Data Description

CITATION

Title Statement

Title: Puget Sound Wastewater Service Affordability Analysis Data Collection

Production Statement

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PROJECT DESCRIPTION

Subject Information

Topic Classification(s): sewer service costs, water utility affordability, Puget Sound National Estuary Program

Abstract

This data collection was compiled in support of Puget Sound National Estuary Program planning efforts related to the Marine Water Quality Implementation Strategy. The strategy identifies current funding levels as a barrier to compliance with a Puget Sound Nutrient General Permit (PSNGP) issued by the Washington Department of Ecology (2021a). Capital costs associated with adding advanced nutrient removal technologies to all municipal wastewater

treatment plants (WWTPs) subject to the PSNGP are likely to exceed $2 billion, based on a preliminary economic evaluation of potential nutrient limits by the Department of Ecology and Tetra Tech (2011) escalated to 2022 dollars. Local wastewater service providers have expressed concerns about the impact of costly upgrades on their ratepayers, and previous research identified existing water utility service affordability challenges in the Puget Sound region (Kinney et al. 2021). Since nutrient reduction upgrades have the potential to exacerbate affordability challenges, additional data collection/analysis was recommended. This data collection includes 4 data files plus this data description. Methodology, data sources, and metadata for each file can be found in the file-by-file description section. This data collection was developed as part of an affordability analysis conducted in three steps.

First, we compiled three types of raw data: (1) U.S. Census Bureau American Community Survey (ACS) population, median household income (MHI), and household income by quintile data for individual census tracts located within the Puget Sound region's 12 counties; (2) spatial data on service area boundaries for local wastewater service providers[1] impacted by the PSNGP; and (3) rate schedules for those utilities.

Next, we processed the raw data to obtain numerators (annual household sewer service cost per utility) and denominators (annual household income for households within the utilities' service area) needed for calculation of the affordability indices. Household income within the utilities' service area was estimated by corresponding the ACS census tracts to cities or utility service areas by joining tabular income and household data to polygon data via GIS. Then average household-weighted Lowest Quintile Income (LQI) was estimated for each city or service area. Rate data was used to estimate annual cost of sewer service for single family residential households assuming 5.5 centum cubic feet (ccf) of water usage per month.

The last step was calculating two affordability indices for each utility by dividing their annual sewer service cost by estimated LQI and MHI within their service area. The affordability indices were compared to U.S. Environmental Protection Agency (EPA) benchmarks. Past EPA (2014) guidance suggested that wastewater costs exceeding 2% MHI have, at the utility level, a high impact on residents. Newer guidance instead uses 2% LQI as a threshold to better reflect affordability impacts at the household level (Teodoro 2018, EPA 2022).

Of the 80 utilities included in the analysis, 71 (89%) had annual service costs exceeding 2% of LQI and 4 (5%) had costs exceeding 2% of MHI. We also estimated how the affordability indices might change when upgrades required by the PSNGP are completed. Ecology and Tetra Tech (2011) estimated monthly costs to ratepayers associated with four different potential regulatory requirements nutrient removal. We escalated those estimates to 2022 dollars and added estimates for the least and most stringent nutrient limits to existing service costs. The number of utilities with affordability $index_{MHI}$ >2% increased from 4 to 8 (10%) with a seasonal 8 mg/L nitrogen discharge limit and 18 (23%) with a year-round 3mg/L nitrogen discharge limit.

Funding Source

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement CE-01J97401 to the Puget Sound Partnership. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

[1] Wastewater/sewage services in the region are administered by a mix of county or municipal governments, Special Purpose Districts, Public Utility Districts, and Interlocal Agreements. For simplicity, we call all these different types of service providers sewer utilities. Some of these utilities operate WWTPs and are directly impacted by the PSNGP. They may or may not bill individual households. Other utilities are indirectly affected due to their relationship as a wholesale customer of a permittee. These utilities own and operate independent collection systems (e.g., pipelines and pump stations) within their service area to convey wastewater to larger regional systems for treatment and disposal. Households in these areas are billed by their local utility. The amount they pay includes wholesale charges set by the regional treatment provider plus the amount needed to operate and maintain their local collection system.

Data Collection Summary

Time Period:	2022 for wastewater rate data, 2015-2019 for population and income data
Date of Collection:	2022
Country:	United States
Geographic Coverage:	12-county Puget Sound, WA region
Geographic Units:	utility service area, city, census tract
Primary Unit of Analysis:	U.S. dollars
Kind of Data:	– Wastewater service rate schedules for 80 wastewater providers/utilities – Population, household size, and household income by quintile for 961 census tracts – Median Household Income (MHI) for 961 census tracts – Correspondence between 745 census tracts and 80 utilities – Calculated annual service costs for 80 utilities – Calculated Lowest Quintile Income (LQI) and MHI for 80 utility service areas – Calculated affordability index$_{MHI}$ for 80 wastewater providers – Calculated affordability index$_{LQI}$ for 80 wastewater providers

DATA ACCESS

Dataset Availability

Location:	ResearchWorks (University of Washington Libraries)
Number of files:	1 Microsoft ACCESS database 3 Microsoft Excel files 1 data description (this document)

Data Use Statement

Citation Requirement:	Publications based on this data should include acknowledgement by means of bibliographic citations in the footnotes or a reference section. The bibliographic citation for this data collection is: Barber, A., K. Bogue, S. Burke, N. Jo, and A. Kinney. 2022. Puget Sound Wastewater Service Affordability Data Collection [Data files]. 1st Version. Prepared by ECO Resources Group; Puget Sound Institute, University of Washington Tacoma; College of Business and Economics, Western Washington University. Distributed by ResearchWorks, University of Washington Libraries.
Disclaimer:	The original collectors of this data, ResearchWorks, and the relevant funding agencies bear no responsibility for uses of this collection or for interpretation or inferences based on such uses.

FILE ORGANIZATION

Microsoft ACCESS was used to manage the American Community Survey data, information about service providers impacted by the PSNGP, and results of the GIS analysis to correspond census tracts with utility service areas. The ACCESS database includes 7 tables:

1. American Community Survey (ACS) Data Codes
2. Census Tract
3. Census Tract and ACS Data
4. Census Tract District Correspondence
5. Income and Population by County
6. Utility Districts
7. Wastewater Treatment Plants

Microsoft Excel was used to store the rate data, calculate estimated annual service cost for each utility, calculate LQI and MHI estimates for each utility (utilizing data from the ACCESS database), calculate the affordability indices, and visualize results. Three Excel spreadsheets are included in this data collection:

1. Monthly Wastewater Rates
2. ACS Income Population Data (Denominators)
3. Indices MHI LQI and Scatter Plots

DATA LIMITATIONS

This analysis compares service costs for 80 utilities to established affordability benchmarks. The geographic scale of this evaluation is broader than analyses an individual utility would undertake for rate setting or financial capability assessment. For example, a statistically valid income survey for the purpose of a funding assistance request requires household surveys conducted via telephone, mail, and/or door-to-door methods (Washington State Infrastructure Assistance Coordinating Council 2019). Our results represent a snapshot in time and are intended to inform development of a regional-scale funding strategy. Here we provide a description of potential sources of error that should be considered when using this data and/or our analysis results.

- Not all Puget Sound region households are included in the study. PSNGP-impacted utilities discharge directly to Puget Sound marine waters. WWTPs that discharge to rivers (upstream of Ecology estuarine monitoring stations) are not included. Likewise, rural areas served by on-site sewage systems (septic) and utilities that discharge via injection wells/groundwater recharge are not included.
- Multifamily households were excluded from the analysis due to the differences in the ways utilities and building managers sub-meter and bill individual units. This may skew income estimates in geographies with a large number of multifamily households, potentially overstating the financial impact of high sewer bills
- Processing of spatial data to correspond census tracts with utility service areas required several assumptions that may skew LQI and MHI estimates and reduce confidence in estimates of population served by each utility. These assumptions were necessary because of three data limitations:
    - Census tract boundaries and sewer service areas/city boundaries do not align. This data limitation is unavoidable because census tracts are the unit needed to obtain household income by quintile data. Figure 1 provides an example of this problem by illustrating where census tract boundaries are located relative to the approximate service area of the Silver Lake Water and Sewer District in Snohomish County. Some tracts are completely inside the service area while others are only partially within the service area.

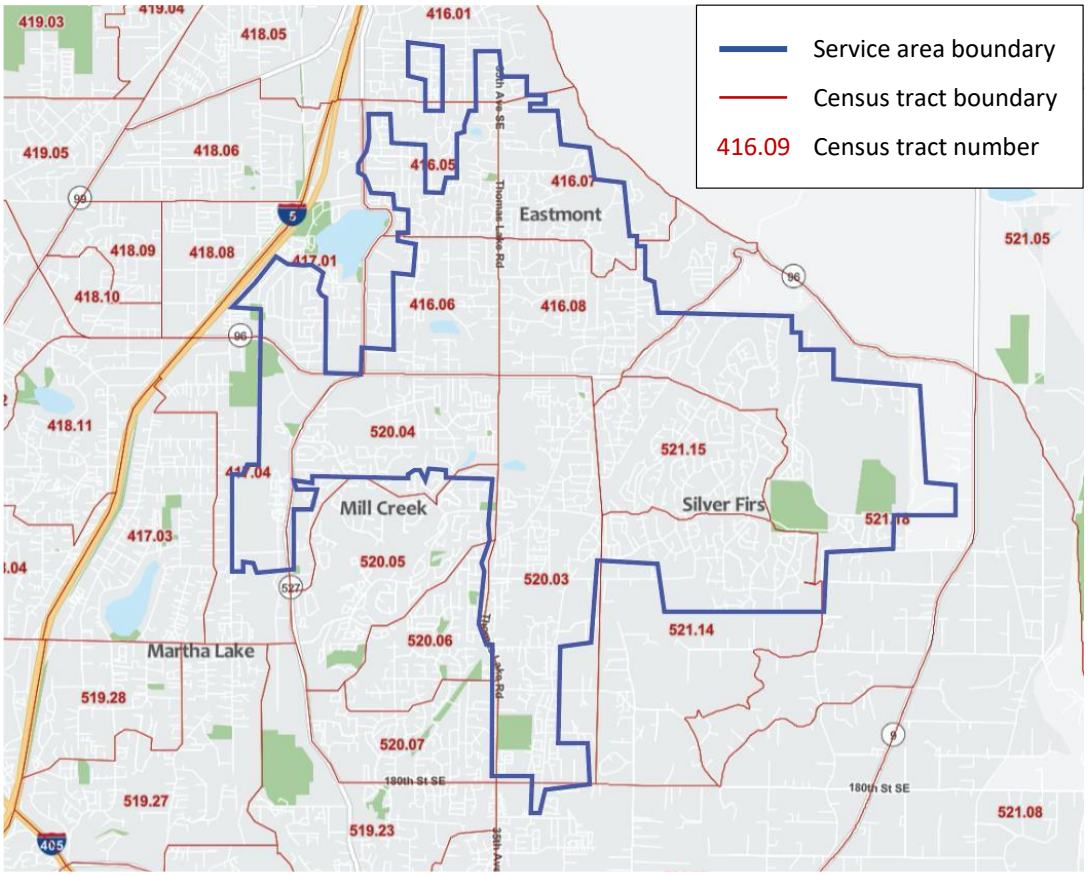
We tested the impact of this issue before deciding on a correspondence method by estimating 1st quintile mean income and MHI in two ways. For Procedure 1, we selected census tracts with approximately 50% or more of their geographic area inside the service area boundary (n=8). For Procedure 2, we selected all census tracts contained in or with boundaries intersecting the service area (n=12). Procedure 2 is the method we ultimately used for the correspondence. Results of this test are provided in Table 1 and indicate that including peripheral census tracts did not introduce significant error to the income estimate. We cannot extrapolate these results to indicate the direction/magnitude of error for each of the 80 utilities included in this analysis but are confident that it is not large nor consistent enough to skew overall affordability index results.

- We obtained digitized shapefiles for 30 utility service areas; these utilities are administered by Special Purpose Districts, Public Utility Districts, or Interlocal Agreements. The remaining 50 utilities included in the analysis are administered by municipalities. We used city boundaries as a proxy for their wastewater service area, even though those boundaries may not always align. For example, a recently annexed area may not yet be connected to the municipal system or unincorporated areas within a municipality's Urban Growth Area may already be connected to their system. See related bullet below.
- Households that use on-site sewage treatment (septic systems) but are located within the service area boundaries of a wastewater utility were not excluded from the population-weighted income estimates. Figure 2 provides an example of this problem by illustrating the number of properties using septic systems within LOTT's service area (Lacey, Olympia, Tumwater, Thurston County). If there is a consistent relationship between household income and on-site versus off-site wastewater treatment, this could skew income estimates in geographies where there are a large number of septic properties interspersed with sewered properties.

- Our 5.5 ccf/month (4,114 gallons) water usage assumption does not explicitly include consideration of household size and seasonal variation. We decided to calculate service costs based on a standardized usage, rather that collecting data on actual usage or bill data, so that cost estimates were normalized to enable direct comparison.
  - The 5.5 ccf/month volume assumption is based on a commonly applied estimate of average winter quarter usage in the region (D. Thompson, City of Tacoma Wastewater Operations Division Manager, pers. comm.). Using a rainy season average excludes outdoor/irrigation use thereby more closely approximating the generally accepted "basic use" estimate of 50 gallons per capita per day (gpcd).[2]
  - Several utilities contacted to verify our service cost calculations responded that their actual annual average household usage volume was higher than 5.5 ccf/month. This results in a conservative cost estimate that may understate the financial impact of high sewer bills.
- Some service providers incorporate state and local utility taxes into their rates, and some do not. We used published rates and did not account for inclusion/exclusion of taxes. This results in a conservative cost estimate that may understate the financial impact of high sewer bills.

[2] See Teodoro (2018) for a discussion of the origins of this estimate for nondiscretionary (drinking, cooking, health, sanitation) indoor water needs. Basic use consumption is significantly less than average consumption and a conservative level of service suitable for evaluating affordability across multiple utilities (Teodoro 2018). 4,114 gallons/month represents basic use for a 2.7-person household (approximate).

Figure 1. Census tracts in and around the Silver Lake Water and Sewer District's service area

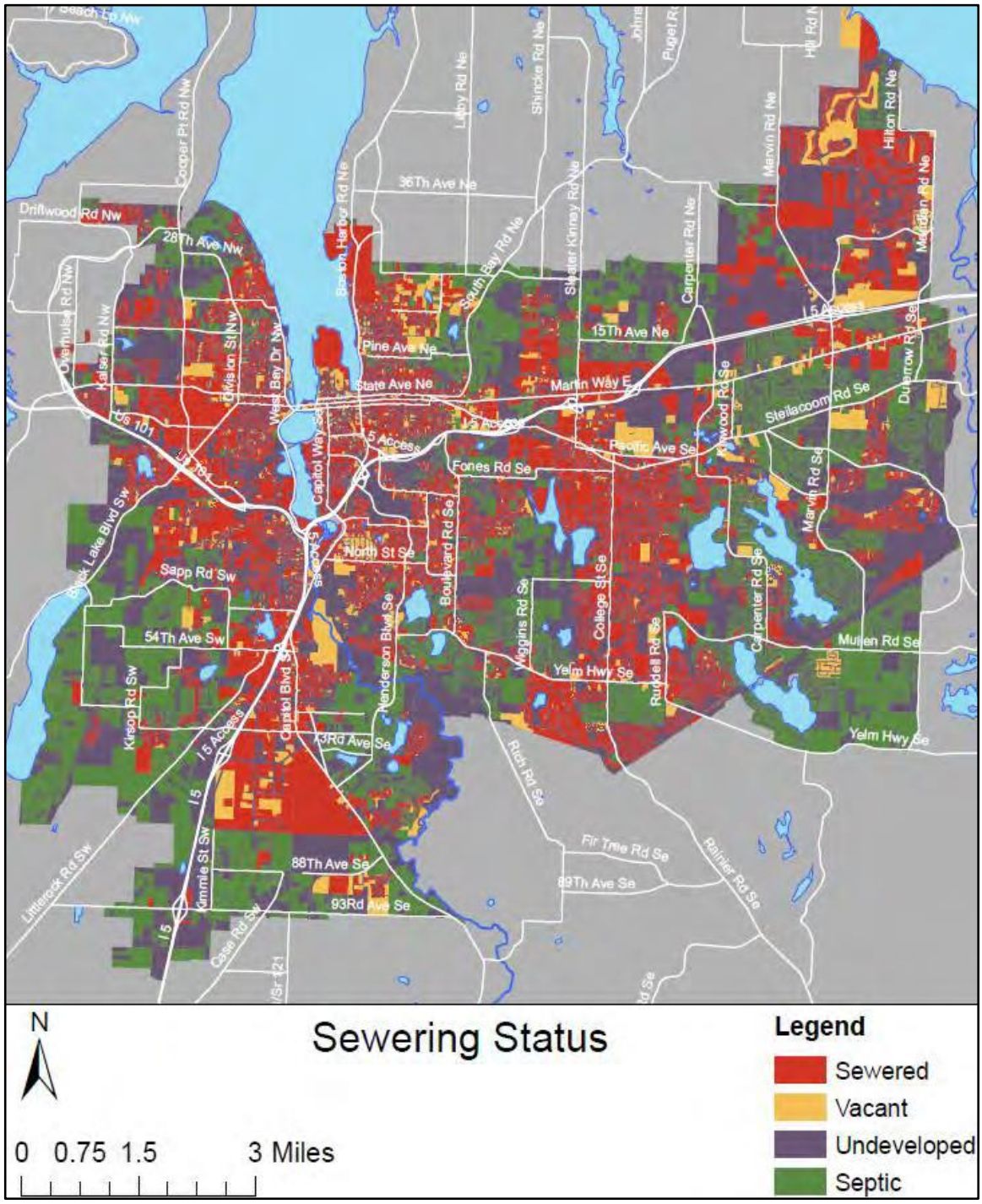


Sources: https://www.slwsd.com/servicearea.html and https://data.census.gov/cedsci/table?q=United%20States

Table 1. Comparison of income estimate results calculated using different service area/census tract correspondence techniques

Statistic	**Procedure 1:** Tracts with >50% of area within Silver Lake boundary (n=8)	**Procedure 2:** All tracts contained/intersected with Silver Lake boundary (n=12)
1st Quintile Min	$18,536	$17,758
1st Quintile Max	$64,056	$64,056
1st Quintile Range	$45,520	$46,298
1st Quintile Weighted Mean	$43,579	$38,374
1st Quintile Standard Deviation	$14,455	$15,263
MHI Min	$86,222	$73,106
MHI Max	$139,730	$144,153
MHI Range	$53,508	$71,047
MHI Weighted Mean	$122,173	$115,005
MHI Standard Deviation	$18,997	$23,199

Figure 2. Sewering status within the LOTT service area



Source: LOTT Clean Water Alliance 2022 Capacity Reports - https://lottcleanwater.org/wp-content/uploads/capacity22.pdf

RELATED PUBLICATION(S)

Burke, S., A. Kinney, K. Bogue, A. Barber, and N. Jo. 2022. Puget Sound Wastewater Service Affordability Analysis: Implications for Implementation Strategies. Critical Analysis Summary Report prepared by ECO Resource Group and Puget Sound Institute for the Stormwater Strategic Initiative and Puget Sound Partnership.

Kinney, A. and C.W. Wright. 2022. Draft Base Program Analysis for the Marine Water Quality Vital Sign. Appendix to Stormwater Strategic Initiative. 2022. Draft Marine Water Quality Implementation Strategy: Improve and Protect Puget Sound Marine Water Quality and Dissolved Oxygen. Prepared in collaboration with: Puget Sound Partnership, Washington Department of Ecology, Puget Sound Institute, and the Marine Water Quality Interdisciplinary and Core Teams.

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Kinney, A., C.A. James, R. Evrard, K. Bogue. 2021. Use of Stormwater Utility Fees in Puget Sound: Summary of Implications for Implementation Strategies. University of Washington Tacoma, Puget Sound Institute. https://pspwa.box.com/s/yf6di8lbzcofsl8ksqelwxo0nch6edux

Teodoro, M.P. 2018. Measuring Household Affordability for Water and Sewer Utilities. *Journal of the American Water Works Association*. 110(1):13-24. DOI: 10.5942/jawwa.2018.110.0002

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U.S. Environmental Protection Agency. 2022. Proposed Financial Capability Assessment Guidance. Office of Water. EPA-HQ-OW-2020-0426-0070. Notice; request for comment. 87 Fed. Reg. 10193 (Feb 22, 2022). https://www.regulations.gov/document/EPA-HQ-OW-2020-0426-0070

U.S. Environmental Protection Agency. 2014. Financial Capability Assessment Framework for Municipal Clean Water Act Requirements. Office of Water. https://www.epa.gov/waterfinancecenter/financial-capability-assessment-framework

File-by-File Descriptions

ACCESS DATABASE

The 7 tables in the ACCESS database are described individually below. The primary key for each table is **bolded**.

ACS data codes

U.S. Census Bureau American Community Survey (ACS) 5-year data (2015-2019) estimates downloaded from the ACS database.[3] Table 1 contains 7 records, each describing the ACS identifier for data type and source from the bulleted list of 7 code identifiers.

Table 1. ACS Data Codes

Field Name	Field Type	Field Description	Source	Note
ACS_Code (see list below)	**Short text**	**Unique ACS code for income (MHI, LQI, etc.) and population**	**Data.census.gov, downloaded on Jan 18, 2022.**	**Primary Key, 7 unique records, 6 for income and one for population**
Description	Short Text	Long text description of ACS code	Data.census.gov, downloaded on Jan 18, 2022	

ACS Code Identifiers:

- B01003_001E – estimate of total population
- B19081_001E – estimate of mean of lowest quintile income
- B19081_002E – estimate of mean of second quintile income
- B19081_003E – estimate of mean of third quintile income
- B19081_004E – estimate of mean of fourth quintile income
- B19081_005E – estimate of mean of highest quintile income
- S1901_C01_012E – estimate of median household income

Census Tract

Table 2 contains individual census tract numbers downloaded from the ACS database. This data was used to correspond the ACS income data to the wastewater provider service area boundaries. Record count: 961 unique census tracts within the twelve Puget Sound counties.

[3] https://data.census.gov/cedsci/table?q=United%20States%20acs%202015-2019&g=0100000US&tid=ACSDP5Y2019.DP05

Table 2. Census Tract

Field Name	Field Type	Field Description	Source	Note
ACS_GEO_ID	**Long**	**Unique ACS code for a census tract**	**Data.census.gov, downloaded on Jan 18, 2022**	**Primary Key, 961 unique**
County	Integer	Census tract county location	GIS analysis	
City	Integer	Census tract city location	GIS analysis	

Census_Tract_ACS_Data

Table 3 contains ACS income and population data by census track. The primary key is the combination of census track ACS_GEO_ID and ACS_Code. Total record count of 6,846 records. Seven codes for each of the 961 census tract ACS_GEO_IDs. NOTE: one census tract (1400000US53009003000) did not have any population or income data reported in the ACS database.

Table 3. Census Tract and ACS Data

Field Name	Field Type	Field Description	Source	Note
ACS_GEO_ID	**Short text**	**Unique ACS code for a census tract**	**Data.census.gov, downloaded on Jan 18, 2022**	**Primary Key**
ACS_Code	**Short Text**	**Unique ACS code for income (MHI, LQI, etc.) and population**	**Data.census.gov, downloaded on Jan 18, 2022**	**Primary Key**
Amount	Number	The value of income or population	Data.census.gov, downloaded on Jan 18, 2022	

Census_Tracts_District_Correspondence

Table 4 is the correspondence between census tracts and utility service areas. This step was necessary to estimate the MHI and the LQI of households within the utility boundary. Of the 961 census tracts in the 12-county region, 745 census tracts intersected a utility service area boundary or a city. The other 261 census tracts are presumably in rural areas not served by a wastewater utility. Nearly every utility service area contains more than one census tract. The correspondence table lists the 745 census tracts assumed to be within the boundaries of at least one utility by assigning the census tract ACS_GEO_ID to the utility district OrgDOHNum.

The correspondence table was developed via GIS analysis. Polygon data was combined with tabular income and household size data (ACS table S1101). Sources of polygon data varied depending on the type of local wastewater service provider. The "Source" field in the Census_Tracts_District_Correspondence table indicates source of the spatial data layer.

If the source field equals "District" (n=30) then a Special Purpose District, Public Utility District, or county provides wastewater services and district boundaries were obtained from the district's website, a county website, or from large wholesalers.[4] If the source field equals "City" (n=50) then municipal-run utilities provide wastewater services

[4] For example, King County provides treatment services to 18 cities and 15 sewer districts. Spatial data layers for each are provided in the County's virtual map counter https://kingcounty.gov/services/gis/Maps/vmc/Utilities.aspx.

and city boundaries were obtained from the Washington Geospatial Open Data Portal (L&I City Limits Statewide). In one geography (Bainbridge Island), households are served by a mix of city-run utility, sewer district, and neighborhood-scale septic over a relatively small area. We requested GIS layers from the City of Bainbridge Island and used what they provided.

In order to estimate the portion of a census tract's population that occurred within a service area, we calculated population density. Areas within each Census Tract that intersected with waterbodies (National Hydrography Dataset Plus Version 2.1) and national, state, county, regional, and local parks and forests (USA Parks 9/10/21 update) were removed in an attempt to pare the land area of each tract to an area approximating where the population might actually live. Population density per square kilometer was estimated for each tract, then multiplied by the area of the local wastewater provider service area. The correspondence table includes total population in each census tract as well as our estimate of the portion that lives in the utility service area.

Due to the lack of alignment between census tract and service area boundaries (discussed in the data limitations section), 261 census tracts are corresponded to more than one utility service area. Due to this duplication of census tracts, there are 1101 records in the correspondence table.

Table 4. Census Tract District Correspondence

Field Name	Field Type	Field Description	Source	Note
OrgDOHNum	**Short text**	**Unique identifier assigned to each sewer utility.**	**DOH webpage of water and sewer utilities augmented with data from sewer utilities web pages**	
ACS_GEO_ID	**Short Text**	**Unique ACS code for a census tract**	**Data.census.gov, downloaded on Jan 18, 2022**	
Source	Short Text	Source of spatial data layers	Tracked while compiling layers from various sources	

Income_Counties

Table 5 contains income and population by County, similar to Census_Tract_ACS_Data (Table 3).

Table 5. Income and Population by County

Field Name	Field Type	Field Description	Source	Note
County	Short Text	One of 12 Puget Sound Counties	Data.census.gov, downloaded on Jan 18, 2022	12 unique values
ACS_Income_Code	Short Text	Unique ACS code for income (MHI, LQI, etc.) and population	Data.census.gov, downloaded on Jan 18, 2022	7 unique values, 6 for income and one for population
Amount	Number	Value of corresponding ACS codes	Data.census.gov, downloaded on Jan 18, 2022	

Utility Districts

Table 6 identifies the 85 utilities directly or indirectly (see footnote 1) subject to PSNGP regulatory requirements. This list established the scope of data collection for the Puget Sound Wastewater Affordability Analysis project. This list was compiled in a stepwise fashion with assistance from Dan Thompson (Tacoma Wastewater Operations Division) and Judy Gladstone (Washington Association of Sewer and Water Districts).

(1) Adding all treatment facilities covered by the PSNGP (Ecology 2021a). WWTPs operated by Washington State Parks and the Washington Department of Corrections were excluded. This original list contained in Table 7, Wastewater treatment Plants.

(2) Identifying the responsible agency for each of those treatment facilities using the list of eligible grant applicants from Ecology (2021b). This information is also contained in Table 7.

(3) Identifying the local agencies that are wholesale customers or permittees using the website of the largest regional provider (King County 2016) and Appendix B from Ecology (2009). Wholesale customers that do not bill households (e.g., U.S. Navy, Washington State Ferries, Washington State Parks Muckleshoot Indian Tribe, Swinomish Indian Reservation) were excluded.

(4) 5 very small (generally <500 connections) utilities were excluded from the analysis due to our inability to locate service area boundary spatial data and/or a rate schedule.

Note that a few agencies are both permittees and wholesale customers, or customers of more than one permittee. The Utility Table includes a field, WWTP_Provider_ID, which lists the provider of the wastewater treatment services. In a few cases a utility may procure treatment services from more than one provider, however for simplicity only one provider is listed for each utility. With the exception of Thurston County, which has varying service rates by geography, utilities do not appear on the list twice.

A Washington Department of Health (WA DOH) organization number was used as the primary key where possible. This is a remnant of an early phase of the study when we intended to include drinking water service in our annual cost estimates. Ultimately this was not possible due to a significantly larger number of drinking water providers, some of which have neighborhood-scale service areas. Wastewater utilities are not assigned DOH organization numbers, in which case we assigned a number using the protocol WW##.

Table 6. Utility Districts

Field Name	Field Type	Field Description	Source	Note
OrgDOHNum	**Short text**	**Unique identifier assigned to each sewer utility.**	**DOH webpage of water and sewer utilities augmented with data from sewer utilities web pages**	**Primary Key. Note: 14 of the utility districts in the study are only wastewater districts and not water utilities, as such they do not have a DOH number, so we assigned one using the protocol WW_##**
Type	Short Text	Retail or wholesale providers of wastewater services	See description below	
Util_Name	Short Text	Name of the utility	WA State Dept of Health web page. Downloaded on January 12,	

Field Name	Field Type	Field Description	Source	Note
			2022, and various web pages	
City	Short text	City where the office is located	WA State Dept of Health web page. Downloaded on January 12, 2022	
County	Short Text	County where the City is located	WA State Dept of Health web page. Downloaded on January 12, 2022	
PopCount	Number	Count of population	WA State Dept of Health web page. Downloaded on January 12, 2022	
ConnCount	Number	Count of connections	WA State Dept of Health web page. Downloaded on January 12, 2022	
WWTP_Provider_ID	Short text	The ID number of the utility that provides wastewater services to the utility.	Various web pages	

Wastewater Treatment Plants

Table 7 contains a list of the 63 WWTPs included in the nutrient general permit (the "permittees").

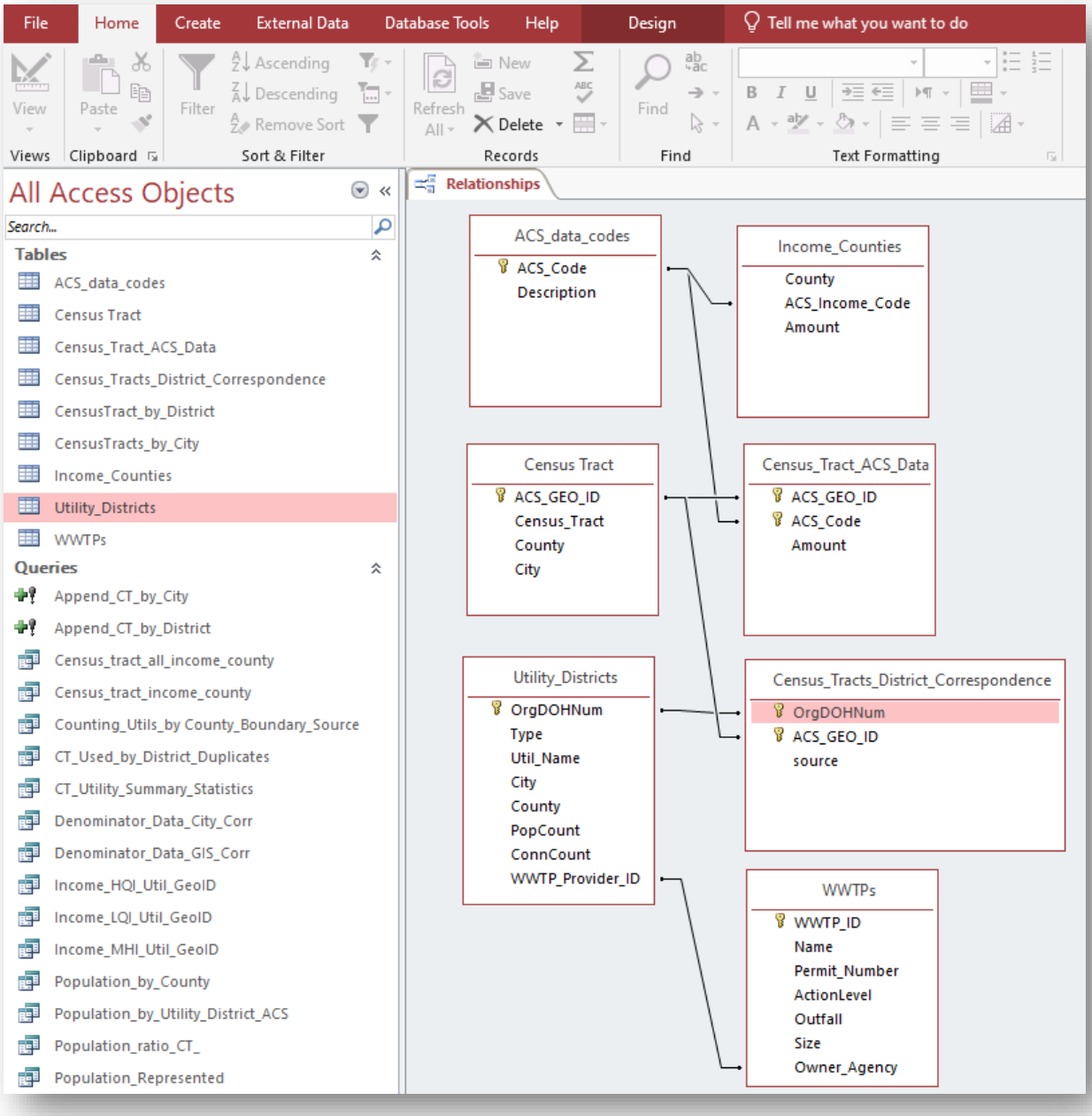
Table 7. Income and Population by County

Field Name	Field Type	Field Description	Source	Note
WWTP_ID	**Short Text**	**An assigned numeric**		
Name	Short Text	Ecology's name for the plant	Puget Sound Nutrient General Permit	
Permit_Number	Short Text	NPDES permit number	Puget Sound Nutrient General Permit	The bubble loaders permit number is not listed in the PSNGP

Field Name	Field Type	Field Description	Source	Note
ActionLevel	Number	TIN per year	Puget Sound Nutrient General Permit.	
Outfall	Number		Puget Sound Nutrient General Permit	
Size	Short Text	Either Dominate, Moderate or Small	Puget Sound Nutrient General Permit	
Owner_Agency	Short Text	The ID number of the permittee agency		

Relationships among the ACCESS tables are shown in Figure 3.

Figure 3. Relationship of ACS Income Data to Puget Sound Wastewater Utilities



EXCEL SPREADSHEET_1_MONTHLY_WASTEWATER_RATES

This spreadsheet contains a list of the estimated monthly sewer rates for each of the 80 retail utilities included in the study. Two assumptions were used to estimate the monthly charges. First, the rates are based on a ¾" residential pipe size. Second, where a variable rate was charge based on water usage, the usage was assumed to be a constant 5.5 ccf per household per month across all utilities. Assuming a constant usage rate allows for comparisons across rates that are solely based on the variable rate and not a difference in water usage.

Rate data was obtained from utilities' webpages. The link to the utility-specific webpage is included in the spreadsheet. Total monthly sewer costs were calculated via formula within the spreadsheet.

The project team emailed utilities that utilize a variable rate structure (i.e., bills are based entirely or partially on the volume of water used) to verify our calculated costs. Dan Thompson (Tacoma Wastewater Operations Division) and Judy Gladstone (Washington Association of Sewer and Water Districts) provided contact information. Of 26 utilities contacted, we received responses from 12 (46% response rate).

The following information for each utility is found in the spreadsheet:

- ORGDOHNumber - the unique code used to identify each utility in the study
- Name/Webpage link - the name of each utility including a link to the utilities sewer rate page, which is the source of the rate data.
- Flat Rate - where applicable, the charge that each utility charges.
    - Number of months in flat rate - some utilities charge on a bi-monthly basis and some utilities charge monthly. If a utility charges on a bi-monthly basis then the value of this statistic = 2 and the stated flat rate is divided by 2 to calculate the monthly rate.
    - 52 utilities in our sample charge flat rates.
- Stated Variable Rate - the rate charge based on water usage. Note: not all utilities charge a variable rate, in which case the value = NA.
    - Unit of measure for variable use - the stated variable rates are stated in one of three units of measure: CF, CCF and gallons. In order to estimate the monthly variable rate the unit of measure was needed.
    - Types of variable rates in our sample: 26 base + usage; 1 usage (Seattle); 1 tier (Alderwood Sewer and Water District)
- Estimated Monthly use - using the unit of measure for the stated variable rate and the assumption that all usage date = 5.5 centum cubic feet = 550 cubic feet = 4,114 gallons. The units of measure of the estimated monthly usage are stated in units to match the state variable rate unit of measure.
- Monthly flat rate - the stated flat rate divided by the number of months in flat rate
- Monthly variable rate - the stated variable rate times the estimated monthly use
- Total monthly Sewer Rate - the sum of the monthly flat rate and the monthly variable rate

EXCEL SPREADSHEET_2_ACS_INCOME_POP_DATA_DENOMINATORS

This spreadsheet utilizes data from the ACCESS database to calculate estimates of income statistics for each utility. The first tab in the spreadsheet is a "Read Me" tab that details the source of the data in the ACCESS database and the calculations for weighted average Lowest Quintile Income (LQI) and Median Household Income (MHI) for each utility.

The tab entitled Denominator_RawData_Calcs contains the following statistics for each utility:

- Population data:
  - OrgDOHNum – A unique code used to identify each utility. There are 80 unique utilities are included in this spreadsheet, the same utilities for which there are estimated monthly sewer rates.
  - Util_Name - The name of the utility
  - ACS_GEO_ID - the unique ACS census tract and its correspondence to the utility.
  - Pop_Census_Tract - the ACS estimate of population by unique census tract.
  - Total_Util_Pop - the total population of all census tracts within a utility. NOTE: due to data constraints and limitations described above, there is known error in the population counts of the utilities.
  - Calculated ratio - the ratio of census tract population to estimated total utility population. These ratios were used to weight the average LQI and MHI for each utility.
- Income data for each LQI, MHI and HQI:
  - OrgDOHNum – A unique code used to identify each utility. There are 80 unique utilities are included in this spreadsheet, the same utilities for which there are estimated monthly sewer rates.
  - Util_Name - The name of the utility district
  - ACS_GEO_ID - the unique ACS census tract and its correspondence to the utility.
  - Pop_Census_Tract - the ACS estimate of population by unique census tract.
  - Income measure (either LQI, MHI or HQI) - the income for each census tract corresponding to a utility.
  - Calculated weighted [income measure] - The individual census tract LQI times the calculated population ratio. The some of the weighted income measure over the utility is the total weighted average income for that utility.

EXCEL SPREADSHEET_3_INDICES_MHI_LQI_AND_SCATTER PLOTS

This spreadsheet utilizes data from the spreadsheet, Spreadsheet_1_Montly_Wastewater_Rates and the Spreadsheet_2_ _ACS_Income_Pop_Data_Denominators to calculate the affordability indices for each utility. Indices are calculated using both MHI and LQI in the denominators of the index. In addition, potential future wastewater rates are calculated utilizing estimated increase in sewer rates from Ecology and Tetra Tech (2011).

- OrgDOHNum – A unique code used to identify each utility. There are 80 unique utilities included in this spreadsheet, the same utilities for which there are estimated monthly sewer rates.
- Util_Name - The name of the utility district
- Estimated Utility District Population - population data taken from Spreadsheet_2_ACS_Income_Pop_data_denominators
- Weighted LQI Population within Utility - twenty percent of the estimated utility district population.
- Population Weighted MHI within utility - MHI income data taken from Spreadsheet_2_ACS_Income_Pop_data_denominators.
- Population Weighted LQI within utility - LQI income data taken from Spreadsheet_2_ACS_Income_Pop_data_denominators.
- Monthly Utility rate:

- Current - estimated monthly rate taken from the Spreadsheet Spreadsheet_1_Monthly Wastewater Rates
- Est. increase in monthly rate at $17.12 - a potential estimated increase in rates based on Ecology and Tetra Tech (2011). The $17.12 increase is based on the scenario of an 8.0 mg/L numeric criteria, seasonally. NOTE: these estimates were developed in 2011, we used an inflation index to adjust the increase to 2022 dollars.
- Est. increase in monthly rate at $35.36 - a potential estimated increase in rates based on the Tetra Tech report (2011). The $35.36 increase is based on the scenario of an 3.0 mg/L numeric criteria, seasonally. NOTE: these estimates were developed in 2011, we used an inflation index to adjust the increase to 2022 dollars.

- Annual Utility rate:
  - Current - monthly rate times 12
  - Est. increase in monthly rate at $17.12 monthly rate times 12
  - Est. increase in monthly rate at $35.36 monthly rate times 12
- Index as a Percent of LQI:
  - Current - using the current annual rate in the numerator and the LQI for the utility in the denominator
  - < 8.0 mg/L numeric - using the estimated annual rate with the numeric criteria < 8.0mg/L and the LQI for the utility in the denominator
  - < 3.0 mg/L numeric - using the estimated annual rate with the numeric criteria < 3.0mg/L and the LQI for the utility in the denominator
- Index as a Percent of MHI:
  - Current - using the current annual rate in the numerator and the MHI for the utility in the denominator
  - < 8.0 mg/L numeric - using the estimated annual rate with the numeric criteria < 8.0mg/L and the MHI for the utility in the denominator
  - < 3.0 mg/L numeric - using the estimated annual rate with the numeric criteria < 3.0mg/L and the MHI for the utility in the denominator
- Rank of index using MHI using current rates - the rank of affordability, where 1 = most affordable (e.g., lowest index value) to 80 = least affordable (e.g., highest index value)
- Rank of index using LQI using current rates - the rank of affordability, where 1 = most affordable (e.g., lowest index value) to 80 = least affordable (e.g., highest index value)