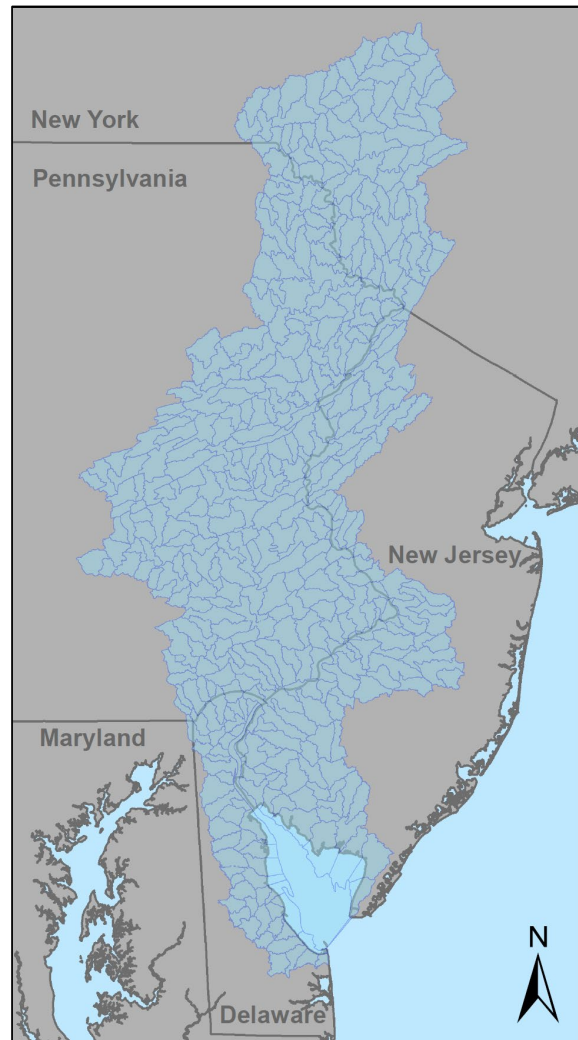


Public Investments in Landscape Preservation and Water Quality Best Management Practices in the Delaware River Basin 2014-2022



Final Project Report

Rutgers, The State University of New Jersey

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Van Abs, D.J., K.M. O'Neill, S.J. Malone, K. Keys and A. Parker. 2021. Estimating Public Investments in Landscape Preservation and Water Quality Best Management Practices in the Delaware River Basin. Rutgers-The State University of New Jersey for the William Penn Foundation.

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- Margaret Waldock, Executive Director, Duke Farms Foundation (formerly with the Geraldine R. Dodge Foundation)

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Disclaimer

This report was developed under a contract between the William Penn Foundation and Rutgers-The State University of New Jersey. The opinions expressed in this report are solely those of the authors, and do not represent any findings, conclusions, or opinions on the part of the Foundation or Rutgers.

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Project Purpose and Overview

The Delaware River Basin is a watershed spanning 13,539 square miles including the 782 square-mile Delaware Bay, encompassing portions of four states and all or part of 42 counties and 868 municipalities. The Delaware River itself is the longest undammed river east of the Mississippi River,¹ though many tributaries have dams. The Delaware River and its tributaries are vital water supplies for New York City, Philadelphia and various other urban, suburban and rural areas. This basin includes only 0.4% of the nation's land area but it provides all or a significant portion of the water supplies for 4% of the nation's population, roughly 13 million people. In addition, the Basin includes large areas of agriculture within the states of Delaware, New Jersey and Pennsylvania, along with Delaware and Broome Counties in New York. The Basin also has extensive forested areas (especially in the northern areas) that provide ecological and water resources benefits to Basin residents and others. Much of the Delaware River north of Trenton is included within the National Wild and Scenic Rivers System, as are tributaries such as the Musconetcong River and portions of the Maurice River watershed in New Jersey. Upper Basin streams include world-class trout fishing and excellent water quality. The estuarine sections of the Delaware River and Delaware Bay and their tidal tributaries are part of the National Estuary Program. The Delaware Estuary also includes shipping ports important to the area.

The William Penn Foundation began its Watershed Protection Program in 2013, funding projects in constituency building, watershed-wide science and advocacy, and targeted watershed preservation and restoration projects. The Foundation's intent is "to create the long-term conditions – the practices, policies, and public engagement — that will ensure the Delaware River Watershed supports aquatic life and recreation in and on the water." As part of this effort, the Foundation supports "efforts to secure concentrated forest protection, agricultural restoration, and stormwater solutions that maintain and improve stream health in targeted sub-watersheds; robust and sustained regulatory protections and funding; and equitable and widespread public access to and engagement with our rivers and streams."² Total funding obligated for these projects over the period 2013 through July 2023 was over \$391 million.

The William Penn Foundation has consistently encouraged other entities such as governments and non-profit organizations to fund or collaboratively fund similar projects. As part of this effort, the Foundation released a Request for Proposals (RfP) in late 2019 to understand recent status and trends regarding governmental budget allocations and expenditures for the protection and restoration of lands in the Basin, and for the implementation of Best Management Practices (BMPs) to improve water quality, including specifically stormwater BMPs. The Foundation sought "a rigorous and transparent methodology for consistently estimating the amount of public funding – federal, state, county, and municipal – allocated for the protection and restoration of Delaware River watershed landscapes." Recognizing that compilation of this information would be challenging, they also wanted to "understand limitations related to existing data and together navigate the necessary tradeoffs to generate useful estimates for monitoring public funding." The RfP focused on land protection, land restoration, and

¹ Delaware River Basin Commission. Basin Information. Available from: <https://www.state.nj.us/drbc/basin/>.

² William Penn Foundation. Watershed Protection. Available from: <https://williampennfoundation.org/what-we-fund-watershed-protection>.

agricultural best management practices.³ A team from Rutgers-The State University of New Jersey was selected to develop the initial (Phase 1) database and assessment for the period 2014 through 2019, resulting in the following report:

Van Abs, D.J., K.M. O’Neill, S.J. Malone, K. Keys and A. Parker. 2021. Estimating Public Investments in Landscape Preservation and Water Quality Best Management Practices in the Delaware River Basin. Rutgers-The State University of New Jersey for the William Penn Foundation. (Available from: <https://williampennfoundation.org/what-we-are-learning/estimating-public-investments-landscape-preservation-and-water-quality-best>)

This effort represented the first project-level compilation of expenditures attempted in the Basin, and to our knowledge for any large river basin in the nation. It is built on prior compilations of program-level budgets, including a study for the William Penn Foundation from the Water Resources Center, University of Delaware. A literature search found only one project that was comparable in scope to this effort, in the Chesapeake Bay region, which is heavily funded by special Clean Water Act appropriations from the federal government; total federal and state spending for water quality improvements in the Chesapeake Bay Basin are roughly \$450 million and \$1 billion per year, respectively.⁴ However, the Chesapeake Bay Program accounting focuses on federal and state funds,⁵ while this Delaware River Basin project also includes funding from county and municipal governments and special governmental agencies such as conservation districts.

With completion of the Phase 1 report, the William Penn Foundation requested that Rutgers extend the data acquisition to the years 2020 through 2022, with two new categories of funding: sewage collection system upgrades and wastewater treatment plant upgrades, including efforts to control combined sewer overflows. In both cases, routine maintenance and repairs were not included.

The Phase 1 and Phase 2 projects did not track expenditures in response to development permit requirements (e.g., development mitigation), or hazardous site cleanup mandates (e.g., Superfund, RCRA, equivalent state programs). In addition, park improvements not associated with the targeted functions (e.g., visitor services, playgrounds, athletic fields) are also not included.

The project resulting in this final report involved five major components from both phases:

- **Expenditure Database** that allows identification of a full range of potential government funding sources and recipients of government funds, along with expended funds for all governmental entities that provided information, with funded projects where available; where project funding is from multiple sources, this is tracked where provided. Where projects include sufficient geographic references, the database allows for geographic analysis of expenditure patterns through use of a geographic information system (GIS). Finally, although data collection focused

³ While the focus of the project is on water quality protection and restoration, many of these projects will have ancillary benefits for mitigating future water supply and flooding stresses. However, these benefits were not the project focus and no projects that were solely for water supply and flooding purposes have been included.

⁴ Chesapeake Progress. “Funding.” Available from: <https://www.chesapeakeprogress.com/?/funding>. The largest federal expenditures are from the U.S. Environmental Protection Agency (most of which is for grants-in-aid to state governments) and the U.S. Department of Agriculture (primarily to fund easements and financial assistance to landowners for conservation practices). Maryland provides the largest share of state funds, followed by Virginia.

⁵ Public Law 113–273 (2014) 128 STAT. 2967, “Chesapeake Bay Accountability and Recovery Act of 2014”.

on government sources of funding, the database allows for collection of projects funded by other sources, such as foundations and non-profit organizations, which is especially useful to this project where such funds were used to match government funds. The database therefore does not present a comprehensive collection of funding outside the government.

- **Tracking spreadsheet** includes detailed information regarding agency contacts for those governmental entities that provided data, and information regarding agencies that either verified expenditures for these purposes or did not respond to multiple attempts at contact.
- **Interviews and surveys of experts** from a wide range of non-profit organizations and governmental agencies to ascertain their perspectives on the nature, trends and equity of government budgets and expenditures for these purposes.
- **Evaluation of expenditures** relative to demographic, regional and environmental factors where feasible, to determine the extent to which the geographic distribution of expenditures matched environmental needs and demographic equity considerations.
- **Recommendations for expenditure analysis** into future years. Included in this section is an evaluation of how governmental data systems and availability constrain the success of a project that seeks to aggregate data from a wide variety of data sources that were not designed for this purpose.
- **Recommendations for using the project results to drive decisions** that can increase the effectiveness, cohesiveness and equity of government funding.

The project is in support of the William Penn Foundation's Watershed Protection program, which addresses the entire Basin. The information has been generated in as granular level as feasible to allow evaluation of how expenditures related to a variety of demographic, environmental and governmental factors. This report provides the final project methodology and all major findings and recommendations. The database itself was provided separately to the William Penn Foundation.

Executive Summary

This section provides an overview of project funding and expenditures and expert practitioner interview and survey process for the full project, along with a summary of recommendations for using the results to improve protection and restoration of the Delaware River Basin related to these programs.

Key Findings

- Reported Delaware River Basin project funding and expenditures for the years 2014 through 2022 were nearly \$4.4 billion, or nearly \$0.5 billion per year. Most known major funding sources reported data, but some government expenditures are still missing to an unknown degree.
- The dominant funding sources were state governments and water utilities, with the latter category dominated by Philadelphia Water Department. Municipal governments and water utilities (again dominated by Philadelphia) had the largest project expenditures.
- The dominant expenditure categories were sewage collection systems and wastewater treatment plant upgrades (primarily in the Philadelphia and Camden areas) and preservation of open space and agricultural lands (primarily in rural areas).
- Statistical analysis of expenditures by category most frequently showed significant correlations between expenditures and total county household income. Total expenditures by county were correlated with relative levels of Black, Indigenous, People of Color (BIPOC) populations and income inequality. The correlations were expected, given the focus of infrastructure projects on densely populated areas and of preservation projects in less densely populated areas.
- Interviews and expert panel surveys provided considerable insight into the status and issues regarding available funding programs and their implementation. Most importantly, they reflected that individual programs each have their own purpose, usually not related to equity issues, and that the combination of programs have not been designed for equity purposes.

Project Funding and Expenditures

The project expenditure database is used to track expenditures from a wide variety of federal, state, interstate regional, intrastate regional, county, municipal and water utility entities, in addition to non-governmental entities that used government funds for projects. It also tracks the many other entities responding that they had no expenditures during these years. The database includes government funding data from 126 entities overall, with 103 entities for the years 2014-2019 and 91 entities for the years 2020-2022, as shown in **Table 1**:

Respondent	2014-2019	2020-2022	Any Year
Federal	8	6	8
State	28	22	28
County	31	27	31
Municipal	32	23	32
Water Utility	23	21	23
Foundations	1	1	1
Nonprofit	3	3	3
TOTAL	126	103	126

These data sources are discussed in [Appendix C](#). Project expenditures were reported for most major federal funding sources in at least one of the four states and often more, providing a good sense of federal expenditures. While many agencies and organizations provided expenditure data or confirmed that they did not have expenditures (or in some cases did have expenditures but did not have information about them), some critical agencies did not respond to inquiries or declined the request for information for various reasons. Key missing programs on the federal and state levels are listed in **Table C-2** in [Appendix C](#). Several substantial state programs also did not provide data. Relatively few municipal governments provided data; the extent to which the lack of reporting reflects a lack of expenditures is unknown, though some local governments did respond that they had no relevant expenditures. Acquiring municipal government data represents a major challenge for future efforts. The lack of municipal funding data is notable because several respondents to interviews and surveys mentioned these local sources as critical for the Basin. Additional analysis is provided in the [Project Expenditure Results and Findings: Missing Data](#).

Nearly \$4.4 billion of relevant projects were reported as occurring within the Delaware River Basin for the years 2014-2022, of which 97% was provided by governmental entities and 3% by foundations and non-governmental organizations (both of which could include some governmental funds passed on by these entities, though efforts were made to correctly assign these funding sources).⁶ The amount by funder level (e.g., federal, state, county, municipal) is shown on **Table 2**. This total represents an average of roughly \$483 million per year.

Funder Type	Total	% of Total
Federal	\$223,281,723	5.1%
State	\$1,448,111,152	33.3%
County	\$410,295,590	9.4%
Municipal	\$333,838,574	7.7%
Water Utility	\$1,799,939,171	41.4%
TOTAL GOVT	\$4,215,316,210	96.9%
Academic	\$660,076	0.0%
Foundations	\$42,902,298	1.0%
Non-profit	\$67,109,582	1.5%
Private Entity	\$1,059,314	0.0%
Unknown	\$24,290,562	0.6%
TOTAL OTHER	\$136,021,833	3.1%
Grand Total	\$4,351,488,043	100.0%

Of these, by far the largest shares of reported funding for expenditures are from state governments and water utilities, with Philadelphia Water Department representing the lion’s share of the latter from its response to combined sewer overflow (CSO) controls. Expenditures by Philadelphia and the Camden County Municipal Utilities Authority (CCMUA) are very large and primarily funded by ratepayers, even where initial funding is provided through State Revolving Fund loans (limited in Philadelphia but more

⁶ While non-governmental funding was not a project focus, some governmental programs require matching funds, and so the non-governmental funds can be a critical factor in the allocation of governmental funds. These matching funds were identified through inquiries to the non-governmental organizations.

common for CCMUA). Notably, the federal government provided only 5% of funding, much of which flows through state governments in the Drinking Water and Clean Water State Revolving Funds but some of which is provided directly to private agricultural operations by the U.S. Department of Agriculture.

Of the total state government funding, nearly \$1.2 billion in project funds (78%) were reported from two states, New Jersey and Pennsylvania, with New Jersey reporting \$738 million and Pennsylvania reporting \$461 million. These two states comprise nearly three-quarters of the Basin, with 50.3% for Pennsylvania and 23.3% for New Jersey,⁷ indicating that reported New Jersey expenditures per square mile are higher than in Pennsylvania. Reported funding in Delaware (with 7.9% of the Basin area) is far higher than for the State of New York (with 18.5% of the Basin area) at \$271 million and \$67 million, respectively. New York State therefore reported far lower total expenditures per square mile than Delaware; this is likely due to the relatively undeveloped nature of that area and its limited population. New York State expenditures do not include expenditures by New York City for protection of its Catskill-Delaware reservoir system, which are part of the municipal accounting.

While **Table 2** shows the source of funds, **Table 3** shows what entities expend the funds (regardless of funding source) to preserve land or restore water resources. Some significant points arise from comparing funding and expenditures. Water utility funding and expenditures are roughly equal percentages, again primarily reflecting the large amount of internally-funded capital projects by Philadelphia Water Department. Municipalities represent a tripled share of expenditures relative to funding. This indicates that municipalities are very successful at gaining funds from other sources (e.g., federal, state and county governments). Counties show an expenditure share double their funding share. Conversely, the state share of expenditures is less than a quarter of its share of funding, providing a good sense of the source for increased county and municipal expenditure shares.

Implementer Type	Grand Total	% of Total
Federal	\$113,090,803	2.6%
State	\$305,792,532	7.0%
County	\$804,049,453	18.5%
Municipal	\$954,918,710	21.9%
Water Utility	\$1,889,465,870	43.4%
TOTAL GOVT	\$4,067,317,368	93.5%
Academic	\$4,216,957	0.1%
Foundations	\$2,000,000	0.0%
Non-profit	\$157,067,876	3.6%
Private Entity	\$12,232,286	0.3%
Unknown	\$108,653,556	2.5%
TOTAL OTHER	\$284,170,675	6.5%
Grand Total	\$4,351,488,043	100.0%

⁷ See Delaware River Basin Commission, “Basin Information”, at <https://nj.gov/drbc/basin/>.

Finally, the project expenditures were assessed by project type, as shown in **Table 4**. Land preservation for open space and agriculture comprise 27% of all reported expenditures, with roughly equal amounts. The Basin states, and especially New Jersey and Pennsylvania, have a long history of land preservation programs as a way of preserving agricultural landscapes, farming as a business, and natural resources, as well as to shape future development patterns. Restoration programs are much smaller (6%), focused on agricultural best management practices and ecological restoration of lakes, stream and wetlands. We know from state water quality inventory reports that a very large number of surface waters violate surface water quality standards and show evidence of ecosystem damage, and yet these purposes are far less funded. Given that land preservation and ecological restoration programs are primarily oriented to rural or exurban regions, most of these funds are going to non-urban areas.

Conversely, nearly two-thirds of all project expenditures are focused on sewage and stormwater infrastructure, with nearly all expenditures for upgrades of sewer collection systems and wastewater treatment plants, an area of significant state and federal regulation. Most but not all of these project expenditures are related to CSO controls in Philadelphia and the Camden area. Stormwater infrastructure upgrades for other purposes represent little of the project expenditure for infrastructure.

Project Type	Total	% of Total
Open Space Preservation	\$557,812,434	12.8%
Farmland Preservation	\$607,065,873	14.0%
PRESERVATION	\$1,164,878,307	26.8%
Agriculture BMPs	\$150,648,517	3.5%
Lake Restoration	\$25,202,048	0.6%
Stream Restoration	\$79,761,871	1.8%
Wetland Restoration	\$6,855,275	0.2%
RESTORATION	\$262,467,710	6.0%
Green Stormwater Infra	\$187,842,573	4.3%
Traditional Stormwater Infra	\$84,363,447	1.9%
Sewage Collection Systems	\$1,610,376,152	37.0%
WWTP Upgrades	\$968,402,346	22.3%
INFRASTRUCTURE	\$2,850,984,518	65.5%
Multi-purpose	\$72,703,416	1.7%
Unknown	\$454,092	0.0%
OTHER	\$73,157,508	1.7%
Grand Total	\$4,351,488,043	100.0%

General geographic references were provided for nearly all projects, but each expenditure category had its own most-common geographic reference, such as HUC12 drainage areas for agricultural best management practices and municipal for open space preservation. The lack of specific geographic referents made it difficult to evaluate expenditures in a consistent manner, requiring development of a GIS-based approach that allows information from different geographic types to be combined for a rough analysis against demographic metrics.

Complete data on funding sources, projects and project types are presented in the data tables provided separately to the Foundation.

Data Analysis and Equity Issues

Several layers of data analysis provide context for the data tables. First, expenditures for each project category were mapped to show the geographic distribution of funds using various metrics, including total expenditures, expenditures per person, and expenditures relative to relevant land area (e.g., agricultural preservation expenditures relative to agricultural land in the geographic area). Depending on the completeness of geographic identification provided with the expenditure data, the mapping was conducted at the HUC12 drainage area, municipal or county level.

Second, statistical analyses identify the project category expenditures relative to socio-economic indicators, including BIPOC populations (i.e., all racial/ethnic groups other than White/non-Hispanic), Gini coefficient (an indicator of income distribution), median household income (both alone and in comparison to the Basin median), and total household income.

For several project categories, the expenditure levels were so low and involved so few reporting units that a relevant statistical analysis could not be performed (e.g., lake, stream and wetlands restoration). However, the analyses performed did provide some insights into the relationship between socio-economic indicators and expenditures. Total expenditures (all categories) at the county level have a significant positive correlation to BIPOC population, Gini Index, and total household income. For dollars per person, there is a positive correlation with BIPOC population. In both cases, high expenditures for wastewater and stormwater seem to be major drivers, with a concentration of expenditures in the Philadelphia/Camden area.

Open space and agricultural preservation expenditures, assessed at the municipal and county level respectively, have a significant positive correlation only with median household income. Green stormwater infrastructure expenditures at the county level show a significant positive correlation with BIPOC population, Gini Index, and total county household income. These correlations are also significant for dollars spent on green stormwater management per person. Most expenditures for this expenditure category are concentrated around Philadelphia and Camden. Collection system upgrades show a significant positive correlation with BIPOC population levels at the municipal level. However, we did not see significant results for traditional stormwater or wastewater treatment plant upgrades.

These results are not surprising given the nature of programs in this field. Programs focused on large-scale agricultural and open space preservation will target less-developed areas, and programs focused on large-scale infrastructure projects will target highly developed areas that tend to have both more total household income (due to higher population densities) and higher BIPOC population levels. However, income inequality (measured by the Gini coefficient) rarely showed a significant correlation.

Expert Practitioner Interviews

Members of the expert panel for this project completed online surveys, while 17 additional expert practitioners were interviewed in person, via video links, all during Phase 1.⁸ Experts explained how the structures and aims of existing programs affect the ways advocates and local governments work within the Basin. Unlike the federal Chesapeake Bay Program or Great Lakes Initiative, the Delaware River Basin has no overarching, dominant federal program and stream of funding to drive results. As the funding data demonstrate, a few state programs dominate the pool of higher-level government funding, especially those for farmland and open space acquisition in New Jersey and Pennsylvania, while other funding is mostly local (e.g., county, municipal, water utility). Each program was created for a targeted purpose and has eligibility requirements that limit where funds can go. Several respondents explained that the major federal and state funding programs aimed to protect resources and did not integrate social equity criteria into their decision-making processes.

Respondents describe taking advantage of major funding programs when possible, pursuing other funding sources when their projects were not eligible for such funds, and seeking new partners when funds dried up or changed their focus. As a result, expert practitioners described the Delaware River Basin as a watershed managed through a patchwork of conservation regimes. One result reported by respondents is the inefficiency of splicing together funding resources, tracking changes in funders' priorities, and learning new grant application procedures for each type of project, especially where projects incorporate elements of multiple funding priorities (e.g., land preservation that includes restoration costs; agricultural preservation that include non-agricultural lands). Respondents to surveys and interviews reported that the need to patch together various sources of funds was especially onerous to local governments lacking a robust tax base that would allow them to act quickly on opportunities. Potential sources for matching funds often have different deadlines that make it difficult to make matches in time.

Respondents said that success at acquiring project funds for nonprofits or local governments depends on meeting statutory and regulatory criteria, access to data and engineering studies, the capacity to write grant applications, the availability of likely partners, the ability to find matching funds, the proven capacity to manage projects, and local sentiment about conservation.

These conditions and capabilities vary across the Basin. Nearly all respondents commented that, coupled with the region's legacy of spatial segregation by race and wealth, funding for conservation is uneven, both geographically and demographically. More detailed information on the results is available in the section on [Interviews and Surveys of Key Experts](#). Further information is available in [Appendix F](#), [Appendix G](#) and [Appendix H](#) regarding the in-person interview questions, the on-line survey questions, and detailed interview results, respectively.

Interview Respondent

WE HAVEN'T SEEN A SHIFT AGAIN—AT LEAST A DISCERNIBLE ONE THAT I'M AWARE OF ANY WAY-- TOWARDS STRONGER PRIORITIZATION FOR THE RESOURCES IN AND AROUND URBAN AREAS THAT HAVE OBVIOUSLY UNIQUE WATER QUALITY ISSUES AND OPPORTUNITIES

⁸ All individual results and the list of interviewees are confidential, in compliance with Rutgers IRB requirements.

Recommendations: Database Management

The results to date provide a detailed view of project expenditures across many government and other funding sources. Inevitably, the database will lose relevance over time if not extended beyond the year 2022, and it has remaining gaps. Experience with the data acquisition process shows that acquiring data across such a large number of federal, state, county and municipal entities is a very laborious and costly process. Therefore, our recommendation for future work involves a triennial focus on those agencies and programs at the federal, state and county level that provided most of the funding identified through this project or are separately identified as being critical missing data sources. Many federal agencies, for example, provide most of their funding to states as grants-in-aid, and therefore tracking funding and expenditures through the state agencies will be more cost-effective. Counties and municipalities with larger budgets are more likely to provide funding and receive grants from higher levels of government. In this manner, project costs can be reduced with a more limited impact on data acquisition success. No change is recommended regarding the project expenditure categories.

Finally, we recommend periodic interviews of expert practitioners, perhaps every three years, to identify changes in perceptions regarding funding programs, project expenditures and equity considerations. One expert panel member commented that setting a regular schedule of review of spending and practitioner perceptions could also help assess the effects of watershed-wide efforts by the William Penn Foundation or other initiatives.

Recommendations: Policy Implications

The information developed for this project provides a very useful perspective on programs and expenditures. It also indicates that governments and non-profit organizations are often quite provincial, focused on their geographic area, needs and expertise, with much less focus on the Basin or even large watersheds. The only regional organization with responsibilities for the full Basin, the Delaware River Basin Commission, is a less dominant player in the Basin than in its early years prior to and just following the Clean Water Act and formation of the current federal and state environmental agencies. The Delaware Estuary Program, administered through the Partnership for the Delaware Estuary, provides an important platform for collaboration, but it has no regulatory authority and limited funding. The Delaware River Basin vies for national attention with many other regions and initiatives that have commanded far more funding, such as the Chesapeake Bay Program, the Great Lakes Initiative and the Colorado River Basin. Even for the four Basin states, the Delaware River Basin must compete with other regions for attention, including the Chesapeake (Pennsylvania) and Great Lakes (New York).

Several issues could drive more efforts and funding to address issues with benefits both to the Basin as a whole and to more localized resources, from tributary rivers to individual municipalities. They are:

- **Climate Change Impacts on Flooding and Drought**
- **Sea Level Rise and the Salt Front**
- **Clean Water Act Implementation**

The section on [Recommendations for Use of the Report](#) discusses these long-term drivers and provides suggestions for more immediate efforts. One important change that may drive short-term improvements in federal funding and local projects is the federal Bipartisan Infrastructure Law (Infrastructure Investment and Jobs Act of 2021) was adopted too recently to be apparent in the 2022

results. However, even a doubling of federal funding will not greatly increase total federal funding for watershed protection.

Finally, continued development, dissemination and technical assistance regarding the use of basin-wide information on a broad range of water supply, water quality, flood and ecological issues can help build a sense of common interests within the Delaware River Basin. Even if different players focus on their local concerns, a perception of common interests and needs should in turn improve federal, state and local government attention and funding for the Basin.

Project Methodology

The overall project methodology was developed in consultation with William Penn Foundation staff and the Phase 1 expert panel, which included members from governmental, non-governmental and academic entities. The project is focused primarily on acquisition, management and interpretation of project expenditure data using government funds, but also includes acquisition of projects that depend on other funding sources, often as match to government grants. The methodology also includes an interview process for expert practitioners to assess the extent to which expert perceptions reflect actual expenditure data, and to understand their perspectives on the current status, trends and equity of funding programs.

The project area is the entire Delaware River Basin (DRB) in the states of New York, Pennsylvania, New Jersey and Delaware. Using available geographic and demographic information, the project identified relevant jurisdictional boundaries (e.g., state, county, municipal) and surface water drainage areas (HUC12, also called “watersheds” for ease of reference) to determine what jurisdictions are partially or entirely within the DRB and the various subwatersheds thereof, and to what extent. This information was linked to the database file through GIS intersection. Finally, demographic information (e.g., population, household incomes) was added to the database for each census tract in the DRB.

The database methodology includes identification of project categories, funding sources and expenditures. The database structure was developed to allow a sorting of analysis of data across these parameters and by year. Based on these initial steps, the project team sought data from the relevant governmental sources and also from non-governmental entities that make extensive use of government funds. The detailed Project Methodology is provided in [Appendix A](#), and consists of the following steps.

CREATION AND IMPROVEMENT OF THE DATABASE STRUCTURE. The initial structure was created using a combination of known fields that store and allow for search queries and relational database analysis, in support of the project. As initial funding and project data were gathered, the database structure was modified to ensure that all critical information could be loaded and searched. The database was built to accommodate funding and expenditure data from 2014 through 2022. Because fiscal years differ between federal, state and local governments, the database stores data using the last year of the fiscal year (e.g., Federal Fiscal Year 2018 is stored as 2018). A separate spreadsheet was created with the same organizational information to allow tracking of data requests and responses.

ALL RELEVANT GOVERNMENTAL ENTITIES RECEIVED DATA REQUESTS. The data inquiry and collection process took place from early 2020 to early 2021 (Phase 1) and late 2021 through mid-2023 (Phase 2), with some follow-up to major funding sources or potential implementing agencies. The data requests were provided to nearly 1,000 governmental entities at the federal, state, regional, county and municipal levels; these are located or have active programs partially or entirely within the Delaware River Basin. Implementation entities are discussed further in [Appendix B: Potential Project Implementation Entities](#). In a few cases, online data were available, but this was rare. The primary objective of the project is a compilation of project expenditures by relevant implementing entities. Identifying funding expenditures involved a top-down approach (i.e., contacting the governmental entities discussed under Funding Sources, above) and a bottom-up approach (i.e., identifying funding sources based on project reporting and grant match information by implementing entities, including non-government entities).

MANAGEMENT OF RESPONSES. In each case where a responsive contact was achieved, the database identifies where data were:

- **Determined to not exist.** The agency confirmed that they neither provided nor expended funds relevant to this project.
- **Determined to exist and provided.** Agency staff were able to access and provide the necessary information for these inquiries. In some cases, funds are provided by a higher level of government to a lower, and then passed on from that receiving agency to other entities that implement projects. This movement of funds through multiple levels (federal to grantee to sub-grantee or contractor) and the requirements for sub-grantees to provide matching funds complicate the understanding of expenditures, potentially resulting in double-counting (where multiple entities identify expenditure of the same funds) or missing expenditures. The project team engaged in quality assurance to identify where multiple funding sources were used and to avoid double-counting, but in some cases, the necessary documentation for this purpose was not available.
- **Determined to exist but currently unavailable.** In some cases, the agency staff indicated that project expenditures had occurred, but the agency declined to or was not able to provide the data.
- **No response or refusal to respond.** Many municipalities (especially in rural areas) and some counties did not respond to repeated requests. Staffing constraints may explain some of this. In some cases, an agency refused to process the data request. Some entities required freedom of information act (FOIA) requests and then denied the request because the relevant laws did not require response to out-of-state entities (e.g., some Delaware State agencies took this approach, while others provided data with no difficulty). The lack of consistency in agency interpretation of FOIA requirements was a significant problem.

AGGREGATION AND REPORTING OF DATABASE RESULTS. The primary purpose of the project is to assess annual government expenditures as described above, including status and trends over the 2014-2022 period, and the extent to which available information allows or limits this assessment. The second purpose is to understand the expenditure patterns of these funds, by funding source, project sponsor and affected populations. To better evaluate the data across jurisdictions and watersheds, expenditures are often normalized (e.g., farmland preservation expenditures relative to farmland acreage per county).

ASSESSMENT OF HOW KNOWN EXPENDITURES REFLECT EQUITY and other considerations. A primary question is how the term “equity” should be applied in the analysis. Based on a literature survey and project discussions, Rutgers decided to focus on distributional equity, regarding how project expenditures relate to multiple socio-economic metrics drawn from Census information: population density, median household income, total household income, Gini coefficient and percent BIPOC populations.

INTERVIEW KEY EXPERTS from state agencies, local governments and the non-governmental sector who work within or lead programs that directly affect water resources in the Basin. The team selected experts with knowledge of programs across the Basin, using a protocol approved through the Rutgers Institutional Review Board (IRB).

Government Funding and Expenditures

This section summarizes the expenditure data results and analysis for the years 2014 through 2022. Because various entities use different fiscal years (calendar, federal, mid-year), all expenditures were logged based on the fiscal year end of the reporting entity (i.e., FY2021 is logged as 2021). While this will result in some mismatch of timelines for any one calendar year, the effect is muted when evaluated over a multi-year time frame.

The project expenditure database compiled for this report includes input from 126 entities, comprising eight federal agencies, 28 state agencies, 31 counties and county soil conservation districts, 32 municipalities, 23 utility authorities, and four non-governmental organizations (See **Table 1**). These entities are listed in [Appendix C](#). In addition, some county and especially municipal governments reported that they had no expenditures in the relevant project categories.

Expenditure Categories

The project used the following expenditure categories for data acquisition and analysis.

- **Agricultural BMPs (AGBMP):** This category includes a wide range of best management practices that are aimed at improving ground or surface water quality. It does not include BMPs that are primarily directed to improved agricultural yields. Animal waste storage, cover crops and stream habitat are three of more than 40 core practices used for water quality purposes.
- **Lake Restoration (LAKE):** This category focuses on capital projects for aquatic habitat improvements and pollutant loading reduction or mitigation. Harmful Algal Bloom (HAB) projects are included.
- **Preservation-Agriculture (PRESRV_AG):** This category focuses on the preservation of farmland for any type of agricultural purposes.
- **Preservation-Open Space (PRESRV):** This category focuses on the preservation of open space for ecological and passive recreation purposes. It does not include preservation for active recreation, to the extent that it was feasible to determine.
- **Sewer Collection System Upgrades (COLLSYST):** This category is new to Phase 2 and includes capital project upgrades such as collection system rehabilitation, replacement, flow capacity increases. Combined sewer line separations are also included, as are the connection of properties on septic systems to the collection system for purposes of water quality restoration.
- **Stormwater Management-Green (SWGREEN):** This category focuses on capital projects to create, improve or rehabilitate any type of green stormwater infrastructure other than open space preservation, which is included in the PRESRV category. Green stormwater infrastructure in this context need not incorporate plant materials, but is focused on mitigating stormwater volumes, flow rates and pollutant loadings in ways that mimic natural hydrology.
- **Stormwater Management-Traditional (SWTRAD):** This category focuses on capital projects dealing with such “gray” infrastructure as inlets, catch basins, storm sewers, basins (detention, retention), and outfall structures.
- **Stream Restoration (STREAM):** As with the LAKE category, this category focuses on aquatic habitat improvements and pollutant loading reduction or mitigation. Harmful Algal Bloom (HAB) projects and riparian buffers are included.

- **Wastewater Treatment Plant Upgrade (WWTPUP):** This category focuses on capital projects that increase the treatment capacity or quality of a wastewater treatment plant. It does not include in-kind replacement of existing facility components that do not improve water quality.
- **Wetlands Restoration (WETLAND):** This category focuses on capital projects for wetlands creation, restoration and improvements.
- **Multiple Categories (MULTI):** This category includes combinations of two or more of the above categories where is not feasible to disaggregate the individual components.

In all cases, ongoing operation and maintenance (O&M) costs are not included, nor are planning and monitoring costs unless they are folded into a capital project (mostly because it is very difficult to disaggregate these costs when they are bundled with capital costs). Projects that are required in new development and redevelopment also are not included, as those are regulatory requirements to mitigate a new stress on water resources. Projects that improve legacy water resource stresses are included in these categories.

Basin Funding and Expenditures

Over \$4.4 billion of relevant projects were reported during the nine years, of which \$4.3 billion (97%) were funded by governments, as shown on **Table 5**. Of these, by far the largest share of reported funding is from utility authorities and state governments (40.5% and 34.6%, respectively). County governments are 9.2% of the reported total, municipal governments are 7.5% and the federal government is 5%. The Water Utility row addresses all types of municipal, county and regional utilities, which are established by governments as authorized by state laws. Notably, this category includes the Philadelphia Water Department.

Non-governmental funders are more limited, at 3% of the reported total, which reflects the project purpose of tracking government expenditures. This section includes a row “Unknown” which reflects data provided that had sufficient project data but did not clearly identify the funding source; some of this line could be government funding. Wherever possible, the database tracks the original source of funding, to avoid double-counting (e.g., when a state agency reports open space funding that is provided to a local government and also reported by them). The intent is to identify both the source of funds and the entity that ultimately spent the funds on a project. Total reported funding was highest for the years 2016 and 2018. Reported federal and county funds declined greatly after 2019, while state and water utility funds varied considerably. Municipal funding is the smallest government category.

Another way of viewing these funding sources is by their primary location. **Table 6** shows these results. As shown, funding sources in New Jersey and Pennsylvania provide nearly all of the funding (22.2% and 63.6%, respectively) with Delaware at nearly 10%.

A third way to view the results is by project implementer. In this case, the funding is reported by the entity that expends funds on projects; those funds may come from internal resources (at which point they would also be part of the equivalent line in **Table 5**), or they may receive funds from other entities. For example, the federal government often provides grants to other entities, such as states, and so **Table 7** shows that more money comes from the federal government (**Table 5**) than is spent directly on projects by the federal government. Note especially that water utilities and municipalities play a much larger role in project implementation expenditures (\$2.9 billion reported) than in funding (\$2.1 billion reported); the opposite is true for state governments.

Funder Type	2014	2015	2016	2017	2018	2019	2020	2021	2022	Grand Total	% of Total
Federal	\$37,029,390	\$12,941,962	\$39,278,685	\$24,448,907	\$28,650,581	\$24,868,478	\$20,909,574	\$16,287,431	\$18,866,714	\$223,281,723	5.1%
State	\$116,042,008	\$98,575,418	\$126,477,200	\$87,528,673	\$195,725,550	\$216,089,072	\$273,124,293	\$204,560,077	\$129,988,860	\$1,448,111,152	33.3%
County	\$51,651,693	\$66,283,900	\$43,456,016	\$50,185,460	\$79,003,240	\$74,976,981	\$26,550,644	\$13,667,908	\$4,669,749	\$410,295,590	9.4%
Municipal	\$15,908,796	\$24,969,300	\$11,662,043	\$24,783,098	\$19,544,763	\$21,371,791	\$14,726,570	\$12,190,889	\$188,681,325	\$333,838,574	7.7%
Water Utility	\$126,991,942	\$99,158,583	\$411,992,171	\$170,967,932	\$171,047,158	\$237,232,298	\$144,502,763	\$273,127,145	\$164,919,180	\$1,799,939,171	41.4%
Total GOVT	\$347,623,829	\$301,929,163	\$632,866,115	\$357,914,070	\$493,971,291	\$574,538,620	\$479,813,844	\$519,833,450	\$507,125,828	\$4,215,466,210	96.9%
Academic	\$8,439	\$2,006			\$363,468	\$87,848	\$188,316	\$10,000		\$660,076	0.0%
Foundations	\$2,366,742	\$2,710,122	\$2,064,550	\$2,618,872	\$5,838,889	\$7,123,401	\$6,556,752	\$7,436,345	\$6,186,625	\$42,902,298	1.0%
Non-profit	\$4,821,609	\$4,882,402	\$5,196,285	\$7,908,863	\$13,206,401	\$8,700,569	\$16,025,646	\$2,930,969	\$3,436,837	\$67,109,582	1.5%
Private Entity		\$14,740		\$210,000	\$55,000	\$148,108	\$347,573	\$283,892		\$1,059,314	0.0%
Unknown	\$4,081,311	\$643,608	\$1,184,227	\$2,921,052	\$127,000	\$10,284,953	\$198,411	\$4,000,000	\$850,000	\$24,290,562	0.6%
Total OTHER	\$11,278,100	\$8,252,878	\$8,445,063	\$13,658,787	\$19,590,759	\$26,344,880	\$23,316,699	\$14,661,206	\$10,473,462	\$136,021,833	3.1%
Grand Total	\$358,901,929	\$310,182,041	\$641,161,178	\$371,572,857	\$513,562,050	\$600,883,499	\$503,130,543	\$534,494,656	\$517,599,290	\$4,351,488,043	100.0%

Location	2014	2015	2016	2017	2018	2019	2020	2021	2022	Grand Total	% of Total
Federal	\$11,502,083	\$14,346,802	\$28,090,239	\$22,359,085	\$52,339,372	\$30,497,485	\$18,288,737	\$45,931,662	\$26,849,450	\$250,204,915	5.7%
Delaware	\$10,728,220	\$12,090,205	\$49,365,004	\$19,629,647	\$53,306,791	\$81,025,581	\$29,479,344	\$22,715,790	\$20,126,503	\$298,467,084	6.9%
New Jersey	\$86,051,572	\$83,632,622	\$67,772,946	\$55,768,369	\$104,506,431	\$116,345,152	\$122,109,523	\$116,920,303	\$98,202,576	\$851,309,494	19.6%
New York	\$9,312,109	\$9,847,348	\$23,060,751	\$11,557,561	\$9,212,486	\$26,109,961		\$16,099,291	\$10,593,160	\$115,792,668	2.7%
Pennsylvania	\$241,307,945	\$190,265,063	\$472,872,237	\$262,258,196	\$294,196,970	\$346,905,320	\$333,252,940	\$332,827,610	\$361,827,601	\$2,835,713,882	65.2%
Grand Total	\$358,901,929	\$310,182,041	\$641,161,178	\$371,572,857	\$513,562,050	\$600,883,499	\$503,130,543	\$534,494,656	\$517,599,290	\$4,351,488,043	100.0%

Implementer	2014	2015	2016	2017	2018	2019	2020	2021	2022	Grand Total	% of Total
Federal	\$6,618,919	\$8,815,883	\$10,981,043	\$18,268,337	\$16,103,430	\$17,254,285	\$13,038,742	\$9,032,722	\$12,977,442	\$113,090,803	2.6%
State	\$25,737,211	\$17,121,355	\$16,683,197	\$14,716,735	\$37,286,752	\$96,644,558	\$30,775,652	\$27,851,987	\$38,975,084	\$305,792,532	7.0%
County	\$107,268,342	\$122,224,105	\$111,990,834	\$92,614,970	\$156,063,224	\$129,890,344	\$35,183,974	\$23,348,089	\$25,465,571	\$804,049,453	18.5%
Municipal	\$68,567,301	\$47,809,707	\$75,595,403	\$60,642,553	\$80,346,001	\$115,736,629	\$194,866,075	\$108,660,332	\$202,694,710	\$954,918,710	21.9%
Water Utility	\$130,201,560	\$99,323,430	\$404,393,707	\$167,137,193	\$196,744,885	\$220,466,011	\$185,735,740	\$297,911,724	\$187,551,620	\$1,889,465,870	43.4%
Total GOVT	\$338,393,334	\$295,294,480	\$619,644,184	\$353,379,788	\$486,544,292	\$579,991,828	\$459,600,181	\$466,804,854	\$467,664,427	\$4,067,317,368	93.5%
Academic	\$1,002,529	\$44,937	\$1,000,000	\$712,500	\$715,900	\$218,958	\$302,133	\$220,000		\$4,216,957	0.1%
Foundations				\$1,000,000	\$1,000,000					\$2,000,000	0.0%
Non-profit	\$16,561,669	\$12,784,270	\$8,134,147	\$15,285,900	\$24,116,966	\$18,734,593	\$32,261,980	\$17,778,668	\$11,409,683	\$157,067,876	3.6%
Private Entity			\$11,594,000				\$638,286			\$12,232,286	0.3%
Unknown	\$2,944,397	\$2,058,355	\$788,847	\$1,194,669	\$1,184,892	\$1,938,121	\$10,327,962	\$49,691,134	\$38,525,180	\$108,653,556	2.5%
Total OTHER	\$20,508,595	\$14,887,562	\$21,516,994	\$18,193,069	\$27,017,758	\$20,891,672	\$43,530,361	\$67,689,802	\$49,934,863	\$284,170,675	6.5%
Grand Total	\$358,901,929	\$310,182,041	\$641,161,178	\$371,572,857	\$513,562,050	\$600,883,499	\$503,130,543	\$534,494,656	\$517,599,290	\$4,351,488,043	100.0%

Location	2014	2015	2016	2017	2018	2019	2020	2021	2022	Grand Total	% of Total
Federal	\$5,429,804	\$5,358,188	\$7,229,201	\$7,033,056	\$8,625,309	\$8,303,232	\$9,534,077	\$8,992,234	\$13,360,096	\$73,865,196	1.7%
Delaware	\$12,870,220	\$19,091,439	\$66,011,867	\$29,401,382	\$91,873,126	\$90,733,577	\$34,146,442	\$59,574,850	\$33,933,511	\$437,636,413	10.1%
Maryland			\$1,161		\$1,738	\$6,152	\$121,757			\$130,809	0.0%
New Jersey	\$89,569,745	\$87,329,381	\$70,989,759	\$62,355,195	\$110,510,615	\$124,156,199	\$127,474,453	\$121,609,931	\$102,005,892	\$896,001,169	20.6%
New York	\$9,312,109	\$10,209,154	\$23,063,568	\$11,560,303	\$10,368,312	\$28,897,592	\$3,584	\$15,862,003	\$10,593,160	\$119,869,784	2.8%
Pennsylvania	\$241,720,051	\$188,193,880	\$473,865,623	\$261,222,921	\$292,182,950	\$348,786,748	\$331,850,231	\$328,455,638	\$357,706,631	\$2,823,984,673	64.9%
Grand Total	\$358,901,929	\$310,182,041	\$641,161,178	\$371,572,857	\$513,562,050	\$600,883,499	\$503,130,543	\$534,494,656	\$517,599,290	\$4,351,488,043	100.0%

Project Type	2014	2015	2016	2017	2018	2019	2020	2021	2022	Grand Total	% of Total
Open Space Preservation	\$83,737,167	\$87,804,354	\$56,039,747	\$74,231,600	\$70,215,554	\$74,104,529	\$59,614,588	\$45,150,697	\$6,914,199	\$557,812,434	12.8%
Farmland Preservation	\$92,958,242	\$75,382,973	\$69,965,063	\$75,671,913	\$92,482,411	\$107,350,243	\$26,916,303	\$31,100,304	\$35,238,420	\$607,065,873	14.0%
Preservation	\$176,695,409	\$163,187,326	\$126,004,810	\$149,903,514	\$162,697,965	\$181,454,772	\$86,530,891	\$76,251,001	\$42,152,619	\$1,164,878,307	26.8%
Agriculture BMPs	\$12,080,836	\$11,838,459	\$14,952,045	\$18,441,601	\$22,641,016	\$21,180,533	\$16,299,320	\$17,204,231	\$16,010,476	\$150,648,517	3.5%
Lake Restoration			\$123,910		\$117,481	\$2,846,880	\$21,976,777	\$11,000	\$126,000	\$25,202,048	0.6%
Stream Restoration	\$5,239,127	\$4,935,632	\$6,334,634	\$2,177,961	\$12,194,602	\$7,819,869	\$5,600,946	\$23,108,125	\$12,350,974	\$79,761,871	1.8%
Wetland Restoration		\$153,145	\$1,681,301	\$462	\$658,664	\$1,197,550	\$2,144,011	\$536,188	\$483,952	\$6,855,275	0.2%
Restoration	\$17,319,964	\$16,927,236	\$23,091,890	\$20,620,024	\$35,611,764	\$33,044,833	\$46,021,055	\$40,859,543	\$28,971,402	\$262,467,710	6.0%
Green Stormwater Infra	\$13,595,687	\$13,917,217	\$15,920,029	\$17,300,753	\$31,379,895	\$33,047,627	\$38,254,756	\$22,714,845	\$1,711,764	\$187,842,573	4.3%
Traditional Stormwater Infra	\$7,113,357	\$7,223,147	\$6,018,585	\$6,662,032	\$20,449,401	\$21,004,296	\$13,233,141	\$1,879,487	\$780,000	\$84,363,447	1.9%
Sewage Collection Systems	\$100,912,473	\$47,810,797	\$371,403,003	\$124,219,007	\$127,341,975	\$235,147,082	\$156,517,436	\$259,234,259	\$187,790,120	\$1,610,376,152	37.0%
WWTP Upgrades	\$42,640,500	\$60,158,000	\$98,299,500	\$50,844,200	\$125,686,830	\$47,439,650	\$159,028,926	\$129,417,740	\$254,887,000	\$968,402,346	22.3%
Infrastructure	\$164,262,017	\$129,109,161	\$491,641,117	\$199,025,992	\$304,858,102	\$336,638,655	\$367,034,259	\$413,246,331	\$445,168,884	\$2,850,984,518	65.5%
Multi-purpose	\$604,227	\$956,850	\$402,933	\$2,003,827	\$10,372,626	\$49,374,450	\$3,544,338	\$4,137,780	\$1,306,385	\$72,703,416	1.7%
Unknown	\$20,312	\$1,468	\$20,428	\$19,500	\$21,594	\$370,790				\$454,092	0.0%
Other	\$624,539	\$958,318	\$423,361	\$2,023,327	\$10,394,220	\$49,745,240	\$3,544,338	\$4,137,780	\$1,306,385	\$73,157,508	1.7%
Grand Total	\$358,901,929	\$310,182,041	\$641,161,178	\$371,572,857	\$513,562,050	\$600,883,499	\$503,130,543	\$534,494,656	\$517,599,290	\$4,351,488,043	100.0%

We can also view expenditures by where the money was spent on projects in **Table 8**, providing a comparison to the location of funding entities (**Table 6**). Pennsylvania and New Jersey have the greatest expenditures by far. Maryland expenditures are related to a very small part of the Christina River watershed, a tributary to the Delaware Bay.

One critical point is that the database was developed based on reported project expenditures, which are distinct from overall program funding (budgets). A good example is the Environmental Protection Agency, which provides funds to the region through Section 319(h) and National Estuary Program (NEP) grants. Most funding flows through state agencies or NEP organizations (e.g., Partnership for the Delaware Estuary), which in turn may sub-grant funds to other entities for project implementation. This movement of funds through multiple levels (federal to grantee to sub-grantee or contractor) complicates the understanding of expenditures, potentially resulting in double-counting (where multiple entities identify expenditure of the same funds) or missing expenditures. The project team engaged in quality assurance to avoid double-counting, but in some cases, expenditures were not reported, likely resulting in an undercount of funding to the Basin.

A fourth way to view the results is by project type. The database reflects reported project expenditures and then compiles that information upward into funding types (shown above) and project types. **Table 9** shows the results by project type (see also **Table 10** and **Table 11** below for federal and state details). Infrastructure spending is the largest category, incorporating upgrades of sewage collection systems, wastewater treatment plants and stormwater (both green and traditional), comprising 64% of reported expenditures. These programs are predominantly active in urban and suburban areas; the results of **Table 5** indicate that a major portion of these expenditures are funded by internal revenues (e.g., ratepayer revenue) rather than funding from higher levels of government. Nearly all of the remaining expenditures are for land preservation (open space and agriculture), comprising 28% of all reported expenditures. These programs are primarily oriented to rural or exurban regions, and much of it is spent by municipalities and counties, with funding from state governments and internal revenues. No other single project type exceeds 5% of reported expenditures, indicating that ecological restoration projects (lakes, streams and wetlands) have a very low priority despite the damages from legacy and current land uses. Agricultural best management practices (BMPs) receive more funding than ecological restoration projects, primarily through the national Farm Bill programs.

Missing Data

The primary caveat to these summaries is that many governmental units and agencies did not report funding or expenditures for a variety of reasons. The team was least successful getting data from municipal and county governments and federal agencies. In some cases, funding from specific sources were reported by entities other than those sources. [Appendix D](#) provides a more detailed analysis of targeted governments and agencies that did not respond to inquiries.

Federal Agency Funding

Federal government funding reported for the Delaware River Basin (2014-2022) is shown in **Table 10**. The two primary agencies within the region are the Environmental Protection Agency and the Departments of Agriculture and the Interior. All other programs are smaller. Within Agriculture, the largest reported funding source was the Natural Resource Conservation Service (NRCS) for agricultural BMPs, at \$90.1 million. USEPA Region 3 reported \$125.6 million in funding. The USDA Forest Legacy Program (\$12.5 million) was also significant, funding forest preservation. Within Interior, no single

program reported funding more than roughly \$6 million over the nine-year period, but several programs for wildlife, wetlands and species recovery came from that department. While the U.S. Environmental Protection Agency Region 2 did not provide data, state agencies that receive the bulk of USEPA funds as categorical state grants did in most cases report expenditures from those funds.

One question is whether the Basin is receiving an equitable share of these federal funds. Many of the federal programs are linked to agriculture and wildlife, where other regions of the country will absorb most of the funding. Many of the Department of Agriculture's Farm Bill programs, for example, are not widely used within this Basin, most likely because these programs' focus is on crop types and large-scale agriculture operations that are not typical of the Basin. Elected officials from the Delaware Basin represent areas with diverse economies that do not depend heavily on resource extraction and so they have little focus or influence on such programs. A regionally appropriate conservation agenda for rural areas, for instance, would focus on conserving forests, according to several respondents to the surveys and interviews in this study. The ability of legislators to advocate for programs tailored to the Basin is also limited, because while the Delaware River Basin is large from an eastern perspective, it is a very small percentage of the nation. Few federal programs are deliberately focused on the Basin or a portion of it, with the exception of the Highland Conservation Act. However, a small increase in the national share of federal funding that is spent in the Delaware River Basin could represent a significant increase in total Basin funds.

State Agency Funding

State government funding programs reported for the Delaware River Basin are shown in **Table 11** for all four states. Direct state funds (not including federal pass-through funds) came primarily from environmental, infrastructure and agriculture agencies. As discussed previously, many of these state expenditures are in the form of grants to other entities.

County, Municipal and Water Utility Expenditures

County and municipal governments provided significant funding for projects, especially for land preservation (agricultural and open space) and municipal water infrastructure. However, water utilities were the largest local government funding sources, primarily for water infrastructure (primarily upgrades to collection systems and treatment plants), as shown in **Table 12**. Water infrastructure (e.g., stormwater, wastewater collection, wastewater treatment) was the target of 83% of all local government funding; land preservation funding was only 16.3% of the total funding from this sector. Lake, wetland and unknown projects have been grouped, as they are minor expenditure categories.

However, all three government categories had high levels of expenditures, reflecting a net increase of expenditures over funding of \$1.2 billion, as shown in **Table 13**. Land preservation totals 27.1% of all reported expenditures by these entities, significantly higher than their funding. Water utility expenditures, however, constitute a lower percentage of expenditures (70.5%), though still a higher overall expenditure. Clearly, funds are moving from higher levels of government to counties, municipalities and water utilities. The conclusion is that they have been very successful in matching local funds (e.g., property taxes, bonds) with funding from higher levels of government and from non-governmental organizations. Although some counties and municipalities did report that they had no relevant expenditures, the expectation is that both county-funded and municipal-funded expenditures during this period were significantly higher than shown in the database. The shortfall in reporting from municipalities, and from counties to a lesser extent, is a major challenge for database development.

Federal Agency	Program	2014	2015	2016	2017	2018	2019	2020	2021	2022	Grand Total
US Dept of Agriculture: US Forest Service	Forest Legacy Program	\$4,026,164		\$414,200				\$8,028,000			\$12,468,364
US Dept of Agriculture: Natural Resources Conservation Service		\$5,429,804	\$5,712,499	\$9,736,613	\$11,223,580	\$13,040,339	\$13,062,277	\$9,906,389	\$9,032,722	\$12,977,442	\$90,121,664
US Dept of Commerce: NOAA - Office for Coastal Management	Coastal Zone Management Program	\$517,000	\$595,087	\$170,476	\$599,998	\$451,542	\$462,250				\$2,796,353
US Dept of Defense: Army Corps of Engineers: Philadelphia District	Regional Watershed Improvement Project	\$985,769	\$82,331	\$151,930	\$182,926	\$63,648	\$194,154				\$1,660,758
US Dept of Interior: US Fish & Wildlife Service	Endangered Species				\$4,181,600						\$4,181,600
US Dept of Interior: US Fish & Wildlife Service	National Coastal Wetland Conservation		\$2,288,159	\$700,000	\$2,380,950	\$2,494,675					\$7,863,784
US Dept of Interior, US Fish & Wildlife Service	Other Programs	\$203,347	\$8,386	\$392,500	\$299,281	\$504,768	\$3,997,854	\$132,353			\$5,538,489
US Environmental Protection Agency: Region 3		\$340,000	\$5,660,340	\$16,524,520	\$3,490,750	\$35,784,400	\$12,780,950	\$221,995	\$36,898,940	\$13,872,008	\$125,573,903
Totals		\$11,502,083	\$14,346,802	\$28,090,239	\$22,359,085	\$52,339,372	\$30,497,485	\$18,288,737	\$45,931,662	\$26,849,450	\$250,204,915

State Agency	Program	2014	2015	2016	2017	2018	2019	2020	2021	2022	Grand Total
State of Delaware											
Dept. of Agriculture	Aglands Preservation and Planning	\$1,410,093		\$2,727,232	\$3,935,329	\$4,432,629	\$5,485,747	\$8,468,814	\$6,070,498	\$9,235,685	\$41,766,027
Dept. of Natural Resources and Environmental Control: Watershed Stewardship:	Non-Point Source Program	\$738,689	\$681,697	\$695,554	\$963,046	\$764,366	\$782,510	\$1,588,711	\$1,053,698		\$7,268,270
Dept. of Natural Resources and Environmental Control	Division of Parks and Recreation	\$2,518,513	\$2,845,526	\$4,823,640	\$1,402,330	\$2,995,000	\$9,844,490				\$24,429,499
Dept. of Natural Resources and Environmental Control	Division of Watershed Stewardship		\$831,238				\$43,373	\$117,505			\$992,116
Dept. of Transportation		\$2,542,806	\$5,025,367	\$4,816,440	\$6,145,453	\$6,486,754	\$10,711,244	\$11,385,961	\$13,607,252	\$10,563,817	\$71,285,094

Table 11: State Agency Reported Funding											
State Agency	Program	2014	2015	2016	2017	2018	2019	2020	2021	2022	Grand Total
State of New Jersey											
Dept. of Agriculture	Agricultural and Natural Resources				\$130,013	\$23,779	\$10,000	\$84,425	\$281,469	\$315,915	\$845,601
State Agriculture Development Committee	Farmland Preservation		\$756,218		\$386,173	\$20,471,039	\$25,780,685	\$5,350,222	\$13,896,020	\$24,381,254	\$91,021,611
Dept. of Environmental Protection	Green Acres Program	\$22,140,375	\$19,630,657	\$24,069,188	\$13,529,483	\$15,591,789	\$9,921,707	\$20,378,042	\$9,164,588	\$5,154,199	\$139,580,028
Dept. of Environmental Protection	Natural Resource Restoration	\$300,000	\$21,650	\$5,300,000		\$7,100,000	\$47,510,683		\$62,178		\$60,294,511
Dept. of Environmental Protection	319h NPS program	\$1,954,868	\$676,864	\$2,002,500	\$2,093,710			\$563,577	\$70,000		\$7,361,519
NJ Infrastructure Bank	Water Bank	\$3,409,590	\$3,086,319	\$2,191,338	\$3,000,170	\$7,655,250	\$8,645,750	\$50,443,110	\$73,087,547	\$59,405,955	\$210,925,029
Highlands Water Protection & Planning Council	Land Acquisition				\$1,200,000	\$8,778,612	\$1,906,363	\$2,403,862			\$14,288,837
Lake Hopatcong Commission									\$489,378		\$489,378
State of New York											
Dept. of Agriculture and Markets	Ag NPS Program		\$12,500	\$7,581					\$1,123,345		\$1,143,426
Dept. of Environmental Conservation	Division of Water		\$1,162,123		\$1,181,195	\$4,881,860	\$109,264		\$3,403,670		\$10,738,112
Environmental Facilities Corporation				\$15,928,900			\$14,318,560		\$7,430,000	\$10,593,160	\$48,270,620
Homes and Community Renewal									\$3,459,350		\$3,459,350
State of Pennsylvania											
Dept. of Agriculture		\$32,076,190	\$30,096,187	\$29,226,357	\$35,076,651	\$35,873,777	\$37,466,180			\$199,815,342	\$32,076,190
Dept. of Conservation and Natural Resources (DCNR)		\$175,000	\$245,000	\$75,000	\$1,000,000	\$1,170,600	\$268,062	\$6,882,048	\$4,750		\$9,820,460
State of Pennsylvania Dept. of Transportation										\$4,600,000	\$4,600,000
PennVest		\$2,794,197	\$6,285,503	\$2,099,550	\$5,706,728	\$11,594,451	\$3,375,561	\$129,812,043	\$34,489,740		\$196,157,773
Dept. of Environmental Protection (PADEP)		\$2,013,131	\$3,538,304	\$1,888,166							\$7,439,601
Dept. of Conservation and Natural Resources (DCNR)	Bureau of Forestry	\$22,483,914	\$4,207,000	\$1,185,000	\$1,932,700	\$4,908,350	\$4,489,500	\$1,311,800	\$3,170,210		\$43,688,474
Totals		\$92,577,363	\$78,232,323	\$102,886,740	\$78,480,107	\$134,320,659	\$143,203,499	\$238,790,120	\$170,863,693	\$324,065,327	\$1,027,941,526

Funding	Agricultural BMPs	Open Space Preservation	Agricultural Preservation	Restoration*	Stormwater – Green	Stormwater – Traditional	Collection Systems	WWTP Upgrades	Grand Total	% of Total
County	\$7,350,176	\$111,982,906	\$189,588,827	\$3,102,370	\$2,415,036	\$10,591,921	\$82,764,323	\$2,469,156	\$410,264,716	16.1%
Municipal	\$1,217	\$97,533,474	\$16,279,330	\$4,477,993	\$3,690,470	\$5,750,827	\$23,835,263	\$182,270,000	\$333,838,574	13.1%
Water Utility				\$155,124	\$97,604,807		\$1,109,260,240	\$592,912,500	\$1,799,932,671	70.8%
Totals	\$7,351,393	\$209,516,379	\$205,868,157	\$7,735,487	\$103,710,314	\$16,342,748	\$1,215,859,826	\$777,651,656	\$2,544,035,961	100.0%
% of Totals	0.3%	8.2%	8.1%	0.3%	4.1%	0.6%	47.8%	30.6%	100.0%	

Expenditures	Agricultural BMPs	Open Space Preservation	Agricultural Preservation	Restoration*	Stormwater – Green	Stormwater – Traditional	Collection Systems	WWTP Upgrades	Grand Total	% of Total
County	\$24,447,957	\$146,099,615	\$439,560,737	\$11,094,541	\$12,039,992	\$14,428,354	\$127,482,611	\$29,614,350	\$804,768,157	21.5%
Municipal	\$1,325,801	\$336,528,235	\$88,371,642	\$28,683,107	\$131,519,721	\$29,385,105	\$113,824,548	\$312,219,740	\$1,041,857,900	27.9%
Water Utility		\$2,461,365		\$24,501,120	\$16,088,814	\$37,333,140	\$1,194,745,461	\$614,335,970	\$1,889,465,870	50.6%
Totals	\$25,773,758	\$485,089,216	\$527,932,379	\$64,278,768	\$159,648,527	\$81,146,599	\$1,436,052,620	\$956,170,060	\$3,736,091,926	100.0%
% of Totals	0.7%	13.0%	14.1%	1.7%	4.3%	2.2%	38.4%	25.6%	100.0%	

*Lake, Stream, Wetlands and Multi-target restoration projects

Geographic Analysis of Expenditures

As part of the Phase 2 process, considerable effort was directed toward improving the geographic location of expenditures. Ideally, expenditures would be geo-located by HUC12 drainage area (i.e., watershed), municipality and county. However, in practice that proved very difficult. Some agencies (e.g., USDA-NRCS) were only able to provide HUC12 locations, while others could only provide municipal or county identifiers. **Table 14** shows the relationship between project categories and the availability of locational attributes, in terms of the percentage of expenditures with each geographic identifier.

The GIS analysis used the HUC12 level if the percentage of missing expenditures was lower than or similar to the municipal level. If not, municipal locations were used if the percentage of missing expenditures was lower than or similar to the county level. Only if the first two tests failed would GIS analyses be conducted at the county level. However, only the Agricultural BMP expenditure category had sufficient HUC12 geographic locations for use in the GIS analysis. In all other expenditure categories, sufficient municipal-level data were available for GIS analysis.

Table 14: Geographic Location Information by Project Expenditure Category			
AGBMP Total	\$150,648,517		
Status	County	Municipality	HUC12
Missing	\$86,508,179	\$144,580,979	\$46,173,159
Available	\$64,140,338	\$6,067,538	\$104,475,358
% missing	57.42%	95.97%	30.65%
COLLSYST Total	\$1,610,376,152		
Status	County	Municipality	HUC12
Missing	\$44,356	\$166,550,732	\$1,398,645,703
Available	\$1,610,331,796	\$1,443,825,420	\$211,730,449
% missing	0.00%	10.34%	86.85%
LAKE Total	\$25,202,048		
Status	County	Municipality	HUC12
Missing	\$0	\$689,577	\$4,338,848
Available	\$25,202,048	\$24,512,471	\$20,863,200
% missing	0.00%	2.74%	17.22%
PRESRV Total	\$555,931,521		
Status	County	Municipality	HUC12
Missing	\$14,426,627	\$94,516,667	\$544,071,111
Available	\$541,504,894	\$461,414,855	\$11,860,411
% missing	2.60%	17.00%	97.87%
PRESRV_AG Total	\$608,946,785		
Status	County	Municipality	HUC12
Missing	\$245,595	\$286,617,431	\$570,045,934
Available	\$608,701,190	\$322,329,354	\$38,900,851
% missing	0.04%	47.07%	93.61%

Table 14: Geographic Location Information by Project Expenditure Category			
STREAM Total	\$79,761,871		
Status	County	Municipality	HUC12
Missing	\$7,387,801	\$28,694,095	\$74,652,626
Available	\$72,374,070	\$51,067,775	\$5,109,245
% missing	9.26%	35.97%	93.59%
SWGREN Total	\$187,842,573		
Status	County	Municipality	HUC12
Missing	\$2,294,159	\$116,073,427	\$87,483,504
Available	\$185,548,414	\$71,769,146	\$100,359,069
% missing	1.22%	61.79%	46.57%
SWTRAD Total	\$84,363,447		
Status	County	Municipality	HUC12
Missing	\$35,389	\$28,717,506	\$72,266,654
Available	\$84,328,058	\$55,645,941	\$12,096,793
% missing	0.04%	34.04%	85.66%
WETLAND Total	\$6,855,275		
Status	County	Municipality	HUC12
Missing	\$639,952	\$4,504,714	\$6,192,921
Available	\$6,215,323	\$2,350,561	\$662,354
% missing	9.34%	65.71%	90.34%
WWTPUP Total	\$968,402,346		
Status	County	Municipality	HUC12
Missing	\$11,594,000	\$211,928,500	\$919,514,526
Available	\$956,808,346	\$756,473,846	\$48,887,820
% missing	1.20%	21.88%	94.95%

Geographic and Equity Analyses

No agency or entity has presented a clear statement of water resources equity applicable to the Delaware River Basin. Without a target, analysis of (and planning for) equity is difficult. In addition to collecting data on governmental and related expenditures on water quality protection and improvement in the Delaware River Basin, the Rutgers team developed an approach for assessing the equity of governmental expenditures for individual expenditure categories. The team also tested several approaches for assessing the equity of overall expenditures. The full methodology is in [Appendix B](#).

The process begins with a simple analysis of expenditures by geographic identifier. In some cases, statistical analyses were feasible at the municipal level, but in several cases availability of data required statistical analysis at the county level even though mapping may have been at the municipal level. For some expenditure categories, the expenditures were so limited that statistical analyses were not appropriate. Results include total expenditures per geographic area and normalized expenditures (e.g., agricultural BMPs relative to agricultural areas; collection system expenditures relative to population). These results are then used in the next step.

To assess equity in water resources expenditure, we need to define “equitable outcomes” in the context of this project and the Delaware River Basin (e.g., clean water, water access, drinking water supplies, recreational use, ecological benefits). Individual programs may be equitable within their context and statutory requirements, and yet when combined with all other relevant programs be inequitable regarding water resources outcomes. Given the nature of this project, our primary focus is on distributional equity (i.e., fair allocation of resources, risks, harms and benefits) (Seigerman et al., 2022)⁹ with an opportunity to address some of the procedural and recognition elements of equity in a qualitative manner through the interviews.

Because each expenditure category has a specific purpose, it is relatively straightforward to determine environmental metrics against which to compare funding and expenditures. More difficult is equity analysis, regarding aggregated expenditures. Because each program was created for specific purposes, there is no reason to expect that any policy maker considered or intended that aggregate watershed expenditures would have a relationship to equity. If aggregate expenditures are equitable, it is likely to be serendipitous rather than intentional. Additional issues arise, as discussed in [Appendix B](#), regarding what level of government funds expenditures (e.g., grants from higher governmental levels versus local taxpayers and ratepayers), appropriate socio-economic metrics to use in the analysis, and available geographic referents for expenditure data.

For these reasons, the Rutgers team decided to focus on a limited number of socio-economic metrics that each provide one perspective on a broader story. Comparison of these results may show equity issues that any one metric might not show. Multivariate analysis will be considered to see whether the indicators can be evaluated together or must be addressed separately. The selected indicators are:

- **BIPOC populations** (i.e., all racial/ethnic groups other than White/non-Hispanic): This metric provides a sense of whether areas with a higher percentage BIPOC populations receive equitable funding.
- **Gini coefficient**: This metric provides a sense of whether areas with high income inequality receive equitable funding compared to those with low inequality. It has a scale of 0 to 1, with higher values indicating higher inequality. For comparison, the Gini coefficient for the United States was 0.398 in 2021 (St. Louis Federal Reserve Bank).
- **Median household income**: This metric provides a broad sense of expenditures relative to income.
- **Median household income (HHI) compared to Basin median HHI**: This metric provides a sense of high and low county or municipal median HHI relative to the basin median.
- **Total household income**: This metric is the median household income multiplied by total population, representing a rough metric for expenditures relative to financial capacity. It recognizes that areas of equal median household income may have different populations.

⁹ Seigerman, Cydney K., S. Kyle McKay, Raul Basilio, Shelly A. Biesel, Jon Hallemeier, Andressa V. Mansur, Candice Piercy, et al. 2022. “Operationalizing equity for integrated water resources management.” *Journal of the American Water Resources Association* 00(0): 1–18. <https://doi.org/10.1111/1752-1688.13086>.

Assessing Equity: Approach by Expenditure Category

This section provides a descriptive approach for assessing the distributional equity of governmental expenditures for each expenditure category, using statistical approaches.¹⁰ In general, there are two approaches. One focuses on the geographic distribution of expenditures relative to the specific issue being addressed. For example, it is expected that agricultural BMP funds will be spent in agricultural areas, with greater expenditures going to areas with more acres of agricultural lands. The analysis tests whether that expectation is met. The National Land Cover Data coverage will be a primary source of geographic information on prevalence of agricultural, forested, wetlands, lake acreages and urbanized lands, and the National Hydrography Dataset for stream miles.

The second approach uses statistics to evaluate the geographic distributions of categorical expenditures relative to certain social and economic metrics such as income and race/ethnicity. For example, are agricultural preservation funds only being spent in rural areas with high percentages of White-Non-Hispanic populations, or are equivalent funds being spent in areas with high BIPOC populations, such as urban areas to create urban farms? The American Community Survey is a primary source of information on demographic information.

Our equity analysis of expenditure data in the Delaware River Basin used two different methodologies, given that different levels of data were available for the distinct project categories. Both methodologies involved measuring total expenditures and dollars per person against key equity metrics (BIPOC Population, Gini Index, Median Household Income, Total Household Income). However, different forms of analysis were used for the most data-rich geographic unit for each expenditure category (i.e., county-level vs municipal-level). At the county level, we used simple pairwise correlation analysis given the smaller size of the sample for counties versus municipalities (N=842 municipalities vs N=44 counties), while at the municipal level we used linear regression analysis.

The county level correlation analysis includes the total expenditure for all expenditure categories as well as individual analyses for the following expenditure categories: agricultural open space preservation, green stormwater management, traditional stormwater management and wastewater treatment plant upgrades. The municipal level regression analysis we conducted includes expenditures for sewer collection system upgrades and open space preservation.

The mapped outputs are shown in [Appendix E](#). The following discussion includes the more interesting maps and the statistical analyses.

Total Expenditures (All Categories)

Total expenditures (all categories) at the county level have a significant positive correlation to BIPOC population, Gini Index, and total household income. For dollars per person, there is a positive correlation with BIPOC population. This means that counties with higher BIPOC populations and greater total wealth (but not necessarily greater median household income) have higher expenditures; this makes sense given that wastewater and green stormwater expenditures comprise a high percentage of total expenditures and much of the infrastructure expenditures are concentrated in the Philadelphia/Camden metro area.

¹⁰ Note that the MULTI (Multiple Categories) category is not assessed in this section.

Table 15: Total Expenditures (All Categories) By County		
Correlations for Total Expenditures		
Metric	Correlation	Significance
BIPOC Population	0.9269	0.0000***
Gini Index	0.3168	0.0385*
Median Household Income	-0.1434	0.3589
Total Household Income	0.4204	0.0050**
Correlations for Total Expenditures per 1000 People		
Metric	Correlation	Significance
BIPOC Population	0.5151	0.0004***
Gini Index	0.1571	0.3143
Median Household Income	0.0534	0.7336
Total Household Income	0.1273	0.4159

Land Preservation

Preservation-Open Space

Open space preservation is one of the largest expenditure categories in the project. Preservation projects are by their nature adventitious – they happen when a combination of project sponsor, land owner and funding come together for a purchase. Therefore, they are sporadic and geographically haphazard year by year. Only over longer periods do patterns become available. Ideally, this analysis would compare preservation expenditures to the acreage of non-developed, non-agricultural, non-preserved lands as of 2014, to avoid analytical problems such as low expenditures in a municipality where there are no available lands to purchase, or high expenditures because pre-2014 conditions had large areas of unpreserved forests. However, such an analysis is not feasible at this time across four states with very different baseline data. Therefore, a broader metric is required. Nearly all open space preservation projects were identified by municipality and county (17% and 2.6% missing, respectively); HUC12 identifiers are rarely available. Therefore, municipalities are the level of analysis.

- Issue Focus:** This analysis compares the total expenditures for open space preservation to the acreage of non-agricultural, non-developed lands (e.g., forests, wetlands, meadows), for each municipality. The primary metric is therefore dollars per open space acre; total dollars per municipality and dollars per person per municipality are used as secondary metrics. The question is whether the results for these metrics are nearly equal or far different among the municipalities. Some municipalities may have no non-agricultural, non-developed lands, providing a null answer, and yet may have expenditures that create new parks in urbanized areas; these new parks are highly likely to be for active recreation, and therefore the analysis will focus on areas that do have non-agricultural, non-developed lands.
- Socioeconomic Focus:** This analysis uses the Issue metrics and compares them at the municipal level to multiple socio-economic metrics drawn from Census information: population density, median household income, total household income, Gini coefficient and percent BIPOC

populations. While measuring expenditures relative to unpreserved open space would provide a better metric,¹¹ that was not feasible with existing databases.

- **Results: Figure E2** shows the municipal results for total expenditures relative to acres of forests and wetlands. The results show a concentration of expenditures in municipalities along the Delaware River itself, in the area of the New York City reservoirs in New York State, along the Schuylkill River in Pennsylvania, and in the Cohansey Aquifer/Delaware Bayshore area of New Jersey. The statistical regression analysis of open space preservation expenditures used municipal level data. The only significant predictor of total expenditures in our model is median household income which correlates positively to total expenditures for open space preservation. BIPOC population, total household income and Gini Index are not significant predictors of these expenditures. In both instances, the models evaluating account dollars spent per person did not yield significant results.

Table 16a: Open Space Preservation Expenditures by Municipality				
Regression for Total PRESRV Expenditures				
Metric	Coefficient	Std Error	t	Significance
BIPOC Population	13.00458	16.83163	0.77	0.440
Gini Index	2631325	2482617	1.06	0.289
Median Household Income***	18.34553	4.836523	3.79	0.000
Total Household Income	-.0001844	.0003484	-0.53	0.597
Constant	-1979356	1107240	-1.79	0.074

F= 4.71 Prob>F= 0.0009 R-Square= 0.0220

Table 16b: Open Space Preservation Expenditures by Municipality				
Regression for Total PRESRV Expenditures Dollars per 1000 People				
Metric	Coefficient	Std Error	t	Significance
BIPOC Population	4.736974	4.77977	0.99	0.322
Gini Index	-110862.8	705002.3	-0.16	0.875
Median Household Income	.0653969	1.373454	0.05	0.962
Total Household Income	-.0001086	.0000989	-1.10	0.272
Constant	249450.1	314429	0.79	0.428

F= 0.44 Prob>F= 0.7782 R-Square= 0.0021

Preservation-Agriculture

Farmland preservation is another of the largest expenditure categories in the project. These projects have the same characteristics as open space preservation projects, just focused on a different land use. Ideally, this analysis would compare preservation expenditures to the acreage of non-preserved agricultural lands as of 2014, for the same reasons as for open space. However, such an analysis is not

¹¹ USGS. Protected Areas Database of the United States (PAD-US) 3.0 Spatial Analysis and Statistics. <https://www.usgs.gov/data/protected-areas-database-united-states-pad-us-30-spatial-analysis-and-statistics>. Also, data from the four states could be used to augment this information.

feasible at this time across four states with very different baseline data. Therefore, a broader metric is required, using total farmland. Nearly all farmland preservation projects were identified by county at least, most by municipality (29% missing), and few by HUC12 area (98% missing). Therefore, the municipality was used as the basis for mapping, and county for statistical analysis.

- Issue Focus:** This analysis compares the total expenditures for farmland preservation to the total acreage of farmland, for each municipality. The primary metric for mapping is therefore dollars per farmland acre per municipality, with a secondary metric of total dollars per municipality. Some municipalities may have no farmland areas, providing a null answer, and yet may have expenditures that create urban agriculture areas; the analysis focuses on areas that do have farmland, but the database will include expenditures in urbanized areas that lack mapped farmland.
- Socioeconomic Focus:** The primary metric used for statistical analysis is dollars per farmland acre county, with a secondary metric of dollars per person per county. The question is whether the results for these metrics are nearly equal or far different among the counties. This analysis uses the Issue metrics and compares them at the municipal level to multiple socio-economic metrics drawn from Census information: population density, median household income, total household income, Gini coefficient and percent BIPOC populations.
- Results:** **Figure E-4** shows the municipal results for total expenditures relative to acres of agricultural land. The patterns are similar in some ways to open space preservation, with a focus on the Delaware River, Delaware Bayshore in New Jersey, and Schuylkill River basin in Pennsylvania, but there is no activity in New York State and little in Delaware State. Expenditures for total county agricultural open space preservation have a significant positive correlation with median household income, meaning that this funding tends to correspond to less populous counties with a higher median income, which also tend to be rural as shown in the maps. In this instance, no correlation with dollars per person proved to be significant.

Table 17: Agricultural Preservation Expenditures by County		
Correlations for Total PRESRV_AG Expenditures		
Metric	Correlation	Significance
BIPOC Population	-0.0711	0.6546
Gini Index	-0.2205	0.1605
Median Household Income	0.4160	0.0061**
Total Household Income	0.0257	0.8718
Correlations for Total PRESRV_AG Expenditures per 1000 People		
Metric	Correlation	Significance
BIPOC Population	-0.1522	0.3298
Gini Index	-0.2129	0.1704
Median Household Income	0.2066	0.1838
Total Household Income	-0.1953	0.2095

Ecological and Farmland Restoration

Agricultural Best Management Practices (BMPs)

Nearly all Agricultural BMP expenditures were provided by the USDA Natural Resources Conservation Service. Due to concerns about recipient privacy, all data were provided by HUC12 drainage area, representing many thousands of projects over the 2014-2022 period. No municipal or county identifiers were provided, and so all analyses must be at the HUC12 level. Both preserved and non-preserved farms are eligible for support under the federal Farm Bill programs. A major advantage for this category is that the large number of farms, small project sizes and annual funding provide a robust database that doesn't vary significantly from year to year.

- **Issue Focus:** This analysis compares the total expenditures for Agricultural BMPs to the acreage of agricultural land, for each HUC12 drainage area. The primary metric for mapping is therefore dollars per farmland acre per HUC12; dollars per HUC12 is used as a secondary metric.
- **Socioeconomic Focus:** Given the nature of this expenditure category, a socioeconomic focus on equity is not expected to yield relevant results.
- **Results:** **Figure E-7** show the municipal results for total expenditures relative to acres of agricultural land. Unlike agricultural preservation, BMP expenditures are widely distributed around the Basin, though more concentrated in the lower Basin.

Lake Restoration

Lake restoration is the smallest expenditure category, perhaps in part because most lakes in the Delaware River Basin are small, with Lake Wallenpaupack (PA) and Lake Hopatcong (NJ) being major exceptions, and many others are private lakes where government funding is not available. Compared to the number of stream miles or sanitary sewer and stormwater lines, there are far fewer potential project areas. In this case, most expenditures were identified by the target lake, allowing for analysis by municipality and county. Nearly all projects have a municipal identifier (3% missing) while 18% lack HUC12 identifiers (all have county identifiers). Therefore, municipalities are used in the mapping.

- **Issue Focus:** This analysis compares the total expenditures for lake restoration to the lake acreage, for each municipality. The primary metric is therefore dollars per lake acre per municipality; dollars per municipality is used as a secondary metric. The question is whether the results for these metrics are nearly equal or far different among the municipalities. Most municipalities will not have any lakes, resulting in a null response to this question.
- **Socioeconomic Focus:** Given the limited projects and total expenditures of this category, a socioeconomic focus on equity is not expected to yield relevant results.
- **Results:** Very few lake restoration expenditures were reported and therefore no statistical analysis is feasible.

Stream Restoration

Stream restoration projects are much less common than land preservation projects, but they are more common than lakes or wetlands restoration projects. Mapping of stream miles is robust, allowing an analysis of stream miles by any geographic area. Because many streams suffer from hydrologic disturbance, resulting in stream bank and bed erosion, using total stream miles is acceptable. A more detailed metric could be stream miles that are listed as impaired (Section 303(d) in each state's Water

Quality Inventory Report), but the states do not necessarily identify the physically impaired stream miles, which would be the focus of this analysis. Most projects were identified by county (9% missing), with fewer by municipality (36% missing) and few by HUC12 area (94% missing); the municipality was selected as the most useful geographic area for mapping.

- **Issue Focus:** This analysis compares the total expenditures for stream restoration to the total stream miles from the National Hydrography Dataset, for each municipality. The primary metric for mapping is therefore dollars per stream mile per municipality; the secondary metric is total dollars per municipality.
- **Socioeconomic Focus:** Given the limited projects and total expenditures of this category, a socioeconomic focus on equity is not expected to yield relevant results.
- **Results:** Some lake restoration expenditures were reported, focused in Philadelphia and a few other areas (see **Figure E-10**, showing expenditures per stream mile by municipality). No statistical analysis is feasible.

Wetlands Restoration

Wetland restoration projects (other than those for mitigation of development activities) are uncommon, similar to lake restoration projects. Most project expenditures have been identified by county (9% missing), with fewer by HUC12 area and municipality (90% and 66% missing, respectively). Given the small expenditures involved, the county level is used for mapping.

- **Issue Focus:** This analysis compares the total expenditures for wetlands restoration to the total wetland acreage, for each county. The primary metric for mapping is therefore dollars per wetlands acre per county; total dollars per county is the secondary metric.
- **Socioeconomic Focus:** Given the limited projects and total expenditures of this category, a socioeconomic focus on equity is not expected to yield relevant results.
- **Results:** Very few wetlands restoration expenditures were reported, mostly with only county identifiers, and therefore no statistical analysis is feasible.

Water Infrastructure

SWGREN: Stormwater Management-Green

Regulatory requirements for municipal separate storm sewer systems (MS4s) and combined sewer systems are prompting increased interest in green stormwater infrastructure to mitigate the damages caused by excessive and polluted stormwater discharges. Expenditures are roughly equivalent to those for stream restoration. Nearly all projects have been identified by county (1% missing), while HUC12 identifiers are missing for 46% of expenditures and municipality identifiers are missing for 62% of expenditures. The mapping used municipal identifiers. While it would be preferable to use municipalities (the primary entity for stormwater management) for statistical analysis, this was not feasible and therefore county identifiers were used.

- **Issue Focus:** This analysis compares the total expenditures for green stormwater infrastructure projects to the urbanized acreage (e.g., residential, commercial, industrial, transportation land uses), for each geographic area. The primary metrics for mapping are therefore dollars per developed acre per municipality; the secondary metric is total dollars per municipality.

- **Socioeconomic Focus:** This analysis uses the Issue metrics and compares them at the county level to multiple socio-economic metrics drawn from Census information: population density, median household income, total household income, Gini coefficient and percent BIPOC populations. The question is whether the results for these metrics are nearly equal or far different among the counties.
- **Results:** Figure E-15 shows expenditures relative to acre of developed land, by municipality. Nearly all reported expenditure were in the Philadelphia area. Total county expenditures for green stormwater management infrastructure correlate positively and significantly to BIPOC population, Gini Index, and total household income. These correlations are also significant for dollars spent on green stormwater management per person. Expenditures correspond to counties with high total populations (and therefore total household income), high BIPOC population and higher levels of inequality, reinforcing that most expenditures for this expenditure category are concentrated around Philadelphia and Camden.

Table 18: Green Stormwater Infrastructure Expenditures by County		
Correlations for Total SWGREEN Expenditures		
Metric	Correlation	Significance
BIPOC Population	0.8755	0.0000****
Gini Index	0.3852	0.0107 *
Median Household Income	-0.0743	0.6357
Total Household Income	0.5660	0.0001***
Correlations for Total SWGREEN Expenditures per 1000 People		
Metric	Correlation	Significance
BIPOC Population	0.5278	0.0003***
Gini Index	0.2825	0.0664
Median Household Income	-0.1153	0.4617
Total Household Income	0.3341	0.0286*

SWTRAD: Stormwater Management-Traditional

Most developed areas have traditional (gray) stormwater infrastructure, and most of that predates modern design standards. In addition, much of the existing infrastructure is aging and experiencing rainfall patterns that are more severe than the systems were designed to manage. For this reason, gray stormwater infrastructure projects are becoming more necessary. Expenditures are slightly higher than for green stormwater infrastructure. Essentially all projects have been identified by county, with more missing expenditures at the municipality and HUC12 level (34% and 86% missing, respectively).

- **Issue Focus:** As municipalities are primarily responsible for traditional stormwater infrastructure, this level is used for mapping. This analysis compares the total expenditures for gray stormwater infrastructure projects to the urbanized acreage (e.g., residential, commercial, industrial, transportation land uses), for each municipality. The primary metric is therefore dollars per developed acre per municipality; total dollars per municipality is also assessed.
- **Socioeconomic Focus:** Given the limited projects and total expenditures of this category, a socioeconomic focus on equity is not expected to yield relevant results.

- **Results:** Figure E-17 shows expenditures relative to acre of developed land, by municipality. Unlike green stormwater infrastructure, which was highly concentrated in Philadelphia, traditional stormwater expenditures were reported outside the Philadelphia area. A regression analysis indicated no significant results regarding expenditures relative to the socioeconomic metrics. There is no variable with a p-value smaller than 0.05.

Sewer Collection System Upgrades

Data on sewer collection system upgrades were provided by the four state revolving fund programs and by local wastewater utilities. By their nature, sewer collection systems are associated with developed areas, and primarily suburban and urban development. Due to the long economic lifespan of these collection systems, projects tend to be more sporadic than agricultural BMPs. While annual funding is relatively constant statewide, each sewer system may have very different expenditures from year to year. Essentially all project expenditures have county identifiers, and most have municipality identifiers (10% missing); however, nearly all expenditures lack HUC12 identifiers (86% missing). In one case, Philadelphia, the municipality is also the county; no information was available to assign the results to a smaller geographic area within the city. The municipal level is used for analysis.

- **Issue Focus:** This analysis compares the total expenditures for sewer collection system upgrades to the urbanized acreage (e.g., residential, commercial, industrial, transportation land uses), for each municipality. The primary metric is therefore dollars per developed acre per municipality; dollars per person and total expenditures per municipality are secondary metrics.
- **Socioeconomic Focus:** This analysis uses the Issue metrics and compares them at the municipal level to multiple socio-economic metrics drawn from Census information: population density, median household income, total household income, Gini coefficient and percent BIPOC populations. These metrics are readily calculated at the municipal level. The question is whether the results for these metrics are nearly equal or far different among the municipalities.
- **Results:** Figure E-19 shows expenditures relative to acre of developed land, by municipality. Two areas of concentrated expenditures are shown, the Philadelphia area and a portion of New York State, with a scattering of other locations. For sewer collection systems at the municipal level, a linear regression model shows that BIPOC population is the most heavily weighted predictor of total expenditures per municipality, correlating positively in this regard at the municipal level. Likewise, within the model Gini index is negatively correlated to total expenditures. Household income variables are not significant in the model.

Table 19a: Wastewater Collection System Upgrade Expenditures by Municipality				
Regression for Total COLLSYST Expenditures				
Metric	Coefficient	Std Error	t	Significance
BIPOC Population***	1025.827	33.55392	30.57	0.000
Gini Index***	-2.02e+07	4949106	-4.08	0.000
Median Household Income	14.4505	9.641625	1.50	0.134
Total Household Income	-.0001544	.0006945	-0.22	0.824
Constant	4675257	2207287	2.12	0.034

F= 5170.66

Prob>F= 0.0000

R-Square= 0.9611

Table 19b: Wastewater Collection System Upgrade Expenditures by Municipality				
Regression for Total COLLSYST Expenditures Dollars per 1000 People				
Metric	Coefficient	Std Error	t	Significance
BIPOC Population	1.022075	2.349408	0.44	0.664
Gini Index	106130.4	346530.8	0.31	0.759
Median Household Income	-.1994026	.6750956	-0.30	0.768
Total Household Income	-9.02e-06	.0000486	-0.19	0.853
Constant	3554.827	154551.8	0.02	0.982

F= 0.47 Prob>F= 0.7556 R-Square= 0.0023

WWTPUP: Wastewater Treatment Plant Upgrades

By their nature, wastewater treatment plants serve areas of urbanized land, with larger treatment plants in the most urbanized areas where intense development or regionalization provide a financial basis for such facilities. Upgrades of existing wastewater treatment plants generally occur in response to regulatory mandates, such as increasing capacity to address combined sewer flows or meeting water quality-based effluent limits. Such projects rarely happen for any single utility, but they involve large expenditures when they do occur. The data show order-of-magnitude differences in basin-wide expenditures from year to year. As such, an equity analysis is difficult except over long periods. Essentially all project expenditures have been identified by county (1% missing), but many are missing information for municipality (22%) and almost none have HUC12 identifiers (95% missing). Therefore, the county level is used for analysis.

- **Issue Focus:** This analysis compares the total expenditures for wastewater treatment plant upgrade projects to the urbanized acreage (e.g., residential, commercial, industrial, transportation land uses), for each county. The primary metric is therefore dollars per developed acre by county; a secondary metric is total dollars per county.
- **Socioeconomic Focus:** This analysis uses the Issue metrics and compares them at the county level to multiple socio-economic metrics drawn from Census information: population density, median household income, total household income, Gini coefficient and percent BIPOC populations. The question is whether the results for this metric are nearly equal or far different among the counties.
- **Results:** **Figure E-22** shows expenditures relative to acre of developed land, by county in this case due to the lack of municipal identifiers (22% missing). Reported expenditures were in the Philadelphia/Camden area, Kent County Delaware, and the Reading area of Pennsylvania. No significant results were found for wastewater treatment plant upgrades.

Comparison of Aggregate Expenditures to General Government Capacity

As discussed in the Methodology section, government capacity to implement programs is not readily assessed. One option is to assess the relative share of expenditures against the relative wealth or lack of wealth in a county. **Table 20** provides an overview of these metrics. For each metric other than BIPOC population, a box in pink indicates a low result relative to the average of all counties in the Basin, and green indicates a high result. The BIPOC Population column shows the percentage of Black, Indigenous and People of Color (aka BIPOC) within the total county population, with counties greater than 35% being highlighted. Counties shown in bold have a significant portion of their area within the Delaware

River Basin; these are of primary concern. Counties with minimal land area within the Basin would be expected to have few project expenditures, regardless of county household income levels. Note that Philadelphia is addressed separately, as its total expenditures comprise 36.7% of all basin expenditures, making a comparison of other counties more difficult. In addition, this analysis only addressed expenditures for which county identification was available, \$3.22 billion out of the total expenditures of \$4.35 billion.

Table 20: Project Expenditure Relative to Household Income Metrics by County						
County	County Median HHI to Basin Median HHI (Green > 1.25; Pink < 0.8)	County Total HHI (\$ billion) (Green > 24; Pink < 13)	Gini Coefficient (0 to 1) (Green <=4 1.25; Pink > Median)	BIPOC* Population (%) (Green < 19; Pink > 30)	County Project Expenditures FY2014-2022 Per 1,000 People (Green > \$76K; Pink < \$40K)	County Project Expenditures FY2014-2022 (% of Total)** (Green > 4%; Pink < 1%)
DELAWARE						
Kent	0.893	\$11.7	0.400	41.1	\$106,655	1.45
New Castle	1.099	\$44.8	0.443	44.8	\$295,974	12.50
Sussex County	0.965	\$17.1	0.453	24.9	\$42,776	0.78
NEW JERSEY						
Atlantic	0.932	\$18.3	0.461	43.9	\$272	0.01
Burlington	1.344	\$44.5	0.441	34.9	\$109,584	3.76
Camden	1.058	\$39.5	0.469	45.1	\$229,471	8.88
Cape May	1.068	\$7.3	0.469	15.0	\$47,406	0.33
Cumberland	0.818	\$9.0	0.459	53.7	\$396,626	4.50
Gloucester	1.306	\$28.4	0.407	23.5	\$176,773	3.97
Hunterdon	1.729	\$16.0	0.455	17.6	\$384,445	3.69
Mercer	1.201	\$33.1	0.487	49.7	\$195,994	5.59
Monmouth	1.546	\$71.2	0.475	25.3	\$65,205	3.11
Morris	1.734	\$63.2	0.461	31.2	\$15,258	0.58
Ocean	1.074	\$49.7	0.464	15.5	\$9,910	0.47
Salem	0.951	\$4.4	0.451	28.0	\$610,213	2.93
Sussex	1.424	\$14.8	0.417	16.9	\$867,671	9.33
Warren	1.193	\$9.4	0.386	20.9	\$620,167	5.07
NEW YORK						
Delaware	0.739	\$2.3	0.448	12.4	\$87,316	2.86
Greene	0.880	\$3.0	0.459	17.8	\$4,234	0.15
Orange	1.200	\$34.6	0.456	36.9	\$39,542	1.18
Sullivan	0.888	\$5.1	0.522	29.0	\$642,984	3.79
Ulster	0.996	\$13.0	0.495	25.6	\$16,021	0.22
PENNSYLVANIA						
Berks	0.971	\$29.7	0.456	29.2	\$86,773	2.75
Bucks	1.392	\$64.2	0.450	17.7	\$56,493	2.70
Carbon	0.831	\$3.9	0.372	8.0	\$36,267	0.18
Chester	1.541	\$59.2	0.443	22.9	\$175,508	6.98

County	County Median HHI to Basin Median HHI (Green > 1.25; Pink < 0.8)	County Total HHI (\$ billion) (Green > 24; Pink < 13)	Gini Coefficient (0 to 1) (Green <=4 1.25; Pink > Median)	BIPOC* Population (%) (Green < 19; Pink > 30)	County Project Expenditures FY2014-2022 Per 1,000 People (Green > \$76K; Pink < \$40K)	County Project Expenditures FY2014-2022 (% of Total)** (Green > 4%; Pink < 1%)
Delaware	1.127	\$46.1	0.491	36.0	\$52,991	2.25
Lackawanna	0.818	\$12.6	0.466	17.1	\$11,523	0.18
Lancaster	1.033	\$40.8	0.437	18.2	\$3,688	0.15
Lebanon	0.927	\$9.5	0.433	20.5	\$16,791	0.18
Lehigh	0.973	\$26.1	0.481	37.9	\$23,535	0.65
Luzerne	0.792	\$18.4	0.448	23.3	\$50,675	1.22
Monroe	1.018	\$12.3	0.434	36.0	\$51,400	0.64
Montgomery	1.392	\$85.5	0.475	26.1	\$46,956	2.98
Northampton	1.080	\$24.2	0.460	25.2	\$141,673	3.28
Pike	1.000	\$4.2	0.431	22.5	\$4,694	0.20
Schuylkill	0.810	\$8.3	0.403	11.5	\$3,715	0.04
Wayne	0.795	\$2.9	0.419	12.4	\$11,462	0.43
Median of All DRB Counties	1.000	\$16.0	0.453	23.5	\$50,675 (Excluding Philadelphia)	1.22% (Excluding Philadelphia)
Philadelphia	0.738	\$83.0	0.515	65.2	\$1,184,435	36.7% (of all counties)

U.S. Bureau of the Census Quick Facts, available from: <https://www.census.gov/quickfacts>.

* “White alone, not Hispanic or Latino”

** Values exclude Philadelphia County except for last line, which compares Philadelphia to all counties.

Focused on the counties located primarily within the Delaware River Basin (in bold in **Table 20**), BIPOC populations and Gini coefficients are often contrary to expenditures per 1,000 people and as a percentage of Basin expenditures (e.g., high expenditures even with high BIPOC populations and Gini coefficients); more often the higher expenditures per 1,000 people seem related to higher Total Household Income (HHI) for a county and a high Median HHI for the county relative to the Basin as a whole. Conversely, there are counties with low expenditures per 1,000 people that have low BIPOC populations and Gini coefficients. The only county with consistent relationships (i.e., higher median HHI, higher Total County HHI, lower Gini coefficient and BIPOC populations, and higher expenditures per 1,000 people) is Gloucester County, NJ. Monroe and Pike Counties, PA, are nearly as consistent.

Expenditures Relative to Household Income

Figure 1 shows the relationship of county project expenditures (as a percentage of total Basin expenditures attributed to county areas) to total county household income, for only those counties shown in bold in **Table 20** above (i.e., with major land areas within the Basin), excluding Philadelphia which has both the highest percentage of expenditures (36.7%) and total household income (\$83 billion). As can be seen, high levels of project expenditures occur across a wide range of total county

household income. However, most of the lower expenditure levels occur at lower total county household incomes.

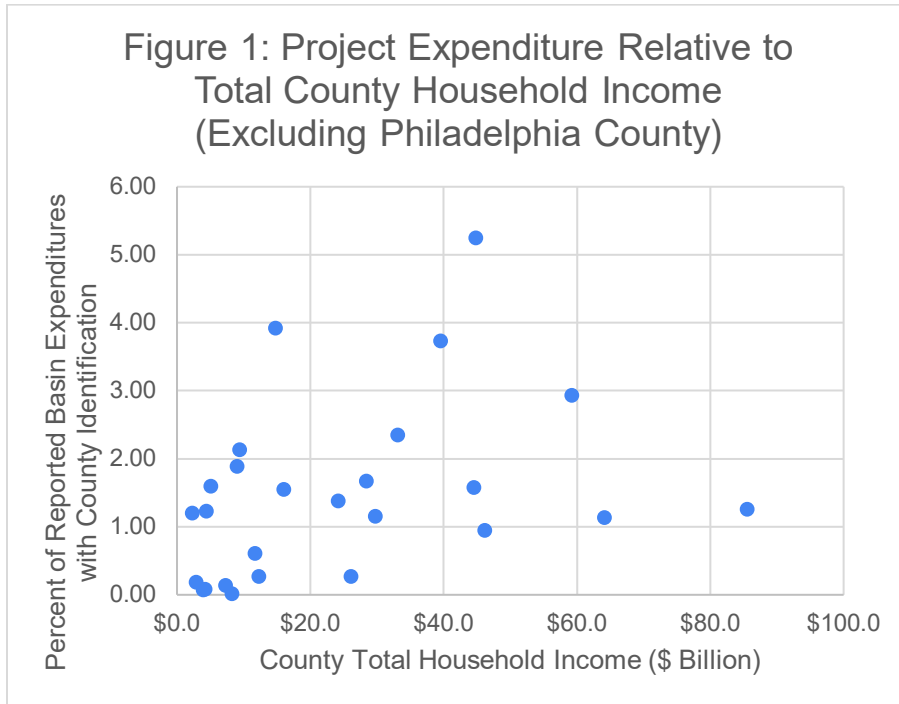
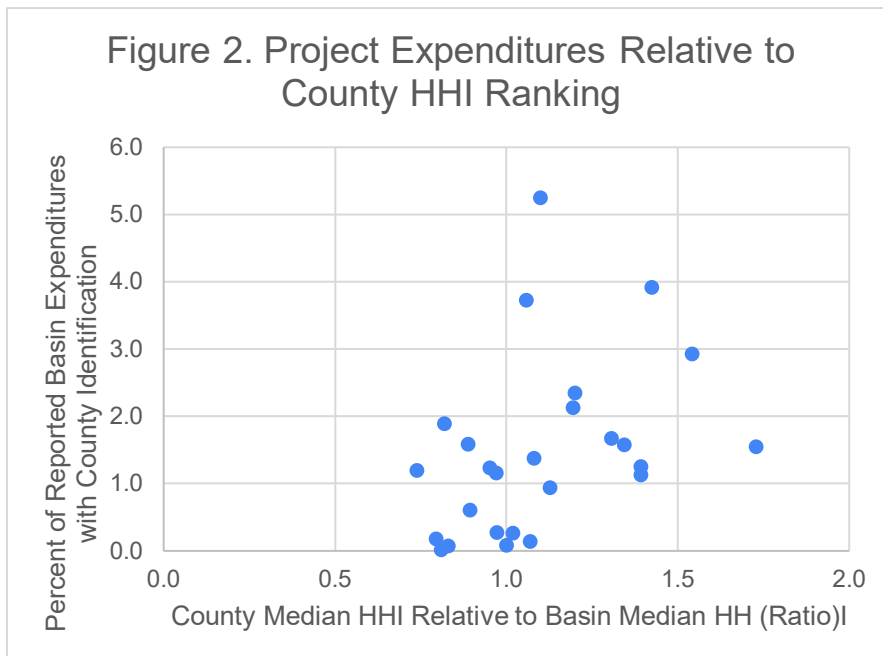
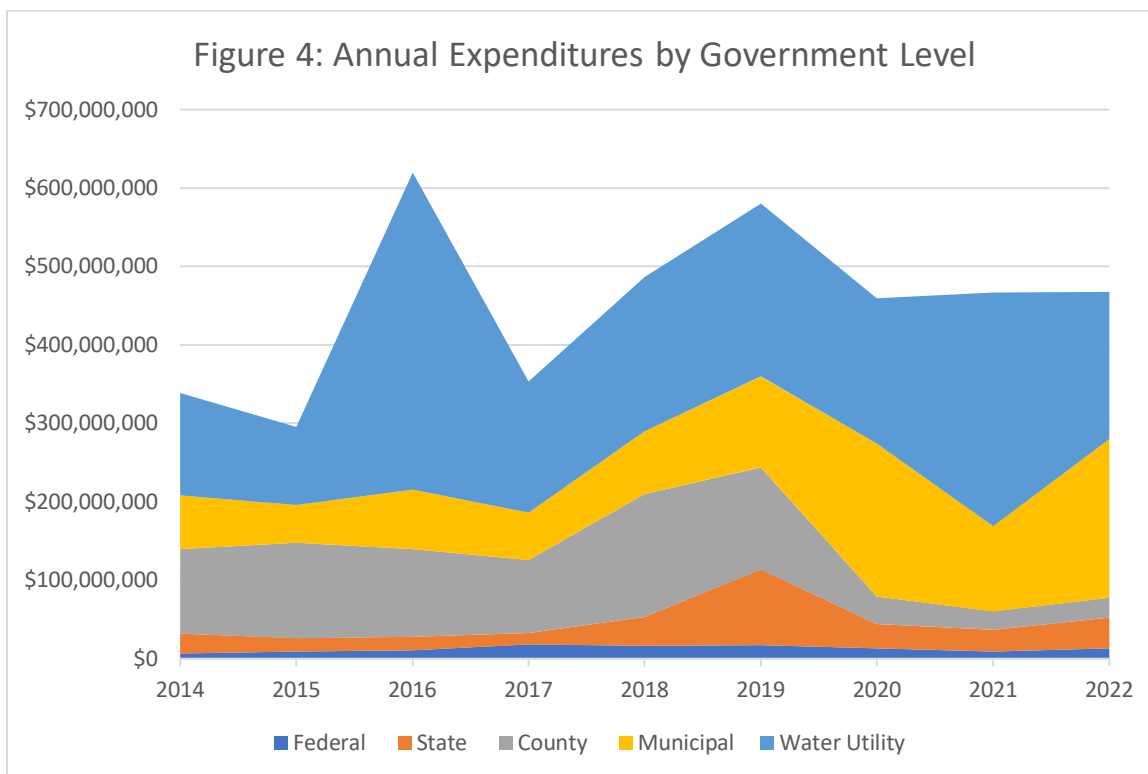
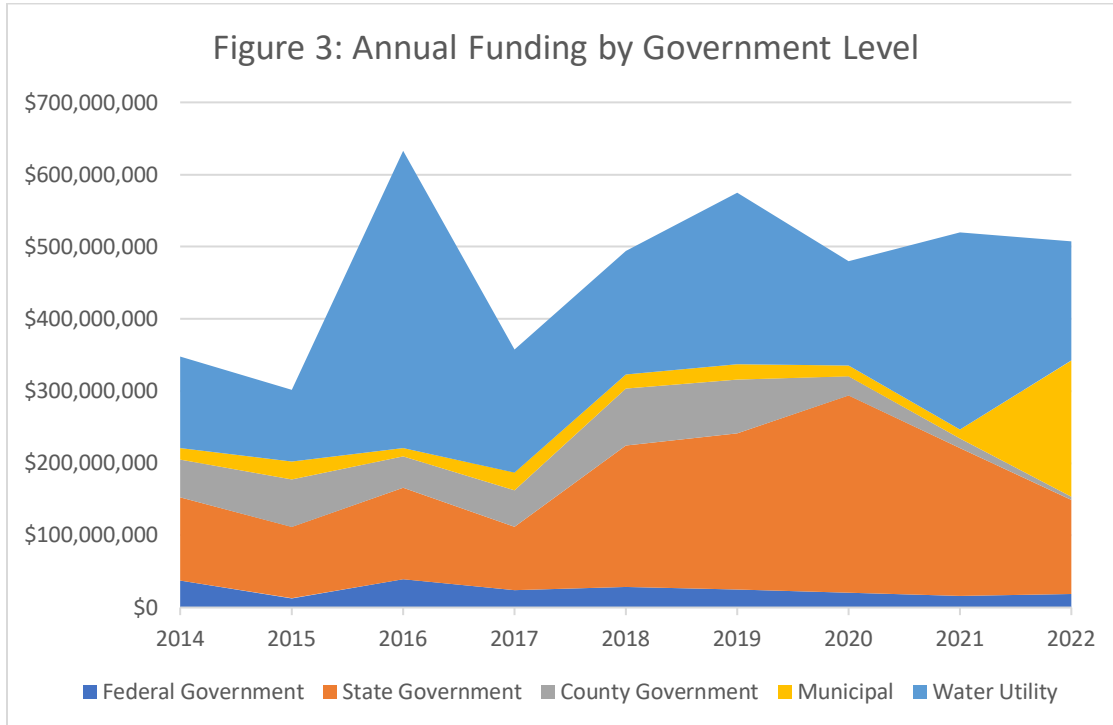


Figure 2 shows the relationship to the average household income by county as a percentage of the Basin average, for only those counties shown in bold in **Table 20** (again excluding Philadelphia). Here, a stronger but scattered pattern emerges, with increased expenditures in line with higher incomes.



Funding and Expenditure Trends

A major question in the research is whether clear trends are discernible from the acquired data. **Figures 3 and 4** provide an overview of funding and expenditures by government entities by category, respectively.



There is no discernible trend regarding total government funding or expenditures. For the specific government levels, the most notable change is in county funding and expenditures, showing a sharp decline between 2019 and 2020. The federal government routinely plays a very limited role in both charts. State funding and expenditures apparently increased in the 2017-2020 period but then declined, with expenditures being always a minor portion of all expenditures (note that the FY2020 budgets would have been approved prior to onset of the pandemic). Funding from municipalities and utilities is variable but large especially as state funding has declined; they expend the largest share by far.

Given these results, it is clear that the federal government has never been a major player. The federal Bipartisan Infrastructure Law (Infrastructure Investment and Jobs Act of 2021) was adopted too recently to be apparent in the 2022 results. Both state and county governments apparently are pulling back from these programs post-pandemic. This retrenchment places significant financial pressure on municipalities and water utilities, which must meet environmental regulatory requirements regardless of funding from higher-level governments.

Interviews and Surveys of Key Experts

We asked Delaware Basin experts about government funding for land acquisition and watershed restoration to learn what they know about government funding and what they think about the way funding is distributed. There were no overtly false statements about funding. Comments from experts affirm some of the top findings from the funding data, including the dominance of farm programs and the common requirements for and wide use of matching funds, though information received for the database often lacked detailed data on matching funds. Most respondents stated they lacked full knowledge of funds spent in the Basin and would benefit from the funding data collected by the project. Respondents reported their perceptions about equity in funding, based on their own areas of policy expertise, but most stated that without data about funding of all types, they felt unqualified to comment decisively about equity in funding. They described the Basin's institutions as not aiming to coordinate water quality improvements across geographic areas or across lands of different kinds. Each program has its own rationale and criteria for funding.

Experts explained how the structures and aims of existing programs affect the ways advocates and local governments work within the Basin. Consistent with the funding data presented in [Project Expenditure Results and Findings](#), experts reported that a few federal and state programs dominate the pool of government funding for the Basin at that level. Respondents expressed that each program was created for a targeted purpose and has eligibility requirements that limit where funds can go. Several respondents explained that the major federal and state funding programs aimed to protect land, soil and environmental resources and did not integrate social equity criteria into their decision-making processes. Some also stated that social equity criteria might be expressed in funding programs in environmental or other agencies that target contaminated sites or city planning.

Respondents describe taking advantage of major funding programs when possible, pursuing other funding sources when their projects were not eligible for such funds, and seeking new partners when funds dried up or changed their focus. Under this practical approach, federal, state, and local funding could become coordinated at the project level when a funding source required matching funds. However, each program demanding a match has its own criteria, and so projects have not yielded a Basin-wide set of criteria or aims for conservation.

As a result, experts described the Delaware Basin as having a patchwork of conservation regimes that have little relationship to one another or to any unified set of watershed-based water conservation or water quality objectives. Programs funded by the Farm Bill to support the production of crops for the market stand apart from programs for wildlife conservation or non-farmland preservation. Also, the regulatory and institutional arrangements described by experts result in a set of policy regimes defined by geographic region, as detailed below.

Only a few expert-practitioners expressed a desire for greater coordination across the Basin, although many stated that current arrangements limit their ability to work collaboratively to address needs. Respondents who reflected about the patchwork pattern of funding and policy stated that it results from the Basin's low political profile relative to other watersheds and rivers in the region. Respondents who work on policy advocacy and lobbying at the federal or state levels were focused on sustaining or increasing funding totals, not on creating institutions for top-down integrated watershed management. Respondents who implement projects at the local level were absorbed with piecing together funding sources, not on creating bottom-up participatory institutions for integrated watershed management.

The most ambitious elements of participatory watershed management planning discussed in the research literature therefore did not emerge as aims for the experts consulted in this study.

Overview of Interviews and Process

Members of the expert panel completed online surveys (see [Appendix E](#) for the online survey questions) and other experts were interviewed (see [Appendix D](#) for the interview survey questions). Experts were asked about their perceptions about the availability of funding, changes in funding patterns, and equity in funding. From the expert panel, surveys were taken between October and November 2020. Among other experts, 17 remote (online) interviews were completed, from August to November 2020. The interviews and questionnaires were conducted in accordance with Rutgers Institutional Review Board procedures and methodology approval.

Potential interviewees were identified by members of the expert panel, William Penn Foundation staff, and the Rutgers project team. The team selected candidates from this list, aiming to reach experts with knowledge of programs across the Basin, experts from agricultural and natural resources programs, and experts with experience across agencies at each level of government, nongovernmental organizations, and firms. Nonrespondents were contacted again, and other candidates were recruited, to capture this range of perspectives.

We sought the perceptions of experts familiar with one or more of the major programs that funds water quality improvements in the Delaware River Basin. Interviewees and survey respondents included government experts who implement federal and state water resource and agriculture programs, state government experts in agencies' environmental justice initiatives, experts working on private sector conservation projects, and leaders from regional and site-specific nongovernmental organizations. Most were in leadership positions within their agencies and organizations. Because the region has a long history of policy innovation in water management, nearly all of the interviewees had experience or knowledge beyond their current job. Interviewees provided information about funding for water quality in Delaware, New Jersey, New York, and Pennsylvania states, covering the range of funding programs at the federal, state, and local levels in those states. They characterized funding available for the Basin's major cities, suburban areas, and rural areas and addressed all major resource programs and agricultural programs. Summary results are discussed in the following sections, while detailed responses to the interview and survey questions are provided in [Appendix F: Interview Results](#). The detailed responses are not interpreted; they represent notations on the direct responses.

One Watershed, Defined by Uncoordinated Conservation Systems

As described by respondents, the Delaware River Basin lacks a distinctive cultural or historical identity that could build public support for protecting the Basin as a whole. Its waters drain from remote sections of upstate New York, past Philadelphia and Camden, and through to the Delaware Bay, each with its own environmental and social conditions. One interviewee called Delaware River Basin the "poor sister" of the great waters because it does not have a dedicated funding program like those for the Great Lakes, the Chesapeake, and the Hudson River.

Only one respondent sketched the possibility that advocates could push for a federal or multistate planning program that could improve on the current patchwork arrangements. When asked about government funding, several respondents stated that it is important to recognize coordinating and staffing functions and not simply grants or loans for specific projects. These respondents pointed to the

U.S. Geological Survey, the Delaware River Basin Commission (DRBC), state government agencies, and the William Penn Foundation for promoting information exchange across states and localities in the Basin. One expert panel member commenting on this report stated that the Basin is among regions most highly monitored by the USGS. Another panel member noted that funding for specific projects give opportunities for “ribbon cutting” and may be more attractive for government funding sources than providing ongoing funds to the coordinating role of the multistate DRBC.

Respondents involved in direct policy advocacy did note recent federal initiatives, including the Highlands Conservation Act and the Delaware Basin Restoration Program (representing between \$10 and \$20 million per year in funding, depending on funding allocations). These provide funds for some of the Basin’s areas but are not designed to coordinate watershed management. All interviewees expressed the need for more funding at all levels of government. One interviewee noted that conservation spending by state agencies and local governments makes the funding base for the Delaware Basin much more diversified than that available for New England, which relies almost entirely on federal funding. Data we collected affirms that state funding is the largest source of support across the Basin. Although few local governments provided funding information, expert respondents reported local governments with dedicated funds (e.g., open space taxes) are important as a ready source of matching funds. With little high-level governmental guidance or technical assistance, respondents who implement conservation projects described working largely on their own to approach funding sources.

As a result, the watershed has a set of uncoordinated conservation regimes. Respondents said that gaining funds depends on statutory and regulatory criteria, access to data and engineering studies, the capacity to win and manage grants, the availability of likely partners, the ability to find matching funds, and local sentiment about conservation. These conditions vary across the Basin, resulting in geographically distinctive ways of raising government funding and geographically uneven access to funding. Nearly all respondents commented that, coupled with the region’s legacy of spatial segregation by race and wealth, funding for conservation is uneven, both geographically and demographically. Their explanations for that unevenness differed. The following geographically based regimes for water quality emerged from interview transcriptions or survey responses and are consistent with data we collected about funding; they are based on general geographic areas rather than specific watersheds or political boundaries. **Figure 6** shows the general outlines of these areas. We did not aim to calculate the actual distribution of government funds across these geographic regimes, which are not formal boundaries.

- **Upstate New York, above the Catskills reservoirs for New York City’s water supply:**

Under one of the country’s most important waivers of federal surface water and drinking water filtration rules, this portion of the Delaware watershed receives much more conservation funding per acre than other portions do, according to respondents; all of it comes from New York City. By paying to set aside land and restore waterways in the Catskills area northwest of the City, respondents noted that New York City can avoid spending billions on water filtration treatment it would otherwise be required to install at its drinking water plants. New York state’s health department renewed its guidance in a 2020 Filtration Avoidance Determination (FAD), reinforcing the requirement that the City continue to conserve lands in this watershed. New York state provides little direct funding in this region. The reported data confirmed this perception, with nearly 100% of all project funding in this area coming from New York City.

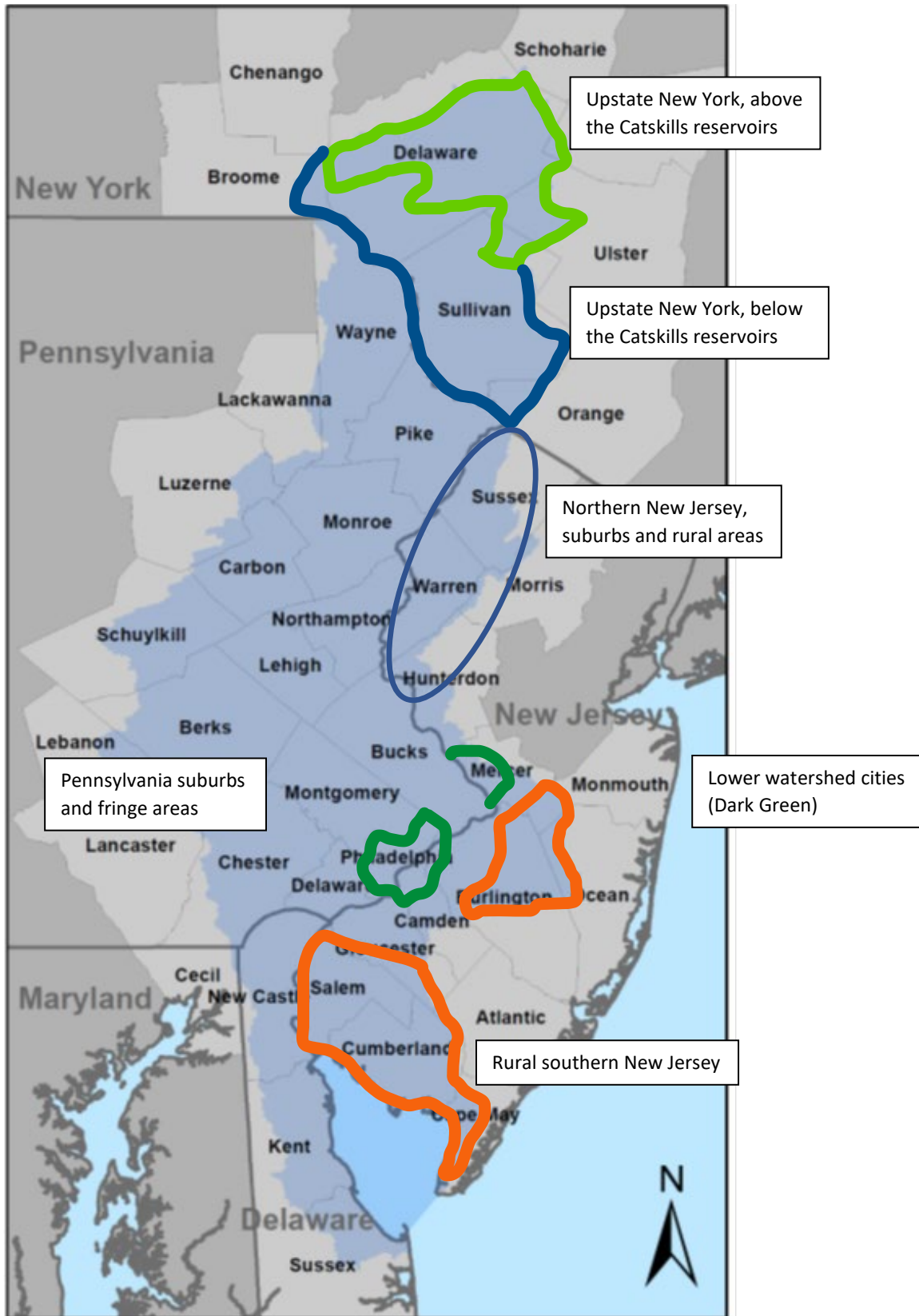


Figure 5. General Geographic Areas Identified from Interviews (not precise)

Reflecting on the influence of economic trends, respondents reported that New York City stepped up land purchases in this area when land values fell after the 2008 economic crisis, but that by 2014, values had rebounded. Land costs, and recommendations by an advisory report from the National Academy of Sciences, led the City to shift more resources toward stewardship and restoration of the lands it already owns or manages under conservation easements on private lands. Experts stated that land purchasing will likely continue but that scientifically informed projects for efforts such as streambank restoration and septic and sewer system upgrades will likely be a growing proportion of the City's spending in the coming years. One member of the expert panel commenting on this report noted that many of the City's stewardship and restoration efforts have been implemented through collaborations with nonprofit organizations, reflecting some of the methods and aims of watershed management discussed in the research literature. For instance, a respondent to the study stated that the City depends almost entirely on an agricultural advisory council to consider and fund projects affecting farms.

Respondents characterized the Catskills rural area as being far from urban areas, majority White, and with a low household income level relative to other parts of the Basin. Experts remarked that many residents and town officials view New York City's purchases and upgrades (e.g., grants to improve septic systems) as intrusive. Some prefer to keep private land unrestricted and available for development, to boost local economies and to resist control from governments outside the local watershed. Some local officials in this area have tried to block New York City's efforts to acquire lands from private sellers, according to respondents. During the COVID emergency, New York City residents who moved to the watershed changed the politics of some communities. It is not clear whether this will permanently shift local politics toward supporting New York City's conservation efforts.

- **Upstate New York, below the Catskills reservoirs:**

Unlike the area above New York City's reservoirs, the conservation regime in this and the other areas described below is based on competing for funds from government sources with suitable eligibility requirements. Experts reported that this area receives no direct funding from New York City (apart from one grant for the Port Jervis wastewater treatment plant, as ordered by the Supreme Court). The Delaware River Basin Restoration Act is now a major source of federal funding for this region, and several New York state resource programs provide smaller amounts. One expert panel member reviewing this report commented that this area forms a portion of the headwaters of the Basin and so is critical to the overall quality of water resources. It recently became more feasible for project organizers in this area to meet the matching funding requirements of federal programs. New York City and managers of several federal programs agreed that projects below the reservoirs could meet their matching requirements by listing funds New York City spent on projects above the reservoirs, because both sections are part of the same larger watershed. Conservation in the area below the reservoirs focuses on acquiring lands with high quality ecological functions, not on restoration projects. This area has noted trout fishing streams.

Experts pointed out that although the areas above and below the reservoirs have similar demographics and similar ecological conditions and problems, they have very different access to

resources that could address those problems. One respondent noted that government conservation is perhaps even less welcome in many of these localities than it is above the reservoirs, because people below the reservoirs cannot benefit from spending by New York City to boost access to recreation. Some farmers in the area below the reservoirs, who do not have the option of selling to New York City, view selling their farm to a developer as their best option for retirement, a stance that has produced scattered housing subdivisions amidst farms.

- **Rural Pennsylvania:**

Without special allocations such as those available to the Chesapeake Bay, rural areas of Pennsylvania in the Delaware Basin compete against other rural areas in the state for a limited set of federal and state funds, according to experts from that state. Observing that there are more applications to general NRCS farm funding pools from the Chesapeake than from the Delaware Basin, one respondent suggested that the Chesapeake program may have broader effects, encouraging Chesapeake farmers to apply for a wide range of government programs. Several experts noted that the pressure to implement water quality regulations in the Chesapeake watershed creates incentives for state officials and federal agricultural officials to direct farmers in that watershed to conservation programs. Such pressure does not exist for the farm areas in the Delaware Basin. Some US Fish and Wildlife Service funding is available in the Delaware Basin areas of rural Pennsylvania, including a wildlife refuge (Cherry Valley) established in the 2010s. The Pennsylvania Department of Conservation and Natural Resources provides funds from the state legislature (e.g., Keystone Recreation, Park and Conservation Fund; Environmental Stewardship Fund) that advocates have managed to sustain in recent years.

Respondents discussed their strategies for conservation in the face of limited local support for conservation. These rural areas are majority White, and they vary in income levels. Some rural localities and counties with established open space programs recently turned away from purchasing open spaces for non-farmland purposes. Respondents reported that support for farmlands was politically popular in these rural areas. The ability to readily match local funds to federal programs also gave them a financial incentive to direct open space funds toward farms. Respondents reported their anecdotal impressions about changes in local funding. For instance, one locality passed a referendum against open space acquisition, and in other localities, newly elected officials decided against floating bonds that had been approved. Some municipalities cut their own open space purchases when their counties stopped providing matching funds.

For land acquisition of non-farmlands, projects often are clustered in wealthier rural areas. Experts throughout the Basin commented that preservation in wealthy communities tended to support the viewsheds of residential areas. In addition, direct land donations usually came from families who sought to benefit their own communities. This pattern reflects longstanding concerns within the natural resource community, echoed by many respondents to this report, that conservation has historically sustained the quality of life of communities that already have high-quality living conditions.

- **Pennsylvania suburbs and fringe areas:**

Some of the expert respondents for this study noted that political support for conservation is high in most of the Basin's suburban areas but that criteria for major conservation funding programs tend to exclude more developed suburban areas. Landscapes in the suburbs have developed unevenly, with developers assembling large parcels by buying individual farms. This resulted in a leapfrog development pattern of undeveloped areas interspersed with development. Federal and state conservation programs for non-farmlands typically give priority for buying plots or easements on plots that are large or are adjacent to other protected lands, conditions that are not typical of the suburbs. Respondents working to conserve land in these areas reported using ad hoc sets of funding sources. Suburban fringe areas with wealthy residents support local open space funds but tend to rely on bequests or other donations from individuals to organize conservation projects. Conservation in these areas is opportunistic. One interviewee stated that in suburban and fringe areas, preserving a farm plot along a highway could boost local political support and contributions for conservation, even though that plot might not rank highly for its environmental qualities when compared to some plots in rural areas.

Some localities in this region are wealthy and White and favor conservation, in part to sustain property values for residential plots. Other localities are poorer and White, and many lack resident support for open space funding. Areas near Philadelphia are somewhat more diverse racially and economically. Conservation in these suburbs faces some of the same barriers faced by major cities, as described below.

- **Lower watershed cities, including Philadelphia, Camden, and Trenton**

Many respondents noted that funding programs for environmental projects in cities overlap little with the preservation programs used in less-developed suburban and rural areas. The database results confirm that most programs are focused on non-urban areas. Funding programs from natural resources programs seek areas with highly functioning ecosystems and so rarely fund projects in cities. Respondents working in cities explained a series of connected problems. Although many urban riverfront areas support ecological functions that could be improved, cities often lack the scientific data to demonstrate that. Some city sites are eligible for environmental restoration projects or recreation projects, but nearly all sites have at least minor amounts of contamination, such as ordinary construction debris, that requires remediation before restoration can proceed. There are no ready sources of federal or state funds for remediation of such routine conditions (i.e., most remedial projects rely on regulatory or court-ordered action by responsible parties, actions normally reserved for large or heavily contaminated sites). Some federal or state funds are available to retrofit or mitigate combined sewer overflow (CSO) systems present in some cities. Matching is a problem because generally cities that have experienced disinvestment seek bonds or loans only when they need emergency repairs to their water and wastewater systems. Getting matching funds therefore often requires coordinating between two or more federal or state environmental programs with different timelines and different criteria. Philadelphia is an exception in installing urban green infrastructure as part of its effort to comply with USEPA surface water rules and judicial consent order for CSO abatement. Many respondents mentioned that the costs of land conservation in

cities is much higher than in rural areas. Respondents reported little coordination between cities and their nearby areas.

Respondents indicated that city residents generally favor conservation but have little to show for that support within their own city borders. The regions of New Jersey and Pennsylvania within the Delaware Basin are residentially segregated by race and income. African Americans and people of color are concentrated in Philadelphia and its nearby suburbs and municipalities, Camden, and Trenton, which have burdens of heavy industrial uses, active and historic. The legacy of racial discrimination means that African Americans and people of color are less likely than Whites to have access to parks and other green spaces. The results of conservation efforts can also have unintended effects. Several respondents felt that public access to waterways could increase public awareness and support for water quality improvements. However, one interviewee worried that building access points to waterways also encourages subsistence fishers to take fish that the state lists as unsafe to eat in any quantity from urban sections of the river. One expert panel member reviewing this report noted the related point that green investments of any kind can yield gentrification that could displace current residents.

- **Northern New Jersey, suburbs and rural areas**

This area, including both the Valley & Ridge and Highlands geophysical provinces, has pockets of significant development but also large rural areas. Many large state and federal preserved areas already exist, along with extensive areas of farms and forests. Respondents explained that projects in the Delaware Basin area in North Jersey are eligible for several sources of funding unavailable to South Jersey, such as the federal Highlands Conservation Act funds and Forest Legacy Program funds. State programs that are available throughout the state include the Green Acres program for non-farmlands and State Agriculture Development Committee funds for farmland easements (both funds are part of the Garden State Preservation Trust). The northern portion of the Basin includes one tributary to the Delaware where restoration projects are eligible for funds from the New Jersey Water Supply Authority, a state agency that protects source waters and reservoirs for a portion of the state's water supply, including the Delaware & Raritan Canal.

Experts contrasted the wealth and landscapes of the two sections of New Jersey in the Delaware Basin. This part of North Jersey is wealthier than many areas of South Jersey, and more of the northern municipalities and counties have created funds for open space purchases, for both farmlands and non-farmlands. Localities in rural and suburban North Jersey that have these funds are mostly White. Interviewees explained that as in Pennsylvania, wealthier residential communities in New Jersey are more likely than poorer communities to receive land from individual donors, more likely to seek federal or state conservation funds, and more likely to provide matching funds from their own open space accounts, in part to protect residential property values.

- **Rural southern New Jersey**

Respondents described the areas of South Jersey outside of the Camden metropolitan area (which includes the developed western parts of Gloucester, Camden and Burlington County) as largely rural. Together, the northern and southern portions of New Jersey within the Delaware

Basin are the state's key agricultural region. Experts noted the Delaware Basin accordingly receives nearly all federal and state agricultural funding granted in New Jersey. Respondents mentioned that there are fewer efforts in South Jersey than in North Jersey to organize non-farmland preservation. (However, we note that ongoing preservation projects in the Pinelands and Delaware Bayshore areas have been funded in part with Green Acres grants.)

The portions of South Jersey in the Delaware Basin are more racially and ethnically diverse than the portions of North Jersey are. Residents in South Jersey have lower average incomes relative to the rest of the state and have not generated large local funds for either farmland or non-farmland open space conservation. Interviewees did not mention the same level of political resistance to land conservation within this rural region that others reported for New York or Pennsylvania. This may be in part because South Jersey is a downstream area. Conservationists have tended to focus their most intensive land acquisition efforts in upstream headwaters areas in the other states. Also, funding data collected by this project show that agricultural preservation is common in this region and generally is supported by municipalities and counties.

Perceptions Regarding Conservation Trends and Equity

In addition to characterizing the funding regimes they experienced, experts discussed current trends in funding and their perceptions about funding equity (see [Appendix D](#) for the survey questions). Many also expressed concern that demographic inequities in funding were well known but that discussion about these inequities has just begun in the region. Several respondents who had spent years working to conserve land with relatively intact ecological functions expressed that such purchases were still urgently needed. These respondents also discussed initiatives to address environmental justice, including their own work to influence criteria used for the new Delaware Basin Restoration Program or to promote and apply for programs that give additional points toward conservation near dense settlements. The feeling overall was that new programs and policies would be needed to extend funding to sites that may not meet strict environmental criteria, rather than pushing existing funding away from the current resource priorities, and that funding overall should be increased.

Interview Respondent

I THINK IT'S TRUE THAT WE SPEND...A HIGHER PROPORTION OR A HIGHER RATIO OF THE DOLLARS IN PLACES WHERE THERE ARE FEW PEOPLE...THAN...WHERE THERE ARE LOTS OF PEOPLE.

Availability of funding

Respondents' perceptions about the quantity of funding in recent years and about the importance of individual funding programs were consistent with the data we gathered from funding sources, although their knowledge often was limited to the programs they directly worked with. Those who advocate for federal funding were pleased with recent and coming increases in funding, especially with the Great American Outdoors Act, which created a permanent funding source for the Land and Water Conservation Fund.

Experts who administer funds or implement projects spoke with protectiveness and praise for state and local programs, knowing about the efforts needed to sustain appropriations. They acknowledged that their value for some of these funding sources isn't necessarily because they are the largest (a point confirmed by the funding data we collected), but that these sources have been reliable over the years. Respondents reported that the steadiest sources of funding were from New York City for its drinking

water sources; from state natural resource funds in Pennsylvania, New Jersey, and Delaware; and from localities with dedicated open space funds. Reports about local funding for open space were mixed, with remarks that some localities had recently created new funds while others had cancelled or reduced their funds.

Changes in funding priorities and eligibility

Interviews may be the best source of information about trends in funding priorities. Trends are not readily analyzed from the data we gathered about funding, because details for project purposes were often not included in our data sources. Respondents reported ongoing adjustments to the aims of some funds but no dominant trends in funding priorities.

Respondents reported two important recent changes to farm programs. Before the study period for this report, federal farmland programs opened eligibility to farmers with low or no income from the farm (i.e., subsistence farmers) and ended eligibility for farmers with very high incomes. Also, a notable opportunity for water quality improvements is the provision in the 2018 Farm Bill that ten percent of the NRCS's conservation funding be directed toward source water protection.

For non-farmland funding, New York City funds and programs in a few other areas had shifted some funds toward restoration or stewardship of land already acquired. In part this is because land values have largely recovered since the 2008 recession, making acquisition more costly, but restoration was also emphasized in a scientific review of New York City's program. Several respondents noted the challenges of managing land once it is acquired. One particularly worried that small land trusts may have trouble sustaining their work over time and that deeding such lands to county governments would lend to more permanent legal protection. Many experts favored recent state efforts to encourage local stormwater plans but reported that few localities were following through. Climate change and recreation are other criteria being integrated into state programs. Only one respondent noted that equity concerns were being integrated into ratings for projects, with settlement density near a project yielding points toward a successful state grant application in New Jersey.

A few respondents mentioned that major farm programs are an awkward fit for the land uses that dominate the Basin. Conservation of farms in this region is more costly than in the Midwest. Land values are high in the Basin, and although farms are much smaller here, costs for administering grants are similar, no matter what a farm's size is. More concerning for attracting farmland preservation funding is that the dominant land cover in our region is forest, not agriculture. Most of the forests in the Basin are held privately, but funds available for private forested lands are limited. In addition, respondents mentioned that many agricultural practices are exempt from Clean Water Act permit requirements, because they are nonpoint sources, meaning that major sources of pollution flow downstream to communities held to water quality standards, where the communities are unable to reduce those upstream sources.

Matching funds requirements

Most projects require patching together funding, according to respondents who implement projects, no matter whether a funding agency requires such matches. Matching was reported as a high barrier for poor rural communities and for urban areas where the costs are high, due to the need to address legacy pollution in nearly any site before restoration can begin. Many respondents mentioned the William Penn Foundation's Delaware River Watershed Initiative Clusters as creating clear priorities and

opportunities for matching funds in the cluster areas. Another notable change in matching was the agreement from several federal programs allowing spending by New York City above its reservoirs to be counted as matching funds for projects below the reservoirs.

Perceptions about why local government provide conservation funding

Funding from municipalities and counties was viewed by experts as a key element of conservation in the Basin but one that results in uneven conservation efforts. Mandates were viewed as important only to the largest cities affected by Basin policies, Philadelphia and New York, because the federal government has pressed them to meet requirements under the Clean Water Act and Safe Drinking Water Act. Experts reported that few municipalities were attempting to comply with Clean Water Act requirements for stormwater. The governing capacity of localities was viewed as very important, determined primarily by the tax base, however experts said that local political views about conservation spending were even more important.

Perceptions about equity in funding

Respondents were concerned about equity in funding because inequities can reduce public support for environmental actions and because inequities burden rural and urban poor and members of minority groups disproportionately. Many respondents commented that resource programs have been designed for preserving resources, not for social equity. As one respondent commented, environmental and farm programs have inequitable results because they exist within an inequitable society.

The inequity in funding mentioned most often is that sites likely to rank high in ecological conditions prioritized by non-farmland conservation programs are concentrated in rural, upstream areas. The country's history of discrimination has led to patterns of segregation by race and class that in this Basin has resulted in upstream rural and exurban areas being mostly White. (Farm programs distribute funds to downstream as well as upstream areas, but again, most farmers are White.) Nearly all respondents mentioned that protections of upstream lands benefit all in the watershed, but many mentioned that the benefits may not be perceived by people living downstream. One respondent added that

downstream cities would also need local projects to address contamination and flooding problems that cannot be solved by upstream conservation. A few respondents said that equity could be addressed within a program (e.g., designated funding pools for beginning farmers within many agricultural programs) or could be addressed by other funding programs.

Interview Respondent

...AN EAR OF CORN DOESN'T CARE WHETHER OR NOT 1000 PEOPLE A DAY DRIVE PAST IT AND SEE THE PRESERVED SIGN. THE FUNDERS CARE, AND THE COMMUNITY CARES... THE PROTECTION OF HIGHLY VISIBLE PROPERTIES HAVE A BENEFIT ABOVE THE CONSERVATION VALUES IN THAT THEY HELP PROMOTE THE PROGRAM AND THE COMMUNITY FEELING THAT LAND IS BEING PROTECTED.

Social structures and technical barriers make it difficult for funding programs to address inequities. For instance, farm programs typically rank highly productive soils as most worthy, and therefore favor farmers able to buy the most expensive lands. Likewise, residential communities with natural amenities and conservation funds are likely to be wealthy. Gaining funding from grant programs was widely reported as difficult for under-resourced communities, where the local governments are unlikely to be

able to track funding opportunities, fund engineers to do the necessary preliminary studies, or provide their own matching funds.

In commenting on their wishes for conservation, experts' answers reflected the diversity of land uses and the diversity of people in the Basin. For instance, several respondents who work primarily in urban setting expressed interest in expanding farm programs for cities and suburbs. Other respondents favored more flexible conservation criteria for plots that had forests and agricultural uses.

Conclusions from interviews and surveys

In summary, respondents describe a Basin with a combination of significant opportunities and multiple challenges for the funding and implementation of conservation priorities for land preservation (i.e., open space and farmland) and resource management (e.g., farmland and open space stewardship, stream and riparian restoration, nonpoint source pollution control). Funding sources evolve as political priorities change. Respondents mentioned that a few localities have cut open space funding, a process we were unable to trace with data, given the low response rate of municipalities and counties. Many of them worried that COVID-19 could lead to budget cutbacks by states and localities. This observation may prove incorrect, given higher state tax revenues than many expected during the pandemic and new federal stimulus funds granted after the interviews and surveys were collected. However, they also discussed that the need for outdoor recreation became more apparent during the pandemic. They also pointed to revenue streams that will likely be permanent, including decisions to dedicate funding streams for state programs and new sources of federal funding. Institutional capacity is a major

constraint on action, especially at the local government (i.e., municipality and county) and non-profit organization levels. Only a handful of funding programs help under-resourced applicants by imposing minimal paperwork burdens or by providing application support. And even when such programs are available, applicants may have trouble finding matching funds or providing up-front project support (e.g., engineering studies). Equitable protection and benefits to Basin populations generally are not deliberately addressed in funding priorities, and in some cases funding is inherently inequitable; dense concentrations of threatened and endangered species will not be found in cities, for example. There may be an even greater divergence between the haves and have-nots among localities after the pandemic. However, respondents did identify opportunities for better addressing and making a case for more equitable approaches to funding.

Interview Respondent

THERE'S A LOT OF DIFFICULTY IN DETERMINING EQUITY... BUT IT IS HARD TO DISCUSS THESE ISSUES REGARDING THE ENVIRONMENT BECAUSE YOU HAVE THE PHYSICAL ELEMENTS THAT MIGHT STRUCTURE A PROGRAM AND THE HUMAN ELEMENTS. THAT IS, THERE MAY BE CRITERIA FOR ENVIRONMENTAL CONDITIONS THAT ARE SET AS A PRIORITY THAT MAY NOT RESULT IN SOMETHING EQUITABLE FOR DIFFERENT GROUPS OF PEOPLE.

Recommendations for Project Improvement and Extension

This project represents the first comprehensive effort to collect and assess government funding and expenditures for protection and restoration of the Delaware River Basin regarding land preservation, agricultural best management practices, ecological restoration, and upgrades to wastewater and stormwater infrastructure. A variety of lessons have been learned from this process. In this section, the Rutgers team provides recommendations for next steps.

The acquisition of data from hundreds of entities requires extensive effort to contact the right person in each agency, government or organization, explain the purpose of the project, have that person collect and transmit the data, and merge the data into the regional database. In most cases, the data received will not be a precise fit to the database, requiring some level of processing to be usable.

For this reason, the Rutgers team recommends that data acquisition not be an annual event. Rather, we recommend a triennial process. A longer period has too much potential for losing immediacy regarding the data, momentum and contacts with the government agencies. A shorter period (e.g., annual) will require too much effort for the amount of additional information collected.

A second consideration is whether the project should focus on a subset of funding sources or expenditure categories from those involved in this project. For example, most federal agencies provide grants to state agencies, which can be tracked through the states along with the other state funding. As only 5% of reported funding was federal, relying on state agencies is more cost effective, with one major exception – the federal Farm Bill programs, where the only reliable data source is the USDA Natural Resources Conservation Service.

State agencies and utility authorities are the dominant funding sources identified through this project, at 33.3% and 41.4%, respectively, and there is good reason to believe that the publicly-owned water utility funding is even higher than reported; many utility authorities did not respond. Municipal and county governments (N=842 municipalities vs N=44 counties) provided only 17.1% of funding and yet required a very large time investment, especially for municipalities. A focus on the most populated counties and municipalities, perhaps 20% of entities in each category, would be far more cost-effective. Funding from foundations and non-profit organizations represent a minimal share (2.5%) of funding, though they often receive government grants. Therefore, the acquisition of funding data from these organizations (with the exception of the National Fish and Wildlife Foundation, NFWF, which was chartered by Congress in 1984) should be a side benefit of acquiring data on expenditures of government funds, which do sometimes flow through non-governmental organizations. Most NGOs are very small; focusing on the larger entities by annual budget could reduce data acquisition costs.

It is difficult to separate routine sewerage and stormwater capital projects (i.e., those that maintain current design capabilities) from upgrades (i.e., those that improve water quality protection). Combined Sewer Overflow (CSO) and green stormwater infrastructure projects are the clearest upgrades. Collection system projects are often difficult to assess. A reasonable assumption is that most major capital projects are funded (loans plus some grants) through state water infrastructure financing programs where data acquisition with good descriptions is somewhat easier. Therefore, with the exception of Philadelphia, which is mostly internally funded, relying on state financing program data will be more cost effective than seeking data from individual utilities.

Improving Data Quality and Completeness

One of the major constraints for a project of this type is that every agency and government collects and stores data according to their own needs, not for purposes of aggregation and analysis by others. Differences in data structure (i.e., everything from hard copy archives to Web-based portals), data gaps, missing data field explanations and many other factors required extensive time and effort to fit acquired data into the database. In addition, staff in small municipalities and non-governmental organizations often lack accessible data, an understanding of specific projects (especially from earlier years in the 2014-2022 project period, and time to correctly answer data requests. The effort will be somewhat reduced with the benefit of recent experience, but data quality control and management required a large proportion of staff time and costs.

A major constraint for most acquired data was the lack of geographic coding for the projects, which made it impossible to derive a sound assessment of how project locations (e.g., by watershed) related to other demographic, environmental and equity considerations.

Another constraint is how agencies account for expenditures. In federal and state government, there are generally three levels of fund commitments. First is the agency budget for specific programs, incorporated in the budget approved by Congress or a state legislature. Second is the obligation of funds to specific projects; an obligation is essentially a promissory note, stating that the agency will repay the costs of the project over the project period, which may be multiple years. Third is the expenditure, when the agency cuts the check to the project implementer. Some federal and state data sets did not distinguish clearly among these three steps, and especially between the last two, making it difficult to know whether the information provided represented a commitment (the obligation), which then could result in an expenditure years later (e.g., after negotiations result in closure on a land purchase), or an actual expenditure where the funds were transferred.

Governments can improve public awareness and ease of evaluation through development of consensus approaches for data structure and quality, to provide consistency. Options include identifying the data fields needed (and not needed) and working with prospective data providers to ensure that appropriate data are compiled and retained, and that their data can be provided or easily programmed into the database. Doing so will help secure comparable data and reduce the time spent cleaning and merging data. The William Penn Foundation could encourage inter-governmental discussions about this issue.

Trends in Expert Perceptions of Equity

The interview process provided very useful information on the general expectations of practitioners regarding funding, funding trends, funding constraints, and the consideration of equity in funding allocations and expenditures. The William Penn Foundation should consider periodic evaluations of practitioner perceptions to determine whether and to what extent they are changing. As perceptions and practices are unlikely to change rapidly, interviews on a two to four-year cycle may be most appropriate, or an approach that varied the interview focus from one cycle to the next. One component of this evaluation could be to identify the most critical programs and resources that could address cross-cutting issues equity in water resource-related programs, focused on the aggregate needs of disadvantaged communities and of existing and potential programs.

Recommendations for Use of the Report

Policy opportunities presented in this section derive from findings presented above – including the review of research literature, data collected about government funding for the Delaware Basin, and expert practitioners’ responses to surveys and interviews – and from reflections on potential changes in the Basin’s physical and regulatory contexts in the future. The Rutgers research team presents these policy opportunities to inform the William Penn Foundation and the public but is not advocating for one or another approach.

The Delaware River Basin has benefitted from a long history of regional water pollution control, water supply management and flood control, initially through the Delaware River Basin Commission (DRBC, formed in 1961) and later through the environmental laws and programs of the four basin states and the federal government that came into existence after Earth Day 1970. The water quality results have been transformational for the Delaware River itself, going from anoxic conditions in the upper tidal river reach to a water quality that allows for the annual passage of shad to their historic spawning areas upstream. Municipal and industrial treatment plants are closely regulated, combined sewer overflows (CSOs) are finally being reduced and controlled, and municipal separate storm sewer systems (MS4s) are in the early stages of improved management. Some flooding potential has been mitigated, somewhat, and a robust water supply management system exists.

Hundreds of municipalities, counties, non-governmental organizations and businesses now play major roles in addition to those of the federal and state governments and the DRBC. The results have been important for open space and farmland preservation, the removal of obsolete dams, and to a lesser extent, stream restoration and nonpoint source pollution control.

However, data and interview results from this project clearly show that these programs and results are often achieved in a fragmented, “silo” approach to management, rather than through a large-scale collaboration such as the Chesapeake Bay Program with its \$1.5 billion in annual federal and state expenditures. Ironically, one possible reason for the difference is that the Delaware River Basin’s worst pollution problems are history, while the Chesapeake Bay is still showing the enormous damage from excessive nutrients. Problems of the Delaware may not be sufficiently bad to garner the same level of attention from the federal government. The Delaware River Basin Commission (DRBC) at one time was the dominant convenor regarding many water problems in the Basin, but now is just one of many players, used more to coordinate issues regarding the Delaware River itself than as a convenor of basin-wide collaborative efforts, except where the four states see a value in DRBC action (such as for control of hydraulic fracturing operations and direct wastewater effluent discharges). This reduced prominence clearly plays out in the DRBC’s longstanding budget problems.

The Basin doesn’t capture federal attention to the same extent as other, more troubled places. The Basin states also may tend to see issues in the Basin as:

- Roughly co-equal to issues in other watersheds (e.g., in New Jersey),
- Less of a concern than other watersheds (e.g., in Pennsylvania, which must place priority on the Susquehanna River as a part of the Chesapeake Bay Program),
- A small area of a large state (e.g., New York State, though New York City plays a major role in the Catskills part of the upper Basin), or
- An estuarine focus more than a freshwater resource (e.g., Delaware and southern New Jersey).

The fragmentation of Basin programs by issue, laws and jurisdiction derives in large part from the different needs and political agendas of the states, the lack of federal focus, and the lack of a dominant environmental issue. The research literature reports that watershed management decisions may be largely uncoordinated across jurisdictions or may be somewhat coordinated. Coordination may emerge because decision-makers seek to avoid or reduce penalties from regulations, but other motivators include reducing costs (e.g., a water utility paying to control upstream erosion) or overcoming a political stalemate over environmental conditions. Watersheds where decisions are coordinated in some fashion depend on networks of institutions and on sharing information, including information about current funding and funding needs.

The data about recent government funding for water quality improvements presented in this report could be a step toward information sharing that could build on existing institutional networks in the Basin. Government funding patterns reflect the priorities of individual funding initiatives at all levels of government, which have been built to operate separately from each other. The total funding available addresses a small portion of conditions that could be improved in the Basin's rural and urban areas. The comments of expert practitioners in surveys and interviews affirm their interest in learning about funding across the Basin and their difficulties in leveraging funds that could improve conditions across jurisdictions. Funding sources enable implementers to achieve goals for site-specific projects. This practical focus on projects was the center for their comments. Few mentioned specific aspirations for broader coordination that could provide a basis for bottom-up watershed coordination. Respondents did affirm that they value existing networks and opportunities for information sharing, such as the Delaware River Basin Commission (DRBC), but they felt these networks could be more robust and effective.

The question is whether a galvanizing environmental issue is likely to emerge that could drive a more collaborative approach that increases the effectiveness of water pollution control, land preservation and stream restoration. The physical and regulatory contexts for the Basin are changing, however, in ways that could be used as opportunities for more integrated actions to improve water quality across the watershed. We pose the following possibilities:

- **Climate Change Impacts on Flooding and Drought:** The DRBC's formation was driven in large part by the record flood of 1955, which led to the realization that individual state actions could not solve problems in the Delaware River itself, which is the boundary between the states. The floods of 2004, 2005 and 2006 emphasized this issue. Drought issues were being addressed separately through agreements through the federal court system, but they have become closely entwined with DRBC programs as well. In both cases, climate change can alter the underlying assumptions regarding the frequency and severity of floods and droughts. The challenge will be relating conservation and restoration programs to these issues, as land preservation, stream restoration and land stewardship are rarely seen in this context.
- **Sea Level Rise and the Salt Front:** A separate issue regarding climate change is the associated sea level rise for coastal waters, with projections of a 50% probability that a 1-meter (3.3 foot)

increase will occur by the year 2100, and 1.4 feet by 2050.¹² The Basin’s water supply management scheme is based on assumptions regarding the location of the salt front in the tidal Delaware River, which must stay downstream of river intakes for the water supplies of Philadelphia and southwestern New Jersey, and of surficial aquifers that intersect with the tidal river. Existing management programs recognize that the salt front is very sensitive to river flow, resulting in a meshwork of agreements regarding reservoir releases and reduced withdrawals during droughts. River flows are driven by base flows (i.e., ground water movement into streams, plus wastewater effluent discharges) plus reservoir releases. Sea level rise in this century will force a modification of all models and agreements, as saline waters push upstream. This single issue has the potential to force changes in policies and programs across the board, to offset the effects of sea level rise over time. The obvious change would be in reservoir releases and downstream consumptive water uses, but other changes could target maintenance and enhancement of base flows, especially to the extent that climate change might reduce base flows.

- **Clean Water Act Implementation:** While the Basin does not see severe water quality impairment such as in the 1960s and 1970s period, water quality standards are still being violated in many parts of the Basin, especially in tributaries throughout the suburban and exurban regions due to municipal stormwater systems and nonpoint source pollution. The Clean Water Act with its water pollution remedial requirements (the Total Maximum Daily Load program) is a major impetus behind the Chesapeake Bay Program collaboration and spending both in the bay area and the tributary rivers. While there may or may not be a strong driver for a mainstem Delaware River TMDL that would force major changes, there already are TMDLs for nutrients and bacteria in many tributary waters. Evolution of the MS4 permitting program in the Delaware River Basin could result in regulatory requirements to reduce pollution loads from stormwater and nonpoint source pollution.¹³ The Delaware River is largely the sum of its tributaries, and so improvement in the tributaries – certainly useful for local watershed conditions – will also improve the Delaware River and Bay.

Interview Respondent

SO THERE [ARE] DOZENS AND DOZENS OF MUNICIPALITIES IN THE UPPER DELAWARE WATERSHED THAT ARE NOT MEETING FEDERAL ENVIRONMENTAL REQUIREMENTS, OR STATE ENVIRONMENTAL REQUIREMENTS, SIMPLY BECAUSE THEY DON'T VIEW THEM AS IMPORTANT, NOR DO THEY HAVE THE MONEY TO MAKE IT HAPPEN.

In all three cases, part of the answer may be gray infrastructure (e.g., treatment plants, flood control structures, reservoirs), which is a typical response of an urbanized, mechanized society. However, there are limits to the effectiveness of gray infrastructure. Management of the land (e.g., preservation,

¹² New Jersey Department of Environmental Protection. 2020. New Jersey Scientific Report on Climate Change, Version 1.0. (Eds. R. Hill, M.M. Rutkowski, L.A. Lester, H. Genievich, N.A. Procopio). Trenton, NJ. 184 pp. Available from: <https://nj.gov/dep/climatechange/docs/nj-scientific-report-2020.pdf>.

¹³ Attention nationally is moving to this concept, resulting in increased expectations for expenditures to modify stormwater systems. See: Water Environment Federation. 2021. 2020 National Municipal Separate Storm Sewer System (MS4) Needs Assessment Survey Results. Available from: <https://stormwater.wef.org/2021/03/2020-ms4-survey-highlights-stormwater-funding-needs/>.

restoration) can play a significant part in mitigating river base flow losses, water demands, water pollutant loads, and flooding, if the actions are effectively designed and coordinated at the watershed and basin level. Isolated actions lack scale and impact, and generally are useful only as educational tools. It may require the implementation of thousands of small-scale but coordinated projects in land preservation, ecosystem restoration and stream restoration to achieve the equivalent river flow from one reservoir, or of the flood protection of a single mega-structure, or of the water quality benefits of a single wastewater treatment plant upgrade. However, these many smaller projects will have local co-benefits that major structures cannot, and they can augment the benefits of major structures in a manner that can't be duplicated by gray infrastructure.

Federal and state attention to the Delaware River Basin is unlikely to ever match that shown to the Chesapeake Bay region, which is nearly five times larger, or to the Great Lake region, which is even larger. However, a concerted regional effort to understand and address these three major issues could result in a more robust collaboration of programs that draw additional attention and resources. Even a doubling of federal funding for the Delaware River Basin and the revival of the DRBC as a basin-wide convener of interests could, in turn, attract far more resources and attention from state and local governments, the non-governmental organizations, foundations and businesses.

While these broader, long-term issues are evolving, Basin interests should develop a collaborative approach to several federal funding sources that have recently become more relevant and sizable.

- **Great American Outdoors Act of 2020:** This new law fully funds the Land and Water Conservation Fund (LWCF) at \$900 million per year; this has long been the authorized amount but historically has been budgeted at roughly half that level. The LWCF funds a variety of conservation projects, including the Forest Legacy Program, federal land acquisition, grants to states for land acquisition, and the Outdoor Recreation Legacy Program (ORLP, funding outdoor spaces in cities of greater than 50,000 people).¹⁴ Our understanding is that the Great American Outdoors Act takes the LWCF out of the annual appropriations process, making the appropriations automatic.
Basin Focus: The revitalized LWCF provides a great opportunity to draw more federal funds into the region, and through the ORLP to deliberately improve regional equity through parks projects in cities that both improve recreational access and better protect water resources for under-served communities. A doubling of LWCF funds would be the minimum target.
- **National Water Quality Initiative, Source Water Protection:** The U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS) implements the NWQI, which provides funding and technical assistance for on-farm conservation practices and water quality monitoring and assessment.¹⁵ In FFY2019, the NRCS expanded the scope of the NWQI to include source water protection projects for public water supplies (both ground and surface water), in response to the 2018 Farm Bill. Readiness (planning) projects identify and plan for implementation projects that will better protect these water supplies, in collaboration with the

¹⁴ Appalachian Mountain Club. August 4, 2020. Great American Outdoors Act Signed Into Law, Fully Funding LWCF. Available from: <https://www.outdoors.org/articles/amc-outdoors/great-american-outdoors-act-signed-into-law-fully-funding-lwcf>

¹⁵ USDA NRCS. National Water Quality Initiative. Available from: <https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/water/?cid=stelprdb1047761>

public water systems.¹⁶ The FFY2021 list of projects includes many in the major agricultural states, but also has projects in Connecticut (New Haven system) and Pennsylvania (Reading system in Berks County).

Basin Focus: A focused project in agricultural watersheds that feed public water supplies could be a valuable way of increasing federal investment in the Basin. The program requires local partners, often the utilities, to provide funds and technical support. New Jersey and Pennsylvania could explore approaches to protect the water intakes of the NJ Water Supply Authority (e.g., the Delaware and Raritan Canal), the NJ American Water Company (Delran intake), and the Philadelphia Water Department (Delaware River and Schuylkill River), using a collaborative approach funded through the utilities, state resources and other sources.

- **Stormwater Utilities:** Stormwater utilities are fee-based enterprise funds that focus on the operations, management, maintenance, repair, rehabilitation and upgrading of municipal stormwater systems, including both combined sewers and separate systems. Most stormwater utilities rely on fees that are based on the amount of impervious surface on each land parcel.¹⁷ Western Kentucky University identified more than 1700 stormwater utilities in 40 states and the District of Columbia as of 2019. Of the four Basin states, Delaware has three (Lewes, Newark and Wilmington), New York has one (Ithaca, outside of the Basin), and Pennsylvania has 27, including several municipalities within the Basin such as Allentown, Chester, Easton, Philadelphia. (New Jersey has now authorized the creation of stormwater utilities but none have been formed to date.) The stormwater utility funds may be used by municipal public works departments, utility authorities that also have other services (e.g., wastewater management), or stand-alone entities; creation of a new level of government is not necessary but is sometimes chosen. Biennial surveys by Black & Veatch have emphasized the importance of creating stormwater utilities only when a clear need is identified and popular support is sufficient to overcome the difficulties of program development and implementation.¹⁸ Evidence from many existing stormwater utilities shows that a fee based on impervious surfaces is a more equitable funding approach for stormwater management than either property taxes or sewer fees.
Basin Focus: A collaborative effort could identify municipalities with extensive impervious cover that are more likely to face federal and state requirements for improved management of either municipal separate storm sewer systems (MS4s) or combined sewer systems, where a stormwater utility has not already been formed. An inter-municipal mentoring program could match these municipalities with other municipalities that already have stormwater utilities, as a way of providing peer-to-peer learning and assistance in understanding whether a fee-based stormwater utility will improve both system management and funding equity.

Finally, continued development, dissemination and technical assistance regarding the use of basin-wide information on a broad range of water supply, water quality, flood and ecological issues can help build a

¹⁶ See: Murphy, John D., and Adam T. Carpenter. 2020. USDA Source Water Protection Funding: Successes and Opportunities. Journal AWWA. Available from: <https://doi.org/10.1002/awwa.1481>.

¹⁷ Western Kentucky University. Stormwater Utility Surveys. Available from: https://www.wku.edu/ce/stormwater_survey.php.

¹⁸ Kumar, Prabha, Anna White and Brian Merrit. 2021 Stormwater Utility Survey Report. Black & Veatch Management Consulting. Available from: <https://www.bv.com/sites/default/files/2021-03/2021%20Stormwater%20Utility%20Report%20WEB%20FINAL.pdf>

sense of common interests within the Delaware River Basin. Even if different players focus on their local concerns, a perception of common interests and needs should in turn improve federal, state and local government attention and funding for the Basin.

Appendix A: Project Methodology: Database Development

The project methodology was developed in consultation with William Penn Foundation staff and an expert panel as listed in the [Acknowledgements](#) section, which included members from governmental, non-governmental and academic entities. The project is focused primarily on acquisition, management and interpretation of project expenditure data using government funds, but also includes acquisition of projects that depend on other funding sources, often as match to government grants. The methodology also includes the interview process for expert practitioners, and a brief literature search.

The methodology for the database includes identification of project categories, funding sources and funding types (e.g., general revenue versus bonds). The database structure was developed to allow a sorting of analysis of data across these parameters and by year. Based on these initial steps, the project team sought data from the relevant governmental sources and also from non-governmental entities that make extensive use of government funds.

Geography

The project area is the entire Delaware River Basin (DRB) in the states of New York, Pennsylvania, New Jersey and Delaware. Using available geographic and demographic information, the project identified relevant jurisdictional boundaries (e.g., state, county, municipal) and watersheds (HUC12) to determine what jurisdictions are partially or entirely within the DRB and the various subwatersheds thereof, and to what extent. This information was linked to the database file through GIS intersection. Finally, demographic information (e.g., population, household incomes) was added to the database for each census tract in the DRB. The following data sources were used.

Step	Data Sources
1. Counties and Municipalities	DRBC: GIS shapefile including the Basin and jurisdictional boundaries
2. Subwatersheds	USGS Hydrologic Unit Code system and maps, https://pubs.usgs.gov/gip/hydrologic_units/index.html
3. Stream reaches	National Hydrography Dataset, https://www.usgs.gov/core-science-systems/ngp/national-hydrography/national-hydrography-dataset?qt-science_support_page_related_con=0#qt-science_support_page_related_con
4. Land use and land cover	Shippensburg University, Delaware High-Resolution Land Cover Dataset (https://drbproject.org/delaware-land-cover-dataset/) for all four states in the Basin NJ Land Use/Land Cover, 2015.
5. Demographics	U.S. Bureau of the Census: 2010 Census, American Community Survey (ACS).

Literature Search

A literature search was conducted across a variety of databases related to funding for projects related to watershed conservation, restoration, and resiliency, and background research on watershed management approaches. The primary purpose of the literature search was to identify similar compilations of regional expenditures for environmental purposes, and especially watershed management programs, that could provide lessons for the construction of a relational database and compilation of relevant data.

Searches of databases used included: PAIS Index, Westlaw Campus Research, Worldwide Political Science Abstracts, Google Scholar, and Rutgers Libraries search engine. Key words used to search across

these databases were: spending AND river, budget AND watershed, budget AND river, appropriations AND watershed, watershed funding, watershed restoration funding, spending AND watershed, spending AND rivers, spending AND watershed, land preservation, stream preservation funding, government capacity, and government environmental capacity.

Methods for searching spending (gray literature)—USA only

- Federal programs:
 - Chesapeake watershed (e.g. Chesapeake Progress, <https://www.chesapeakeprogress.com/?/funding>, and Chesapeake Bay Program Funding, https://www.chesapeakebay.net/who/funding_and_financing)
 - Great Lakes
 - Farm Bill conservation practices
 - Delaware River Basin Restoration Program (DRBRP) in U.S. Fish and Wildlife Service
- Other similar watershed management or source water protection examples
 - NYC’s Catskill/Delaware watersheds (filtration avoidance program)
 - Philadelphia: Schuylkill not much has been studied, but new Action Plan being developed per web site
 - Pennsylvania Land Trust Association analysis of municipalities with dedicated open space funding

Methods for searching spending (academic) —USA only

- What methods have academics used to research spending for... [potential search terms]
 - Budget/appropriations/spending/expenditures... and
 - Land acquisition/ conservation/preservation/stewardship
 - Land/ecosystem restoration
 - Biodiversity conservation
 - Watershed management
 - Water quality
- Analog searches: similar policy realms that include the initial investments (we capture this as spending to purchase land) plus monitoring, maintenance, or upgrades (we capture this as spending on restoration of degraded lands). NOTE: this component is secondary to the next section on policy, administration, etc.
 - Public health—who has written about how you can calculate the total spending being done to improve public health? This approach is more complex than estimating spending on land conservation within a specific geographic scope (e.g., a search on “new york city watershed protection”) but might provide some useful ideas.
 - Infrastructure—similar approach

Policy, administration, organizational studies, research on concepts

- Local organizational or agency capacity (including current staffing, wealth, and other indicators of what might be spent)
- Equity (household financial, demographic, ethnic/racial) in spending for public purposes (whether spending comes from government or private sources)
- Efficiency? Do only a simple search of academic research on this.

Conceptual bounds--academic

- How do people define what constitutes spending on a policy concern? Search for useful guidelines, not philosophical debates.
 - Distinguishing: Budgets, appropriations, spending (project implementation)
 - Budgets as expressions of values
 - How do people distinguish spending for operations (ongoing staff etc. budgets) from spending on projects (land purchases, etc.)
- Governance vs. government
 - Without getting into debates about the neoliberal state, identify any literature review articles about
 - Spending by fed agencies vs. matching sources
 - Federalism and conservation spending

Once literature was identified, copies were collected using Zotero reference management software (or EndNote). Further relevant literature was identified by examining bibliographic sections of previously collected literature. The general result of the literature search is that there are few scholarly or practitioner references that address similar compilations of regional expenditures. These and other references are included in [Appendix F: Bibliography](#).

Interviews and Surveys of Key Experts

The Rutgers team interviewed key experts from state agencies, local governments and the non-governmental sector who work within or lead programs that directly affect water resources in the Basin. Potential interviewees were identified by members of the expert panel, William Penn Foundation staff, and the Rutgers project team. The team selected candidates from this list, aiming to reach experts with knowledge of programs across the Basin, experts from agricultural and natural resources programs, and experts with experience across agencies at each level of government, nongovernmental organizations, and firms.

We sought the perceptions of experts familiar with one or more of the major programs that funds water quality improvements in the Delaware River Basin. Interviewees and survey respondents included government experts who implement federal and state water resource and agriculture programs, state government experts in agencies' environmental justice initiatives, experts working on private sector conservation projects, and leaders from regional and site-specific nongovernmental organizations. Each interview was conducted through conversations online due to pandemic restrictions, using a protocol approved through the Rutgers Institutional Review Board (IRB). [Appendix D](#) provides the questions used for the in-person interviews.

In addition, the expert panel answered the same questions using an online Qualtrics survey, again in accordance with an IRB-approved protocol. [Appendix E](#) provides the Qualtrics survey questions.

Database Structure

The database structure was developed through an iterative process. Initially, Microsoft Access was selected as the initial database program platform, due to William Penn Foundation staff familiarity and common use of Access with ESRI GIS software. The initial structure was created using a combination of known fields that store and allow for search queries and relational database analysis, in support of the project. As initial funding and project data were gathered, the database structure was modified to

ensure that all critical information could be loaded and searched. The following steps were used in database structure development. The database was built to accommodate expenditure data from 2014 through 2020. Because fiscal years differ between federal, state and local governments, the database stores data using the last year of the fiscal year (e.g., Federal Fiscal Year 2018 is stored as 2018). In Phase 2, the database was switched to MySQL 5.7.43 because MySQL is available for any user who wants to access the data in the future, regardless of operating system. Microsoft no longer ships Access as part of the Office suite and is slowly moving away from this software. At some point Access will no longer be supported and will be difficult to install on a machine.

Step	Method	Comments
1. Data fields and definitions	Develop a full set of data fields that need to be part of the database, with field definitions	Based on the literature search, project needs and initial identification of funding sources and expenditure types and locations. Included: contact and organization information and identifiers; project information, identifiers and locations; funding organization; receiving/expending organization; project category; project funding sources and levels (current year and future year expenditures); jurisdiction; project watershed(s) and subwatershed(s); fiscal year and relationship to database year.
2. Database structure	Create database table structure	Structure must allow full database development and analysis methods. See chart below
3. Field linkages	Create linkages between relevant database fields	See chart below
4. Data queries and reports	Develop a full set of data queries, statistical analyses and report templates	Statistics by: year; project category; funding source type; funding government level (e.g., federal, state, county, municipal) and agency; receiving/expending organization category (e.g., government, non-profit, utility); and watershed location.
5. Beta testing	Test all aspects of the database for correct operation and GIS interoperability	Initial data sets from readily available sources. Trial and modification as needed.
6. Final testing	Address any issues from beta testing and finalize database structure and protocols	Trial and modification as needed. Iterative process as new data sets are acquired.

Figure A-1 provides the current database structure, showing the relationships between organizational descriptions, data request status, contact information, funding entity, project information and project funder. To avoid double-counting (where multiple entities identify expenditure of the same funds), reports were analyzed to detect possible duplicate entries. An Access Query showing project name, type of project, location, amount, fiscal year, funding entity, and data source was generated and copied into Excel. Using the Conditional Formatting feature to highlight cells with duplicate values, projects with the same location, same funder, same funding amount, and same project type, but which data was provided by different data sources were identified and scrutinized to determine if they were duplicate data or complementary data. Duplicate records were deleted.

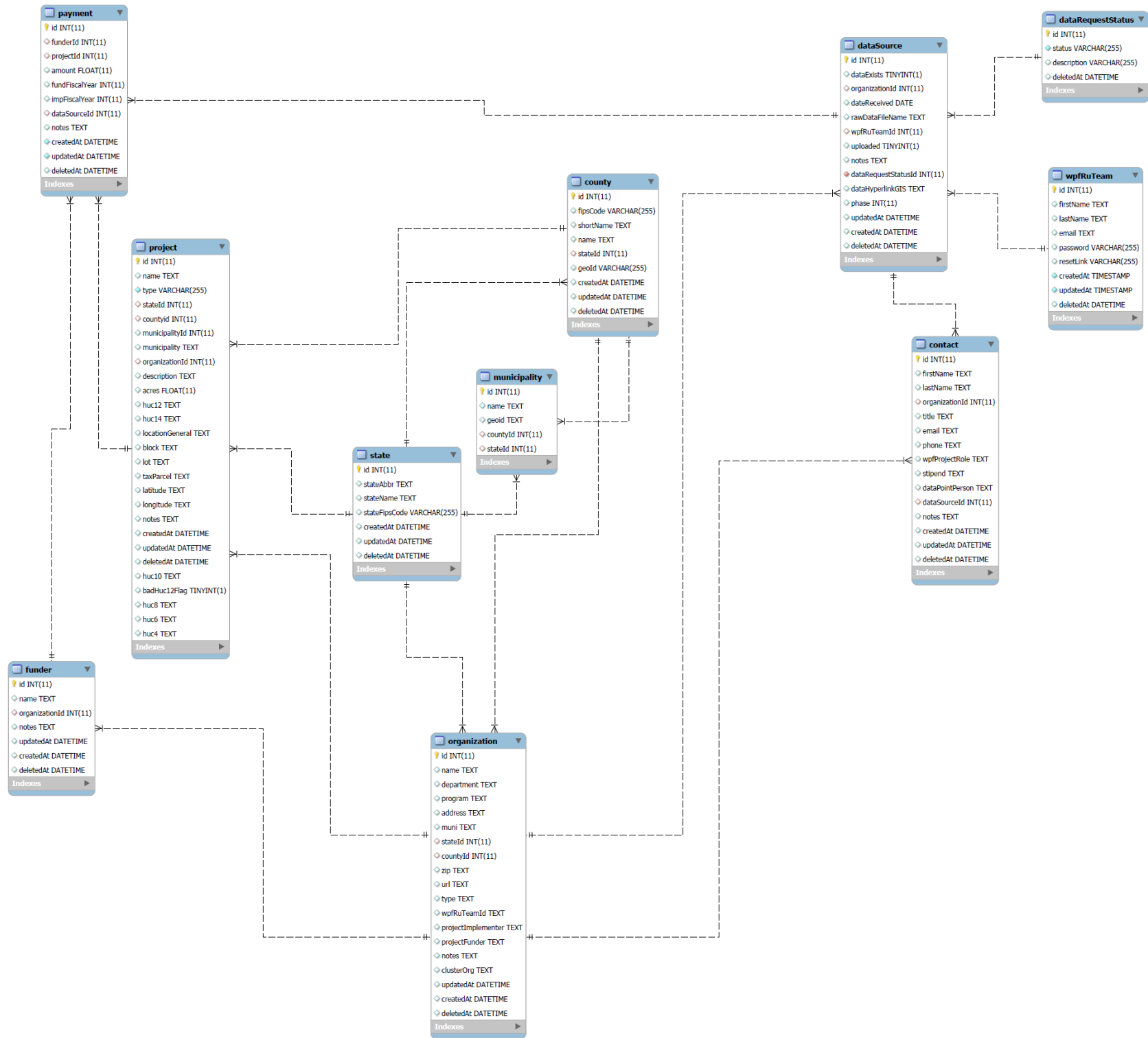


Figure A-1. Project Database Structure

Governmental Agencies Associated with Project Spending

The first step in data collection was identification of nearly 1,000 governmental entities that represent federal, state, regional, county and municipal levels located or with active programs partially or entirely within the Delaware River Basin, using a spreadsheet that incorporated available information on funding programs and sources (e.g., land preservation, best management practices, stream restoration) where a single governmental entity has more than one program. A 2016 University of Delaware report previously developed for the William Penn Foundation¹⁹ was used as one source of information on existing entities and programs. The spreadsheet includes contact information, request status, data availability (Yes/No) and data collection status. Initial inquiries to New Jersey agencies plus on-line search for all readily available data were used to test the process.

Government Funding Entities

The following entities represent the major categories of federal and state funding programs and associated agencies. A more complete discussion of federal agencies can be found in [Appendix C: Government Funding Agencies and Programs](#). Local government programs are primarily focused on land preservation; they may use grants from higher levels of government and from foundations and the non-profit sector to implement nonpoint source pollution control projects. There are nearly 900 counties and municipalities in the Basin, which were identified and contacted, but are not listed here for brevity. In addition, while non-governmental funding as a standalone funding source and as a matching source is mentioned by respondents to the survey or in interviews, it is not addressed here.

Federal Agencies	
Departments	Agency/Programs
Department of Agriculture (Note: for NRCS and FSA, identify WQ-focused Ag BMPs)	<ul style="list-style-type: none"> NRCS/FSA: Environmental Quality Incentives Program NRCS: Regional Conservation Partnership Program NRCS: Conservation Stewardship Program NRCS: Healthy Forests Reserve Program NRCS: Agricultural Conservation Easement Program US Forest Service: Land & Water Conservation Fund – Forest Legacy Program
Department of Interior	<ul style="list-style-type: none"> USF&WS: National Wildlife Refuge Program, Cooperative Endangered species fund, national coastal wetland conservation grant, Delaware Watershed Conservation Fund; Partners for Fish and Wildlife; Wildlife and Sportfish Restoration Funds; Resource Management base funds. National Park Service (NPS): Delaware Water Gap National Recreation Area; National Monuments; National Historic Parks; Wild & Scenic Rivers Program; LWCF State and Local Assistance Program Land & Water Conservation Fund – Cooperative Endangered Species Conservation Fund (“Section 6”), Highlands Conservation Act (HCA)
Environmental Protection Agency	<ul style="list-style-type: none"> State Grants in Aid for 319, 604b, Clean Water SRF (e.g., stream restoration, lake restoration, green stormwater infrastructure) Supplemental Environmental Projects (SEP) Natural Resource Damage (NRD) funds

¹⁹ Water Resource Center. 2016. Survey of Investment in the Delaware River Watershed (draft). University of Delaware on behalf of the William Penn Foundation.

Federal Agencies	
Departments	Agency/Programs
	<ul style="list-style-type: none"> National Estuary Program (Section 320 CWA); Delaware Estuary
Department of Defense	<ul style="list-style-type: none"> Army Corps of Engineers-Civil Division Department of the Army: Compatible Use Buffer (ACUB) Program
Department of Commerce: NOAA	Fisheries: Office of Habitat Conservation; Restoration Center
Department of Homeland Security	Federal Emergency Management Agency

State Agencies	
Delaware	Department of Agriculture: Aglands Preservation and Planning Department of Health and Social Services <ul style="list-style-type: none"> Division of Public Health, Office of Drinking Water Department of Natural Resources and Environmental Control: <ul style="list-style-type: none"> Division of State Parks Division of Climate, Coastal and Energy Division of Fish and Wildlife Division of Parks and Recreation Division of Water Division of Watershed Stewardship, Nonpoint Source Control Program DNREC/DHSS (Joint Program): Clean Water State Revolving Fund and Drinking Water Sate Revolving Loan Fund DELDOT - Transportation Alternative Program (stormwater management)
New Jersey	NJDEP Green Acres Program (Green Acres, Blue Acres) NJ State Ag Development Council (Farmland Preservation) NJDEP, Office of Natural Resources Restoration – NJDEP Division of Water Monitoring (319h NPS program) NJ Infrastructure Bank NJDOT - Transportation Alternative Program (stormwater management)
New York	Department of Environmental Conservation (e.g., Water Quality Improvement Program) Department of Health Department of Parks, Recreation & Historic Preservation NYSDOT - Transportation Alternative Program (stormwater management)
Pennsylvania	Department of Agriculture Department of Conservation and Natural Resources: <ul style="list-style-type: none"> Community Conservation Partnership Program Department of Environmental Protection Fish and Boat Commission Game Commission PENNVEST (PA Infrastructure Investment Authority) PADOT - Transportation Alternative Program (stormwater management)

Funding Categories

Governmental funding sources vary among governmental levels, agencies and programs. The specific programs generally use one typical funding source, such as these major funding categories. In some cases, funding sources for a program may shift over time, such as from bond funds to a dedicated tax or general revenue.

“Permanent” Revenue Sources	Temporary or Special Revenue Sources
General revenue (e.g., income tax, sales tax)	Bond acts and authorizations
Ad valorem property tax	Grants in aid (from higher level of government)
Enterprise funds (e.g., utility rate revenue)	Natural resource damages
Real estate transfer tax	Foundation grants
Excise taxes	Improvement district fees
Consumer demand-based revenue (e.g., permit fees, user fees, hotel taxes)	Time-limited revenues (i.e., authorized for specific number of years)

Project Identification

The primary objective of the project is a compilation of project expenditures by relevant implementing entities. Identifying funding budgets and obligations involved a top-down approach (i.e., contacting the governmental entities discussed under Funding Sources, above) and a bottom-up approach (i.e., identifying funding sources based on project reporting and grant match information by implementing entities, including non-government entities).

Some federal agencies do not directly implement projects, but rather provide funds through grants-in-aid to the states, which are then either directly used for state projects (e.g., land acquisition) or are passed through to other recipients (e.g., Section 319(h) grants, State Revolving Funds). Federal agencies also provide funds directly to landowners in some circumstances (e.g., NRCS/FSA Farm Bill programs). Federal agencies that operate public parks and wildlife refuges, on the other hand, will implement some acquisition and restoration projects directly while at other times providing grants to other entities (e.g., the National Park Service operates the Delaware Water Gap National Recreation Area but also provides funds to governmental entities and non-profit organizations to purchase lands). All the same government categories from [Government Funding Entities](#) were included as targets for project identification. (Note that ongoing operations of federal agencies, technical assistance programs, public education functions and such are not included in the database, as they are not land acquisition or water restoration projects.)

In addition, many non-profit organizations implement government-funded projects, and some water and sewer utilities may also. Regarding non-profit organizations, the Coalition for the Delaware River Watershed, the National Fish & Wildlife Foundation, the Open Space Institute, and the Delaware River Watershed Initiative organizations were the first points of contact. Online searches and networking were used to identify additional projects. [Appendix B: Potential Project Implementation Entities](#) has a more detailed listing of potential non-profit organizations, water utilities and universities that may implement projects that are funded by federal, state and local governments.

In each case, the initial contact was by email, with follow-up by email and telephone, and if necessary, a formal public information request. The emails followed the following general format.

Rutgers is working with the William Penn Foundation (WPF) to quantify annual government spending in the Delaware River Basin (DRB, see attached map) from 2014 through 2019 for open space and farmland preservation, stormwater management and stream restoration projects that protect and improve water quality (see attached listing of project types). Please note, the project does not include government expenditures for regulatory actions such as development review, compliance and enforcement, nor for developer efforts in response to permit requirements or enforcement actions.

We understand that your agency may fund or use pass-through grants for such efforts. If not, please let us know so that we can correct our information. If so, we request your assistance in providing available data for the 2014-2019 period, preferably as a digital spreadsheet, database, or GIS file. Let us know if there is a more appropriate point person for this information in your organization.

Specifically, we are interested in the following data for related activities in the DRB:

1. Government budgets (e.g., appropriations, obligations) and actual expenditures for each funding source
2. Government expenditures by project for each year, including geographic location (at least municipal level, preferably site level where allowed or feasible)
3. Where matching funds are used, the source (government and non-government) by project where available, or at least identification of any project partners outside of your agency who may have provided matching or supporting funds.

Please advise us of whether the requested information can be provided and a timeline. Our planned data acquisition period is through July.

Many thanks for your assistance and stay well!

One critical point is that the database was developed based on reported project expenditures, which are distinct from overall program funding (budgets). A good example is the Environmental Protection Agency, which provides funds to the region through Section 319(h) and National Estuary Program grants. Most of these funds flow through state agencies or NEP organizations (i.e., Partnership for the Delaware Estuary), which in turn may sub-grant funds to other entities for project implementation. This movement of funds through multiple levels (federal to grantee to sub-grantee or contractor) complicates the understanding of expenditures, potentially resulting in double-counting (where multiple entities identify expenditure of the same funds) or missing expenditures. The project team engaged in quality assurance to avoid double-counting, but in some cases, expenditures were not reported, resulting in an undercount of funding to the Basin. In some cases, the necessary documentation for this purpose was not available. Each agency or organization collects (or does not collect) information as appropriate to its own purposes. None of the data sets were developed with the intent of contributing to a regional compilation.

Data Acquisition

The data inquiry and collection process took place from April to September 2020, entirely overlapping with the SARS-CoV-2 pandemic, and then from late-2021 through early 2023. In a few cases, online data were available, but this was rare.

Where online data were not available, the “owners” of the data were contacted by email and/or telephone, wherever an appropriate contact point could be identified. Where necessary, formal requests were filed; some agencies have policies requiring that data will be released only upon receipt of a formal open public records request, which allows tracking of data responses. Such requests were

rarely required but in some cases were required and then rejected. The larger problem was identifying the appropriate point of contact for data. There are numerous cases (especially at the municipal level) where multiple inquiries resulted in no response, and so it is not known whether data exist.

In each case where a responsive contact was achieved, the database identifies where data were:

- **Determined to not exist.** The agency confirmed that they neither budgeted nor expended funds relevant to this project.
- **Determined to exist and provided.** Agency staff were able to access the necessary information for these inquiries.
- **Determined to exist but currently unavailable.** In some cases, the agency staff did not have full access to in-office computer systems and files, making it difficult or impossible to respond to the data requests. For those agencies with data access, in some cases the staff lacked sufficient time to compile and provide the data due to furloughs, shifts in work assignments, etc. Data also may exist in hard-copy storage, requiring physical access to file storage and significant time commitments for compilation.

Online and agency-provided data were reformatted and clarified as necessary to allow for loading in the database. No substantive information was changed, though the native data structure usually required modifications, and information needed to be added to fill the required fields for the database, such as project location, contact and organizational information, etc.

Data Evaluation

A variety of analyses were performed and provided using the database. The primary purpose of the project is to assess annual government expenditures as described above, including status and trends over the 2014-202 period. The second purpose is to understand the expenditure patterns of these funds, by funding source, project sponsor and affected populations. In addition to the tabular results, narrative discussions will be provided, including maps where relevant. More detail is provided in the next section, [Assessment of Expenditure Patterns](#). This project report discusses data gaps and identifies methods for improving the database over time. Primary analyses include:

Step	Discussion
1. Data completeness, quality and weaknesses	Data identification and acquisition efforts will inevitably result in missing or incomplete information, especially regarding small municipalities and non-governmental organizations. The identification of expenditures by water and sewer utilities also was difficult. Data quality issues may include low-resolution locational information (e.g., municipality only, with no watershed referent), missing information on project partners or funding sources, missing budget information, etc.
2. Budget and expenditures by project category	Summation in tabular form. This analysis provides a basin-wide aggregation of budgets (or obligations, where necessary to differentiate budgeted funds by whether or not they are focused on the DRB) and expenditures.
3. Budget and expenditures by project category,	Summation in tabular form. This analysis breaks down the basin-wide aggregation by government level (e.g., federal, state, county and

Step	Discussion
government level, jurisdiction	municipal). Specific local jurisdictions are highlighted where they play a major or unusual role.
4. Budget and expenditures relative to watershed	Summation in tabular form. This analysis breaks down the basin-wide aggregation by watershed, to provide a geographic sense of expenditures. However, many project expenditures lacked sufficient geographic identification information.
5. Budget and expenditures relative to landowner category	Summation in tabular form. This analysis compares expenditures for land preservation and BMPs against the total amount of eligible lands in those categories, for the DRB as a whole, and by watershed for comparison to the Basin level.
6. Budget and expenditures relative to average household income, racial/ethnic geography	Equity indicator. Summation in tabular form. Comparison of expenditures by county against the average household income as an indicator of wealth, and racial/ethnic concentrations as a potential indicator.
7. Budget and expenditures relative to governmental fiscal capacity	Equity indicator. Summation in tabular form. Comparison of actual expenditures relative to an indicator of government fiscal capacity to fund projects.
8. Budget and expenditures relative to environmental benefit	Deferred due to methodology issues and the increased project effort required for data acquisition. The intent was to assess how funds related to environmental objectives.

Assessment of Expenditure Patterns

This report includes an assessment of how known expenditures reflect a variety of considerations, most important being equity. A primary question is how the term “equity” should be applied in the analysis. Rutgers evaluates how revenue sources, budget allocations and expenditures relate to the following factors.

- Governmental capacity
- Geographic and demographic equity
- Environmental and land use situation
- Environmental benefit

Governmental capacity

The question here is the extent to which governmental capacity affects the types of funding used for watershed projects, the level of expenditures and the types of projects. The [Literature Search](#) provided few thoughts on how to assess governmental capacity to support public functions in the environmental field. National discussions regarding affordability of water and sewer utilities provide some insights on governmental capacity²⁰ and are reflected in this report. However, some simple metrics could be valuable either alone or in combination. The focus is on the level of available economic wealth from which a government can tap some portion for public purposes. The focus here is not on how much of that wealth a government decides to tap, which is affected by mandates and local priorities. For

²⁰ A good discussion is available from: National Academy of Public Administration. 2017. Developing a New Framework for Community Affordability of Clean Water Services. Washington, DC. This report is available from: https://www.napawash.org/uploads/Academy_Studies/NAPA_EPA_FINAL_REPORT_110117.pdf

example, one wealthy community may decide to minimize general government services,²¹ while a similar community may decide that additional expenditures (e.g., open space acquisitions) enhance the long-term value of the community. A less-wealthy community may also decide that additional expenditures (e.g., green infrastructure to control local flooding) are beneficial despite the more constrained availability of resources.

The Rutgers team did consider the possibility of assessing the concept of social capital as a partial measure of governmental capital, but no statewide or regional assessments of social capital are available, and deriving this information is not within the project budget or framework. However, we recognize that increased social capital does play a major role in the ability of governments to think through issues, identify solutions and marshal funds to implement the solutions.²²

Based on the considerations above, the following metrics were evaluated.

- **Aggregate annual household income of the jurisdiction:** This metric incorporates both population and household income. The concept here is that more total wealth provides more flexibility in raising and expending government revenues. Jurisdictions with few people, however wealthy, will likely spend most government revenue on mandatory programs such as schools, police and road maintenance, as they do not benefit from economies of scale. Those with many people can support a more diverse set of programs and needs, and those with more people and of higher income will have even more flexibility to fund needs beyond the mandatory programs. Again, whether they choose to increase the municipal expenditures budget is a separate issue, beyond the scope of this project.
- **Average annual household income of the jurisdiction:** Whether small or large, a jurisdiction with a low average household income will be more constrained regarding non-mandatory expenditures. Those with many households below the statewide 20th percentile income or poverty level will face large needs to mitigate threats to those households. It will be difficult to free funds for programs that are both non-mandatory and not directly aimed at mitigating the impacts of low incomes and poverty. In most Basin states, local governments do not rely heavily on income taxes, which are primarily a state tax.²³ Still, areas with higher average household incomes generally should be able to tolerate higher local property tax burdens.
- **Aggregate corporate income of the jurisdiction:** This metric addresses the wealth generated by business activity, some portion of which can be captured for government activities. Because corporate income taxes are usually reserved to the federal and state governments, this metric is not relevant to local governments.

²¹ In this analysis, school costs are not included within municipal expenses, as in most areas elected school boards determine school taxation levels rather than municipal governing bodies.

²² For example, see: Larson, Lincoln R., T. Bruce Lauber, David L. Kay, Bethany B. Cutts. 2017. Local Government Capacity to Respond to Environmental Change: Insights from Towns in New York State. *Environmental Management* (2017) 60:118–135. DOI 10.1007/s00267-017-0860-1

²³ A major exception is New York City. However, the Catskill/Delaware watershed management programs of interest for this study are funded with NYCDEP utility revenue from ratepayers.

- **Total ad valorem property tax assessments:** Municipal governments throughout the region rely heavily on a combination of property taxes and state aid. Therefore, understanding the total assessed property value provides a good metric for capacity to capture government revenue. Individual municipalities will differ in how much they tap that capacity (the property tax rate), but that is a matter of priorities, not capacity. However, it should be recognized that tax assessments do not necessarily reflect the ability of households to pay taxes. It is common in areas with aging populations to have households that are land-rich and cash-poor, until such time that these households shift to other housing or age out and are replaced by those with more balanced housing to income ratios. This metric would provide a sense of local residential wealth (as distinct from income). However, difficulties arise with differences among the states regarding assessment methods, online availability of comprehensive results, and whether the municipality's assessments are current. Unfortunately, while this information is available for New Jersey, similar information from the other states was not found.
- **Annual governmental revenue budget:** The total budget of a government has major effect on whether a jurisdiction will fund open space purchases and water resources restoration. However, this is a metric of actualized capacity, not inherent capacity. It reflects taxing and spending priorities, rather than the underlying capacity of a government to raise revenues. In addition, the total budget reflects grants in aid from higher levels of government, which are measures of the granting jurisdictions rather than the recipient government that adopts the budget. Therefore, this measure should only be used if it is feasible to identify the self-generated revenues for specific jurisdictions. Identifying jurisdictions that have been especially active, or inactive, in seeking discretionary grants may be another useful approach, given the increased use of competitive federal grants in recent decades. For funds from the federal level, there is no issue. State budgets directly distinguish state revenues from federal aid. The question will be whether local governments do likewise.

FINAL APPROACH: With a universe of only four state governments, each of which has major areas outside of the Basin, an analysis of state financial capacity was not deemed useful. For counties and municipalities, a relative ranking of capacity to generate government revenue uses the following three metrics:

- **Aggregate annual household income at the jurisdictional level.** This metric is the most direct method of understanding local residential income. Note that it does not measure investment or savings assets, which would be beneficial to know but not feasible in this study. This information was drawn from U.S. Bureau of the Census information.
- **The percentage of households at or below the national poverty level.** This information is reported by the U.S. Bureau of the Census. As the national poverty level is a "one size fits all" national metric, use of the 20th percentile income level was preferred, but this metric is not reported by the U.S. Bureau of the Census, and is more difficult to derive from Census information. **Figure A-2** shows the Census results, with a map showing the Basin coverage.

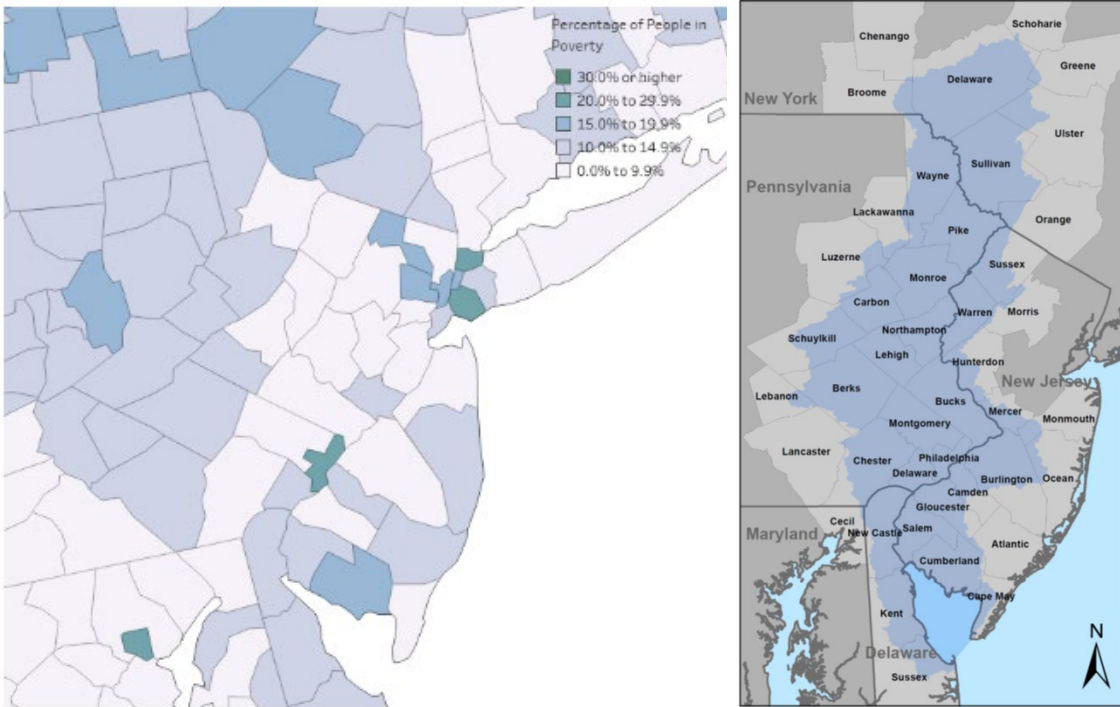


Figure A-2. Percentage of People in Poverty by County: 2015-2019

U.S. Census Bureau, <https://www.census.gov/library/visualizations/interactive/acs-percentage-poverty-2015-2019.html>

One significant difficulty encountered by the project team was a recent, major modification of the public portal for information from the U.S. Bureau of the Census, which complicated access to information by municipality and county due to coding and data portal construction.

The two metrics can be used in combination but for this report are each used independently, as there is no readily available method for combining the metrics. Rather, sorting the counties and municipalities for each metric yields a graduated ranking for each that can be divided into ranges; quintiles are used here. Jurisdictions in the bottom quintile for the first two metrics and top quintile for the third are considered the most stressed in terms of governmental capacity, and vice versa.

Census estimates of total households and average household income were compiled for counties and municipalities. However, given the lack of sufficient geographic location data, the analysis was performed at the county level, focused on those counties with significant land area in the Delaware River Basin. **Table A-1** shows the results; counties shown in bold are entirely or largely within the Basin, and therefore of greatest interest. For all Basin counties, the average household income is slightly more than \$78,000. Counties that are greater than 120% of that average are highlighted in green, and counties that are less than 80% of that average are highlighted in pink. The right-hand column shows the Census Bureau estimates of the population (not households) below the National Poverty Level.

Table A-1. Average Household Income, Total Household Income and Population Below National Poverty Levels, by County in the Delaware River Basin (Counties in bold are largely in the Basin)						
County	# of Households	Average HH Income	HHI Relative to Average of Basin Counties	County HH Income (million)	Population Below National Poverty Level	BIPOC Population
DELAWARE						
Kent	54,896	\$63,041	80.6%	\$3,461	13.0%	39.6%
New Castle	199,840	\$79,539	101.6%	\$15,895	10.1%	36.4%
Sussex	74,029	\$60,732	77.6%	\$4,496	12.6%	24.6%
NEW JERSEY						
Atlantic	100,096	\$66,404	84.9%	\$6,647	11.1%	44.0%
Burlington	163,961	\$95,028	121.4%	\$15,581	5.5%	33.4%
Camden	189,895	\$74,571	95.3%	\$14,161	10.7%	77.2%
Cape May	42,763	\$76,635	97.9%	\$3,277	8.8%	15.0%
Cumberland	50,237	\$64,370	82.3%	\$3,234	13.2%	54.6%
Gloucester	104,782	\$83,765	107.0%	\$8,777	7.7%	22.2%
Hunterdon	47,550	\$120,962	154.6%	\$5,752	3.6%	15.2%
Mercer	131,500	\$95,784	122.4%	\$12,596	12.8%	51.8%
Monmouth	234,582	\$109,907	140.4%	\$25,782	6.0%	24.9%
Morris	177,786	\$121,784	155.6%	\$21,651	5.5%	29.5%
Ocean	220,972	\$72,963	93.2%	\$16,123	9.0%	15.7%
Salem	24,898	\$69,308	88.6%	\$1,726	12.4%	26.6%
Sussex	54,881	\$96,527	123.3%	\$5,297	4.7%	14.9%
Warren	41,208	\$85,614	109.4%	\$3,528	6.8%	19.6%
NEW YORK						
Broome	78,549	\$69,491	88.8%	\$5,458	18.8%	17.3%
Delaware	18,968	\$63,417	81.0%	\$1,203	16.6%	8.2%
Greene	17,100	\$70,633	90.3%	\$1,208	14.0%	15.2%
Orange	124,627	\$80,178	102.5%	\$9,992	12.5%	37.3%
Sullivan	31,599	\$57,954	74.1%	\$1,831	16.0%	29.3%
Ulster	68,581	\$67,106	85.7%	\$4,602	11.9%	21.2%
PENNSYLVANIA						
Berks	155,329	\$65,824	84.1%	\$10,224	12.0%	29.7%
Bucks	227,393	\$91,799	117.3%	\$20,874	5.9%	16.7%
Carbon	25,135	\$57,312	73.2%	\$1,441	11.7%	9.0%
Chester	184,160	\$107,732	137.7%	\$19,840	6.4%	21.2%
Delaware	206,516	\$79,614	101.7%	\$16,442	10.0%	34.4%
Lackawanna	84,662	\$59,472	76.0%	\$5,035	14.7%	16.2%
Lancaster	194,028	\$65,390	83.6%	\$12,687	10.1%	18.7%
Lebanon	50,701	\$65,572	83.8%	\$3,325	10.8%	19.0%
Lehigh	133,421	\$66,769	85.3%	\$8,908	12.5%	37.5%
Luzerne	129,884	\$55,862	71.4%	\$7,256	14.7%	20.7%
Monroe	58,234	\$66,397	84.8%	\$3,867	11.2%	35.5%
Montgomery	308,233	\$99,641	127.3%	\$30,713	5.9%	25.0%
Northampton	111,706	\$72,010	92.0%	\$8,044	8.6%	24.6%
Philadelphia	575,413	\$49,307	63.0%	\$28,372	24.3%	65.7%
Pike	22,119	\$84,629	108.1%	\$1,872	9.5%	20.4%
Schuylkill	60,449	\$51,384	65.7%	\$3,106	12.4%	9.9%
Wayne	18,841	\$70,356	89.9%	\$1,326	11.4%	10.1%
Basin Counties	4,799,524	\$78,260		\$375,608		

The results are distributed as shown in **Figure A-3**.

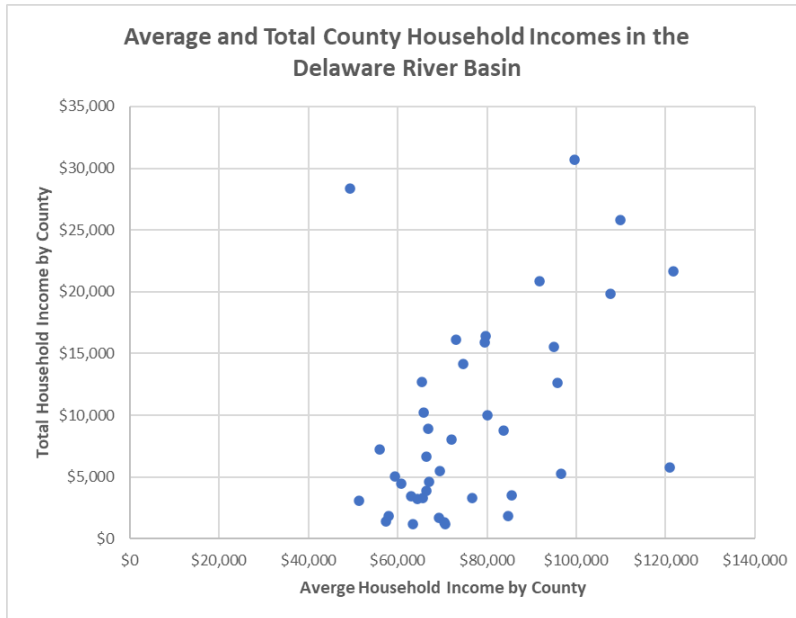


Figure A-3. Average and Total County Household Incomes in the Delaware River Basin

Geographic and demographic equity

Equity can be defined in many ways, including equity of process (freedom from bias or favoritism) and equity of results (Brasheer et al 2002; Sheppard et al., 1992). The latter can be applied going forward, so that new decisions are equitable, or it can be applied comprehensively to both the future and the results of the past, which can require redressing past inequities where the past has result in currently inequitable conditions. Programs that distribute funds widely, like farm and resource programs, are expected at least to have processes that are procedurally fair. Equity can be viewed program by program (e.g., source water protection), or relative to the overall impact of multiple programs within a category (e.g., protection of drinking water at the source, upon treatment and upon deliver to customers). Equity can be viewed based on a variety of social and demographic groups. In this case, the concept is applied to the equity of government decisions from the years 2014 through 2019. In addition, the differences in governmental capacity discussed in the prior section provide clear inference of the present expression of past inequities.

Equity can be evaluated in many ways. Are all small municipalities receiving the same types of assistance? Are areas with high concentrations of disadvantaged households or ethnic/racial groups receiving sufficient funds to elevate their efforts to achieve a more equal level of watershed services as wealthier areas? Are farmers in all major agricultural areas provided with equivalent funding relative to agricultural land area? The focus of these questions is related to the movement of funds from a higher jurisdiction to a lower, or from a jurisdiction to landowners, either directly or through non-governmental entities. A more comprehensive evaluation that includes historic inequities was beyond the scope of this

project, however. To assist in future evaluations, the [Interviews and Surveys of Key Experts](#) explored concepts of equity from multiple perspectives.

Based on the concepts discussed above, the following approaches were considered.

- **Distributional equity by jurisdiction:** How does the provision of federal and state grants and subsidies to local governments, and direct funding to non-governmental interests, differ by jurisdiction type (e.g., county and municipal government), jurisdiction government capacity (as discussed in [Government capacity](#)), and relative Basin location (i.e., headwaters versus estuary, or urban versus suburban or rural)? Here, the question is whether some local governments within the Basin receive more or less funding from the federal and state governments, compared to similar jurisdictions within a state or in other states that face similar environmental challenges or needs. Differences may reflect in part the ability of some jurisdictions to compete for competitive grants.
- **Distributional equity by household income:** The question here is simply whether wealthier jurisdictions receive more governmental funding per capita than poorer ones, or vice versa. The metric would be federal and state funding per capita compared to average household income. An alternative metric also would include local funding for the target purposes, to gain a sense of total government activity.
- **Distributional equity by racial/ethnic concentration:** The question here is whether jurisdictions with low minority populations (by percentage) receive more or less funding (e.g., open space, water quality improvement projects) than those with higher ratios. The metric would be federal and state funding per capita compared to percentage of minority populations.
- **Distributional equity by Basin watershed:** This metric would identify total expenditures per area for each major watershed of the Basin (e.g., Lehigh, Neversink, Paulinskill, Rancocas, Schuylkill). Normalizing the results using per area analyses is important to understanding how expenditures differ. This analysis could also evaluate expenditures per capita per area for each watershed. Finally, expenditures for land preservation and water quality restoration could be separately assessed.
- **Distributional equity by landowner category:** Government funds for the targeted purposes can preserve farmland or non-farm open space, and can restore water quality on public lands, other preserved lands, developed private lands, undeveloped private lands and farms (preserved or not). The metric here would be government expenditures in each category relative to the acres of available lands for that purpose.
 - Open space funding relative to total acres of unpreserved open space. This metric could be modified if it is possible to identify the areas of unpreserved open space that have significant values for watershed protection (e.g., core forests versus an undeveloped parcel in the middle of a major developed area).
 - Farmland preservation funding relative to total acres of unpreserved farmland. Again, this metric could be modified if it is possible to identify the areas of unpreserved farmland that have significant values for watershed protection (e.g., farm parcels with stream segments versus those without) or agricultural potential (e.g., soil quality).

- Water quality restoration funds relative to total acres of each land ownership category. This metric would be relevant to both preserved and unpreserved lands.

A potential constraint for this set of metrics is whether information is available on preserved open space and farmland in Delaware, Pennsylvania and New York State (see [Geography](#)). New Jersey routinely tracks preserved open space and farmland, both preserved (routine updates) and not preserved (roughly every five years).

FINAL APPROACH: The first four concepts have merit and can be implemented using available information. The selected approaches are:

- **Distributional equity by jurisdiction:** Federal and state funding per capita by county and municipal government jurisdiction, relative to jurisdiction government capacity (as discussed in [Government capacity](#)).
- **Distributional equity by household income:** Federal and state funding per capita by county and municipality, relative to average household income. Insufficient data are available to address equity at the municipal level or to add local government funding for relevant projects.
- **Distributional equity by poverty concentration:** Federal and state funding per capita compared to percentage of populations with income below the National Poverty Level by county.

While the “Distributional equity by landowner category” metric would be useful, its use is constrained regarding available data on land use/land cover and preservation status.

Environmental and land use situation

In this factor, the focus is on the extent to which funds are appropriately targeted (e.g., preservation funds to the highest value lands, based on criteria to be determined). A related question is the extent to which the expenditures achieve the highest benefit to cost (e.g., dollars per pound of pollutant loading removed). Existing tools developed through the Delaware River Watershed Initiative (DRWI) or similar programs that are applicable to the Basin could be used. Data available and the identification of priority preservation and restoration areas are major needs for any evaluation. Some states have useful information. The NJ Department of Environmental Protection has GIS information on lands critical for threatened and endangered species (animal and plant), and the NJ State Agriculture Development Commission has mapped farmlands at various levels of state importance. The non-profit New Jersey Conservation Blueprint project (<https://www.njmap2.com/blueprint/>) is identifying high-priority lands for preservation. The NYS Department of Environmental Conservation has developed a GIS coverage of “New York State Natural Land Patches” (2020), defined as natural land areas greater than 100 acres in size (<http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1366>).

FINAL APPROACH: There are major methodological and data acquisition issues that could not be addressed within the project schedule. Therefore, Rutgers used simplified environmental metrics, including acres of forests/wetlands, acres of agricultural lands, acres of wetlands, acres of lakes, miles of streams, and acres of developed lands. These metrics were compared to the total expenditures and total expenditures per capita for the relevant geographic area, which depending on data availability with geographic attributes for HUC12 drainage area, municipality or county.

Other agencies in same geographic/topical space

Finally, Rutgers intended to evaluate whether agencies are “bunched” together, providing many services in some areas while other areas are not receiving significant service and benefits. The database captures both the governmental source of funds and the entity responsible for direct expenditures on land preservation and water quality restoration. The intent was analysis of project locations by geographic area, associated with funding and implementation entities. This analysis would provide for “hot spot” identification of watersheds where collections of entities are most active. The results would be used in combination with the earlier equity analyses to determine whether the hot spots could help address or deepen inequities. Again, insufficient project locational information was provided by many sources to effectively assess this issue. It remains an opportunity for future analysis.

Appendix B: Project Methodology: Equity Analysis

In addition to collecting data on governmental and related expenditures on water quality protection and improvement in the Delaware River Basin, the Rutgers team has developed an approach for assessing the equity of governmental expenditures for individual expenditure categories. The team also has tested several approaches for assessing the equity of overall expenditures.

Defining Equity: Issues

To assess equity in water resources expenditure, we need to define “equitable outcomes” in the context of this project and the Delaware River Basin (e.g., clean water, water access, drinking water supplies, recreational use, ecological benefits). Individual programs may be equitable within their context and statutory requirements, and yet when combined with all other relevant programs be inequitable regarding water resources outcomes. For this analysis, we needed to provide a sense of what we mean by “equitable” so that the analysis flows from that point and judgments can be made. The recent paper by Seigerman et al. (2022)²⁴ provides useful ideas to this end. They define equity as “ensuring that people have fair opportunities to participate in society through interconnected dimensions of recognition, procedure, and distribution.” They suggest that equity has three primary components: *recognition* (acknowledgement and respect of differences), *procedural* (fair participation in decision-making) and *distributional* (fair allocation of resources, risks, harms and benefits). Given the nature of this project, our primary focus is on distributional equity, with an opportunity to address some of the procedural and recognition elements of equity in a qualitative manner through the interviews. Getting better information about recognition elements would require interviewing more people who live or work in cities and who view water issues as they affect human health and wellbeing. With one major exception (and a few ideas others mentioned), the people interviewed in Phase 1 did not have the background or organizational focus to address those equity framework perspectives.

Importantly, no agency or entity has presented a clear statement of water resources equity applicable to the Delaware River Basin. Without a target, analysis of (and planning for) equity is difficult. In addition, many programs were created without consideration of how they affect equity other than in the terms of “equal treatment” from programmatic and administrative (i.e., procedural) perspectives. Each program has intended benefits and beneficiaries that are considered appropriate for the purposes of the program but may not be “equitable” in a broader, societal context, either regarding the intersection of various programs in unintended ways, or the effects of each program on other equity issues that are outside of their jurisdiction or legislative mandate. The focus is generally on operational metrics such as wastewater treated, aggregate preserved open space or farmland, and stream miles improved. Projects are selected based on these operational metrics and a process that emphasizes fair treatment only of those directly involved in the program. However, whether the net sum of these programs addresses broader equity issues is not part of their mandate or operational system.

Another issue is one of time scale; current programs may have different equity impacts than past programs. For example, massive water quality improvements of the Delaware River and Schuylkill River in the Philadelphia area occurred from the 1960s through 1980s and directly benefited Philadelphia

²⁴ Seigerman, Cydney K., S. Kyle McKay, Raul Basilio, Shelly A. Biesel, Jon Hallemeier, Andressa V. Mansur, Candice Piercy, et al. 2022. “Operationalizing equity for integrated water resources management.” *Journal of the American Water Resources Association* 00(0): 1–18. <https://doi.org/10.1111/1752-1688.13086>.

residents and other urban areas through improved drinking water quality and treatment costs, improved water-related public access and recreational benefits, economic development potential along the rivers, etc. That work was heavily subsidized by federal grants. Current programs that benefit upstream areas would appear to be biased toward rural and suburban areas. Meanwhile, Philadelphia is largely financing its CSO work with local ratepayer revenue. At what time scale do we measure benefits and equity?

Expenditure Categories

The Rutgers project collected information for the following categories of governmental (and other) expenditures:

- **AGBMP: Agricultural BMPs.** This category includes a wide range of best management practices that are aimed at improving ground or surface water quality. It does not include BMPs that are primarily directed to improved agricultural yields. Animal waste storage, cover crops and stream habitat are three of more than 40 core practices used for water quality purposes.
- **COLLSYST: Sewer Collection System Upgrades.** This category is new to Phase 2 and includes capital project upgrades such as collection system rehabilitation, replacement, flow capacity increases. Combined sewer line separations are also included, as are the connection of properties on septic systems to the collection system for purposes of water quality restoration.
- **LAKE: Lake Restoration.** This category focuses on capital projects for aquatic habitat improvements and pollutant loading reduction or mitigation. Harmful Algal Bloom (HAB) projects are included.
- **PRESRV: Preservation-Open Space.** This category focuses on the preservation of open space for ecological and passive recreation purposes. It does not include preservation for active recreation, to the extent that it was feasible to determine.
- **PRESRV_AG: Preservation-Agriculture.** This category focuses on the preservation of farmland for any type of agricultural purposes.
- **STREAM: Stream Restoration.** As with the LAKE category, this category focuses on aquatic habitat improvements and pollutant loading reduction or mitigation. Harmful Algal Bloom (HAB) projects and riparian buffers are included.
- **SWGREN: Stormwater Management-Green.** This category focuses on capital projects to create, improve or rehabilitate any type of green stormwater infrastructure other than open space preservation, which is included in the PRESRV category. Green stormwater infrastructure in this context need not incorporate plant materials, but is focused on mitigating stormwater volumes, flow rates and pollutant loadings in ways that mimic natural hydrology.
- **SWTRAD: Stormwater Management-Traditional.** This category focuses on capital projects dealing with such “gray” infrastructure as inlets, catch basins, storm sewers, basins (detention, retention), and outfall structures.
- **WWTPUP: Wastewater Treatment Plant Upgrade.** This category focuses on capital projects that increase the treatment capacity or quality of a wastewater treatment plant. It does not include in-kind replacement of existing facility components that do not improve water quality.
- **WETLAND: Wetlands Restoration.** This category focuses on capital projects for wetlands creation, restoration and improvements.
- **MULTI: Multiple Categories.** This category includes combinations of two or more of the above categories where is not feasible to disaggregate the individual components.

In all cases, ongoing operation and maintenance (O&M) costs are not included, nor are planning and monitoring costs unless they are folded into a capital project (mostly because it is very difficult to disaggregate these costs when they are bundled with capital costs). Projects that are required in new development and redevelopment also are not included, as those are regulatory requirements to mitigate a new stress on water resources. Projects that improve legacy water resource stresses are included in these categories.

Assessing Equity: Approach by Expenditure Category

This section provides a descriptive approach for assessing the distributional equity of governmental expenditures for each expenditure category. In general, there are two approaches. One focuses on the geographic distribution of expenditures relative to the specific issue being addressed. For example, it is expected that agricultural BMP funds will be spent in agricultural areas, with greater expenditures going to areas with more acres of agricultural lands. The analysis tests whether that expectation is met. The National Land Cover Data coverage will be a primary source of geographic information on prevalence of agricultural, forested and urbanized lands, and the National Hydrography Dataset for stream miles and lakes.

The second approach evaluates the geographic distributions of categorical expenditures relative to certain social and economic metrics such as income and race/ethnicity. For example, are agricultural preservation funds only being spent in rural areas with high percentages of White-Non-Hispanic populations, or are equivalent funds being spent in areas with high BIPOC populations, such as urban areas to create urban farms? The American Community Survey will be a primary source of information on demographic information.

Note that the MULTI (Multiple Categories) category is not assessed in this section.

Evaluating Geographic Areas to Use In Equity Analyses

The first step is understanding the extent to which expenditures are tagged with geographic identifiers (county, municipality and HUC12), based on percentage of expenditures that cannot be associated with that geographic area (% missing). The following table from October 2023 shows this information for each expenditure category.

As can be seen below, the “best fit” geographic area varies by category. Not surprisingly, in many cases the county level provides the smallest “% missing”, as the largest geographic area used. However, using a smaller geographic area provides more detailed analyses, even if slightly more information is lost. In many cases, the municipality or HUC12 level is nearly the same as the county level and would be useful for a more refined analysis. Only for AGBMP does the HUC12 level provides the best fit.

AGBMP Total	\$150,648,517		
Status	County	Municipality	HUC12
Missing	\$86,508,179	\$144,580,979	\$46,173,159
Available	\$64,140,338	\$6,067,538	\$104,475,358
% missing	57.42%	95.97%	30.65%

COLLSYST Total	\$1,610,376,152		
Status	County	Municipality	HUC12
Missing	\$44,356	\$166,550,732	\$1,398,645,703
Available	\$1,610,331,796	\$1,443,825,420	\$211,730,449
% missing	0.00%	10.34%	86.85%
LAKE Total	\$25,202,048		
Status	County	Municipality	HUC12
Missing	\$0	\$689,577	\$4,338,848
Available	\$25,202,048	\$24,512,471	\$20,863,200
% missing	0.00%	2.74%	17.22%
PRESRV Total	\$555,931,521		
Status	County	Municipality	HUC12
Missing	\$14,426,627	\$94,516,667	\$544,071,111
Available	\$541,504,894	\$461,414,855	\$11,860,411
% missing	2.60%	17.00%	97.87%
PRESRV_AG Total	\$608,946,785		
Status	County	Municipality	HUC12
Missing	\$245,595	\$286,617,431	\$570,045,934
Available	\$608,701,190	\$322,329,354	\$38,900,851
% missing	0.04%	47.07%	93.61%
STREAM Total	\$79,761,871		
Status	County	Municipality	HUC12
Missing	\$7,387,801	\$28,694,095	\$74,652,626
Available	\$72,374,070	\$51,067,775	\$5,109,245
% missing	9.26%	35.97%	93.59%
SWGREN Total	\$187,842,573		
Status	County	Municipality	HUC12
Missing	\$2,294,159	\$116,073,427	\$87,483,504
Available	\$185,548,414	\$71,769,146	\$100,359,069
% missing	1.22%	61.79%	46.57%
SWTRAD Total	\$84,363,447		
Status	County	Municipality	HUC12
Missing	\$35,389	\$28,717,506	\$72,266,654
Available	\$84,328,058	\$55,645,941	\$12,096,793
% missing	0.04%	34.04%	85.66%

WETLAND Total	\$6,855,275		
Status	County	Municipality	HUC12
Missing	\$639,952	\$4,504,714	\$6,192,921
Available	\$6,215,323	\$2,350,561	\$662,354
% missing	9.34%	65.71%	90.34%
WWTPUP Total	\$968,402,346		
Status	County	Municipality	HUC12
Missing	\$11,594,000	\$211,928,500	\$919,514,526
Available	\$956,808,346	\$756,473,846	\$48,887,820
% missing	1.20%	21.88%	94.95%

AGBMP: Agricultural BMPs

Nearly all Agricultural BMP expenditures were provided by the USDA Natural Resources Conservation Service. Due to concerns about recipient privacy, all data were provided by HUC12 drainage area, representing many thousands of projects over the 2014-2022 period. No municipal or county identifiers were provided, and so all analyses must be at the HUC12 level. Both preserved and non-preserved farms are eligible for support under the federal Farm Bill programs. A major advantage for this category is that the large number of farms, small project sizes and annual funding provide a robust database that doesn't vary significantly from year to year.

- **Issue Focus:** This analysis compares the total expenditures for Agricultural BMPs to the acreage of agricultural land, for each HUC12 drainage area. The primary metric is therefore dollars per farmland acre per HUC12; dollars per HUC12 is used as a secondary metric.
- **Socioeconomic Focus:** Given the nature of this expenditure category, a socioeconomic focus on equity is not expected to yield relevant results.

COLLSYST: Sewer Collection System Upgrades

Data on sewer collection system upgrades were provided by the four state revolving fund programs and by local wastewater utilities. By their nature, sewer collection systems are associated with developed areas, and primarily suburban and urban development. Due to the long economic lifespan of these collection systems, projects tend to be more sporadic than agricultural BMPs. While annual funding is relatively constant statewide, each sewer system may have very different expenditures from year to year. Nearly all project expenditures have county identifiers, and most for municipality identifiers (10% missing); however, nearly all expenditures lack HUC12 identifiers. In one case, Philadelphia, the municipality is also the county; no information was available to assign the results to a smaller geographic area within the city.

- **Issue Focus:** This analysis compares the total expenditures for sewer collection system upgrades to the urbanized acreage (e.g., residential, commercial, industrial, transportation land uses), for each municipality. The primary metric is therefore dollars per developed acre per municipality; dollars per person and total expenditures per municipality are secondary metrics.

- **Socioeconomic Focus:** This analysis uses the Issue metrics and compares them at the municipal level to multiple socio-economic metrics drawn from Census information: population density, median household income, total household income, Gini coefficient and percent BIPOC populations. These metrics are readily calculated at the municipal level. The question is whether the results for these metrics are nearly equal or far different among the municipalities.

LAKE: Lake Restoration

Lake restoration is the smallest expenditure category, perhaps in part because most lakes in the Delaware River Basin are small, with Lake Wallenpaupack (PA) and Lake Hopatcong (NJ) being major exceptions, and many others are private lakes where government funding is not available. Compared to the number of stream miles or sanitary sewer and stormwater lines, there are far fewer potential project areas. In this case, most expenditures were identified by the target lake, allowing for analysis by municipality and county. Nearly all projects have a municipal identifier (3% missing) and all have county identifiers, while 18% lack HUC12 identifiers. Therefore, municipalities are used in the mapping.

- **Issue Focus:** This analysis compares the total expenditures for lake restoration to the lake acreage, for each municipality. The primary metric is therefore dollars per lake acre per municipality; dollars per municipality is used as a secondary metric. The question is whether the results for these metrics are nearly equal or far different among the municipalities. Most municipalities will not have any lakes, resulting in a null response to this question.
- **Socioeconomic Focus:** Given the limited projects and total expenditures of this category, a socioeconomic focus on equity is not expected to yield relevant results.

PRESRV: Preservation-Open Space

Open space preservation is one of the largest expenditure categories in the project. Preservation projects are by their nature adventitious – they happen when a combination of project sponsor, land owner and funding come together for a purchase. Therefore, they are sporadic and geographically haphazard year by year. Only over longer periods do patterns become available. Ideally, this analysis would compare preservation expenditures to the acreage of non-developed, non-agricultural, non-preserved lands as of 2014, to avoid analytical problems such as low expenditures in a municipality because there are no available lands to purchase, or high expenditures because pre-2014 conditions involved large areas of unpreserved forests. However, such an analysis is not feasible at this time across four states with very different baseline data. Therefore, a broader metric is required. Nearly all open space preservation projects were identified by municipality and county (17% and 2% missing, respectively); HUC12 identifiers are mostly missing (98% missing). Therefore, municipalities are the level of analysis.

- **Issue Focus:** This analysis compares the total expenditures for open space preservation to the acreage of non-agricultural, non-developed lands (e.g., forests, wetlands, meadows), for each municipality. The primary metric is therefore dollars per open space acre; total dollars per municipality and dollars per person per municipality are used as secondary metrics. The question is whether the results for these metrics are nearly equal or far different among the municipalities. Some municipalities may have no non-agricultural, non-developed lands, providing a null answer, and yet may have expenditures that create new parks in urbanized

areas; these new parks are highly likely to be for active recreation, and therefore the analysis will focus on areas that do have non-agricultural, non-developed lands.

- **Socioeconomic Focus:** This analysis uses the Issue metrics and compares them at the municipal level to multiple socio-economic metrics drawn from Census information: population density, median household income, total household income, Gini coefficient and percent BIPOC populations. While measuring expenditures relative to unpreserved open space would provide a better metric,²⁵ that was not feasible with existing databases.

PRESRV AG: Preservation-Agriculture

Farmland preservation is another of the largest expenditure categories in the project. These projects have the same characteristics as open space preservation projects, just focused on a different land use. Ideally, this analysis would compare preservation expenditures to the acreage of non-preserved agricultural lands as of 2014, for the same reasons as for open space. However, such an analysis is not feasible at this time across four states with very different baseline data. Therefore, a broader metric is required, using total farmland. Nearly all farmland preservation projects were identified by county at least, and most by municipality (29% missing), and few by HUC12 area (98% missing). The municipality was used as the basis for mapping and the county for statistical analysis.

- **Issue Focus:** This analysis compares the total expenditures for farmland preservation to the total acreage of farmland, for each municipality. The primary metric is therefore dollars per farmland acre per municipality. Some counties may have no farmland areas, providing a null answer, and yet may have expenditures that create urban agriculture areas; the analysis will focus on areas that do have farmland, but will flag expenditures in urbanized areas that lack mapped farmland.
- **Socioeconomic Focus:** The primary metric used for statistical analysis is dollars per farmland acre county, with a secondary metric of dollars per person per county. The question is whether the results for these metrics are nearly equal or far different among the counties. This analysis uses the Issue metrics and compares them at the county level to multiple socio-economic metrics drawn from Census information: population density, median household income, total household income, Gini coefficient and percent BIPOC populations.

STREAM: Stream Restoration

Stream restoration projects are much less common than land preservation projects, but they are more common than lakes or wetlands restoration projects. Mapping of stream miles is robust, allowing an analysis of stream miles by any geographic area. Because many streams suffer from hydrologic disturbance, resulting in stream bank and bed erosion, using total stream miles is acceptable. A more detailed metric could be stream miles that are listed as impaired (Section 303(d) in each state's Water Quality Inventory Report) but the states do not necessarily identify the physically impaired stream miles, which would be the focus of this analysis. Most projects were identified by county (9% missing), with

²⁵ USGS. Protected Areas Database of the United States (PAD-US) 3.0 Spatial Analysis and Statistics. <https://www.usgs.gov/data/protected-areas-database-united-states-pad-us-30-spatial-analysis-and-statistics>. Also, data from the four states could be used to augment this information.

fewer by municipality (36% missing) and few by HUC12 area (94% missing); municipality was selected as the most useful geographic area for mapping.

- **Issue Focus:** This analysis compares the total expenditures for stream restoration to the total stream miles from the National Hydrography Dataset, for each municipality. The primary metric for mapping is therefore dollars per stream mile per municipality; the secondary metric is total dollars per municipality.
- **Socioeconomic Focus:** Given the limited projects and total expenditures of this category, a socioeconomic focus on equity is not expected to yield relevant results.

SWGREN: Stormwater Management-Green

Regulatory requirements for municipal separate storm sewer systems (MS4s) and combined sewer systems are prompting increased interest in green stormwater infrastructure to mitigate the damages caused by excessive and polluted stormwater discharges. Expenditures are roughly equivalent to those for stream restoration. Nearly all projects have been identified by county (1% missing), while HUC12 identifiers are missing for 46% of expenditures and municipality identifiers are missing for 62% of expenditures. The mapping used municipal identifiers. While it would be preferable to use municipalities (the primary entity for stormwater management) for statistical analysis, this was not feasible and therefore county identifiers were used.

- **Issue Focus:** This analysis compares the total expenditures for green stormwater infrastructure projects to the urbanized acreage (e.g., residential, commercial, industrial, transportation land uses), for each municipality (mapping) and county (statistical analysis). The primary metric is therefore dollars per developed acre per municipality; the secondary metric is total dollars per municipality.
- **Socioeconomic Focus:** This analysis uses the Issue metrics and compares them at the county level to multiple socio-economic metrics drawn from Census information: population density, median household income, total household income, Gini coefficient and percent BIPOC populations. The question is whether the results for these metrics are nearly equal or far different among the counties.

SWTRAD: Stormwater Management-Traditional

Most developed areas have traditional (gray) stormwater infrastructure, and most of that predates modern design standards. In addition, much of the existing infrastructure is aging and experiencing rainfall patterns that are more severe than the systems were designed to manage. For this reason, gray stormwater infrastructure projects are becoming more necessary. Expenditures are slightly higher than for green stormwater infrastructure. Almost all projects have been identified by county, with more missing expenditures at the municipality and HUC12 level (34% and 86% missing, respectively).

- **Issue Focus:** As municipalities are primarily responsible for traditional stormwater infrastructure, this level is used for mapping. This analysis compares the total expenditures for gray stormwater infrastructure projects to the urbanized acreage (e.g., residential, commercial, industrial, transportation land uses), for each municipality. The primary metric is therefore dollars per developed acre per municipality; the secondary metric is total dollars per

municipality. The question is whether the results for this metric are nearly equal or far different among the municipalities.

- **Socioeconomic Focus:** Given the limited projects and total expenditures of this category, a socioeconomic focus on equity is not expected to yield relevant results.

WWTPUP: Wastewater Treatment Plant Upgrades

By their nature, wastewater treatment plants serve areas of urbanized land, with larger treatment plants in the most urbanized areas where intense development or regionalization provide a financial basis for such facilities. Upgrades of existing wastewater treatment plants generally occur in response to regulatory mandates, such as increasing capacity to address combined sewer flows or meeting water quality-based effluent limits. Such projects rarely happen for any single utility, but they involve large expenditures when they do occur. The data show order-of-magnitude differences in basin-wide expenditures from year to year. As such, an equity analysis is difficult except over long periods. Almost all project expenditures have been identified by county, but many are missing information for municipality (22%) and few have HUC12 (95% missing). Therefore, the county level is used for analysis.

- **Issue Focus:** This analysis compares the total expenditures for wastewater treatment plant upgrade projects to the urbanized acreage (e.g., residential, commercial, industrial, transportation land uses), for each county. The primary metric is therefore dollars per developed acre by county; a secondary metric is total dollars per county.
- **Socioeconomic Focus:** This analysis uses the Issue metrics and compares them at the county level to multiple socio-economic metrics drawn from Census information: population density, median household income, total household income, Gini coefficient and percent BIPOC populations. The question is whether the results for this metric are nearly equal or far different among the counties.

WETLAND: Wetlands Restoration

Wetland restoration projects (other than those for mitigation of development activities) are uncommon, similar to lake restoration projects. Most project expenditures have been identified by county (9% missing), with fewer by HUC12 area and municipality (90% and 66% missing, respectively). Given the small expenditures involved, the county level is used for the equity analysis.

- **Issue Focus:** This analysis compares the total expenditures for wetlands restoration to the total wetland acreage, for each county. The primary metric for mapping is therefore dollars per wetlands acre per county; total dollars per county is the secondary metric.
- **Socioeconomic Focus:** Given the limited projects and total expenditures of this category, a socioeconomic focus on equity is not expected to yield relevant results.

Assessing Equity: Approach for Aggregate Expenditures

The analyses discussed above all address equity from the perspective of each expenditure category. Because each expenditure category has a specific purpose, it is relatively straightforward to determine environmental metrics against which to compare funding and expenditures.

This section addresses a more difficult equity analysis, regarding aggregated expenditures. Because each program was created for specific purposes, there is no reason to expect that any policy maker

considered or intended that aggregate watershed expenditures would have a relationship to equity. If aggregate funding or expenditures are equitable, it is likely to be serendipitous rather than intentional.

A further complication is that this project gathered funding and expenditures from multiple levels of government. Aggregating these requires lumping federal and state funding (supported by taxpayers and borrowing from a much larger geographic area) with county and municipal funding (supported by local taxpayers and fees). Funding from federal and state governments provide a transfer of wealth into an area, where the question is whether the various parts of the region are treated equitably in distributing those funds. Use of local funding involves a fiscal stress to the same area, where the question is whether local governments are contributing local revenues in an equitable fashion (i.e., whether one municipality is spending more relative to household income than another for equal or lesser benefits). A good example is Philadelphia, where most of the funding for combined sewer system improvements is locally derived, while across the river the City of Camden has benefited from federal, state and regional (e.g., Camden County MUA) funding.

Another issue is what socio-economic metrics to use in the analysis. Each metric has positive and negative attributes for this purpose. Racial and ethnic metrics (i.e., BIPOC populations) are often used as surrogates for influence on the distribution of funds, programs and other societal benefits. However, some ethnic populations will have more influence than others, due to higher incomes, household wealth, or concentration in specific areas allowing for more political influence. Immigrant households may also have different experiences. Median household income is often used in analyses, but income distributions around the median can be very different from one area to another. The Gini coefficient (or Index) can be used as a measure of income inequality, but that also doesn't fully reflect the financial status of the lower income groups. Recent research on affordability has pointed to use of the 20th percentile income level, but that metric is not reported by the Census Bureau; rather, it must be derived. Education level or the Lorenz curve may also be worth assessing for viability as metrics.

Other metrics attempt to combine metrics into an overall sense of a community's socio-economic status, such as the CDC/ASTDR Social Vulnerability Index (SVI), which was created to assess risk during public health emergencies. However, the SVI includes metrics that have little to do with the Rutgers project. Use of an index also makes it difficult to understand which aspects of the index raised concerns relative to funding or expenditures, and whether funding and expenditures raise equity issues that are muted by use of a broad index rather than individual metrics.

For these reasons, the Rutgers team decided to focus on a limited number of socio-economic metrics that each provide one perspective on a broader story. Comparison of these results may show equity issues that any one metric might not show. Multivariate analysis will be considered to see whether the indicators can be evaluated together or must be addressed separately. The selected indicators are:

- **Population density:** This metric provides a broad sense of whether expenditures per person are higher or lower as population density increases.
- **BIPOC populations** (i.e., all racial/ethnic groups other than White/non-Hispanic): This metric provides a sense of whether areas with a higher percentage BIPOC populations receive equitable funding.
- **Gini coefficient:** This metric provides a sense of whether areas with high income inequality receive equitable funding compared to those with low inequality.

- **Median household income:** This metric provides a broad sense of expenditures relative to income.
- **Total household income:** This metric is the median household income multiplied by total population, representing a rough metric for expenditures relative to financial capacity. It recognizes that areas of equal median household income may have different populations.

Finally, the geographic referents available for projects varies; very few projects have point locations that allow for comprehensive identification of HUC12 drainage area, municipality and county. While most agricultural projects have HUC12 identifiers, for example, most infrastructure projects have municipal or county identifiers. Aggregating funding and expenditures for analysis requires a method that allows for melding of data that have different geographic units.

Given these issues, the Rutgers team developed the following approach and tested a variety of statistical and GIS approaches for evaluating and describing the results.

Geographic Aggregation Approach

Analytically, the most important and complex question is how to meld funding and expenditure data that have different geographic identifiers. After evaluating and testing various approaches, the Rutgers team determined that the most appropriate approach is to evaluate aggregate expenditures against the socioeconomic metrics at the county level. It is easy to aggregate municipal information with the county data. Where data are primarily at the HUC12 level (AGBMPs), the zonal statistics method is used to approximate the expenditures per county, recognizing that there will be some inaccuracies. However, these expenditure categories are a small portion of the more than \$4.5 billion in regional expenditures collected by the project.

Funding: Federal, State and Local

This analysis will compare the funding sources used for all projects against socio-economic indicators. The funding sources will be subdivided into federal/state and local (county, municipal, utility authorities). Roughly 55% of all funding is from federal/state sources, the vast majority from state government. County and municipal governments total more than 30% (November 2022 data).

Federal and state funding reflect “outside” funding coming to the Delaware River Basin. The question is how this funding is distributed overall. Equity is measured in several ways: relative to population density, to BIPOC populations, to Gini coefficient, and to median household income. Where federal and state funds benefit lower income areas, for example, there is a sense of increased equity to allow for environmental benefits despite low local financial resources.

Local funding reflects “internal” funding used for local purposes; it is fundamentally different from federal and state funding. Local funding reflects a burden on local taxpayers and fee payers, not largess from outside entities. The question is whether some groups are burdened by local financing more than others, whether voluntarily (reflecting local purposes) or involuntarily (reflecting federal and state regulatory mandates), which represents the inverse situation from federal/state funding. Equity is measured in several ways: relative to population density, to BIPOC populations, to Gini coefficient, and to median household income. Where local funding relative to household income is higher, for example, that would indicate a greater financial stress and therefore a less equitable situation.

Funding: Aggregate

While the bifurcation of funding will provide a more nuanced analysis of equity issues, the analysis of aggregate funding was also performed to see whether additional lessons could be learned. Again, equity is measured in several ways: relative to population density, to BIPOC populations, to Gini coefficient, and to median household income.

Expenditures: Aggregate

Expenditure data are based upon which level of government actually spent the funds, regardless of funding source. Roughly 80% of all expenditures are by county and municipal governments and publicly-owned water and wastewater utilities (November 2022 data), indicating the large flow of funds from the federal and especially state governments (which represent nearly half of funding but roughly one-tenth of expenditures) to local governments.

Equity is measured in several ways: relative to population density, to BIPOC populations, to Gini coefficient, and to median household income. Where expenditures benefit lower income areas, for example, there is a sense of increased equity to allow for environmental benefits despite low local financial resources. However, this conclusion won't always be correct, depending on whether the majority of funding for, say, a municipality, is from higher levels of government or local resources.

Appendix C: Potential Project Implementation Entities Other than Federal and State Agencies

The following table lists non-governmental organizations and regional utilities that may implement relevant projects using governmental funds as generated using searches and available data, including the University of Delaware’s prior study on expenditures in the Delaware River Basin.

Table C-1: Potential Non-Profit Project Implementation Entities	
Location	Data Sources/Comments
1. Basin-wide or Major Portion	National Fish & Wildlife Foundation Open Space Institute Partnership for the Delaware Estuary (PDE) Trout Unlimited
2. Delaware	Brandywine Conservancy Brandywine Red Clay Association Christina Conservancy Coalition for Natural Stream Valleys Delaware Audubon Society Delaware Nature Society Natural Lands (NL) Stroud Water Research Center (SWRC) The Nature Conservancy - Delaware Chapter
3. New Jersey	American Littoral Society Association of New Jersey Environmental Commissions (ANJEC) Hunterdon Land Trust Musconetcong Watershed Association Natural Lands (NL) New Jersey Audubon Society (NJAS) New Jersey Conservation Foundation (NJCF) New Jersey Highlands Coalition North Jersey Resource Conservation & Development (RC&D) Pineland Preservation Association South Jersey Land and Water Trust The Land Conservancy of New Jersey The Nature Conservancy - New Jersey Chapter Wallkill River Watershed Management Group
4. New York	Catskill Watershed Corporation Watershed Agricultural Council Catskill Center County SWCDs (Greene, Sullivan, Delaware, Ulster) Orange County Land Trust
5. Pennsylvania	(See also the WeConservePA web site that includes listings of land trusts and conservation collaborations by county, at https://weconservepa.org/groups/) Audubon Society - Pennsylvania (APA) Berks Nature (BN) Brodhead Watershed Association Delaware Highlands Conservancy

Table C-1: Potential Non-Profit Project Implementation Entities	
Location	Data Sources/Comments
	Eastern Delaware County Stormwater Collaborative French & Pickering Creeks Conservation Trust Friends of Poquessing Watershed Friends of Upper Darby Creek Green Valleys Watershed Association Lower Merion Conservancy Natural Lands (NL) North Pocono Care Pennsylvania Environmental Council Pennypack Ecological Restoration Trust Philadelphia Resources Council Pinchot Institute for Conservation Poconos Heritage Land Trust (PHLT) Stroud Water Research Center (SWRC) The Nature Conservancy - Pennsylvania Chapter (TNC-PA) Tookany-Tacony-Frankford Watershed Association Wildlands Conservancy Wissahickon Valley Watershed Association

Appendix D: Government Funding Agencies and Programs

Entities Providing Project Expenditure Data

The project expenditure database compiled for this report includes input from 126 entities, comprising six federal agencies (in some cases with multiple state or regional offices per agency), 17 state agencies, 31 counties and county soil conservation districts, 31 municipalities, 3 water utilities (other than those expenditures reported by municipal governments) and 29 non-governmental organizations. These entities are listed in **Table D-1**.

Table D-1. Agencies and Organizations Provided Data Used in Project		
Primary Entity	Agency	Sub-agency or Program
FEDERAL GOVERNMENT		
US Department of Agriculture	Forest Service	Forest Legacy Program
US Department of Agriculture	Natural Resources Conservation Service	Multiple Programs, including the Farmland Protection Program, Environmental Quality Incentive Program
US Department of Commerce	NOAA - Office for Coastal Management	Coastal Zone Management Program
US Army Corps of Engineers	Philadelphia District	Chester, Delaware, Montgomery Counties Regional Watershed Improvement Project
US Department of the Interior	US Fish & Wildlife Service	Endangered Species; National Coastal Wetland Conservation Grant
Environmental Protection Agency	Region 3 Office	Multiple programs
STATE GOVERNMENTS		
State of Delaware	Dept. of Agriculture	Aglands Preservation and Planning
State of Delaware	Dept. of Natural Resources and Environmental Control	Division of Parks and Recreation
State of Delaware	Dept. of Natural Resources and Environmental Control	Division of Watershed Stewardship
State of Delaware	Dept. of Transportation	
State of New Jersey	Dept. of Agriculture	Division of Agricultural and Natural Resources
State of New Jersey	Dept. of Agriculture	State Agriculture Development Committee (SADC)
State of New Jersey	Dept. of Environmental Protection	Green Acres Program
State of New Jersey	Dept. of Environmental Protection	Office of Natural Resource Restoration
State of New Jersey	Dept. of Environmental Protection	Water Monitoring (319h NPS program)
State of New Jersey	NJ Infrastructure Bank	Water Bank (aka Environmental Infrastructure Trust)
State of New Jersey	Highlands Water Protection & Planning Council	Land Acquisition Fund
State of New Jersey	Lake Hopatcong Commission	
State of New York	Dept. of Agriculture and Markets	Ag Nonpoint Source Abatement and Control Program

Table D-1. Agencies and Organizations Provided Data Used in Project		
Primary Entity	Agency	Sub-agency or Program
State of New York	Dept. of Environmental Conservation	Division of Water
State of New York	Environmental Facilities Corporation	
State of New York	Homes and Community Renewal	
State of Pennsylvania	Dept. of Agriculture	
State of Pennsylvania	Dept. of Conservation and Natural Resources	State Parks Conservation and Natural Resources Bureau of Forestry
State of Pennsylvania	Dept. of Environmental Protection	
State of Pennsylvania	Department of Transportation	
State of Pennsylvania	PENNVEST	
COUNTY GOVERNMENT		
Berks County		
Berks County Conservation District		
Bucks County Conservation District		
Burlington County		
Cape May County		
Carbon County Conservation District		
Chester County		
Cumberland County		
Delaware County		
Delaware County Conservation District		
Gloucester County		
Hunterdon County		
Kent County		
Lancaster County		
Lebanon County Conservation District		
Lehigh County Conservation District		
Mercer County		
Monmouth County		
Monroe County		
Monroe County Conservation District		
Montgomery County		
Morris County	Planning Department	
New Castle County		

Table D-1. Agencies and Organizations Provided Data Used in Project		
Primary Entity	Agency	Sub-agency or Program
Northampton County		
Northampton County Conservation District		
Ocean County		
Schoharie County Soil & Water Conservation District		
Schuylkill County		
Sussex County		
Warren County		
Wayne County Conservation District		
MUNICIPAL GOVERNMENTS		
Abington Township		
Alexandria Township		
Arden Village		
Bethlehem City		
Caln Township		
Camden City		
Centre Township		
Cheltenham Township		
Darby Township		
Doylestown Township		
East Bradford Township		
East Pikeland Township		
Glenolden Borough		
Hamilton Township		
Lansdowne Borough		
Londonderry Township		
Lower Alloways Creek Township		
Lower Gwynedd Township		
Lower Makefield Township		
Media Borough		
Nether Providence Township		
Newtown Township		
New York City	Dept. of Env. Protection	Bureau of Water Supply
Newark City, DE		
Philadelphia City		
Port Jervis City		
Reading City		
Salisbury Township		

Table D-1. Agencies and Organizations Provided Data Used in Project		
Primary Entity	Agency	Sub-agency or Program
Springfield Township		
Upper Merion Township		
Whitemarsh Township		
WATER UTILITIES		
Bordentown Sewerage Authority		
Camden County Municipal Utilities Authority		
Philadelphia Water Department		
NON-GOVERNMENTAL ORGANIZATIONS		
American Littoral Society		
Association of New Jersey Environmental Commissions		
Berks Nature		
Brandywine Red Clay Alliance		
Darby Creek Valley Association		
French and Pickering Creeks Conservation Trust		
Friends of the Wissahickon		
Heritage Conservancy		
Lower Merion Conservancy		
Musconetcong Watershed Association		
National Audubon Society		
National Fish & Wildlife Foundation		
Nature Conservancy	New Jersey Field Office	
New Jersey Audubon Society		
New York State Council Trout Unlimited		
Open Land Conservancy of Chester County		
Partnership for the Delaware Estuary (PDE)		
Pennsylvania Resources Council	Eastern Office	
Pennypack Ecological Restoration Trust		
Schuylkill River Greenway Association		
South Jersey Land and Water Trust		
Stroud Water Research Center		

Table D-1. Agencies and Organizations Provided Data Used in Project		
Primary Entity	Agency	Sub-agency or Program
Tookany/Tacony - Frankford Watershed Partnership		
Trust for Public Land	Newark	
Trust for Tomorrow	Northeast Programs Field Office	
White Clay Creek Wild and Scenic River Program		
Wildlands Conservancy		
Wildlife Management Institute (WMI)		
Wissahickon Valley Watershed Association		

Federal and State Programs: Missing or Partial Project Expenditure Data

Unfortunately, various federal and state agencies provided only partial data or no data for many programs. In some cases, data were provided from entities other than the federal or state agency, indicating that such funds flow through that entity (e.g., a state agency using federal funds, a local government or non-governmental organization using federal or state funds). **Table D-2** provides an overview of the programs for which no data were provided. The agencies or programs noted in bold font are those expected to represent the largest amounts of missing expenditures.

With additional efforts through Phase 2 of data acquisition, the only major missing federal funding agency is the Region 2 office of USEPA. USEPA is primarily a regulatory agency and much of the grant funding it has available is provided to states either for operational purposes (e.g., implementation of delegated permit programs and associated monitoring networks) or to provide capital funds for the Drinking Water and Clean Water State Revolving Funds. A portion of funding for the National Estuary Program may be used for restoration purposes, but most is used to maintain the planning, educational and research programs of NEP agencies. The Drinking Water SRF is not used for purposes relevant to this project. Historically, only a very small portion of the Clean Water SRF has been used for relevant restoration projects, such as stream and lake restoration and green stormwater infrastructure. Of the USEPA funding, only the Section 319 Nonpoint Source Control grants are largely focused on restoration projects. Region 3 reported data. For Region 2 expenditures, the New York expenditures within the Basin should be quite small due to the limited population in that area. New Jersey data were received from the NJDEP and NJ Infrastructure Bank.

For state programs, the ones shown in bold are based on similar programs in other states for which data were available, or funding identified through other preservation or restoration programs (e.g., matching funds to land preservation projects). As noted, many Delaware state agencies did not provide data, as the FOIA requests were rejected; Delaware law does not require agencies to respond to out-of-state requests (though some did very quickly despite this law). Efforts to gather information from the Delaware state agencies through other means were unsuccessful.

Table D-2: Key Federal and State Funding Programs: Missing or Partial Project Expenditure Data (See Table D-1 for data received from other programs in the same agencies)		
Agency	Sub-agency	Program
US Department of Commerce	NOAA	NMFS Office of Habitat Conservation and Restoration Center
US Department of Homeland Security	FEMA	Region 2 and Region 3, various programs
US Environmental Protection Agency	Region 2 offices	Various programs, including Natural Resource Damage (NRD) funds
State of Delaware	Dept. of Agriculture	Forest Service
	Dept. of Natural Resources and Environmental Control	Division of Water; Drinking Water State Revolving Loan Fund ; Division of Waste and Hazardous Substances
	Dept. of Environmental Protection	Climate and Flood Resilience; Division of Fish and Wildlife; Site Remediation
State of Pennsylvania	Dept of Environmental Protection	Environmental Stewardship Funds
	Fish & Boat Commission	

Federal Government Budgets and Allocations

Some federal agencies at the headquarters level (i.e., in Washington, DC) declined to or were not able to provide information on budgets, appropriations, allocations and commitments for the targeted program types. In some cases, regional or state-level offices did provide information, but the reporting was not comprehensive for the Delaware River Basin. Therefore, an internet search of federal agency budgets and funding commitments was conducted to help assess where major Basin expenditures may have been made but not reported to the Rutgers project team by any level of the relevant agencies.

Federal departmental or agency budget proposals to Congress generally include the President's proposal for the upcoming federal fiscal year and an overview of approved budgets for the prior two fiscal years. One of the major difficulties in using budget proposals is that they often provide too limited information to determine what funds are provided for operations (e.g., staff) versus state grants-in-aid versus competitive project funds. At times, units or programs within the larger agency provided more detailed information, such as the U.S. Fish & Wildlife Service within the Department of the Interior. In some cases, sufficient information is available to know or estimate how much funding went to each state, but in no case was information localized enough to determine the Delaware River Basin share with any precision; only the Department of Agriculture information provided enough detail for a general estimate.

With completion of Phase 2 efforts, no federal agency that might be significant to the project is missing data on direct expenditures (i.e., not including grants in aid provided to the states).

Appendix E: Geographic Analysis of Expenditures

The following maps are GIS interpretations of expenditures for each expenditure category in the project.

Land Preservation

Map Title	Discussion
1. Open Space Preservation Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars)	Shows total expenditures by municipality; where a municipality extends beyond the Delaware River Basin (DRB), the expenditures are only for the DRB area.
2. Open Space Preservation Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars) Per Acre of Forest and Wetlands	Map #1 normalized based on acres of forest and wetlands within the DRB for each municipality.
3. Open Space Preservation Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars) Per Person	Map #1 normalized based on municipal population, including those not within the DRB.
4. Agricultural Preservation Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars)	Shows total expenditures by municipality; where a municipality extends beyond the Delaware River Basin (DRB), the expenditures are only for the DRB area.
5. Agricultural Preservation Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars) Per Acre of Agricultural Land	Map #4 normalized based on acres of farmlands within the DRB for each municipality.

Land Stewardship and Ecological Restoration

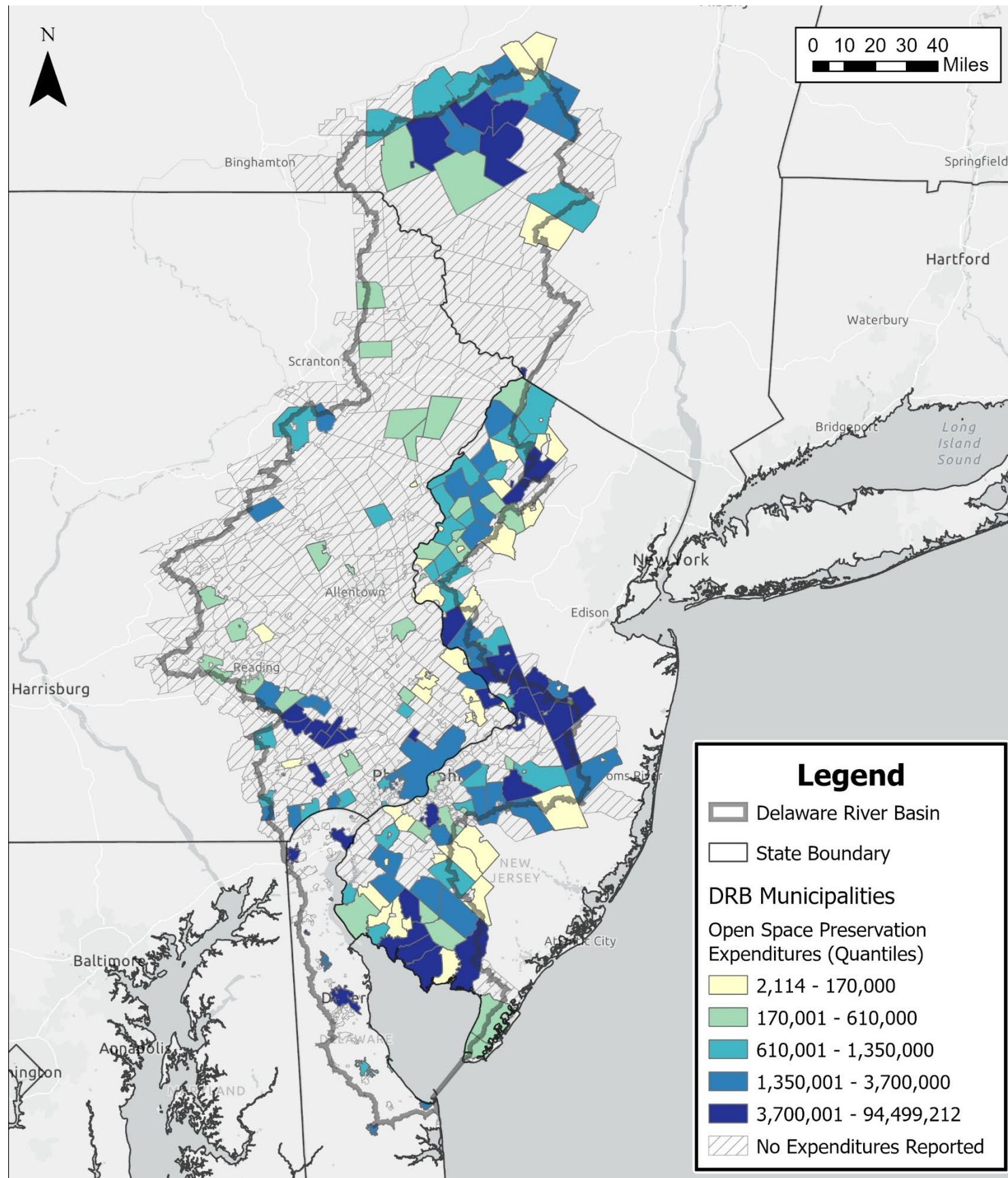
Map Title	Discussion
6. Agricultural BMP Expenditures 2014-2022 Delaware River Basin (HUC12 Watershed Level): Total Expenditures (Dollars)	Shows total expenditures by HUC12 drainage area (aka watershed).
7. Agricultural BMP Expenditures 2014-2022 Delaware River Basin (HUC12 Watershed Level): Total Expenditures (Dollars) Per Acre of Agricultural Land	Map #6 normalized based on acres of farmlands within the HUC12 area.
8. Lake Restoration Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars)	Shows total expenditures by municipality; where a municipality extends beyond the Delaware River Basin (DRB), the expenditures are only for the DRB area.
9. Lake Restoration Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars) Per Acre of Lakes	Map #8 normalized based on acres of lakes within the DRB for each municipality.

Map Title	Discussion
10. Stream Restoration Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars)	Shows total expenditures by municipality; where a municipality extends beyond the Delaware River Basin (DRB), the expenditures are only for the DRB area.
11. Stream Restoration Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars) Per Mile of NHD River/Stream	Map #10 normalized based on miles of streams and rivers within the DRB for each municipality, as identified through the National Hydrography Dataset (NHD).
12. Wetlands Restoration Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars)	Shows total expenditures by municipality; where a municipality extends beyond the Delaware River Basin (DRB), the expenditures are only for the DRB area.
13. Wetlands Restoration Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars) Per Acre of Wetlands	Map #12 normalized based on acres of wetlands within the DRB for each municipality.

Water Infrastructure

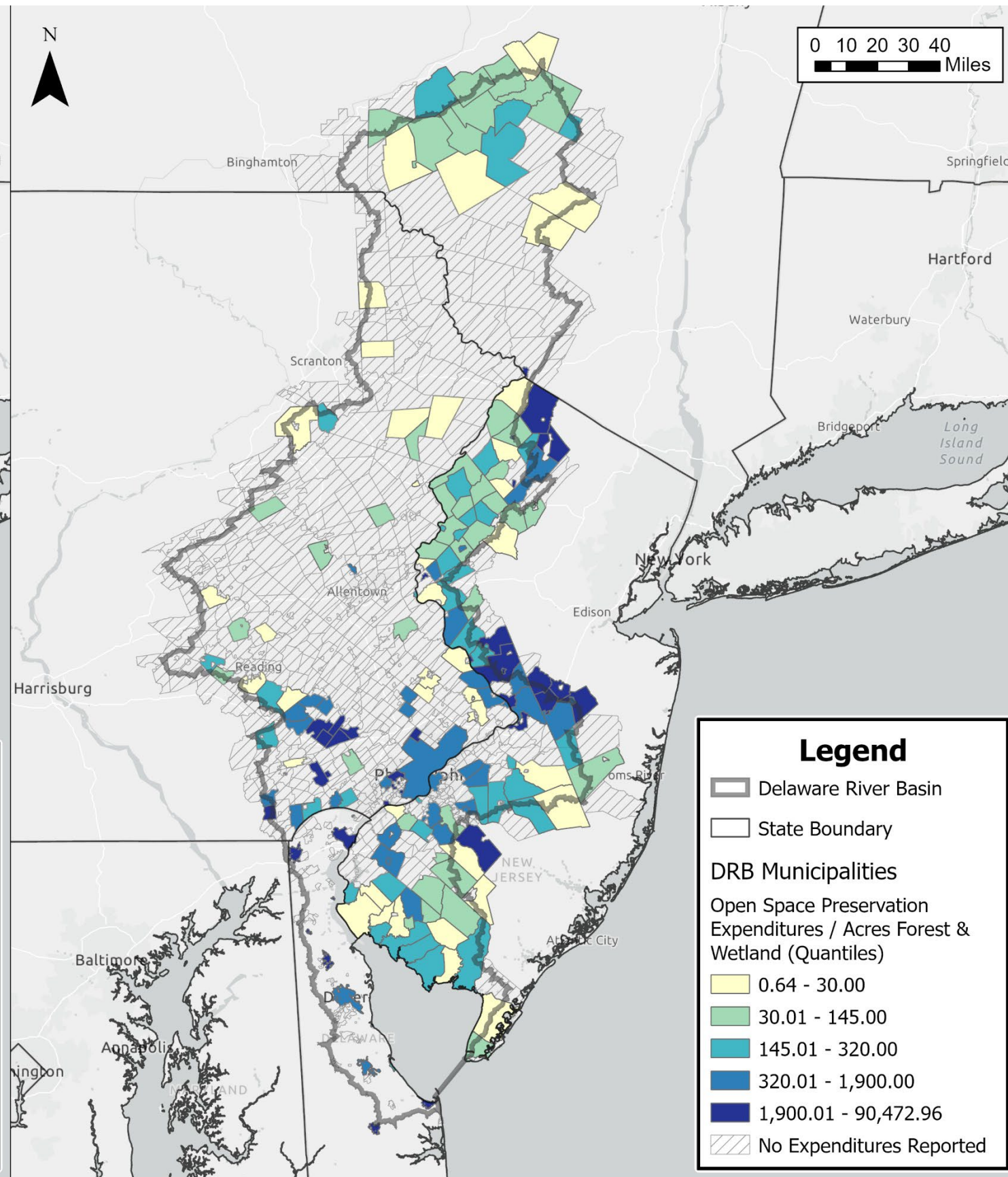
Map Title	Discussion
14. Green Stormwater Management Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars)	Shows total expenditures by municipality; where a municipality extends beyond the Delaware River Basin (DRB), the expenditures are only for the DRB area.
15. Green Stormwater Management Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars) Per Acre of Developed Land	Map #14 normalized based on acres of developed lands within the DRB for each municipality.
16. Traditional Stormwater Management Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars)	Shows total expenditures by municipality; where a municipality extends beyond the Delaware River Basin (DRB), the expenditures are only for the DRB area.
17. Traditional Stormwater Management Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars) Per Acre of Developed Land	Map #16 normalized based on acres of developed lands within the DRB for each municipality.
18. Sewer Collection System Upgrade Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars)	Shows total expenditures by municipality; where a municipality extends beyond the Delaware River Basin (DRB), the expenditures are only for the DRB area.
19. Sewer Collection System Upgrade Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars) Per Acre of Developed Land	Map #18 normalized based on acres of developed lands within the DRB for each municipality.
20. Sewer Collection System Upgrade Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars) Per Person	Map #18 normalized based on municipal population, including those not within the DRB.

Map Title	Discussion
21. Wastewater Treatment Plant Upgrade Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars)	Shows total expenditures by municipality; where a municipality extends beyond the Delaware River Basin (DRB), the expenditures are only for the DRB area.
22. Wastewater Treatment Plant Upgrade Expenditures 2014-2022 Delaware River Basin (Municipal Level): Total Expenditures (Dollars) Per Acre of Developed Land	Map #21 normalized based on acres of developed lands within the DRB for each municipality.



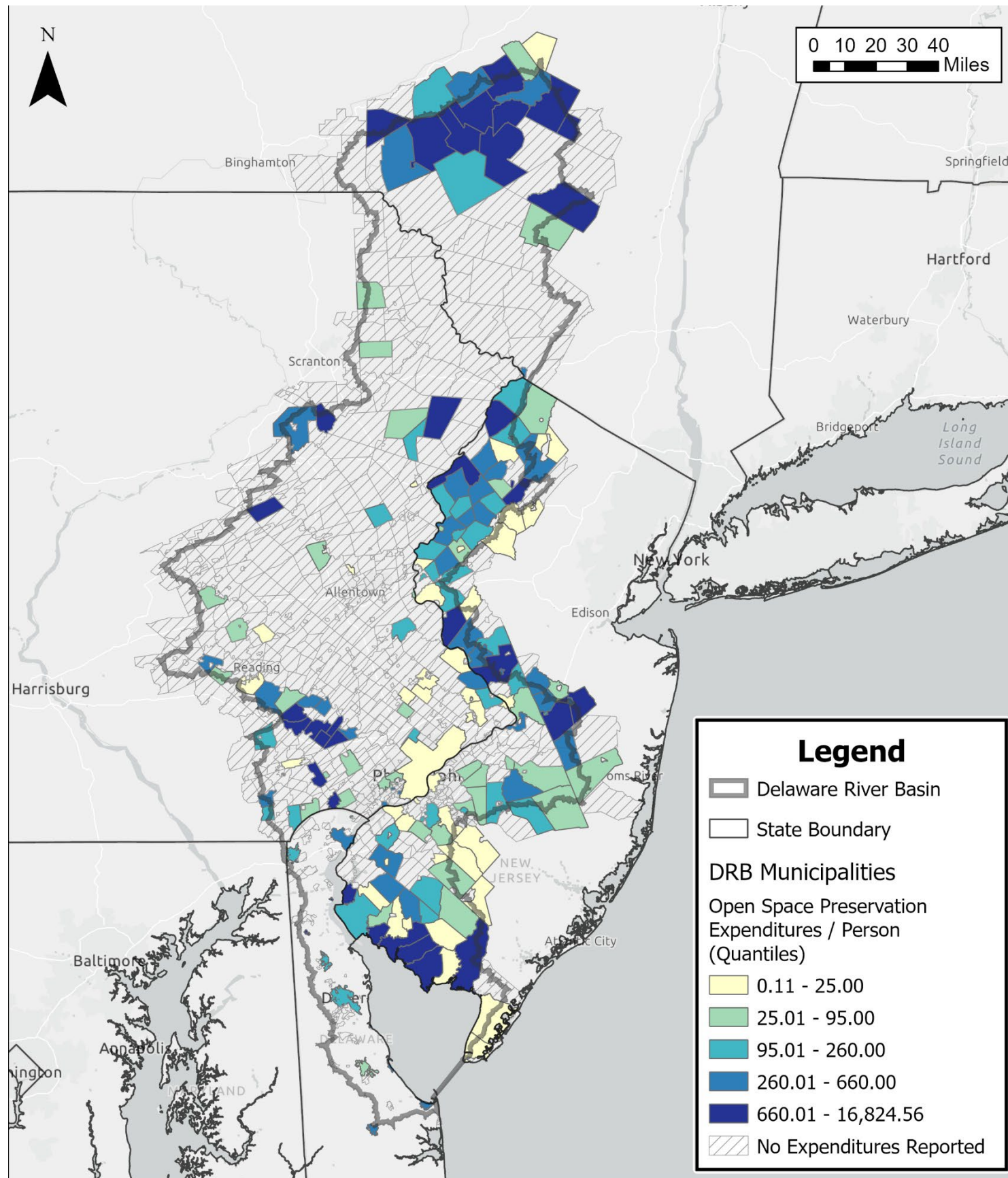
**Open Space Preservation Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars)**

E1

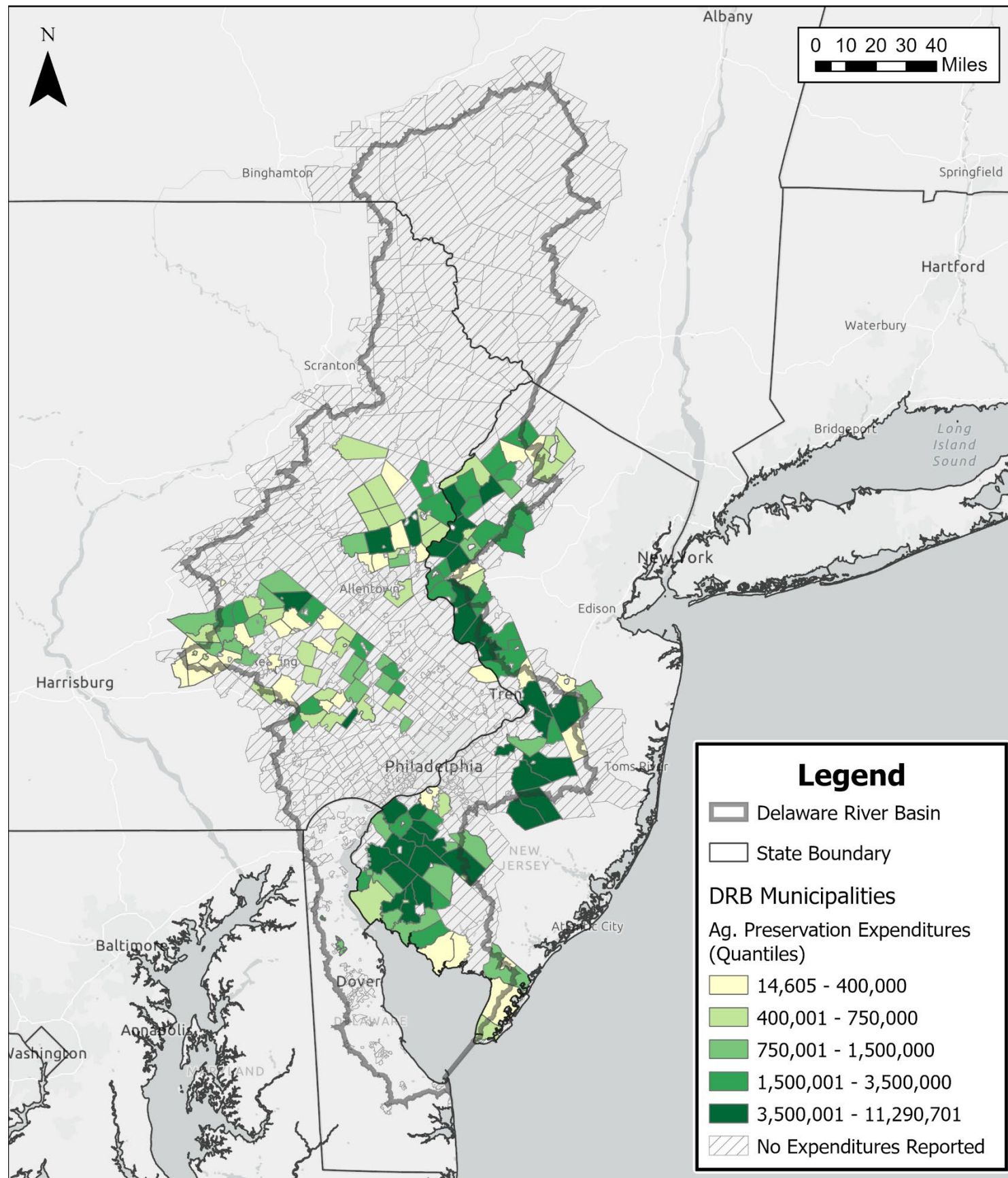


**Open Space Preservation Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars) Per Acre of Forest and Wetland**

E2

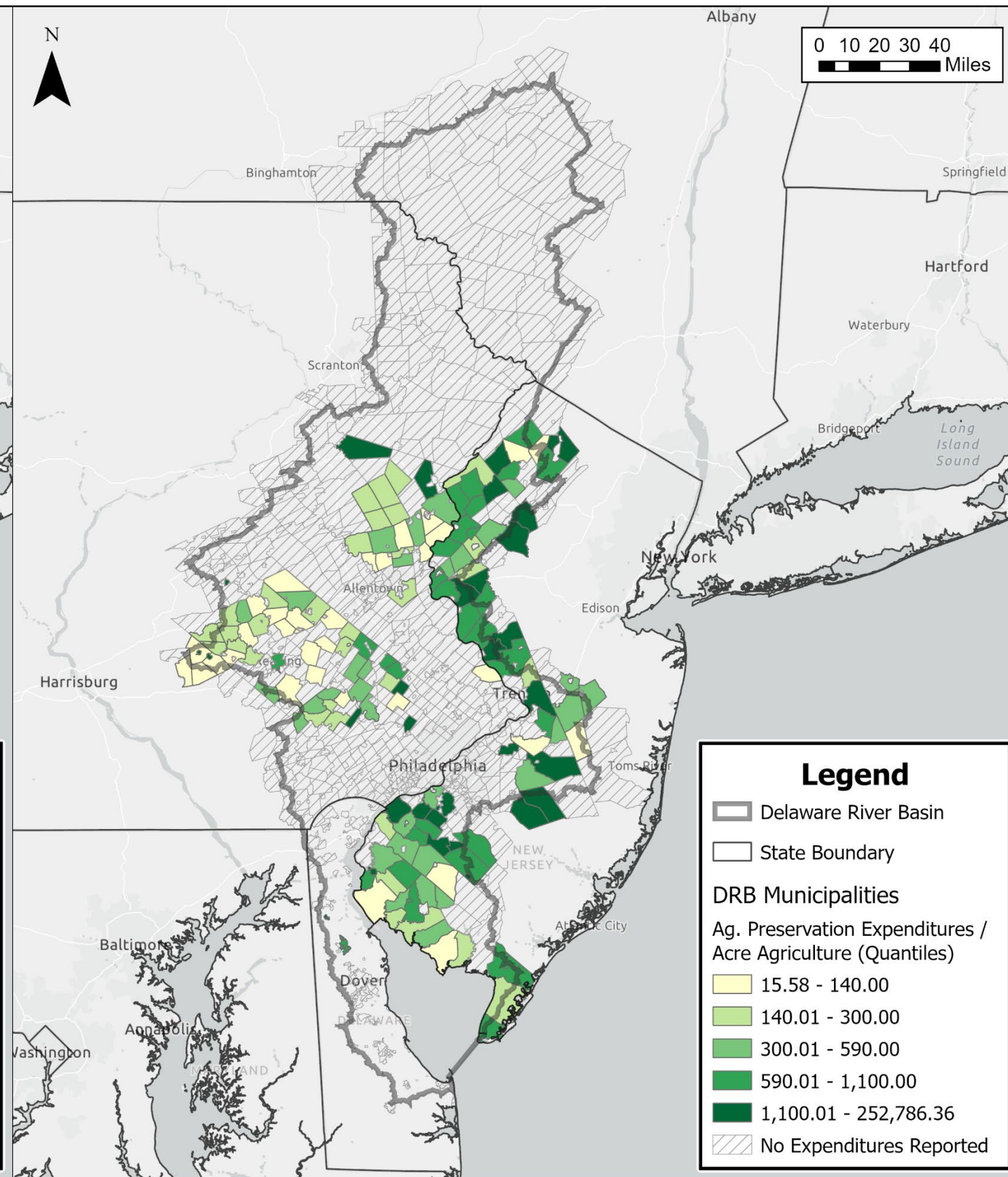


**Open Space Preservation Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars) Per Person**



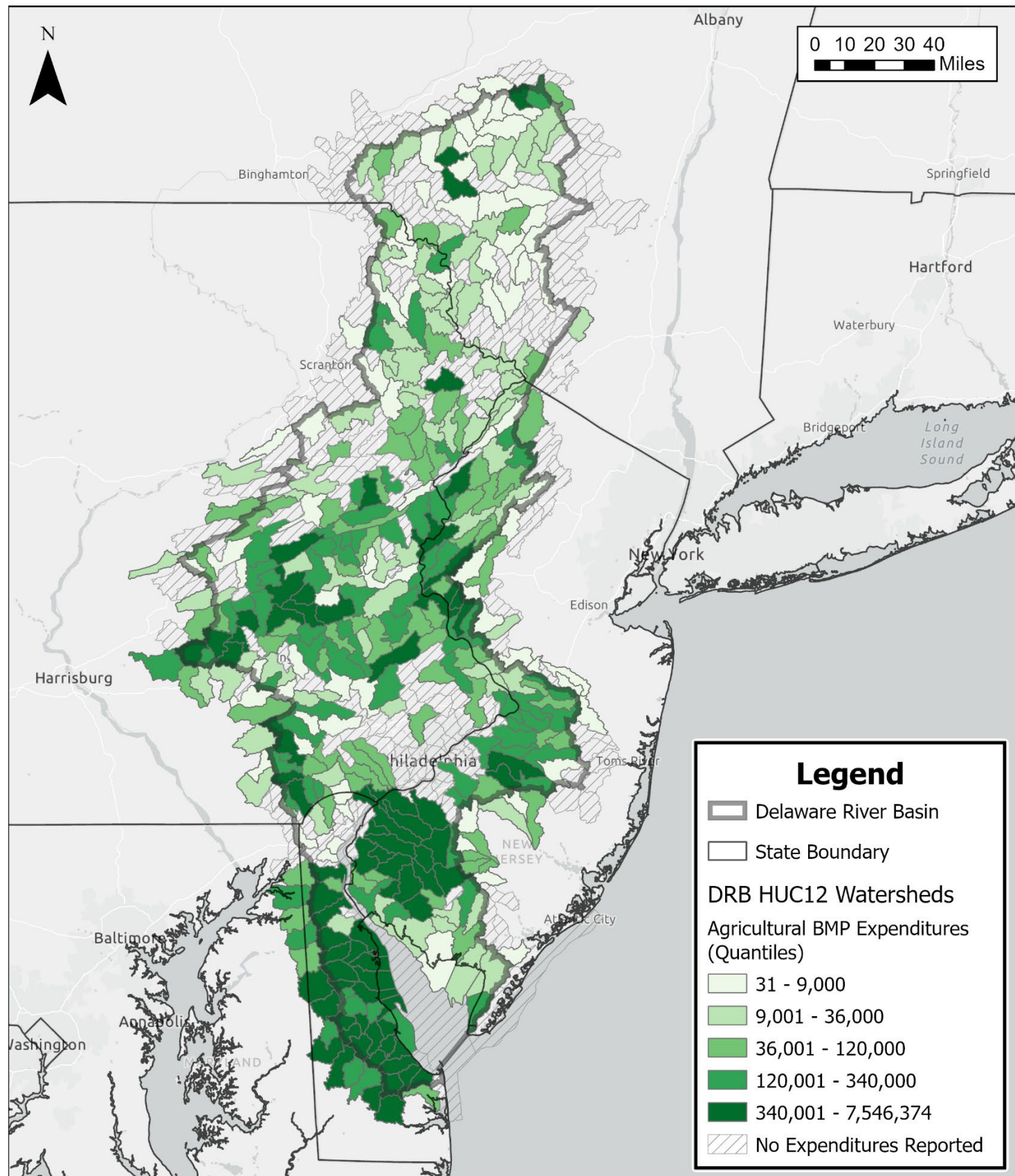
**Agricultural Preservation Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars)**

E4



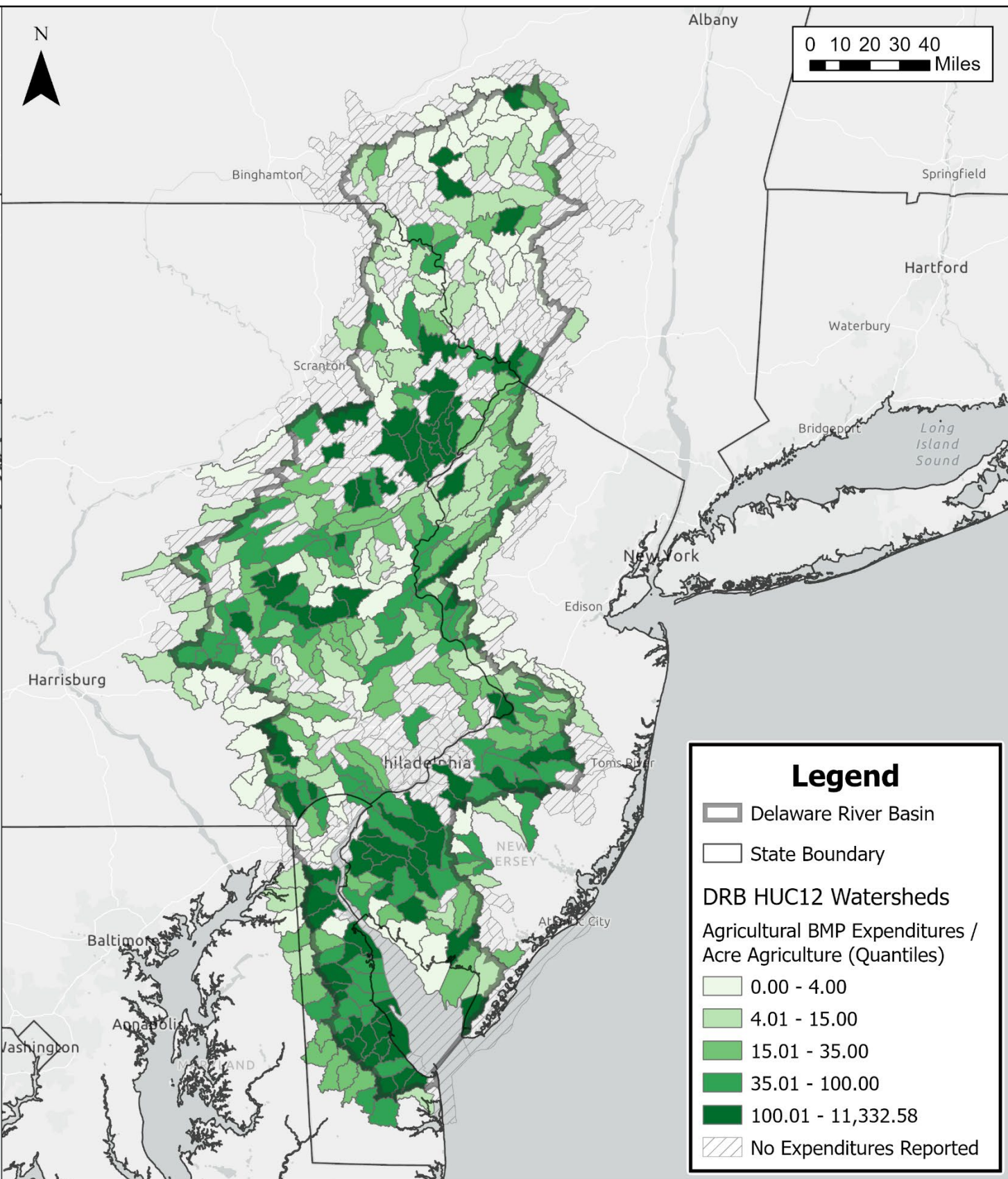
**Agricultural Preservation Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars) Per Acre of Agricultural Land**

E5



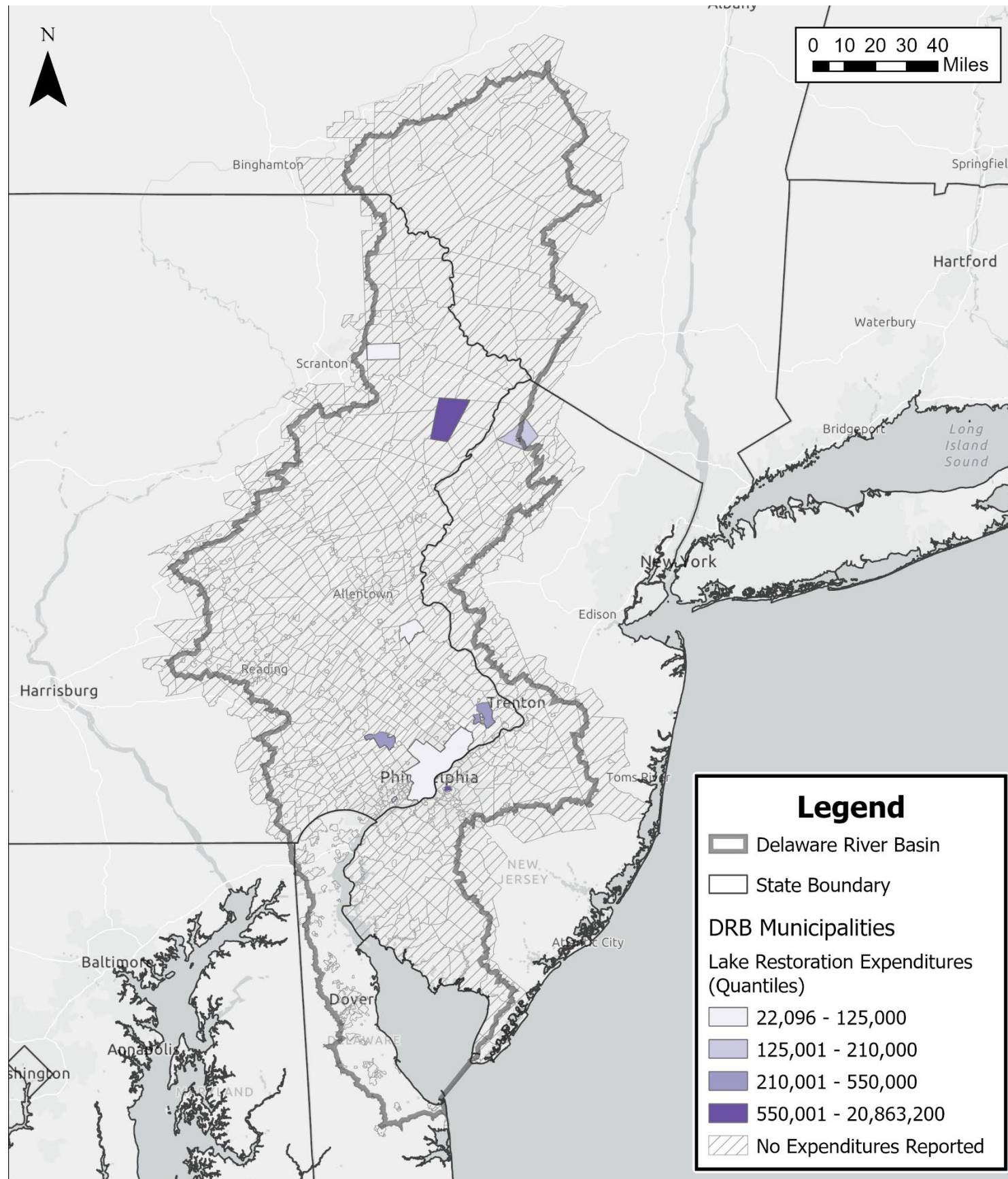
**Agricultural BMP Expenditures 2014-2022
Delaware River Basin (HUC12 Watershed Level)
Total Expenditures (Dollars)**

E6



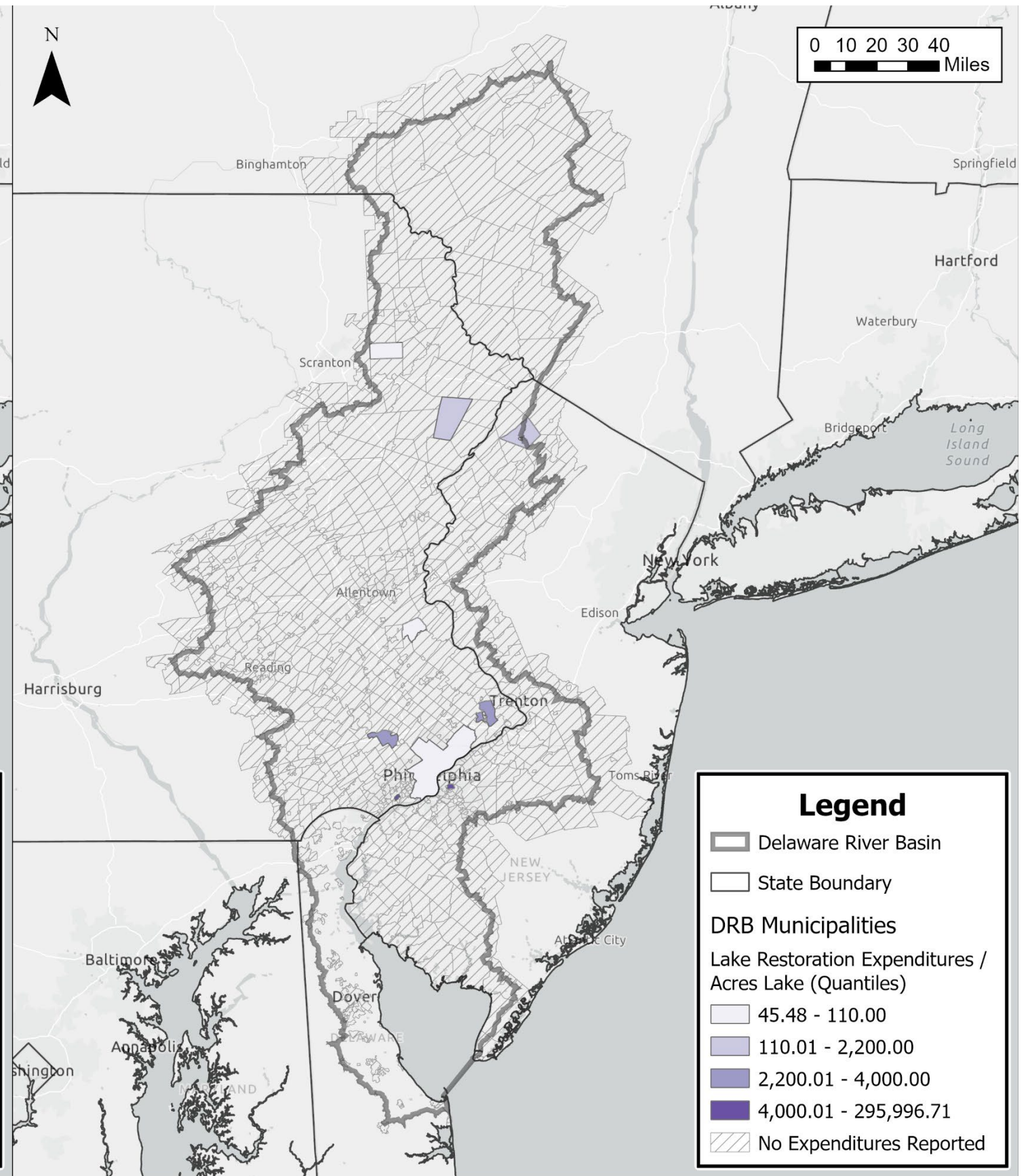
**Agricultural BMP Expenditures 2014-2022
Delaware River Basin (HUC12 Watershed Level)
Total Expenditures (Dollars) per Acre of Agricultural Land**

E7



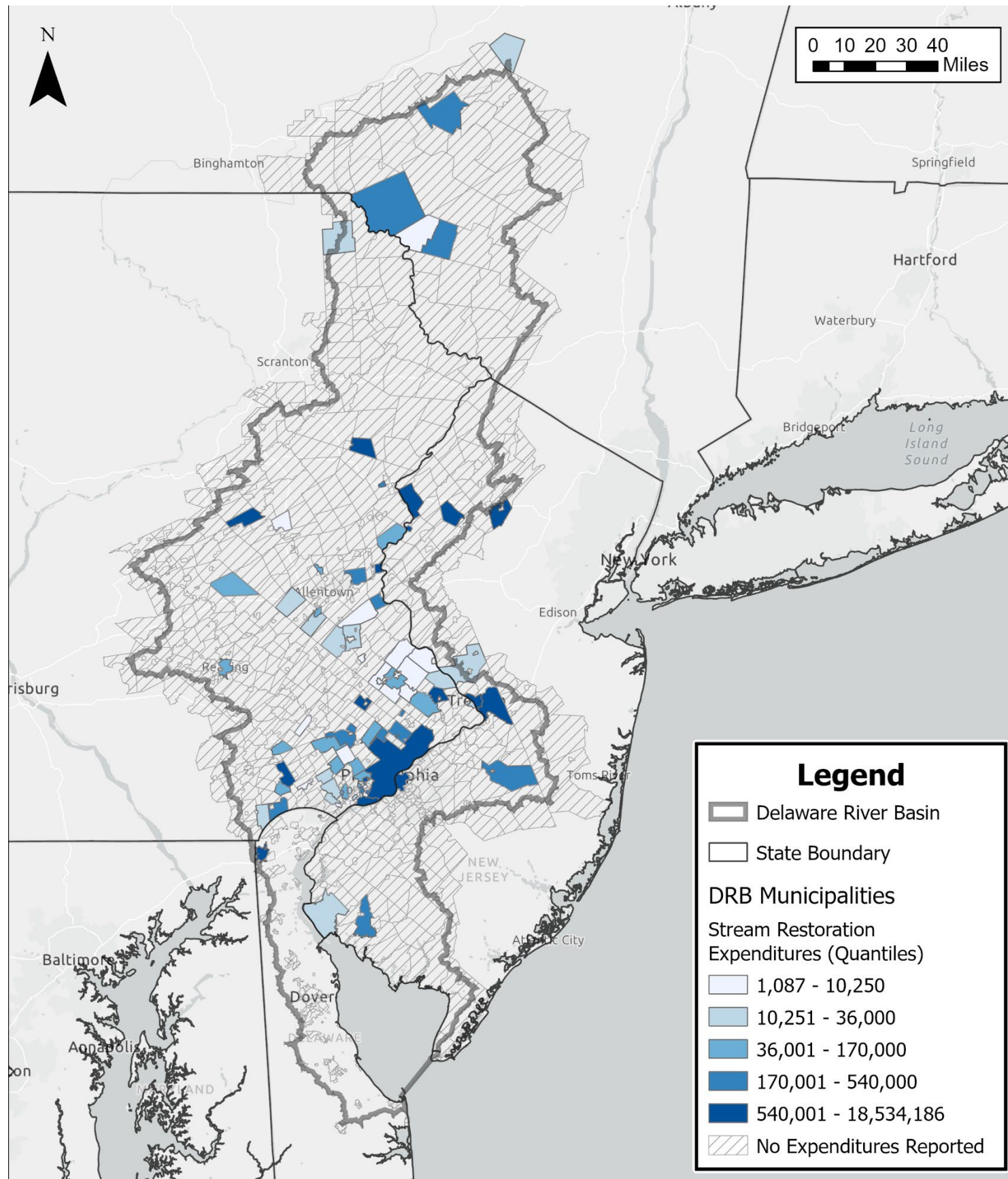
**Lake Restoration Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars)**

E8



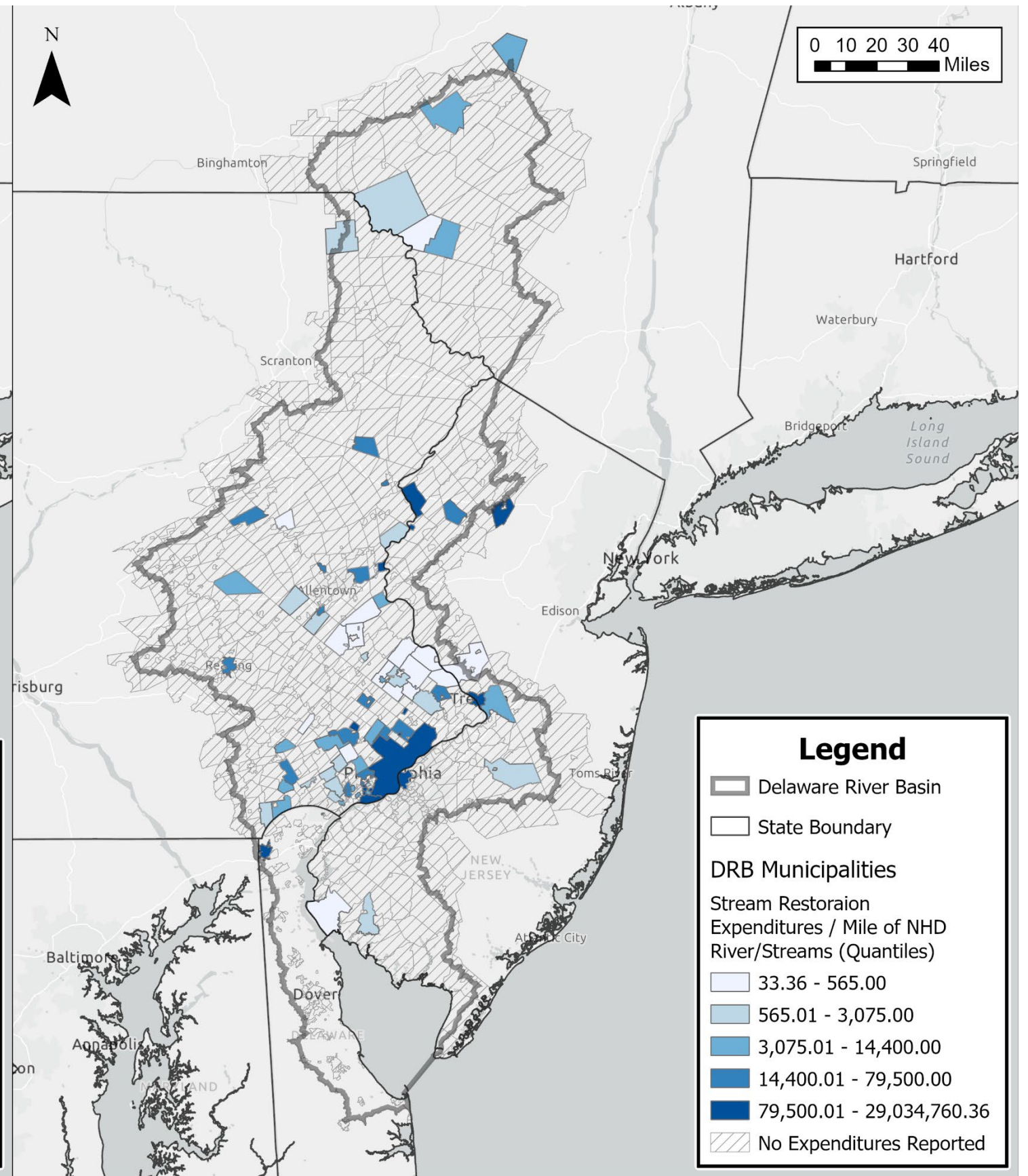
**Lake Restoration Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars) Per Acres of Lakes**

E9



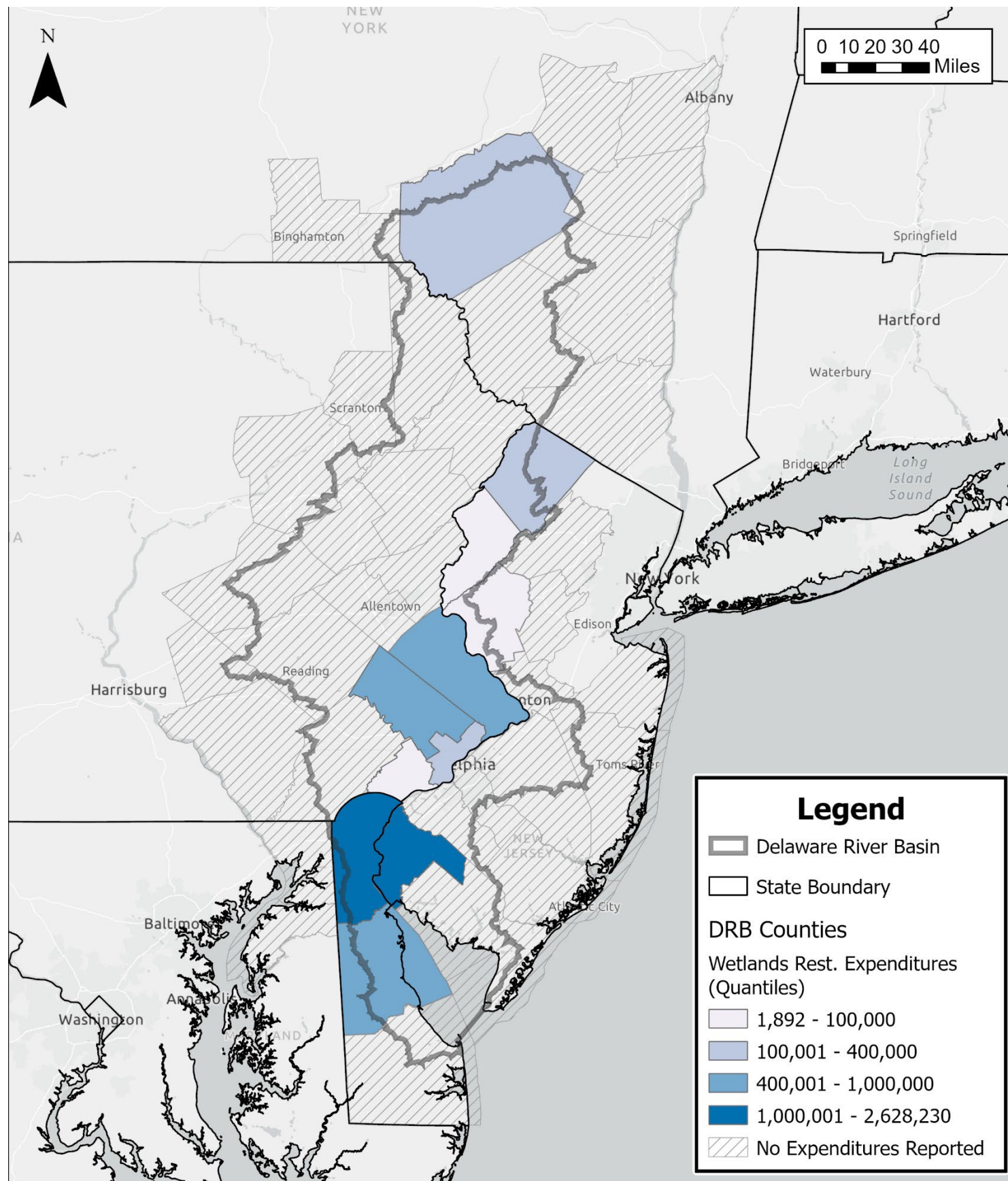
**Stream Restoration Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars)**

E10



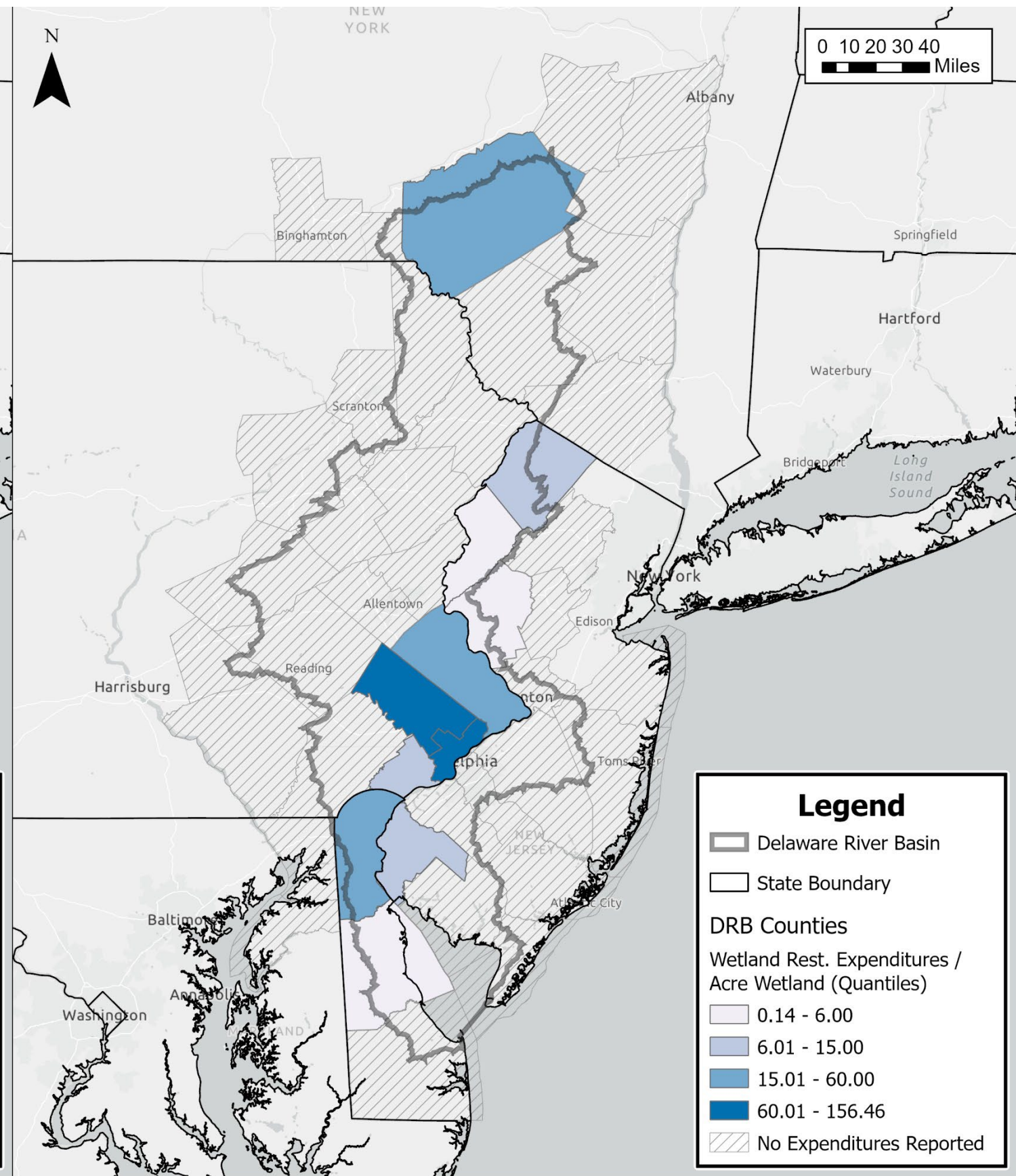
**Stream Restoration Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars) Per Mile of NHD River/Stream**

E11



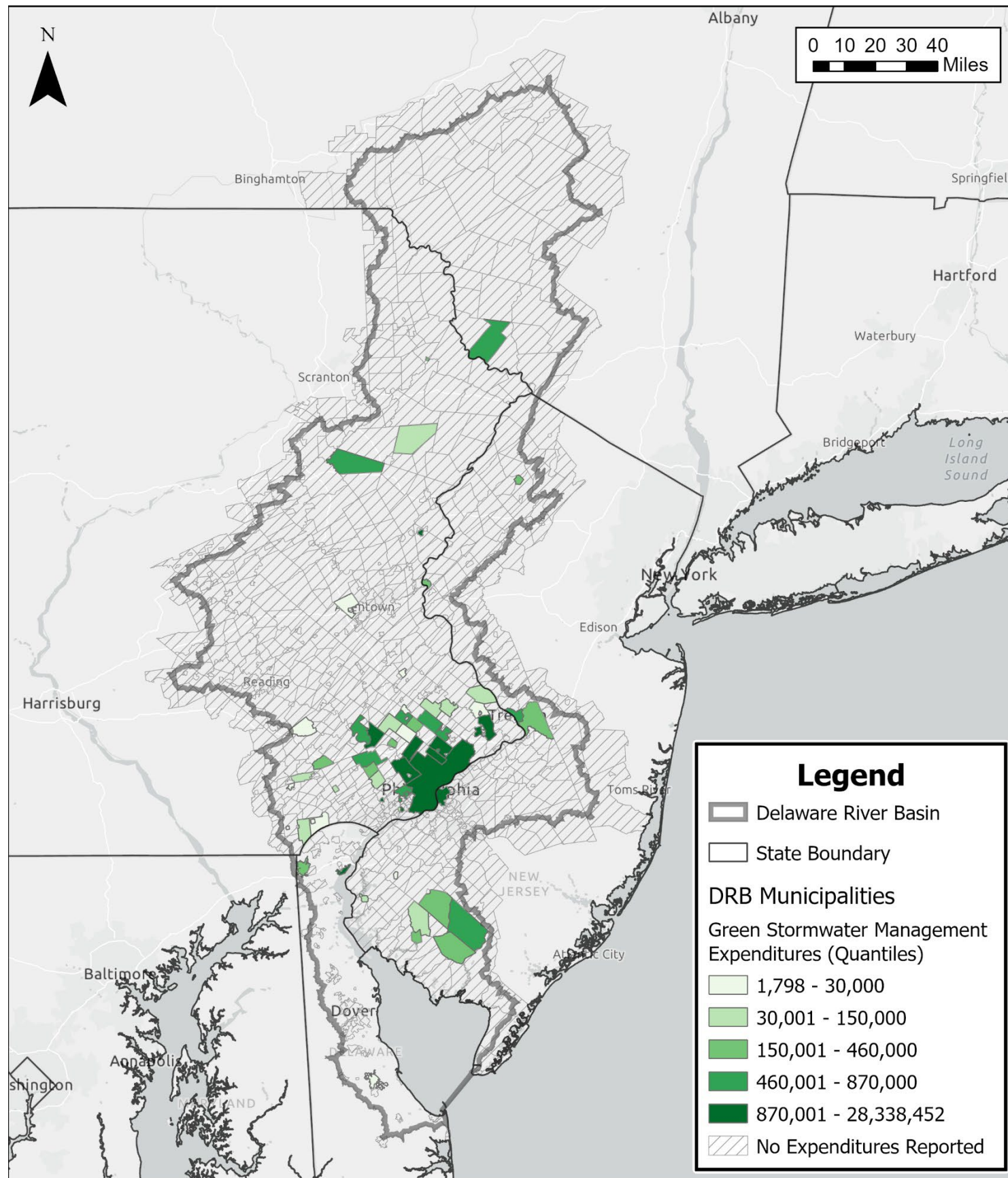
**Wetlands Restoration Expenditures 2014-2022
Delaware River Basin (County Level)
Total Expenditures (Dollars)**

#12



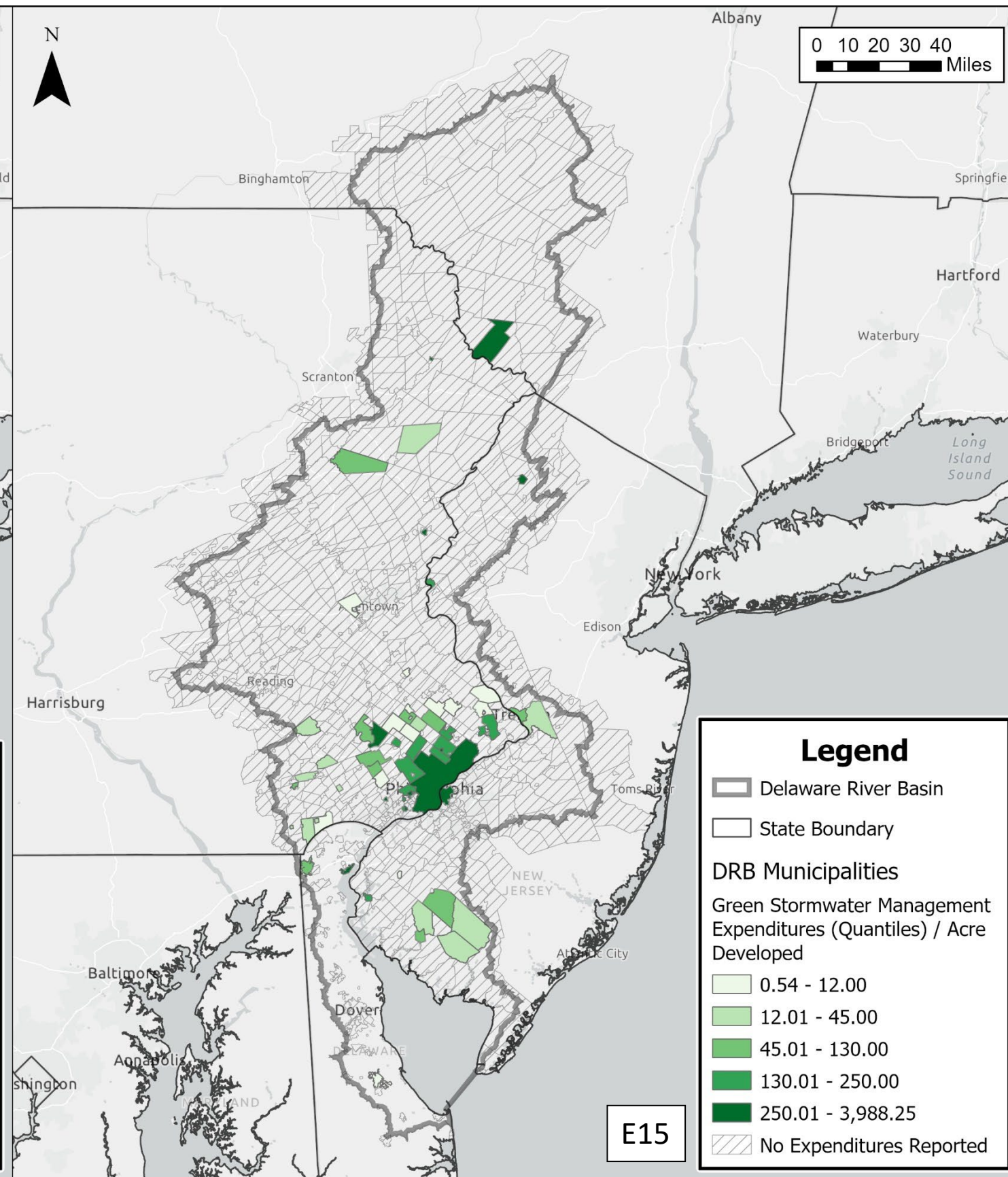
**Wetlands Restoration Expenditures 2014-2022
Delaware River Basin (County Level)
Total Expenditures Per Acre of Wetlands (Dollars)**

#13



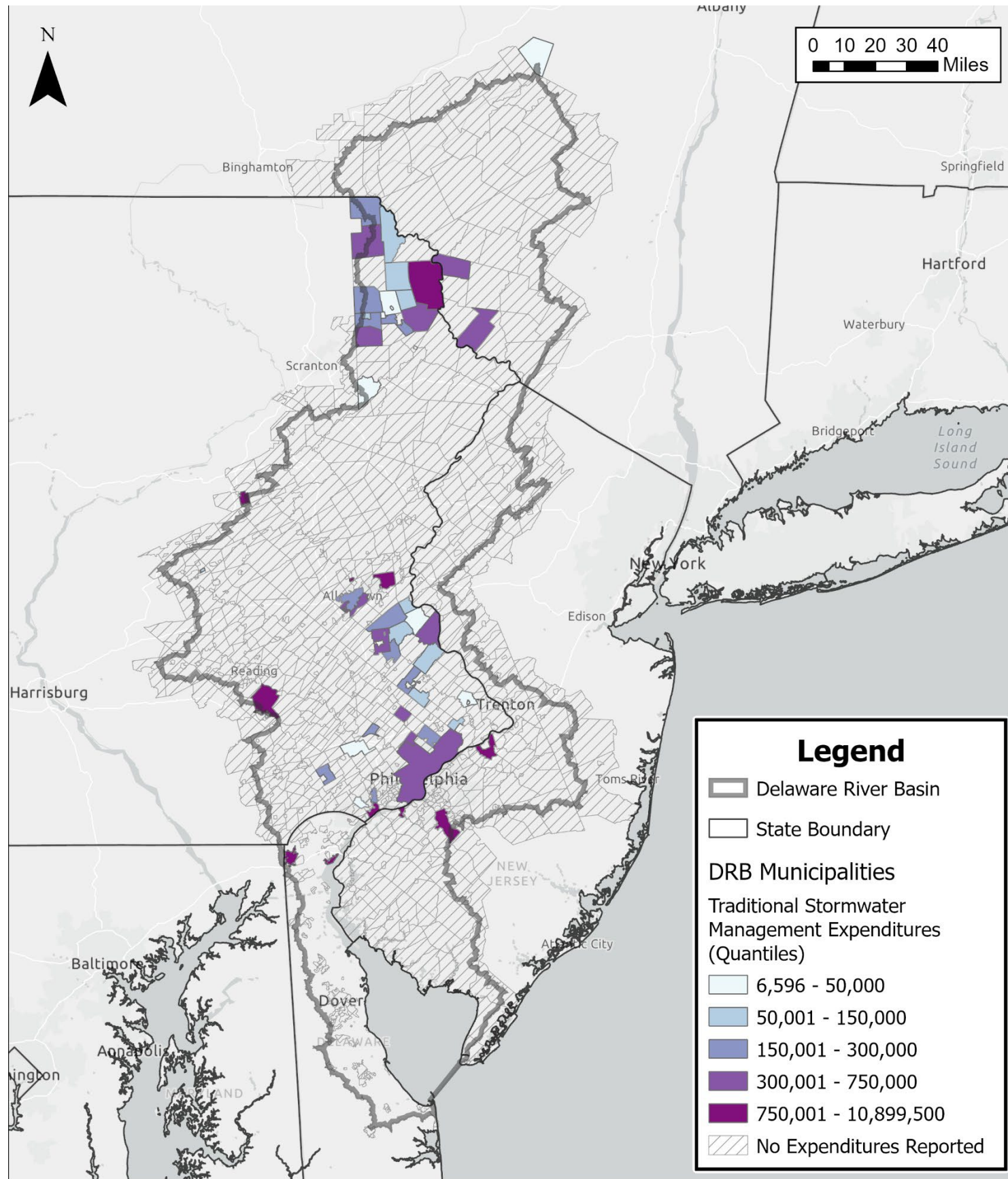
**Green Stormwater Management Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars)**

E14



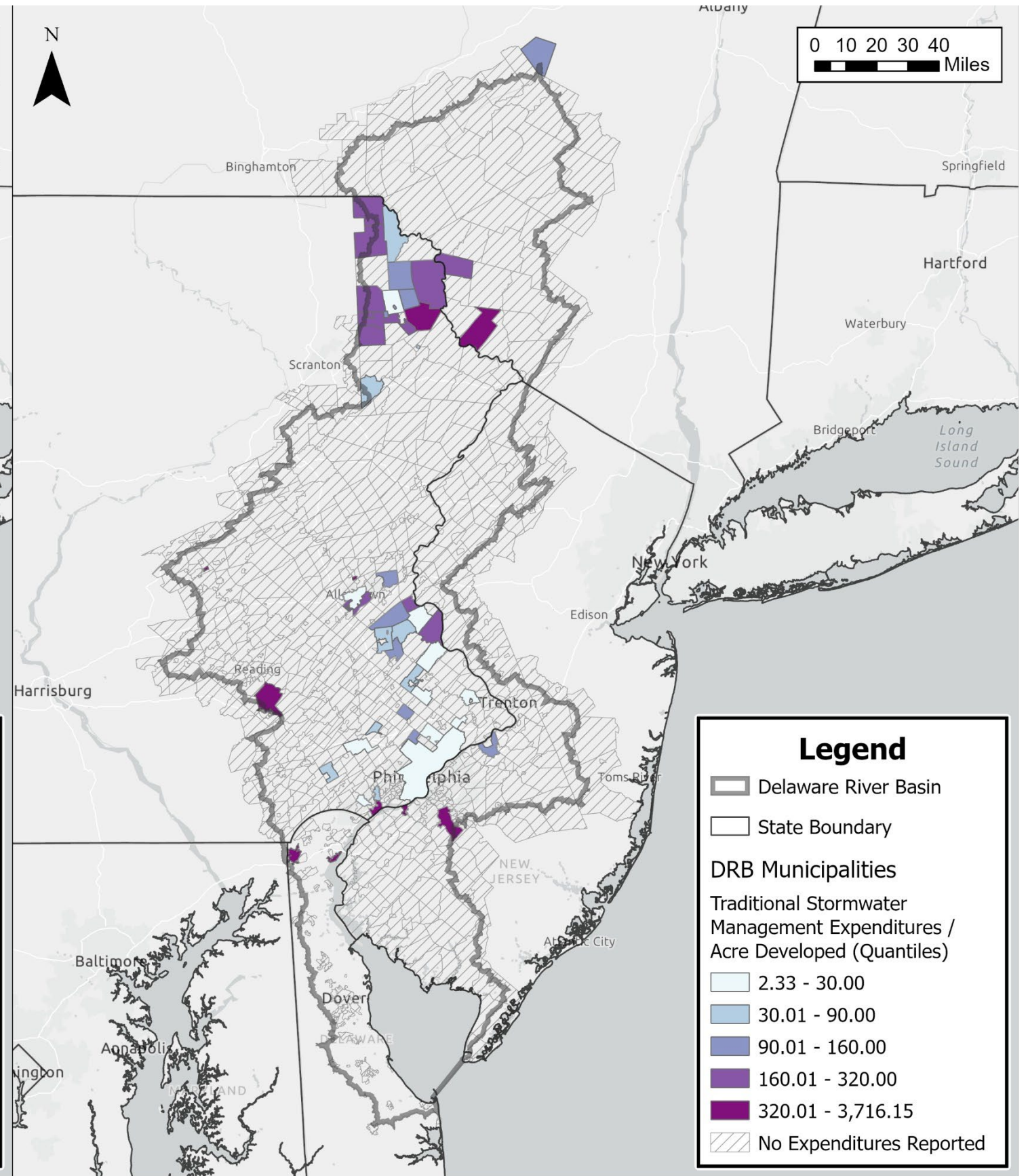
**Green Stormwater Management Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars) Per Acre of Developed Land**

E15



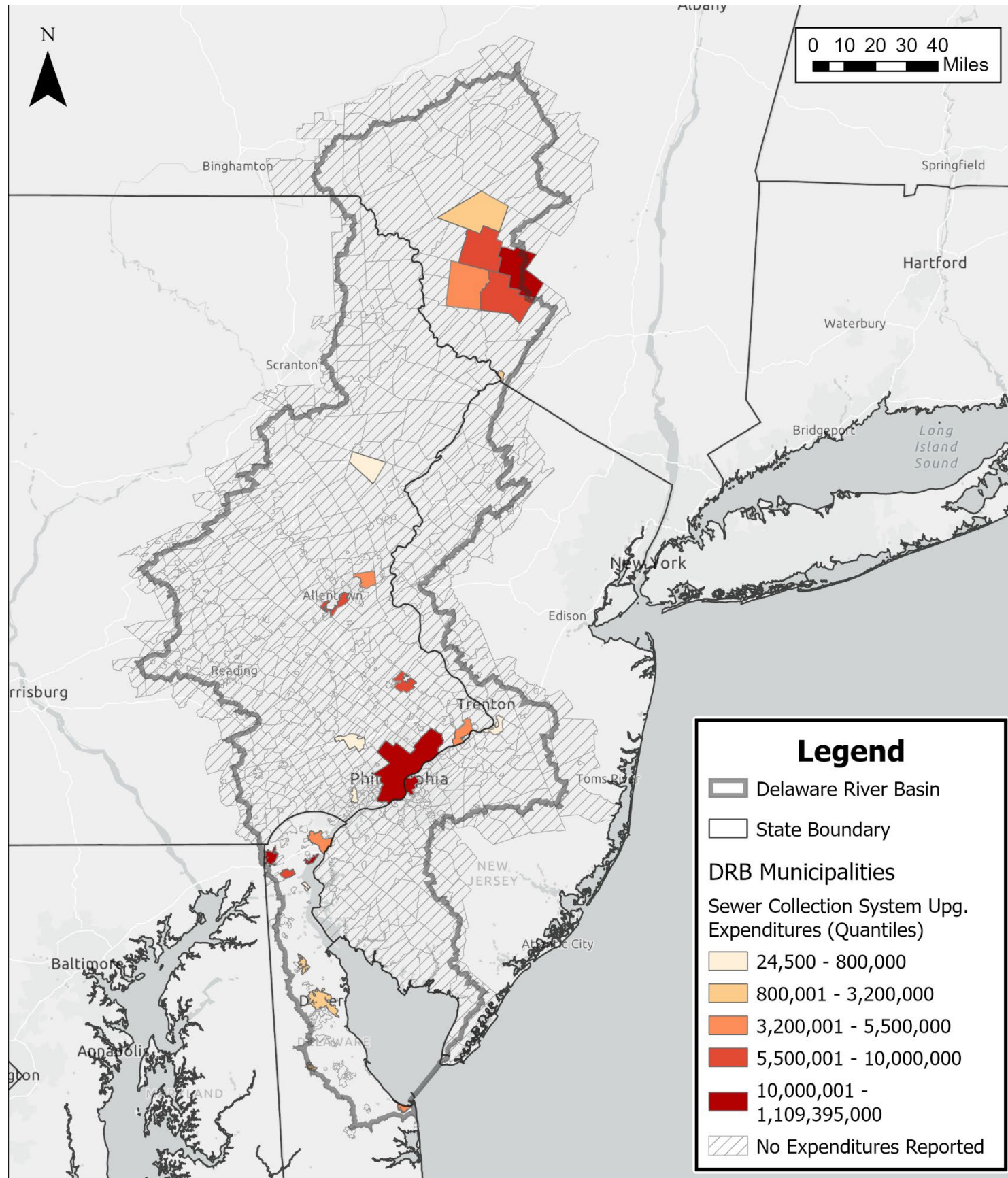
**Traditional Stormwater Management Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars)**

E16



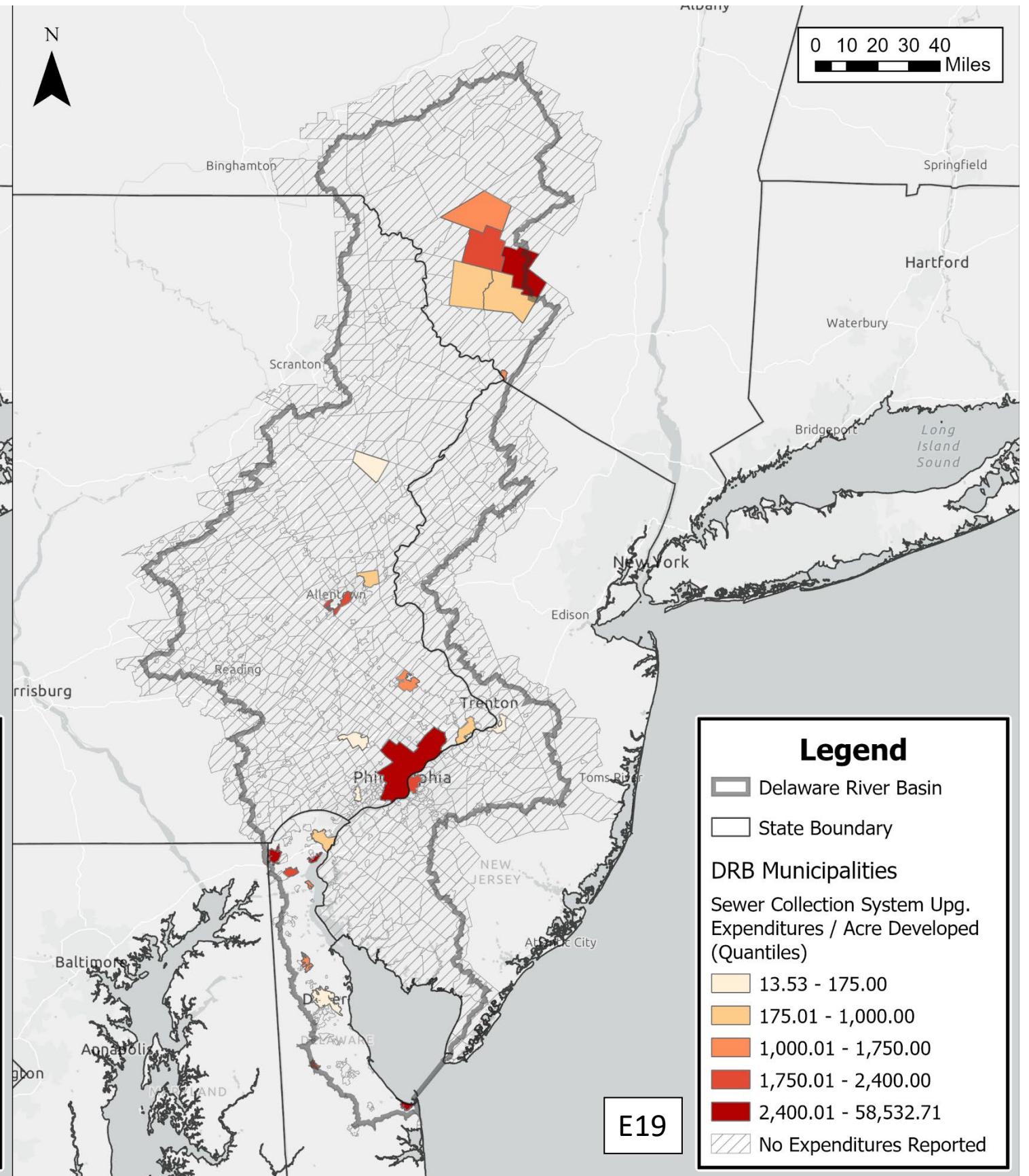
**Traditional Stormwater Management Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars) Per Acre of Developed Land**

E17



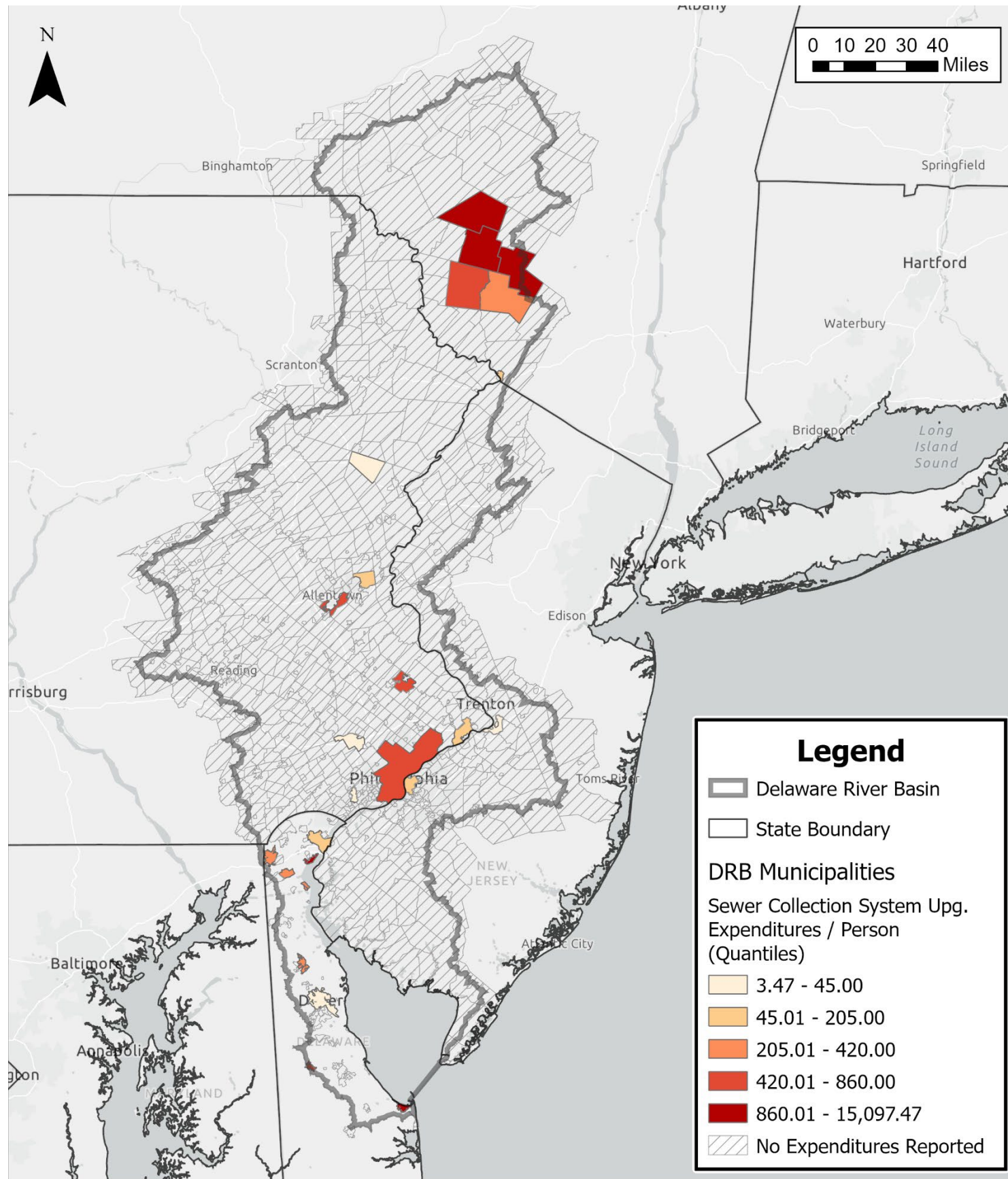
**Sewer Collection System Upgrade Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars)**

E18

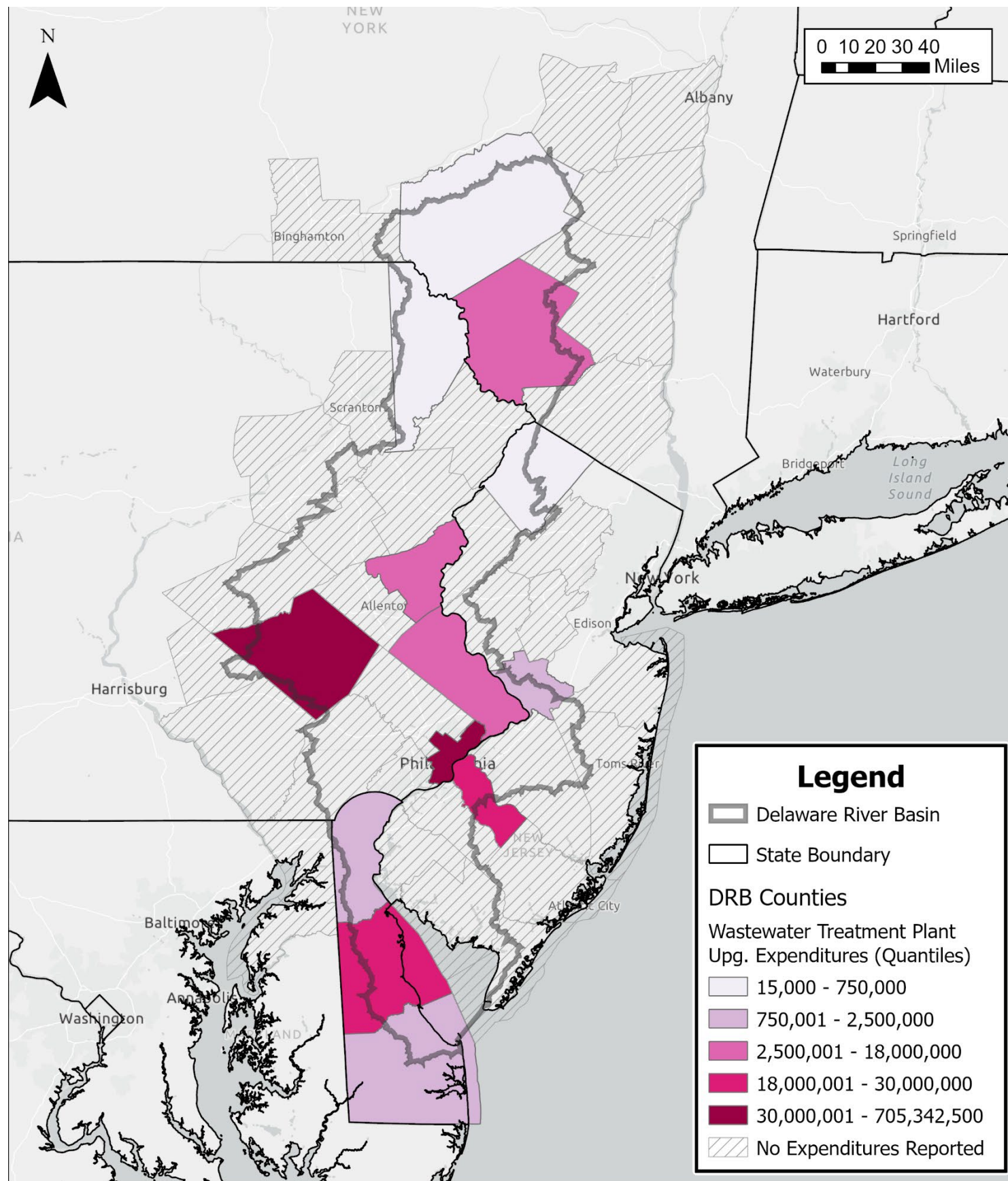


**Sewer Collection System Upgrade Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars) Per Acre of Developed Land**

E19

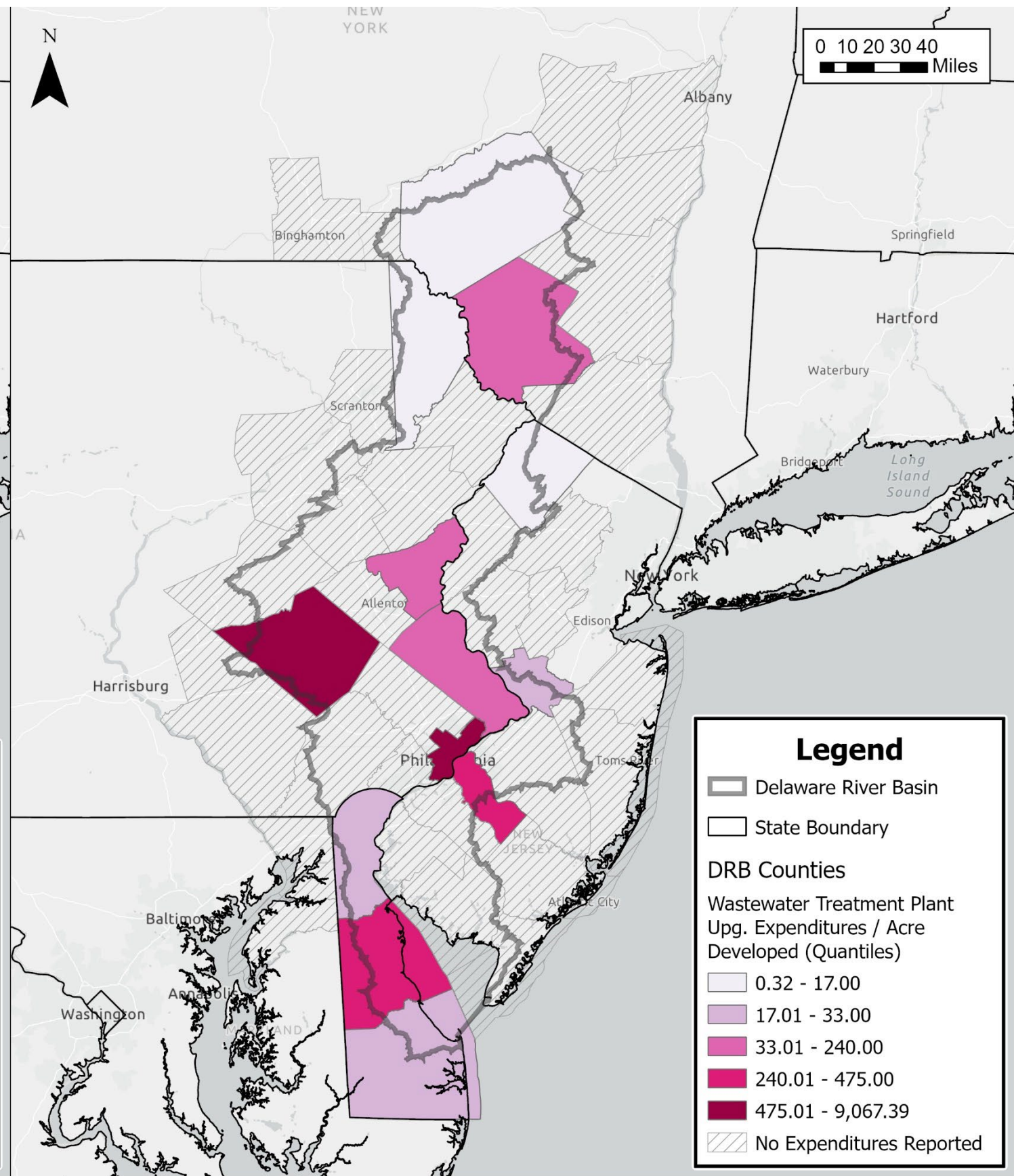


**Sewer Collection System Upgrade Expenditures 2014-2022
Delaware River Basin (Municipal Level)
Total Expenditures (Dollars) Per Person**



**Wastewater Treatment Plant Upgrade Expenditures 2014-2022
Delaware River Basin (County Level)
Total Expenditures (Dollars)**

E21



**Wastewater Treatment Plant Upgrade Expenditures 2014-2022
Delaware River Basin (County Level)
Total Expenditures (Dollars) Per Acre of Developed Land**

E22

Appendix F: In Person Interview Questions

This appendix provides the interview script used for in-person interviews conducted by Karen O'Neill, PhD, Associate Professor, Rutgers.

Interview questions for experts in government funding for conservation

[NOTE: Each interviewee will be asked only some of the following questions, depending on their knowledge.]

[NOTE: Interviews will be done by phone or video call. Before the interview, interviewees will receive by email the full text of the oral consent section, including contact information for the research team and the IRB staff. This information will be restated in the interview.]

Thank you for talking with me about conservation and restoration to improve water quality.

Before I ask you questions, I am going to review information about consent, which we sent to you by email.

I expect this interview will take between 20 minutes to an hour. Your participation is entirely voluntary. You may end the interview at any time or refuse to answer any question. If you decide to quit at any time before you have finished the interview your answers will NOT be recorded.

There are no foreseeable risks to this study. We believe that a wide range of people will benefit from our compiling current funding for conservation and water quality improvements.

This interview is confidential. That means that I will use a code number for the interview notes and will not identify you by name in our notes. In oral or written scientific presentations and in the report to the William Penn Foundation, we may mention the type of job you hold but will not identify your name or organization.

If there is information you are willing to tell us but don't wish to share directly with other organizations, please tell me so and I will note that.

Are these conditions acceptable to you, and are you willing to proceed with the interview?

[IF NOT] Are there others in your organization/agency or a similar entity that you think might be interested in talking to us?

May I record your answers on a digital recorder? The recording will not include information identifying you or your organization, and it will be used only to help me transcribe your comments.

[IF YES] I have started the recorder now...

If you have any questions about this interview, please contact Karen O'Neill at 848-932-9208. The mail address is:

Karen M. O'Neill, Assoc. Prof.
Human Ecology Dept.

55 Dudley Rd., #213
Rutgers University
New Brunswick, NJ 08901
karen.oneill@rutgers.edu

If you have questions about your rights as a research subject, you can contact the Director of the Institutional Review Board at:

New Brunswick/Piscataway Arts and Sciences IRB (732) 235-2866 or the Rutgers Human Subjects Protection Program at (973) 972-1149 or email them at humansubjects@ored.rutgers.edu.

This contact information was also included in the materials we previously sent to you via email.

Let me introduce our project.

Our team from Rutgers University is working with the William Penn Foundation to quantify annual government spending in the Delaware River Basin from 2014 through 2019. We're tracking spending to protect and improve water quality, including open space and farmland preservation plus stormwater management and stream restoration projects. We sent you a list of project types by email. We aren't tracking government spending for regulatory programs or actions like development review, compliance, or enforcement. We're also not tracking developer or governmental expenditures in response to regulatory requirements or enforcement actions.

We are doing interviews to help us understand the relative importance of various government funding sources, how these sources promote spending by other parties, and funding equity.

First, I'm going to ask you about the big picture of funding in the Basin.

For the years 2014 through 2019, did you see any trends in the quantity of government funding to improve water quality in the Basin?

[IF YES] Which government programs have changed the amount they are spending?

Did you see any important changes in the priorities or purposes for government funding in the Basin?

[IF YES] Which government programs have changed their priorities?

[PROMPT] For instance, do you see changes in the proportion of funding spent on acquiring land, on land stewardship and restoration, or on recreational improvements?

What government funding sources do you feel are most important for the Basin?

[FOLLOW-UP] Why are these sources important?

Which of these important government funding sources do you feel are most reliable for the Basin?

Did any major changes in government funding processes redefine who qualified for and received funding?

Did you see any trends in how organizations were getting matching funds for projects that need a match?

Now I'm going to ask about how funds have been distributed.

Equity in government spending does not usually mean giving **equal** dollar amounts to all farm-owners or to all jurisdictions. We want to learn how you would define **equity or fairness** in government spending. We're seeking your professional opinion as an individual. We will not use your answers as representing the views of any organization you are affiliated with.

First, I will ask you about how the purposes of some programs might create perceptions of that spending isn't done with equity.

Some government programs protect existing environmental functions, like land with high biodiversity. Do you think these programs cause equity problems in the Basin?

[PROBE] For instance, source waters are often in rural areas.

Another set of programs restore or improve environmental functions. Do you think water quality restoration programs cause equity problems in the Basin?

[PROBE] For instance, some programs target the most polluted sites and may leave other sites under-funded.

Is funding for water quality improvements done with equity for farmlands versus non-farmlands?

Next, I'll ask about concepts often used to assess equity.

Do you think there is equity in spending for water quality improvements as they affect poor versus wealthy people in the Basin?

Is there is equity in spending for water quality improvements as they affect people in different racial or ethnic groups?

Do you think there is equity in spending for rural versus urban areas?

Is there equity in spending across municipalities and counties with large versus small populations?

Now I want to ask specifically about farmland programs.

Is there equity in funding from farmland preservation and restoration programs for farm owners of different racial or ethnic groups or of different genders?

Is there funding equity for owners of small farms versus large farms?

Should some types of farmlands receive more conservation funding than they currently receive?

Do you think there is equity in funding for water quality improvements on farmlands across the Basin's major watersheds?

Next, I'll ask about spending for non-farmlands.

Should some ecological functions on non-farmlands be given more funding than they currently receive?

Do you think there is equity in funding for non-farmlands across the Basin's major watersheds?

Now I will ask about municipal sources of funding.

Do municipal governments across the Basin spend similar proportions of their budgets for water quality improvements?

[IF NO]: How do they differ?

Do you think communities with major local water problems spend high proportions of their revenues on water quality protection and restoration?

Do you think mandates from higher levels of government lead municipalities to spend high proportions of their revenues on water quality improvements?

Reflecting on your comments about equity, are there organizations working in the Basin you think are doing important or interesting work on promoting equity in funding for water quality?

[IF SO]: Any others?

Any last thoughts about equity in funding for water quality improvements in the Delaware Basin?

Now I will ask about funding sources.

We are gathering data from federal, state, county, and local governments in this region. Based on the list we sent by email, are there significant federal or state funding sources we've missed?

Finally, I'm going to ask you about things we should look for in the future

The William Penn Foundation will probably track funding changes after 2019. Are there emerging spending initiatives they should watch? Are there spending initiatives that are sunsetting or transitioning?

Is there anyone else you suggest we contact?

Thank you so much for your help with this project. We hope the results will be useful for the Basin going forward. We look forward to sharing the results with you and others. Please contact us if you have any further thoughts.

Appendix G: Qualtrics Survey Questions

This appendix provides the script used for online survey of the expert panel, as conducted by Karen O’Neill, PhD, Associate Professor, Rutgers, with technical assistance from Kevin Keys of the Rutgers team.

Q1 *Project: Estimating Public Investments for the Delaware River Watershed by Rutgers, The State University of New Jersey*

Funding: William Penn Foundation. *Principal Investigators:* Daniel J. Van Abs, PhD, FAICP/PP, Associate Professor of Professional Practice, Department of Human Ecology. Karen O’Neill, PhD, Associate Professor, Department of Human Ecology. Sara Malone, MES, Senior Research Specialist, Environmental Analysis and Communications Group, Edward J. Bloustein School of Planning and Public Policy.

End of Block: Title

Start of Block: Introducing the project

Q2 Our Project

Our team from Rutgers University is working with the William Penn Foundation to quantify annual government spending in the Delaware River Basin from 2014 through 2019. We’re tracking spending to protect and improve water quality, including open space and farmland preservation, plus stormwater management, and stream restoration projects.

We aren’t tracking government spending for regulatory programs or actions like development review, compliance, or enforcement. We’re also not tracking developer or governmental expenditures in response to regulatory requirements or enforcement actions.

We are doing surveys to help us understand the relative importance of various government funding sources, how these sources promote spending by other parties, and funding equity.

Our questions cover a wide range of programs, and you are likely familiar with some more than others. For questions with an answer box, please tell us about the reasons why you think those conditions exist. If you have no opinion about a question, just indicate that in the answer box. Part of our aim is to learn about the patchwork nature of conservation in the Basin.

End of Block: Introducing the project

Start of Block: Consent

Q3 CONSENT TO TAKING THIS SURVEY:

Thank you for taking this survey about conservation and restoration to improve water quality.

This section reviews information about consent, which was included in the survey email. We expect this survey will take between 20 minutes and 45 minutes to complete. Your participation is entirely voluntary. You may end the survey at any time or skip any question you do not wish to answer. If you decide to quit at any time before you have submitted the survey your answers will NOT be recorded.

There are no foreseeable risks to this study. We believe that a wide range of people will benefit from our compiling information about recent funding for conservation and water quality improvements.

This survey is confidential. That means that we will use a code number for the survey notes and will not identify you by name in our notes. In oral or written scientific presentations and in the report to the William Penn Foundation, we may mention the type of job you hold but will not identify your name or organization.

If there is information you are willing to tell us but don't wish to share directly with other organizations, please mention that in your answer to the specific survey question.

By proceeding to take this survey, you affirm that these conditions are acceptable to you.

If you have any questions about this survey, please contact Karen O'Neill at 848-932-9208. The address is:

Karen M. O'Neill, Assoc. Prof.
Human Ecology Dept.
55 Dudley Rd., #213
Rutgers University
New Brunswick, NJ 08901
karen.oneill@rutgers.edu

If you have questions about your rights as a research subject, you can contact the Director of the Institutional Review Board at:

New Brunswick/Piscataway Arts and Sciences IRB, (732) 235-2866, or the Rutgers Human Subjects Protection Program at (973) 972-1149, or email them at humansubjects@ored.rutgers.edu.

This contact information was also included in the survey email materials.

Q4 Proceed with survey?

Yes

No

End of Block: Consent

Start of Block: End of Survey for No Consent

Q5 Thank you for taking the time to consider participating in this study. If you have further questions, please contact Karen O'Neill at karen.oneill@rutgers.edu or leave a message at 848-932-9208.

End of Block: End of Survey for No Consent

Start of Block: Questions about the big picture of funding in the Basin

Q6 Overall Funding Trends 2014-2019

Q7 For the years 2014 through 2019, did you see any trends in the quantity of government funding to improve water quality in the Basin?

Yes

No

Display This Question:

If For the years 2014 through 2019, did you see any trends in the quantity of government funding to... = Yes

Q8 Which government programs have changed the amount they are spending? How have they changed?

Q9 Did you see any important changes in the priorities or purposes for government funding in the Basin?

Yes

No

Display This Question:

If Did you see any important changes in the priorities or purposes for government funding in the Basin? = No

Q10 For instance, do you see changes in the proportion of funding spent on acquiring land, on land stewardship and restoration, or on recreational improvements?

Yes

No

Display This Question:

If Did you see any important changes in the priorities or purposes for government funding in the Basin? = Yes

Or For instance, do you see changes in the proportion of funding spent on acquiring land, on land st... = Yes

Q11 Which government programs have changed their priorities? How have they changed?

Q12 What government funding sources do you feel are most important for the Basin and why are they important?

Q13 Which of these important government funding sources do you feel are most reliable for the Basin and why do you think they are reliable?

Q14 Did any major changes in government funding processes redefine who qualified for and received funding?

Q15 Did you see any trends in how organizations were getting matching funds for projects that need a match?

Q16 Do you have any further thoughts on overall government funding in the Delaware River Basin?

End of Block: Questions about the big picture of funding in the Basin

Start of Block: How funds have been distributed

Q17

How Funds Have Been Distributed

Equity in government spending does not usually mean giving **equal** dollar amounts to all farm-owners or to all jurisdictions. We want to learn how you would define **equity or fairness** in government spending.

We're seeking your professional opinion as an individual. We will not use your answers as representing the views of any organization you are affiliated with.

First, we present questions about how the purposes of some programs might create perceptions that spending isn't done with equity.

Q18 Some government programs protect existing environmental functions, like land with high biodiversity. Do you think these programs cause equity problems in the Basin? For instance, source waters are often in rural areas.

Yes

No

Q19 Why do you think so?

Q20 Another set of programs restore or improve environmental functions.

Q21 Do you think water quality restoration programs cause equity problems in the Basin? For instance, some programs target the most polluted sites and may leave other sites under-funded.

Yes

No

Q22 Why do you think so?

Q23 Is funding for water quality improvements done equitably for farmlands versus non-farmlands?

Yes

No

Q24 Why do you think so?

Q25 Do you have any further thoughts on how government funds have been distributed in the Delaware River Basin?

End of Block: How funds have been distributed

Start of Block: Concepts often used to assess equity

Q26

Concepts Often Used to Assess Equity

For the following questions, please describe the extent to which you think there is equity in the Basin.

Q27 To what extent do you think there is equity in spending for water quality improvements as they affect poor versus wealthy people in the Basin?

Q28 To what extent is there equity in spending for water quality improvements as they affect people in different racial or ethnic groups?

Q29 To what extent is there equity in spending for rural versus urban areas?

Q30 To what extent is there equity in spending across municipalities and counties with large versus small populations?

End of Block: Concepts often used to assess equity

Start of Block: Spending in farmland programs

Q31

Spending for Farmlands

For the following questions, please describe the extent to which you think there is equity regarding funding for farmland in the Basin.

Q32 To what extent do you think there is equity in funding from farmland preservation and restoration programs for farm owners of different racial or ethnic groups or of different genders?

Q33 To what extent is there funding equity for owners of small farms versus large farms?

Q34 Should some types of farmlands receive more conservation funding than they currently receive?

- Yes
 - No
 - I don't know
-

Display This Question:

If Should some types of farmlands receive more conservation funding than they currently receive? = Yes

Q35 What types of farmlands should receive more conservation funding than they currently receive?

Q36 To what extent is there equity in funding for water quality improvements on farmlands across the Basin's major watersheds?

Q37 Do you have any further thoughts on funding equity and farmlands in the Delaware River Basin?

End of Block: Spending in farmland programs

Start of Block: Spending for non-farmlands

Q38 Spending for Non-Farmlands

Q39 Should some ecological functions on non-farmlands be given more funding than they currently receive?

- Yes
 - No
 - I don't know
-

Display This Question:

If Should some ecological functions on non-farmlands be given more funding than they currently receive? = Yes

Q40 What types of non-farmlands should receive more conservation funding than they currently receive?

Q41 Please describe to what extent you think there is equity in funding for non-farmlands across the Basin's major watersheds. For example, water quality improvements could include habitat restoration, stream channel restoration, or rainwater cisterns.

Q42 Do you have any further thoughts on funding equity and non-farmlands in the Delaware River Basin?

End of Block: Spending for non-farmlands

Start of Block: Municipal sources of funding

Q43 Municipal Sources of Funding

Q44 Do municipal governments across the Basin spend similar proportions of their budgets for water quality improvements?

- Yes
 - No
 - I don't know
-

Display This Question:

If Do municipal governments across the Basin spend similar proportions of their budgets for water qu... = No

Q45 How do they differ?

Q46 Do you think communities with major local water problems spend higher proportions of their revenues on water quality protection and restoration?

- Yes
 - No
 - I don't know
-

Display This Question:

If Do you think communities with major local water problems spend higher proportions of their revenu... = Yes

Or Do you think communities with major local water problems spend higher proportions of their revenu... = No

Q47 Why do you think so?

Q48 Do you think mandates from higher levels of government lead municipalities to spend higher proportions of their revenues on water quality improvements?

- Yes
- No
- I don't know

Display This Question:

If Do you think mandates from higher levels of government lead municipalities to spend higher propor... = Yes

Or Do you think mandates from higher levels of government lead municipalities to spend higher propor... = No

Q49 Why do you think so?

Q50 Reflecting on your comments about equity, could you name any organizations working in the Basin you think are doing important or interesting work on promoting equity in funding for water quality, and explain why you think so?

Q51 Any last thoughts about equity in funding for water quality improvements in the Delaware Basin?

End of Block: Municipal sources of funding

Start of Block: Things we should look for in the future

Q52 The William Penn Foundation will probably track funding changes after 2019. We anticipate governmental funding programs may change in the future.

Q53 Are there emerging spending initiatives the Foundation should watch?

Q54 Are there any governmental spending initiatives that are sunseting or transitioning?

End of Block: Things we should look for in the future

Start of Block: End

Q55 Do you have any further thoughts for us?

Q56 Thank you so much for your help with this project. We hope the results will be useful for the Basin going forward. We look forward to sharing the results with you and others.

End of Block: End

Appendix H: Interview Results

The report provides an overview of interview and survey results in the section on [Interviews and Surveys of Key Experts](#). We describe top-line results for each question here, based on edited notes and the survey responses. These responses are not interpreted by the Rutgers team but rather reflect what the respondents provided based on their own viewpoints. The statements are not necessarily in priority order under each heading.

Quantity of funding

- Increases in funding from the Delaware River Basin Restoration Program each year, from its inception in 2018 to present (the Delaware Conservation Fund of the USFWS, administered by NFWF); Great American Outdoors Act made funding for the Land and Water Conservation Fund permanent; NRCS's Regional Conservation Partnership Program grant, with the help of the William Penn Foundation
- One respondent commented that federal and state funding for monitoring, modeling, and assessment has reportedly declined in the Basin. Another respondent stated that the US Geologic Service (USGS) Office of the Delaware River Master has new monitoring instrumentation.
- Delaware state funding increased for water programs (Clean Water State Revolving Fund and Drinking Water State Revolving Fund) and land conservation; New Jersey voters approved constitutional amendment dedicating a portion of the corporate business tax to permanently fund land conservation and Blue Acres.
- Some local governments increased open space spending, others reduced it; few created stormwater fees or utilities.

Change in funding priorities

- Delaware River Basin Restoration Program bringing new federal attention to the Basin and some capacity for planning, although not regulatory power. Fish and wildlife prioritized in this program.
- One expert panel member commenting on this report said that the NFWF Delaware Conservation Fund is increasingly likely to be used for land acquisition to meet its goals, not just restoration.
- One expert panel member commenting on this report said that the New York State Water Quality Improvement Funds may be applicable to projects in the Delaware watershed in some cases.
- The 2018 Farm Bill required that 10% of conservation funding (in the Regional Conservation Partnership Program) be dedicated to source water protection. NRCS and the Farm Services Agency are responsible for implementation. The RCPP also set priority areas for conservation in the Basin. According to an expert panel member commenting on this report, the RCPP has also funded carbon aggregation projects in the upper basin.
- Some federal and state programs give points for projects near densely settled sites, such as New Jersey's Roebling Park freshwater tidal wetlands restoration (funded in part by the Delaware Conservation Fund).
- Pennsylvania and Delaware states have encouraged stormwater management but have provided little new funding for this.
- It is difficult to get projects approved by Pennsylvania's DCNR unless the project has a recreational component.
- State and private foundations increasingly emphasizing climate change in their project funding.

- There has been a general shift in land trust and conservancies' emphasis from land acquisition toward stewardship of the lands already under conservation. Pennsylvania state rules changed in 2013 to emphasize stewardship, but municipalities still submitting mostly open space acquisition projects. Respondents specified this for New York City watershed land and for suburban and rural fringe land in Pennsylvania and New Jersey. The economic downturn of 2008 had created an unusual opportunity for buying land, but prices have increased.
- Local open space programs are changeable. Some have ended, some have shifted to funding only agricultural easement purchases (tied in part to superior matching opportunities for farmland projects), and a few are creating new open space initiatives.
- Municipal (MS4) stormwater permit requirements have encouraged some municipalities to create new projects.

Most important governmental funding sources

- Farm Bill funds through USDA
- New York City
- Delaware River Basin Restoration Program
- Highlands Conservation Act
- Land and Water Conservation Fund
- Forest Stewardship Program
- Wildlife and Sportfish Restoration Fund
- North American Wetlands Conservation Act Grant Program
- National Coastal Wetlands Conservation Grant Program
- Hurricane Sandy Coastal Resiliency Competitive Grant program
- Federal funding for federal and state transportation departments to reduce runoff of contaminants from roads, a process that has often lacked transparency.
- Science assessment by USGS, USFS, EPA, and state departments of environmental protection
- Local programs
- Pennsylvania's Keystone Recreation, Park and Conservation Fund and Environmental Stewardship Fund
- Garden State Preservation Trust (including the New Jersey Green Acres and farmland preservation programs)

Most reliable governmental funding sources

- U.S. Department of Agriculture: NRCS/FSA
- New York City
- Delaware River Basin Restoration Program
- Land and Water Conservation Fund
- Local programs
- State revolving funds for drinking water and wastewater
- Water utility revenue
- New Jersey Garden State Preservation Trust
- Pennsylvania DCNR; Pennsylvania's Keystone Recreation, Park and Conservation Fund and Environmental Stewardship Fund
- Delaware state programs

Changes in who qualifies for governmental funding

- As a new program, advocates hope to shape DRBRP funding to be more equitable (e.g., points for serving under-served communities).
- NRCS has more strongly enforced its restrictions to funding only farm owners with income below \$900,000 a year and has dropped minimum income requirements.
- Trends toward shovel-ready projects puts poor cities at a disadvantage because they cannot pay for engineering studies in advance.
- New Jersey's programs shifted to funding more coastal projects after Hurricane Sandy
- PENNVEST's temporary program allowing re-loaning of funds enabled private grantees to receive state funds, which gave project managers some flexibility and produced novel approaches.

Changes in matching funds

- The negotiation to allow funds spent by New York City to count as matching funds in the areas below its reservoirs was a major change that enabled the tailwater areas of New York state to apply for more of the DRBRP funds. II.
- William Penn Foundation's funds dramatically changed the ability to fund projects in its cluster areas (administered through NFWF and the Open Space Institute)
- Corporate grants and private investment in dam removal (or perhaps sediment trading in the future) are increasing but could become even more important.
- Organizations increasing their use of multiple sources of matching funds, nontraditional sources such as Natural Resources Damage Assessment funds and state transportation funds, and in-kind matches.
- Difficult for some projects to get matching funds. In Delaware it is difficult to find state or local matches, in part because of local government structures and because there is a less developed nongovernmental sector.

Equity in protecting environmental functions

- Respondents agreed that protection of upstream rural areas is a public good and potentially helps people elsewhere. But benefits from the improved quality of the environment and access to recreation are mostly gained by wealthier white residents who live there, or who can visit. Programs operate within a social context of inequality.
- Resource programs have been designed for preserving resources, not for social equity. The foremost equity concerns are the lack of conservation in more racially and ethnically diverse cities, which also have high burdens of their industrial past. Some poor rural, majority White communities also face equity problems when they are excluded from land that is preserved and are not provided new opportunities for local recreation. Those residents may also fear that conservation will block the possibility of local economic development.
- Resource programs are often based on ecological scientific criteria and on analyses that show protecting upstream and rural areas is most cost effective. However, these criteria are not necessarily superior to others. Including estimates of the economic impacts of living near polluted sites could yield different funding priorities.
- Federal and state farm programs have separate pools for small farm parcels and underrepresented groups, but their main emphasis is on conserving high quality soils. By its nature this discriminates against poor and beginning farmers.

- The reliance on grant applications puts poor communities at a disadvantage. They lack staff capacity and resources to track opportunities, to apply, to get partners, to get matching funds, and to administer projects.
- Giving technical assistance and extra points for projects in cities or for under-represented farmers can improve equity.

Equity in restoration

- Funds for environmental restoration are often directed to places that have little environmental damage, to preserve more intact ecosystems. But restored riparian buffers can improve water quality even at developed sites.
- Comments about functions other than land conservation and restoration projects tabulated in this report include the following: In developed areas, gray infrastructure investments or loans for water and wastewater upgrades should be included in comparisons to land conservation projects, because these produce important gains in water quality. An expert panel member commenting on this report added that green infrastructure projects can also provide co-benefits such as recreation and reduction of the heat-island effect.
- Existing systems do not intentionally distribute funds inequitably but do not include equity as key factor in making decisions.
- Places with the most need for restoration are also the most disadvantaged and face the greatest number of barriers in finding and applying for grants.

Equity in funding for farms versus non farms

- A much higher proportion of money is spent on farms than on forests or on other types of non-farmland. The federal farm programs are a poor fit for our region, which has much more acreage in forested land than in farms.
- Reducing runoff from farms helps the entire watershed and is very cost effective. Farms contribute a third of the nutrient load to the Basin. Treating a single farm can yield immediate improvements in surface water quality.
- When non-farmland is preserved, the burden passes to an agency or organization to sustain stewardship, as opposed to a private farm owner. Small land trusts may have difficulty sustaining legal control over these parcels, and all land managers are faced with questions about how to manage land once it is acquired.
- Farm programs are designed to address any resource need a farmer might have. That sort of service to the owner is not present for stewardship programs regarding non-farmlands. Farmers have access to cost-share funding that other owners do not have. Farmers are also not required to file for permits under the Clean Water Act.

Equity in poor versus wealthy communities

- Wealthy residential areas are more likely to seek funds and are better able to access and win funds, treating them as investments in water quality, because they have greater political and organizational capacity and resources. In poorer communities, other priorities dominate, such as housing.
- Much local conservation depends on individuals who donate land to local conservancies. Conservation also depends on the availability of local open space funds paid for by residents.
- Not all upstream communities where conservation is intensive are wealthy, however.

- Drinking water concerns in poor communities that are poorly addressed by policies include the local quality of septic systems and wells in rural areas and lead in service lines for drinking water to urban areas.
- Site exposure to forever chemicals like PFOA is not well measured and may affect wealthy and poor areas.

Racial equity

- There are racial inequities in the way that people benefit from conservation projects. In our region, African Americans in particular tend to be concentrated and segregated in the region's cities. In some places, they may have access to high-quality drinking water, but in other communities, they may be served by lead service lines.
- How the environmental movement goes forward depends on overcoming such obvious inequities. People in minority racial and ethnic groups support conservation and pay taxes for it, but they do not share equitably in the resulting conservation projects.

Equity in rural and urban areas

- Conservation is prioritized in the upstream headwaters areas of this region and in agricultural areas anywhere in the Basin. These projects can help the entire watershed. It is cheaper to preserve rural lands than urban lands because the underlying land costs are less expensive and because urban lands nearly always require remediation before restoration can begin.
- The benefits of upstream protections for downstream residents are less apparent and could be better promoted.
- Some municipalities with a high tax base can better access conservation programs that require matching funds, however those are mostly in wealthy suburban or rural fringe areas.
- Spending for improvements to water and wastewater systems in urban areas is costly and can yield high-quality drinking water in some places. Poor rural communities may have low-quality drinking water.

Equity in locales with large versus small populations

- Municipalities and counties with large populations may have more capacity and a larger tax base, a larger number of people to push for environmental issues, and simply a more diverse policy agenda that leaves some room for environmental issues to be discussed. But any funds received by these locales may be spread thinly across that population.
- Most respondents saw population in itself as less important than local leadership, affluence, or organizational capacity.

Equity in farm funding by race and gender

- High value lands are less likely to be owned by women, racial or ethnic minorities, or non-English speaking owners (see the next question about farm size).
- There is a long history of discrimination against members of ethnic and racial minority groups in federal farm programs. NRCS programs do require counties to submit parity reports, comparing grantees to County ethnicities.

Equity in small versus large farms

- The paperwork burden is the same for small versus large farms and so programs are more worthwhile for large landholders. Large farmers are likely first to the table, and they are the easiest for programs to process because they have the capacity to apply and manage grants.
- The preference of farm programs toward high quality soils biases these programs toward high-cost farmlands, and the paperwork burdens, biases these programs toward large acreage farms. From the point of view of the agencies, large farms have a better return on investment for conservation because the administrative costs are nearly the same for a large farm as for a small farm.
- Large farms are also more likely to have resource problems that would be eligible for grants. An expert panel member commenting on this report noted that owners of large farms also have greater ability to legally delay or resist environmental regulations.
- Even when development rights have been stripped and farms preserved through conservation easements, agricultural land in New Jersey is still too expensive for purchase by most new farmers.
- However, the NRCS set aside separate pools for small farmers. Minimum acreage and minimum income requirements for farm and forest production have been dropped.

Farm types that should get more conservation funding

- Farms that grow food for people²⁶
- Dairy farms, because they often produce the most pollution.
- Urban agriculture
- Lands with large portions of forest, which have complicated funding needs because they combine open space and farmland preservation components.
- Requires stewardship of farms that are already in programs, not just having them complete conservation plans. Incentives to farmers who adopt low- or no-till practices and other protective approaches.
- Farms with high biodiversity especially threatened and endangered species; farms near streams
- Farms that are marginally productive and that could be retired.
- Farms that are able to sequester carbon through soil regeneration.

Equity of conservation spending on farms across the Basin

- The Chesapeake Bay Basin receives much more funding than the Delaware River Basin does.
- Within the Basin, New York City's watershed area gets much more funding than all the other areas of the Basin combined.
- Because farm funds flow to high quality soils, they are concentrated geographically, including the New Jersey Bayshore and the Brandywine regions.
- Within New Jersey, farms in the Delaware Basin receive much more funding than farms in the rest of the state because the Basin is the prime farm area of the state.

Ecological functions that should receive more funding on non-farmlands

- Swales
- Forests
- Old-fields, with restoration
- Brownfield remediation

²⁶ By example, roughly half of all New Jersey agricultural receipts are for turf grass, flowers and nursery plants.

- Carbon sequestration in forests
- Prioritizing land near people, rather than relying primarily on ecological metrics
- Climate resilience
- Habitat and biodiversity
- Wetlands
- Opportunities for recreation
- Projects that can provide co-benefits; sites that can contribute to landscape and aquatic connectivity; resilience to landscape change; permeability; higher ecological integrity

Geographic equity in spending for non-farmlands

- One respondent stated that the New York City watershed receives far more funding than that of all other states combined.
- Another respondent stated that the Delaware Estuary attracts more funds than elsewhere, likely referring to areas in the lower Basin.
- Each program creates different inequities. For example, wealthy suburbs and rural fringe areas may protect land that does not have high ecological value, and some federal and state programs target special areas such as migratory bird flyways.
- Expensive land values in New Jersey mean that projects in that state are less competitive in funding pools than projects in some less expensive rural Pennsylvania lands. Land values are also challenging for non-farmland preservation; as an expert panel member commenting on this report noted, a program of the Open Space Institute has a ceiling of \$500,000 for most grants, which limits their ability to be a key funder for large projects.
- The presence of land conservancies drives some conservation projects.
- In Delaware state, there is little funding outside of William Penn Foundation's cluster areas.

Proportion of budgets spent by municipalities

- New York City stands out as spending more than any other government entity in the Basin, whether at the federal, state, or local level.
- Municipalities vary greatly in their spending on open space. Rural municipalities spend very little. Wealthy communities spend more, often to protect residential property values.
- Some municipalities limit their open space spending to farmland preservation, often because there are better matching opportunities to state funds.
- Municipalities with active environmental organizations tend to spend more on local conservation.
- Municipalities with an MS4 permit will have more of their budgets invested in managing stormwater.

The influence of local water quality problems on municipal spending

- Municipalities in the downstream, developed areas of the Basin probably have the worst water quality conditions. But the municipalities (other than New York City) that spend the most are probably suburbs that are facing development pressure.
- Municipalities may not be aware of problems, or may be aware of problems but unable to address them or to have direct effect on those problems through local action.
- Emergencies can prompt municipalities to spend more money, however.

- New York City as the major funder in the Basin defines some conditions as water quality problems that other municipalities would not consider problems.

The influence of mandates on municipal spending

- A judicial consent order in Philadelphia (CSOs) and the Filtration Avoidance Program for the New York City Catskills reservoirs (both Delaware and Hudson) have led to major water quality restoration and protection efforts in the Basin. Most other communities require leadership and coordination from a higher level to get projects going. Incentives seem to be more effective than mandates.
- Mandates may get attention and may even provoke more spending, but they don't necessarily yield results. Municipal MS4 permitting and Total Maximum Daily Load (TMDL) guidelines have encouraged some local actions, for example. But there has been no clear evidence of water quality improvement from all the spending on the resulting stormwater projects.
- Rural communities have not responded with much action in response to sewage treatment mandates and other rules.
- Unfunded mandates are ineffective. You also need education and political pressure to get action.

Organizations working on equity in funding

- The Nature Conservancy's city projects in Philadelphia and Wilmington (added by an expert panel member commenting on this report)
- Natural Lands (PA)
- Tookany/Tacony-Frankford Watershed Partnership (PA)
- Coopers Ferry Partnership (NJ) and the Camden Smart Initiative
- Coalition for the Delaware River Watershed, operated by New Jersey Audubon, formed with the William Penn Foundation (regional)
- Mercer County's funding for programs in underserved areas (NJ)
- The Alliance for Watershed Education (regional)
- Camden County Municipal Utility Authority (NJ)
- The Watershed Institute (NJ)
- Jersey Water Works (NJ)
- Trust for Public Land projects in Philadelphia school yards, and park access

Potential funding and program trends to track

- Program cuts due to the COVID crisis, already evident in 2020 revenues for states. Losing state funds would reduce the ability to provide matches to federal funds that will be provided in the coming years.
- Stewardship versus acquisition as an emphasis in funding, which shifts concern to sustained, long-term funding needs for lands that have already been conserved. There is a question of whether sources of funding for land acquisition would be willing to fund long-term maintenance and stewardship.
- Innovative uses of credits such as sediment trading, mitigation banking, carbon markets, or other approaches that involve private parties.
- The role of County preservation boards to leverage funds and to act as more permanent land holders. Private land trusts may dissolve overtime, but counties will continue to exist and be able to manage preserved lands.

- New Jersey reformatting its infrastructure bank. This could allow municipalities to manage long term plans.
- The potential for the Regional Greenhouse Gas Initiative and cap and trade funds to generate conservation funds.
- America's Great Outdoors Act, which should double the Land and Water Conservation Fund
- The US Climate Alliance Natural Working Lands initiatives
- Hurricane Sandy Coastal Resiliency Competitive Grant Program is sunseting
- New York City's Regen NY program
- Stormwater fees in communities, and the potential for stormwater banking
- New York state's environmental bond, which is likely in 2021 (was pulled from the 2020 ballot)
- The push to create a Growing Greener 3 program in Pennsylvania
- NYC's possible expansion of its Schoharie riparian buffer pilot program
- Environmental justice legislation just passed in New Jersey
- New Jersey's interagency climate panel
- User-pay and beneficiary-pay initiatives
- EPA EFAB work on opportunity zones

Appendix I: Bibliography

- Brashear TG, Brooks CM, Boles JS (2004) Distributive and procedural justice in a sales force context: Scale development and validation *Journal of Business Research* 57:86-93
[https://doi.org/10.1016/S0148-2963\(02\)00288-6](https://doi.org/10.1016/S0148-2963(02)00288-6)
- Castillo, D., Kaplan, D., & Mossa, J. (2016). A Synthesis of Stream Restoration Efforts in Florida (USA): Florida Stream Restoration. *River Research and Applications*, 32(7), 1555–1565.
<https://doi.org/10.1002/rra.3014>
- Duke, J. M., & Aull-Hyde, R. (2002). Identifying public preferences for land preservation using the analytic hierarchy process. *Ecological Economics*, 42, 131–145. [https://doi.org/10.1016/S0921-8009\(02\)00053-8](https://doi.org/10.1016/S0921-8009(02)00053-8)
- Fleming, W. M., & Hall, G. E. (2000). Water conservation incentives for New Mexico: Policy and legislative alternatives. *Natural Resources Journal*, 40(1), 69–92.
- Gargan, J. J. (1981). Consideration of Local Government Capacity. *Public Administration Review*, 41(6), 649–658. <https://doi.org/10.2307/975741>
- Gerlak AK (2005) Federalism and U.S. Water Policy: Lessons for the Twenty-First Century *Publius: The Journal of Federalism* 36:231-257 doi:10.1093/publius/pji032
- Hassett, B., Palmer, M., Bernhardt, E., Smith, S., Carr, J., & Hart, D. (2005). Restoring watersheds project by project: Trends in Chesapeake Bay tributary restoration. *Frontiers in Ecology and the Environment*, 3(5), 259–267. [https://doi.org/10.1890/1540-9295\(2005\)003\[0259:RWPBPT\]2.0.CO;2](https://doi.org/10.1890/1540-9295(2005)003[0259:RWPBPT]2.0.CO;2)
- Hardy SD (2010) Governments, Group Membership, and Watershed Partnerships *Society & Natural Resources* 23:587-603 doi:10.1080/08941920802534572
- Jenkins-Smith HC, Sabatier AP (1993) The Study of Public Policy Processes. In: Sabatier AP, Jenkins-Smith HC (eds) *Policy Change and Learning: An Advocacy Coalition Approach*. Westview Press, Boulder, CO
- Jiang, Y., & Swallow, S. K. (2017). Impact Fees Coupled with Conservation Payments to Sustain Ecosystem Structure: A Conceptual and Numerical Application at the Urban-Rural Fringe. *Ecological Economics*, 136, 136–147. <https://doi.org/10.1016/j.ecolecon.2017.02.007>
- Johnston, R. J., Swallow, S. K., & Weaver, T. F. (1999). Estimating Willingness to Pay and Resource Tradeoffs with Different Payment Mechanisms: An Evaluation of a Funding Guarantee for Watershed Management. *Journal of Environmental Economics and Management*, 38, 97–120.
<https://doi.org/10.1006/jeem.1999.1077>
- Kafle, A., Swallow, S. K., & Smith, E. C. (2015). Does Public Funding Affect Preferred Tradeoffs and Crowd-In or Crowd-Out Willingness to Pay? A Watershed Management Case. *Environmental and Resource Economics*, 60(3), 471–495. <https://doi.org/10.1007/s10640-014-9782-z>
- Kaiser, C. (2015). NatureVest: Natural Capital Investment Solutions to Transform the Way We Protect Nature. *Social Research*; New York, 82(3), 749-760,860.
- Koontz, T. M., & Sen, S. (2013). Community Responses to Government Defunding of Watershed Projects: A Comparative Study in India and the USA. *Environmental Management*, 51(3), 571–585.
<https://doi.org/10.1007/s00267-012-0008-2>

- Larson, L. R., Lauber, T. B., Kay, D. L., & Cutts, B. B. (2017). Local Government Capacity to Respond to Environmental Change: Insights from Towns in New York State. *Environmental Management*, 60(1), 118–135. <https://doi.org/10.1007/s00267-017-0860-1>
- Lin, H., & Ueta, K. (2012). Lake watershed management: Services, monitoring, funding and governance. *Lakes & Reservoirs: Science, Policy and Management for Sustainable Use*, 17(3), 207–223. <https://doi.org/10.1111/lre.12003>
- Nelson, L. S., & Weschler, L. F. (1998). Institutional readiness for integrated watershed management: The case of the Maumee River. *The Social Science Journal*, 35(4), 565–566.
- O'Neill KM (2002) Why the TVA Remains Unique: Interest Groups and the Defeat of New Deal River Planning *Rural Sociology* 67:163-182
- Palmer, M. A., & Allan, J. D. (2006). Restoring Rivers. *Issues in Science and Technology*, 22(2), 40–48.
- Sabatier AP (1993) Policy Change Over a Decade or More. In: Sabatier AP, Jenkins-Smith HC (eds) *Policy Change and Learning: An Advocacy Coalition Approach*. Westview Press, Boulder, CO, pp 13-39
- Sabatier AP, Focht W, Lubell M, Trachtenberg Z, Vedlitz A, Matlock M (2005) Collaborative Approaches to Watershed Management. In: Sabatier AP, Focht W, Lubell M, Thrachtenberg Z, Vedlitz A, Matlock M (eds) *Swimming Upstream: Collaborative Approaches to Watershed Management*. MIT Press, Cambridge, MA, pp 3-21
- Sheppard BH, Minton JW, Lewicki RJ (1992) *Organizational justice: the search for fairness in the workplace*. Issues in organization and management series, vol xii, 227 p. Lexington Books ; M. Macmillan Canada ; M. Macmillan International, New York : Toronto
- Sheppard BH, Minton JW, Lewicki RJ (1992) *Organizational justice: the search for fairness in the workplace*. Issues in organization and management series, vol xii, 227 p. Lexington Books ; M. Macmillan Canada ; M. Macmillan International, New York : Toronto
- Sloan, M. A., & Bidolli, B. T. (2014). Watershed management through transportation funding. *WIT Transactions on Ecology and The Environment*, 181, 603–614.
- Swallow, S. K., & McGonagle, M. P. (2006). Public Funding of Environmental Amenities: Contingent Choices Using New Taxes or Existing Revenues for Coastal Land Conservation. *Land Economics*, 82(1), 56–67. <https://doi.org/10.3368/le.82.1.56>
- Talberth, J., Selman, M., Walker, S., & Gray, E. (2015). Pay for Performance: Optimizing public investments in agricultural best management practices in the Chesapeake Bay Watershed. *Ecological Economics*, 118, 252–261. <https://doi.org/10.1016/j.ecolecon.2015.07.033>
- University of Delaware Water Resource Center. (2016). Survey of Investment in the Delaware River Watershed. Project for the William Penn Foundation.
- Warson, A. (1996). Voters say “yes” to spending on parks, water, open lands. *Planning*, 62(12), 20.
- Weiland, P. S. (1998). Environmental Regulations and Local Government Institutional Capacity. *Public Administration Quarterly*, 22(2), 176–203.

Williams, J. R., Smith, C. M., Roe, J. D., Leatherman, J. C., & Wilson, R. M. (2012). Engaging Watershed Stakeholders for Cost-Effective Environmental Management Planning with “Watershed Manager.” *Journal of Natural Resources and Life Sciences Education*, 41, 44–53.