Report to Congress

on

The Prevalence Throughout the U.S. of Low- and Moderate-Income Households Without Access to a Treatment Works

and

The Use by States of Assistance under Section 603(c)(12) of the Federal Water Pollution Control Act

U.S. Environmental Protection Agency, Office of Water

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Contents

Introduction

Purpose of the Report

This report responds to Section 4107(b) of the America's Water Infrastructure Act (AWIA) of 2018, which states:

> *(b) Report.--Not later than 2 years after the date of enactment of this section, the Administrator of the Environmental Protection Agency shall submit to the Committee on Environment and Public Works of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives a report describing--*
>
> > *(1) the prevalence throughout the United States of low- and moderate-income households without access to a treatment works; and*
> >
> > *(2) the use by States of assistance under section 603(c)(12) of the Federal Water Pollution Control Act.*

EPA's response to *(1) the prevalence throughout the U.S. of low- and moderate-income households without access to a treatment works* includes: a review of the national data sources available on decentralized wastewater treatment use; the approach and methodology used to calculate the prevalence of low- and moderate-income households without access to a treatment works; and, to complement the analysis, a summary of four state examples that had robust data on the use of decentralized wastewater treatment systems. EPA's response to *(2) the use by States of assistance under Section 603(c)(12) of the Federal Water Pollution Control Act* includes a description of databases that record the use of state assistance and a graphical representation of the cumulative decentralized wastewater treatment system project assistance.

Appendices A and B provide background information on the national data sources available on decentralized wastewater treatment use, their limitations, and state-county tables and maps of the four state examples. Appendix C includes a detailed table of state use of funds under Section 603(c)(12) of the Federal Water Pollution Control Act.

Definitions

- The term "decentralized wastewater treatment system," or decentralized system, is used as a general term to include a wide range of decentralized wastewater systems such as, but not limited to, septic systems, cesspools[1], onsite wastewater treatment systems, or onsite sewage disposal systems for use by an individual household. Where specific states are discussed, this report uses that state-specific terminology.
- Households "without access to a treatment works" include those with decentralized systems, as well as those without wastewater treatment systems, as the Code of Federal Regulations Chapter 40 Section 122.2 definitions[2] exclude septic tanks or similar devices from its definition of a treatment works.
- Low- and moderate-income households are defined as those households that earn less than or equal to the median household income (MHI). The national MHI was $61,372 in 2017, according to the U.S. Census Bureau (Fontenot, et al., 2018).

Summary

EPA performed a review of the national data sources available on decentralized wastewater treatment use (*e.g.*, septic systems). This report examines those national data sources (See Appendix A), discusses their limitations, and presents

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[1] Note: EPA does not consider cesspools to be decentralized wastewater treatment systems, since cesspools are used only for sanitary waste disposal, not treatment. EPA is not aware of any states that permit new cesspools, and most states and local governments require replacement of cesspools upon transfer of property ownership. Construction of new large capacity cesspools have been banned by EPA nationwide since April 5, 2005. Because the American Housing Survey (AHS) categorizes cesspools alongside "septic tanks," EPA classified cesspools under the general "decentralized systems" umbrella for the national data analysis in this report.

[2] Section 122.2 Definitions; see report: § 122.2 Definitions.

the methodology for calculating the national prevalence of low- and moderate-income households without access to a treatment works.

Given the definitions above, EPA interpreted *(1) the prevalence throughout the U.S. of low- and moderate-income households without access to a treatment works* as the percentage of households at less than or equal to the MHI with a decentralized wastewater system (or no wastewater treatment) as compared to all households with decentralized systems (or no wastewater treatment). This allows Congress to better understand the needs of those who have a decentralized system (or no wastewater treatment) and the number of households that might benefit from assistance in repairing or replacing their systems. According to the U.S. Census Bureau's 2017 American Housing Survey (AHS), approximately 18 percent of all U.S. households (about 1 in 5 homes) are served by an individual decentralized system (or have no wastewater treatment).

Based on this Census Bureau information, of those households not connected to a treatment works, approximately 52 percent have a household income less than or equal to $61,000. To clarify, about 18 percent of total U.S. households have decentralized systems (or no wastewater treatment) and, as calculated, approximately 52 percent of those households earn less than or equal to the MHI. Therefore, about 9.5 percent of all U.S. households both lack a treatment works and earn less than or equal to the MHI. These data indicate households that earned less than or equal to the MHI were almost 10% more likely to lack access to a treatment works than those that earned greater than the MHI, in 2017.

EPA reviewed available data for four states (*i.e.*, Florida, Hawaii, Rhode Island, and Delaware) to further describe the prevalence of households with decentralized systems that earned less than their respective state MHIs. Appendix B includes the state-specific, mappable decentralized system data. The results from Florida, Hawaii, and Delaware demonstrate a strong correlation between income and household decentralized system usage, while the results from Rhode Island indicate a minimal correlation between those variables. In general, while not true in all instances, the data indicate that as income levels rise, household decentralized system usage declines.

EPA interpreted *(2) the use by States of assistance under Section 603(c)(12) of the Federal Water Pollution Control Act,* as state use and distribution of funding through the Clean Water State Revolving Fund (CWSRF) Program, which under Section 603(c) authorized nonprofit entities to provide assistance for decentralized systems projects. EPA uses two methods to track funding: the CWSRF National Information Management System (NIMs) and the Clean Water Benefits Reporting (CBR) database. Part Two of this report includes information from both these reporting systems. To date, 26 states have utilized the CWSRF Program for decentralized wastewater projects; however, only nonprofit entities in Washington and West Virginia have applied for CWSRF funds for these projects. Appendix C provides a detailed table of CWSRF funding by state since 1988.

Part One: The Prevalence of Decentralized Systems in the U.S.

Data Review

EPA evaluated the following data sources in preparing this report: the Decennial Census; the American Community Survey (ACS); the American Housing Survey (AHS); the Survey of Construction (SOC); and available local, state, and government databases. While each data source has strengths and weaknesses, the AHS was the only source that could provide adequate data to support the development of this report . Below is the primary limitation of each data source. Further descriptions and limitations of the data sources are provided in Appendix A.

The data limitations are as follows:

- The 1990 Decennial Census was the last to collect information on decentralized systems, and that data is now 30 years old;
- The ACS does not include a relevant question on access to treatment works;

- The AHS sample size and data collection methodology do not allow for estimates at state or local levels and the AHS excludes Puerto Rico;
- The SOC does not include existing homes; and
- Due to resource limitations, states do not have a consistent method of gathering and reporting decentralized system use statewide by county.

In general, the existing data sources do not provide the information necessary to accurately characterize use of decentralized systems nationally. Therefore, prior to enactment of AWIA (2018), EPA submitted a proposal to the U.S. Census Bureau to include specific question(s) on decentralized system use in the 2025 ACS (EPA, 2018). The U.S. Census Bureau is currently testing the decentralized system question for possible inclusion on the 2025 ACS Survey.

Approach

For purposes of this report, EPA calculated the national prevalence of low- and moderate-income households without access to a treatment works by using the 2017 AHS data on decentralized wastewater systems as well as income data, available from the Census Bureau. Table 1 provides the AHS' data on the number of households served by decentralized systems according to income level.

Table 1: Households Served by Decentralized Systems in 2017 with Household Income Ranging from $10,000 or Less to $120,000 or More (U.S. Census Bureau, 2017c)

Household Income Level	Total Households with Septic Tank or Cesspool
$10,000 or Less	1,443,000
$10,000-$19,999	1,785,000
$20,000-$29,999	2,035,000
$30,000-$39,999	2,132,000
$40,000-$49,999	1,899,000
$50,000-$59,999	1,671,000
$60,000-$79,999	2,924,000
$80,000-$99,999	2,272,000
$100,000-119,999	1,692,000
$120,000 or More	3,865,000
Total	21,718,000

The 2017 AHS indicates approximately 21,718,000 households have a "septic tank or cesspool." For comparison, the number of households served by a public sewer system in 2017 is 99,571,000 (U.S. Census Bureau, 2017c). Using the AHS data, EPA calculated the prevalence of households with an income less than or equal to the MHI served by decentralized systems (or no wastewater treatment) as compared to all households with decentralized systems (or no wastewater treatment). The detailed methodology is explained in the next section.

Methodology

In order to calculate the prevalence throughout the U.S. of low- and moderate-income households without access to a treatment works, EPA compared the AHS data with income data obtained from the ACS. This analysis uses total households that responded to the AHS "type of sewage system" (as described in Table 2) question. Type of sewage system included everything that is not considered a treatment works, including the responses "septic tank or cesspool" (Response 1 [R1]), "other" (R2), or "none" (R3)[3]. For EPA's calculation, the responses "other" and "none" were included

[3] "Septic Tank or Cesspool" (R1) includes "standard septic tank and subsurface leach field," "pump used to distribute wastewater," "elevated above natural soil surface," "applied treated wastewater," and "other." Under the category "septic tank or cesspool," "other" means the housing unit has a septic system or cesspool but the specific type of system is not one of the other four listed

as households without access to treatment works. In addition to the responses above, households had the option of selecting "not reported." For the purposes of this report, the response "not reported" was not included. Table 2 shows the estimated number of decentralized wastewater treatment systems for each category factoring in MHI data as explained below.

The MHI was $61,372 in 2017, according to the ACS. The U.S. Census Bureau assisted EPA in the development of custom tabulations to merge ACS income data with AHS decentralized system data (Table 2). These data were rounded for disclosure protection to the nearest thousandth. For purposes of this calculation, an MHI less than or equal to $61,000 was used. The prevalence throughout the U.S. of low- and moderate-income households without access to a treatment works (also see Table 2) was calculated using the following equation:

$$\text{National Prevalence Calculation} = \frac{\textbf{[Septic Tank or Cesspool + Other + None (less than or equal to \$61,000)]}}{\textbf{[Septic Tank or Cesspool + Other + None (total)]}}$$

Mathematically expressed as:

$$P = \frac{\sum R1+R2+R3 \leq MHI}{\sum R1+R2+R3}$$

Where:

P = National Prevalence

Response 1 (R1) = Households with Septic Tank or Cesspool; Response 2 (R2) = Households with Other; Response 3 (R3) = Households with None

≤ MHI = less than or equal to the Median Household Income ($61,000 in 2017)

Table 2: Estimated Number of Decentralized Wastewater Treatment Systems ≤ MHI based on AHS (2017)

2017 American Housing Survey			
Type of Sewage System	**Households with Income ≤$61,000**	**Total Households**	**Percent of Total**
Septic Tank or Cesspool (R1)	11,333,000	21,718,000	52%
➢ *Standard septic tank and subsurface leach field*	10,867,000	20,657,000	52%
➢ *Pump used to distribute wastewater*	257,000	605,000	42%
➢ *Elevated above natural soil surface*	144,000	314,000	45%
➢ *Applied treated wastewater*	22,000	57,000	38%
➢ *Other*	43,000	85,000	50%
Other (R2)	116,000	180,000	64%
None (R3)	29,000	35,000	82%
Not Reported	36,000	56,000	64%

Calculation

Using the 2017 AHS estimates on type of sewage system and 2017 MHI data, the national prevalence throughout the U.S. of low- and moderate-income households without access to a treatment works was calculated as:

$$P = \frac{\sum R1+R2+R3 \leq MHI}{\sum R1+R2+R3}$$

types. The second "other" category (not under "septic tank or cesspool") (R2) means the housing unit's sewage disposal system is something other than a public sewer, septic system, or cesspool, such as a chemical toilet, outhouse, or other types of disposal. The "none" category (R3) refers to no form of decentralized system nor treatment work.

$$\frac{(11{,}333{,}000 + 116{,}000 + 29{,}000)}{(21{,}718{,}000 + 180{,}000 + 35{,}000)}$$

$$= 0.5233 \times 100 = 52.33\%$$

Based on this information, of those households not connected to a treatment works, approximately 52 percent have a household income less than or equal to $61,000. To clarify, approximately 18 percent of total U.S. households have decentralized systems (or no wastewater treatment) and, as calculated, 52 percent of those homes are at or below the MHI. Therefore, about 9.5 percent of all U.S. households both lack a treatment works and earn less than or equal to the MHI. This is the answer to (1) of America's Water Infrastructure Act, Sec. 4107(b).

Furthermore, a simple risk ratio calculation illustrates the disparity between income and households that lack access to a treatment works. As stated above, the prevalence of households that have decentralized systems (or no wastewater treatment) and earn less than or equal to the MHI is approximately 52%. Therefore, the prevalence of households that have decentralized systems (or no wastewater treatment) and earn more than the MHI is approximately 48%. A simple risk ratio[4] analysis indicates households that earned less than or equal to the MHI were almost 10% more likely to lack access to a treatment works than those that earned greater than the MHI, in 2017.

State Mapping and Analysis

State-specific data on decentralized system use is limited. Most states do not have centrally managed data on decentralized systems. Typically, state data is only available on a county-by-county basis, and county records are often only available as paper copies, which makes accessing the records challenging. EPA identified four states with robust state-wide data compiled for public use. The data from these states was used to provide a characterization of decentralized system prevalence among low- and moderate-income households at a local level.

EPA completed data mapping and analysis for Florida, Hawaii, Rhode Island, and Delaware, detailed in Appendix B. For each state, EPA mapped state MHI data by census tract (color-coded). The census tract was then overlaid with decentralized system locations via ArcGIS to provide visual representation at the county and state level. The data were used to calculate state-wide prevalence of those households less than or equal to the MHI with decentralized systems. Further, individual counties within states were mapped and the prevalence calculated at the county level.

Three of the four states (*i.e.*, Florida, Hawaii, and Delaware) displayed similar trends for decentralized system use and MHI. In general, households with decentralized systems and incomes less than or equal to their state MHI had a higher prevalence of decentralized systems usage as compared to households with decentralized systems and incomes above the state MHI. In other words, as household income went down, decentralized wastewater system use went up. Rhode Island exhibited no clear trends with respect to decentralized system use and MHI. Table 3 below provides an overall summary of state prevalence for those highlighted in this report.

Table 3: Summary of State Prevalence of Households with Decentralized Systems ≤ MHI

State	Prevalence of Households with Decentralized Systems ≤ MHI	State MHI
Florida	51.4%	$49,800
Hawaii	61.0%	$74,923
Rhode Island	9.1%	$61,043
Delaware	67.1%	$65,627

[4] Risk Ratio calculation:
18.05% * 52.33% /50% = 18.89% of households lack access to a treatment works if ≤ MHI
18.05% * 47.67% /50% = 17.21% of households lack access to a treatment works if > MHI
Risk Ratio = 18.89/17.21 = approximately 1.10

Only general trends can be noted from this analysis because states vary greatly in many aspects, including the percentages of households with decentralized systems or household income levels. As such, this analysis is limited to these four state examples. Further details and analysis for these state examples is provided in Appendix B.

Part One Conclusions

The absence of current electronic data on decentralized wastewater system use at a national, state, and county level is a significant impediment, substantially limiting the analysis that could be conducted to address the question posed by Congress. Despite the limitations of the AHS, the AHS is the best available data that provides the basis for a response to the prevalence throughout the U.S. of low and moderate-income households without access to a treatment works. The AHS data indicate that of the roughly 18 percent of households in the U.S. without access to a treatment works, approximately 52 percent of them earn a household income less than or equal to the national MHI, corresponding to 9.5 percent of all U.S. households. These data indicate households that earned less than or equal to the MHI were almost 10% more likely to lack access to a treatment works than those that earned greater than the MHI, in 2017.

Although MHI varies both between and within states, the four state examples complement the national AHS data trends. In general, three of the four states demonstrate a trend of decentralized system use increasing as MHI decreases. EPA believes the addition of a decentralized system question to the 2025 ACS will be immensely useful in analyzing the prevalence of decentralized wastewater systems nationally and demonstrating trends that could help EPA, as well as state and local programs, support the decentralized wastewater community.

Part Two: Assistance under Section 603(c)(12) of the Federal Water Pollution Control Act

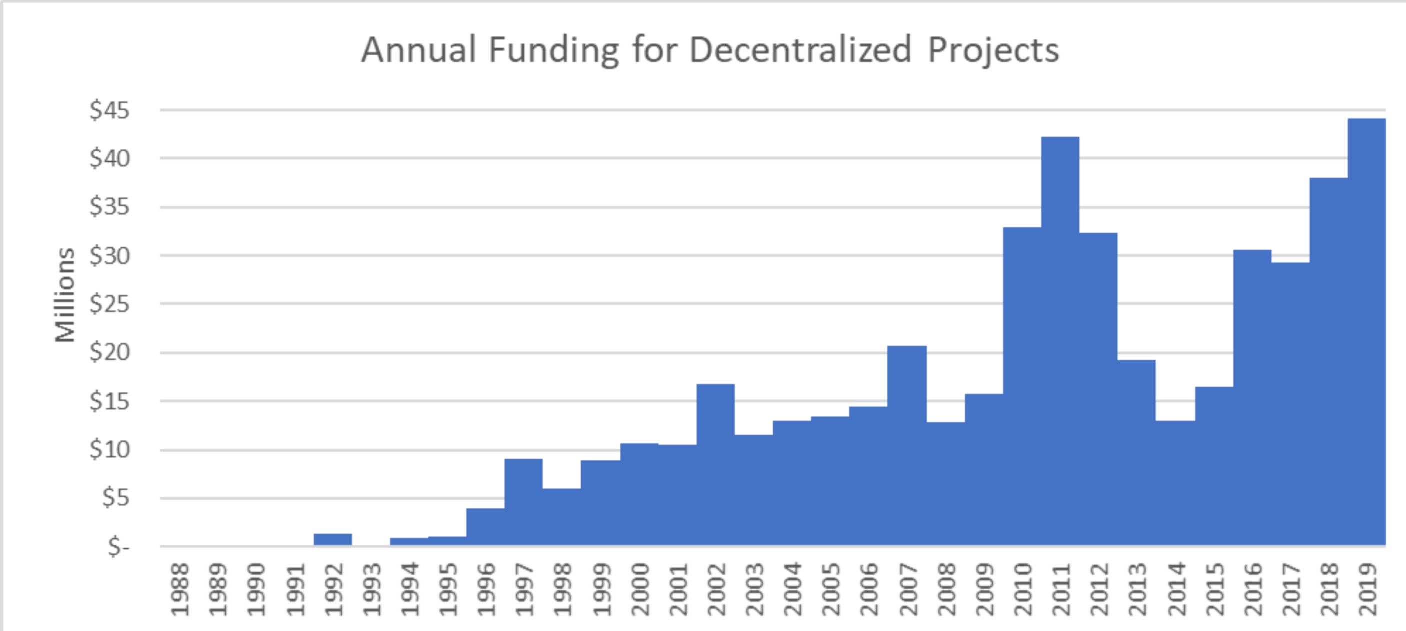
America's Water Infrastructure Act of 2018, Sec. 4107(b) also requires EPA to report on *the use by States of assistance under Section 603(c)(12) of the Federal Water Pollution Control Act*. This section authorizes Clean Water State Revolving Fund (CWSRF) programs to lend money to nonprofit entities for financial and technical assistance to individuals in repairing, replacing, or new construction of household decentralized systems. It also authorizes funding for low-income households with decentralized systems to connect to publicly owned treatment works.

Data Sources

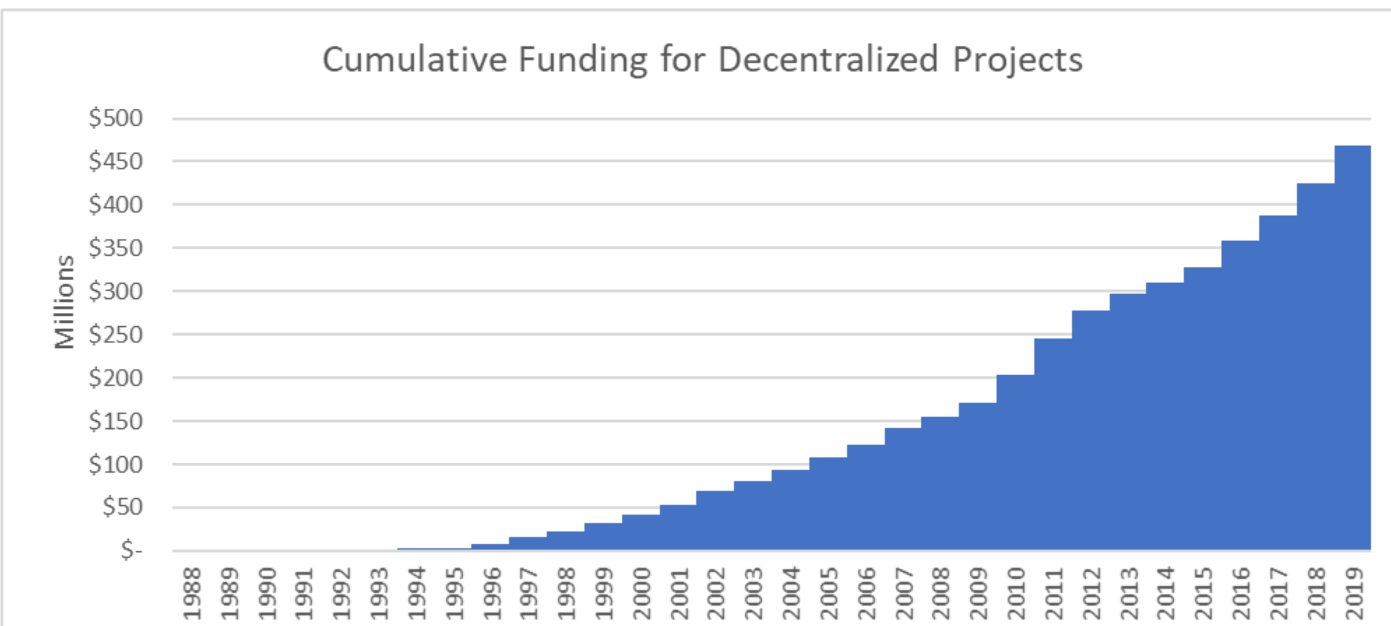
Section 603(c)(12) relies on data collected by EPA's CWSRF National Information Management System (NIMS) and CWSRF Benefits Reporting (CBR) databases. Since 1988, the CWSRF NIMS database has collected annual program level information that provides a snapshot of CWSRF loan activity (*e.g.*, project type, borrower population) and has tracked the financial performance of these state managed programs (*e.g.*, federal grant awards, state contributions, repayments, earnings). By contrast, the CBR database captures more detailed CWSRF activity since 2010. CWSRF activity reported into the CBR database includes such things as funding amounts, loan terms, project descriptions, and projected environmental benefits.

Data Review

Background on CWSRF decentralized wastewater project funding is essential for context on this eligibility. Since the inception of the CWSRF in 1988, 26 states have provided over $469 million in funding for decentralized treatment projects (*e.g.*, repairing, replacing, or new construction). The highest annual funding for decentralized wastewater projects was in 2019, with over $44 million provided by the CWSRF programs. Graphs 1 and 2 below show the annual and cumulative funding for decentralized wastewater assistance provided by the CWSRF.

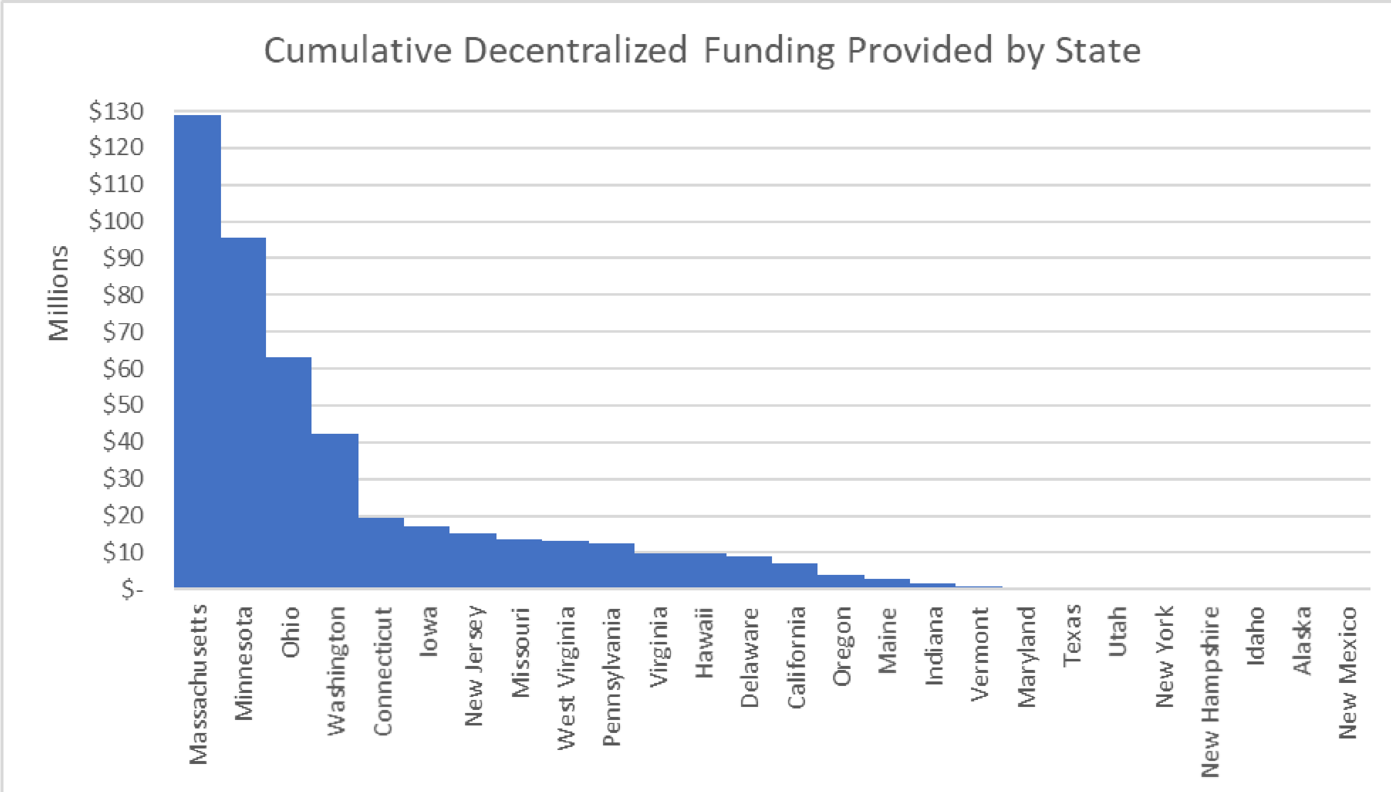


Graph 1: Annual Funding for Decentralized Wastewater Projects Since 1988



Graph 2: Cumulative Funding for Decentralized Wastewater Projects Since 1988

Only four states have provided just over 70% of the cumulative decentralized wastewater assistance. These states and their respective percentages and totals are as follows: Massachusetts (27.5 percent, $128.8 million), Minnesota (20.4 percent, $95.7 million), Ohio (13.5 percent, $63.2 million), and Washington (9.0 percent, $42.1 million). Graph 3 shows the cumulative amount of funding provided by each state that has recorded decentralized wastewater assistance.



Graph 3: Cumulative Decentralized Wastewater Funding Provided by State

Further analysis of the CWSRF NIMS and CBR databases indicate that two states used the Section 603(c)(12) authority under the Federal Water Pollution Control Act to assist nonprofit entities. Washington provided two loans to Craft3, a regional nonprofit financial institution[5]. Those two loans total almost $12.5 million, including $1 million as principal forgiveness. West Virginia provided one loan of $100,000 to the West Virginia Safe Housing and Economic Development (SHED) organization[6]. Based on these successes, EPA might expect to see more loans to nonprofit entities for assistance to private property owners with individual decentralized wastewater needs. Additional data describing loans to nonprofit entities will be included as an addendum to this report as available.

Part Two Conclusions

The use by States for decentralized wastewater project assistance under Section 603(c) of the Federal Water Pollution Control Act is summarized as follows: 26 states have funded decentralized wastewater treatment projects, 75 percent of the total decentralized wastewater project financing was from five states, and two states have provided financing to a nonprofit entity for decentralized systems under Section 603(c)(12). Since the CWSRF is often considered a financing tool for utilities, it is not well known that nonprofit entities are eligible for assistance. Further, some states have their own rules and regulations that may prevent them from lending to private or nonprofit entities. Additional information is provided in Appendix C.

[5] Craft3 helps families of all income levels finance energy upgrades, build accessory dwelling units, and replace failing septic systems and aging manufactured homes; see Craft3 Mission Statement.

[6] The West Virginia SHED is a nonprofit organization that directly assists people in southern West Virginia to provide housing and economic development opportunities for a better quality of life; see West Virginia SHED Mission Statement.

Appendix A

Below is a summary of the national data sources evaluated for use in determining the prevalence throughout the U.S. of low- and moderate-income households without access to a treatment works. EPA believes it is critical to identify each data source's limitations because their limitations impact EPA's ability to adequately assess or predict wastewater infrastructure and financing needs at a state or local level.

1990 Decennial Census and U.S. Census American Community Survey

Decentralized system data was collected as part of the 1970, 1980, and 1990 U.S. Census Bureau surveys. The data is no longer collected on the short-form decennial census and was not carried over as part of the American Community Survey (ACS) in 2005 or after. EPA and states continue to rely on data from the 1990 Decennial Census, although it is now over 30 years old. The only sewage-related data collected through the ACS are the total costs of a home's sewer and water bill and whether the housing unit has complete plumbing facilities. In addition, after the 2014 survey, the ACS eliminated "flush toilets" as a response to the plumbing question. Although most homes in the U.S. have flush toilets, the presence (or absence) of a flush toilet does not necessarily indicate adequate wastewater treatment. In some areas of the country, and for some households, a flush toilet may discharge directly into a backyard, wooded area or ditch via a straight pipe that provides no treatment. Identifying information on household wastewater infrastructure provides necessary information for decision makers to meet community needs and protect human health and the environment. Given the age of the data from the 1990 Decennial Census and the absence of relevant data in the ACS, neither of these data sources were used in this report.

In 2018, prior to enactment of AWIA (2018), EPA submitted a proposal to the U.S. Census Bureau for the ACS to include specific questions on decentralized system use. EPA's proposal also provided a rationale for why the currently available data sources do not accurately represent the national landscape regarding decentralized systems. The U.S. Census Bureau is currently conducting testing and evaluation of additional questions for the 2025 ACS. If a question on decentralized systems use is included, the earliest that data would be available is 2025 or 2026.

U.S. Census American Housing Survey

The U.S. Census Bureau's American Housing Survey (AHS) collects information on various housing characteristics in odd numbered years. The AHS provides a national estimate and seven state estimates of septic system usage. It only includes estimates for larger areas, the smallest of which are zones with a population of 100,000 in select metropolitan areas (Schwartz, 2007). AHS data on sewage system failure rates have not been made available since 2009 and the question is no longer on recent surveys.

Due to the longitudinal survey design[7] of the AHS, the national septic system usage rate appears to be decreasing since the 1970s (Eggers & Thackeray, 2007). In 2015, the U.S. Department of Housing and Urban Development and the U.S. Census Bureau selected an entirely new sample for the AHS (U.S. Census Bureau, 2018a). Given this new sample selection, the percentage of households served by decentralized systems did increase in 2015[8] from previous survey years, however, the usage rate decreased again in 2017. The AHS is also more likely to classify rural homes as vacant instead of a "second home" and therefore further undercount the septic system usage rate (U.S. Census Bureau, 2018a).

Lastly, the AHS does not survey Puerto Rico, where there is a high percentage of homes (roughly 40 percent) connected to septic systems. Most of these systems are substandard (*i.e.*, open-bottomed tanks with no drain fields) and/or failing (PRASA, 2020). Although the AHS has the most current national-level estimate on decentralized system usage in the U.S.

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[7] Longitudinal surveys are defined at: https://www.census.gov/topics/income-poverty/about/glossary.html

[8] In 2015, according to the AHS, 19.9% of U.S. households were served by decentralized wastewater systems.

and is used for this report, it is important to note the AHS does not accurately represent small geographic areas where septic system usage rates are increasing due to new construction or are historically high. For example, the 2017 AHS reports that 17.8 percent of U.S. households rely on decentralized systems alone, whereas Vermont estimates that 55 percent of its residents rely on decentralized systems (EPA, 2018). The AHS can only provide estimates across the country at the regional Census Bureau division level due to a small sample size that is not representative of a state or county.

U.S. Census Survey of Construction

The U.S. Census Bureau's Survey of Construction (SOC) provides national and census division estimates of decentralized systems in new homes but does not include existing homes. The SOC also has a relatively small sample size and does not include mobile homes, which are often connected to decentralized wastewater systems. When six or more homes are connected to a shared septic system, the SOC counts this type of cluster decentralized system as a public sewer. EPA does not consider this type of cluster system a public sewer unless it directly discharges into a waterbody[9]. The SOC provides a national estimate of new homes built with decentralized systems; however, omitting existing homes and mobile homes precluded its use in this report.

State and Local Data

Many states and localities do not have the resources to systematically collect or make decentralized system data available. When data is available, it is not comparable across states or from locality to locality; in addition, there is no nationally standardized method for quality control.

Decentralized systems are typically regulated and permitted at the county or township level and the data largely originates from these local regulatory programs. However, not all decentralized systems are permitted; in some cases, permits have been obtained for systems that have never been built. Permit management methods and database tools also vary across the country. Some localities use electronic systems and make permit information publicly available online.

The following state examples further illustrate this disparity across the country:

- Indiana lacks decentralized system data across localities. This is in part due to inconsistent paper record-keeping practices, a lack of design plans on file for septic systems, and a lack of communication between building and health departments, according to a Brown County Board of Health member (Clifford, 2017).
- Michigan foresees greater reliance on decentralized systems as more than half of new single-family homes in Michigan are built with a septic system; however, there is no central system to track on-site systems, their precise locations, conditions, or possible risks to groundwater (Michigan Department of Environment, Great Lakes, and Energy, 2016).
- Minnesota is one of the few states that uses a centralized data collection system to obtain current decentralized systems data (Robinson, 2018).
- In the Commonwealth of Pennsylvania, permits for decentralized systems are issued by Sewage Enforcement Officers who work for local agencies or municipalities.. The local agencies send these permits to the Pennsylvania Department of Environmental Protection (PA DEP); however, the PA DEP does not have a comprehensive database of all decentralized system data throughout the Commonwealth[10].

[9] The National Pollutant Discharge Elimination System program overseen by EPA regulates wastewater discharge into waterbodies; see NPDES Program Website.
[10] Information gathered via EPA / PA DEP email correspondence in December 2020.

- Tennessee began digitizing permits and made state-wide data available online in 2017. The state still relies on the 1990 Decennial Census decentralized system statistics to fill gaps in permit records (Tennessee Department of Environment and Conservation, 2017).
- Every one of Washington State's 39 county local governments has its own method of managing decentralized system data. Counties near the Puget Sound estuary and sensitive waterways have more robust data on decentralized systems than inland counties due to funding available to address sensitive waterway needs[11].

The State Onsite Regulators Association (SORA)[12] in 2015 attempted to estimate the U.S. population relying on decentralized wastewater systems at the state-level. Nine states did not respond, and a 25 percent estimate was imputed for the missing state values. For the states that did respond, data was not available for all counties and the quality of the data was low due to a lack of standardized data reporting and missing data. States with insufficient staff and funding tend to be those with the greatest decentralized wastewater needs but are often unable to adequately document or demonstrate the scope and range of that need.

[11] Information gathered via EPA interview with Washington State On-site Sewage Systems program staff in May 2018.
[12] EPA Decentralized Wastewater MOU Partner.

Appendix B

EPA assessed four states (*i.e.*, Florida, Hawaii, Rhode Island, and Delaware) that each have a complete set of state-wide data on decentralized systems. For those states, EPA's assessment used publicly available state decentralized system shapefile data[13], as well as the state specific median household income (MHI) from the ACS. For each state, the analysis includes individually mapped MHI data by census tract, overlaid with decentralized system locations via ArcGIS. The maps provide visual representation and state-level analysis of prevalence. County level maps and calculations for several counties provide further granularity within states. Data also were graphed by county, with MHI arranged from low to high on the x-axis, and the prevalence of decentralized systems along the y-axis. A linear trend line, as well as a calculation of Spearman's rank correlation coefficient[14], was included to demonstrate the statistical relationship, if any, between the two variables. Spearman's ρ (rho), which is the correlation coefficient, measures the linear correlation between two variables, with a value of -1 being total negative correlation, 0 being no correlation, and +1 being total positive correlation.

Florida

The Florida Department of Health uses the term "onsite sewage treatment and disposal systems" (OSTDSs) when referring to decentralized wastewater systems permitted in their state. The OSTDS shapefile data (2016) was retrieved from the Florida Department of Health. Income data was retrieved from the 2016 ACS five-year estimates where the MHI for Florida was $48,900 (U.S. Census Bureau, 2016a).

To provide an analysis, 6 of the 67 Florida counties were mapped. This included those counties with the lowest MHI (Madison, $29,806; Putnam, $33,003), middle MHI (Miami-Dade, $44,224; Alachua, $44,702), and highest MHI (Seminole, $60,652; Santa Rosa, $69,523). County prevalence was also calculated and was based on the number of households less than or equal to the state MHI with an OSTDS. Those counties with no census tracts above the state MHI were interpreted to be counties where all households (100 percent) in that county earn less than or equal to the state MHI. In 2016, the estimated overall prevalence of households with an OSTDS that earned less than the Florida MHI among all households with an OSTDS was 51.4 percent. The lowest median household income in Florida with an OSTDS was Madison County ($29,806, 100 percent) and the highest was Santa Rosa County ($69,523, 18.6 percent).

Although discernable trends are difficult to identify with limited state examples, Florida displays overall trends due to the robust data from its 67 counties. Table 4 shows, for all of Florida's counties, the estimated prevalence of households with OSTDS that earn less than the state MHI. Based on the table, the prevalence of low- and moderate-income households with OSTDSs decreases with higher MHI levels.

Graph 4 illustrates the association[15] between prevalence of households with an OSTDS earning less than or equal to the state MHI, and county MHI. Counties are arranged based on county MHI, from low to high. The dashed blue line indicates the decrease in prevalence of households with an OSTDS as county MHIs increase.

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[13] A shapefile is a simple, nontopological format for storing the geometric location and attribute information of geographic features. Geographic features in a shapefile can be represented by points, lines, or polygons (areas). (ArcGIS/ ESRI definition)

[14] The Spearman rank correlation coefficient is a nonparametric measure of the associative direction and strength between two variables (*i.e.*, MHI and prevalence of decentralized systems less than or equal to MHI). The use of Spearman's correlation has the advantage of working with monotonic relationships between variables – where the rate of increase/decrease of the linear relationship is non-constant. Additionally, MHI is a nonparametric variable; therefore, Spearman's correlation should provide a more robust inference on the measure of linear association between MHI and prevalence of decentralized systems less than or equal to MHI.

[15] In Microsoft Excel, the bar graph's trend lines are based on y-axis values while the x-axis is plotted only as a linear series. Therefore, the trend line that is generated is a means to represent a line that is the best fitting visual representation of the data, which is why the line extends slightly above 100 percent.

A Spearman rank correlation test was performed to evaluate the relationship between MHI and OSTDS prevalence. The test result of ρ = - 0.76 indicates a strong negative correlation. Based on the Florida data presented, as household incomes increase, the prevalence of those with an OSTDS decreases.

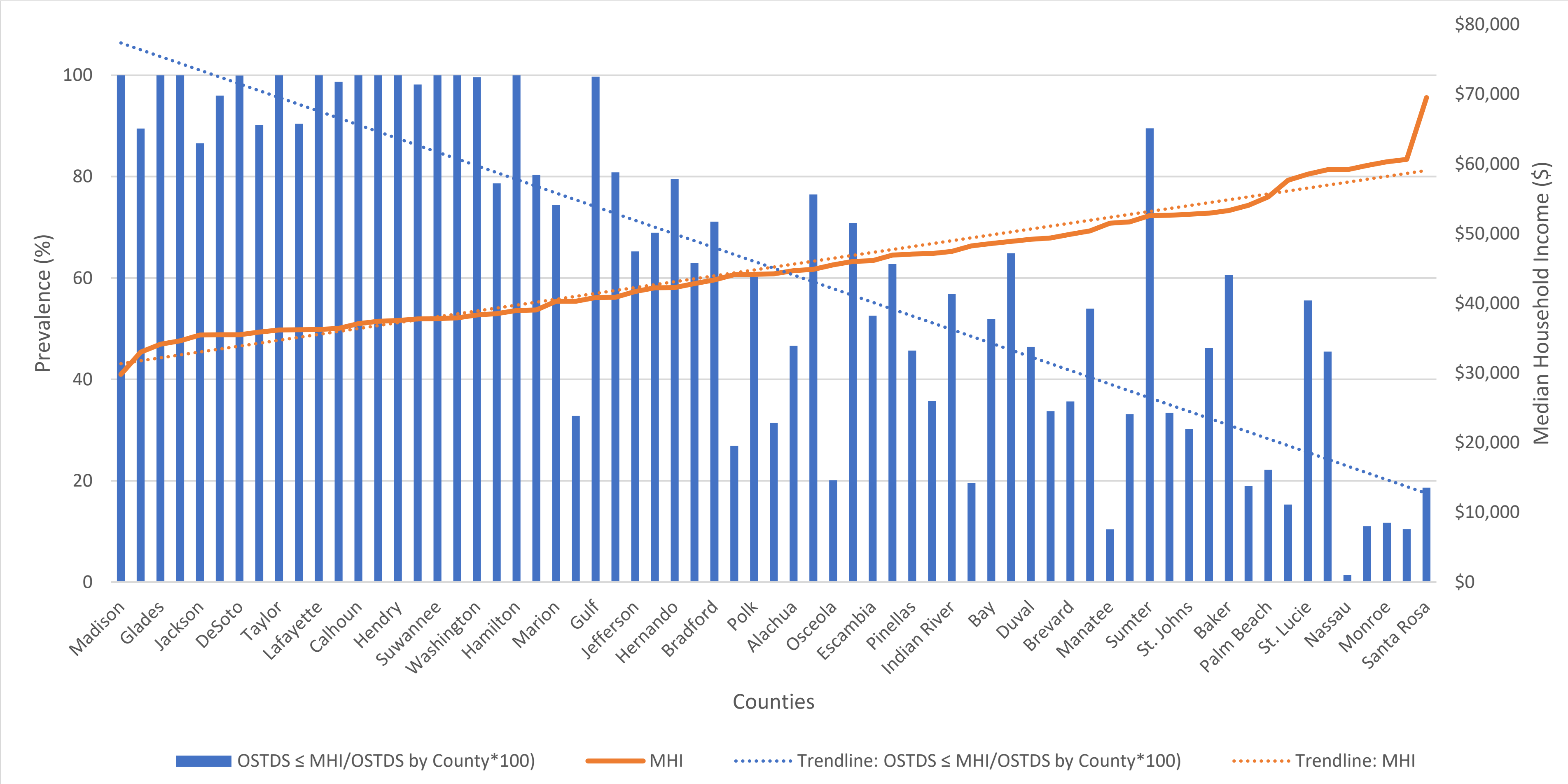
Florida county analyses, maps, and calculations are below.

Table 4: The Prevalence of Households with OSTDS ≤ State MHI in Florida by County (2016)

County	Total OSTDS	Total OSTDS ≤ MHI	% of OSTDS ≤ MHI ([Total OSTDS ≤ MHI]/ [Total OSTDS] *100)	MHI
Madison*	499	499	100.00	$29,806
Putnam*	6383	5711	89.47	$33,003
Glades	427	427	100.00	$34,143
Dixie	478	478	100.00	$34,634
Jackson	3393	2938	86.59	$35,470
Levy	4214	4046	96.01	$35,480
DeSoto	2510	2509	99.96	$35,513
Highlands	7754	6991	90.16	$35,865
Taylor	833	833	100.00	$36,195
Hardee	1523	1377	90.41	$36,222
Lafayette	66	66	100.00	$36,236
Okeechobee	3006	2967	98.70	$36,415
Calhoun	582	582	100.00	$37,089
Holmes	1547	1547	100.00	$37,437
Hendry	2489	2489	100.00	$37,552
Union	218	214	98.17	$37,778
Suwannee	4088	4088	100.00	$37,796
Liberty	95	95	100.00	$37,917
Washington	3030	3019	99.64	$38,330
Gadsden	3653	2873	78.65	$38,533
Hamilton	462	462	100.00	$38,980
Citrus	21776	17496	80.35	$39,054
Marion	31560	23502	74.47	$40,295
Franklin	1368	449	32.82	$40,301
Gulf	1504	1500	99.73	$40,822
Gilchrist	2142	1732	80.86	$40,881
Jefferson	886	578	65.24	$41,696
Volusia	41279	28461	68.95	$42,240
Hernando	17964	14285	79.52	$42,274
Columbia	2874	1809	62.94	$42,848
Bradford	1430	1017	71.12	$43,373
Sarasota	3623	974	26.88	$44,140
Polk	30926	18641	60.28	$44,146
Miami-Dade*	18058	5672	31.41	$44,224
Alachua*	7394	3448	46.63	$44,702
Charlotte	13504	10330	76.50	$44,865
Osceola	7632	1535	20.11	$45,536
Pasco	19865	14081	70.88	$46,010
Escambia	19953	10487	52.56	$46,117

Walton	4663	2926	62.75	$46,910
Pinellas	3031	1385	45.69	$47,090
Lake	20264	7237	35.71	$47,141
Indian River	16215	9210	56.80	$47,446
Leon	9802	1911	19.50	$48,248
Bay	7983	4143	51.90	$48,577
Flagler	2781	1804	64.87	$48,898
Duval	15788	7330	46.43	$49,196
Orange	27015	9108	33.71	$49,391
Brevard	23785	8475	35.63	$49,914
Lee	56960	30739	53.97	$50,390
Manatee	4290	448	10.44	$51,483
Hillsborough	19085	6331	33.17	$51,681
Sumter	3929	3519	89.56	$52,594
Martin	11455	3828	33.42	$52,622
St. Johns	9810	2963	30.20	$52,796
Broward	12531	5792	46.22	$52,954
Baker	754	457	60.61	$53,327
Wakulla	3713	706	19.01	$54,078
Palm Beach	24564	5452	22.20	$55,277
Okaloosa	10126	1551	15.32	$57,655
St. Lucie	7353	4087	55.58	$58,538
Clay	8190	3723	45.46	$59,179
Nassau	2442	34	1.39	$59,196
Collier	16683	1838	11.02	$59,783
Monroe	880	103	11.70	$60,303
Seminole*	8956	937	10.46	$60,652
Santa Rosa*	13675	2546	18.62	$69,523
Unnamed Coordinates[16]	17342	8320	-	-
State Totals:	**655,053**	**336,612**	**51.39%**	**$48,900**
* Indicates FL counties mapped for further analysis (Madison, Putnam, Miami-Dade, Alachua, Seminole, and Santa Rosa counties)				

[16] Note on unnamed coordinates: there were locations identified for OSTDSs however those "unnamed coordinates" were missing information such as address or county, thus they are categorized as such and not included in the analysis.



Graph 4: The Prevalence of Households with OSTDSs ≤ MHI in Florida by County (2016)

Figure 4: Onsite Sewage Treatment and Disposal Systems in Florida & Census Tract Income Data (2016)[17]

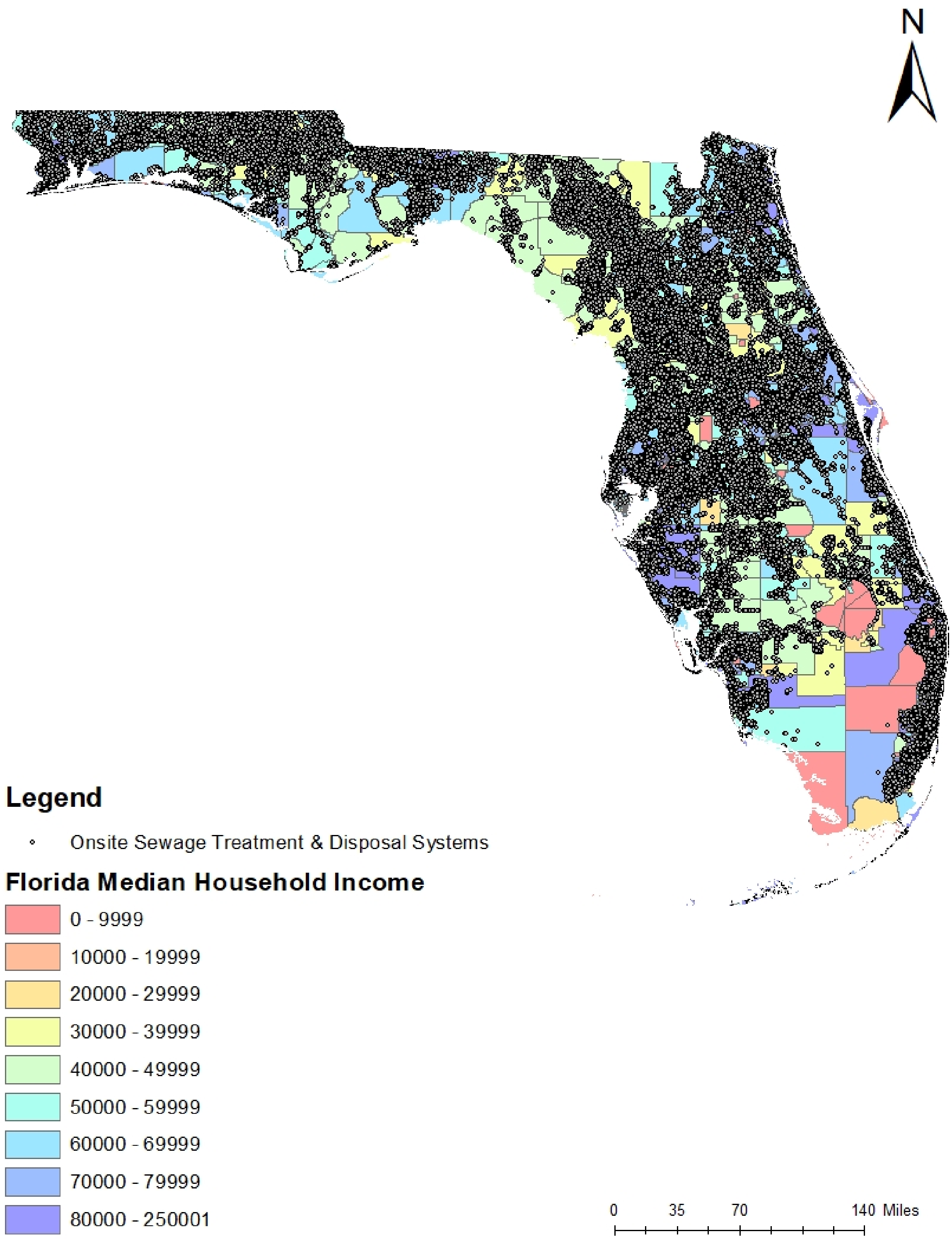


Table 5: The Prevalence of Households ≤ MHI with OSTDSs in Florida

Total Mapped OSTDS	Total Mapped OSTDS ≤ MHI	% of OSTDSs ≤ MHI ([Total OSTDS ≤ MHI]/ [Total Mapped OSTDS] *100)	Florida MHI
655,053	336,612	**51.39%**	$48,900

[17] Due to the large number of OSTDS in close proximity to each other throughout various parts of Florida, some of the individual census tracts / counties (color-coded based on MHI) may not be visible on this map. See Table 4 for county MHI levels.

Figure 5: Onsite Sewage Treatment and Disposal Systems in Madison County & Census Tract Income Data (2016)

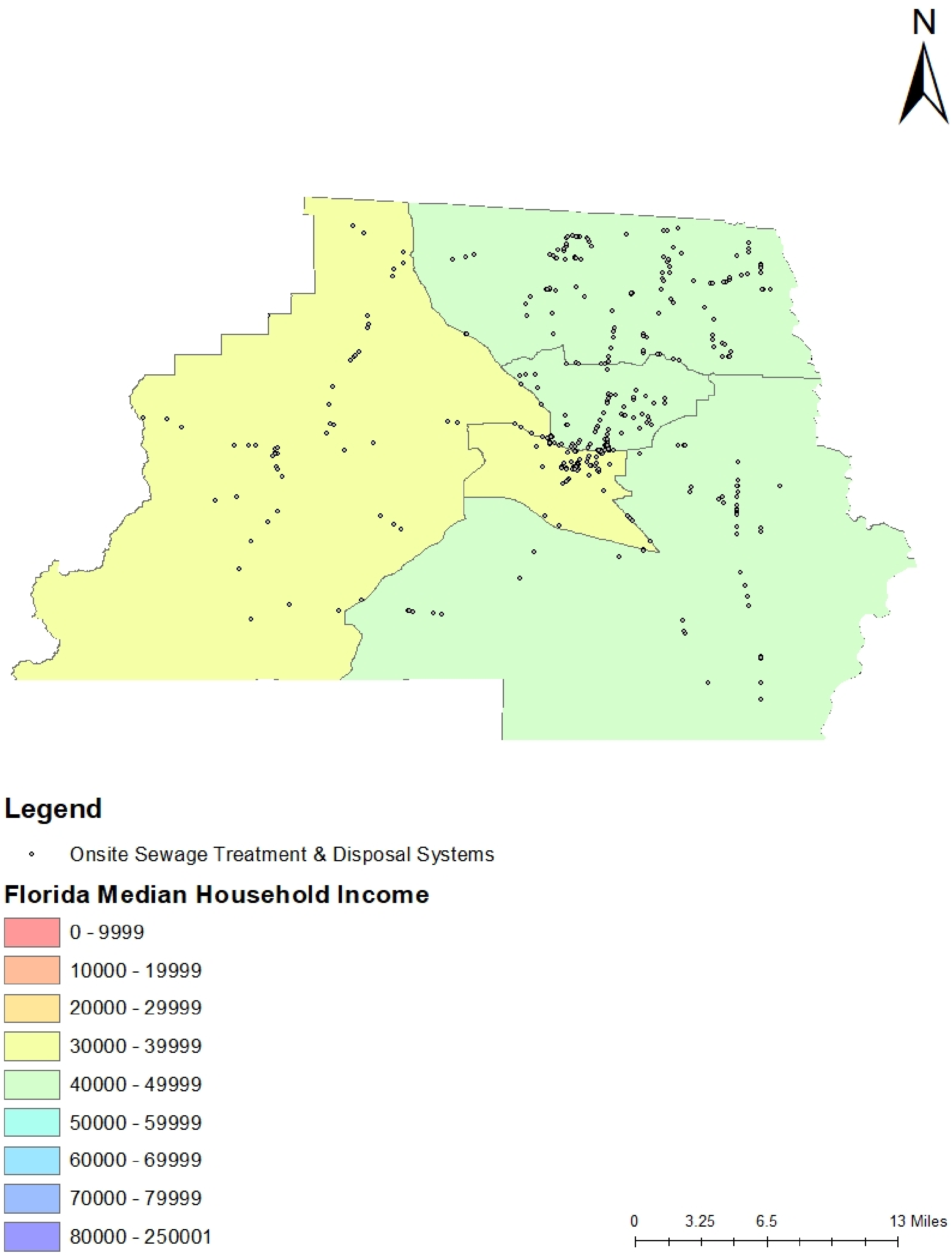


Table 6: The Prevalence of Households ≤ MHI with OSTDSs in Madison County

Total Mapped OSTDS	Total Mapped OSTDS ≤ MHI	% of OSTDS ≤ MHI ([Total OSTDS ≤ MHI]/ [Total Mapped OSTDS] *100)	Madison County MHI
499	499	**100%**	$29,806

Figure 6: Onsite Sewage Treatment and Disposal Systems in Putnam County & Census Tract Income Data (2016)

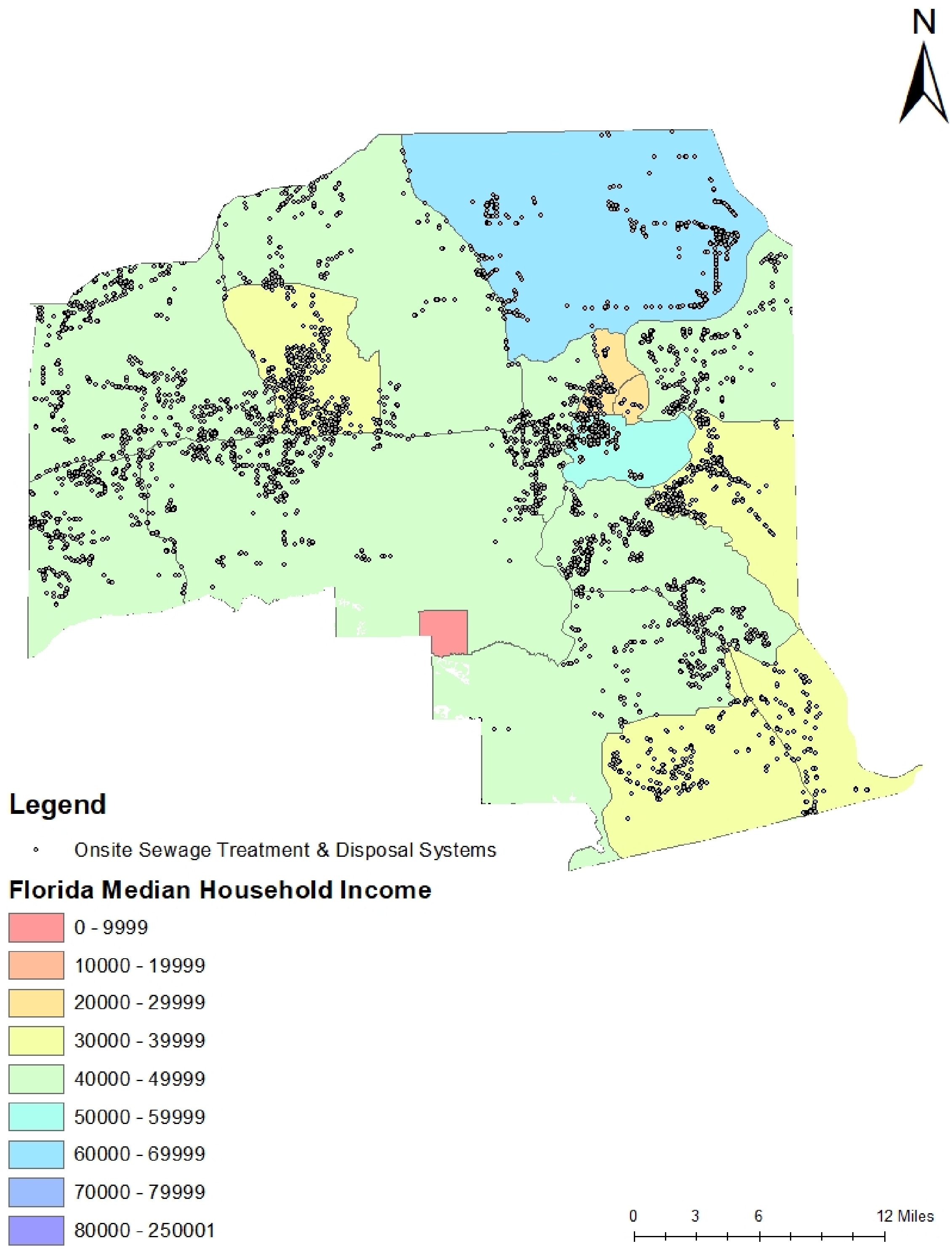


Table 7: The Prevalence of Households ≤ MHI with OSTDSs in Putnam County

Total Mapped OSTDS	Total Mapped OSTDS ≤ MHI	% of OSTDS ≤ MHI ([Total OSTDS ≤ MHI]/ [Total Mapped OSTDS] *100)	Putnam County MHI
6,383	5,711	**89.47%**	$33,003

Figure 7: Onsite Sewage Treatment and Disposal Systems in Alachua County & Census Tract Income Data (2016)

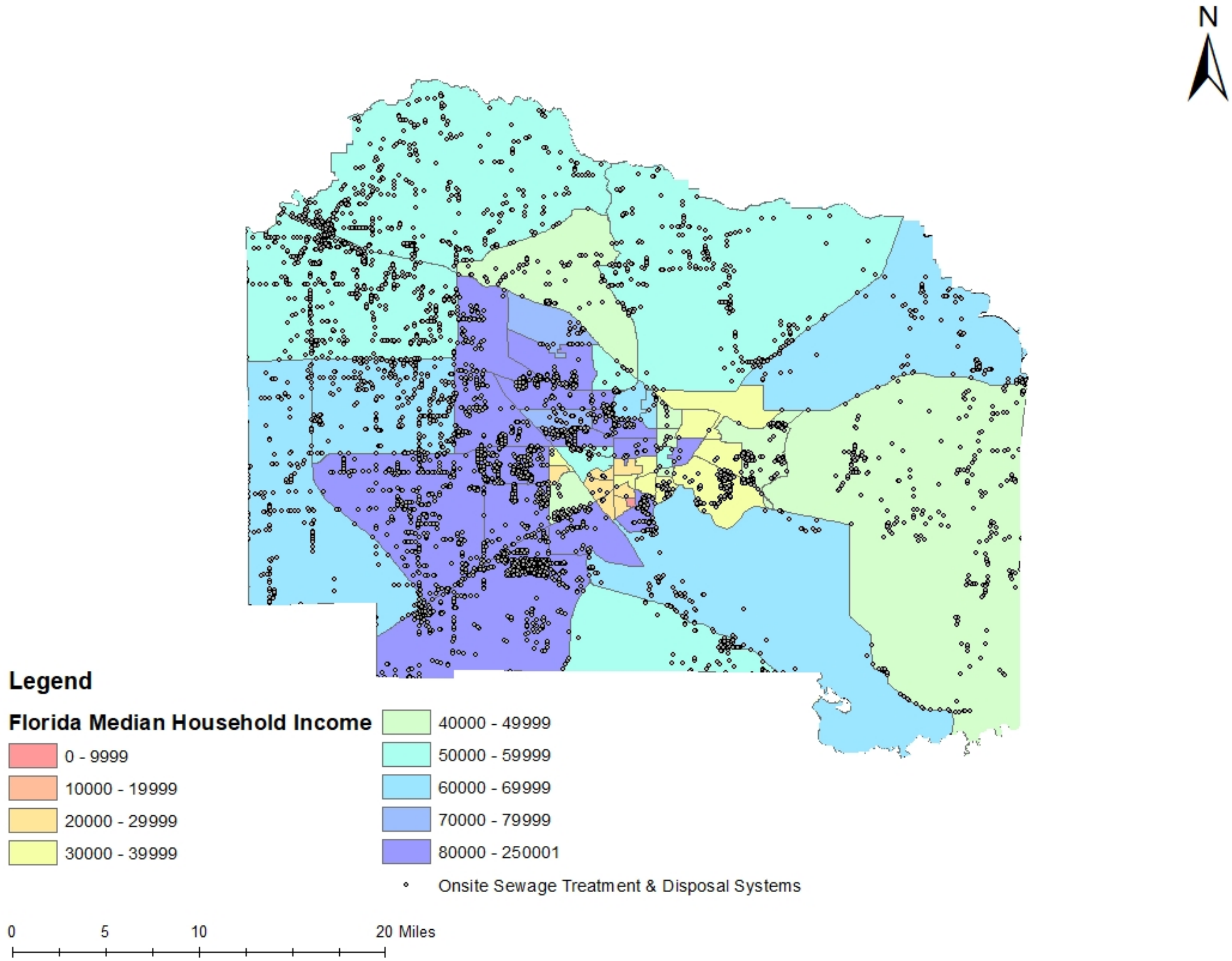


Table 8: The Prevalence of Households ≤ MHI with OSTDSs in Alachua County

Total Mapped OSTDS	Total Mapped OSTDS ≤ MHI	% of OSTDS ≤ MHI ([Total OSTDS ≤ MHI]/ [Total Mapped OSTDS] *100)	Alachua County MHI
7,394	3,448	**46.63%**	$44,702

Figure 8: Onsite Sewage Treatment and Disposal Systems in Miami – Dade County & Census Tract Income Data (2016)

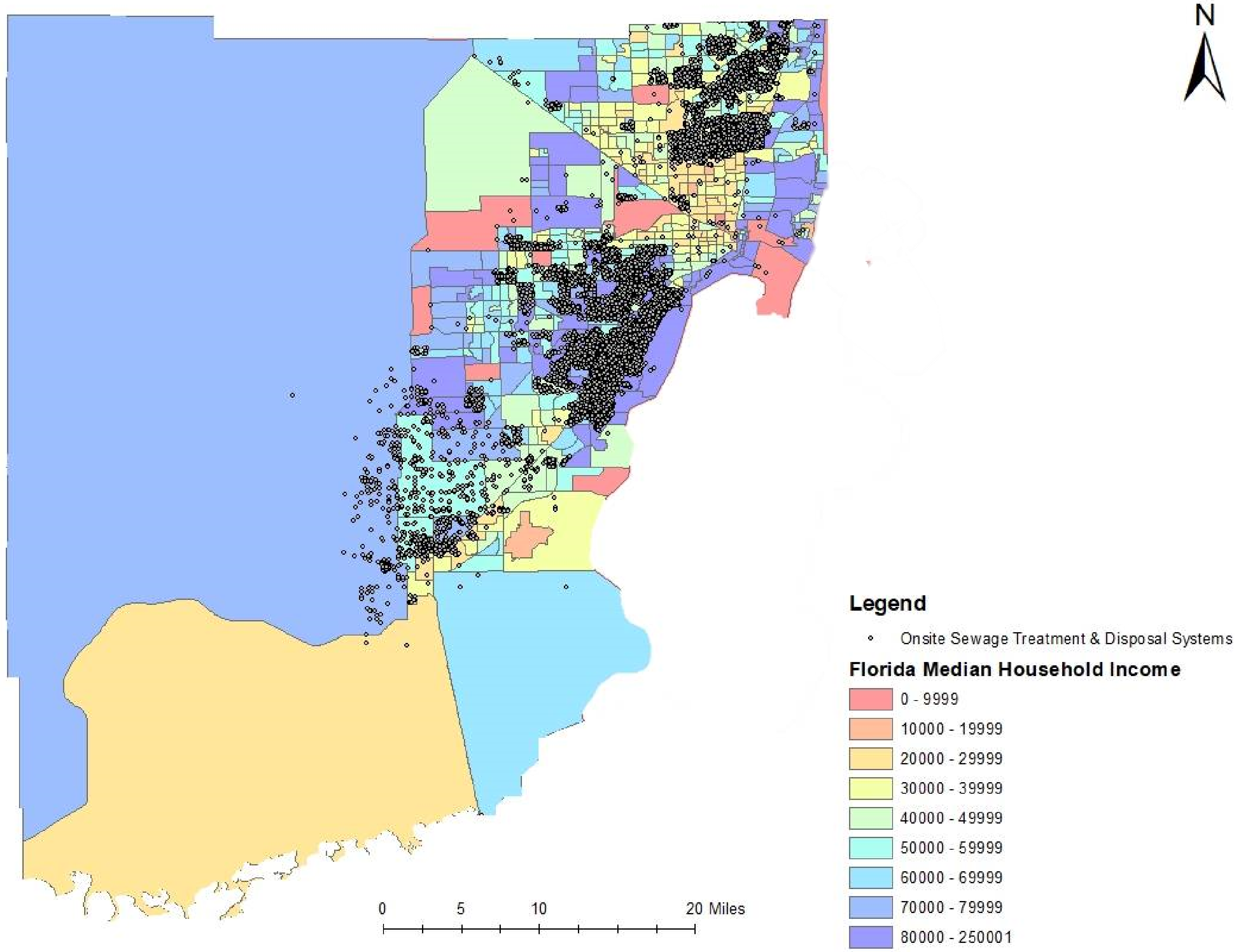


Table 9: The Prevalence of Households ≤ MHI with OSTDSs in Miami-Dade County

Total Mapped OSTDS	Total Mapped OSTDS ≤ MHI	% of OSTDS ≤ MHI ([Total OSTDS ≤ MHI]/ [Total Mapped OSTDS] *100)	Miami-Dade County MHI
18,058	5,672	**31.41%**	$44,224

Figure 9: Onsite Sewage Treatment and Disposal Systems in Seminole County & Census Tract Income Data (2016)

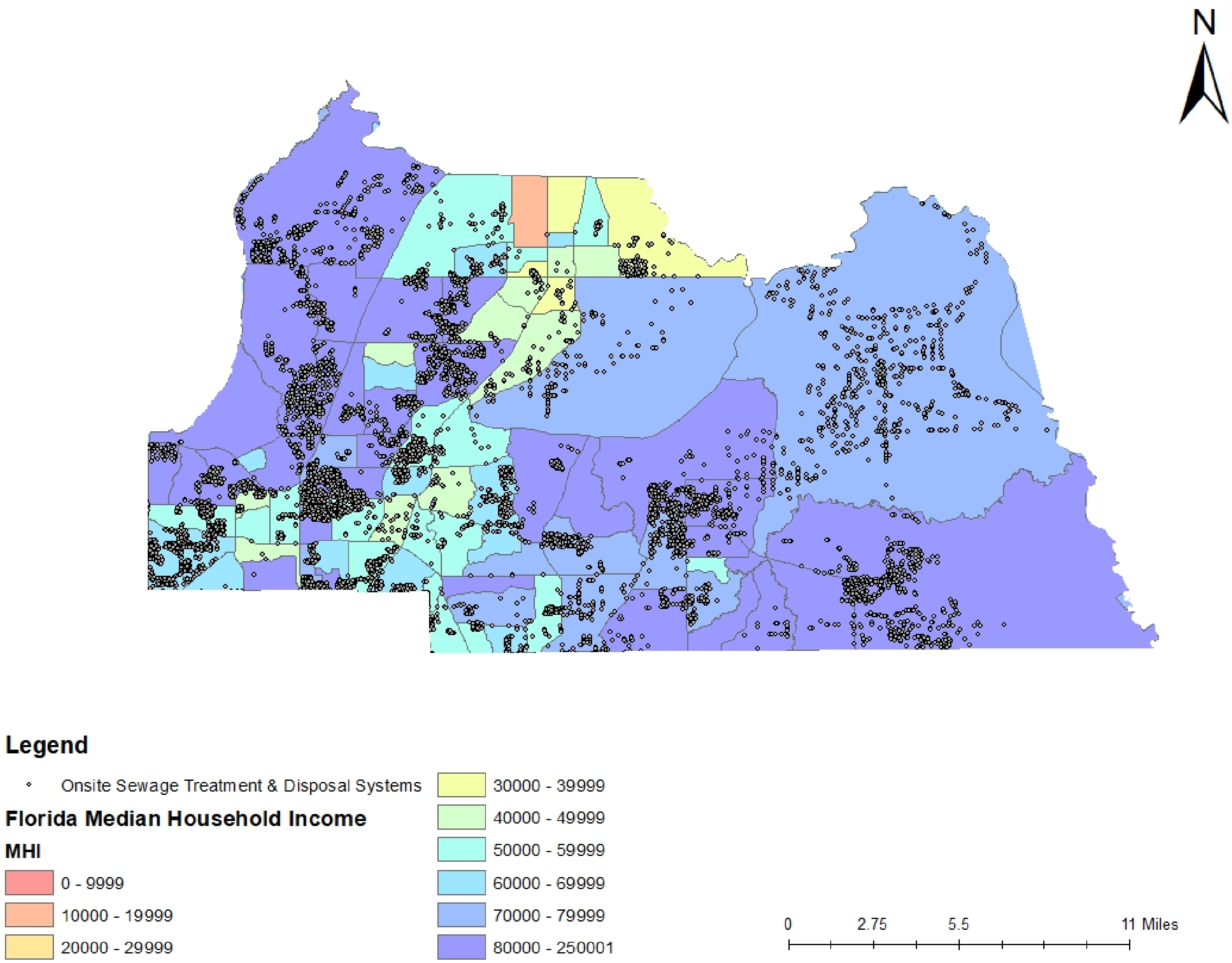


Table 10: The Prevalence of Households ≤ MHI with OSTDSs in Seminole County

Total Mapped OSTDS	Total Mapped OSTDS ≤ MHI	% of OSTDS ≤ MHI ([Total OSTDS ≤ MHI]/ [Total Mapped OSTDS] *100)	Seminole County MHI
8,956	937	**10.46%**	$60,652

Figure 10: Onsite Sewage Treatment and Disposal Systems in Santa Rosa County & Census Tract Income Data (2016)

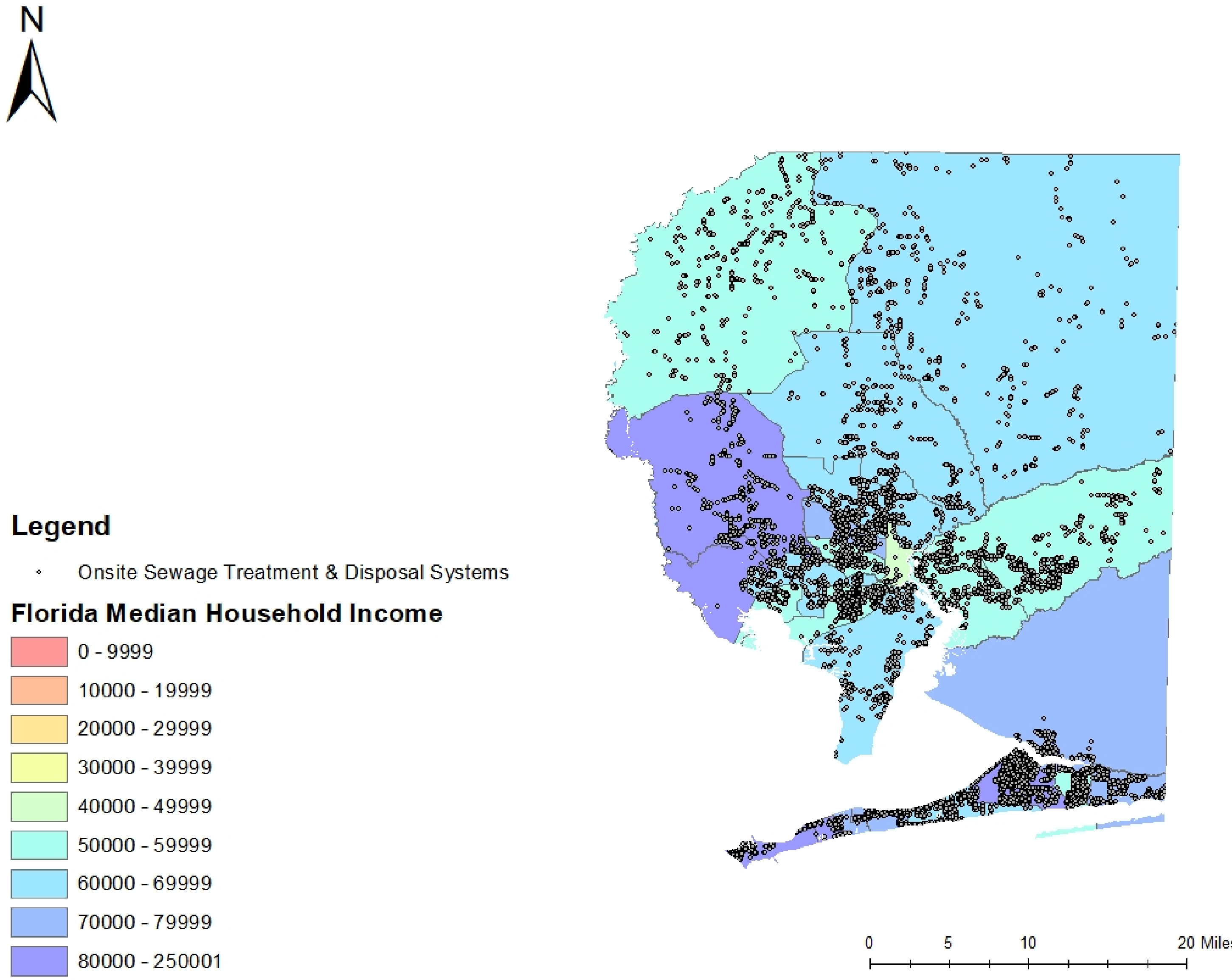


Table 11: The Prevalence of Households ≤ MHI with OSTDSs in Santa Rosa County

Total Mapped OSTDS	Total Mapped OSTDS ≤ to MHI	% of OSTDS ≤ MHI ([Total OSTDS ≤ MHI]/ [Total Mapped OSTDS] *100)	Santa Rosa County MHI
13,675	2,546	**18.62%**	$69,523

Hawaii

The Hawaii Department of Health uses the term "onsite sewage disposal systems[18]" (OSDS) when referring to decentralized wastewater systems permitted in their state. The OSDS shapefile data (2017) was retrieved from the Hawaii Department of Health. It is important to note that this data includes information on roughly 88,000 cesspools[19]. Income data was retrieved from the 2017 ACS five-year estimates where the MHI for Hawaii was $74,923 (U.S. Census Bureau, 2017a).

To provide an analysis, all five Hawaiian Islands (*i.e.*, Oahu, Molokai, Maui, Kauai, and Hawaii Island) were individually mapped, and island-wide prevalence was calculated. In the case of Maui County, which includes the islands of Maui and Molokai, individual island MHI was calculated from averaging the census tract MHI for both islands. Kalawao County/Island was not included in this analysis because data was not provided. In 2017, the estimated overall prevalence of households with an OSDS that earned less than the Hawaii MHI among all households with an OSDS was 61.0 percent. The lowest MHI in Hawaii was Molokai which had the highest prevalence ($49,674, 99.9 percent) and the highest MHI was the City and County of Honolulu, Oahu, which had a much lower prevalence ($80,078, 15.4 percent).

Hawaii's five islands provide a detailed look at the state OSDS use, relative to income. Table 12 provides the prevalence of households with OSDS less than or equal to the state MHI, as well as the island-wide MHI. Molokai has the highest percentage of households with OSDS less than or equal to the state MHI (99.9 percent). The Island of Hawaii has the highest total number of OSDS and the second lowest MHI with a prevalence of 94.3 percent. In general, those islands with higher median incomes had a much lower prevalence of households with an OSDS.

Graph 5 illustrates the association between the prevalence of households with an OSDS earning less than or equal to the state MHI, for each island. As MHI for each island goes from low to high, the dashed blue line shows the decrease in prevalence of households with an OSDS.

A Spearman rank correlation test was performed to evaluate the relationship between MHI and OSDS prevalence. The test result of $\rho = -0.7$ indicates a strong negative correlation. Overall, the data presented for the state of Hawaii indicate that as household incomes increase, the prevalence of households with an OSDS decreases.

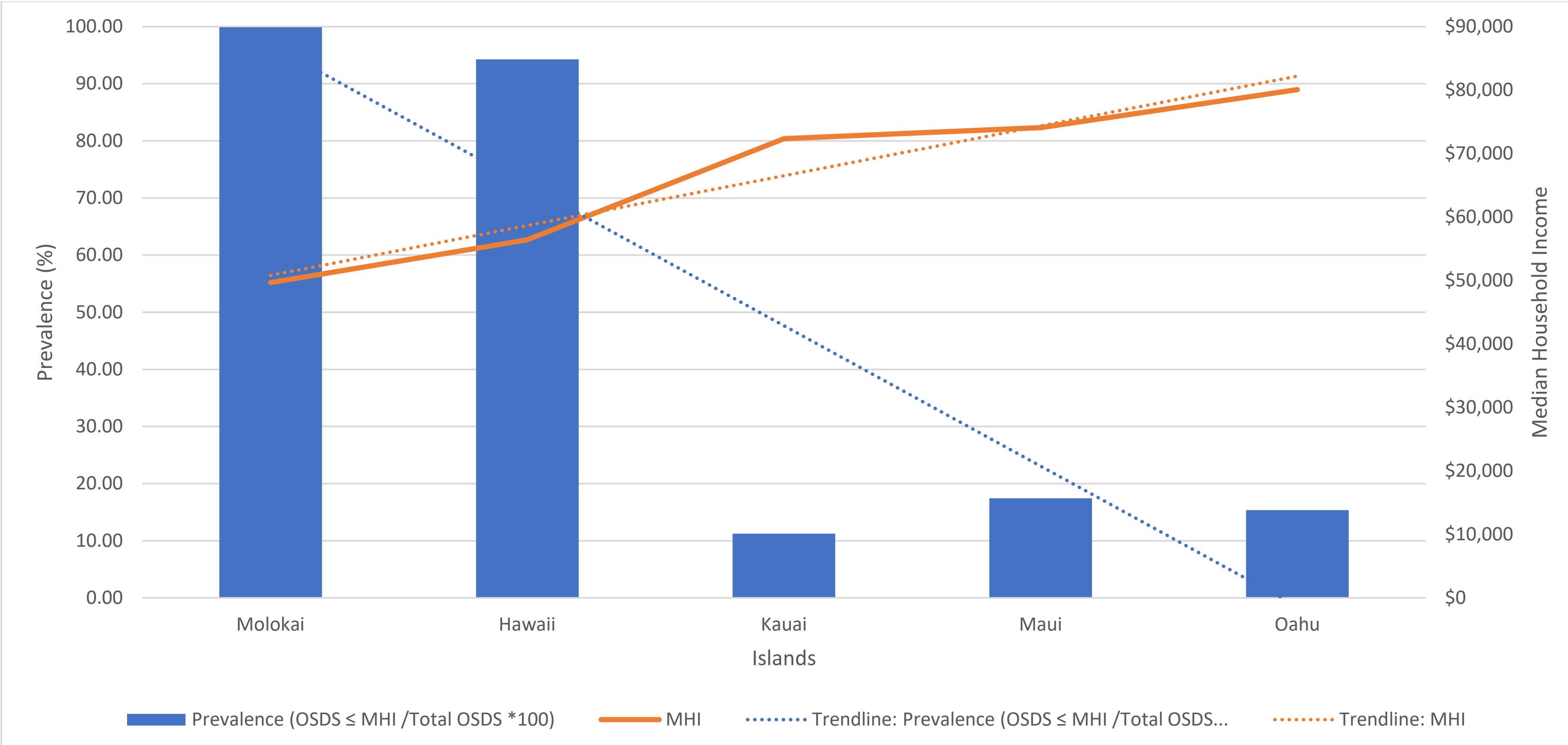
Notably, the sample size for Hawaii is much smaller than for the state of Florida. Individual Hawaii island analysis, maps, and calculations are provided below.

Table 12: The Prevalence of Households with OSDS ≤ state MHI in Hawaii by Island (2017)

Island	Total OSDS	Total OSDS ≤ MHI	% of OSDS ≤ MHI ([Total OSDS ≤ MHI] / [Total OSDS] *100)	MHI
Molokai	1,651	1,649	99.88	$49,674
Hawaii	53,530	50,463	94.27	$56,395
Kauai	13,351	1,500	11.24	$72,330
Maui	12,780	2,230	17.45	$74,077
Oahu	13,684	2,105	15.38	$80,078
State Totals:	**94,996**	**57,947**	**61.00**	**$74,923**

[18] Includes septic systems and cesspools.

[19] Hawaii Department of Health statistic; see webpage Cesspools in Hawaii.



Graph 5: The Prevalence of Households with OSDS ≤ MHI in Hawaii by Island (2017)

Figure 11: Onsite Sewage Disposal Systems in Hawaii & Census Tract Income Data

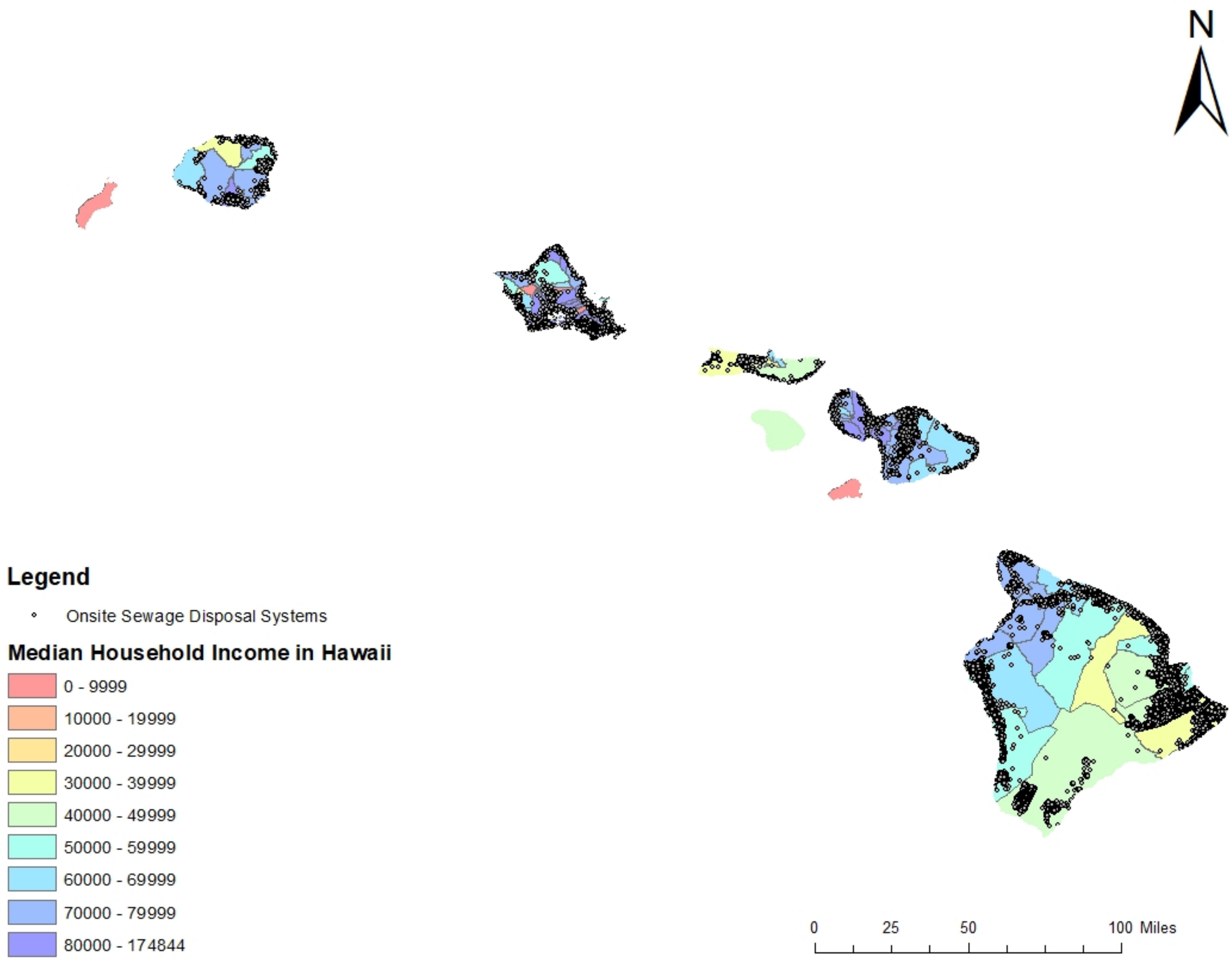


Table 13: The Prevalence of Households ≤ MHI with OSDS in Hawaii

Total Mapped OSDS	Total Mapped OSDS ≤ MHI	% of OSDS ≤ MHI ([Total OSDS ≤ MHI]/ [Total Mapped OSDS] *100)	Hawaii MHI
94,996	57,947	**61.00%**	$74,923

Figure 12: Onsite Sewage Disposal Systems on Island of Hawaii & Census Tract Income Data (2017)

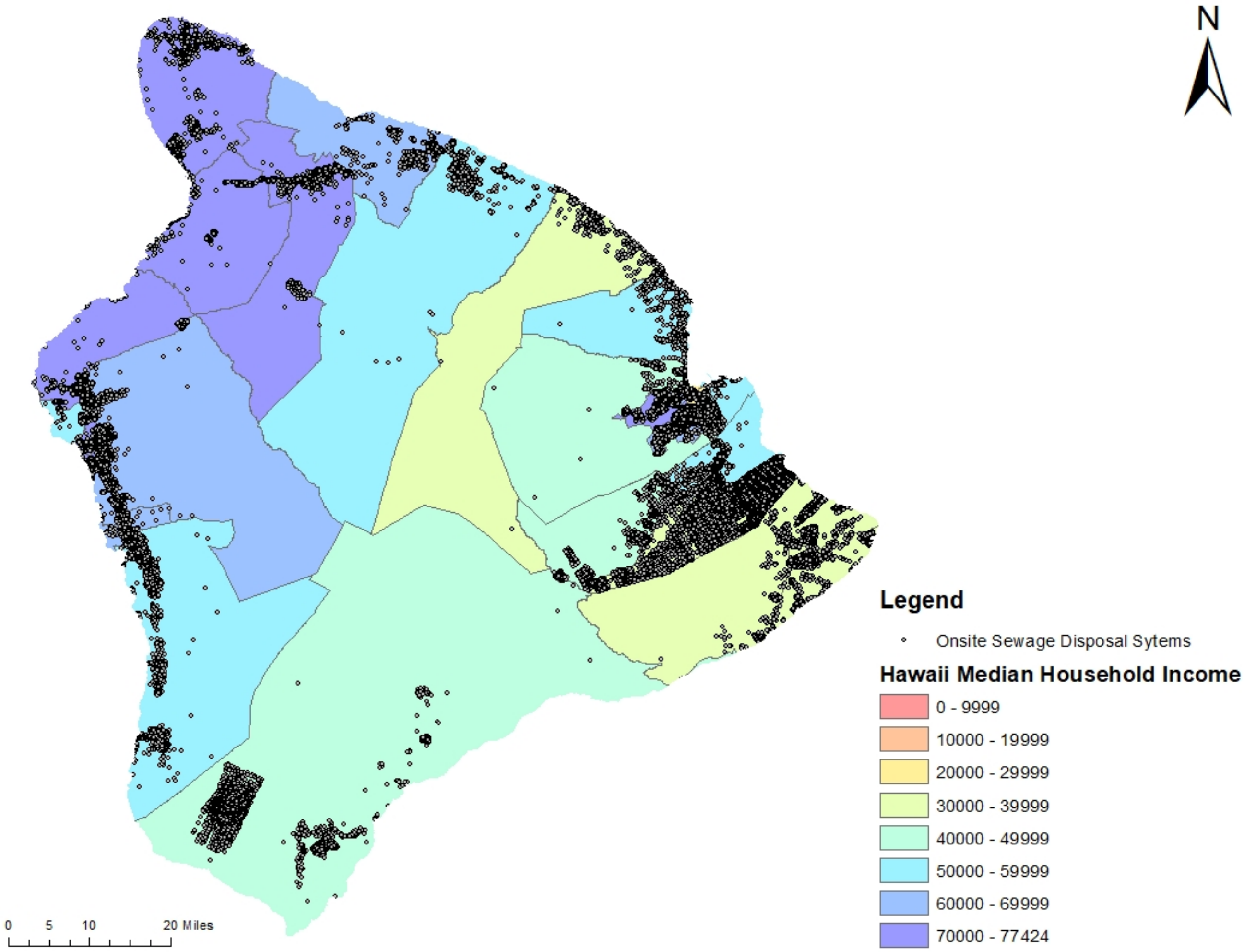


Table 14: The Prevalence of Households ≤ MHI with OSDS on the Island of Hawaii

Total Mapped OSDS	Total Mapped OSDS ≤ MHI	% of OSDS ≤ MHI ([Total OSDS ≤ MHI]/ [Total Mapped OSDS] *100)	Island of Hawaii MHI
53,530	50,463	**94.27%**	$56,395

Figure 11: Onsite Sewage Disposal Systems on the Island of Kauai & Census Tract Income Data (2017)

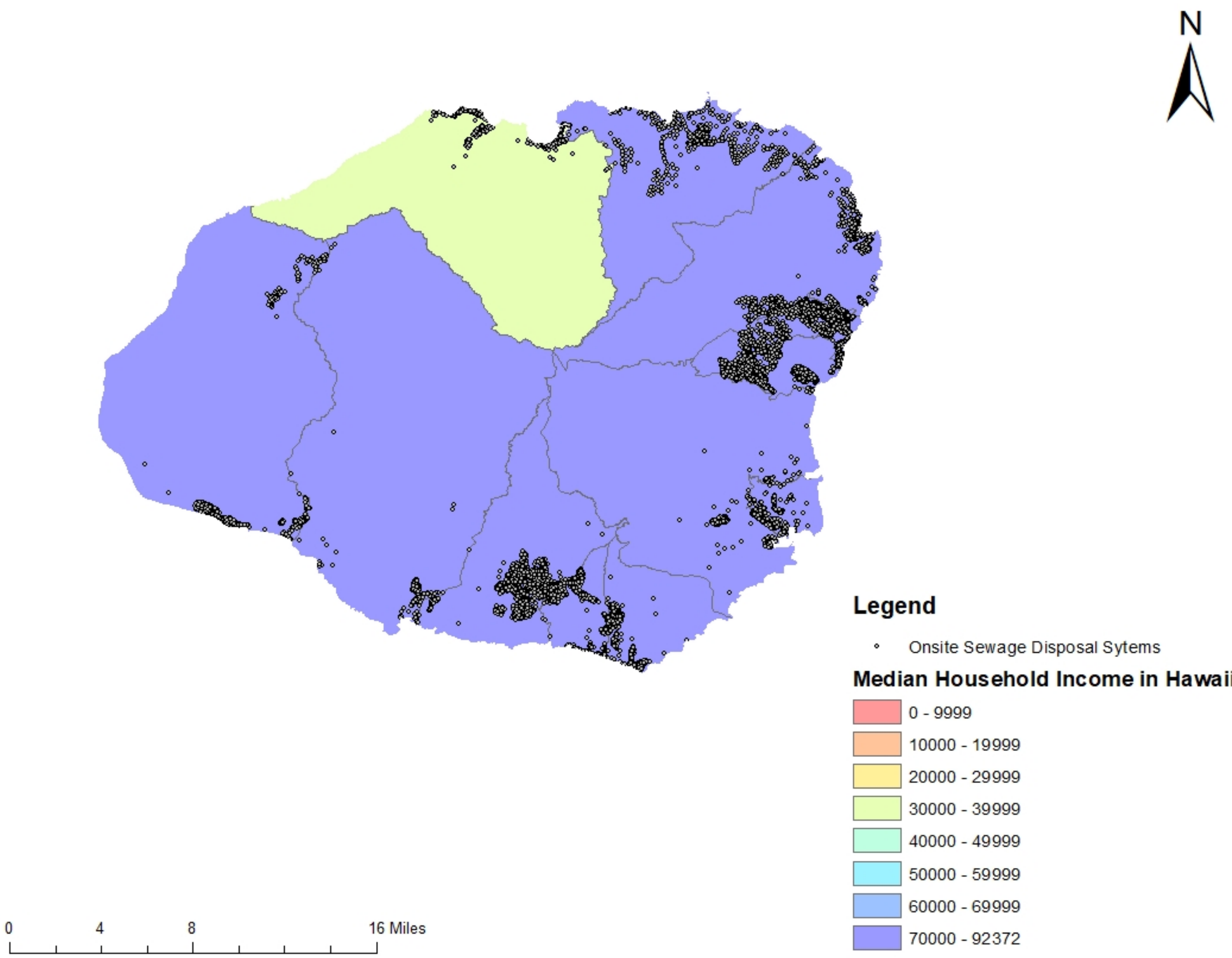


Table 15: The Prevalence of Households ≤ MHI with OSDS on the Island of Kauai

Total Mapped OSDS	Total Mapped OSDS ≤ MHI	% of OSDS ≤ MHI ([Total OSDS ≤ MHI]/ [Total Mapped OSDS] *100)	Island of Kauai MHI
13,351	1,500	**11.24%**	$72,330

Figure 12: Onsite Sewage Disposal Systems on Island of Oahu & Census Tract Income Data (2017)

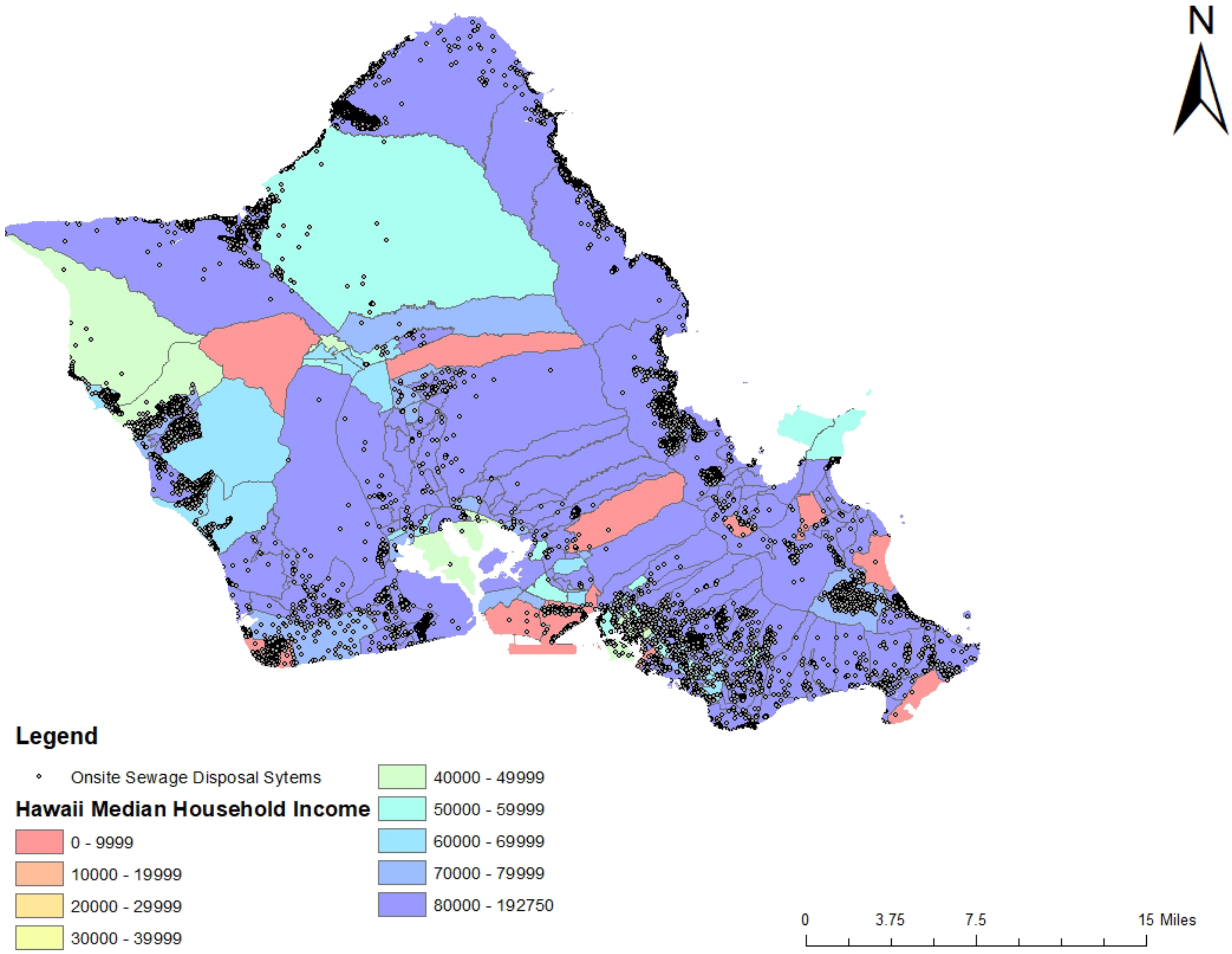


Table 16: The Prevalence of Households ≤ MHI with OSDS on the Island of Oahu

Total Mapped OSDS	Total Mapped OSDS ≤ MHI	% of OSDS ≤ MHI ([Total OSDS ≤ MHI]/ [Total Mapped OSDS] *100)	Island of Oahu MHI
13,684	2,105	**15.38%**	$80,078

Figure 13: Onsite Sewage Disposal Systems on Island of Maui & Census Tract Income Data (2017)

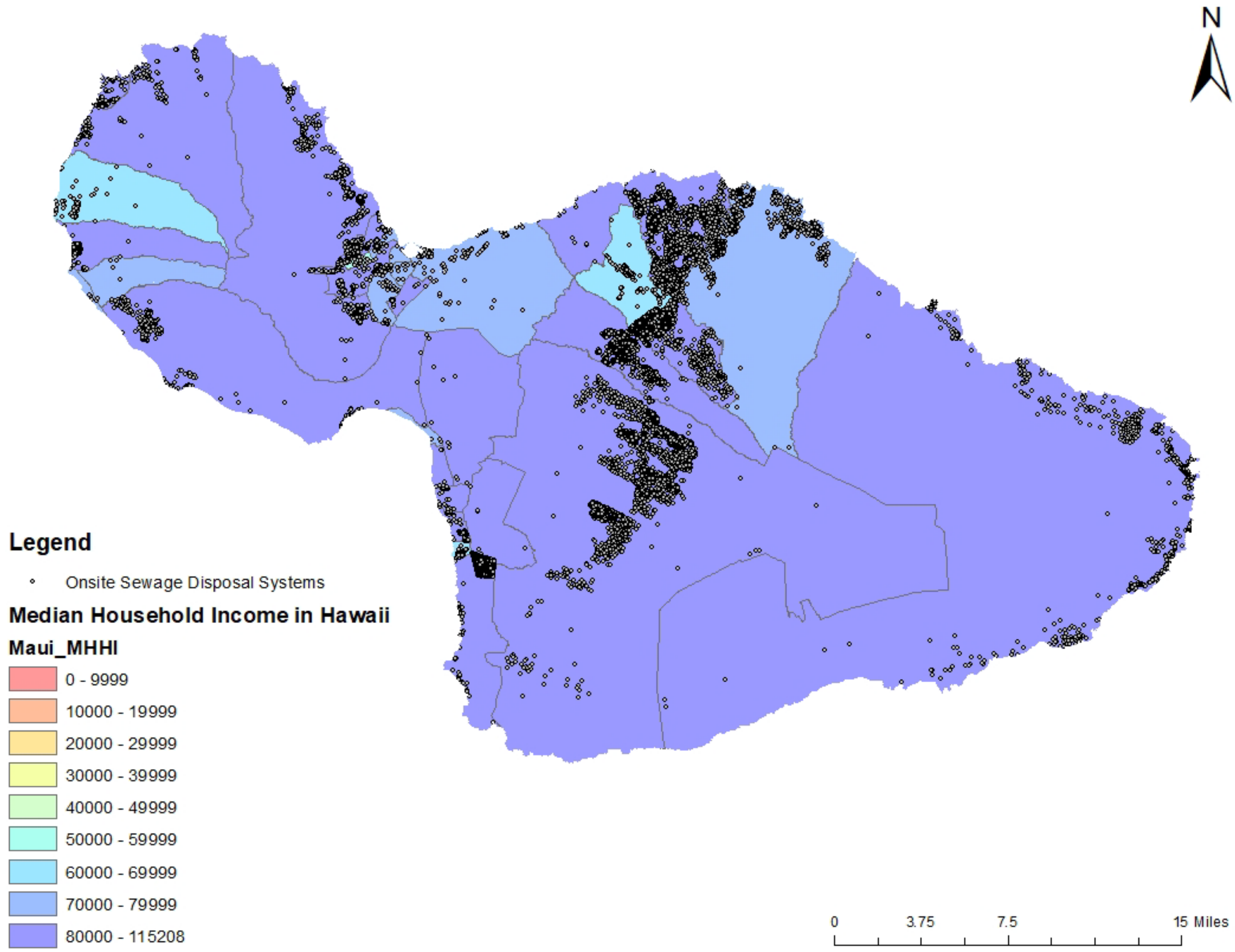


Table 17: The Prevalence of Households ≤ MHI with OSDS on the Island of Maui

Total Mapped OSDS	Total Mapped OSDS ≤ MHI	% of OSDS ≤ MHI ([Total OSDS ≤ MHI]/ [Total Mapped OSDS] *100)	Island of Maui MHI
12,780	2,230	**17.45%**	$ 74,077

Figure 14: Onsite Sewage Disposal Systems on Molokai Island & Census Tract Income Data (2017)

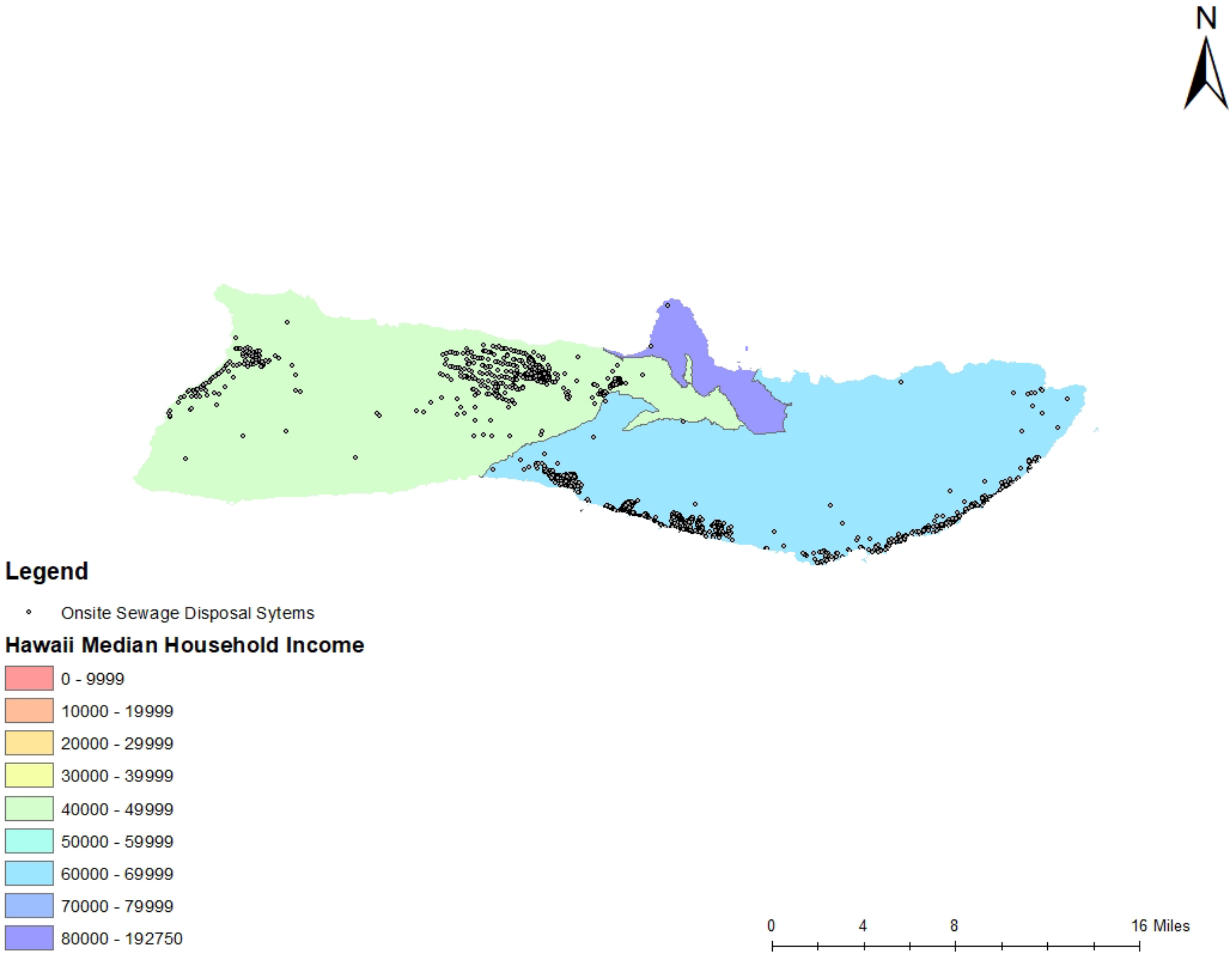


Table 18: The Prevalence of Households ≤ MHI with OSDS on the Island of Molokai[20]

Total Mapped OSDS	Total Mapped OSDS ≤ MHI	% OSDS ≤ MHI ([OSDS ≤ MHI]/ [Total Mapped OSDS] *100)	Island of Molokai MHI
1651	1649	**99.88%**	$49,674

[20] The Island of Molokai is in Maui County. MHI is available only by county. For a more accurate analysis of the island, MHI was analyzed for each of the census tracts on the island and averaged. Data: https://data.census.gov/cedsci/table?q=median%20household%20income&g=0500000US15009.140000&hidePreview=true&tid=ACSST5Y2017.S1903&t=Income%20%28Households,%20Families,%20Individuals%29&vintage=2018&moe=false

Rhode Island

The Rhode Island Department of Environmental Management uses the term "onsite wastewater treatment system" (OWTS) when referring to decentralized wastewater systems permitted in its state. The OWTS shapefile data (2017) was retrieved from a 2017 "State of Narragansett Bay and its Watershed Technical Report", which includes complete state data for Rhode Island, and limited data from Connecticut and Massachusetts. Income data was retrieved from the 2017 ACS five-year estimates where the MHI for Rhode Island was $61,043 (U.S. Census Bureau, 2017a).

To provide an analysis, all five Rhode Island counties (*i.e.*, Bristol, Newport, Kent, Providence, and Washington) were individually mapped, and county-wide prevalence was calculated. In 2017, the estimated overall prevalence of households with an OWTS that earned less than the Rhode Island MHI was 9.1 percent. The lowest MHI county in Rhode Island was Providence ($52,530, 6.8 percent) and the highest was Washington ($77,862, 7.5 percent).

As with Hawaii, the small number of Rhode Island counties limits the analysis of prevalence of low- and moderate-income households with OWTSs. At the county level, Rhode Island does not demonstrate the same general trends between household income and OWTS prevalence as the other state examples. The data indicate that of all Rhode Island households connected to an OWTS, only about 9 percent of them earned less than or equal to the state-wide MHI of $61,043. See Table 19 for prevalence of OWTSs and MHI data by county in Rhode Island.

Graph 6 illustrates a slight association between prevalence of OWTS households earning less than or equal to the state MHI, and county MHI. As county MHI increases from low to high, the dashed blue line indicates a slight decrease in prevalence of households with an OWTS.

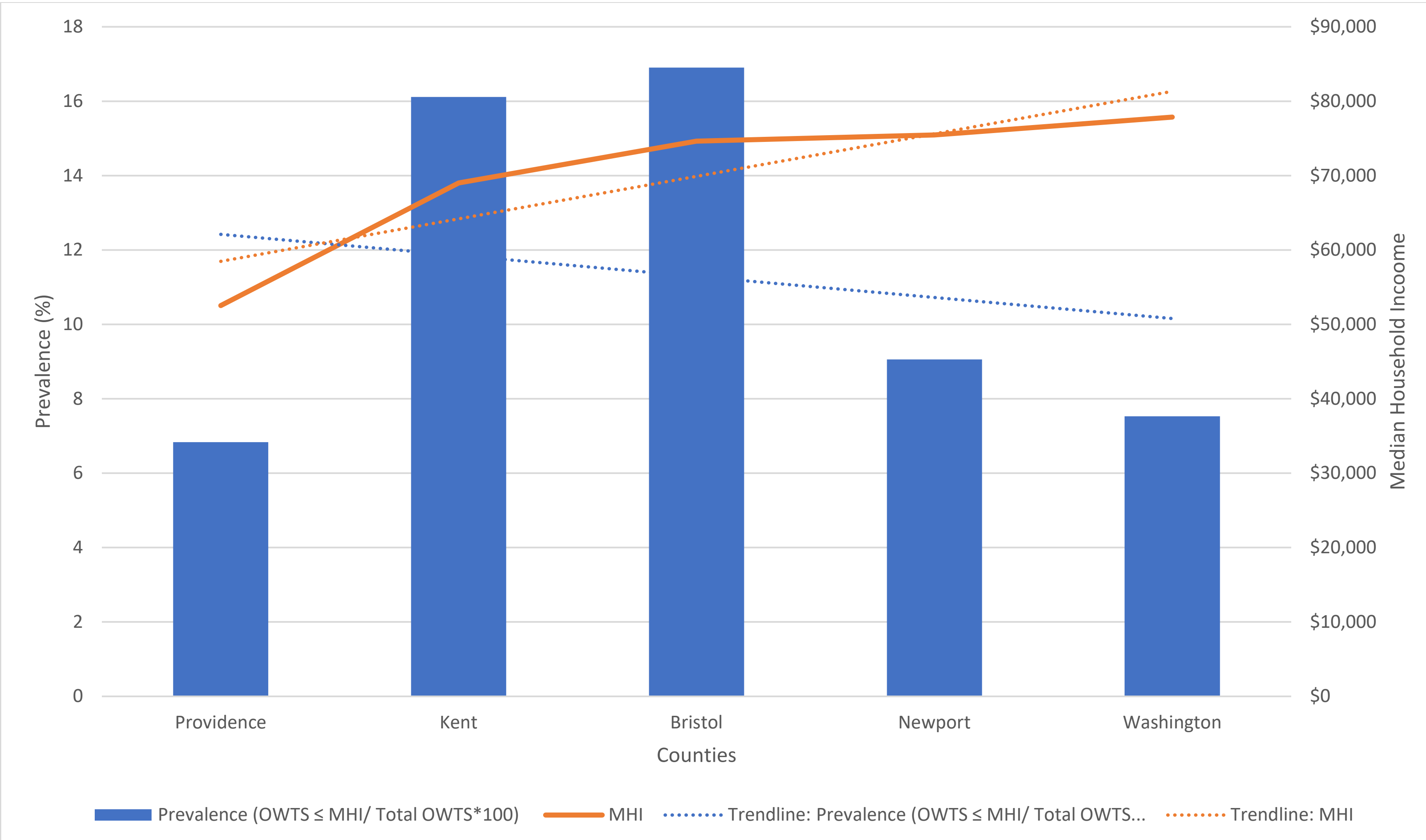
A Spearman rank correlation test was performed to evaluate the relationship between MHI and OWTS prevalence. The test result of $\rho = 0.1$ indicates a minimally positive correlation. Given these results, a definitive determination could not be made between the prevalence of OWTSs and household income for Rhode Island.

The sample size for Rhode Island is much smaller than Florida, thereby limiting the analysis. Graph 6 illustrates a slight negative trend in overall prevalence versus MHI, while the statistical correlation is slightly positive, making it difficult to draw conclusions on Rhode Island for this report.

Rhode Island state and county analyses, maps, and calculations are provided below.

Table 19: The Prevalence of Households with OWTSs ≤ State MHI in Rhode Island by County (2018)

Counties	Total OWTS by County	Total OWTS ≤ MHI	% of OWTS ≤ MHI ([Total OWTS ≤ MHI]/ [Total OWTS]*100)	MHI
Providence	33,867	2,315	6.84	$52,530
Kent	20,381	3,284	16.11	$69,013
Bristol	846	143	16.90	$74,630
Newport	19,590	1,775	9.06	$75,463
Washington	45,571	3,433	7.53	$77,862
State Totals:	**120,255**	**10,950**	**9.11**	**$61,043**



Graph 6: The Prevalence of Households with OWTSs ≤ MHI in Rhode Island by County (2017)

Figure 15: Onsite Wastewater Treatment Systems in Rhode Island & Census Tract Income Data (2017)

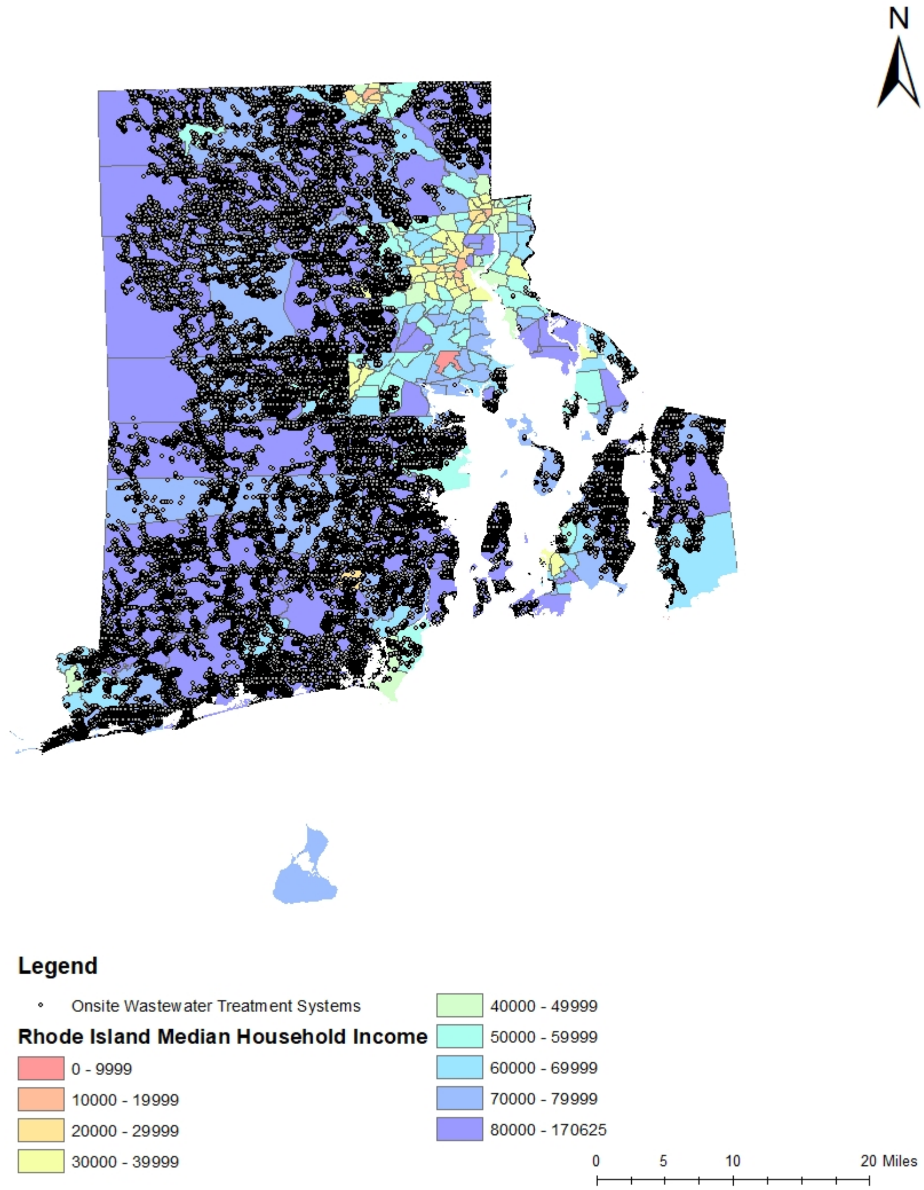


Table 20: The Prevalence of Households ≤ MHI with OWTSs in Rhode Island

Total Mapped OWTS	Total Mapped OWTS ≤ MHI	% of OWTS ≤ MHI ([Total OWTS ≤ MHI]/ [Total Mapped OWTS] *100)	Rhode Island MHI
120,255	10,950	**9.11%**	$61,043

Figure 16: Onsite Wastewater Treatment Systems in Bristol and Newport County & Census Tract Income Data (2017)

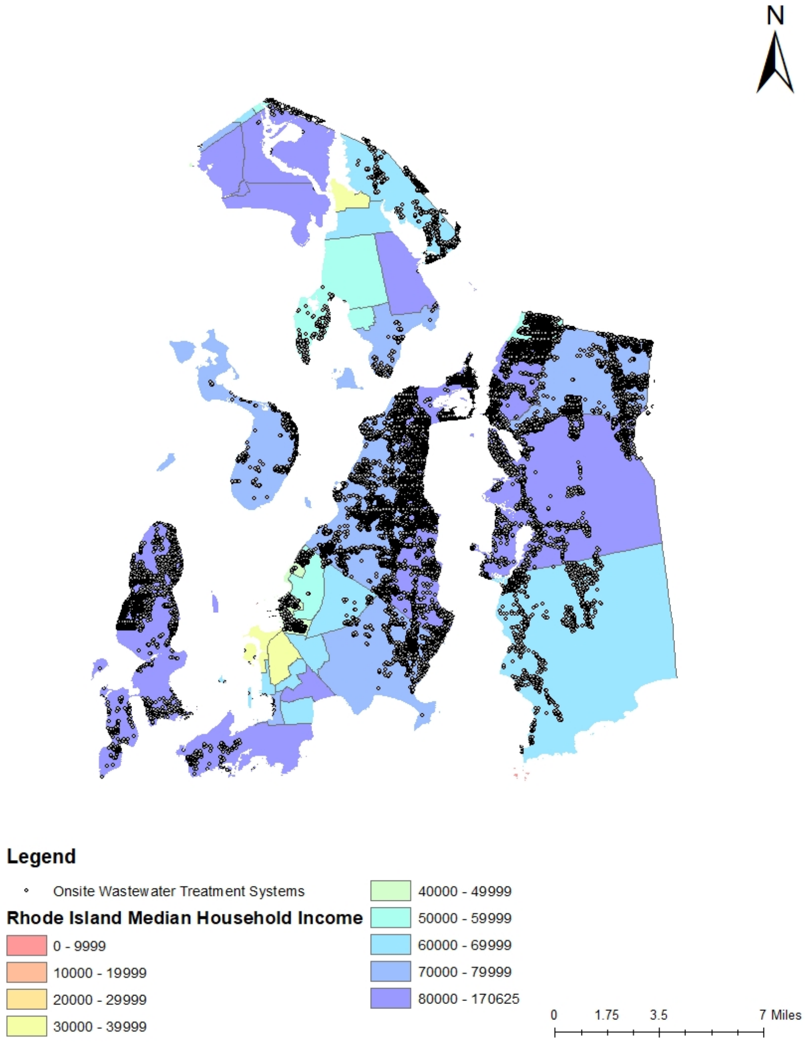


Table 21: The Prevalence of Households ≤ MHI with OWTSs in Bristol County

Total Mapped OWTS	Total Mapped OWTS ≤ MHI	% of OWTS ≤ MHI ([Total OWTS ≤ MHI]/[Total Mapped OWTS] *100)	Bristol County MHI
846	143	**16.9%**	$74,630

Table 22: The Prevalence of Households ≤ MHI with OWTSs in Newport County

Total Mapped OWTS	Total Mapped OWTS ≤ MHI	% of OWTS ≤ MHI ([Total OWTS ≤ MHI]/[Total Mapped OWTS] *100)	Newport County MHI
19,590	1,775	**9.06%**	$75,463

Figure 17: Onsite Wastewater Treatment Systems in Kent County & Census Tract Income Data (2017)

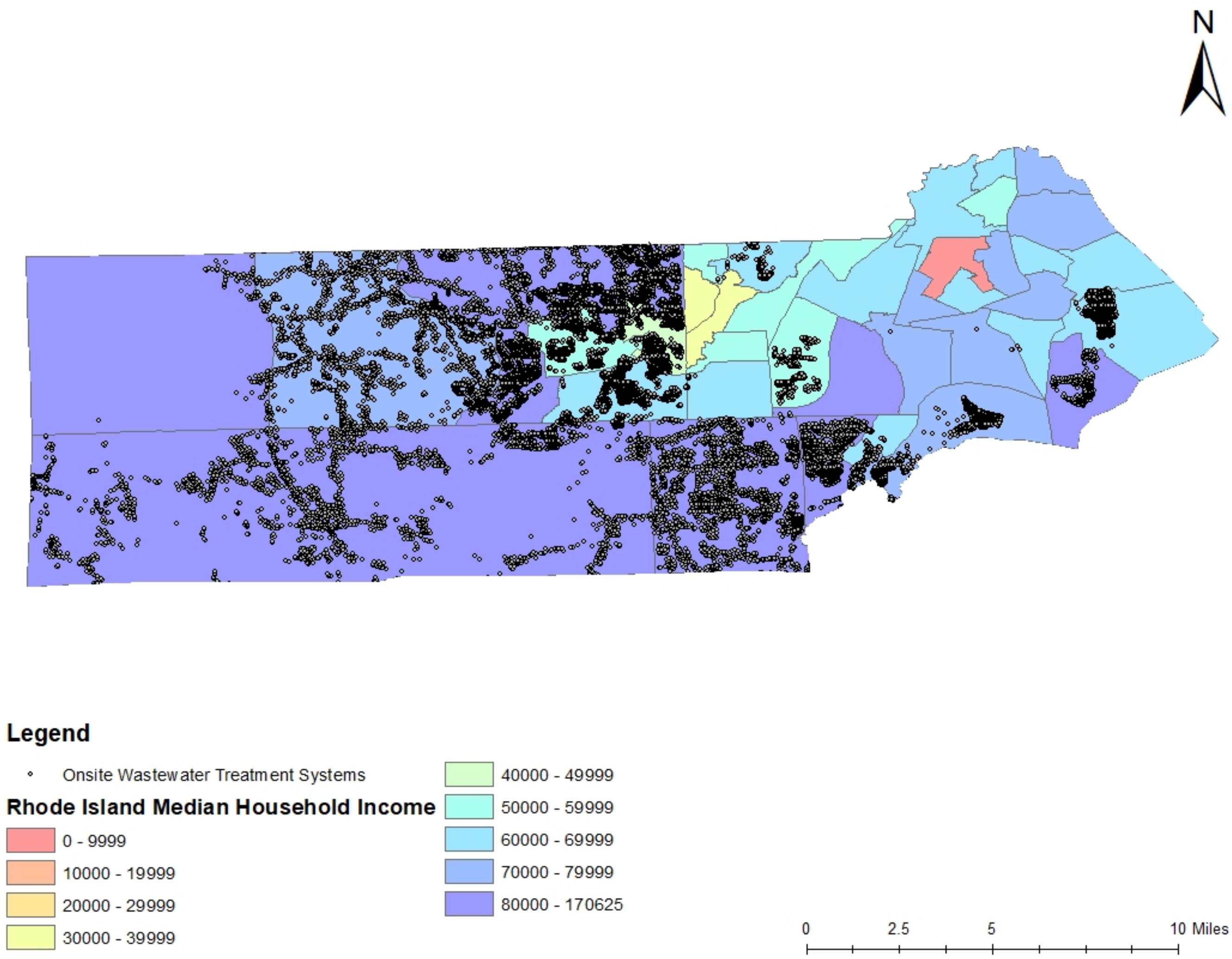


Table 23: The Prevalence of Households ≤ MHI with OWTSs in Kent County

Total Mapped OWTS	Total Mapped OWTS ≤ MHI	% of OWTS ≤ MHI ([Total OWTS ≤ MHI]/ [Total Mapped OWTS] *100)	Kent County MHI
20,381	3,284	**16.11%**	$69,013

Figure 18: Onsite Wastewater Treatment Systems in Providence County & Census Tract Income Data (2017)

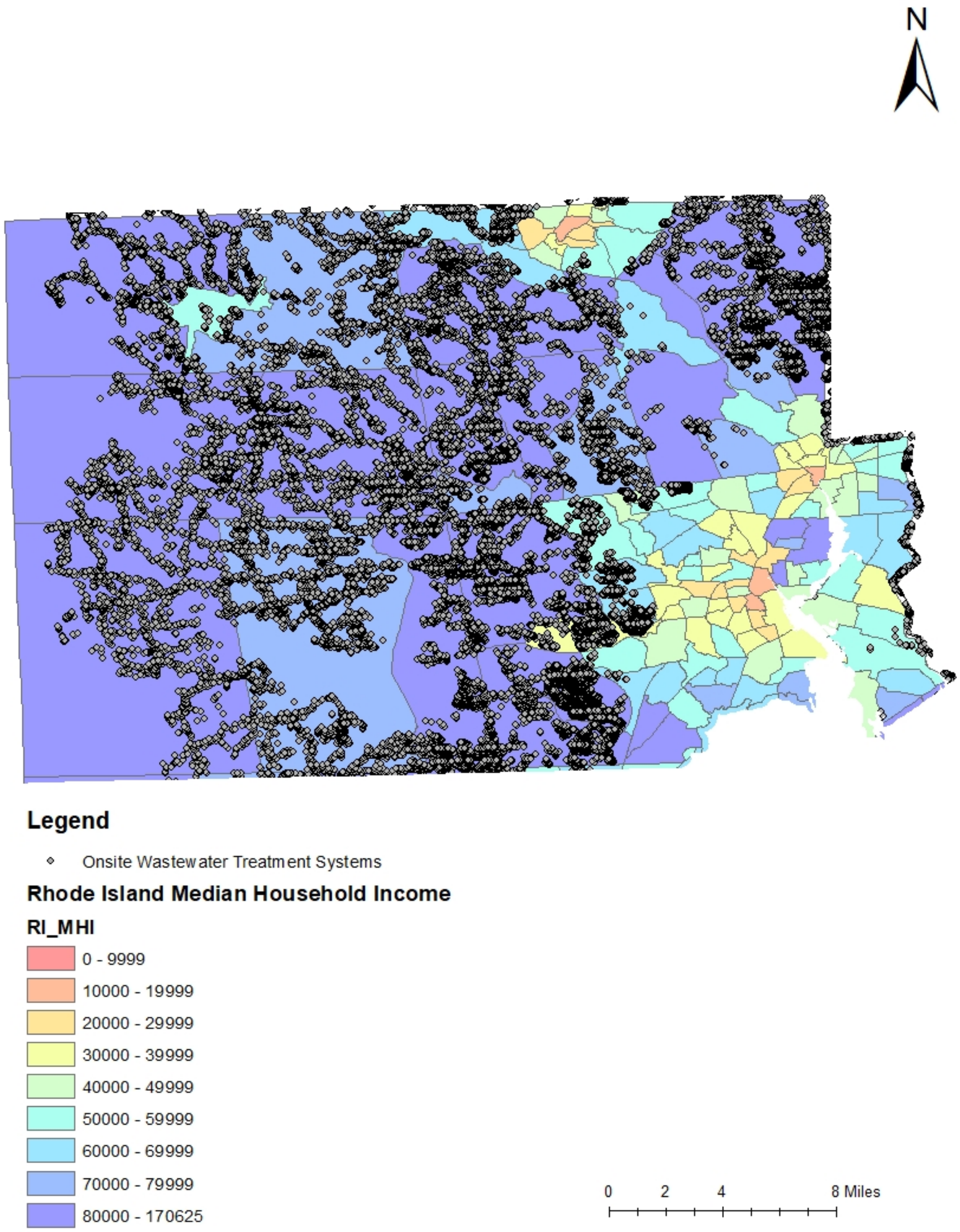


Table 24: The Prevalence of Households ≤ MHI with OWTSs in Providence County

Total Mapped OWTS	Total Mapped OWTS ≤ MHI	% of OWTS ≤ MHI ([Total OWTS ≤ MHI]/ [Total Mapped OWTS] *100)	Providence County MHI
33,867	2,315	**6.84%**	$52,530

Figure 19: Onsite Wastewater Treatment Systems in Washington County & Census Tract Income Data (2017)

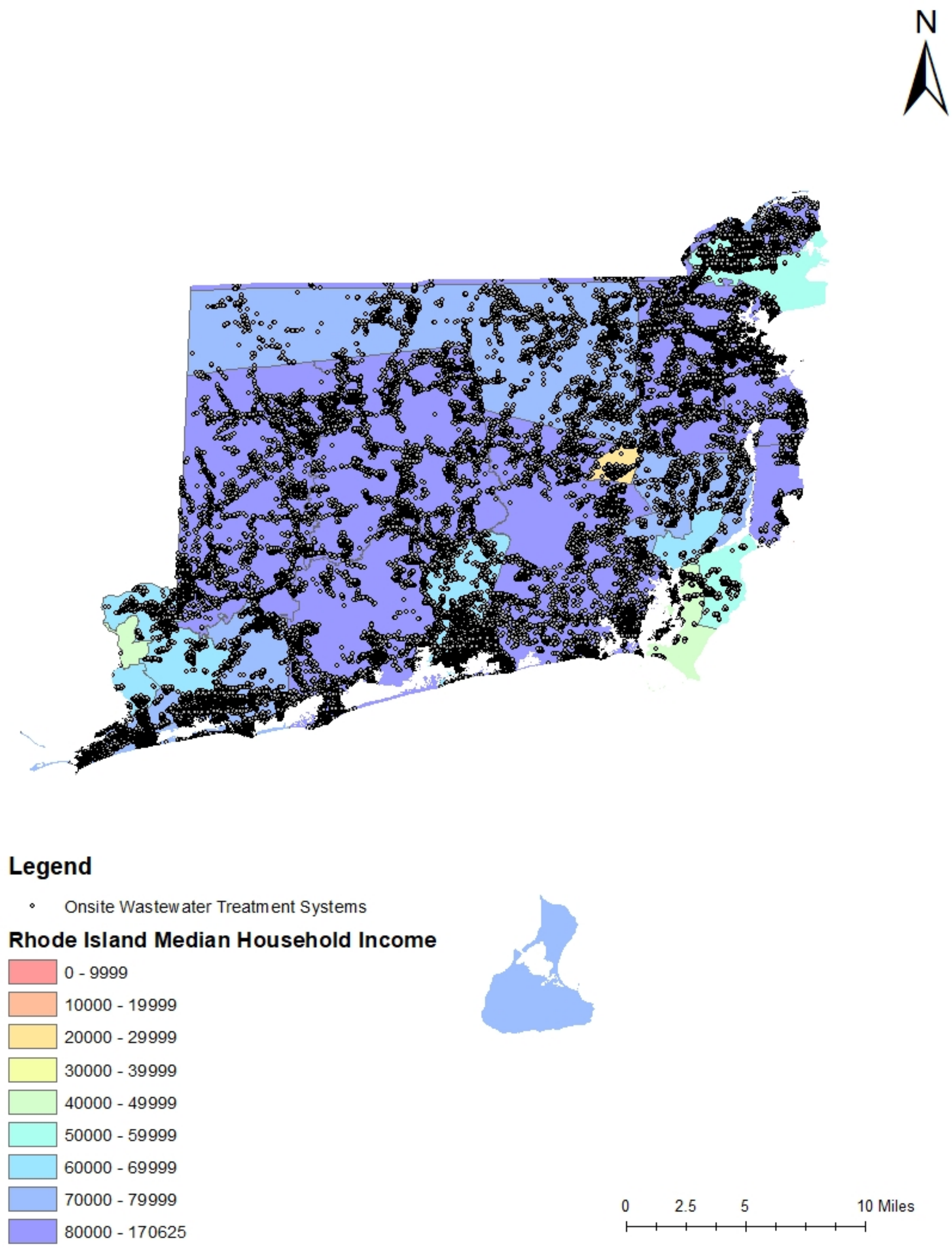


Table 25: The Prevalence of Households ≤ MHI with OWTSs in Washington County

Total Mapped OWTS	Total Mapped OWTS ≤ MHI	% of OWTS ≤ MHI ([Total OWTS ≤ MHI]/ [Total Mapped OWTS] *100)	Washington County MHI
45,571	3,433	**7.53%**	$77,862

Delaware

The Delaware Department of Natural Resources and Environmental Control (DNREC) uses the term "septic systems" when referring to decentralized wastewater systems permitted in their state. The septic system shapefile data (2020) was retrieved from the DNREC. Income data was retrieved from the 2018 ACS five-year estimates where the MHI for Delaware was $65,627 (U.S. Census Bureau, 2018b).

To provide an analysis, all three Delaware counties (*i.e.*, Kent, New Castle, and Sussex) were mapped, and county-wide prevalence was calculated. In 2018, the estimated overall prevalence of households with septic systems that earned less than the Delaware MHI among all households with a septic system was 67.1 percent. The lowest MHI county in Delaware was Kent ($58,775, 79.3 percent) and the highest was New Castle ($70,996, 22.7 percent).

As with Hawaii and Rhode Island, the limited number of Delaware counties make it difficult to find a robust correlation between prevalence of septic systems and income, based on county data alone. Table 26 shows the prevalence of septic systems by county, as well as by county MHI.

The county with the lowest MHI (Kent) also had the highest prevalence of households with a septic system (approximately 80 percent). Sussex County had the second lowest MHI and a slightly lower prevalence, at approximately 70 percent. New Castle County, which has the highest MHI on a county-wide scale, had the lowest prevalence at approximately 23 percent. While difficult to determine state-wide trends from three counties, in general as county MHI increases, households on a septic system and earning less than or equal to the state-wide MHI, decreases.

Graph 7 illustrates the association between the prevalence of households with a septic system earning less than or equal to the state MHI, and county MHI. As county MHI goes from low to high, the dashed blue line indicates the decrease in prevalence of households with a septic system.

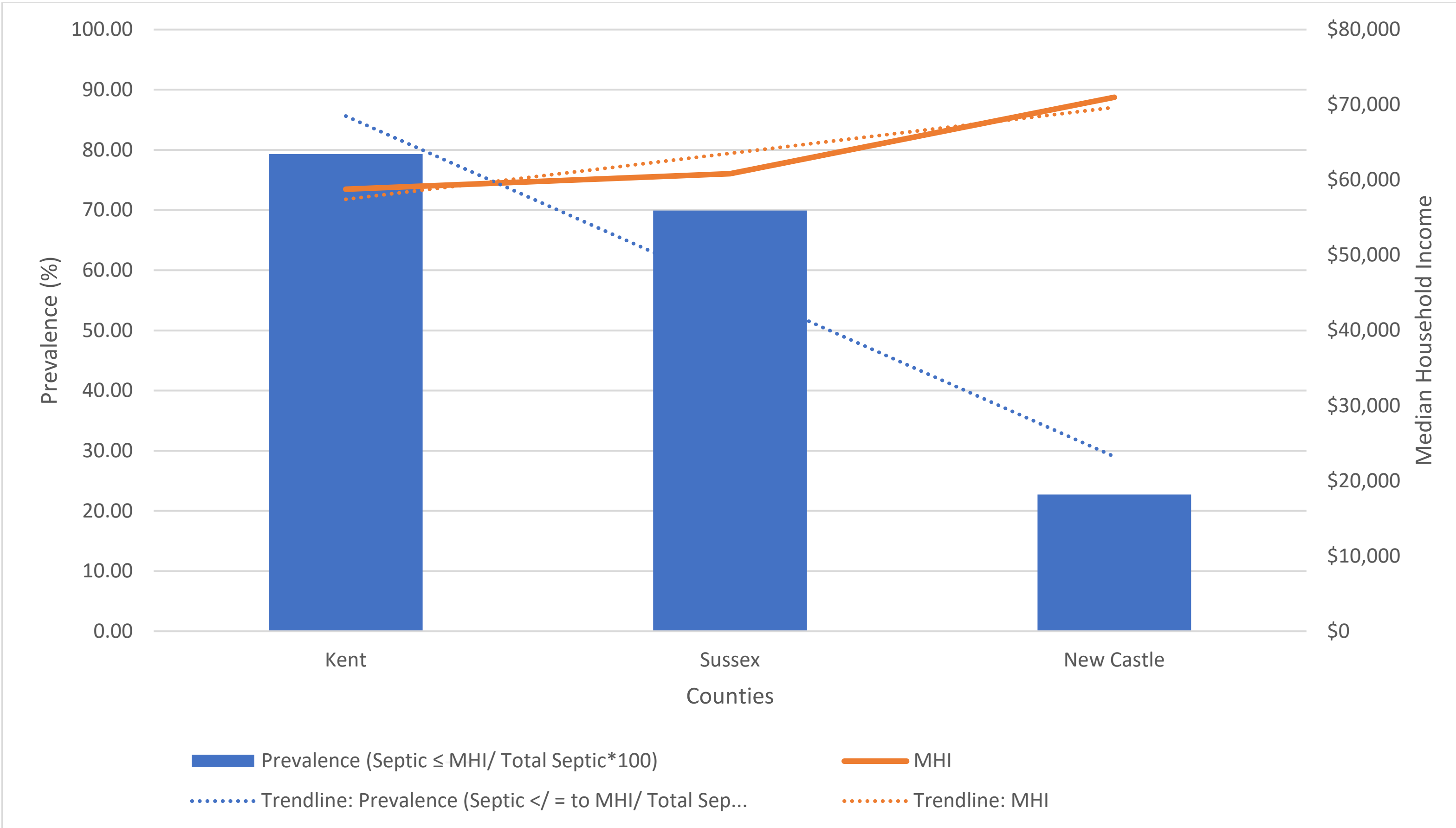
A Spearman rank correlation test was performed to evaluate the relationship between MHI and septic system prevalence. The test result of $\rho = -1$ indicates a total negative correlation. These test results, along with the data presented, suggest a correlation between households with a septic system and MHI at the county level. However, due to the limited sample size of three counties, this trend can only be generalized for purposes of this report.

Delaware state and county analyses, maps, and calculations are below.

Table 26: The Prevalence of Households with Septic Systems ≤ State MHI in Delaware by County (2018)

Counties	Total Septic Systems by County	Total Septic Systems ≤ MHI	% of Septic Systems ≤ MHI ([Total Septic Systems ≤ MHI]/ [Total Septic Systems] *100)	MHI
Kent	29,662	23,529	79.32	$58,775
Sussex	61,663	43,119	69.93	$60,853
New Castle	13,463	3,060	22.73	$70,996
Unnamed County Coordinates[21]	1,674	1,673	-	-
Totals:	**106,462**	**71,381**	**67.05**	**$65,627**

[21] Note on unnamed county coordinates: as with Florida, there were locations identified for septic systems however those "unnamed county coordinates" were missing information such as address or county, thus they are categorized as such and not included in the analysis.



Graph 7: The Prevalence of Households with Septic Systems ≤ MHI in Delaware by County (2017)

Figure 20: Septic Systems in Delaware & Census Tract Income Data (2018)

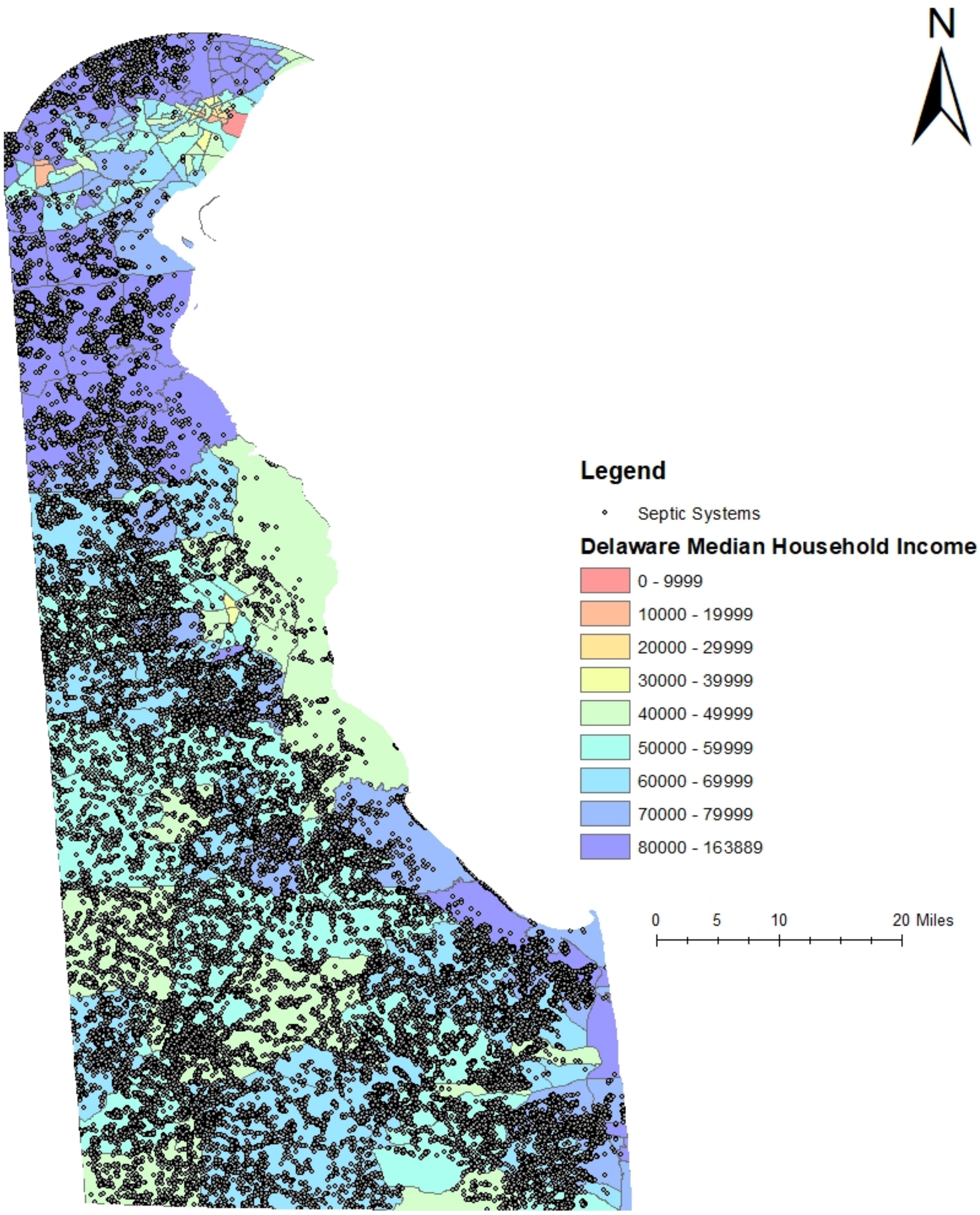


Table 27: The Prevalence of Households ≤ MHI with Septic Systems in Delaware

Total Mapped Septic Systems	Total Mapped Septic Systems ≤ MHI	% of Septic Systems ≤ MHI ([Total Septic Systems ≤ MHI]/ [Total Mapped Septic Systems] *100)	Delaware MHI
106,462	71,381	**67.05%**	$65,627

Figure 21: Septic Systems in Kent County & Census Tract Income Data (2018)

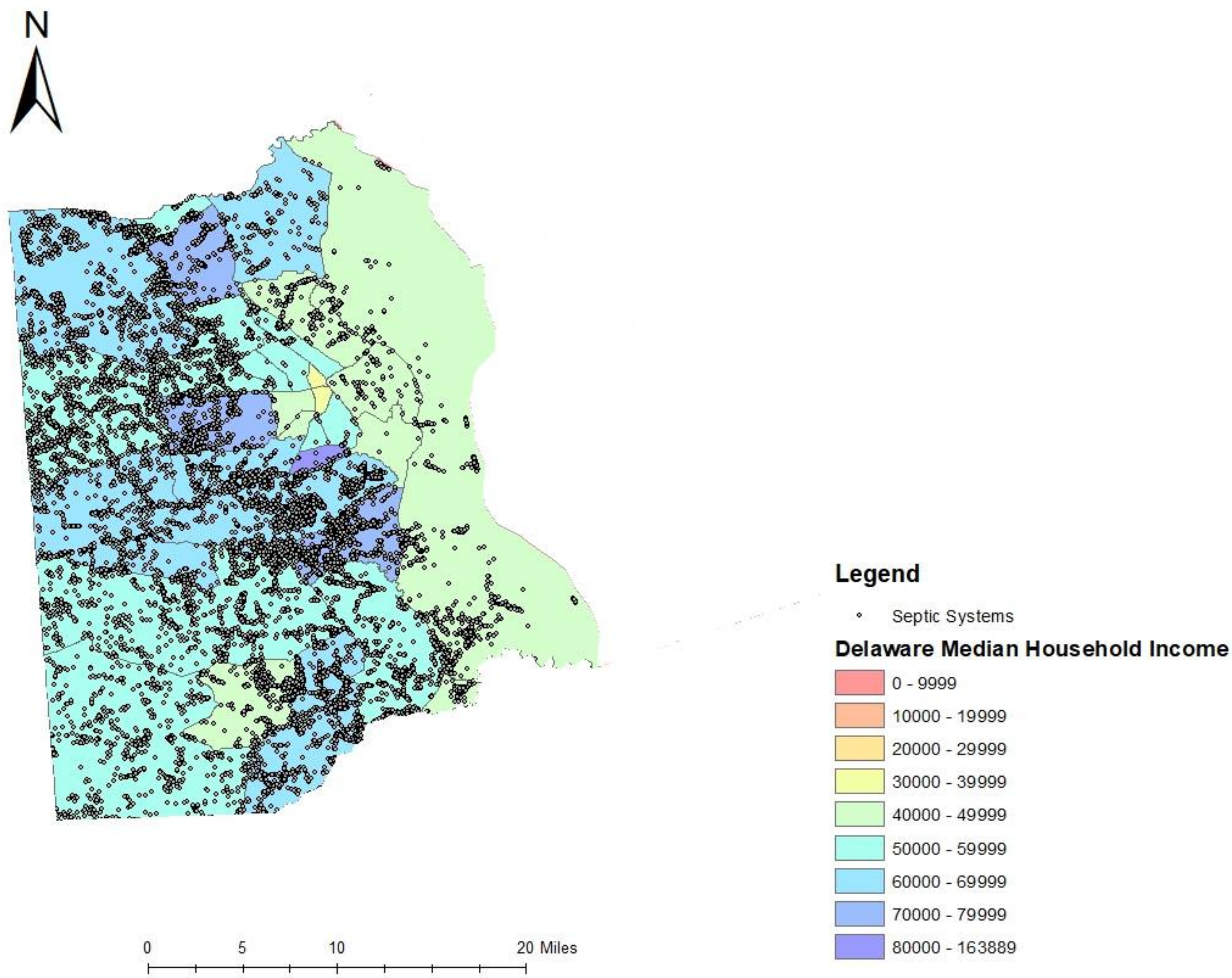


Table 28: The Prevalence of Households ≤ MHI with Septic Systems in Kent County

Total Mapped Septic Systems	Total Mapped Septic Systems ≤ MHI	% of Septic Systems ≤ MHI ([Total Septic Systems ≤ MHI]/ [Total Mapped Septic Systems] *100)	Kent County MHI
29,662	23,529	**79.32%**	$58,775

Figure 22: Septic Systems in New Castle County & Census Tract Income Data (2018)

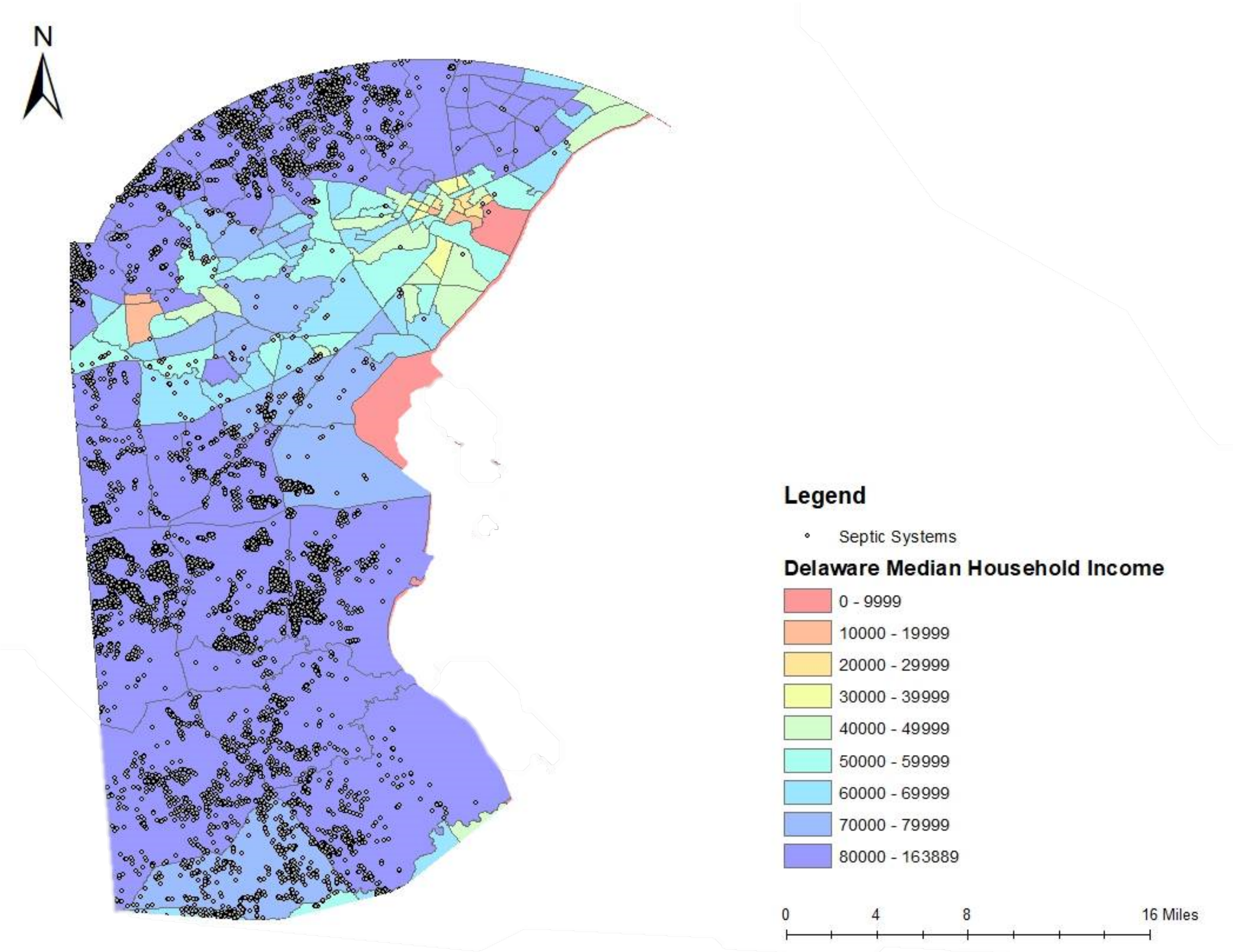


Table 29: The Prevalence of Households ≤ MHI with Septic Systems in New Castle County

Total Mapped Septic Systems	Total Mapped Septic Systems ≤ MHI	% of Septic Systems ≤ MHI ([Total Septic Systems ≤ MHI]/ [Total Mapped Septic Systems] *100)	New Castle County MHI
13,463	3,060	**22.73%**	$70,996

Figure 23: Septic Systems in Sussex County & Census Tract Income Data (2018)

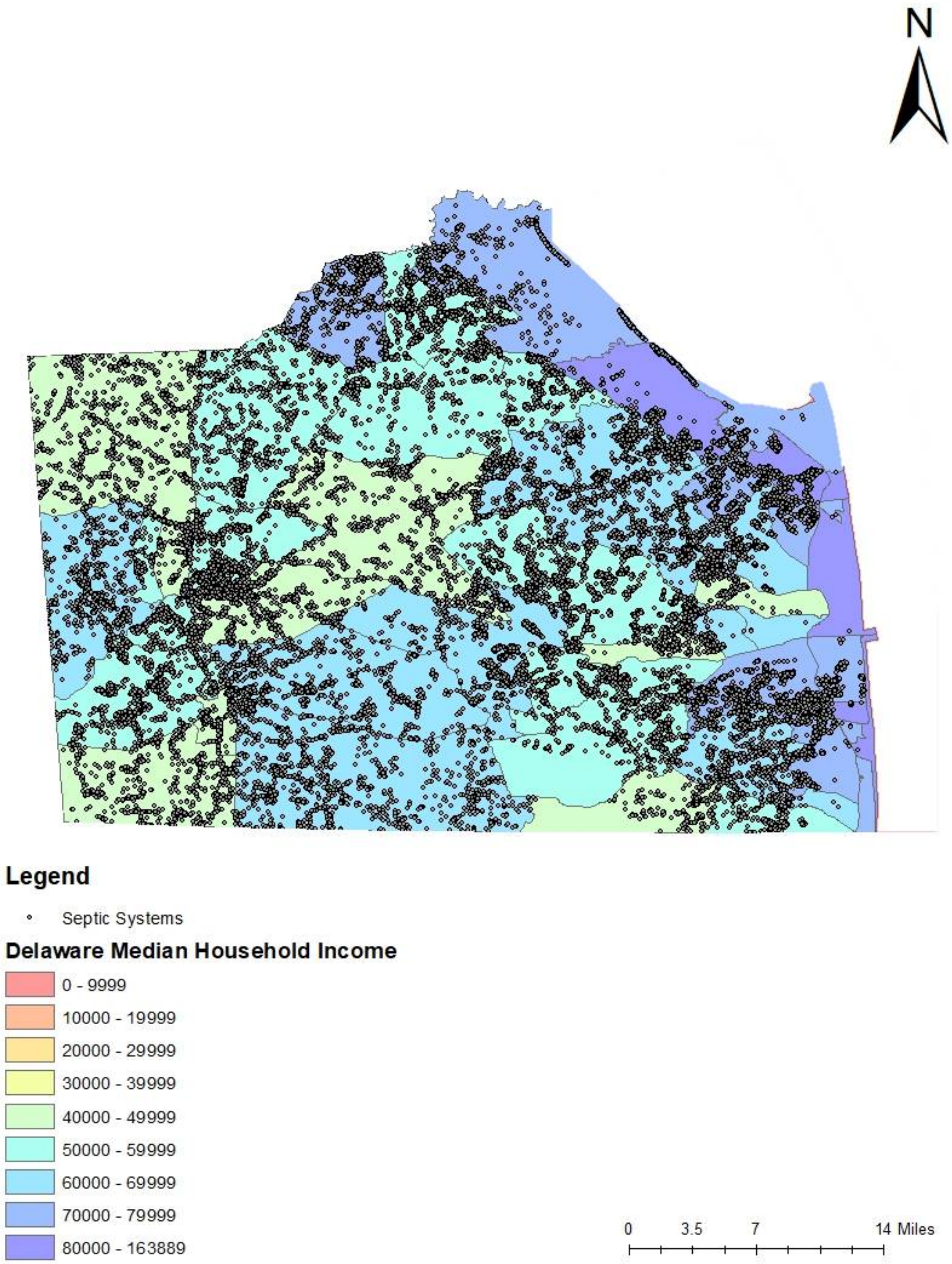


Table 30: The Prevalence of Households ≤ MHI with Septic Systems in Sussex County

Total Mapped Septic Systems	Total Mapped Septic Systems ≤ MHI	% of Septic Systems ≤ MHI ([Total Septic Systems ≤ MHI]/ [Total Mapped Septic Systems] *100)	Sussex County MHI
61,663	43,119	**69.93%**	$60,853

Appendix C

There are two methods to track funding provided by the Clean Water State Revolving Fund (CWSRF) program. The CWSRF National Information Management System (NIMs) is an annual snapshot of all assistance provided for all eligible projects by each CWSRF program. The Clean Water Benefits Reporting (CBR) database tracks projects throughout the year. The data provided below in Table 31 reflect information from both reporting systems to address Part Two of this report to Congress. Table 31 includes data from the 26 states that have used the CWSRF for decentralized wastewater projects.

Table 31: CWSRF Funds Spent on Decentralized Wastewater Projects in the U.S. Since 1988 (cont. across pages below)

State	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Alaska	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
California	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,200,000	$0	$0
Connecticut	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Delaware	$0	$0	$0	$0	$0	$0	$123,498	$199,874	$186,472	$157,740	$33,509	$163,677
Hawaii	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Idaho	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Indiana	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Iowa	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Maine	$0	$0	$0	$0	$0	$0	$0	$0	$214,140	$482,041	$407,016	$235,374
Maryland	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$9,927
Massachusetts	$0	$0	$0	$0	$0	$0	$0	$0	$650,000	$299,807	$1,717,980	$4,072,375
Minnesota	$0	$0	$0	$0	$0	$0	$0	$0	$2,419,133	$5,183,142	$1,790,458	$2,758,867
Missouri	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
New Hampshire	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
New Jersey	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
New Mexico	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
New York	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Ohio	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$19,650	$270,205
Oregon	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pennsylvania	$0	$0	$0	$0	$0	$0	$0	$113,907	$396,129	$614,229	$419,532	$370,304
Texas	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Utah	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Vermont	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Virginia	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$725,600	$909,000
Washington	$0	$0	$188,328	$0	$1,364,030	$22,664	$832,585	$674,554	$71,113	$186,621	$894,648	$139,027
West Virginia	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Total	**$0**	**$0**	**$188,328**	**$0**	**$1,364,030**	**$22,664**	**$956,083**	**$988,335**	**$3,936,987**	**$9,123,580**	**$6,008,393**	**$8,928,756**

State	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Alaska	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
California	$0	$0	$0	$0	$0	$0	$0	$0	$0	$69,574	-$141,875
Connecticut	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Delaware	$423,857	$354,850	$401,758	$370,614	$208,590	$2,648,317	$222,019	$150,363	$90,422	$124,667	$176,741
Hawaii	$0	$0	$0	$0	$0	$0	$1,350,474	$8,908,035	$0	$0	$0
Idaho	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Indiana	$0	$0	$0	$0	$50,000	$0	$0	$0	$0	$0	$0
Iowa	$0	$0	$0	$449,027	$647,069	$749,176	$930,817	$1,020,735	$965,774	$1,169,611	$1,409,902
Maine	$203,370	$0	$0	$21,107	$20,917	$44,917	$36,086	$208,255	$197,606	$300,000	$200,311
Maryland	$50,925	$116,824	$32,724	$45,131	$11,400	$10,000	$57,710	$24,100	$61,980	$39,297	$0
Massachusetts	$899,999	$5,165,574	$9,600,852	$5,593,696	$3,604,502	$5,072,170	$6,306,408	$4,898,498	$3,325,390	$5,835,043	$14,455,382
Minnesota	$2,853,911	$3,850,528	$3,340,195	$3,755,483	$5,650,734	$3,725,411	$4,708,451	$3,186,756	$7,306,266	$2,023,393	$5,596,699
Missouri	$0	$0	$2,941,000	$0	$646,680	$535,600	$318,000	$0	$0	$1,700,000	$4,563,776
New Hampshire	$0	$0	$0	$0	$0	$0	$0	$0	$0	$43,500	$425,000
New Jersey	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
New Mexico	$0	$63,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
New York	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Ohio	$207,663	$37,525	$5,000	$0	$8,600	$7,500	$15,560	$132,910	$104,649	$261,812	$3,434,072
Oregon	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,610,150	$0
Pennsylvania	$2,977,094	$278,749	$332,298	$200,626	$188,974	$285,804	$226,472	$171,666	$200,796	$265,520	$191,196
Texas	$195,000	$295,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
Utah	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Vermont	$0	$0	$0	$0	$150,000	$0	$0	$0	$300,000	$0	$0
Virginia	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Washington	$2,887,492	$418,553	$122,559	$1,100,395	$1,770,519	$289,351	$222,759	$1,928,696	$230,271	$0	$1,573,972
West Virginia	$3,700	$7,848	$0	$0	$0	$0	$0	$0	$95,606	$245,213	$985,476
Annual Total	**$10,703,011**	**$10,588,451**	**$16,776,386**	**$11,536,079**	**$12,957,985**	**$13,368,246**	**$14,394,756**	**$20,630,014**	**$12,878,760**	**$15,687,780**	**$32,870,652**

State	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Alaska	$0	$122,100	$0	$0	$0	$0	$0	$0	$0	$122,100
California	$0	$5,000,000	-$36,083	$0	-$13,694	$0	$0	$0	$0	$7,077,922
Connecticut	$7,653,125	$2,450,000	$0	-$2,219,549	$11,698,278	$0	$0	$0	$0	$19,581,854
Delaware	$97,585	$646,095	$101,981	$291,987	$557,240	$264,366	$334,060	$300,999	$482,238	**$9,113,519**
Hawaii	-$544,262	$0	$0	$116,542	$0	$0	$0	$0	$0	**$9,830,789**
Idaho	$0	$0	$0	$0	$0	$0	$0	$150,000	$0	**$150,000**
Indiana	$0	$0	$1,766,095	$0	$0	$0	$0	$0	$0	**$1,816,095**
Iowa	$1,430,709	$1,697,550	$839,618	$1,034,395	$898,030	$935,237	$868,812	$1,212,829	$915,480	**$17,174,771**
Maine	$56,645	$18,660	$21,507	$38,464	$25,106	$0	$0	$0	$0	**$2,731,522**
Maryland	$0	$42,500	$0	$0	$0	$0	$0	$0	$0	**$502,518**
Massachusetts	$24,522,528	$8,406,241	$9,921,110	$2,950,000	$1,150,000	$1,600,000	$2,500,000	$2,650,000	$3,650,000	**$128,847,555**
Minnesota	$5,609,538	$3,109,840	$4,289,082	$3,153,175	$1,807,863	$2,218,205	$8,747,990	$3,962,472	$4,699,133	**$95,746,725**
Missouri	$0	$1,000,000	$1,000,000	$0	$0	$1,000,000	$0	$0	$15,000	**$13,720,056**
New Hampshire	$0	-$166,961	$0	$0	$0	$0	$0	$0	$0	**$301,539**
New Jersey	$0	$0	$0	$0	$0	$0	$0	$0	$15,073,856	**$15,073,856**
New Mexico	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$63,000**
New York	$0	$0	$402,345	$0	$0	$0	$0	$0	$0	**$402,345**
Ohio	$25,300	$6,020,523	$167,950	$1,938,000	-$46,025	$13,964,904	$13,122,367	$13,334,381	$10,194,000	**$63,226,546**
Oregon	$0	$0	$0	$0	$0	$250,000	$0	$0	$0	**$3,860,150**
Pennsylvania	$350,000	$0	$322,786	$113,063	$365,891	$368,287	$803,815	$1,208,818	$1,871,908	**$12,637,864**
Texas	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$490,000**
Utah	$0	$0	$0	$469,000	$0	$0	$0	$0	$0	**$469,000**
Vermont	$0	$155,507	$54,696	$0	-$41,668	$0	$0	$425,759	-$74,272	**$970,022**
Virginia	$250,000	$664,984	$0	$0	$0	$200,000	$0	$7,102,800	$0	**$9,852,384**
Washington	$1,852,028	$1,733,887	$155,818	$493,943	-$180,919	$9,416,836	$47,847	$7,500,031	$6,177,262	**$42,114,870**
West Virginia	$877,898	$1,471,638	$194,945	$4,579,332	$279,593	$447,226	$2,832,611	$234,098	$1,131,148	**$13,386,332**
Annual Total	**$42,181,094**	**$32,372,564**	**$19,201,850**	**$12,958,352**	**$16,499,695**	**$30,665,061**	**$29,257,502**	**$38,082,187**	**$44,135,753**	**$469,263,334**

References

America's Water Infrastructure Act, S. 3021. (2018). *Public Law 115 – 270. 115th Congress.* §4107(b). https://www.congress.gov/115/bills/s3021/BILLS-115s3021enr.pdf

Clifford, S. (2017). *Health board: Septic law will help plug data holes*. Brown County Democrat. http://www.bcdemocrat.com/2017/03/29/health_board_septic_law_will_help_plug_data_holes/

Delaware Division of Water Department of Natural Resources and Environmental Control. (2016). Permitted Septic Systems: Delaware Open Data Portal. Accessed from https://data.delaware.gov/Energy-and-Environment/Permitted-Septic-Systems/mv7j-tx3u

Eggers, Frederick J. and Thackeray, Alexander. (2007). *32 Years of Housing Data*. Prepared for U.S. Department of Housing and Urban Development Office of Policy Development and Research. https://www.huduser.gov/datasets/ahs/ahs_taskc.pdf.

Environmental Protection Agency. (2018). *Justification for Requested Revision, Addition or Deletion to Questions on the American Community Survey (ACS).* FOIA Online. https://foiaonline.gov/foiaonline/action/public/submissionDetails?trackingNumber=EPA-HQ-2018-010667&type=request

Florida Department of Health. (2016). *Florida Water Management Inventory Project.* http://www.floridahealth.gov/environmental-health/onsite-sewage/research/flwmi/index.html

Fontenot, Kayla, Jessica Semega, and Melissa Kollar. (2018). *Income and Poverty in the United States: 2017*. U.S. Census Bureau. https://www.census.gov/content/dam/Census/library/publications/2018/demo/p60-263.pdf

Hawaii State Department of Health. (2017). *On-site Sewage Disposal Systems - Hawaii Island*. Hawaii Statewide GIS Program. https://geoportal.hawaii.gov/datasets/on-site-sewage-disposal-systems-hawaii-island

Hawaii State Department of Health. (2017). *On-site Sewage Disposal Systems - Molokai*. Hawaii Statewide GIS Program. https://geoportal.hawaii.gov/datasets/d5dd71c0b4b0444080b2eadff3edbf77_23

Hawaii State Department of Health. (2017). *On-site Sewage Disposal Systems – Kauai.* Hawaii Statewide GIS Program. https://geoportal.hawaii.gov/datasets/e6c595f44c004763a85106ecadf43b51_25

Hawaii State Department of Health. (2017). On-site Sewage Disposal Systems - Maui. Hawaii Statewide GIS Program. https://geoportal.hawaii.gov/datasets/108b8d29611a4a5e8bed2f7c658ddf68_24

Hawaii State Department of Health. (2017). *On-site Sewage Disposal Systems - Oahu*. Hawaii Statewide GIS Program. https://geoportal.hawaii.gov/datasets/3d638ed89da245949de574c02b5dc911_22

Michigan Department of Environmental Quality. (2016). *Sustaining Michigan's Water Heritage: A Strategy for the Next Generation*. https://www.michigan.gov/documents/deq/deq-ogl-waterstrategy_538161_7.pdf

Narragansett Bay Estuary Program. (2017). *State of Narragansett Bay and Its Watershed 2017 Technical Report.* Ch 7 Wastewater Infrastructure, p 147-165. http://nbep.org/01/wp-content/uploads/2017/03/Chapter-7-Wastewater-Infrastructure.pdf

Puerto Rico Aqueduct and Sewer Authority (PRASA). (2020). *2020 Fiscal Plan for PRASA: Transforming PR's Water and Wastewater System FY 2021 – 2025*. https://www.aafaf.pr.gov/wp-content/uploads/2020-Fiscal-Plan-for-PRASA-as-Certified-by-FOMB-on-June-29-2020.pdf.

Rhode Island Department of Environmental Management. (2009). *Rules Establishing Minimum Standards Relating to Location, Design, Construction and Maintenance of Onsite Wastewater Treatment Systems.* http://www.dem.ri.gov/pubs/regs/regs/water/owts09.pdf

Robinson, C. (2018) *Septic System Data Collection and Management in Minnesota. Minnesota Pollution Control Agency.* Webinar, accessed from https://www.epa.gov/sites/production/files/2018-09/documents/epa_webinar_mn_data_management.pdf.

Schwartz, M. (2007). *2007 American Community Survey: A Comparison to Selected Housing and Financial Characteristics for the United States from the 2007 American Housing Survey.* https://www.huduser.gov/portal/datasets/ahs/ACS-AHSComparisonReport.pdf

Tennessee Department of Environment and Conservation (2017). *TDEC Digitizes Septic System Files in Hawkins and Johnson Counties.* https://www.tn.gov/environment/news/2017/7/31/news-tdec-digitizes-septic-system-files-in-hawkins-and-johnson-counties.html

U.S. Census Bureau. (2014). *American Community Survey: Handbook of Questions and Current Federal Uses.* https://www.census.gov/content/dam/Census/programs-surveys/acs/operations-and-administration/2014-content-review/ACS_Federal_Uses.pdf

U.S. Census Bureau. (2016a). *ACS 2016 (5-Year Estimates), Social Explorer*. Available from https://www.socialexplorer.com/data/ACS2016_5yr/metadata/?ds=SE.

U.S. Census Bureau. (2016b). *American Community Survey: Median Income in the Past 12 Months (In 2016 Inflation-Adjusted Dollars).* Available from https://data.census.gov/cedsci/table?q=median%20household%20income&t=Household%20and%20Family%3AIncome%20and%20Earnings&tid=ACSST1Y2016.S1901&hidePreview=false

U.S. Census Bureau (2016c). *Characteristics of New Housing: Survey of Construction Microdata Files.* https://www.census.gov/construction/chars/microdata.html#:~:text=Houses%20for%20which%20construction%20was,of%20areas%20not%20requiring%20permits.

U.S. Census Bureau. (2017a). *ACS 2017 (5-Year Estimates), Social Explorer*. Available from https://www.socialexplorer.com/data/ACS2017_5yr/metadata/?ds=SE.

U.S. Census Bureau. (2017b). *American Community Survey: Median Income in the Past 12 Months (In 2017 Inflation-Adjusted Dollars).* Available from https://data.census.gov/cedsci/table?q=median%20household%20income&t=Household%20and%20Family%3AIncome%20and%20Earnings&tid=ACSST1Y2017.S1901&hidePreview=false

U.S. Census Bureau. (2017c). *American Housing Survey Table Creator: Plumbing, Water, and Sewage Disposal.* Available from https://www.census.gov/programs-surveys/ahs/data/interactive/ahstablecreator.html?s_areas=00000&s_year=2017&s_tablename=TABLE4&s_bygroup1=1&s_bygroup2=1&s_filtergroup1=1&s_filtergroup2=1

U.S. Census Bureau. (2018a). *2015 AHS Integrated National Sample: Sample Design, Weighting, and Error Estimation.* https://www2.census.gov/programs-surveys/ahs/2015/2015%20AHS%20National%20Sample%20Design,%20Weighting,%20and%20Error%20Estimation.pdf

U.S. Census Bureau. (2018b). *ACS 2018 (5-Year Estimates), Social Explorer*. Available from https://www.socialexplorer.com/data/ACS2018_5yr/metadata/?ds=SE.

U.S. Census Bureau. (2018c). *American Community Survey: Median Income in the Past 12 Months (In 2018 Inflation-Adjusted Dollars).* Available from https://data.census.gov/cedsci/table?q=median%20household%20income&t=Household%20and%20Family%3AIncome%20and%20Earnings&tid=ACSST1Y2018.S1901&hidePreview=false

U.S. Census Bureau. (2020). *Mapping Files: TIGER/Line Shapefiles*. https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html