

The results of the STI process are incorporated into STIP. NCDOT is currently developing STI Prioritization 7.0 (P7). Project submittal opened to prioritization partners in early July 2023 and closed on October 27. Project scoring is now underway. The Ferry Division has submitted 38 projects including 18 vessel projects costing $531 million.

6.1.2 Toll Revenues

Under the authority of G.S. 136-82(a), the NCDOT is empowered to establish and maintain ferry services as part of the state highway system, where deemed necessary for the public good. This includes the authority for the Board of Transportation to set and collect tolls on designated ferry routes. For the seasonal Ocracoke Express (Division 1), a fare of $7.50 each way with an additional $1 charge for bicycles, as shown in Table 6-1. The other year-round designated routes are Southport-Fort Fisher (Division 3), Cedar Island-Ocracoke (Divisions 1 and 2), and Swan Quarter-Ocracoke (Division 1), with the stipulation that toll revenues are to be used for vessel replacement projects in which the Department of Highway Division the fares are collected. Table 6-2 and Table 6-3 provide details on the fares for each route. As of December 31, 2023, $1.8 million has been collected this fiscal year, with $1.3 million collected in FY 2023

Table 6-1 Cost for Ocracoke Express (Division 1)

Type	One-Way Fare
Passenger	$7.50
Bicycle	$1

Table 6-2 Fare cost for Swan Quarter–Ocracoke (Division 1) & Cedar Island–Ocracoke (Division 1/2)

Type	One-Way Fare
Pedestrian	$1
Bicycle Rider	$3
Motorcycle	$10
Scooter, Golf Cart or ATV	$10
3-Wheel Motorcycle	$10
Motorcycle with Trailer or Side Car	$15
Vehicle and/or Combination less than 20 feet	$15
Vehicle and/or Combination 20 to 40 feet	$30
Vehicle and/or Combination 40 to 65 feet	$45

Table 6-3 Fare cost for Southport–Fort Fisher (Division 3)

Type	One-Way Fare
Pedestrian	$1
Bicycle Rider	$2
Motorcycle	$3
Scooter, Golf Cart or ATV	$3
3-Wheel Motorcycle	$3
Motorcycle with Trailer or Side Car	$7
Vehicle and/or Combination less than 20 feet	$7
Vehicle and/or Combination 20 to 40 feet	$14
Vehicle and/or Combination 40 to 65 feet	$28

The accumulation of sufficient funds for replacement vessels will require deliberate accumulation of funding over time with the relatively low fares. Table 6-4 provides Ferry Capital Fund Balances as of December 31, 2023.

Table 6-4 Ferry capital fund balances of period ending December 31, 2023

Route	Current Fund Balance
Currituck–Knotts Island	$11,106.15
Hatteras Vehicle Terminal	$134,125.57
Hatteras Passenger Ferry	$245,929.54
Pamlico River	$53,474.87
Swan Quarter–Ocracoke	$2,462,987.78
Ocracoke–Cedar Island	$2,815,450.35
Cedar Island–Ocracoke	$314,776.07
Cherry Branch–Minnesott Beach	$313,723.62
Southport–Fort Fisher	$7,782,922.04

6.2 Federal Funding Awarded to NCDOT Ferry Division

Federal transportation apportionments are awarded to NCDOT (and subsequently to the Ferry Division) each federal fiscal year for eligible activities and projects. These apportionments are included in the STIP. In addition, federal formula funding that relates to ferry vessels that NCDOT is ineligible for are described.

6.2.1 FHWA Funding

FEDERAL HIGHWAY ADMINISTRATION FERRY BOAT PROGRAM (FBP) FORMULA

The Bipartisan Infrastructure Law amended funding amounts and eligibility for this Ferry Boat Program. To be awarded the funds, states must report information to the Bureau of Transportation Statistics (BTS) National Census of Ferry Operators (NCFO). This formula based program provides funding to publicly owned ferry systems and terminals. For federal fiscal year 2023, North Carolina was scheduled to receive a total of $3.1 million for allocation. The funding is made available to the Ferry Division when they are ready to obligate the funds, meaning enter a contract for the construction of a new ferry for example. For the federal fiscal year 2023 funds, this action must be taken by September 2026. These federal funds can provide up to 85 percent of a project's cost.

FHWA FEDERAL LANDS ACCESS PROGRAM

The Federal Lands Access Program (FLAP) was established in 23 U.S.C. 204 and is administered by FHWA to improve transportation facilities that provide access to, are adjacent to, or are located within federal lands. For NCDOT Ferry Division, this includes locations such as Hatteras, Ocracoke, Knotts Island, and Fort Fisher. FLAP supplements state and local resources for public roads, transit systems, and other transportation facilities, emphasizing high-use recreation sites and economic generators. Funds are allocated by FHWA using a statutory formula based on road mileage, number of bridges, land area, and visitation. North Carolina was allocated just over $10.7 million in federal fiscal year 2021. The Ferry Division received FLAP funding in 2018 in the amount of $3.5 million for improvements related to the implementation of the passenger ferry vessel and in 2023 for improvements to ferry docks and ramps.

Projects are selected by a Programming Decision Committee in North Carolina. The Programming Decision Committee requests project applications through a call for projects every 3 years and scores them according to established criteria. This program requires a 20 percent matching share of the project's total estimated completion cost.

6.2.2 FTA 5311 Funding for Rural Areas

In general, ferry services that accommodate walk-on passengers are considered public transportation and, therefore, eligible for FTA funding. However, routes that are over 90 minutes one-way may only be eligible if at least 50 percent of trips return the same day. NCDOT does not operate any ferry routes within an urbanized area (population over 50,000), so only FTA's 5311 funding for rural areas is applicable.

This formula grants program is dedicated to enhancing public transportation in rural settings, potentially benefiting the Ferry Division. It provides funding for capital projects, operational costs, and

other transportation-related activities suitable for initiatives like vessel replacements or upgrades. To leverage these funds, the Ferry Division must demonstrate how its services align with the program's objectives, which include improving access to essential services and efficient use of transportation funds in rural areas.

In a proactive move, the Ferry Division started reporting information to the FTA's National Transit Database (NTD). After 2024, which is the second year of reporting, the Ferry Division will receive FTA 5311 funding.

6.2.3 Ineligible Federal Funding Resources

This section highlights federal programs that were assessed for eligibility but were excluded due to the Ferry Division not being eligible. These programs are shown in Table 6-5.

Table 6-5 Summary of ineligible programs

Program	Basis for Exclusion
FTA Passenger Ferry Program	The Ferry Division is not eligible because they are not a designated recipient or direct recipient of FTA's Urbanized Area Formula Grant, nor is it a public entity eligible as per the program's criteria.
FTA Section 5307 Urbanized Area Formula Grant	An urbanized area, as defined by the U.S. Department of Commerce's Bureau of the Census, is an incorporated region with a population exceeding 50,000. According to this definition, the Ferry Division does not qualify for funding due to the specific locations of its terminals and routes, which fall outside the designated boundaries of an urbanized area.
Congestion Mitigation and Air Quality Improvement (CMAQ)	The Ferry Division is not an eligible applicant because none of the areas it services are eligible counties. CMAQ provides funding for areas that do not meet the national ambient air quality standards (NAAQS) for ozone, carbon monoxide, or particulate matter, referred to as nonattainment areas, and for former nonattainment areas that are now in compliance (maintenance areas).[3]

6.3 Discretionary Federal Funding Program

Because there is limited state capital funding available to the Ferry Division, this section of the study focuses on discretionary federal funding and financing opportunities for the Ferry Division's needs. The needs include both vessel replacement and port electrification. in this section, the Ferry Division should identify viable procurement strategies, project elements, and potential projects that qualify for grants and financing, and engage actively with stakeholders for support and cost-sharing. Lastly, this plan allows the Ferry Division to create a solid foundation for leveraging federal and state resources, achieving its goals, and ensuring a sustainable future for its vessel operations.

Given the current age of the vessel fleet and the anticipated costs associated with replacing these vessels at the end of their useful life, a number of alternative vessel replacement scenarios were created to help determine the best combination of replacement cost and vessel useful life over the next 50-year period. These scenarios were then compared, and a recommended scenario was used to create the vessel prioritization plan outlined in Section 7.

[3] https://connect.ncdot.gov/projects/planning/TPB%20Systems%20Planning/Overview%20of%20CMAQ%20Procedure.pdf

This subsection presents a guide to seeking discretionary federal funding using a structured five-step process. It also provides an overview of the key federal competitive grant programs which should be considered for accelerating funding for the Ferry Division's fleet replacement, expansion, and transition to more sustainable technologies.

6.3.1 Identifying and Applying for Discretionary Funding Programs

To prepare discretionary grant applications, the Ferry Division should consider five initial steps:

1. Identification of discrete project elements to pursue grant funding.
2. Definition of scope, schedule, and budget for each project element.
3. Identification of lead or co-applicants for the grant and management/reporting to a federal agency.
4. Discussion with federal, state, and local policy makers and elected officials to ensure sponsorship and buy-in from stakeholders to secure a non-federal match.
5. Preparation of benefit-cost analyses and other technical evaluations to support grant applications (as required).

To optimize federal grant funding prospects, the Ferry Division should initially pinpoint specific project elements to target for funding. This entails a detailed understanding of each element's scope, timeline, and budget, ensuring they are clearly outlined for a comprehensive grant application. For example, NCDOT must consider if they plan on seeking a full vessel replacement within a grant application or seeking funding for cleaner engine upgrades. This decision may vary based on vessel or class resulting in determination of an ideal funding program aligned with the project scope.

The next step involves securing the support of federal, state, and local policy makers, a critical factor for project success. Their support often leads to a commitment to match funds for the project and can be demonstrated through obtaining official letters of funding and advocacy. The amount of funding that can be matched directly affects the chances of securing a grant. Typically, coastal counties may not be in a position to provide such funds, leaving the responsibility to the State. Applicant cost-share must be appropriated prior to applying for a grant. Therefore, seeking support from elected officials is critical. Furthermore, local elected officials can lobby and advocate for the Ferry Division to federal and state agencies.

The last step is demonstrating the economic viability and benefit. Many grant programs require a benefit-cost analysis to measure the project's financial benefits over a 25- or 50-year life cycle. The analysis typically requires a comparison of no-build versus build. Completing other technical reports, such as a project management plan including an asset management plan, can significantly strengthen the grant application.

HDR has identified the following federal funding sources as viable options for the Ferry Division to consider.

Table 6-6 Viable federal funding sources

Program Name	Agency	Fleet Expansion and Applicable Engine Retrofitting	Electrification at Maintenance and Harbor Facilities
Electric or Low-Emitting Ferry Pilot Program	Federal Transit Administration	☑	
Ferry Service for Rural Communities	Federal Transit Administration	☑	
Diesel Emissions Reduction Act	Environmental Protection Agency	☑	
Port Infrastructure Development Program	U.S. Maritime Administration		☑
Clean Ports Program: Zero-Emission Technology Deployment (Equipment and Infrastructure)	Environmental Protection Agency		☑

FEDERAL TRANSIT ADMINISTRATION DISCRETIONARY GRANT PROGRAMS

The FTA ferry programs allocate funds through two specialized programs aimed at modernizing the U.S. ferry systems. Key focuses of the program include expanding ferry services in rural areas, assisting communities in acquiring modern vessels (including electric ones to minimize carbon pollution), and enhancing shore infrastructure.

Electric or Low-Emitting Ferry Pilot Program

This program provided $50 million in FY 2024 funding for projects that support the purchase of electric or low-emitting vessels and the electrification of, or other emissions reduction from, existing vessels. These vessels should reduce emissions through alternative fuels or on-board energy storage systems. Related charging or fueling infrastructure that reduces emissions or produces zero onboard emissions under normal operations is also covered. The vessel must accommodate both car and walk on passengers. The vessels included in the recommended vessel replacement plan meet this criterion.

Ferry Service for Rural Communities

This program provided $170 million in FY 2023 funding (FY 2024 funding not yet released) to improve and expand ferry services, facilitating access to employment and other community opportunities. It covers capital, operating, or planning assistance for eligible projects. Capital projects include purchasing, constructing, replacing, or rehabilitating vessels, terminals, related infrastructure, and equipment such as fare equipment and communication devices.4.

Table 6-7 summarizes key information from the FTA ferry programs.

[4] This report suggests verifying rural eligibility due to a potential change in status following the FTA designation. Previously, the NCDOT Ferry Division received a grant for rural ferries, but this situation might alter with any new designations.

Table 6-7 FTA ferry program summary

Grant Program	Funding Availability and Maximum Grant Award	Funding Cycle	Eligible Activities
Electric or Low-Emitting Ferry Pilot Program	Funding availability: $50 million per year in authorized funding from FY 22–FY 26. Maximum grant award: no maximum	Annual: the next round of applications is anticipated in 2024	Capital projects
Ferry Service for Rural Communities	Funding availability: $200 million per year in authorized funding from FY 22–FY 26. Maximum grant award: no maximum	Annual: most recent round of applications closed on 07/17/2023	Capital, planning, and operating projects

Both grant programs focus on funding for vessel acquisition and align well with the strategic objectives of the Ferry Division. Over the past two years (FY 2022–2023), the FTA has allocated $253,701,292 to eight projects for new vessel acquisitions. It is important to note that this funding differs from allocations for building or retrofitting vessels. The level of competition for this program also varies by year.

The Ferry Division has successfully leveraged these funding opportunities in recent years. Notably, in FY 2023, they secured a $400,000 grant from the Rural Ferry Program to conduct a comprehensive study for a new depot maintenance facility at the Cherry Branch Ferry Terminal. This follows their previous success in FY 2022, where they were awarded $1,345,241 to modernize the Manns Harbor Shipyard paint facility.

ENVIRONMENTAL PROTECTION AGENCY DISCRETIONARY GRANT PROGRAM

Diesel Emissions Reduction Act (DERA)

The DERA program provided $115 million in FY 2022–2023 funding to expedite the modernization of the nation's aging diesel engine fleet. This initiative involves retrofitting or replacing existing diesel engines, vehicles, and equipment with EPA and California Air Resources Board-certified configurations and verified retrofit and idle reduction technologies. The goal is to decrease pollution, enhance public health, and comply with stricter environmental standards.

The EPA's Tier III marine vessel engine standard is part of the agency's regulatory framework aimed at reducing emission from marine diesel engines. These standards specifically target Category 3 engines, which are typically used in large ocean-going vessels. The EPA's Tier III is equivalent to the International Maritime Organization's (IMO) Marine Engine II. These engines reduce emissions by engine controls/low sulphur fuel without installation of exhaust gas recirculation (EGR) or SCR. IMO Tier III and EPA Tier IV are equivalent with selective catalytic reduction (SCR) and EGR requirements to achieve the reductions. Based on the present horsepower and cylinder displacement, engines currently used onboard Division vessels are Category 1 and 2 Marine Diesel Engines that are applicable for the DERA funding program.

To maximize the potential for upgrading their vessels to IMO Tier III standards, the Ferry Division should closely review the specific notice of funding opportunity as it contains vital information on

eligibility criteria and key details. This focused approach will ensure a clear understanding of the requirements and opportunities for enhancing their fleet in compliance with IMO Tier III standards.

The DERA program aims to reduce pollution by updating or retiring old diesel engines and vehicles using EPA and California Air Resources Board approved technologies. Table 6-8 summarizes the DERA program key information.

Table 6-8 DERA program summary

Funding Availability and Maximum Grant Award	Likelihood of Funding the Project	Matching Requirements	Funding Cycle	Eligible Activities
Funding availability: $115 million was allocated for FY 22/23 Maximum grant award: $2.5 million	Medium	0%	Annual – the next round of applications is anticipated in 2024.	Marine and fleet deployment or replacement

6.3.2 Electrification of Ports

As an important consideration accompanying the main objectives, the Ferry Division is taking steps towards the electrification of its fleet, with ongoing studies evaluating the feasibility on both short and long-haul routes. This effort includes the potential integration of microgrids utilizing wind and solar energy on Ocracoke Island. The shift towards electric vessels is envisioned to foster a cleaner, more sustainable mode of transportation; however, it is imperative to acknowledge the substantial capital investment required for port upgrades to accommodate electric vessels. This aspect forms a critical prerequisite for the successful implementation of any vessel electrification projects. As detailed in this section, various programs are available to provide funding assistance for these essential port upgrades.

An important reason to include this information is if the Ferry Division was successful in securing these federal funds, it can free up STIP allocations for vessel replacement. Further, the Bipartisan Infrastructure Law requires capital projects to focus on sustainability and climate initiatives among other priorities.

U.S. MARITIME ADMINISTRATION (MARAD)

Port Infrastructure Development Program

The Port Infrastructure Development Program (PIDP) is a competitive grant program administered by the Maritime Administration of the USDOT. This program aims to enhance the safety, efficiency, and reliability of the movement of goods through ports and their intermodal connections. For FY 2023, the PIDP was allocated $662 million sourced from the Infrastructure Investment and Jobs Act (Bipartisan Infrastructure Law) and the Consolidated Appropriations Act 2023.

The PIDP grants will support a range of projects that improve port operations and infrastructure. Eligible projects include those that enhance port loading and unloading facilities, improve goods movement within and around ports, bolster operational efficiency, and promote environmental

sustainability and emissions reduction. The program also emphasizes port resilience, electrification, and technology upgrades.

Eligible entities for the PIDP grant include port authorities, commissions, state or local governmental bodies, Indian tribes, public agencies, publicly chartered authorities, special purpose districts with a transportation mandate, and multistate or multijurisdictional entities. This is another program the Ferry Division could pursue for electrification funding.

The PIDP program provides funding to enhance U.S. port safety, efficiency, and sustainability through infrastructure improvements with a focus on resilience, electrification, and technology advancements. Table 6-9 summarizes the PIDP program key information.

Table 6-9 PIDP program summary

Funding Availability and Maximum Grant Award	Likelihood of Funding the Project	Matching Requirements	Funding Cycle	Eligible Activities
Funding availability: $662 million was allocated for FY 23 Maximum grant award: no maximum	Medium	20%	Annual - the next round of applications is anticipated in 2024	Planning environmental & final design, construction

ENVIRONMENTAL PROTECTION AGENCY

Clean Ports Program

The Clean Ports Program, established by the Inflation Reduction Act, is a $3 billion initiative by the EPA designed to fund zero-emission (ZE) port equipment and technology and assist U.S. ports in developing climate action plans to reduce air pollutants. This program, a part of the broader EPA Ports Initiative, aims to improve U.S. ports' environmental and public health impacts while maintaining job growth and competitiveness.

The program's first year of funding was released in two separate notice of funding opportunities on February 28, 2024. The separate documents reflect the two sub-programs: Climate and Air Quality Planning and ZE Technology Deployment, with $300 million allocated to the former and over $2.6 billion to the latter. The program encourages large-scale, high-impact projects and emphasizes community engagement, environmental justice, and workforce and labor considerations.

The Ferry Division could consider pursuing ZE Technology Deployment funds for the electrification of their fleet. It is recommended that the Division review both documents to determine project eligibility based on port and vessel requirements. Table 6-10 summarizes the Clean Ports program key information.

Table 6-10 Clean Ports Program summary

Funding Availability and Maximum Grant Award	Likelihood of Funding the Project	Matching Requirements	Funding Cycle	Eligible Activities
Funding availability: $3 billion is allocated for FY 2024. Maximum grant award depends on port type	Not available	0% for planning; 10-20% for technology deployment	Annual - the first round of applications is open with a May 28, 2024, deadline	Planning and technology deployment

6.4 Federal Financing Programs

This section examines USDOT's financing programs in supporting significant transportation projects like those of the Ferry Division. An overview of federal financing benefits and the viability of vessel or fleet expansion are addressed.

6.4.1 USDOT Build America Bureau Transportation Infrastructure Finance and Innovation Act

USDOT's Transportation Infrastructure Finance and Innovation Act (TIFIA), administered by the BAB (Build America Bureau), provides federal credit assistance through direct loans, loan guarantees, and standby lines of credit to finance surface transportation projects of national and regional significance. TIFIA leverages federal funds by attracting private and non-federal investments to projects. TIFIA credit assistance provides improved access to capital markets, offers flexible repayment terms, and potentially provides more favorable interest rates for similar instruments than in private capital markets. Any transit capital projects eligible for federal aid and included in the applicable STIP may qualify for the TIFIA program.

Each dollar of federal funding applied to TIFIA (as the subsidy amount) can provide up to $15 in credit assistance. With applicant funding, the match supports up to $50 in transportation infrastructure investment. Historically, credit assistance was limited to 33 percent of anticipated eligible project costs. However, in October 2022, USDOT authorized borrowing of up to 49 percent of eligible costs for transit and public transit-oriented development projects. The combined share of TIFIA proceeds and other federal funding for a given project may not exceed 80 percent of the total cost.

For the Ferry Division to be considered a viable candidate for TIFIA assistance, it must demonstrate a reliable repayment stream to establish creditworthiness. The Ferry Division must be at least partially supported by user charges such as fare revenues, toll revenues, or other non-federal dedicated funding sources. The benefits of TIFIA are substantial, such as low-interest rates and the ability to capitalize on debt for up to five years, coupled with credit risk premium assistance. However, the process of proving creditworthiness is thorough and demanding.

The program offers an extended repayment period of up to up to 35 years, with some projects under the Bipartisan Infrastructure Law even allowed to extend it up to 75 years. It allows borrowers to defer principal and capitalize interest payments for up to 5 years. Creditworthiness is a critical factor in the

evaluation process; if the revenue streams of a project are unproven, an additional pledge by the state or local government can be used to secure the loan. Applicants for TIFIA loans do not have to pay a credit risk premium to cover the cost of potential losses on the project. Congress appropriates funding each year to cover those costs.

TIFIA RURAL PROJECTS INITIATIVE

The Rural Projects Initiative (RPI) initiative is a loan program to support transportation infrastructure in America's rural communities. The program seeks to enhance the accessibility and efficiency of transportation, which is essential for accessing services like medical care, education, and retail. Through RPI.

- Loans are more likely to provide up to 49 percent of total project costs.
- Fixed interest rates equal to one-half of the U.S. Treasury rate of equivalent maturity at the time of closing (the traditional TIFIA program offers rates equal to the U.S. Treasury rate at the time of closing).
- Borrower fees are waived for projects under $75 million in total cost (to be eligible for RPI, total project costs should be between $10 million and $100 million).

Despite the rarity of ferry projects in TIFIA financing history, there are precedents, such as the significant funding received by Staten Island Ferries in FY 2000. This project received $159 million for the construction and acquisition of three vessels and redevelopment of two ferry terminals, the St. George Terminal in Staten Island, and the Whitehall Terminal in lower Manhattan, including a new traveler information system and multi-modal connection to taxis and transit. The Ferry Division could secure TIFIA financing for vessel or fleet expansion projects. Table 6-11 summarizes the TIFIA program's features and benefits.

Table 6-11 Federal financing program

Program Name	Description	Financing Capacity	Matching Requirements	Funding Cycle	Eligible Activities			
					Planning	Env. & Final Design	Construction	O&M
TIFIA Transportation Infrastructure Finance and Innovation Act	The TIFIA program provides federal credit assistance in the form of direct loans, loan guarantees, and standby lines of credit to finance surface transportation projects of national and regional significance.	$3 billion in loans	33% financing; requires dedicated repayment stream	Rolling	☑	☑	☑	

6.5 State and Local Funding and Financing Options for Federal Cost Share Requirements

Cost share, also known as "non-federal share" or "local match," is the percentage of costs of a federally assisted project or program funded by an applicant. Most federal discretionary funding programs require at least a 20 percent match. This cost share can be from any number of sources. Guidance from USDOT federal grant reviewers indicate that local match must be demonstrated as ready and accessible within the grant application. If the funds are not ready and accessible, USDOT federal grant reviewers could give an application with a lower score. As a best practice, HDR encourages NCDOT Ferry Division staff to consider demonstrating accessibility of these funds within a grant application.

This section details leveraging existing capital sources and potential external sources for the Ferry Division to consider securing the necessary match for federal discretionary funding programs.

6.5.1 Cost Share from NCDOT Allocations

While a part of NCDOT, the Ferry Division's ability to provide matching funds for federal grants can be limited by its budget allocations. Identifying federal and other grant opportunities and creating an executable plan to use the funds will help NCDOT leadership and the State Transportation Board dedicate local resources to the Ferry Division's efforts. The STI process may constrain ferry vessel replacement prioritization for funding and require Board of Transportation intervention.

6.5.2 Fares from Toll Revenue

Another consideration for providing cost share would be an expansion of how toll revenues can be used by the Ferry Division. Currently, the revenues are limited to projects within the Division where they were collected. With the cost of vessel replacements as described later in this Section, amending the statute to allow for use throughout the ferry system should be a consideration.

6.5.3 Local and Regional Stakeholders

Beyond potentially securing matching funds from the State, the Ferry Division should engage with local and regional stakeholders to enhance project support and collaboration. The Ferry Division serves Currituck County, Dare County, Hyde County, Carteret County, Beaufort County, Pamlico County, Craven County, Brunswick County, and New Hanover County. These counties can provide financial support, in-kind contributions, or other resources to help meet the cost-sharing requirements. However, it is crucial to recognize the significant economic challenges that characterize some of these counties.

In addition, the Ferry Division can engage with a diverse range of other stakeholders, including regional transportation authorities, port authorities, tourism boards, chambers of commerce, economic development agencies, environmental groups, universities and research institutions, public-private partnerships, and community organizations and non-governmental organizations. Example agencies/organizations/businesses include:

- Eastern Carolina Council
- Outer Banks Visitors Bureau

- North Carolina State Ports Authority
- North Carolina's Southeast
- University of North Carolina
- North Carolina State University
- Carteret County Chamber of Commerce

To demonstrate partnership with project stakeholders, some federal grant applicants have demonstrated financial contributions towards the cost share from varying organizations like those listed. While the contribution could be small, it demonstrates a partnership beyond a support letter.

6.6 Financial Forecasting Scenarios

6.6.1 Results of Financial Forecasting Scenarios

This section provides an overview of the financial forecasting scenarios used to determine the cost implications of various strategies for replacing the fleet vessels.

As noted in the introduction, a total of ten scenarios were developed to determine the best strategy, informed by cost escalation, for vessel replacement.

Table 6-12 Financial forecasting prioritization

Scenarios 1 through 8	Scenarios 9 and 10
• Class	• Condition
○ Sound	• Criticality
○ River	
○ Hatteras	
○ Aluminum Ferry	
• Age	
○ Descending	
Condition assessment was not included	

Scenarios 9-10 recommend a replacement schedule of the vessels based on a risk-based prioritization framework for each vessel including condition and criticality as described in Section 5.

1. Condition (Probability of Vessel Failing): This aspect evaluates the current state of vessel, considering its age, wear and tear, maintenance history, and any known issues. The condition score reflects the likelihood or probability of the vessel experiencing a failure. A vessel in poor condition is more likely to fail, thereby receiving a lower score in this category.
2. Criticality (Impact if the Vessel Fails): Criticality assess the potential impact of a vessel's failure on the ferry service's operation and its user. Factors considered include the vessel's role in the fleet, the number of passengers and vehicles it carries, its importance to specific routes (especially those with limited alternatives), and the potential economic and social impacts of its outage. A vessel that is critical to maintaining essential services would score lower in this category.

To advance the analysis, this study assumes 5 percent inflation per year based on a number of inputs:

- U.S. projected annual inflation rate 2010–2028, IMF data.
- 2029 and beyond uses forecast estimates from 2026–2028.
- Inflation in shipbuilding industry according to the U.S. Federal Reserve.
- US Steel price index.

Further, each vessel replacement assumes a 5 percent overhead/administrative/procurement oversight cost in addition to the vessel replacement cost.

Table 6-13 notes the summary of the vessels, average age, and base cost of new vessel in 2023 dollars based on class. The average age of the vessels does not include the Aluminum Ferry.

Table 6-13 Summary of vessel age and base cost by class

Class	Number of Vessels	Average Age	Base Cost of New Vessel (million dollars, 2023)
Sound	5	28.4	35
River	11	17.3	20
Hatteras	6	34.3	20
Aluminum Ferry	1	2	8
Total/Cumulative	**23**	**24.5**	

*Note: The Total/Cumulative Average Age does not include the Aluminum Ferry class

Table 6-14 notes the number of vessels to be replaced in each cycle and the scheduled replacement for each vessel. As noted with an asterisk, Scenarios 9 and 10 are based on the replacement of vessels by the risk-based prioritization framework as described in Section 5 of this study.

Table 6-14 Summary of assumptions used for financial forecast scenarios

Scenario	Number of Vessels Replaced in Each Cycle	Scheduled Replacement	Final Year of Funding
Scenario 1	1	2 years	2069
Scenario 2	1	3 years	2092
Scenario 3	1	4 years	2115
Scenario 4	1	5 years	2138
Scenario 5	2	2 years	2047
Scenario 6	2	3 years	2059
Scenario 7	2	4 years	2071
Scenario 8	2	5 years	2083
Scenario 9*	1	3 years	2092
Scenario 10*	2	3 years	2059

The results of the scenarios are detailed in Table 6-15 and include the total cost for complete fleet replacement, the federal cost share on an assumption of 80 percent, the local match requirement on an assumption of 20 percent, and the final date of acquisition.

Scenario 5 assumes two vessels replaced every 2 years and results in a $991.78 million total cost of fleet replacement by 2047. It notes a required local match, based on the assumption of 20 percent, of $198.36 million that NCDOT must consider.

Scenario 6, based on a prioritized replacement by class, and Scenario 10, based on HDR's Quality Score Metric for Vessel Replacement, are similar due to the number of vessels replaced in each cycle, two, as well as the schedule replacement of 3 years. The two scenarios both complete acquisition in 2059, and only differ by little more than $4.5 million as part of the required local match for NCDOT. An additional difference between Scenarios 5 and 6 compared to Scenario 10 is the replacement of the Aluminum Ferry. Scenarios 5 and 6 do not account for the significant expected difference in useful life of the Aluminum Ferry. Scenario 10 anticipates the expected useful life of the Aluminum Ferry and begins the procurement to replace the vessel in 2032, alongside two additional vessels. Scenario 10 does not replace the vessel a second time during the scenario window.

The final date of procurement for Scenarios 1 through 4, as well as Scenario 9, vary from 2069 through 2138, due to only one vessel being replaced in each cycle. The delay in replacing the vessels leads to a rise in both the total cost and the NCDOT's required local match, alongside an increased average life of the ferry fleet. By deferring the cost of replacement, Scenarios 3 and 4 are not completed until the 2100s with costs from $9 to $23 billion, respectively.

Table 6-15 Summary results of all scenarios, based on full vessel replacement

Scenario	Number of Vessels Replaced in Each Cycle	Schedule Replacement	Total Cost for Complete Fleet Replacement (millions)	Total Federal Cost Share (80%) (millions)	Total Local Match Requirement (20%) (millions)	Final Year of Funding
Scenario 1	1	2 years	$1,895.17	$1,516.14	$379.03	2069
Scenario 2	1	3 years	$4,081.94	$3,265.55	$816.39	2092
Scenario 3	1	4 years	$9,471.75	$7,577.40	$1,894.35	2115
Scenario 4	1	5 years	$23,125.16	$18,500.13	$4,625.03	2138
Scenario 5	2	2 years	$991.78	$793.42	$198.36	2047
Scenario 6	2	3 years	$1,388.04	$1,110.43	$277.61	2059
Scenario 7	2	4 years	$1,993.33	$1,594.67	$398.67	2071
Scenario 8	2	5 years	$2,316.77	$1,853.42	$463.35	2083
Scenario 9	1	3 years	$4,878.96	$3,903.17	$975.79	2092
Scenario 10	2	3 years	$1,412.03	$1,129.63	$282.41	2059

Table 6-16 notes the 50-year forecast for all scenarios, including cost through 2073, as well as the number and percentage of vessels replaced in that timeframe.

Scenarios 1, 5, 6, and 10 can complete vessel procurement within the 50-year forecast period. At a cost of $1.89 billion, Scenario 1 is the costliest of the four scenarios. Scenario 5 notes a cost of $991.78 million. Scenarios 6 and 10 note costs of $1.38 and $1.41 billion, respectively.

Table 6-16 Summary results of all scenarios, based on 50-year replacement

Scenario	Number of Vessels Replaced in Each Cycle	Schedule Replacement	50 Year Cost Through 2073 (millions)	Number of Vessels Replaced in 50 Years	Percent of Fleet Replacement Over 50 Years
Scenario 1	1	2 years	$1,895.17	23	100%
Scenario 2	1	3 years	$1,356.31	17	74%
Scenario 3	1	4 years	$1,041.98	15	65%
Scenario 4	1	5 years	$948.25	12	52%
Scenario 5	2	2 years	$991.78	23	100%
Scenario 6	2	3 years	$1,388.04	23	100%
Scenario 7	2	4 years	$1,993.33	23	100%
Scenario 8	2	5 years	$2,155.13	20	87%
Scenario 9	1	3 years	$1,399.19	17	74%
Scenario 10	2	3 years	$1,412.03	23	100%

To advance a deeper analysis, this report focused on Scenarios 5, 6, and 10. Tables 6-17, 6-18, and 6-19 provide a breakdown of the year of replacement for each vessel as well as the total costs and their age at time of replacement for Scenarios 5, 6, and 10. Cost at age of replacement, including estimated overhead cost, in the far right column of each table, indicates the raw cost of each vessel as well as the estimated administrative cost involved in procurement. The column, age at time placed into service, notes the age of the vessel following the acquisition date of an assumed five-year procurement period.

Vessels in Table 6-17 and Table 6-18 are sorted by class and age. Vessels in Table 6-19 are sorted by their risk-based prioritization.

Table 6-17 Summary results of Scenario 5, vessel breakdown of age and cost

Vessel	Class	Age (as of 1/2024)	Year of Funding/ Start of Design	Year Placed into Service	Age at Time Placed into Service	Cost at Year of Funding, Including Estimated Overhead Cost (millions)
Silver Lake	Sound	55	2025	2030	61	$40.52
Carteret	Sound	35	2025	2030	41	$40.52
Cedar Island	Sound	29	2027	2032	37	$44.67
Swan Quarter	Sound	12	2027	2032	20	$44.67
Sea Level	Sound	11	2029	2034	21	$49.25
Gov. Daniel Russell	River	31	2029	2034	41	$28.14
Southport	River	27	2031	2036	39	$31.03
Neuse	River	25	2031	2036	37	$31.03
Floyd J. Lupton	River	23	2033	2038	37	$34.21
Fort Fisher	River	23	2033	2038	37	$34.21
Croatoan	River	20	2035	2040	36	$37.71
W. Stanford White	River	20	2035	2040	36	$37.71
Hatteras	River	17	2037	2042	35	$41.58
Rodanthe	River	4	2037	2042	22	$41.58
Avon	River	0	2039	2044	20	$45.84
Salvo	River	0	2039	2044	20	$45.84
Gov. James B. Hunt	Hatteras	39	2041	2046	61	$50.54
Frisco	Hatteras	34	2043	2048	58	$55.72
Kinnakeet	Hatteras	34	2041	2046	56	$50.54
Chicamocomico	Hatteras	33	2043	2048	57	$55.72
Cape Point	Hatteras	33	2045	2050	59	$61.43
Ocracoke	Hatteras	33	2045	2050	59	$61.43
Ocracoke Express	Aluminum Ferry	2	2047	2052	26	$27.91

Table 6-18 Summary results of Scenario 6, vessel breakdown of age and cost

Vessel	Class	Age (as of 1/2024)	Year of Funding/ Start of Design	Year Placed into Service	Age at Time Placed into Service	Cost at Year of Funding, Including Estimated Overhead Cost (millions)
Silver Lake	Sound	55	2026	2031	62	$42.54
Carteret	Sound	35	2026	2031	42	$42.54
Cedar Island	Sound	29	2029	2034	39	$49.25
Swan Quarter	Sound	12	2029	2034	22	$49.25
Sea Level	Sound	11	2032	2037	24	$57.01
Gov. Daniel Russell	River	31	2032	2037	44	$32.58
Southport	River	27	2035	2040	43	$37.71
Neuse	River	25	2035	2040	41	$37.71
Floyd J. Lupton	River	23	2038	2043	42	$43.66
Fort Fisher	River	23	2038	2043	42	$43.66
Croatoan	River	20	2041	2046	42	$50.54
W. Stanford White	River	20	2041	2046	42	$50.54
Hatteras	River	17	2044	2049	42	$58.51
Rodanthe	River	4	2044	2049	29	$58.51
Avon	River	0	2047	2052	28	$67.73
Salvo	River	0	2047	2052	28	$67.73
Gov. James B. Hunt	Hatteras	39	2050	2055	70	$78.40
Frisco	Hatteras	34	2053	2058	68	$90.76
Kinnakeet	Hatteras	34	2050	2055	65	$78.40
Chicamocomico	Hatteras	33	2053	2058	67	$90.76
Cape Point	Hatteras	33	2056	2061	70	$105.07
Ocracoke	Hatteras	33	2056	2061	70	$105.07
Ocracoke Express	Aluminum Ferry	2	2059	2064	38	$50.12

Table 6-19 Summary results of Scenario 10, vessel breakdown of age and cost.

Vessel	Class	Age (as of 1/2024)	Risk-Based Prioritization	Year of Funding/ Start of Design	Year Placed into Service	Age at Time Placed into Service	Cost at Year of Funding, Including Estimated Overhead Cost (millions)
Silver Lake	Sound	55	7.67	2026	2031	62	$42.54
Gov. James B. Hunt	Hatteras	39	5.52	2026	2031	46	$24.31
Chicamocomico	Hatteras	33	7.6	2029	2034	43	$28.14
Hatteras	River	17	8.7	2029	2034	27	$28.14
Carteret	Sound	35	8.91	2032	2037	48	$57.01
Cedar Island	Sound	29	8.94	2032	2037	42	$57.01
Ocracoke Express	Aluminum Ferry	2	Not Scored	2032	2037	15	$13.42
Croatoan	River	20	9.08	2035	2040	36	$37.71
W. Stanford White	River	20	9.34	2035	2040	36	$37.71
Frisco	Hatteras	34	9.42	2038	2043	53	$43.66
Kinnakeet	Hatteras	34	9.56	2038	2043	53	$43.66
Sea Level	Sound	11	9.72	2041	2046	33	$69.49
Cape Point	Hatteras	33	9.93	2041	2046	55	$69.49
Ocracoke	Hatteras	33	10.12	2044	2049	58	$58.51
Gov. Daniel Russell	River	31	10.27	2044	2049	56	$58.51
Neuse	River	25	10.4	2047	2052	53	$67.73
Southport	River	27	10.44	2047	2052	55	$67.73
Swan Quarter	Sound	12	10.55	2050	2055	43	$137.20
Floyd J. Lupton	River	23	12.92	2050	2055	54	$78.40
Fort Fisher	River	23	13.76	2053	2058	57	$90.76
Rodanthe	River	4	14.24	2053	2058	38	$90.76
Avon	River	0	20.37	2056	2061	37	$105.07
Salvo	River	0	20.37	2056	2061	37	$105.07

Table 6-17 and Table 6-18 demonstrate the strategy of replacing by class and age might conflict with a grant strategy of FTA funding for lifecycle replacement. FTA assumes a lifecycle for steel marine vessels of 50 to 60 years. The aggressive replacement schedule of Scenario 5 might result in the attempt to replace vessels that have not yet surpassed their useful lifecycle, while Scenario 6 results in several vessels significantly exceeding their useful life, especially the Aluminum class. Nearly all vessels within Scenario 10 are within the FTA lifecycle assumption, including the Aluminum Ferry. Although the total cost is higher than costs in Scenarios 5 and 6, Scenario 10 reflects vessel replacement based on the state of good repair and replaces all vessels within a 50-year time frame.

07

Vessel Replacement Plan

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7 Vessel Replacement Plan

This section presents the vessel replacement plan, including a prioritize list of vessels, estimated time to replace the vessels, what vessels will be replaced with, the estimated cost the Ferry Division will incur to replace each vessel, and proposed intervention strategies that could extend the life of each vessel.

7.1 Recommendations for Prioritized Vessel Replacement Plan

Based on the results of the scenarios detailed in Section 6.5, the best strategy for NCDOT to consider is replacement of two vessels every 3 years with vessels identified for replacement determined through the use of a risk-based prioritization framework. Scenario 10 is the recommended option as shown in Table 7-1.

Table 7-1 Recommended replacement plan - Scenario 10

Vessel	Class	Age (as of 1/2024)	Risk-Based Prioritization	Year of Funding/ Start of Design	Year Placed into Service	Age at Time Placed into Service	Cost at Year of Funding, Including Estimated Overhead Cost (millions)
Silver Lake	Sound	55	7.67	2026	2031	62	$42.54
Gov. James B. Hunt	Hatteras	39	5.52	2026	2031	46	$24.31
Chicamocomico	Hatteras	33	7.6	2029	2034	43	$28.14
Hatteras	River	17	8.7	2029	2034	27	$28.14
Carteret	Sound	35	8.91	2032	2037	48	$57.01
Cedar Island	Sound	29	8.94	2032	2037	42	$57.01
Ocracoke Express	Aluminum Ferry	2	Not Scored	2032	2037	15	$13.42
Croatoan	River	20	9.08	2035	2040	36	$37.71
W. Stanford White	River	20	9.34	2035	2040	36	$37.71
Frisco	Hatteras	34	9.42	2038	2043	53	$43.66
Kinnakeet	Hatteras	34	9.56	2038	2043	53	$43.66
Sea Level	Sound	11	9.72	2041	2046	33	$69.49
Cape Point	Hatteras	33	9.93	2041	2046	55	$69.49
Ocracoke	Hatteras	33	10.12	2044	2049	58	$58.51
Gov. Daniel Russell	River	31	10.27	2044	2049	56	$58.51
Neuse	River	25	10.4	2047	2052	53	$67.73
Southport	River	27	10.44	2047	2052	55	$67.73
Swan Quarter	Sound	12	10.55	2050	2055	43	$137.20
Floyd J. Lupton	River	23	12.92	2050	2055	54	$78.40
Fort Fisher	River	23	13.76	2053	2058	57	$90.76
Rodanthe	River	4	14.24	2053	2058	38	$90.76
Avon	River	0	20.37	2056	2061	37	$105.07
Salvo	River	0	20.37	2056	2061	37	$105.07

The average local match requirement of vessel replacement for Scenario 10 is $25.67 million per replacement cycle.

Aligning with annual notice of funding opportunity schedule releases, it is feasible that NCDOT could utilize the FTA Electric or Low-Emitting Ferry Pilot Program as well as FTA Ferry Service for Rural Communities within all the scenarios. However, Scenario 10 best reflects the FTA's requirements for aligning with guidance on lifecycle vessel replacement. This report recommends further analysis of utilizing the EPA's DERA program on specific engine replacement requirements and eligibility.

7.2 Vessel Replacement Strategy by Class Type

7.2.1 Sound Class Vessels

Sound class vessels would involve a modified design that addresses specific operational challenges and enhances overall functionality. Key design modifications would include the removal of vessel elevators to passenger decks, addressing recurring failures that compromise ADA compliance for passenger facilities such as heads and lounges. Moreover, considerations for crew storage and rest areas are essential, particularly for vessels overnighting at Ocracoke, ensuring crew comfort and operational efficiency.

Additionally, the modified design should feature robust deck strength and ample space to accommodate heavy trucks and larger passenger vehicles, facilitating efficient loading and unloading operations. Propulsion systems should be diesel-electric, equipped with sufficient horsepower to navigate the challenging conditions of the Pamlico Sound effectively, ensuring reliable performance and safety across varied operational scenarios.

7.2.2 Hatteras Class and River Class Vessels

Hatteras and River class vessels should be replaced with a modified River class vessel with several key enhancements to optimize performance and compliance with operational requirements. The modified vessel would ideally feature Voith Schneider e-VSP drives at each end, powered by diesel generators, ensuring enhanced maneuverability and efficiency in various operating conditions.

Furthermore, the revised design would integrate holding tanks to facilitate compliance with EPA No Discharge Zones along designated routes, aligning with environmental regulations and promoting sustainable maritime practices. In response to the extended duration of the route due to shoaling issues, adjustments would include additional crew accommodation facilities such as heads and a galley, catering to the longer 1.5-hour journey duration compared to the previous 20-minute route. Moreover, the vessel class should boast sufficient deck strength and ample space to accommodate heavy trucks and larger passenger vehicles, ensuring seamless operation, and facilitating efficient loading and unloading processes.

7.3 Intervention Strategies

The intervention strategies outlined in this section are based on a visual condition assessment of the 23 vessels in the Ferry Division's fleet. This assessment included both in-person evaluations of 20 vessels and desktop reviews of the remaining three. Additionally, a thorough desktop assessment of functional condition and criticality, coupled with the Ferry Division's operational experience, informed the recommended strategies. It is recommended that a detailed life cycle plan for each vessel be prepared to identify the timing as well as more detailed and specific activities for each vessel.

The recommended intervention strategies for NCDOT vessels are as follows.

1. Safety Management System Implementation or Expansion
   Implement or expand a Safety Management System (SMS aligned with Passenger Vessel Association (PVA) guidelines and 33CFR96 standards. This integrated system would streamline operational and maintenance procedures across the ferry system, enhancing maintenance tracking, trend identification, and repair planning. Initial implementation costs, if not already underway, are estimated at $250,000.

2. HVAC Improvements
   Continue the transition from central and standalone HVAC systems to mini split units, known for their suitability, cost-effectiveness, and reduced maintenance requirements. Estimated implementation costs per vessel are $60,000, with specific timing determined by individual vessel maintenance histories.

3. Propulsion System Upgrades
   Replace existing mechanical Voith Schneider propulsion units on older vessels with more efficient e-VSP electro-mechanical units. If the systems could be easily interchanged, installing additional generators in place of the propulsion engines would decrease maintenance requirements for shafting and bearings. Estimated implementation costs stand at $500,000 per vessel.

4. Maintenance History and Analysis Integration
   Review the maintenance history for each vessel to identify the causes of failures and associated interventions and timings. Analyzing maintenance records for each vessel helps pinpoint recurring issues and understand past intervention effectiveness. This data-driven approach aids in prioritizing maintenance tasks and optimizing resource allocation, ensuring efficient vessel upkeep and operational reliability.

5. Channel Depth Maintenance and Management
   Consider the depth of channels and dredging options, to allow for enough room for the vessels to operate. This will help avoid any groundings due to channel shoaling. Evaluating channel depths and dredging options minimizes the risk of vessel groundings due to shallow waters. Proactive maintenance of channel depths ensures safe navigation, reducing delays and operational disruptions, thus enhancing overall ferry service efficiency and passenger safety. The shallow depth, difficult channel routing and increased voyage time on the Hatteras to Ocracoke route contribute to damage susceptibility to propulsion and steering systems, in particular exposed rudders for the Hatteras class vessels and exposed Voith drive blades for River class vessels operating on this route. This accounts for emergency repair operations which disrupts the regularly scheduled vessel maintenance and repair schedules.

08

Future Improvements

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8 Future Improvements

This section identifies activities to improve management of vessels at the Ferry Division. These improvement recommendations are based on discussions with Ferry staff and analysis conducted as a part of this study.

The recommended improvements are as follows.

1. Risk-Based Prioritization Framework Expansion
   Building on the risk-based prioritization framework used as part of the recommended vessel replacement plan, the Ferry Division should consider extending its application to encompass activities beyond replacement, such as vessel rehabilitation, maintenance, and enhancements. By integrating this risk-based approach, the Ferry Division could prioritize resources effectively, focusing efforts where they are most needed to optimize vessel performance and longevity.

2. Life Cycle Plan Development
   Develop comprehensive life cycle plans for each vessel, informed by current conditions, risk factors identified in this plan, and historical maintenance records. These life cycle plans would facilitate precise scheduling of interventions, improved coordination of work logistics (e.g., dock space), and support securing necessary funding.

3. Routine Vessel Inspection Program Setup
   Implement a routine vessel inspection program to promptly identify and address any emerging issues or unplanned interventions. This proactive approach would enable the Ferry Division to maintain vessel reliability and continuously update the life cycle plans, as well as align inspections with USCG requirements.

4. Root Cause Analysis of Historical Unplanned Maintenance
   Connected to earlier recommendations, upon review of vessels and maintenance records, conduct root cause analyses for historical unplanned maintenance on the vessels. By pinpointing underlying issues contributing to maintenance disruptions, these analyses can inform prioritization of vessels for replacement, leveraging insights gained from the vessel replacements study's planning-level analysis.

5. Useful Life Extension Interventions
   Given that future funding is uncertain, identify interventions that may help extend the life of the vessels (beyond their planned useful life) and identify the benefit-cost ratio for life extension interventions. Integrating these findings into all vessel life cycle plans ensures informed decision-making and proactive management of the vessel assets.

6. Scalable Vessel Procurement Contracts

   Considering the constrained and competitive landscape of the U.S. shipbuilding industry, along with the adherence to diverse regulatory requirements such as Buy America, explore developing innovative procurement strategies to entice shipbuilders to bid on vessel replacement contracts. For instance, one potential strategy could involve structuring contracts to procure batches of six vessels at a time, with funding disbursed at 3-year intervals over a 9-year term.

A

Appendix A – Visual Condition Assessment Breakdown

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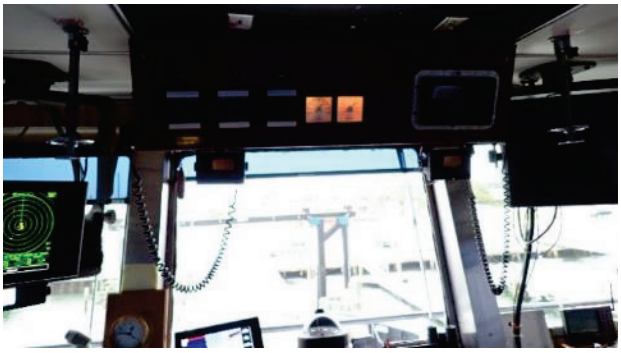
Appendix A: Visual Condition Assessment Breakdown

Appendix A provides a detailed visual breakdown used to assess each vessel. It includes representative photos of the components assessed across all ten categories.

A.1 Communication

Assesses the condition of communication equipment including radar, very high frequency (VHF) radios, automatic identification system (AIS), telephone, and intercom systems. Double ended vessels require duplication of equipment.

Older style bridge console



Typical older bridge style with radar, VHF radios and other communications gear

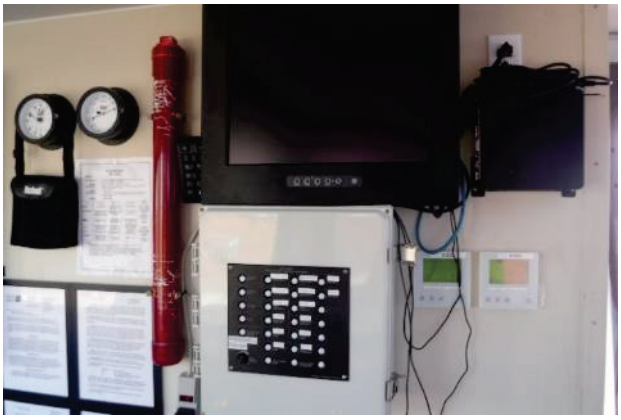
Older style engine control with Caterpillar engine controls

Older sound powered telephone

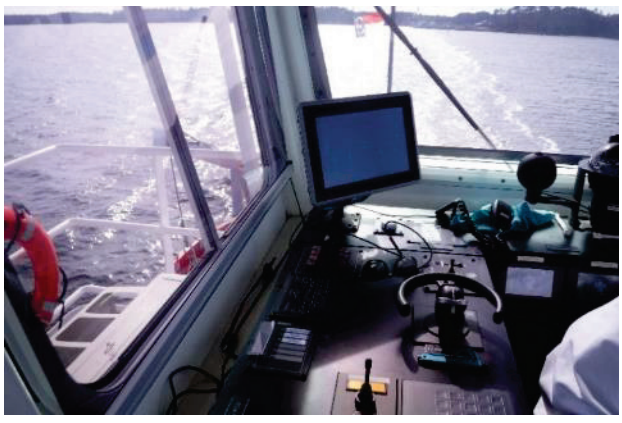
Older VHF radio install

Typical alarm panels on bridge

More updated radar and GPS unit, VHF



Updated monitor of new vessel



New vessel monitor and bridge controls

New vessel electronic telephone

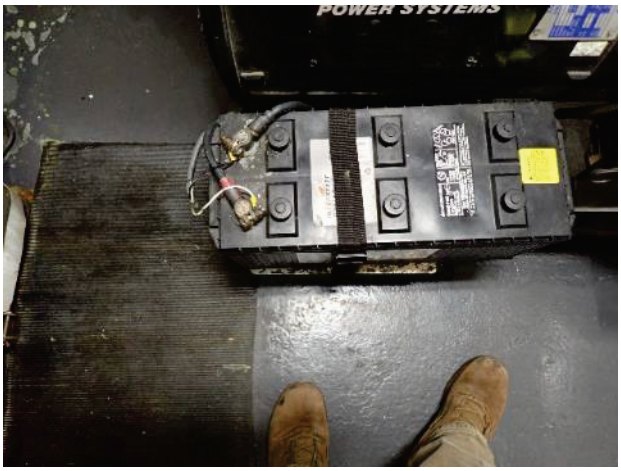
New vessel communications arrangement

Communications arrangement on mid age vessel

A.2 Electrical

Assesses the condition of electrical cable, switchboards, and electrical generators. Cable insulation, routing and conditions are considered.

Typical cables mounted on bulkheads



Starting battery for emergency generator.

Typical emergency generator arrangement. Not lack of cover over hot lead of starter motor.

Switchboard of medium age

Condition of some controller panels.

Switchboard installation.

Typical Caterpillar auxiliary generator

Very old switchboard from Gov Hunt

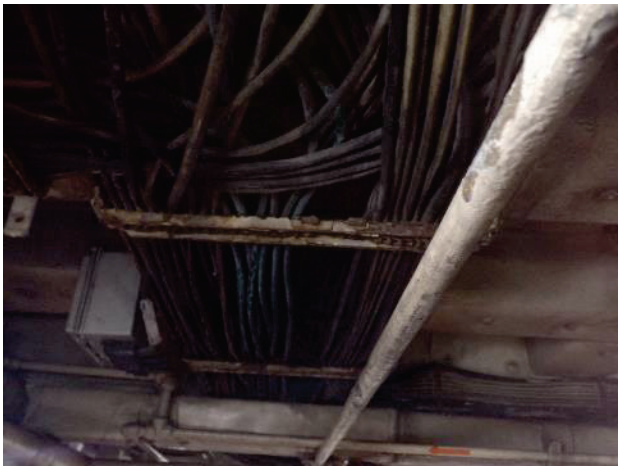
Typical electric sub panel and cables.

Newer vessel cable and bulkhead penetration

Neat cable way on newer vessel

Newer vessel switchboard example

Newer vessel emergency generator



Wiring arrangement of older vessel note blackened cables

A.3 Emergency

Assesses the condition and arrangement of life saving equipment, rescue boat and davits, life rafts, fire-fighting arrangements.

Life jacket locker for newer vessel

Typical fire station

Older style and rescue boat and davit

New vessel fire extinguisher and ring buoy typical for all vessels

New vessel fixed firefighting set up

Newer fixed firefighting and fire pump

Updated rescue boat arrangements

Older CO2 fixed fire fighting arrangement

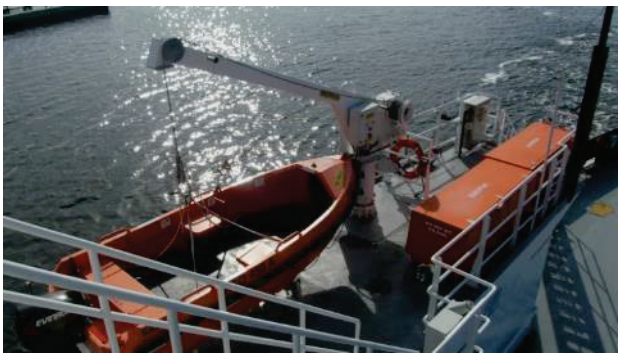
Typical emergency shutoff for E-Gen Fuel oil

Additional view of older style fixed fire fighting

Fixed fire-fighting CO2 hoses in very good condition

Standard configuration of life rafts on racks with hydrostatic releases

Older style non-quick release hook for rescue boat

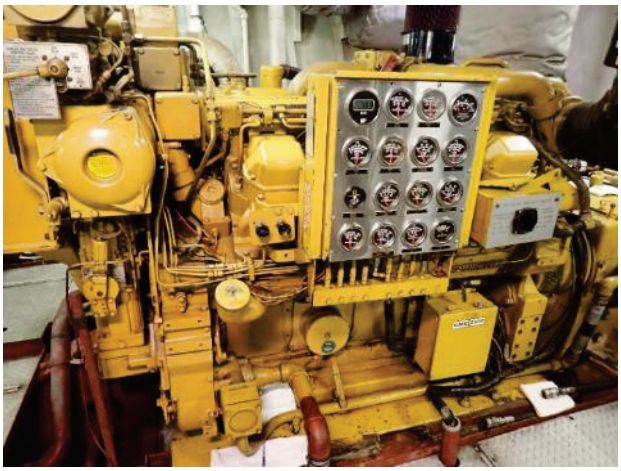


New rescue boat with now-standard quick release hook

A.4 Engine

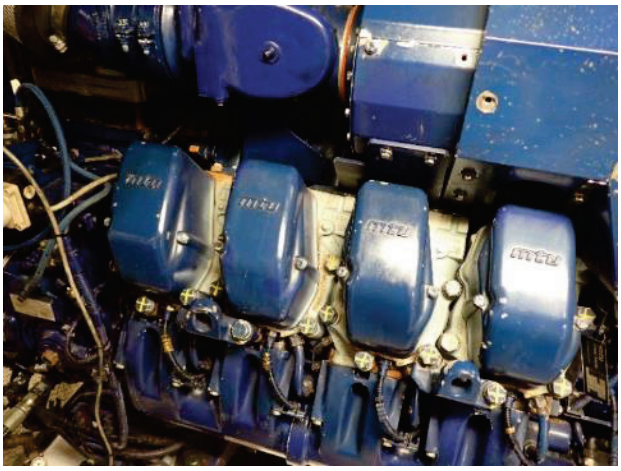
Assesses the condition and tier level of the propulsion and generator engines. Checking for leaks, hazardous conditions and vibrations for operating engines.

Newer Tier III E-Gen engine



Non-Tier CAT 3408 engine

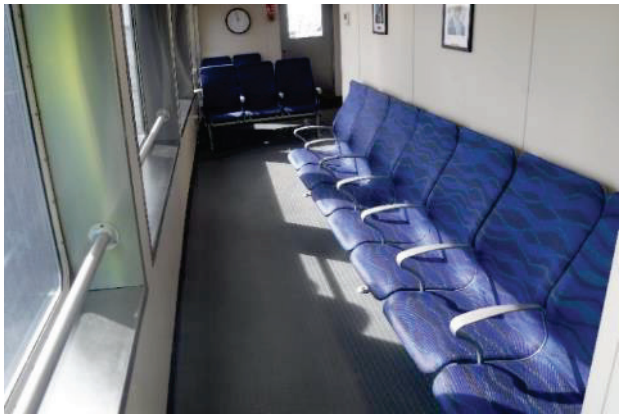
Non-tier older generator and engine



MTU Tier III engine

A.5 Interior and Equipment

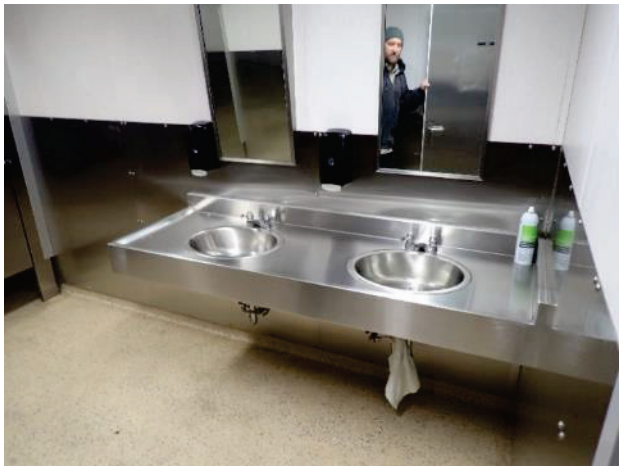
Assesses the condition of passenger lounge windows, wall panels and seating areas as well as crew accommodations as applicable. Also includes the condition of passenger and crew heads.



New vessel lounge with resilient decking and seating areas

New vessel passenger accessible head stainless on bulkhead and terrazzo type deck

Mid Age Passenger lounge and seating, tile deck



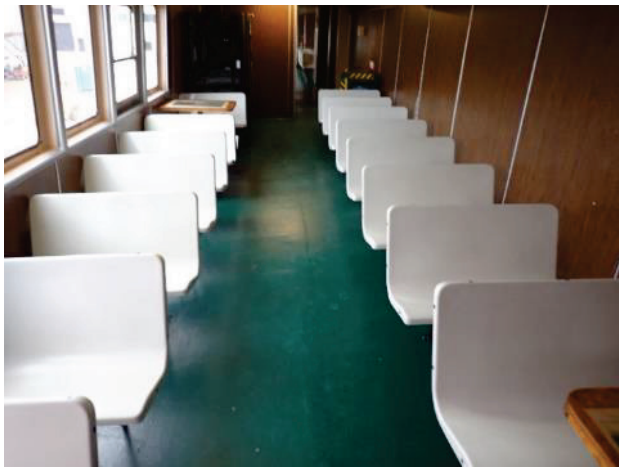
Mid age passenger accessible head, although on second deck with elevator out of commission

Crew accommodation on Sound class vessel

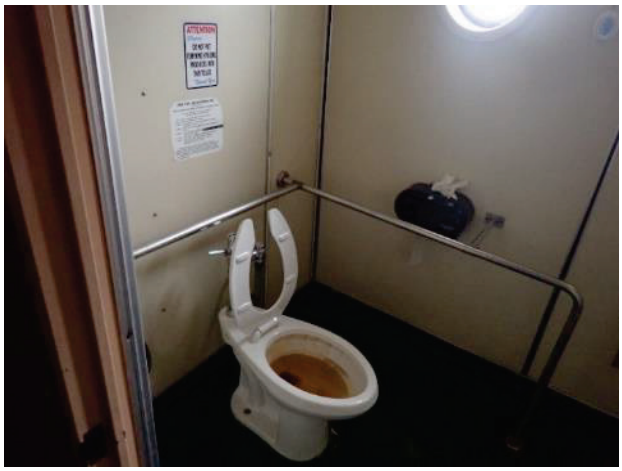
Older vessel passenger lounge

Older vessel head and deck

Older vessel passenger lounge with updated resilient deck.

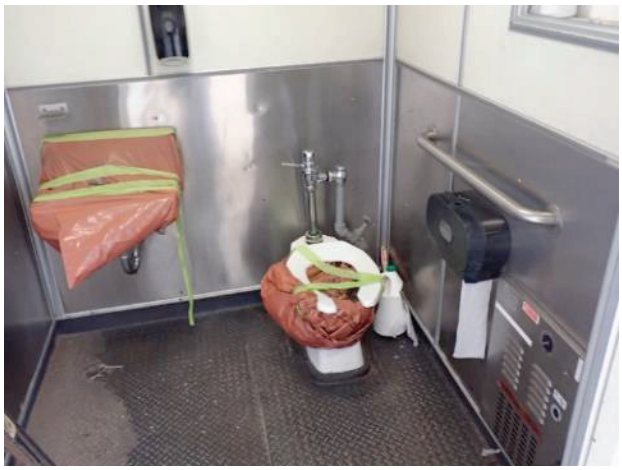


Oldest vessel passenger lounge seating and deck



Oldest vessel head and deck

Mid aged Sound class vessel with leaking window



Accessible head on older vessel, updated slightly

A.6 HVAC

Assesses the condition, type, and age of the HVAC systems. Central HVAC systems are typically more difficult to maintain/repair and mini-split systems easier and less costly.

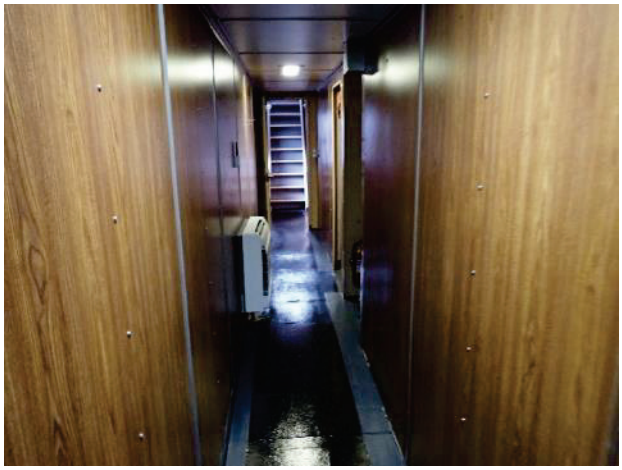
Mini split HVAC systems for upgraded pilot house

Typical central HVAC system register

Typical mini-split register

Newer mini-split systems installed

Another view of mini split in accommodation



Mini split in passageway

Electric heater on older vessel

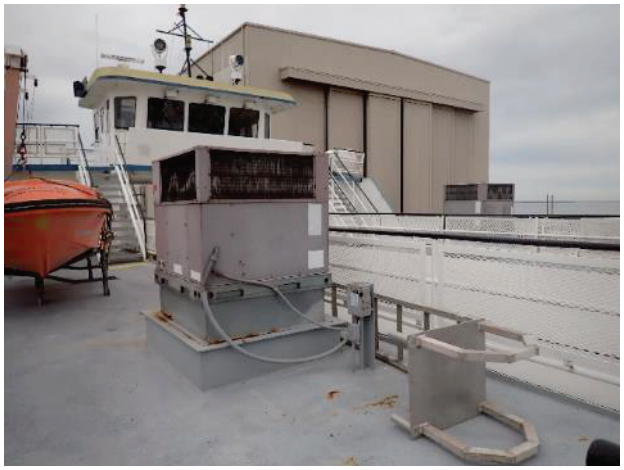
HVAC duct on older vessel

Central HVAC unit onboard older vessel

Second part of central HVAC system onboard older vessel

Typical ducting for central HVAC

Mini split showing susceptibility to damage



Non mini split HVAC Unit

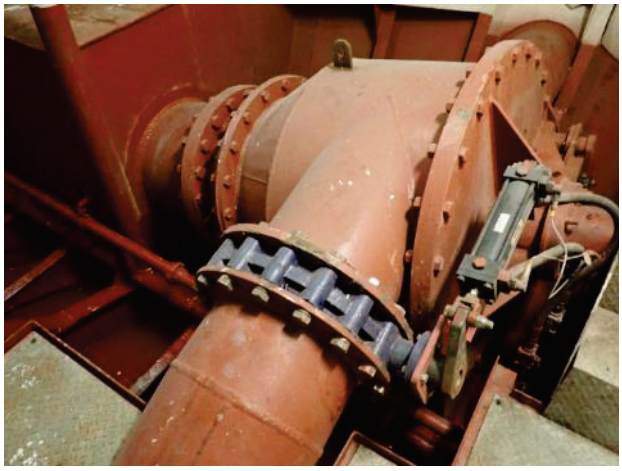
Duct system for non mini split system

A.7 Plumbing

Assesses the condition of piping and valves for sea water, sewage, air and potable water systems.

Example of piping insulation repaired with vinyl tape

Typical sea chest and piping on older vessel in bilge area



Typical sea water piping in bilge area

Typical piping on deck area

Piping, vents and containment on deck

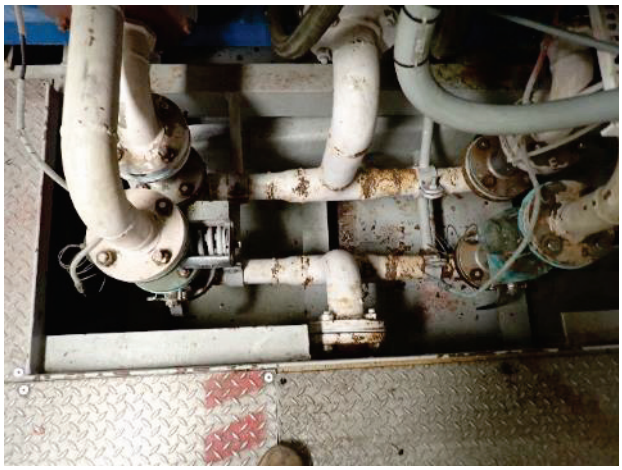
Firefighting piping installed

Piping in bilge area

Piping in bilge area

Water pumps and piping systems as typical

Piping in engine room showing maintenance done



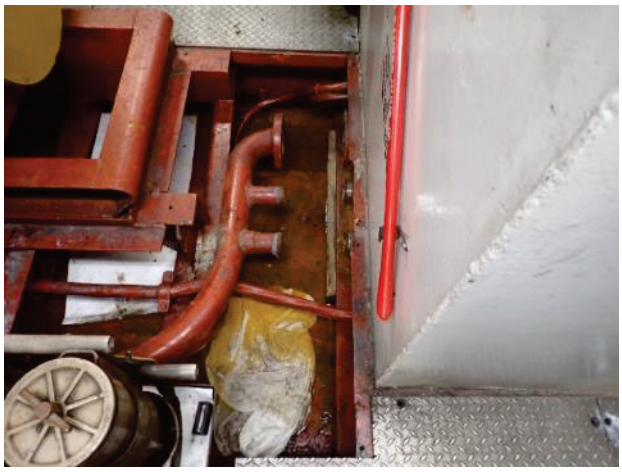
Valves and piping at deck level

Potable water piping and pumps

Another potable water system with piping pumps, pressure tanks and heater

Sea water pumps and piping system

Reworked/new valve on vessel in shipyard



Piping with valves removed on vessel in shipyard

Valves for bilge system

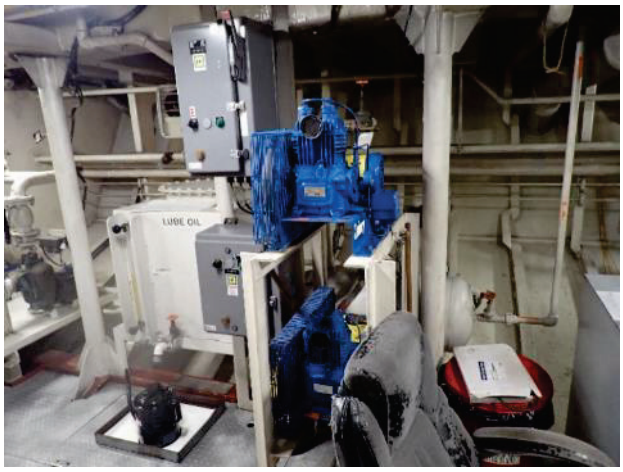
Piping with valves and insulation

Sewage treatment system on older vessel

Typical air receivers installation

Red Fox sewage treatment system

Sewage holding tanks installed on older vessel for operation in no discharge zone (Southport to Fort Fisher)



Air compressor and L.O. tanks

New vessel piping

New vessel piping and coolers

New vessel piping and fire pump

Different valve and piping arrangement for engine room bilge area

Sewage treatment plant

A.8 Propulsion

Assesses the condition of propulsion shaft, seals, and propellers as found.

Shaft area for Voith unit

Voith unit inside ship

Older 4 blade Voith unit

Screw of twin screw vessel with rope fouling

Twin screw vessel single ended

Shaft in engine room and shaft seal

Another Voith unit

Second shaft and seal system for propeller vessel

Propeller and rudder for double ended ferry

A.9 Steering

Assesses the condition of rudder mechanism, rudder/rudder stock, rudder hydraulics as applicable. Voith Schneider vessels and pod propulsion vessels do not have separate steering machinery.

Rudder for double ended ferry

One of rudders for twin screw vessel

Voith unit with fin, but not rudder

Rudder post and system for twin screw vessel

Opposite side rudder with connecting pipe

A.10 Structure

Assesses the condition of the structure of the hull, bulwarks, bilges, decks, and accommodations including pilot house. Corrosion conditions, as well as coating conditions are considered in the rating.

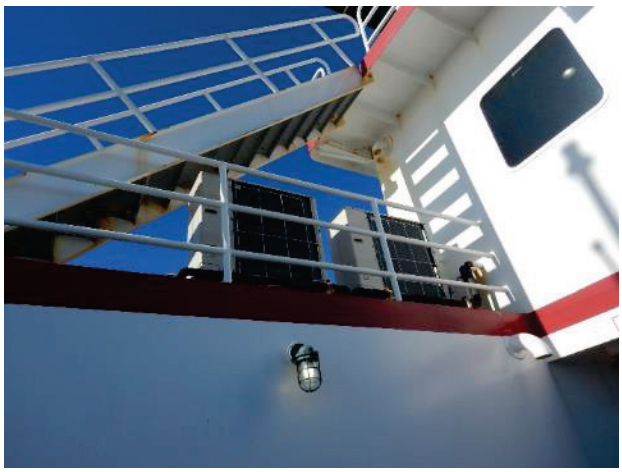
Example of emergency generator access door

Moderate corrosion in way of superstructure opening

Example of bulwark in good condition as well as car deck

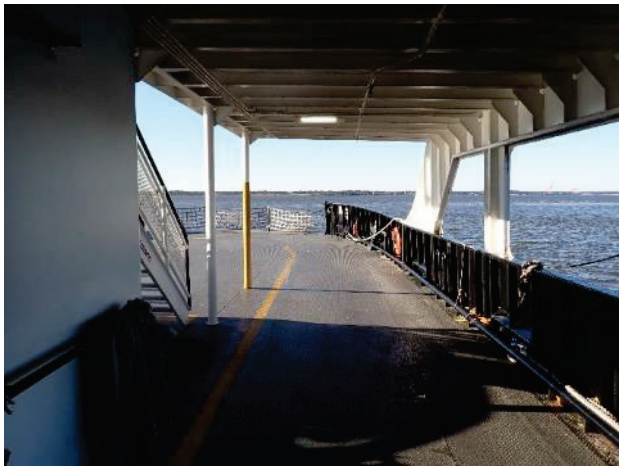
Typical condition of emergency vent and closing apparatus

Compartment vent with blanking plate



Minor superstructure corrosion

Superstructure access door

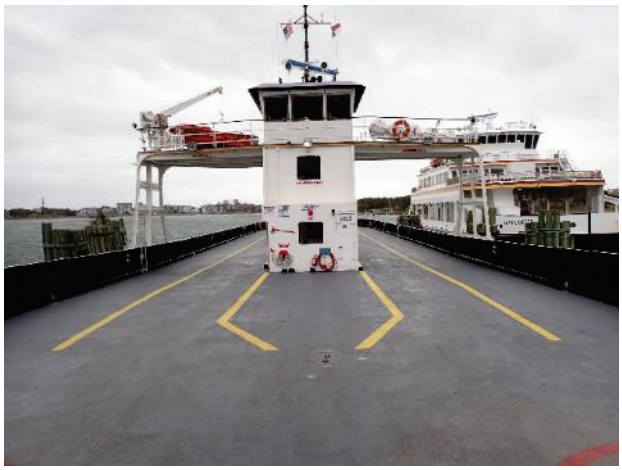


Typical car deck and lane of passenger ferry

CAPAC systems have all been decommissioned in favor of hull zinc anodes

Depleted zinc anodes on keel cooler of hull.

Hull being prepped with new zinc anodes visible



Island and deck of vessel

Typical condition around windows as vessels age

Typical condition around windows as vessels age

Under deck of hull in shipyard

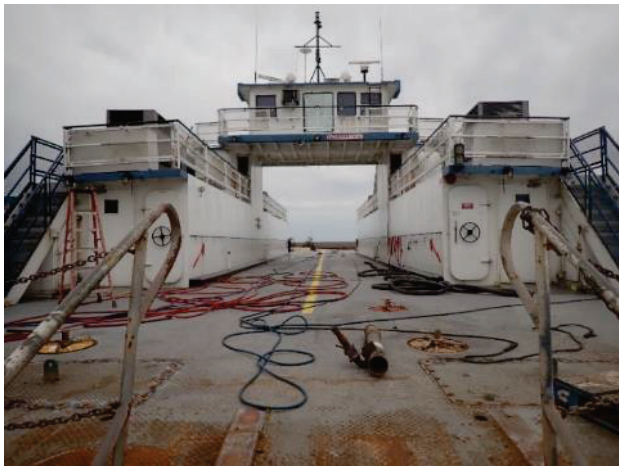
Bilge condition typical

Deck and hull condition of older Hatteras class vessel

Structure and deck of Sound Class vessel

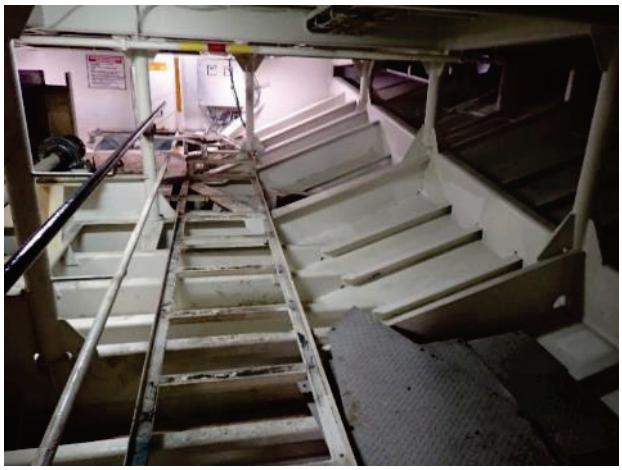
Typical corrosion under deck of Sound Class vessel

Structure of vessel recently out of shipyard



Structure of Hunt in shipyard

Sea chest open in shipyard from outside



Typical interior compartment structure

Structure view showing corrosion

Interior structure in way of outside vent

Interior structure

B

Appendix B – Risk-Based Prioritization Breakdown

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Appendix B: Risk-Based Prioritization Breakdown

Appendix B provides the detailed scoring for each vessel aligned to the risk-based prioritization framework.

		Age			Visual Condition										
Vessel		Vessel Age	% Useful Life Passed	Age Score	Communication	Electrical	Emergency	Engine	Interior and Equipment	HVAC	Plumbing	Propulsion	Steering	Structure	Visual Condition Score
		(as of Jan 24)			4%	4%	12%	8%	5%	4%	8%	20%	10%	25%	
Silverlake 299744	Sound	55	110%	1	3	3	3	3	2	3	3	3	4	4	3.3
Carteret 928441	Sound	35	70%	3	3	3	3	3	2	2	3	3	3	3	2.9
Cedar Island 1023760	Sound	29	58%	3	4	3	4	3	3	4	3	4	4	4	3.8
Swan Quarter 1234389	Sound	12	24%	5	3	2	3	4	2	2	3	4	4	4	3.5
Sea Level 1237503	Sound	11	22%	5	3	4	4	4	3	3	4	4	4	3	3.6
Gov Daniel Russell 978475	River	31	62%	3	2	2	3	3	2	2	3	2	3	2	2.4
Southport 1043680	River	27	54%	3	3	3	4	3	2	4	2	3	4	3	3.1
Neuse 1051627	River	25	50%	3	3	3	3	3	3	3	3	3	3	3	3.0
Floyd J Lupton 1090004	River	23	46%	4	3	3	3	3	3	3	3	4	4	3	3.3
Fort Fisher 1090005	River	23	46%	4	4	3	4	3	3	3	3	3	3	4	3.4
W Stanford White 1133333	River	20	40%	4	4	4	4	3	3	4	3	3	3	2	3.0
Croatoan 1135643	River	20	40%	4	3	3	2	2	2	3	3	3	3	3	2.8
Hatteras 1174277	River	17	34%	4	3	3	3	2	3	2	3	3	3	3	2.9
Rodanthe 1285078	River	4	8%	5	5	4	4	5	5	4	4	4	4	3	3.9
Avon 1333143	River	0	0%	5	5	5	5	5	5	5	5	5	5	5	5.0
Salvo 1316739	River	0	0%	5	5	5	5	5	5	5	5	5	5	5	5.0
Kinnakeet 944638	Hatteras	34	68%	3	4	3	3	3	3	2	3	4	4	4	3.6
Frisco 946908	Hatteras	34	68%	3	4	3	3	5	4	4	4	4	4	4	3.9
Chicamocomico 949252	Hatteras	33	66%	3	3	3	2	4	2	2	3	3	4	3	3.0
Cape Point 949251	Hatteras	33	66%	3	4	4	4	4	4	4	4	4	4	4	4.0
Ocracoke 964046	Hatteras	33	66%	3	4	4	4	4	3	3	3	4	4	4	3.8
Gov James B Hunt 665747	Hatteras	39	78%	2	2	1	2	2	2	2	2	3	3	2	2.3
Ocracoke Express 1281353	Aluminum Ferry	2	4%	5	-	-	-	-	-	-	-	-	-	-	-

		Functional Condition							Criticality								Prioritization						
Vessel	Class	Accessibility	Capacity and Configuration	Maintenance	Obsolescence	Route Alignment	Route Interchangeability	Functional Condition Score	Maint.-Planned-Time	Maint.-Planned-Cost	Maint.-Emerg.-Time	Maint.-Emerg.-Cost	Level of Service	Regulatory	Safety	Criticality Score	Age	Visual	Physical	Functional	Condition	Criticality	Final
		15%	20%	25%	20%	5%	15%		15%	15%	10%	10%	20%	10%	20%		40%	60%	50%	50%	-	-	
Silverlake 299744	Sound	3	4	3	3	3	3	0.0	2	3	4	3	3	3	2	-	1	3.30	2.38	0.00	1.19	2.75	3.27
Carteret 928441	Sound	3	4	3	3	3	3	0.0	1	3	5	3	4	3	2	-	3	2.91	2.95	0.00	1.47	2.90	4.27
Cedar Island 1023760	Sound	3	4	4	4	4	3	0.0	3	3	2	1	3	3	2	-	3	3.75	3.45	0.00	1.73	2.50	4.31
Swan Quarter 1234389	Sound	2	4	3	4	4	3	0.0	3	2	4	4	3	3	2	-	5	3.50	4.10	0.00	2.05	2.85	5.84
Sea Level 1237503	Sound	3	4	3	4	4	3	0.0	4	1	2	3	3	3	2	-	5	3.62	4.17	0.00	2.09	2.55	5.32
Gov Daniel Russell 978475	River	3	2	4	2	3	3	0.0	3	4	5	5	4	3	3	-	3	2.38	2.63	0.00	1.31	3.75	4.93
Southport 1043680	River	3	3	4	3	3	3	0.0	2	2	5	5	4	3	3	-	3	3.13	3.08	0.00	1.54	3.30	5.08
Neuse 1051627	River	3	3	4	3	4	3	0.0	1	3	5	5	4	3	3	-	3	3.00	3.00	0.00	1.50	3.30	4.95
Floyd J Lupton 1090004	River	3	3	4	3	4	5	0.0	3	3	5	5	4	3	3	-	4	3.30	3.58	0.00	1.79	3.60	6.44
Fort Fisher 1090005	River	3	4	4	4	4	5	0.0	2	4	5	5	4	3	3	-	4	3.41	3.65	0.00	1.82	3.60	6.56
W Stanford White 1133333	River	4	4	1	4	4	5	0.0	2	3	2	3	3	3	3	-	4	2.99	3.39	0.00	1.70	2.75	4.67
Croatoan 1135643	River	3	3	3	2	3	3	0.0	2	2	4	5	3	3	3	-	4	2.75	3.25	0.00	1.63	3.00	4.88
Hatteras 1174277	River	3	3	3	3	3	3	0.0	2	3	1	4	3	3	3	-	4	2.88	3.33	0.00	1.66	2.75	4.58
Rodanthe 1285078	River	4	4	4	4	4	5	0.0	2	5	4	4	3	3	3	-	5	3.92	4.35	0.00	2.18	3.35	7.29
Avon 1333143	River	5	5	5	5	5	3	0.0	5	5	5	5	4	3	3	-	5	5.00	5.00	0.00	2.50	4.20	10.50
Salvo 1316739	River	5	5	5	5	5	3	0.0	5	5	5	5	4	3	3	-	5	5.00	5.00	0.00	2.50	4.20	10.50
Kinnakeet 944638	Hatteras	3	3	5	3	3	3	0.0	2	4	4	4	2	3	2	-	3	3.55	3.33	0.00	1.67	2.80	4.66
Frisco 946908	Hatteras	3	3	4	3	4	3	0.0	2	3	4	5	2	3	2	-	3	3.92	3.55	0.00	1.78	2.75	4.88
Chicamocomico 949252	Hatteras	2	3	4	3	3	3	0.0	1	3	4	4	2	3	2	-	3	2.97	2.98	0.00	1.49	2.50	3.73
Cape Point 949251	Hatteras	3	3	4	3	3	3	0.0	3	3	5	4	2	3	2	-	3	4.00	3.60	0.00	1.80	2.90	5.22
Ocracoke 964046	Hatteras	3	3	4	3	3	3	0.0	3	3	5	5	2	3	2	-	3	3.83	3.50	0.00	1.75	3.00	5.25
Gov James B Hunt 665747	Hatteras	3	1	4	2	3	1	0.0	2	3	2	4	2	3	2	-	2	2.26	2.16	0.00	1.08	2.45	2.64
Ocracoke Express 1281353	Aluminum Ferry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	Not Scored

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