

# Community-Centered Natural Resource Benefits: Mispillion Watershed, Delaware



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# REPORT SUMMARY

The project purpose was to identify ecosystem services cited by key resource experts and local stakeholders knowledgeable about the Mispillion and Cedar Creek watersheds in Delaware (project area, Figure 1); and conduct exercises to quantify and characterize the benefits associated with these ecosystem services. The estimated benefit values in the project area will assist local and state leaders in decision making and resource management.

Economic valuation identifies and quantifies the ways humans express the significance of natural resources through observable market transactions (e.g., fisheries market value) or by a survey of what humans spend or say they are willing to spend to access, restore, or preserve natural resources. These values take considerable effort, time, and funding to estimate, and are typically very context-specific. That said, federal and scientific agencies' have provided essential guidance regarding to use valuation when funding is not available for a primary study.

Based on the findings, this report found that natural ecosystems and their services are valued at several million dollars per year for leisure and recreation alone.<sup>1</sup> The values estimated are annual unless otherwise noted. Instead of deriving a "Total Economic Value"<sup>2</sup> for the Watershed, researchers determined economic contributions and/or values for key components in each of three broad ecosystem categories:

- **Urban River Park and Inland**

This includes recreational- and tourist-centered [Abbott's Mill Nature Center](#), [Mispillion Riverwalk Greenway](#), and the [Vinyard Shipyard](#). Abbott's Mill visitation data indicates general recreation values between \$323,000 and \$6.54 million; and for greenway park leisure activities \$480,000-\$1.23 million. Vinyard Shipyard activity value was not captured in this analysis.

- **Marsh, River, and Wetlands**

The [Marvel Saltmarsh Preserve Boardwalk](#) is especially valued for shorebird viewing. The value of annual birding trips in 2020 is estimated at \$435,000; protection by saltmarsh/wetlands reduces monetary damage of storms by 10%. Using flood insurance claims, a sensitivity analysis between 10% and 50% marsh storm protection saves between \$7,800 and \$125,200 per event.

- **Marine, Harbor, Slaughter Beach.**

[Mispillion Harbor Reserve](#) and [DuPont Nature Center](#) and [Slaughter Beach](#) support wildlife, shorebird, and horseshoe crab viewing; bay beach recreation; recreational and commercial boating; and commercial shipping. Annual nature center and harbor shorebird viewing values: \$574,000 to \$1.15 million. The annual Slaughter Beach recreational accessed value is estimated to be \$458,000.

<sup>1</sup> It should be noted that given limitations in initial scope, the economic estimates highlighted in this report are derived from previous studies. Please note that the individual values presented below should not be summed to a "Total Economic Value" as this was not the goal of this study, nor should they be considered revenue for the community.

<sup>2</sup> These values are "baseline" values and will need to be adjusted, as needed, for use with resource changes due to policy action.

In addition, these resources are directly or indirectly responsible for sustaining 1,251 jobs across eighty three businesses in the region, dominated by hospitality and recreational services (restaurants, bars, hotels, campgrounds), and other marine and coastal-dependent industries. Finally, economic contributions estimated by day trip expenditures to the Milford Riverwalk Greenway range between \$1 million - \$2 million dollars a year. The estimated benefit values from this report will support an evaluation of ecotourism projects to enhance access and resource investment decisions for the community. Ecotourism options will be developed along with a vulnerability analysis and management plan as part of a recently awarded National Fish and Wildlife Foundation (NFWF) grant. Project partners for the NFWF grant include Partnership for the Delaware Estuary, Delaware Sea Grant, The Pew Charitable Trusts, and University of Maryland Environmental Finance Center, all of which are part of the newly formed Waterways Infrastructure Investment Network (WIIN).

## Protected and Developed Lands in the Mispillow River and Cedar Creek Watershed

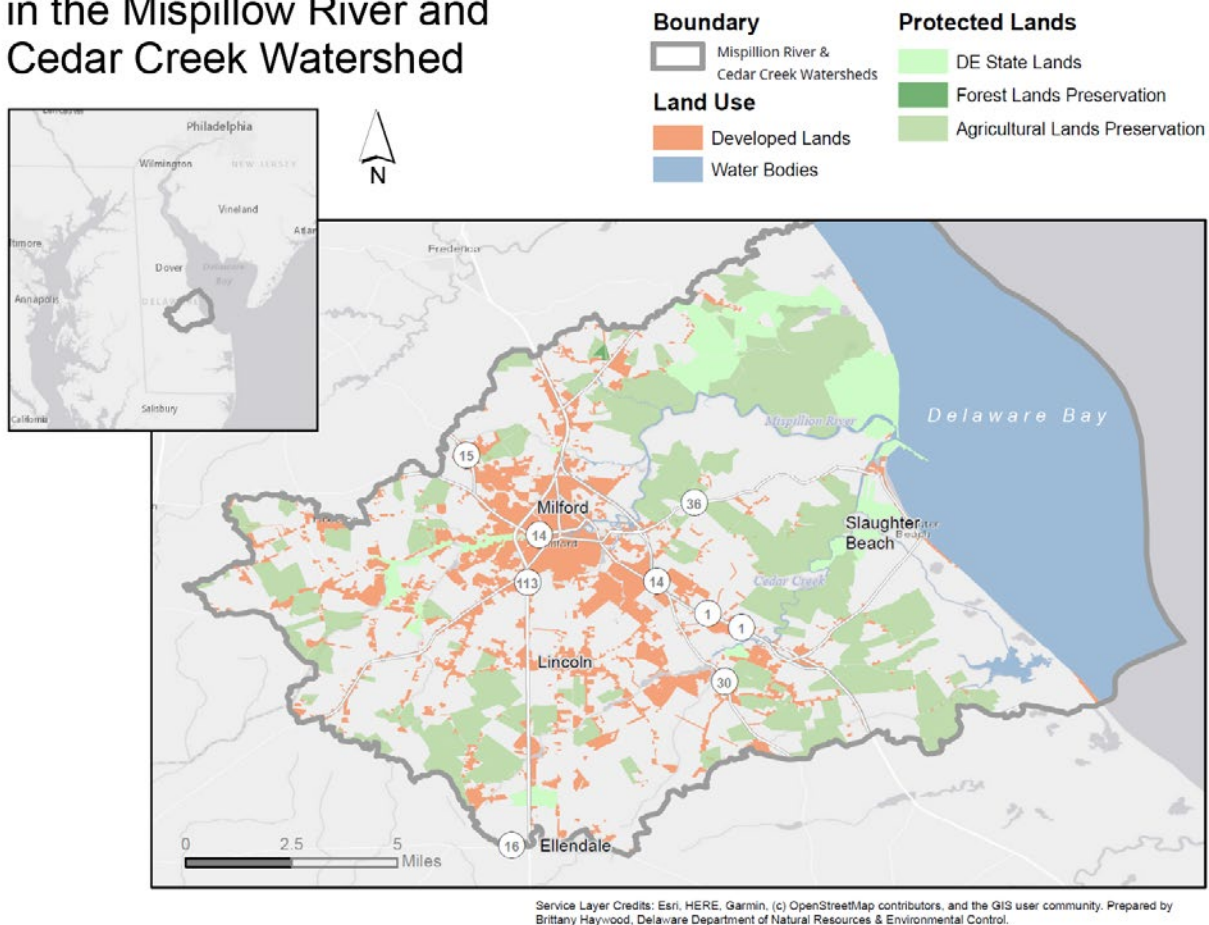


Figure 1: Map of the project area



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# INTRODUCTION

Throughout their existence on earth, humans have depended on nature. Natural resources such as water, wood, and fish provide vital goods for human use. As our scientific understanding of the complexities of nature has grown, so has our recognition, in a broader sense, of the extensive services nature provides for humans. Nature's services are "invisible" at times—such as trees purifying the air and wetlands filtering pollution from water. As the human population has grown past 7 billion, resource use has also increased. One thing economists study is how to use, distribute, and price scarce resources so that human well-being is maintained. This is challenging when some things do not have tangible value. It is easy to see that water, wood, and fish have value because we can buy and sell those items. Lesser understood by researchers is how to place value on the numerous services that nature provides. In the early 2000s, an international working group of 1,360 experts produced the Millennium Ecosystem Assessment, which built consensus on how to assess and classify services for international communication. These broad classifications include *provisioning* of products such as wood and fish; *regulating*, such as water purification; *cultural*, such as recreation; and *supporting*, such as nutrient cycling (M.A., 2005).

Units within nature are called ecosystems. Ecosystems are "...dynamic complexes of plant, animal, and microorganism communities and the non-living environment, interacting..." as systems or units (p.5, Anderson and Gilbert, 2004). There is global agreement that ecosystems, via the services flowing from them, are important, but exactly how to determine what that means—especially in an economic sense—is a work in progress. This is due to many factors, such as the scientific complexity of the systems and the overlapping nature of the services themselves. Although it is difficult to derive the importance of ecosystems from the services they provide, economic tools have been

developed to elicit the values—in dollars—that humans place on specific elements or attributes of the systems. These methods and the outcomes they produce provide ways to look at what ecosystems do for humans, and enable better-informed approaches to making decisions about how to manage nature's resources.

Policy and decision-making processes increasingly use benefit valuation of ecosystem services (Diringer et al., 2020; NESP, 2016; Berghöfer et al., 2016; Daily et al., 2009; Lipton et al., 1995). Early in federal policymaking, econometric methods to value environmental policies' benefits did not exist (Lipton et al., 1995). The importance of understanding how changes and decisions to manage resources provide benefits or harm to humans was fundamental to sound decision-making. Each year more federal agency and international guidance documents provide process-oriented methods to operationalize ecosystem services concepts and science (Potschin-Young et al., 2018; NESP, 2016). Berghofer et al. suggested elements to increase the policy and decision-making impact of benefit valuation and its information: 1) balancing credibility, legitimacy and relevance; 2) closing the loop between valuation and policy making (i.e., ground the numbers to a policy process); and 3) tailoring valuation to a practical purpose (2016). The results of this project are to assist in decision-making for stakeholders and policymakers in and around the City of Milford and Slaughter Beach.

The report contains the following sections: (1) project background and location; (2) a brief overview of benefit valuation; (3) stakeholder interview process followed by a physical description of the three ecosystem categories for the project area; (4) a description of the ecosystem categories for the project area and particular benefits of focus for the report; (5) – (9) method summaries and estimates of benefits; (10) summary of findings; (11) assumptions caveats and uncertainties; (12) database access; (13) conclusions, and references.

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# 1. PROJECT BACKGROUND AND LOCATION

The main aim of this study is to provide a community-driven benefit valuation of the natural resources for the Mispillion River and Cedar Creek watersheds (Watershed, Figure 1). A benefit valuation of the area's natural resources will help inform policy actions and ecotourism potential to enhance access to this unique and pristine area's natural capital. The Mispillion and Cedar Creek areas contain the City of Milford and Town of Slaughter Beach in Kent and Sussex County, Delaware. These areas are part of the Delaware Bayshore (Bayshore). The state of Delaware is invested in protecting and promoting the Bayshore in the three counties it encompasses, and along the Delaware Bay itself. The state of Delaware allocates funding toward the Delaware Bayshore Initiative that was created with the goal of "enhancing the state's natural resources for world-class conservation and boosting the economy through recreational activities." However, strategic protection and enhancement strategies have not been developed specific to the areas including the City of Milford and the town of Slaughter Beach areas, and concern exists that the natural capital stocks may be threatened by development or natural causes related to changing land use (e.g., sea-level rise). The study was conducted by the University of Maryland Environmental Finance Center with support from The Pew Charitable Trusts.

Residents and stakeholders have significant interest and passion for the beauty and bounty of the Watershed. Over the last century, the lands around the Milford and Slaughter Beach have experienced considerable losses in forests and wetlands, and have seen agricultural lands converted into developed areas. The Watershed also contains significant state and non-profit preserved land, natural areas, and is bordered by National Wildlife Refuges. The Bayshore is an internationally recognized flyway for migrating birds, including the endangered Red Knot. The communities have a significant interest in working together to protect and enhance the areas' natural resources, not only for long-term resource management for the citizens of the area, but also for the Bayshore region's potential to draw visitors to the beauty of the area through recreational opportunities.

## 2. HOW SERVICES AND BENEFITS TO HUMANS ARE VALUED

An analysis of ecosystem services captures the total economic value of benefits to humans. Benefits summed in monetary (dollar) terms are more easily compared with costs of policy interventions (EPA, 2010). The anticipated outcomes communicated as a balance of benefits against costs is used to support different decisions for monetary expenditures. “Use” and “Non-use values” comprise the total values (Figure 2). The uses may be observed in market transactions or may be unobservable (not included in market transactions). Direct uses involve both consumptive use (e.g., harvesting timber for building or other materials) and non-consumptive uses (e.g., recreational enjoyment of natural spaces, cultural values). Indirect uses are “secondary” to the ecosystem, such as

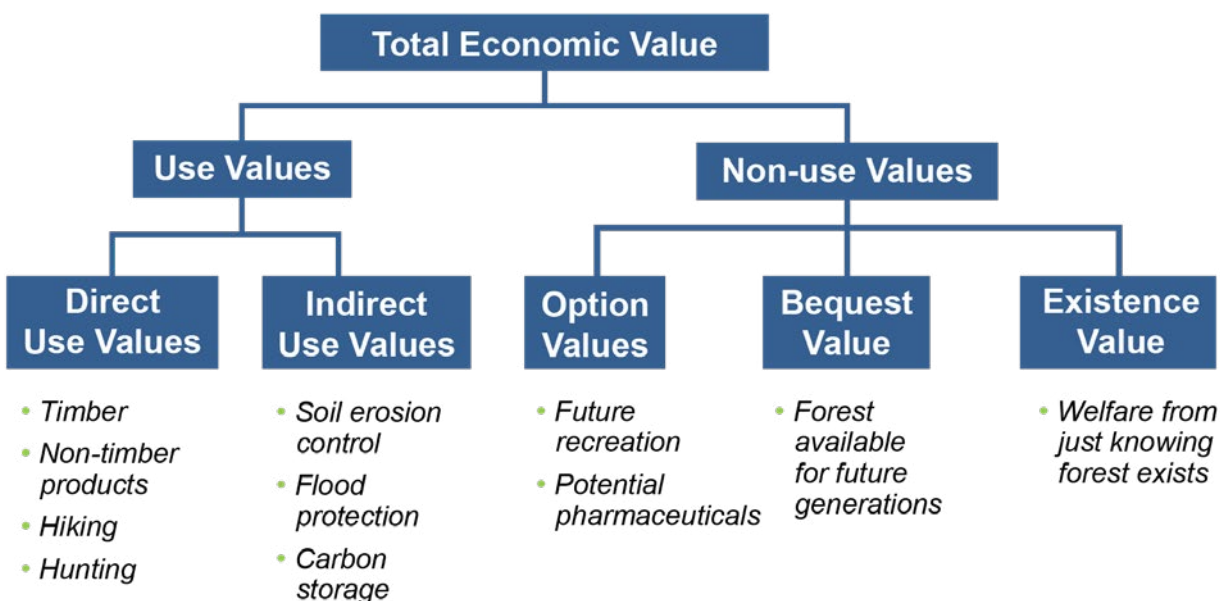


Figure 2: Components of Total Economic Value. (Harris and Roach, 2017).

a forest providing increased air and water filtration. “Option” and “bequest benefit values” involve current or future generations’ ability to use resources, with the idea the use may never actually occur. Finally, “existence values” relate to humans knowing a resource is present, again, even if they may never use the resource themselves (Anderson and Gilbert 2004).

The values depend on scientific knowledge and information about how the ecosystems’ output (service) relates to human values. Economists break valuation methods into two categories: “revealed” and “stated preferences” (Table 1). Values from one study can be “transferred” if the context and other original study parameters apply to a different study area’s context and parameters.















*Table 1: Summary of some valuation methods used in research to obtain benefit values (Adapted from Anderson and Gilbert, 2004, pg. 11).*

Methodology	Approach	Applications	Data Requirements	Limitations
<b>Revealed preference methods</b>				
Travel cost	Derive demand curve from data on actual travel costs	Recreation	Survey to collect monetary and time costs of travel to destination, distance traveled	Limited to recreational benefits; hard to use when trips are to multiple destinations
Hedonic pricing	Extract effect of environmental factors on price of goods that include those factors	Air quality, scenic beauty, cultural benefits	Prices and characteristics of goods	Requires vast quantities of data; very sensitive to specification
<b>Stated preference methods</b>				
Contingent valuation	Ask respondents directly what they would pay for a specified service	Any Service	Survey that presents scenario and elicits potential payment for specified service	Many potential sources of bias in responses; guidelines exist for reliable application
Choice modeling	Ask respondents to choose their preferred option from a set of alternatives with particular attributes	Any Service	Survey of respondents	Similar to contingent valuation; analysis of the data generated is complex
<b>Other methods</b>				
Benefits Transfer	Use results obtained in one context in a different context	Any for which suitable comparison studies are available	Valuation exercises at another, similar site	Can be very inaccurate, as many factors vary even when contexts seem 'similar'; should be used with extreme caution

No valuation method perfectly measures total values of a natural resource. Data requirements and costs limit the use of many of these techniques. Measuring the choices of individuals (demand) through what they are willing to pay or accept for benefit acquisition or loss is complex and time-consuming. Many methods employ hypothetical examples to construct a story for the individuals to make choices. The research design—to be valid—is fundamental in using the techniques appropriately. That said, a valuation is an effective tool for policymaking, which estimates a “non-zero number” to ecosystem services that likely did not have a monetary value. Lack of monetary value leads to humans undervaluing services, and makes essential aspects of the environmental service unfit for market transactions (because it is unobserved as part of the transaction).

Constructing a relevant benefit story for a discrete study area, with benefits identified by stakeholders and experts, and estimating values using transparent methods provides communities with pertinent information for decision making. Caveats and assumptions should also be clearly stated. Benefits inform management, program valuation, and project decision-making in various ways (Figure 3). This project’s goals are similar to the first two columns on the left of Figure 3, with interviews and existing studies in the literature used to estimate values to educate and inform policymakers and stakeholders. The NFWF project will employ a general benefit cost approach to determine new recreational and ecotourism opportunities for the communities, which is similar to columns three and four in Figure 3.

Tell a story about benefits	Show benefits of specific project	Compare projects with similar benefits	Calculate if benefits exceed costs	Estimate how project spending trickles through economy	Show value of the coastal or marine economy
					
<p>Case Studies Focus Groups Interviews Literature Review Surveys</p>	<p>Case Studies Benefits Valuation Benefit-Cost Analysis Input-Output Analysis</p>	<p>Cost-Effectiveness Analysis Benefit-Cost Analysis Input-Output Analysis</p>	<p>Benefit-Cost Analysis</p>	<p>Input-Output Analysis</p>	<p>Regional Economic Accounting Input-Output Analysis</p>
<p><b>EXAMPLE</b></p> <p>Inform people about the benefits of natural infrastructure to decrease flooding</p> 	<p><b>EXAMPLE</b></p> <p>Show benefits of making improvements to a beach and adjacent wetland</p> 	<p><b>EXAMPLE</b></p> <p>Select the least expensive strategy for decreasing erosion in a coastal community</p> 	<p><b>EXAMPLE</b></p> <p>Calculate the return on investment of using living shorelines to decrease storm surge during hurricanes</p> 	<p><b>EXAMPLE</b></p> <p>Estimate how port redevelopment will impact jobs and gross domestic product in the coastal economies located nearby</p> 	<p><b>EXAMPLE</b></p> <p>Estimate employment and gross domestic product in the recreation and tourism sector</p> 



Resources anticipated to be expended, such as time, expertise, and funding

Figure 3: NOAA's description of the way benefits and economic analysis differ in use and time/cost effort and are used in decision-making.

# 3. KEY EXPERT AND LOCAL STAKEHOLDER ENGAGEMENT

University of Maryland Environmental Finance Center (UMD EFC) developed a list—in consultation with project partners Waterways Infrastructure Investment Network (WIIN)—of the key resource experts and local government stakeholders knowledgeable about the project area’s resources. Project partner WIIN is a group of local stakeholders, government officials, and local business leaders. UMD EFC conducted interviews with twenty three via video and telephone between November 10, 2020, and January 27, 2021. UMD EFC reached a total of twenty six persons from various sectors (See Appendix 1, Interview Sectors).

## INTERVIEWS

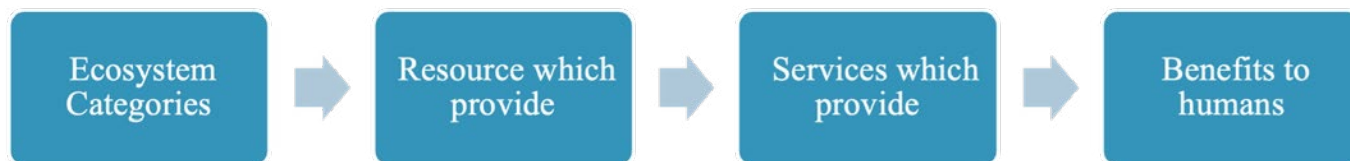
The conceptual diagram of the process to identify the categories and resources for protection and future investment as part of the management plan, as shown in Figure 4. The arrows indicate the “service cascade” similar to Potschin-Young et al. (2018), which describes how biophysical structures, such as a woodland habitat, provide functions, services and benefits that can be economically valued. The interviews centered on services first, to elicit the specific “things” nature provides, rather than asking stakeholders about resources or ecosystems.

UMD EFC contacted each potential interviewee with an invitation to schedule an interview, brief overview of the project, and the interview’s intent. Two staff from the UMD EFC participated in each interview. Each participant confirmed consent, and UMD EFC also confirmed understanding of the project’s intent, and that the collection, storage, and use of information were clear to the participant (See Appendix 2, Consent). The consent also requested the interviewees’ approval to record the interview. Semi-structured questions guided discussion to elicit participants’ views and perceptions of local natural resources, and their knowledge and experience regarding the concepts of ecosystem services and valuation (see Appendix 3, Interview Questions). The final question requested the interviewee’s recommendations for additional people to interview. The interviews were screened and coded using common ecosystem service keywords and phrases (Elmendorf and Luloff, 2006). Interviews took approximately 45 minutes to one hour. Both UMD EFC staff took detailed notes.

Participants’ responses described certain activities that relate to services (such as nature-based recreation). UMD EFC related the activities and services to a resource based on the interviewee’s description. This is similar to mapping benefit-relevant indicators (Olander et al., 2018). Ecosystem and environmental values can be highly personal, local and context-dependent. Measuring human welfare and how human’s trade off goods and services to maximize their welfare is at the heart of valuation techniques. Identifying benefit-relevant indicators ensure “... that ecosystem services assessments measure outcomes that are demonstrably and directly relevant to human welfare” (Olander et al., 2018 pg. 1262). Olander et al. recognize the importance of discrete connectivity between an aspect of an ecosystem and the benefits received from that aspect by humans: that is, “until there is some person somewhere who benefits from a given element or process of an ecosystem, that element or process is not a service.” (2018, pg. 1263). Benefit relevant indicators should be: 1) units relevant to beneficiaries; 2) physical and institutional components integral to benefit use (e.g., access to the resource, and/or restrictions or regulations on resource use); 3) intensity of resource use (i.e., “how much” of the resource is used and enjoyed; for non-use values the quality of the resource may be important); 4) use of causal chains to map the ecological system to people interested in, or using the resource (Olander et al., 2018).

Information on the project area’s ecosystems and assets that provide or increase access, gathered through key expert and stakeholder interviews, was matched to human benefits. The access for recreation and intensity of use factored into the valuation through identified assets and the number of visits via those assets (i.e., nature center visits and boardwalk visits). The “benefits to humans” column in Appendix 4 developed by EFC reflect available data (either through visitation numbers or literature searches) for the project area that could be used to estimate benefit value.

Data collected from interviewees was instrumental in constructing context-specific, benefit- relevant estimations of potential values for the project area in the Mispillion and Cedar Creek Watersheds. Resources were grouped into ecosystem categories to enable cohesive descriptions of the “systems” that benefit humans. Interviewees identified specific “assets” like nature centers, or particular built elements (facilities etc.) that increase access opportunities to resources. The assets (such as DuPont Nature Center) are listed in Appendix 4, and staff provided UMD EFC with information regarding visitation data.



*Figure 4: Conceptual diagram of process used with stakeholders to identify ecosystem categories and relevant benefits to humans.*

## NOTES REVIEW AND CODING

Interviewee responses related to specific natural and cultural resources (also referred to as assets), ecosystem services, and benefits to value were coded and tracked in a Microsoft Excel worksheet. Multiple sources helped populate the services, which were expanded or reduced based on interview responses (Table 2, NESP, 2016; Anderson and Gilbert, 2004). Specific asset names (non-profit organizations and particular locations) were also recorded based on questions related to natural assets that the participants recognize as providing access to nature (such as the Marvel Saltmarsh Preserve Boardwalk). The services were grouped based on the resources which provide the service that the interviewee mentioned; the resources were then further categorized into broader ecosystems. The UMD EFC team used the groupings and services in literature and data search for benefit values specific to interviewee responses that were mentioned often. For a complete list of ecosystems, resources, and services elicited from the interviews, see Appendix 4.

*Table 2: List of services and changes due to services (adapted from NESP, 2016) used to code benefits identified from key informant interviews. (Highlighted services were most mentioned by interviewees.)*

### **Ecosystem Services**

- Providing clean water for drinking and irrigation
- Filtering water to keep it clean
- Removing pollution from the air
- Keeping soil fertile and productive
- Providing protection against floods and hurricanes
- Preventing erosion of fertile soil
- Pollinating plants and crops to help them grow
- Providing fish and wildlife for use as food
- Offering sources of unique ingredients for medicines
- Removing carbon and global warming pollution from the air
- Providing raw materials like wood that help to support industries and jobs
- Providing green spaces to help reduce the temperature of urban areas
- Providing a place for relaxation and spiritual renewal
- Providing a place for hiking, camping, or other outdoor recreation
- Providing places for exercise to improve health
- Moderating extremes of weather
- Providing timber for buildings and material for paper

### **Changes Due to Ecosystem Services**

- Attracting tourists to support the economy
- Increasing the value of surrounding properties



## 4. ECOSYSTEM CATEGORIES FOR LOCAL INTEREST

Ecosystem categories provide ways for future policy, investment, and planning to target intact systems and focus preservation, enhancement, investment, or policy interventions. The ecosystem categories, within the project area, include: urban; inland freshwater (including rivers); cultivated (open space, agriculture); forest; coastal (including saltmarsh); and marine (these categories are within the M.A., 2005).

The majority of stakeholders and experts discussed services related to recreation (shorebird and horseshoe crab viewing, fishing, boating); the aesthetic value of open space; and damage reduction offered by marsh and rivers. Multiple interviewees also mentioned cultural and historical values of shipping/shipbuilding in Milford and along the Mispillion River and Cedar Creek. The project area's ecosystems categories selected by UMD EFC based on multiple interviewee responses were Urban River and Inland, Marsh/River (open space), and Marine/Bay. Forests and cultivated land (agriculture) were mentioned but not by as many interviewees as the other ecosystems. Physical descriptions and supporting information summarized for interviewees identified services and benefits are in the following three sections. Consultation of recognized classification systems helped determine the goods, services, and processes that produce the goods and services (Newcomer-Johnson et al., 2020).

### URBAN RIVER/PARK AND INLAND (CITY OF MILFORD) – BENEFITS CITED

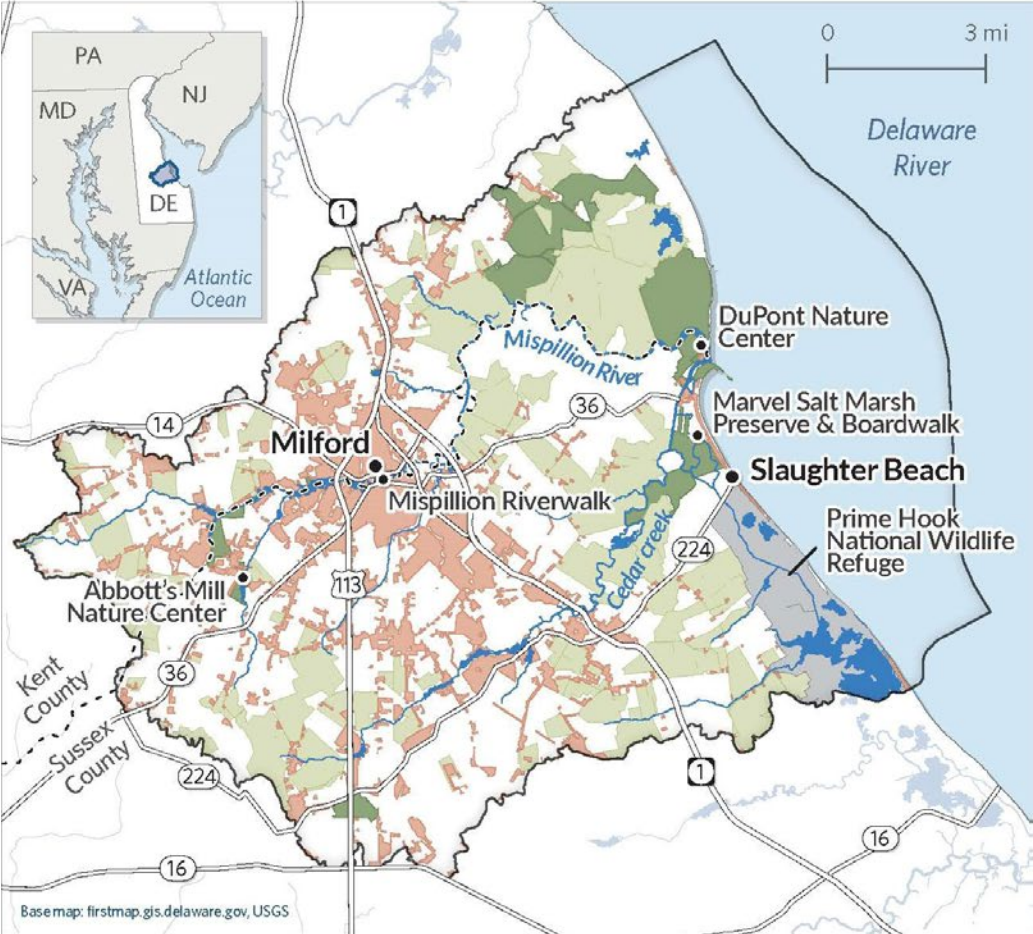
The Mispillion River runs directly through the Milford, Delaware (pop. 11,732, U.S. Census 2019). The city is one of the fastest-growing areas in Delaware; its population increased approximately 15% from 2010 to 2016 (UD IPA, 2018). Over the past 30 years, the city has focused on the river as a source of opportunity to anchor and rebuild the town as a “Rivertown” (Arnett Muldrow, 2015). The Mispillion Riverwalk Greenway is a bicycle and pedestrian path along the river and is the largest municipal park in Delaware. Greenways supply many benefits to residents and visitors to the area, such as promoting social connections to the community, providing leisure activity (recreation), fostering aesthetic beauty, increasing property values, enhancing historical value, and preserving cultural significance for the community. They also provide connected habitat space for wildlife, protect or improving water quality, and reduce flooding (Hellmund and Smith, 2006).

Local parks supply many economic benefits that can be valued, including direct, indirect, and induced effects (NRPA, 2018). The National Recreational Park Association conducted an IMPLAN<sup>3</sup> analysis for all U.S. states, and estimated economic impacts, including spending by recreational agencies, revenue generated by vendors and contractors for providing recreational services, consumer spending, and labor. Additional economic benefits provided by local parks are economic development, visitor spending, health and wellness, conservation, resiliency, and property values (NRPA, 2018). *Interviewees identified the Mispillion Riverwalk Greenway (Figure 5) and associated park space for leisure activities, tourist visitation, and cultural importance as vital to the community.*

<sup>3</sup> IMPLAN is a software modeling tool that uses economic data in an input-output analysis to estimate impacts or changes to the economy for interest scenarios. (See <https://www.implan.com/platform/>).

# Delaware's Mispillion River and Cedar Creek Watersheds Vital for Wildlife, Local Economy

Internationally recognized flyway—one of world's most productive horseshoe crab spawning areas—faces challenges



- Mispillion River and Cedar Creek watersheds
- Developed land
- Delaware state lands
- Agricultural and forest lands preservation
- Federal lands

Sources: FirstMap@De, "Delaware Public Protected Lands" (2019), [http://firstmap.gis.delaware.gov/arcgis/rest/services/Society/DE\\_Public\\_Protected\\_Lands/FeatureServer](http://firstmap.gis.delaware.gov/arcgis/rest/services/Society/DE_Public_Protected_Lands/FeatureServer); FirstMap@De, "Delaware Forest Land Preservation" (2019), [https://firstmap.delaware.gov/arcgis/rest/services/PlanningCadastre/DE\\_AgLandsPreservation/FeatureServer/1](https://firstmap.delaware.gov/arcgis/rest/services/PlanningCadastre/DE_AgLandsPreservation/FeatureServer/1); FirstMap@De, "Delaware Ag Lands Preservation" (2019), [http://firstmap.gis.delaware.gov/arcgis/rest/services/PlanningCadastre/DE\\_AgLandsPreservation/FeatureServer/2](http://firstmap.gis.delaware.gov/arcgis/rest/services/PlanningCadastre/DE_AgLandsPreservation/FeatureServer/2); FirstMap@De, "Delaware 2017 Land Use Land Cover" (2017), [https://enterprise.firstmap.delaware.gov/arcgis/rest/services/PlanningCadastre/DE\\_LULC\\_2017\\_Condensed/FeatureServer](https://enterprise.firstmap.delaware.gov/arcgis/rest/services/PlanningCadastre/DE_LULC_2017_Condensed/FeatureServer)

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**Figure 5: Map of key assets and areas in the Mispillion watershed.**

## MARSH/RIVER/WETLAND – BENEFITS CITED

The Mispillion River Watershed is 128 square miles and includes the Cedar Creek and Mispillion River sub-Watersheds. The Mispillion River flows northeast from Milford for 20 miles, where it joins Cedar Creek near Slaughter Beach before entering the Delaware Bay via the Mispillion Inlet. Based on the 2012 National Land Cover Database (NLCD, Figure 6), 46% of the Watershed is in agricultural lands, encompassing row crops, nurseries, feedlots, and rangelands. Wetlands<sup>4</sup> cover almost one-quarter (24%) of the Watershed, followed by development (14%), and forests (11%) (pg. 6, Smith et al., 2016). Man-made barriers to wetland migration—such as roads and other structures—along with invasive species, cause moderate to severe stress on approximately 73% of the Mispillion Watershed wetlands (pg. 26, Smith et al., 2016). The Mispillion Watershed provides vital marsh habitat within five states and one federal wildlife area that “. . .are considered unique because they are key habitats for species of greatest conservation need. . .” outlined in the Delaware Wildlife Action Plan (Smith et al., 2016, pg. 9; DEWAP, 2015). The Milford Neck Natural Area is the largest state-owned tract. The federally owned Prime Hook National Wildlife Refuge to the south consists of approximately 4,000 acres of wetlands and protected natural areas (Figure 5, Smith et al., 2016).

In addition to human benefits, coastal marsh and wetlands provide many ecological benefits. Torres and Hanley (2016) summarized the outcomes and policy implications of coastal and marine ecosystem service studies between 2000 and 2016. Examining the literature values for wetlands show that in addition to human benefits such as recreation; amenity values; local employment opportunities; research; and education, these ecosystems also provide: pollution reduction; habitat-fish linkage (breeding and nurseries); coastal protection, including erosion control; biomass production; and groundwater recharge and protection; (Torres and Hanley, 2016). *The interviewees cited services that relate to recreation, aesthetic beauty (open space), protection from storms, habitat for shorebirds, and nurseries for aquatic life as integral to Milford and Slaughter Beach communities.*

## MARINE/HARBOR/BAY BEACH— BENEFITS CITED

The eastern area of the Mispillion River Watershed contains extensive wetland and saltmarsh habitats (Figure 5). The Town of Slaughter Beach is south, where the rivers empty into the Delaware Bay, with saltmarsh to the west and bay beach to the east. This small residential community comprises approximately 300 homes, has a strong environmental ethic, and is a National Wildlife Federation Community Wildlife Habitat that provides food, shelter, water, and places for wildlife to raise their young. The community also has the distinction of being a Horseshoe Crab Sanctuary and Reserve, as the sandy beaches provide the chelicerates' perfect habitat (Jackson and Nordstrom, 2009). In the spring of each year, horseshoe crabs arrive in Slaughter Beach and other bay beaches, and spawn in numbers greater than anywhere in the world. Thousands of migratory shorebirds, including the endangered Red Knot, are drawn to these beaches to feed on horseshoe crab eggs. The DuPont Nature Center is located at the mouth of the Mispillion and is an educational center that tracks visitation to the area.

<sup>4</sup> Wetlands and marshes are treated analogously herein. Wetlands and marsh are names for broad categories of ecosystems with many characteristics that further categorize the system's functions (e.g., freshwater wetland, salt marsh, and beyond). The functional break down into different categories was not necessary for this report due to interviewees not differentiating in the various, more particular, categorizations.

Prime Hook National Wildlife Refuge, the Marvel Saltmarsh Preserve, and Milford Neck Nature Preserve surround Slaughter Beach. Various tracts of pristine beaches, dunes, tidal marsh, forests, and farmland managed by the state and non-profit organizations comprise the Milford Neck Nature Preserve (The Nature Conservancy, nd.). The forest is the only remaining forest on the Delaware coast larger than 1,000 acres (The Nature Conservancy, nd.). Milford Neck, Prime Hook, and the surrounding areas provide high-quality wildlife viewing, as well as hunting and fishing opportunities. The Marvel Scenic Byway Boardwalk (constructed in 2019) provides access to view wildlife in the saltmarsh. *Interviewees cited the recreational benefits of wildlife viewing, shorebirds and horseshoe crabs as most prominent. Boating—both recreational and commercial—aesthetic beauty, and the region’s historic shipbuilding industry’s cultural value are also important to the Mispillion Harbor and Mispillion River/ Cedar Creek. Lastly, the saltmarsh and bay beach as a “barrier island” are important coastal storm buffers for inland areas.*<sup>5</sup>

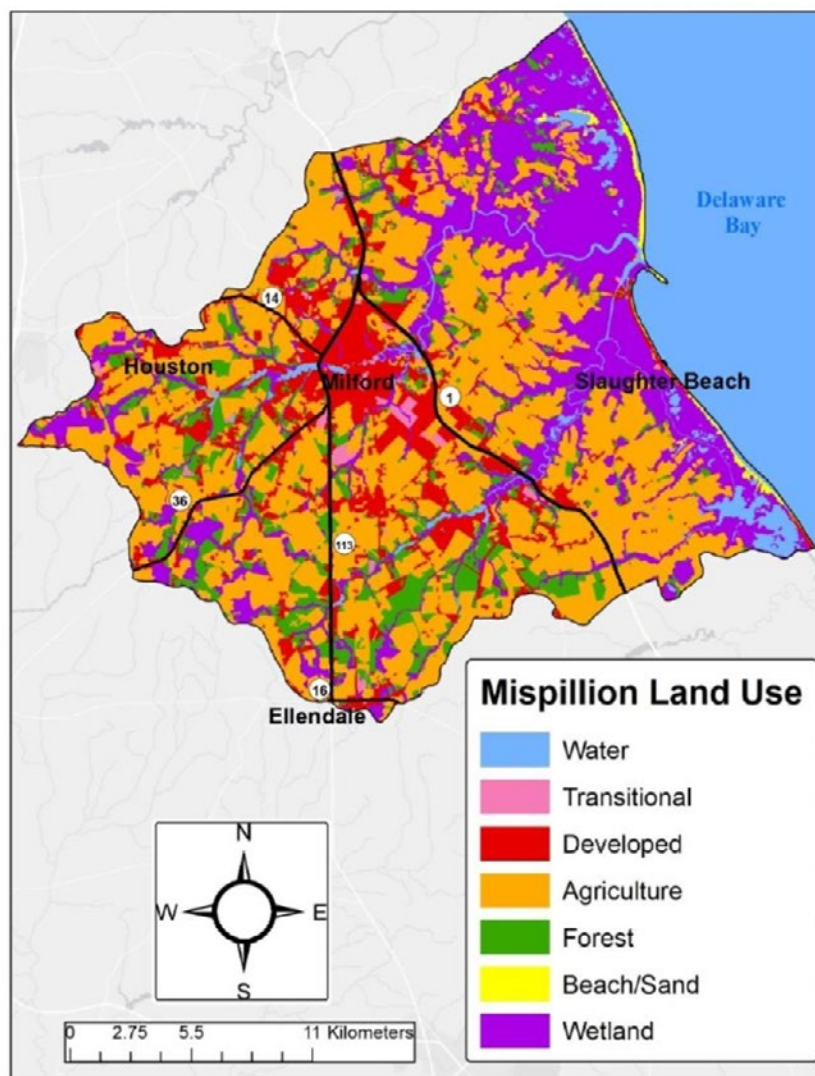


Figure 6: Land use in the Mispillion River watershed (Smith et al., 2016).

<sup>5</sup>Value of two benefits: of aesthetic beauty and boating (commercial and recreational) may be further explored as part of the NFWF study. The limitations in data and ability to transfer values from literature precluded estimating these values in this report. Duke and Ilvento found high importance for environmental and nonmarket services in preserved agricultural land (2004). The interviewees cited aesthetic appeal of marsh over agricultural land therefore further study is necessary to provide benefit estimates. Boating value precursor data (businesses and employment) is within the NAICS data and can be further explored as part of the NFWF study.



## 5. BENEFIT TRANSFER METHODS

“Benefit transfer” is a method that applies values from a study done in a different area to a new location of interest (see Johnston et al., 2015). Databases or research literature searches supply the average, maximum, and minimum dollar values. This can oversimplify the process of value transfers. However, for purposes outside of research (such as this report), value transfers are adequate for general estimates. The intent is to begin a conversation for stakeholders and policymakers related to the “non-zero” value that local ecosystem services supply to communities.

The U.S. Geological Survey (USGS) contains roughly 2,900 value estimates (USGS Benefit Transfer Toolkit)<sup>6</sup> and the Oregon State University Recreation Use Values Database (RUVD) contains 421 estimates from literature, which can be sorted by citation, location, data years, valuation method, and economic value estimates, among other study attributes. These databases were queried, and additional literature consulted, to provide values for the benefits described in this section.

### MISPILLION RIVERWALK GREENWAY– VALUE OF PARK SPACE FOR OUTDOOR LEISURE ACTIVITY

The benefit value for four annual events within and around the Mispillion Riverwalk Greenway estimated the green space’s value as a place for leisure activity. The four events center on enjoyment of the outdoors, predominantly family-oriented events, and draw non-locals as well as residents to downtown Milford. Events used for the estimate were:

- Bug & Bud Festival (held for 16 years,<sup>7</sup> a one-day family event in April, 9 a.m.- 4 p.m.)
- Ladybug Music Festival (2018, 2019, a one-day event in September, 3 p.m.- 9 p.m.)
- Riverwalk Freedom Festival (started in 2000, a one-day family event in September, 9 a.m.- 4 p.m.)
- Riverwalk Farmers Market (26 years, May-October, Saturdays, 9 a.m.- 1 p.m.)

#### BOX 1

Other benefits found in literature derived from revealed and stated preference methods for rivers and green space abound. Examples of the many benefits noted in valuation studies: estimates of increased property values (residential and commercial) provided by parks and water views, air and water improvement through trees and pervious surface, and human health benefits related to exercise.

<sup>6</sup> The USGS Benefit Transfer Toolkit builds upon the Benefit Transfer and Use Estimating Model Toolkit originally developed at Colorado State University (Loomis et al., 2008; Loomis and Richardson, 2008).

<sup>7</sup> The 17th annual festival would have been held in 2020 but has been canceled in 2020 and 2021 due to COVID.



*Table 3: Annual Benefit Values of Park Recreation - Mispillion Riverwalk Greenway to humans*

Event	Attendees	Picnic*	Sightseeing**
			\$65.05
Bug & Bud Festival (17 years, one day family event April 9-4pm) (1)	9,000	\$136,890	\$351,270
Ladybug Music Festival (two years, one day event September 3-9pm) (2)	2,500	\$63,375	\$162,625
Riverwalk Freedom Festival (19 years, one day family event Sept 11 9am-4) (3)	10,000	\$152,100	\$390,300
Farmers Market (May- Oct Saturdays 9-1pm) (4)	8,369	\$127,292	\$326,642
<b>Annual Value</b>		<b>\$479,657</b>	<b>\$1,230,837</b>

(1), (3), (4) Estimates calculated for 60% attendees as adults 30% as children

(2) Estimates calculated for all attendees as adults

\*McKean et. al., (2005) with \$2016 values (\$22.78) from Recreation Use Values Database (RUV) converted to \$2021

\*\*Sanders et. al., (1991) with \$2016 values (\$58.46) from Recreation Use Values Database (RUV) converted to \$2021

The Milford Parks and Recreation Department estimates attendance for yearly events in the Mispillion Riverwalk Greenway and downtown Milford (personal communication via email, Doreen Wrightsman January 21, 2021). Table 3 contains the benefit transfer estimates for attending four events in the Mispillion Riverwalk Greenway. A paucity of studies report urban park recreation or leisure activity values applicable to the urban riverfront parks. The majority of literature is for “value of recreation” in national and state parks. The Recreation Use Values Database (RUV) (2016) contains two studies for parks with rivers and passive recreation values for picnicking and sightseeing. These values were used to estimate the benefit value of the family events at the Milford Riverwalk Greenway.

Based on these estimates, the *Mispillion Riverwalk Greenway's value as an outdoor leisure and recreation attraction for the community and region is from \$480,000 to \$1.23M for one year*. This estimate is almost certainly an underestimate of the total value associated with these activities. For example, the differences in how an individual's time is valued adds uncertainty about how individuals may trade-off leisure time, as accounted by fractions of wage rates (Edwards et al., 2011; Feather and Shaw, 1999). In addition, values for cultural events (music festivals in park settings) may be higher than picnic or sightseeing. These values are only a portion of how frequently and intensely the Riverwalk is used (e.g. it receives daily use), and therefore, the value is likely higher.

## MARVEL SALTMARSH PRESERVE BOARDWALK— VALUE OF SHOREBIRD VIEWING

Marvel Saltmarsh Preserve on the Delaware Bayshore Byway contains a boardwalk and observation deck, which were constructed in 2019 to provide access to the saltmarsh (Figure 5). The deck enables visitors to view birds and wildlife on the 108.91-acre tract. The Delaware Nature Society owns and manages natural lands, educational centers, and trails throughout Delaware, and conducts visitor counts for specific areas. Car counts are obtained for the Marvel boardwalk by laser tracking (TRAFx by DataNet) of cars entering the parking area. The counts shown have been divided by two because each vehicle is counted twice (upon entry and exit) (Table 4).

A 2011 study conducted by University of Delaware researchers captured the economic value of viewing migratory shorebirds around the Delaware Bay (Edwards et al., 2011). Using the literature value from this study and assuming the primary purpose of visiting Marvel Saltmarsh Preserve Boardwalk is to view shorebirds, *the estimated aggregate value for day trips per year (2020) is \$435,000 (rounded from Table 4)*<sup>8</sup> The cars may have more than one occupant; however, the estimates assume cars carry one person. There are likely other reasons people visit the Marvel Saltmarsh, but the available literature related to shorebird viewing is the most appropriate match to this area and its characteristics (Edwards et al., 2011).

*Table 4: Estimates of Aggregate Trip Value for Shorebird Viewing at Marvel Saltmarsh Preserve Boardwalk (2020 visitation)*

Marvel Saltmarsh parking Number of Cars (1)	9,233
Marvel Saltmarsh non consumptive bird viewing (2) (\$47.13 per person per trip, 2021\$)	\$435,151

(1) 2020 Car counts from Delaware Nature Society TRAFx DataNet. Count is divided by half car entry and exit count.

(2) Edwards et al. (2011) Shore bird viewing \$38 2008\$ per person per trip.

## DUPONT NATURE CENTER AT MISPELLION HARBOR RESERVE— VALUE OF SHOREBIRD VIEWING

The DuPont Nature Center is located within the Mispillion Harbor Reserve (Figure 5) and includes an observation deck with opportunities for viewing wildlife and shorebirds in the harbor and bay. The Center offers educational programs and has exhibits with live horseshoe crabs, shellfish, and terrapins. The DuPont Nature Center provided a number and residential status of visitors for 2019 (Table 5). Assuming the primary purpose for the visit to the DuPont Nature Center and the area is to view shorebirds, estimated values for local day trips and non-local overnight trips used a local study that included estimates for overnight expenditures (Myers et al., 2010).

<sup>8</sup> Based on car counts for the beginning of 2021, approximately 4,000 cars have visited in the first two months of 2021. The data indicating a 43% car count within two months of 2021 could point to the greater interest in the outdoors due to the COVID-19 pandemic and increased outdoor recreation (Venter et al., 2020).

Estimates per-person, per-day, and per-person for an overnight visit, adjusted to 2021 dollar values, and were applied to numbers obtained for visitation that included residents (1,568), non-residents (3,234), and international visitors (98). The trip value estimate is low-to-high for residents and non-residents, who may have stayed in the area one or two nights. *The aggregate yearly value of shorebird viewing in 2019 based on visitation to the DuPont Nature Center is estimated to be between \$574,000 for low-cost resident and one overnight for non-residents, and \$1.15 M for an upper value of the high resident trip and two overnights for non-residents (rounded from Table 4).*

**BOX 2**

Horseshoe crabs are ancient creatures that have survived for 445 million years (the dinosaurs were around 65 million years ago). Their blue blood, valued at \$4,000 per cup, is vital for safety testing in the biomedical and pharmaceutical industries worldwide. Almost every marketable drug or medical device is safer because the tests using horseshoe crab blood helps researchers uncover potential for infection in humans (Krisfalusi-Gannon 2018; Madrigal 2014).

*Table 5: Aggregate Value Estimates for Shorebird Viewing at DuPont Nature Center (2019 visitation)*

	Day trip residents (low \$)*	Day trip residents (high \$)**	Non-residents <sup>^</sup>	International <sup>+</sup>
Estimated visitors, 2019	1,568	1,568	3,234	98
Day trip	\$77,788	\$116,690		
1 overnight			\$481,348	\$14,586
2.5 overnight			\$1,002,831	\$30,388
Year total visit value - low day trip and one overnight				\$573,722
Year total visit value - high day trip and 2.5 overnights				\$1,149,909

Myers et al., (2010); 2008\$ converted to 2021\$

Per person per day range		Per person overnight range	
Low*	High**	Low <sup>^</sup>	High <sup>+</sup>
\$49.61	\$74.42	\$148.84	\$310.09

## BAY BEACH– RECREATIONAL VALUE

In a 2014 study, Johnston and Ramachandran estimated access values to predict recreation demand changes based on beach width and recreational demand for different beach nourishment scenarios in Slaughter Beach and other bay beach communities (in JMT, 2014). The access estimates for beach recreation from the 2014 report are modified to 2021-dollar values to coarsely illustrate the predicted access value for Slaughter Beach (Table 6).

***The potential access values, as of 2021, are between \$4,500 for extended overnight trips for homeowners and \$204,600 for day trips by non-owners and a total of approximately \$458,000 (rounded from Table 6).***

In the 2014 study, Johnston and Ramachandran pointed out that if erosion eliminated the beach, the values would be effectively zero, which points to the importance of maintaining and nourishing the beach for recreation. However, the prohibitive cost of sand has been a barrier to recent beach nourishment projects.

*Table 6: Predicted 2010 (converted to 2021 \$) Total Access Value for Slaughter Beach from Johnston and Ramachandran, in JMT 2014*

Beach and Visitor Type	2010 Access Value Day Trips (2021 \$)	2010 Access Value Short Overnight (2021 \$)	2010 Access Value Long Overnight (2021 \$)
Slaughter (non-owners) 8137 days	\$170,532 (\$204,571)	\$78,668 (\$94,370)	\$29,964 (\$35,945)
Slaughter (owners) 2949 days	\$50,150 (\$60,160)	\$48,703 (\$58,424)	\$3,755 (\$4,504)

## ABBOTT'S MILL– VALUE FOR THREE DIFFERENT TRIP PURPOSES

The USGS Benefit Transfer Toolkit provides an average benefit estimate from studies by region. The car counts provided by the Delaware Nature Society for Abbott's Mill (location; see Figure 5) conservatively estimated the value of the non-coastal recreational interest in this area. Three trip purposes were estimated because Abbott's Mill provides multiple opportunities for recreation as well as education. The car trip counts were used to estimate the per-car value for individual trip purposes because data was unavailable on actual trip purposes and actual person count. USGS Benefit Transfer Toolkit that matched potential trip purpose to Abbott's Mill were hiking, wildlife viewing, and general recreation (Table 7). The USGS data includes observations (how many observations in the estimates) and low, average, and high values for each trip purpose. For this report, the low and average values were used to assume that most persons are only visiting Abbott's Mill for the day.<sup>9</sup> The average trip cost for general recreation is slightly higher than the high trip cost for hiking; therefore, the estimates of general recreation are close to a high value for hiking. With the assumption that most persons visit Abbott's for hiking or education, and not more cost-intensive purposes, the average value for general recreation can be considered an upper bound of value. Because the trip purpose was not specified, car counts numbers below only reflect scenarios which all

<sup>9</sup> The USGS methods are primarily travel costs and contingent valuation for recreation on public lands. The database allows selecting the northeast region to narrow the area of application.

cars are assumed to have persons hiking, wildlife viewing, or traveling for general recreational purposes. The main activities at Abbott’s Mill include hiking trails and a handicap-accessible boardwalk, as well as kayak and stand-up paddle boards for rent. As such, the general recreation values may be most appropriate and encompass the other activity values. *The range for general recreation is \$323,000 to \$6.54 million. (All values rounded from Table 7).* The large ranges reflect different assumptions in the “opportunity cost” of time.

*Table 7: Aggregate Value Estimates for Abbott’s Mill Recreation (2020 visitation)*

USGS \$ Values	Abbott's Mill Cars +	Value estimates for hiking	Value estimates for wildlife viewing	Value estimates for general recreation
Average*	45,469	\$3,133,234	\$3,003,649	\$6,535,188
Low **		\$336,922	\$366,476	\$322,826

+ 2020 Car counts from Delaware Nature Society TRAFx DataNet. Count is divided by half car entry and exit count.

*USGS Benefit Transfer Tool Kit^ (values travel cost per person per day, 2016\$ converted to 2021\$)*

Northeast	Observations	Average*	Low**	High (for comparison only)
Hiking 2016\$ 2021\$	5	\$61.93 \$68.91	\$6.66 \$7.41	\$129.33 \$143.90
Wildlife Viewing 2016\$ 2021\$	134	\$59.37 \$66.06	\$7.24 \$8.06	\$410.76 \$457.05
General Recreation 2016\$ 2021\$	21	\$129.17 \$143.73	\$6.38 \$7.10	\$390.77 \$434.81

(^Access at <https://sciencebase.usgs.gov/benefit-transfer/>)

## DAMAGE COST

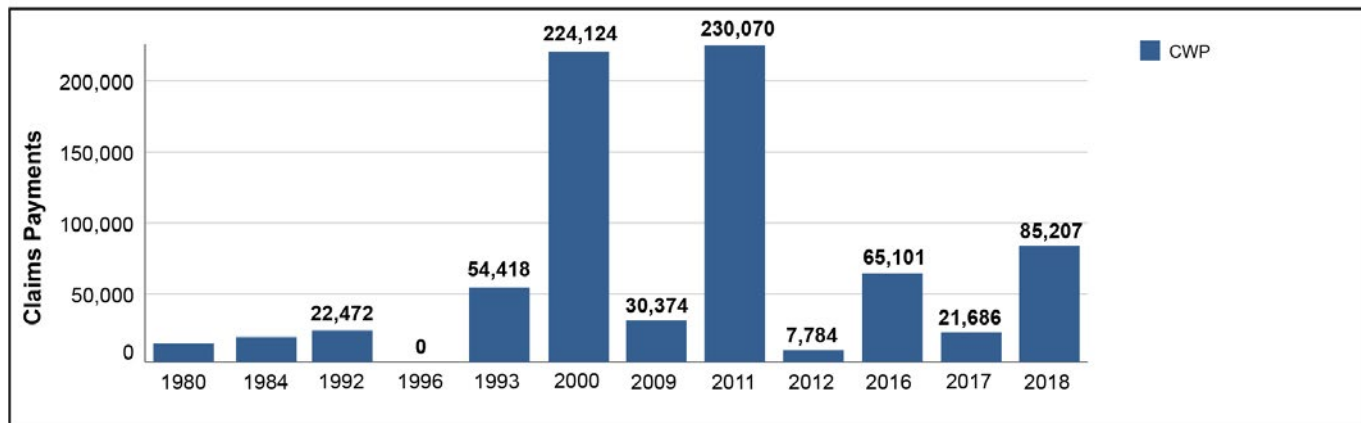
Costs of flooding from nor’easters and hurricanes can be substantial, but are directly linked to storms- severity, topography, and context. Damage estimates help policy maker’s asses the vulnerability of an area, decisions for adaptation or mitigation, and financial appraisals for the insurance and reinsurance sectors (Mertz et al., 2010). A typical approach for assessing the likely costs of damage is to model depth-damage functions related to floodwaters’ inundation and the expected damages caused by the level of flooding (e.g., Eastern Research Group, 2013; Lee and Kim, 2019). Damage estimates increasingly include the measurement of “damage” from direct losses (cost of building and infrastructure damage), indirect losses (disruption of services), and projections of intangible costs (human or ecological injury and the distress flooding causes, Fernandez et al., 2019; Mertz et al., 2010).



# STORM DAMAGE REDUCTION– MARSH

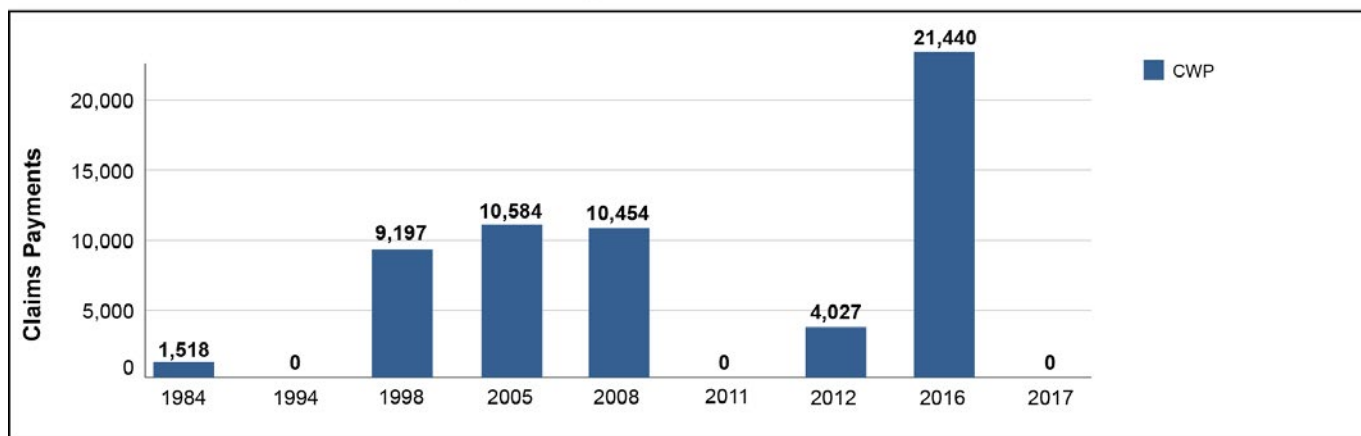
Marshes protect areas from storm damage relative to open water (Narayan et al., 2017). To capture the protective value of saltmarshes, which then, in turn, protect communities from flooding, the Department of Natural Resources and Environmental Control (DNREC) provided aggregate flood loss payments from the National Flood Insurance Program (NFIP) from storms in the early 1980s to 2018. Figures 7 and 8 show the per-event claims with payment (CWP) for the City of Milford and Slaughter Beach, respectively.

**Claims Payments by Claims Status and Year of Loss**



*Figure 7: NFIP Flood loss claims with payment 1980 – 2018 for the City of Milford.*

**Claims Payments by Claims Status and Year of Loss**



*Figure 8: NFIP Flood loss claims with payment 1980 – 2018 for Slaughter Beach.*

Narayan, et al., modeled coastal wetlands’ flood damage reduction values in northeast states (2017). High-resolution flood and loss models estimated the damage reductions associated when saltmarshes are present or absent (open water). The study showed an approximate 10% increase in statewide losses when saltmarshes are absent (pg. 2, Narayan et al., 2017). The physical effect of wetlands and marshes on reducing peak storm surges (flow) and storm energy by attenuating waves and current velocities and related damage costs will be increasingly crucial because storm strength and frequency are anticipated to get stronger in the future (Paquier et al., 2017). Table 8 shows potential increases flood losses when wetland functions are reduced in and around the communities of Milford and Slaughter.

If a proxy for storm damage protection is assumed to be NFIP payout (flood loss in dollars), Table 8 shows a 10%-to50% increase in flood loss (NFIP) payout. This range was chosen as an example of ranges that may occur as future storms potentially become more damaging (Paquier et al., 2017). *As an example, rounded, per-event estimates increase for Milford to approximately \$69,500 at 10% or \$125,200 at 50% loss increase. For the town of Slaughter Beach the cost per event may increase to \$7,900 at 10% or \$14,200 at 50%. While these values are low, they are only a small portion of the value the marsh provides (see Box 3).*

**BOX 3**

Interviewees mentioned other services and benefits from the marsh which are important to the ecosystem and fisheries in the project area. In addition to coastal protection, tourism and recreation profiled in this report, marsh benefits in literature from around the world include raw materials and food; erosion control; water purification; maintenance of fisheries; carbon sequestration; tourism, recreation, education, and research.

Table 8: Per event payout of NFIP Claims in City of Milford and Slaughter Beach due to flooding

	Number of Claims	Number of Events	Total NFIP Claims 1980-2018	Cost per Event	Range in hypothetical per event payout increase without buffering of marsh		
					10%	20%	50%
City of Milford	38	12	\$758,604	\$63,217	\$69,539	\$83,446	\$125,170
Slaughter Beach	19	8	\$57,221	\$7,153	\$7,868	\$9,441	\$14,162

As made evident in Figures 7 and 8, some storms are more damaging than others. Damage is also not linear, and the cost-per-event in Table 8 is simplistic. The payout for flooding is only a portion of the potential total damage costs of flooding. Information relayed during interviews indicates that roads are more frequently being obstructed when flooding occurs. The cost of flooded roads and disrupted services may be more substantial because those events occur more frequently than larger weather events. However, nuisance flood costs are challenging to quantify, and negligible literature is available to provide estimates (Moftakhari et al., 2017).

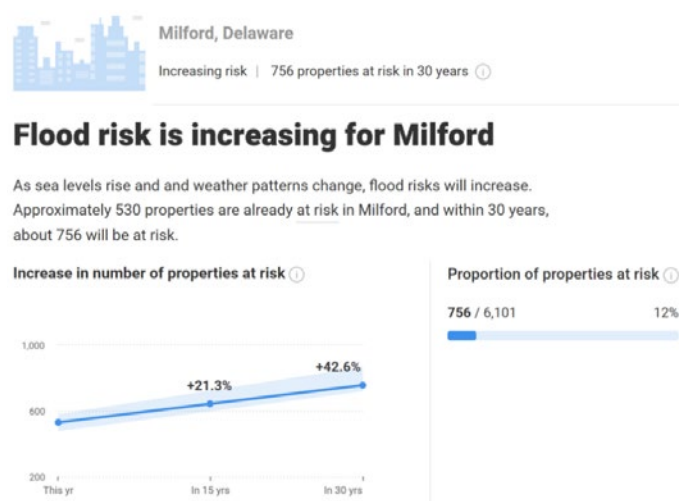


Figure 9: Future flood risk estimates for Milford (floodfactor.com)

The study conducted by Narayan et al. (2017) demonstrates the essential functions and vital protection marshes offer to humans. These protective benefits will become more critical in the future, given sea-level rise and the growing intensity and frequency of storm events. Current flood cost based on The Flood Factor tool (Figure 9) shows that 40% more properties will be at risk of flooding in Milford within 30 years. Because Slaughter Beach is already entirely within a flood-risk zone, Flood Factor doesn't project increased risk (because all properties are already at risk; see [https://floodfactor.com/city/slaughter-beach-delaware/1067050\\_fsid](https://floodfactor.com/city/slaughter-beach-delaware/1067050_fsid)). With approximately 256 housing units and a median value of around \$400,000, property loss of more intense storms could be substantial (U.S. Census Bureau ACS, 2020). Also, residents report that flooding in Slaughter Beach typically occurs from the marshland's back bays. Loss of marsh in this area could increase future damages residents face.

## 6. CULTURAL VALUES– VINYARD SHIPYARD

Cultural ecosystem services are “intangible, subjective, and difficult to measure,” but meaningfully contribute to people’s well-being and identity (Tandarić et al., 2020). Tandarić et al. argue that cultural values are very intertwined with environment and sense of place; therefore, they need a stronger position in urban planning (2020). However, very few studies have measured the economic values of cultural sites (Claesson, 2011). Noonan’s meta-analysis of 65 studies found typical problems that arise when using contingent valuation to estimate nine “topics” of cultural amenities, such as archeological sites, historical sites, and museums (2003). The problems encountered in the analysis included poor survey design and biased responses. For example data collection methods relying on dichotomous – yes or no – choice questions lead to higher willingness to pay than other methods (Noonan, 2003).

Hucheson et al. conducted perhaps the most applicable research to this study related to interviewees’ interest in historic shipbuilding as culturally important to the city (2018). Hucheson et al. involved a travel cost model for environmental education at Manhattan’s Hudson River Park as a cultural ecosystem service. The study involved five separate models with different explanatory variables, including distance from the school to the park and a substitute park, median income, students meeting or exceeding state standards for science, college-educated residents in the district, and English as a second language. The results indicated:

- distance to a substitute park from the school increased trips to the Hudson park;
- an increase in income increases participation in environmental education programs;
- the higher the percentage of students exceeding science standards, the more likely they are to attend educational programs;
- the number of college-educated residents also increases participation in educational programs; and,
- the number of African-American students and English language-learning students increased participation in environmental education at the Hudson River Park.

Capitalized value estimates for the Hudson River Park’s cultural ecosystem services—based on “economic welfare measure per trip”—indicated an annual value of \$0.6 million.

Like the Mispillion River, Slaughter Beach, and Delaware Bay ecosystems, the Hudson River and its estuary had oyster reefs and diverse marine life. After colonization, resource exploitation, and development, the water quality and ecology collapsed. The Mispillion Watershed and Milford also have a history of shipping and shipbuilding. The Vinyard Shipyard in downtown Milford is one of the original shipyards, beginning operations in 1896. The Mispillion Harbor still serves as important access for the region to the Delaware Bay. A group of residents formed the Vinyard Shipyard Task Force and partnered with Downtown Milford Inc. The group drafted a strategic plan to bolster visitation to the Mispillion Riverwalk Greenway and to increase the historic offerings the Vinyard Shipyard offers, with the goal of boosting historic visitation opportunities (Smith, 2018).

The dearth of studies that value cultural and historic amenities precluded estimating cultural values for the shipbuilding history in the project area. However, as a potential future study, interest in visitation to Milford and the area for cultural and environmental education purposes could be explored, with an objective of increasing ecotourism in the area. The study could be conducted similarly to the Hudson River Park study.

# 7. ECONOMIC CONTRIBUTIONS

## MARINE ECONOMY— BUSINESS AND EMPLOYMENT NUMBERS

An exploration of the economic impact associated with natural resources in study areas of Milford and Slaughter Beach obtained data on business industries reliant on the Bayshore, based on data from ArcGIS Business Analyst (BA) and mapping tool<sup>10</sup> for the zip codes 19963 and 19960 (Figure 10). Economic contributions are more direct

values that impact the economy of the study area. The ArcGIS BA data provides the number of industries by North American Industry Classification System (NAICS) code and the number employed. Industries are grouped into sectors that contribute to the economy and are partially marine-dependent, either by physical proximity to the water, or in that a share of their business is marine-dependent. Sectors identified for this project include tourism and recreation, marine transportation, offshore mineral resources, and living resources. Data obtained from ArcGIS BA for eleven marine-dependent industries showed that eighty three individual businesses employ approximately 1,251 people (Table 9). Smaller employment are hotel and lodging, RV Parks and campgrounds, amusement and recreation, zoos and aquaria, and warehousing. Eating and drinking establishments generate around 87% (1088/1251) of the jobs within the marine economy, primarily in the Milford (Table 9).

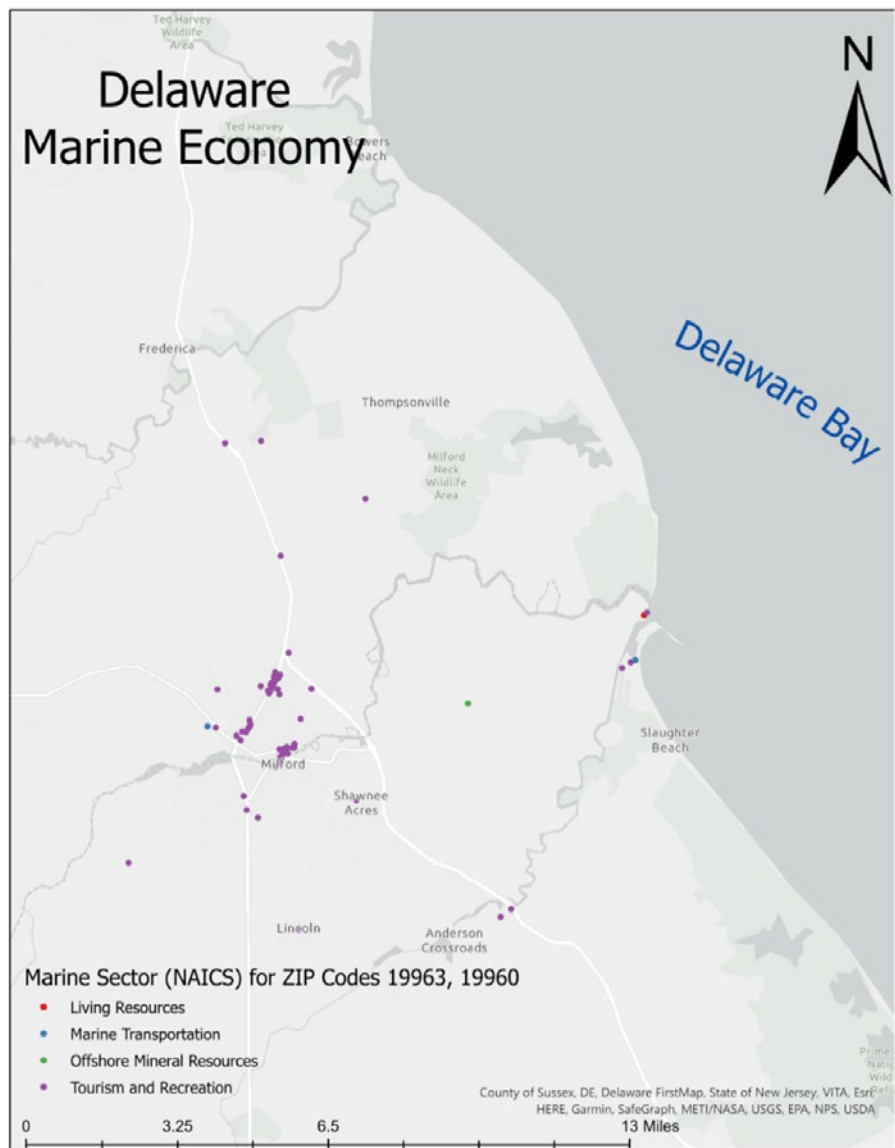


Figure 10: ArcGIS Business Analyst mapping tool, locations of 83 marine economy businesses in the project area.

<sup>10</sup> Data from ArcGIS Business Analyst provides "...market planning, site selection, and customer segmentation by combining demographic, business, lifestyle, spending, and census data with map-based analytics" (see <https://www.esri.com/en-us/arcgis/products/arcgis-business-analyst/overview>). The information for the Marine Economy in the project area is the economic activity supported by the coastal character and is not the total economy which is also indirectly reliant on the coastal/marine attributes of the area.

Table 9: ArcGIS Business Analyst data for the Marine Economy in and around Milford and Slaughter Beach, Delaware zip code areas

Industries*	Number of Establishments	Number of Employees
Amusement and Recreation Services	6	24
Eating and Drinking Places	62	1088
Hotels and Lodging Places	4	40
Marinas	2	8
Marine Transportation Services	1	10
Oil and Gas Exploration and Production	1	6
RV Parks and Campgrounds	3	28
Seafood Markets	1	1
Warehousing	1	22
Zoos and Aquaria	2	24
<b>All sectors Total</b>	<b>83</b>	<b>1,251</b>

Source: ArcGIS Business Analyst (2020). Overview of data provided at <https://www.esri.com/en-us/arcgis/products/arcgis-business-analyst/overview>.

\*Industries are grouped into sectors that contribute to the economy and are partially marine-dependent, either by physical proximity to the water, or in that a share of their business is marine-dependent. Sectors identified for this project include tourism and recreation, marine transportation, offshore mineral resources, and living resources.

## MILFORD RIVERWALK GREENWAY

Appendix 5 contains estimations of expenditures for the four events described in section 5.1. The events draw many visitors that spend the day in Milford, and some may stay overnight. Expenditures for day trips indicate the potential economic impact of Milford events. The events draw as many as 29,000 people per year; however, the assumptions in the Appendix 5 are that a sizable portion of these attendees are children accompanied by the family events with adults. Some of these events have taken place for longer than a decade. ***A conservative estimate of expenditures for one year is approximately \$1.07 Million.***

As part of the NFWF project, this data will be useful in describing the ecotourism potential. It also will be beneficial to project how existing businesses, which are dependent on the marine economy (including lodging and restaurants), may grow and be supported by new tourism opportunities.



# SUMMARY

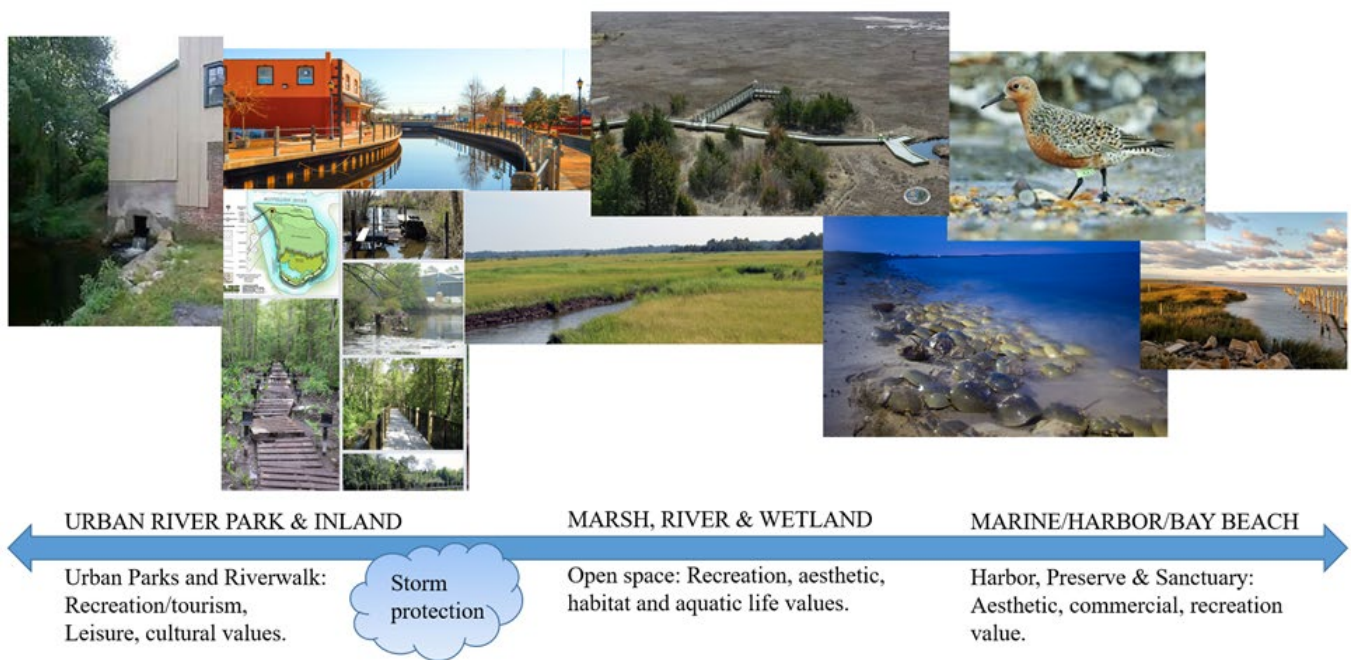
Key experts and stakeholders from the state of Delaware, Kent, and Sussex counties, federal agencies and the Milford and Slaughter Beach identified specific resources that provide extraordinary and unique character that is valued by residents and visitors. The UMD EFC conducted interviews with 23 key experts and stakeholders in the project area to understand the benefits, resources, and ecosystems important to residents in the Mispillion Watershed communities. The majority of stakeholders and experts discussed the natural resources that provide services related to recreation (shorebird and horseshoe crab viewing, fishing, boating), the aesthetic value of open space, and damage reduction offered by marsh and rivers (by buffering coastal communities from storms and flooding). Multiple interviewees also mentioned the cultural and historical importance of shipping/shipbuilding in Milford, and along the Mispillion River and Cedar Creek.

The interviews provided common themes and keywords to describe the values provided. The interviews also provided information on particular assets (centers, walkways, and built structures) that increase access to resources, and also assisted in quantifying—through visitation data—the potential benefit values these assets attract. The interviews suggested specific benefits that were explored as part of this report:

- space for leisure activities;
- tourist visitation;
- cultural importance of shipbuilding history;
- recreation for hiking and wildlife viewing (shorebirds and horseshoe crabs were most prominent);
- protection from storms;
- aesthetic beauty (open space); and,
- boating, both recreational and commercial.

To provide specific benefit values for consideration, UMD EFC employed several techniques based on benefit valuation methods. The ecosystem categories, benefits, and value estimates are shown in Figure 11 and Table 10.

The project area's ecosystems categories (larger grouping of systems that provide ecosystem services) selected by UMD EFC and based on multiple interviewee responses, were: Urban River and Inland; Marsh/River (open space); and Marine/Bay (Figure 12). Forests and cultivated land (agriculture) were mentioned, but not by as many interviewees as the ecosystems. The Urban River and Inland area surrounding the Milford provides leisure activities and tourist activity in the Mispillion Riverwalk Greenway and Abbott's Mill Nature Center. Additionally, an educational and cultural tourism draw is the Vinyard Shipyard, which offers visitors insight into the rich history of shipbuilding in and around the Mispillion Watershed. The Mispillion and Cedar Creek meander through open marshland, and interviewees cited pristine beauty and recreational opportunities, along with the marsh's storm-protecting nature and vital aquatic life habitat, as crucial to the community. At the easternmost portion of the project area lies Slaughter Beach, the Mispillion Harbor, Dupont Nature Center, and Marvel Saltmarsh Boardwalk. Slaughter Beach stakeholders described the town as a barrier beach that provides marshes and rivers, the first line of defense from storms. Interviewees related that the area's leading natural resource-dependent activities are wildlife, shorebird, horseshoe crab viewing, and recreational and commercial boating. The commercial shipping industry and recreational boating in the Mispillion Harbor are also vital to local and state economies.



*Figure 11: Community-identified benefits from natural resources in the Mispillion Watershed, City of Milford and Slaughter Beach Delaware.*

*Table 10: Community-Identified Benefits and Estimated Values Summary*

	<b>Asset</b>	<b>Benefit Indicators</b>	<b>Estimated Benefit Values, Annual unless otherwise noted (2021\$)*</b>
<b>Urban River Parks and Inland</b>	Abbott's Mill Nature Center (Delaware Nature Society)	General Recreation	Range from \$323,000 using low values to \$6.54 million using average values.
	Mispyllion Riverwalk Greenway	Park space for outdoor leisure activity	Recreation attraction for the community and region from \$480,000 to \$1.23 million
	Vinyard Shipyard	Cultural value of shipping history	(No value estimated, however a study of cultural value for education at Hudson River park estimated cultural values at \$0.6 million)
<b>Saltmarsh and Wetland</b>	Marsh-wetland urban storm protection	Flood cost reduction due to marsh protection vs open water from storm damage payout (National Flood Insurance Program)	Storm protection for City of Milford potentially saves \$69,500 to \$125,200 per event.
	Marvel Saltmarsh Preserve Boardwalk	Value of shorebird viewing- Marsh	Day trips \$435,000
	Marsh-harbor bay beach storm protection	Flood cost reduction due to marsh protection vs open water from Storm damage payout (National Flood Insurance Program)	Storm protection for Slaughter Beach potentially saves \$7,800 to \$14,200 per event.
<b>Marine/Harbor/Bay Beach</b>	DuPont Nature Center at Mispyllion Harbor Reserve	Value of shorebird viewing - Harbor	\$574,000 - \$1.15 million
	Bay Beaches	Recreational value	Day and overnight trips \$458,000
	Economic Contributions		
	Marine and Coastal-related Business	Number of businesses related to coastal and marine activities	83 businesses
Number of employees		1251 persons	
	Milford Riverwalk Greenway Economic Impact	Estimated expenditures	\$1.07 Million

\* It should be noted that given limitations in initial scope, the economic estimates highlighted in this report are derived from previous studies. Please note that the individual values presented below should not be summed to a "Total Economic Value" as this was not the goal of this study.

# ASSUMPTIONS, CAVEATS, AND UNCERTAINTIES

Many challenges exist when performing a benefit valuation. Uncertainties begin at the scientific and quantifiable processes that are "...complex, dynamic, variable, interconnected, and often nonlinear..." (NRC, 2005, p.241). The ability to connect the exact nature and importance of services and benefits to humans is also dependent on imperfect or incomplete information, with imperfect understanding of how various humans actually value the benefits stemming from the ecosystems (NRC, 2005, p.242). Many methods can be used to reduce error and "... the current state of both ecological and economic analysis and modeling in many cases allows for estimation of the values people place on changes in ecosystem services, particularly when focused on a single service or a small subset of total services" (NRC, 2005, p.242). Some typical errors encountered in valuation were avoided in this report by focusing on single services and a small subset of total services. That said, the numbers herein undervalue the total economic value of benefits (which would include use and non-use values). However, to conduct a thorough valuation would take considerable more time and effort beyond the scope of this report. Total values are tricky to separate, and the overlapping nature of services often lead to double-counting (i.e., counting the same benefit twice and overestimating values) if the analysis does not account for partitioning the benefits. By estimating single values, the instance of double-counting is minimized. The goal is to provide estimates of the benefits important to the Milford and Slaughter Beach, and not a sum of all values (total economic value) of all benefits.

“  
**There is a much greater danger of underestimating the value of ecosystem goods and services than over-estimating their value. (NRC, 2005 p.242)**  
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# DATABASES ACCESSED

## Keyword searches and criteria for literature inclusion

The methods for this report included reviewing and establishing criteria for potential benefits transfer. The list of keywords used, and methods included are in Appendix 6. The criteria for inclusion excluded the majority of literature found and the methods developed utilized a few studies that were conducted in and around the project area of the Town of Milford and Slaughter Beach. The screening of literature included policy effects under consideration, goods of study interest, similarity of policy site and study site characteristics, location, and population (Johnston et al., 2015). Many of the studies encountered were benefit transfer from other studies.

## The Pew Charitable Trusts, University of Delaware and University of Maryland Libraries

The methods for this report included reviewing and establishing criteria for potential benefits transfer. The Pew Charitable Trusts and UMD EFC conducted a keyword search at the beginning of the project. The initial screen searched for proximal studies to the project area (i.e., in Delaware or surrounding coastal states). Thirty-six studies from The Pew Charitable Trusts' library databases were reviewed for applicable values. Using the University of Maryland Libraries, 10 studies on rivers and 18 on marsh values were reviewed. The University of Delaware Library database was used to access journal articles in the searches, as well as forward search other articles citing or cited by the articles found.

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## Environmental Valuation Reference Inventory (EVRI)

The EVRI is the largest database in the world developed by U.S. and international experts and organizations. Compilation of studies began in the early 1990s and the database now contains over 4,000 literature studies and summaries. The summaries make it easy to determine if literature is applicable and useful for assessing inclusion in benefit transfer potential. Approximately 20 studies were extracted from EVRI, and the spreadsheet provides the general information needed to screen the literature for applicability to the project area. Many studies were from Louisiana or Florida, and were deemed too dissimilar to the project area or questions herein.



### **USGS Benefit Transfer Toolkit – Nonmarket Valuation Database:**

Approximately 2,900 values estimates are in the searchable database. “The updated USGS Benefit Transfer Toolkit includes expanded valuation databases, a series of statistical forecasting models, and an interactive map of outdoor recreation studies. The Bureau of Land Management Socioeconomics Program, the National Park Service Social Science Program, and the USGS Sustaining Environmental Capital Initiative have contributed to the Toolkit’s development. Additionally, the development of the USGS Benefit Transfer Toolkit would not have been possible without the support of Dr. John Loomis at Colorado State University and Dr. Randy Rosenberger at Oregon State University.” (USGS Benefit Transfer Toolkit. Documentation. Toolkit Development.) The Toolkit was used to obtain average and a range of values by region, based on a certain number of recreational travel cost studies. The average values by region are available for 22 recreational activities. The Toolkit also has meta-regression calculators; however, because the primary studies done for the literature used were within Delaware, the meta-regression data in the Toolkit was not used.

### **BlueValue summary from database:**

BlueValue was previously GecoServ (Gulf of Mexico Ecosystem Services Valuation Database), supported by the United States Environmental Protection Agency’s Gulf of Mexico Program, National Oceanic and Atmospheric Administration (NOAA), and the Harte Research Institute for Gulf of Mexico Studies. Partial support was also provided by the National Oceanic and Atmospheric Administration, Office of Education Educational Partnership Program award (NA16SEC4810009). It is a searchable database that returns a list of literature pertaining to valuation of ecosystem services from ten coastal habitat types including oysters, seagrass, beach, beach/dunes, coastal wetlands, coral reefs, dunes, estuary, mangroves, and marine/open water. Twenty-two studies were reviewed, but the same article was cited multiple times for different benefits, or the literature study areas were not similar to the project area herein, leading to the exclusion of literature from the BlueValue database.

### **Recreation Use Values Database (2016) Randall S. Rosenberger summary from database:**

The RUVB currently contains 421 documents of economic valuation studies that estimated the use value of recreation activities in the U.S. and Canada from 1958 to 2015, totaling 3,192 estimates in per person per activity day units, adjusted to 2016 USD. Twenty-one primary activity types are provided, with several more available, if segregated by activity mode, resource type, primary species sought, or little-studied activities (i.e., ‘other recreation’ has an additional 22 activities identified).

These recreation use value estimates are measures of net willingness-to-pay, or consumer surplus for recreational access to specific sites, or for certain activities at broader geographic scales (e.g., state or province, national) in per-person, per-activity day units. (The RUVB does not contain information on marginal values for changes in site quality or condition.)

The RUVB is currently offered as an Excel workbook containing the database and coding protocols. It is currently sorted by primary activity by region—of course, researchers may download and sort it however they wish. The bibliography cross-references entries in the RUVB via the document code.

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## CONCLUSIONS

Community-focused identification of natural resources specific to a discrete project area provides a targeted and context-specific estimation of economic benefits. Economic benefit valuation is an increasingly beneficial way of communicating what the natural world offers to humans, in dollar values. Dollar-value estimates help in decision analysis, and in comparing potential costs and benefits of various policies or projects which impact natural resources.

This project helps communicate the benefits nature provides to the economies, residents, and visitors to the communities profiled. The values help support broader statewide planning to implement, invest in, and enhance nature-based solutions and ecotourism opportunities in the Milford and Slaughter Beach, their respective counties of Kent and Sussex, and potentially other Bayshore towns. Benefit estimations for the Milford and Slaughter Beach reflect the importance to the communities of their coastal and nature-based activities. The value estimate for leisure, recreation, and wildlife viewing alone is potentially substantial, at over several million dollars per year. Promoting and increasing strategic and targeted ecotourism, and tracking visitors to specific areas, will increase these values in the future. The monetary value of storm protection by marshes and barrier beaches is increasingly urgent to quantify. Studies to predict the protective benefits are most accurate when tailored to the area of interest. However, regional models estimate that marshes in Delaware reduce flood damages by at least 10%. Notably, the increasing intensity of storms will make this protective value essential in planning future land use. Studies tailored to the Delaware Bayshore communities could help fine-tune marsh protection estimates and support marsh retreat and protection policy. Finally, as observed by the NAICS information, the marine economy shows that there is substantial employment supporting the tourist and recreation in and around the Milford and broader coastal area.

The unique and exceptional urban river, marsh, and harbor area already draws local, regional, and international visitation. Increasing access points and infrastructure to safely access the resources while also protecting their integrity will increase benefits to Milford and Slaughter Beach communities. This report is a preliminary step for the NFWF. It will help estimate benefits and costs for ecotourism options, promote the natural resources, and support the assets vital to sustainability, increasing access for humans to enjoy the Mispillion and surrounding areas.

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# APPENDICES

*Appendix 1: Sectors and organizations interviewed in dark font.*

Sector/Organization
<b>Federal</b>
Bombay Hook National Wildlife Refuge
Prime Hook National Wildlife Refuge
USACE/Consultant to Slaughter
<b>State</b>
Delaware Bayshore Initiative (Division of Fish and Wildlife)
DelDOT - Byways
Sussex County Planning and Zoning
Department of Planning Services, Kent County
DNREC - Coastal Programs Resilient Community Partnership
DNREC – Wetland Monitoring and Assessment
DNREC – Division of Parks and Recreation
DNREC - DuPont Nature Center
<b>Local - Slaughter</b>
Taylor Marine Centers
Local government former Mayor Slaughter
Local government Current Mayor Slaughter
Local government Vice Mayor Slaughter
<b>Local - Milford</b>
City of Milford Mayor
City of Milford City Council
City of Milford City Manager
Town of Milford Council (2)
Kent County Levy Court
Business /real-estate
Business/Vineyard Shipyard advisory
Town of Milford Parks and Rec
Business – Owner Vineyard Shipyard
Tourism Sussex Co
Former Council/Business

*Appendix 2: Interviewee consent and information use*

Your perception and view of natural resources in the towns of Milford and Slaughter as well as the Mispillion and Cedar Creek Watersheds will inform an appraisal of the area's natural resources. The appraisal will describe the community benefits and values the resources provide.

Natural resources in the Mispillion and Cedar Creek Watersheds surrounding Slaughter and Milford provide value to these communities. This interview is to understanding how to "value" these natural resources in an "economic" sense. Pew Charitable Trusts have funded the University of Maryland Environmental Finance Center to 1) interview key technical and policy experts, and 2) provide a framework and valuation of resources identified by the interviews.

The information from this interview will be added to information from other interviews from federal state and local government and businesses to protect and enhance the area's natural resources, not only to ensure a healthy environment for its citizens over the long-term, but also to secure the Delaware Bay region's potential for visitors through recreation and other opportunities.

With your permission we will record the interview. (START RECORDING IF YES)

The recorded information and notes will be stored on the server at UMD EFC and only be accessible to UMD EFC staff. Please note that the information in this interview will be synthesized thus findings will not be attributable to specific individuals.

The information from the interview will be screened for common themes and keywords and compared and contrasted with other interviewee's perceptions and views. The count of similar themes will inform valuation for the final report.

We would like to share a map for you to refer to the areas of interest, let us know if you can screen share?

Before we begin do you have questions?

*Appendix 3: Guiding questions for interviews*

Date, Person Interviewed, Position concerning the Delaware Bay and broader coastal area

Purpose of this interview 1) Understanding your view and perception of what natural resources are vital to local and state interest. With the interview results, we will 2) Use a research framework to develop natural resource value in dollars and connect the potential to inform policy, project funding, and policy prioritization.

**Q1 For locals)** Describe the “way of life” in your community.

**Q1a)** How is the quality of life in the community?

**Q1 For non-locals)** How would you describe the state or federal government’s interest in the Bayshore within the Milford Neck/Mispillion area?

**Q2)** Why do you think this area should receive (or receive more) federal or state funding to protect its natural resources?

Perspectives and experiences to inform valuation

Ecosystem Services: This question will help understand gaps in knowledge about what natural resources do for communities and why they are “valued.”

**Q3)** Ecosystem services: Have you heard this term? If so, please describe your understanding.

Ecosystem Service Valuation: This question will help understand if the links between the services and monetary values are understood.

**Q4)** Ecosystem Service Valuation: Have you heard this term? If so, please describe your understanding.

(Interviewer) Combine the two terms and how they are used and other terms (such as “natural capital” or “natural assets”) and how they are used with a few examples.

**Q5)** What would you describe as “natural assets” that are important to the way of life for the community?

**Q5.1)** List natural/cultural assets that you are aware of:

**Q5.2)** What do these assets do for the community?

**Q5.3)** Where are these assets located? Show the map (above) and discuss different areas.

**Q5.5)** What is the state of these assets in your opinion? (i.e., how “healthy” are they? are they growing or shrinking?)

**Q5.6)** Are there risks to these assets? Explain.

**Q5.7)** Do you think there are opportunities to make these assets better for the community? (how can these assets be improved? for conservation or business opportunity?)

**Q6)** Are there any persons you would like to recommend we interview to provide their views and perceptions of vital Bayshore resources?

*Appendix 4: Results and benefit mapping of City of Milford and Slaughter Beach key expert and stakeholder interviews. Green highlight indicates the services and benefits described most often in the interviews. Blue highlight indicates specific assets that interviewees identified which provide access to nature.*

Ecosystem Types	Resource that provides	Services that provide	Benefits to humans
River/Marsh	forest	protection against floods and hurricanes	reduced flood damage
River/Marsh	forest	filtering water to keep it clean	water quality measures
River/Marsh	Mispillion and Cedar rivers	buffers to development	increased land values
Marsh/Marine	forest	area for marsh migration	reduction in storm damage
Marsh	saltmarsh	filtering water to keep it clean	water quality measures
Marsh	saltmarsh	waterfowl/fish habitat	value of hunting / fishing
Marsh	saltmarsh	protection against floods and hurricanes	reduced flood damage
Marsh	saltmarsh	erosion of fertile soil	value of crops
Marsh	saltmarsh	preventing erosion of marsh land	value of fish
Marsh	saltmarsh	Increasing the value of surrounding properties	housing value
Marine/Marsh	horseshoe crab, Saltmarsh for fisheries	fish and wildlife for use as food for animals	nursery, fisheries health, shorebird viewing
Marine/Marsh	harbor, revetment	protection against floods and hurricanes	reducing flood damage, land for marsh migration
Natural or open space	land preservation and management	sufficient clean water for drinking and commercial activities	water quality preservation compared to urban water quality
Natural or open space	buffers on agriculture	keeping soil fertile and productive	salt water abatement
Natural or open space	agricultural land	land for water filtration	nitrate pollution, value to human health
Natural or open space	agricultural land	protection against floods and hurricanes	reduced flood damage
Natural or open space	agricultural land	area for marsh migration	storm mitigation, damage cost
Working lands	agricultural land	jobs and employment	Number of jobs
Working lands	agricultural land	food for humans	value of crops and chickens
Harbor and Bay Beach	horseshoe crab	offering sources of unique ingredients for medicines	value of blood on the market
Open space	Saltmarsh, forest	a place for relaxation and spiritual renewal	aesthetic and mental non-use
River/Marsh/Marine	harbor, Mispillion and Cedar rivers, beach	NATURAL Providing a place for hiking, camping, kayaking or other outdoor recreation	recreational values, boating, kayaking, shorebird viewing



River	floodplain	flood absorption	reduced flood damage, asset protection
River	Mispillion River	waterway	value of transportation alternative for the area and visitors
Marine	shorebird	Attracting tourists to support the economy	recreational, shorebird viewing
Marine	harbor / Bay	only harbor on Bay providing waterway for ships	anchorage and boating data / commercial fishery /only first responder port
Open active use	Trails	access to nature	recreational value
-	shipbuilding areas in the towns	-	cultural values
Marine	barrier beach	protection to marsh	marsh preservation aesthetic value and storm protection, damage cost
Marine	beach	bay access	visitation/recreation
Marine	facilities for wildlife viewing/ beach in harbor/freshwater impoundments	MAN MADE providing access for recreation	shorebird viewing, cycling, auxiliary economy (visits to town)
Open water	freshwater impoundments	MAN MADE providing access for recreation	water fowl hunting, muskrats

Asset names		Benefit Relevant Indicators	
Marine	Cedar Creek Marina	access to river and bay	commercial boating
Marine	Mispillion Harbor Reserve	horseshoe crab and shorebird viewing	recreation
Marine/Marsh	Milford Neck Wildlife Area	fish and wildlife for use as food for people	hunting, water fowl, deer, small game, muskrat
Marine	Slaughter Beach	bay access	recreation
River/Natural open	Abbott's Mill	education and viewing	recreation
Marsh	Marvel Saltmarsh Preserve and boardwalk	access to open area, marsh, wildlife	# visits for recreation/bird viewing
Marine	Fowler Beach	fish and wildlife for use as food for people	values hunting, crabbing, fishing
Marine/Harbor	DuPont Nature center	wildlife and marsh access	# visits education and viewing
Urban River	Mispillion River Walk	aesthetic enjoyment	higher economic value of surrounding property
		aesthetic enjoyment	# visits for leisure and recreation
Urban water	Marshall's Mill Pond	water access	potential recreation in Milford
-	Ft. Salisbury	historical significance	cultural and historical experience

Surrounding Areas			
Marsh/Marine	Delaware National Estuarine Research Reserve		recreation
	Byway (Lewes and Delaware Bayshore)		recreation
	Markell and Castle trails 2015/2018 viewing structures		cycling, walking, recreation

Value of the two benefits: of aesthetic beauty and boating (commercial and recreational) were not estimated. The limitations in data and ability to transfer values from literature precluded estimating these values in this report.

### Appendix 5: Mispillion Riverwalk Greenway expenditure estimates

Event in Milford	Attendees	Distance traveled (local miles, roundtrip)	Distance traveled (non-local miles, roundtrip)	Mode of travel	Private vehicle mileage (GSA 2021)	Other expenses (Food GSA per Diem) (^, \$)	Lodging (^, GSA)	Fee for entry	Cost of travel local	Cost of travel non-local	Food	Cost of lodging	Total
		Bug and Bud Festival (17 years, one day family event April 9-4pm) (1)	9,000	20	120	car	\$0.56	\$41	no	no	\$26,880	\$40,320	\$123,750
Ladybug Music Festival (two years, one day event September 3-9pm) (2)	2,500	20	120	car	\$0.56	\$55	\$96	\$20	\$22,400	\$33,600	\$151,000	\$24,000	\$281,000
Riverwalk Freedom Festival (19 years, one day family event Sept 11 9am -4) Farmers Market (May-Oct Saturdays 9-1pm) (4)	10,000 8369 (27 Saturdays, 300 per day)	20	120	car	\$0.56	\$41	no	no	\$16,800	\$302,400	\$226,875	-	\$546,075
				car	\$0.56	-	no	no	\$56,000	-	-	-	\$56,000
<b>Total</b>	<b>29,869</b>												<b>\$1,074,025</b>

- 1) Estimate 2400 adult local and 600 adult non-local (3000 children)
- 2) Estimate 2000 local and 500 non-local adults or young
- 3) Estimate 1500 adult local and 4500 adult non-local (4000 children)
- 4) Estimate 5000 adult locals and 3369 children
- 5) 75% per diem assumed for non-full day attendance - adults only

#### ^Meals & Incidentals (M&IE) Breakdown

Primary Destination	County	M&IE Total	Continental Breakfast/ breakfast	Lunch	Dinner	Incidental Expenses	First & Last Day of Travel	75% Per Diem
Lewes	Sussex	\$61	\$14	\$16	\$26	\$5	\$45.75	
Standard Rate	locations without specified rates	\$55	\$13	\$14	\$23	\$5	\$41.25	\$ 41.25

GSA, 2021 (accessed at <https://www.gsa.gov/travel/plan-book/per-diem-rates>)

#### \*Lodging by month (excluding taxes) | October 2020 - September 2021

2020	2021	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Lewes	Nov Sussex	\$96	\$96	\$96	\$96	\$96	\$96	\$96	\$96	\$138	\$138	\$200
Standard Rate	Applies for all locations without specified rates	\$96	\$96	\$96	\$96	\$96	\$96	\$96	\$96	\$96	\$96	\$96

GSA, 2021 (accessed at <https://www.gsa.gov/travel/plan-book/per-diem-rates>)

*Appendix 6 List of library databases and keyword literature search*

**Delaware Coastal Economic Values – The Pew Charitable Trusts, University of Delaware and University of Maryland, Library Search**

Overall Project Scope Habitat and Ecosystem Service Valuation Study in Mispillion and Cedar Creek Watershed, Southern Delaware

**Keywords for literature review search**

Delaware Bay, Bayshore, Mispillion Harbor, Mispillion Watershed, Cedar Creek, Slaughter Beach, Kent County, Sussex County (Delaware), Milford, Northeast US

**Habitat Types**

Wetlands, Estuary, Salt Marsh, River, Urban River, Parks, Urban Parks

**Other categories**

Coastal tourism, bird watching, kayaking (canoeing, paddle boarding), ecotourism, nature viewing, camping, charter boat tourism, recreational fishing, beach tourism

Tourism and Recreational Values Economic Values of Oysters/Oyster Conservation, Aquaculture, Smart Growth, Urban Sprawl, Open space values,

Cultural values

Coastal resiliency, living shorelines, flooding

**Methodologies**

(Delaware relevant and General Wetland/Coastal) - Natural Resource Valuation, Stated Preference: Contingent Valuation, Choice Experiment; Revealed Preference: Hedonic study, Travel Cost; Recreational Demand

Flood Protection Values Nature-Based Solutions, Green Infrastructure, Blue-Green Infrastructure

