THE COASTAL PRIMARY SAND DUNE AND BEACH ACT

RECOMMENDATIONS TO UPDATE THE ACT AND COMPLETE THE OVERSIGHT OF VIRGINIA TIDAL SHORELINES

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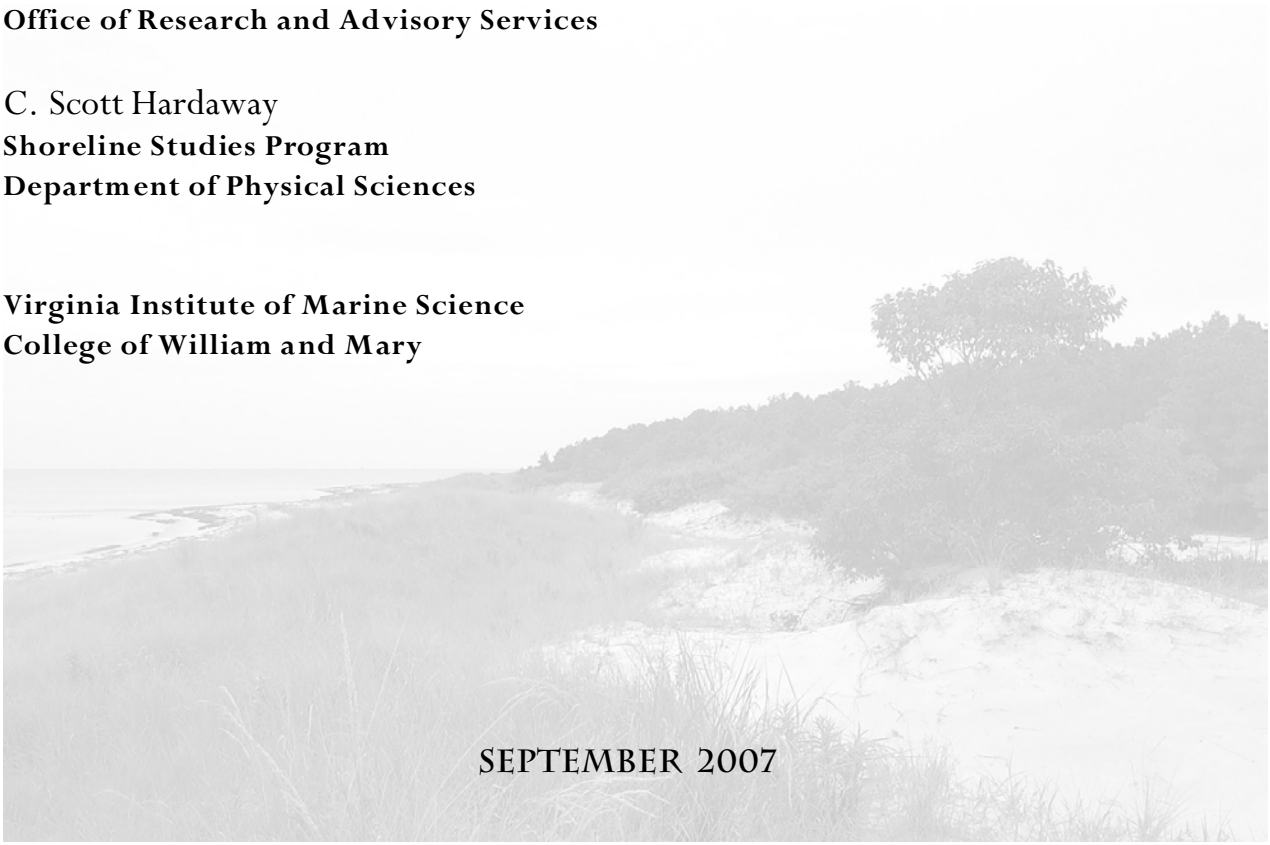

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Virginia Institute of Marine Science

Executive Summary

Management of tidal shorelines in the Virginia portion of the Chesapeake Bay has a long history of change and success. The evolution of Virginia's natural resource management program has resulted in a condition of incompleteness with respect to beaches and dunes; primarily due to incomplete data on the distribution and amount of beaches and dunes throughout the lower Chesapeake Bay. Recent investments by the Virginia Coastal Program have resulted in a comprehensive data set on Virginia's Bay beaches and dunes, which provides the information necessary to modify Virginia tidal shoreline management into a fully resource-comprehensive program. Completing the scope of regulatory oversight is necessary for the proper protection and restoration of the Chesapeake Bay, and for promoting fairness between Tidewater localities for the wise us of valuable shoreline resources. This document presents the supporting information and justification for the following recommendations:

- Adding Middlesex County and Westmoreland County to the list of localities authorized to adopt the model ordinance of the Coastal Primary Sand Dune and Beach Act (Title 28.2, Chapter 14 of the Virginia Code) would result in the inclusion of significant dune resources into Virginia's tidal shoreline management program.

- Adding the localities of Charles City, Essex, Gloucester, Isle of Wight, James City, King and Queen, King George, Middlesex, New Kent, Newport News, Prince George, Richmond (county), Stafford, Surry, Westmoreland, and York to the list of localities authorized to adopt the model ordinance of the Coastal Primary Sand Dune and Beach Act would result in the inclusion of significant beach resources into Virginia's tidal shoreline management program. This action also would address the lack of oversight for dunes currently excluded from the Coastal Primary Sand Dune and Beach Act for Middlesex County and Westmoreland County.

- Modifying the Coastal Primary Sand Dune and Beach Act to include all of Tidewater Virginia as defined in § 28.2-100 of the Virginia Code would eliminate all remaining deficiencies in the regulatory oversight of tidal shorelines, resulting in a fully comprehensive management program.

- Secondary dunes (natural dune features landward of jurisdictional dunes) are unique and valuable, but limited, resources currently not recognized through Virginia coastal management programs. An analysis of these resources and related development pressures showed that new or modified regulatory programs were unnecessary, but that five isolated shorelines should be considered for conservation.

- The list of native dune plants named in the Coastal Primary Sand Dune and Beach Act that are necessary for jurisdictional determinations is incomplete and should include the non-native Japanese sedge (*Carex kobomugi*), the native Virginia pine (*Pinus virginiana*), and the native broom sedge (*Andropogon virginicus*).

Introduction

The beaches of the lower Chesapeake Bay and adjacent Atlantic Coast are the result of millions of years of complex geological processes. These sand resources originated from eroded crystalline rock that date back to the late Cretaceous Period (about 75 million years ago). In other words, it has taken a very long time to make and deliver this sand. Sand is abundant, but only a minute portion is strategically positioned along Virginia's shorelines so as to maximize its value to coastal Bay inhabitants– a natural buffer to coastal hazards and habitat for many estuarine species. Therefore, exposed shoreline sand (i.e. beaches and dunes) is not only a limited natural resource in Virginia but also is a critical component of a sandy shore single-unit continuum. This continuum can extend from the uplands adjacent to dune fields out to and beyond the nearshore sand bars that occur around much of the Bay's littoral zone.

The coastal hazards protection, habitat substrate, and natural erosion control functions of dunes and beaches have long been recognized and are inherent within the underlying justifications of existing law. However, out of the approximately 7,200 miles of tidal shoreline outlining Virginia's portion of the Chesapeake Bay and its tributaries (VIMS Comprehensive Coastal Inventory 2007) only about 178 miles, or less than 2.5 percent, of this shoreline is composed of dune and/or beach. Since 1980, and continuing today, the dunes and beaches only in nine localities, a total of 100 shoreline miles, are afforded regulatory oversight through the Coastal Primary Sand Dune and Beaches Act (see the research synopsis *Sands of the Chesapeake* in Appendix A for further information).

The social and ecological value of sandy shorelines to the Commonwealth has increased due to natural (erosion) and anthropogenic (structural) losses which have resulted in a reduced amount and distribution of sandy shores, in addition to the functions sandy shores play in shoreline ecological health and natural erosion control in the face of sea level rise (see Appendix A). The historical development of sandy shore management is both direct and intertwined with other resource-centric regulatory programs, but still is incomplete. The recommendations within are presented as a part of the continuing evolution of sandy shore management, and tidal shoreline management in general.

An Historical Perspective on Dune and Beach Management

In 1894 the United States was feeling the effects of the economic decline known as the Panic of 1893 where 15,000 companies, 500 banks, and three major railroads failed. Unemployment rates nationally were pushing 25 percent and social unrest in the form of labor strikes and rights marches were widespread. In response, tariffs and income taxes were being debated by President Grover Cleveland and the United States Legislature. Specific to Virginia during this time of national economic crisis the Commonwealth legislature was dealing with issues such as a Constitutional Amendment to expand tax levying authority to fund public education, proper care for the mentally ill, voting laws and candidacy declaration requirements, road and rail infrastructure, chartering new towns, and protecting minors (<16 years old) from tobacco, pistols, and bowie-knives. Amongst all of these significant economic and social issues there was one Act passed that deemed the removal of twenty or more bushels of sand from any waterfront along the

Potomac River a felony punishable either by serving between one to three years in the state penitentiary or a fine of between $100 and $500 (for reference, in 2006 dollars this equates to $2,033 and $10,165, respectively). The exact motives behind this action probably will never be known, but it serves to illustrate the long-recognized value associated with shoreline sand.

Moving to the period from 1928 to 1932, the United States was experiencing a social and economic spectrum ranging from the first talking moving pictures and the first animated film to the Great Depression. Virginia's legislature was responding to these national-scale events by passing laws addressing tax guidelines for businesses showing "moving pictures," reorganization of the Commonwealth's governmental structure, powers of the young State Corporation Commission, judicial councils, and adding to the restrictions and penalties concerning "ardent spirits and intoxicating liquors." This also was the time period that comprehensive concerns for Virginia's tidal shoreline integrity emerged. State Senator Lesner offered a resolution, with the House of Delegates concurring, to create a commission to "consider the matter of encroachment by waves and tides on the shores and beaches of this State.." The ***Report of the Commission to Consider the Matter*** was submitted to the General Assembly during the 1932 Session, and stated the issue eloquently:

Just a few years ago beaches were desolate wastes of sand dunes and underbrush, little enjoyed by the people of the hinterland of our States bordering on the coast. Today a beach is recognized as the playground and health restoring asset of a State, and each year finds this asset attracting more and more people, with the logical result of enhanced values in land once considered of little value. It, therefore, behooves us to give careful thought to the permanence of an asset of such potential importance.....The ocean is engaged in a tireless attack upon the land, beating it back slowly but surely, carrying away the sands to a resting place in deep water, or into the bays and lagoons which fringe the shores. Man must come to the rescue of these beaches if this repulse is to be checked. To resist successfully the encroachments of the sea, he must organize his defense on a comparative basis. This means a comprehensive and carefully planned resistance by the largest possible unit.

This report further recommended creation of an "engineering agency" within the Department of Conservation and Development to carry on the work of the Commission, and "that a study be made of the littoral drift along our shores and the resultant erosion and accretion."

The primary focus of the Commission to Consider the Matter of Encroachment by Waves and Tides on the Shores of the Commonwealth was economic development through recreation and tourism. We can interpret no other intent within the available records. Given that these areas were considered wastelands, this is not surprising. Nevertheless, this began a long evolutionary journey into shoreline management for the Commonwealth of Virginia that evolved through studies of the range of functions and values provided by various types of tidal shorelines.

Beginning in 1966 tidal shoreline management became almost a yearly issue for Virginia's General Assembly. House joint resolution 59 created the Virginia Marine Resources Study Commission to broadly assess the use and conservation practices of all marine resources of the Commonwealth. A significant part of this Commission's report of 1967 was a recommendation that the Virginia Institute of Marine Science (VIMS) study the marshes and wetlands of Virginia

as a basis for the future tidal wetlands management program. Through House joint resolution 69 the 1968 session of the General Assembly formally charged VIMS with this task.

VIMS presented the results of their study in 1969. The final report provided justification for wetlands protection and management– including a recommendation to offer the same protections to intertidal beaches as was proposed for vegetated tidal wetlands. This report provided the basis for the creation of a commission to study and report on the wetlands of Virginia through the adoption of House joint resolution 60 during the 1971 session.

Within this period the 1970 session of the General Assembly amended the State Constitution to promote the wise use, conservation, and protection of Virginia's natural resources, public lands, and its historical sites and buildings (Article XI, Sections 1 and 2).

During the watershed session of 1972 the General Assembly expeditiously followed the recommendations forwarded in the report of the HJR 60 commission and passed the Wetlands Act. However, only vegetated wetlands initially were included. Also of significance during this session was the declaration of State Policy on tidal shoreline erosion (1972 Virginia Code §21-11.16):

> *The shores of the Commonwealth of Virginia are a most valuable resource that should be protected from erosion which reduces the tax base, decreases recreational opportunities, decreases the amount of open space and agricultural lands, damages or destroys roads and produces sediment that damages marine resources, fills navigational channels, degrades water quality and, in general adversely affects the environmental quality; therefore, the General Assembly hereby recognizes shore erosion as a problem which directly or indirectly affects all of the citizens of this State and declares it the policy of the State to bring to bear the State's resources in effectuating effective practical solutions thereto.*

Throughout the 1970s VIMS undertook studies and inventories of Virginia's tidal shorelines. VIMS published on the dynamics of the Eastern Shore's barrier islands a comprehensive report on shoreline erosion throughout Tidewater Virginia, and a series of locality-specific shoreline situation reports that described the character and status of the shoreline at that time. Following these reports VIMS produced two policy guidance documents developed from the results of these studies– *Values and Management Strategies for Nonvegetated Tidal Wetlands*, which provided justification for including nonvegetated tidal wetlands (including intertidal beaches) within the existing wetlands management program; and *Shoreline Erosion in the Commonwealth of Virginia: Problems, Practices, and Possibilities,* which presented a suite of recommendations on shoreline management approaches.

The General Assembly took notice of these documents and established the Coastal Erosion Abatement Commission in 1978. This commission's report recognized the need for a formal beach nourishment program for Virginia's public beaches and also recommended that an advisory service be created specifically to provide guidance to localities and land owners on erosion abatement strategies. In response the 1980 session of the General Assembly passed legislation authorizing the formation of the Shoreline Erosion Advisory Service, and the Public

Beach Conservation and Development Act, which created the Commission on Conservation and Development of Public Beaches.

The Coastal Primary Sand Dune and Beach Act: How the Program came to Exist in its Current Form

Many issues significant to shoreline management continued throughout the latter half of the 1970s. Vegetated tidal wetlands management by locality-based citizens boards was firmly established, erosion and its proper control was a primary concern throughout Tidewater, and the Commonwealth began a feasibility study of becoming a partner in the federal Coastal Zone Management program. At a more local level, the City of Virginia Beach was administering a young dune protection ordinance to address heavy emerging development pressures on Bay-front dunes and beaches. This ordinance ultimately served as the prototype for the Commonwealth's Dune Act.

Dunes proved to be a nexus of all of the shoreline issues dealt with by lawmakers throughout the 1970s. The reasonable course of action was to incorporate dunes into the Commonwealth's shoreline management program. In response, the Coastal Primary Sand Dune Protection Act (the Act) was passed during the 1980 session of the Virginia General Assembly. No report to the General Assembly was associated with this legislation, so the Division of State Planning and Community Affairs (one of the precursor agencies to the current Department of Planning and Budget) assisted in developing details of the Act. A group of local officials, state agency personnel, and academicians used topographic maps, navigational charts, and empirical knowledge to produce a simplistic analysis of the location and distribution of dune resources. The eight original localities chosen for inclusion in the Act were the counties of Accomack, Northampton, Mathews, Lancaster, and Northumberland; and the cities of Virginia Beach, Norfolk, and Hampton. Inherent within the definition of a coastal primary sand dune was the lateral boundaries determining jurisdiction of individual dunes between private property lines. The definition read as follows:

"..a mound of unconsolidated sandy soil which is contiguous to mean high water, whose landward and lateral limits are marked by a change in grade from ten per centum or greater to less than ten per centum, and upon any part of which is growing as of July one, nineteen hundred eighty, or grows thereon subsequent thereto, any one or more of the following:.."

The Act continues with a list of ten native dune plants.

Administration of the Act was modeled after the Wetlands Act, which had been in effect since 1972. The eight localities were authorized to adopt the Coastal Primary Sand Dune Zoning Ordinance only if they previously had adopted the Wetlands Zoning Ordinance. This insured that the decision making body, a locally appointed citizens board, was established and the locality had the structure in-place to absorb the additional regulatory burden. The Virginia Marine Resources Commission, the agency charged with oversight of all local wetlands boards, was charged with administering the Act in those localities that did not adopt the model dune ordinance. Only the localities of Accomack county and the city of Hampton chose not to adopt the model dune ordinance, and the citizens of these localities still today rely on VMRC to manage their dunes and

beaches.

Since initial adoption the Act has been modified several times in response to various limitations unrecognized until the Act was actively administered. The exclusion of intertidal beaches from both the Act and the Wetlands Act precipitated the action of incorporating all nonvegetated wetlands (for example, mud flats, sand flats, and intertidal beaches) into the Wetlands Act during the 1982 General Assembly session. This followed a recommendation from a 1978 VIMS publication explaining the functions and value of nonvegetated tidal wetlands. With this action, all subdivisions of tidal shorelines were captured for regulatory review– if a dune was present. However, areas of wide beach that were not backed by a distinct dune created some regulatory confusion with respect to definition and jurisdiction. In response, the 1984 session of the General Assembly modified the Act to incorporate "reaches" (re-titled the Coastal Primary Sand Dune and Reaches Act). Reaches is a technical term that refers to a contiguous section of shoreline influenced by similar physical marine forces, with similar geomorphologic characteristics. The intent of the modified Act was to capture beaches with lateral limits characterized by upland scarps, abrupt changes in vegetation communities, or structures of anthropogenic origin such as roads, bulkheads, and/or riprap.

A series of minor modifications to the Act have followed that continue to refine intent and expand protection:

- In 1985, the definition of a coastal primary sand dune was amended to delete the phrase "*...any mound of sand, sandy soil or dredge soil which has been deposited by man for the purpose of temporary storage of such material for later use.*" This modification effectively eliminated the possibility of temporary sand storage features from being considered as coastal primary sand dunes.

- In 1989, the General Assembly amended the Act by substituting the term "beach" for "reach", and extended the jurisdiction to the mean low water mark. The Act was then re-titled the Coastal Primary Sand Dune and Beaches Act.

- In 1990, penalty and civil charge provisions for unauthorized impacts to dunes and/or beaches was added to the ordinance.

- In 1992, sections of the Virginia Code addressing the Virginia Marine Resources Commission were re-codified and the Act became Chapter 14 of Title 28.2 (§28.2-1400 *et seq.*).

- In 1994, the Town of Cape Charles was added to the Act as a locality authorized to adopt the dune and beach ordinance. The Town since has adopted the ordinance.

- In 1998, in response to a localized problem in the Ocean Park area of Virginia Beach, House Bill 1244 added "beach replenishment or beach nourishment" as exclusions to the definition of a coastal primary sand dune and beach. A written request by VIMS precipitated the House Committee on Chesapeake and Its

Tributaries to further amend the definition by adding "...nor can the slopes of any such mound be used to determine the landward or lateral limits of a coastal primary sand dune."

The Current Status of Dune and Beach Resources and Management

Since its enactment in 1980 the Act has been implemented with regulatory oversight only authorized in the eight original localities, with the Town of Cape Charles added upon request in 1994. Concerns for comprehensive tidal shoreline resource management structure emerged through the 1980s, resulting in the passage of the Chesapeake Bay Preservation Act. The riparian areas added to Virginia's shoreline management program modified localities' abilities to protect Bay water quality and shoreline habitats, but did not effectively complete the oversight of all important shoreline components. Depending upon the definitions applied to the Resource Protection Area (RPA) by the individual localities coastal primary sand dunes and beaches generally are included under the Bay Act umbrella; however, the impacts review and decision making structure are not consistent with those localities authorized to adopt the dune and beach ordinance. Bay Act implementation also varies between localities and does not provide the Commonwealth with a consistent, thorough, or sustainable process for dune and beach management.

In addition to addressing issues specific to dune and beach management the Commonwealth simultaneously was researching and debating other measures of protection that recognized the importance of the wise use of sand resources and the land-water interface. During the same General Assembly session that produced the Coastal Primary Sand Dune Protection Act, the Public Beach Conservation and Development Act was passed. This Act created the Commission on Conservation and Development of Public Beaches that was active for many years, but has since become dormant. The 1980 session also established the Shoreline Erosion Advisory Service in response to the recommendations of the Coastal Erosion Abatement Commission as outlined in Senate Document 4 (1979).

The joint subcommittee charged to "study whether the Commonwealth's tidal shoreline erosion control policy reflects an appropriate balance between the rights of individual property owners and the Commonwealth's responsibility to protect the environment," as requested in House Joint Resolution 46 of 1986, developed novel recommendations on shoreline management. As a result of this committee's work it was required that the beaches of the Commonwealth be given priority for the disposal of dredged material of appropriate sand composition (Virginia Code §10.1-704). Also, the Virginia legislature established and funded the Comprehensive Coastal Inventory at VIMS to study and monitor the character and dynamics of tidal Bay shorelines. Also during the 1986 - 1989 tenure of the Commonwealth's Tidal Shoreline Erosion Policy study the Virginia Coastal Resources Management Program was established (Governor's Executive Order Number Thirteen (1986)), which joined Virginia in the Coastal Zone Management Program administered by the National Oceanic and Atmospheric Administration. As a member state, Virginia agreed to promote several goals and objectives which include conservation of coastal sand dune systems, addressing shoreline erosion, promotion of the wise use of coastal resources, and to minimize the dangers to life and property from coastal storms and

flooding.

The importance of Virginia's dune and beach resources were identified as high priority areas of concern in the Virginia Coastal Program's 1998 Multi-Agency Strategic Planning document. In 1999 this concern was incorporated into the National Oceanic and Atmospheric Administration's Section 312 evaluation of Virginia's Coastal Program as a coastal hazard issue needing immediate attention. The Virginia Coastal Program responded to NOAA's review by funding VIMS to begin a series of studies and inventories of all Virginia Bay dunes and beaches (ocean dunes and beaches were not a part of these efforts). As a result, VIMS produced the following list of documents that provide a comprehensive understanding of these valuable resources:

Chesapeake Bay Dune Systems: Evolution and Status (2001)

Detailed Shore Change at Chesapeake Bay Dune Systems (2001)

An Analysis of Shoreline Development Risk for Secondary Dune Systems in Tidewater Virginia with Associated Management Recommendations (2002)

Northumberland County Dune Inventory (2003)

City of Hampton Dune Inventory (2003)

City of Virginia Beach Dune Inventory (2003)

Mathews County Dune Inventory (2003)

Accomack County Dune Inventory (2004)

Lancaster County Dune Inventory (2004)

City of Norfolk Dune Inventory (2004)

Northampton County Dune Inventory (2004)

Northampton County: Shoreline Evolution (2004)

City of Norfolk: Shoreline Evolution (2005)

City of Hampton: Shoreline Evolution (2005)

City of Virginia Beach: Shoreline Evolution (2005)

Mathews County: Shoreline Evolution (2005)

Lancaster County: Shoreline Evolution (2006)

Northumberland County: Shoreline Evolution (2006)

Accomack County: Shoreline Evolution (2006)

Westmoreland County: Shoreline Evolution (2006)

Middlesex County: Shoreline Evolution (2006)

The Value of Created Dunes to Address Coastal Hazards in Chesapeake Bay: Hurricane Isabel Impacts (2004)

Chesapeake Bay Dune Systems: Monitoring (2005)

Tidewater Virginia's Non-Jurisdictional Beach Assessment (2006)

The information within these documents demonstrates that significant amounts of sandy shore resources currently are not afforded the oversight necessary for use consistent with Virginia's efforts to protect, restore, and enhance the Chesapeake Bay. These documents may be viewed at http://www.vims.edu/physical/research/shoreline/.

The evolving process of shoreline management in Virginia has resulted in fair and effective programs based on sound principles, but is incomplete with respect to dunes and beaches. The body of work herein presented provides a thorough understanding of the status of the valuable yet highly limited sandy shore resources in the Virginia portion of the Chesapeake Bay. As recognized for over a century by the actions of Virginia lawmakers and natural resource managers, it generally is undesirable to remove sand from tidal shoreline systems. The wise use of sandy shores is consistent with Virginia's approach to natural resource management, and the recommendations that follow are meant as a guide to maturing Virginia shoreline management into a fully comprehensive program.

Management Recommendations

These recommendations are born from VIMS' direct historical involvement with shoreline management, and eight years of comprehensive study and inventory of the dunes and beaches of the Virginia portion of the Chesapeake Bay– both natural and created/restored. These studies were undertaken in response to recognized limitations of the current management program and should appropriately be viewed as the most recent portion of the continuing evolution of shoreline management in Tidewater Virginia. These recommendations outline the legislative actions necessary to modify the Coastal Primary Sand Dune and Beach Act.

Management and Resource Concern: The lack of oversight of significant dune resources.

- Only the localities of Accomack, Northampton, Mathews, Lancaster, Northumberland; the cities of Virginia Beach, Norfolk, and Hampton; and the Town of Cape Charles. currently are authorized to allow impact evaluations on proposed impacts to dunes.

- Middlesex County and Westmoreland County currently contain significant dune resources. Middlesex County contains 1.23 linear miles of dune shoreline and Westmoreland County contains 0.81 miles of dune shoreline. Each locality's amount of dunes are similar to the amounts found in many of the localities listed in the Act.

- Dunes occur to a lesser degree along the shorelines of other non-jurisdictional localities.

Recommended Action: If it is the Commonwealth's intent to provide more complete oversight of dunes, then the Coastal Primary Sand Dune and Beach Act (Title 28.2, Chapter 14 of the Virginia Code) should be modified to include Middlesex County and Westmoreland County.

Management and Resource Concern: The lack of oversight of significant beach resources.

- Only the localities of Accomack, Northampton, Mathews, Lancaster, Northumberland; the cities of Virginia Beach, Norfolk, and Hampton; and the Town of Cape Charles. currently are authorized to allow impact evaluations on proposed impacts to beaches.

- The amount of beach in sixteen localities currently excluded from the Coastal Primary Sand Dune and Beach Act totals 75.9 linear miles of the approximately 7,200 total linear miles of Virginia Bay shoreline. This constitutes one percent of Virginia's total Bay tidal shoreline, and combined with the beaches in the jurisdictional localities constitutes less than two percent of Virginia's total Bay

tidal shoreline. Therefore, beaches can be considered a rare shoreline resource.

- A limited amount of beach occurs in other non-jurisdictional localities.

Recommended Action: If it is the Commonwealth's intent to provide more complete oversight of beaches, then the Coastal Primary Sand Dune and Beach Act (Title 28.2, Chapter 14 of the Virginia Code) should be modified to include the localities of Charles City, Essex, Gloucester, Isle of Wight, James City, King and Queen, King George, Middlesex, New Kent, Newport News, Prince George, Richmond (county), Stafford, Surry, Westmoreland, and York. This action also would address the lack of oversight for dunes currently excluded from the Coastal Primary Sand Dune and Beach Act for Middlesex County and Westmoreland County.

Management and Resource Concern: The lack of comprehensive oversight of Virginia's dune and beach resources.

- Only the localities of Accomack, Northampton, Mathews, Lancaster, Northumberland; the cities of Virginia Beach, Norfolk, and Hampton; and the Town of Cape Charles. currently are authorized to allow impact evaluations on proposed development of beaches and dunes.

- Middlesex County and Westmoreland County currently contain significant dune resources. Middlesex County contains 1.23 linear miles of dune shoreline and Westmoreland County contains 0.81 miles of dune shoreline. Each locality's amount of dunes are similar to the amounts found in many of the localities listed in the Act.

- The linear amount of beach located in sixteen localities currently excluded from the Beach and Dune Act totals 75.9 linear miles of the approximately 7,200 total linear miles of Virginia Bay shoreline. This constitutes one percent of Virginia's total Bay tidal shoreline, and combined with the beaches in the jurisdictional localities constitutes less than two percent of Virginia's total Bay tidal shoreline. Therefore, beaches can be considered a rare shoreline resource.

- Dunes and beaches occur to a lesser degree along the shorelines of other non-jurisdictional localities.

Recommended Action: If it is the Commonwealth's intent to provide comprehensive oversight of beaches and dunes throughout Tidewater Virginia, then the Coastal Primary Sand Dune and Beach Act (Title 28.2, Chapter 14 of the Virginia Code) should be modified to include all of Tidewater Virginia as defined in § 28.2-100 of the Virginia Code.

Management and Resource Concern: The lack of oversight of secondary dunes (see Appendix B, *An Analysis of Shoreline Development Risk for Secondary Dune Systems in Tidewater Virginia with Associated Management Recommendations*).

- Secondary dunes are of significant value to tidal shorelines. They function in additional natural erosion control to adjacent uplands, act as reservoirs of sand, and provide unique habitat for coastal migratory and resident birds.

- Only 18.83 linear miles of shoreline containing 310 acres of secondary dunes have been identified in the Virginia portion of Chesapeake Bay.

- A risk assessment reduced the amount of highest-value secondary dunes to 2.4 linear miles of shoreline containing 44.4 acres.

- The most valuable secondary dune systems are privately owned and located at isolated sites in Lancaster County, Northumberland County, Northampton County, and the Town of Cape Charles.

Recommended Action: If it is the Commonwealth's intent to conserve Virginia's limited and unique secondary dunes, then the most cost effective, comprehensive protection strategy is land control such as direct acquisition, development rights purchases, conservation easements, or combinations thereof. The number of private owners is significantly small, which would make regulatory approaches impracticable.

Management and Resource Concern: The incomplete codified list of dune vegetation species. The species identified in §28.2-1400 are used to define a dune.

- Dunes in the cities of Norfolk and Virginia Beach have been documented to support large communities of the non-native *Carex kobomugi*, commonly known as the Japanese sedge or Asiatic sand sedge. Occurrences in the city of Hampton and Mathews County also have been documented.

- *C. kobomugi* can outcompete native plants, resulting in a non-native monotypic dune plant community.

- *C. kobomugi* is not included in §28.2-1400. Therefore, should a dune on a private parcel support only *C. kobomugi* there would be no basis for jurisdiction since dunes must contain one or more of the species listed in §28.2-1400.

- *C. kobomugi* was introduced to North America due to its value as a dune stabilizing plant. Therefore, *C. kobomugi* has a desirable function consistent with the native plants identified in §28.2-1400.

- This has not yet been highly problematic, but the potential exists should this species spread throughout the lower Chesapeake Bay.

- The Virginia pine (*Pinus virginiana*) and broom sedge (*Andropogon virginicus*) are native species that also should be considered for inclusion due to their known distribution and habitat preferences.

Recommended Action: If it is the Commonwealth's intent to have accurate and complete definitions for regulated natural resources then *Carex kobomugi, Pinus virginica,* and *Andropogon virginicus* should be added to the species list of §28.2-1400.

APPENDIX A

Sands of the Chesapeake

Sands of the Chesapeake

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What is the Origin of Our Sandy Shores?

Figure 1. *Exposed and eroding upland banks along the Rappahannock River, Virginia.*

Sand is the foundation, the small durable bits, that comprise the beaches found around the world including Chesapeake Bay. The quartz and feldspar sands, naturally found around the Chesapeake Bay, are derived from erosion of the bluffs adjacent to the shore (Figure 1). Bank sediments typically consist of fine-grained silt and clay as well as coarser sands and gravel. As a bank erodes, these materials slump to the base where wave action separates out the finer sediments suspending them in the water, and reshapes the deposit of coarser, heavier sands and gravel along the shore. The resultant beach deposit absorbs the energy from incoming waves until the deposit is eroded during subsequent storms. Bay shores adjacent to the Bay mouth also receive sand from transport from oceanic sources.

The life span of a beach and dune may vary from a few years to several decades or longer depending on the "stability" of the geomorphic setting and the local supply of sand either from bank erosion and/or an offshore bar system. Beaches are dynamic yet resilient features that are constantly reshaped by waves. In addition to movement in the onshore-offshore direction, sand is transported alongshore. Thus, erosion at one site may provide sand to adjacent beaches (sometimes as spits and washovers (Figure 2) and may create nearshore features such as tidal flats, sand bars and shoals, often creating prime habitat for submerged aquatic vegetation.

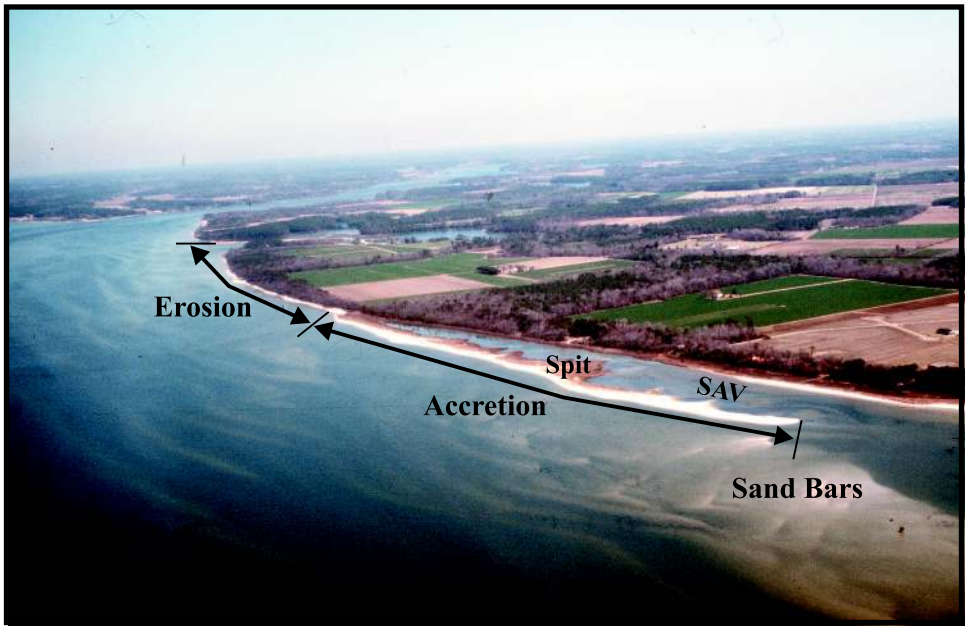


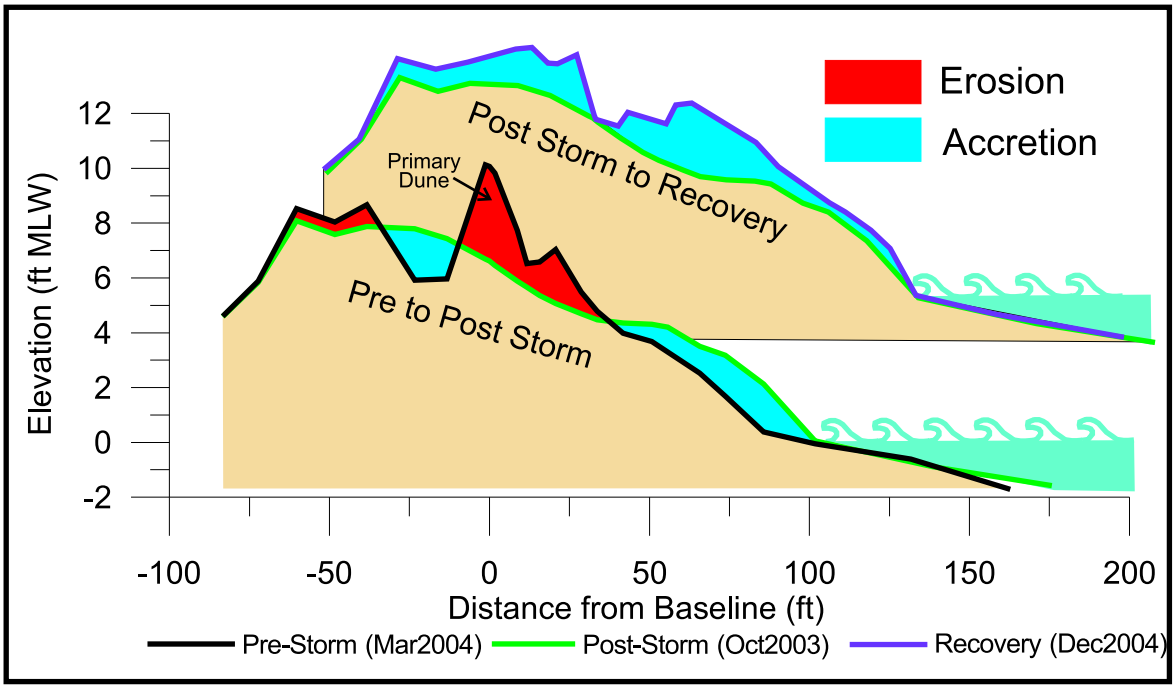
Figure 2. *Erosion of sandy upland banks along the Eastern Shore provides significant sediment to create spits and offshore sand bars that protect the "mainland" from wave attack in addition to providing a haven for submerged aquatic vegetation.*

If the beach becomes wide enough, then a dune can form along the landward side. A dune often begins as wind blown sand from the beach that is trapped by "wrack," pieces of water-born debris, often dead vegetation (Figure 3). In the back beach or back shore certain species of adaptive grasses and forbs will colonize the wrack, grow, trap sand, and begin the process of dune building. With time, and lack of storm wave attack, the dune will grow both laterally and vertically. This process will be interrupted from time to time by storms which may damage, alter, or otherwise erode the beach and dune. By their very existence, however, beaches and dunes act as buffers during storms since they attenuate incoming waves.

Figure 3. *Dune formation processes in Northampton County, Virginia. A dune dimple forms close to the high water line on wrack (water-born debris) and accumulates wind-blown sand allowing dune vegetation to grow into a dunelet. Over time, the area where the dunelets occur becomes a foredune. With continued sand accretion, a primary dune will evolve.*

Thus, the function and value of sand when it is formed into beaches and dunes is important from a coastal hazards perspective. The ability of dunes and beaches to protect upland properties and recover from storms is well documented whether the dunes are man-made or natural (Figure 4). Hurricane Isabel in September 2003 impacted many areas of Chesapeake Bay. Beach and dune monitoring data showed that while erosion of these areas occurred during the storm, recovery began quickly particularly at sites where dune fencing was installed. In more sand-limited areas or those that cannot wait for mother nature to once again provide protection, amending shorelines with sand can be considered a preferred erosion control strategy.

Figure 4. *Cross-sectional beach profile data from Mathews County, Virginia showing erosion and accretion of the beach and dune associated with Hurricane Isabel and the accretion on the entire backshore during the recovery period. Sand fencing was placed along the beach after the storm to help rebuild the dune.*



Why Should We Care About Beaches and Dunes?

Throughout the life span of sandy shores, the beach-dune system is not only home to specific species of salt tolerant flora but also numerous species of fauna that live and transit this unique landscape. The Virginia Marine Resource Commission's (VMRC) Dune and Beach Guidelines provide more information about which species use the beach-dune habitat. The ecosystem services provided by beaches and dunes depend on the structure and local factors such as climate, salinity, turbidity, and wave energy to which they are exposed (Figure 5). Ecosystems services commonly listed for dunes and beaches include: habitat, nutrient uptake, food production, shore protection, and recreation.

Habitat: These sheltered, coastal environments provide habitat for a variety of organisms. The shallow refuge areas of beach environments provide suitable conditions for pupping by some shark species. Some turtle species nest on upper beaches and within low dune areas around the Bay. This is an important consideration if erosion mitigation measures are proposed because many turtle species are endangered or threatened. The dune environments provide important habitat for mammals including rabbits and small rodents and for numerous shore birds.

Nutrient Uptake: Coastal plants are quite effective at removing and recycling nutrients from the sandy soil in the upper beach and dune. Many beaches and dunes are naturally nutrient deficient that promotes a unique plant community which, in turn, can increase the types of animal habitat available.

Food Production: Beaches have extensive food utilization processes created by infauna (animals that live in the sediment), bacteria and microalgae to molluscs, crustaceans, and shore birds.

Shore Protection: The role of beach and dunes in protecting interior areas from wave attack is very dependent on the size of the waves relative to the size of the sand feature. Beach shape can adjust to gradually reduce wave energy across the upper and lower beach provided there is a sufficient supply of sediment. Such adjustments have been well documented in response to seasonal changes in wave conditions. These sandy shores provide a natural and effective erosion control. Secondary dunes are additional storage for sand which provides greater protection during storms.

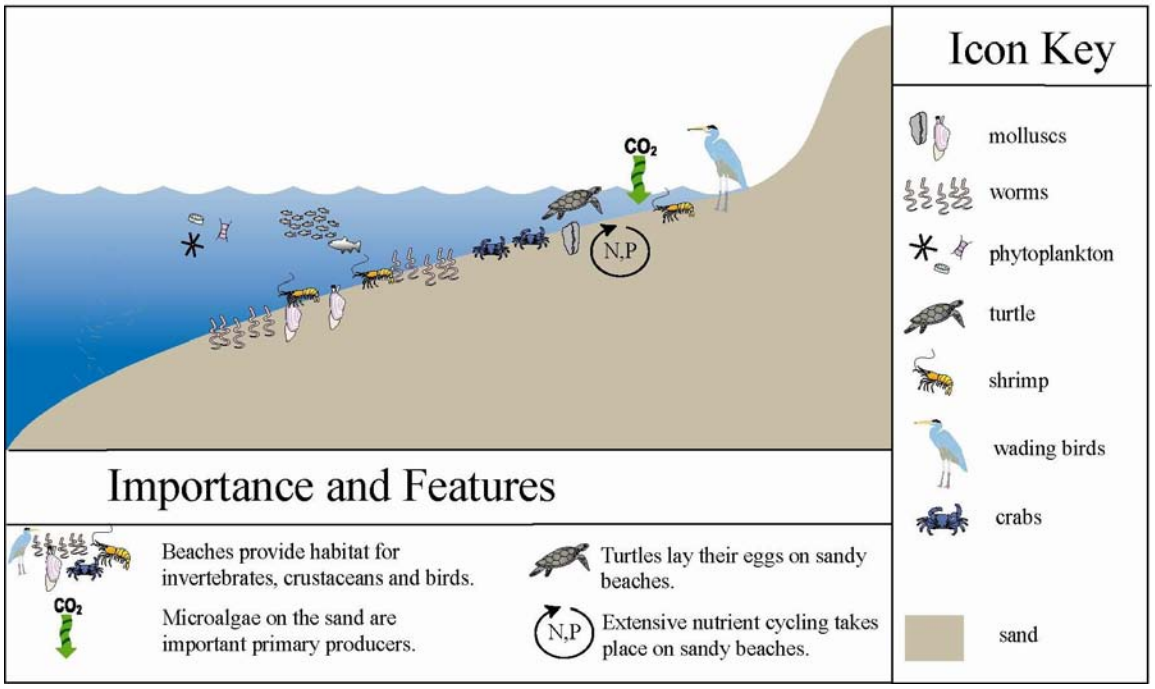


Figure 5. *Conceptual diagram of a beach emphasizing its importance along sheltered coasts and outlining processes that occur on beaches (from the National Research Council's report "Mitigating Shore Erosion along Sheltered Coasts, 2007, www.nap.edu).*

Where are Dunes Located?

The geographic extent of beaches and dunes recently has been assessed by VIMS. Dunes were the primary focus of sand deposits in localities that have enacted the sand dune ordinance (jurisdictional). The dunes, of course, always have a beach associated with them, but in many instances a secondary dune also is found. The secondary dune is not regulated but nearly ½ of the 50 miles of jurisdictional dune coast have secondary dunes. Many dunes and beaches occur in localities without dune regulations as well (Figure 6). Over 1,300 beaches encompassing about 76 shoreline miles occur in those localities and many have associated dunes.

Although Virginia's dunes and beaches are scattered throughout the lower Chesapeake Bay, regulatory oversight is geographically limited. Of the 25 localities surveyed and over 1,260 miles of shoreline assessed, only nine localities and about 39 miles of beaches with dunes plus another 42 miles of beach shoreline (Table 1) are included in the Coastal Primary Sand Dune and Beach Act (Code of Virginia § 28.2-1400 to -1420). Within the nine jurisdictional localities (Figure 6) (the Counties of Accomack, Northampton, Northumberland, Lancaster, and Mathews; the Cities of Hampton, Norfolk, and Virginia Beach; and the Town of Cape Charles) jurisdiction begins at the mean high water line and extends to the back of the primary dune denoted by a ten percent change in slope. Where only beaches occur, jurisdiction extends from the mean high water line to an abrupt change in topography, soil characteristics, or vegetation; or to an existing erosion control structure.

Diversity of Sandy Shores

Unlike oceanic beaches and dune, estuarine, sandy shores occupy a variety of coastal settings. They can be in natural settings or influenced by man's activities such as dredging or by shore protection structures. Beaches and dunes will occur as isolated features or as long "dune fields" and spits. Primary dune growth occurs when there is: 1) an "adequate" supply of sand, 2) onshore wind, and 3) a stable coastal setting.

Jurisdictional Locality	Beach Length (miles)	Dune Length (miles)
Accomack	6.0	5.0
Hampton	4.0	2.0
Lancaster	4.1	2.8
Mathews	7.1	3.6
Norfolk	2.3	4.5
Northampton	7.0	10.2
Northumberland	8.3	6.3
Virginia Beach	3.6	4.5
Total	**42**	**39**
Non-Jurisdictional Locality	**Beach Length (miles)**	**Dune Length (miles)**
Charles City	0.6	0
Essex	1.5	0.01
Gloucester	8.7	3.6
Isle of Wight	10.3	2.3
James City	2.8	0.5
King & Queen	0.2	0.1
King George	8.7	2.9
Middlesex	10.1	2.7
New Kent	0.4	0
Newport News	2.2	0.3
Prince George	1.3	0
Richmond	1.0	0.3
Stafford	3.3	1.4
Surry	10.4	0.3
Westmoreland	12.2	3.2
York	2.3	0.7
Total	**76**	**18**

Table 1. *Beach and dune shore lengths.*

Figure 6. *Tidewater localities that have enacted the Dune and Beach Act (jurisdictional) and those that are not included (non-jurisdictional).*

A classification of dunes and beaches was developed in order to assess these sand bodies. Beaches are categorized by their widths above mean high water as narrow (<5ft) moderate (5 to 10 ft) or wide (>10 ft). These beaches can occur at creek mouths or be linear, pocket, salient of spits features. Beach shore lengths vary from a few feet to hundreds of feet.

Dunes can be found as small features (<500 ft long) such as spits, barriers or at the mouths of tidal creeks or they can be larger dune fields (>500 ft long) particularly along more open, linear reaches of coast. It is in dune fields where we often find secondary dunes.

Research efforts have resulted in information that is directly useful for management such as consistency in the composition and form, which can help us better protect, manage, restore and engineer sandy shores. This research included the first comprehensive inventory that established the geology and biology of Chesapeake Bay dunes, the first classification system for fetch-limited dunes and the first comprehensive assessment of coastal protection potential (dune height and width).

Although geologically diverse across the Bay landscape, important similarities among dunes exist. Analysis of the relationship of various dune parameters shows a strong relationship between dune height and dune width (Figure 7). Basically, as a dune grows in height, it expands in width. A strong agreement was found between crest height and the distance to mean low water. Research measured a 1:10 relationship which means that for every one foot of dune crest height the distance to mean low water is 10 ft. This metric has shown to be useful in the analysis and design of beach nourishment projects along Bay shores.

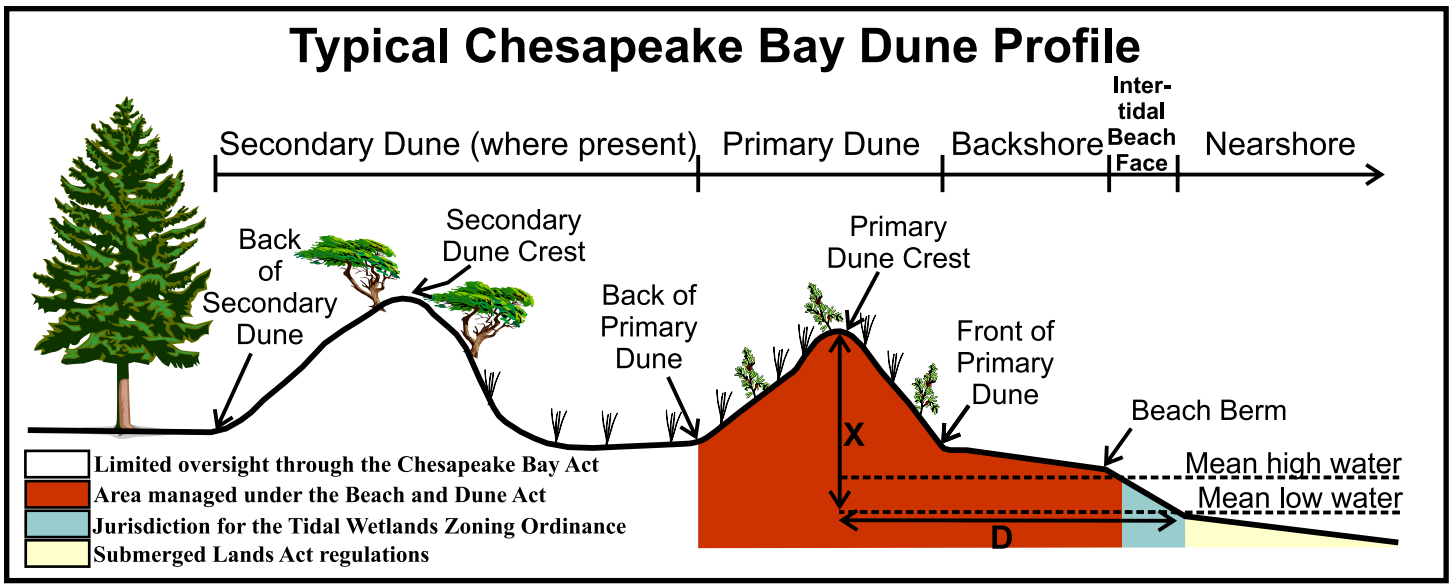


Figure 7. *Typical Chesapeake Bay beach and dune profile showing dune height (X) to dune and beach width (D). Also shown are the boundaries of the present management structure. In coastal Virginia localities, tidal wetlands (vegetated and non-vegetated) are managed under the Tidal Wetlands Zoning Ordinance between mean low water and mean high water. In the localities included in the Dune and Beach Act, additional protection is afforded sandy beaches above mean high water to the back of the primary dune where one exists and to the base of the bank where no dune exists. No management of the upper beach and dune occurs when they exist in localities that are not part of the Dune and Beach Act.*

Sandy Shore Management

The importance of sand and sandy shores was not lost on Virginia politicians as early as 1932 but with a more anthropogenic twist. From Virginia Senate Document No.14 of that year: "Just a few years ago beaches were desolate wastes of sand dunes and underbrush, little enjoyed by the people of the hinterland of our States bordering on the coast. Today a beach is recognized as the playground and health restoring asset of the State, and each year finds this asset attracting more and more people, and contributing annually to the welfare and happiness of our people, with the logical result of enhanced values in land once considered of little value. It, therefore, behooves us to give careful thought to the permanence of an asset of such potential importance."

It was not until 1980 that the sand residing along the Virginia shorelines became protected by law as a comprehensive shoreline system but only in a few select localities. Two years later, in 1982, the tidal wetlands zoning ordinance (1972) was modified to include non-vegetated wetlands and thus, gave every tidewater locality jurisdiction over the intertidal portion of the beaches. The Dune Act completed the management oversight continuum from the state-owned bottom lands (all areas below mean low water) to the landward portion of the primary dune for the localities named in the Dune and Beach Act (Figures 7 and 8A).

It is unknown how much beach and dune sand has been removed because no bay-wide regulatory program exists that could support comprehensive monitoring of resource impacts. Mechanisms for sand losses and impacts can come from lack of jurisdictional oversight as well as natural and man-made influences such as storms and shoreline hardening. Shore hardening (Figure 8) can impound bank sands and cut off a source of sand to the littoral system. Conversely, sand nourishment can have a positive impact by introducing more sand to the littoral system. Most secondary dunes have been impacted by development but many of these features occur on public lands and are afforded a default level of protection. A few dune areas, about 46 acres, were deemed in critical danger of development. VIMS's recommendations included land use controls such as conservation easements and land acquisition.

Virginia's Bay and tributary dunes and beaches show amazing similarity in sand features throughout the lower Bay. Importantly, these features, which are the basis of dune and beach function and values, were not found to differ across political boundaries. Recent research shows that beaches and dunes in non-jurisdictional localities have the same attributes and benefits as those beaches and dunes in jurisdictional localities. If these accumulations of sand are important, then they should be important region wide and should be afforded the same protection. For example, different rules apply for impacts to beaches in jurisdictional Mathews County vs. non-jurisdictional Middlesex County which are adjacent. You can impact a beach with a bulkhead in Middlesex without permission but in Mathews you cannot unless construction is approved by the Wetlands Board. Shoreline sand is an important natural resource that should not be removed from the land-water interface without proper, critical evaluation.

Sandy habitats landward of the primary dune, *i.e.* secondary dunes, dune fields, and sandy scrub areas, may receive some management oversight through the Chesapeake Bay Preservation Act; however, this varies by locality and depends on how each separate locality administers its program. Sandy habitats and sand resources channelward of beaches receive impact review in response to proposed development through either the laws governing tidal wetlands or state-owned subaqueous bottom. The existing regulatory structure leaves a significant amount of sandy shorelines landward of mean high water open to exploitation without the rigorous scientific and resource management review afforded those sand resources located in jurisdictional localities that are equivalent in geological character and shoreline function.

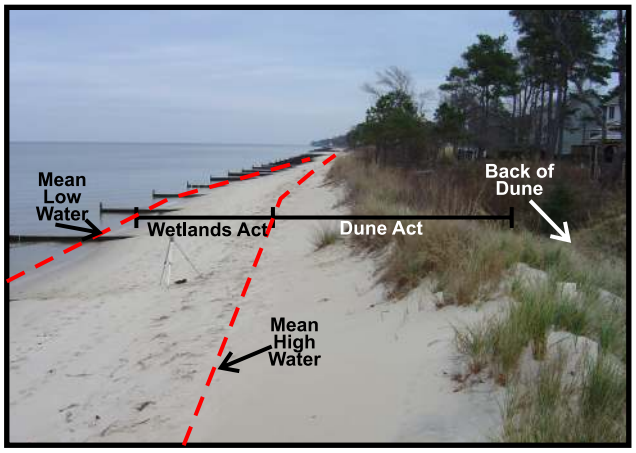


Figure 8A. *A beach and dune system on the Potomac River in Northumberland County, Virginia, a locality in the Dune and Beach Act. Mean high water is the management limit of the Wetlands Act while the Dune and Beach Act manages to the back of the primary dune.*

Figure 8B*. A revetment and bulkhead in Westmoreland County, Virginia, a non-jurisdictional locality, has impounded bank sands decreasing the amount of sand available to the beach and dune system. The mean high water line is the limit of the Wetlands Act jurisdiction.*

The Virginia Institute of Marine Science's Department of Physical Science, Shoreline Studies Program has had a 10-year partnership with Virginia's Coastal Zone Management Program to locate and enumerate beach and dune resources within the Virginia portion of Chesapeake Bay. Funding by the National Oceanic and Atmospheric Administration through the Virginia CZM Program also has provided the means to perform basic research on beach and dune evolution as well as analyses to determine the best management strategies for these resources. Many reports have been produced as a result and can be found at the VIMS website listed below.

Location of dune sites in jurisdictional localities.

To Learn More

Chesapeake Bay Dune Website
http://www.vims.edu/physical/research/shoreline/cbdunes/

Available on this site are links to:
Chesapeake Bay Dune Inventories
Chesapeake Bay Evolution Reports

Coastal Resources and the Permitting Process
http://ccrm.vims.edu/wetlands/techreps/CoastalResourcesandPermitProcess.pdf

Legislative Code
http://law.justia.com/virginia/codes/toc2802000/28.2-1403.html

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Cover Photo: *Dune site in Mathews County, Virginia on September 10, 2006 (Top) and June 4, 2007 (Bottom). In less than a year, sand fencing installed at the site has trapped sand and allowed the dune to grow higher.*

APPENDIX B

An Analysis of Shoreline Development Risk for Secondary Dune Systems in Tidewater Virginia with Associated Management Recommendations

An Analysis of Shoreline Development Risk for Secondary Dune Systems in Tidewater Virginia with Associated Management Recommendations

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This project was funded by the Coastal Resources Management Program
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Introduction

This project was done in response to concerns by environmental resource managers of historic and potential adverse impacts to Virginia's secondary dune ecosystems. Virginia environmental regulatory programs have little decision-making authority over the use of secondary dunes as these areas are not included in the Coastal Primary Sand Dune Act (the Dunes Act). These areas function as estuarine edge habitat and provide natural upland erosion control, and are thus valuable to estuarine and coastal plain fauna and adjacent upland property owners.

Methods

Secondary dunes were identified, characterized, and classified through a related project (Hardaway et al. 2001a). The lack of a legal or science-based definition of estuarine secondary dunes made this project problematic; however, working definitions and delineation criteria were developed through the previous project and formed the basis of these analyses.

Secondary dune physical parameters are based on the data of Hardaway et al. (2001a). The reported acreage represents only the secondary dune field and excludes adjacent primary dunes, uplands, and maritime forests that may be included in a land parcel.

Risk is defined as the potential for loss resulting from shoreline development of substrate and/or vegetation from secondary dunes. Risk of impacts from natural sources (erosion, storm effects) were not analyzed. Adverse impacts determinations were defined based on the relative amount of sand and vegetation removal and/or displacement.

Demographics for the localities containing secondary dunes were characterized from United States Department of Commerce, Bureau of Economic Analysis (BEA) data. Land parcels containing all or portions of secondary dunes, their associated ownership, and 2001 assessed values were obtained from locality records.

The criteria for determining the need for protection of individual secondary dune areas were based on the investigators' analyses of the area's character, location, potential for development (based in part on accessibility and local development), uniqueness, size, probable habitat value, probable sustainability (based on local sand resources and erosion rates), landscape setting, and degree of current impact.

Results and Discussion

Secondary Dune Metrics

There are 99,423 linear feet (18.83 miles) of shoreline containing secondary dunes (Figure 1). This constitutes approximately 47.9% of the total dune shoreline length in Virginia's Chesapeake Bay. These are found within the localities of Mathews (sites 2, 3, 8, and 13) (Figure 2),

Lancaster (sites 11, 32, 39A, 68, 72, and 73) (Figure 3), Northumberland (sites 4, 42, 43, 54, 58, and 59) (Figure 4), Northampton (sites 14, 15, 33, 41B, 42, 43, 48, 51, 53 54, 57, and 58) (Figure 5), Accomack (sites 27, 41, 61, 62, 65, 66, and 69) (Figure 6); and the cities of Norfolk (sites 5, 8, 9A, 9B, and 11) (Figure 7), Hampton (sites 4, 7, and 12) (Figure 8), and Virginia Beach (sites 4, 6, and 15) (Figure 9). Total estimated secondary dune acreage is 310.

Coastal Demographics

The Chesapeake Bay Coastal Zone population is expected to increase significantly and relatively rapidly (Year 2020 Panel 1988). Population increases will require the associated infrastructure development necessary to accommodate the added needs within the locality.
Increases in coastal zone development may increase the risk to shorelines, including dunes.

Historical Coastal Plain demographics (1980-1999) support the projected growth trends (U.S. Dept. of Commerce 2002). Population in dune-containing localities generally has increased significantly during the time series (Table 1). Building permits issued in Virginia coastal localities increased from 19,682 in 1990 to 25,214 in 1999 (an increase of 22%), although the number of building permits per year has generally declined (Table 2). Per capita income in dune-containing coastal plain localities generally has shown significant increases (Table 3). Personal income is calculated as the sum of wage and salary disbursements, other labor income, proprietors' income, rental income, personal dividend income, personal interest income, and transfer payments to persons, less personal contributions for social insurance. It does not include the self-employed. In general, the higher the income, the more money is put into the local economy and the greater the economic vitality of the region. Per capita income is seen as the proxy for the overall economic health of a region or community, which can indicate the underlying potential for growth.

Population growth in Northampton County may exceed projections due to recent improvements to the Chesapeake Bay Bridge-Tunnel and toll reductions. Northampton County contains the largest dune resource in the lower Chesapeake Bay.

The information presented above provides evidence that the potential for risk to Virginia's secondary dunes is significant.

Protection Targeting

Table 4 presents site-specific information for all Virginia secondary dunes. Total value and zoning (2001) were not available for all parcels, and some minor assumptions were made concerning property limits and value. However, we are of the opinion that these data are accurate to the degree that supports reasonable evaluations, and that greater accuracy would not alter our conclusions.

Ownership and zoning designation were two significant factors in classifying probable risk. Ownership is not presented in Table 4, but is included in the archived data.

Approximately 55.1% of secondary dune shoreline length is privately owned (54,789 feet). The remainder is owned by the Commonwealth of Virginia (21.9%), federal entities (9.1%), local government (9.5%), and Non-Governmental Organizations (NGO) (4.4%). 28.9% (28,893 linear feet) of the secondary dune shoreline length is zoned for residential development; 24.3% (24,274 linear feet) is zoned agriculture/forestry; 10.5% (10,480) is zoned conservation; and 36.3% (36,356 linear feet) is zoned for other categories.

At least 33,342 linear feet of secondary dune shoreline (33.3% of total secondary dune shoreline) have been developed (dwellings/structures are located on the lot(s)), with varying degrees of adverse impact. Structures contribute to the overall economic value of the land, and the total assessed secondary dune land value (including structure values) is at least $61,868,737.

Approximately 49.5% of secondary dune acreage and 36.8% of the total dune shoreline length are classified as "protected" due to government or NGO ownership (AC41, NH53/54, NH57/58, NH41B, VB4A/B, MA2, NL43, HP4, HP12, VB15, and NF11) (Figure 10). An additional 20.0% of the acreage and 16.9% of the dune shoreline length are classified as "protected" due to low potential risk from development (Figure 11). These areas are generally remote and/or inaccessible by road (MA8, MA13, LN72/73, NL58, NH14/15, AC27, AC61/62, AC65/66, and AC69). A minor percentage (1.0% of the acreage and 1.8% of the dune shoreline length) is contained in relatively small units and/or units with associated use resulting in questionable value from an ecological and management perspective (LN32, LN68, NL54, NH30, and NH48) (Figure 12).

It is not considered prudent environmental policy to recommend protection strategies for areas where impacts to the secondary dunes (and frequently the primary dune) are already significant. Therefore, areas meeting this criterion were excluded from the candidate group. The amount of secondary dunes impacted from development to the degree that function is significantly impaired is 15.2% of the total acreage and 31.8% of dune shoreline length (MA3, LN11, NL42, NL59, NF5, NF8, NF9, HP7, VB4C, and VB6) (Figure 13). Due to the degree of development at most of the significantly impaired sites, it is probable that little additional development will occur. Coupled with the relatively minor additional adverse environmental impacts that would result from further development, the need for environmental review was deemed minor.

Exclusion of the areas discussed above based on ownership, access, level of probable function, and degree of adverse impacts results in approximately 14.3% of the total acreage (44.4 acres) and 12.7% of the dune shoreline (2.4 miles) that may require management action to maintain their current level of natural function. These sites are Mosquito Point in Lancaster County (LN39), Bluff Point in Northumberland County (NL4), and sites in Northampton County consisting of Savage Neck (NH33), Cape Charles (NH42/43), and Pond Drain (NH51) (Figure 14). These are areas of generally high ecological value (expansive systems with high plant community diversity) that are considered vulnerable to development and/or alteration based on ownership, zoning, landscape situation, and ease of access.

Mosquito Point

Mosquito Point is located near the mouth of the Rappahannock River in Lancaster County. This 3.4 acre dune feature covers approximately 850 linear feet of shoreline. Mosquito Point is classified as a natural and relatively stable salient dune field with a broad beach (greater than 60 feet from primary dune crest to mean low water (MLW)) and a variable width nearshore gradient. The primary dune crest elevation ranges from 3.7 feet to 5.3 feet above MLW. There is no local SAV.

Mosquito Point

This dune feature inhabits a unique position in the landscape. Both Bay and river hydrology have influenced the development of Mosquito Point. Differences in the character of the primary dunes are evidence of the multiple forces that have shaped this feature. The highest elevation primary dune faces southeast toward the open Bay. The west-facing primary dune's crest elevation, formed from comparatively weaker upriver wind and hydrologic forces, generally rests 1.5 feet lower than the southeast-facing primary dune.

The primary dunes form a protective perimeter around a secondary dune field that supports a diverse herb and shrub community. Species present include saltmeadow hay (*Spartina patens*), American beach grass (*Ammophila breviligulata*), seaside spurge (*Chamaesyce polygonifolia*), sea rocket (*Cakile edentula*), running dune grass (*Panicum amarum*), switchgrass (*Panicum virgatum*), prickly pear cactus (*Opuntia compressa*), yucca (*Yucca filamentosa*), lazy daisy (*Aphanostephus skirrhobasis*), rabbit-tobacco (*Gnaphalium chilense*), horseweed (*Conyza canadensis*), buttonweed (*Diodia virginiana*), various asters (*Aster* spp.), loblolly pine (*Pinus taeda*), red cedar (*Juniperus virginiana*), wax myrtle (*Myrica cerifera*), groundsel tree (*Baccharis halimifolia*), persimmon (*Diospyros virginiana*), black cherry (*Prunus serotina*), and sweetgum (*Liquidambar styraciflua*).

Mosquito Point is a privately owned residential community. The dunes and beaches are used recreationally and currently there is minimal development on the secondary area. This is a unique feature in Tidewater Virginia and one of the few prominent secondary dune fields on the western Bay shore. Uncertainties as to the fate of this area exist based on natural and anthropogenic factors. All of Mosquito Point is zoned Residential and houses occupy all lots. It is probable that this area is "built out", but accretion over the last few decades has created developable land that did not exist prior to initial residential development.

Mosquito Point was probably formed from erosion of the high banks immediately upstream. It appears that an erosion control structure placed near the downstream end of the peninsula in the 1960s provided the initial mechanism for sand accumulation. The feature currently appears to be in a state of natural equilibrium; however, should further erosion control occur on the upstream eroding banks thus removing the major sand supply that nourishes this feature, it is unclear how it will respond geologically.

Bluff Point

Bluff Point is an open Bay shoreline natural creek mouth barrier spit in Northumberland County. This three acre dune feature covers approximately 710 linear feet of shoreline. Bluff Point is characterized by a broad beach (greater than 140 feet from the primary dune crest to MLW) and a broad shallow offshore gradient. The primary dune crest elevation is approximately 5.6 feet above MLW. There are numerous small local patches of SAV, and a large persistent bed exists approximately 1000 meters north at Jarvis Point.

Bluff Point

Bluff Point dune field is the result of the migration of a barrier spit that became trapped between eroding headlands. At this point in time Bluff Point is relatively stable, and should remain stable until the maginal headlands erode to the point that local winds and hydrology (primarily from the east) have greater influence on the geomorphology of this dune system. The dunes support a diverse herb community that includes sea rocket (*Cakile edentula*), saltmeadow hay (*Spartina patens*), running dune grass (*Panicum amarum*), switchgrass (*Panicum virgatum*), common reed (*Phragmites australis*), Russian thistle (*Salsola kali*), and others. This dune system is part of a mixture of diverse estuarine edge habitats. The surrounding land use is forest with some adjacent agriculture. Nontidal wetlands exist between the back of the secondary dune field and the forested upland.

Bluff Point is privately owned and zoned agricultural. Some of the local land parcels are currently for sale. The fate of this area is uncertain due to potential changes in local land use. The dune field is easily accessed from the upland, and surrounding upland development could impact the dune/wetland/adjacent shoreline complex.

Savage Neck

Savage Neck is a northwest/west facing natural open Bay linear dune field covering 2,680 linear feet of shoreline in Northampton County. Secondary dune acreage is relatively small, about 2.46 acres, due to the narrow herbaceous/shrub area between the primary dune crest and extensive maritime forest. The primary dune crest ranges from approximately 11 feet to 30 feet above MLW and is fronted by a broad beach (120 feet to 287 feet from the primary dune crest to MLW). Savage Neck dune field is classified as land transgressive, with erosion of the northern reach feeding the offshore bar complex immediately offshore of the southern, and relatively stable, end of the area. These offshore bars support extensive SAV beds.

Savage Neck

The vegetative character of the secondary dunes is created by the relatively rapid transition from the herb-dominated primary dune community of American beach grass (*Ammophila breviligulata*), saltmeadow hay (*Spartina patens*), and running dune grass (*Panicum amarum*) to the narrow shrub/woody-dominated community channelward of the maritime forest.

The Commonwealth of Virginia owns a small portion of this dune field, with the remainder held privately. The area is zoned for agriculture. Due to the projected growth of Northampton County and the market potential of beachfront property the fate of this area is uncertain.

Cape Charles

The Cape Charles dune field is located south of the Town of Cape Charles in Northampton County. This 7.7 acre natural open Bay linear dune field covers approximately 3,486 linear feet of shoreline below Cape Charles harbor. The Cape Charles dune field is characterized by high-elevation primary dune crests (ranging from 9.3 feet to 11.8 feet above MLW) fronted by a broad beach (greater than 120 feet from primary dune crest to MLW) and a broad shallow nearshore gradient. There are significant SAV resources immediately offshore of the beach.

The secondary dune area is vegetatively similar to the secondary dunes of Savage Neck. An herbaceous community dominated by American beach grass (*Ammophila breviligulata*),

saltmeadow hay (*Spartina patens*), and running dune grass (*Panicum amarum*) transitions into a dense shrub community that is relatively broad along the northern portion of the shoreline but narrows to the south.

This shoreline has been affected by the maintenance dredging of Cape Charles harbor and is currently undergoing changes on the upland landward of the secondary dunes. Accretion has occurred on the northern portion of the shoreline from dredge spoil placement and appears relatively stable. The southern portion of the shoreline contains no primary or secondary dunes and is experiencing erosion to its terminus at Elliots Creek.

Cape Charles

The two tracts that include the secondary dunes are zoned municipal and are owned by the Industrial Development Authority and an LLC. Thus, these are likely targeted for future development. The area landward of these parcels is a retirement/resort community and golf course complex. The fate of this area is highly uncertain due to zoning and adjacent land use.

Pond Drain

Pond Drain is natural open Bay linear dune field in Northampton County. This is the largest dune complex in the lower Chesapeake Bay and extends over 4,900 linear feet of shoreline and contains approximately 27.8 acres of secondary dune. This area is characterized by broad beaches (approximately 100 feet from the primary dune crest to MLW) and high primary dunes (10.3 feet to 14.5 feet above MLW). There are local beds of SAV to the north.

Pond Drain

Pond Drain's secondary dunes support a diverse herb and shrub community. Species present include American beach grass (*Ammophila breviligulata*), sea oats (*Uniola paniculata*), saltmeadow hay (*Spartina*

patens), sea rocket (*Cakile edentula*), running dune grass (*Panicum amarum*), bluestem (*Schizachyrium littorale*), yucca (*Yucca filamentosa*), various asters (*Aster* spp.), seaside goldenrod (*Solidago sempervirens*), trumpet vine (*Campsis radicans*), loblolly pine (*Pinus taeda*), red cedar (*Juniperus virginiana*), wax myrtle (*Myrica cerifera*), persimmon (*Diospyros virginiana*), black cherry (*Prunus serotina*), various oaks (*Quercus* sp.), and American holly (*Ilex opaca*).

This shoreline is considered relatively stable. Erosion south of the mouth of Elliots Creek has supplied substrate to the Pond Drain dune field. Erosion control measures, now porposed for this reach could affect Pond Drain's current stability.

The Commonwealth of Virginia owns a portion of the Pond Drain dune field. The remainder is privately owned and zoned for agriculture. Due to the projected growth of Northampton County and the market potential of beachfront property the fate of this area is uncertain.

Policy Recommendations

Management options currently available include no action, modified implementation of the Chesapeake Bay Preservation Act (Bay Act), modifying the Dunes Act, establishing conservation easements, procuring development rights, land acquisition, or combinations of these.

The no action option is not recommended if greater oversight of secondary dune use is warranted.

Bay Act modifications would require that localities establish buffers entirely landward of the primary dune rather than from the high tide line. Many secondary dunes extend landward greater than the Resource Protection Area (RPA) width, leaving portions of some secondary dunes excluded from environmental review. If the Bay Act were implemented such that the channelward extent of the RPA began at the landward extent of the primary dune (i.e. no overlapping jurisdictions) with no granting of variances, approximately half (49,854 feet or 9.44 miles)of the total dune shoreline length and 22.7% of the secondary dune acreage (70.19 acres) would be completely captured for regulatory review. Additionally, greater than 75% of the secondary dune area could be captured for regulatory review for 10.6% (10,550 feet) of the shoreline and 8.6% (26.8 acres) of the acreage (cumulative 60.7% of the shoreline length and 31.3% of the acreage); greater than 50% of the secondary dune area could be captured for regulatory review for 20.5% (20,369 feet) of the shoreline and 20.1% (62.44 acres) of the acreage (cumulative 81.2% of the shoreline length and 51.4% of the acreage); and greater than 25% of the secondary dune area could be captured for all secondary dunes (i.e. the RPA covers at least 25% of all of the secondary dune areas). For the areas recommended for conservation action, the RPA would cover 100 % of NH33 and NH42, 57% of LN39, 54% of NL4, 68% of NH43, and 40.5% of NH51. Therefore, modified implementation of the Bay Act would provide limited

management opportunities.

Dunes Act modifications may be impracticable due to the political and financial resources required to establish and administer an expanded program, and the limited number of private holdings that would be regulated. The most cost effective, comprehensive protection strategies are land acquisition, purchase of development rights, conservation easements, or combinations of these (collectively termed "land control"). Land control could be achieved more rapidly than a new regulatory structure can be created, probably would require much less financial resources than those needed to develop, enact, and administer regulatory programs, and would afford a greater level of protection. The areas recommended for protection are currently assessed at $10,201,400 (including structures where present). This equates to $808 dollars per linear foot of shoreline. Further economic analysis is warranted, but this amount appears cost-effective when compared to restoration costs.

It would be imprudent to recommend expending public resources for protection of natural areas that are subject to significant and rapid degradation from natural causes. The probability of sustainability, absent anthropogenic impacts, was considered in our analyses and addressed above. The secondary dune areas recommended for protection appear to have either adequate local sand supplies or favorable landscape situations, or both, and are considered sustainable. Relating these characteristics to erosion rates would provide a more complete assessment of the probable sustainability of the targeted areas, but comprehensive erosion rates for Tidewater Virginia have not been quantified for many years and may not now be accurate. If land control is the chosen course of action, we recommend quantifying erosion rates for the targeted areas.

Literature Cited

Hardaway, C.S., L.M. Varnell, D.A. Milligan, G.R. Thomas, and C.H. Hobbs, III. 2001a. Chesapeake Bay Dune Systems: Evolution and Status. Final Report to the National Oceanic and Atmospheric Administration Office of Coastal Resources Management. 19 pp.

United States Department of Commerce, Bureau of Economic Analysis (2002). htp://www.bea.gov/bea/regional/reis/.

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Table 1. Population trends for jurisdictional tidewater localities containing dunes.

Locality	1980	1995	1999	Percent Change 1980-1999	Percent Change 1995-1999
Accomack	31,288	32,062	32,121	+ 2.7	+ <1
Lancaster	10,149	11,232	11,349	+ 11.8	+ 1
Mathews	8,016	8,819	9,255	+ 15.5	+ 5
Northampton	14,580	12,903	12,810	- 12.1	- <1
Northumberland	9,836	11,134	11,668	+ 18.6	+ 4.8
Hampton	123,148	138,575	137,193	+ 11.4	- 1
Norfolk	268,469	239,723	225,875	- 15.9	-5.8
Virginia Beach	264,821	428,499	433,461	+ 63.7	+ 1.1

Table 2. Time series of building permits for single family and duplex dwellings issued to jurisdictional tidewater localities containing dunes.

Locality	1990	1995	1999
Accomack	144	189	141
Lancaster	148	71	109
Mathews	194	61	50
Northampton	77	48	49
Northumberland	312	104	132
Hampton	482	368	332
Norfolk	258	175	191
Virginia Beach	1,555	1,439	1,304

Table 3. Time series of per capita personal income (dollars) for tidewater localities containing dunes.

Locality	1980	1995	1999	Percent Change 1995-1999
Accomack	6,972	17,382	20,194	+ 16
Lancaster	9,079	25,393	29,430	+ 16
Mathews	9,005	22,911	27,081	+ 18.2
Northampton	6,238	16,453	20,233	+ 23
Northumberland	8,312	19,093	23,425	+ 22.7
Hampton	8,338	19,064	22,250	+ 16.7
Norfolk	9,223	19,405	22,390	+ 15.4
Virginia Beach	10,882	23,681	28,356	+ 19.7

Table 4. Secondary Dune physical and risk metrics by site.

Site[1]	Zoning	Value	Shoreline Length (ft)	Depth of Secondary(ft)	Secondary Acreage	Risk Category[2]	Risk Rationale'	Protection Target	Protection Rationale'
MA2	Conservation	NA[3]	1,600	168	6.17	P	NGO owned	No	ow Risk
MA3	Residential	$6,160,200	4,290	90	8.86	I-MO	Developed	No	Impacted
MA8	Conservation	$34,900	3,150	160	11.57	P	Remote/Zoning	No	Low Risk
MA13	Residential	$158,800	450	31	0.32	I-MI	Local Land Use/Zoning	No	Low Risk/Small
LN11	Residential	$265,700	990	45	1.02	I-MO	Sparce development	No	Impactec/Small
LN32	Residential	$389,100	320	115	0.84	I-MI	Community commons	No	Small
LN39	Residential	$311,700	850	175	3.41	V	Accessible/sparce use	Yes	Unique/High Value
LN68	Residential	$300,100	250	60	0.34	I-MI	Adjacent development	No	Small/Isolated
LN72	Residential	$322,100	870	60	1.20	I-MO	Adjacent development	No	Low Risk/Small
NL4	Agriculture	$591,400	710	184	3.00	V	Accessible/developable	Yes	Locally Significant
NL42	Residential	Unknown	3,690	77	6.52	I-MI	Local development	No	Impacted
NL43	Other	$930,000	2,750	74	4.67	P	NGO owned	No	Low Risk
NL54	Residential	$39,800	240	22	0.12	I-MI	Adjacent development	No	Small/Low value

Table 4 continued

Site[1]	Zoning	Value	Shoreline Length (ft)	Depth of Secondary(ft)	Secondary Acreage	Risk Category[2]	Risk Rationale'	Protection Target	Protection Rationale'
NL58	Residential	$153, 100	900	103	2.13	V	Accessible	No	Low Risk
NL59	Residential	$275,500	1,680	39	1.50	I-MO	Adjacent development	No	Impacted/Low Risk
NH10	Agriculture	Unknown	300	64	0.44	V	Accessible/Impacted	No	Small
NH14	Ag/Forest	$1,347,700	854	32	0.63	P	Remote/Unbuildable	No	Low Risk/Small
NH33	Agriculture	$2,206,100	2,680	40	2.46	V	Accessible/developable	Yes	Large/High Value
NH41	Residential	Unknown	600	90	1.24	I-MO	Public beach	No	Government Owned
NH42	Municipal	$883,800	3,486	90	7.73	V	Planned for Development	Yes	Large/High Value
NH48	Agriculture	Unknown	703	87	1.40	I-MI	Community Commons	No	Small/Planned Use
NH51	Agriculture	$6,208,400	4,900	247	27.78	I-MI	Accessible/Minor Use	Yes	Large/High Value
NH53	NA	Unknown	4,900	237	26.66	I-MI	State Park	No	Low Risk
NH58	Agriculture	$387,700	4,100	93	8.75	P	Federal Lands	No	Government Owned
AC27	Agriculture	$26,000	970	151	3.36	P	Inaccessible/Unbuildable	No	Low Risk/Small
AC41	Agriculture	$46,500	1,380	130	4.12	P	Inaccessible/Remote	No	Low Risk

Table 4 continued

Site[1]	Zoning	Value	Shoreline Length (ft)	Depth of Secondary(ft)	Secondary Acreage	Risk Category[2]	Risk Rationale'	Protection Target	Protection Rationale'
AC69	Agriculture	$234,700	650	43	0.64	P	Inaccessible/Remote	No	Low Risk/Small
AC62	Agriculture	$543,700	4,880	203	22.74	P	Inaccessible/Remote	No	Low Risk
AC65	Agriculture	$335,100	1,040	55	1.31	P	Accessible/Unbuildable	No	Low Risk
NF5	Residential	$22,500,000	7,390	37	6.28	I-S	Cluster Development	No	Highly Impacted
NF8	Residential	$5,640,000	2,500	52	2.98	I-S	Cluster Development	No	Highly Impacted
NF9	Residential	$5,560,000	3,330	51	3.90	I-S	Cluster Development	No	Highly Impacted
NF11	Open Space	Unknown	900	285	5.89	I-MI	Adjacent Development	No	Low Risk
HP4	Unknown	NA	550	52	0.66	P	Federal Lands	No	Low Risk
HP12	Unknown	NA	4,200	106	10.22	P	City Owned	No	Low Risk
HP7	Residential	$1,509,800	1,540	80	2.83	I-S	Cluster Development	No	Highly Impacted
VB4A	NA	Unknown	11,150	298	76.28	I-MI	State Park	No	Low Risk
VB4C	Residential	$3,270,453	3,750	110	9.47	I-MO	Adjacent Development	No	Impacted

Table 4 continued

Site[1]	Zoning	Value	Shoreline Length (ft)	Depth of Secondary(ft)	Secondary Acreage	Risk Category[2]	Risk Rationale'	Protection Target	Protection Rationale'
VB6	Residential	$1,237,284	2,450	64	3.60	I-MO	Adjacent Development	No	Authorized Build
VB15	NA	Unknown	4,430	85	8.64	I-MO	Heavy Vehicle Use	No	Federal Lands
TOTALS		$61,868,737	99,423		309.79				

[1] **MA**– Mathews County **LN**– Lancaster County **NL**– Northumberland County **NH**– Northampton County

AC– Accomack County **NF**– City of Norfolk **HA**– City of Hampton **VB**– City of Virginia Beach

[2] **P**– Protected **I-MI**– Impacted Minimal **I-MO**– Impacted Moderate **I-S**– Impacted Significant **V**– Vulnerable

[3] **NA**– Not Available

Figure 1. Locations (red dots) of all Virginia secondary dunes.

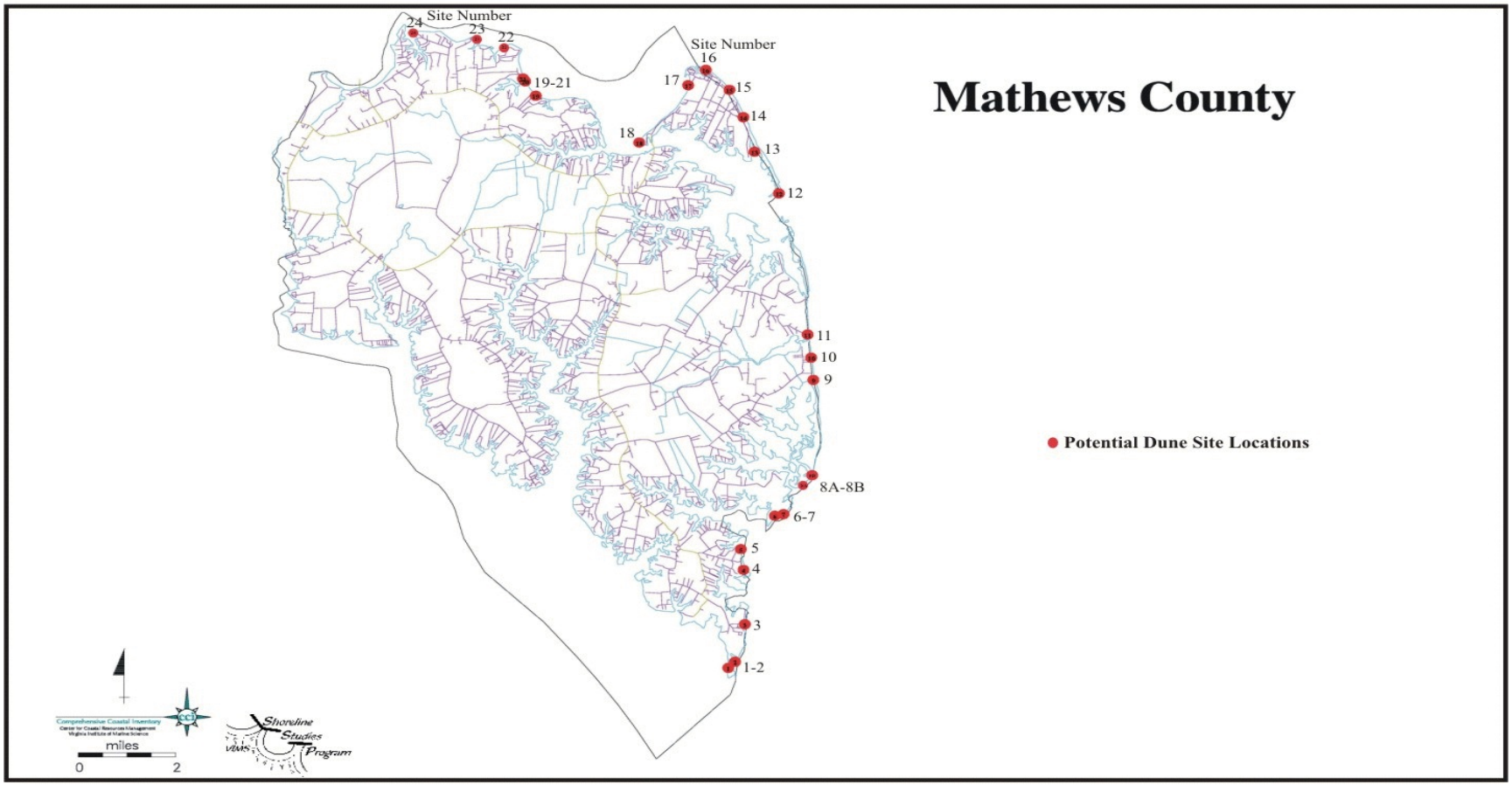

Figure 2. Mathews County dune locations.

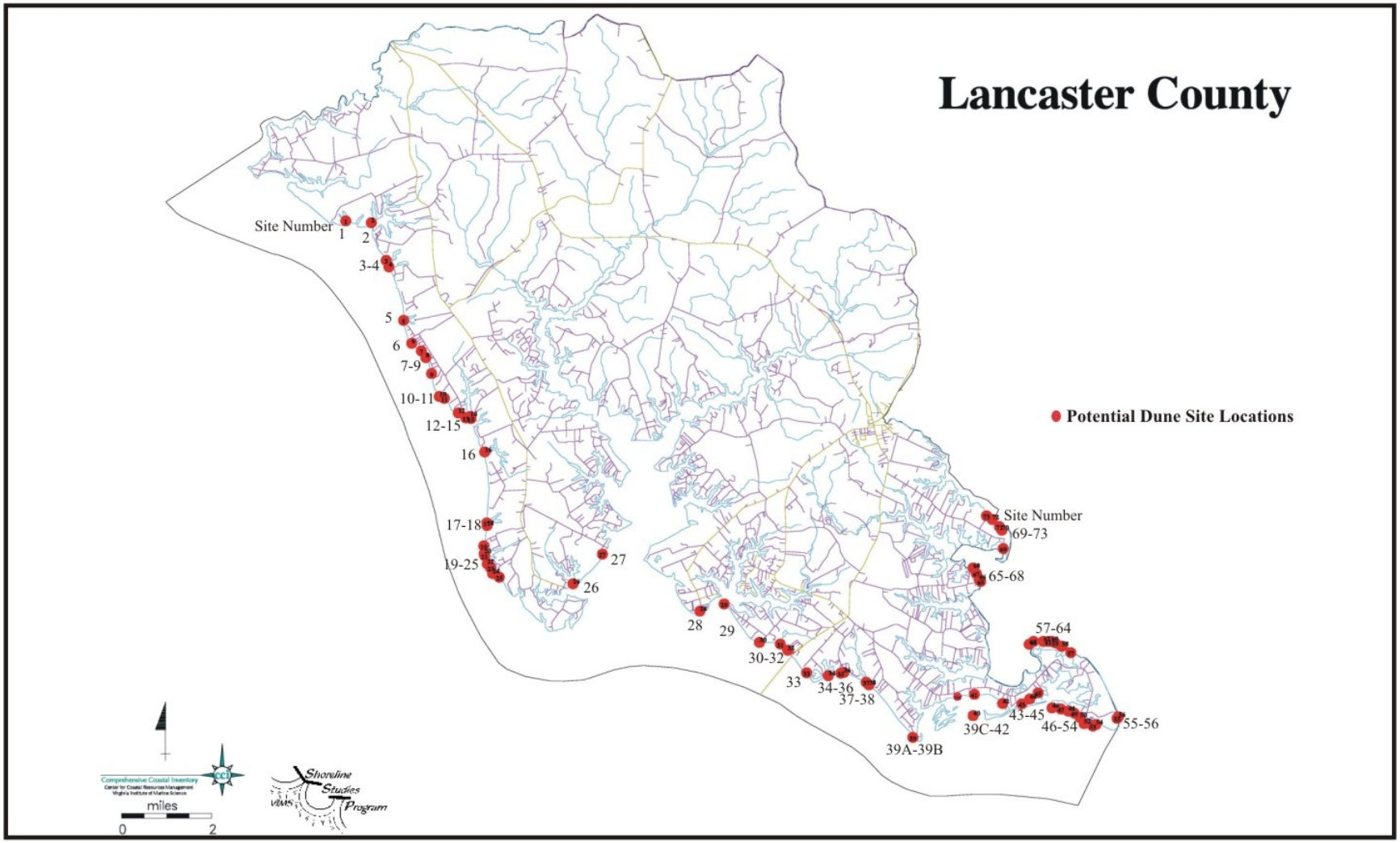

Figure 3. Lancaster County dune locations.

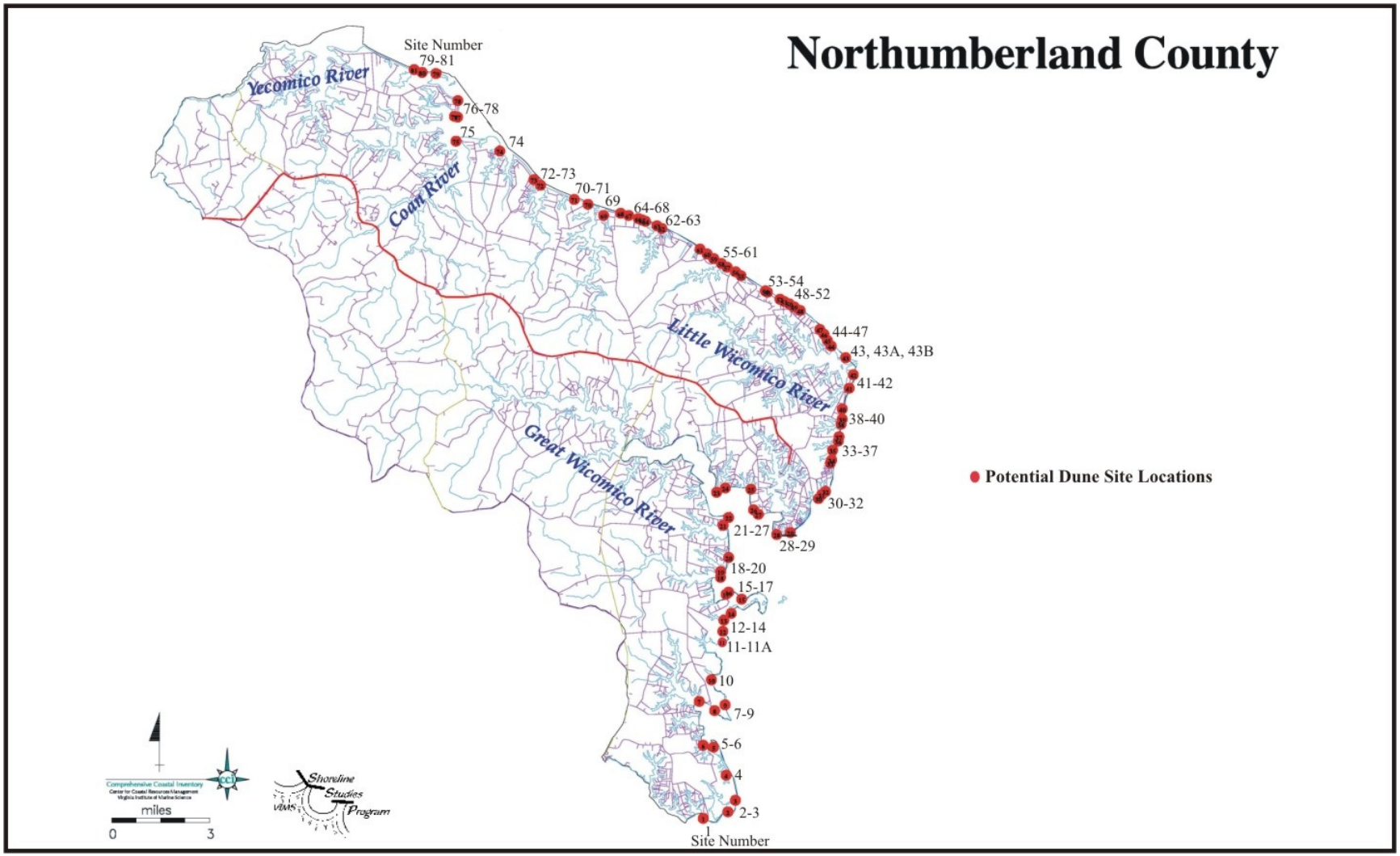

Figure 4. Northumberland County dune locations.

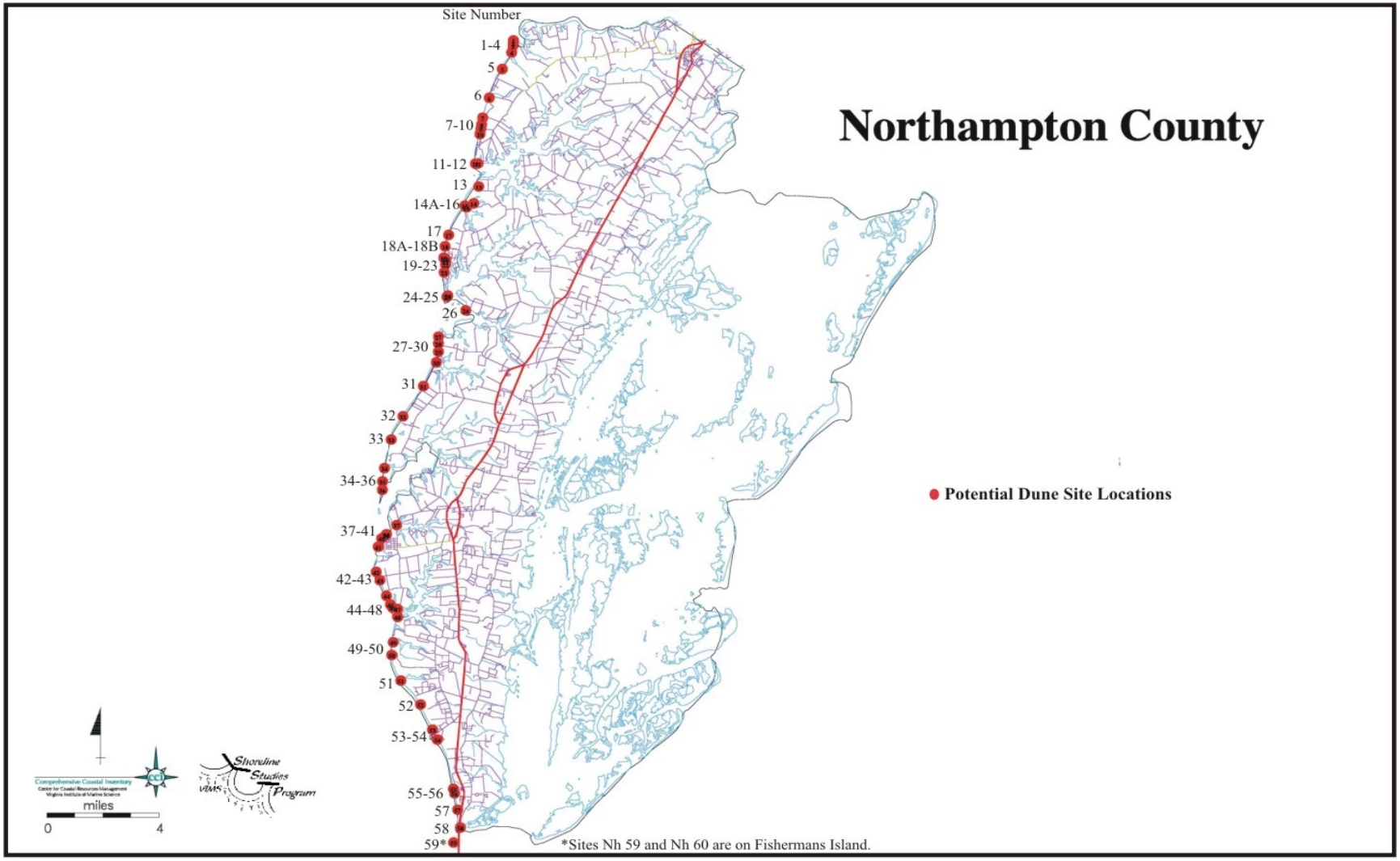

Figure 5. Northampton County dune locations.

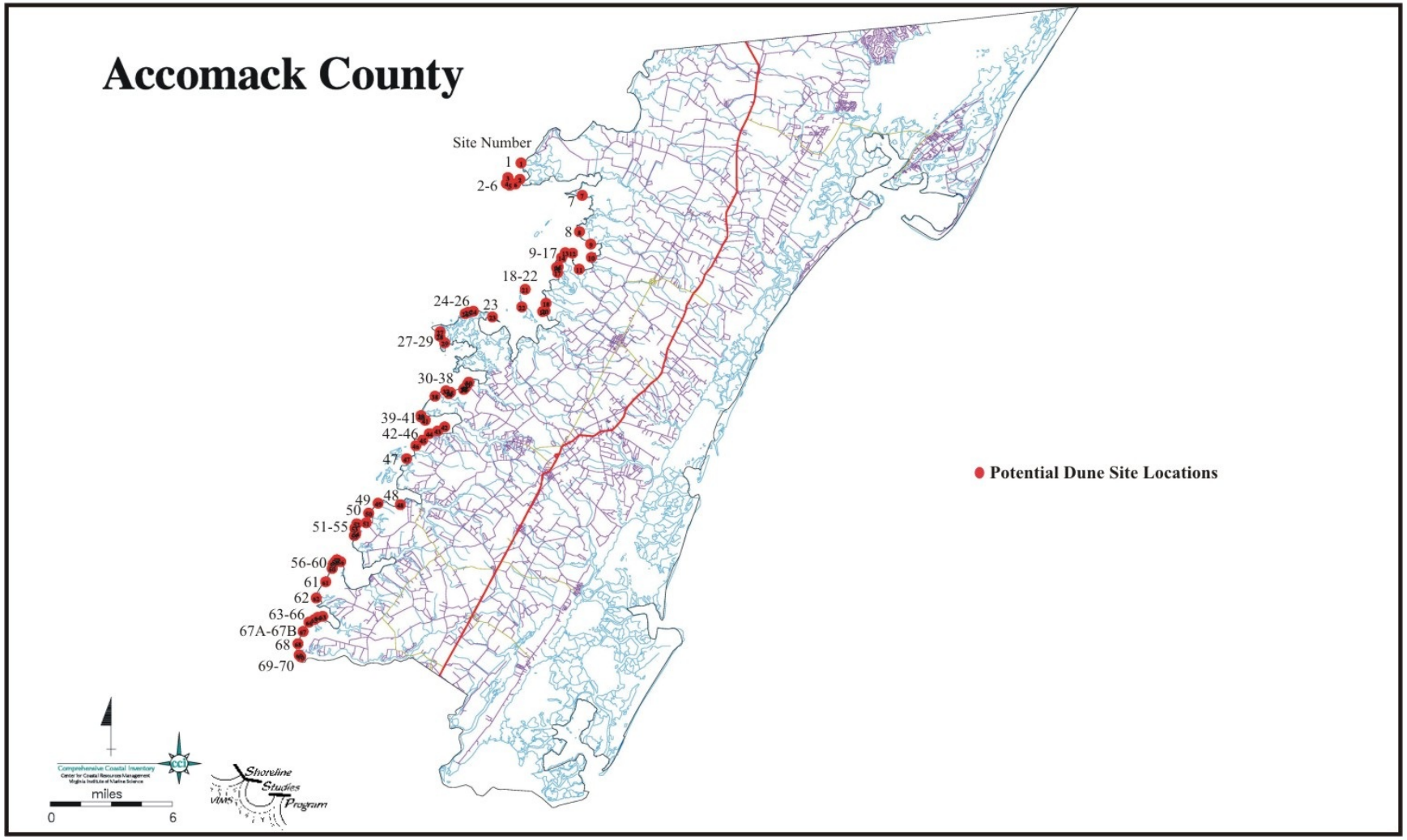

Figure 6. Accomack County dune locations.

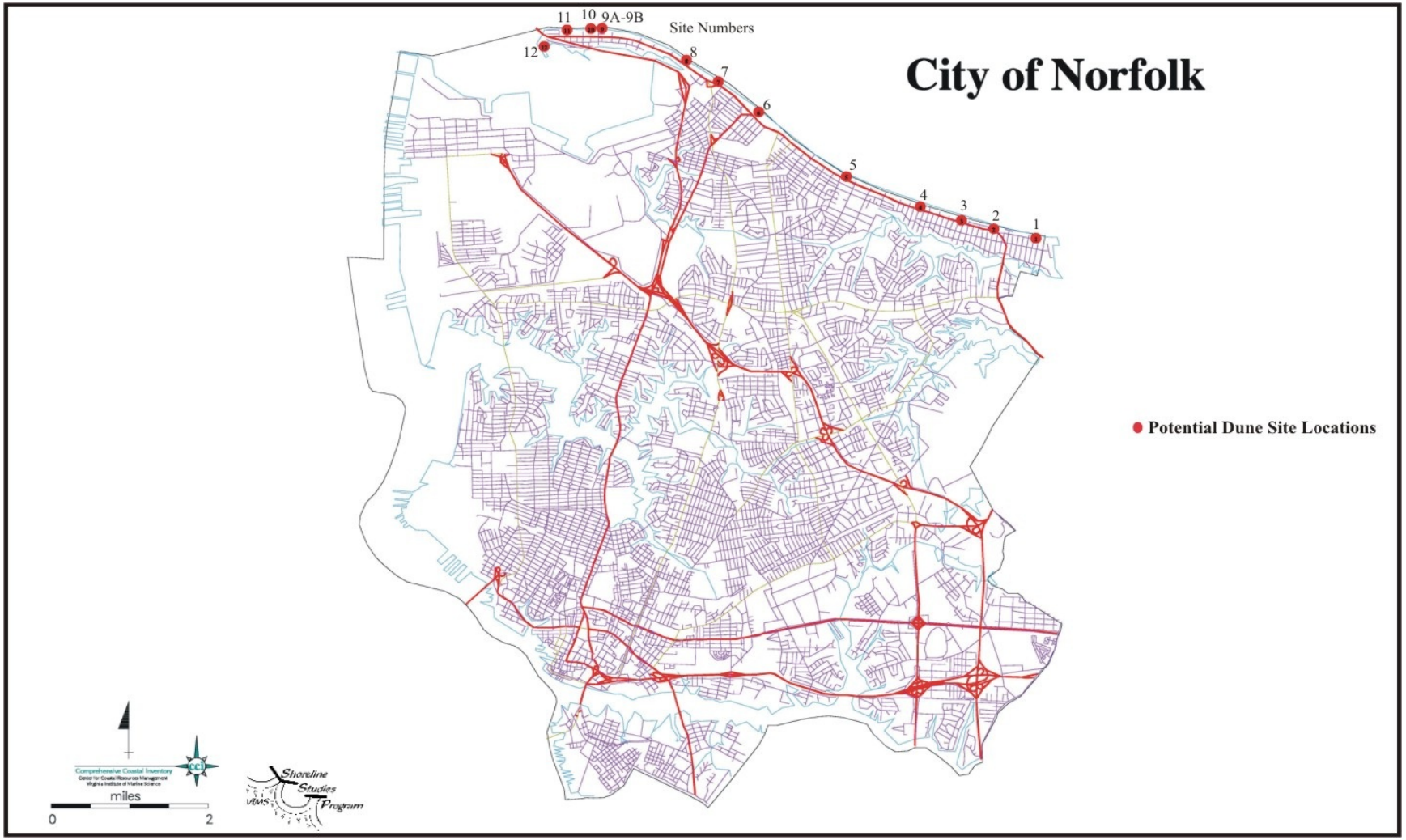

Figure 7. City of Norfolk dune locations.

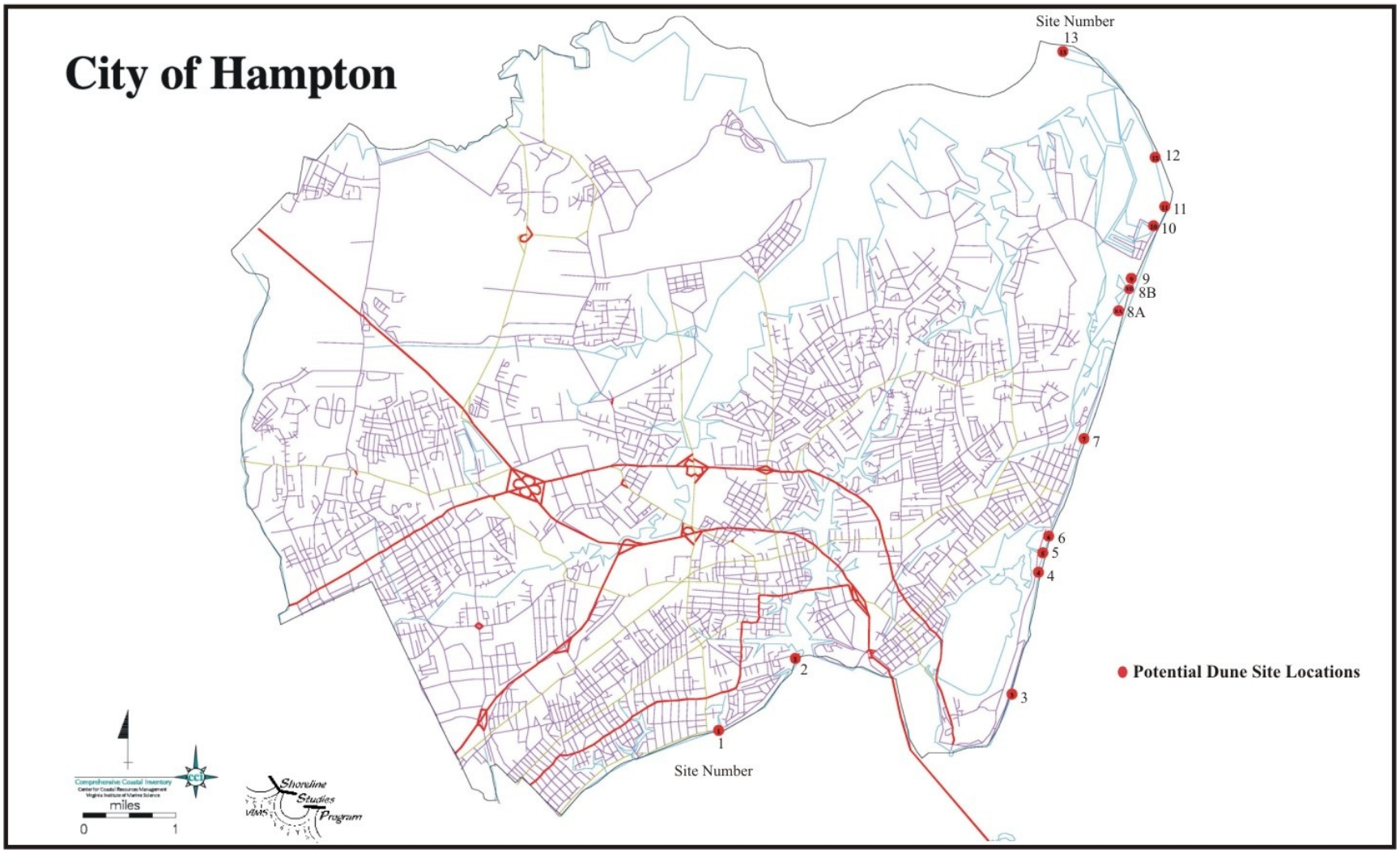

Figure 8. City of Hampton dune locations.

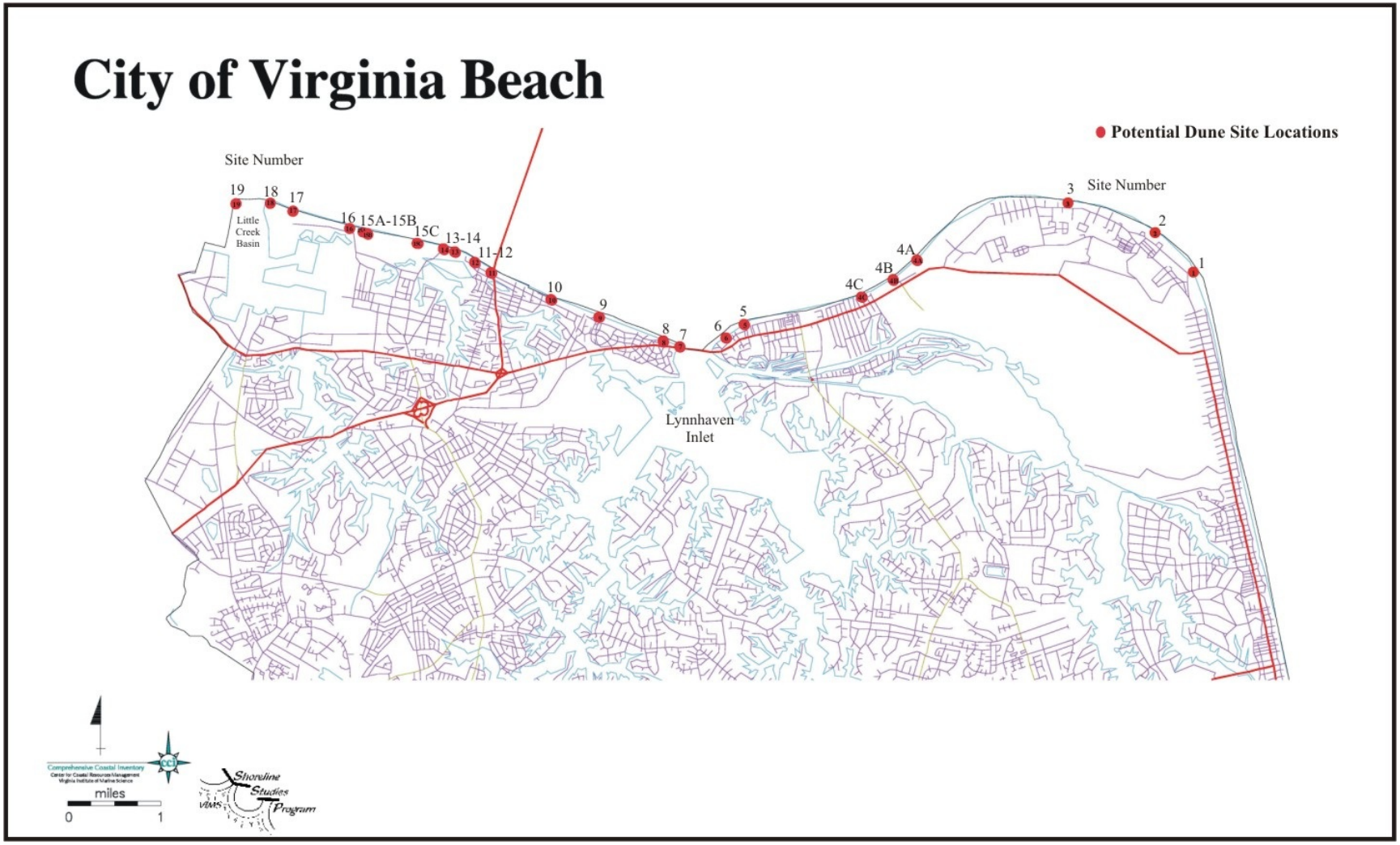

Figure 9. City of Virginia Beach dune locations.

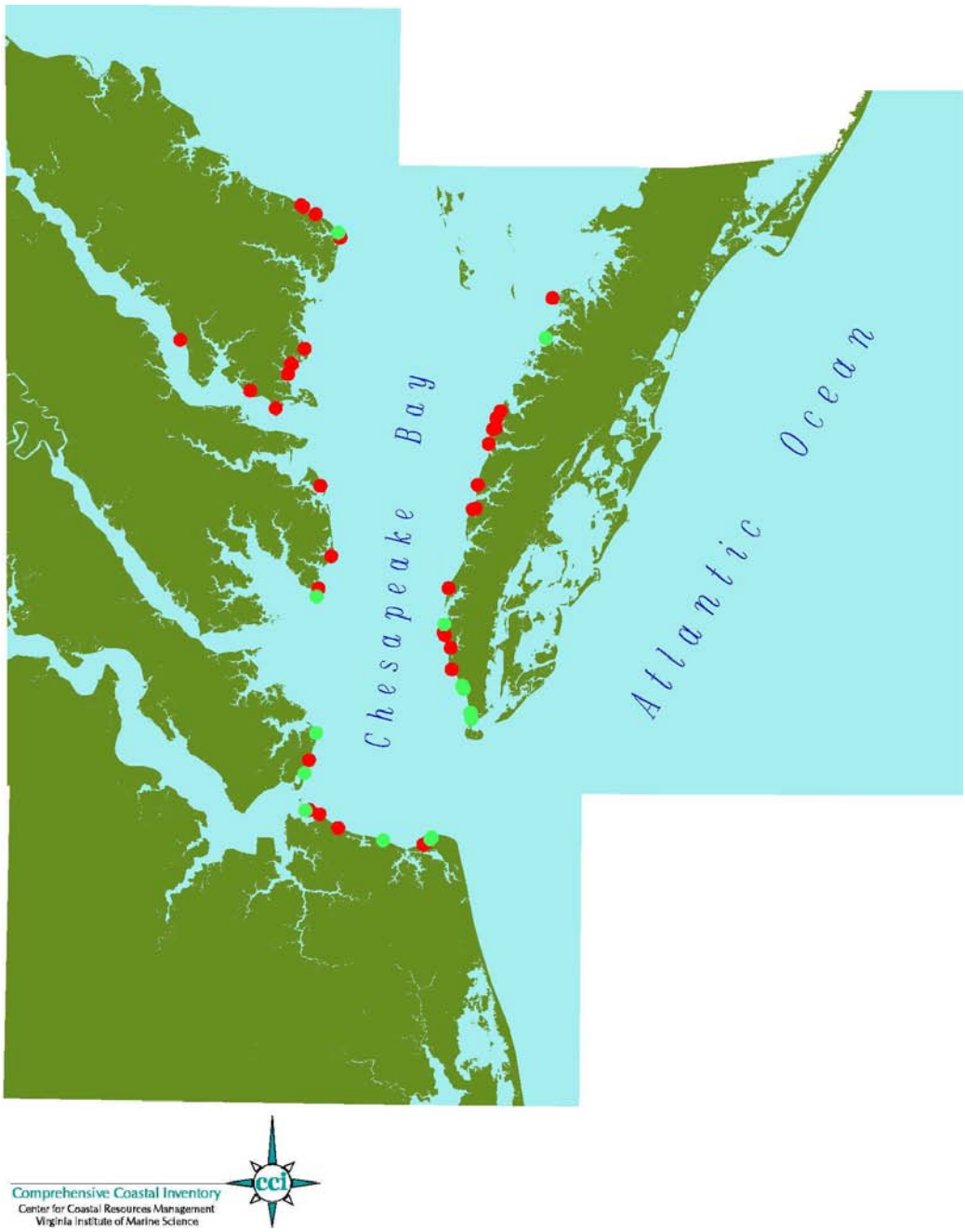

Figure 10. Locations of secondary dunes deemed protected by ownership (lime green dots) in relation to all Virginia secondary dunes (red dots).

Figure 11. Locations of secondary dunes deemed protected by a low potential risk from development (purple dots) in relation to the Virginia secondary dunes remaining after removal of the areas deemed protected by ownership.

Figure 12. Locations of secondary dunes deemed to possess relatively low potential ecological and coastal hazard value (orange dots) in relation to the Virginia secondary dunes remaining after removal of the areas deemed protected by ownership and low development risk (red dots).

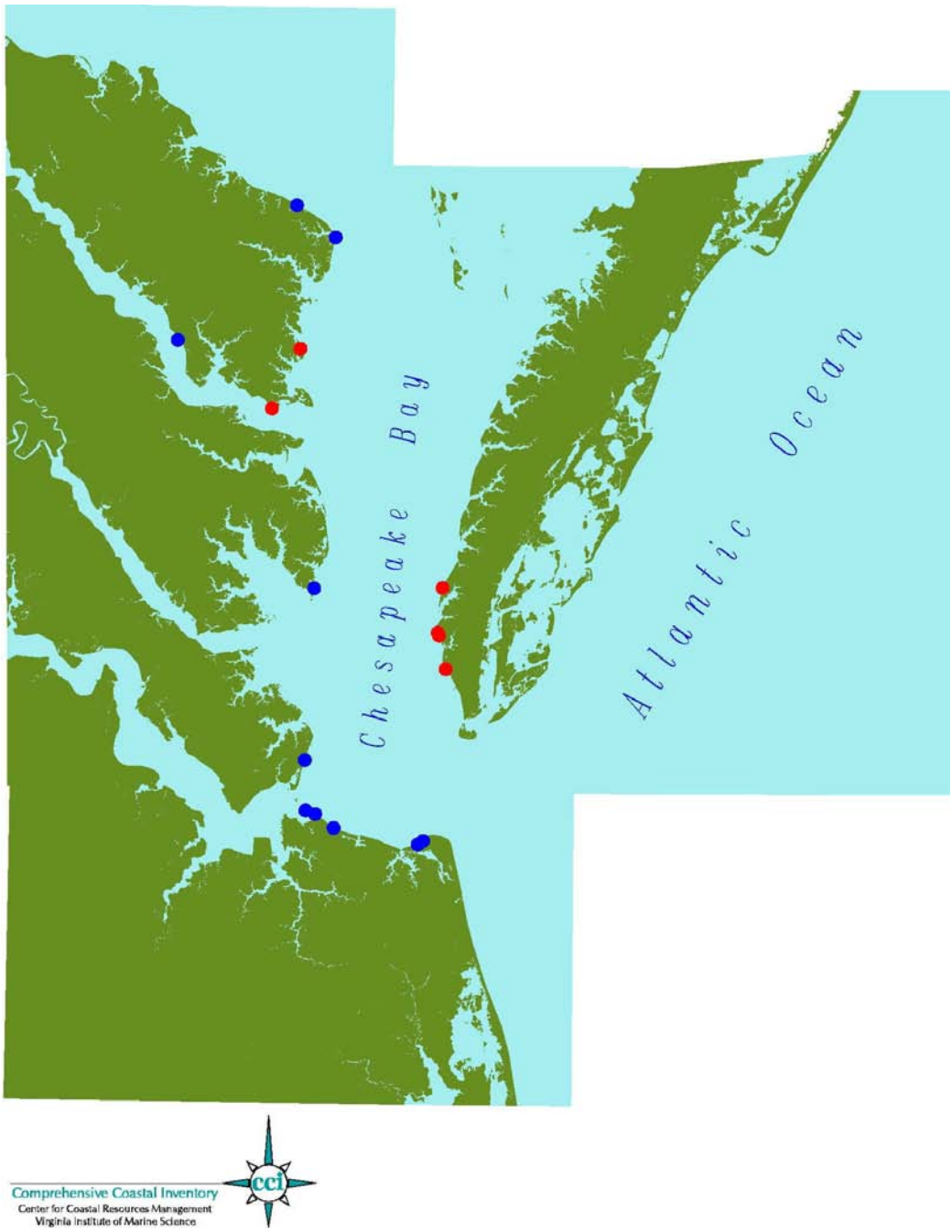

Figure 13. Locations of secondary dunes impacted by development (blue dots) in relation to the Virginia secondary dunes remaining after removal of the areas deemed protected by ownership, low development risk, and low ecological/coastal hazard value (red dots).

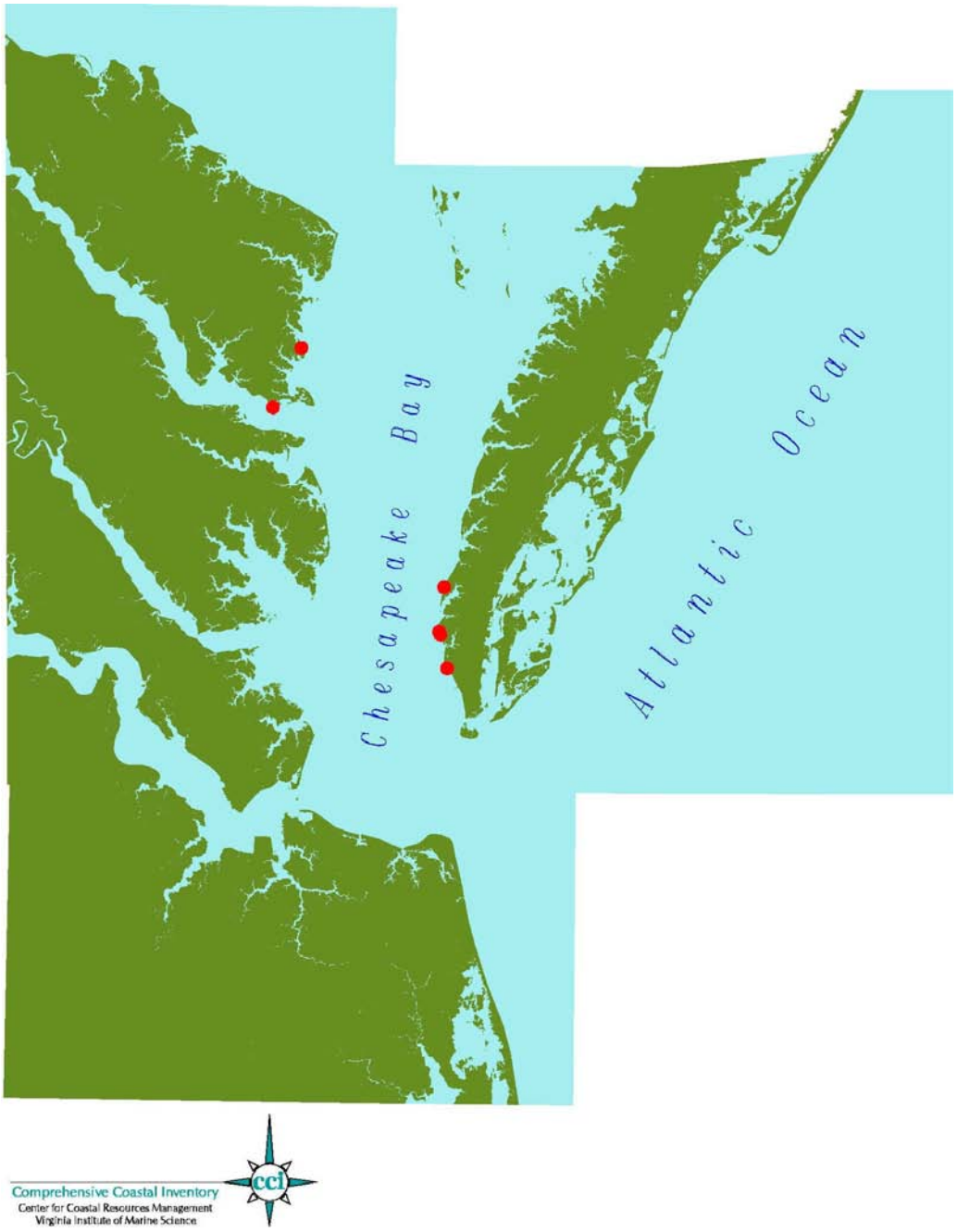

Figure 14. Locations of secondary dunes considered at risk from potential development (red dots). These are considered to have a high coastal hazard value and are ecologically important.