



Ocracoke Light Station Rehabilitation Project Environmental Assessment



US DEPARTMENT OF THE INTERIOR, NATIONAL PARK SERVICE
Cape Hatteras National Seashore Recreation Area
Ocracoke Light Station Rehabilitation Project Environmental
Assessment

The National Park Service (NPS) has prepared this environmental assessment (EA) to evaluate the impacts of rehabilitation options for the Ocracoke Light Station at Cape Hatteras National Seashore Recreational Area (the Seashore), Hyde County, North Carolina. The Ocracoke Lighthouse and supporting structures (Double Keepers' Quarters, Carpenter's Shop, Store House, Cisterns, Privy, Oil House, and Generator House) were damaged by Hurricanes Matthew, Florence, and Dorian (2017 to 2019) and are susceptible to future flooding due to climate change and sea level rise.

This EA presents three alternatives for management of the Ocracoke Light Station, describes the environment that would be impacted by the alternatives, and analyzes the potential environmental consequences of implementing the alternatives. Under alternative A (no action), the Ocracoke Lighthouse would be rehabilitated and exterior and interior storm damage on the supporting structures would be repaired. Under alternative B (elevate some structures), the Lighthouse would be rehabilitated, and along with storm repairs, the Double Keepers' Quarters would be elevated approximately 4 feet and some of the supporting structures would be elevated approximately 1 to 2 feet for flood resiliency. Under alternative C (ghost structure), the Lighthouse would be rehabilitated, the storm damage on the supporting structures would be repaired, and the Double Keepers' Quarters would be removed and replaced with a ghost structure. A ghost structure mimics the size, shape, and location of the existing building.

This EA has been prepared in compliance with the National Environmental Policy Act of 1969, as amended, and the implementing regulations of the 2020 Council on Environmental Quality (40 Code of Federal Regulations 1500-1508), to provide the decision-making framework that 1) analyzes a reasonable range of alternatives to meet objectives of the proposal, 2) evaluates potential issues and impacts on the park's resources and values, and 3) identifies mitigation measures to lessen the degree or extent of these impacts.

How to Comment

We invite you to comment on this EA during the 30-day public review period. The preferred method of providing comments is through the NPS's Planning, Environment, and Public Comment (PEPC) website for the park at: https://parkplanning.nps.gov/CAHA_ocracoke_lightstation.

You may also submit written comments to:

Ocracoke Light Station Project
Cape Hatteras National Seashore
1401 National Park Drive
Manteo, North Carolina 27954

Only written comments will be accepted. Please submit your comments postmarked or transmitted no later than 30 days after the posting of the notice of availability on the PEPC website. Please be aware that your entire comment will become part of the public record. If you wish to remain anonymous, please clearly state that within your correspondence; however, the National Park Service cannot guarantee that personal information, such as email address, phone number, etc., will be withheld.

CONTENTS

Chapter 1: Purpose of and Need for Action	1
Purpose of and Need for Action.....	1
Climate Change and Sea Level Rise	4
Issues and Resource Topics Retained	6
Historic Buildings and Structures	6
Cultural Landscapes.....	6
Issues and Resource Topics Dismissed.....	7
Air Quality	7
Wetlands and Floodplains.....	7
Environmental Justice.....	7
Soils and Vegetation	8
Archeological Resources	8
Viewsheds.....	9
Soundscapes.....	9
Visitor Use and Experience	9
Chapter 2: Alternatives	11
Common to All Alternatives	11
Alternative A: No-action.....	11
Alternative B: Elevate Some Structures (Proposed Action/Preferred Alternative)	12
Alternative C: Ghost Structure.....	13
Mitigation Measures	17
Chapter 3: Affected Environment and Environmental Consequences	19
Historic Buildings and Structures	19
Cultural Landscapes.....	26
Chapter 4: Consultation and Coordination.....	31
Public Participation	31
Agency Consultation.....	31
List of Preparers	31
References.....	33
Appendix A: Cultural Resource Investigations Near the Ocracoke Light Station.....	35
Appendix B: Actions Considered but Dismissed.....	37

FIGURES

Figure 1. Location of Cape Hatteras National Seashore and the Ocracoke Light Station	2
Figure 2. Aerial Image of the Ocracoke Light Station, 2015	3
Figure 3. Current Conditions and Projected Sea Level Rise at Ocracoke Light Station.....	5
Figure 4. Alternative A – No-action Alternative	14
Figure 5. Alternative B – Elevate Some Structures	15
Figure 6. Alternative C – Ghost Structures.....	16

TABLES

Table 1. Important Character-Defining Features	21
Table 2. Contributing Resources and Features in the Cultural Landscape	26

ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
EA	Environmental Assessment
FFE	Finished Floor Elevation
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	National Park Service
NRHP	National Register of Historic Places
PEPC	Planning, Environment, and Public Comment
RV	Recreational Vehicle
SEAC	Southeast Archeological Center
Seashore	Cape Hatteras National Seashore Recreational Area
SHPO	State Historic Preservation Office
USC	US Code
USEPA	US Environmental Protection Agency

CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

Cape Hatteras National Seashore Recreational Area (the Seashore) is located on the Outer Banks of North Carolina and is the nation's first national seashore, designated in 1937 (figure 1). The Seashore was designated to preserve the dynamic barrier islands and their unique vegetation, wildlife, and coastal processes, and to provide recreation and enjoyment for the public. The Seashore stretches for approximately 70 miles north to south and crosses Bodie Island and two barrier islands (Hatteras and Ocracoke) that are linked by North Carolina Highway 12 and by the Hatteras Inlet Ferry. The Seashore's barrier islands are constantly shifting and reshaping as a result of wind, waves, storms, ocean currents, and sea level changes. The Seashore's variety of aquatic and terrestrial habitats, including beaches, dunes, wetlands, shrub thickets, and maritime forest, supports a variety of animal life. The Seashore also has a long and rich cultural heritage. The islands that make up the Seashore have been home to Native Americans, farmers, watermen, enslaved people, lighthouse keepers, surfmen, and many others. The Seashore provides an opportunity to protect a diverse natural community and a collection of cultural resources, while also providing a unique Seashore experience for visitors.

Ocracoke Island is in the southwestern-most area of the Seashore, about 16 miles long and 8.6 square miles. The Ocracoke Light Station (figure 2) is nestled within the residential neighborhood of Ocracoke Village on the southwest tip of Ocracoke Island, north of Ocracoke Inlet and facing towards Pamlico Sound to the west in Hyde County, North Carolina. The Ocracoke Light Station includes the Ocracoke Lighthouse, Double Keepers' Quarters, five outbuildings, and other ancillary structures. The Ocracoke Lighthouse was built in 1823; two additional buildings were also built at that time, the Keeper's Quarters and the Privy. Placed in the National Register of Historic Places (NRHP) in 1977, it is the oldest functioning lighthouse in North Carolina and the second oldest lighthouse still in service in the United States. The Light Station is also within and contributing to the NRHP-listed Ocracoke Historic District (listed in 1990). Buildings and structures associated with the Ocracoke Light Station include the Double Keepers' Quarters, Carpenter's Shop, Store House, Cisterns, Privy, Oil House, and Generator House. A wooden picket fence (non-historic) encloses the station, and several historic southern live oaks (*Quercus virginiana*) and eastern red cedars (*Juniperus virginiana*) and two bald cypresses (*Taxodium distichum*) survive in the landscape near the dwelling. Modern visitor amenities include a wooden boardwalk that links the parking area with the Lighthouse, which is currently not open to visitors.

Purpose of and Need for Action

In the wake of recent storm damage and flooding events and in consideration of future impacts exacerbated by climate change and sea level rise, the National Park Service is proposing to sustainably rehabilitate the Ocracoke Light Station and mitigate reasonably foreseeable flooding impacts to the site.

The project is needed because historic structures have been damaged from recent storms and, if the buildings are left as they are, it is expected they will be damaged further by future storms. Furthermore, the site has evolved with the addition, alteration, and demolition of structures over the years to meet the needs of the Seashore, and rehabilitation of these structures is needed to assist with storm recovery and preservation. The Seashore needs guidance on a sustainable path forward that considers the longevity and sustainability of any changes considered.

Figure 1. Location of Cape Hatteras National Seashore and the Ocracoke Light Station



Figure 2. Aerial Image of the Ocracoke Light Station, 2015



Climate Change and Sea Level Rise

The Seashore is vulnerable to multiple coastal hazards including coastal erosion, storm surge, and sea level rise. Ocracoke Light Station is not located on the oceanfront or immediately adjacent to Pamlico Sound, so erosion of coastline has not directly affected the site; however, the site is at low elevation and frequently inundated with rainwater and surge associated with storms and tidal flooding during exceptionally high tides. Climate change and resulting sea level rise are likely to increase the frequency and magnitude of flooding events in the future. Vulnerability to flooding at the low-elevation Ocracoke Light Station landscape is projected to increase with local estimates of 2 to 3 feet of sea level rise over the next 50 years (Sweet et al. 2022). As the sea level rises, the site's vulnerability to coastal storms and the associated surges also increases, putting the historic structures at an elevated level of risk during severe weather events (Allen 2017). Figure 3 shows the current mean higher high water at Ocracoke Light Station and the same area with a sea level rise of 2 feet.

National Park Service (NPS) policy, including Policy Memorandum 14-02: *Climate Change and Stewardship of Cultural Resources* and Policy Memorandum 12-02: *Applying NPS Management Policies in the Context of Climate Change*, provide guidance on managing cultural resources affected by climate

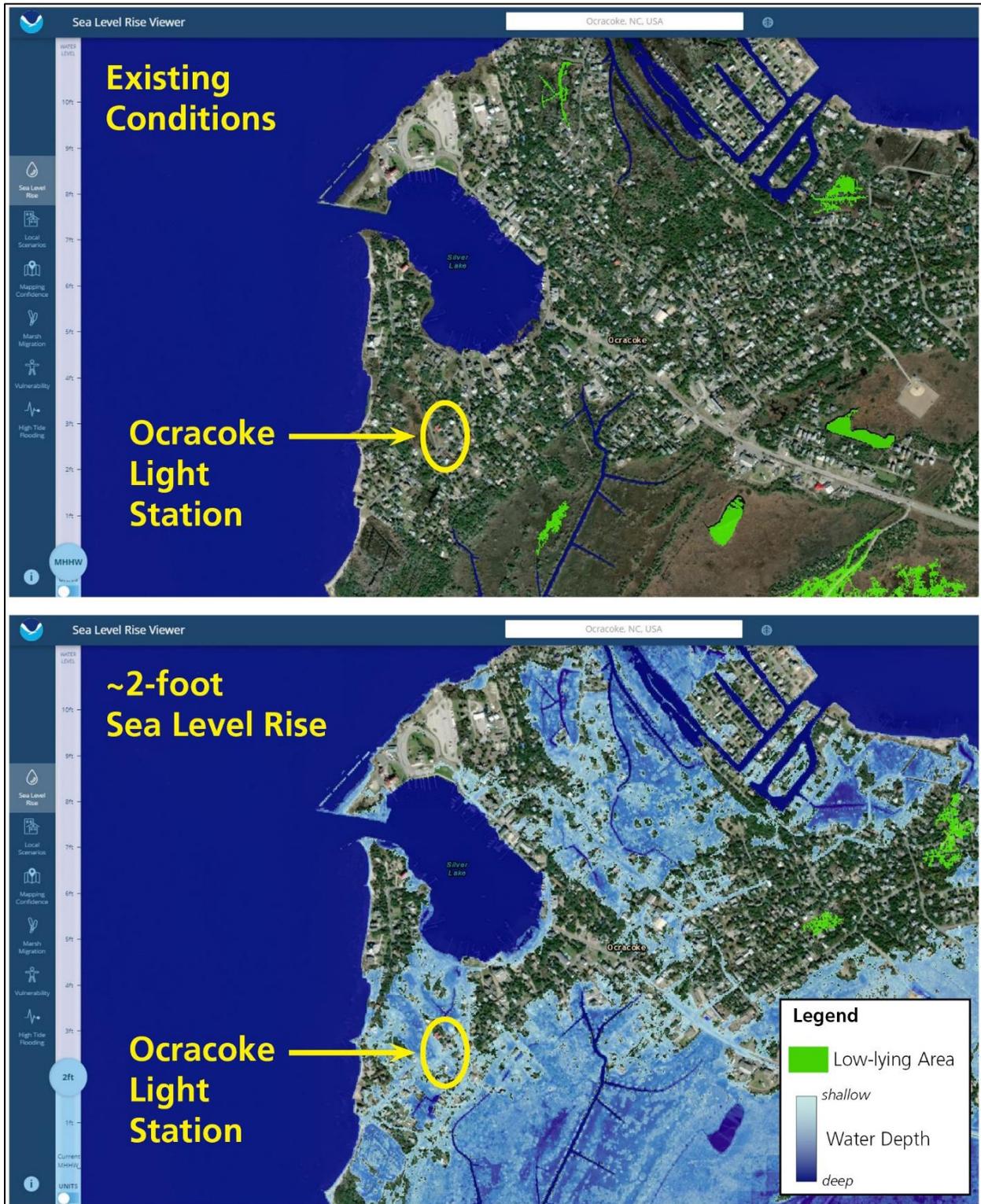


change. Further, the National Park Service published the *Guidelines on Flood Adaptation for Rehabilitating Historic Buildings* (Eggleston, Parker, and Wellock 2021), which provides information about adapting historic buildings to be more resilient to flooding risk in a manner that will also meet *The Secretary of the Interior's Standards for Rehabilitation*. In this context, resiliency is the capacity of a historic property to withstand and recover from a flooding event (Eggleston, Parker, and Wellock 2021).

Future impacts associated with climate change and sea level rise should be considered when making decisions on the long-term management of the Ocracoke Light Station. Between 2017 and 2019, Hurricanes Matthew, Florence, and Dorian damaged the buildings and structures at the Ocracoke Light Station. Most recently, the site was severely flooded from Hurricane Dorian in 2019, as shown in the photograph to the left.

Figure 3. Current Conditions and Projected Sea Level Rise at Ocracoke Light Station

Source: National Oceanographic and Atmospheric Administration Sea Level Rise Viewer (NOAA 2021)



Issues and Resource Topics Retained

Identifying issues — potential problems, concerns, conflicts, obstacles, or benefits that would result if an action were implemented — is an important part of the environmental review process. It is standard practice to organize issues by resource impact topics. Impact topics for this proposed project have been identified based on federal laws, regulations, and Executive Orders; the NPS National Environmental Policy Act (NEPA) Handbook (NPS 2015); NPS *Management Policies 2006*; NPS Director's Orders, and NPS knowledge of resources at the park.

In accordance with the guidance in the NPS NEPA Handbook, issues should be retained for consideration and discussed in detail if:

- the environmental impacts associated with the issue are central to the proposal or of critical importance
- a detailed analysis of environmental impacts related to the issue is necessary to make a reasoned choice between alternatives
- the environmental impacts associated with the issue are a big point of contention among the public or other agencies
- there are potentially significant impacts to resources associated with the issue

Impact topics that are carried forward for further analysis are listed below.

Historic Buildings and Structures

According to NPS-28: *Cultural Resource Management Guidelines*, structures are defined as material assemblies that extend the limits of human capability or constructed works, usually immovable by nature or design, consciously created to serve some human activity. The Ocracoke Light Station was listed in the NRHP on November 25, 1977 as a historic district with contributing buildings and structures that include the Ocracoke Lighthouse, the Keeper's Quarters, and outbuildings and ancillary structures — the Carpenter's Shop, Store House, Cisterns, and Oil House. The Privy and Generator House have been replaced but are designs and materials based on an earlier structure (Oppermann 2015). The period of significance for the NRHP nomination is 1823 through the present. The actions under the proposed alternatives could adversely affect the character-defining features of the Ocracoke Light Station that qualify it for listing on the NRHP and are described in the *Ocracoke Light Station Historic Structures Report* (Oppermann 2015). To ensure compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, the National Park Service is consulting with the State Historic Preservation Office (SHPO) and other consulting parties (see chapter 4 for more information on consultation).

Cultural Landscapes

Cultural landscapes are settings that humans have created in the natural world, revealing essential ties between the land and the people. These special places illustrate human manipulation and adaptation of the land. Implementation of the alternatives could include elevating some of the buildings and structures at the Ocracoke Light Station to protect them from future flood events, altering some of these structures, or demolishing some of these structures and replacing them with interpretive structures. Altering or removing character-defining features, such as the buildings and structures, vegetation, circulation patterns, vistas and views, or archeological resources, as described in the *Ocracoke Light Station Cultural Landscape Report* (Hitchcock 2016) at the site could adversely affect the cultural landscape. The analysis

of cultural landscapes includes historic viewshed issues between the Ocracoke Light Station and the Ocracoke Historic District, concerns, constraints, or opportunities that may arise with the proposed action.

Issues and Resource Topics Dismissed

The following impact topics and issues were dismissed from further analysis, as explained below.

Air Quality

The 1963 Clean Air Act, as amended (42 United States Code [USC] § 7401 et seq.) requires federal land managers to protect air quality and to meet all federal state, and local air pollution standards. The Seashore is subject to federal, state, and local air pollution standards. The US Environmental Protection Agency (USEPA) has established national ambient air quality standards. Current standards are set for sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, particulate matter equal to or less than 10 microns in size, fine particulate matter equal to or less than 2.5 microns in size, and lead. The Seashore is located in an area classified by the USEPA as being in attainment for all six criteria air pollutants (USEPA 2020). The proposed action could have short-term effects on air quality from vehicle and heavy equipment operation during demolition and construction activities, which would result in the emission of criteria air pollutants nitrogen oxides, volatile organic compounds, and particulate matter. There would be a temporary increase in criteria air pollutants related to the proposed action during the construction and demolition period; however, because these activities would be short in duration and localized, emissions are not expected to be at a level that would contribute noticeably to air quality impacts. Efforts to remove mold from the structures would improve air quality within the structures, benefiting the air quality in these microhabitats. For these reasons, air quality was considered but dismissed from further analysis.

Wetlands and Floodplains

Executive Order 11988, “Floodplain Management,” and NPS Director’s Order 77-2: *Floodplain Management* (NPS 2003), require an examination of impacts to floodplains and potential risk involved in placing facilities within floodplains. The National Park Service manages wetlands in accordance with Executive Order 11990, “Protection of Wetlands,” the Clean Water Act, the Rivers and Harbors Appropriation Act of 1899, and the procedures described in NPS Director’s Order 77-1: *Wetland Protection* (NPS 2002). All federal agencies are required to avoid building permanent structures within the 100-year floodplain unless no other practical alternative exists. In the absence of such alternatives, agencies must modify actions to preserve and enhance floodplain and wetland values and minimize degradation. All portions of the project area are within the 100-year floodplain (FEMA 2020). A wetland delineation of the project area was completed in October 2020 (NPS 2020), and this survey identified two estuarine intertidal wetlands with persistent emergent vegetation, which cover a large portion of the project area. Wetland 1 covers the southern portion of the site, extending along the western edge to the northern edge of the site. Wetland 2 is smaller and located in the northeastern corner of the site. Both wetlands extend beyond the project area. The proposed action would result in a negligible amount of fill (less than 0.1 acres) in an area that has been previously disturbed. The amount of fill would not affect the natural functions and values of either the floodplain or the wetlands. For these reasons, floodplains and wetlands have been dismissed from full analysis.

Environmental Justice

Executive Order 12898, “General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing the disproportionately high and/or adverse human health or environmental effects of their programs and policies on minorities and low-income populations and

communities. According to the USEPA, environmental justice is the "...fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies."

The goal of *fair treatment* is not to shift risks among populations, but to identify potentially disproportionately high and adverse effects and identify alternatives that may mitigate these impacts. Environmental justice was considered but dismissed from further analysis for the following reasons:

- Seashore staff and the planning team will solicit public participation as part of the planning process and will give equal consideration to all input from persons regardless of age, race, income status, or other socioeconomic or demographic factors.
- Implementation of the proposed action would not result in any identifiable adverse human health effects; therefore, there would be no direct or indirect adverse impacts on any minority or low-income population.
- The impacts associated with the implementation of the proposed action would not disproportionately affect any minority or low-income population or community.
- Implementation of the proposed action would not result in any identified effects that would be specific to any minority or low-income community.

Soils and Vegetation

The project area lies within the coastal plain and does not contain any unique geologic features or soils. The vegetation communities at the project site are a mix of natural and maintained. The majority of the site is comprised of a maintained Bermuda grass (*Cynodon dactylon*) lawn. A number of mature live oaks surround the structures along with several eastern red cedars and two bald cypresses. Wetland vegetation, adjacent to the maintained landscape, includes swamp sawgrass (*Cladium mariscus*) southern cattail (*Typha domingensis*), pennywort (*Hydrocotyle umbellata*), and saltbush (*Baccharis halimifolia*). Demolition or structure removal activities could impact the soils and vegetation surrounding the structures. The impacts on soils would be localized and negligible. Individual trees could be affected, as discussed in the analysis for Historic Structures in chapter 3. Additionally, best management practices (to be determined at the time of design before construction) would be taken to minimize damage. Soils and vegetation were considered but dismissed from further analysis.

Archeological Resources

A review of survey reports from previous cultural resources surveys in the vicinity of the Ocracoke Light Station revealed only one prehistoric site located within a half-mile. Appendix A presents the reports reviewed and the results of the surveys.

As described in the *Ocracoke Light Station Cultural Landscape Report* (Hitchcock 2016), NPS Southeast Archeological Center (SEAC) archeologists monitored work being done on the Double Keepers' Quarters in June 1987 (Imashima 1987). SEAC uncovered cultural materials from several locations within the monitored areas. After the removal of drift sand from the 1929 wing, at a depth of about 2.5 feet below the flooring, archeologists recovered loose bricks with a soft mortar. At a depth of about 3 feet below the flooring, a pre-addition midden (refuse dump) dating to the mid-nineteenth century was observed and left *in situ*. In removing the sand from an addition to the 1929 wing, archeologists discovered that the western half of the crawl space lies on the slabs of an earlier concrete walk. Archeologists also monitored a series

of utility trench excavations that included both hand and machine methods. All the areas monitored, except the 1929 wing, appeared to be light-to-moderate redepositions of materials with little potential for providing insight into domestic activities at the Keepers' Quarters (Hitchcock 2016). Based on the previous surveys and monitoring, it is likely that buried cultural materials are present in the project area, but the potential significance and integrity of these deposits is unknown.

Implementation of alternative A would not include ground disturbance and therefore would not result in new impacts to archeological resources. Implementation of alternatives B or C would involve ground disturbance. Although the impacts to archeological resources would vary among the alternatives, measures have been included to avoid and/or mitigate impacts (see chapter 2, Mitigation Measures). Specifically, the National Park Service would conduct archeological monitoring during ground-disturbing activities and data recovery for new discoveries. Impacts to archeological resources would be limited to areas of construction, and a more detailed analysis (beyond that presented above) would not aid in selecting the preferred alternative. For these reasons, this topic is dismissed from further analysis.

Viewsheds

Part of the mission of the National Park Service, as stated in the Organic Act of 1916, is to protect the scenery unimpaired for the enjoyment of future generations (54 USC § 100101(a) et seq.), and NPS *Management Policies 2006* includes scenic views in the definition of park resources (NPS 2006). The visual landscape includes factors such as landform, land cover, night sky, and air quality. The presence of large construction equipment, construction crews, and construction activities would result in short-term (the duration of individual construction projects) impacts on viewsheds. As impacts to the viewshed are related to the cultural landscape, these impacts will be covered under that impact topic. Therefore, viewsheds as a standalone topic is dismissed from further analysis.

Soundscapes

During construction and demolition, human-caused sounds would increase as a result of construction activities, equipment, vehicular traffic, and construction crews. Sounds generated from construction and demolition would be temporary, lasting only as long as the activity. Project-related construction noise would be minimized through the use of best management practices including limiting work to daylight hours in the project area to avoid night-time noise disruption and properly maintaining construction equipment to minimize noise. Following construction and demolition, the soundscape would be similar to existing conditions. Overall, the soundscape of the project area would not be noticeably altered in the long term. For this reason, the impact topic of soundscapes was considered but dismissed from further analysis.

Visitor Use and Experience

Cape Hatteras was the nation's first national seashore, and its enabling legislation provides for recreational use and enjoyment that is compatible with preserving its natural and cultural resources. The Seashore's lighthouses are popular sites for visitors, as they provide tangible links to understanding humankind's ability to adapt to a harsh and changing coastal environment in isolation from the mainland. The potential management actions could change the presentation of the structures at the Ocracoke Light Station, ranging from the continuation of the current conditions to elevation of some structures to construction of interpretative structures and materials replacing existing structures. During construction and demolition activities, if any, temporary visitor restrictions may be in place. However, construction would be performed when visitation is low and this impact would be temporary, lasting only during active construction activities. The Double Keepers' Quarters, once repaired, may be used as park housing or as a visitor center, or as both (one side housing and one side a visitor center). The building as a visitor center

would enhance a visitor's experience to the site but would not be at a level that would require further analysis in this environmental assessment, since the site can only accommodate a small number of visitors. If the Double Keepers' Quarters were to become housing, there may be minor aesthetic impacts to the landscape, but occupancy guidelines would mitigate these impacts since residents would be required to maintain the landscape and would not be allowed to store their equipment or personnel items outside on the property. Over the long term, visitor experience would be enhanced from being able to walk around the restored buildings, the potential for being able to enter the Double Keepers' Quarters, and the improved condition of the Lighthouse. Because all the effects would be beneficial, visitor use and experience is dismissed from full analysis.

CHAPTER 2: ALTERNATIVES

This environmental assessment (EA) evaluates three alternatives: the no-action alternative (alternative A) and two action alternatives (alternatives B and C). This chapter describes these alternatives. The alternatives that were considered but dismissed from detailed analysis by an interdisciplinary team are presented in appendix B.

The alternatives present several options for the management of the buildings and structures at the Ocracoke Light Station. The alternatives focus on rehabilitation, which is one of the four approaches to the treatment of historic properties, as defined by the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*. Rehabilitation acknowledges the need to alter or add to a historic property to meet continuing or changing uses while retaining the property's historic character (Grimmer 2017). The alternatives also consider the *Secretary of the Interior's Guidelines on Flood Adaptation for Rehabilitating Historic Buildings 2021*.

In this document, elevations are referenced to North American Vertical Datum 1988, the current vertical datum for the contiguous United States and Alaska. A vertical datum is a zero reference to which elevations are referenced. Further, building elevations are described as the finished floor elevation (FFE).

Common to All Alternatives

Under all alternatives, the Ocracoke Lighthouse would be rehabilitated, which would include the following actions:

- Removing the shotcrete from the exterior of the Lighthouse and replacing it with a coating that will allow appropriate protection of the masonry and moisture control
- Replacing damaged masonry, including replacing bricks and mortar (estimated to be approximately 20% of the existing bricks)
- Repairing or replacing all windows with historically appropriate windows
- Repairing leaks at the top lantern and repaint
- Recoat interior masonry
- Exposing the original stone foundation

In addition to the above actions, the two action alternatives (alternatives B and C) would also include the replacement of the interior metal staircase with a wooden spiral staircase to match the original material and orientation as described in the *Historic Structure Report* (Oppermann 2015).

Alternative A: No-action

Under alternative A (figure 4), ongoing maintenance and storm repairs would be completed, as these are ongoing practices for maintaining the historic structures at the Ocracoke Light Station. The Ocracoke Lighthouse would be rehabilitated as described above, the storm damage to existing buildings at the Ocracoke Light Station (Double Keepers' Quarters, Carpenter's Shop, Store House, Oil House, Generator House, and Privy) would be repaired, and the site would be preserved as-is.

These repairs would address exterior and interior storm damage, and the buildings and structures would be repainted. Lead-based paint would be removed from the structures, mold and mildew would be

removed from the Oil House and Double Keepers' Quarters, asbestos would be removed from the Double Keepers' Quarters if necessary, and the Store House would be reoriented back to its original location. The buildings would be repaired and remain at the existing FFE of 4.8 feet. All repairs would be completed in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*.

Alternative B: Elevate Some Structures (Proposed Action/Preferred Alternative)

Alternative B would elevate some of the structures (Double Keepers' Quarters, Carpenter's Shop, Store House, Privy, and Generator House) at the Ocracoke Light Station; the Lighthouse and Oil House would not be elevated (figure 5). The Ocracoke Lighthouse would be rehabilitated as described in the "Common to All Alternatives" section. The repair of the buildings (Double Keepers' Quarters, Carpenter's Shop, Store House, Oil House, Generator House, and Privy) would include addressing the exterior and interior storm damage, as described under alternative A.

Some existing non-historic trees and vegetation around the structures would be pruned or removed to prepare for construction. The Double Keepers' Quarters would be elevated approximately 4 feet. Before raising the building, the National Park Service would document it in accordance with the *Secretary of the Interior's Standards for Architectural and Engineering Documentation*. The Double Keepers' Quarters would be separated from its foundations, raised on hydraulic jacks, and held by temporary supports while a new foundation is constructed below the building (FEMA 2014). The existing foundation would be removed, and a new foundation would be installed, which could be constructed of materials such as timber pile foundations or masonry brick piers on top of concrete footers. Other architecturally appropriate alterations would be made to generally match the look and feel of the exterior of the building. For example, a masonry foundation wall could be constructed around the new crawl space formed by elevating the Double Keepers' Quarters, and siding material matching the existing or other siding material that meets the *Secretary of Interior's Standards for Treatment* would be installed to conceal the crawl space. The screening material for the crawl space could be brick, wood lattice, or solid breakaway panels; details such as this would be decided as the design is finalized. If a solid masonry foundation wall is selected, either an open pattern or flood vents would be installed to allow the flow of water during flood events, protecting the structure from becoming inundated by floodwater. The Double Keepers' Quarters would have stairs for each of the existing entry points to the structure (figure 5). An elevated Americans with Disabilities Act-compliant wheelchair lift station to meet the floor level of the building would be added to the Double Keepers' Quarters to provide accessibility. A new accessible concrete sidewalk would be added to provide access from the driveway around the side of the Double Keepers' Quarters to the new lift station. Details on the design of the rehabilitation to the Double Keepers' Quarters will be addressed in the ongoing Section 106 consultation. Where appropriate, utilities would be reworked to the elevated structures.

The Store House, Carpenter's Shop, Generator House, and Privy would be elevated approximately 1 to 2 feet on concrete masonry piers with concrete footers. The piers would be masked by historically appropriate material. Stairs and handrails would be constructed to the entrance of the structures; the stairs would be scaled to the size of the structure. The Privy would be relocated south of the existing site where a previous privy was located. The Carpenter's Shop would be shifted 1 to 3 feet westward and the live oak tree adjacent to the Carpenter's Shop would be trimmed to avoid contact with the roof.

The existing Oil House, Cisterns, boardwalk, and driveway would remain in place. The existing paths among the buildings would be replaced in kind. The septic system, leach field, domestic water, and electric lines at the Ocracoke Light Station would remain in place and would be repaired. Following construction, the disturbed areas would be revegetated with vegetation that is suitable for current growing

conditions at the site and compatible with recommendations in the *Ocracoke Light Station Cultural Landscape Report* (Hitchcock 2016).

Alternative C: Ghost Structure

Alternative C would rehabilitate the Ocracoke Lighthouse in place and repair storm damage to the Carpenter’s Shop, Store House, Oil House, Generator House, and Privy, as discussed in the “Common to All Action Alternatives” and “Alternative A: No-action Alternative” sections, respectively. Alternative C would also demolish and replace the Double Keepers’ Quarters with a ghost structure (figure 6). This alternative is proposed because the long-term preservation of the Double Keepers’ Quarters may become challenging in the future. Before removing the structure, the National Park Service would document it in accordance with the *Secretary of the Interior’s Standards for Architectural and Engineering Documentation* for the Historic American Landscapes Survey and the Historic American Buildings Survey. Once removed, the site would be leveled by the placement of suitable imported fill material. The ghost structure of the Double Keepers’ Quarters would most likely be a pavilion with a closed roofline mirroring the existing building. Interpretive materials would be installed, allowing for an educational history of the site, the maritime environment, sea level rise and climate change, and their impact on the Ocracoke Light Station and adjacent village. The photographs below present examples of ghost structures at Independence National Historical Park. The President’s House Site (left) contains the foundations of a house that Presidents Washington and Adams lived and worked in, and Franklin Court (right) contains a steel ghost structure outlining the spot where Benjamin Franklin’s house previously stood.



In addition to exterior and interior storm damage repair, the Carpenter’s Shop, Store House, Generator House, and Privy would be anchored to the ground or placed on piers to elevate them slightly (approximately 1 to 2 feet). The piers would be masked by historically appropriate material. These options could require small concrete footers below grade to which the structures would be anchored. The Carpenter’s Shop would be shifted 1 to 3 feet westward and the live oak tree adjacent to the Carpenter’s Shop would be trimmed to avoid contact with the roof. If the Carpenter’s Shop, Store House, Generator House, Oil House, and/or Privy were to be damaged in the future, they would either be repaired or — if damaged beyond repair — would be demolished and removed and possibly replaced with either a ghost structure, an interpretive sign, or a simple marker placed on the ground. If these buildings were to be demolished and removed, the National Park Service would document the building(s) prior to removal as described above for the Double Keepers Quarters.

The septic system, leach field, Cisterns, and domestic water at the Ocracoke Light Station site would remain in place, and electricity would be maintained to the ghost structure. Following removal of the Double Keepers’ Quarters, disturbed areas would be restored with vegetation that is suitable for current growing conditions at the site and compatible with recommendations in the *Ocracoke Light Station Cultural Landscape Report* (Hitchcock 2016).

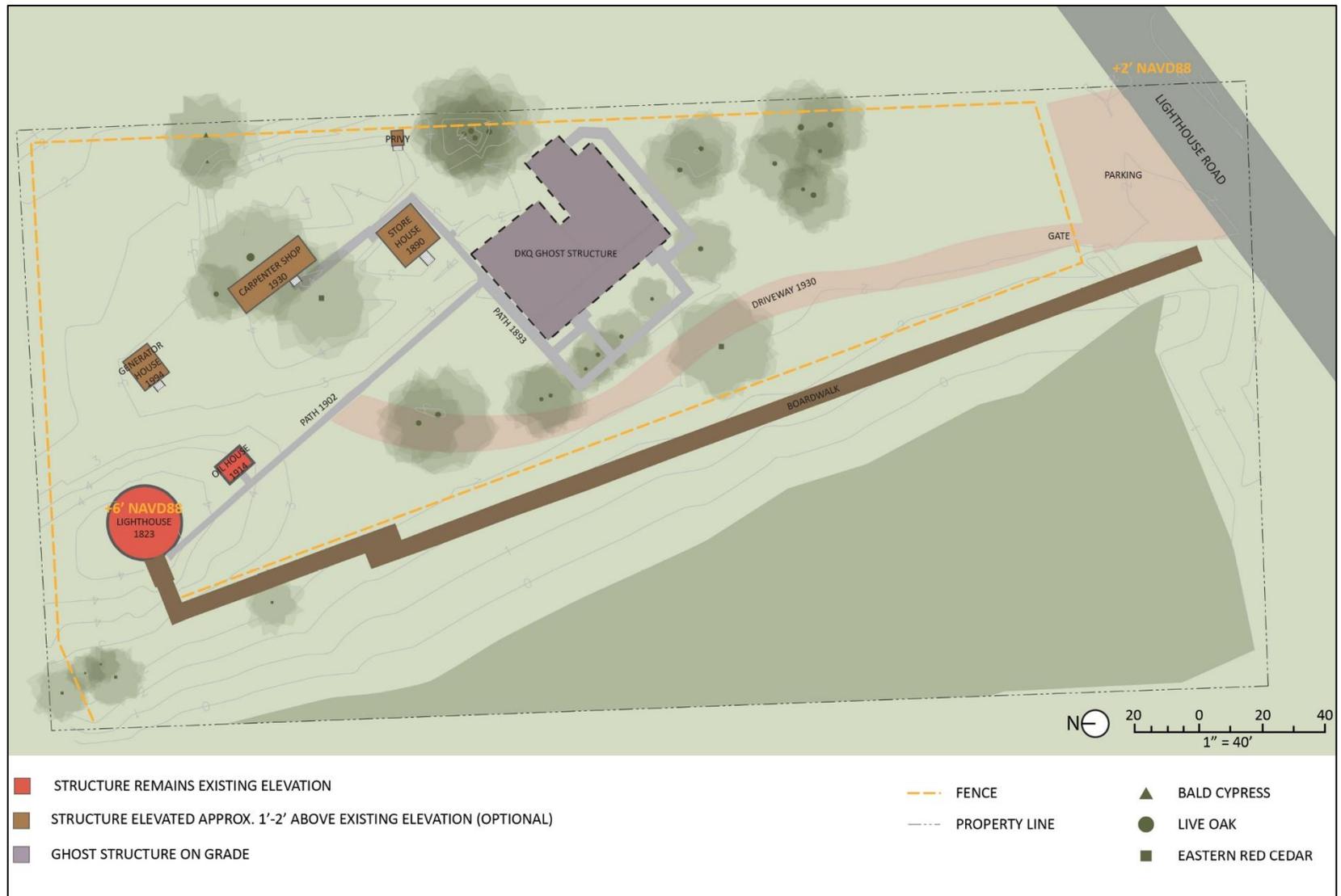
Figure 4. Alternative A – No-action Alternative



Figure 5. Alternative B – Elevate Some Structures



Figure 6. Alternative C – Ghost Structures



Mitigation Measures

To avoid, minimize, and mitigate impacts related to the alternatives, the Seashore would commit to the following measures during the planning and implementation of the Ocracoke Light Station project. Subject to the final design and approval of plans by relevant agencies, mitigation measures would include, but would not be limited to, the items listed below.

- Ground disturbance would be minimized to the extent possible in the vicinity of the Double Keepers' Quarters where there is a potential to encounter artifacts.
- To ensure that construction activities do not have impacts on unknown archeological resources, an archeological monitor would be present during ground-disturbing activities. Should archeological resources be uncovered during construction, work would be halted in the discovery area and Seashore staff would consult with the North Carolina SHPO regarding treatment. The construction contract should anticipate the need for data recovery when considering scope and phasing.
- The National Park Service would continue consultation with the SHPO throughout the final design phases of the project to ensure the project would have no adverse effect on the historic buildings/structures and cultural landscape. The National Park Service would prepare a Programmatic Agreement in consultation with the SHPO. The Programmatic Agreement would stipulate that the later phases of design development would include the professional expertise of a historic architect and historic landscape architect, and plans would be provided for review and comment by SHPO and other interested consulting parties.
- During final design and construction, the National Park Service would follow the guidance of *The Secretary of the Interior's Standards for Rehabilitation and Guidelines on Flood Adaptation for Rehabilitating Historic Buildings*, as well as specific recommendations contained in the *Historic Structures Report* and the *Cultural Landscape Report*, to ensure rehabilitation and adaptation measures do not adversely affect historic buildings and structures and cultural landscapes. An assessment of building condition, existing documentation, and needs for supplemental documentation would be conducted before the implementation of an adaptation strategy. The National Park Service would also include considerations to avoid impacts to the Ocracoke Historic District.
- A historic landscape architect would work as part of the team during the design development and construction phases to identify the vegetation to be removed/trimmed based on designs and identify appropriate replacement vegetation that is suitable for current growing conditions at the site, based on the recommendations in the *Ocracoke Light Station Cultural Landscape Report* (Hitchcock 2016). (The National Park Service anticipates that replanting with existing tree and shrub taxa may be unsuccessful due to the high groundwater table and salt-water intrusion.) A professional arborist would be used to trim and remove trees, where needed, within the project area. A tree and shrub protection plan would also be prepared during the design phase.
- Ground protection mats, or similar, would be placed in the construction and demolition areas to reduce trampling impacts on vegetation from heavy machinery.
- To minimize the risk of invasive species being introduced or spread, all construction vehicles would be washed and inspected before use in the project area.
- During design development, a structural engineer would inspect the Double Keepers' Quarters for soundness with regard to elevating the structure.

- Construction and demolition work would be limited to daylight hours in the project area to avoid night-time noise disruption. Construction equipment would be properly maintained to minimize noise.
- To minimize possible fluid leaks from construction equipment, the contractor would regularly monitor and check construction equipment to identify and repair any leaks.
- Before any work in the Double Keepers' Quarters, an accredited inspector would do testing to determine if asbestos-containing material, lead paint, or other hazardous materials are present.
- The boardwalk would remain open during construction, so visitors could still visit the Ocracoke Light Station. The parking lot would be used as a staging area for construction vehicles and materials. To protect visitors, the parking lot would be fenced during construction.
- Demolition and construction contractor(s) would implement best management practices, such as appropriately handling and disposing of packing materials and other debris to ensure it does not mobilize beyond the construction limits.
- All construction debris would be properly disposed of in an approved landfill.

CHAPTER 3: AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the existing condition of resources retained for analysis that could be impacted by implementing the alternatives and the methods for analyzing impacts. This chapter is organized by resource topic (historic buildings and structures and cultural landscapes) to allow a comparison between the alternatives. The interdisciplinary team considers these topics the key issues that could inform the NPS decision on how to manage the Ocracoke Light Station. The descriptions of the resources provided in this chapter include resource trends and planned actions. They serve as an account of the baseline conditions against which the potential effects of the proposed actions considered in this plan are compared.

Historic Buildings and Structures

Affected Environment

Historic properties at the Seashore range from cemeteries to entire complexes. The Ocracoke Light Station was listed in the NRHP on November 25, 1977. It is significant in the areas of commerce, transportation, and architecture. The Ocracoke Light Station includes the Ocracoke Lighthouse, the Double Keepers' Quarters, the Carpenter's Shop, Store House, Oil House, Generator House, Cisterns, and Privy. The buildings and structures are briefly described below, except for the Generator House, which was constructed in 1994 and is not historic. These descriptions are summarized from the *Ocracoke Light Station Historic Structures Report* (Oppermann 2015). Additional information has been added to describe damage from recent hurricanes and storms.

The Ocracoke Lighthouse was designed and constructed of brick and painted white in 1823. It was coated in shotcrete in 1952. The conical tower wall tapers on both the interior and exterior to the base of the lantern deck. A north-facing access hatch in the wall provides entry out to the 16.5-foot diameter balcony. Atop the wall sits the iron-framed lantern room that houses a fourth-order Fresnel lens installed in 1899. The focal plane of the lens sits at an elevation of about 74 feet. The recessed Lighthouse entrance doorway faces west and is reached by a modern 400-foot-long wood boardwalk completed in 2010. Inside, a modern steel spiral staircase connects the three landings inside of the brick tower. Six windows at varying levels follow the original staircase to the top and provide natural lighting (Oppermann 2015).

The Ocracoke Lighthouse is in poor condition. Unlike the historic limewash coating, the shotcrete exterior does not permit the masonry wall system to 'breathe.' The harder coating traps moisture in the masonry walls causing it to deteriorate, leaving the structure significantly compromised. A vertical crack travels from near the base of the structure more than halfway up the side, which is a sign that the structure and/or foundation may be failing. The rigidity of the shotcrete surface increases the rate of damage to the shell of the Lighthouse from cracking. The existing windows are not adequately sealed from water infiltration to the interior of the structure. Two of the windows have broken and/or missing glass and are currently boarded up. The lantern's metal components at the top of the Lighthouse are deteriorating, leaking, and in need of repair. The original whitewashed interior finish was sandblasted off in the early 1950s. With the removal of this hard-fired protective surface, moisture penetration has increased and has intensified the effects of the freeze-thaw cycle (Croft 2021, Esterline pers. comm.). The FFE of a building provides critical information for understanding flood risk. Allen (2017) documented the FFE of the Ocracoke Lighthouse as approximately 5.8 feet, but a 2020 topographic survey of the site identified the FFE of the Lighthouse as 6.2 feet (Croft 2020).

The Double Keepers' Quarters dwelling has two units, the Keeper's Quarters built in 1823, and the Assistant Keeper's Quarters addition built in 1929. The 1823 Keeper's Quarters is located near the middle

of Ocracoke Light Station. The residence is a two-story, L-shape building with a one-story shed addition inset on the inside angle of the L-shape. A screened porch runs nearly the full width of the front façade. The house has a central hall plan with a living room, dining room, and kitchen. The second floor has three bedrooms and a full bathroom. The 1823 Keeper's Quarters is constructed of brick, and the original plaster walls are extant. The circa-1940s shed addition is wood-framed. The enclosed porch is a one-story addition used for storage and laundry (Oppermann 2015).

The 1929 Assistant Keeper's Quarters was built adjacent to the south wall of the 1823 Keeper's Quarters. The addition is also two stories with a central hall plan. It has a living room, dining room, kitchen, three bedrooms, and a bathroom. The front porch of the 1823 Keeper's Quarters was extended the full length of the west façade of the 1929 Assistant Keeper's Quarters, unifying the two dwellings. A one-story east shed addition was added to the 1929 Assistant Keeper's Quarters during the 1940s and is used as a mudroom (Oppermann 2015).

The Double Keepers' Quarters is currently in poor condition. Past storms have caused floodwaters to enter the building add/or damage building systems under the finished floor. The flooding has damaged the fixtures and electrical system, caused the oak floors to buckle, the ventilation ductwork to be submerged, the plaster walls to crumble, insulation to become saturated, and the foundation to shift (Oppermann 2015). Standing water underneath the building has perpetuated the moisture in the walls and promoted the growth of mold and mildew (Oppermann 2015). The original brick wall, the exterior cedar shake siding, the screened porch, the exterior wood sheathing, and insulation are damaged, and all the exterior windows are performing poorly (Croft 2021, Esterline pers. comm.). Allen (2017) identified the FFE of the Double Keepers' Quarters as approximately 5.8 feet; a 2020 topographic survey of the site identified the FFE of the Double Keepers' Quarters as 4.8 feet (Croft 2020).

The Store House is located just to the northeast of the Double Keepers' Quarters. It is believed to be the oldest of the outbuildings. It measures 16-feet, 3-inches wide by 16-feet deep, and is a single room. It is wood-framed with board-and-batten siding and a wood-shingled gable roof (Oppermann 2015). Storm surge flooding during Hurricane Dorian, of approximately 36 inches, moved the Store House approximately 9 feet southwest of its original location (Croft 2021, Esterline pers. comm.) with an FFE of 4.8 feet.

The Carpenter's Shop is the largest of the outbuildings. The shop is a single room, wood-framed with board-and-batten siding, a shingled gable roof, and a single door. It is approximately 286 square feet (Oppermann 2015). The wood flooring in the Carpenter's Shop is damaged from water infiltration (Croft 2021, Esterline pers. comm.). The FFE of the Carpenter's Shop is approximately 4.8 feet (Croft 2021).

Rainwater, collected off the roof of the Double Keepers' Quarters, was fed from gutters into two Cisterns east of the 1823 Keeper's Quarters. The walls and cap of each Cistern are painted white to match the house. The original Cistern, constructed in 1908, is brick and the latter Cistern is concrete (Oppermann 2015). The construction date of the south Cistern is unknown, but it can be seen in a 1941 aerial image and was recorded on a 1950 plot plan (Hitchcock 2016).

Kerosene was used to illuminate the Lighthouse lamp. The low flashpoint of kerosene necessitated a detached oil storage building. The Oil House was constructed in 1914 of poured concrete and equipped with a cast iron door and wall ventilators. The Oil House housed the backup generator after the Lighthouse was electrified in 1929. The Oil House is 10-feet, 9-inches wide by 7- feet, 6-inches deep, and encloses a single room. It has a low-sloped shed roof and sits on a concrete slab. The original sheet-iron door and cast-iron wall vents are intact but cracked and rusted (Oppermann 2015). The Oil House is constructed at ground level (an FFE of 4.8 feet) (Croft 2021); during Hurricane Dorian, the Oil House was submerged in saltwater (Croft 2021, Esterline pers. comm.).

The two-hole Privy is a single room approximately 5-feet wide by 4-feet deep. It is wood-framed with board-and-batten siding and a wood-shingled shed roof. The wood siding and trim are deteriorating. The structure consists almost entirely of modern materials (Oppermann 2015). The Privy currently at the site was constructed in 2010 and stands in the location of the 1930 Privy. It is constructed at ground level (an FFE of 2.0 feet) (Croft 2021).

Table 1 provides a list of the important character-defining features for each of the historic buildings and structures, as described in Oppermann 2015. During repairs or rehabilitation, these are the features that should be retained to respect the property's significance and integrity.

Table 1. Important Character-Defining Features

Building/ Structure	Important Character-Defining Features
Ocracoke Lighthouse	<ul style="list-style-type: none"> • Historic design of the entry-level door • Original stone/brick entry step beneath the modern wood entrance ramp • Tapering conical brick shell wall of the Lighthouse tower • White paint color of the exterior walls • Historic design of the six-over-six-light wood double sash windows • Brick corbelling supporting the lantern deck balcony • Pargeted stone lantern deck balcony • Offset 1854 lantern • Ferrous-based framing and dome of the lantern • Black paint color of the lantern • Trapezoidal window design of the lantern • Vented finial crowning the lantern dome • Cemented patches where the original wood staircase attached to the exterior wall • Domed ceiling supporting the lantern room • 1890s fourth-order Fresnel lens in the lantern room • Three brass vents in the masonry wall of the lantern room • Steel floor hatch providing entry into the lantern room • Cast-iron door providing entry to the lantern balcony • Design of the historic iron post-and railing system of the lantern balcony
Original Keeper's Quarters (1823, 1897, 1929, 1940, 1950)	<ul style="list-style-type: none"> • Original brick walls of the first floor • Wood mantels in Rooms 101 and 103 • Wood four-panel interior doors and remaining early door hardware • Wood-shingled second-story exterior walls • Board-and-batten interior walls • Historic design of the six-over-six-light wood double sash windows • 3-inch-wide pine flooring on the second floor • Southeast shed addition • Screened-in front (east) porch • Brick chimneys with corbelled caps • Wood staircase • Ceramic tiled second-floor bathroom • 2.25-inch-wide oak flooring of the first floor

Building/ Structure	Important Character-Defining Features
Assistant Keeper's Quarters (1929)	<ul style="list-style-type: none"> • Stuccoed first-story exterior walls • Wood-shingled second-story exterior walls • Cornice molding delineating the first and second stories • Historic design of the six-over-six-light wood double sash windows • Multi-light quarter-round attic-level windows on the gable ends • Gable roof • Brick chimneys with corbelled caps • Screened-in west porch • Original fifteen-light wood sash doors • Original five-horizontal panel wood doors • Original door hardware • Original 2.5-inch-wide pine flooring • Ceramic tiled second-floor bathroom
All Outbuildings	<ul style="list-style-type: none"> • Proximity of the outbuildings and ancillary structures to the Lighthouse and the Double Keepers' Quarters
Carpenter's Shop	<ul style="list-style-type: none"> • Board-and-batten cladding • Shingled gable roof • Exposed framing of the interior • Fenestration and sash pattern
Store House	<ul style="list-style-type: none"> • Board-and-batten cladding • Wood shingled gable roof • Fenestration and sash pattern • Open-stringer wood entrance steps • 2.5- to 3-inch-wide tongue-and-groove floorboards • Interior beaded-board wall and ceiling cladding
Oil House	<ul style="list-style-type: none"> • Poured-in-place concrete walls and roof • Original sheet-iron door • Original cast-iron wall vents • Fenestration and sash pattern • Pargeted interior walls and faux painted baseboard
Privy	<ul style="list-style-type: none"> • Historic design and proportion of the exterior, based on an earlier outbuilding in the same location • Board-and-batten cladding • Wood shingled shed roof • Historic design of the two-hole Privy seat
Cisterns	<ul style="list-style-type: none"> • Pargeted brick walls of the earlier northern Cistern • Cast-in-place walls of the later southern Cistern • Cast-concrete sloped lids of both Cisterns

Historic Buildings and Structures Impacts Analysis

For the purposes of NEPA, this analysis focuses on the potential impacts of the proposed action and alternatives to the individual historic buildings and structures and their features. The geographic area for the project is defined as the Ocracoke Light Station site and the viewshed.

When assessing impacts to historic buildings and structures, the National Park Service considers the potential changes to the integrity, spatial relationship, and character-defining features of contributing elements of the historic buildings and structures. Impacts are considered to be adverse if the action may alter any of the characteristics of a historic building or structure that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association (36 Code of Federal Regulations [CFR] 800.5).

Impacts of Alternative A: No-action Alternative. Under alternative A, the Ocracoke Lighthouse would be rehabilitated as described in chapter 2. The rehabilitation of the Lighthouse would result in a beneficial effect on this structure by restoring the integrity of the structure and preventing additional deterioration of the Lighthouse's features. At its current FFE, the Lighthouse elevation should be sufficient to prevent flooding from sea level rise and storm flooding for the foreseeable future.

The exterior and interior storm damage to existing buildings and structures at the Ocracoke Light Station (Double Keepers' Quarters, Carpenter's Shop, Store House, Oil House, Cisterns, and Privy) would be repaired as needed, and the site would be preserved as-is. Repairs would address the storm damage. The buildings and structures would be repaired and remain at their respective existing FFE.

The National Park Service would continue to manage the Double Keepers' Quarters, Carpenter's Shop, Store House, Oil House, Cisterns, and Privy as it does currently to allow for continued use. Minimal repairs and maintenance efforts would sustain the historic buildings and structures near their existing state of integrity. However, changes are occurring in the frequency, intensity, and timing of flooding due to sea level rise and storm surge. Future storm events and flooding could stress historic structures beyond the conditions in which they were built, so action to adapt to that risk would be needed. Otherwise, potential loss is anticipated.

Impacts of Alternative B: Elevate Some Structures (Proposed Action/Preferred Alternative). Under alternative B, the Ocracoke Lighthouse would be rehabilitated as described in chapter 2. In addition, alternative B would include the replacement of the interior metal staircase. Effects to the Lighthouse would be similar to those described for alternative A with the additional beneficial effect of replacing the interior staircase with a wooden spiral staircase to match the original material and orientation.

Under alternative B, the Double Keepers' Quarters, Carpenter's Shop, Store House, and Privy, would be raised onto higher foundations. The Generator House would also be raised; however, it is not a historic structure or a contributing resource to the district. The Cisterns and the Oil House would not be raised. This adaptation treatment can generally protect a historic building from any type of flooding if the water does not reach the new FFE (Eggleston, Parker, and Wellock 2021). The *Secretary of the Interior's Standards for Rehabilitation and Guidelines on Flood Adaptation for Rehabilitating Historic Buildings* states the following with regards to elevating buildings:

This adaptation method involves raising the height of a building by lifting the building from the existing foundation, constructing a higher foundation, and resetting the building on the new base. While this is one of the most common solutions for addressing flood risk, the historic character and appearance of the building can be considerably impacted when the change in height of the new foundation is significantly different from the original height. Elevating a building on a new

foundation can greatly affect the historic character and integrity of the building, and any associated historic district, if not carefully planned and considered.

The size, scale, height, and massing of a building will affect how much change in height may be acceptable without impacting the historic character of the property. Generally, there is less perceived impact on the character of a historic building when the proportional and massing relationships of the foundation to the body of the building and the overall vertical or horizontal emphasis of the building are maintained.

Raising the Double Keepers' Quarters, Carpenter's Shop, Store House, Privy, and Generator House would reduce the risk of flooding and inundation. As noted in the Climate Change section of chapter 1, sea level rise at the Ocracoke Light Station is projected to increase 2 to 3 feet over the next 50 years (Allen 2017). The proposed elevation would make the buildings and structures more resilient to future storm and flooding events.

The effect of the elevation rise would be reduced through the design and materials that would be compatible with the building/structure without detracting from the historic character and would avoid impacting the character-defining features. Stairs and handrails, scaled to the size of the structure, would be added to each of the elevated buildings/structures. The Double Keepers' Quarters and Store House already have stairs, so this would not be a new element. The installation of the wheelchair lift station on the Double Keepers' Quarters would remove a section of the porch railing and install a new door in the screened-in porch. The accessible lift system could easily be removed at a later date if needed, so the addition and changes, including the new accessible path to the lift, are reversible and would not result in an adverse effect, since they would not alter the important character-defining features of the Double Keepers' Quarters. To preserve the largest and most predominant live oak tree at the site, the Carpenter's Shop would be shifted 1 to 3 feet westward before elevating. One large limb of this live oak tree would need to be trimmed to avoid contact with the roof during elevation. These changes would minimally impact the individual structure and the tree but would not alter the character-defining features of the structure. The Privy would be moved south to one of the original locations and elevated between 1 and 2 feet. Since the Privy has been replaced and moved several times over the years, this would not have an effect on the character-defining features of the individual structure and would have a beneficial effect on the overall historic property's setting.

The rehabilitation and resiliency actions and measures proposed under alternative B would not alter the character-defining features of the individual buildings and structures that comprise the historic property. The impacts described above would not be to a scale that would disqualify the property for inclusion in the NRHP. As stated in chapter 2, Mitigation Measures, the National Park Service would continue consultation with the SHPO throughout the final design phases of the project to ensure the project would have no adverse effect on the historic property. Therefore, the effects of alternative B would not be considered as adverse.

Impacts of Alternative C: Ghost Structures. Under alternative C, the Ocracoke Lighthouse would be rehabilitated as described in chapter 2 and the effects would be the same as described for alternative B.

The Carpenter's Shop would be shifted 1 to 3 feet westward and a live oak tree next to the structure would be trimmed. As described for alternative B, these changes would result in an effect on the individual structure and the tree. The Carpenter's Shop, Store House, Oil House, and Privy would either be anchored to the ground or elevated slightly (1 to 2 feet) on piers. If these structures are elevated, the impacts from future flood damage and sea level rise would be as described for alternative B — these structures would be more resilient than at their current elevation, and elevating them would not alter the character-defining features of the individual buildings and structures that comprise the historic property.

If these structures are anchored to the ground, they would be susceptible to future flood damage caused by climate change and sea level rise. As the frequency, intensity, and the flooding increases due to sea level rise and storm surge, the historic structures would be stressed beyond the conditions in which they were built, so action to adapt to that risk would be needed. Otherwise, potential loss is anticipated, resulting in an adverse effect due to the eventual loss of the structures. If damage occurs to these structures that is determined to be beyond repair, the structures would be demolished and possibly replaced with ghost structures, interpretive signs, or markers. The characteristics that qualify these structures for inclusion in the NRHP would no longer exist, and the integrity of the property's location, design, setting, materials, workmanship, feeling, or association would be destroyed. Depending on the extent of the damage and number of structures to be demolished, this could result in an adverse effect on this historic property.

The Double Keepers' Quarters would be demolished and replaced with a ghost structure. The characteristics that qualify this building for inclusion in the NRHP would no longer exist, and the integrity of the property's location, design, setting, materials, workmanship, feeling, or association would be destroyed. This would result in an adverse effect on this historic property and on the district to which it contributes.

Before removing any historic structure, the National Park Service would document it in accordance with the *Secretary of the Interior's Standards for Architectural and Engineering Documentation* for the Historic American Landscapes Survey and the Historic American Buildings Survey.

Conclusion for Historic Buildings and Structures. All of the alternatives would result in beneficial effects to the Ocracoke Lighthouse. Implementation of alternative A would result in adverse effects to the remaining historic buildings and structures, as the features fail or are destroyed due to repeated inundation from future floodwaters. As the important character-defining features are lost, the integrity of the individual structures would be diminished or lost, and the structures would no longer qualify for inclusion in the NRHP. The repairs and elevation rise under alternative B would be constructed to be compatible with the historic materials in terms of design, color, and texture and be in accordance with the *Secretary of Interior Standards for Rehabilitation*. The overall integrity and character-defining features for the Double Keepers' Quarters, Store House, Carpenter's Shop, and Privy would be minimally affected. The overall relationship of the buildings to each other within the setting is more important than keeping the buildings at the same elevation. The characteristics that qualify these buildings for inclusion in the NRHP would not be diminished, and the integrity of the property's location, design, setting, materials, workmanship, feeling, and association would remain relatively intact. Shifting the Carpenter's Shop and trimming the largest and most predominant live oak tree at the site would have a minimal effect on the Ocracoke Light Station setting; however, the scale of the change would not diminish the integrity of the structure or disqualify the property for inclusion in the NRHP. The Privy would be moved to an original location and elevated 1 to 2 feet. This would not have an effect on the character-defining features of the individual structure and would have a beneficial effect on the overall setting. Under alternative C, the adverse effects to the Double Keepers' Quarters would be immediate and permanent. If the support structures are elevated, it would not alter the character-defining features of the individual structures, and the structures would be more resilient than at their current elevation. If the support structures are not elevated, some of the additional character defining features of these contributing resources that qualify this property for inclusion in the NRHP may also be lost. The integrity of the property's design, setting, materials, workmanship, feeling, and association of the property would be altered or destroyed. This would also have an adverse effect on the setting and viewshed of the Ocracoke Historic District.

Cultural Landscapes

Affected Environment

Cultural landscapes are places that illustrate human manipulation and adaptation of the land. A cultural landscape report, *Ocracoke Light Station Cultural Landscape Report, Cape Hatteras National Seashore* (Hitchcock 2016), has been prepared for this site. This report defines the Ocracoke Light Station Cultural Landscape as including the historic buildings and structures described above plus the addition of contributing landscape characteristics and features. These characteristics and features include spatial organization, site circulation, topography, vegetation, and views and vistas.

The spatial pattern of the Lighthouse and support buildings and structures comprising the cultural landscape are dominated by a central northeast to southwest axis aligned with the Double Keepers' Quarters and a cross-axis on the northwest. The historic circulation system links the Lighthouse, Double Keepers' Quarters, and historic outbuildings. Contributing features of the circulation include the concrete walkways and the driveway. The enclosing picket fence and historic vegetation patterns are also features of the cultural landscape. (Hitchcock 2016).

Topographic changes are part of the cultural geography of the Outer Banks of North Carolina. The opening and closing of inlets, which permit water to flow through the banks between the ocean and the sound, is common. It was typical to site lighthouses on coastal high points to be seen by vessels out at sea. The station was also known to be a high spot by villagers who sought refuge in the Double Keepers' Quarters during storms, sometimes arriving by boat. The higher elevation of the Ocracoke Light Station is a contributing feature of the cultural landscape (Hitchcock 2016).

The landscape is characterized by mature live oak and eastern red cedar trees around the dwelling, open ground around the Lighthouse, areas of grass throughout most of the site, and marsh/wetland along the western half of the site. Contributing vegetation includes the lawn, native marsh grasses, mature live oaks, eastern red cedars, and two bald cypresses (Hitchcock 2016). Most trees at the site are in fair to poor condition, damaged by storms and flooding.

Views from the Lighthouse of the marsh and Pamlico Sound beyond and views of Silver Lake to the north are contributing features to the cultural landscape. The sightlines along the primary northeast axis and the northwest cross axis are also contributing features (Hitchcock 2016).

There are also small-scale features that contribute to the historic landscape. They include the wooden picket fence, wooden enclosure for two metal trash cans, metal yard hydrant, and a boundary marker located in the northeast corner of the property (Hitchcock 2016).

Table 2 provides a list of the historic buildings and structures and the contributing features of the cultural landscape. This table is modified from the table in appendix A of the *Ocracoke Light Station Cultural Landscape Report* (Hitchcock 2016).

Table 2. Contributing Resources and Features in the Cultural Landscape

Feature	Construction Date
Ocracoke Lighthouse	1823
Double Keepers' Quarters	1823 and 1929
Carpenter's Shop	1930
Store House	1890

Feature	Construction Date
Concrete Oil House	1914
Privy	1823
Cisterns	1893-1916
Spatial pattern between buildings	1823
Concrete sidewalks	1916-1929
Driveway into station	1897
Higher elevation of the Ocracoke Light Station	1823
Open expanse of lawn	1823
Native marsh grasses	1823
Pattern of live oak, cedars, and bald cypress	1890s for some live oaks
Sightlines along a central northeast to southwest axis aligned with the Double Keepers' Quarters and a cross-axis northwest	1823
Views to the Pamlico Sound	1823
360-degree view from the top of Lighthouse	1823
Views of Silver Lake	1823
Hydrant	Unknown
Boundary marker	1823

Noncontributing structures and features within the landscape boundaries include the 400-foot wooden boardwalk and wooden ramp extension, parking area, and Generator House. Various NPS staff living in the Double Keepers' Quarters have planted ornamental plants in the beds adjacent to the Double Keepers' Quarters and Store House. These ornamental plants are not historic but include the following: hollies (*Ilex* spp.), hydrangea (*Hydrangea macrophylla*), azalea (*Rhododendron* cvs.), loquat (*Eriobotrya japonica*), gladiolus (*Gladiolus* cvs.), thorny elaeagnus (*Elaeagnus pungens*), lantana (*Lantana camera*), rose (*Rosa* cvs.), rosemary (*Rosmarinus officinalis*), daylilies (*Hemerocallis* cvs.), black-eyed Susan (*Rudbeckia* sp.), Morning Glory (*Ipomoea* sp.), and a chinaberry (*Melia azederach*) volunteer (Hitchcock 2016). The modern trash cans, waysides and signage, bollards, bicycle rack, and purple martin (*Progne subis*) house are also non-contributing.

Ocracoke Light Station is also part of the Ocracoke Historic District. The district encompasses 228 contributing buildings, 15 contributing sites, and 4 contributing structures on Ocracoke Island in Ocracoke village. The district includes notable examples of Late Victorian, Shingle Style, Bungalow/American Craftsman, and Coastal Cottage style architecture dating from about 1823 to 1959. A number of the houses were constructed from salvaged ship timbers.

Cultural Landscapes Impacts Analysis

For the purposes of NEPA, this analysis focuses on the potential impacts of the proposed action on the cultural landscape, including the contributing resources and features (table 2). When assessing impacts to historic properties, the National Park Service considers the potential changes to the integrity, spatial relationship, and character-defining features of contributing elements of the cultural landscape. Impacts are considered to be adverse if the action may alter any of the characteristics of a cultural landscape that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association (36 CFR 800.5).

Because the Ocracoke Light Station is part of the Ocracoke Historic District, the National Park Service also considers how the proposed actions may change the viewshed within the entire historic district.

Impacts of Alternative A: No-action Alternative. Under the no-action alternative, the Ocracoke Lighthouse would be rehabilitated as described in chapter 2, resulting in a beneficial effect by restoring the integrity of the structure and preventing additional deterioration of the primary cultural landscape resource. At its current FFE, the elevation should be sufficient to prevent flooding from sea level rise and storm flooding for the foreseeable future.

The storm damage to other existing buildings and structures at the Ocracoke Light Station (Double Keepers' Quarters, Carpenter's Shop, Store House, Oil House, Cisterns, and Privy) would be repaired as needed, and the site would be preserved as-is. Building/structure repairs would address the storm damage and perform abatement for lead-based paint. Mold and mildew would be removed from the Oil House and Double Keepers' Quarters, and the Store House would be reoriented back to its original location. The buildings and structures would be repaired and remain at their existing FFE.

The National Park Service would continue to manage the Double Keepers' Quarters, Carpenter's Shop, Store House, Oil House, Generator House, Cisterns, and Privy as it does currently to allow for continued use. Minimal repairs and maintenance efforts would sustain the historic buildings, structures, and landscape features near its existing state of integrity, but these resources would continue to be degraded by flooding events, which would cause additional damage to building materials, ground erosion, and destruction of landscape features, including the Cisterns, sidewalks, driveway, lawn, grasses, and trees, resulting in a loss of historic fabric. The frequency, intensity, and timing of flooding are increasing due to sea level rise and storm surge. The historic structures would be stressed beyond the conditions in which they were built, so action to adapt to that risk would be needed. Otherwise, potential loss is anticipated. The cultural landscape would be retained with minimal change for a period of time. However, over time, the integrity of workmanship, materials, and feeling would be adversely impacted as the materials deteriorate, vegetation dies, and the buildings and structures fail or be destroyed. These changes would be of a scale that would disqualify the property for inclusion in the NRHP, and therefore, result in adverse effects to the cultural landscape. The viewshed into the Ocracoke Light Station from other parts of the district would be retained for a period of time; however, over time, the viewshed would change as most of the buildings and structures are lost. This would result in an adverse effect on the historic district.

Impacts of Alternative B: Elevate Some Structures (Proposed Action/Preferred Alternative). Under alternative B, the Ocracoke Lighthouse would be rehabilitated as described in chapter 2. Effects to the Lighthouse would be similar to those described for alternative A with the additional beneficial effect of replacing the interior staircase with a wooden spiral staircase to match the original material and orientation. Under alternative B, Double Keepers' Quarters, Store House, Carpenter's Shop, and Privy would be raised onto a higher foundation. The Generator House would also be raised; however, it is not a contributing resource to the district. This adaptation treatment would follow the *Secretary of the Interior's Flood Adaptation Guidelines for Rehabilitating Historic Buildings* and protect the historic buildings and structures from future flooding and inundation. The visual effects of the elevation rise for the Double Keepers' Quarters, Store House, Carpenter's Shop, Privy, and Generator House, would be reduced through the design and materials used to blend the new foundation with the existing structures. Stairs and handrails, scaled to the size of the structure, would be added to each of the elevated buildings and structures. The Double Keepers' Quarters and Store House already have stairs so this would not be a new addition. Shifting the Carpenter's Shop and trimming the largest and most predominant live oak tree at the site would have a minimal effect on the cultural landscape's setting; however, the scale of the change would not diminish the integrity of the landscape or disqualify the property for inclusion in the NRHP. The Privy would be moved to an original location. This would have a beneficial effect on the overall historic setting. The spatial patterns between buildings and structures, the pathways and circulation,

vegetation types and patterns, the higher elevation of the Ocracoke Light Station, sightlines, and views to the surrounding district would all be retained, and the integrity of the landscape would not be diminished or the property disqualified for inclusion in the NRHP. The rehabilitation and resiliency actions and measures under proposed under alternative B would not alter the contributing resources or features that comprise the cultural landscape.

In the long-term, adverse effects to the cultural landscape setting would likely occur from flooding, saltwater inundation, and erosion. The frequency, intensity, and timing of flooding are increasing due to sea level rise and storm surge. The cultural landscape features, including the Cisterns, sidewalk, driveway, lawn, mature trees, and grasses, would be stressed beyond the conditions in which they can survive, so action to adapt to that risk would be needed; however, such actions are not proposed as part of this alternative. Otherwise, potential loss is anticipated. These changes would have an adverse effect on the integrity of the setting of the cultural landscape.

The Ocracoke Historic District would not be adversely affected by the actions under alternative B. Within the Ocracoke Historic District, many other buildings and structures have already been altered (e.g., adapted for elevation) to make the buildings/structures more resilient to future storm events, flooding and other impacts associated with climate change and sea level rise. As such, the relationship among buildings and structures within the district continues to change relative to similar threats. Many of the contributing resources or features of the cultural landscape (table 2) would be retained. These include the higher elevation of the Ocracoke Light Station to the surrounding area, the Lighthouse, the open expanse of lawn, the native marsh grasses, and many others. The overall views of the Ocracoke Light Station would be similar as they are today, and any noticeable elevation changes to the buildings and structures would diminish the farther the viewing distance. The views from within the Ocracoke Light Station to other parts of the historic district would not be affected by the changes proposed as part of alternative B.

Impacts of Alternative C: Ghost Structures. Under alternative C, the Ocracoke Lighthouse would be rehabilitated, resulting in beneficial effects.

The Double Keepers' Quarters is the second most prominent building on the site and a contributing resource. Under alternative C, the Double Keepers' Quarters would be demolished and replaced with a ghost structure. Therefore, some of the contributing resources that qualify this cultural landscape for inclusion in the NRHP would no longer exist, and the integrity of the property's design, setting, workmanship, feeling, and association would be diminished. This would result in an adverse effect on the cultural landscape and could result in adverse impacts to a scale that would disqualify the property for inclusion in the NRHP.

The Carpenter's Shop would be shifted westward 1 to 3 feet and a live oak tree next to the structure would be trimmed. As described for alternative B, these changes would result in a minimal impact on the individual structure and the tree; however, moving the Carpenter's Shop would not result in an effect to the landscape that would disqualify the property for inclusion to the NRHP, since its relationship to the site and other buildings and structures, as well as its place in with respect to the contributing qualities of site circulation, views, and sightlines would be retained. The Carpenter's Shop, Store House, Oil House, and Privy would either be anchored to the ground or elevated slightly (1 to 2 feet) on piers. Similar to alternative B, if these structures are elevated, the integrity of the landscape would not be diminished, or the property disqualified for inclusion in the NRHP. Elevating the structures would not alter the contributing resources or features that comprise the cultural landscape. If these structures are anchored to the ground, they would be susceptible to future flood damage caused by climate change and sea level rise. If damage occurs to these structures that is determined to be beyond repair, the structures would be demolished and possibly replaced with ghost structures. The characteristics that qualify these structures for inclusion in the NRHP would no longer exist, and the integrity of the property's location, design,

setting, materials, workmanship, feeling, or association would be destroyed. Depending on the extent of the damage and number of structures to be demolished, this could result in an adverse effect on this historic property.

In the long-term, adverse effects to the cultural landscape setting would likely occur from flooding, saltwater inundation, and erosion. The frequency, intensity, and timing of flooding are increasing due to sea level rise and storm surge. The cultural landscape features, including Cisterns, sidewalk, driveway, lawn, mature trees, and grasses, would be stressed beyond the conditions in which they can survive, and if no actions are taken to adapt to that risk, potential loss is anticipated. These changes would have an adverse effect on the setting of the cultural landscape.

The Ocracoke Historic District described the Ocracoke Light Station as “the oldest documented historic building and the most famous landmark on the island” (Keller, et al. 1990). The removal of the Double Keepers’ Quarters, and potentially other buildings and structures and the mature trees that screen some views of the property, would have noticeable changes to the views from and to the Ocracoke Light Station. This would result in an adverse effect on the historic district.

Conclusion for Cultural Landscapes. All of the alternatives would result in beneficial effects to the Ocracoke Lighthouse. Implementation of alternative A would result in adverse effects to the remaining cultural landscape buildings, structures, and contributing resources as the features fail or are destroyed. The repairs and elevation rise under alternative B would be constructed to be compatible with the historic materials in terms of design, color, and texture and be in accordance with the *Secretary of Interior Standards for Rehabilitation*. The overall integrity and contributing resources of the cultural landscape would be minimally affected. The overall relationship of the buildings and structures to each other within the setting would be maintained. The characteristics that qualify this landscape for inclusion in the NRHP would not be diminished, and the integrity of the property’s locations, designs, settings, materials, workmanship, feeling, and association would remain relatively intact. Shifting the Carpenter’s Shop and trimming the largest and most predominant live oak tree at the site would have a minimal effect on the landscape setting; however, the scale of the change would not diminish the integrity of or disqualify the property for inclusion in the NRHP. The Privy would be moved to an original location. This would have a beneficial effect on the overall setting. Alternative C would result in beneficial (Lighthouse) and adverse (Double Keepers’ Quarters) effects to the primary contributing resources of the cultural landscape. The adverse effects on the cultural landscape would be immediate and permanent. Elevating the support structures would retain the integrity of the landscape. If the support structures are not elevated, some of the additional contributing resources that qualify this landscape for inclusion in the NRHP may also be lost. The integrity of the property’s design, setting, materials, workmanship, feeling, and association would be altered or destroyed. This would result in an adverse effect on this cultural landscape and could result in the changes to the landscape disqualifying the property for inclusion in the NRHP.

The Ocracoke Historic District described the Ocracoke Light Station as “the oldest documented historic building and the most famous landmark on the island” (Keller, et al. 1990). The removal of the Double Keepers’ Quarters, and potentially other buildings and mature trees, would have noticeable changes to the views from and to the Ocracoke Light Station. This would result in an adverse effect on the historic district.

CHAPTER 4: CONSULTATION AND COORDINATION

This chapter summarizes the consultation and coordination process for the Ocracoke Light Station project.

Public Participation

Civic Engagement. The National Park Service initiated stakeholder meetings beginning in February 2021 with the State Historic Preservation Office, Hyde County, Outer Banks Lighthouse Society, Ocracoke Preservation Society, and the US Coast Guard. The NPS presented the preliminary alternatives through two civic engagement meetings one in-person and one virtual on May 6 and 10, 2021.

Public Review. The EA will be on formal public and agency review for 30 days and has been distributed to a variety of interested individuals, agencies, and organizations. It also is available on the internet at https://parkplanning.nps.gov/CAHA_ocracoke_lightstation, and hard copies are available by request.

Agency Consultation

National Historic Preservation Act, Section 106. As required by Section 106 of the NHPA, the Seashore consulted with the North Carolina SHPO through a notification provided in February of 2021. The SHPO responded on March 24, 2021, stating they concur that the undertaking will affect the historic property and look forward to providing meaningful comments. In addition, the Seashore provided notification to the Coast Guard, as well as via letter to the Outer Banks Lighthouse Society (April 21, 2021) and Ocracoke Preservation Society (April 21, 2021). Recently, the Seashore had an update meeting with the SHPO to provide an outline of the alternatives discussed in the environmental assessment (November 30, 2021).

List of Preparers

National Park Service, Cape Hatteras National Seashore

Dave Hallac, Superintendent
Sabrina Henry, Environmental Protection Specialist (on detail with the NPS Region 2, Storm Recovery Team from June 2020 to 2021)
Scott Babinowich, Chief of Interpretation
Jami Lanier, Cultural Resources Manager/Historian

National Park Service, Region 2, Storm Recovery Team

Darrell Stone, Project Manager
Byron Tsang, Ecologist
Linda York, Regional Coastal Geomorphologist
Pam Baughman, Section 106 Specialist
Anne Finney, Historian
Paul (Philip) Alimia, NEPA Specialist
Stephen Lacey, Archeologist

National Park Service, South Atlantic Gulf Region 2

Jami Hammond, Regional Environmental Coordinator

Croft and Associates

David Esterline, Project Manager
Ed Setzler, Value Analysis Facilitator
Marysia LaRosa, Senior Architectural Designer

EA Engineering, Science, and Technology, Inc., PBC

Suzie Boltz, Compliance Lead/Senior Scientist
Jayne Aaron, Cultural Resource Specialist
Anita Struzinski, Environmental Scientist

REFERENCES

- Allen, T.R.
- 2017 *Identify Cultural Resources Sites Affected by Sea Level Rise at Cape Hatteras National Seashore*. Prepared by Eastern Carolina University. Final Report to US National Park Service for Piedmont-South Atlantic Cooperative Ecosystems Studies Unit. January.
- Brock, T.J.
- 2017 *Cultural Resource Monitoring for Geotechnical Boring Ocracoke Passenger Ferry Terminal*.
- Croft and Associates (Croft)
- 2020 *Ocracoke Light Station Topographic and Subsurface Utility Survey* (NAVD88).
- 2021 Email from David Esterline (Croft and Associates) with notes on current conditions of the facilities at the Ocracoke Light Station based on visual observations while on site, review of the Historic Structure Report, and from the PMIS statements provided by the Seashore. April 28, 2021.
- Eggleston, J., J. Parker, and J. Wellock
- 2021 *The Secretary of the Interior's Standards for Rehabilitation and Guidelines on Flood Adaptation for Rehabilitating Historic Buildings*. US Department of the Interior National Park Service, Technical Preservation Services, Washington, DC.
- Federal Emergency Management Agency (FEMA)
- 2014 *Homeowner's Guide to Retrofitting: Six Ways to Protect Your Home from Flooding, Third Edition*.
- 2020 "FEMA's National Flood Hazard Layer (NFHL) Viewer." Available online at <https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd>. Accessed January 2021.
- Grimmer, A.E.
- 2017 *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings*. Revised. US Department of the Interior, National Park Service. Technical Preservation Services, Washington, DC.
- Hammersten
- 1991 *NPS Trip Report for CAHA Housing Project*. (SEAC ACC # 904, 913, 914). May.
- Hitchcock, S.
- 2016 *Ocracoke Light Station Cultural Landscape Report, Cape Hatteras National Seashore*. National Park Service. National Park Service Southeast Region, Cultural Resources, Partnerships & Science. January.
-

Imashima, Paul Y.

- 1987 Archeological Monitoring Report, Sand Removal and Utility Trench Excavation at Ocracoke Light Station Keeper's Quarters, NPS, DSC, Applied Archaeological Center, MD.

Keller, G., T. Keller, and M.R. Little

- 1990 National Register of Historic Places Registration Form, Ocracoke Historic District.

National Oceanographic and Atmospheric Administration (NOAA)

- 2021 "Sea Level Rise Viewer." Available online: <https://coast.noaa.gov/slr/#/layer/slr>. Accessed March 15, 2021.

National Park Service (NPS)

- 2002 Directors Order 77-1: *Wetland Protection*. October.
- 2003 Directors Order 77-2: *Floodplain Management*. September.
- 2006 *NPS Management Policies 2006*.
- 2015 *National Park Service NEPA Handbook*. September 2015.
- 2020 Wetland delineation report for Cape Hatteras National Seashore and related compliance notes for PMIS 254061, PEPC 96021 "Repair Ocracoke Lighthouse and Double Keepers Quarters (Florence)"

Oppermann, J.K.

- 2015 *Ocracoke Light Station Historic Structures Report, Cape Hatteras National Seashore*. National Park Service. December.

Sweet, W.V., B.D. Hamlington, R.E. Kopp, C.P. Weaver, P.L. Barnard, D. Bekaert, W. Brooks, M. Craghan, G. Dusek, T. Frederikse, G. Garner, A.S. Genz, J.P. Krasting, E. Larour, D. Marcy, J.J. Marra, J. Obeysekera, M. Osler, M. Pendleton, D. Roman, L. Schmied, W. Veatch, K.D. White, and C. Zuzak

- 2022 *Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines*. NOAA Technical Report NOS 01. National Oceanic and Atmospheric Administration, National Ocean Service, Silver Spring, MD, 111 pp.

Swindell, E.C.

- 2009 *SEAC-02254, Phase I Archaeological Survey of Proposed Waste Water Drain Field at Ocracoke Island*.

Thompson, T.A.

- 1977 *SEAC-00386, Archaeological Resources at The Cape Hatteras National Seashore - A Management Study*.

US Environmental Protection Agency (USEPA)

- 2020 "National Wetlands Inventory, Wetlands Mapper." Available online: <https://www.fws.gov/wetlands/data/mapper.html>. Accessed January 2021.

APPENDIX A: CULTURAL RESOURCE INVESTIGATIONS NEAR THE
OCRACOCKE LIGHT STATION

Table A-1. Previous Cultural Investigations near Project Area

Report Title	Author, Year	Sites	Area Covered	Comments
<i>Archaeological Resources at The Cape Hatteras National Seashore — A Management Study</i>	Timothy A. Thompson July 1977	3 shipwrecks along the coast 1 prehistoric site near the Lighthouse	Entire beach strand	Shipwrecks are spread along the coast.
<i>Phase I Archaeological Survey of Proposed Wastewater Drain Field at Ocracoke Island</i>	E. Clay Swindell 2009	No sites	60 feet by 106 feet	This proposed drain field is located near the Lighthouse.
<i>Trip Report for CAHA Housing Project</i>	Hammersten 1991	Cultural material lacks significance	Approximately 6 acres	Near the Coast Guard maintenance area; 7 of the 16 tests produced cultural remains. All the materials recovered from this area were consistent with fill material (i.e., glass, plastic, shotgun caps, aluminum foil).
<i>Cultural Resource Monitoring for Geotechnical Boring Ocracoke Passenger Ferry Terminal</i>	Timothy J. Brock 2017	Cultural material lacks significance	20 feet by 40 feet	Boring test sites near the Visitors Center, small amounts of potential cultural material (construction artifacts – glass, nails), located near the Lighthouse.
<i>Archeological Monitoring Report - Sand Removal and Utility Trench Excavation at The Ocracoke Light Station Keeper's Quarters.</i>	Paul Y. Imashima 1987	Pre-1920 Kitchen midden cultural materials/artifacts	Beneath Keeper's Quarters and a section south and west of the Quarters	Area has potential for cultural material.

APPENDIX B: ACTIONS CONSIDERED BUT DISMISSED

Actions Considered but Dismissed

The National Park Service considered many alternatives for the management of the Ocracoke Light Station. To fully explore the range of alternatives, the National Park Service evaluated alternatives ranging from full site elevation and rehabilitation of all buildings to partial elevation to the relocation of the site to a different location. Elevating the site and or the structures provides some protection from future damage caused by sea level rise. However, even with the most protective alternative (raising most of the site to 6.85 feet and all buildings to an FFE of 10.85 feet), the site cannot be completely protected from the impacts of future sea level rise. Additionally, the most protective alternatives would have important impacts on floodplains and wetlands. Alternatives that rehabilitated only the 1823 buildings/structures¹ were slightly lower in cost, but had important impacts on historic structures, the cultural landscape of the Ocracoke Light Station, and the Ocracoke Historic District. In reviewing these alternatives, the National Park Service determined that the significant effort and costs of these alternatives were not justified by the limited benefits that they would provide. The relocation of the buildings to a new site might offer slightly better long-term protection but also came at significant cost and impacts to cultural resources. The following table summarizes the alternatives and the rationale for dismissing specific alternatives.

Alternative	Elevate Site or Buildings	Treatment of Buildings	Other Actions	Rationale for Dismissal
Alternative 1. Elevate Entire Site and Rehabilitate and Restore Only 1823 Buildings/Structures	<ul style="list-style-type: none"> Elevate the center of the site to 6.85 feet, tapering to 4 feet. Elevate the Double Keepers Quarter to an FFE of 10.85 feet. Install a low perimeter site wall to maintain the topography at the property line. 	<ul style="list-style-type: none"> Rehabilitate and restore 1823 buildings/structures only (Ocracoke Lighthouse, Original, Keeper's Quarters, and Privy). Demolish other buildings/structures — Assistant Keeper's Quarters, Carpenter's Shop, Store House, Cisterns, and Oil House (historic) and Generator House (not historic). 	N/A	<p>The project area is within the 100-year floodplain and contains portions of two estuarine intertidal wetlands. This alternative would require a substantial amount of fill to elevate the entire site, which would result in a loss of natural functions and values of the floodplains and wetlands.</p> <p>There would be an adverse effect on historic structures demolished and the cultural landscape from the loss of character-defining features (the demolished buildings), the history of this site told through those buildings/structures, and the addition of the low perimeter wall. These changes would also have an adverse effect on the Ocracoke Historic District.</p> <p>The 1823 Structures would be better protected but would still be vulnerable to future storm events.</p> <p>Given the impacts to natural and historic resources and the fact that even with this substantial effort and cost the site would still be vulnerable and future damage to the buildings/structures likely, this alternative was dismissed from further analysis.</p>
Alternative 2. Elevate, Rehabilitate, and Restore Only 1823 Buildings/Structures at 6.85 Feet	<ul style="list-style-type: none"> Elevate only the areas around the Keeper's Quarters and the Privy to 6.85 feet. 	<ul style="list-style-type: none"> Rehabilitate and restore 1823 buildings/structures only (Ocracoke Lighthouse, Original, Keeper's Quarters, and Privy). Demolish other buildings/structures — Assistant Keeper's Quarters, Carpenter's Shop, Store House, Cisterns, and Oil House (historic) and Generator House (not historic). 	N/A	<p>The project area is within the 100-year floodplain and contains portions of two estuarine intertidal wetlands. This alternative would require less fill than alternative 1 to elevate only a portion of the site but would still result in a loss of natural functions and values of the floodplains and wetlands.</p> <p>As for alternative 1, there would be an adverse effect on historic structures demolished and to the cultural landscape from the loss of character-defining features (the demolished buildings) and the history of this site told through those buildings/structures. These changes would also have an adverse effect on the Ocracoke Historic District.</p> <p>Under this alternative, the Double Keepers' Quarters would be less protected than alternative 1 (elevated only to 6.85 feet compared to 10.85 feet for the Double Keepers' Quarters), making the Double Keepers' Quarters more vulnerable to future storm events.</p> <p>Given the impacts to natural and historic resources and the fact that even with this substantial effort and cost the site would still be vulnerable and future damage to the buildings/structures likely, this alternative was dismissed from further analysis.</p>

¹ The *Ocracoke Light Station Cultural Landscape Report* describes the National Register of Historic Places period of significance as beginning in 1823 with the construction of the Lighthouse, Original Keeper's Quarters, and Privy and continues to the present, indicating its ongoing use as a federal aid to national and international navigation (Hitchcock 2016). However, the Seashore chose a period of interpretation of the Ocracoke Light Station as 1823 through 1854, the period when the Ocracoke Lighthouse was critical for navigation through the Ocracoke Inlet. Only three structures were present at the Ocracoke Light Station during the period of interpretation, the Lighthouse, the Keeper's Quarters, and the original Privy (1823). When considering potential management strategies for the Ocracoke Light Station, the treatment of the structures present during the period of interpretation was weighed heavily.

Alternative	Elevate Site or Buildings	Treatment of Buildings	Other Actions	Rationale for Dismissal
Alternative 3. Elevate, Rehabilitate, and Restore Only 1823 Buildings at 10.85 Feet	<ul style="list-style-type: none"> Elevate only the areas around the Keeper's Quarters and the Privy to 10.85 feet. 	<ul style="list-style-type: none"> Rehabilitate and restore 1823 buildings/structures only. Demolish other buildings/structures — Assistant Keeper's Quarters, Carpenter's Shop, Store House, Cisterns, and Oil House (historic) and Generator House (not historic). 	N/A	<p>The project area is within the 100-year floodplain and contains portions of two estuarine intertidal wetlands. This alternative would require less fill than Alternative 1 to elevate portions of the site, but it would still result in a loss of natural functions and values of the floodplains and wetlands.</p> <p>As for alternatives 1 and 2, there would be an adverse effect on historic structures demolished and to the cultural landscape from the loss of character-defining features (the demolished buildings) and the history of this site told through those buildings/structures. These changes would also have an adverse effect on the Ocracoke Historic District.</p> <p>The protection of the Double Keepers' Quarters would be the same as alternative 1, but it would still be vulnerable to future storm events.</p> <p>Given the impacts to natural and historic resources and the fact that even with this substantial effort and cost the site would still be vulnerable and future damage to the buildings/structures likely, this alternative was dismissed from further analysis.</p>
Alternative 4. Elevate the Double Keepers' Quarters and Rehabilitate Buildings/Structures	<ul style="list-style-type: none"> Elevate the Double Keepers' Quarters 4 feet on pile foundations to an FFE of 8.85 feet. Retain all other structures at the current elevation. 	<ul style="list-style-type: none"> Rehabilitate buildings/structures (Ocracoke Lighthouse, Double Keepers' Quarters, Carpenter's Shop, Store House, Oil House, Privy, and Generator House). 	N/A	<p>This alternative would have minimal impact on the floodplain and wetlands, as only the piles to elevate the Double Keepers' Quarters would be added.</p> <p>All historic structures would be rehabilitated.</p> <p>This alternative is very similar to the proposed action, except that the Double Keepers' Quarters would be elevated to 6.85 feet. Because this alternative was not substantially different from the proposed action, it was dismissed from further analysis.</p>
Alternative 5. Elevate the Entire Site and Rehabilitate Buildings/Structures	<ul style="list-style-type: none"> Elevate the center of the site to 6.85 feet, tapering to 4 feet. Elevate the Double Keepers' Quarter to an FFE of 10.85 feet. 	<ul style="list-style-type: none"> Rehabilitate buildings/structures (Ocracoke Lighthouse, Double Keepers' Quarters, Carpenter's Shop, Store House, Oil House, Privy, and Generator House). 	N/A	<p>Like alternative 1, this alternative would require a substantial amount of fill to elevate the entire site, which would result in a loss of natural functions and values of the floodplains and wetlands.</p> <p>Historic structures would be better protected compared to existing conditions but would still be vulnerable to future storm events.</p> <p>Given the impacts on natural resources, and the fact that even with this substantial effort and cost the site would still be vulnerable and future damage to the building likely, this alternative was dismissed from further analysis.</p>
Alternative 6. Elevate a Portion of the Site and Rehabilitate at 6.85 Feet	<ul style="list-style-type: none"> Elevate the portion of the Ocracoke Light Station that contains the Double Keepers' Quarters, Carpenter's Shop, Store House, Oil House, and Generator House to an elevation of 6.85 feet. Install a low perimeter site wall to maintain the topography at the property line. 	<ul style="list-style-type: none"> Rehabilitate buildings/structures (Ocracoke Lighthouse, Double Keepers' Quarters, Carpenter's Shop, Store House, Oil House, Privy, and Generator House). 	N/A	<p>This alternative would impact slightly less area than alternatives 1 and 5 but would still require a substantial amount of fill to elevate the portion of the site occupied by the buildings, resulting in a loss of natural functions and values of the floodplains and wetlands.</p> <p>Historic structures would be better protected compared to existing conditions but would still be vulnerable to future storm events. Additionally, the low perimeter wall would have an adverse effect on the cultural landscape.</p> <p>Given the impacts on natural and cultural resources and the fact that even with this substantial effort and cost the site would still be vulnerable and future damage to the building likely, this alternative was dismissed from further analysis.</p>

Alternative	Elevate Site or Buildings	Treatment of Buildings	Other Actions	Rationale for Dismissal
Alternative 7. Elevate a Portion of the Site and Rehabilitate All Structures	<ul style="list-style-type: none"> Elevate the portion of the Ocracoke Light Station that contains the Double Keepers' Quarters, Carpenter's Shop, Store House, Oil House, and Generator House to an elevation of 6.85 feet. Further elevate all structures to an FFE of 10.85 feet. Install a low perimeter site wall to maintain the topography at the property line. 	<ul style="list-style-type: none"> Rehabilitate buildings/structures (Ocracoke Lighthouse, Double Keepers' Quarters, Carpenter's Shop, Store House, Oil House, Privy, and Generator House). 	N/A	<p>This alternative would impact slightly less area than alternatives 1 and 5 but would still require a substantial amount of fill to elevate the portion of the site occupied by the buildings, which would result in a loss of natural functions and values of the floodplains and wetlands.</p> <p>This is the only alternative to elevate all historic buildings/structures to an FFE of 10.85 feet, providing the best protection. Even so, the buildings would still be vulnerable to future storm events. Additionally, the low perimeter wall would have an adverse effect on the cultural landscape.</p> <p>Given the impacts on natural and cultural resources and the fact that even with this substantial effort and cost the site would still be vulnerable and future damage to the building likely, this alternative was dismissed from further analysis.</p>
Alternative 8. Relocate 1823 Buildings to a New Site	N/A	<ul style="list-style-type: none"> Demolish the Assistant Keeper's Quarters, Carpenter's Shop, Store House, Cisterns, and Oil House (historic) and the Generator House (not historic). 	<ul style="list-style-type: none"> Relocate the Ocracoke Lighthouse and Original Keeper's Quarters to a new site with an elevation between 6.85 and 8.85 feet. Maintain the relationship of the structures to the landscape to the extent possible. 	<p>Relocating the Ocracoke Lighthouse and Original Keeper's Quarters would require identifying a suitable site within a reasonable distance, preferably within the Ocracoke Historic District.</p> <p>There would be an adverse effect on the historic structures demolished and the cultural landscape from the loss of character-defining features (the demolished buildings). Under this alternative, the historic property (the Ocracoke Light Station) would no longer have integrity of location, setting, feeling, or association, and its relationship to the Ocracoke historic district would change in terms of viewshed.</p> <p>Relocation would have greater environmental impacts since entire new locations need to be developed for these facilities.</p> <p>Relocating the structures would be a significant and challenging undertaking and at this time would be economically infeasible. For these reasons, this alternative was dismissed from consideration.</p>
Alternative 9. Relocate All Buildings to a New Site	N/A	N/A	<ul style="list-style-type: none"> Relocate all the buildings/structures at the Ocracoke Light Station to a new site with an elevation between 6.85 and 8.85 feet. Maintain the relationship of the structures to the landscape to the extent possible. 	<p>Relocating the buildings/structures would require identifying a suitable site within a reasonable distance, preferably within the Ocracoke Historic District.</p> <p>Under this alternative, the historic property (the Ocracoke Light Station) would no longer have integrity of location, setting, feeling, or association, and its relationship to the Ocracoke historic district would change in terms of viewshed.</p> <p>Relocation would have greater environmental impacts since entire new locations need to be developed for these facilities.</p> <p>Relocating the structures would be a significant and challenging undertaking and at this time would be economically infeasible. For these reasons, this alternative was dismissed from consideration.</p>
Alternative 10. Create Floodable Structures	N/A	<ul style="list-style-type: none"> Install in all buildings/structures floodable vents/louvers in the walls and trap doors installed in the floors, replace interior materials with water-resistant materials, and elevate the electrical and mechanical systems above the flood zone within the buildings. Protect the first-floor walls of the Double Keepers' Quarters from water damage by the addition of a water barrier. 	N/A	<p>Although this alternative would likely provide better long-term protection than alternatives 1 through 7 above, it would still leave the building vulnerable to damage from sea level rise, and the effort and costs to complete this are significantly more than the proposed action. Additionally, the effort to maintain a floodable structure would be more than maintenance for the proposed action.</p> <p>Although the materials within a floodable structure would be more resilient and the utilities would be relocated, allowing water to enter the structure; significant time and energy would be required after major storm events to clean out and dry the building afterward. The benefits did not outweigh the cost of this alternative.</p>

Note: N/A = no actions would occur under this category