



Cape Hatteras National Seashore Alternative Transportation Study for Bodie Island District: *Needs Assessment*



From upper left (clockwise): Truck on NC 12; lack of bicycle facilities along SR 1243 between the end of Nags Head multi-use trail and NC 12; bicycle rack in Bodie Island District, at Bodie Island Lighthouse; and road and pavement conditions at Bodie Island Lighthouse.

Source: Volpe Center photographs (January 2010) and NPS Southeast Region photographs (December 2009).

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Report Notes

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Acronym List

AADT	Annual average daily traffic
AASHTO	American Association of Highway Transportation Officials
ACS	American Community Survey
ADA	American Disability Act
ATPPL	Alternative Transportation in Parks and Public Lands
BID	Business Improvement District
BILH	Bodie Island Lighthouse
CCRTA	Cape Cod Regional Transit Authority
CID	Community Improvement District
CIRS	Case Incident Reporting System
CMP	Corridor Management Plan
CRIMES	Crime Reporting Incident Management Entry System
CTIP	Coordinated Technology Implementation Program
CUA	Commercial Use Authorization
CUYD	Cubic Yards
DCTS	Dare County Transportation System
DOI	Department of Interior
EA	Environmental Assessment
EIS	Environmental Impact Statement
FHWA	Federal Highway Administration
FLHP	Federal Lands Highway Program
FLREA	Federal Lands Recreation Enhancement Act
FTA	Federal Transit Administration
FWS	Fish & Wildlife Service
GMP	General Management Plan
HARS	highway advisory radio system
HSIP	Highway Safety Improvement Program
IT	information technology
ITS	intelligent transportation systems
ICPTA	Inter-County Public Transportation Authority
IMARS	Incident Management, Analysis, and Reporting System
LH	Lighthouse
LOS	Level of service
MDT	Montana Department of Transportation
MOU	Memorandum of Understanding
mph	miles per hour

MUTCD	Manual of Uniform Traffic Control Devices
NCDOT	North Carolina Department of Transportation
NEPA	National Environmental Policy Act
NHS	National Historic Site
NM	National Memorial
NPS	National Park Service
NS	National Seashore
NSBP	National Scenic Byways Program
NWR	National Wildlife Refuge
OBSB	Outer Banks Scenic Byway
O&M	Operations and maintenance
ONPS	Operation of the NPS
ORV	Off-road vehicle
PEPC	Planning, Environment, and Public Comment
PLHDP	Public Lands Highway Discretionary Program
PMIS	Project Management Information System
PRP	Park Roads and Parkways
RIP	Road Inventory Program
RPO	Rural planning organization
RTCA	Rivers, Trails, and Conservation Assistance
RTP	Recreational Trails Program
SAFETEA-LU	Safe Accountable Flexible Efficient Transportation Equity Act – A Legacy for Users
SDEIS	Supplemental draft EIS
SR	secondary road
STARS	Service-wide Traffic Accident Reporting System
STIP	State Transportation Improvement Plan
STP	Surface Transportation Program
SQYD	square yards
TAB	Transportation Advisory Board
TAG	Transportation Assistance Group
TE	Transportation Enhancements
TIF	Tax Increment Financing
TMA	transportation management association
TODS	Tourist Oriented Directional Signage (TODS) Program
TRIP	Paul S. Sarbanes Transit in Parks Program
VMS	variable message sign
VSP	Visitor Services Program

1. Introduction and purpose

This report is part of the alternative transportation study for the Bodie Island District of the Cape Hatteras National Seashore (NS). It builds upon the evaluation of regional and local transportation conditions provided in the separate Conditions Inventory/Assessment report and it will inform the final report, the Alternative Transportation Analysis. The Analysis will identify potential alternative transportation strategies, with an emphasis on improving visitor access and circulation; improving connectivity, enhancing health, safety and security; protecting resources; minimizing impacts to resources; and achieving efficient management, operations and maintenance.

The Needs Assessment identifies unmet transportation needs within the study area, defined as the Bodie Island District. Needs, or key deficiencies, are defined in a number of ways, including by mode, physical location, type of need, and goal/objective. The report considers both current needs and future anticipated needs due to changes in visitation, population, and other trends. The two most significant known future changes in the study area are the replacement of the Bonner Bridge, which this study does not address directly, and the opening of the Bodie Island Lighthouse for climbing in 2012 or 2013, which is anticipated to increase visitation to the site. This report also acknowledges ongoing or planned efforts that were identified in the Conditions Inventory/Assessment report (Section 6) and that address some of the current and future needs.

Strategies to address the key deficiencies identified in this report will be developed as part of the Alternative Transportation Analysis. This report introduces and references the goals and objectives that helped to identify the needs but that will primarily be used to assess the effectiveness of proposed solutions. Thus, although this report identifies the needs and explains why those needs exist and are important, the subsequent report will include how those needs may best be addressed given the goals and objectives of the study and implementation considerations such as cost, funding, technical feasibility, and public acceptance.

1.1 Assessment methodology

Several sources were used in the development of the Needs Assessment. The study team drew upon the information presented in the Conditions Inventory/Assessment, previous studies (listed in the Conditions Inventory/Assessment), Cape Hatteras NS staff and stakeholder input, and study team site observations and technical expertise. In addition, analysis of the impact of the opening of Bodie Island Lighthouse to climbing on parking demand was conducted.

Needs were also identified by matching them to the goals and objectives of the study, taken from the Paul S. Sarbanes Transit in the Parks (TRIP) program¹ and study statement of work, as well as sample performance measures identified by the study team (see Table 1). These elements provided a framework by which the needs were identified and will be used to evaluate solutions that are identified in the Alternative Transportation Analysis. The sample performance measures provide an example of ways in which achievement of the goals can be tracked moving forward, once recommendations from the study or other sources have been implemented. The goals are referenced periodically throughout the text in this report and are mapped to each category of need in Section 3.0 Findings and Conclusion.

¹ To conserve natural, historical, and cultural resources; to reduce congestion and pollution; to improve visitor mobility and accessibility; to enhance visitor experience; and to ensure access to all, including persons with disabilities.

Table 1
Goals and objectives and sample performance measures

Goal	Objective(s)	Sample performance measure(s)
To conserve natural, historical, and cultural resources	<ul style="list-style-type: none"> To minimize impacts to resources 	<ul style="list-style-type: none"> Area of potential impact/footprint of proposed infrastructure (e.g., number of acres of land to be disturbed)
To reduce congestion and pollution	<ul style="list-style-type: none"> To decrease vehicle miles traveled 	<ul style="list-style-type: none"> Passengers per vehicle Single occupancy vehicle use Emissions calculation based on miles traveled by staff and visitors. Reduction in vehicle trips / percent of visitors who travel to and within Bodie Island District by alternative means (e.g., bus, nonmotorized boat, bicycle, foot)
To improve visitor mobility and accessibility.	<ul style="list-style-type: none"> To improve visitor access and circulation To improve connectivity within area as well as to area from other sites 	<ul style="list-style-type: none"> Visitation to and travel within Bodie Island District by mode (motor vehicle, boat, bicycle, foot, or other) Presence of bicycle and pedestrian facilities/amenities, such as designated bicycle routes, on-road and off-road paths, sidewalks, trails, marked crosswalks, and pedestrian signals Capacity and utilization of parking for various modes (number of times per year filled, number of times visitors use non-designated parking) Wayfinding signs/directional sign systems Information regarding alternative transportation availability and accessibility / conditions (e.g. ITS/traveler information systems, maps, kiosks etc.) Accessibility to alternative transportation systems Presence of intermodal connectivity
To enhance the visitor experience	<ul style="list-style-type: none"> To enhance health, safety, and security 	<ul style="list-style-type: none"> Crash rates, crash locations, high frequency locations Severity of crashes (fatality, injury, or property damage). Visitor satisfaction Wayfinding signs/directional sign systems Access to additional interpretive, educational, and/or recreational opportunities
To ensure access to all, including persons with disabilities	<ul style="list-style-type: none"> To provide access to individuals without access or ability to drive a vehicle To provide infrastructure that can accommodate all users 	<ul style="list-style-type: none"> American with Disabilities Act (ADA) compliance/degree of accommodation on transportation network/within district
To achieve efficient management, operations and maintenance	<ul style="list-style-type: none"> To estimate future visitation for Bodie Island Lighthouse to assess needs of potential future visitation Provide a financially sustainable transportation system in which life -cycle revenue exceeds (or is equal to) life-cycle costs 	<ul style="list-style-type: none"> Comparison of life cycle, operating, maintenance and capital costs with revenues and calculation of various transit metrics (cost per rider, cost per mile, etc.)
To coordinate with NPS and other planning entities and stakeholders as appropriate	<ul style="list-style-type: none"> To identify relevant plans and studies To identify potential conflicts and partnerships 	<ul style="list-style-type: none"> Consistent with and/or not in conflict with existing or proposed plans Establishment of partnerships and encouragement of a continuing, cooperative, and comprehensive planning process

1.2 Stakeholder input

Public involvement for the study as of the development of this report has consisted of an initial scoping meeting and the development of a public website on the National Park Service (NPS) Planning, Environment, and Public Comment (PEPC) site, which provides access to planning and environmental documents for projects at various NPS units. The Conditions Inventory/Assessment report contains more information on the meeting and the PEPC site. A public meeting will be held on August 4, 2010, at the Wright Brothers Memorial, to inform the public of the study's purpose, status, and future products, and solicit input on the existing conditions, needs assessment, and preliminary strategies. Study documents will be made available to the public for a four week comment period via PEPC. A summary of the meeting and public comments will be included in the final report.

2. Needs evaluation

This section describes the transportation needs and opportunities for the study area based on the sources and methodology described in Section 1.1. Needs are presented by mode, or type of transportation (roadway, parking, transit, bicycle and pedestrian, and marine), and transportation-related infrastructure (way-finding and traveler information and intermodal connections). Within each subsection, an overview is provided, followed by program needs, defined as system level management and organizational needs, and infrastructure needs, defined as specific capital or service needs. Although references are made to regional needs, the focus is on needs for the study area only, for both existing and future anticipated conditions. This section is followed by findings and conclusions, including a summary table and map illustrating the major infrastructure needs.

2.1 Roadway needs

Overview

Bodie Island District has one primary roadway, NC 12, with limited access to the ocean and sound and the four primary destinations on Bodie Island: Whalebone Junction Information Station, Coquina Beach, Bodie Island Lighthouse and Visitor Center, and Oregon Inlet Fishing Center. Cape Hatteras NS staff and stakeholders reported a desire to increase vehicle safety and to accommodate bicycle travel along NC 12 throughout Bodie Island. Projects by Cape Hatteras NS and NCDOT are currently underway to expand the shoulders on NC 12 through Bodie Island, as described in the Conditions Inventory/Assessment and illustrated in Figure 1. Combined, the projects will improve the safety of motorists, bicyclists, and pedestrians using the route, visitor experience and access, and alternate transportation access to and through the area. Roadway needs associated with pedestrian and bicycle modes will be explored in Section 2.4.

Traffic congestion within Bodie Island is not identified as a problem currently. However, in 2006, an Outer Banks Visitors Bureau visitor research study found that although most (95%) of visitors to the Outer Banks found the regional transportation system easy or somewhat easy to access, over half (61%) thought that traffic throughout the region had gotten either a little or a lot worse over the past several years. The public perception of worsening regional travel conditions, coupled with projections by the North Carolina Department of Transportation (NCDOT) that traffic volumes will increase and lead to lower roadway level of service,² is an important future consideration for transportation in the region, including Bodie Island District.³

This section outlines key roadway issues and needs identified by NPS staff, stakeholders, and the study team.

Program needs

Incident reporting system

A February 2004 mandate from the U.S. Department of Transportation requires that all NPS roads funded under the Federal Lands Highway Program apply asset management systems specific to pavement, bridges, safety, and congestion to inform the development of transportation plans and to inform NPS

² For more information, see Section 3.2 of the Conditions Inventory Assessment.

³ According to the Bonner Bridge Replacement SDEIS (p.1-15) summer average Saturday traffic over the Bonner Bridge will exceed 20,000 vehicle per day, and the level of service on peak season Saturdays will be rated “E”, which indicates roadway capacity will be reached, traffic speeds are irregular, or the posted speed limit is not consistently met, and congestion exists.

resource allocation decisions.⁴ The safety section of the mandate requires NPS to report traffic accident data in an accurate and timely manner.

The consistent and comprehensive collection, reporting, and analysis of incident data (e.g. traffic information and accidents, security or resource threats, etc) is a significant challenge for NPS, if not the entire Department of Interior (DOI). Currently, park units may report incidents in hard copy, and use separate databases like the Crime Reporting Incident Management Entry System (CRIMES), the Case Incident Reporting System (CIRS)⁵, the Service-wide Traffic Accident Reporting System (STARS), or proprietary systems developed for a specific unit. Compliance with this mandate varies from park to park. In park locations where only hard copy reports are maintained, assembling incident data to illustrate baseline safety conditions or to reveal trends may be administratively challenging. In addition, parks may have separate criteria for determining what is considered a reportable accident; for example, some parks report all traffic accidents and some report only accidents with property damage over \$1000 or when an insurance company is involved.⁶ Thus the types of incidents reported by parks may vary greatly. In summation, the various reporting systems and methodologies for collecting incident data at parks makes expedient and meaningful analysis of the information difficult.

Based on discussions with Cape Hatteras NS staff, traffic incidents, especially severe accidents and those involving fatalities, are documented by local or state authorities but NPS does not maintain separate documentation. Crash data including detailed report descriptions such as accident type (i.e. right-angle, rear-end, head-on, pedestrian/bicycle/animal related), location, description of event, severity, and weather conditions are integral to effectively evaluating existing transportation safety needs and planning for potential future roadway safety needs, especially as road user groups may change over time.

Since comprehensive crash data on Bodie Island were not available to analyze for this study, the study team relied on 1999- 2006 crash data from a combination of NCDOT and NPS sources. As reported in Section 4 of the Conditions Inventory/Assessment, for the years 1999-2006, available crash data indicated that vehicular incidents on NC 12 through Bodie Island occurred infrequently, with no reported pedestrian or bicycle accidents.⁷ However, during the same period, two fatalities resulted from separate events, a low-speed head-on collision along Lighthouse Bay Drive (RIP Route #0202)⁸ and a failed U-turn along NC 12.⁹

Infrastructure needs

Non-motorized and vehicular access on Lighthouse Bay Drive (RIP Route #0202)

Bodie Island Lighthouse is accessed by a narrow two-lane, two-way asphalt road, Lighthouse Bay Drive (RIP Route #0202), from NC 12 immediately across from the entrance to Coquina Beach. Three main safety needs have been identified for access to and along Lighthouse Bay Drive (RIP Route #0202).

Cape Hatteras NS staff has entered a project into the NPS Project Management Information System (PMIS), a service-wide intranet application to manage information about requests for project funding,

⁴ Code of Federal Regulations. Title 23: Highways PART 970—National Park Service Management Systems. § 970.212 (2004). <http://law.justia.com/us/cfr/title23/23-1.0.1.12.48.html#23:1.0.1.12.48.2.1.7>, Accessed May 14, 2010.

⁵ DOI Interior Enterprise Architecture, Law Enforcement Modernization Blueprint, Law Enforcement Line of Business. Final – Version 1.1 August 30, 2005. P.15

⁶ Draft NPS Road Safety Data Analysis U. S. Department of Transportation Research and Special Programs Administration . Volpe National Transportation Systems Center, Cambridge, MA. August, 2005. P.5

⁷ According to NCDOT data from 2003 to 2006 and NPS accident data from 1999 to 2006 for NC 12 from the U.S. 64/U.S. 264 intersection with NC 12 to the intersection of NC 12 with SR 1243, the total number of crashes was 16, or approximately 2 per year.

⁸ Cape Hatteras National Seashore. Relocation of the Bodie Island U.S. Coast Guard Station Complex: Environmental Assessment. November 1, 2008.

⁹ Project PRA-CAHA 10(2). Cape Hatteras National Seashore Overlay and Replace Culverts on NPS Route 010, NC State Route 12. Description: Feasibility of Improving Vehicle-Bicycle Safety by Adding Bike Lanes. January 2008. P.4

that identifies a need to rehabilitate Lighthouse Bay Drive (RIP Route #0202). According to Cape Hatteras NS staff, the project is needed because the existing width of the road is too narrow for current vehicle types, resulting in one fatality and three serious injuries in 1999 in a low-speed head-on collision.¹⁰ As described in Section 6 of the Conditions Inventory/Assessment, the project would repave and widen the road, which is currently in poor condition, to create wider travel lanes and a shoulder to accommodate non-motorized traffic. A second option would only address the accommodation of non-motorized traffic by paving over a new right of way for an NPS water line, which is to be relocated parallel and within eight feet of Lighthouse Bay Drive (RIP Route #0202). Currently, neither project is planned or funded.

Another safety-related issue is inconsistent speed limit signage upon entrance and exit. The speed limit is posted as 15 mph upon entering Lighthouse Bay Drive (RIP Route #0202) but upon exiting, the speed limit for the last 0.2 miles is given as 25 mph. Although limited in scope, given concerns about the width of the road, this inconsistency should be addressed.

Finally, at the intersection of Lighthouse Bay Drive (RIP Route #0202) with NC 12, there are no exclusive right turn lanes on NC 12 to Lighthouse Bay Drive (RIP Route #0202) or Coquina Beach. Cape Hatteras NS staff indicate through their own experience that turning maneuvers at the intersection, whether traveling north or south, can be dangerous. The lack of exclusive right turn lanes require through-traffic, traveling at the speed limit of 55 mph or higher, to reduce their speeds to allow for vehicles to turn. Avoidance techniques, such as passing the turning vehicle(s) are currently complicated by the presence of exclusive left turn lanes in both directions. Though to date there has been no documentation of crashes or vehicle queues at this junction, the same PMIS project referenced above indicates a need to reconstruct the intersection of NC 12 and the Lighthouse Bay Drive (RIP Route #0202) to include exclusive right turn lanes that would provide traffic with a space to reduce speeds to allow for safe northbound or southbound turns onto Lighthouse Bay Drive (RIP Route #0202). As visitation to the lighthouse increases once it is open for climbing, the current roadway configuration may lead to congestion and the risk of vehicle conflicts, especially as tour bus visits increase.

Roadside viewing areas for Bodie Island Lighthouse

Currently, there are no designated roadside viewing platforms or pull-out areas along NC 12 for visitors traveling south or north to view Bodie Island Lighthouse from the road. Roadside viewing platforms are typical amenities in park settings with notable vistas to improve visitor experience and road safety by providing drivers with an alternative to slowing down or pulling onto the shoulder. The Corridor Management Plan for the Outer Banks Scenic Byway identifies the need to install a pull-off area to view Bodie Island Lighthouse to improve the visitor experience, provide interpretation, and possibly reduce parking demand at the lighthouse.¹¹ Cape Hatteras NS staff are supportive of the idea but a decision has been deferred to the upcoming update of the General Management Plan (GMP).

Roadway traffic information

According to Cape Hatteras NS staff, no reliable system of highway advisory radio (HAR) exists within the district. Additionally, no variable message signs (VMS) are owned by Cape Hatteras NS; NCDOT has a VMS located at Whalebone Junction but it is limited to providing information on NCDOT traffic advisories for NC12 and the Hatteras-Ocracoke ferry. There is a need to convey messages to visitors and motorists traveling through the area of specific alerts related to weather and road conditions, safety, or other information such as special events, peak visitation days, parking availability, or water or surf conditions. Currently, road closure information is provided on the websites of NCDOT and the Outer Banks Visitors Bureau. Yet many seasonal visitors or intermittent travelers in the area are not likely to

¹⁰ Cape Hatteras National Seashore Project Management Information System, Overlay Asphalt on the Bodie Island Lighthouse Road and Parking Areas (CAHA).

¹¹ Outer Banks Scenic Byway Advisory Committee. Corridor Management Plan for the Outer Banks Scenic Byway. December 1, 2008. P.70

actively seek information on a website. Because of the dynamic nature of the weather, land vulnerability to storms, and travel conditions on the Outer Banks there is a need to communicate information quickly to travelers en route.

2.2 Parking needs

Parking throughout the Bodie Island District is free, and available on a first-come, first-served basis. Currently, the Bodie Island District does not experience frequent parking shortages or periods of unmanageable peak parking demands. However, Cape Hatteras NS has indicated that, on occasion, parking capacity is exceeded during Memorial Day, July 4th, and Labor Day at Bodie Island Lighthouse and Coquina Beach. In addition, the current practice of parking on the side of the loop road by Off Island Gun Club members causes issues for buses accessing the lighthouse area. Stakeholders have reported capacity issues at the Oregon Inlet Fishing Center, as well. These intermittent situations where parking capacities are reached are not considered a major concern for parking management or resource protection, but are a concern for the commercial and other varied uses, including beach access, at the Oregon Inlet Fishing Center.

In terms of future need, the opening of the Bodie Island Lighthouse to climbers in 2012 or 2013 is expected to increase visitation, including tour bus visitation, and thus increase the demand for parking at Bodie Island Lighthouse. There is a concern by Cape Hatteras NS staff that the current capacity of Bodie Island's parking lot will not be sufficient to accommodate additional visitors and that increased tour bus traffic may cause further conflicts with the parking practices of Off Island Gun Club members. Existing parking capacities and locations, along with utilization, have been identified in Section 3.2 of the Conditions Inventory/Assessment.

Program needs

Parking utilization and management program

Currently, Cape Hatteras NS staff does not collect parking utilization data or have any parking management in place for any of the NPS parking lots, including those within Bodie Island. Instead, parking utilization estimates at the various parking areas are generalized, and based on staff observation and experience. Because parking lots in Bodie Island do not generally reach capacity, the resource intensive collection of comprehensive parking lot utilization data is likely not necessary. However, with sample information about where parking problems exist within the district, Cape Hatteras NS would be able to make more targeted investments in transportation infrastructure. For example, a consistent shortage of parking in an area may indicate the need to add capacity or increase multi-modal access the site (e.g. transit, bicyclist, or pedestrian) to reduce the effective demand on parking. Alternatively, underutilization of a parking area might indicate that parking could be reduced or used to serve areas where demand is high, resulting in a more efficient use of the facility. This type of information will be particularly important in regard to the parking area at Bodie Island Lighthouse.

Parking demand assessment for increased visitation to Bodie Island Lighthouse

Cape Hatteras NS staff identified the need to assess the impact on parking from the anticipated increase in visits to the Bodie Island Lighthouse once it is opened to climbers. There is a concern that the current parking lot capacity at Bodie Island Lighthouse may not be able to accommodate the expected increase in visitation. The parking demand assessment provided here is intended to inform this study and Cape Hatteras NS staff of the expected demands on the site and make recommendations regarding the appropriate demand management or other transportation strategies to be considered.

The parking demand assessment focused on the following tasks:

- *Identification of peak visitation patterns.* The intent of this analysis is to establish the number of times, or frequency, and when the parking capacity may be exceeded and to what extent. (See Appendix A for more details).
- *Parking demand based on climbing capacity restrictions.* In this analysis, the lighthouse capacity is assumed to be a limiting factor for demand. Impact of this capacity limitation on bus visitation is discussed. (See Appendix A for more details).
- *Expected demand for climbing relative to other uses at the site.* Currently, Bodie Island Lighthouse is visited by people seeking activities other than climbing the lighthouse, such as viewing the lighthouse, visiting the store and visitor center, walking the trails, or accessing the Sound. In addition, Cape Hatteras NS staff have indicated an interest in having parking available for Off Island Gun Club members as an alternative to parking on the side of the loop road, which blocks the right of way for buses.

The study acknowledges that in reality, demand will be independent of capacity, especially if the appropriate demand management strategies are not implemented. Parking demand based on the projected increase in visitation was considered but not quantified as regardless of the demand for climbing, the lighthouse capacity policy will determine the number of visitors that can be accommodated throughout the day. Qualitatively, although many of the current visitors will take advantage of the climbing, it is assumed that opening up Bodie Island Lighthouse to climbing will also attract visitors who previously had not been interested in visiting the site. Other factors that may serve to impact this level of demand, but that are not possible to account for, include:

- Proximity to higher-density population/tourist centers,
- Substitution of a trip to Cape Hatteras Lighthouse, and
- Novelty effect of the opening of the facility on attendance - when Bodie Island Lighthouse first opens for climbing, an artificial and unsustainable temporary increase in visitation may occur. As the novelty wears off, these gains in visitation may be maintained or may diminish over time.

For the identification of peak visitation and expected demand for non-climbers, Cape Hatteras Lighthouse was used as a comparison, due to its proximity, historical similarity, and its management as an NPS facility. Cape Hatteras Lighthouse, however, does have important differences, including: a larger climber capacity, a location much further south of major populations in the north such as Kill Devil Hills, and national fame for being the tallest lighthouse in the U.S. and for having been relocated. A summary of the characteristics and assumptions used for the analysis including peak visitation times and expected demand for non-climbers, are included in Table 2. It should be noted that Cape Hatteras Lighthouse has four times the capacity for climbers per day as Bodie Island Lighthouse but only twice the number of parking spaces; there are no data available to determine whether the current capacity at Cape Hatteras Lighthouse is sufficient for the demand.

Table 2

Characteristics and Assumptions for Bodie Island Lighthouse and Cape Hatteras Lighthouse

Sources: NPS communication (5/17/2010); Cape Hatteras Lighthouse peak month and day determined from daily climber data for 2009; Bodie Island Lighthouse peak month determined from NPS Public Use Statistics data

Characteristic	Bodie Island Lighthouse	Cape Hatteras Lighthouse
Parking capacity	53	109
Parking utilization	No data available; anecdotally Cape Hatteras NS staff report full on holiday weekends during summer	No data available
Number of motorcoaches	5 to 6 per day (spring and fall) Very few during summer	5 to 10 per day (spring and fall) Less during summer
Hours of operation	Assumed to be same as Cape Hatteras Lighthouse but may be open a couple months longer	Third Friday in April to Columbus Day in October 9:00 am to 4:40 pm (spring and fall) 9:00 am to 5:40 pm (Memorial Day to Labor Day)
Daily capacity / limit on climbers	394 (assuming 23 people every 30 minutes over 8.5 hours)	1380 (spring and fall) 1560 (summer) (assuming 30 people every 10 minutes over 7.5 and 8.5 hours during spring/fall and summer, respectively)
Number of non-climbers	Assumed to be same as for Cape Hatteras Lighthouse	Half of total visitation (or an equivalent number of non-climbers as climbers) ¹²
Length of stay	30 minutes but expect to increase to 1 to 2 hours	1 to 2 hours
Peak months	June, July, August	June, July, August
Peak days	Wednesdays (bell shaped curve with Sat/Sun lowest)	Wednesdays (bell shaped curve with Sat/Sun lowest)
Peak times	10:00 am to 12:00 pm (may change once open to mirror Cape Hatteras Lighthouse 11am-2pm)	11:00 am to 2:00 pm

As a result of the analyses conducted, the study team came to the following conclusions:

- Peak visitation to both Bodie Island Lighthouse and Cape Hatteras Lighthouse is greatest during the months of June, July, and August and during the middle of the week, with fewer climbers on the weekend, a trend that Cape Hatteras NS staff confirmed for visitation overall, including to Bodie Island Lighthouse. During non-peak months, visitation is more evenly spread throughout the week, with the only fluctuation being a slight peak occurring at the end of the week and into the weekend. These patterns inform NPS about when its sites are likely to be at capacity and thus potentially have parking demand issues. It appears from the current visitation patterns that the frequency of peak visitation, when parking capacity may be exceeded, is low and thus any strategy applied to address capacity should take into account the transient and short-term nature of capacity needs.

¹² Analysis of the Cape Hatteras Lighthouse visitation and climbing data for 2005 to 2009 revealed that nearly half (49 percent) of persons visiting Cape Hatteras Lighthouse climbed the Lighthouse. It is important to note that Bodie Island Lighthouse offers different types and composition of attractions than those offered at Cape Hatteras Lighthouse, so the actual ratio of climbers to non-climbers for the two locations may be different. Nonetheless, this ratio has been applied using the best available data and provides a tool for estimating potential impacts to parking at Bodie Island.

- The parking at Bodie Island Lighthouse at a minimum needs to accommodate the number of visitors climbing, waiting to climb, or having just finished climbing and the number of visitors pursuing other activities on-site. According to the analysis, the current parking capacity can accommodate these three sets of climbers and an equal number of non-climbing visitors during the months when peak visitation, and thus maximum climbing activity, will occur. Table 3 shows how current parking capacity is sufficient for three tours or sets of climbers based on the assumptions stated.
- Assuming that more people will show up to climb than can be accommodated by the expected capacity limitations, parking is not sufficient to accommodate both visitors who are willing to wait one hour or more to climb (four or more “tours” or sets of climbers) AND expected non-climbers. This would most likely result in competition between the two user groups and in demand exceeding capacity. Table 3 shows how current parking capacity is exceeded with four or more tours of climbers based on the assumptions stated.
- The analysis presented assumes that all visitors are accessing the site by personal vehicle; in reality, bus tours are and will continue to be an important source of visitors. Tour buses take up less space than equivalent cars but have special parking needs, in terms of space and turning capacity. Bus tours will also have significant impacts on climbing capacity that will need to be addressed through management of arrivals of such tours.

Table 3
Potential climbing and non-climbing parking demand

Month(s)	Number of tours	Number of persons	Persons per vehicle assumption *	Vehicles for climbers	Vehicles for non-climbing visitors (assuming equal number as climbers)	Total Vehicles	Current parking capacity	Parking Surplus / Demand (Parking capacity minus total vehicles)
June, July, August	3	69	2.7	26	26	52	53	1
	4	92		34	34	68		-15
	5	115		43	43	86		-33

* NPS Public Use Statistics Office

As a result of this analysis, the study concludes that there is a need for demand management strategies to ensure that demand for parking is matched with the capacity for the lighthouse to accommodate climbers. Demand management strategies could include the following: advance climbing ticket sales, a climbing reservation system that includes bus groups, clear communication of the limited capacity and parking on the NPS website and other materials, communication to visitors of wait time or availability of tickets for climbing, and provision of alternative means to access the site if parking is unavailable.

In terms of needing to increase parking capacity, the study concludes that there is a need for designated bus parking that may involve a new parking area but that there is a need for more data collection, in terms of information on the parking use at Cape Hatteras Lighthouse and of parking use when Bodie Island Lighthouse opens for climbing. Any decisions regarding increased parking capacity should include the following considerations:

- Desired level of parking accommodation of visitors who are willing to wait an hour or more to climb the lighthouse;

- Desired level of parking accommodation for other activities and uses provided on-site currently, such as the Dike Trail and Off Island Gun Club, and in the future, such as additional non-motorized water access, that NPS plans to and wants to offer; and
- Potential impacts, if any, of providing additional parking for peak visitation days on environmentally vulnerable and historically significant resources and the visitor experience.

Infrastructure Needs

Parking Accommodations

The parking demand assessment indicates that current parking is sufficient to accommodate the full capacity of the lighthouse and other uses on site, but that accommodation of excess demand would require additional parking capacity or the provision of other transportation options to Bodie Island Lighthouse once it is open for climbing. Several solutions will be explored and evaluated in the Alternative Transportation Analysis.

Cape Hatteras NS staff have submitted a project to the NPS Project Management Information System (PMIS) to resurface the Bodie Island Lighthouse parking area, because the existing surface has degraded over time and has separated from the base material, which creates a non-uniform rough roadway surface.¹³ Any potential expansions or re-design of the area based on a demand analysis should be cooperatively planned with this project, and take into consideration NPS goals and objectives such as natural or cultural resource impacts (e.g. visual impacts on the historic district).

Field observations by the study team point to a need to improve parking access for bicycles, shuttles, hunters, and other recreational visitors that may arrive at the site to engage in activities other than climbing the lighthouse that may require long stays (e.g., kayaking in the Sound), or that may arrive with oversized vehicles. Such diversity of uses and users on the site may lead to conflicts in the future as visitation increases. Currently, one bicycle rack with a capacity of approximately four bicycles exists at Bodie Island Lighthouse, and there are no designated shuttle or tour bus parking spaces or areas to accommodate oversized vehicles. Currently these conditions do not present problems for the limited numbers of visitors to the site. However, it is anticipated that visitation to the site will increase when Bodie Island Lighthouse opens for climbing, and the development of additional activities (e.g. kayaking) in the area could also increase visitation. Overflow parking along the southern edge of the loop road by Off Island Gun Club members is currently considered an issue for tour bus access to the site as it limits the width of the road and the turning radius. This conflict will likely increase as visitation, including by tour buses, increases with the opening of the lighthouse.

Management of Coquina Beach northern parking lot

Cape Hatteras NS staff indicates that Coquina Beach does not frequently reach capacity and overall parking capacity is considered adequate. However, the northernmost parking lot, which does not have a separate entrance, is considered to be underutilized while the southern parking lots, closest to the entrance, are often congested. Improving access to and operations of this parking area may improve the circulation of traffic within Bodie Island and decrease the congestion created as a result of the single entrance.

Management of Oregon Inlet Fishing Center parking lot

Cape Hatteras NS staff and several stakeholder groups identified a current need for more parking at the Oregon Inlet Fishing Center. Stakeholders indicate that during the fishing season and on summer weekends, the parking area consistently reaches capacity, which is exacerbated by the loss of a portion of the parking lot to NCDOT, which is currently in use as a staging area for Bonner Bridge maintenance

¹³ Cape Hatteras National Seashore Project Management Information System, Overlay Asphalt on the Bodie Island Lighthouse Road and Parking Areas (CAHA).

activities. The Oregon Inlet Fishing Center parking lot is used for a variety of activities, including: to access charter boats; to switch from a passenger vehicle to an ORV for use on the beach; to park horse trailers; to access the Sound via kayak or personal motorized boat; to visit the Center's store; and to watch the marina activities, such as the arrival of boats with freshly-caught fish.

Need for off-site shared parking if transit considered

Cape Hatteras NS staff and stakeholders identified a need to consider shared parking locations north of Bodie Island, where there may be appropriate properties available to consider as satellite parking destinations. The need to identify these options is related specifically to the implementation of potential transit shuttle services that link populations in the north with Cape Hatteras NS attractions on Bodie Island. Transit needs are discussed within Section 2.3, below. Strategies, such as satellite parking and transit technology options will be addressed further in the Alternative Transportation Analysis report in the next phase of this study.

2.3 Transit needs

Overview

Currently, no public transportation service is in operation within the Bodie Island District. Although Cape Hatteras NS and local stakeholders expressed interest in transit and several plans have documented proposals, additional analysis is necessary to determine if any transit service is feasible for the study area. Such analysis will be provided in the next phase of this study. This following section reviews findings of previous transit studies for the region and outlines visitor access and experience needs identified by Cape Hatteras NS staff, stakeholders, and the study team that could be addressed by the provision of transit. This section presents information for the region as a whole primarily, but all the information is relevant to the study area; specific transit strategies for the Bodie Island District will be examined further in the Alternative Transportation Analysis.

Program needs

Previous studies

Cape Hatteras NS has previously identified and studied the need for transit for Ocracoke Island, outside the study area, due to congestion and limited parking, and several external studies and plans have identified the need for new or expanded transit systems and management of such systems within the Outer Banks region for a variety of reasons and to serve several user groups, including local residents, seasonal visitors, and seniors and handicapped. Such documents have not included the study area explicitly but provide important context, especially as transit is often provided at a regional level.

The Albemarle Coordinated Public Transit & Human Service Transportation Plan identified several public transit needs for the region, including the need for transit service that provides access to shopping and recreation destinations.¹⁴ An NCDOT study, *Regionalizing Public Transportation Services*,¹⁵ identified Dare County as one of the counties that is not yet part of a regional rural transit system. NPS and the Outer Banks Scenic Byway Corridor Management Plan both have acknowledged the need for

¹⁴ The Albemarle Rural Planning Organization and Public Transportation Division, North Carolina Department of Transportation. *Coordinated Public Transit & Human Service Transportation Plan*. May 2009.

¹⁵ Cook, Thomas J. *North Carolina Department of Transportation Research Project 2002-11: Regionalizing Public Transportation Services*. Public Transportation Group, Institute for Research and Education, North Carolina State University. October 25, 2002. Raleigh, NC. <http://www.ncdot.org/doh/preconstruct/tpb/research/download/2002-11FinalReport.pdf>

transit in Ocracoke, although the idea for a system has not moved forward due to a number of constraints, including:

- Narrow road width and inability to provide pull-off areas for shuttle (resulting in concern that shuttles would worsen traffic congestion);
- Constricted road access, especially turning radius, to the Ocracoke Lighthouse;
- Limited parking on Ocracoke; and
- Concern that visitors would not want to leave cars on Hatteras or the mainland.

A private consultant, KFH Group, Inc. conducted public transportation feasibility studies for three local counties (Dare, Currituck, and Hyde), but no action has yet been taken to implement any of the systems identified by the studies. The Outer Banks Transportation Study (2006) proposed several transit routes within the area between Kitty Hawk and Manteo but these have also not moved forward. The Roanoke Island Transportation Plan (2005) also identified the need for a trolley system to be examined for Roanoke Island.¹⁶ However, no further consideration of a trolley system has been made for lack of funding.

User needs and preferences

Individuals in need of an alternative to travel by personal vehicle consist of three main groups: households with no or limited access to vehicles, individuals who cannot or prefer not to drive due to disabilities, age, or other conditions, and visitors with limited access to vehicles. In addition to visitors who may need transit, there are visitors who may prefer transit to renting a car or driving in traffic or may be interested in the experience itself due to the vehicle type and/or possible interpretive services that could be provided on the service. Information on what percentages of visitors to Cape Hatteras NS fall into these groups is not available but national figures provide some estimate of the number of people who may be affected. Such user groups are important to the NPS and study goal of providing access to all, regardless of age, socioeconomic status, or disability.

According to the American Community Survey (ACS) (2006-2008), almost nine percent of U.S. households do not have access to a personal vehicle and another third (33 percent) only have access to one personal vehicle.¹⁷ Information on access to vehicles and transit dependency for the visitors to Cape Hatteras NS is not available but would provide useful guidance for Cape Hatteras NS priorities and future investment in transit options.

The number of visitors who are unable to drive due to disabilities, age, or other conditions is not available for visitors to Cape Hatteras NS, although visitor surveys did indicate that many visitors travel with children. National figures provide some estimates of the number of people who may be affected. According to the ACS (2006-2008), approximately 20 percent of U.S. residents are under 14 and are therefore ineligible to apply for a license or learner's permit in most states. According to a 2004 report¹⁸ that drew upon data from the 2001 National Household Transportation Survey, more than one in five (21 percent) of Americans age 65 and older do not drive.. In addition, according to a report by the U.S. Census Bureau, over 20 percent of Americans age 15 and older have a disability, which may prevent them from driving.¹⁹

Another group of individuals that often have limited access to vehicles are visitors. According to visitor surveys, visitors travel in relatively large groups on average to both Cape Hatteras NS (4.4 per group in 2002)²⁰ and the Outer Banks (6.3 per group in 2006)²¹ and not all group members are drivers or have

¹⁶ Town of Manteo. Roanoke Island Transportation Plan. 2005.

¹⁷ U.S. Census Bureau American Factfinder. <http://factfinder.census.gov>

¹⁸ Bailey, Linda. Aging Americans: Stranded Without Options. Surface Transportation Policy Partnership. http://www.transact.org/library/reports_html/seniors/aging.pdf

¹⁹ U.S. Census Bureau. Americans with Disabilities: 2005. December 2008. <http://www.census.gov/prod/2008pubs/p70-117.pdf>

²⁰ Outer Banks Group Parks Visitor Survey, University of Idaho.

access to cars but they may have different interests in visiting sites and doing activities. Providing additional transportation options, including transit, can address these access needs.

For those visitors who prefer or have an interest in transit, there is also very little information available. According to a survey conducted by the Outer Banks Visitor Bureau in 2005-2006,²² over half (59 percent) of visitors reported being at least somewhat interested in a trolley system. Additionally, the majority (91 percent) of visitors reported being willing to pay \$1 to ride a trolley. Preference surveys are much needed and would provide Cape Hatteras NS with a sense of its visitors' needs and interests in terms of transportation and visitor experience.

Physical access

If additional parking is determined to be infeasible or undesirable at Bodie Island Lighthouse to accommodate increased demand, as discussed in Section 2.2, transit might be explored as it can provide a way to collect visitors from other parking areas, including at other key destinations, or collector sites in areas of high density residential and/or visitor accommodation.

Connections

Transit can provide an alternative to motor vehicle travel, especially where parking may not be available, and can add value to the visitor experience by providing an opportunity for interpretation to be delivered onboard by staff or by an audio or video tour. Stakeholders and park staff identified the following connection needs for transit for the entire region:

- There is a need to move people from the residential areas to beach access points.
- There is a need to connect significant destinations in the region.
- There is a need for a larger regional transit system- a “hub and spoke” system – to serve the major population centers and destinations, though it may best to first attempt a small-scale pilot.

These items were considered needs for several reasons, including the desire for the Outer Banks communities to brand themselves as a “green” destination with alternative transportation, the desire to serve visitors either interested or dependent on a car-free option, and the desire to reduce regional congestion and parking demand.

Within the Bodie Island District, important destinations and connections for visitors include Coquina Beach, Bodie Island Lighthouse, and the Oregon Inlet Campground and Fishing Center. However, there are also important regional destinations and connections, such as the other Cape Hatteras NS sites to the south and NPS and local town sites to the north.

Infrastructure needs

There is currently no transit infrastructure in place within Bodie Island District. Infrastructure, such as shelters, seats, signage, maintenance and fueling facilities, and designated stop areas would be needed to support transit.

2.4 Bicycle and pedestrian needs

Overview

²¹ Outer Banks Visitors Bureau. Visitor Research: Wave 4 – 2006. September 2006.

http://www.outerbanks.org/pdf/2005_2006_Year_Long_Visitor_Profile.pdf

²² Outer Banks Visitors Bureau. Visitor Research: Wave 4 – 2006. September 2006.

http://www.outerbanks.org/pdf/2005_2006_Year_Long_Visitor_Profile.pdf

Cape Hatteras NS staff, regional stakeholders, and the study team identified the need for bicycle and pedestrian improvements in connectivity, access, and safety within Bodie Island District. Bicycle and pedestrian use on Bodie Island currently consists of experienced bicyclists along the two-foot shoulder of NC 12 and mixed bicycle and pedestrian use on a narrow sidewalk along Secondary Road 1243/Old Oregon Inlet Road. Pedestrian use also occurs within destinations such as at the Bodie Island Lighthouse, Coquina Beach and the adjacent parking area, Oregon Inlet Campground, Oregon Inlet Fishing Center, and along existing trail segments. There is a lack of designated bicycle or pedestrian facilities to connect the Bodie Island sites.

Visitors currently use the bicycle infrastructure in Nags Head and Kitty Hawk for both recreation and transportation purposes. Recreational use refers to a resident or visitor's use of bicycle or pedestrian infrastructure for pleasure or exercise, only, while transportation use refers to use of bicycle or pedestrian infrastructure in order to access a site, to move from one site to another, or for commuting purposes. This study is only addressing transportation needs although in some cases, the needs for one use will overlap with the needs of the other.

This section outlines pedestrian and bicycle transportation needs within the study area that were identified by Cape Hatteras NS staff, stakeholders, and the study team.

Program needs

Data collection

While there are bicycle and pedestrian crash data available for the incorporated towns north of Bodie Island,²³ there are no detailed data for Bodie Island, Pea Island NWR, or the unincorporated towns on Hatteras Island. There are also no data available on the number of visitors who access Bodie Island District or move between sites by bicycle or foot but anecdotal and visitor survey information indicate that both modes are popular in the region and that bicycling for exercise is popular along NC 12.²⁴ This lack of data means that Cape Hatteras NS staff is unable to track areas that receive the most bicycle and pedestrian use, measure safety change over time, or identify the key location of dangerous roadway segments and intersections. If Cape Hatteras NS staff could record and track changes in safety and use over time, staff would have the data to inform them of the need for new bicycle and pedestrian infrastructure investments and locate the most hazardous areas. Cape Hatteras NS staff would also be able to better determine the importance of coordinating bicycle and pedestrian facilities within Bodie Island with existing facilities in nearby Nags Head and Kitty Hawk and with future facilities on Hatteras Island.

Infrastructure needs

Bicycle facilities along NC 12

As mentioned in Section 2.1, NPS and NCDOT are in the planning phases to widen the existing two-foot shoulders on NC 12 to create five-foot wide shoulders to facilitate bicycling and improve bicycling safety and other vehicular operating needs (e.g., breakdown area). Figure 1 on page 31 illustrates the limits of the project. The widening is the result of an FHWA safety study that concluded that expanded shoulders on NC 12 would increase vehicular operational safety on the roadway and provide appropriate space for bicycling.²⁵ Additionally, the NPS Environmental Assessment of improvements to NC 12 shoulders

²³ Volpe Center. *Conditions Inventory/Assessment*, Section 4.2, Transportation safety – Pedestrian and bicycle safety (59).

²⁴ Volpe Center. *Conditions Inventory/Assessment*, Section 3, Transportation Network – (26).

²⁵ Project PRA-CAHA 10(2) CAPE HATTERAS NATIONAL SEASHORE. Overlay and Replace Culverts on NPS Route 010, NC State Route 12 Description: Feasibility of Improving Vehicle-Bicycle Safety by Adding Bike Lanes. January 2008 U.S. Department of Transportation, Federal Highway Administration *Eastern Federal Lands Highway Division*. P.7

concluded the cumulative impact of the project would be beneficial and noticeable in terms of health and safety, traffic operations, park operations, and visitor experience.²⁶

The proposed facility exceeds the four-foot minimum recommended by the American Association of State Highway and Transportation Officials (AASHTO) for a paved shoulder suitable for bicycle use. However, AASHTO also recommends that widths should be increased where there is high bicycle use, vehicle speeds are greater than 50 mph, and/or there is a high percentage of truck and bus traffic.²⁷ The shoulder expansion may attract additional experienced bicyclists to Bodie Island, thus increasing demands for other bicycle facilities and amenities. Appropriate signage needs to be considered with the expanded shoulders to communicate to motorists the possible presence of bicyclists.

NC 12 has been designated as part of regional and national bicycle routes; however, it has not been formally designated as a bicycle facility by the State DOT. No roadway signage or bicycle markings will be provided in the re-design of the span.²⁸ The AASHTO *Guide for the Development of Bicycle Facilities* (1999) section on the creation of bicycle-safe paved shoulders does not recommend bicycle specific (e.g. “share the road,” “bike route”, or bicycle graphic image signs), signage or marking where shoulders are expanded to facilitate bicycle travel in part because the shoulders still serve motor vehicle safety purposes.²⁹ However, bicycle signage on shared roadways is recommended in rural areas when “the route is preferred for bicycling due to low motor vehicle traffic volume or paved shoulder availability.”³⁰ Signs and pavement markings for bicycle facilities help to encourage facility use and have the effect of raising awareness of the presence of bicycles adjacent to the roadway and legitimizing the presence of bicycles to motorists. However, most states do not designate paved rural highway shoulders as bicycle facilities.

There is a need for the improvement project on NC 12 to consider and plan for increased bicyclist use of the facility and provide adequate forewarning to motorists that bicyclists may be expected within the roadway shoulders.

Missing connections

There is a lack of north to south connectivity for cyclists and pedestrians traveling between Bodie Island and nearby populated areas to the north as well as lack of connectivity within Bodie Island District. These gaps have a negative impact on access and safety for visitors.

Current bicycle and pedestrian travel in Nags Head and north is reportedly high because of the multiple pedestrian and bicycle pathways. Key gaps in the bicycle and pedestrian network exist between the Nags Head Beach Road multi-use trail and the Whalebone Junction Information Center (via Whalebone Junction) and between the end of the Nags Head Beach Road multi-use trail and NC 12 (via South Old Oregon Inlet Road or RIP Route #0011). Another gap exists between Whalebone Junction and the bicycle lane on the US 64 bridge to Roanoke Island.

The need for a bicycle connection from Bodie Island to Pea Island will depend on the redesign of Bonner Bridge. This study will not propose a new bridge design, however, the existing two-foot shoulder and high traffic speeds result in a significant safety need along the bridge. The current Environmental Assessment (May 2010) proposes a eight-foot wide shoulder,³¹ which exceeds the AASHTO minimum of four feet

²⁶ National Park Service. Cape Hatteras National Seashore NC 12 Improvements / Environmental Impact Statement. January 2010.

²⁷ Bicyclinginfo.org Paved Shoulders. Accessed July 16, 2010. <http://www.bicyclinginfo.org/engineering/facilities-shoulders.cfm>

²⁸ Project PRA-CAHA 10(2) CAPE HATTERAS NATIONAL SEASHORE. Overlay and Replace Culverts on NPS Route 010, NC State Route 12 *Description: Feasibility of Improving Vehicle-Bicycle Safety by Adding Bike Lanes*. January 2008 U.S. Department of Transportation, Federal Highway Administration *Eastern Federal Lands Highway Division*. P.7

²⁹ American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities* (1999). P.16

³⁰ *Ibid* P.19

³¹ NC 12 Replacement of Herbert C. Bonner Bridge: Environmental Assessment. May 2010. <http://www.ncdot.org/projects/bonnerbridgerepairs/download/EA.pdf>

described previously. Bicyclists who are unwilling or unable to cross the existing bridge, from Bodie Island to the south or from Pea Island to the north, are unable to visit the resources on the other side. A connection across the Oregon Inlet would enable bicyclists in the future to travel between facilities in Nags Head and the proposed bicycle and pedestrian paths for Avon, Rodanthe, Waves, and Salvo.³² Stakeholders expressed the advantages of incorporating bicycle and pedestrian facilities into the new bridge design, which currently does not accommodate either use. If pedestrian and bicycle facilities are incorporated into the design, stakeholders pointed out the potential need to provide facilities near the bridge if it became a destination.

As mentioned in Section 2.1, Cape Hatteras NS has proposed an expanded shoulder or off-road facility along the length of Lighthouse Bay Drive (RIP Route #0202), from NC 12 to the Bodie Island Lighthouse Historic District. This trail would improve bicycle and pedestrian access to the lighthouse from NC 12 and Coquina Beach. The trail would be approximately one mile long and although it may be too far for some pedestrians, bicycle access between the sites would be feasible for most visitors. In addition, the Dike Trail currently connects to NC 12 but does not provide a direct, safe connection to Coquina Beach or the proposed Lighthouse Bay Drive (RIP Route #0202) facility. Although an extension of the trail to Lighthouse Bay Drive (RIP Route #0202) along NC 12 would serve a recreational purpose, the Dike Trail does provide access to a remote area of the island that is otherwise not accessible and an extension could provide a safer pedestrian link than the Lighthouse Bay Drive (RIP Route #0202) facility to nearby sites such as Coquina Beach and the relocated U.S. Coast Guard buildings.

Condition of existing infrastructure

The width of the existing paved multi-use trail along the Secondary Road 1243/Old Oregon Inlet Road varies from six to eight feet and is therefore narrower than recommended by the American Association of State Highway and Transportation Officials (AASHTO) for a multi-use trail (see Figure 1 on page 31). According to AASHTO, a shared use path should be at least ten feet wide (although eight feet wide is permissible in low use areas) with two foot graded shoulders on both sides of a path.³³ A shared use path is designed to accommodate bicycle and pedestrian traffic in addition to other trail users such as in-line skaters, persons in a wheelchair, and joggers.

Availability of bicycles and bicycle amenities

Many visitors arrive to the Outer Banks without bicycles. There are no rental facilities located within the Bodie Island District. The closest bicycle rental stores are located in Waves (15 miles to the south of the study area) and Kill Devil Hills (5 miles north of the study area). There is a lack of bicycle amenities such as bicycle racks at major Bodie Island destinations. One bicycle rack, with a capacity of four bicycles, exists within the study area, located near the Bodie Island Lighthouse. The lack of bicycle rentals and bicycle amenities discourages visitors and residents from bicycling between major destinations. The addition of bicycle amenities would encourage more bicycle use within Bodie Island. Additional bicycle use would improve visitor access and mobility and could reduce motor vehicle trips between sites within Bodie Island District. With the addition of bicycle amenities, Bodie Island's flat terrain and concentration of major destinations would encourage bicycle use by both local residents and visitors.

Intersection and roadway safety

There are no crosswalks or pedestrian crossing signs within the Bodie Island District and the speed limit is 55 mph, although during the summer the speed limit for the section of road adjacent to the Oregon Inlet

³² Morris, Rob. The Outer Banks Voice. "Hatteras byways project to seek \$1.95 million grant" <http://outerbanksvoice.com/2010/04/05/byway-project-to-seek-1-95-million-grant/>

³³ U.S. Department of Transportation, Federal Highway Administration "Shared Use Path Design" <http://www.fhwa.dot.gov/environment/sidewalk2/sidewalks214.htm>

Campground and Fishing Center is reduced to 45 mph. There is a need for pedestrian accommodations at specific intersections where pedestrian activity exists or could exist in the future: at Whalebone Junction, between Oregon Inlet Campground and the Oregon Inlet Fishing Center, and in the future, if a multi-use trail is provided, between Coquina Beach and Lighthouse Bay Drive (RIP Route #0202). Section 2.1 also addressed this issue.

According to the Outer Banks Scenic Byway Corridor Management Plan many bicyclists recommend against traveling past Oregon Inlet from the north because of the high vehicular speeds, narrow roadways, and sandy shoulders. Cape Hatteras NS staff and stakeholders also expressed a concern over bicycle safety near the Oregon Inlet Fishing Center due to the tractor trailer traffic, road width, and vehicle speeds.

Between Whalebone Junction and Bodie Island Lighthouse there are several small turnouts along the west side of the NC 12 for hunters to park and access remote areas. The trails do not connect to one another or provide access to any specified destinations, including the Sound. Section 2.6 addresses other needs related to these turnouts and trails.

2.5 Marine transportation needs

Overview

The Bodie Island District currently provides landside infrastructure (e.g., docks) for both motorized boats and non-motorized boats but they are limited in number and amenities (e.g., fuel and storage). Currently, no water taxi, ferry, or other waterborne public transportation service is in operation within the Bodie Island District although several plans have identified the need to examine the feasibility of water taxi services in the area. There are currently efforts underway to develop designated non-motorized water trails along the North Carolina coast that may require additional facilities. Marine transportation can meet several needs, including providing an alternative means to travel between or to sites, especially in cases where there are no surface transportation options or such options are oversubscribed or otherwise not ideal. Recreational use of marine transportation, such as for fishing or exercise, is not a transportation need.

Program needs

The Outer Banks Scenic Byway Corridor Management Plan identifies the need for additional public docks and the establishment of water trails along the length of Cape Hatteras NS, including the study area. The Outer Banks Transportation study and Roanoke Island Transportation Plan both identify the need for a study of new water taxi service for Roanoke Island to Bodie Island. A report from the East Carolina University, *North Carolina's Coasts in Crisis: A Vision for the Future*,³⁴ similarly calls for looking into the possibility of connecting various villages on the Outer Banks by water taxi. The NPS Draft ORV Management Plan is considering proposing a water taxi option from the Oregon Inlet Fishing Center to the Bodie Island Spit as a means to provide access to areas previously accessible by ORV. Although several plans have documented the opportunity for, and interest in, water taxi services within the area, there is a need for coordination of such plans and identification of how such plans may apply to the study area.

Infrastructure needs

No existing infrastructure needs have been identified for motorized water transportation in the study area, given that currently launch and dock facilities are provided at the Oregon Inlet Fishing Center and are considered adequate and used primarily for charter boats rather than transportation services. The one exception is the dependence of motorized water access on the continued dredging of channels in the Roanoke Sound by Dare County and the Oregon Inlet Channel by the U.S. Army Corps of Engineers.³⁵ For future needs, if a water taxi or similar transportation service were to be introduced, additional infrastructure may be necessary, depending on the service location, such as docks, shelters, seats, signage, and maintenance and fueling facilities.

For non-motorized water transportation, there are currently only two sites within the study area with any infrastructure, in the form of access points at the Off Island Gun Club dock south of Bodie Island Lighthouse and at the Oregon Inlet Fishing Center. There may be a need for additional sites, especially in coordination with the ongoing development of designated water trails,³⁶ and for improved infrastructure at those sites, including docks, boat storage, and lockers. These facilities could serve recreational uses but for the purposes of this study, the intent is to identify potential transportation uses, such as providing a

³⁴ Riggs, S. R., et al. *North Carolina's Coasts in Crisis: A Vision for the Future*. North Carolina Coastal Geology Cooperative Research Program, East Carolina University. October 2008. <http://www.ecu.edu/cs-acad/sustainabletourism/upload/Stan-Riggs.pdf>

³⁵ U.S. Army Corps of Engineers. Manteo – (Shallowbag) Bay, North Carolina. http://www.saw.usace.army.mil/oregon_inlet/Executive_Summary.htm

³⁶ Volpe Center. *Conditions Inventory/Assessment*, Section 3.1 Transportation network - Regional – Recreational transportation” (44).

way for visitors to access the Bodie Island Lighthouse by boat from communities to the north or south or to travel between sites within the Bodie Island District by boat.

2.6 Traveler information and wayfinding needs

Overview

Cape Hatteras NS currently provides visitors to Bodie Island with limited on-site wayfinding or traveler information and limited online guidance for visitors planning a trip.³⁷ As Cape Hatteras NS provides additional infrastructure or encourages alternate modes of access and travel within Cape Hatteras NS, such as by foot, bicycle, marine transportation or transit, wayfinding and traveler information should be incorporated and tailored to all modes of travel to provide directions, identification of sites including hours and amenities, modes of travel, and mileage.

Program needs

Wayfinding and information coordination

The Outer Banks Scenic Byway Corridor Management Plan (CMP) identified the need for a coordinated signage plan for the length of Cape Hatteras NS, including the Bodie Island District. There are several towns and land management agencies within Cape Hatteras NS that include a variety of wayfinding and information signs. The CMP states that local entities need to coordinate and partner with each other to provide visitors with sufficient information along the roadways.

Gateway facilities

The CMP also concludes there are very few gateway signs and facilities to designate the start and end of the corridor and to provide information to travelers on the significance of the corridor and its primary attractions. As the northern entrance to Cape Hatteras NS, the Bodie Island District needs to clearly provide information not only on sites within Bodie Island, but on other sites within Cape Hatteras NS and along the Outer Banks Scenic Byway, both of which extend to the south from Whalebone Junction.

Trip planning information

Cape Hatteras NS currently provides online information for visitors arriving by private vehicle or airplane. However, there is no online information or wayfinding information specifically for alternate modes of travel such as bicycle and pedestrian modes and marine and public transportation. Such information is necessary to improve mobility and wayfinding and to encourage use of alternate modes.

Infrastructure needs

Wayfinding Infrastructure

There is limited infrastructure on Bodie Island that provides visitors with wayfinding and traveler information. Current traveler information indicating access points to destinations exists on signs along NC 12 although there is limited information on Bodie Island sites at the entrance to Cape Hatteras NS near Whalebone Junction. In addition, as mentioned in Section 2.1, NCDOT has a VMS at Whalebone Junction to provide information on the ferries. However, information on mileage between key destinations, site locations, facilities, visitor amenities, mode options, and parking availability is not

³⁷ Volpe Center. *Conditions Inventory Assessment*, Section 2.2, Transportation network – Pedestrian only facilities (43) and Section 3.2, Transportation Safety– Pedestrian facilities (62).

provided. While there is no data to suggest that visitors get lost or skip Bodie Island destinations, Cape Hatteras NS staff and stakeholders recognized the lack of signage and opportunity to better inform visitors. Signage that informs visitors of the distance between sites and amenities at destinations enable visitors to make informed decisions about their mode of travel and selected destinations. As additional non-motorized transportation routes are developed, signage with information on level of difficulty and distances will be needed.

Currently there are no pedestrian or bicycle safety warning devices for vehicular traffic along NC 12 or other roads or at key intersections. Key intersections also lack sufficient traveler information and wayfinding. These intersections include Whalebone Junction and the intersections of NC 12 with Secondary Road 1243, Coquina Beach access/Lighthouse Bay Drive (RIP Route #0202), and Oregon Inlet Campground and Fishing Center access roads.

2.7 Intermodal connection needs

Previous sections, namely 2.4 and 2.5, have documented individual modal needs. The following list identifies modal connections and their infrastructure needs:

- Water-land connections may warrant docks and boat storage.
- Bicycle-pedestrian connections may warrant lockers and bicycle parking.
- Bicycle-vehicle connections may warrant showers and vehicle parking.

If a transit system is implemented, future intermodal connection needs might include bicycle racks on transit vehicles for transit-bicycle connections, and shelters, signage, seats, and designated stop areas for transit-pedestrian connections.

All modal connections require signage and maps to inform visitors of modal options and the locations of connections, as detailed in Section 2.6. In addition, users of transit and vehicles who do not have bicycle or water equipment require rental services to be able to use those modes for transportation to sites within the study area and to other destinations.

3. Findings and conclusion

This section summarizes the needs identified by mode and by type of need (program or infrastructure) and provides main findings to be considered in the Alternative Transportation Analysis. Table 4 provides a summary of the program and infrastructure needs by mode or related infrastructure. Key safety-related needs are highlighted in bold. Each need is also matched with the goal or goals to which it most strongly relates. Figure 1 illustrates the key infrastructure needs, by type and by primary physical locations, for all modes except transit.

The main conclusions from the Needs Assessment include:

- Data collection, safety, and wayfinding/traveler information needs exist across all modes.
- *Roadway.* The three main safety needs that have been identified for access to and along Lighthouse Bay Drive (RIP Route #0202) are the need to widen the road to accommodate vehicles and nonmotorized access more safely, the need to resolve the inconsistency in speed limits upon entrance and exit, and the need to add exclusive right turn lanes on NC 12 to Lighthouse Bay Drive (RIP Route #0202) and Coquina Beach. Other needs, which also relate to safety, include the provision of roadside viewing areas for Bodie Island Lighthouse and roadway traffic information.
- *Parking.* The parking demand assessment indicates that current parking is sufficient to accommodate the full capacity of the lighthouse and other uses on site at any one time, but that demand for climbing may exceed the lighthouse capacity. Consequently, there is a need for demand management strategies to ensure that demand for parking is matched with the capacity for the lighthouse to accommodate climbers. If this excess demand were to be accommodated, there would be a need for additional parking capacity or the provision of other transportation options to Bodie Island Lighthouse once it is open for climbing. There is also a need for designated bus parking that may involve a new parking area and there is a need for more data collection, in terms of information on the parking use at Cape Hatteras Lighthouse for comparison, and of parking use at Bodie Island Lighthouse, once it opens for climbing. Any decisions regarding increased parking capacity should include consideration of visitor experience and resource protection goals.
- *Transit.* No public transportation service is in operation within the Bodie Island District. Cape Hatteras NS staff and local stakeholders have expressed interest in transit and several plans have documented previous proposals. Transit would provide visitors with another transportation option, may reduce vehicle use and parking demand, and may have interpretive and partnership opportunities so warrants consideration but such a system would need to be financially sustainable.
- *Bicycle and Pedestrian.* There are several needs for bicycle and pedestrian improvements in terms of connectivity, access, and safety. Needs include connections between the Nags Head multi-use trail and NC 12, additional signage and intersection accommodations along NC 12, and improved access within the Bodie Island Lighthouse area.
- *Marine.* No water taxi, ferry, or other marine public or private transportation is in operation within the Bodie Island District. Although several plans have documented the opportunity for and interest in water taxi services within the area, there is a need for coordination of such plans and identification of how such plans may apply to the study area. In addition, there is a need for improved nonmotorized water amenities and access and there are currently efforts underway to develop designated nonmotorized water trails along the North Carolina coast that may require additional facilities.

- *Traveler information and wayfinding.* There is a need for improved on-site and pre-trip wayfinding or traveler information especially as Cape Hatteras NS provides additional infrastructure or encourages alternate modes of access and travel within Cape Hatteras NS. Wayfinding and traveler information should be incorporated and tailored to all modes of travel to provide directions, identification of sites including hours and amenities, modes of travel, and mileage.
- *Intermodal connection.* As individual modal facilities and access are improved, need for facilities, such as storage/parking at transfer points, to accommodate connections between these modes will increase.

The needs identified in this report will be used to inform development of solutions to be considered in the Alternative Transportation Analysis report. Next steps for the study include researching potential strategies to address the identified needs; evaluating proposed strategies based on the identified goals/objectives as well as financial feasibility and potential funding, partnerships, and resource impacts; and prioritizing strategies.

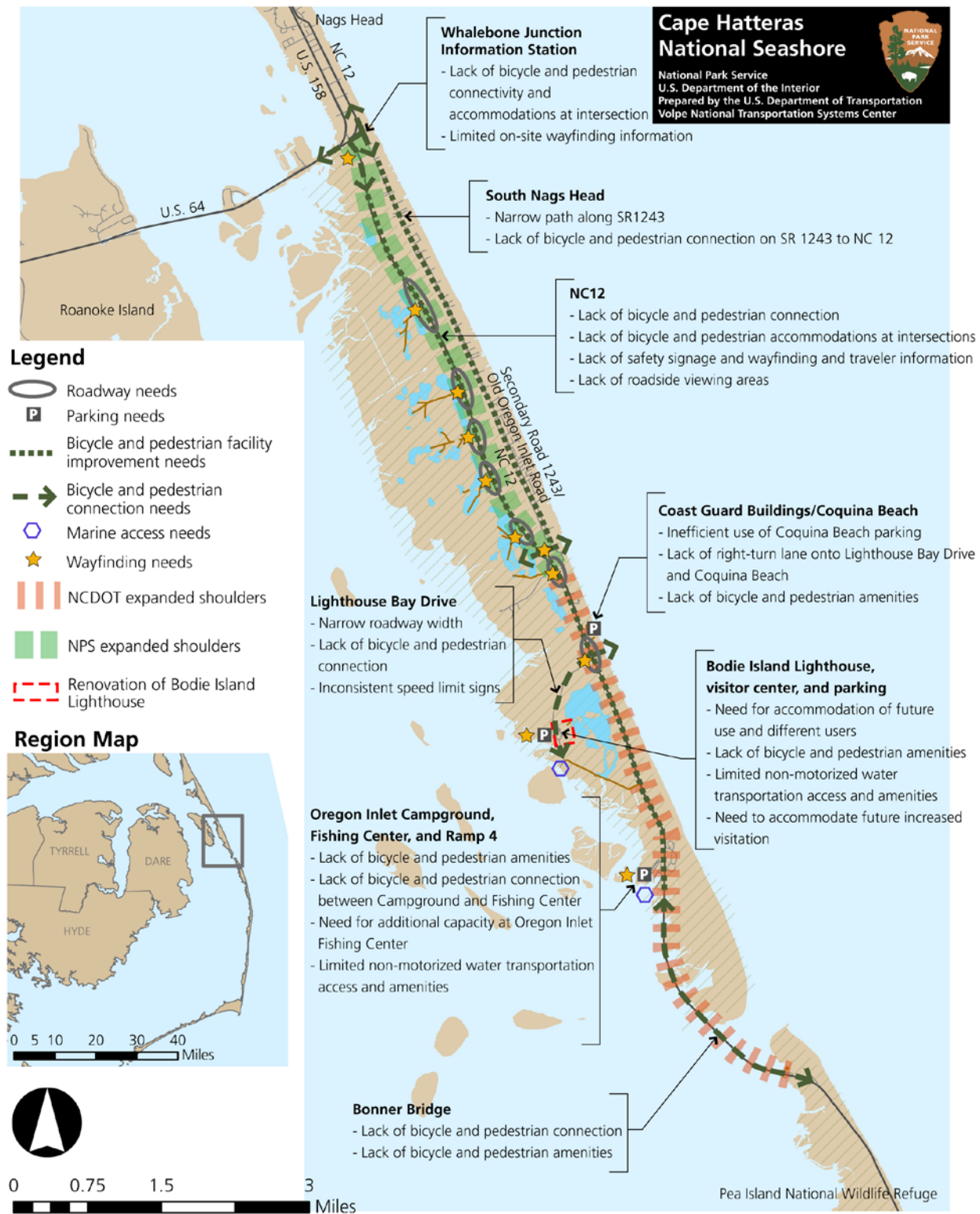
Table 4
Summary of needs and associated goals

Mode or Related Infrastructure	Program Need (goal)*	Infrastructure Need (goal)*
Roadway	<ul style="list-style-type: none"> Incident reporting system (3,4,6) 	<ul style="list-style-type: none"> Lack of safety and bicycle signage (3,4) Lack of traffic information (3,4) Lack of roadside viewing areas (4) Lighthouse Bay Drive (RIP Route #0202) narrow width (3,4,6) Lack of exclusive right turn lanes onto Lighthouse Bay Drive (RIP Route #0202) and Coquina Beach (2,3) Inconsistent speed limit signs
Parking	<ul style="list-style-type: none"> Parking utilization and management program (1,3,4,5) Parking demand assessment (3,4,6) 	<ul style="list-style-type: none"> Need for consideration of accommodation of future use and different users at Bodie Island Lighthouse (3,4,6) Inefficient use of Coquina Beach parking (3,4,6) Need for additional capacity at Oregon Inlet Fishing Center (3,4) Off-site parking for possible future transit (2,3,4)
Transit	<ul style="list-style-type: none"> User needs and preferences (2,3,4,5) Connections (4,7) 	<ul style="list-style-type: none"> Lack of public transportation Potential future need for shelters, maintenance and storage, etc. (3,4,6)
Bicycle and Pedestrian	<ul style="list-style-type: none"> Data collection (3,4,6,7) 	<ul style="list-style-type: none"> Missing connections (2,3,4,7) Need for improvement to existing and planned facilities - Narrow path along SR1243 and expanded shoulders along NC 12 (3,4) Lack of bicycle and pedestrian accommodations and signage at intersections and along roads (2,3,4) Lack of bicycle and pedestrian amenities (2,3,4)
Marine	<ul style="list-style-type: none"> Lack of planning coordination and feasibility assessment (7) 	<ul style="list-style-type: none"> Limited non-motorized water transportation access and amenities (3,7) Lack of water taxi, ferry, or other marine public transportation system Potential future need for docks, maintenance, and fueling facilities, etc. for motorized water transportation (3,7)
Wayfinding/Traveler Information	<ul style="list-style-type: none"> Lack of coordination (7) Lack of trip planning resources (3,4) 	<ul style="list-style-type: none"> Limited on-site wayfinding information (3,4,7)
Intermodal Connections	<ul style="list-style-type: none"> Limited strategies and pre-trip traveler information (3,4) 	<ul style="list-style-type: none"> Limited amenities to facilitate transitions between modes (3,4)

*** Key**

1. To conserve natural, historical, and cultural resources.
2. To reduce congestion and pollution.
3. To improve visitor mobility and accessibility.
4. To enhance the visitor experience
5. To ensure access to all, including persons with disabilities
6. To achieve efficient management, operations and maintenance.
7. To coordinate with NPS and other planning entities and stakeholders as appropriate.

Figure 1
Summary of infrastructure needs assessment findings for the study area



Appendix A: Parking demand assessment analyses

The following two sections present the methodology employed in preparing an assessment of parking demand due to the increased visitation from the opening of Bodie Island Lighthouse to climbing. The sections consist of the following:

1. Identification of peak visitation patterns, and
2. Parking demand created by the climbing capacity restrictions.

Analysis 1: Peak visitation

Peak visitation to both Bodie Island Lighthouse and Cape Hatteras Lighthouse occur during June, July, and August (see Figure 2 and Figure 3). During these months, climbing visitation to Cape Hatteras NS peaks during the middle of the week, with fewer climbers on the weekend (see Figure 4), a trend that Cape Hatteras NS staff confirmed for visitation overall, including to Bodie Island Lighthouse. During non-peak periods, visitation is spread more evenly throughout the week, with the only fluctuation being a slight peak at the end of the week into the weekend. These patterns inform NPS about when sites are likely to be at capacity and have potential of experiencing parking demand issues.

Figure 2
5-Year average monthly visitation (2005-2009) for Bodie Island Visitor Center, Cape Hatteras Visitor Center, and Cape Hatteras Lighthouse.

Source: NPS Public Use Statistics Office

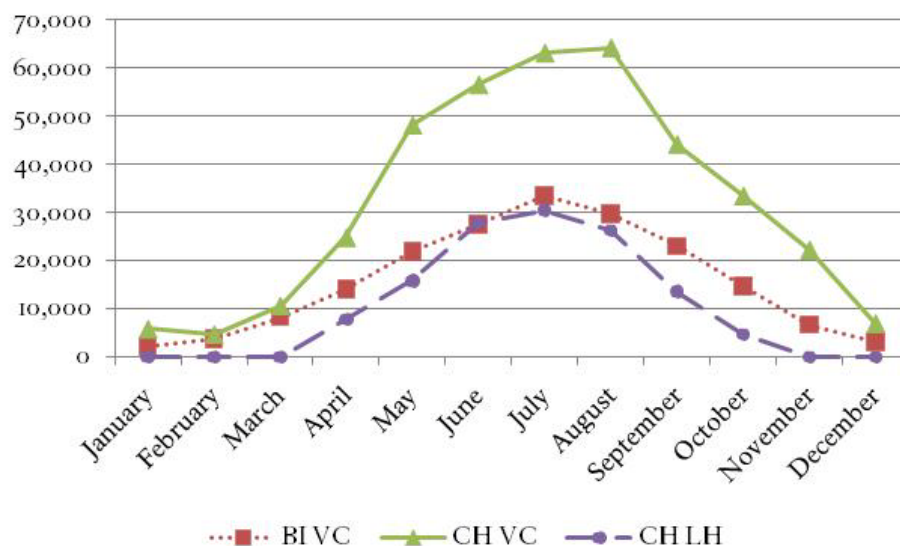
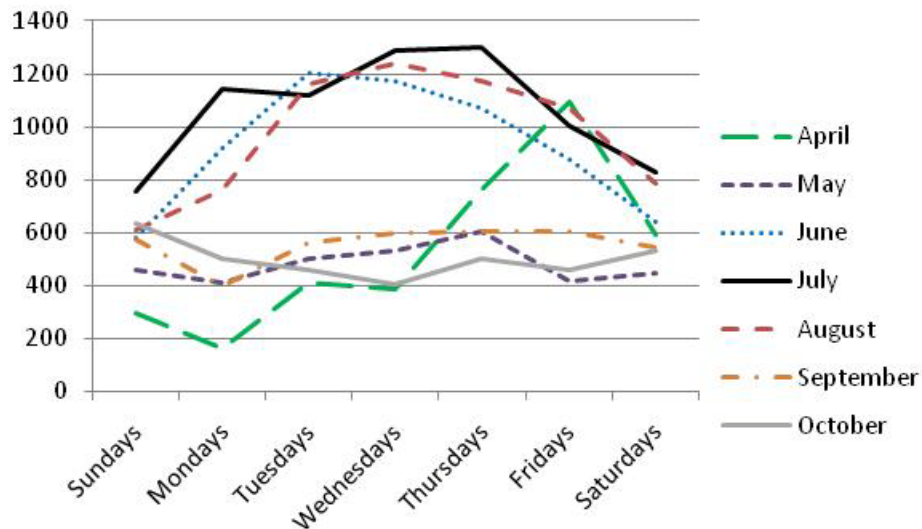
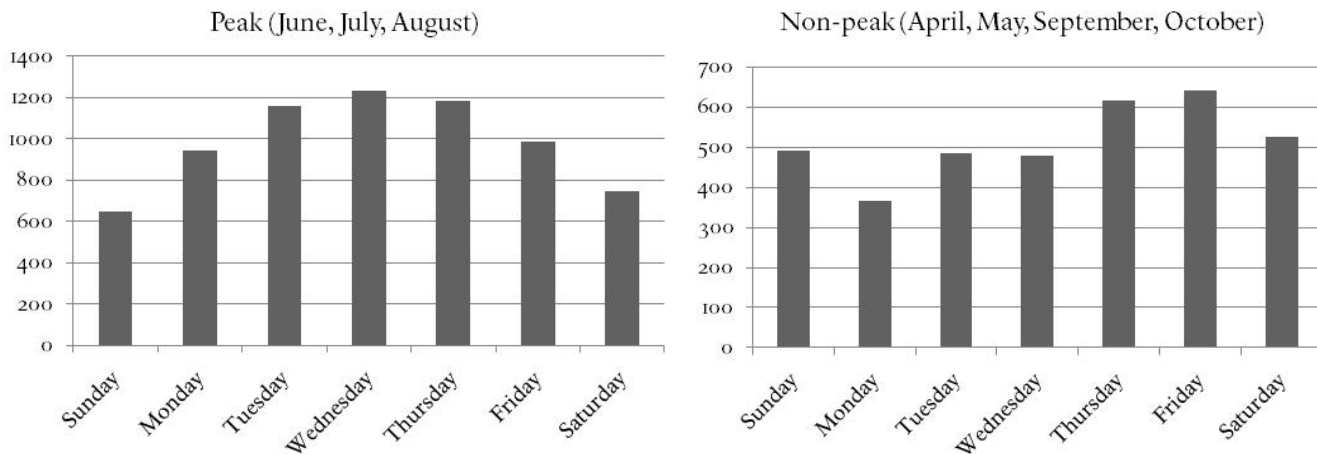


Figure 3
Cape Hatteras Lighthouse climbing daily averages by month for 2009
 Source: Cape Hatteras NS staff.



Note: The first day the lighthouse was open for climbing was Friday, April 17, and it experienced unusually high visitation according to the data.

Figure 4
Cape Hatteras Lighthouse climbing daily averages for peak (June, July, and August) and off-peak (April, May, September, October) months of 2009
 Source: Cape Hatteras NS staff.



Analysis 2: Capacity for climbers

The study team calculated the parking impacts of the lighthouse operating at maximum capacity. This approach assumes Cape Hatteras NS will limit the number of climbers to 394 visitors per day and 23 visitors at a time based on the consideration of the structural features of the lighthouse, long-term

maintenance needs, and repair decisions pursued by Cape Hatteras NS as a result of a Value Analysis report, which examined several alternatives.^{38,39}

For the purpose of this calculation, the one-time limit of 23 can be viewed as tours that are 30 minutes in length, based on Cape Hatteras NS staff assumptions for time on average that visitors will spend climbing the lighthouse. In reality, Cape Hatteras NS does not plan to conduct formal tours or restrict visits to 30 minutes but rather intends to take the necessary steps to ensure that a maximum of 23 people are allowed in the lighthouse at any one time. Based on these assumptions the lighthouse can accommodate approximately 17 tours per day, assuming 30 minutes per tour and assuming the lighthouse is open 8 ½ hours a day (9 a.m.- 5:30 p.m.). If there is one tour on site at a time, or 23 people, then we can apply the recreation persons-per-vehicle multipliers by month used by Cape Hatteras NS staff to determine the number of expected vehicles per day for 394 visitors. For 23 visitors or one tour, during a peak month such as June, July, and August, there will be approximately nine vehicles. However, in peak conditions, it can be assumed that, at any one time, at least three tours will be onsite; one tour will be arriving, one tour will be in the lighthouse, and one will be leaving (see Table 5 for additional tours and vehicle estimations).

However, it is unlikely that climbing visitation will be easily controlled and more visitors – or number of “tours” – may show up than can be accommodated by the lighthouse capacity policy. In that case, the existing parking could accommodate three tours, or sets, of visitors waiting to climb while one tour climbs and one finishes climbing. Visitors in the waiting tours would have to be willing to wait one hour (four tours on-site) or 1.5 hours (five tours on-site) – assuming there is no demand from non-climbing visitors, which is not expected to be the case in reality. Analysis and discussion of non-climbing demand and its impact on parking capacity is provided in the main text of the report.

Table 5
Lighthouse capacity and parking scenarios

Source: Volpe Center and NPS

Persons and Vehicles per Tour	Number of Tours				
	1 tours	2 tours	3 tours	4 tours	5 tours
Number of persons per tour	23	46	69	92	115
NPS persons per vehicle assumption (for June, July, and August)	2.7				
Number of vehicles per tour	9	17	26	34	43

The analysis presented assumes that all visitors are accessing the site by personal vehicle; in reality, bus tours are and will continue to be an important source of visitors. Bodie Island Lighthouse – as well as Cape Hatteras Lighthouse – are visited by bus tours, some of which may be interested in having their groups climb the lighthouse. Tour buses on average accommodate 30-45 passengers, which would fill two “tours,” or an hour, based on the lighthouse’s capacity limitations. Thus, although the tour buses would take up less space than the equivalent personal vehicles (17 assuming 2.7 passengers per vehicle) and would thus free up parking capacity, lighthouse climbing capacity would be reduced.

³⁸ Email communication with Cape Hatteras NS staff. May 18, 2010.

³⁹ Denver Service Center. Value Analysis Study for Preserve / Rehabilitate Bodie Island Lighthouse and Oil House, Draft Report. 2005.

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NPS 603/108004 / October 2010