Broadkill Beach Dune Realignment

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Technical Narrative

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ABBREVIATIONS

DNREC	Department of Natural Resources and Environmental Control
EFH	Essential Fish Habitat
HSCA	Hazardous Substance Cleanup Act
IPaC	Information for Planning and Consultation
MHHW	Mean Higher High Water
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
O&M	Operations and Maintenance
Project	Broadkill Beach Dune Re-alignment Project
SHPO	State Historic Preservation Office
SIRS	Site Investigation and Restoration Section
SWMS	Shoreline and Waterway Management Section
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

1. Introduction

This document has been developed to support the application for a United States Army Corps of Engineers (USACE) Section 408 permit to repair and realign a one-mile section of dune in Broadkill Beach, Sussex County, Delaware. The Project aims to rebuild the severely eroded beach and realign the dune so that it corresponds to the current shoreline orientation by redistributing sand and subsequently modifying the federal design template.

DNREC Shoreline and Waterway Management Section (SWMS) has been responsible for the Operations and Maintenance (O&M) of Broadkill Beach since completion of the USACE-led Delaware River Main Channel Deepening Project in 2016. Major storm events have impacted the area since then, causing significant erosion and dune scarping at the center of the Broadkill Beach community near the Route 16 access road. SWMS has been repairing the scarped dune face and maintaining beach access through the addition of sand; however this method has proven to be costly and ineffective for long-term beach management.

1.1 Project Location

Broadkill Beach is an unincorporated community located along a three-mile stretch of coastline on the western shore of Delaware Bay in Sussex County, Delaware (Figure 1). Bound by Prime Hook National Wildlife Refuge to the west and Beach Plum Island Nature Preserve to the south, this area supports horseshoe crab spawning, migratory bird feeding, recreational and anthropogenic activities. Route 16 provides the only accessible roadway to the Broadkill Beach community and serves as an evacuation route. The project site is approximately one mile in length, extending from Georgia Avenue (north of Route 16) to Bay Front Road (Figure 1).

Figure 1: Project Location Map

Broadkill Beach has been historically affected by coastal storms, including tropical storms, hurricanes, and nor'easters that have caused severe coastal erosion, flooding, and damage (NOAA NWS). As a result, the first repair project was completed in 1957 using dredged material as beachfill. Similarly, Broadkill Beach has been repaired many times since then using either dredged or truck fill sand. Table 1 below summarizes the previous beachfill volumes placed at Broadkill Beach (USACE, 2016).

Table 1: Broadkill Beachfill Projects

Year	Volume (CY)	Source Material
1957	77,000	Dredged
1961	120,000	Dredged
1973	118,000	Dredged
1975	295,000	Dredged
1976	60,000	Dredged
1981	220,000	Dredged
1997-88	81,000	Dredged
1993-94	67,000	Dredged
1996	25,000	Dredged
2005	152,000	Dredged
2011	30,000	Truck fill
2012	10,000	Truck fill
2013	10,000	Truck fill
2014	29,000	Truck fill
2016	1,700,000	Dredged

1.2 Project Purpose

The USACE's Coastal Storm Risk Management Project delivered 1.7 million cubic yards of sand dredged from the Delaware River navigation channel to Broadkill Beach, widening it nearly 150 feet. The project completed in March 2016, and then DNREC SWMS took responsibility of the O&M. In addition, routine surveys were performed to monitor beach change and observe seasonal erosion and accretion trends. Results suggest that large-scale beach nourishment activities and subsequent storm events have greatly impacted the morphology of the shoreline (Dohner et al., 2016, 2020).

Topographic survey data indicate the center of the Broadkill Beach community is eroding while the northern and southern sections are accreting. Therefore, the latter sections of the beach will recover the material that erodes during winter months, whereas the center section does not recover and continues to erode each season. The greatest average volume reduction occurred between Summer 2021 and Winter 2022 due to a particularly stormy Fall 2021 season. Two coastal flood events, including a nor-easter were recorded during this time, which coincided with maximum water levels reported at the Lewes, DE monitoring station (Table 2). Shoreline retreat measured 9-18 feet/year on average in the center of Broadkill Beach and a "hotspot" of rapid erosion was identified at the main beach access near Route 16 (DNREC, 2022). Figure 2 below shows the Route 16 beach access following the October 2021 storms that resulted in dune scarping of 2-3 feet. A third coastal flood event and winter storm during January 2022 further eroded this area (Table 2).

Table 2: NOAA Storm Events & Water Level Data

Date	Storm Event & Description for the Delaware Beaches [a]	Lewes, DE [b] MHHW, feet
11-Oct-2021	**Coastal Flood Event**. Slow moving coastal storm caused widespread moderate tidal flooding.	2.33
29-Oct-2021 30-Oct-2021	**Coastal Flood Event.** Slow moving nor-easter coastal storm caused persistent onshore flow, driving water towards the coast into local bays and tidal rivers, preventing drainage back out to sea. Heavy rainfall, onshore (easterly) winds with gusts up to 60 mph.	2.42
3-Jan-2022	**Winter Storm & Coastal Flood Events**. Winter storm caused widespread snow (6-12") and the new moon resulted in higher tides and moderate tidal flooding.	2.86
2-Oct-2022 3-Oct-2022	**Coastal Flood & High Wind Events.** Low pressure offshore system was the remnants of Hurricane Ian that resulted in persistent onshore flow, causing widespread flooding and some property inundation in tidal areas.	2.78

[a] NOAA Storm Events Database for the Delaware Beaches. https://www.ncdc.noaa.gov/stormevents
[b] NOAA Tides and Currents, Station ID: 8557380, Lewes, DE. https://tidesandcurrents.noaa.gov/stationhome.html?id=8557380

Figure 2: Broadkill Beach erosion at the Route 16 access following the Oct 2021 Nor'easter storm

In October 2022, remnants of Hurricane Ian produced coastal flood and high wind events that affected the Delaware beaches (Table 2). Figure 3 below was captured during a storm tide and further demonstrates sand retreat and dune scarping just south of the Route 16 beach access. Highwater indicators show that high tides reached the toe of the scarped dune, which likely caused erosion and collapse of this feature. In contrast, the berm and primary dune in the southern section of the project site, near Bayfront Road, remained in good condition after the October 2022 storm. This variability in erosion rates implies the orientation of the beach is not in equilibrium with the hydrodynamic forcing along the shoreline.

Figure 3: Erosion at Broadkill Beach (looking south from Route 16) following the October 2022 storm

A recent desktop review and subsequent thorough topographic survey suggest the equilibrium shoreline of Broadkill Beach is misaligned with the constructed dune template. Therefore, the project intends to work above the high tide line to realign a one-mile section of dune to correspond with the current shoreline orientation. The project would alter the Federal design template for the purposes of enhancing coastal resiliency, reducing O&M demands, providing safer beach access, and re-establishing critical horseshoe crab habitat. The project would also serve as baseline for future nourishment projects and require the following key components:

- Shift the existing dune landward
- Redistribute sand to reconstruct the highly eroded center section of Broadkill Beach
- Remove existing scarping at beach access points

1.3 Current Conditions

Current conditions at Broadkill Beach include a near total loss of dune in the vicinity of the Route 16 beach access. Recent field measurements show the natural dune position on the post-nourished beach is a ± 25 foot offset of the dune toe from the high tide contour. Figure 4 below is an aerial photograph demonstrating the relationship between the shoreline and dune alignments. Both alignments diverge on the south end of the project site, where a "natural" dune is accreting on the constructed berm. However, convergence between the shoreline and dune alignments occurs just north of the Route 16 beach access near Maryland and Virginia Avenues, causing erosion and severe dune scarping.

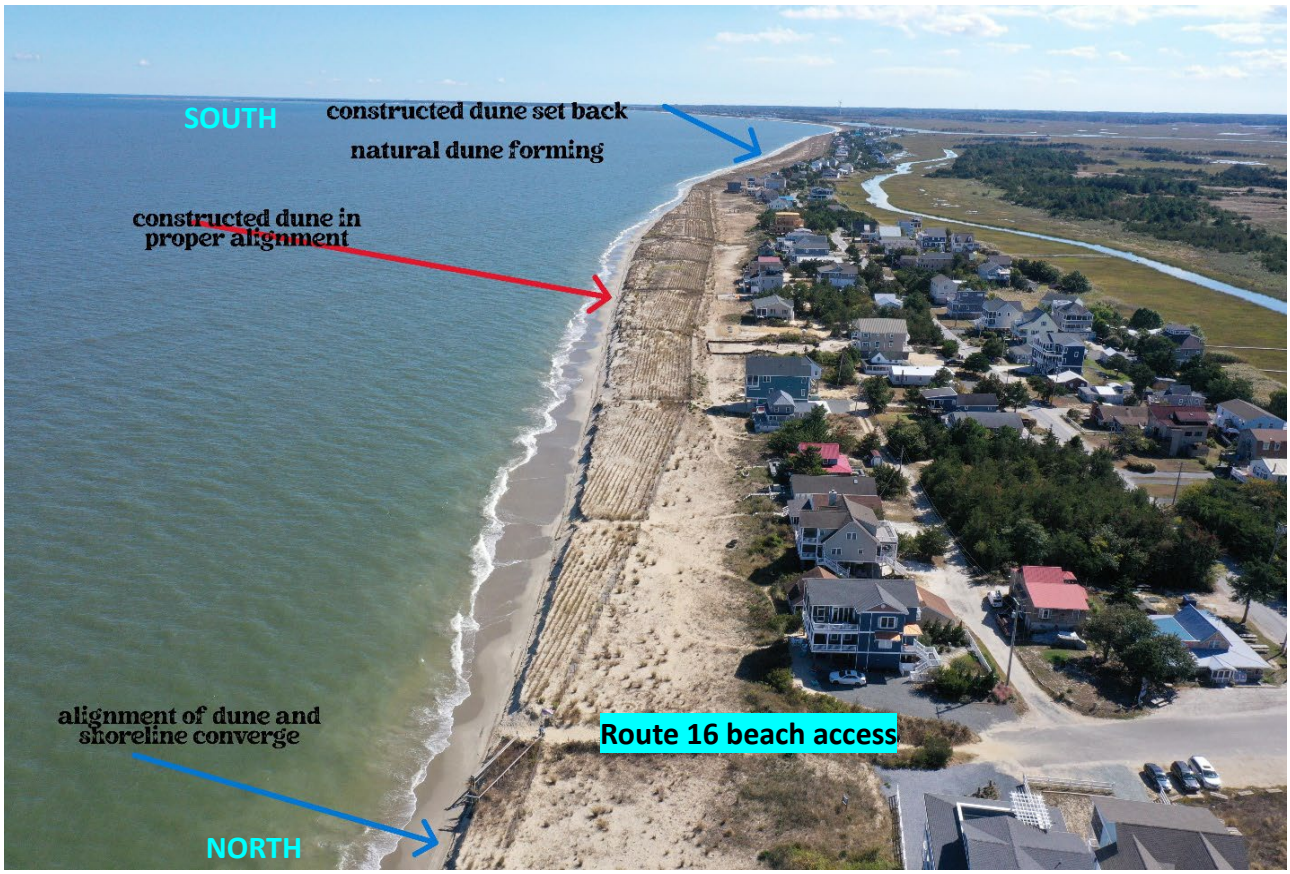

Figure 4. Aerial photograph of Broadkill Beach showing the shoreline and dune alignments.

Currently, the only means for repairing Broadkill Beach is by adding truck haul sand from inland sources to repair the dune face. Survey observations coupled with O&M experience has proven this method to be costly and inefficient for mitigating coastal erosion. By re-distributing sand to obtain shoreline equilibrium and modifying the Federal design template, future scarping of the dune will be avoided. The proposed project would improve coastal resiliency to erosive storm events, provide safer beach access, reduce O&M demands, and preserve habitat.

1.4 Real Estate Requirements

The proposed project is located on privately owned parcels. While most construction activities would occur within the existing property easements, the proposed re-alignment will require earthwork beyond the established easements for approximately one-half of the project length. It should be noted, the large USACE-led nourishment project completed in 2016 added beachfill to areas beyond the existing easements, similar to what is proposed for this project. SWMS fully expects individual property owners to be cooperative given recent community concerns about the current dune and beach access issues.

To manage expectations, SWMS is seeking all permitting approvals prior to approaching the community and individual property owners regarding real estate needs. Following a favorable Section 408 review, SWMS will work with the property owners in question to attain legal permission to perform construction beyond the current easements. Included in the Section 408 package is a map showing the parcels affected by the proposed project, a list of the affected parcels and whether there are easement requirements, and a supplementary table that summarizes ownership of these parcels.

2. Construction Methods

An engineering plan set is provided as part of the Section 408 permit package. All construction activities are planned above the high tide line. No work will occur during the peak horseshoe crab spawning months of May and June to avoid any potential disturbance.

2.1 Broadkill Beach Dune Re-alignment & Repair

The project aims to re-distribute material from the southern section of the project site, where sand is accreting, to the center section of Broadkill Beach near the Routh 16 access, to reconstruct the severely eroded dune and repair the existing scarping. In addition, shoreline equilibrium will be achieved by shifting the dune landward and establishing an alignment that will ultimately alter the Federal design template and inform future nourishment projects. The project will likely be contracted with an approved State vendor. It is expected that sand will be moved using an excavator working from the inland side and/or a bulldozer pushing sand from the seaward side.

2.2 Best Management Practices

The following best management practices are included as part of the plans and specifications to ensure the project is completed in accordance with the design and applicable regulations:

- Beach construction will only occur above the high tide line to avoid or minimize adverse impacts to benthic communities including horseshoe crabs and aquatic species.
- Fill material originates from the existing beach, and thus is compatible with the native material.
- Constructed dunes will be planted with native vegetation to trap natural windblown sediment for long-term stabilization.

- Pre- and post-project monitoring via topographic and aerial drone surveys will be performed, particularly after storm events, to help inform maintenance needs.

- Proper construction oversite will be implemented. Conditions and construction activities will be documented to verify that best operational practices are being performed.

2.3 Project Alternatives Considered

Alternatives considered for maintaining Broadkill Beach include: 1) no action, 2) using truck haul sand for repair, and 3) re-aligning the dune to establish shoreline equilibrium. The alternatives were considered with respect to project cost, disturbances to fish and wildlife, human safety, and recreational uses of the area.

2.3.1 No Action

The no action alternative provides no measures for erosion control, recreational beach access, or storm damage protection within Broadkill Beach. Continuous erosion and shoreline retreat would promote overwash processes, flooding and damage to property, utilities, and loss of infrastructure. If no action is taken, the Route 16 evacuation route would become inaccessible due to inundation, and the Broadkill Beach community would experience significant economic losses. Given the proximity of roads to the shoreline and the concentration of homes in the community, this alternative is not recommended.

2.3.2 Using Truck Haul Sand for Repair

This alternative involves purchasing suitable sand that is available from local inland quarries for placement directly onto the eroded beach. The sand would be transported via multiple truckloads and then spread and graded to help restore beach access and provide some level of storm protection. DNREC has been using this method to maintain Broadkill Beach for years; however it is expensive and not ideal for a short-term fix or long-term sand management. The costs associated with transporting sand, as well as the wear and tear on the existing roadways, increased emissions, and traffic are all factors that negatively impact this alternative. In addition, the center section of Broadkill Beach will continue to erode faster than the adjacent areas north and south since the shoreline and dune alignments would remain unchanged.

2.3.3 Re-aligning the Dune to Establish Shoreline Equilibrium

The preferred alternative is to realign the dune so that it corresponds with the current shoreline orientation. This will prevent severe erosion and dune scarping, reduce O&M demands, and provide adequate beach access within the central Broadkill Beach community. This alternative involves shifting the existing dune landward and redistributing sand within a one-mile section of beach to remove scarping and rebuild the severely eroded area. A design baseline with the proper shoreline and dune alignments will be established, and modifications to the current easements would be required. This alternative does not involve the purchase of sand, and instead relies on the existing material for beach repair at a relatively lower cost. For these reasons, this alternative is preferred.

3. Environmental Analysis

The following subsections address the potential environmental impacts due to repairing and realigning the dune at Broadkill Beach.

3.1 Habitat and Species

All construction activities are planned on the beach and above the high tide line; therefore water column turbidity and loss of benthic habitat are not likely. By realigning the dune and establishing shoreline equilibrium, the project will provide enhanced habitat for horseshoe crab spawning and seabird activity as well as bolster shoreline resiliency and mitigate dune scarping that eventually leads to habitat loss.

3.1.1 Aquatic and Terrestrial Biological Resources

Broadkill Beach is host to many coastal plant communities. The predominant species that grows on the dune is American beachgrass (*Ammophila breviligulata*), which can survive harsh conditions such as extreme temperatures and high wind energy. Seaside goldenrod (*Solidago sempervirens)* and beach clotbur (*Xanthium echinatum*) are other dominant plant species that grow on the dune. Broadkill Beach also supports a variety of intertidal species, including ghost crabs (*Ocypode quadrata*) and amphipods (*Orchestia* spp. and *Talorchestia* spp.). The most notable organism is the horseshoe crab (*Limulus polyphemus*) with peak spawning activity occurring during May and June.

Horseshoe crab eggs provide food for the endangered Red Knot (*Calidris canutus rufa*) and thousands of other migratory shorebirds that visit the Delaware Bay each year and include the sanderling (*Calidris alba*), semipalmated sandpiper (*C. pusilla*), western sandpiper (*C. mauri*), willet (*Catoptrophorus semipalmatus*), and short-billed dowitcher (*Limnodromus griseus*). Gulls may be present within the upper and lower beach feeding on carrion, plant matter, or invertebrates within the wrack line. Gull species that inhabit Broadkill Beach include the herring gull (*Larus smithsonianus*), laughing gull (*L. atricilla*), and ring-billed gull (*L. delawarensis*). Other beach dwelling birds that use this area include the savannah sparrow (*Passerculus sandwichensis*), song sparrow (*Melospiza melodia*), mourning dove (*Zenaida macroura*), and northern mockingbird (*Mimus polyglottos*).

3.1.2 Special Status Species

The U.S. Fish and Wildlife Service Information for Planning and Consultation (IPaC) system was used to determine if any special status species have the potential to occur within the project area. The results are listed in Table 1 below. IPaC letters and species determinations are included with the permit package.

Table 1. Federal Special Status Species within the Project Area

Common Name	Scientific Name	Special Status	Special Status
Rufa Red Knot	*Calidris canutus rufa*	Bird	Threatened species
Seabeach Amaranth	*Amaranthus pumilus*	Flowering Plant	Threatened species
Monarch Butterfly	*Danaus Plexippus*	Insect	Proposed Threatened
Tricolored Bat	*Perimyotis subflaavus*	Mammal	Proposed Endangered

Beach repair activities are not expected to affect the special status species listed in Table 1. Construction will not occur during spring and summer months when horseshoe crab spawning peaks and +200,000 migratory birds seek refuge in Delaware Bay. Monarch butterflies and bats will prefer to leave or avoid the beach repair

area, if present during construction. In addition, the current loss of habitat and severe dune scarping could be preventing special status species from using Broadkill Beach.

3.1.3 Essential Fish Habitat

The project area contains Essential Fish Habitat (EFH) for both highly migratory and New England/Mid-Atlantic species that have the potential to be impacted by the proposed beach repair activities. However, since all construction is planned above the high tide line, aquatic species will not be affected. In addition, there are no critical habitats identified within the project site. EFH Assessment Worksheets are included with the permit package.

3.2 Air Quality

Ambient air quality data is collected by the DNREC Division of Air Quality via a series of monitoring stations throughout the state, and then compared to the National Ambient Air Quality Standards (NAAQS) pursuant of the Clean Air Act of 1970. Air quality standards account for an adequate margin of safety to protect children and asthmatics and include criteria for six principal pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), lead (Pb), and particulate matter including both fine ($PM_{2.5}$) and coarse (PM_{10}) particles.

The project area is located in Sussex County, Delaware which is classified by the U.S. Environmental Protection Agency as a marginal nonattainment area based on the 8-Hour Ozone (2008) NAAQS. General Conformity regulations under 40 CFR § 93.153 (b) list the threshold for ozone in nonattainment areas as 100 tons/yr for NOx (oxides of nitrogen) and 50 tons/yr for VOCs (volatile organic compounds). Air quality in coastal Delaware is generally classified as posing little to no risk based on EPA's Air Quality Index for ozone and particle pollution. Impacts from air quality would be limited to emissions from heavy equipment, and no long-term significant impacts to the local air quality are expected.

3.3 Hazardous, Toxic and Radioactive Waste (HTRW)

The Delaware Environmental Navigator (DEN) site was reviewed to identify any areas of concern near the project vicinity that may contain HTWR. The review identified two projects within the Hazardous Substance Cleanup Act (HSCA) database (formerly SIRS): 1) Broadkill Beach Fire Control Station (DE-0309) and 2) Broadkill Beach Drum (DE-0258).

The Broadkill Beach Fire Control Station is part of the Formerly Used Defense Sites (FUDS) program. It is located inland of the project site and just north of Route 16. The USACE completed the Broadkill Beach Fire Control Station inventory project report in 1991. The report concluded that while unexploded waste and chemical hazards are unknown, the potential for adverse environmental effects is low. More recently, Delaware HSCA lists the Broadkill Beach Fire Control Station as a 'low priority" remediation project (DNREC, 2018). The Broadkill Beach Drum project refers to an underground drum that was discovered near parcel 235-4.17-87.00. This remediation project was completed as of the fiscal year ending in 2018 (DNREC, 2018).

DEN was also used to identify two existing underground storage tanks located at the Broadkill Store and Clyde Betts & Son Inc. These storage tanks are not leaking and expected to be in satisfactory condition.

3.4 Cultural Resources

The Broadkill Beach dune realignment project will have no adverse effect on significant cultural resources. In 1994, the USACE Philadelphia District completed a Submerged and Shoreline Cultural Resources Investigation for Broadkill Beach. Remote sensing identified one potential shipwreck offshore; however no significant cultural resources were identified along the shoreline, and no prehistoric sites have been documented in the project vicinity (Cox and Hunter, 1994). The Delaware Division of Historical and Culture Affairs, State Historic Preservation Office (SPHO) was consulted and confirmed in a letter dated September 10, 1996, that beach nourishment would have no adverse effect on significant cultural resources. In addition, SHPO was recently consulted regarding the proposed dune realignment project; this letter is included the permit application package.

3.5 Aesthetics

Minor, temporary impacts to the aesthetics of Broadkill Beach will occur during construction when large machinery will be visible on the beach. Overall, the project will enhance the aesthetic value of Broadkill Beach by removing the existing scarping, rebuilding the severely eroded beach, maintaining public access, and planting native vegetation. A natural-looking beach and dune will be more aesthetically pleasing and attractive to residents and tourists.

4. Summary

DNREC SWMS has been responsible for the O&M of Broadkill Beach since 2016 following completion of the Delaware River Main Channel Deepening Project. Several major storm events have impacted the area since then, causing severe erosion and dune scarping. Currently, there is a near total loss of dune in the central section of the community, particularly near the Route 16 access, while accretion and natural dune formation is occurring in the northern and southern sections of Broadkill. A desktop review and thorough topographic survey support the hypothesis that the equilibrium shoreline is misaligned with the current dune alignment. Survey observations are complimented by experience with O&M which has shown that repairs to the dune face with the addition of sand is ineffective. In addition, field measurements following the 2016 beachfill suggest the natural dune position was constructed with a ±25 foot offset of the dune toe from the high tide contour. Therefore, DNREC SWMS proposes modifying the federal design template to realign a one-mile section of dune to correspond with the current shoreline orientation. This project would repair Broadkill Beach by enhancing coastal resiliency, reducing O&M demands, providing safer beach access, and re-establishing critical horseshoe crab habitat.

5. References

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