



The Economic Value of the Delaware Inland Bays

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This report was prepared by the Delaware Sea Grant College Program and the Delaware Center for the Inland Bays based on analysis performed by Key-Log Economics, an independent ecological economic research and consulting firm.

The Delaware Sea Grant College Program was established in 1976 to promote the wise use, conservation, and management of Delaware's coastal resources. To achieve this mandate, Delaware Sea Grant leverages federal and state funding to provide financial support to external partners for innovative research, community development, and conservation projects. Our staff also provide one-on-one consultations, deliver workshops and trainings, develop balanced written assessments, and lead hands-on projects regarding a diverse array of issues pertaining to healthy coastal ecosystems, resilient communities and economies, sustainable fisheries and aquaculture, and environmental literacy. Benefits of this work are provided to a diverse array of stakeholders, including communities, elected officials, industry, and other non-profit organizations.

The Delaware Center for the Inland Bays is a nonprofit organization established in 1994 and is one of 28 National Estuary Programs. With its many partners, the Center works to preserve, protect and restore Delaware's Inland Bays and their watershed. To achieve its mission, the Center facilitates the implementation of the Inland Bays Comprehensive Conservation and Management Plan, conducts public outreach and education, develops and implements water quality and habitat restoration projects, conducts research, and supports public policy.

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Acknowledgements

This report was prepared by Delaware Sea Grant under award NA180AR4170086 from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce. This project has also been funded in part by the University of Delaware Sustainable Coastal Communities Initiative, the Delaware Department of Natural Resources and Environmental Control, Sussex County Council, The University of Delaware Water Resources Association, The Town of Henlopen Acres, The Town of Fenwick Island, and by the United States Environmental Protection Agency under assistance agreements CE99399015 and CE99399014 to the Delaware Center for the Inland Bays. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document. Key-Log Economics, an independent ecological economic research and consulting firm, provided technical input and performed the economic analysis using the U.S. Bureau of Economic Analysis Regional Input-Output Modeling System (RIMS II). The University of Delaware Water Resources Center provided valuable technical insight and contributed to supporting case studies. We are grateful for the input of multiple federal, state, and local government stakeholders into the formulation of this research.

Contributing Photographers

Chris Bason, J. Albert Bowden II, Gordon Campbell at Altitude Gallery, Delaware Center for the Inland Bays, Delaware Sea Grant, Driscoll Drones, J&J Photography, Mark Jolly-Van Bodegraven, Neil Parry, Nivette Perez-Perez, Ken Sigvardson, Matt Sprague, Sussex Conservation District, Lisa Tossey, Ed Jackson, Vickie York at Beach Realty, Yvonne Navalaney, ondreicka, David Pimborough, and Gorodenkoff.

Introduction

The Delaware Inland Bays are a valuable resource that contribute to the economic health and wellbeing of Sussex County and the state of Delaware. In their current condition, the Bays support a wealth of economic activity, including tourism and recreation, a vibrant real estate market, numerous service industries, and an emerging commercial aquaculture industry. However, these contributions are dependent on the quality of the water within the Inland Bays and the associated services provided by a healthy coastal ecosystem, conditions which are impacted by human activity and resource management decisions. This report establishes the value of these assets and their contribution to the economy under existing conditions, which are considered impaired. Case studies are presented to demonstrate potential economic gains that could be realized should water quality conditions improve through implementation of the Inland Bays Pollution Control Strategy. These efforts are intended to provide context for discussions between the public, resource managers, and policy makers that can inform future action. The following sections present key findings and the methods used to estimate the economic value of the Bays under each scenario.



Key Findings

- The Delaware Inland Bays support \$4.5 billion in economic activity every year and over 35,000 jobs throughout the state.
- Approximately 89% of these contributions and 94% of the jobs occur within Sussex County (\$4.0 billion in economic activity and 33,774 jobs), with 11% of the contributions and 6% of the jobs (\$511 million in economic activity and 2,345 jobs) occurring more broadly in Delaware.
- Economic activity within the Inland Bays study region also provides tax revenue to federal, state, and county governments estimated at \$458 million.
- Improved water quality conditions within the Inland Bays have the potential to increase these economic contributions significantly:
 - With continued investment in water quality, the value of both waterfront homes and homes in close proximity to the water would collectively increase to \$10.7 billion, an increase of almost \$200 million.
 - Associated real estate contributions to the economy would also increase significantly, up to almost \$186 million each year, which would support approximately 1,200 total jobs. This includes up to \$500,000 in new money being added to the economy each year.
 - Outdoor recreation is anticipated to increase by more than 5%, resulting in an additional \$10.7 million being added to the local economy each year and supporting more than 120 new jobs.
- These examples demonstrate that the economic effects of improved water quality on real estate and outdoor recreation alone (approximately \$11.2 million per year) will pay for almost 50% of the annual cost to implement the Inland Bays Pollution Control Strategy (estimated to be \$25 million per year over a 10-year period). This does not include the \$200 million in increased home values that will add to the net worth of coastal property owners, or likely gains in other economic sectors.





The Delaware Inland Bays And Their Economy

The Delaware Inland Bays consist of three interconnected coastal lagoons in southeastern Sussex County: Indian River Bay, Little Assawoman Bay, and Rehoboth Bay. Collectively, the Bays and their tidal tributaries cover 32 square miles with a watershed of approximately 320 square miles.

Throughout history, the abundant natural resources and sheltered waters of the Inland Bays have attracted residents to the area. In precolonial times, the Nanticoke people established communities in proximity to the Inland Bays, fished their waters, and harvested wildlife from the surrounding forests and wetlands. Following European colonization, the Inland Bays region supported fishing communities and associated

industries, including boat building, canning, and shipping. An agricultural economy followed, which grew exponentially after the advent of the modern poultry industry. Today, the Inland Bays support a diverse, multi-billion dollar economy that is fueled by tourism, recreation, and, increasingly, residential development and associated services.

The backbone of this economy remains the abundant natural resources of the Bays, which draw tourists from metropolitan areas throughout the mid-Atlantic region and support a plethora of recreational opportunities, including fishing, crabbing, boating, and bird watching. These visitors stimulate the local economy by taking advantage of recreational opportunities, shopping, and dining, the economic ramifications of which reverberate throughout the state and region. In 2019, there were 7.5 million visitors to Sussex County, and tourism is now the state's fourth largest employer.

Increasingly, people are also choosing to relocate either seasonally or permanently to the Inland Bays region. This is the acceleration of a trend that is several decades old and is primarily fueled by incoming retirees. The reasons for this growth are numerous and may be attributed to changing demographics throughout the mid-Atlantic region, increasing real estate values in metropolitan areas, and a favorable tax structure in Delaware. However, it is the natural

beauty of the Inland Bays coastal environment and its diverse natural resources that ultimately draw new residents to this area of Delaware. The COVID-19 pandemic has only served to accelerate this growth, with many people deciding to retire early and making the possibility of working remotely from coastal communities a reality for many others.

This influx of new residents has supported a development boom throughout the Inland Bays, which itself has lasted over half a century. New housing starts in communities inspired by their surrounding coastal environments, such as Americana Bayside, Seagrass Plantation, and The Peninsula, continue to increase. From 2017 through 2020, the number of new subdivision lots proposed in Sussex County averaged over 4,300 each year, with a peak of 6,985 in 2017. Similarly, the number of new building permits issued each year is substantial, averaging over 10,000 each year during the same four-year period (Sussex County Council, 2021).

Collectively, these different facets of the market—tourism, outdoor recreation, real estate, and service industries—form the Inland Bays economy, which generates jobs and income for tens of thousands of Delaware residents and contributes tax revenue to local and state governments. The following sections establish the value of the Inland Bays economy under existing conditions. The potential value of the Inland Bays economy under improved water quality conditions that may be realized through implementation of the Inland Bays Pollution Control Strategy is also discussed.

Residential development and associated population growth within the Inland Bays region have both benefits and drawbacks. On the one hand, it is now a significant driver of the Inland Bays economy and supports associated industries encompassing everything from construction to restaurants to healthcare. However, if poorly planned, development can also lead to further impairment of the Inland Bays, the wonderful resource that attracted so many new residents in the first place. Because of this dynamic, careful consideration must be given to balance on-going development with measures intended to protect and restore the integrity of the Bays.



Economic Contribution of the Delaware Inland Bays Under Existing Conditions

Under existing conditions, the economic contributions of the Inland Bays consist of clear, direct effects, such as businesses and jobs directly related to activity supported by the Inland Bays and associated payroll. However, it also includes indirect economic effects, consisting of the additional jobs, payroll, and output created when a business directly supported by the Inland Bays purchases goods and services from the many diverse businesses necessary to sustain operations. These businesses include equipment suppliers, construction, transportation, management, food services, and many other types of support businesses. The Inland Bays also result in induced economic effects, which are defined as the additional jobs, payroll, and output created throughout the economy when employees of a direct or indirect employer spend their personal incomes on consumer goods, other property, services, and taxes. Collectively, these factors demonstrate the total economic contributions of the Inland Bays to the region.

One example of this is a small, fishing charter boat business run out of a marina located on the Inland Bays. This business depends directly on the waters and resources of the Inland Bays to sustain it and provides direct economic impacts by employing staff to operate the fishing vessels and to captain chartered fishing trips. However, it also results in indirect effects by relying on other local and regional businesses to service the boats, supply oil and fuel, and provide bait and tackle. This business also results in induced economic impacts as its employees spend their earnings to purchase and maintain houses



and personal vehicles, buy food and clothing, and pay for entertainment.

These direct, indirect, and induced economic contributions of the Delaware Inland Bays to Sussex County and the rest of Delaware were quantified using the Regional Input-Output Modeling System (RIMS II), which was developed by the U.S. Bureau of Economic Analysis to estimate the contribution of an industry or industries to a regional economy (U.S. Bureau of Economic Analysis, 2018). This model has been widely used by government agencies, economic development organizations, regional planners, and businesses. RIMS II requires defining the study region geographically, identifying relevant industries within the study region, querying existing economic data (e.g., publicly available sales or revenue data), and using RIMS II to combine this information to quantify the economic contribution. Tax revenues were estimated separately. These steps are described in the following sections.

Inland Bays Study Region

The Inland Bays study region was defined as the land area in the eleven ZIP Codes surrounding the three Inland Bays (Figure 1). The eleven ZIP Codes

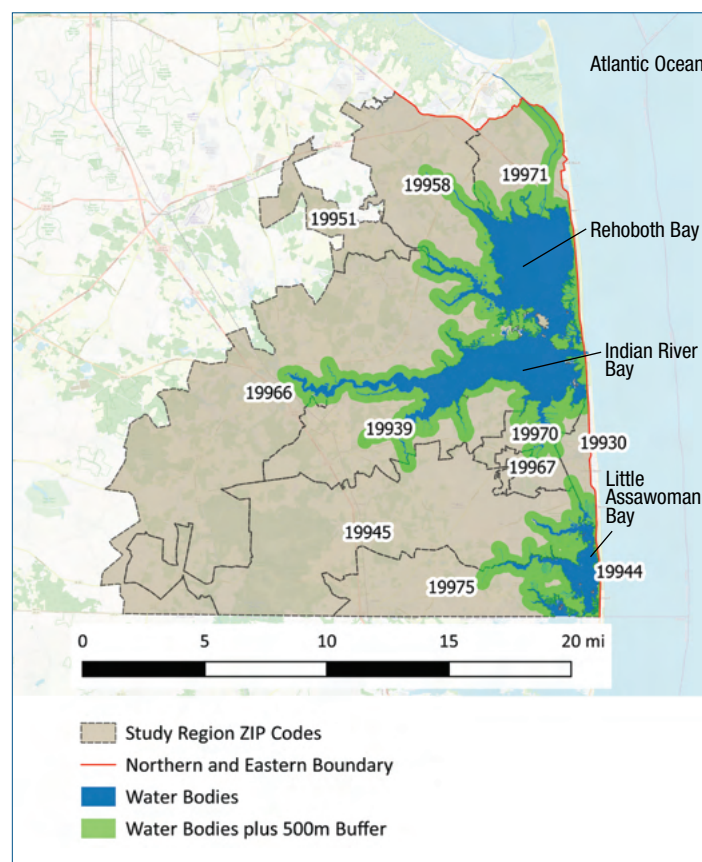


Figure 1. Delaware's Inland Bays with study region ZIP codes used in analysis



that were selected are those immediately adjacent to or within three miles of the Inland Bays. ZIP Codes were used to define the study region due to the public availability of “business pattern data” for individual ZIP Codes.

ZIP code areas adjacent to both the Delaware Inland Bays and the coastal ocean were divided to separate economic activity derived from the ocean from that of the Inland Bays. This delineation generally follows Delaware Route 1 north from the Delaware-Maryland border. This delineation intentionally excludes the seaward portions of ZIP Codes for Lewes, Rehoboth Beach, Bethany Beach, and Fenwick Island where economic activity and water-related benefits are more likely to be related to the ocean than to the Inland Bays. Based on this boundary, approximately 92% of the land area within the eleven selected ZIP Codes was included within the Inland Bays study region.

Relevant Industries

For the study region, relevant industries were selected from three categories: (1) those that are water-related, (2) tourism and recreation, and (3) those necessary to support residents that live in proximity to the Inland Bays, visitors, and those moving to the region (e.g., infrastructure and services) (Table 1). Water-related activities include



Table 1. Industries Included in Inland Bays economy

Water-Related

Commercial shellfish fishing: Quahog clams and oyster aquaculture

Fish and seafood markets

Marinas

Boat dealers (includes boat trailers, parts & accessories, repairs)

Public water supply

Electric power generation: Indian River Power Plant

Tourism and Recreation

Accommodations (hotels and motels, B&Bs, RV parks, campgrounds)

Travel arrangements and reservation services (e.g., travel agencies, tours)

Sporting goods stores (includes bait & tackle, fishing & boating equipment)

Recreational goods rental

Sports and recreation instruction (e.g., boating & swimming)

Scenic water transportation (e.g., fishing charters)

Other recreation (e.g., boating clubs without marinas, fishing guide services)

Infrastructure and Services

Residential and non-residential construction

Clothing and accessories stores

General merchandise stores

Health and personal care stores

Grocery stores

Gasoline stations

Restaurants and bars

Health care services

Real estate agencies, brokers and leasing

Legal services

Architectural, engineering, drafting, and building inspection services

Research and development in sciences

Environment, conservation and wildlife organizations

***Agriculture** is inherently connected to the Inland Bays; it occurs across much of the Inland Bays watershed, impacts water quality both positively, through the implementation of conservation measures and regenerative agricultural practices, and negatively, through agricultural runoff. Farmland also provides the open space and land area needed to facilitate continued residential development. It therefore has the potential to significantly influence the Inland Bays economy. However, the economic impacts of agriculture are specifically excluded from this assessment because agricultural outputs are not dependent on the Inland Bays themselves—agriculture occurs across much of the Delmarva Peninsula, regardless of proximity to coastal waterbodies. As such, agricultural industries that occur within the Inland Bays study area, like poultry production and commodity crops, were not included in this economic analysis.*



commercial shellfish fishing, seafood markets, boat dealers, and marinas.

Industries related to tourism and recreation include accommodations (e.g., hotels and motels, bed and breakfasts, campgrounds, etc.), travel agencies, and recreational goods rentals (e.g., kayak rental companies, bait and tackle stores, fishing charters, etc.). Residential infrastructure and services include construction, general merchandise stores, health and personal care stores, grocery stores, gasoline stations, and real estate agencies, among others. An example of an important industry within the study region that was deemed largely unrelated to

the Inland Bays economy and thus was excluded is agriculture.

Existing Economic Data

Economic data for most industries, represented by sales or revenue, are publicly available through the U.S. Census Bureau's Economic Census (2021), which was most recently completed in 2017. Data from 2017 were adjusted to 2020 dollars using the Consumer Price Index (CPI), which is published by the U.S. Bureau of Labor Statistics.

Since economic data were only available at the county level, a portion of sales and revenue data for Sussex County were allocated to the Inland Bays study region based on the proportion of each industry's establishments that were located within the study region². For example, Sussex County sales from hotels and other lodging totaled \$127 million, and 60 of 77 establishments (78%) were located in the Inland Bays study region. Therefore, 78% of \$127 million, or \$99 million, was attributed to the Inland Bays study region. This assumes that average sales per establishment are the same throughout the

² There were two exceptions to this approach: the sale of public groundwater supplies and the value of the commercial quahog clam industry, both of which were specifically calculated for the Inland Bays study region.

county, which is likely a conservative assumption since across industries both demand and price tend to increase as proximity to the water increases.

Regional Input-Output Modeling

The Regional Input-Output Modeling System (RIMS II) forecasts the contribution of an industry, or suite of industries, within a given area on a broader region by using “multipliers” provided by the U.S. Bureau of Economic Analysis. Multipliers are available at both the county and state levels. These multipliers quantify the direct, indirect, and induced economic contributions of an industry, as well as the number of jobs provided by the industry, based on existing sales or revenue data. Multipliers in RIMS II are based on a detailed set of industry accounts that measure the goods and services produced by each industry and the use of these goods and services by industries and final users (U.S. Bureau of Economic Analysis, 2018).

For example, to calculate the economic contribution of boat dealers to Sussex County, publicly available boat dealer sales of \$44.9 million in the Inland Bays study region are multiplied by 1.4491, which is the multiplier provided by RIMS II for that industry. This multiplier indicates that every dollar spent in the boat dealer industry generates an additional 45 cents of economic activity throughout the region in indirect and induced contributions. When these factors are combined, they sum to a total of \$65.1 million in economic contributions. Boat dealer sales

(\$44.9 million) are also multiplied by 9.619 to quantify the number of full- and part-time jobs supported by the industry, which equals 432 jobs.

A similar approach was used to quantify the economic contribution of Inland Bays economic activity to the state (i.e., state multipliers were used to forecast contributions based on existing sales and revenue data).

Findings

Based on the defined study region, relevant industries, and existing economic data, RIMS II estimates that the Delaware Inland Bays support \$4.5 billion in economic activity and over 35,000 jobs throughout the state of Delaware. This value represents the direct, indirect, and induced economic contributions of the Delaware Inland Bays.

Approximately 89% of these contributions and 94% of the jobs occur within Sussex County (\$4.0 billion in economic activity and 33,774 jobs) (Table 2), with 11% of the contributions and 6% of the jobs (\$511 million in economic activity and 2,345 jobs) occurring more broadly in Delaware (Table 3).

The majority of the economic contributions come from industries that are necessary to support residents who live in proximity to the Inland Bays (e.g. infrastructure and services). This includes residential and non-residential construction, grocery stores, health care services, and real estate.



Table 2. Economic Contribution of the Inland Bays to Sussex County: Direct, Indirect, Induced and Total Contribution (in millions of 2020 dollars) and Jobs

	Direct	Indirect	Induced	Total	Jobs
WATER					
Commercial shellfish fishing (Quahog clams & aquaculture oysters)	\$1.1	\$0.1	\$0.2	\$1.4	14
Fish & seafood markets	2.2	0.5	0.6	3.3	30
Marinas	6.6	2.2	1.7	10.5	124
Boat dealers (includes trailers, parts & accessories, repairs)	44.9	7.1	13.0	65.1	432
Public water supply	12.9	2.0	1.7	16.5	41
Electric power generation: Indian River Power Plant	7.4	1.3	0.9	9.6	20
Total Water	\$75.0	\$13.2	\$18.1	\$106.3	661
TOURISM AND RECREATION					
Accommodations (e.g., hotels, motels, B&Bs, campgrounds)	\$98.7	\$22.7	\$22.5	\$143.8	1,040
Travel arrangement & reservation services (travel agencies, tours)	11.4	2.7	2.4	16.4	76
Sporting goods stores	18.0	4.6	5.6	28.2	314
Recreational goods rental	5.1	1.2	1.5	7.9	42
Sports and recreation instruction (e.g., boating & swimming)	0.5	0.1	0.2	0.8	10
Other amusement & recreation industries (e.g., boating)	13.2	4.3	3.4	20.9	249
Total Tourism and Recreation	\$146.8	\$35.7	\$35.6	\$218.1	1,731
INFRASTRUCTURE AND SERVICES					
Residential and non-residential construction (new & remodeling)	\$410.4	\$119.9	\$144.2	\$674.5	4,169
Clothing & accessories stores	307.7	95.0	69.4	472.1	4,794
General merchandise stores	159.2	31.1	39.6	229.9	2,332
Health & personal care stores	165.3	40.1	55.1	260.4	2,525
Grocery stores	323.4	76.5	90.8	490.8	4,501
Gasoline stations	190.9	53.6	51.3	295.8	2,733
Restaurants, bars & food service (caterers, contractors, mobile food) services	405.2	109.9	108.9	624.1	6,443
Ambulatory health care services (e.g., doctors, dentists, chiropractors, physical therapists, emergency centers)	238.7	44.3	85.1	368.1	2,298
Real Estate	136.5	29.4	19.5	185.4	1,196
Legal services	10.1	1.9	4.0	15.9	81
Architectural, engineering & related services	34.3	7.1	11.5	52.9	302
Environment, conservation & wildlife organizations	0.6	0.1	0.2	0.9	7
Total Infrastructure and Services	\$2,382.4	\$609.0	\$679.5	\$3,670.9	31,382
Total Contribution	\$2,604.2	\$657.8	\$733.2	\$3,995.3	33,774

Source: Calculated using RIMS II final-demand multipliers, Type I and Type II (U.S. Bureau of Economic Analysis, 2021b and 2021c).

Table 3. Economic Contribution of the Inland Bays Study Region to Sussex County and the State of Delaware (millions of 2020 dollars)

	Total	Jobs
Contributions to Sussex County	\$ 3,995	33,774
Contributions to the Rest of Delaware	\$ 511	2,345
Percent of Contributions that Occur within Sussex County	89%	94%

Source: Calculated using RIMS II final-demand multipliers, Type II (U.S. Bureau of Economic Analysis, 2021b and 2021d).

Tax Revenues

Economic activity within the Inland Bays study region also provides tax revenue to federal, state, and county governments. Sources of revenue include taxes and fees levied on businesses, personal income tax, property taxes, and real estate transfer taxes. These tax revenues were estimated as a proportion of the total tax revenue generated by the coastal economy of Delaware. A supporting case study for tourism-related taxes is also provided.

Federal, State, and County Tax Revenues

Tax revenue to federal, state, and county governments were estimated as a proportion of the total tax revenue generated by the coastal

economy of Delaware. This value was calculated in 2011, which was published in *The Contribution of the Coastal Economy to the State of Delaware* (2012). In 2011, tax revenue for the total coastal economy was estimated to be \$711 million, which equates to \$833 million in 2020 dollars based on the Consumer Price Index (CPI). The total coastal economy of Delaware was estimated to be \$6.9 billion, which equates to \$8.1 billion in 2020 dollars. The value of the Inland Bays economy, estimated in this report, is approximately \$4.5 billion, which constitutes approximately 57% of the total coastal economy of Delaware. This ratio suggests that tax revenue generated by the Inland Bays is approximately \$458 million (57% of \$711 million).

Tourism-Related Tax Revenues

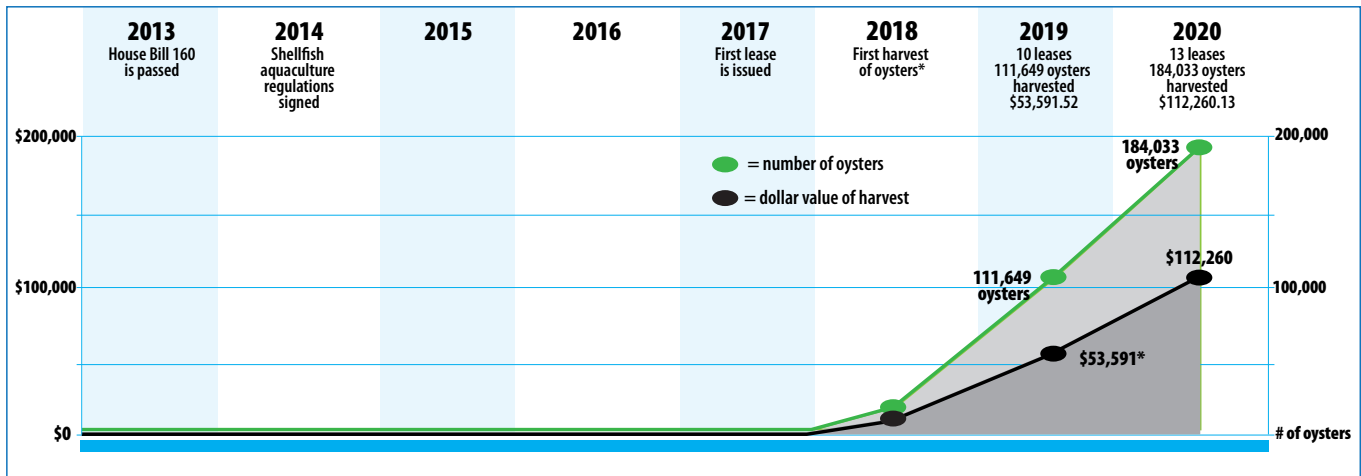
The estimate of federal, state, and local tax revenue calculated for the Inland Bays study region consists of specific sources, which include several pertaining directly to tourism. According to the Delaware Tourism Office, \$223.8 million in tourism-initiated state and local taxes were collected in Sussex County in 2019 (M. Chesney, Delaware Tourism Office, personal communication, May 25, 2021; Delaware Tourism Office, 2020), equivalent to \$226.5 million in



2020 dollars (adjusted using the CPI)². The amount of this total tax revenue attributed to the Inland Bays was estimated by multiplying \$226.5 million by the portion of travel-related economic activity in Sussex County occurring in the Inland Bays region, which is approximately 79%. Based on this approach, the Inland Bays contribute approximately \$178.9 million tourism-initiated state and local taxes, which is approximately 39% of the \$458 million in tax revenue estimated herein.

² The amount of tax revenue from each source is not available, per the Delaware Tourism Office (M. Chesney, personal communication, June 1, 2021).

The commercial oyster fishery in the Delaware Inland Bays peaked in the 1950s when more than 4,000 acres of subaqueous lands in Rehoboth Bay and Indian River Bay were leased for oyster production. However, this leased acreage declined through the 1960s due to disease-related losses and reduced availability of seed oysters. By 1978, there was no remaining oyster production or available seed oyster supply. As a result, in 1979 the Delaware General Assembly returned all remaining bottom leases back to public ownership, which effectively prohibited shellfish aquaculture in the Delaware Inland Bays.



After 35 years, in 2013, the Delaware 147th General Assembly passed **House Bill 160**, which again allowed for shellfish aquaculture leasing and harvesting in the Delaware Inland Bays. In 2014, the Delaware **shellfish aquaculture regulations** were signed into law by the Governor. Delaware's Inland Bays Shellfish Aquaculture Program issued its **first lease in December 2017**. The first harvest of oysters from the Inland Bays occurred in **2018**. In **2019**, there were **10 commercial leases**, which **sold 111,649 oysters for a total revenue of \$53,591.52***. In **2020**, the number of commercial leases increased to 13; **184,033 oyster were sold for a total revenue of \$112,260.13**.

*Sales could only be reported once at least three growers were selling their oysters. Therefore, while sales started in 2018, no figures are available, and the 2019 figures only represent sales from August through December.

While currently small, the commercial oyster aquaculture industry in the Delaware Inland Bays is growing and is anticipated to someday rival that of similar states, like Rhode Island. Under the 2014 law, Delaware made available 343 acres for shellfish aquaculture within the Inland Bays, which is generally equivalent to the 339 acres currently farmed in Rhode Island's Narragansett Bay. In Rhode Island, this acreage supports over 200 aquaculture-related jobs and generates \$6 million in annual revenue, which presents a reasonable target for the future growth of the industry within the Delaware Inland Bays.



Effects of Water Quality on the Inland Bays Economy

The health of the Inland Bays is critical to the long-term sustainability of their economic contributions. Without a healthy coastal ecosystem as the foundation, many of the economic activities centered on the Inland Bays become less sustainable, lose value over time, and ultimately may cease to be viable, the sum of which has the potential to affect the economy of southern

Delaware and the state more broadly. Conversely, improved water quality conditions have the potential to significantly increase the value of the Inland Bays and the economic sectors that they support.

To address water quality concerns, a series of measures have been taken over the past several decades:

Time Line of Water Quality Improvement Measures

- 1988: The United States Congress recognized the ecological and economic importance of the Inland Bays through their enrollment in the National Estuary Program.

Because of their shallow depth and naturally slow rates of flushing, water quality within the Inland Bays is easily altered by human activities, such as agriculture and development, and associated resource management and policy decisions. While historically the Inland Bays featured clear, healthy waters, plentiful bay grasses, productive oyster reefs, and diverse and abundant fish populations, as a result of human activity, these conditions have deteriorated over time. Today, these factors continue to impact ecosystem health.

Due to agricultural fertilizers, wastewater disposal, wetland loss, and urban runoff, the Bays have become highly enriched with nitrogen and phosphorus. While these nutrients are essential for plant and animal growth, water quality can deteriorate when these nutrients are present in excessive amounts. This has occurred within the Inland Bays, which has accelerated algal growth and decreased oxygen levels, significantly affecting organisms like fish and crabs. In addition to these problems, the loss of valuable aquatic, upland, and wetland habitats have contributed to the decline of water quality in the Inland Bays.

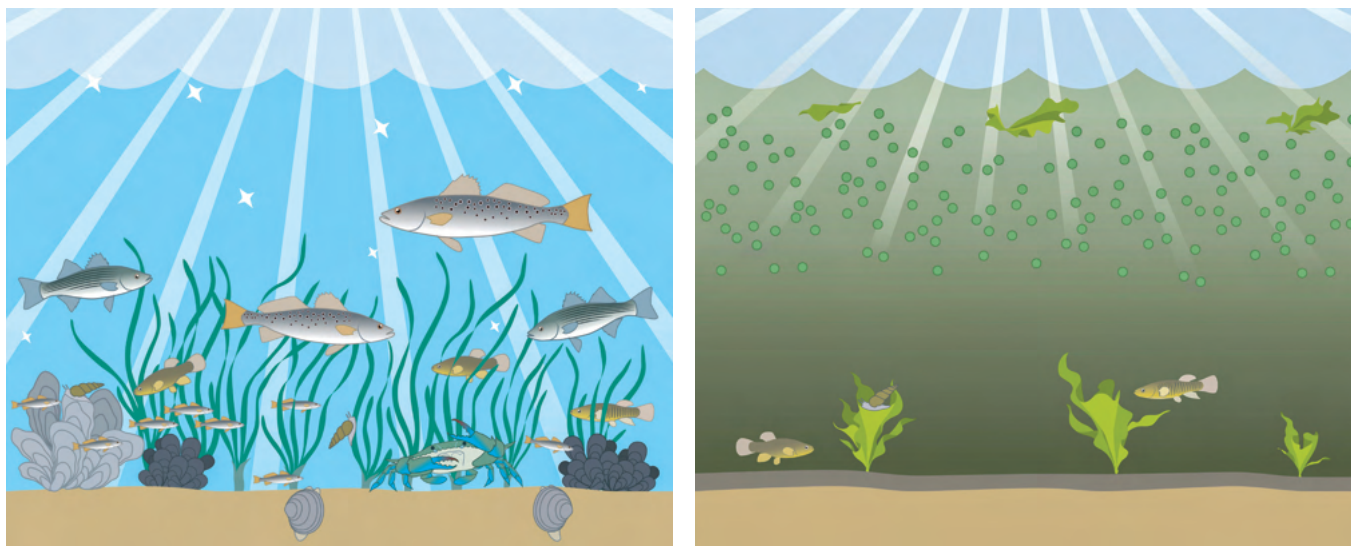


Figure 2. In healthy waters (illustrated on left), sunlight reaches the bottom of shallow areas, allowing submerged aquatic vegetation (SAV) to grow, which provides habitat and oxygen for animal life. However, when a waterbody is overloaded with nutrients like phosphorous and nitrogen (illustrated on right), excess algal growth clouds the water, blocking sunlight from reaching the bottom, which precludes the growth of SAV. When the excess algae dies, its decomposition removes oxygen from the water column, which can kill fish, crabs, oysters, and other aquatic organisms.

- 1994: The Delaware Center for the Inland Bays was created as the local host for the Program to oversee the implementation of the 1995 Inland Bays Comprehensive Conservation and Management Plan.
- 1998: the Delaware Department of Natural Resources and Environmental Control set Total Maximum Daily Loads (TMDLs) for nitrogen and phosphorus for the Indian River and Rehoboth Bays.
- 2005: A TMDL was created for Little Assawoman Bay and the tributaries of all the Inland Bays,



Based on the reduction targets presented in each TMDL, diverse groups of stakeholders, called Tributary Action Teams, developed recommendations, including voluntary and regulatory actions, to reduce nutrients entering the Bays and their tributaries. The resulting Pollution Control Strategy (PCS), which was finalized

in 2008, focused on addressing four main areas of pollution: agriculture, urban land use, stormwater, and wastewater. While some aspects of the Strategy have been challenged legally and declared void, the majority of the regulatory components and voluntary actions summarized within it present a clear pathway to improving water quality within the Inland Bays.

The PCS was designed for full completion within 10 years of its promulgation. After 13 plus years of implementation, phosphorus loads remain above target for the Inland Bays, and only about 40% of nitrogen reductions have been realized. Despite the significant actions taken to date, few locations within the Inland Bays meet water quality standards, and most tributaries remain severely polluted with extremely high algae levels and poor dissolved oxygen conditions during the summer months.

Significant federal, state, and local funding is necessary to further advance the PCS. However, this investment in water quality has the potential to significantly increase the already substantial economic value of the Inland Bays. Under existing water quality conditions, the Delaware Inland Bays support \$4.5 billion in economic activity and over

Total Maximum Daily Loads (TMDLs) as defined by the U.S. Environmental Protection Agency, calculate the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody can meet water quality standards. A TMDL sets a “pollutant reduction target” and “load reductions” necessary to target the source(s) of the pollutant so that impaired waterways can once again be fishable and swimmable.

The TMDLs created for the Inland Bays call for the systematic elimination of all point sources of nutrient loading (such as a direct discharge from a wastewater treatment plant), a 40% to 65% reduction in nonpoint phosphorus loading, and a 40% to 85% reduction of nonpoint nitrogen loading. The nonpoint source reductions required in the Inland Bays watershed are among the highest in the State.





35,000 jobs throughout the state. The following case studies focused on real estate values and outdoor recreation are presented to demonstrate how this value might grow should additional water quality improvements be realized.

Real Estate Values and Contributions

The economic analysis presented in the first portion of this report identified real estate as one of the top economic drivers within the Inland Bays economy. As has been demonstrated on numerous occasions and in numerous watersheds, improved water quality has the potential to further increase property values and the contributions of the real estate market to the economy (e.g., businesses and jobs directly related to real estate activity). In a seminal paper that was used to support the Clean Water Act, in 1973 the U.S. Environmental Protection Agency estimated that improved water quality increased residential property values by 18% for waterfront homes, 8%

for homes within 1,000 feet of the waterfront, and 4% for homes within 2,000 feet of the water. Similar studies have estimated that improvements due to reduced bacteria levels (Leggett and Bockstael, 2000) and decreased nitrogen content (Poor et al. 2007) may increase property values between 6% and 10%. More recently, a meta-analysis published in 2016, which quantified the effect of water clarity in the Chesapeake Bay estuary on property values, estimated that an increase of 4.3 inches in light attenuation, as measured by Secchi disk³, resulted in a 1.6% increase in the value of waterfront homes, and a 0.2% increase for homes within 1,500 feet of the water (Klemick, et al., 2016).

This last study is particularly useful given its proximity to the Inland Bays and use of water clarity as an indicator of water quality. Within the Inland Bays, water clarity is a key metric. Over the past 30 years, water clarity within the Inland Bays, as measured with a Secchi disk, has decreased by an average of 8 inches. The few areas with a measured improvement have increased by approximately 4.5 inches on average. From 1998 to 2015, the average depth of water clarity within the Inland Bays was approximately 2.3 feet. However, the measures outlined in the Pollution Control Strategy should improve water clarity metrics significantly above existing conditions, which would allow for reestablishment of submerged aquatic vegetation across much

³ A Secchi disk is an opaque disk, typically white and black, used to gauge the transparency of water by measuring the depth (Secchi depth) at which the disk ceases to be visible from the surface.



of its historical extent. The relatively high-quality coastal bays of Maryland and New Jersey provide a reasonable target that may be achieved through implementation of the Pollution Control Strategy. Within unimpaired portions of these systems, the average depth of light attenuation is approximately 3.2 feet⁴. This is approximately 0.9 feet, or 10.8 inches more than what is currently observed in the Delaware Inland Bays. It is reasonable to anticipate that similar levels of light attenuation may be achieved within the Inland Bays through implementation of the Pollution Control Strategy.

***Benefits transfer** is a means of transferring information about ecological-economic relationships from one location, where primary research has been performed, to another location where this information is lacking. Essentially, estimates or values from one site are used as an approximate measure for what may be expected at another site. In this case, primary research being done elsewhere has been applied to the Delaware Inland Bays to forecast the impact of water quality on residential real estate values.*

Based on these studies, and the anticipated gains in water clarity that could be achieved under the Pollution Control Strategy, a benefits transfer approach was used to quantify the impacts of improved water quality on residential real estate values and the associated economic contributions of the real estate market within the Inland Bays study region. The following sections detail the approach and findings.

Approach

GIS was used to quantify the number of waterfront homes and those within close proximity to the Delaware Inland Bays. The current value of these homes was estimated using a publicly available dataset; the economic contribution of waterfront homes and those in close proximity to the Delaware Inland Bays was estimated based on the ratio between

⁴ New Jersey Water Quality Data: <https://www.nj.gov/dep/bmw/coastalwaterquality.htm>. Maryland Water Quality Data: https://eyesonthebay.dnr.maryland.gov/bay_cond/bay_cond.cfm?station=TRC0043¶m=sec



their number and the total number of residential properties within the study area. The resulting home values and annual economic contributions were adjusted based on the percent increase in real estate values presented in other studies, relative to observed and anticipated water quality improvements in the Inland Bays, and then summed to quantify the total values and contributions.

GIS

GIS software was used to identify waterfront properties and those in close proximity to the water within the Delaware Inland Bays study region. Based on Klemick et al. (2016), close proximity was defined as properties within 1,500 feet of the Delaware Inland Bays. Approximately 90% of waterfront parcels were identified as residential; 75% of parcels in close proximity were residential; the remainder of the parcels were excluded from the analysis. Based on this approach, 15,424 residential parcels were identified; 5,489 were waterfront and 9,935 were in close proximity to the water (within 1,500 feet). These values represent 5.2% and 9.4% of the estimated 105,370 residential properties identified within the total study region.

Real Estate Valuation

Since parcel data do not contain property values, “Zestimate®” values provided by Zillow Group, Inc. were used to estimate the current value of waterfront homes and those in close proximity. Zestimate® values are based on actual sale prices of homes with similar characteristics (e.g., number of bedrooms, square footage, etc.); according to Zillow Group, Zestimates® are generally within 10% of the actual market value of a given home.

Since Zestimate® values cannot be queried in bulk, to estimate the current value of the 489 waterfront



homes and 9,935 homes in close proximity to the water, a random sampling of these properties was selected. Power analysis was used to determine the appropriate number of homes to return a representative estimate of value with a 5% margin of error. This was determined to be 378 properties, which were selected using the random selection tool built into QGIS, an open-source cross-platform desktop geographic information system application that supports viewing, editing, and analysis of geospatial data. Using this approach, the average value of waterfront homes was estimated to be \$757,761; the average value of homes in close proximity to the water was estimated to be \$630,014. Across all properties, this suggests that the current, latent value of waterfront homes and homes in close proximity to the water within the Inland Bays study region is approximately \$10.5 billion (\$4.2 billion and \$6.3 billion, respectively).

These values may increase by up to 4% and 0.5%⁵, respectively, based on research performed by Klemick et al. (2016) should additional investments in water quality within the Delaware Inland Bays occur and result in improved water clarity conditions analogous to those observed in the high-quality portions of the Maryland and New Jersey coastal bays. These increases fall within the range of the other published studies cited above and likely present a reasonable estimate. Increases of this magnitude would result in the latent value of waterfront homes and homes within close proximity of the water to increase by \$168 million and \$31.5 million, respectively, bringing the total value to \$10.7 billion.

⁵ 1.6% and 0.2% increases in real estate value for a 4.3-inch improvement in water clarity, as documented in Klemick et al. (2016), equate to 4% and 0.5% increases for a 10.8-inch improvement in water clarity, which is likely to be achieved within the Delaware Inland Bays should additional investments in water quality occur.



Realty Transfer Taxes

In addition to property taxes included in the tourism tax revenue estimate above, a portion of the state of Delaware's Realty Transfer Taxes collected can be attributed to the Inland Bays. Delaware imposes a transfer tax of 4% on the value of property sold, of which 1.5% is collected by the county (for sales outside town or city corporate limits). In 2020, Realty Transfer Taxes distributed to Sussex County totaled \$35.5 million (Sussex County, 2021b). Transfer taxes collected by the state of Delaware on sales within Sussex County are estimated to be up to \$59.2 million.

The contribution of the Inland Bays to this total was estimated by multiplying realty transfer taxes collected by the County and State by the percentage of homes located within the study region (approximately 67%). This approach suggests that the Delaware Inland Bays contribute \$23.8 million and \$39.7 million in tax revenue for Sussex County and the state, respectively.

Economic Contributions

Based on the analysis performed in the first portion of this report, real estate contributes approximately \$185 million and 1,196 jobs to the Delaware Inland Bays economy each year. Using the proportions identified above (5.2% and 9.4%), approximately \$9.6 million of the \$185 million of real estate contributions to Delaware Inland Bays economy and 62 jobs



result from waterfront property transactions; approximately \$17.4 million and 112 jobs result from properties in close proximity to the water.

Using the same benefits transfer approach, these contributions may increase by up to 4% and 0.5%, respectively, should additional investments in water quality occur. Increases of this magnitude would result in \$500,000 in increased economic contributions to the local economy each year and would create three new jobs.

Findings

This assessment demonstrates that with continued investment in water quality, real estate values and associated contributions to the economy are likely to increase significantly. This would result in waterfront home values and the value of homes in close proximity to the water to collectively increase to \$10.7 billion. Improvements in water quality would also cause the economic contributions of the real estate market to increase by \$500,000 each year.



Outdoor Recreation

Outdoor recreation, including boating, recreational fishing, and swimming, is a significant driver of the Delaware Inland Bays economy. A recent survey of outdoor recreation by the Delaware Department of Natural Resources and Environmental Control (2018) found that 66% of eastern Sussex County households participate in fishing, 49% canoe or kayak, 41% powerboat, and 43% participate in bird watching or wildlife viewing. Across all of the industries necessary to support these activities, the analysis performed in the first portion of this report demonstrates that outdoor recreation contributes \$202 million to the local economy each year and supports more than 2,300 jobs.

These contributions are likely to increase with improved water quality. A 2003 publication found significant benefits of water quality improvements to recreational users in six states (Parsons et al., 2003). For boating and fishing, if water quality were to be improved from existing conditions to moderate water quality conditions, this would result in an average increase of 5.3% in economic benefits.

Using the benefits transfer approach, if a similar level of increase were to be observed in the industries that support outdoor recreation in the Delaware Inland Bays, economic contributions would increase by \$10.7 million each year, up to \$212.7 million annually, and would support almost 2,450 jobs, an increase of more than 120 jobs.







Summary and Conclusions

The Delaware Inland Bays are a valuable resource that contribute to the economic health and wellbeing of Sussex County and the state of Delaware. In their current condition, the Bays support a wealth of economic activity, including tourism and recreation, a vibrant real estate market, and an emerging commercial aquaculture industry which contributes \$4.5 billion in economic activity every year and over 35,000 jobs throughout the state. These values highlight the importance of the Inland Bays to the Delaware coastal economy, which consists of contributions from the Inland Bays, the coastal ocean, and Delaware Bay. In 2012, Delaware's coastal economy was estimated to provide \$8.2 billion (\$6.9 billion in 2012 dollars) in industry product and support 59,000 jobs (Latham and Lewis, 2012).

However, these contributions are dependent on the quality of the water within the Inland Bays and the associated services provided by a healthy coastal ecosystem, conditions which are subject to change

based on human activity and resource management decisions. Should water quality conditions improve through implementation of the Inland Bays Pollution Control Strategy, economic contributions are anticipated to increase significantly. In fact, the economic effects of improved water quality on real estate and outdoor recreation alone (approximately \$11.2 million per year) are estimated to pay for almost 50% of the annual cost to implement the Inland Bays Pollution Control Strategy, which was estimated at \$25 million per year over a 10-year period. This does not include the almost \$200 million in increased home values that will add to the net worth of coastal property owners, or potential gains in other sectors. These findings demonstrate the value of both the Inland Bays as an economic driver within the region and state, as well as the economic importance of clean water. This analysis is intended to provide context for discussions between the public, resource managers, and policy makers that can inform future action.



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