BENCHMARKING AND OPTIMIZATION OF THE NORTH CAROLINA FERRY SYSTEM

Technical Report

March 29, 2010

For the

North Carolina Department of Transportation Ferry Division

Conducted by

Institute for Transportation Research and Education
North Carolina State University

Technical Report Documentation Page

1. Report No. FHWA/NC/2009-27	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Benchmarking and Optimization of the North Carolina Ferry Services		5. Report Date March 29, 2010
		6. Performing Organization Code
7. Author(s) Jeffrey Tsai, Tom Cook, Daniel Findley, Mike Miller		8. Performing Organization Report No.
9. Performing Organization Name and Address Institute for Transportation Research and Education North Carolina State University Campus Box 8601, Raleigh, NC 27695-8601		10. Work Unit No. (TRAIS)
		11. Contract or Grant No.
12. Sponsoring Agency Name and Address North Carolina Department of Transportation 1 South Wilmington Street Raleigh, North Carolina 27601		13. Type of Report and Period Covered Final Report May 1, 2009 to March 31, 2010
		14. Sponsoring Agency Code RP 2009-27

Supplementary Notes:

16. Abstract

The North Carolina Department of Transportation (NCDOT) Ferry Division is facing several challenges. Recent U.S. Coast Guard (USCG) regulations increasing the minimum crew size on vessels carrying over 149 passengers will require the North Carolina Ferry System (NCFS) to add 79 employees. Difficulty in finding additional funds and certified crew to meet these regulations, coupled with reduced NCFS financial allocations from recent state budget cuts, resulted in a reduced number of ferry sailings on some routes during the peak operation period in the summer of 2009.

In addition, the NCFS experienced challenges from ferry service outages that resulted from the need to operate aging ferry vessels, a lack of stand-by ferry vessels in case of breakdowns, and vessels out of service due to increased USCG dry-dock inspection frequency. The NCFS also must also make do with unreliable support vessels that have exceeded their useful lives, and a lack of certified welders and marine electricians to support maintenance functions. Finally, in order to meet Environmental Protection Agency Tier 3 diesel emissions regulations, the NCFS will need to replace 110 diesel engines at a cost of $15 million.

However, these resource and operation challenges present an opportunity to analyze existing ferry operations, and to develop optimal scenarios to maximize the efficiency of the ferry system. The goal for this project was to analyze available data in order to provide the NCFS with recommendations to optimize its current resources, as well as to explore future opportunities.

17. Key Words ferry, optimization, toll, elasticity	18. Distribution Statement		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages ***79***	22. Price

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**

DISCLAIMER

The contents of this report reflect the views of the author(s) and not necessarily the views of the University. The author(s) are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of either the North Carolina Department of Transportation or the Federal Highway Administration at the time of publication. This report does not constitute a standard, specification, or regulation.

Table of Contents

1. Background/Introduction

Section Outline:

1. Purpose of the Study
2. North Carolina Ferry System
3. Ferry Route Profiles
4. Vessels and Other Equipment

Purpose of the Study

The North Carolina Department of Transportation (NCDOT) Ferry Division is facing several challenges . Recent U.S. Coast Guard (USCG) regulations increasing the minimum crew size on vessels carrying over 149 passengers will require the North Carolina Ferry System (NCFS) to add 79 employees. Difficulty in finding additional funds and certified crew to meet these regulations, coupled with reduced NCFS financial allocations from recent state budget cuts, resulted in a reduced number of ferry sailings on some routes during the peak operation period in the summer of 2009.

In addition, the NCFS experienced challenges from ferry service outages that resulted from the need to operate aging ferry vessels, a lack of stand-by ferry vessels in case of breakdowns, and vessels out of service due to increased USCG dry-dock inspection frequency. The NCFS also must also make do with unreliable support vessels that have exceeded their useful lives, and a lack of certified welders and marine electricians to support maintenance functions. Finally, in order to meet Environmental Protection Agency Tier 3 diesel emissions regulations, the NCFS will need to replace 110 diesel engines at a cost of $15 million.

However, these resource and operation challenges present an opportunity to analyze existing ferry operations, and to develop optimal scenarios to maximize the efficiency of the ferry system. The goal for this project was to analyze available data in order to provide the NCFS with recommendations to optimize its current resources, as well as to explore future opportunities.

This project involved the following eight tasks:

1. Conduct an on-site visit of the Ferry Division
2. Review the literature and benchmark other ferry operations
3. Collect data
4. Conduct surveys
5. Summarize revenue, usage and cost data
6. Prepare an interim report and present findings
7. Develop an optimization model and produce optimization scenarios
8. Write and present a final report

North Carolina Ferry System

The NCDOT Ferry Division operates the second largest state-owned ferry system in the United States. The 21 ferry vessels serve seven routes, operate over 200 trips daily, and transport more than 1.1 million vehicles and 2.5 million passengers annually.

As shown in Figure 1, the seven ferry routes serve critical roles in North Carolina coastal communities. Some passengers use the ferry as public transportation for their daily commute; some use the ferry to transport students to attend schools; some travel to remote coastal areas for recreation; and some ride the ferry to experience the ride, which is a large tourist draw in coastal North Carolina. The ferries also serve important community service and public safety roles, providing emergency services and a means of emergency evacuation to residents and visitors, and sometime even rescuing stranded boaters. North Carolina ferries are truly a part of the fabric of our coastal communities.

The North Carolina ferries travel through six bodies of water: Pamlico Sound, Pamlico River, Neuse River, Currituck Sound, Cape Fear River, and Hatteras Inlet. Pamlico Sound is the second largest estuary in the United State with 80 miles of fetch in its north–south orientation. Pamlico Sound is shallow with water depths ranging from 5 to 20 feet and filled with shoals. Currituck Sound's average water depth is 6 feet and it can easily become impassable during periods of prolonged strong winds from the north. Hatteras Inlet and the waters near Ocracoke Island are notorious for shifting shoals and sandbars, and are a challenge to navigate even for experienced boaters.

Figure 1: Location of North Carolina Ferry Routes

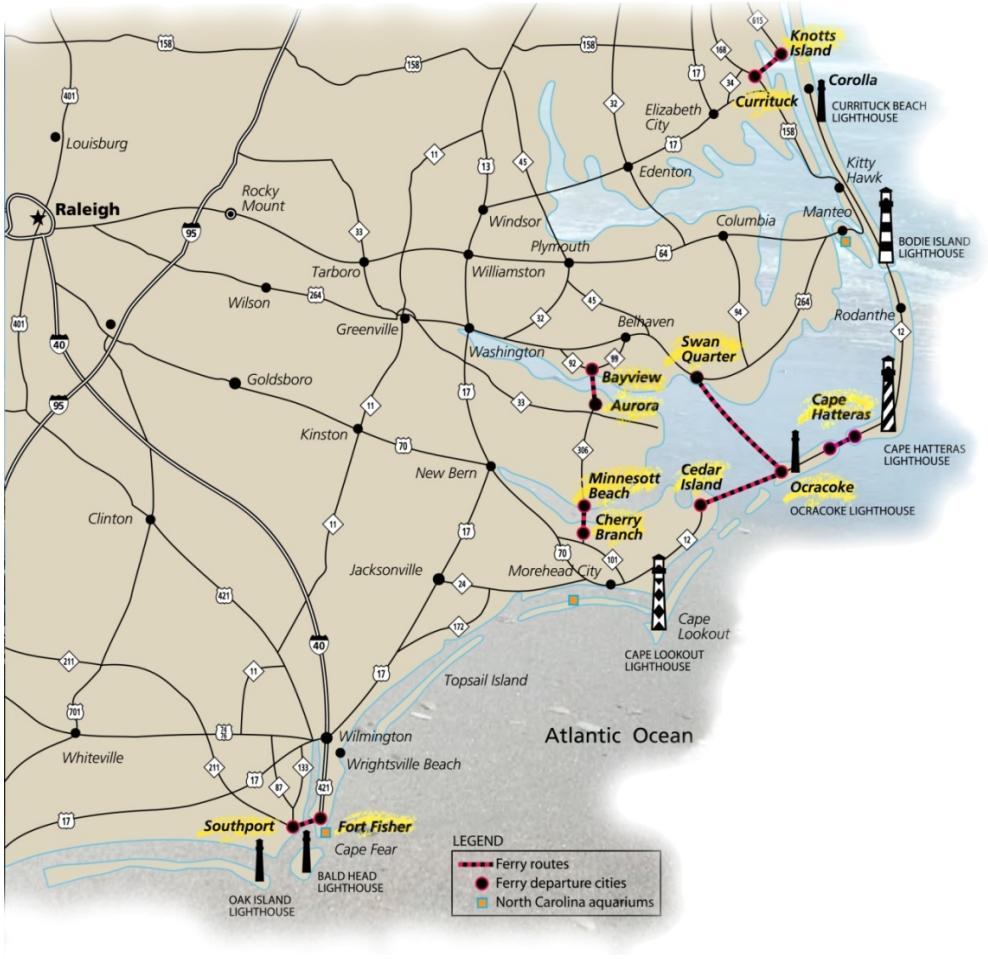
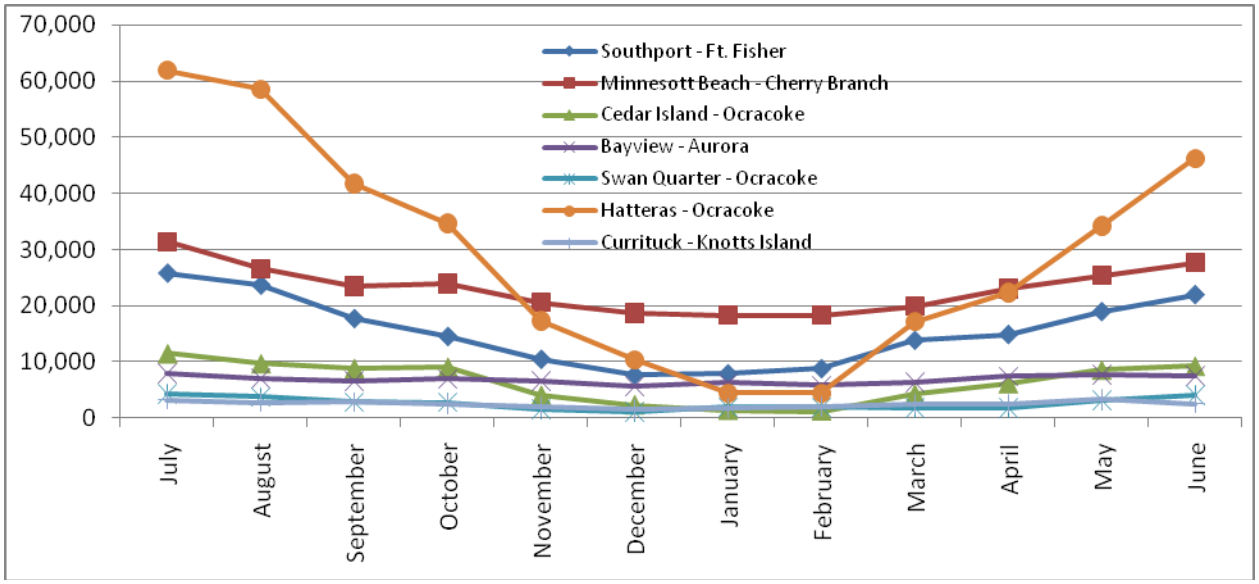


Figure 2 illustrates monthly ridership variations among the seven ferry routes. The ferry system experiences its highest demand during the month of July. Conversely, February is the month with the lowest number of riders. The Hatteras – Ocracoke route is the nineteenth busiest ferry route by passenger count and the twenty-second busiest route by vehicle count in the U.S.

Figure 2: 2007-2008 Monthly Ridership by Ferry Route



Given its diverse users, operating environments, and regulations, the NCFS is a unique entity without peers within the NCDOT.

Recently enacted USCG regulations on the minimum size of crews on vessels over 149 feet in length will require the Ferry Division to add 79 employees. At the same time, the NCDOT, similar to all state agencies, faced reductions in personnel and services as a result of state budget cuts. The outcome from this unfortunate combination of events resulted in a reduction in the frequency of ferry service in some locations during the peak operations period during summer of 2009.

The Ferry Division experienced equipment challenges as a result of aging ferry vessels serving some routes. In addition, some support vessels (e.g., the tug Albemarle and the dredge Carolina) that have surpassed their useful lives and are in poor condition.

However, these changes in resources and operations present an opportunity to analyze existing ferry operations to develop optimal scenarios for maximizing the efficiency of the ferry system. The goal for this project is to provide Ferry Division staff with a quantitative analysis of available data and to utilize decision science-based scenarios to optimize the ferry operations.

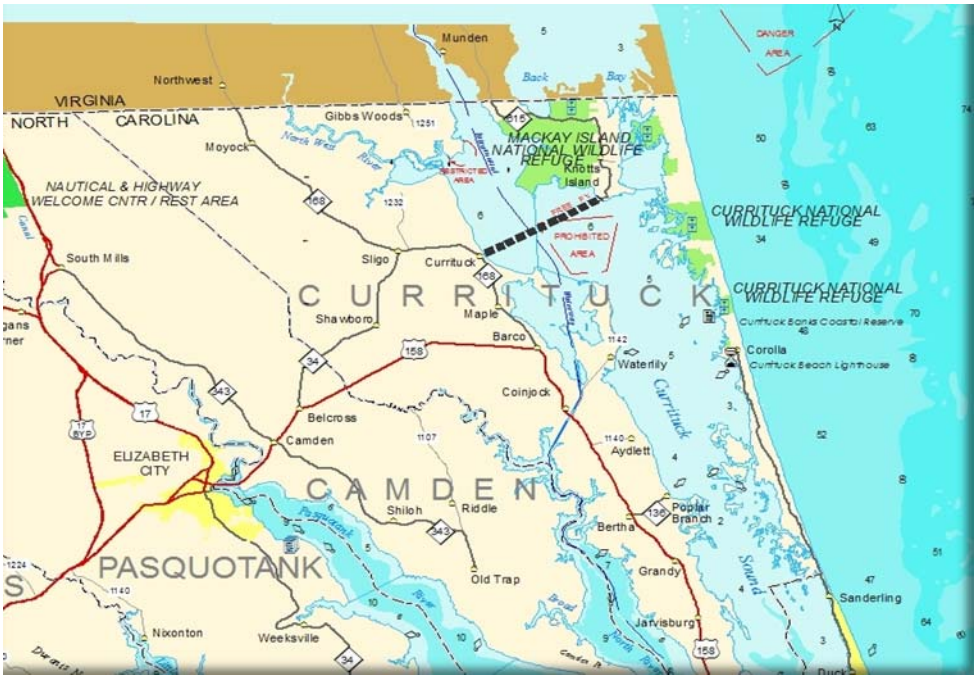
Ferry Route Profiles

This section provides brief profiles of the seven NCFS routes. All ridership data reflects Fiscal Year (FY) 2007-2008.

Knotts Island – Currituck Route

- Route Length: 5 miles
- Sailing Time: 45 minutes
- Annual Ridership: 29,490 vehicles, 89,438 passengers
- Schedule: first departure 6 a.m. from Currituck, last departure 6:30 p.m. from Knotts Island
- Number of Daily Sailings: 12
- Number of Vessels: one (*Gov. James B. Hunt*) based at the Currituck terminal
- Number of Crews: one
- Characteristics: transports three-bus loads of Currituck County Schools students from Knotts Island to attend mainland schools. One regular and one special needs bus are transported on the ferry. A third bus is parked at the Knotts Island terminal and students are transported as passengers and met by a bus at the Currituck terminal that transports them to school. The third bus can only be transported on the ferry if there is room available.

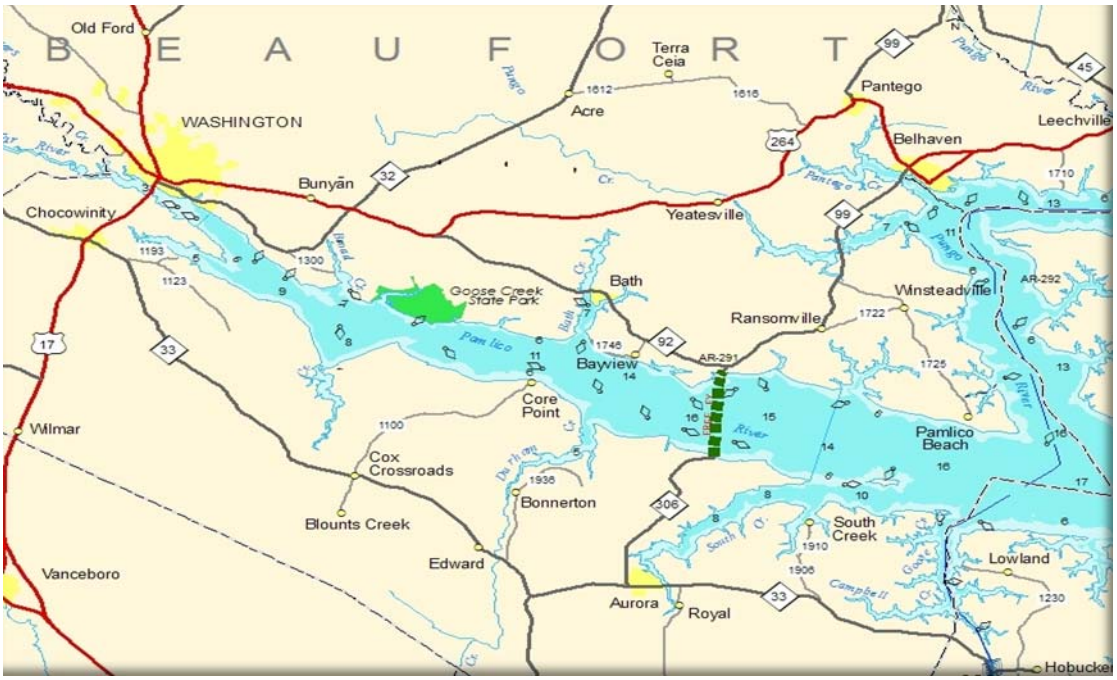
Figure 3: Knots Island – Currituck Ferry Route



Bayview – Aurora Route

- Route Length: 3.5 miles
- Sailing Time: 30 minutes
- Annual Ridership: 81,572 vehicles, 129,564 passengers
- Schedule: first departure 5:30 a.m. from Bayview, last departure 12:30 p.m. from Aurora
- Number of Daily Sailings: 22
- Number of Vessels: one (*Gov. Daniel Russell*) based at the Bayview terminal
- Number of Crews: one
- Characteristics: a majority of riders are Potash Corporation of Saskatchewan (PCS) phosphate mine workers.

Figure 4: Bayview – Aurora Ferry Route



Minnesott Beach – Cherry Branch Route

- Route Length: 2 miles
- Sailing Time: 20 minutes
- Annual Ridership: 277,254 vehicles, 486,782 passengers
- Schedule: first departure 5:15 a.m. from Cherry Branch, last departure 12:15 p.m. from Minnesott Beach
- Number of Daily Sailings: 56
- Number of Vessels: three (*Neuse*, *Floyd J. Lupton*, *Kinnakeet*)
- Number of Crews: three
- Characteristics: ridership is comprised of primarily of commuters to Marine Corps Air Station Cherry Point (MCAS), plus Pamlico County residents, and tourists.

Figure 5: Minnesott Beach – Cherry Branch Ferry Route

Southport – Fort Fisher Route

- Route Length: 4 miles
- Sailing Time: 35 minutes
- Annual Ridership: 185,447 vehicles, 499,796 passengers
- Schedule: first departure 5:30 a.m. from Southport, last departure 7 p.m. from Fort Fisher.
- Number of Daily Sailings: 28
- Number of Vessels: two (*Fort Fisher*, *Southport*)
- Number of Crews: two
- Tolls: passengers—$1, bicycles—$2, motorcycles—$3, vehicles less than 20' long—$5, vehicles 20 to 40 feet long—$10, vehicles 40 to 65 feet long—$15.
- Characteristics: ridership is a mixture of commuters and tourists

Figure 6: Southport – Fort Fisher Ferry Route

Swan Quarter – Ocracoke Route

- Route Length: 30 miles
- Sailing Time: 2.5 hours
- Annual Ridership: 27,431 vehicles, 64,634 passengers
- Schedule: first departure 7 a.m. from both terminals, last departure 5 p.m. from Swan Quarter and 4:30 p.m. from Ocracoke
- Number of Daily Sailings: peak schedule—8, off-peak schedule—4
- Number of Vessels: two (*Gov. Hyde*, *Pamlico*)
- Number of Crews: two
- Tolls: passengers—$1, bicycles—$3, motorcycles—$10, vehicles less than 20' long—$15, vehicles 20 to 40 feet long—$30, vehicles 40 to 65 feet long—$45.
- Characteristics: provides transportation for Hyde County residents in Ocracoke Village to the county seat in Swan Quarter, plus some summer tourists.

Cedar Island – Ocracoke Route

- Route Length: 26 miles
- Sailing Time: 2.25 hours
- Annual Ridership: 75,783 vehicles, 183,583 passengers
- Schedule: first departure 7:30 a.m. from both terminals, last departure 7 p.m. from Cedar Island and 9:30 p.m. from Ocracoke
- Number of Daily Sailings: peak schedule—12, off-peak schedule—8
- Number of Vessels: three (*Carteret*, *Cedar Island*, *Silver Lake*)
- Number of Crews: three
- Tolls: passengers—$1, bicycles—$3, motorcycles—$10, vehicles less than 20' long—$15, vehicles 20 to 40 feet long—$30, vehicles 40 to 65 feet long—$45.
- Characteristics: high tourist and recreation users, some commuters.

Figure7: Swan Quarter/Cedar Island – Ocracoke Island Ferry Routes

Hatteras– Ocracoke Route

- Route Length: 4.5 miles
- Sailing Time: 40 minutes
- Annual Ridership: 353,192 vehicles, 951,491 passengers
- Schedule: first departure 5 a.m. from both terminals, last departure midnight from both terminals
- Number of Daily Sailings: peak schedule—63, off-peak schedule—31
- Number of Vessels: nine (*Frisco*, *Chico*, *Cape Point*, *Ocracoke*, *Thomas A. Baum*, *Stanford White*, *Croatoan*, *Hatteras*, *Roanoke*)
- Number of Crews: 9
- Characteristics: heavy tourist day-trippers visiting Ocracoke Village. A standby vessel and crew are available during the night to provide emergency transportation from Ocracoke to Hatteras.

Figure 8: Hatteras – Ocracoke Ferry Route


Avon
Buxton
Frisco
Buxton Woods
Coastal Reserve
NATIONAL
SEASHORE
HATTERAS
CAPE
HATTERAS
Hatteras
CGS
Hatteras Inlet
CAPE
HATTERAS
OCRACOKE ISLAND
Ocracoke
CGS
Ocracoke
Island
Lighthouse
Ocracoke Inlet
B A Y
AR-296
AR-298
AR-220
AR-225
AR-230
DANGER
AREA
12

Vessels and Other Equipment

The North Carolina Ferry Division operates 21 ferry vessels. Five Sound Class vessels serve the longest ferry routes: Cedar Island – Ocracoke and Swan Quarter – Ocracoke. Nine River Class vessels serve 4 river crossing routes: Knotts Island – Currituck, Bayview – Aurora, Minnesott Beach – Cherry Branch, and Southport – Fort Fisher routes. The remaining seven vessels serve the Hatteras – Ocracoke route. Information on each of these vessels in summarized in Table 1.

Table 1: North Carolina Ferry System Vessel Inventory

Vessel Name	Vehicle Capacity	Passenger Capacity	Length	Breath	Draft	Gross Ton	Year Built	Vessel Age	Modifications
Gov. James B. Hunt	17 (1)	149	159' -3"	40'-0"	5'-0"	462	1984	25	30' mid-body extended (1999)
Ocracoke	30	149	42'-0"	8'-6"	4'-0"	275	1990	19	
Kinnakeet	30	149	151'-9"	42'-0"	4'-0"	280	1989	20	
Chicamacomico	30	149	149'- 9"	42'-0"	4'-0"	275	1990	19	
Cape Point	30	149	151' -9"	42'-0"	4'-0"	275	1990	19	Bow and Hull extended (1989)
Frisco	30	149	149'- 9"	42'-0"	4'-0"	275	1990	19	
Roanoke	30	149	149' -9"	42'-0"	4'-0"	248	1993	16	
Thomas A. Baum	30	149	149' -9"	42'-0"	4'-0"	248	1995	14	Bow thruster added (2000)
Gov. Hyde	35	300	161'-0"	48'-0"	7'-5"	574	1977	32	
Floyd J. Lupton (2)	40	300	180'-0"	44'-0"	6'-0"	374	2000	9	
Neuse (2)	40	300	180'-0"	44'-0"	6'-0"	374	1998	11	
Fort Fisher (2)	40	300	180'-0"	44'-0"	6'-0"	374	2000	9	
Croatoan (2)	40	300	180'-0"	44'-0"	6'-0"	376	2003	6	
Stanford White (2)	40	300	180'-0"	44'-0"	6'-0"	372	2003	6	
Hatteras (2)	40	300	180'-0"	44'-0"	6'-0"	407	2006	3	
Southport (2)	40	300	180'-0"	44'-0"	6'-0"	374	1996	13	
Daniel Russell (3)	40	300	180'-0"	44'-0"	6'-0"	418	1993	16	
Carteret	50	300	220'-0"	50'-0"	6'-6"	771	1989	20	60' mid-body extended (1998)
Cedar Island	50	300	220'-0"	50'-0"	6'-6"	648	1994	15	
Silver Lake	50	300	220'-0"	48'-0"	6'-0"	688	1965	44	60' mid-body extended (1987)
Pamlico	50	300	220'-0"	48'-0"	6'-0"	734	1965	44	60' mid-body extended (1986)

(1) Vehicle capacity reduces to 4 when transporting 3 school buses during school-travel times

(2) Vessels with Voith-Schneider propulsion system or "double-ender" that enable embarking/disembarkng without turning the vessel around

(3) "Double-ender" with conventional propeller engines

The average age of Ferry System vessels is 17 years. The three oldest vessels are the *Silver Lake* and *Pamlico*, both 45 years old; and the *Hyde*, 33 years old. These oldest vessels are part of the five Sound Class vessels serving the two Pamlico Sound crossing routes, from Swan Quarter and Cedar Island, to Ocracoke.

The NCFS operates ten support vessels that are responsible for maintaining the navigation channels at the 13 ferry terminals, and maintaining the pilings and docks at the terminals and the shipyard. Among the 10 support vessels, the tug *Albemarle*, dredge *Carolina*, and the crane barge *Skyco* conduct the majority of the dredging operations.

The dredge *Carolina* was built in 1968, and is a Sound Class dredge capable of working the sound side of the shallow draft ocean access inlets. At this time, the *Carolina* requires extensive rebuilding, at a high-cost. The tug *Albemarle*, built in 1977, is the primary vessel used to move barges and cranes to job sites. The tug is also the first responder for assisting disabled ferries.

It is important to note that the tug *Albemarle* and the dredge *Carolina* serve vast areas of the North Carolina coastal waters. Crews live in these vessels during their mission. The *Albemarle* has berths for a crew of four, and the *Carolina* has berths for a crew of eight. The conditions of these two vessels impact their ability to perform tasks efficiently as well as the safety of the crew.

The crane barge *Skyco* was placed in service in September 2008. *Skyco* measures 136 feet long, by 40 feet wide with a three-foot draft. It was the first vessel built entirely in-house at the Ferry Division shipyard in Manns Harbor. *Skyco* can service docks, ramps, replace bulkheads and perform piling installation and maintenance.

The NCFS's shipyard in Manns Harbor is the largest state-owned and operated shipyard in the U.S. The shipyard is totally self-sufficient with its own electrical generating power plant and water system, and has the capabilities to work around the clock in any weather conditions. The shipyard is capable of conducting all maintenance, from basic dry docking to making any repairs required to meet USCG regulations. The facility can also paint a vessel from top to bottom.

However, the NCFS's shipyard and the field maintenance facilities, are facing a critical shortage of skilled and certified workers. The number of NCFS vessels subject to USCG dry-dock inspection has increased from nine to 21 vessels. The shipyard is having a difficult time attracting certified workers due to the high cost of living in coastal communities and competition with the Norfolk, VA shipyard.

2. Peer Analysis

Section Outline:

1. Selected Findings from a Review of the Literature
2. Peer Selection
3. Peer Statistics
4. Selected Peer Information

Selected Findings from a Review of the Literature

In 2005, the most recent year for which data are available, the five states of California, Massachusetts, Michigan, New York, and Washington accounted for two-thirds of all U.S. ferry passenger capacity. At that time, the median length of a ferry route was five nautical miles (or approximately 5.8 statute miles), and the median travel time was 30 minutes per ferry route.[1]

In 2005, the average passenger ferry vessel age was about 25 years, and the average capacity was 338 passengers. The typical ferry operating speed was 14 knots (approximately 16.1 statute miles per hour), compared to their average maximum speed of 17 knots (approximately 19.6 statute miles per hour). Most ferries (53.2%) had steel hulls, while 26.1 percent had aluminum hulls. The majority of self-propelled ferries used diesel fuel (96.9%).[2]

Information in this section is categorized according to the following topics: Ferry System Planning, Funding, Tolling, Service Standards, and Customer Information.

Ferry System Planning

The Washington State Ferries (WSF) is a significant source of information on ferry planning, operations, and financing. Two documents were of particular interest to this study—the "*Washington State Department of Transportation Ferries Division: Final Long-Range Plan: 2009-2030* (the WSF Plan), and the "*Auto-Passenger Vessel Sizing and Timing (2009-2030) Draft Report*." The information below was compiled from the WSF Plan,[3] which addressed similar concerns to those in this research project.

The goal of the WSF Plan was to provide information about the needs of ferry customers, establish new operational and pricing strategies to meet those needs, and identify vessel and terminal operations and capital requirements. The WSF Plan addressed a 22-year period (2009-2030, or fiscal years 2010-2031).

[1] Roberto, Elizabeth, *Highlights of the 2006 National Census of Ferry Operators*, Bureau of Transportation Statistics Special Report, August 2008, U.S. Department of Transportation, Washington, DC.
[2] Roberto, Elizabeth, *Highlights of the 2006 National Census of Ferry Operators*, Bureau of Transportation Statistics Special Report, August 2008, U.S. Department of Transportation, Washington, DC.
[3] *Washington State Department of Transportation Ferries Division: Final Long-Range Plan: 2009-2030*, June 30, 2009, Washington State Department of Transportation, Ferries Division.

The WSF Plan addressed critical challenges, including:

- Long-term funding—Voter approval of a bill in 1999 substantially reduced funding for the ferry system. For the last ten years, the funding gap has been filled by allocating transportation funds to WSF that would have otherwise supported the landside highway system. Given the unfunded needs in the landside highway capital program, continued use of that funding is unsustainable. Therefore, the ferry system lacks sufficient revenue to sustain its current level of service.
- Role of fares in long-term funding—One of the impacts of the lost funding has been a significant increase in fares over a relatively short period of time. Since 2000, fares have increased between 37% and 122%. WSF's operation is 65 percent supported by fares (2008 fiscal year), compared to an approximately 60 percent fare box recovery in fiscal year 2001.
- Aging asset base—WSF's fleet is among the oldest of any major ferry operator, with four vessels retired in 2007. Eight more vessels are to be retired over the 22-year planning period. In addition, many terminal facilities were built in the 1940's and the 1950's and have had few improvements beyond basic maintenance and preservation.
- Long lead times for capital investments—Significant lead times are required to build new vessels or improve terminals. However, WSF capital assets are long lasting, with vessels having an anticipated lifespan of 60 years.
- Growth, Ridership Demand, and Service Needs—While population growth is expected in many of the communities served by WSF, it is not clear how that will translate into increased demand for ferry service. Ridership declined from 2000 to 2006 throughout the system, despite population growth in counties serviced by WSF. By 2030, total demand is projected to increase by 37% over 2006 ridership, and vehicle demand is expected to increase by 30% overall.

The WSF Plan maintains current levels of service with limited improvements as new vessels are acquired to replace retiring vessels. The WSF Plan is an attempt to outline operational and pricing strategies to maximize the use of existing assets and to provide the most cost effective service, while responding and adapting to the changing characteristics of its customer base.

Vehicle capacity during peak periods is identified as WSF's greatest constraint and is seen as the primary factor driving the need for additional services and larger facilities. There is little unused capacity available during peak periods, especially in the summer, when a recreational traffic surge causes capacity challenges.

By adopting operational and pricing strategies, WSF will be able to provide the best service at the lowest possible cost, minimize fare increases, and fill under-used non-peak capacity. The WSF Plan is built on the following strategies that are designed to either spread vehicle demand to non-peak periods and/or increase use by walk-on passengers:

- Vehicle reservation system
- Transit enhancements
- Pricing strategies
- Marketing"

The effort to manage costs has included three significant efforts: (1) cost containment strategies designed to reduce operating and capital costs; (2) updating Life Cycle Cost Models to ensure that preservation funding is optimized; and (3) reviewing and revising terminal design standards to ensure future terminal improvements are appropriately sized.

Several key themes came out of public outreach activities conducted as part of the WSF Plan development, including:

- A belief that the ferry system is a part of the state highway system and, as such, should be a fully-funded state responsibility. A variation on this theme addressed the perception that ferry customers were already paying twice – once in the form of state gas taxes and a second time when they pay their fare – and that this is not equitable since most other highway users do not pay tolls. According to that logic, the State should fund ferries without looking to local taxes or additional fares to address funding challenges.

  However, planners responded that ferry operations are an expensive part of the highway system. Costs are much higher than for highways, since the State must provide labor and fuel to operate the vessels and terminals. The capital costs are also higher, mostly due to the large, ongoing preservation capital needs of the system.

  Since the 1970's, ferry tolls have been used exclusively to defray a portion of the operating costs of the ferry system. Fare revenue does not fund the capital needs of the system.
- Consideration should be given to economic impacts from any reduction in ferry service to island communities. Concerns focused on the potential reductions in home and property values in communities with few or no other transportation options.
- Concerns about a vehicle reservation system. Many of the concerns expressed were about how such a system might actually operate and how it would require customers to plan their trips in advance. Some people thought that a vehicle reservation system would make terminal congestion worse and not better. Others felt that a vehicle reservation system was a costly extravagance when basic ferry services were under threat due to funding challenges. Others commented that reservations were not required on the landside highway system.

  The primary objective of the proposed reservation system is to better utilize existing assets, which will allow WSF to meet growing demands without growing capacity in a proportionate way. A vehicle reservation system will help to better align demand with available supply of auto capacity on ferries. The cost to implement a reservation system will be lower than the investment that would be needed to provide additional holding capacity for vehicles to queue at terminals.
- WSF should consider building vessels out of state if doing so would save money. That issue was not addressed in the Plan as it is a state policy issue.

One section of the WSF Plan describes demand forecasts derived from the use of two models—a revenue model and a planning model. The revenue model focuses on near-term ridership and fare revenue expectations, and is used to support the budget process. The planning model is designed to evaluate the potential peak period ridership for two future planning years – 2020 and

2030. The focus is on the expected ridership growth during the average afternoon peak travel period, as that is a key factor in evaluating system and service sizing issues. Demand in the peak is then applied to annual ridership estimates for the planning years, and then further extended to fill in the intervening years.

There are two principal elements accounting for growth in ridership demand under the model. The first is external factors, such as demographic growth, with many added residents commuting across Puget Sound for employment opportunities. The second is internal WSF policy factors such as choices about fare prices and service levels, which can impact the level of customer demand.

State legislation requires WSF to both accommodate ridership growth and to "level peak period demand." The variable to manage these two directives is the time of the day when customers attempt to use the system. In other words, the projected ridership growth is relatively easy to accommodate if it occurs primarily on off-peak sailings.

Two travel mode choice trends cut across all ridership groups. The first is the proportion of walk-on passengers, and the vehicle capacity constraints on many of WSF's routes. System wide (and assuming no changes in service levels or implementation of adaptive management strategies), the proportion of walk-on passengers is expected to remain relatively constant between 2006 and 2030, though there is more variation at the route level. Given vehicle capacity constraints, it will be important to focus on pricing and operational strategies that encourage mode shift and affect the relative proportion of vehicle and walk-on passengers.

The second trend is a slight increase in the average occupancy of vehicles using WSF. Growth among in-vehicle passengers is greater than vehicle growth on all routes. This trend reflects capacity constraints that will make carpools, vanpools, and other high-occupancy vehicles more attractive over time.

WSF's ability to accommodate the forecast growth levels is significantly affected by the available vessel capacity during the "normal peak periods: and the capacity of terminal facilities to process traffic during these periods. While demand for ferry services can vary widely by time-of-day, day-of-week, and season, for planning purposes, it is useful to look at the "typical" peak conditions.

The information summarized below is from the second Washington State Ferries document, "*Auto-Passenger Vessel Sizing and Timing (2009-2030) Draft Report*."[4] This document describes the steps involved in developing the fleet planning model that the consultants used to determine optimal numbers and types of vessels for WSF in 2030. The model considered: fleet size (the total number of vessels); fleet composition (how many of various different sized vessels); and fleet deployment (which vessels are assigned to each route). The steps in the model include:

1. Establish baseline service—the fleet size (number of vessels), composition (size of vessels), and deployment (route assignment and service hours). To analyze fleet size,

[4] John Boylston, *Auto-Passenger Vessel Sizing and Timing (2009-2030) Draft Report*. prepared for the Joint Transportation Committee, Washington State Legislature; Cedar River Group, LLC, November 14, 2008.

fleet composition, and fleet deployment, the consultants established a baseline against which alternative fleet sizes, compositions, and deployments could be tested. The baseline fleet conforms to the vessel size, composition, and deployment assumptions used by WSF in the development of its 2006-2030 ridership forecast and draft long-range plan (discussed above).

2. Determine a recommended fleet size—what number of vessels is recommended to provide the same level of service as provided by the baseline fleet?
3. Determine fleet composition—what size vessels are recommended to provide baseline service with the recommended fleet size?
4. Timing—when should new vessels be acquired?
5. Impact on long-range plan—what is the impact of these recommendations on WSF long-range operating and capital plan and service?

The consultants conducted an analysis of WSF routes, ridership and the existing fleet. Auto ridership (the number of vehicles that come on board, averaging motorcycles and trucks to the equivalent of passenger cars) was used as the key measure of capacity. Increases in anticipated auto traffic were estimated by route, and for weekdays and weekends for each route. Finally, changes in ridership were estimated for summer travel and for the rest of the year.

Next, the auto capacity and retirement dates for the current fleet were noted. The following factors were then used in an analysis of the baseline fleet:

- Fixed costs
- Vessel acquisition costs
- Vessel reserve capacity
- Route vessel deployment
- Service hours
- Variable costs
- Fixed and variable costs per service hour
- Terminal requirements and costs

Three key indicators for the ferry system and for each route were calculated based on 2006 data, and estimated 2020 and 2030 ridership levels:

- Percentage of auto capacity utilized
- Percentage of sailings in which auto capacity is sold out or fully reserved
- Variable costs per auto carried

These calculations developed a baseline fleet for 2030. This fleet included several vessels that would be acquired and/or used to replace current vessels during the period from 2006 to 2030. From developing those fleet acquisition requirements, the acquisition costs for the 25-year period were calculated. Depreciation costs were based on a 60-year vessel life. Each vessel was assumed to be available for service 45 weeks per year, spending seven weeks per year out-of-service for maintenance and preservation work.

Baseline fleet vessels were then assigned to routes for each of the three operating seasons—the off-season (winter), the "shoulder" seasons (spring and fall), and peak season (summer). Service hours per year were then calculated for each route by class of vessel.

Baseline fleet variable costs—costs that change with service hours and route deployment—were calculated. WSF has determined that 95% of its non-fuel variable costs are for deck labor. Fuel costs vary by class of vessel, by route, and by speed. Fuel costs were calculated by route and class of vessel.

Key indicators that were used to compare fleet alternatives included: percent of auto capacity used, percent of sailings on which auto capacity was sold out, and variable cost per auto carried. Each of those indicators were calculated both system wide and by route. Routes with relatively low capacity utilization or high costs per auto carried were highlighted.

Finally, costs were calculated to modify/improve terminals on routes where vessel sizes in 2030 would changes from those currently assigned.

The consultants recommended that the fleet could be reduced from 23 to 21 vessels. That recommendation was based on a reduction in out-of-service time from seven to six weeks per year. The reduction in fleet size translated into a reduction from 12 to 10 vessels that would need to be acquired by 2030, resulting in significant capital cost savings. The following strategies were recommended to reduce out-of-service time:

- Consolidate repair work
- Contract with dry docks for winter use
- Conduct Underwater Inspection in Lieu of Dry-Docking (UWILD) to reduce time required in dry-dock. Coast Guard regulations require dry-docking twice in five years; however, UWILD is allowed at the midpoint of the five year period in lieu of a dry-docking.
- Reduce out-of-service time for topside painting—consolidate topside painting with dry-docking; paint less frequently, utilize a single paint supplier/contractor, design and construct to reduce maintenance (North Carolina has standard vessel specifications for these areas that result in standard, relatively maintenance-free construction details), and use an enclosed painting facility (North Carolina is contracting for a painting building).
- De-emphasize lowest cost, which has resulted in longer out-of-service time

In addition, the consultants noted that the North Carolina Ferry System uses vessels that need some significant amount of dockside work as their emergency relief vessel, and recommended that WSF adopt that practice.

To determine what size vessels to use on each route, landside constraints on vessel size were compiled, and then alternatives were established for each route for the most cost-effective vessel configuration to be assigned in the low, shoulder, and peak seasons.

Two strategies were recommended to conserve fuel:

- Relatively minor reductions in vessel speed (0.5 knots)
- Slowing at-dock engine RPMs (from 60 to 30)

In addition, two design adjustments were recommended:

- Use of an aluminum superstructure to reduce weight

- A longer length-to-beam ratio, to reduce drag

Considerations used to develop the proposed timing for vessel acquisition include:

- Vessel retirement schedule
- Restoration of service on one route
- Vessel acquisition costs
- Fleet uniformity

The consultants calculated the capital and operating costs for the 2009-2030 period. They recommended that adding vessels to the fleet to improve service should be the action of last resort, as it is most cost-efficient to add sailings within existing service hours (in which case the marginal cost is only for fuel). The second most cost-efficient way to improve service is to extend service hours with an existing vessel (in which case the marginal cost is for deck labor and fuel). The least cost-efficient way to improve service is to add a vessel, with its attendant fixed costs.

Funding

Several documents address various aspects of funding, including long-term capital funding, and fares. A document of interest from Washington State Ferries is the "*Long-Term Ferry Funding Study*."[5] That document was the result of a study conducted to address WSF's long-term funding needs as described in the Long-Range Plan (discussed previously). The report provides an analysis of the pros and cons of different methods that could be adopted to fund WSF's long-term needs. It reviews the advantages, disadvantages, and revenue generation potential of possible funding sources, grouped into state, local, ferry state, and Federal sources.

The most pressing funding need that was identified was for the long-term capital program. The consultants concluded that significant fare increases would be needed to address increasing annual operating deficits, but would not suffice as a viable source of capital funding for a high growth scenario. A fuel surcharge and a summer surcharge were recommended to increase fare revenues.

The study also found that while local participation in funding the WSF system was vital, the revenue generation potential of any district comprised primarily of ferry-dependent populations was very small relative to system capital funding needs.

The study recommended a statewide revenue source, such as the sales tax, fuel tax, vehicle registration and weight fees, and a vehicle excise tax, as a means to address long-term capital funding needs. An excise tax based on the value of motor vehicles in the State was seen as the most viable mechanism for long-term capital funding.

[5] "*Final Report: Ferry Funding Recommendations*," prepared for the Washington State Transportation Commission by Cambridge Systematics, Inc., Oakland, CA, February 2009.

Another report, "*Passenger/Vehicle/Cabin Rate Study for the Alaska Marine Highway System*,"[6] analyzed fares on the Alaska state-run ferry system, and compared those fares with fares in place at similar ferry systems around the world. Again, the methodology used in the study was of more interest than the specific findings, as the Alaska ferry system is not similar to the North Carolina Ferry System. Alaska routes are significantly longer than those in North Carolina; however, the study involved calculations of fares per nautical mile for various types of services for both Alaska routes as well as world-wide peers. Recommendations included making minor adjustments to fares on routes with unusually high or low rates in order to bring them more in line with comparable routes, and to implement a seasonal rate structure.

Tolling

The WSF "5+5+5" Business Plan involves reducing costs by 5 percent, capping ferry fare increases at 5 percent, and generating 5 percent in new revenues with a comprehensive retail, marketing, and advertising program. Under that plan, the ferry system proposed to recover 90% of its operating costs by 2008 with revenues generated by the ferry system (in FY 2003, revenues covered approximately 73 percent of WSF operating costs).[7]

WSF increased fares between 2000 and 2007 by 37 percent to 122 percent, varying by route. WSF's operations during Fiscal Year 2007 were 70 percent supported by fares, compared to approximately 60 percent in Fiscal Year 2001."[8] WSF's fare sensitivity analysis estimates a 10% fare increase (on routes with tolls already in place) would result in a 4% drop in riders.[9]

Strategies that WSF intends to implement to either spread vehicle demand to non-peak periods and/or increase walk-on use include:[10]

- Deployment of a vehicle reservation system
- Transit enhancements to maximize the potential walk-on ridership in the future
- Three significant pricing proposals. The first two are focused on demand management: (1) not charging an extra fee for reservations to encourage customer use of the system; (2) increasing passenger fares at half the rate of vehicle fares; and (3) implementing a fuel surcharge mechanism that will automatically adjust fares up and down for fluctuations in fuel prices.

A 1992 report by the Texas State Department of Highways and Public Transportation[11] stated "Although the State Department of Highways and Public Transportation is authorized to charge a

---

[6] "*Passenger/Vehicle/Cabin Rate Study for the Alaska Marine Highway System*," prepared for the Alaska Department of Transportation and Public Facilities/Alaska Marine Highway System by Northern Economics, Inc., Anchorage, AK, April 2008.

[7] *2003 WSF Progress Report*, page 12, on the Internet: http://www.wsdot.wa.gov/

[8] *Washington State Department of Transportation Ferries Division: Revised Draft Long-Range Plan*," Washington State Department of Transportation, January 31, 2009, p. 5.

[9] "*Washington State Department of Transportation Ferries Division: Revised Draft Long-Range Plan*," Washington State Department of Transportation, January 31, 2009, p. 6.

[10] "*Washington State Department of Transportation Ferries Division: Revised Draft Long-Range Plan*," Washington State Department of Transportation, January 31, 2009, p. 7.

[11] Accessed on the Internet at: http://www.window.state.tx.us/tpr/btm/btmtr/tr13.html

toll for ferry passage, the Commission has chosen not to do so. State statutes allow ferry operations to recover all or a portion of their costs by charging tolls."

The report also states "Alternative routes of travel to avoid use of the ferries are substantial in length at both locations. The TTI report estimates that as long as a ferry toll is less than the related costs of an alternative form of transportation, little reduction in ridership should occur with implementation of the toll. To avoid the ferry system at Port Aransas, a traveler would have to travel 70 miles one way through parts of Corpus Christi with an estimated driving time of one and one-half to two hours. The estimated cost of this trip was $3 for gasoline plus the motorist's time. To avoid the ferry system at Port Bolivar, a traveler would have a 133-mile trip through parts of Houston with an estimated driving time of three to three and one-half hours. The estimated cost for this trip was $5 for gasoline plus the motorist's time. These assumptions regarding estimated costs were based on a car achieving 25 miles per gallon and gasoline prices of $1.00 per gallon.

The recommended policy was "to implement a toll structure for the Port Aransas and Port Bolivar ferry systems. The structure for each must be set to recover at least 50 percent of the costs of operating that ferry system." However, no tolls have yet been implemented on either of those ferry routes.

Service Standards

Since 1994, WSF has utilized Level of Service (LOS) Standards to gauge the performance of its ferry services.[12] The original standards, adopted in 1994, quantified LOS by measuring congestion delay, expressed as the number of vessels that sail before a vehicle can board, deemed "boat-wait." For vehicles, the boat-wait standards were set to 1 boat-wait for most routes. For passengers, the boat-wait standards were set to 0 boat-waits for all routes.

As part of the 2009 Long-Range Plan, WSF revisited its LOS standards and determined that there was a need to re-establish them, based on the following:

- Boat-wait is not a consistent measure of the customer experience, nor can it be compared across routes.
- Boat-wait as defined is only a peak period measure.
- Boat-wait is not a meaningful indicator of LOS provided to the ferry customer when combined with other strategies, like a vehicle reservation system.

The recommended new LOS standards are the percent of total sailings filled to capacity in May, August, and January. That measure offers the following advantages:

- Greater system wide consistency—all routes will use the same measures.
- Simplification—standards are focusing only on vehicle LOS.
- Works with a vehicle reservation system.
- Whether or not a customer can board his/her desired sailing is captured by this measure and is one indicator of that customer's experience.
- It is a better indicator of asset utilization than a standard based on wait times during the peak periods.

[12] "*Washington State Department of Transportation Ferries Division: Revised Draft Long-Range Plan*," Washington State Department of Transportation, January 31, 2009, pp. 47-50.

- Identifies peak congestion—a percent of sailings full measure will be able to identify routes where peak sailings are full, even if the rest of the day's sailings are significantly underutilized.

WSF plans to incorporate the new LOS standard into planning efforts as follows. Two standards will be utilized, one to indicate when additional pricing and operational strategies might be needed, and one to indicate when additional service might be needed.

Two levels of LOS standards will be applied, by route and season. In general, values for the standards are higher during the summer months to reflect additional recreational ridership on all routes and standards are higher on recreational routes to reflect the increased feasibility of spreading ridership to underutilized sailings.

BC Ferries also tracks the quality of its services. The BC Ferry Commission requires BC Ferries to report on the quality of its service every quarter and to show changes over time. There are two measures for each of the 25 routes:

- On-time performance—the percentage of sailings that actually depart within ten minutes of scheduled departure
- Overloads—the percentage of sailings that depart full, leaving customers behind to wait for the next sailing.

On a fleet-wide basis, 86.5 percent of 2007/08 sailings departed within ten minutes of the scheduled departure time. On-time departures ranged from 53.5 percent to 98.5 percent for various routes during that period. The on-time performance target identified in the BC Ferries "*Strategic Plan 2003-2025*," is 90 percent of departures to occur within 10 minutes of the scheduled time. The target was to rise to 90 percent of departures within 5 minutes of scheduled time in 2008.

The performance measures used by BC Ferries include:

1. Change in number of vehicles and passengers, by route and overall
2. Percent of capacity utilized, by route and overall
3. On-time performance, by route and overall (see BC Ferries Business Plan, goal #2 for definition of a reliability index: scheduled number of round trips less cancelled sailings/scheduled number of round trips)
4. Overload sailings

The BC Ferry Commission requires BC Ferries to report on the quality of its service every quarter and to show changes over time. The overall customer satisfaction target is a 4.2 out of 5 (the 2007 score was 4.1, when the target was 4.0 out of 5). Satisfaction is tracked by route, and incorporates feedback on several aspects of the ferry trip. Two measures are tracked for each of the 25 routes:

- On-time performance—the percentage of sailings that actually depart within ten minutes of scheduled departure. On a fleet-wide basis, 86.5% of 2007/08 sailings departed within ten minutes of the scheduled departure time. On-time departures ranged from 53.5% to 98.5% for various routes during that period. The on-time performance target identified in the BC Ferries "*Strategic Plan 2003-2025*," is 90 percent of departures to occur within 10

minutes of the scheduled time. The target was to rise to 90 percent of departures within 5 minutes of scheduled time in 2008.

- Overloads—the percentage of sailings that depart full, leaving customers behind to wait for the next sailing.

BC Ferries also provides annual information on capacity utilization. Capacity is calculated on the basis of Automobile Equivalents (AEQ). An AEQ represents the amount of vessel capacity occupied by a particular vehicle type, expressed in terms of an automobile equivalent, and the number of under height vehicles it displaces (e.g., a bus that displaces three under height vehicles would have an AEQ of 3). In 2007/08, BC Ferries provided capacity sufficient to carry the traffic, with capacity utilization of the designated ferry routes ranging from 26% to 81%.[13]

Customer Satisfaction

Washington State Ferries has conducted extensive customer surveys, as evidenced in the "*2008 Ferry Customer Survey Final Report*."[14] That document summarized data from on-board surveys of WSF customers during March 2008. Survey questions were developed from comments by focus group convened in November and December 2007. Additional input was gathered from people who no longer rode the ferry or did so infrequently, to determine the reasons for that lack of or change in use. Input on the ferry system was also compiled from freight customers. Finally, some people who submitted on-board surveys were selected to participate in additional research to help determine sensitivity to pricing, and to test the effects that changes to services and pricing would have on vehicle drivers' decisions to walk on instead of to drive on ferries. Findings from the survey are not described here, as the methodology used in conducting the survey was of more interest to the research team for its potential adaptation to the survey that was conducted as a part of this study.

The British Columbia ferry system (BC Ferries) has also conducted extensive surveys on customer satisfaction with its services, as summarized in the "*Annual Report to the British Columbia Ferries Commissioner*."[15] In addition to summarizing operations and financial information on a route-by-route basis, the report discussed findings from an annual customer satisfaction survey.

The overall customer satisfaction target is a 4.2 out of 5 (the 2007 score was 4.1, when the target was 4.0 out of 5). Satisfaction is tracked by route, and incorporates feedback on several aspects of the ferry trip, including:

- Satisfaction before arriving at the terminal—phone and on-line information and/or reservations services, and highway signage.
- Satisfaction at the terminal—ticket purchasing, concessions, boarding, and staff professionalism/courtesy.

---

[13] *Annual Report to the British Columbia Ferries Commissioner—Year Ended March 31, 2008*, British Columbia Ferry Services, Inc., 31 July, 2008, page 5.

[14] "*2008 Ferry Customer Survey, Final Report*," prepared for Washington State Transportation Commission, by Opinion Research Corporation, November 2008, http://wstc.wa.gov/ferrycustomersurvey/2008_FerryCustSurveyExecSum.pdf

[15] "*Annual Report to the British Columbia Ferries Commissioner: Year Ended March 31, 2008*," British Columbia Ferry Services, Inc. 31 July 2008.

- Satisfaction onboard—concessions, rest rooms, seating, announcements, and staff professionalism/ courtesy.
- Satisfaction with sailing schedules—on-time departures, number and timing of sailings.
- Safety—terminal operations, and loading/unloading.
- Satisfaction with overall value—value for fare/toll costs.

PEER SELECTION

The steps involved in selecting peer ferry systems for comparison with the North Carolina Ferry System included:

1. Categorizing North Carolina ferry routes—the characteristics of the seven routes vary greatly, so they were placed into three categories to enable more similar comparisons.
2. Gathering statistics from the Bureau of Transportation Statistics (BTS) and other information (generally from an Internet search) on potential peers.
3. Developing criteria to determine appropriate potential peers at a route level.
4. Applying the criteria and select appropriate peers for analysis.

Each of these steps is described below.

Categorization of North Carolina Ferry Routes

There are distinct differences among the seven North Carolina Ferry System routes. To help provide a more similar comparison of those routes, they were categorized as "River," "Hatteras," or "Sound" crossings. The categorization was based on the type of water body crossed, and the length of the crossing. Characteristics of routes in each of these categories are as follows:

- River—relatively short route length;
- Hatteras—medium route length, coastal marine environment; and
- Sound—relatively long route length, also in a coastal marine environment.

Statistical Information

Statistical information was reviewed from "*National Census of Ferry Operators*" database compiled in 2006 by the Bureau of Transportation Statistics.[16] Information included aggregate data on other operators, as well as more specific data for ferry vessels, routes, and tolling/fares. Table 2 shows the ranking for the seven North Carolina Ferry System routes (shaded) as well as the numbers of annual vehicles transported and the associated rankings for many of the ferry routes that were selected as peers (shown in **bold** font) for comparison with the various North Carolina routes.

Table 2: Ranking U.S. Ferry Routes by Annual Vehicle Transported

Route	Vehicles	Ranking
Edmonds (WA) - Kingston (WA)	2300000	1
Mukilteo (WA) - Clinton (WA)	2200000	2
Galveston (TX) - Port Bolivar (TX)	**2134999**	**3**
Seattle, Pier 52 (WA) - Winslow, Bainbridge Island (WA)	2100000	4
Fauntleroy, West Seattle (WA) - Vashon (WA)	1200000	5
Port Aransas (TX)-Harbor Island (TX)	**1084654**	**6**

[16] *National Census of Ferry Operators*, Bureau of Transportation Statistics, Research and Innovative Technology Administration, U.S. Department of Transportation , Washington, DC, accessed on the Internet at: http://www.transtats.bts.gov/DatabaseInfo.asp?DB_ID=616&Link=0

Route	Vehicles	Ranking
New Orleans, Donald Street (LA) - Chalmette (LA)	**1080605**	**7**
Scotland, Scotland Wharf (VA) - Jamestown, Jamestown Wharf (VA)	**997430**	**8**
Anacortes, WSF Ferry Terminal (WA) - Sidney (BC)	890000	9
North Haven (NY) - Shelter Island (NY)	724938	10
Seattle, Pier 52 (WA) - Bremerton (WA) (RoRo service)	710000	11
Algonac, State Route 29 (MI) - Harsens Island, State Route 154 (MI)	700000	12
Belle Chasse (LA) - Scarsdale (LA)	633370	13
Fauntleroy, West Seattle (WA) - Southworth (WA)	**560000**	**14**
Bridgeport (CT) - Port Jefferson (NY)	**480000**	**15**
Grafton (IL) - Brussels (IL)	428950	16
Woods Hole (MA) - Vineyard Haven, Martha's Vineyard (MA)	416483	17
Point Defiance, Ruston (WA) - Tahlequah (WA)	**405000**	**18**
Lynchburg, South Lynchburg Rd. (TX) - San Jacinto Battleground, State Route 134 (TX)	372915	19
Port Townsend (WA) - Keystone (WA)	**370000**	**20**
Lewes (DE) - Cape May (NJ)	**359450**	**21**
Hatteras (NC) - Ocracoke (NC)	342461	22
Mayport (FL) - Fort George Island (FL)	340611	23
Balboa Island (CA) - Balboa (CA)	338560	24
Plaquemine (LA) - Plaquemine Point (LA)	333114	25
Saint Francisville (LA) - New Roads, State Route 10 (LA)	332820	26
Cameron (LA)-Holly Beach (LA)	321348	27
Eldred, State Route 108 (IL) - Kampsville, State Route 100 (IL)	312141	28
Sault Ste Marie (MI) - Sugar Island (MI)	297966	29
Cameron, Cameron West Bank (LA) - Cameron, Cameron East Bank (LA)	294253	30
Cherry Branch (NC) - Minnesott Beach (NC)	264929	31
Brooks (OR) - Wheatland (OR)	233971	32
Hyannis (MA) - Nantucket (MA)	**228754**	**33**
Constance (KY) - Cincinnati (OH)	226583	34
De Tour Village (MI) - Drummond Island (MI)	212786	35
Edgartown, Memorial Wharf (MA) - Chappaquiddick (MA)	202207	36
Cruz Bay, Saint John (VI) - Red Hook, Saint Thomas (VI)	184059	37
Southport (NC) - Fort Fisher (NC)	183306	38
Anacortes, Guemes Ferry Terminal (WA) - Guemes (WA)	162773	39
New Orleans, Canal Street (LA) - Algiers, Morgan Street (LA)	**152949**	**40**
Pointe a la Hache (LA) - West Pointe a la Hache (LA)	133731	41
Edgard (LA) - Reserve (LA)	131226	42
Wilsonville (OR) - Canby (OR)	122630	43
Vashon (WA) - Southworth (WA)	121000	44
Grafton (IL)-Saint Charles (MO)	108900	45
Spears (KY) - Valley View, State Route 169 (KY)	108081	46

Route	Vehicles	Ranking
Catawba Point (OH) - Put-In-Bay (OH)	103889	47
Inchelium (WA) - Gifford (WA)	98283	48
Ketchikan International Airport, Ketchikan (AK) - Ketchikan (AK)	84754	49
Cedar Island (NC) - Ocracoke (NC)	78759	50
Mammoth Cave, S. Side of Green River (KY) - Mammoth Cave, N. Side Of Green River (KY)	78053	51
Turkey Neck Bend (KY)-Tompkinsville, State Route 214 (KY)	76800	52
Detroit Harbor (WI) - Northport, Door Peninsula (WI)	75745	53
Aurora (NC) - Bayview (NC)	74143	54
Grand Island (CA) - Ryer Island, Howard Landing Ferry (CA)	72800	55
Rio Vista (CA) - Ryer Island (CA)	72800	56
Duty (LA)-Enterprise (LA)	70842	57
Woods Hole (MA) - Oak Bluffs, Martha's Vineyard (MA)	66417	58
Angola Landing (LA) - Lettsworth (LA)	66015	59
Point Judith (RI) - Block Island, Old Harbor (RI)	64412	60
Duty, State Route 124 (LA) - Duty, State Route 559 (LA)	63837	61
Raymond (ME)-Frye Island (ME)	63105	62
Keller, State Route 21 (WA) - Wilbur, State Route 21 (WA)	62540	63
White Castle (LA) - Carville (LA)	60536	64
Puget Island, State Route 409 (WA) - Westport (OR)	56815	65
Lincolnville (ME) - Islesboro (ME)	53127	66
Fredericktown (PA) - East Fredericktown (PA)	53088	67
Cumberland City (TN) - Throckmorton, Indian Mound (TN)	52195	68
New London, State Street (CT) - Fishers Island (NY)	**46782**	**69**
Sistersville (WV) - Fly (OH)	45259	70
Woodland, County Road 79 (DE) - Bethel, State Route 78 (DE)	37609	71
Chester (CT) - Hadlyme (CT)	36696	72
Bayfield (WI) - La Pointe, Madeline Island (WI)	34873	73
Peel (AR) - Protem (MO)	31436	74
Gretna (LA) - New Orleans, Jackson Avenue (LA)	**31431**	**75**
Portland, Casco Bay Ferry Terminal (ME) - Peaks Island (ME)	**26566**	**76**
Barbeau (MI) - Neebish Island (MI)	23104	77
Ocracoke (NC) - Swan Quarter (NC)	22710	78
Rockland (ME) - Vinalhaven (ME)	**20298**	**79**
Wolfe Island (ON) - Cape Vincent (NY)	19301	80
Morgan City (LA) - Avoca Island (LA)	19285	81
Marine City (MI) - Sombra (ON)	18603	82
Currituck (NC) - Knotts Island (NC)	18382	83
Dorena, Dorena Landing (MO) - Hickman (KY)	18368	84

Criteria to Determine Appropriate Peers

As a result of the significant differences in the characteristics of the seven North Carolina ferry routes, the research team conducted a peer analysis at the route, rather than at the system, level. Several factors were considered in evaluating candidate ferry routes as peers for comparison with the North Carolina Ferry System. The primary factors that were used as selection criteria were:

- Operating environment—type of water body crossed, length of crossing.
- Type of operator—public or private sector. Public sector operators were favored, as they more closely mirrored the North Carolina situation. However, some private operators were included, as there were an insufficient number of public operators for a particular type of operation and/or the characteristics of routes under private operators most closely mirrored those in North Carolina.
- Type of transport—vehicles plus passengers vs. passengers-only. Ferry operations that transport vehicles as well as passengers were selected for this analysis, as all North Carolina Ferry System routes transport vehicles.
- Type of trip purpose—primary orientation of riders as commuters, residents, or tourists. This factor differs according to the type of North Carolina ferry route under analysis. Many of the North Carolina "River" crossings provide a relatively high percentage of trips for commuters, particularly the Aurora—Bayview, and Cherry Branch—Minnesott Beach routes. The "Hatteras" crossing is primarily oriented to transporting tourists during its peak summer season, but primarily serves the travel needs of Ocracoke Island residents during the off-peak winter season. The "Sound" crossings serve a mixture of residents' and tourists' travel needs. To the extent possible, ferry operations meeting similar travel purposes were selected for comparison with each of these different types of routes.

Selected Peers

The four primary selection criteria were applied to ferry systems with BTS data. That excluded ferry systems and routes that operate outside of the U.S. The ferry routes selected for comparison as peers include those listed in Table 3 on the following page.

Table 3: Peer Ferry Systems

Operator Name	Organizational Type	State(s)	Route(s)
"River" Crossings			
North Carolina Ferry System	State Department of Transportation (DOT)	North Carolina	Currituck—Knotts Island, Aurora—Bayview Cherry Branch—Minnesott Beach Southport—Fort Fisher
Louisiana Department of Transportation & Development/ Crescent City Connection Division (CCCD)	State DOT	Louisiana	New Orleans—Algiers New Orleans—Chalmette Gretna—New Orleans
Lake Champlain Transportation Company	Private, for-profit	New York/Vermont	Grand Isle, VT—Plattsburgh, NY Charlotte, VT—Essex, NY
Virginia Department of Transportation	State DOT	Virginia	Jamestown—Scotland
Washington State Ferries	State DOT	Washington	Point Defiance—Tahlequah
"Hatteras" Crossings			
North Carolina Ferry System	State DOT	North Carolina	Hatteras—Ocracoke
Hornblower Marine Services, under contract to Alabama DOT	State DOT (contracted operations)	Alabama	Dauphin Island—Fort Morgan
Delaware River and Bay Authority	Public Authority	Delaware/New Jersey	Cape May, NJ—Lewes, DE
Casco Bay Island Transit District/Casco Bay Lines	Quasi-municipal non-profit	Maine	Portland—Peaks Island
Texas Department of Transportation	State DOT	Texas	Galveston—Bolivar Port Aransas
Washington State Ferries	State DOT	Washington	Port Townsend—Keystone Fauntleroy—Southworth
"Sound Crossings"			
North Carolina Ferry System	State DOT	North Carolina	Cedar Island—Ocracoke Ocracoke—Swan Quarter
Inter-Island Ferry Authority	Public Authority	Alaska	Ketchikan—Hollis
The Bridgeport & Port Jefferson Steamboat Company	Private, for-profit	Connecticut/New York	Bridgeport, CT—Port Jefferson, NY
Fishers Island Ferry District	Public tax district	Connecticut/New York	New London, CT—Fishers Island, NY
Cross Sound Ferry Services, Inc.	Private, for-profit	Connecticut/New York	New London, CT—Orient Point, NY
Maine State Ferry Service	State DOT	Maine	Rockland—Vinalhaven
Woods Hole, Martha's Vineyard and Nantucket Steamship Authority	Public Authority	Massachusetts	Hyannis—Nantucket
Charlevoix County Transportation Authority	Public Authority	Michigan	Charlevoix—St. James, Beaver Island
Lake Champlain Transportation Company	Private, for-profit	New York/Vermont	Burlington, VT—Port Kent, NY

Peer Ferry Route Statistics

Comparative information on each of these ferry routes was compiled, including data on vessels, operations, and tolling. Vessel, operations, and tolling data are organized in separate tables for "River," "Hatteras," and "Sound" crossings. Information on vessels, as summarized in Tables 4, 5, and 6 includes:

- Number(s) operating on each route
- Capacities—vehicles/passengers
- Maximum/typical operating speed
- Year built/rebuilt
- Gross tons
- Horsepower
- Type of propulsion system
- Length/breadth
- Load draft

Information on operations, as summarized in Tables 7, 8, and 9 includes:

- Crossing length
- Scheduled crossing time
- Days of operation (daily, weekdays only)
- Operations period (daily start/end times)
- Peak/off-peak frequency of service
- Toll/charged—Yes/No
- Number of passengers/vehicles transported (2006 data)

Information on tolling, as provided in Tables 10, 11, and 12, includes:

- Peak/off-peak toll amounts charged for cars and trucks
- Tolls charged for other types of vehicles (typically motorcycles)
- Bicycle toll amount
- Vehicle passenger fare amount
- Comments—describing special toll practices and/or discounted tolls/fares available

Table 4: Vessel Information—"River" Crossings

Route/State	Vessel Name	Passenger Capacity	Auto Capacity	Max/Typical Speed (Knots)	Built/ Rebuilt	Gross Tons	Horse-power	Propulsion	Length/ Breadth	Load Draft
Cape Fear, Neuse, Pamlico Rivers; Knotts Island—Currituck, NC (4 crossings)	Gov. Hunt	149	22	10 / 10	1984	462	850	Diesel reduction, some Voith Schneider	155 / 40	5
	Southport	300	40	11 / 11	1996	374	950		168 / 44	6
	Gov. Russell	300	40	11 / 11	1992	469	950		173 / 44	6
	Neuse	300	40	11 / 11	1998	380	950		168 / 44	6
	Floyd Lupton	300	40	11 / 11	2000	374	950		168 / 44	6
	Fort Fisher	300	40	11 / 11	2000	374	950		168 / 44	6
	Croatoan	300	40	11 / 11	2003	376	950		168 / 44	6
	Stan White	300	40	11 / 11	2003	372	950		168 / 44	
New Orleans, LA (CCCD) (three crossings)	Sen. Stumpf	1,000	60	8 / 8	1978	858	1,500	Diesel reduction, two with 360 degree rotatable fixed pitch propeller (Z-drive)	190 / 66	6.9
	Capt. N. Levy	1,000	60	8 / 8	1977	858	1,500		190 / 66	6.9
	Louis Porterie	794	50	8 / 8	1937/1994	566	850		140 / 54	8.8
	Col. Armiger	402	N.A.	8 / 8	1978	268	900		88 / 30	6.6
	St. John	233	45	8 / 8	1977	656	932		143 / 60	6.9
	T. Jefferson	794	50	8 / 8	1942/2001	477	850		142 / 54	9.1
Jamestown—Scotland, VA	Pocahontas	400	70	14 / 10	1995	1,197	3,000	Diesel reduction, 1 with Voith Schneider	264 / 65	11
	Surry	361	50	14 / 10	1979	825	1,450		190 / 64	9.5
	Virginia	192	28	12 / 10	1936	327	900		152 / 39	6.5
	Williamsburg	355	50	12 / 10	1983	837	1,450		200 / 65	9.9
Port Defiance—Tahlequah, WA	Rhododendron	546	65	12 / 11	1947/ 1990	937	2,172	Diesel Reduction	228 / 62	10
Grand Isle, VT—Plattsburgh, NY	E.-W.-Wolcott	150	45	12 / 12	1988	267	775	Diesel reduction	188 / 44	8
	Plattsburgh	150	39	12 / 12	1984	268	700		173 / 37	7
	Vermont	225	48	12 / 12	1992	279	775		187 / 44	7
	Cumberland	200	50	12 / 12	2000	94	855		208 / 43	7.3
Charlotte, VT—Essex, NY	Grand Isle	150	44	12 / 12	1953	95	503	Diesel reduction	169 / 37	8.3
	Gov. G. Aiken	130	25	12 / 12	1975	94	365		132 / 37	8.4

Table 5: Vessels—"Hatteras" Crossing

Route/State	Vessel Name	Passenger Capacity	Auto Capacity	Max/Typical Speed (Knots)	Built/ Rebuilt	Gross Tons	Horse-power	Propulsion	Length/ Breadth (feet)	Load Draft (feet)
Hatteras—Ocracoke, NC	Baum	149	30	10 / 10	1995	283	1,060	Diesel reduction	144 / 34	4.5
	Cape Point	149	30	10 / 10	1989	276	886		140 / 42	4
	Chicamacomico	149	30	10 / 10	1989	276	886		140 / 42	4
	Frisco	149	30	10 / 10	1990	275	886		140 / 42	4
	Kinnakeet	149	30	10 / 10	1977	280	886		140 / 42	4
	Roanoke	149	30	10 / 10	1989	248	940		144 / 34	3.6
	Ocracoke	149	22	10 / 10	1994	275	886		140 / 34	4
	Hatteras	300	40	10 / 10	N.A.	407	N.A.		180 / 44	6
Cape May, NJ—Lewes, DE	Cape Henlopen	800	100	15 / 13	1981	2,120	4,000	Diesel reduction	285 / 68	7
	Cape May	895	100	13 / 13	1998	2,165	4,000		301 / 68	8.2
	Delaware	898	100	15 / 13	1974	2,108	4,000		301 / 68	7.5
	New Jersey	800	100	15 / 13	1974	2,108	4,000		284 / 68	7
	Twin Capes	895	100	13 / 13	1975/1996	2,262	4,000		301 / 68	8
Galveston—Bolivar, TX	Gibb Gilchrist	500	70	12 / 12	1977	1,145	2,000	1@Diesel-electric 4@Diesel reduction (cycloidal)	253 / 66	11
	Robert Lanier	500	70	12 / 12	1991	1,156	2,500		237 / 66	11.5
	DeWitt Greer	500	70	12 / 12	1994	1,196	2,500		253 / 66	11.5
	Ray Stoker, Jr.	500	70	12 / 12	1996	1,082	3,000		253 / 66	10.7
	Robert Dedman	500	70	12 / 12	1998	1,082	3,000		253 / 66	10
Port Aransas, TX	J.C. Dingwall	120	20	10 / 4	1987	94	285	Diesel reduction	91 / 44	9
	Mark G. Goode	120	20	10 / 4	1989	94	285		91 / 44	9
	B.L. DeBerry	120	20	10 / 4	1987	94	285		91 / 44	9
	RE..Stotzer, Jr.	120	20	10 / 4	1993	94	285		91 / 44	9
	Arnold Oliver	120	20	10 / 4	1996	94	285		91 / 44	9
	William Burnett	120	20	10 / 4	1999	94	285		91 / 44	9
Port Townsend—Keystone, WA	Steilacoom II	300	50	12 / 11.4	2007	N.A.	2,100	N.A.	216 / 68	10
Fauntleroy—Southworth, WA	Tillikum	1,200	87	13	1958	2,069	2,500	Diesel-electric	310 / 73	15
	Issaquah	1,200	124	16	1980	2,469	5,000		328 / 79	15.8
	Klahowya	800	87	13	1958	2,174	2,500		310 / 73	15
Dauphin Island—Fort Morgan, AL*	Fort Morgan	149	22	8 / 7	1988	99	900	Diesel reduction	140 / 30	3.9
	Marissa Nicole	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		N.A.	N.A.
Portland—Peaks Island, ME	Machigonne II	399	12	10 / 9	1987	88	800	Diesel reduction	116 / 36	6.7

* No information available for second vessel on Dauphin Island—Fort Morgan route.

Table 6: Vessels—"Sound" Crossing

Route/State	Vessel Name	Passenger Capacity	Auto Capacity	Max/Typical Speed (Knots)	Built/ Rebuilt	Gross Tons	Horse-power	Propulsion	Length/ Breadth	Load Draft
Cedar Island--	Carteret	300	50	12 / 11.5	1988	687	1,610	Diesel	208 / 50	6.3
Ocracoke &	Cedar Island	300	50	12 / 11.5	1994	648	1,610	reduction	208 / 38	6.5
Swan Quarter—	Governor Hyde	300	35	12 / 11.5	1977	574	1,650		161 / 48	7
Ocracoke, NC	Pamlico	300	50	12 / 11.5	1986	734	1,130		208 / 38	6.5
	Silver Lake	300	50	12 / 11.5	1987	688	1,610		208 / 38	6.5
Bridgeport, CT—	Grand Republic	1,000	110	20 / 15	1983	1,129	3,000	Diesel	261 / 44	11
Port Jefferson, NY	Park City	1,000	80	16 / 15	1986	1,237	3,000	reduction	262 / 47	11.5
	P.T. Barnum	1,000	110	20 / 15	1999	1,595	6,000		290 / 52	11.5
New London,	Munnatawket	209	24	11 / 10	1978	95	1,000	Diesel	116 / 29	7.5
CT—Fishers	Race Point	246	34	12 / 11	1985	87	1,080	reduction	162 / 33	8.5
Island, NY										
New London,	Cape Henlopen	900	90	13 / 12	1944	1,492	2,880	Diesel	308 / 50	9.5
CT—Orient Point,	Caribbean	134	22	12 / 11	1971	94	1,340	reduction (6)	116 / 38	7
NY	John H.	1,000	110	12 / 11	1989	96	3,000	Diesel direct	230 / 36	10.3
	New London	300	60	15 / 14	1979	98	1,920	(Caribbean)	247 / 42	10.5
	North Star	300	34	11 / 11	1968	238	1,500		158 / 38	9.5
	Susan Anne	800	86	16 / 14	1964	1,348	3,200		238 / 55	12
	Mary Ellen	650	86	16 / 14	1983	1,237	3,000		261 / 44	11
Ketchikan—	Prince of Wales	170	30	15 / 14	2001	95	3,000	Diesel	173 / 53	N.A.
Hollis, AK								reduction		
Charlevoix—St.	Beaver Islander	200	10	13.5 / 13.5	1962	95	1,350	Diesel	87 / 27	7
James, Beaver	Emerald Isle	298	20	14.5 / 14.5	1997	95	3,000	reduction	117 / 38	8
Island, MI										
Burlington, VT—	Adirondack	275	30	12 / 12	1913	333	365	Diesel	130 / 40	8.5
Port Kent, NY	Champlain	375	32	12 / 12	1930	440	550	reduction	148 / 41	7.5
	Valcour	225	48	12 / 12	1947	446	850	Diesel direct	177 / 44	7.5
								(Champlain)		
Hyannis—	Eagle	799	N.A. ~60?	14.3 / 13	1987	276	3,000	Diesel	220 / 60	9.9
Nantucket, MA	Gay Head	140	N.A. ~45?	13 / 12.6	1981/1999	99	3,050	reduction	218 / 52	9.5
	Nantucket	779	N.A. ~45?	13.8 / 12.5	1974	1,152	3,000		220 / 60	11
Rockland—	Capt. Philbrook	221	N.A. ~32?	13 / 12	1993	288	804	Diesel	127 / 36	10
Vinalhaven, ME	Governor Curtis	221	N.A. ~32?	13 / 12	1968	303	804	reduction	123 / 36	9.8

Table 7: Operations—"River" Crossings

Route/State	Crossing Length (miles)	Crossing Time (minutes)	Days of Operation	Operations Period	Peak Frequency	Off-Peak Frequency	Toll	Passengers (2006)	Vehicles (2006)
Currituck—Knotts Island, NC	5	45	Daily (365)	7:00 am – 6:30 pm	60 minutes	120 minutes	No	61,637	18,382
Aurora—Bayview, NC	3	30	Daily (365)	5:30 am – 12:30 am	Varies, 90 minutes min.	Varies, up to 150 minutes	No	118,276	74,143
Cherry Branch—Minnesott Beach, NC	1.75	20	Daily (365)	5:15 am – 12:15 am	30 minutes	60 minutes	No	467,113	264,929
Southport—Fort Fisher, NC	3	30	Daily (365)	5:30 am – 7:00 pm	45 minutes	90 minutes	Yes	496,029	183,306
New Orleans--Algiers, LA (CCCD)	0.5	7	Daily (365)	6:00 am – 12:15 am	30 minutes	30 minutes	Yes	1,280,418	152,949
New Orleans—Chalmette, LA (CCCD)	0.5	7	Daily (365)	6:00 am – 8:45 pm	N.A.	N.A.	Yes	13,924	1,080,605
Gretna—New Orleans, LA (CCCD)	0.5	7	Monday-Friday	6:00 am – 8:45 pm	N.A.	N.A.	Yes	67,867	31,431
Jamestown—Scotland, VA	2.2	18	Daily (365)	24 hours	25 minutes	60 minutes	No	N.A.	997,430
Point Defiance—Tahlequah, WA	1.5	15	Daily (365)	5:30 am – 10:00 pm	50 minutes	60 minutes	Yes	295,000	405,000
Grand Isle, VT—Plattsburgh, NY	1.4	12	Daily (365)	24 hours	10 minutes	20 minutes	Yes	N.A.	N.A.
Charlotte, VT—Essex, NY	2.3	25	Daily (365)	6:00 am – 10:pm (peak) 7:00 am – 5:30 pm (off-peak)	30 minutes	60 minutes	Yes	N.A.	N.A.

Table 8: Operations—"Hatteras" Crossing

Route/State	Crossing Length (miles)	Crossing Time	Days of Operation	Operations Period	Peak Frequency (minutes)	Off-Peak Frequency (minutes)	Toll	Passengers (2006)	Vehicles (2006)
Hatteras—Ocracoke, NC	4.25	40	Daily (365)	5:00 am -- Midnight	30 minutes	60 minutes	No	891,599	342,461
Cape May, NJ—Lewes, DE	17	80	Daily (365)	7:30 am – 9:05 pm	60	90	Yes	1,029,429	359,450
Galveston—Bolivar, TX	3	20	Daily (365)	24 hours	20 minutes	60 minutes	No	6,320,648	2,134,999
Port Aransas, TX	0.25	5	Daily (365)	24 hours	12 minutes		No	26,254	1,084,654
Port Townsend—Keystone, WA	4.3	30	Daily (365)	4:45 am – 9:15 pm	90 minutes	105 minutes	Yes	407,000	370,000
Fauntleroy—Southworth, WA	4.4	35	Daily (365)	4:25 am – 2:10 am	25-45 minutes	60-75 minutes	Yes	420,000	560,000
Dauphin Island—Fort Morgan, AL	4.2	45	Daily (365)	8:00 am – 7:15 pm	45 minutes	90 minutes	Yes	23,669	10,653
Portland—Peaks Island, ME	2.5	15	Daily (365)	5:35 am – 11:55 pm	60 minutes	90 minutes	Yes	691,599	26,566

Table 9: Operations—"Sound" Crossings

Route/State	Crossing Length	Crossing Time	Days of Operation	Operations Period	Peak Frequency	Off-Peak Frequency	Toll	Passengers (2006)	Vehicles (2006)
Cedar Island—Ocracoke, NC	23	135	Daily (365)	7:30 am – 5:00 pm	150 minutes	180 minutes	Yes	195,047	78,759
Ocracoke—Swan Quarter, NC	26	150	Daily (365)	7:00 am – 5:00 pm	150 minutes	420 minutes	Yes	46,979	22,710
Bridgeport, CT—Port Jefferson, NY	14	75	Daily (365)	6:00 am – 9:15 pm	60 minutes	90 minutes	Yes	850,000	480,000
New London, CT—Fishers Island, NY	8	45	Daily (365)	4:30 am – 10:45 pm (7:00 am – 7:45 pm weekends)	120 minutes	140-255 minutes	Yes	162,495	46,782
New London, CT—Orient Point, NY	18	80	Daily (365)	7:00 am – 8:30 pm (9:45 pm weekend)	30 minutes	60 minutes	Yes	N.A.	N.A.
Ketchikan—Hollis, AK	36	180	Daily (365)	8:00 am – 6:30 pm	One round trip daily	One round trip daily	Yes	56,000	15,105
Charlevoix—St. James, Beaver Island, MI	28	130	Seasonal: April—December	8:30 am – 5:30 pm	180 minutes	Once each direction daily	Yes	41,885	6,409
Burlington, VT—Port Kent, NY	9.8	55	Seasonal (June-October)	8:00 am – 6:15 pm (summer) 9:00 am – 7:10 pm (fall)	75 minutes	135 minutes	Yes	N.A.	N.A.
Hyannis—Nantucket, MA	30	150	Daily (365)	6:30 am – 10:15 pm	105 minutes	210 minutes	Yes	511,798	114,377
Rockland—Vinalhaven, ME	15	75	Daily (365)	7:00 am – 3:15 pm (4:30 pm summer)	90 minutes	105 minutes	Yes	62,760	20,298

Table 10: Tolls—"River" Crossings

Route/State	Car (< 20') Off-Peak Toll	Car (< 20') Peak Toll	Truck Off-Peak Toll	Truck Peak Toll	Other Vehicle Toll	Bicycle Toll	Vehicle Passenger Fare	Comments
Currituck—Knotts Island, NC	No toll	No toll	No toll	No toll	No toll	No toll	No toll	
Aurora—Bayview, NC	No toll	No toll	No toll	No toll	No toll	No toll	No toll	
Cherry Branch—Minnesott Beach, NC	No toll	No toll	No toll	No toll	No toll	No toll	No toll	
Southport—Fort Fisher, NC	$5	$5	20'-40' = $10 >40' = $15	20'-40' = $10 >40' = $15	No	$2	No	$1 Walk-on passenger
New Orleans—Algiers, LA (CCCD)	$1	$1	$1	$1	No toll	No toll	No toll	
New Orleans—Chalmette, LA (CCCD)	$1	$1	$1	$1	No toll	No toll	No toll	
Gretna—New Orleans, LA (CCCD)	$1	$1	$1	$1	No toll	No toll	No toll	
Jamestown—Scotland, VA	No toll	No toll	No toll	No toll	No toll	No toll	No toll	
Port Defiance—Tahlequah, WA	$18.50	$18.50	$27.75 to $148	$27.75 to $148	$8 Motorcycle	$4	$4.30	$4.30 Walk-on passenger. Senior, youth discounts. Multi-ride pass, Monthly pass available.
Grand Isle, VT—Plattsburgh, NY	$9.50	$9.50	$15-$47	$15-$47	$6 Motorcycle	$1	$3.75	Round trip discount available. Commuter cards available.
Charlotte, VT—Essex, NY	$9.50	$9.50	$15-$47	$15-$47	$6 Motorcycle	$1	$3.75	Round trip discount available. Commuter cards available.

Table 11: Tolls—"Hatteras" Crossing

Route/State	Car (up to 20') Off-Peak Toll	Car (up to 20') Peak Toll	Truck Off-Peak Toll	Truck Peak Toll	Other Vehicle Toll	Bicycle Toll	Passenger Fare	Comments
Hatteras—Ocracoke, NC	No toll	No toll	No toll	No toll	No toll	No toll	No toll	
Cape May, NJ—Lewes, DE	$29.50 $25.25 return 6-ticket book $153	$43.25 $31.75 return 6-ticket book $153	$33.75 to $84.50	$49.75 to $113	Motorcycle: $24.25 (off-peak) -- $36 (peak)	No toll	$7.50 (off-peak) w/ $5.25 return $10 (peak) w/$8 return 6-ticket book $43.50	$7.50-$10 Walk-on passenger. Discount rates available for return trips, and with 6-ticket book. Shuttles operate on both sides. Discounted 6 ticket books. $2 Internet reservation discount
Galveston—Bolivar, TX	No toll	No toll	No toll	No toll	No toll	No toll	No toll	
Port Aransas, TX	No toll	No toll	No toll	No toll	No toll	No toll	No toll	
Port Townsend—Keystone, WA	$11.15	$11.15	$16.75 to $89.20	$16.75 to $89.20	$4.85	$4.80	$2.60	$2.60 Walk-on passenger. Senior, youth discounts. Multi-ride & Monthly passes available.
Fauntleroy—Southworth, WA	$11.15	$11.15	$16.75 to $89.20	$16.75 to $89.20	$4.85	$4.30	$4.30	Multi-ride pass, Monthly pass available.
Dauphin Island—Fort Morgan, AL	$16	$16	N.A.	N.A.	$8 Motorcycle $10 Trailer/ Boat $35 Motor home	No toll	$4.50	$5 Walk-on passenger Round trip discount. Children <12 free.
Portland—Peaks Island, ME	$34	$80	$42 to $132	$82.80 to $194	None	$6	$8.20 peak (Round Trip) $4.25 off-peak (RT)	Child, senior discounts. Commuter book (5 RT tickets). Monthly & Annual passes.

Table 12: Tolls—"Sound" Crossings

Route/State	Car (up to 20') Off-Peak Toll	Car (up to 20') Peak Toll	Truck Off-Peak Toll	Truck Peak Toll	Other Vehicle Toll	Bicycle Toll	Passenger Fare	Comments
Cedar Island—Ocracoke, NC	$15	$15	20'-40' = $30 >40' = $45	20'-40' = $30 >40' = $45	$10 Motorcycle	$3	None	$1 Walk-on passenger
Ocracoke—Swan Quarter, NC	$15	$15	20'-40' = $30 >40' = $45	20'-40' = $30 >40' = $45	$10 Motorcycle	$3	None	$1 Walk-on passenger
Bridgeport, CT—Port Jefferson, NY	$51	$51	$74.75 to $165	$74.75 to $165	$29.75 Motorcycle	No toll	$14.64	$17 Walk-on passenger (round trip, child, and senior discounts). Monthly walk-on passes.
New London, CT—Fishers Island, NY	<18'=$13 plus $3 per ft. over 18' (plus $8 for driver)	<18'=$22.50 plus $2 per ft. over 18' (plus $12.50 for driver)	<18= $33 plus $2 per ft. over 18'	<18'=$41 plus $3 per ft. over 18'	$22 Motorcycle	$22	$8 off-peak $12.50 peak	Round trip purchase required (twice the indicated prices). Senior, child discounts. 10-trip Commuter Books available at discount.
New London, CT—Orient Point, NY	$46.92	$46.92	$2.55 / foot	$3.06 / foot	$27.54 Motorcycle	$4.08	$14.28	$14.28 Walk-on passenger. Discounts available for passenger round trips, and commuters.
Ketchikan—Hollis, AK	$5 per foot (plus $37 for driver)	$5 per foot plus $37 for driver)	$5.50 to $8 per foot	$5.50 to $8 per foot	$3 per foot Motorcycles, etc.	No toll	$37	Senior, child discounts. Other vehicles include kayaks, canoes, inflatables, ATVs. Tolls subject to a fuel surcharge. Connecting Ketchikan bus.
Charlevoix—St. James, Beaver Island, MI	$75 (plus $22 for driver)	$75 (plus $24 for driver)	N.A.	N.A.	$30-$40 Motorcycle (+ driver fare)	$9	$24 Peak; $22 Off-peak	Fares vary for adults, children, and pets. Tolls for kayak/canoe, & ATV.
Burlington, VT—Port Kent, NY	$17.50	$17.50	$23.50-$87.75	$23.50-$87.75	$6.75 Motorcycle	$1	$4.95	Round trip discount available. Commuter card available.
Hyannis—Nantucket, MA	<17'=$190 <20'=$215	<17'=$130 <20'=$150	N.A.—varies by dimensions	N.A.—varies by dimensions	$45 (off-peak) $60 (peak) Motorcycle	$6	$16.50	Discounts for children. Discounts for island residents. Discounted 10 ride coupon book.
Rockland—Vinalhaven, ME	$24.75	$24.75	$2 per foot	$2 per foot	No toll	$10.50	$8.75	Round trip ticket required for car, truck, and passengers at twice the listed prices. One way ticket available only for bicycles.

Table 13: Comparison of Per-Mile Toll Amounts

	Per-Mile Toll Amounts (Calculated)									
Route/State	**Car (< 20') Off-Peak Toll**	**Car (< 20') Peak Toll**	**Truck Off-Peak Toll (min.)**	**Truck Off-Peak Toll (max.)**	**Truck Peak Toll (min.)**	**Truck Peak Toll (max.)**	**Other Vehicle Toll**	**Bicycle Toll**	**Vehicle Passenger Fare**	**Walk-On Passenger**
"River" Crossings										
Southport—Fort Fisher, NC	$1.67	$1.67	$3.33	$5.00	$3.33	$5.00	No toll	$0.67	No toll	$0.33
New Orleans—Algiers, LA (CCCD)	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	No toll	No toll	No toll	No toll
New Orleans—Chalmette, LA (CCCD)	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	No toll	No toll	No toll	No toll
Gretna—New Orleans, LA (CCCD)	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	No toll	No toll	No toll	No toll
Port Defiance—Tahlequah, WA	$12.33	$12.33	$18.50	$98.67	$18.50	$98.67	$5.33	$3.20	$2.87	$2.87
Grand Isle, VT—Plattsburgh, NY	$6.79	$6.79	$10.71	$33.57	$10.71	$33.57	$4.29	$0.71	$2.68	$2.68
Charlotte, VT—Essex, NY	$4.13	$4.13	$6.52	$20.43	$6.52	$20.43	$2.61	$0.43	$1.63	$1.63
Maximum "River" Rate	**$12.33**	**$12.33**	**$18.50**	**$98.67**	**$18.50**	**$18.50**	**$5.33**	**$0.71**	**$2.87**	**$2.87**
Minimum "River" Rate	**$1.67**	**$1.67**	**$2.00**	**$2.00**	**$2.00**	**$2.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Average "River Rate	**$4.42**	**$4.42**	**$6.44**	**$23.38**	**$6.44**	**$23.38**	**$4.08**	**$1.25**	**$2.39**	**$1.88**
"Hatteras" Crossings										
Cape May, NJ—Lewes, DE	$1.74	$2.54	$1.99	$4.97	$2.93	$6.65	$1.43	$0.00	$0.44	$0.44
Port Townsend—Keystone, WA	$2.59	$2.59	$3.90	$20.74	$3.90	$20.74	$1.13	$1.12	$0.60	$0.60
Fauntleroy—Southworth, WA	$2.53	$2.53	$3.81	$20.27	$3.81	$20.27	$1.10	$1.20	$0.98	$0.98
Dauphin Island—Fort Morgan, AL	$3.81	$3.81	N.A.	N.A.	N.A.	N.A.	$1.90	No toll	$1.07	$1.19
Portland—Peaks Island, ME	$13.60	$32.00	$16.80	$52.80	$33.12	$77.60	No toll	$2.40	$0.85	$0.85
Maximum "Hatteras" Rate	**$13.60**	**$32.00**	**$16.80**	**$52.80**	**$33.12**	**$77.60**	**$1.90**	**$2.40**	**$1.07**	**$1.19**
Mimimum "Hatteras" Rate	**$2.53**	**$2.53**	**$1.99**	**$4.97**	**$2.93**	**$6.65**	**$1.13**	**$0.00**	**$0.44**	**$0.44**
Average "Hatteras" Rate	**$4.85**	**$8.70**	**$6.62**	**$24.70**	**$10.94**	**$31.32**	**$1.39**	**$1.18**	**$0.79**	**$0.81**
"Sound Crossings"										
Cedar Island—Ocracoke, NC	$0.65	$0.65	$1.30	$1.96	$1.30	$1.96	$0.43	$0.13	$0.00	$0.04
Ocracoke—Swan Quarter, NC	$0.58	$0.58	$1.15	$1.73	$1.15	$1.73	$0.38	$0.12	$0.00	$0.04
Bridgeport, CT—Port Jefferson, NY	$3.64	$3.64	$5.34	$11.79	$5.34	$11.79	$2.13	$0.00	$1.05	$1.21
New London, CT—Fishers Island, NY	$3.38	$4.94	$4.13	N.A.	$5.13	N.A.	$2.75	$0.00	$0.92	$1.06
New London, CT—Orient Point, NY	$2.61	$2.61	$2.83	N.A.	$3.40	N.A.	$1.53	$0.23	$0.79	$0.79
Ketchikan—Hollis, AK	$2.78	$2.78	$3.06	N.A.	$3.06	N.A.	$0.00	No toll	$1.03	$1.03
Charlevoix—St. James, Beaver Island, MI	$3.46	$3.86	N.A.	N.A.	N.A.	N.A.	$1.07	$0.32	$0.79	$0.79
Burlington, VT—Port Kent, NY	$1.79	$1.79	$2.40	$8.95	$2.40	$8.95	$0.69	$0.10	$0.51	$0.51
Hyannis—Nantucket, MA	$7.17	$5.00	N.A.	N.A.	N.A.	N.A.	$1.50	$0.20	$0.55	$0.55
Rockland—Vinalhaven, ME	$1.65	$1.65	N.A.	N.A.	N.A.	N.A.	$0.00	$0.70	$0.58	$0.58
Maximum "Sound" Rate	**$3.64**	**$5.00**	**$5.34**	**$11.79**	**$5.34**	**$11.79**	**$2.75**	**$0.70**	**$1.05**	**$1.21**
Mimimum "Sound" Rate	**$0.58**	**$0.58**	**$1.15**	**$1.73**	**$1.15**	**$1.73**	**$0.38**	**$0.00**	**$0.00**	**$0.04**
Average "Sound" Rate	**$2.77**	**$2.75**	**$2.89**	**$6.11**	**$3.11**	**$6.11**	**$1.05**	**$0.20**	**$0.62**	**$0.66**
Overall Statistics										
Maximum Overall Rate	$13.60	$32.00	$18.50	$98.67	$33.12	$77.60	$5.53	$2.40	$2.87	$2.87
Minimum Overall Rate	$0.58	$0.58	$1.15	$1.73	$1.15	$1.73	$0.00	$0.00	$0.00	$0.00
Average Overall Rate	$3.77	$4.63	$5.10	$19.13	$6.14	$20.89	$1.41	$0.52	$0.79	$0.83

Selected Information on Peer Routes/Operators

In addition to statistical information, qualitative information was gathered on each of the peer ferry systems and routes, primarily from a search of the Internet, but also supplanted with communications with representatives of some ferry systems. The following information is not intended to provide a complete description of the vessels, operations, or other aspects of any particular ferry system, but rather to enrich and expand on the statistical information provided in Tables 4 through 13 and to better inform the reader of selected activities and applicable best practices in place at other ferry systems in the U.S.

Vessels

- All Washington State Ferries (WSF) vessels are double-ended, to eliminate the need to have to turn the vessel around at either end of a run.
- WSF uses a 60-year useful life for ferry vessels. [17]
- In December 2008, Washington State Ferries contracted for the construction of a 64-car ferry at a contract price of $65.5 million. That vessel is scheduled to go into service in late summer 2010. On October 13, 2009, WSF announced award of a contract to construct two additional 64-car ferries for a total of $114 million. Construction of those vessels is planned to take approximately 20 months. The design of the 64-car ferries is based on the *Island Home*, a vessel operating between Woods Hole and Martha's Vineyard, Massachusetts. If sufficient resources are available, WSF will procure a 144-car ferry instead of a fourth 64-car ferry.[18] The option to construct a fourth vessel expires May 31, 2011.
- Four of the five ferries in operation on the Galveston—Bolivar, TX route employ Voith-Schneider propulsion systems. All five vessels are double-ended.
- The Jamestown—Scotland Wharf route is the only 24-hour state-run ferry in Virginia. The Virginia Department of Transportation (VDOT) took over operation of the ferry in 1945. Heaviest traffic volumes occur on holidays and weekends, with peak traffic times between 6-8 am and 4-6 pm. VDOT estimates vehicle loads of approximately 2.5 passengers per car. No reservations are taken for this route, and there is no toll.
- In 2007, VDOT spent approximately $12.5 million to operate four ferry services and to maintain seven vessels. The two oldest ferries in the Scotland-Jamestown ferry operation were both eligible for replacement at that time. The estimated replacement cost was $20 million per vessel.[19]
- The Lake Champlain Transportation Company's "Adirondack" is the oldest in-service, double-ended American ferryboat, and will celebrate 100 years of service on January 15, 2013.
- Many ferry systems operate accessible vessels. For example, both vessels operated by the Inter-Island Ferry Authority (AK), seven of the nine vessels operated by the Woods Hole, Martha's Vineyard and Nantucket Steamship Authority, some of the vessels operated by the Cross Sound Ferry Services, Inc., and one of the two vessels operated by the Charlevoix County Transportation Authority are accessible. ADA access to the Cape May—Lewes ferries is via elevator in the terminal buildings, as there are no elevators on-board vessels to permit moving among decks.
- Some vessels of the Woods Hole, Martha's Vineyard and Nantucket Steamship Authority have free Wi-Fi Internet access.

Operations

- The Casco Bay Island Ferry District transports U.S. mail and school children to and from Portland (ME) to the island.
- Overall, commuters account for 50 percent of Washington State Ferries annual ridership.

---

[17] Cedar River Group, LLC and John Boylston, *Auto-Passenger Vessel Sizing and Timing (2009-2030) Draft Report*, prepared for Joint Transportation Committee, Washington State Legislature, November 14, 2008.
[18] From the Internet: http://www.wsdot.wa.gov/News/2009/08/7_wsdot-seeks-bids-for-ferries.htm.
[19] *Biennial Report on the Condition and Performance of Surface Infrastructure in the Commonwealth of Virginia*, Virginia Department of Transportation, Richmond, September 2007, page 12.

- Performance measures used by WSF:
  1. Percent of total sailings filled to capacity in May, August, and January—recommended to replace the "Boat-Wait" measure adopted in 1994 (number of vessels that sail before a vehicle can board—set at one "boat wait" for most routes).
  2. Two LOS standards are needed—one to indicate when additional pricing and operational strategies might be necessary, and one to indicate when additional service might be needed. Also, two levels of LOS standards might be applied—higher standards in summer, reflecting additional ridership, versus in the off-peak periods.

Many ferry systems' employees are unionized (Washington, British Columbia, Woods Hole, Martha's Vineyard & Nantucket Steamship Authority, etc.). For example, Washington State Ferries hires all employees, with the exception of management positions, through various unions. All positions are entry-level, on-call, and last only through the summer season. As an employee builds seniority, they will be called back earlier each year and work longer, until they are working full-time, which usually takes three to four years or longer.[20] A table of Union wages effective July 1, 2008, and a description of required training and compensation are available on the Internet.

The Woods Hole, Martha's Vineyard and Nantucket Steamship Authority employs 750 people during the peak season. The workforce is nearly totally unionized, with eight bargaining units represented by four different unions. The Authority's budget includes operating revenues of approximately $80 million. The Authority has not had to assess the taxpayers of the participating communities for monetary support since 1963.

Some ferries operate shuttles to provide transportation to communities and/or places of interest at one or both ends of a route. An example, at which shuttle service is operated from both terminals, is the Cape May, NJ—Lewes, DE ferry.

Information/Reservations

While many ferry systems provide information on schedules and reservations via the Internet, several peers provide additional information on-line. For example:

- The Woods Hole, Martha's Vineyard and Nantucket Steamship Authority provides information on-line on vehicle standby status, trip status, and parking lot availability. Information is also available via 511 Massachusetts.
- Washington State Ferries has webcams at 13 of its terminals, and webcams show boarding areas at both Port Aransas—Aransas Pass, TX terminals. Wait times are also posted on the website.

Many ferry routes that charge a toll allow travelers to make reservations. Some routes require reservations. Travelers can make on-line reservations for many of the peer ferry routes, including those operated by Washington State Ferries (only for the Port Townsend—Keystone, and Anacortes—Sidney, BC routes), the Cape May—Lewes Ferry, the Ketchikan—Hollis ferry, the Bridgeport—Port Jefferson ferry, the New London—Fishers Island ferry (non-business vehicles only), the New London—Orient Point ferry, and the Woods Hole, Martha's Vineyard and Nantucket Steamship Authority routes.

[20] From the Internet: http://www.wsdot.wa.gov/ferries/info_desk/faq/index.cfm?faq_id=19.

Some ferry route reservations are subject to a maximum advance time. For example:

- Reservations for the New London, CT—Fishers Island, NY ferry using the on-line system may be made up to 30 days in advance.
- The Woods Hole, Martha's Vineyard and Nantucket Steamship Authority reservations system involves use of staggered advance dates (e.g., reservations for travel on the Hyannis—Nantucket ferry from April 4 through May 18, 2009 could be made starting December 1, 2008; reservations for travel from May 19 through October 12, 2009 could be made starting January 7, 2009; etc.).
- The Maine State Ferry Service does not accept vehicle reservations more than one month in advance of the travel date for travel on the Rockland—Vinalhaven ferry.

Several ferry systems impose a fee if a reservation is cancelled. Examples of cancellation fees include:

- Cape May—Lewes Ferry—$5 (non-refundable).
- Woods Hole, Martha's Vineyard and Nantucket Steamship Authority—$10 vehicle reservation cancellation fee.
- Bridgeport, CT—Port Jefferson, NY—cancellation required at least three hours prior to departure and during regular office hours for a refund of the reservation deposit. Failure will result in a $15 service charge.
- Charlevoix—Beaver Island, MI—forfeit of reservation deposit if a trip is cancelled less than 72 hours prior to departure. There is a $10 processing charge for all cancelled reservations.
- New London, CT—Orient Point, NY—no fee for changing the date and/or time of reservations; however, all cancellations are assessed a $5 processing fee per vehicle, per direction. Same day cancellations made prior to departure times are assessed a $15 late cancellation fee per vehicle per direction. Unused reservations or those not cancelled prior to departure time forfeit the entire payment amount.
- Rockland—Vinalhaven, ME—payment must include all transportation charges and a non-refundable reservation fee. Tickets have no expiration date; therefore, no refunds are made.
- Hyannis—Nantucket—$10 fee for vehicle reservations cancellation; 14-day notice is required to receive a refund on vehicle fares. Passenger fares are fully refundable. Reservations may be changed up to one hour prior to scheduled departure. First change is free of charge; subsequent changes are assessed a $10 fee. Vehicles with a change in trip reservation are accepted for standby travel on a first come, first served basis.

Parking/Shuttles at Terminals

Several ferry systems have parking available at one or more terminals, often involving a charge.

- Cape May—Lewes Ferry—parking lots are available at both terminals, with no charge for parking. Shuttles provide transportation to communities at both ends of the route, allowing foot passengers to access shopping, dining, and entertainment venues. Shuttle service operates daily mid-June through September, with weekend service only during May, early June, and October.
- Portland—Peaks Island, ME—long-term parking is not available at the terminal; however, there is a City of Portland parking garage next to the terminal. Transit bus service is available at the Portland terminal, with connections to Amtrak and intercity bus services.

- The Woods Hole, Martha's Vineyard and Nantucket Steamship Authority owns and operates year-round parking lots in Woods Hole and Hyannis, and operates seasonal off-site parking lots in Falmouth, Bourne, and Hyannis, as well. Per-day parking charges at Authority lots range from $5-$12 per day, depending on time of year. The Woods Hole, Martha's Vineyard and Nantucket Steamship Authority charges $5-$12 per day at lots on the mainland, depending on the time of year.
- New London, CT—Orient Point, NY—free parking is available at the Orient Point terminal on a first come, first served basis. Limited on-site parking is available at a cost of $10 per day at the New London terminal, also on a first come, first served basis. Additional parking is available in a parking garage across the street from the New London terminal at $6 per day Monday-Thursday, and $15 per day Friday, Saturday, Sunday, and holidays.
- Ketchikan—Hollis, AK—connections to transit service and Alaska marine Highway System ferries are available in Ketchikan. Taxi service to island communities is available from the Hollis terminal.
- New London, CT—Fishers Island, NY, and New London, CT—Orient Point, NY—the New London terminal has access to Amtrak and commuter rail services, as well as to intercity bus, taxicab, and casino shuttle bus services, as well as allowing transfers between these and other ferry routes.

Budget Reductions

Several ferry systems have taken action to reduce costs in response to recent budget reductions. Examples include: the Virginia Department of Transportation, the Casco Bay Island Ferry District, the Woods Hole, Martha's Vineyard and Nantucket Steamship Authority, and the Inter-Island Ferry Authority. Activities undertaken by each of those operators are described briefly below.

The Virginia Commonwealth Transportation Board (VDOT) adopted the Six-Year Improvement Program for Fiscal Years 2010-2015 on June 18, 2009. The budget for that program, $7.4 billion is a reduction from the $8.9 billion in the revised FY 2009-2014 program that was approved in February 2009. Various services were reduced in the maintenance and operations budget for fiscal year 2010 including:

- Closing 19 rest areas
- Reducing $20 million of mowing and roadside maintenance
- Reducing ferry services
- Scaling back interstate maintenance contracts
- Reducing Safety Service Patrols
- Closing VDOT residency offices and equipment shops

VDOT implemented $1.27 million in total ferry service reductions starting in July 2009. While the Jamestown-Scotland Ferry will retain 24/7 operations, streamlined internal operations and security practices will save $1.1 million annually. Vehicle security screening will change from a 24/7 process to a condensed, alternating schedule. VDOT will pursue $30 million to replace the oldest boat in service on the Scotland-Jamestown route.

The Hatton Ferry near Charlottesville will no longer be maintained by the department. Albemarle County may provide maintenance and operations of that ferry. Ferry service was reduced on two

other routes on July 1, 2009. New hours of service for the Merry Point Ferry are Monday-Saturday 9 am—5:30 pm. New hours of service for the Sunny Bank Ferry are Monday-Friday 8 am-4:30 pm, and 8 am-noon Saturdays.

Cost-cutting measures implemented by the Casco Bay Island Ferry District, operator of the Portland—Peaks Island, ME ferry, to address fuel cost overruns and to meet decreased revenues include:

- Reductions in part-time employee work hours during FY 09 with savings of $13,500. Those reductions will carry through FY10.
- Reduction in shoreside and marine-side seasonal employees with savings of $28,200.
- Governing the engine of one vessel and reduced speed of other boats with savings of $32,500.
- Fixed fuel contracts with savings of $165,000 for boats and $1,250 for the terminal facility.
- Mothballing two boats during the winter season with $25,884 in fuel savings.

As a result of the decline in traffic volumes from 2008, on March 17, 2009, the governing board of the Woods Hole, Martha's Vineyard and Nantucket Steamship Authority approved two changes to the 2009 Spring Operating Schedule:

- On the Nantucket route, one vessel was not operated during the first month of the Spring period (April 4-May 3, 2009), and reservations would not be accepted for travel on that vessel from May 4-May 18, 2009 unless traffic demand increased to the point where operating that vessel would be warranted.
- On the Martha's Vineyard route, four round trips were operated, instead of the previously scheduled seven round trips a day, resulting in one vessel being manned with a double crew instead of a triple crew.

On March 12, 2009, as a result of low ridership and a lack of alternative operating funds, the Inter-Island Ferry Authority board cancelled operations of the Coffman Cove, Wrangell, and Petersburg's South Mitkof Terminal route until additional operating funds can be identified. Low ridership, declining populations in the region, and the recent economic downturn led to the decision to discontinue service on the route.

Tolling

- Washington State Ferries (WSF) fares increased by 37%to 122% between 2000 and 2007. Fares covered 70% of operating expenses in 2007. A 2003 business plan proposed recovering 90% of operating costs by 2008 from revenues.
- WSF's fare sensitivity estimates a 10% fare increase would result in a 4% decrease in ridership.
- WSF strategies being investigated to spread vehicle demand to non-peak periods and/or increase walk-on use include: a vehicle reservation system, transit enhancements, and pricing changes including a fuel surcharge.
- While there is no toll charged on the two ferries operated by the Texas Department of Transportation (TXDOT), a 1992 report by the TXDOT noted that authorization to charge tolls was in place, and recommended imposing them at a rate to recover at least 50% of the operating costs. At that time, the driving alternative to the Galveston—Port Bolivar ferry

involved a 133-mile trip through Houston, with an estimated driving time of three to three and one-half hours.

- Ticketing for the New London, CT—Fishers Island, NY ferry is available only on a round-trip basis, with full payment collected prior to sailing to the island. There is no toll collected on the return trip. Passenger and vehicle tickets for the Rockland—Vinalhaven, ME ferry are sold for round trips only—no one-way tickets are available.
- Several ferry systems impose fuel surcharges, including: the Inter-Island Ferry Authority (AK), Cross Sound Ferry (CT—NY), and Charlevoix County Transportation Authority (MI).
- Several ferry systems charge a fare for vehicle drivers/passengers, in addition to a toll for the vehicle. Examples of peers with such charges include: Ketchikan—Hollis, AK, New London, CT—Fishers Island, NY, and Charlevoix—Beaver Island, MI. Passenger tickets are valid for one year from date of purchase on the Charlevoix—Beaver Island, MI ferry; however, expired passenger tickets can be updated for an additional year at a cost of $2 per ticket.
- Fares on the New London, CT—Orient Point, NY ferry include a low-sulfur diesel fuel surcharge, and may include a "floating surcharge." The Charlevoix County Transportation Authority may impose a fuel surcharge in addition to tolls/fares on the Charlevoix—Beaver Island, MI route.

3. Economic Dimensions of Ferry Operations

Section Outline:

1. Impacts on Tourism
2. Impacts on Employment
3. Travel Time Benefits

The North Carolina Ferry System provides mobility to coastal areas for local residents and visitors by transporting approximately 1 million vehicles each year (FY2007-2008). This mobility supports tourism, provides access for residents to employment opportunities, and provides travel time savings to a variety of destinations. This section provides estimates of some of the contributions supported by NCDOT ferry operations, including impacts on tourism, impacts on employment, and travel time benefits.

Impacts on Tourism

Tourism plays a significant role in the nine counties in which the ferries operate, with 2008 tourism spending in those counties valued at $2.2 billion or 13 percent of total statewide tourism expenditures (U.S. Travel Association).[21] The access provided by the Ferry System is key to supporting tourism in the coastal areas of North Carolina.

Although a more rigorous study would be needed to determine a more precise estimate of the impact of the ferries on tourism, a rough estimate based on visitor travel patterns was generated. The parameters that constitute the ferries impact on tourism include:

- The annual vehicle count from the NC Ferry Division,
- The percentage of visitors from the survey conducted during this study, and
- The average visitor party spending per trip of $562 (TNS TravelsAmerica).[22]

Based on these values, the approximate impact of the Ferry System operations on tourism in North Carolina is estimated to be $325 million, as shown in Table 14 below.

[21] *The Economic Impact of Travel on North Carolina Counties*. prepared for the North Carolina Division of Tourism, Film and Sports Development by the U.S. Travel Association. Raleigh, NC, 2008.

[22] *Fast Facts – 2008 Economic Impact of Tourism*. North Carolina Division of Tourism, Film and Sports Development. North Carolina Department of Tourism. Raleigh, NC, 2009.

Table 14: Tourism Impacts

Ferry Route	Annual Vehicle Count (FY 2007-2008)	Percent Visitors	Tourism Expenditures	Jobs Supported
Swan Quarter - Ocracoke	14,463	81%	$ 6,583,847	74
Currituck - Knotts Island	29,490	57%	$ 9,446,827	107
Cedar Island - Ocracoke	38,763	80%	$ 17,427,845	197
Bayview - Aurora	81,572	33%	$ 15,128,343	171
Southport - Fort Fisher	185,447	69%	$ 71,912,638	812
Cherry Branch - Minnesott Beach	277,254	23%	$ 35,837,852	405
Hatteras - Ocracoke	353,192	85%	$ 168,719,818	1,906
Total	980,181		$ 325,057,169	3,672

Tourism expenditures also help to support local employment. Table 14 shows that the NCDOT ferries support over 3,600 jobs based on values discussed above and according to information from the U.S. Travel Association.[23]

Impacts on Employment

Although a more rigorous study would be needed to determine an estimate of the impact of the Ferry System operations on local employment, the research team estimates approximately 24 percent of Ferry System trips are work-related. Therefore, the ferry system serves a major role in facilitating access to local employment opportunities for residents. Calculations supporting this estimate are provided in Table 15

Table 15: Local Employment Impacts

[23] *The Economic Impact of Travel on North Carolina Counties*. prepared for the North Carolina Division of Tourism, Film and Sports Development by the U.S. Travel Association. Raleigh, NC, 2008.

Ferry Route	Annual Vehicle Count (FY 2007-2008)	Percent Work Related Trips	Work Trips Supported
Swan Quarter - Ocracoke	14,463	5%	723
Currituck - Knots Island	29,490	18%	5,308
Cedar Island - Ocracoke	38,763	7%	2,713
Bayview - Aurora	81,572	52%	42,417
Southport - Fort Fisher	185,447	20%	37,089
Minnesott Beach - Cherry Branch	277,254	47%	130,309
Hatteras - Ocracoke	353,192	5%	17,660
Total	980,181		236,221

Travel Time Benefits

Taking one of the NC Ferry System routes offers many travelers a shorter travel option than if they were to drive for their entire trip. The ferry option provides an opportunity for travelers to save both travel time and vehicle operations costs. The agencies that maintain local roads (transportation providers) also experience savings from decreased vehicle volume on their roadways. In the following calculations, as displayed in Table 16, the transportation provider savings are based on Federal Highway Administration (FHWA) estimates of average spending of $0.05 per vehicle mile traveled.[24] The vehicle savings are calculated as the reduction in driving distance from using a ferry, multiplied by the Internal Revenue Service cost of $0.55 per mile. Travel time savings are calculated as the difference between the trip length incorporating a ferry route and the alternative distance for an all-drive trip, multiplied by a time value of $16.66. Total travel time benefits are the sum of transportation provider, vehicle, and time savings. Vessel operating costs were provided by the NCDOT Ferry Division, and were subtracted from the total travel time benefits to determine the net impact. The total travel time benefits from use of NCDOT ferries are calculated to be over $26 million, with a net positive impact of over $8 million.

Table 16: Travel Time Benefits

Ferry Route	Annual Vehicle Count (FY 2007-2008)	Vehicle Occupancy	Alternate Driving Distance (hours)[A]	Alternate Driving Distance (miles)[A]	Ferry Trip Length (hours)	Transportation Provider Savings	Vehicle Savings	Time Savings[B]	Total Travel Time Benefits	Vessel Operating Costs	Net Impact (Benefits - Costs)
Swan Quarter - Ocracoke	14,463	2.4	3.6	121	2.50	$ 87,501	$ 962,513	$ 308,421	$ 1,358,434	$ 2,081,337	$ (722,903)
Currituck - Knotts Island	29,490	3.0	1.4	39	0.75	$ 57,506	$ 632,561	$ 496,216	$ 1,186,282	$ 2,273,594	$ (1,087,312)
Cedar Island - Ocracoke	38,763	2.4	6.0	237	2.25	$ 459,342	$ 5,052,757	$ 2,893,146	$ 8,405,245	$ 5,346,222	$ 3,059,023
Bayview - Aurora	81,572	1.6	1.5	48	0.50	$ 194,957	$ 2,144,528	$ 1,098,403	$ 3,437,888	$ 1,728,274	$ 1,709,614
Southport - Fort Fisher	185,447	2.7	0.7	26.5	0.58	$ 245,717	$ 2,702,890	$ 278,059	$ 3,226,667	$ 3,245,772	$ (19,105)
Cherry Branch - Minnesott Beach	277,254	1.8	1.0	35.7	0.33	$ 494,898	$ 5,443,882	$ 2,777,590	$ 8,716,370	$ 3,623,018	$ 5,093,352
Total	*626,989*					*$ 1,539,921*	*$ 16,939,130*	*$ 7,851,836*	*$ 26,330,887*	*$ 18,298,217*	*$ 8,032,670*

[A] Alternative driving distance estimates assume the utilization of no other ferries to reach the destination (or destination closest to terminal)

[B] 50% of the wage rate is used for the calculation of time savings, source: Office of the Secretary of Transportation, Guidance for the Valuation of Travel Time in Economic Analysis, U.S. DOT, February 2003.

[24] *Status of the Nation's Highways, Bridges, and Transit: 2006 Conditions and Performance*. Federal Highway Administration, 2006, http://www.fhwa.dot.gov/policy/2006cpr/

4. Passenger Survey

Section Outline:

1. Survey Methodology
2. Selected Findings
3. Responses to Survey Questions

The research team conducted a survey of NCDOT Ferry System passengers to gain information on travelers' demographics, their assessments of the service they received, their willingness-to-pay for ferry service, and any suggestions they might have for improving ferry services. This section first discusses the methodology used to conduct the survey, and then provides brief summary information of the responses to each of the survey questions.

Survey Methodology

Passengers on each of the seven ferry routes were surveyed between Monday, July 20, 2009 and Sunday, July 26, 2009. Surveys were distributed to passengers by Ferry Division staff. The runs to be surveyed were selected randomly from the schedules for each route, with a goal of surveying travelers on nine runs from Monday to Thursday and on an additional nine runs from Friday to Sunday. The exception to this schedule was the Swan Quarter—Ocracoke route, on which travelers on all 14 runs were surveyed during the week-long period. A total of 2,081 surveys were completed. The greatest number of surveys—431—were completed on the Minnesott Beach—Cherry Branch route, and the lowest number of surveys—168—were completed on the Pamlico River route.

Envelopes with surveys targeted to specific ferry runs, as well as a schedule outlining the runs to be surveyed, and a return shipping label were distributed to Ferry Division staff at each route. Prepaid shipping of the completed surveys was arranged, to facilitate the return of those surveys to the research team. Ferry Division staff who distributed surveys to travelers were asked to distribute each envelope of surveys on or as close as possible to the randomly selected sailing date and time listed on each envelope. If anything, such as severe weather, were to occur to interfere with distribution of a set of surveys on a given sailingFerry Division staff were instructed to distribute that set of surveys on the next available sailing, and to note the change in sailing on the survey envelope.

A survey was distributed to each vehicle driver or adult walk-on passenger in the ferry boarding line until the supply of surveys in the envelope was gone. After travelers completed their survey, Ferry Division staff collected the completed surveys for that sailing and placed them in the envelope and sealed it. If there were any uncompleted surveys after the scheduled distribution, the remaining surveys were distributed on the return sailing and all completed as well as any uncompleted surveys were placed in the envelope for return to the research team.

Selected Findings

The surveys provided valuable information to the research team. Overall, 72 percent of respondents were extremely satisfied with their experience on the ferry, while another 25 percent were somewhat satisfied. Survey respondents on five ferry routes (Aurora—Bayview, Knotts Island—Currituck, Fort Fisher—Southport, Cedar Island—Ocracoke, and Swan Quarter—Ocracoke) ranked boarding their intended ferry as their primary concern. On average, 76 percent of those riders were extremely satisfied with their ability to board their intended ferry. Respondents on the Hatteras—Ocracoke route ranked length of wait-time to board as their most important concern, and 63 percent of those travelers were extremely satisfied with the length of their wait-time. Respondents on the Minnesott Beach—Cherry Branch route ranked number of scheduled trips as their most important concern. The survey showed that 50 percent were satisfied and 50 percent were dissatisfied with the number of trips scheduled on that route.

When asked if they were willing to pay for the service received, the responses were split nearly evenly between those who indicated they were willing to pay, and those who were not willing to pay. The Hatteras—Ocracoke route had the largest percentage (63%) of travelers who were willing to pay for the service they received, while the Minnesott Beach—Cherry Branch route had the lowest percentage of travelers (45%) who indicated a willingness to pay. Overall, the greatest percentage (61%) of survey respondents was using the ferry for tourism or recreational activities (61%), with 22 percent of respondents using the ferry for work trips. When asked to indicate what percent of operating costs passengers should pay for using the ferry (choices were 0%, 25%, 50%, and 75%), approximately one- third replied 0 percent, and one-third indicated 25 percent.

Survey Responses

The following tables provide a summary of the responses to the ferry passenger survey. Responses are broken out by route.

Table 17: Completed Surveys, by Route

Ferry Route	Number of Completed Surveys
Cherry Branch	431
Pamlico	168
Currituck	216
Hatteras	303
Southport	307
Cedar Island	384
Swan Quarter	272

Table 18: Respondents Who Had Completed a Previous Survey

Ferry Route	No/Don't Recall	Yes
Cherry Branch	98%	2%
Pamlico	98%	2%
Currituck	99%	1%
Hatteras	99%	1%
Southport	100%	0%
Cedar Island	99%	1%
Swan Quarter	99%	1%

Table 19: Date of Survey Completion

Ferry Route	07/15/09	07/16/09	07/17/09	07/18/09	07/19/09	07/20/09	07/21/09	07/22/09	07/23/09	07/24/09	07/25/09	07/26/09	07/27/09	07/28/09
Cherry Branch	0%	0%	0%	0%	0%	18%	13%	16%	0%	9%	21%	22%	0%	0%
Pamlico	0%	0%	0%	0%	0%	10%	12%	28%	4%	14%	24%	8%	0%	0%
Currituck	0%	0%	0%	0%	1%	19%	13%	13%	0%	13%	19%	22%	0%	0%
Hatteras	0%	0%	0%	0%	0%	23%	14%	13%	14%	2%	27%	7%	0%	0%
Southport	0%	0%	0%	0%	0%	22%	19%	8%	4%	15%	16%	16%	0%	0%
Cedar Island	0%	0%	0%	0%	0%	25%	6%	13%	10%	16%	15%	15%	1%	0%
Swan Quarter	3%	16%	8%	14%	11%	7%	10%	4%	7%	12%	6%	0%	0%	0%

Table 20: Frequency of Use of Surveyed Ferry Route

Ferry Route	Daily	Weekly	Monthly	Once or Twice a Year
Cherry Branch	36%	33%	13%	19%
Pamlico	45%	14%	12%	29%
Currituck	9%	16%	15%	60%
Hatteras	2%	7%	3%	87%
Southport	15%	5%	5%	75%
Cedar Island	0%	6%	5%	89%
Swan Quarter	0%	9%	12%	79%

Table 21:

Ferry Route	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	19	22	25	51
Cherry Branch	41%	34%	10%	8%	3%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Pamlico	46%	24%	13%	9%	2%	3%	1%	1%	0%	0%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%
Currituck	23%	30%	13%	10%	9%	4%	3%	3%	2%	1%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%
Hatteras	9%	34%	12%	25%	6%	6%	3%	1%	1%	0%	1%	0%	0%	0%	0%	0%	0%	1%	0%	0%
Southport	22%	20%	15%	24%	11%	5%	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cedar Island	13%	43%	10%	18%	7%	3%	2%	1%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Swan Quarter	16%	40%	13%	18%	5%	2%	1%	1%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table 22: Mode of Boarding for Trip Surveyed

Ferry Route	Pedestrian	Bicycle	Motorcycle	Vehicle (<20 ft)	Vehicle (20-40 ft)	Vehicle (>40 ft)
Cherry Branch	0%	0%	0%	89%	9%	1%
Pamlico	3%	1%	2%	90%	4%	1%
Currituck	3%	1%	12%	78%	6%	0%
Hatteras	0%	0%	2%	92%	5%	1%
Southport	1%	1%	0%	91%	7%	0%
Cedar Island	1%	1%	3%	82%	10%	3%
Swan Quarter	1%	0%	1%	83%	12%	2%

Table 23: Able to Board Intended Departure

Ferry Route	No	Yes
Cherry Branch	3%	97%
Pamlico	1%	99%
Currituck	2%	98%
Hatteras	16%	84%
Southport	18%	82%
Cedar Island	11%	89%
Swan Quarter	3%	97%

Table 24: Number of Sailings Past Intended Departure Until Boarding

Ferry Route	1	2	3	4	5
Cherry Branch	100%	0%	0%	0%	0%
Pamlico	100%	0%	0%	0%	0%
Currituck	100%	0%	0%	0%	0%
Hatteras	35%	51%	8%	5%	0%
Southport	93%	8%	0%	0%	0%
Cedar Island	82%	6%	6%	0%	6%
Swan Quarter	100%	0%	0%	0%	0%

Table 25: Satisfaction with Number of Trips Scheduled for Route Surveyed

Ferry Route	1	2	3	4	5
Cherry Branch	100%	0%	0%	0%	0%
Pamlico	100%	0%	0%	0%	0%
Currituck	100%	0%	0%	0%	0%
Hatteras	35%	51%	8%	5%	0%
Southport	93%	8%	0%	0%	0%
Cedar Island	82%	6%	6%	0%	6%
Swan Quarter	100%	0%	0%	0%	0%

Table 26: Satisfaction with Wait Time to Board Ferry

Ferry Route	Extremely Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Extremely Dissatisfied
Cherry Branch	48%	35%	12%	5%
Pamlico	65%	30%	4%	1%
Currituck	80%	16%	3%	0%
Hatteras	63%	28%	6%	2%
Southport	53%	36%	10%	1%
Cedar Island	51%	38%	6%	5%
Swan Quarter	75%	24%	0%	1%

Table 27: Satisfaction with Length of Line to Board Ferry

Ferry Route	Extremely Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Extremely Dissatisfied
Cherry Branch	43%	37%	13%	7%
Pamlico	62%	32%	4%	2%
Currituck	83%	16%	0%	0%
Hatteras	69%	22%	7%	2%
Southport	52%	38%	9%	1%
Cedar Island	54%	38%	5%	2%
Swan Quarter	75%	24%	1%	0%

Table 28: Satisfaction with Boarding Intended Departure

Ferry Route	Extremely Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Extremely Dissatisfied
Cherry Branch	57%	32%	7%	3%
Pamlico	72%	27%	1%	0%
Currituck	88%	12%	0%	0%
Hatteras	75%	19%	5%	1%
Southport	63%	24%	11%	2%
Cedar Island	70%	25%	3%	3%
Swan Quarter	88%	11%	0%	0%

Table 29: Satisfaction with Onshore Amenities

Ferry Route	Extremely Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Extremely Dissatisfied
Cherry Branch	54%	37%	7%	2%
Pamlico	65%	31%	2%	1%
Currituck	70%	25%	3%	1%
Hatteras	72%	24%	3%	1%
Southport	57%	33%	9%	1%
Cedar Island	47%	41%	8%	4%
Swan Quarter	55%	34%	8%	2%

Table 30: Satisfaction with Onboard Amenities

Ferry Route	Extremely Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Extremely Dissatisfied
Cherry Branch	53%	39%	6%	2%
Pamlico	54%	36%	8%	2%
Currituck	70%	26%	2%	2%
Hatteras	65%	29%	3%	2%
Southport	59%	36%	4%	0%
Cedar Island	41%	41%	13%	6%
Swan Quarter	53%	35%	9%	3%

Table 31: Satisfaction with Ferry Travel Time

Ferry Route	Extremely Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Extremely Dissatisfied
Cherry Branch	75%	22%	2%	1%
Pamlico	72%	24%	2%	2%
Currituck	79%	19%	1%	0%
Hatteras	76%	22%	1%	1%
Southport	80%	19%	1%	0%
Cedar Island	60%	33%	4%	2%
Swan Quarter	65%	29%	5%	1%

Table 32: Satisfaction with On-Time Departure

Ferry Route	Extremely Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Extremely Dissatisfied
Cherry Branch	68%	24%	5%	3%
Pamlico	83%	14%	2%	1%
Currituck	85%	14%	0%	0%
Hatteras	78%	18%	2%	1%
Southport	82%	16%	1%	0%
Cedar Island	69%	24%	2%	5%
Swan Quarter	86%	14%	0%	0%

Table 33: Satisfaction with Current Toll Amount (applies only to tolled routes)

Ferry Route	Extremely Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Extremely Dissatisfied
Southport	75%	21%	4%	0%
Cedar Island	59%	34%	4%	3%
Swan Quarter	62%	35%	2%	1%

Table 34: Satisfaction with Overall Ferry Experience

Ferry Route	Extremely Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Extremely Dissatisfied
Cherry Branch	57%	36%	6%	1%
Pamlico	76%	21%	2%	1%
Currituck	84%	15%	1%	0%
Hatteras	77%	20%	1%	1%
Southport	74%	24%	1%	0%
Cedar Island	61%	34%	3%	3%
Swan Quarter	76%	22%	1%	1%

5. Optimization of Resources

Chapter Outline:

1. Variations in Travel Demand
2. Potential Actions to Better Meet Travel Demands

The seven North Carolina ferry routes are vastly different in terms of their riders, schedules, seasonal demands, and operating environments. In addition, the routes are far apart. For those reasons, there is a lack of potential to optimize the system among the seven routes. Therefore the research team investigated annual and monthly ridership data for individual routes to assess potential resource savings. As mentioned in a previous chapter, consideration of meeting community needs is a part of establishing the schedules for the various ferry routes, resulting in a challenge to develop an intricate balance between maximizing operating efficiency and best meeting community needs and expectations.

Variations in Travel Demand

Four of the seven ferry routes exhibit pronounced seasonal variations resulting in schedule changes to provide increased services to meet peak demands during the summer tourist season, with fewer sailings during the winter off-peak season. The off-peak schedules for these four routes are:

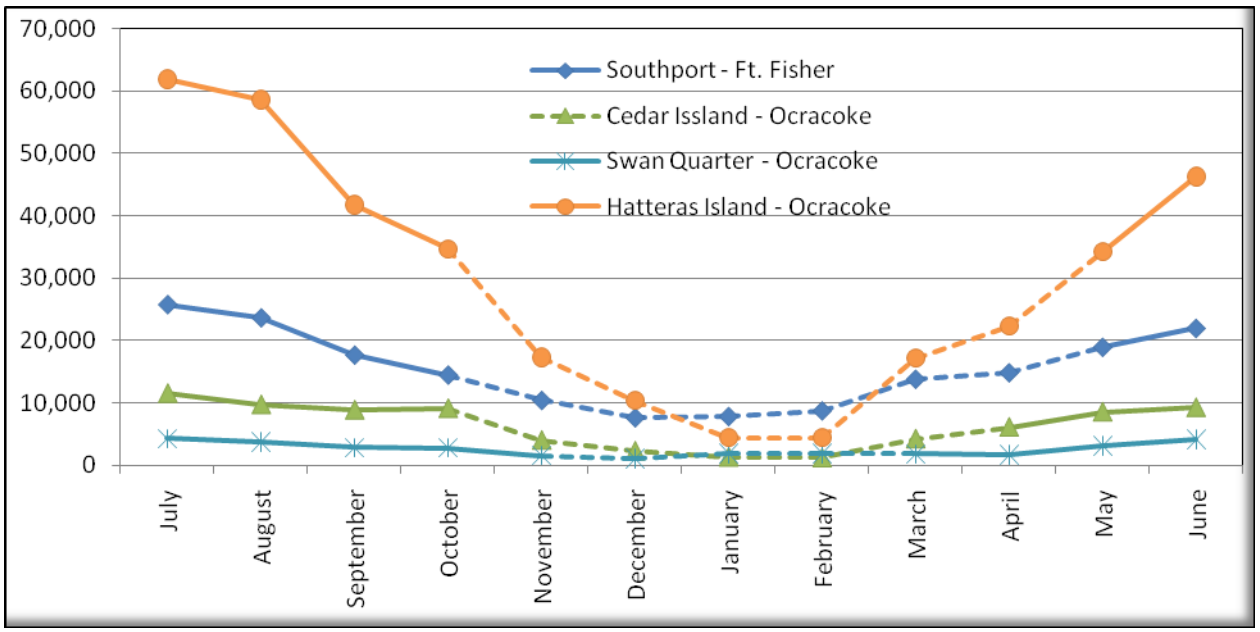
- Southport – Fort Fisher (off-peak schedule: October through March, four peak season sailings eliminated)
- Cedar Island – Ocracoke (off-peak schedule: November through March, four peak season sailings eliminated)
- Swan Quarter – Ocracoke (off-peak schedule: November through March, four peak season sailings eliminated)
- Hatteras – Ocracoke route (off-peak schedule: October through April, 23 peak season sailings eliminated)

North Carolina ferry ridership is highest during the month of July. Using that month as a reference and using State Fiscal Year (FY) 2007-2008 ridership data, Figure 9 illustrates the seasonal ridership variations for each of these four routes. The dashed lines represent the period when ridership falls below 50 percent of July ridership.

The Ferry Division has implemented various peak/off-peak schedules in past years including a "transitional" schedule on some routes to accommodate additional ferry demand during holidays, such as Easter weekend, during which tourists have historically visited coastal areas. Recently, the change between off-peak and peak season (summer) schedules has been oriented to Memorial Day (May 25th) and Labor Day (the first Monday in September). In the spring, ferry ridership begins to increase the week prior to Memorial Day weekend. At the end of the summer, relatively high ridership continues past Labor Day through the month September and falls in October.

The ridership analysis shown in Figure 9 supports the Ferry Division's practice of operating peak and off-peak schedules at different times of the year.

Figure 9: Changes in Seasonal Ridership on Four Ferry Routes



The research team searched for potential savings from reducing operations during the off-peak period on the three routes that are most heavily used by commuters to and from work. The potential savings could be gained by (1) instituting abbreviated weekend sailing schedule due to less commuter traffic during the weekend, and (2) through additional savings during the non-commuting time period throughout the day.

The Bayview – Aurora, Minnesott Beach – Cherry Branch, and Southport – Fort Fisher routes were included in this analysis. February 2008 ridership data was used in this analysis because ridership on these routes is lowest during February, so the daily ridership data for that month best reflects commuter traffic with the least influence from tourists.

Figure 10 illustrates ridership on the Bayview – Aurora ferry route. February 2008 ridership was 81,572 vehicles and 129,564 passengers. According to information from the passenger survey, approximately 52 percent of ferry travelers on this route are commuters. The ferry operates from 5:30 a.m. to 12:30 a.m. making 22 daily sailings. The weekday vehicle count (blue line) shows peak demand for the 5:30 a.m., 7 a.m., and 5:30 p.m. sailings departing from Bayview and 4:45 p.m. and 6:17 p.m. sailings departing from Aurora. These peak sailing demands align with the shift schedule at the PCS facility in Aurora.

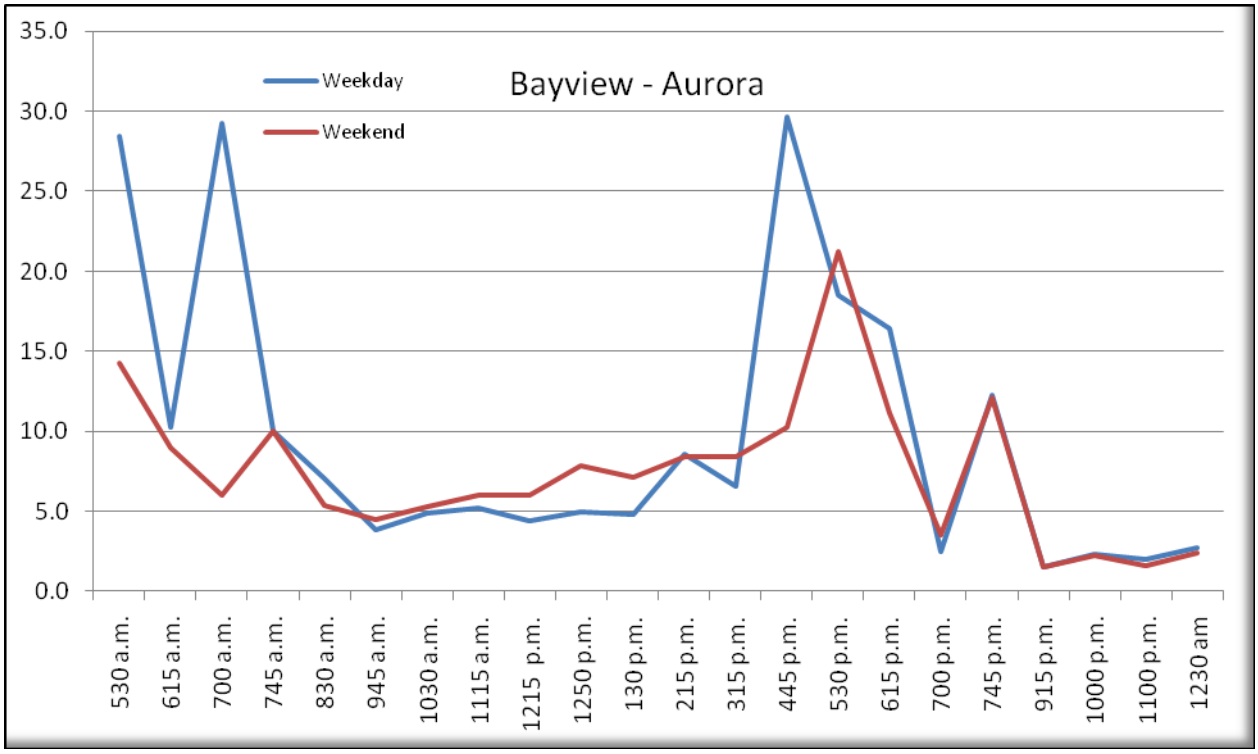
Because the PCS facility in Aurora operates 24 hours per day, seven days per week, weekend demand is similar to weekday demand, with only slightly lower vehicle counts during peak periods

of demand. According to a PCS spokesperson, this reduction in the workforce is attributable to fewer maintenance workers being at the facility during weekends.

The lowest demands are for the four sailings after 7:45 p.m. and those sailings were eliminated in 2009. The Ferry Division also eliminated the 9:45 a.m. and 10:30 a.m. sailings during 2009 to reduce crew overtime.

Because only one vessel is operated on the Bayview – Aurora ferry route, the 7 p.m. sailing with low ridership during both weekend and weekdays cannot be eliminated because it involves returning the ferry from the Bayview terminal after servicing the high demand sailings departing from Aurora.

Figure 10: Weekday/Weekend Travel Demand, Bayview—Aurora Route



Minnesott Beach – Cherry Branch is the second busiest Ferry System route, transporting nearly 280,000 vehicles and 490,000 passengers. Responses to the passenger survey indicated that 47 percent of travelers on that route were commuters. There is only a small difference in ridership between July and February for this route (13,000), reflecting a high proportion of commuters.

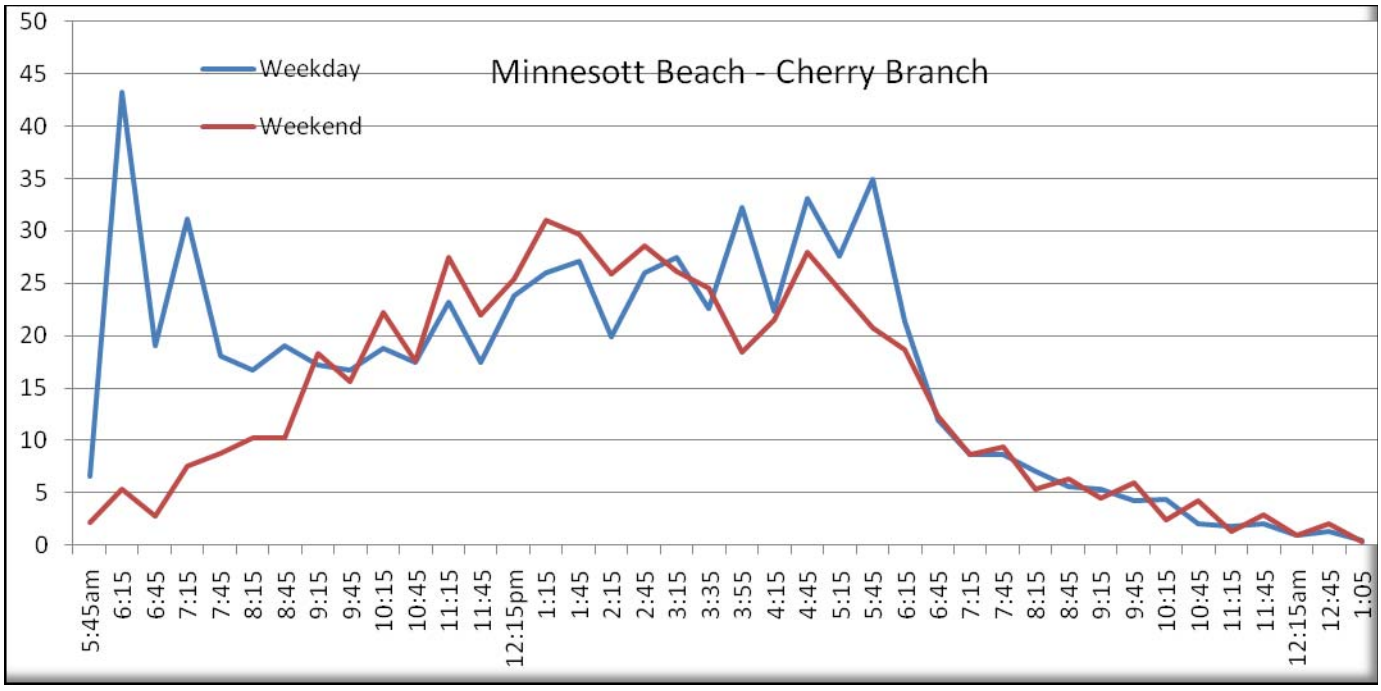
The data illustrated in Figure 11 shows high ridership during the morning commute period from 6:15 a.m. to 8:45 a.m. The duration of the afternoon commute period is longer, between 3:55 p.m. to 6:15 p.m. Unlike the Bayview – Aurora route, which demonstrates a dip in ridership during the mid-day period on both weekends and weekdays, this route shows relatively consistent demand throughout the day, averaging 23 vehicles per sailing.

Vehicle counts drop off gradually after the 9:45 p.m. sailings on both weekends and weekdays. During the 2009 season, the Ferry Division eliminated four sailings on this route—those at 11:45 p.m., 12:15 p.m., 12:45 p.m., and 1:05 a.m.

Weekend and weekdays variations in demand are most noticeable during the three earliest sailings—those before 7:15 a.m. One or more of those sailings could be eliminated on weekends.

Among the seven ferry routes, the Minnesott – Cherry Branch ferry route experienced the greatest impact from the 2009 service reduction. Instead of operating two vessels departing simultaneously from both terminals, 32 sailings were eliminated by operating only one vessel during several periods—5:45 a.m. to 11:45 a.m., 1:15 to 2:15 p.m., and 5:45 p.m. to 11:15 p.m. These service reductions were required in order to operate that route with one less vessel crew. If funding were to be made available to hire an additional crew, we recommend that the majority of the sailings during those periods be restored.

Figure 11: Weekday/Weekend Travel Demand on Minnesott Beach—Cherry Branch Route



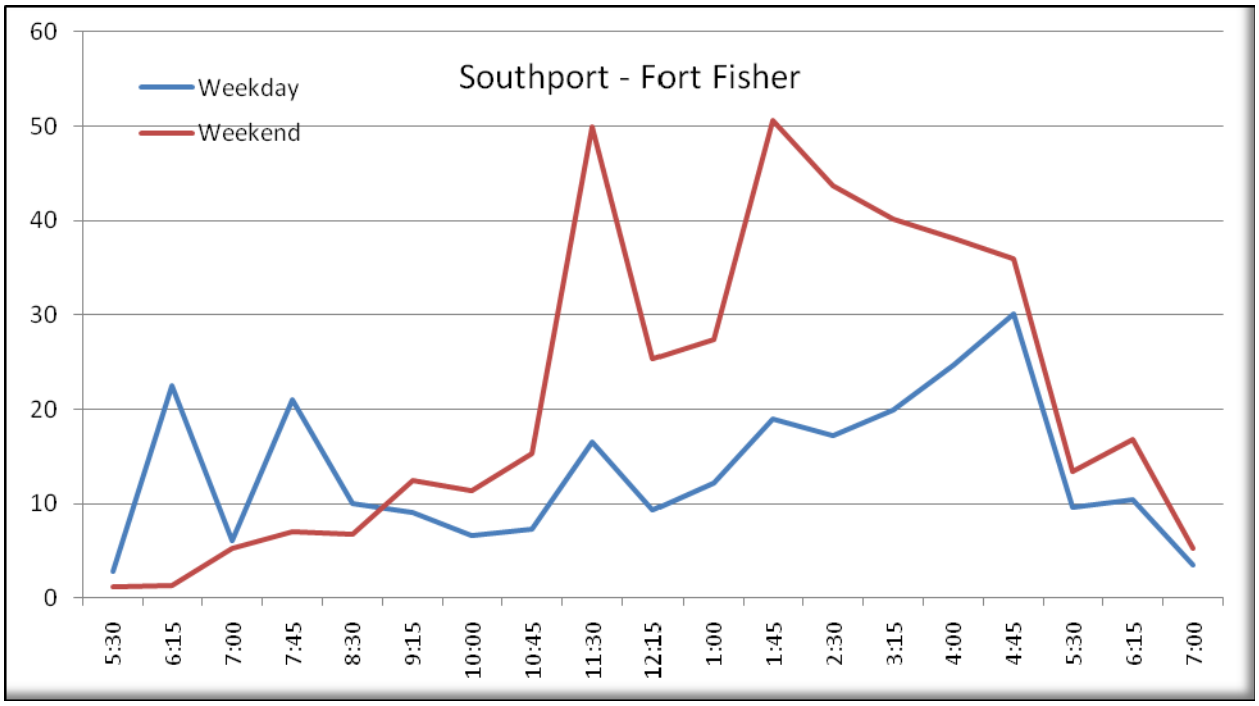
The Southport – Fort Fisher route is the third busiest in the system, transporting approximately 185,000 vehicles and 500,000 passengers annually. According to data from the passenger survey, commuters comprise only 20 percent of ridership on this route.

Figure 12 shows the peak traffic periods on this route occur between 6:15 a.m. and 7:45 a.m., and between 4:00 p.m. and 5:30 p.m. Unlike other ferry routes, demand during the mid-day weekend period exceeds the mid-day weekday demand on this route.

The data also show two weekend sailings—those at 11:30 a.m. and 1:45 a.m.—having extremely high ridership. This is attributed to vehicle left-over when the 10:00 a.m., 10:45 a.m., 12:15 p.m. and 1:00 p.m. sailings were eliminated during the off-peak season. These sailings were also eliminated from the 2009 peak season schedule.

There is potential for saving by eliminating the 5:30 and 6:15 a.m. weekday sailings. However, there is also a need to restore a portion of the mid-day weekend sailings to better meet demand.

Figure 12: Weekday/Weekend Travel Demands on the Southport—Fort Fisher Route



When viewed through the preceding analyses, the NCDOT Ferry Division has done excellent job of identifying and taking advantage of opportunities to reduce sailings with minimal impacts to the level of service on most routes. The use of Memorial Day and Labor Day as markers to separate peak and off-peak sailing schedules is supported by the data.

There are few opportunities to eliminate early morning weekend sailings on the Minnesott Beach – Cherry Branch and Southport – Fort Fisher routes. However, ridership data support restoration of the mid-day weekend sailings on the Southport – Fort Fisher route. Ridership data also support restoration of a portion of both the weekday and weekend mid-day sailings on the Minnesott Beach – Cherry Branch route. If those changes were to be implemented, that would unfortunately add to the costs of those operations.

6. Financial Sustainability

Chapter Outline:

1. Introduction
2. Tolls Required to Recover 25% of Each Route's Operating Costs
3. Toll Revenue Assumptions
4. A System-Wide Toll Structure
5. Additional Tolling Options
6. Seasonal Toll Rates
7. Toll Rates by Vehicle Length
8. Toll Collection

Introduction

There are five primary components of toll collection:[25]

1. Setting the toll rate
2. Collecting the toll
3. Enforcement against violations
4. Management and accounting
5. Interoperability

This section first addresses various aspects of a strategy to establish toll rates for the various ferry routes, and then provides information on aspects of tolling techniques/technologies, including a discussion of potential tolling techniques to expedite the ferry boarding process, and manual versus electronic collection methods, concluding with a potential application of tolling techniques to the seven North Carolina Ferry System routes.

The research team was asked to explore various tolling structures as a means to recover a portion of operating costs as well as to generate funds for a ferry vessel replacement program. As the ferry fleet ages, mechanical failures are becoming more common, resulting in the loss of service, sometimes for extended periods. As the age of a fleet increases, maintaining vessels requires an increasing amount of financial resources. In order to maintain the level of service the coastal community has come to expect from the NC Ferry System, a vessel replacement program must be a part of any long-range plan.

To examine how tolling might contribute to revenues that could be used to replace ferry vessels, a modeling tool was developed that uses data from a variety of sources – historical ridership, system

[25] Washington State Comprehensive Tolling Study Final Report—Volume 2, "*Background Paper #8: Toll Technology Considerations, Opportunities, and Risks*," prepared by the IBI Group, with assistance from Cambridge Systematics, Inc. in January 2006.

operations, and survey results – to generate potential toll structures that satisfy given conditions. As with all models, it is important to understand the assumptions used in creating the model and the limitations those assumptions may impose.

The adoption of tolls is unprecedented for four of the seven North Carolina ferry routes. If system-wide tolls were to be adopted, riders that have never paid a toll to ride a ferry on those routes would be required to do so. That would represent a major paradigm shift for the North Carolina Ferry System, the residents, commuters and tourists that use the ferries, and the North Carolina coastal community as a whole. Therefore, it is important that the anticipated impacts from adopting ferry tolls not be underestimated, and that careful consideration be given to those impacts before any change in the tolling structure might be implemented.

It is the magnitude of this shift that presents the biggest challenge in modeling toll revenues for the North Carolina Ferry System. It has been stated previously that the North Carolina Ferry System is unique in many aspects, perhaps most notably in that the services provided by the ferry system are currently either free or at a greatly discounted rate when compared to other ferry systems. Simply put, it is difficult to project how the public – whether they are a resident or tourist, commuter or school bus rider – will react to the system-wide adoption of tolls. And, although in most scenarios the revenue model assumes there will be a decrease in ferry demand due to increased tolls, at this point it is impossible to know exactly how large that impact might be.

Setting a Toll Rate

Tolls to Recover 25% of Each Route's Operating Costs

One question in the passenger survey asked respondents to indicate what percentage of operating costs ferry passengers should pay. Between 30 percent and 38 percent of respondents on all routes indicated that 25 percent of operating costs would be a reasonable proportion of costs for passengers to pay. Table 35 illustrates the toll amounts that would be required by route to achieve a 25 percent operating cost recovery, assuming a system-wide elasticity of demand of -0.34. Please see the next section for a detailed explanation of elasticity.

Table 35: Tolls, by Route, to Achieve a 25 Percent Operating Cost Recovery

Cherry Branch—Minnesott Beach	Bayview—Aurora	Knotts Island—Currituck	Hatteras—Ocracoke	Southport—Ft. Fisher	CI/SQ—Ocracoke system
$7.84	$11.01	$32.85	$12.82	$9.57	$42.23

The table shows that differences in demand for individual routes yield significantly different costs per vehicle. For instance, the Knotts Island – Currituck route's annual operating cost is $2.5M, slightly higher than that of the Bayview – Aurora route but only 45 percent that of the Cherry Branch – Minnesott route. However, the annual number of vehicles transported on the Knotts Island – Currituck route is only 30 percent of that on the Bayview – Aurora route and only 10 percent of that on the Cherry Branch – Minnesott route. Because of the disproportion in the number of vehicles transported, the cost per vehicle required on the Knotts Island – Currituck route

is approximately four times higher than that of otherwise comparable river crossing routes. Therefore, if the toll recovery rate were to be targeted to recover 25 percent of the operating cost on each route individually, then the Knotts Island – Currituck toll would be disproportionally high.

The research team suggests that any approach to recover some percentage of operating costs through tolls should not be route-based. Instead, the research team recommends using a system-level optimal toll recovery rate that considers diverse route demands as the starting point for determining any toll structure.

Toll Revenue Model Assumptions

The toll revenue model uses historical ridership data from FY 2005-06 through FY 2007-08 including average vehicle (all lengths) counts by month and by route. Tolling structures presented assume all vehicles are less than 20 feet in length. (Historically, the percentage of ferry traffic having lengths longer than 20 feet is less than 0.5%.) Additional information will be presented later in this section relating to this assumption.

In order to analyze models maximizing revenue, a value must be assumed for the elasticity of demand. In other words, we must make two assumptions. First, we assume that an increase in the price of a ferry trip will negatively impact demand. Second, we must assume some value for that negative impact, typically expressed as a fraction. In other words, if the price of a ferry trip is increased by ten percent, what will be the corresponding percentage decrease in demand for that trip? The Washington State Ferries noted in their 2008 study that non-discretionary ferry trips appear to be inelastic, ranging from -0.22 to -0.43 over the system.[26] The research team decided to use the overall demand elasticity of -0.34 from that study except where noted.

The price/demand characteristics of the North Carolina Ferry System relative to tolling are not known at this point. Therefore, it is essential to clearly understand the implications of any elasticity assumptions. It is suspected that for the North Carolina Ferry System, demand elasticity will vary widely among individual routes, largely dependent on passenger demographics. For instance, demand for the Hatteras—Ocracoke route would be expected to exhibit more inelastic behavior than a route which is comprised primarily of commuters. Once again, the adoption of tolls in a system in which the majority of travelers have always traveled free of charge is a fundamental systematic change that cannot be easily modeled.

To implement demand elasticity in a revenue model, a baseline cost must be established: For this study, the current Southport – Fort Fisher toll of $5 and the Pamlico Sound-ferry toll of $15 were extended to comparable routes over the entire system, with the exception of the Hatteras Inlet route, which was assigned a baseline toll of $10.

Assumptions were made regarding the make-up of vehicle traffic based on responses to Question 9 of the passenger survey, which asked riders to indicate the primary purpose of their ferry trip. The portion of riders using the ferry for travel to/from work ranged from 5 percent on the Hatteras—Ocracoke route to 52 percent on the Bayview – Aurora route. Those percentages were used to estimate the numbers of riders that would purchase and use an annual Commuter Pass on each route, if one were to be available.

[26] *Final Long-Range Plan*, Washington State Ferries, December 2008, page 52.

All scenarios include the implementation of a Commuter Pass, which could be renewed annually. All scenarios assume the Commuter Pass would cost $250 per year per vehicle and would provide a 50 percent discount per vehicle per one-way trip. A guiding principle throughout the tolling analysis is the desire to offer weekly ferry travelers (vehicles making 100 or more one-way trips per year) a significant incentive for the purchase of a Commuter Pass. At a cost of $250 per vehicle per year, a weekly traveler could to save 25 percent or more annually from the full toll price. The effective annual toll discount increases with increasing trip frequency, nearing a rate of 45 percent for daily travelers (those making 500 one-way trips per year).

Based on recent ferry system data, approximately 58 percent of the passenger survey respondents would opt to purchase a Commuter Pass. The research team believed that this figure would be too low if a system-wide tolling structure were implemented, i.e., there were no free ferries. The team assumed that 90 percent of those ferry riders whose primary trip purpose is work would elect to purchase an annual Commuter Pass and take advantage of the 50 percent toll discount for each one-way trip.

A System-Wide Toll Structure

Based on the assumptions described above, the tolling revenue scenarios presented here can provide a template for analyzing various tolling structures for the entire ferry system. These scenarios are not intended to be considered only as toll recommendations; they can also be used to:

- Examine limitations to revenue generation that may occur as a result of traffic characteristics on individual ferry routes.
- Provide guidance for the negotiation of final toll rates.
- Examine possible toll structure extensions such as seasonal tolling and variable vehicle lengths.

In addition to the optimal generation of revenue, a tolling structure requires simplicity and practicality. Those requirements for successful application of a tolling structure contributed a sense of direction to the analysis of the tolling scenarios presented here. As seen in the calculation of the tolls required to cover 25 percent of operating cost by route that was described previously, the various ferry routes have very different ridership and cost characteristics that often suggest the use of diverse toll rates. The research team's strategy in developing a toll structure was to strive for a structure that offers a reasonable compromise between optimal tolling by route and a simple and equitable tolling structure.

The modeling approach was performed on a system-wide level, but uses data compiled from the July 2009 survey to incorporate traveler characteristics of the individual routes. System-wide demand elasticity was applied to the calculations. From a theoretical perspective, it is reasonable to assume that any optimized toll structure would yield toll rates that are suited to specific routes but may have little in common with other routes. However, in Scenario 1, it may be argued that the optimal toll structure does exhibit some banding: (1) Cherry Branch – Minnesott Beach, and Aurora—Bayview; (2) Knotts Island—Currituck. and Southport – Fort Fisher; and (3) Hatteras—Ocracoke, and the two Pamlico Sound routes. Also, note that under the assumptions of Table 36, the maximum system-wide toll recovery is equivalent to 27 percent of total operating costs.

Table 36: Optimal Toll Structure to Maximize Ferry System Revenues

Cherry Branch—Minnesott Beach	Aurora—Bayview	Knotts Island—Currituck	Hatteras—Ocracoke	Southport—Fort Fisher	Cedar Island—Ocracoke	Swan Quarter—Ocracoke
$15.00	$14.00	$11.00	$20.00	$12.00	$31.00	$30.00

While assigning different tolls to individual routes might be the most efficient way to maximize revenue, it presents logistical problems in implementation. The research team considered scenarios forcing the optimal toll structure into three (Table 37) and two (Table 38) bands as shown in the tables below.

Table 37: Optimal Three-Band Toll Structure to Maximize Ferry System Revenues

Cherry Branch—Minnesott Beach	Aurora—Bayview	Knotts Island—Currituck	Hatteras—Ocracoke	Southport—Fort Fisher	Cedar Island—Ocracoke	Swan Quarter—Ocracoke
$ 13.00	$ 13.00	$ 13.00	$ 20.00	$ 13.00	$ 31.00	$ 31.00

Table 38: Optimal Two-Band Toll Structure to Maximize Ferry System Revenues

Cherry Branch—Minnesott Beach	Aurora—Bayview	Knotts Island—Currituck	Hatteras—Ocracoke	Southport—Fort Fisher	Cedar Island—Ocracoke	Swan Quarter—Ocracoke
$16.00	$16.00	$16.00	$16.00	$16.00	$31.00	$31.00

Note that when assuming a system-wide elasticity of demand equal to -0.34, the toll structure in a two-band toll structure yields total annual toll revenues of $9.86M or approximately 24.5 percent of annual system-wide operating costs. If the same toll structure is applied using a system-wide elasticity of demand equal to 0, system-wide annual toll revenues would total $15.46M.

Additional Tolling Options

Beyond the basic toll structure scenarios outlined above, consideration may be given to other tolling options that accommodate specific characteristics of the ferry system and the communities it serves. For instance, many routes are subject to dramatic changes in demand between Peak and Off-Peak seasons. Adopting seasonal toll rates that adjust during the Peak/off-Peak season may benefit coastal communities that rely on the ferries for necessary trips.

Tolling Techniques/Technologies

Tolling Techniques

Tolling techniques offer relatively simple and low cost methods to reduce the burden involved with toll collection. Considerations involved in the selection of appropriate techniques that might be applied to toll collections include:

- The location of the payment transaction—will payment be made at a ferry terminal or off-site;
- The means of payment transaction—will payment be made manually (in person) or via an electronic fund transfer;
- Efficiency—how can toll collection be streamlined to minimize vessel loading/unloading time, and what benefits and cost savings may be possible from the use of toll technologies, as opposed to manual collection; and
- Variations among terminals/routes—differences among routes and between terminals, such as the number of vehicles transported, the size of the vehicle holding area, etc. may suggest or dictate the application of different techniques and/or technologies on a route-by-route or a terminal-by-terminal basis.

Some relatively low cost tolling techniques that could be applied to help expedite the ferry boarding process include the following:

- On-Site:
  - Round-trip ticketing—collecting a round-trip toll at only one terminal to reduce the number of transactions and infrastructure/facilities;
  - Incentives for use of one or more methods of preferred payment—this could include a reduced toll rate for annual/seasonal pass holders, and/or electronic/prepaid customers;
  - Self-service kiosks—to reduce staff requirements at some terminals;
  - Installation of additional ticketing booths—to reduce vehicle lines; and
  - Payment method ticketing—separate lines for electronic/prepaid customers, to reduce wait times (and provide another incentive for travelers to use those methods of payment).
- Off-Site:
  - Remote ticketing—selling tickets at remote locations; and
  - Electronic ticketing—implementing on-line ticketing, similar to what airlines use.

Toll Collection Methods/Technologies

In addition to setting one or more toll rates, tolling involves:

1. Collecting the toll through either:
   - Direct cash transfer at a booth
   - Transfer of data via electronic technology
2. Enforcement against violations, involving:
   - Identifying, quantifying, and mitigating potential losses
   - Ensuring an acceptable level of compliance
   - Ensuring enforcement efforts are fair and consistent
3. Conducting management and accounting functions, including:

- Managing collection, audit, accounting, maintenance, security, customer service, and enforcement
- Providing a full accounting of all revenue and costs

4. Interoperability considerations, involving compatibility with other toll collection mechanisms.

Figure 13: Electronic Toll Collection

Tolls can be collected manually and electronically. Differences between these two methods of toll collection are summarized in Table 39.

Table 39: Manual versus Electronic Toll Collection

Attribute	Manual Collection	Electronic Collection
Procedure	Stop and pay collector in a tollbooth	Automatic Vehicle Identification technology used to identify specific vehicles
Crosscheck	Vehicle sensors check vehicle characteristics	System determines if passing vehicles are enrolled in the program
Enforcement	Use of gates	Use of license plate reader and mailed violation notice/fine payment request
Payment	Accept cash, checks, credit/debit cards, smart cards	Deducted from an account or invoiced
Capacity (per lane)	400 vehicles per hour	2,000 vehicles per hour
Components	Tollbooth, collector	(1) Automatic Vehicle Identification (AVI), (2) Automated Vehicle Classification (AVC), (3) Customer Service, (4) Violation Enforcement

Each of the components of an electronic toll collection system are described below. Automatic Vehicle Identification (AVI) systems include the following components:

a. Transponder (Radio Frequency Identification (RFID) unit
   - Transmit an identification code between a vehicle and a roadside reader
   - Two-way radio with microprocessor
   - Can be read-only or read-write
   - Can use batteries or use radio wave energy
   - Cost $10-$40 per transponder
b. License Plate Readers
   - Capture an electronic image of a vehicle's license plate
   - Charge accounts of pre-registered customers or invoiced (with a service fee) to plate owner
   - Can allow infrequent users to register for a day via phone or Internet
c. Global Positioning System (GPS)
   - In-vehicle system used to locate a vehicle within a charge area
   - On-board unit contains charging structure information
   - Charges applied using position information provided by the in-vehicle GPS system
   - Cost $200-$400 per on-board unit

Typical costs for these technologies are summarized in Table 40.

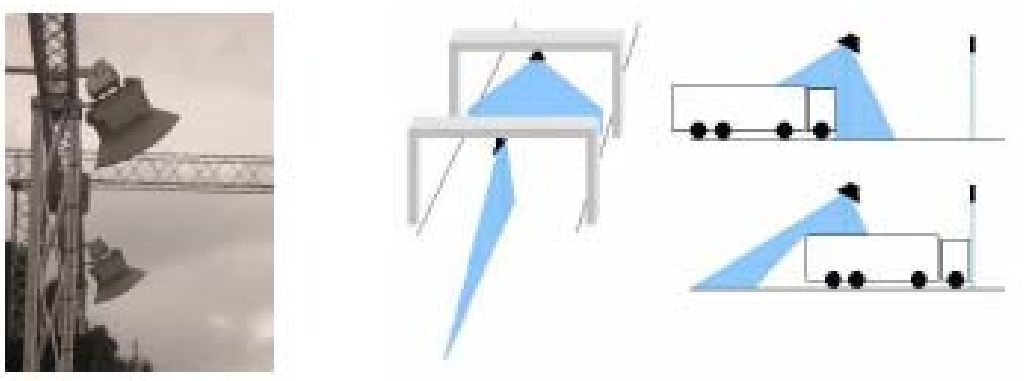
Table 40: Typical Technology Costs[27]

Technology	Low Estimate	High Estimate
Electronic Toll Reader	$2,000	$5,000
High-Speed Camera	$7,000	$10,000
Toll Administration Hardware	$5,900	$8,800
Toll Administration Software	$38,000	$76,000
Infrared Sensor	$5,500	$7,000
Conduit Design and Installation (per mile)	$50,000	$75,000
Fiber Optic Cable Installation (per mile)	$20,000	$52,000

An Automated Vehicle Classification (AVC) system involves the use of vehicle sensor technology that can classify a vehicle based upon its characteristics. The number of axles is the most common classification scheme. As shown in Figure 14 there are several types of sensors that are used to determine the number of axles on a vehicle, including treadles that count the number of axles passing over them; light curtains and laser profilers that record vehicle shapes (to distinguish trucks and trailers from cars); and advanced inductive loop sensors embedded in the roadway that can determine a vehicle's length, speed, and number of axles.

[27] Maccubbin, Robert P., et al. Intelligent Transportation Systems Benefits, Costs, Deployment, and Lessons Learned: 2008 Update. US DOT. Report FHWA-JPO-08-032. September 2008.

Figure 14: Automated Vehicle Classification System



Customer service can be provided at a physical location, by telephone, or via the Internet. The functions involved in providing customer service include:

- Creation and maintenance of customer accounts
- Issuing transponders
- Accounting

Violation enforcement involves:

- Use of technology to automatically identify toll evaders and demand toll payment
- Key elements:
  a. License plate image capture
  b. Name and address acquisition
  c. Violator payment—issuing a demand letter; placing a hold on annual vehicle registration renewal (in-state violators only)
  d. Legal system interfaces—citations and appeals process

One of the key aspects of a successful implementation of electronic toll collection is interoperability, which includes several customer expectations. Customers typically want one on-board device per vehicle (whatever device a customer has needs to have interoperability with all electronic toll collection systems, to avoid the need for multiple devices). Other needs include a single customer service point of contact, and a single billing statement. At the transponder level, this translates to the use of a single transponder at interoperable facilities, but with separate accounts for each tolling agency or facility. At the peer-to-peer level, this means including the

capability for exchange of transaction and account files among agencies so that the customer has only one transponder and account.

Potential Technology Applications

Given the variations among the seven North Carolina Ferry System routes, a "one size fits all" approach is not appropriate for the application of tolling techniques/technologies. However, the number of variations should be minimized to the extent possible, in order to facilitate operations, maintenance, and oversight of the applications. Different techniques could be applied to several categories of routes, as outlined below.

Potential applications for relatively low volume ferry routes, including Knotts-Island—Currituck, Swan Quarter—Ocracoke, Cedar Island—Ocracoke, and Aurora—Bayview:

- Manual toll collection using attendants at booths, and some self-service kiosks;
- Round-trip ticketing, with tolls collected only at one end of a route; and electronic ticketing (on-line ticket purchase, similar to buying an airline ticket).

Potential applications for medium volume routes, including Cherry Branch—Minnesott Beach, and Southport—Fort Fisher:

- A combination of manual (attendants at booths, and self-service kiosks) and electronic toll collection (electronic toll readers with in-vehicle transponders); and
- Electronic ticketing, which could be linked to a reservations process.

Potential applications for the high volume route, Hatteras—Ocracoke:

- Electronic toll collection electronic toll readers with in-vehicle transponders;
- Electronic license plate readers;
- Attendants at only a few lanes, primarily to monitor electronic equipment; and
- Electronic ticketing, which could be linked to a reservations process.

It is important to note that if the NCFS does adopt expanded tolling option, NCFS should collaborate with the North Carolina Turnpike Authority to adopt a seamless tolling system that serves both North Carolina highway and ferry travelers.

7. Future Options

Chapter Outline:

1. Public Transportation
2. Alternate Ferry Vessel Designs

Public Transportation

Public transportation is used in conjunction with ferry transportation in many settings to provide a multi-modal transportation system that allows many travelers to avoid using their car. As such, public transportation has been considered as a means to increase ferry route capacity by shifting some ferry travelers from driving aboard to walking aboard, reducing their footprint on the vessel.

With regard to the North Carolina Ferry System, the route that appears to offer the greatest opportunity for a combination of ferry and transit is the Hatteras—Ocracoke route. That route attracts a high proportion of tourists during its peak summer operations season, and those travelers typically take their own vehicle on day trips to and from Ocracoke, creating heavy traffic both on the island and at the ferry terminals.

The KFH Group, Inc. conducted a study in 2005 to investigate the feasibility of, and to develop potential operating scenarios for a public transportation system on Ocracoke Island. The study report recommended use of a beach trolley between the Pony Pens and Ocracoke village, and an internal circulator tram within the village. While that type of transit would not have reduced the need for travelers to bring their vehicles on board the Hatteras—Ocracoke ferry, it could have reduced vehicular traffic on the southern part of the island and in the village.

The period for operation proposed for the beach trolley and the tram was May through September, with the vehicles operating between 9:00 a.m. and 8 p.m. daily. The vehicles were recommended to operate fare-free, with some operating expenses being met by contributions from private sponsors. The bulk of the operations (and capital) funds were to come from the NCDOT, and the National Park Service. The consultants estimated that 15 percent to 25 percent of daily visitors would utilize the trolley and tram.

The trolley and tram were not implemented. Conversations with National Park Service (NPS) staff and a resident of Ocracoke who was involved with the study revealed that there were several reasons for the failure to follow through with implementing the service. The NPS superintendent who had championed the trolley and tram left his position to accept a position at another national park. The NPS would not allow permits to be issued to construct a parking lot for visitors to leave their personal vehicles, stating that construction of the lot would not be environmentally acceptable. There were concerns about the ability of the tram and trolley to navigate narrow, congested village streets. Finally, there was a lack of space to construct pull-outs for the tram to board and disembark its passengers. That would have resulted in the trams having to stop on the roadway, and add to the traffic congestion.

The lessons learned from that proposal would need to be addressed if any future public transportation venture on Ocracoke were to be successful. Concerns to be addressed would include:

- Parking—there is a lack of space for vehicle parking at the Hatteras ferry terminal. A parking facility would need to be located at a remote location, with a shuttle to the ferry terminal, which would involve an additional transfer and tend to discourage ridership. Also, any parking facility would need to successfully navigate the environmental review and approval process.
- Operations—vehicles would operate on narrow, congested streets within Ocracoke village, and a lack of space for pull-outs could compromise riders' safety when waiting for, and disembarking from vehicles.
- Seasonal demand—the need for public transportation for only a few months would result in underutilization of vehicles that would sit unused during the off-peak season. That could result in a lack of interest in operating such a service by some private contractors or increase the cost of such an operation.
- Funding—challenges remain in developing partnerships/agreements among potential funding agencies at the federal (NPS), state (NCDOT), and local (county, municipal) levels.

Alternate Ferry Vessel Designs

The NSFS requested the research team to explore use of a high speed ferry as one of the vessel replacement options. The obvious advantage of a high speed ferry is that it is capable of traveling three times faster than a conventional ferry vessel, approximately 40 miles per hour. In order to achieve that service speed, such vessels are made of welded aluminum to save weight and are powered by a diesel powered water jet propulsion system instead of a traditional shaft and propeller propulsion system.

High speed ferries capable of carrying both automobiles and passengers typically have two hulls (catamaran) with an overall width of nearly 60'. Even though there are single hull high speed passenger-only ferries operating in the U.S., the catamaran design is required to save vessel weight, to reduce draft and most importantly to maintain vessel stability when fully loaded.

The Lake Express vessel that operates on Lake Michigan is the only high speed auto-passenger ferry in the U.S. Placed in service in June 2004, the Lake Express links the states of Wisconsin and Michigan with a 2.5-hour crossing time between the terminals in Milwaukee, WI and Muskegon, MI. The high speed vessel was manufactured by Austal USA's shipbuilding facility in Mobile, Alabama. The vessel has an overall length of 190 feet, and is 57 feet wide and draws 7 feet of water. The vessel can carry 46 automobiles and 248 passengers. Compared to North Carolina's ferry vessels, the Lake Express is similar in length to an average River Class vessel and 7 feet wider than the widest Sound Class vessel. The passenger carrying capacity of the Lake Express vessel is 50 fewer, and the vehicle carrying capacity is four fewer than a Sound Class vessel.

According to a 2004 study performed by PB Consult, Inc., the initial cost of the Austal USA high speed ferry is three times that of a traditional ferry vessel, and the operating cost per hour is twice that of traditional ferry vessels.[28] Given that the primary objective of introducing a high speed ferry vessel is to save transient time, Table 41 below illustrates the estimated operating cost comparison for a high speed ferry if it were to be operated on the Cedar Island – Ocracoke and Swan-Quarter – Ocracoke ferry routes (all costs rounded up to the nearest $50)

Table 41: Estimated High-Speed Ferry Operating Costs

Cedar Island – Ocracoke	Crossing Time	Cost per Hour	Cost per Sailing
Conventional Ferry	145	$600	$1,500
High Speed Ferry	48	$1,200	$1,000

Swan Quarter – Ocracoke	Crossing Time	Cost per Hour	Cost per Sailing
Conventional Ferry	175	$600	$1,700
High Speed Ferry	57	$1,200	$1,150

It should be noted that the potential exists for a single high speed ferry to serve both the Cedar Island—Ocracoke and the Swan Quarter—Ocracoke ferry routes during the off-peak season, with some schedule adjustments. The higher cost per hour would be offset by the shorter sailing times and would result in the operation of only one high speed vessel instead of three traditional vessels. However, to meet the summer sailing schedule, in which vessels are scheduled to depart from both terminals at similar times, a combination of high speed and traditional vessels would be required.

The second alternative vessel design studied by the research team is the use of composite materials for a vessel superstructure (the above deck portion of the vessel). The use of a composite superstructure was explored first by the Swedish ship-building industry. The goal of using lightweight building materials was to improve operating efficiency, increase speed, reduce fuel costs, and provide greater stability and carrying capacity. The primary benefit of a composite superstructure for the NCFS would be a lighter vessel with greater vehicle carrying capacity without increasing the vessel's draft. Such vessels could help the NCFS to sustain the current level of service and to meet future demand challenges.

The first composite ferry vessel in the U.S. is currently under construction for Kitsap Transit in the State of Washington. The passenger-only vessel will serve the Bremerton to Seattle route. The vessel will be 77 feet in length, and capable of transporting 118 passengers at speeds of 33 to 38 miles per hour. The goal for this specific application of a composite superstructure is to create an ultra low-wake vessel to minimize environmental impacts. The estimated cost of the vessel is $5.3 million.

There are two challenges to designing and constructing a ferry with a composite superstructure for the NCFS. First, the U.S. Coast Guard does not have standards in place regulating composite superstructures. Use of a composite superstructure in vessels is approved on a case-by-case base. Second, traditional commercial vessel builders in the U.S. may not have the workforce with the

[28] "Maryland-Virginia Ferry Feasibility Study" for Somerset County, the city of Crisfield, Northumberland County, and the Northern Neck Planning District Commission, PB Consult, Inc., 2004.

necessary skills to work with composite materials, as the vast majority of commercial vessels are built of steel. The use of composite materials, however, prevails in the recreational boat-building industry. There are approximately 100 recreational boat builders in North Carolina that sell $500 to $600 million dollars worth of boats per year, making that industry a major contributor to the state's economy.

Given the Ferry System's desire to develop a sustainable vessel replacement program for the next 30 years, coupled with an interest in composite superstructure vessels to improve operating efficiency, it could make economic sense for North Carolina to tap into its own workforce of skilled boat builders to construct ferry vessels and to elevate the state's boat-building capabilities to a new level.