Philadelphia Water Department
2024 Watershed Sanitary Survey

This report was produced for the Pennsylvania Department of Environmental Production in accordance with the Environmental Protection Agency National Primary Drinking Water Regulations: Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), 25 Pa. Code §109.

Originally Published December 2015

Updated December 2024

Philadelphia Water Department
Source Water Protection Program
1101 Market Street, 4th FL
Philadelphia, PA 19107

Executive Summary

Background and Scope

In December 2012, the Pennsylvania Department of Environmental Protection (PADEP) approved Philadelphia Water Department's (PWD) *Watershed Control Plan* (WCP), a 5-year plan to reduce *Cryptosporidium* in the source watershed of the Queen Lane Water Treatment Plant (WTP). In June 2021, PADEP approved the Philadelphia Water Department's (PWD) *Watershed Control Plan Update*, which outlines ongoing pathogen control initiatives in the Schuylkill River Watershed and includes goals and potential actions and initiatives for implementing similar pathogen controls in priority areas of the Delaware River Watershed. The Watershed Control Plan (WCP) earns back-up credit towards requirements for compliance with the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). To maintain the WCP credit, PWD is required to submit annual status reports describing activities towards the implementation of the WCP. Additionally, a watershed sanitary survey must be completed every three years. This report is the third update to the Schuylkill River Watershed Sanitary Survey.

PWD submitted an approach document for the WSS to PADEP, which was approved in May 2015. Following US Environmental Protection Agency (EPA) recommendations published in the *Long Term 2 Enhanced Surface Water Treatment Rule Toolbox Guidance Manual*, the WSS incorporates the suggested format from the 1993 *Watershed Sanitary Survey Guidance Manual*, prepared by the American Water Works Association (AWWA) California-Nevada Section while focusing on the priorities of the LT2ESWTR regulation. LT2ESWTR aims to reduce the incidence of disease caused by *Cryptosporidium* and other pathogens. In 2024, the Watershed Sanitary Survey was updated to reflect any changes within the last three years.

Pathogen Sources

In the Watershed Control Plan (2011) and Watershed Control Plan Update (2020), PWD identified wastewater discharges, runoff from agricultural land use and wildlife as priority sources of *Cryptosporidium* and pathogens in the Queen Land and Baxter Area of Influence (AOI). The 2024 update to the Watershed Sanitary Survey compiles updated data and evaluates existing and potential sources of pathogens.

Wastewater Discharges

Upstream of the Queen Lane Water Treatment Plant there are 104 wastewater treatment plants (WWTPs) discharging a total average of 80.73 million gallons per day (MGD) to the Queen Lane AOI in 2024. Upstream of the Baxter Water Treatment Plant there are 89 WWTPs discharging an average of 48.12 MGD in 2024. Ultraviolet (UV) disinfection inactivates *Cryptosporidium* making it incapable of infecting a human or animal host. Of the WWTPs in the Schuylkill River watershed, 29 WWTPs discharging a combined average of 32.8 MGD have UV disinfection systems.

Additional wastewater discharges include combined sewer overflows (CSOs), illegal discharges of untreated wastewater to streams or "wildcat sewers" and discharges to septic systems.

There is greater uncertainty associated with the discharge quality and contribution of pathogens to the Schuylkill River watershed from CSOs, wildcat sewers and discharges to septic systems as compared to wastewater treatment plant effluent. The annual flow diverted to CSOs is available in compliance reporting submitted to PADEP. Additional information on wildcat sewers and septic systems may be available at the municipal level. However, collection and analysis of these data by PWD was not logistically feasible for this survey. In most cases, it would not have provided a consistent and useful level of detail to estimate the contribution of pathogens to the watershed from these *Cryptosporidium* sources.

Agricultural Runoff

From 2016-2019, agricultural land cover has decreased slightly (0.5%) in the Queen Lane AOI and remain stable in the Baxter AOI. The Queen Lane AOI is 27.1% agricultural land cover and the Baxter AOI is 15.2% agricultural land cover based on the 2019 National Land Cover Database (NLCD). PWD will continue to track livestock populations and prioritize projects that manage stormwater on dairy and cattle farms. Significant funds from the Natural Resource Conservation (NRCS) Resource Conservation Partnership Program (RCPP) and the William Penn's Delaware River Watershed Initiative (DRWI) are committed to areas in the Schuylkill and Delaware River watersheds over the next few years. With this funding, increased implementation of agricultural BMPs addressing sediment, nutrient and stormwater management on farms is anticipated.

Wildlife

The third priority source of *Cryptosporidium* is wildlife. PWD specifically focuses on controlling Canada geese, identified as mechanical vectors of *Cryptosporidium* in collaborative research with Lehigh University. In the absence of watershed-specific data on changes in geese or other wildlife populations, it is difficult to evaluate pathogen contribution to the Queen Lane and Baxter AOIs from watershed from wildlife. PWD controls goose populations and other wildlife at priority PWD facilities and public parks through a professional services contract with the United States Department of Agriculture (USDA).

Protection Initiatives

PWD manages the watershed within Philadelphia city limits internally through initiatives in the Office of Watersheds and outside Philadelphia County boundaries through the Source Water Protection Program. Additionally, many federal, state and regional agencies, conservation districts, county planning, watershed organizations and other partners play a critical role in watershed management upstream by overseeing wastewater discharge and stormwater permits, mining reclamation, recreational activities, county planning, resource conservation, water withdrawals and reservoir management. Coordination between PWD and these partners is accomplished through the Schuylkill Action Network (SAN), Schuylkill River Restoration Fund (SRRF), LT2ESWTR Watershed Control Program, DRBC committees, and Delaware Valley Early Warning System (EWS).

Compliance Status

PWD maintains compliance with federal and state Safe Drinking Water Act (SDWA) regulations in addition to its continued voluntary participation in the Partnership for Safe Water to protect the public from health risks associated with *Cryptosporidium* and pathogens. PWD regularly monitors turbidity, fecal coliform and *E. coli,* indicators that disease-causing pathogens may be present, at the WTP intakes and throughout the water system. Additionally, through research contracts with local universities, PWD engaged in additional water quality monitoring and method development for sample collection and laboratory analysis.

Conclusions and Recommendations

After review of the data collected in the 2021 Watershed Sanitary Survey process, PWD believes wastewater discharges, runoff from agricultural land and wildlife continue to be priority sources of *Cryptosporidium* and pathogens in the watershed. PWD recommends continuing a partnership approach to track changes and implement strategies to address these sources.

Contents

List of Tables

List of Figures

List of Acronyms

ACE	Army Corps of Engineers
AFO	animal feeding operation
AMD	abandoned mine drainage
AWWA	American Water Works Association
BLS	Bureau of Laboratory Services
BMP	best management practice
CAFO	confined animal feeding operation
CFE	combined filter effluent
CSO	combined sewer overflow
DRBC	Delaware River Basin Commission
DRWI	Delaware River Watershed Initiative
eDMR	electronic Discharge Monitoring Report
EPA	U. S. Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
EWS	Delaware Valley Early Warning System
GIS	Geographic Information System
IESWTR	Interim Enhanced Surface Water Treatment Rule
IFE	individual filter effluent
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
LTCP	Long Term Control Plan
LTCPU	Long Term Control Plan Update
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MPN	most probable number
MS4	municipal separate storm sewer system
NLCD	National Land Cover Database
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resource Conservation Service
NWQI	National Water Quality Incentive
OOW	Office of Watersheds
PADEP	Pennsylvania Department of Environmental Protection
PCS-ICIS	Permit Compliance System and Integrated Compliance Information System
PDE	Partnership for the Delaware Estuary
PSW	Partnership for Safe Water
PWD	Philadelphia Water Department
SAN	Schuylkill Action Network
SDWA	Safe Drinking Water Act
SDWIS	Safe Drinking Water Information System
SIC	Standard Industrial Classification

SRHA	Schuylkill River Heritage Area
SRLM	Schuylkill Runoff Loading Model
SRRF	Schuylkill River Restoration Fund
SWA	Source Water Assessment
SWMM	Storm Water Management Model
SWPP	Source Water Protection Plan
SWTR	Surface Water Treatment Rule
TAG	Technical Advisory Group
TCR	Total Coliform Rule
TT	treatment technique
USDA	United States Department of Agriculture
USGS	U.S. Geological Survey
UV	ultraviolet
WCP	Watershed Control Plan
WSS	Watershed Sanitary Survey
WTP	water treatment plant
WWTP	wastewater treatment plant

Section 1. Introduction

In April 2011, the Philadelphia Water Department (PWD) completed its *Watershed Control Plan (WCP)* for compliance credit for the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) at the Queen Lane Water Treatment Plant on the Schuylkill River. The Schuylkill River is one of two rivers from which Philadelphia gets its drinking water for 1.6 million residents. After receiving approval from the Pennsylvania Department of Environmental Protection (PADEP), the WCP went into effect December 2012 and was updated in October 2020 to extend the scope of the plan to address priority areas of the Delaware River watershed and extend compliance credit to the Baxter Water Treatment Plant on the Delaware River. The *Watershed Control Plan Update (2020)* was approved by PADEP in July 2021.

The purpose of a watershed control plan is to develop a comprehensive source water protection approach to reducing levels of infectious *Cryptosporidium* in finished drinking water (US EPA, 2006). The elements of the PWD WCP are being achieved through previously established and ongoing efforts of the PWD's Source Water Protection Program and through Watershed Control Plan actions aimed to specifically reduce levels of *Cryptosporidium* in the Schuylkill and Delaware River watersheds. As part of the WCP credit, LT2ESWTR requires a Watershed Sanitary Survey (WSS) be completed every three years. This report was originally published in December 2015 and is updated and posted to the PWD Regulatory Reporting website every three years.

1.1 Background

The US Environmental Protection Agency (EPA) published the first source water quality based drinking water regulation on January 5, 2006. LT2ESWTR, an amendment to the Safe Drinking Water Act, serves to protect the public from waterborne illness caused by *Cryptosporidium* and other microbial pathogens in drinking water. In the United States, *Cryptosporidium* has been the cause of several outbreaks of Cryptosporidiosis, a gastrointestinal disease particularly dangerous for immunocompromised individuals. The LT2ESWTR requires public drinking water systems with surface water sources, or groundwater sources influenced by surface water, to monitor monthly for *Cryptosporidium* at each supply intake for two years. The observed *Cryptosporidium* concentrations categorize each intake into one of four 'Bins.' Public water systems placed in Bin 1 indicate the lowest concentrations of *Cryptosporidium* and require no additional treatment. Public water systems placed in Bins 2, 3 and 4 indicate increasingly greater concentrations of *Cryptosporidium* and require 4-log, 5-log and 5.5-log removals, respectively. Public water systems using conventional treatment processes i.e., coagulation, flocculation, sedimentation, and filtration, are assumed to achieve a 3-log removal. Therefore, additional 1-log, 2-log or 2.5-log treatment credit(s) is required of a conventional treatment facility if placed in Bins 2 through 4. The EPA provides a "microbial toolbox" describing options to earn additional treatment credits including source water protection and management programs, pre-filtration processes, treatment performance programs, additional filtration components and inactivation technologies.

For the first round of LT2ESWTR sampling, PWD submitted grandfathered *Cryptosporidium* monitoring data collected from March 2001 through March 2003 and categorized each of Philadelphia's three drinking water treatment plants (WTPs) into Bins. PWD's Baxter and Belmont WTPs achieved Bin 1 status with average oocyst concentrations less than 0.075 oocysts/L. However, data from the Queen Lane Water Treatment Plant on the Schuylkill River resulted in an average oocyst concentration of 0.076 oocysts/L, falling into Bin 2. Since the Queen Lane Water Treatment Plant uses conventional treatment processes, and automatically receives a 3-log removal credit, an additional 1-log removal credit is required. PWD has selected to use the combined filter effluent for 0.5-log credits, the individual filter effluent for 0.5-log credits, and the development and implementation of a WCP for 0.5-log back up credits. PWD submitted a WCP to the PADEP in April 2011 and received approval in December 2012. Subsequently, PWD submitted revisions to the WCP in the *Watershed Control Plan Update* (2020) that was approved by PADEP in July 2021. To maintain the WCP treatment credit for both the Queen Lane and Baxter Water Treatment Plants, PWD is required to submit a status report every year, and a Watershed Sanitary Survey every three years to the Pennsylvania Department of Environmental Protection (PADEP). The following text comprises the triennial update of the Watershed Sanitary Survey.

1.2 Scope of Watershed Sanitary Survey

This report follows a four-component format described in the *1993 Watershed Sanitary Survey Guidance Manual*, prepared by the American Water Works Association (AWWA) California-Nevada Section, with a focus on pathogens in the Schuylkill and Delaware River watersheds. PWD addresses many of the features of a Watershed Sanitary Survey through the ongoing work of its Source Water Protection Program (SWPP). Much of the watershed data the Guidance Manual recommends, including in a Watershed Sanitary Survey, is documented and analyzed in the Schuylkill River Source Water Assessment (2002), the Watershed Control Plan Update (2020), and other PWD reports publicly available on the PWD website. However, since the completion of these reports, some new information and improved data has become available. This new and updated data is compiled in the Water Sanitary Survey and will additionally be used to inform the Source Water Protection Program. This report serves as the 2024 Watershed Sanitary Survey and will include the following four components described below.

1) Watershed and Water System: Provides a brief overview of both the Schuylkill and Delaware River watersheds within the Queen Lane and Baxter AOIs and the PWD water supply system.
2) Pathogen Sources: Compiles updated data on sources of pathogen contamination in the Schuylkill and Delaware River watersheds including wastewater treatment plant (WWTP) effluent, combined sewer overflows (CSOs), illegal wastewater discharges, septic system discharge and runoff from agricultural land and wildlife.
3) Protection Initiatives: Demonstrates how PWD supports and implements source water protection initiatives in the City of Philadelphia through PWD initiatives, and within the Schuylkill and Delaware River watersheds through the Source Water Protection Program and a watershed partnership approach.
4) Compliance Status: Summarizes pertinent regulations that protect public health from pathogens in the drinking water supply and describe PWD’s ability to treat the source water to a level that meets or exceeds federal and state regulations.

Section 2. Watershed and Water Supply System

WATER SYSTEM | Pathogen Sources | Protection Initiatives | Compliance Status

2.1 Watersheds

2.1.1 Baxter and Queen Lane Water Treatment Plants Area of Influence

With Queen Lane located on the Schuylkill River and Baxter located on the Delaware River, there are distinct areas of influence (AOI) for each drinking water treatment plant, Figure 1.

The entire Schuylkill River watershed upstream of the Queen Lane Water Treatment Plant is designated as the AOI, 1,911 square miles. The Schuylkill River watershed includes large portions of Schuylkill, Berks, Montgomery, Chester and Philadelphia counties and smaller portions of Carbon, Lehigh, Lebanon, Lancaster, Bucks and Delaware counties. The major towns and cities in the Queen Lane AOI include Pottsville, Reading, Pottstown, Phoenixville, Norristown, Conshohocken and Philadelphia.

Careful considerations were made delineating the Baxter AOI due to the enormous size of the Delaware River Basin upstream of the Baxter Water Treatment Plant. In total, the Delaware River Basin is greater than 13,500 square miles, extending over four states, 42 counties, and 836 municipalities. As a result, a watershed-scale AOI for Baxter would present clear logistical challenges for data collection, project implementation, and compliance enforcement. Given that the priority *Cryptosporidium* sources are agricultural runoff, urban stormwater runoff, and treated wastewater effluent, the portions of the Delaware River Basin over 25 hours travel time to Baxter are excluded from the Baxter AOI. Cross-channel transport models suggest that contaminants on the New Jesey bank of the Delaware are not likely to reach the Pennsylvania bank of the Delaware River, which supports exclusion of New Jersey Delaware River Basin portions from the Baxter AOI.

The selected Baxter AOI includes only the Pennsylvania portions of the Lehigh, Upper Central, Lower Central, and Upper Estuary sub-basins of the Delaware River Basin, totaling 2,843 square miles. Shown in gray in Figure 1 are the areas of the Delaware River Basin that are not designated as part of Baxter's area of influence. The Queen Lane and Baxter AOIs are under the jurisdiction of the Pennsylvania Department of Environmental Protection (PADEP) and EPA Region III, who facilitate oversight of plan implementation and data collection efforts.

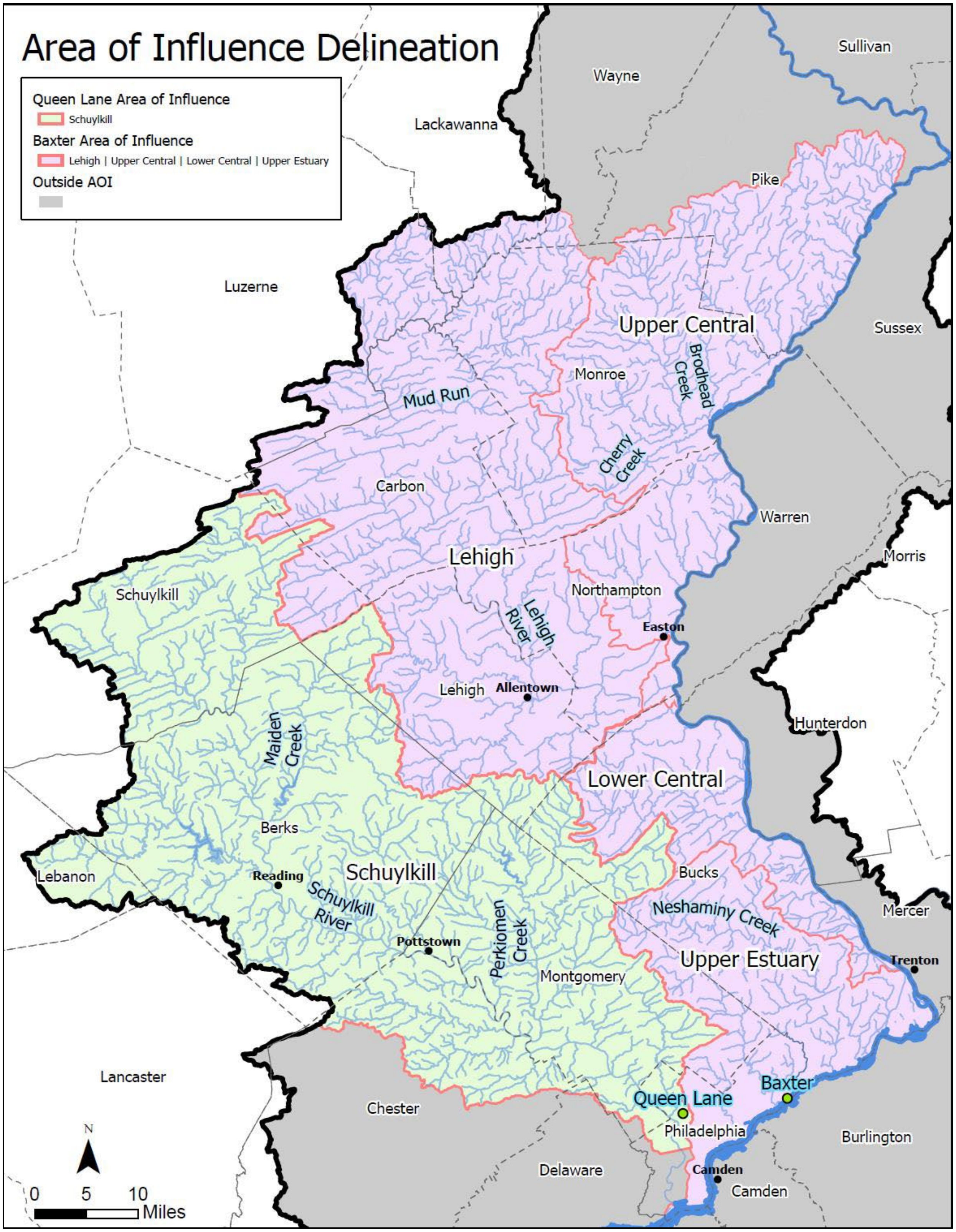

Figure 1 Queen Lane and Baxter Areas of Influence (AOI)

The sections that follow provide an overview of the history, geology, and land cover of the Queen Lane and Baxter AOIs.

2.1.1.1 Queen Lane AOI Schuylkill River Watershed History, Physiography, Geology, and Soils

Section 1.2.2 of the Schuylkill River Watershed Source Water Assessment, available on https://water.phila.gov/reporting/watershed-plans-reports/, includes a brief history of the Schuylkill River watershed beginning with colonial settlement of the lower Schuylkill and establishment of the city of Philadelphia and following the industrialization of the watershed and development of the Schuylkill River as a water supply. Key points from the rich history of the Schuylkill River Watershed include:

- The lower Schuylkill River Watershed was the home of the Lenape tribe prior to colonial settlement by the British, which initially occurred at the confluence of the river's mouth with the Delaware River.
- Coal was discovered in the headwaters of the watershed as early as the 1770s. Coal production reached its peak in the 1920s, declined during the Great Depression, rose during World War II, and then declined to its current low production rate. Environmental impacts of historic coal mining in the headwaters of the Schuylkill River Watershed headwaters can still be observed today in the form of excess metals in abandoned mine drainage into the watershed.
- Population growth in the watershed's early history increased the amount of untreated sanitary and industrial wastewater that was discharged directly into the Schuylkill River up to the late 1800s and is documented in the 1884 PWD Sanitary Survey. Along with population growth came land development, which greatly changed the quality and quantity of stormwater runoff in the Schuylkill River Watershed.
- In 1801, the City of Philadelphia began to use the Schuylkill River as a potable water supply. Today the Schuylkill River watershed is the source of drinking water for nearly 2 million people.

Section 1.2.3 of the 2002 Schuylkill River Watershed Source Water Assessment includes a characterization of the physiography, geology and soils in the Schuylkill River watershed. Key points include:

- Between its origin in the Appalachian Mountains and its confluence with the Delaware River, the Schuylkill River drains over 1,900 square miles and includes 12 major sub-watersheds.
- The Schuylkill River flows through the Valley and Ridge Province in the Appalachian Mountains, then enters the Great Valley section at the boundary between Schuylkill and Berks counties, the Piedmont Province downstream of the City of Reading, and the Coastal Plain downstream of the Fairmount Dam.
- Susceptibility to erosion is determined by the physical properties of the soils in the Schuylkill River Watershed. The majority of the watershed contains well drained soils on significant slopes that generate moderate runoff during rain events. Development on steeply sloping areas can create more of an impact on river water quality than development on gently sloped areas.

2.1.1.2 Baxter AOI Delaware River Watershed History, Physiography, Geology, and Soils

Section 1.2.2 of the 2002 Delaware River Source Water Assessment, available on https://water.phila.gov/reporting/watershed-plans-reports/, includes a brief history of the industrialization and development of the Delaware River Watershed as a water supply. Key points from the history of the Delaware River watershed include:

- The early European settlers in the Delaware River watershed began a 300- year legacy of pollution in the 1600s that would not be abated until protective measures were deemed a priority in the mid-1900s.
- Direct dumping of waste into the river, poor farming practices, the erosion and runoff that resulted from excessive land clearing, and developments in industrialization, transportation, and coal mining all contributed to the watershed's pollution problems.
- Significant improvements in water quality have been made in the Delaware River since its darkest days in the 1940s, when pollution threatened the fishing, shipping, and transportation industries, as well as the health and well-being of watershed inhabitants who depended on it.
- Except for seasonal violations of a few parameters such as dissolved oxygen and fecal coliform in the estuary area and occasional toxic contaminant and nutrient loading alerts in certain river zones, the Delaware now meets the current water quality standards.
- The Delaware River clean-up effort that began in the 1960s now serves as a model of successful interstate water resource management.

Section 1.2.3 of the 2002 Delaware River Source Water Assessment includes a characterization of the physiography, geology, and soils in the Delaware River Watershed. Key points include:

- The Delaware River Watershed is composed of a number of smaller subwatersheds, the most notable of which include: the Lehigh River, Crosswicks Creek, Musconetcong River, Rancocas Creek, Neshaminy Creek, and Tohickon Creek watersheds.
- The watershed is also divided into five physiographic provinces, each with its own unique geology, groundwater, and soil composition. From north to south, the five provinces are: the Appalachian Plateau, the Valley and Ridge, the New England Upland, the Piedmont, and the Atlantic Coastal Plain.
- In 1999, after it was discovered that development was adversely affecting groundwater levels in certain areas, the Delaware River Basin Commission adopted regulations that established groundwater withdrawal limits for 76 watersheds that are within, or partly within, the Groundwater Protected Area of Southeastern Pennsylvania, in order to protect this important resource.

2.1.1.3 Queen Lane AOI Land Cover

In 2021, the United States Geological Survey released the latest iteration of the National Land Cover Database (NLCD). This latest release does not include differences from the Land Cover and Impervious Surface data which had been released in 2019. PWD recently completed land use assessments using NLCD 2019 data and will continue to cite this data until NLCD releases updated Land Cover data. This section includes a summary of the land cover in the Schuylkill River watershed and an analysis of the land cover changes that occurred from 2016 to 2019.

More information and definitions of the land cover classifications are available from the Multi-Resolution Land Characteristics Consortium. The 2019 dataset is mapped for the Schuylkill River watershed in Figure 2.

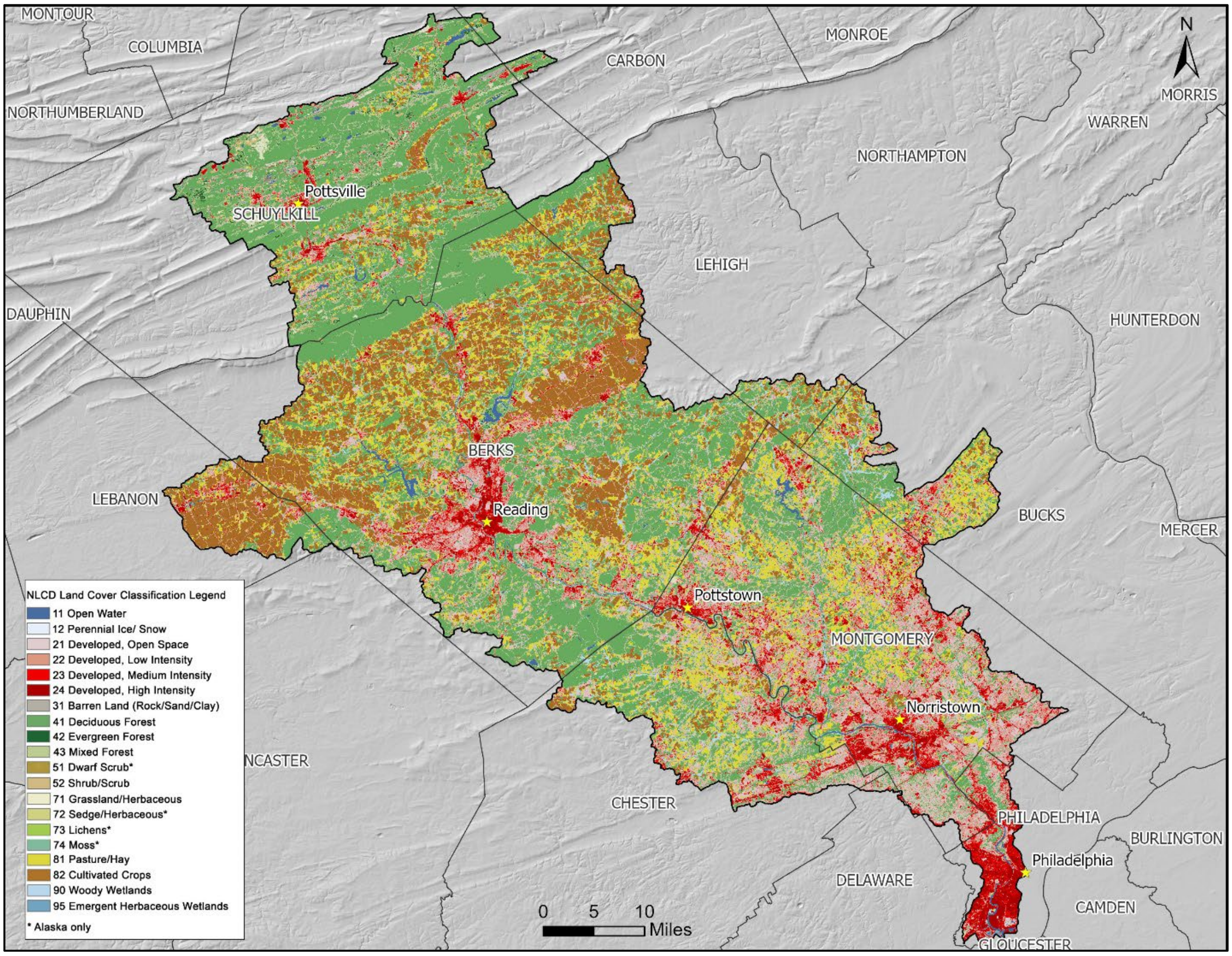

Figure 2 Land Use in Queen Lane AOI, NLCD 2019

Table 1 lists the total land area by land cover class in 2016 and 2019 in square miles. Table 2 lists the percent land area with each land cover class in the Schuylkill River Watershed in 2016 and 2019.

Table 1 Land Cover Classification of the Queen Lane AOI, Square Miles (NLCD 2019)

Land Cover Class	Land Use Classification	Code	2016 Area (Sq. Miles)	2019 Area (Sq. Miles)
Water	Open Water	11	17.9	17.6
Water	Perennial Ice/Snow	12	0.0	0.0
Developed	Developed-Open Space	21	254.5	255.6
Developed	Developed-Low Intensity	22	139.3	154.8
Developed	Developed-Medium Intensity	23	75.6	91.7
Developed	Developed-High Intensity	24	36.4	48.6
Barren	Barren Land	31	11.25	8.7
Forest	Deciduous Forest	41	627.9	636.6
Forest	Evergreen Forest	42	7.65	6.5
Forest	Mixed Forest	43	157.7	117.0
Shrubland	Shrub/Scrub	52	21.9	18.6
Herbaceous	Grassland/Herbaceous	71	7.9	11.5
Planted/Cultivated	Pasture/Hay	81	256.6	247.1
Planted/Cultivated	Cultivated Crops	82	271.9	271.5
Wetlands	Woody Wetlands	90	22.0	23.8
Wetlands	Herbaceous Wetlands	95	1.58	1.9

Table 2 Land Cover Classification of the Queen Lane AOI, Percent of Total Area (NLCD 2019)

Land Cover Class	Land Use Classification	Code	2016 % of Total Area	2019 % of Total Area
Water	Open Water	11	0.9%	0.9%
Water	Perennial Ice/Snow	12	0.0%	0.0%
Developed	Developed-Open Space	21	13.3%	13.4%
Developed	Developed-Low Intensity	22	7.3%	8.1%
Developed	Developed-Medium Intensity	23	4.0%	4.8%
Developed	Developed-High Intensity	24	1.9%	2.5%
Barren	Barren Land	31	0.6%	0.5%
Forest	Deciduous Forest	41	32.9%	33.3%
Forest	Evergreen Forest	42	0.4%	0.3%
Forest	Mixed Forest	43	8.3%	6.1%
Shrubland	Shrub/Scrub	52	1.1%	1.0%
Herbaceous	Grassland/Herbaceous	71	0.4%	0.6%
Planted/Cultivated	Pasture/Hay	81	13.4%	12.9%
Planted/Cultivated	Cultivated Crops	82	14.2%	14.2%
Wetlands	Woody Wetlands	90	1.2%	1.2%
Wetlands	Herbaceous Wetlands	95	0.1%	0.1%

A total of 27.1% of the Schuylkill River Watershed land cover is attributed to agricultural uses (e.g., pasture/hay and cultivated crops). In general, from 2016 to 2019, there has been a slight (~2%) increase in developed land (open space, low intensity, medium intensity and high intensity). From 2016 to 2019 there has been a slight (~2%) decrease in mixed forest land.

Table 3 Net Gain or Loss of Land Area by Land Cover Classification in the Queen Lane AOI 2016- 2019

Land Cover Classification	2016 to 2019 Difference, Sq. Miles	2016 to 2019 Difference, % of Total Area
Open Water	-0.3	0.0
Perennial Ice/Snow	0.0	0.0
Developed-Open Space	1.1	0.1
Developed-Low Intensity	15.5	0.8
Developed-Medium Intensity	16.1	0.8
Developed-High Intensity	12.2	0.6
Barren Land	-2.6	-0.1
Deciduous Forest	8.7	0.5
Evergreen Forest	-1.1	-0.1
Mixed Forest	-40.7	-2.1
Shrub/Scrub	-3.3	-0.2
Grassland/Herbaceous	3.6	0.2
Pasture/Hay	-9.5	-0.5
Cultivated Crops	-0.4	0.0
Woody Wetlands	1.8	0.1
Herbaceous Wetlands	0.3	0.0

Table 3 shows the net gain or net loss of land area in square miles from 2016 to 2019 in each of the 16 classes of land cover. There was a net gain of approximately 44 square miles of low, medium, and high intensity developed land over the three-year period. Developed open space also increased by approximately 1 square mile. There was a net loss of approximately 41 square miles of mixed forest and a net loss of approximately 10 square miles of pasture/hay and cultivated crops over the same period.

Table 4 summarizes the major land cover classifications and the percent land area of each classification within the Schuylkill River watershed. Developed lands include developed open space, low intensity, medium intensity and high intensity land cover classifications. Forested lands include deciduous forest and evergreen forest land cover classifications. Agricultural lands include pasture/hay and cultivated crops land cover classifications. From 2016 to 2019, there was a 2.3% increase in developed land area, a 6.5% increase in forested land area, and a 0.5% decrease in agricultural land area.

Table 4 Percent Developed, Forested and Agricultural Land in the Queen Lane AOI 2016-2019

Land Cover Group	2016 % Land Cover Area	2019 % Land Cover Area	Percent Change 2016 to 2019
Developed	26.5%	28.8%	2.3%
Forest	33.3%	39.8%	6.5%
Agriculture	27.6%	27.1%	-0.5%

Source: Adapted from National Land Cover Database 2016, 2019 (2019 Editions)

2.1.1.4 Baxter AOI Land Cover

The sub-basins of the Delaware River Watershed within the Baxter AOI are delineated in the 2020 *PWD Watershed Control Plan Update.* The Baxter AOI covers a total of 2,873 square miles and includes the Lehigh Valley sub-basin and the Pennsylvania side of the Upper Central, Lower Central, and Upper Estuary sub-basins comprising 47%, 28%, 9%, and 15% of the land area in the AOI, respectively.

A land use analysis of the Baxter AOI using the 2019 NLCD is summarized in this section. More information and definitions of the land cover classifications are available from the Multi-Resolution Land Characteristics Consortium. Figure 3 presents the NLCD 2019 land use for the Baxter AOI.

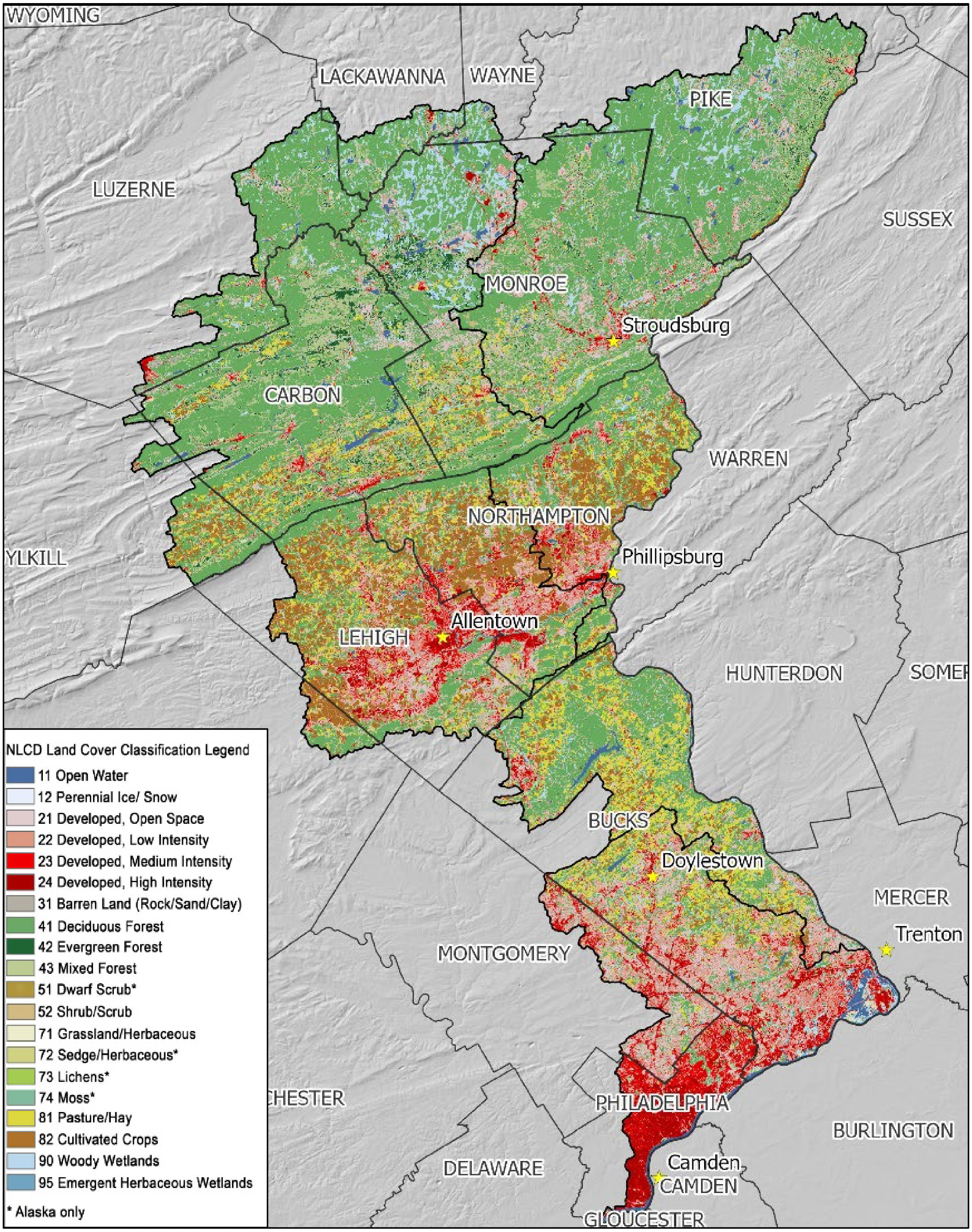

Figure 3 Map of Land Use in the Baxter AOI, NLCD 2019

Table 5 lists the total land area by land cover class in 2016 and 2019 in square miles. Table 6 lists the percent land area within each land cover class in the Baxter AOI in 2016 and 2019.

Table 5 Land Cover Classification of the Baxter AOI in Square Miles, NLCD 2019

Land Cover Class	Land Use Classification	Code	2016 Area (sq. mi)	2019 Area (sq. mi)
Water	Open Water	11	52.8	51.7
Water	Perennial Ice/Snow	12	-	-
Developed	Developed-Open Space	21	366.8	365.5
Developed	Developed-Low Intensity	22	217.8	218.3
Developed	Developed-Medium Intensity	23	128.6	130.8
Developed	Developed-High Intensity	24	74.1	75.2
Barren	Barren Land	31	12.3	10.7
Forest	Deciduous Forest	41	1,173.0	1,175.9
Forest	Evergreen Forest	42	47.4	47.2
Forest	Mixed Forest	43	207.3	207.6
Shrubland	Shrub/Scrub	52	19.2	15.5
Herbaceous	Grassland/Herbaceous	71	15.0	15.2
Planted/Cultivated	Pasture/Hay	81	223.4	223.1
Planted/Cultivated	Cultivated Crops	82	214.2	214.4
Wetlands	Woody Wetlands	90	127.4	127
Wetlands	Herbaceous Wetlands	95	5.1	6.5

Table 6 Land Cover Classification of the Baxter AOI by Percentage, NLCD 2019

Land Cover Class	Land Use Classification	Code	2016 % of Total Area	2019 % of Total Area
Water	Open Water	11	1.8%	1.8%
Water	Perennial Ice/Snow	12	-	-
Developed	Developed-Open Space	21	12.7%	12.7%
Developed	Developed-Low Intensity	22	7.6%	7.6%
Developed	Developed-Medium Intensity	23	4.5%	4.5%
Developed	Developed-High Intensity	24	2.6%	2.6%
Barren	Barren Land	31	0.4%	0.4%
Forest	Deciduous Forest	41	40.7%	40.8%
Forest	Evergreen Forest	42	1.6%	1.6%
Forest	Mixed Forest	43	7.2%	7.2%
Shrubland	Shrub/Scrub	52	0.7%	0.5%
Herbaceous	Grassland/Herbaceous	71	0.5%	0.5%
Planted/Cultivated	Pasture/Hay	81	7.7%	7.7%
Planted/Cultivated	Cultivated Crops	82	7.4%	7.4%
Wetlands	Woody Wetlands	90	4.4%	4.4%
Wetlands	Herbaceous Wetlands	95	0.2%	0.2%

Approximately 15% of the Delaware River Watershed land cover is attributed to agricultural uses (e.g., pasture/hay and cultivated crops). In general, from 2016 to 2019, there has been an increase in developed land (open space, low intensity, medium intensity and high intensity). Cultivated crops saw a slight decrease during this period. Deciduous forest, pasture/hay, and mixed forest land have remained relatively the same.

Table 7 shows the net gain or net loss of land area in square miles from 2016 to 2019 in each of the 16 classes of land cover. There was a net gain of approximately 3.8 square miles of low, medium, and high intensity developed land over the three-year period. There was an increase of approximately 2.9 square miles of deciduous forest and a net loss of approximately 0.1 square miles of pasture/hay and cultivated crops over the same period.

Table 7 Net Gain or Loss of Land Area by Land Cover Classification in Baxter AOI 2016- 2019

Land Cover Classification	2016 to 2019 Difference, Sq. Miles	2016 to 2019 Difference, % of Total Area
Open Water	-1.1	-2.1
Perennial Ice/Snow	0.0	
Developed-Open Space	-1.3	-0.4
Developed-Low Intensity	0.5	0.2
Developed-Medium Intensity	2.2	1.7
Developed-High Intensity	1.1	1.5
Barren Land	-1.6	-15.0
Deciduous Forest	2.9	0.2
Evergreen Forest	-0.2	-0.4
Mixed Forest	0.3	0.1
Shrub/Scrub	-3.7	-23.9
Grassland/Herbaceous	0.2	1.3
Pasture/Hay	-0.3	-0.1
Cultivated Crops	0.2	0.1
Woody Wetlands	-0.4	-0.3
Herbaceous Wetlands	1.4	21.5

Table 8 summarizes the major land cover classifications by groups and the percent land area of the Schuylkill River watershed in each group. Developed includes developed open space, low intensity, medium intensity and high intensity land cover classifications. Forested includes deciduous forest and evergreen forest land cover classifications. Agriculture includes pasture/hay and cultivated crops land cover classifications. From 2016 to 2019, there was a 0.1% increase in developed land area, a 7.1% decrease in forested land area, and no change in agricultural land area.

Table 8 Percent Developed, Forested and Agricultural Land in the Baxter AOI 2016-2019

Land Cover Group	2016 % Land Cover Area	2019 % Land Cover Area	Percent Change 2016 to 2019
Developed	27.3%	27.4%	0.1%
Forest	49.5%	42.4%	-7.1%
Agriculture	15.2%	15.2%	0.0%

2.2 Water Supply System

Philadelphia is supplied by two surface water sources, the non-tidal Schuylkill River and tidal Delaware River. PWD owns and operates three drinking water treatment plants (WTPs); the Baxter WTP, Belmont WTP, and Queen Lane WTP. Baxter WTP is supplied by the freshwater tidal Delaware River and the Belmont and Queen Lane WTPs are supplied by the non-tidal Schuylkill River. WTPs have been owned and operated by PWD for over 100 years at their current locations. The WTPs have undergone treatment modifications over time, converting from slow sand to rapid sand filtration in the 1960s and converting again in the 1980s and 1990s to the dual media filtration used today. All three PWD WTPs are conventional treatment plants with coagulation, flocculation, sedimentation, filtration, and disinfection processes.

The PWD distribution system is responsible for moving water from the intakes to the treatment plants, and from the treatment plants to 1.6 million customers. Water is moved across Philadelphia through over 3,145 miles of water mains to approximately 483,000 residential connections, 12,900 commercial connections, 25,355 fire hydrants and residential fire suppression systems. Distribution system assets include over 91,717 valves, 2,298 miles of cast iron pipe, 756 miles of ductile iron pipe, 85 miles of steel pipe, and 6.5 miles of concrete pipe. The distribution system is also composed of the 3 intake pumping stations, 12 finished water storage facilities, and 13 finished water pumping stations that service 13 pressure districts.

PWD emergency response capabilities consist of a multi-barrier approach with established protections for the drinking water supply, treatment facilities, and distribution system. PWD has a robust Source Water Protection Program with numerous capabilities to address contamination risks upstream and facilitate rapid emergency response. These capabilities include communication and warning systems, water supply modeling, cross-channel transport modeling, watershed partnerships, and chemical and biological laboratory testing. PWD also solicits and investigates customer feedback and has multiple channels to directly communicate with customers in the event of an emergency.

Section 3. Potential Sources of Pathogens in the Watershed

Identifying potential sources of contamination in the watershed is the second component of a Watershed Sanitary Survey (WSS) as described in the 1993 Watershed Sanitary Survey Guidance Manual from the AWWA Nevada-California Section. This section will focus on potential sources of *Cryptosporidium* and pathogens to align with the priorities of the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR).

In the WCP, PWD identified three priority sources of *Cryptosporidium*: wastewater discharges, runoff from agricultural land use; and wildlife and animal vectors. These priority sources are described in further detail in this section.

3.1 Wastewater Discharges

In the Watershed Control Plan (WCP), PWD identified wastewater discharges in the watershed as the largest source of *Cryptosporidium* in the Queen Lane and Baxter AOIs. *Cryptosporidium* loading to the Queen Lane and Baxter AOIs from WWTP effluent may be estimated using available data sources and a series of assumptions.

The following section will provide an updated list of WWTPs discharging to the Queen Lane and Baxter AOIs. It will also summarize available information on the disinfection technology used at these facilities, where available.

3.1.1 Wastewater Treatment Plants

The EPA Water Pollutant Loading Tool is an online database of facilities with permits to discharge treated wastewater effluent into rivers. The database includes site location, permit and compliance information. PWD compiled an updated list of major and minor wastewater treatment plants (WWTPs) in the Queen Lane and Baxter AOIs from searches performed in November and December 2024.

The EPA Water Pollutant Loading Tool provides permitted flow capacity and the daily average flow summarized by year. To capture the most up to date data, a search was performed for 2024 average flow. It should be noted that due to the search being performed during November and December 2024, it is anticipated that the 2024 average flow (MGD) excludes the reported flows from November and December 2024.

A complete list of WWTPs discharging to the Queen Lane and Baxter AOIs is included in Appendix A. The following tables summarize the 2024 average flow and permitted flow capacity by county.

Table 9 2024 Daily Average and Permitted Flows from Wastewater Treatment Plants in the Queen Lane AOI

County	2024 Average Flow, MGD*	Permitted Flow, MGD**
Berks	15.35	28.61
Bucks	3.80	5.39
Chester	10.34	18.39
Lebanon	1.72	2.50
Lebanon County	0.00	0.00
Lehigh	0.08	0.12
Montgomery	45.15	77.51
Schuylkill	4.29	10.45
Total	**80.73**	**142.78**

*2024 daily average flow includes data from 1/1/2024 – 11/30/2024 depending upon available data in EPA ECHO database, search performed 12/1/2024

**Data from EPA ECHO database, search performed 12/1/2024

In the Queen Lane AOI the largest 2024 wastewater discharges come from Montgomery County (45.15 MGD), Berks County (15.35), and Chester County (10.34 MGD). The other counties within the Queen Lane AOI only provide small contributions of treated wastewater effluent to the watershed.

Table 10 2024 Daily Average and Permitted Flows from Wastewater Treatment Plants in the Baxter AOI

County	2024 Average Flow, MGD*	Permitted Flow, MGD**
Bucks	27.30	45.09
Carbon	2.21	4.66
Lackawanna	0.07	0.07
Lehigh	2.31	4.23
Luzerne	0.06	0.09
Monroe	2.19	5.64
Montgomery	10.34	13.08
Northampton	3.49	4.25
Schuylkill	0.02	0.06
Wayne	0.13	0.50
Total	**48.12**	**85.67**

*2024 daily average flow includes data from 1/1/2024 – 11/30/2024 depending upon available data in EPA ECHO database, search performed 12/1/2024

**Data from EPA ECHO database, search performed 12/1/2024

In the Baxter AOI the largest 2024 wastewater discharges come from Bucks County (27.30 MGD) and Montgomery County (10.34 MGD). Wastewater discharges within the Queen Lane AOI are nearly double the flow of wastewater discharges within the Baxter AOI.

3.1.1.1 Wastewater Treatment Technology

Wastewater treatment technology significantly impacts the *Cryptosporidium* loading to the watershed from NPDES discharges. The majority of WWTPs traditionally use secondary treatment, which may achieve 0.7- to 2-log removal. *Cryptosporidium* can be difficult to remove or inactivate using traditional treatment techniques. Alternative technologies, such as ultraviolet (UV) disinfection, can be more effective (Crockett, 2007). Typical UV applications are categorized as Low Pressure and dose approximately 40 mJ/cm^2. These applications achieve a 3- to 4-log inactivation of protozoa including *Cryptosporidium* (Water Research Foundation, 2015).

There are a number of benefits to modifying disinfection processes in the wastewater treatment process, such as implementing UV. WWTPs have NPDES compliance requirements to reduce chlorine residual in effluent. The use of UV disinfection provides the opportunity to address compliance requirements and potentially lower the cost of dechlorination. Additionally, improved inactivation of *Cryptosporidium* and other pathogens provides recreational benefits. UV is more effective at inactivating *Cryptosporidium* oocysts than chlorine disinfection, but it does not physically remove them. Both viable and nonviable oocysts are accounted for in Method 1623, the sample and lab analysis method required by LT2ESWTR. Therefore, nonviable oocysts will still be counted towards a water treatment plant's Bin status. Modifying WWTP treatment processes for UV disinfection requires capital investment that must be weighed against other capital needs and alternatives for reducing *Cryptosporidium* and pathogen loading to the watershed.

PWD does not have jurisdiction over upstream WWTP discharges and looks to PADEP to enforce NPDES requirements. As part of the WCP program, PWD continues to track WWTP discharges and changes in treatment technologies employed upstream with assistance from watershed partners through the SAN. In a WWTP operator survey completed through the SAN in 2007, 54 WWTPs reported using chorine disinfection and 14 WWTPs reported using UV disinfection. PWD included the survey results in the 2011 WCP and identified two WWTPs, Upper Gwynedd and Fleetwood, in the Schuylkill River watershed in the process of installing UV disinfection systems. PWD tracked these WWTP upgrades through media sources.

Disinfection treatment technology information was available in the Chapter 94 Wasteload Management reports submitted to PADEP. Out of the 72 WWTPs in the Queen Lane AOI, 32 (44%) disinfect effluent using UV. Table 9 lists the total WWTP discharge by major sub-watershed in the Queen Lane AOI disinfected using UV treatment, disinfected using other treatment technology (typically chlorine) and with unknown treatment technology. Of the 108 MGD of treated WWTP effluent discharged into the Schuylkill River watershed, 27.8 MGD has been disinfected using UV, and 80.2 MGD has been treated with chlorine or other non-UV techniques. Over 90% of the WWTP effluent discharged to the Allegheny Creek, Maiden Creek and Wissahickon Creek sub-watersheds has been disinfected using UV. This high percentage of UV disinfected WWTP discharge is particularly notable for the Wissahickon Creek as flow from this sub-watershed influences the raw water quality for the PWD Queen Lane WTP.

PWD will begin analysis of Chapter 94 Wasteload Management reports submitted to PADEP for WWTPs located within the Baxter AOI beginning January 2025 and provide the results of this research in the next

Watershed Sanitary Survey. PWD will work closely with the PADEP Southeast Regional and Northeast Regional offices to obtain and review the Chapter 94 reports to track which WWTPs in the Baxter AOI utilize UV disinfection technology.

Table 11 WWTP Discharge Treated with UV Disinfection by Sub-Watershed within the Queen Lane AOI

Sub-Watershed	WWTP Discharge with UV Disinfection (MGD)	WWTP Discharge with Other Disinfection Technology* (MGD)	WWTP Discharge with Unknown Disinfection Technology (MGD)	% Treated With UV
Allegheny Creek	0.51	0	0	100%
Little Schuylkill	0.11	3.51	0.0020	3%
Lower Schuylkill (Above Philadelphia)	0	2.23	0.0004	0%
Maiden Creek	1.30	0.11	0.0157	91%
Manatawny Creek	0.21	0.19	0.0002	52%
Middle Schuylkill 1	6.09	15.78	0.0031	28%
Middle Schuylkill 2	0.97	9.21	0.0007	10%
Middle Schuylkill 3	0.02	22.24	0.0034	0%
Perkiomen Creek	6.22	16.76	0.1123	27%
Tulpehocken Creek	1.81	1.56	0.0494	53%
Upper Schuylkill	0.92	8.81	0.0958	9%
Wissahickon Creek	9.65	0.65	0	94%
Total	**27.8**	**81.1**	**0.3**	

Typically chlorine disinfection

3.1.2 Other Wastewater Discharges

3.1.2.1 Combined Sewer Overflows

There are a number of communities in the Schuylkill River watershed, including Philadelphia, with combined sewer systems that experience combined sewer overflows (CSOs) during wet weather. In the 2002 SWA, PWD identified two communities, Norristown and Bridgeport, with CSOs that were considered potentially significant sources of *Cryptosporidium* and fecal coliform. Additional communities in Schuylkill County have CSOs as well and are located farther upstream from Philadelphia. There are no Philadelphia CSO outfalls located upstream of the city's drinking water intakes along the Schuylkill River.

In the Delaware River watershed there are very few CSOs within the Baxter AOI. PWD identified three communities within the Baxter AOI—Bethlehem, Easton and Lansdale— that have a small number of active CSOs.

In 1994, EPA published the CSO Control Policy which provided guidance to communities with combined sewer systems to meet Clean Water Act goals. The policy required communities to first implement minimum technology-based controls and then develop a long-term control plan (LTCP) that would ultimately lead to full compliance with the Clean Water Act. Table 12 summarizes the number of CSOs in each of these communities categorized as ACTIVE by the PADEP-maintained list of CSO communities in Pennsylvania. PWD relies on PADEP to oversee permit compliance, including the reduction and elimination of CSOs. The implementation of LTCPs is critical to this effort.

Table 12 Summary of Facilities with CSOs Upstream of Philadelphia

FACILITY NAME	COUNTY	CURRENT NUMBER OF CSO OUTFALLS
Queen Lane AOI		
Bridgeport Borough STP	Montgomery	5
Norristown Municipal STP	Montgomery	1
St. Clair WWTP	Schuylkill	6
Coaldale-Lansford-Summit Hill Sewer Authority	Schuylkill	6
Tamaqua Borough	Schuylkill	12
Minersville Sewer Authority WWTP	Schuylkill	4
Pottsville Main STP	Schuylkill	22
Baxter AOI		
Bethlehem City WWTP	Northampton	2
Easton City	Northampton	2
Lansdale Boro STP	Montgomery	2
Total		62

Source: Adapted from PADEP Combined Sewer Overflow Listing available from PADEP eLibrary (December 2024)

3.1.2.2 Wildcat Sewers

In the 2002 Source Water Assessment, PWD identified communities in Schuylkill River watershed suspected of having ‘wildcat’ sewers. Wildcat sewers are illegal sewers that discharge untreated or partially treated sewage to waterways, the land, or storm sewer systems. The Schuylkill Action Network (SAN), a watershed-wide organization, formed in 2003 and detailed in Section 4.3.1, is divided into workgroups to address major pollutant sources, protect priority land, and conduct education and outreach in the Schuylkill River watershed. The SAN Pathogens/Compliance Workgroup works to improve NPDES compliance, reduce discharges from unsewered communities and prevent drinking water illness outbreaks. The workgroup has four strategies to address these issues: improve discharger and water supplier communication of events; identify priority wastewater discharges and issues in the watershed; provide support for partners and communities to implement projects that reduce priority discharges; and provide a forum for partner and agency communication and coordination around discharge issues. The SAN Pathogens/Compliance workgroup members include EPA, PADEP, PENNVEST, Partnership for the Delaware Estuary (PDE), and drinking water suppliers. Since its formation, the SAN Pathogens/Compliance workgroup— particularly its members representing EPA, PADEP, and PENNVEST —have led efforts to identify and abate wildcat sewers in the Schuylkill River Watershed (PWD, 2011). PENNVEST has funded a number of projects that address wildcat sewers as well as other sewage issues.

As of 2018, the SAN Pathogens/Compliance Workgroup has addressed 30 wildcat sewer dischargers in the Schuylkill River Watershed.

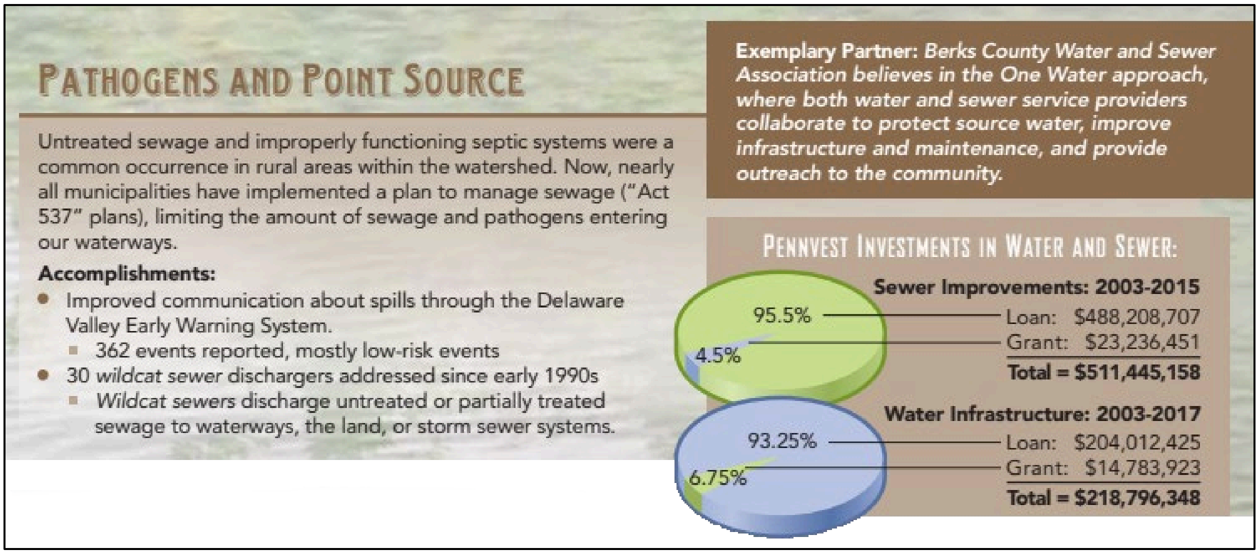

Figure 4 Summary of Schuylkill Action Network Pathogen Committee Progress, 2018 Annual Report

In the Baxter AOI within Delaware River watershed there are no wildcat sewers known to PWD. However, as the newly created Delaware River Improvement Partnership and the DRBC Subcommittee on Source Water Protection continue to grow and become more established, PWD will work through these groups to identify any wildcat sewers. In the upper Schuylkill River watershed, wildcat sewers were a known and high priority issue for watershed stakeholders participating in the SAN. A group of similar stakeholders has yet to emerge from within the Delaware River watershed, but that does not mean wildcat sewers don't exist. PWD will reach out to stakeholders through these watershed partnerships and work to identify any wildcat sewers in the Baxter AOI.

3.1.3 Septic System Communities

Wastewater discharge through septic systems is a potential source of *Cryptosporidium* and pathogens in the Queen Lane and Baxter AOIs. Malfunctioning or improperly sited or maintained septic systems may present an increased risk of contamination of groundwater and surface water. Using potable water supply data from PADEP, the potential location of watershed areas with septic systems may be interpreted from Figure 5 and Figure 6. It may be broadly assumed that most communities that *do not* receive potable water from a community water supplier also don't receive wastewater service from a wastewater utility and therefore utilize a septic system.

During the Act 220 State Water Planning effort, PADEP identified areas of the state supplied by community water suppliers. The information is included in a GIS layer available on pasda.psu.edu. The data is revised on an as needed basis, and the layer presented in this analysis was revised in July 2015. Areas served by community waters systems are shown on the map in Figure 5 and Figure 6.

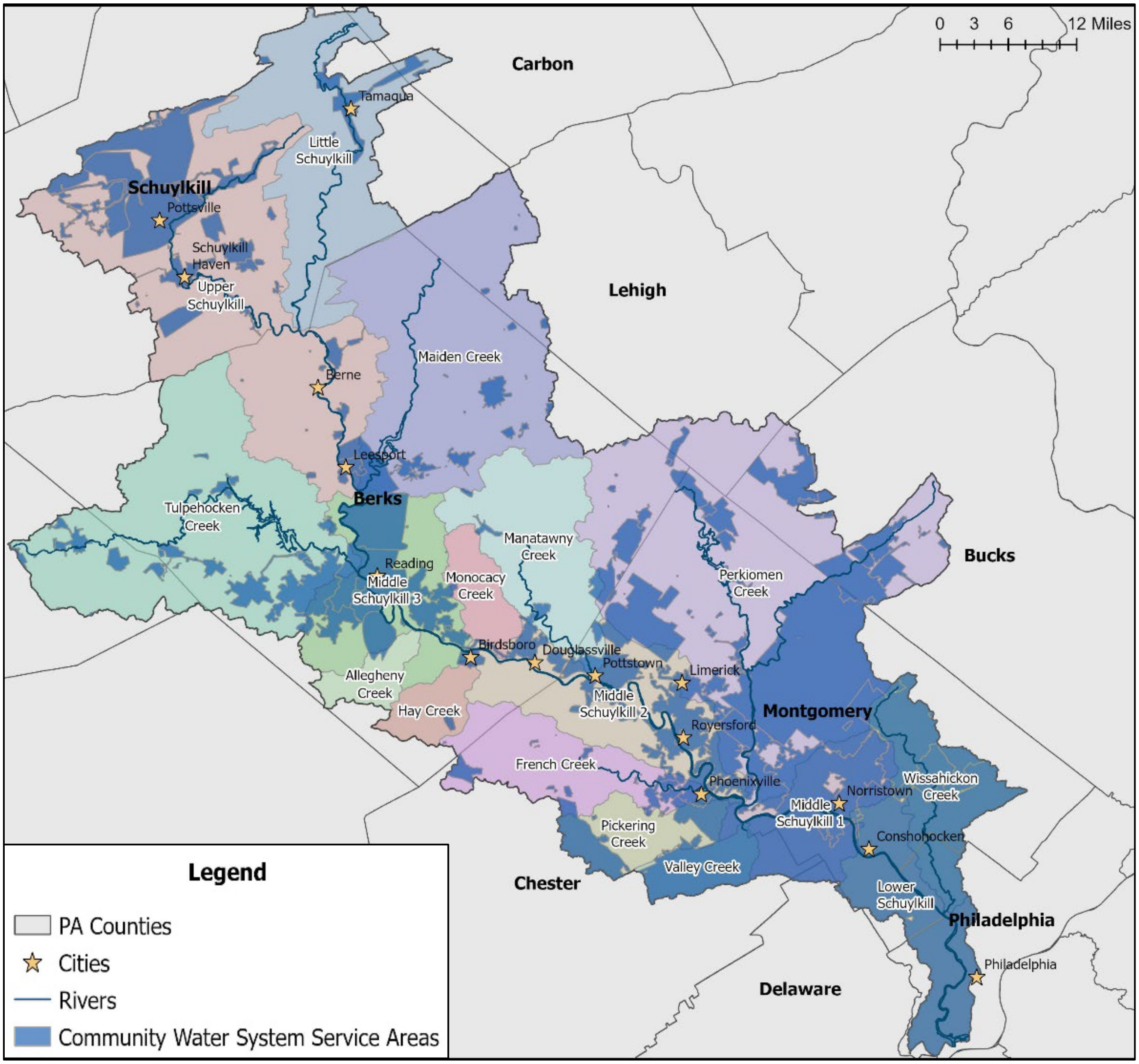

Figure 5 Map of Community Water Supply Service Areas in the Queen Lane AOI

Septic systems are assumed to be used in communities within the Queen Lane AOI where the Community Water System Services Areas (dark blue) do not extend. With the Community Water System Areas overlain on top of the Schuylkill River sub-watersheds, there are many sub-watersheds with communities that may be nearly 100% on septic systems. While not unexpected for rural areas, this contrasts with the highly developed middle and lower Schuylkill River communities that are nearly 100% covered by Community Water Systems.

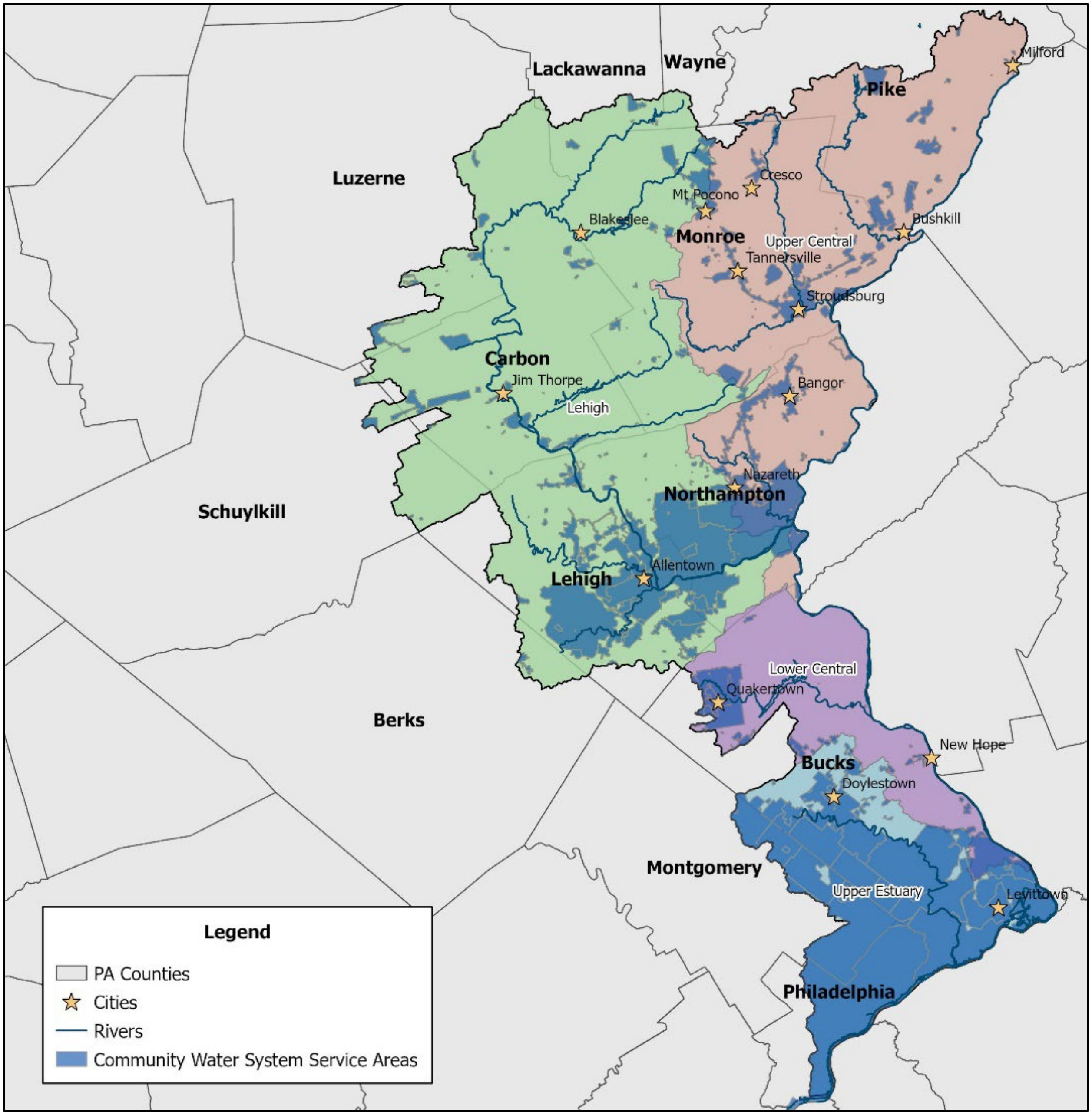

Figure 6 Map of Community Water Supply Service Areas in the Baxter AOI

Septic systems are assumed to be used in communities within the Baxter AOI where the Community Water System Services Areas (dark blue) do not extend. With the Community Water System Areas overlain on top of Delaware River sub-watersheds, there are many small boroughs and towns covered by Community Water System Areas that are surrounded by areas where broad septic system use is assumed.

More detail is known about septic system locations within Philadelphia County due to the updated dataset maintained by the Philadelphia Department of Public Health. This dataset is used to track and map the locations of septic systems in Philadelphia County within the Queen Lane and Baxter AOIs, Figure 7 and Table 13.

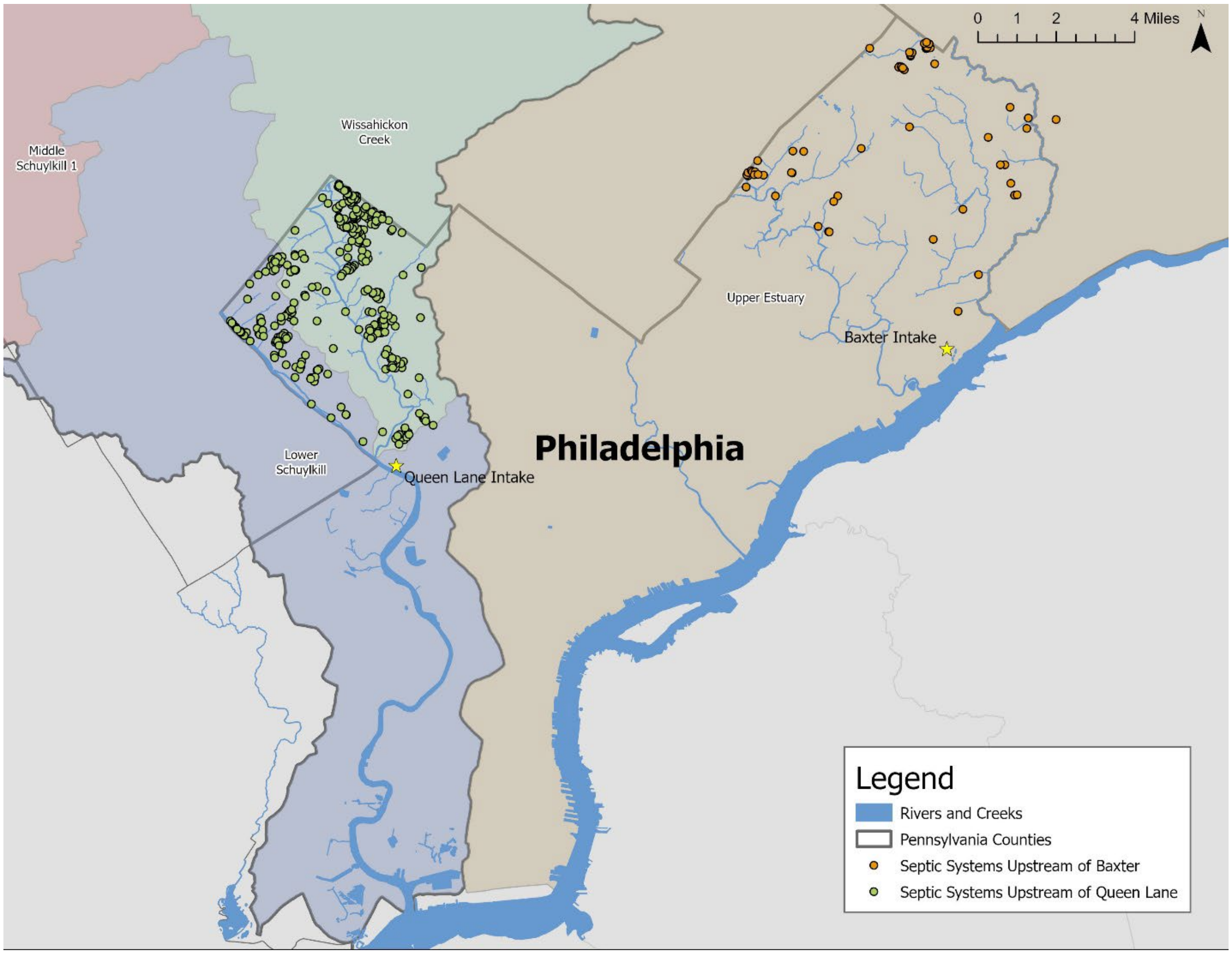

Figure 7 Map of Septic Systems in Philadelphia County Upstream of Queen Lane Water Treatment Plant

Table 13 Number of Septic Systems in Philadelphia County Upstream of Queen Lane and Baxter AOIs

Location	Number of Septic Systems
Baxter AOI	69
Schuylkill AOI	419
Total	**488**

A total of 42 septic system properties within the Philadelphia portion of the Lower Schuylkill sub-watershed are located along River Road in northwest Philadelphia. This stretch of road runs along the Schuylkill River directly upstream of two PWD treatment plant intakes. Sitting at a low elevation, the stretch of residential road is prone to flooding during rain events. Both the city and PADEP had been concerned about the on-lot septic systems of many River Road residential properties sitting in the Schuylkill River's floodplain, but the existing septic systems could not be replaced as they did not meet

PWD began the design for sewer installation and hosted public meetings in 2007, permits and approval for the project were obtained from PADEP in 2008 and 2009, and the road's residents agreed to move forward following more public meetings in 2017.

The approximately mile-long new sanitary sewer provides service for 42 properties along River Road from Port Royal Avenue to County Line Road. A sewage pumping station was constructed and sewage is pumped to the nearby Nixon Street sewer. Construction began in early 2019 and was completed during 2021. According to the updated dataset from the Philadelphia Department of Public Health there are still over 20 septic systems in the vicinity of River Road. PWD will work to follow up with the PWD Construction Division and PDOPH to understand if all septic systems in this reach were mitigated by the new sewer project.

The risk of pathogen contamination to the Queen Lane and Baxter AOIs from septic system discharge may only be understood with broad assumptions. While wastewater from septic systems likely contains pathogens and possibly *Cryptosporidium*, the design, siting, and condition of the septic system will ultimately determine if these pathogens reach the groundwater and ultimately surface water sources.

3.2 Agricultural Land Use Runoff

3.2.1 Agricultural Land Cover

Land cover data from the 2019 NLCD are described in detail in Section 2.1.4. PWD considered pasture/hay and cultivated crops land cover from the NLCD agricultural land use. The Schuylkill River watershed is 27% (518 square miles) agricultural land cover including pasture/hay and cultivated crops. Each sub-watershed had a decrease in agricultural land since 2001, with the exception of the Little Schuylkill watershed, which had a slight increase. The sub-watersheds with the largest proportion of agricultural land cover include the Maiden, Tulpehocken and Monocacy Creek sub-watersheds, which are each approximately 50% agricultural land cover.

The portion of the Baxter Area of Influence within the Delaware River watershed is 15% (438 square miles) agricultural land cover including pasture/hay and cultivated crops.

3.2.2 Livestock Populations

Livestock populations were used to calculate the total loading of *Cryptosporidium* oocysts to the Schuylkill River watershed in the WCP and that methodology is used here. The assumptions and calculations are detailed in Section 5.2.2 of the WCP 2017 Annual Status Report. Livestock populations are available by county from the USDA Pennsylvania Census of Agriculture published every five years. USDA can withhold population data to protect the privacy of individual operations. In such cases, the data are suppressed and shown as “(D),” meaning “withheld to avoid disclosing data for individual operations.” A dash represents zero, no data for that particular data item. “(NA)” means the data is not available. These values were considered null values in the population calculations.

To estimate the population of certain livestock groups in the Queen Lane and Baxter AOIs, the total population of each livestock group in each county was multiplied by the percent of that county within the watershed. The percent land area of each county in the watershed is shown in the second column of Table 14 and Table 15. The percent land area of the watershed in each county is shown in the third column. Montgomery, Berks and Schuylkill Counties comprise more than 75% of the Schuylkill River watershed land area. This simple estimation method does not consider the actual locations of the farms on which these livestock are kept. It assumes each livestock group is evenly distributed throughout the county.

Table 14 Percent County Land Area in the Queen Lane AOI

County	% County Land Area in Queen Lane AOI	% Queen Lane AOI in each County
Berks	87.2%	39.5%
Bucks	11.9%	3.9%
Carbon	1.9%	0.4%
Chester	22.9%	9.1%
Delaware	1.3%	0.1%
Lancaster	0.01%	0.01%
Lebanon	14.7%	2.8%
Lehigh	20.2%	3.7%
Montgomery	82.8%	21.1%
Philadelphia	32.2%	2.4%
Schuylkill	41.5%	17.0%

Table 15 Percent County Land Area in the Baxter AOI

County	% County Land Area in Baxter AOI	% Baxter AOI in each County
Berks	2.5%	0.8%
Bucks	88%	19%
Carbon	97.4%	13.1%
Lackawanna	8.9%	1.4%
Lehigh	79.8%	9.6%
Luzerne	14.6%	4.6%
Monroe	99%	21.2%
Montgomery	16.2%	2.7%
Northampton	100%	13.1%
Philadelphia	62%	3.1%
Pike	45.6%	9%
Schuylkill	7.3%	2%
Wayne	1.6%	0.4%

Several livestock groups are known to have potential to contribute the *Cryptosporidium* loading to the watershed through runoff from agricultural land (PWD, 2011). Table 16, Table 17 and Table 18 show the estimated population of cattle/calves, hogs/pigs and sheep/lambs, respectively, by county in the Queen Lane and Baxter AOIs for each Census of Agriculture year since 2012. The population change and percent change in each county from 2017 to 2022 are also shown in the furthest right columns.

The overall cow and calf population in the Queen Lane AOI decreased by approximately 28%, or about 30,000 cattle/calves, from 2017 to 2022. There were an estimated nearly 54,600 cattle/calves in Berks County in the Schuylkill River watershed in 2022. Since the last Census of Agriculture in 2017, cow and calf populations have decreased in every county in the Schuylkill River watershed by a total of approximately 30,000.

In the Baxter AOI, the population decreased by almost 32%, or around 7,700 cattle/calves over the same period. Northampton County had the largest population of cattle/calves in 2022, at nearly 3,000. This population decreased by over 1,000 or 39%, since the last Census of Agriculture in 2017. Cow and calf populations decreased in every county except Luzerne, where it increased by 4%.

Table 16 Summary of Cows and Cattle for Counties Located in the Queen Lane and Baxter AOIs, 2012-2022

Queen Lane AOI - Cattle and Calves					
County	2012	2017	2022	Population Change 2017 To 2022	% Change In Population 2017 to 2022
Berks	69,132	74,637	54,593	-20,044	-26.9
Bucks	832	1,156	790	-366	-31.7
Carbon	27	28	21	-7	-25.5
Chester	9,031	10,877	5,998	-4,879	-44.9
Delaware	(D)	(D)	--	--	--
Lancaster	37	25	18	-7	-27.1
Lebanon	8,698	9,494	8,379	-1,115	-11.7
Lehigh	780	818	709	-109	-13.3
Montgomery	2,743	3,539	1,421	-2,118	-59.9
Philadelphia	(D)	(D)	(D)	--	--
Schuylkill	5,293	5,473	3,892	-1,581	-28.9
Total	**96,572**	**106,047**	**75,821**	-30,226	-28.5

Baxter AOI - Cattle and Calves					
County	2012	2017	2022	Population Change 2017 To 2022	% Change In Population 2017 to 2022
Berks	701	2,140	1,565	-575	-26.9%
Bucks	2,239	8,548	5,841	-2,707	-31.7%
Carbon	346	1,437	1,069	-367	-25.6%
Lackawanna	124	343	245	-98	-28.6%
Lehigh	1,365	3,233	2,801	-432	-13.4%
Luzerne	203	325	339	14	4.4%
Monroe	164	1,078	456	-622	-57.7%
Montgomery	236	692	278	-414	-59.9%
Northampton	2,398	5,268	3,208	-2,060	-39.1%
Philadelphia	(D)	(D)	(D)	--	--
Pike	46	98	(D)	--	--
Schuylkill	286	963	685	-278	-28.9%
Wayne	111	223	146	-77	-34.6%
Total	**10,230**	**24,348**	**16,634**	-7,714	-31.7%

Table 17 Summary of Hogs and Pigs for Counties Located in the Queen Lane and Baxter AOIs, 2012-2022

Queen Lane AOI - Hogs and Pigs					
County	**2012**	**2017**	**2022**	**Population Change 2017 To 2022**	**% Change in Population 2017 To 2022**
Berks	58,083	68,186	63,693	-4,493	-6.6%
Bucks	63	92	107	15	16.3%
Carbon	1	2	1	-1	-37.3%
Chester	6,286	4,935	3,230	-1,705	-34.6%
Delaware	0	(D)	--	--	--
Lancaster	48	31	32	1	3.9%
Lebanon	14,973	13,288	8,178	-5,110	-38.5%
Lehigh	427	(D)	942	942	--
Montgomery	2,419	879	116	-763	-86.8%
Philadelphia	(D)	7	(D)	--	--
Schuylkill	9,839	4,314	246	-4,068	-94.3%
Total	**92,139**	**91,734**	**76,544**	-15,190	-16.6%

Baxter Area Of Influence – Hogs and Pigs					
County	**2012**	**2017**	**2022**	**Population Change 2017 To 2022**	**% Change in Population 2017 To 2022**
Berks	1,666	1,955	1,826	-129	-6.6%
Bucks	466	677	791	114	16.9%
Carbon	63	102	64	-38	-37.1%
Lackawanna	7	12	8	-4	-32.1%
Lehigh	1,690	(D)	3,719	--	--
Luzerne	31	(D)	42	--	--
Monroe	121	46	153	108	237%
Montgomery	473	172	23	-149	-86.8%
Northampton	268	342	273	-69	-20.2%
Philadelphia	(D)	14	(D)	--	--
Pike	10,813	--	--	--	--
Schuylkill	26	759	43	-716	-94.3%
Wayne	--	5	10	5	89.4%
Total	**15,625**	**4,084**	**6,954**	2,870	70.3%

In the Queen Lane AOI, the population of hogs and pigs decreased by almost 17%, or 15,000 hogs/pigs, from 2017 to 2022. The largest estimated population of hogs and pigs, over 63,000 in 2022, is in Berks County. This population decreased by nearly 5,000 hogs/pigs, or 6.6%, since the 2017 Census of Agriculture. The hog and pig population decreased in Carbon, Chester, Lancaster, Lehigh, and Schuylkill counties, with Schuylkill seeing the greatest decrease of about 4,000 hogs/pigs from 2017 to 2022. Hog and pig populations increased in Bucks and Lancaster Counties, with Bucks County's being the largest at approximately 16%.

In the Baxter AOI, the population of hogs and pigs increased by about 70%, or around 2,800 hogs/pigs, from 2017 to 2022. There were several counties that omitted population data and were therefore not accounted for in the percentage of change calculation. The largest estimated population of hogs and pigs, over 3,700 in 2022, was in Lehigh County.

In the Queen Lane AOI, the population of lambs and sheep increased by 1.3%, or 53 sheep/lambs, from 2017 to 2022. The largest estimated population of sheep and lambs, about 2,800, is in Berks County. This population decreased by approximately 32 sheep/lambs, or 1.1%, since the last Census of Agriculture in 2017. The sheep and lamb population decreased in Berks, Lebanon, and Schuylkill counties. Sheep and lamb populations increased in Bucks, Carbon, Chester, Lehigh, and Montgomery counties. Lancaster County had no change.

In the Baxter AOI, the population of sheep and lambs increased by 12.6%, or 409 sheep/lambs, from 2012 to 2017. The largest estimated population of sheep and lambs, nearly 1,600 in 2017, is in Bucks County. This population increased by 173 sheep/lambs, or 12.2%, since the last Census of Agriculture in 2017. The sheep and lamb population decreased in Berks, Carbon, Pike, Schuylkill, and Wayne counties. Sheep and lamb populations increased in Bucks, Lackawanna, Lehigh. Luzerne, Monroe, Montgomery, and Northampton Counties.

Horse population in the Queen Lane and Baxter AOI is not detailed in the WCP report, but populations of horses and ponies by county in the Queen Land and Baxter AOIs are included here (Table 19). The population of horses and ponies decreased in the Queen Lane AOI by approximately 9%, or 546 horses/ponies, from 2017 to 2022. The largest estimated populations of horses and ponies, ranging from 1,300 to 1,600 in 2017 are in Berks, Chester, and Montgomery Counties. These populations have each decreased by about 1 to 16% since the last Census of Agriculture in 2017. The horse and pony populations increased in Carbon and Lehigh Counties. Populations decreased in Berks, Bucks, Chester, Lebanon, Montgomery, and Philadelphia Counties. Schuylkill and Lancaster Counties had no change.

In the Baxter AOI, the horse and pony population increased by nearly 30%, or 1,200 horse/ponies, from 2017 to 2022. The largest estimated population of horses and ponies is in Northampton County, with 1,400 horses/ponies. Northampton county also had the largest increase in horses/ponies from 2017 to 2022, with the population increasing by nearly 350%, or 1,000 horses/ponies. The horse and pony populations increased in Carbon, Lehigh, and Northampton. Populations decreased in Berks, Bucks, Lackawanna, Luzerne, Monroe, Montgomery, Philadelphia, and Wayne counties. Pike and Schuylkill Counties had little to no change in population.

Table 18 Summary of Sheep and Lambs for Counties Located in the Queen Lane and Baxter AOIs, 1987-2017

Queen Lane AOI – Lambs and Sheep					
County	2012	2017	2022	Population Change 2017 To 2022	% Change In Population 2017 To 2022
Berks	2,007	2,871	2,838	-32	-1.1%
Bucks	228	192	216	23	12.2%
Carbon	4	5	6	1	25.8%
Chester	623	406	569	164	40.3%
Delaware	2	1	(D)	--	--
Lancaster	1	1	1	0	27.9%
Lebanon	297	371	285	-86	-23.2%
Lehigh	144	151	174	23	15.1%
Montgomery	884	589	1,154	566	96.1%
Philadelphia	(D)	(D)	--	--	--
Schuylkill	124	171	122	-49	-28.6%
Total	4,313	4,759	4,215	53	1.3%

Baxter AOI – Lambs and Sheep					
County	2012	2017	2022	Population Change 2017 To 2022	% Change In Population 2017 To 2022
Berks	58	82	81	-1	-1.1%
Bucks	1,678	1,422	1,595	173	12.2%
Carbon	221	299	238	-61	-20.5%
Lackawanna	32	26	27	1	2.7%
Lehigh	568	597	687	90	15.1%
Luzerne	91	109	140	31	28.6%
Monroe	290	(D)	26	26	
Montgomery	173	115	226	111	96.1%
Northampton	543	439	524	85	19.4%
Philadelphia	(D)	(D)	0	--	
Pike	77	37	11	-26	-70.7%
Schuylkill	22	30	22	-9	-28.6%
Wayne	27	16	6	-10	-65.2%
Total	3,779	3,173	3,582	409	12.6%

Table 19 Summary of Horses and Ponies for Counties Located in the Queen Lane and Baxter AOIs, 2012-2022

Queen Lane Area of Influence – Horses and Ponies					
County	2012	2017	2022	Population Change 2017 To 2022	% Change in Population 2017 To 2022
Berks	2,570	1,747	1,472	**-275**	**-15.7%**
Bucks	386	235	224	**-11**	**-4.5%**
Carbon	2	4	6	**2**	**50.1%**
Chester	2,060	1,636	1,620	**-16**	**-1.0%**
Delaware	4	4	--	**--**	**--**
Lancaster	2	1	1	**0**	**18.0%**
Lebanon	314	227	190	**-37**	**-16.4%**
Lehigh	241	141	208	**67**	**47.7%**
Montgomery	1,745	1,478	1,260	**-218**	**-14.7%**
Philadelphia	38	71	16	**-55**	**-77.3%**
Schuylkill	337	378	378	**0**	**0.1%**
Total	**7,699**	**5,922**	**5,376**	**-546**	**-9.2%**

Baxter Area of Influence – Horses and Ponies					
County	2012	2017	2022	Population Change 2017 To 2022	% Change in Population 2017 To 2022
Berks	74	50	42	**-8**	**-15.8%**
Bucks	2,844	1,734	1,660	**-75**	**-4.3%**
Carbon	111	213	308	**94**	**44.3%**
Lackawanna	56	46	38	**-8**	**-17.1%**
Lehigh	951	557	823	**266**	**47.7%**
Luzerne	106	65	43	**-22**	**-34.2%**
Monroe	670	340	317	**-23**	**-6.7%**
Montgomery	341	293	247	**-46**	**-15.9%**
Northampton	891	316	1,414	**1,098**	**347.5%**
Philadelphia	74	138	31	**-107**	**-77.5%**
Pike	79	26	26	**0**	**0%**
Schuylkill	59	66	67	**0**	**0.2%**
Wayne	16	13	11	**-1**	**-8.4%**
Total	**6,274**	**3,857**	**5,026**	**1,169**	**30.3%**

3.2.3 Confined Animal Feeding Operations (CAFOs)

Concentrated animal feeding operations (CAFOs) are agricultural operations where animals are confined in small land areas. CAFOs have the potential to contribute *Cryptosporidium* contaminated runoff to the Schuylkill River watershed. In 2022, PWD retrieved updated CAFO data from PADEP including number of animal equivalent units and primary animal for each operation. As of November 2022, a total of 86 CAFOs exist in the Queen Lane AOI representing more than 69,000 animal equivalent units (AEUs, 1 AEU = 1,000 lbs. of animal weight). These totals mark a significant increase from 2019 data, during which 36 CAFOs representing more than 25,000 AEUs existed in the Queen Lane AOI.

Following the first full implementation year of the approved Watershed Control Plan update, in 2022 PWD for the first time also retrieved CAFO data from PADEP for the Baxter AOI. Within the Baxter AOI, a total of 8 CAFOs exist representing over 3,400 AEUs.

A map depicting 2022 data for both the Schuylkill River watershed and the Baxter intake's area of influence is shown below in Figure 8. Due to a lack of significant changes from year to year, this dataset will be updated every 5 years.

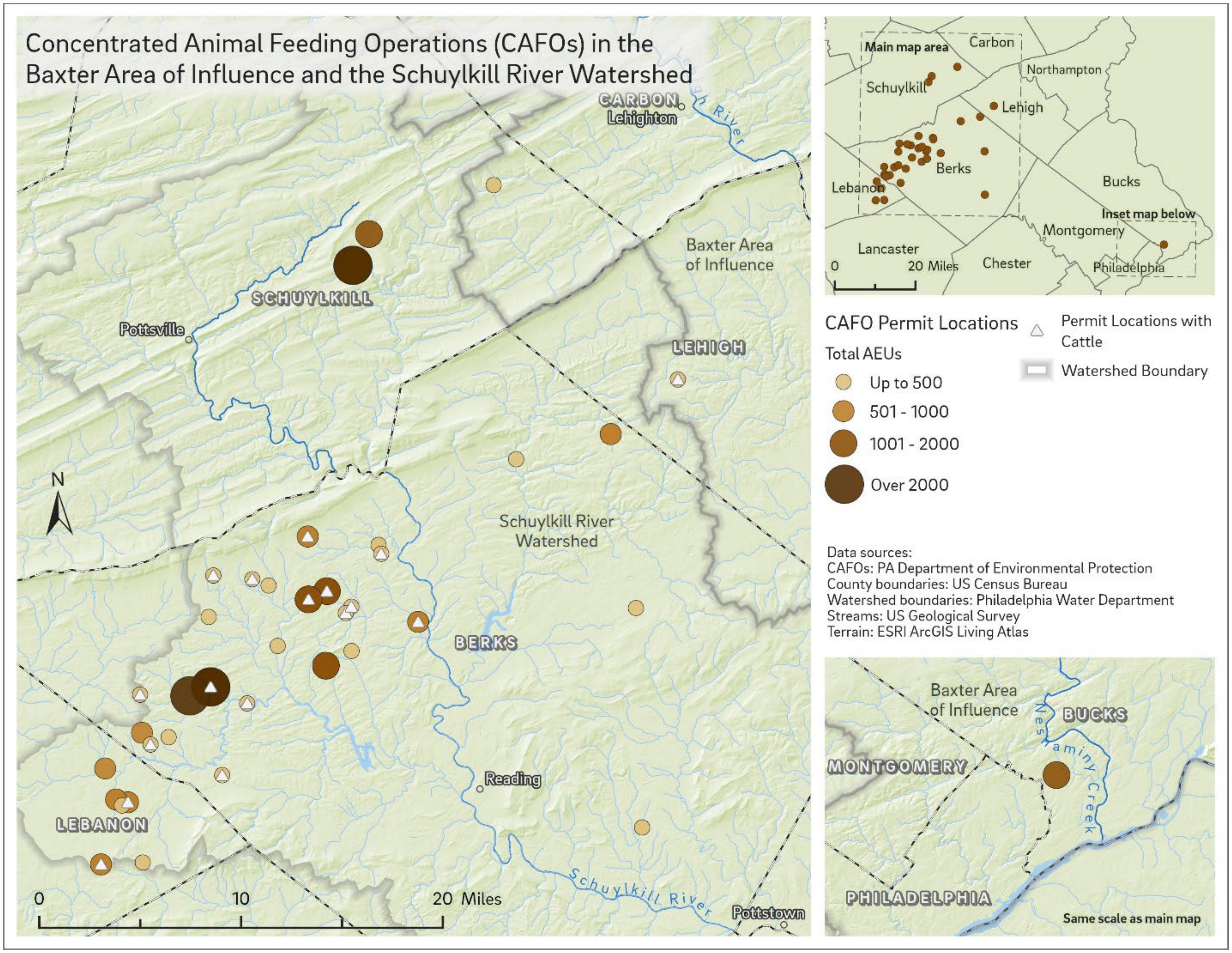

Figure 8 Map of CAFO Locations in the Queen Lane and Baxter AOIs

3.3 Wildlife

In the WCP, PWD recognized Canada geese as a priority source of *Cryptosporidium* in the watershed. Canada geese are abundant in the region and within the City of Philadelphia. Through a source tracking research project with Lehigh University, detailed in Section 5.4, geese were identified as mechanical vectors of *Cryptosporidium*. In the absence of data specific to the Schuylkill River watershed, it is difficult to track changes in resident geese populations or draw conclusions on a watershed scale. This section provides a brief history of the management of Canada geese populations in the eastern portion of North America, and population estimates for the state of Pennsylvania.

Wildlife managers recognize two distinct populations of Canada geese on the Atlantic coast of North America: migrant Canada geese and "resident" Canada geese population. The migrant Atlantic Population nests throughout the Canadian province of Quebec and especially along Ungava Bay and on the Ungava Peninsula on the eastern shore of the Hudson Bay. The Atlantic Population migrates south to spend winters in the United States from New England to South Carolina with the largest populations occurring in the Delmarva Peninsula (USFWS, 2014).

Resident Canada geese populations nest in southern Quebec, the southern Maritime provinces of Canada and the US states in the Atlantic Flyway (USFWS, 2014). The Atlantic Flyway is the migration path that follows the Atlantic coast of North America and the Appalachian Mountains. Resident Canada geese are largely nonmigratory but may shift slightly south during winter (USFWS, 1997). After the arrival of the Europeans in North America, the original population of resident geese became locally extinct. The current population of resident geese was introduced beginning in the early 1900s with the release of Canada geese from private individuals. Furthermore, live hunting decoys were outlawed in 1935, and the release of captive Canada geese flocks followed. From the 1950s to the 1980s, U.S. wildlife management agencies in the Atlantic Flyway states introduced populations through relocation and stocking programs primarily in rural areas (USFWS, 2005).

The Migratory Bird Treaty Act of 1918 protects migratory birds making it illegal to hunt, take, possess, sell, purchase, and transport migratory birds, including Canada geese, without a permit. However, due to hunting pressures and poor gosling survival in the early 1990s, the migratory Atlantic Population declined more than 75% in less than a decade from 1988 to 1995. This led to a ban on sport hunting of the Atlantic Population of Canada geese in 1995 in the U.S. and Canadian provinces of Ontario and Quebec. Due to similar appearance and regional overlap during migration of the Atlantic population, the two populations of Canada geese proved difficult to manage independently (USFWS, 1997). Resident Canada geese generally have an abundance of preferred habitat, low numbers of predators, and tolerance of disturbances from human activity. Without harvest pressure, these populations increased dramatically (USFWS, 2005).

In Pennsylvania, the Game Commission implemented special hunting seasons to address the increasing populations of resident Canada geese in the early 1990s. These seasons include early September and late winter when the migratory geese are largely not present. Harvests during the special hunting seasons were increasingly successful. Although hunting resident geese for sport proved an effective management technique in rural areas, it did not address issues in suburban and urban areas where hunting is not an option. An effective management of resident geese in the more populous regions of the state was needed (Dunn, 2000).

In 2005, the US Fish and Wildlife Service (USFWS) completed an Environmental Impact Statement for resident Canada geese that evaluated management technique options for states and proposed a plan of action. The plan of action called for an Integrated Damage Management and Population Control approach. This recommendation included authorizing trapping, relocation and culling programs for resident Canada geese and egg and nest destruction to control resident goose populations while protecting migrant geese such as the Atlantic Population. This strategy would be applied at airports to address safety concerns, on agricultural properties to avoid crop damage, and in cases when geese are a threat to public health. Additionally, the action plan included expanded hunting seasons authorized under the Migrant Bird Treaty to further target resident Canada Geese populations (USFWS, 2005). The Final Environmental Impact Statement: Resident Canada Goose Management is available online at www.fws.gov.

The Department of Natural Resources conducted a breeding pair survey of Canadian Geese in the Ungava Peninsula in Quebec in 2024. The study estimates a total population of breeding pairs and grouped birds of 88,890 pairs in 2024. This was less than the 2023 estimate of 115,328 pairs. The total population estimate includes breeding pairs, non-breeders, failed breeders, and molt migrants from other areas. The total population estimate was 611,590 and 606,672 in 2023 and 2024, respectively. The total population estimate decreased by 64,870 from 2023 to 2024.

The USFWS Atlantic Flyway Breeding Waterfowl Plot Survey provides resident Canada geese population estimates by state. A total population of 250,880 and 288,883 were estimated in 2023 and 2024, respectively. The US Fish and Wildlife Service discontinued publishing the results of this survey in 2015. Data can be obtained by contacting the US Fish and Wildlife Service. Figure 9 shows the total population of resident Canada geese estimated each year from 2016 to 2024, with standard error bars. These estimates do not indicate a significant increase or decrease since 2005.

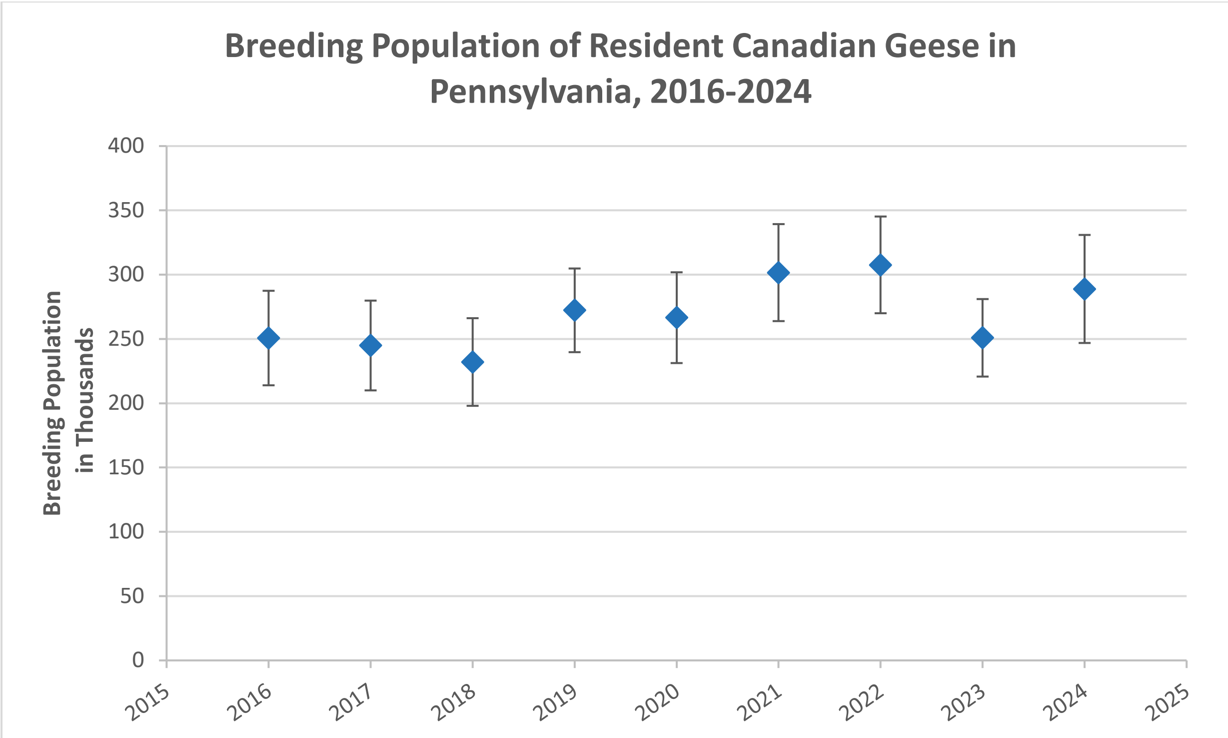

Figure 9 Breeding Population of Resident Canada Geese in Pennsylvania, 2016-2024

Source: U.S. Fish and Wildlife Service Atlantic Flyway Breeding Waterfowl Plot Survey

3.4 Significance of Potential Sources of Pathogens in the Watershed

3.4.1 Wastewater Discharges

The WCP identified WWTP effluent as a priority source of *Cryptosporidium* in the Schuylkill River watershed. In the most recent (2024) search of the EPA ECHO database, PWD identifies 104 WWTPs discharging into the Queen Lane AOI for a 2024 average flow of 80.73 MGD and 89 WWTPs discharging into the Baxter AOI with a 2024 average flow of 48.12 MGD.

The *Cryptosporidium* loading to the watershed from WWTP effluent was estimated in the WCP. To demonstrate the effect of implementing UV disinfection at WWTPs, a revised estimated *Cryptosporidium* loading to the Queen Lane and Baxter AOIs from WWTP effluent is summarized in Table 20. This estimation method was used in the WCP to determine *Cryptosporidium* loading to the Queen Lane AOI and will be applied to the Baxter AOI. The loading estimate in the WCP cannot be directly compared to the loading estimated in this report because PWD has access to additional information on WWTP discharges and UV treatment technology upstream that was not available during the development of the WCP. With this method, loading values are calculated using estimated concentrations of oocysts in WWTP effluent and the WWTPs' average flows included in this report. Minimum and maximum estimates of oocyst concentrations in WWTP effluent receiving secondary treatment are based on pooled values from literature (Crockett, 2007). Tertiary treatment was taken into consideration in the WCP, but not in this report in order to isolate the estimated significance of UV disinfection to *Cryptosporidium* reduction in the watershed.

To establish a baseline *Cryptosporidium* loading, it is first assumed all WWTPs in the Queen Lane and Baxter AOIs use conventional treatment with no UV disinfection. This baseline loading range is 5.52E+09 to 7.06E+14 oocysts per year. This report identifies 32 WWTPs, a total average flow of 27.8 MGD, with UV disinfection systems. For WWTPs with UV disinfection, 99.9% *Cryptosporidium* inactivation was assumed decreasing the estimated *Cryptosporidium* loading total to a range of 4.33E+09 to 5.54E+14 oocysts per year. However, as explained in Section 3.1.1.2, it is important to note that inactivated *Cryptosporidium* oocysts are still counted in the Method 1623 for LT2ESWTR.

Table 20 Quantitative Estimate of *Cryptosporidium* Loading (PWD WCP 2011)

	2024 AVERAGE FLOW (MGD)	NUMBER OF WWTPS	MINIMUM ESTIMATE (OOCYSTS/YEAR)	MAXIMUM ESTIMATE (OOCYSTS/YEAR)
Baxter AOI *Cryptosporidium* Loading Total baseline (assumes secondary treatment with no UV disinfection at all WWTPs)	48.12	89	2.06E+09	2.64E+14
Queen Lane AOI *Cryptosporidium* Loading Total baseline (assumes secondary treatment with no UV disinfection at all WWTPs)	80.73	104	3.46E+09	4.42E+14
Cryptosporidium Loading Reduction from UV Disinfection *(accounts for WWTPs with UV disinfection)*	27.8	32	1.19E+09	1.52E+14
Estimated Cryptosporidium Loading	**128.85**	**193**	**5.52E+09**	**7.06E+14**
Estimated Cryptosporidium Loading with Reduction from UV Disinfection	**128.85**	**193**	**4.33E+09**	**5.54E+14**

The purpose of this estimate is to demonstrate the potential significance of the implementation of UV disinfection at WWTPs to the *Cryptosporidium* loading in the watershed. It does not represent the reduction in *Cryptosporidium* loading in the watershed since the initiation of the WCP in 2012 because the date of UV disinfection implementation for each WWTP is not known and many existed prior to 2012. PWD will continue to track WWTP upgrades in the Queen Lane and Baxter AOIs, particularly UV disinfection installations.

CSOs and illegal 'wildcat' discharges can contribute pathogens to the Schuylkill River watershed as well. The significance of the pathogens contributed to the watershed from these discharges is not well known as there is limited data on the discharge quality and quantity. PWD continues to track available data on CSO and wildcat sewer discharges in the watershed.

3.4.2 Agricultural Land Use Runoff

In the WCP, PWD uses two methods to estimate the *Cryptosporidium* loading to the watershed from agricultural land. Both methods are detailed in Section 5.2.2 of the 2017 WCP Annual Status Report (PWD, 2017). The first estimation method is a runoff calculation using land cover, a method with significant limitations. Although the NLCD shows a slight decrease in agricultural land cover in the watershed, this information does not account for changes in animal population density or the conservation and nutrient management practices employed on individual farm properties, which have significant potential impacts on the *Cryptosporidium* loading to the waterways. Therefore, PWD does not expect a meaningful change in *Cryptosporidium* loading to the watershed based on NLCD data.

The second method used to estimate the *Cryptosporidium* loading to the watershed from agricultural land is based on animal populations. This method also has significant limitations. *Cryptosporidium* loading by this method is calculated using animal populations from the Census of Agriculture, and estimated prevalence of infection in livestock types and number of *Cryptosporidium* oocysts shed per year per animal from literature sources. As with the first calculation method, this method does not consider conservation and nutrient management practices on individual farms. Additionally, much uncertainty is associated with the numbers of *Cryptosporidium* oocysts shed per year per animal from literature as the actual rates may vary by region and individual farm.

Although it is difficult to assess changes in *Cryptosporidium* loading from agricultural sources, conclusions meaningful to WCP strategies can still be made. Cattle and calves are known sources of *Cryptosporidium* and have the greatest populations in the watershed when compared to pigs/hogs, sheep/lambs and horses/ponies. Both the Queen Lane and Baxter AOIs had a decrease in cattle and calves from 2017 to 2022, of 28.5% and 31.7%, respectively. Berks County had the largest population of cattle and calves in the Queen Lane AOI, at nearly 55,000. In the Baxter AOI, Bucks County had the highest population, at approximately 6,000. It is evident from the distribution of livestock in the Queen Lane AOI that Berks County continues to be the highest priority area for implementation of agricultural BMPs. PWD will continue to partner with NRCS, Berks Conservancy, Berks County Conservation District and other stakeholders to address this priority source of *Cryptosporidium* in the watershed.

3.4.3 Wildlife

Although the significance of Canada geese and other wildlife as potential sources of *Cryptosporidium* cannot be quantified, PWD focuses efforts to control geese populations in priority source water areas. PWD participates in a program through the USDA to reduce geese populations at PWD facilities and park properties and implements and maintains riparian buffers to deter geese and filter runoff near drinking water intakes. These efforts are detailed in the WCP annual status reports.

3.4.4 Relative Significance of Potential Sources of Pathogens

In the WCP, PWD identified three priority sources of *Cryptosporidium*: WWTP effluent, runoff from agricultural land and wildlife. Based on estimated *Cryptosporidium* loadings, WWTP effluent contributes the greatest loadings. The larger discharges with no UV disinfections systems are of greatest concern. Runoff from agricultural land was estimated as the second greatest contributing source. The most uncertainty is associated with *Cryptosporidium* loadings from wastewater from wildcat sewers and CSOs and from wildlife. With no jurisdiction outside of Philadelphia County including over upstream WWTPs, PWD takes a partnership approach to addressing *Cryptosporidium* and pathogens in the Queen Lane and Baxter AOIs. PWD believes these sources identified in the WCP still represent the highest priorities in the watershed and will continue to track WWTP upgrades upstream, support BMPs that reduce *Cryptosporidium* loadings on agricultural properties, and deter wildlife from priority areas in the City. These efforts are detailed in Section 4.3.

3.5 Anticipated Changes in Sources of Pathogens

3.5.1 Wastewater Discharges

PWD continually tracks changes in wastewater discharges upstream. In addition to compiling updated information and data on WWTP discharge volumes and treatment technologies, PWD looks at wastewater treatment planning to anticipate changes in WWTP discharges upstream. Municipalities treating wastewater are required to plan for sewage disposal needs under Act 537. To address financial needs, PENNVEST awards low interest loans and grants for WWTP projects and upgrades. The following sections summarize the status of Act 537 plans for municipalities in the Queen Lane and Baxter AOIs, and the recently awarded PENNVEST loans and grants for wastewater projects in each AOI.

3.5.1.1 Act 537 Planning

Under the Act 537 Program, municipalities are required to develop and implement a plan that addresses the sewage disposal needs and accounts for future land development and sewage disposal needs. PADEP reviews and approves the Act 537 plans and all subsequent revisions.

PADEP provides an updated list of Act 537 plans and plan ages on their website. There are 230 municipalities with Act 537 plans in the Queen Lane AOI. There are 216 municipalities with Act 537 plans in the Delaware River watershed. The oldest plans were developed in 1966. Act 537 official plan ages were last updated by DEP in 2019. Table 21 is a summary of Act 537 plan age for municipalities with land area in the Schuylkill and Delaware River watersheds.

Table 21 Number and Age of Act 537 Plans in the Queen Lane and Baxter AOIs

	Number of Act 537 Plans				
	Older than 40 years	Between 20 and 40 years	Between 10 and 20 years	Between 5 and 10 years	Less than 5 years
Queen Lane AOI	30	53	95	47	1
Baxter AOI	45	75	60	35	0
Total	75	128	155	82	1

Figure 10 and Figure 11 illustrate the Act 537 plan age of each municipality in the Queen Lane and Baxter AOIs. Light blue indicates municipalities with the oldest Act 537, older than 40 years, and pink indicates municipalities with the newest Act 537 plans, updated within 5 years.

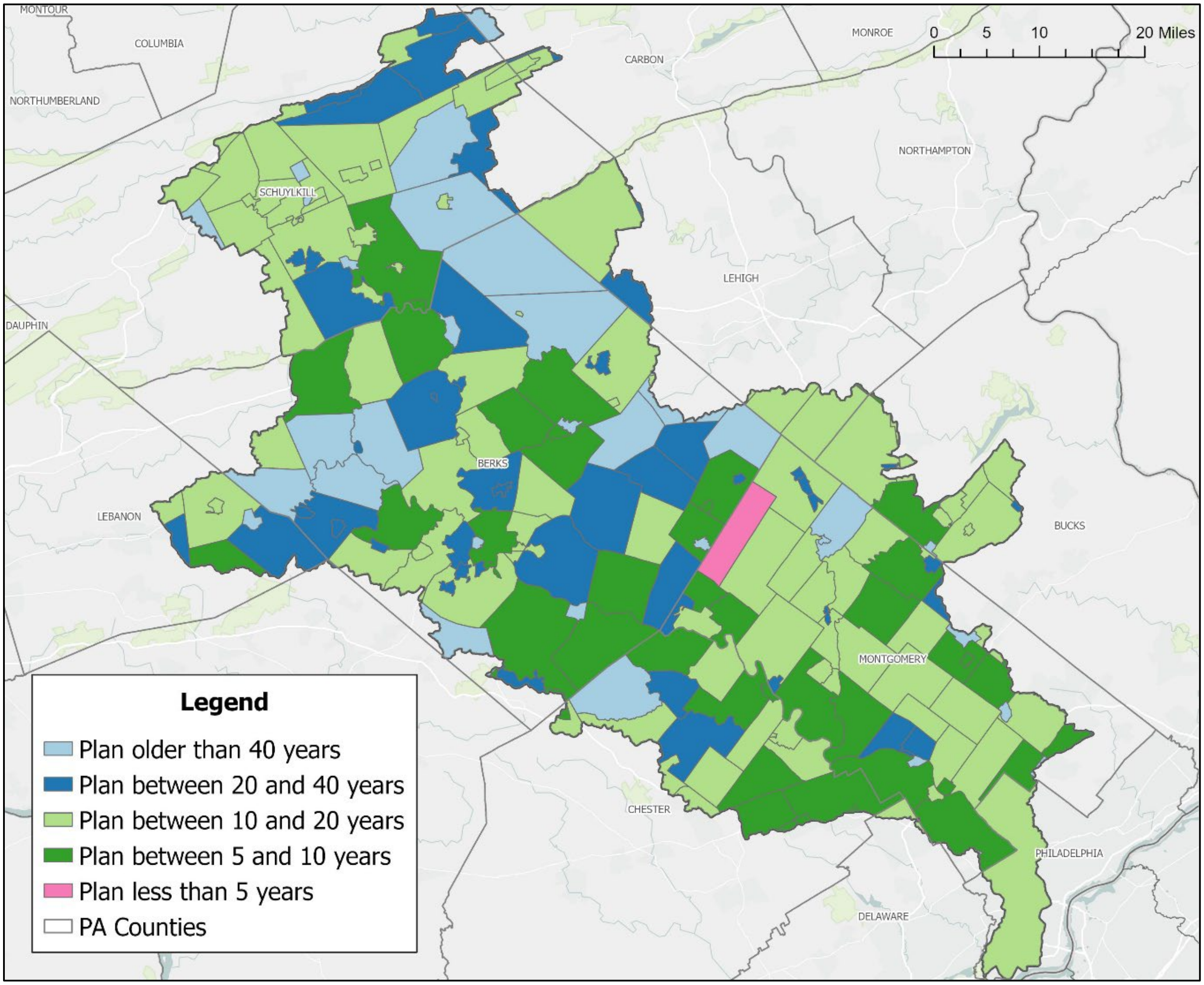

Figure 10 Act 537 Plan Ages in the Queen Lane AOI

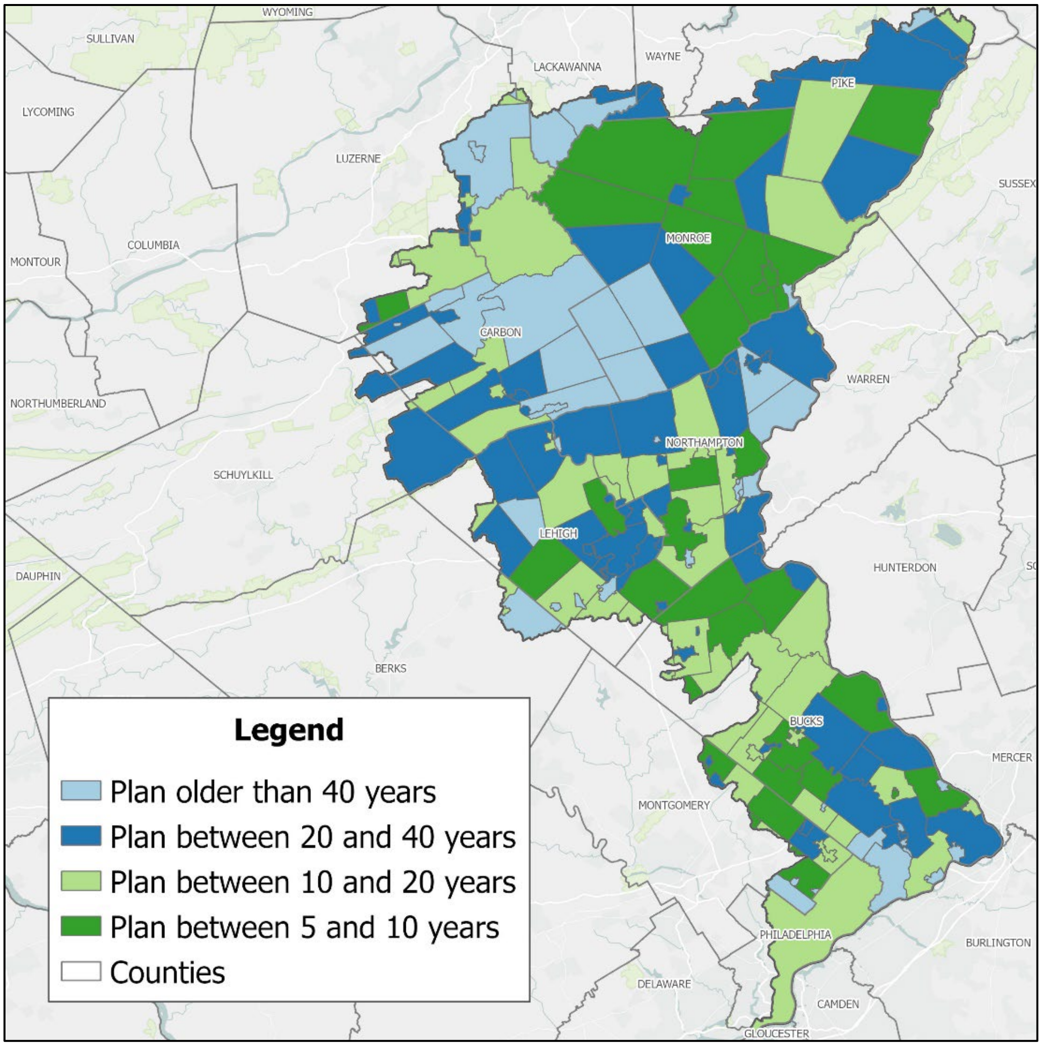

Figure 11 Act 537 Plan Ages in the Baxter AOI

3.5.1.2 PENNVEST

PENNVEST provides low-cost financial assistance for sewer, stormwater and drinking water projects in Pennsylvania. A number of townships and municipal authorities in the Queen Lane and Baxter AOIs were awarded PENNVEST funding for wastewater, non-point source and stormwater projects from 2020-2024, Table 22.

Table 22 PENNVEST Wastewater, Stormwater and Non-Point Source Projects 2020-2024

Project Name	County	Project Type	Approval Date	Total Funding	Funding Source	AOI
Borough of Sinking Spring - Broad Street Sanitary Sewer Improvement	Berks	Wastewater	1/29/2020	$832,739	Federal	Queen Lane
PAWC - Exeter WW Collection System I&I Repairs	Berks	Wastewater	10/16/2024	$2,100,000	State	Queen Lane
Borough of Shoemakersville - Headworks & Solids Handling Upgrade	Berks	Wastewater	10/20/2021	$1,972,945	State	Queen Lane
Amity Township WWTP Upgrades Project	Berks	Wastewater	4/24/2024	$20,400,000	Federal	Queen Lane
Montgomery Township Municipal Sewer Authority Eureka Influent Equalization Tank Project	Montgomery	Wastewater	10/16/2024	$2,050,000	State	Queen Lane
Bangor Borough Sanitary Sewer Improvements	Northampton	Wastewater	4/24/2024	$2,094,727	State	Baxter
Tamaqua Borough Authority Wastewater Treatment Plant Improvements	Schuylkill	Wastewater	4/24/2024	$20,000,000	Federal	Queen Lane
Bethlehem Township Municipal Authority - Easton Avenue Flood Mitigation Phase 1 (MS4)	Northampton	Non-Point Source	4/24/2024	$5,517,000	State	Baxter
Gwynedd Woods Condominium Association Culvert Replacement Project	Montgomery	Stormwater	2/21/2024	$112,353	State	Queen Lane
Bethlehem Township Municipal Authority - Phase 1 Pollution Reduction Plan Project	Northampton	Stormwater	1/12/2023	$2,490,000	Federal	Baxter
Bethlehem Township Municipal Authority- Walnut Street Drainage Improvements	Northampton	Stormwater	1/24/2024	$4,354,000	State	Baxter
North Catasauqua Borough Stormwater Improvements	Northampton	Stormwater	7/22/2020	$782,867	State	Baxter
Palmer Township Stormwater Authority - Old Nazareth Road Drainage Improvements	Northampton	Stormwater	10/16/2024	$3,793,000	State	Baxter

Source: PENNVEST approved project search tool, search for wastewater, stormwater and non-point source projects (November 2024)

3.5.2 Agricultural Land Use Runoff

Significant federal funds are committed to areas in the Schuylkill and Delaware River watersheds over the next years. The USDA offers funding to farmers through the Environmental Quality Incentives Program (EQIP) with the Maiden and Saucony Creek watersheds, tributaries to the Schuylkill River watershed in Berks County, named priority for the National Water Quality Incentive (NWQI) funding pool under EQIP. Through the SRRF, PWD has leveraged grants for a number of agricultural BMP projects with funding secured through EQIP. In 2014, the NRCS introduced the Regional Conservation Partnership Program (RCPP). The RCPP focuses on public-private partnerships encouraging businesses, communities and non-governmental organizations to invest in conservation and water quality initiatives. Since its inception, RCPP has made 717 awards involving over 4,000 partner organizations. In 2023, RCPP committed $5.9 million to the portion of the Delaware River watershed within Pennsylvania.

The NRCS and the USDA are critical partners in working towards restoring and protecting the Queen Lane and Baxter AOIs. The recent commitment of these federal resources will support agricultural improvements in upcoming years at a greater number of farms, reducing runoff contaminated with nutrients, sediment and pathogens to waterways. With strong partners working towards this common goal, water quality improvements are anticipated and may be fully realized over years and decades to come.

Additionally, the federal Farm Bill passed in 2018 elevated source water protection priorities. The newly passed legislation requires that ten percent of the roughly $4 billion in funding authorized for conservation programs be used to protect sources of drinking water. These increased incentives for agricultural producers to implement practices that benefit source water protection and for NRCS to work with community water systems to identify state/local source water protection priorities should enhance source water protection initiatives in the years ahead.

3.5.3 Wildlife

The available data on Canada geese populations is not specific to the Queen Lane and Baxter AOIs. However, it is evident that high populations of resident Canada geese are a widespread issue in urban and suburban areas. In addition to controlling geese populations at priority areas in Philadelphia, PWD continues to work with upstream water suppliers and other watershed organizations to communicate the importance of managing geese populations in drinking water supply areas to protect water quality.

Section 4. Watershed Control and Management Practices

Water System | Pathogen Sources | **PROTECTION INITIATIVES** | Compliance Status

Identification of watershed control and management practices is the third component of a watershed sanitary survey as described in the 1993 Watershed Sanitary Survey Guidance Manual from the AWWA Nevada-California Section. This section summarizes the PWD watershed management both within the City limits and upstream of Philadelphia, as well as watershed management practices of other agencies and organizations in the watershed.

4.1 PWD Watershed Management Practices

4.1.1 Watershed Management in Philadelphia

In 1999, PWD integrated three historically separate programs - Combined Sewer Overflow, Stormwater Management and Source Water Protection – to form the Office of Watersheds (OOW) within the PWD Planning and Environmental Services division. The intention of this reorganization was to optimize resources allocated to controlling Philadelphia's sewer discharges, protect drinking water resources, achieve regulatory compliance, and effectively manage the watersheds within the City limits.

OOW is tasked with monitoring and managing Philadelphia watersheds. OOW houses PWD stormwater management and combined sewer overflow National Pollutant Discharge Elimination System (NPDES) permit compliance programs. A major component of Philadelphia's CSO permit requirements is the implementation of the Long Term Control Plan Update (LTCPU), *Green City, Clean Waters. Green City, Clean Waters* is a 25-year plan with a green stormwater infrastructure-based approach to reduce pollutants discharged by the combined sewer system. OOW studies streamflow and water quality in Philadelphia watersheds by monitoring Philadelphia streams, including maintaining a series of gaging stations in the City in partnership with the USGS. Hydrodynamic and water quality models for Philadelphia waterways are developed and validated in OOW. OOW also identifies and implements projects for waterway restoration and enhancement. PWD's Ecological Restoration Group is working on a number of projects that will manage stormwater and stabilize stream channels upstream of the Queen Lane WTP intake. In 2022, an ERG project stabilized approximately 100 feet of stream channel around a sanitary sewer crossing along an unnamed tributary to the Wissahickon Creek, which will prevent erosion and sediment contamination of the stream. Through outreach and partnerships, OOW coordinates with local watershed community groups and engages Philadelphia residents and businesses to be stewards of the Philadelphia watersheds. More information on the projects and programs maintained by OOW's Source Water Protection Program is available at https://water.phila.gov/sustainability/watershed-protection/.

The PWD Source Water Protection Program within OOW studies water quality and quantity, land use and other influences on the drinking water supply upstream of Philadelphia. Philadelphia's drinking source watershed includes approximately 2,000 square miles of the Schuylkill River watershed and 8,100 square miles of the Delaware River watershed. The Source Water Protection Program takes a partnership approach to watershed management because over 98% of the Schuylkill River watershed is outside of Philadelphia's jurisdiction. Shortly after being established in 1999, PWD Source Water

Protection Program embarked on a state mandated Source Water Assessment (SWA), detailed in the following section.

4.1.2 Source Water Assessment

The 1996 Safe Drinking Water Amendments required all water suppliers to complete a Source Water Assessment (SWA). The purpose of the SWA was to identify potential sources of contamination in the Schuylkill River watershed, determine the vulnerability of the water supply to those potential sources, and make the information available to the public. To complete the SWA for PWD and other drinking water suppliers in the Schuylkill River watershed, the Pennsylvania Department of Environmental Protection (PADEP) coordinated among water suppliers, watershed organizations and stakeholders. PWD, as PADEP's primary contractor in developing the multiple SWAs, partnered with Pennsylvania American Water Company and Suburban Water Company, now Aqua Pennsylvania, to form the Schuylkill River Source Water Assessment Partnership. The Partnership completed a SWA for 42 surface water intakes in the Schuylkill River watershed.

The SWA included several parts. First, the Schuylkill River watershed was delineated into three zones. The three zones indicate the potential time it would take for a source located in that zone to flow down a river and contaminate a public water supply intake. Next, an inventory of point sources was conducted from PCS-ICIS, Resource Conservation and Recovery Act and the Comprehensive Environmental Response Compensation and Liability Act Information Systems, Toxic Release Inventory, above ground storage tanks, and facilities identified by water suppliers' self-assessment under the Source Water Assessment Program. The non-point sources were accounted for by determining the contaminant loadings from sub-watersheds using the Schuylkill Runoff Loading Model (SRLM). For more detailed information on the point source inventory and the SRLM methodology, refer to Sections 2.2.2 and 2.2.3 of the 2002 SWA, respectively. Once all point sources and non-point sources were compiled, the Partnership conducted a susceptibility analysis. After a series of multi-criteria screenings, point and non-point sources were pooled and ranked both by ten specific contaminant categories and all contaminant categories combined. Both the combined contaminant and contaminant-specific analysis resulted in a final ranking of sources by order of priority. The sources on the final ranked lists were designated into groups A, B and C for high, moderately high and moderate priority. For more details on the screening for individual types, refer to Section 2.2.4 and 3.2.4 in the 2002 SWA.

An important aspect of the SWA process was the involvement of the public. The Partnership established a Technical Advisory Group (TAG) to establish communication between stakeholders and the Partnership and to assist in gathering information throughout the watershed. Public meetings were also conducted to attempt to involve and educate interested citizens. The Partnership held 25 TAG and public meetings to obtain information on what potential sources were of most concern to the watershed stakeholders. Additionally, the TAG gave input into the assessment technologies and criteria used. A SWA website was established as a location where information on the assessment process and results could be accessed.

The SWA made a series of recommendations documented in reports specific to each water supplier and their intakes. The recommendations include general issues to be addressed at a watershed wide level, such as identification of grant funding and development of a watershed wide organization to improve coordination of restoration efforts. The SWA recommended protection and preservation of priority land to reduce the impacts of future development, and reduction of impacts from sewage discharge, stormwater runoff, acid mine drainage, agriculture, erosion and sedimentation, wildlife, spills and accidents. Improved public education, data and information collection and coordination, and water quality monitoring were also recommended. The detailed analysis of potential sources of contamination for each of PWD's water supply intakes, Belmont and Queen Lane on the Schuylkill River, identified regional and location specific recommendations. Location specific efforts would target the priority corridor of the Schuylkill River from Reading to Philadelphia and the Wissahickon Creek. One of the regional recommendations included the development of a coordinated regional Source Water Protection Plan that would incorporate and expand on the conclusions and recommendations of the SWA.

4.1.3 Source Water Protection Plan and Program

The Source Water Protection Plan (SWPP), completed in 2006, builds on the results of the SWA by further prioritizing the potential sources of contamination to the water supply previously identified. As part of the SWPP, a build out model was completed for the Schuylkill River watershed using the EPA Source Water Management Model (SWMM) and available county zoning data. The build out analysis concluded that the developed area and impervious cover in the watershed could increase significantly in a period of 50 to 100 years. This would increase stormwater runoff and consequently the loading of priority pollutants deposited into waterways in the Schuylkill River watershed. Additionally, projected increases in population would result in additional sewage treatment plants and point source discharges to the Schuylkill River and its tributaries.

Using results from the SWA, the SWPP takes priority sources for individual intakes and further prioritizes them based on impact to the Schuylkill River watershed as a whole. While the SWA examined ten parameters, the SWPP selected the five pollutants of primary concern: *Cryptosporidium*, fecal coliform, nutrients, total organic carbon and turbidity. For point sources, the prioritization method in the SWPP focused on NPDES permit point sources as the SWA concluded those to be the greatest threat to water quality according to the susceptibility analysis. During the SWA process, a susceptibility analysis was completed for each public water supply intake in the Schuylkill River watershed. High, moderately high and moderate priority sources for each of the specific intakes assessed were selected for further prioritization. To identify sources with the greatest impact to the Schuylkill River watershed as a whole, new weighting criterion was used to rank the selected sources. After separate analysis of point and non-point sources, the top 100 sources for each of the five primary concern pollutants as well as the combined parameters were identified. For further details on the prioritization method, refer to Section 3.1 of the Source Water Protection Plan (PWD, 2006). Although acid mine drainage, CSO and SSO sources were not considered in this analysis, they were identified as primary concerns in the SWA and would be incorporated in the SWPP objectives.

In the SWPP, PWD and the Schuylkill Action Network (SAN) (formerly the SWA Partnership) identified potential projects to be completed in the watershed. The projects targeted restoration and protection efforts in specific areas based on the prioritization analysis in the SWA and SWPP as well as the PADEP

303 (d) stream assessments, project location on streams with TMDLs, and the Little Schuylkill River and Upper Schuylkill River Assessment Reports prepared by L. Robert Kimball & Associates, which linked acid mine drainage sources to metal loadings in the Schuylkill River watershed. The SWPP presents seven objectives and addresses them by recommending projects and future work for the PWD Source Water Protection Program:

> *<u>Objective 1:</u> Establish the Schuylkill Action Network as a permanent watershed-wide organization charged with identifying problems and prioritizing projects and funding sources to bring about real improvement in water quality throughout the Schuylkill River watershed.*
>
> *<u>Objective 2:</u> Create a long-term, sustainable fund to support restoration, protection, and education projects in the Schuylkill River watershed.*
>
> *<u>Objective 3:</u> Increase public awareness of the Schuylkill River watershed's regional importance as a drinking water source.*
>
> *<u>Objective 4:</u> Initiate changes in polices and decision-making that balance and integrate the priorities of both the Safe Drinking Water Act and Clean Water Act.*
>
> *<u>Objective 5:</u> Establish the Early Warning System as a regional information sharing resource and promote its capabilities for water quality monitoring and improving emergency communication.*
>
> *<u>Objective 6:</u> Reduce point source impacts to water quality.*
>
> *<u>Objective 7:</u> Reduce non-point source impacts to water quality (PWD, 2006).*

Since the completion of the SWA and the SWPP, the Source Water Protection Program and Office of Watersheds at PWD, as well as watershed partners, have strived to address each of these objectives. Major accomplishments have been made towards each of the objectives through a partnership watershed management approach. Program highlights, particularly those addressing *Cryptosporidium* and pathogens in the watershed, are described in Section 4.3.

4.2 Watershed Management outside PWD Jurisdiction

With nearly the entire Queen Lane and Baxter AOIs outside the jurisdiction of Philadelphia, PWD's Source Water Protection Program takes a partnerships approach to source water protection. PWD considers the policies and practices of other agencies, organizations, and municipalities upstream critical to effective watershed management and depends on the development and enforcement strategies that promote and protect upstream waterways. This section briefly summarizes the policies and practices that PWD considers particularly important to source water protection. These agencies and organizations are well represented in the SAN, through which PWD is able to work with partners addressing priority issues in the watershed.

4.2.1 Ambient Water Quality and Wastewater Discharges

The Clean Water Act passed in 1972 sets the framework for regulation of water quality in surface waters and discharges of pollutants. The Pennsylvania Department of Environmental Protection established water quality standards for surface waters in Pennsylvania that meet the requirements of the Clean Water Act. These standards are included in Chapter 93, *Water Quality Standards*, Title 25 *Environmental Protection* of the Pennsylvania Code, a publication with all rules and regulations from the government of Pennsylvania. Chapter 93 defines critical uses for Pennsylvania waterways for aquatic life, water supply, recreation and fish consumption, special protection and navigation. The main stem of the Schuylkill River has multiple designated uses: warm water fishery, migratory fishes, and potable water supply. Based on these designations, a set of water quality criteria applies to the waterway. Chapter 93 Water Quality Standards inform the NPDES permitting process.

There are hundreds of municipal and industrial wastewater dischargers upstream of Philadelphia that discharge to the Queen Lane and Baxter AOIs. Wastewater concerns upstream of Philadelphia are outside of PWD's jurisdiction to address. PWD relies on the crucial role PADEP, EPA and DRBC play in ensuring upstream wastewater treatment facilities and collections systems are adequate to protect downstream water quality. PADEP issues and enforces NPDES permits for discharging facilities. DRBC requires an application from wastewater dischargers in the Delaware River Basin to obtain an approved docket.

PADEP also addresses sewerage-related issues posing a threat to water quality through the Act 537 Program, and Chapter 94, *Municipal Wasteload Management*, Title 25 *Environmental Protection* of the Pennsylvania Code. Act 537 plan ages in the Queen Lane and Baxter AOIs are detailed in Section 3.5.1.1 of this report. Chapter 94 requires owners of sewage facilities to plan, manage, and maintain sewage facilities in order to: anticipate and prevent overloading of a facility, limit additional connections to an overloaded facility, prevent the introduction of pollutants into the system that interfere with the treatment process or pass through a facility untreated, and improve reclamation and recycling of wastewaters and sludges. The PADEP reviews annual Chapter 94 reports from sewerage facilities and ensures there is adequate time to address operation and maintenance issues and plan for needed additions. Sewerage facilities that regularly experience hydraulic overloads are tracked, the causes assessed, and actions taken to resolve these issues.

PWD strongly values these enforcement efforts from EPA, PADEP and DRBC. These agencies are active leaders in the SAN, and PWD plans to continue working with government agencies and other organizations through the SAN to identify and address sources of pathogen contamination in the Schuylkill River watershed.

4.2.2 Stormwater Regulations

The Pennsylvania Stormwater Management Act of 1978 (PA Act 167) requires each county in Pennsylvania to adopt a stormwater management plan for each designated watershed within that county. The stormwater management plan provides a mechanism for municipalities within a watershed to plan for and manage expected increases in stormwater from increased development and land use change. The purpose of the stormwater management plan is not to address current flooding and stormwater issues, but to anticipate future issues and plan for proper management. Municipalities are then required to adopt ordinances to regulate future development consistent with the stormwater management plan.

The NPDES Municipal Separate Storm Sewer System (MS4) Regulations seek to prevent polluted stormwater runoff from entering municipal storm sewers and discharging to creeks without treatment. Operators of MS4s are required to obtain an NPDES permit and develop a stormwater management program to implement stormwater BMPs. The first phase, passed in 1990, required municipalities with populations of 100,000 or greater to obtain an NPDES permit for their stormwater outfalls. The second phase, passed in 1999, required small MS4s to obtain NPDES coverage for stormwater discharges.

PADEP and municipalities with MS4s participate in the SAN stormwater workgroup. The SAN allows PWD and these watershed stakeholders to share information and strategies for developing and implementing stormwater management strategies that protect downstream water quality and meet regulatory requirements.

4.2.3 Mining Reclamation

Abandoned mine drainage (AMD) impacts water quality in the Schuylkill River and Delaware River headwaters. The PADEP Bureau of Abandoned Mine Reclamation oversees the Abandoned Mine Reclamation Program in the state of Pennsylvania. The Bureau is responsible for addressing mine fires, mine subsidence, dangerous highwalls, open shafts and portals, mining-impacted water supplies and other hazards resulting from the historical coal mining practices in regions of Pennsylvania. PWD relies on PADEP's efforts in resolving abandoned mine drainage impacts on water supplies. Representatives from the Bureau of Abandoned Mine Reclamation participate in the SAN AMD workgroup. Through the SAN, PWD stays informed on AMD in the Schuylkill River watershed and can support projects addressing water quality issues. AMD working groups have yet to be formed within the DRBC Subcommittee on Source Water Protection or the Delaware River Improvement Partnership. However, as these groups mature and begin to prioritize focus areas AMD may become a priority for areas in the Lehigh River and upper Delaware River watershed with historical coal mining economies.

4.2.4 Recreational Activities and Management

The Schuylkill River Heritage Area (SRHA) leads programs that promote recreation in the Schuylkill River watershed. The Schuylkill River received National Heritage Area designation from the U.S. Congress in 2000 and Pennsylvania Heritage Area designation by the Department of Conservation and Natural Resources in 1995. National Heritage Areas, including the Schuylkill River Heritage Area, work to revitalize and restore the region through natural and cultural resource preservation, education, recreation, community revitalization and heritage tourism. More information is available at schuylkillriver.org. The SRHA is managed by the nonprofit Schuylkill River Greenways National Heritage Area. Recreation is also permitted in the Blue Marsh Reservoir. The Army corps of Engineers (ACE) manages the Blue Marsh Recreation Area. Recreation efforts and initiatives are discussed through the SAN's Engagement and Stewardship workgroup, and both the SRHA and the ACE are represented in the network. The SRHA is an active leader in the SAN and plays a critical role in administering the Schuylkill River Restoration Fund, detailed in Section 4.3.2.

The Pennsylvania Municipalities Planning Code gives municipalities and counties in Pennsylvania the authority to land planning in their locality. The Planning code gives options for creating a planning governing body and provides guidelines for planning, zoning, and land development. County planning commissions play a vital role in comprehensive county planning for counties in the Queen Lane and Baxter AOIs. These responsibilities can include trail, park, and open space planning; environmental protection; community revitalization and economic development; transportation and corridor planning; subdivision and land development and zoning ordinance review under Act 247; sewerage facility changes and Act 537 plan review; mapping; and data analysis and dissemination. PWD works with many of the county planning commissions through the SAN workgroups and Delaware River focused partnerships.

4.2.5 Natural Resource Conservation

The county conservation districts have a vital role in the conservation of resources in the Queen Lane and Baxter AOIs. The Pennsylvania conservation districts are supported by the State Conservation Commission, housed under the PA Department of Agriculture. Conservation districts provide programs for erosion and sediment control, watershed protection and nutrient management. Erosion and sediment controls are required under Title 25 Pa. Code Chapter 102. According to the State, Chapter 102 serves to protect surface waters of the Commonwealth through the utilization of Best Management Practices (BMPs) that minimize accelerated erosion and sedimentation during earth disturbance activities and manage post construction stormwater runoff after earth disturbance activities. County conservation district watershed specialists provide watershed organizations with watershed assessment, technical assistance, procurement of funding and education and outreach to support restoring and protecting water resources. This can include streambank stabilization, invasive species removal and native landscaping. Nutrient management is required under Pennsylvania's Nutrient Management Act (Act 38). Agricultural operations that meet the animal population density threshold are required to develop and implement a Nutrient Management Plan. Farms with smaller animal populations are encouraged to voluntarily adopt a plan. Nutrient Management Plans can improve water quality, reduce fertilizer cost, and improve animal health.

Conservation Districts have many more programs to support the conservation of natural resources. PWD works with a number of county conservation districts through the Farm Forward initiative of the Delaware River Improvement Partnership and the SAN, particularly with the Berks County Conservation District addressing soil conservation and nutrient management and watershed protection on Berks County farms. For more information on support provided by the conservation districts in the Schuylkill River watershed, visit the websites of Berks County Conservation District (berkscd.com), Montgomery County Conservation District (montgomeryconservation.org), Schuylkill Conservation District (schuylkillcd.org), Lehigh County Conservation District (lehighconservation.org), and Chester County Conservation District (chesco.org).

US Department of Agriculture Natural Resource Conservation Service (NRCS) also plays a crucial role in resource conservation. NRCS provides services including conservation and nutrient planning, technical services for the implementation of BMPs on agricultural properties, and procurement of federal funding and resources. NRCS is an active partner in the SAN Agriculture workgroup. Funding sources from the Environmental Quality Incentives Program (EQIP) and the Regional Conservation Partnership Program (RCPP) (Section 3.5.2) support projects in the Schuylkill River watershed. For more information on NRCS programs in Pennsylvania, visit www.nrcs.usda.gov/wps/portal/nrcs/site/pa/home.

4.2.6 Water Withdrawals

DRBC implements a water conservation program that manages water withdrawals in the Delaware River Basin. The program includes conservation policies to reduce water demand in the basin and requires water purveyors with projects having a substantial effect on the water resources of the basin to submit a permit application to DRBC. For all withdrawals over 100,000 gallons per day, metering and reporting of withdrawals and implementation of a leak detection and repair system are required. The program sets conservation and performance standards for plumbing fixtures. It also requires permit applicants to submit a conservation plan.

4.2.7 Reservoir Management

The Army Corps operates Blue Marsh Lake within the Queen Lane AOI. This federally owned and operated facility plays a critical role in maintaining fish habitat, providing streamflow augmentation during drought conditions, and providing protection from flooding to downstream communities. During periods of drought the Army Corps works closely with the DRBC to implement the reservoir release requirements within the DRBC Drought Operations Plan and Flexible Flow Management Plan.

4.3 PWD Coordination for Watershed Management

After the initial SWA and SWPP, the PWD Source Water Protection Program has made significant progress towards addressing the objectives laid out in the SWPP. This section highlights major accomplishments of the Source Water Protection Program and management strategies in place to address *Cryptosporidium* and pathogens in the watershed.

4.3.1 Schuylkill Action Network

After the completion of the SWA, PWD recognized the need for watershed-wide efforts to improve and promote the health of the Schuylkill River watershed. The Schuylkill River has a diverse watershed affected by a range of pollution sources: abandoned mine drainage primarily in the headwaters, agricultural runoff in the central region, and urban stormwater runoff in the most populous region near Philadelphia and the confluence with the Delaware River. To transition from assessment to protection of the watershed, PADEP, EPA, PWD, DRBC and the Partnership for the Delaware Estuary (PDE) formed the SAN in 2003 with the intention of it becoming a permanent organization. The SAN is a watershed-wide organization with a mission to improve the water resources of the Schuylkill River watershed. Partners in the SAN include state agencies, local watershed organizations, land conservation organizations, businesses, academics, water suppliers, local and state governments, regional agencies, and the federal government. With the power to transcend regulatory and jurisdictional boundaries, the SAN implements protective measures throughout the Schuylkill River watershed.

SAN members are organized into a number of workgroups, and the organization is led by an Executive Steering Committee. The Executive Steering Committee provides feedback and direction for workgroups and ensures partners are in support of SAN projects. The Planning Committee supports the goals of the Executive Steering Committee leading strategy development and implementation, workshops, web services, communication and events. The Executive Steering Committee and Planning Committee are made up of members from EPA, PADEP, PWD, PDE, DRBC, SRHA, and AQUA America. The other workgroups directly address issues including abandoned mine drainage, agricultural runoff, stormwater, pathogens, land use, and engagement and stewardship to implement projects. SAN progress reports and detailed information on SAN projects, initiatives and upcoming events are available on the SAN website: schuylkillwaters.org.

PWD provides ongoing financial support for the SAN. PWD participates in many projects led by these workgroups, but because the Schuylkill River watershed is a diverse watershed affected by a range of pollution sources, PWD looks to the expertise of SAN partners to achieve certain watershed protection goals and WCP objectives. The SAN Agriculture and SAN Pathogens Workgroups are particularly important to the WCP because they address potential sources of *Cryptosporidium* in the watershed. To further support this effort, PWD continues to contribute funding to the administration of SAN through a contract with PDE to support the SAN coordinator position and SAN workgroup leadership.

4.3.2 Schuylkill River Restoration Fund

The Schuylkill River Restoration Fund (SRRF), established in 2006, provides grants to support environmental projects that improve and protect water quality in the watershed. Initially, Exelon (now Constellation Energy) provided all funding for the projects. Beginning in 2010, PWD became the second annual contributor to the SRRF. PDE became a contributor in 2011, AQUA PA followed in 2012, MOM's Organic Market contributed from 2014 through 2016, and PA American Water began contributing in 2022. Government agencies, non-profits, businesses and other organizations with projects ready for implementation apply to the SRRF and are responsible for project execution, monitoring and documentation. Members of the SAN serve as technical experts for grant recipient selection to ensure applicant projects will be beneficial to the Schuylkill River watershed. SRHA oversees the SRRF and distributes grant money. The SRHA encompasses the region of the Schuylkill River watershed, and is managed by a nonprofit, the Schuylkill River Greenways National Heritage Area.

Since the SRRF was established, over $5 million has been collected and grants have been awarded to 136 projects. In 2011, Land Protection Transaction Grants were introduced as a part of the SRRF. This allows matching grants to be awarded up to $4,000 each for conservation easements or other land protection transactions. Grant recipients from the SRRF are selected by a committee comprised of representatives from Constellation, DRBC, PWD, AQUA, EPA, DEP, PDE, SRHA, PA American Water and SAN. Projects address contamination from AMD, agriculture, and stormwater runoff. As of 2024, 121 of those projects have been completed, including 11 abandoned mine drainage projects and 40 agricultural improvement projects for farms in Berks, Montgomery, and Lehigh counties. Over 2,000 acres of high priority lands have been permanently preserved within the Schuylkill River watershed, with the help of SRRF funding.

The SRRF is the mechanism through which PWD can contribute to projects that support WCP goals. PWD addresses *Cryptosporidium* in the watershed both by implementing Source Water Protection Program (SWPP) initiatives and WCP specific structural and non-structural control measures in the watershed. One of the WCP control measures includes supporting the installation of manure storage basins and vegetated buffers on farms throughout the Schuylkill River watershed. The SRRF receives several applications each year for implementation of agricultural BMPs on farms. Typically, these applicants are seeking funding to match contributions from other watershed partners including NRCS, the conservation district, local municipalities and water suppliers, and watershed non-profit organizations.

4.3.3 Delaware River Improvement Partnership (DRIP)

Hoping to replicate the SAN's success within Baxter's AOI, PWD began meeting with Partnership for the Delaware Estuary (PDE) staff in 2020 to develop an initial framework for a water quality collaborative focused on the lower Delaware River watershed, as outlined in the 2020 Watershed Control Plan Update. PDE staff is already tasked with coordinating and facilitating the SAN, which will serve as a model for the future Delaware River Improvement Partnership (DRIP).

PWD worked with PDE to create a list of potential partners within the lower Delaware River watershed, and PDE began conducting outreach to those entities in 2021 through preliminary focus groups, gauging interest in collaborative work and determining shared goals in the region. PDE received immediate interest from conservation districts and other stakeholders in replicating the SAN's Agriculture workgroup for the purposes of soliciting technical assistance and discussing potential project funding mechanisms. Agricultural BMPs tie directly into PWD's Watershed Control Plan *Cryptosporidium* reduction goals and the SAN Agriculture workgroup currently acts as the primary conduit for the SRRF's agricultural projects. With the hope of building relationships with stakeholders in the lower Delaware River watershed and creating a queue of potential projects that could be supported by an SRRF-style funding mechanism in the future, initial agriculture-focused meetings consisting of lower Delaware River watershed stakeholders began in 2023. Four quarterly meetings were held in 2024, attended by water suppliers, county conservation districts, and non-profits interested in agriculture and/or water quality. Initial meetings identified partner needs and interests and began to develop a strategic plan with which to move forward. The partners agreed to name this new working group "Farm Forward" and to continue to meet with the goal of assisting stakeholders in improving agricultural management practices to improve water quality of the lower Delaware River watershed.

Collaboration among regional water utilities in the lower Delaware River watershed was also identified as a high priority. Strengthening these connections should promote opportunities for open dialogue focused on shared regional concerns and create forums to discuss regulatory updates and impacts. PWD began outreach to water utilities in the Baxter area of influence in 2023, holding an in-person meeting with Lehigh County Authority (LCA) to discuss watershed protection, source water monitoring, and the Delaware Valley Early Warning System. In 2024, DRBC formally approved and convened a Source Water Protection subcommittee, on which PWD holds the position of reserved member. PWD attended DRBC's inaugural Source Water Protection Subcommittee meeting on November 14, 2024, and accepted the position of chair of the new subcommittee. The initial meeting convened nearly one dozen water and wastewater utilities along the lower Delaware River, along with regulatory partners. This initial meeting focused on available spill modeling and coordinated spill response for future events. The next meeting is expected to be held in spring 2025. Given the enthusiasm and interest generated at the initial subcommittee meeting, PWD will use this forum in place of recreating the SAN's Pathogens & Point Source working group. In the longer-term, open dialogue afforded by this subcommittee may be used to explore opportunities to implement a Delaware River grant funding program with peer water utilities, modeled after the continuously successful SRRF.

PWD continues to meet with PDE to determine next steps for building out more working groups under the DRIP, with replication of the SAN's Stormwater and Engagement & Stewardship likely to follow.

4.3.4 Watershed Control Plan

In December 2011, PADEP approved PWD's WCP as a back-up credit towards compliance with LT2ESWTR. The WCP identifies potential and actual sources of *Cryptosporidium* in the designated area of influence, which includes the entire Schuylkill River upstream of Philadelphia. The WCP discusses the effectiveness and feasibility of various control measures, establishes a set of goals for implementation and presents a quantitative assessment of the measures to be taken. The WCP focuses on three priority sources of *Cryptosporidium*: wastewater discharge and compliance, agricultural land use runoff, and animal vectors. PWD addresses *Cryptosporidium* in the watershed both by implementing Source Water Protection Program initiatives and WCP specific structural and non-structural control measures in the watershed. Control measures implemented though the WCP program are described in Section 4.4.

Education and outreach to support the WCP is implemented through PWD's continued collaboration with the Partnership for the Delaware Estuary (PDE). Initiatives include engaging Philadelphia residents in the prevention of stormwater pollution to the Schuylkill and Delaware Rivers and facilitating coordinated action, communication, and projects for the SAN. PDE coordinated the Philly's Best Friend Spokesdog Competition to educate citizens on the importance of picking up pet waste. PDE also organizes an annual clean water art contest for Philadelphia students and hosts the annual Delaware River Festival at Penn's Landing in Philadelphia. Additionally, PDE aids coordination of the annual Schuylkill Scrub cleanup effort and collects photo entries for the Schuylkill Shots photo contest. In 2014, PDE and the SAN launched the Schuylkill Students Street Art Contest for which students designed an environmentally themed street art sticker. The winning stickers were installed on storm drains to educate the public on storm drain pollution.

4.3.5 Delaware Valley Early Warning System

The Delaware Valley Early Warning System (EWS) is designed to improve the safety of the drinking water supply by providing event notification to subscribers. The coverage area includes the Schuylkill and Delaware River watersheds from the Delaware Water Gap to Wilmington, Delaware. The user base forms the EWS partnership and is comprised of water suppliers, industries, PADEP, and other state and federal regulatory agencies. As of 2024, there are more than 450 users representing 55 organizations. Figure 12 shows a map of the industry and public water system subscribers.

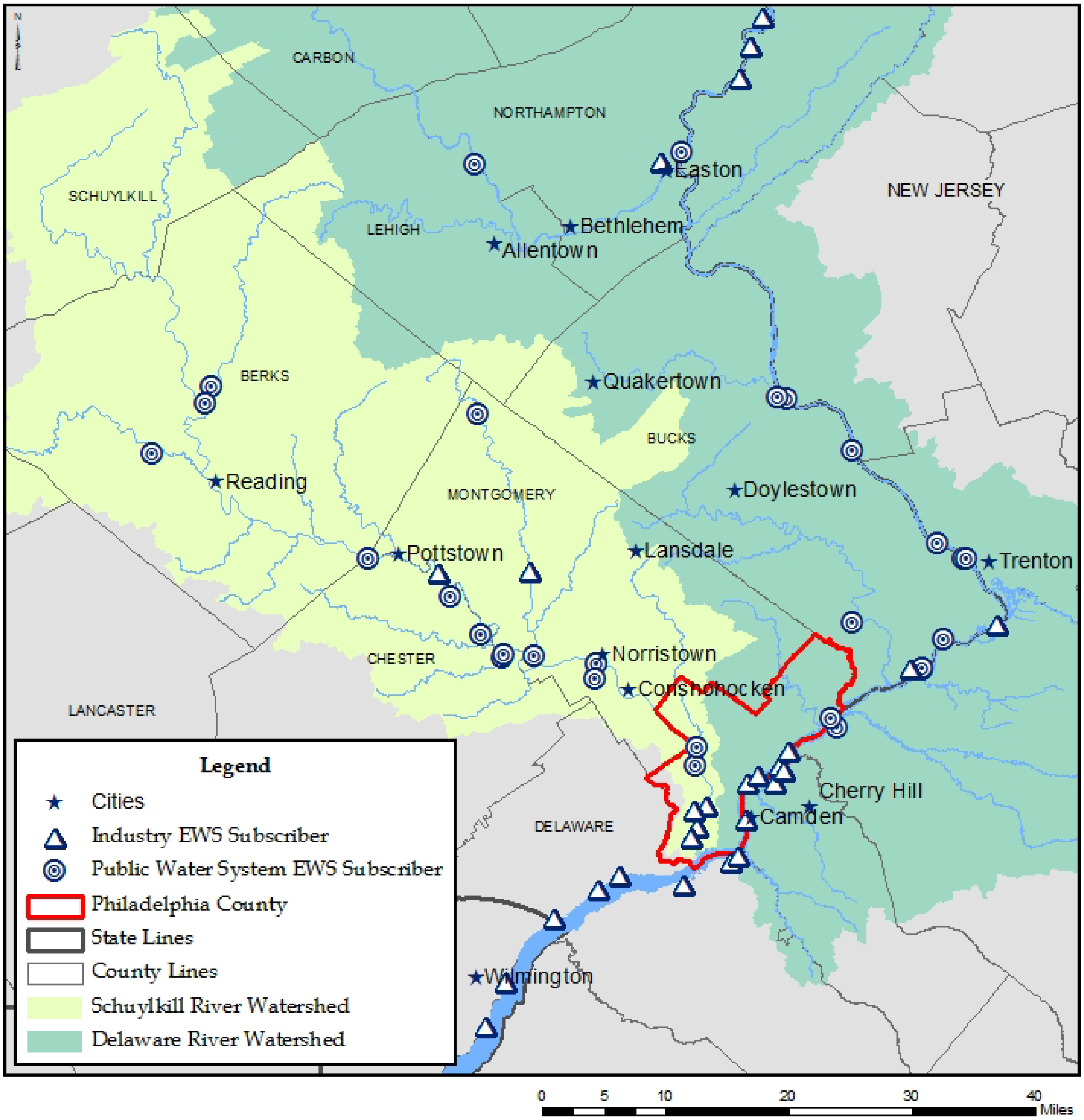

Figure 12 Early Warning System industry and public water system subscribers

The EPA and PADEP funded the project start up in 2002, and EWS went online in 2004. PWD as the technical host underwrites the costs of system enhancement and expansion as well as repairs and upgrades for the system components. A portion of the operations and maintenance costs is paid for by an annual subscriber fee that takes into consideration the annual average quantity of water withdrawn by each subscriber and the watershed drainage area upstream of their intake. EWS provides subscribers with an advanced communication tool that includes a notification system, time of travel model, Spill Model Analysis Tool, real-time water quality data and a central website where users can access event information, analysis tools and data. A Port Security Grant, awarded in 2011 from the Federal Emergency Management Agency (FEMA) through the Department of Homeland Security, provided funding for PWD to enhance and upgrade the EWS. Updated mapping tools were fully integrated into EWS in 2013 followed by the Tidal Spill Trajectory Tool in 2014.

In 2020, PWD implemented significant updates to the EWS user interface. Notable updates include full mobile device (smartphone) functionality for the EWS website and improved mapping and notification features. These updates were presented to EWS users through a series of regional workshops that were adapted to a virtual platform to align with COVID-19 pandemic public health and safety recommendations.

Although the technical components of EWS allow subscribers to easily and rapidly communicate with upstream and downstream systems users, the EWS partnership makes the system invaluable. Only subscribers have access to the EWS. Subscribers know one another and are empowered to directly communicate during emergency events that affect more than one organization. The EWS Steering Committee, which oversees the development, enhancement, maintenance, and expansion of the system, holds annual meetings where users can provide feedback on their experiences and meet face to face. As an integrated drinking water, wastewater and stormwater utility, PWD recognizes that accidents are inevitable. Some of these events, such as wastewater spills, sewerage line ruptures or discharges of wastewater bypassing treatment, have the potential to contain high levels of pathogens. Rapid communication and planning are critical for mitigating adverse effects. The confidence that emergency responders, regulators and dischargers have in reporting accidents to the system drives the success of EWS and provides a valuable watershed-wide partnership.

4.4 Recommended Control Measures

The WCP identified recommended control measures to address *Cryptosporidium* and pathogens in the watershed. The WCP control measures include supporting the installation of manure storage basins and vegetated buffers on seventeen farms throughout the Schuylkill River watershed, implementation of a Comprehensive Nutrient Management Plan at seven farms, planting of riparian buffers to deter animal vectors select sites, and execution of waterfowl management program at priority locations in Philadelphia. Table 23 summarizes the WCP control measure project type, description, and status for each year of the WCP since the last submission of the Watershed Sanitary Survey in 2021. For more detail on total project progress, yearly Watershed Control Plan Annual Reports can be found on PWD's reporting website: https://water.phila.gov/reporting/watershed-plans-reports. To date, PWD has tracked the installation of UV at the Upper Gwynedd and Fleetwood WWTPs, and supported watershed partners in the installation of sixteen manure storage basins and implementation of eighty-two CNMPs. Additionally, at Fairmount Park properties and PWD facilities, animal vectors of *Cryptosporidium*, specifically geese, have been removed and goose eggs have been treated throughout each year of the WCP plan implementation. Moving forward, PWD will continue to track WWTP upgrades upstream, support BMPs that reduce *Cryptosporidium* loadings on agricultural properties, and deter wildlife from priority areas in the City.

For over a decade, PWD supported *Cryptosporidium* monitoring and source tracking research with Lehigh University. PWD and Lehigh University monitored *Cryptosporidium* in streams in Philadelphia source watersheds and studied the effects of wastewater discharges, agricultural land use and animal vectors on the presence of *Cryptosporidium* in the waterways and the associated and public health risk. Findings from this research have influenced the control measures selected in the WCP. For example, Lehigh University identified geese as vectors of *Cryptosporidium* in Philadelphia's source watershed. An article detailing some of the outcomes of research collaboration, "Biofilm Sampling for Detection of *Cryptosporidium* Oocysts in a Southeastern Pennsylvania Watershed" was published in November 2020 in *Applied and Environmental Microbiology*[1]. Due to budgetary limitations resulting from the City of Philadelphia's COVID-19 pandemic response and mitigation efforts, the research collaboration with Lehigh University is paused for the foreseeable future.

[1] Jellison K, Cannistraci D, Fortunato J, McLeod C. 2020. Biofilm sampling for detection of Cryptosporidium oocysts in a southeastern Pennsylvania watershed. Appl Environ Microbiol 86: https://doi.org/10.1128/AEM.01399-20.

Table 23 WCP Project Progress Summary from 2024 WCP Annual Status Report

	WCP Project Type	Project Description	Project Status
2021	Farm BMP	Manure storage basin at Bolton Farm	Complete
	Farm BMP	Manure storage basin at Miller Farm	Complete
	Riparian Buffer Planting	Invasive species removal and riparian buffer restoration along Schuylkill River at Kelly Drive	Complete
	Waterfowl Management	Geese removed and eggs treated at Fairmount Park properties and PWD facilities 2021	Complete/Ongoing
2022	Farm BMP	Manure storage basin at Hollinger Farm	Complete
	Farm BMP	Manure storage basin at Lynnacres Dairy Farm	Complete
	Farm BMP	Manure storage basin at Pond View Farm	Complete
	Waterfowl management	Geese removed and eggs treated at Fairmount Park properties and PWD facilities 2022	Complete/Ongoing
2023	Farm BMP	Manure storage basin at Phillips Farm	Complete
	Farm BMP	Manure storage basin at Burkholder Farm	Complete
	Farm BMP	Manure storage basin at Last Chance Angus Farm	Complete
	Riparian Buffer Planting	In-stream habitat and streambank protection on 1,400 linear feet of stream along Cold Run in Berks County	Complete
	Waterfowl management	Geese removed and eggs treated at Fairmount Park properties and PWD facilities 2023	Complete/Ongoing
2024	Farm BMP	Manure storage basin at Weinsteiger Farm	Complete
	Farm BMP	Manure storage basin at Masemore Farm	Complete
	Farm BMP	Manure storage basin at Bitler-Vista Grande Farm	Complete
	Farm BMP	Manure storage basin at Sterner Dairy Farm	Complete
	Waterfowl management	Geese removed and eggs treated at Fairmount Park properties and PWD facilities 2024	Complete/Ongoing
WCP Completion Requirement Check	WWTP Upgrades	Track UV Installation at 2 plants	Complete
	Farm BMPs	Manure storage basins – 26	Complete
		Vegetated buffers – 3	Complete
	Nutrient Management Plans	Nutrient Management Plans – 7	Complete
	Riparian Buffer Planting	Sites – 3	Complete
	Waterfowl management	Years – 12	Complete/Ongoing

Section 5. Water Quality Compliance

Water System | Pathogen Sources | Protection Initiatives | **COMPLIANCE STATUS**

A discussion of the water quality at the water supply system intake is the fourth component of a watershed sanitary survey as described in the 1993 Watershed Sanitary Survey Guidance Manual from the AWWA Nevada-California Section. This section briefly summarizes drinking water regulations and Philadelphia's source water quality pertaining to microbial contaminants and describes PWD's ability to meet these compliance obligations.

5.1 Drinking Water Regulations

The objective of the Safe Drinking Water Act (SDWA), originally passed by Congress in 1974, is to protect public health by regulating the national water supply. The SDWA establishes national health-based drinking water contaminant levels to protect against natural and anthropogenic water contaminants that pose risks to public health. The SDWA was amended in 1986 and 1996 to extend protective barriers outside of treated drinking water to include source water protection, treatment plant operator training, funding for water system improvements, and customer information requirements. The Commonwealth of Pennsylvania, through PADEP, has the authority to enforce the SDWA within Pennsylvania. PADEP is also authorized to promulgate and enforce more stringent drinking water standards than the SDWA. This section describes PWD regulatory obligations and compliance under the SDWA pertaining to microbial contaminants and risks.

5.1.1 Surface Water Treatment Rules

5.1.1.1 Surface Water Treatment Rule

The Surface Water Treatment Rule (SWTR) was promulgated by the EPA in 1989 and effective December 1990 with the objective of further protecting public health from microbial contaminants such as viruses, *Legionella* bacteria, and *Giardia*. The rule sets a maximum contaminant level goal (MCLG) of zero for *Legionella*, *Giardia*, and viruses.

Prior amendments to the SDWA in 1986 allowed for the establishment of treatment technique (TT) requirements when it is not feasible to measure biological contaminants, which the SWTR applied to turbidity. The turbidity MCL of 1 NTU at the point in the system after treatment and before the distribution system in the 1976 SDWA was removed and replaced with a TT requirement for 3 log (99.9%) and 4 log (99.99%) removal/inactivation of *Giardia* and viruses, respectively. The SWTR specified a disinfection residual of greater than or equal to 0.2 mg/L after treatment.

In 1989 the PADEP made treatment turbidity regulations more stringent than that of the EPA, where the number of combined filter effluent (CFE) samples greater than 0.5 NTU cannot exceed 5% of all monthly samples and at no time can exceed 2 NTU. Under the SWTR, a heterotrophic plate count must be taken when chlorine residual is less than 0.02 mg/L (non-detection).

5.1.1.2 Interim Enhanced Surface Water Treatment Rule

The Interim Enhanced Surface Water Treatment Rule (IESWTR) was promulgated by the EPA in December 1998 and went into effect in January 2002. The IESWTR builds on the SWTR TT approach by creating more stringent CFE turbidity standards and establishing a new individual filter effluent (IFE) turbidity monitoring requirement to address *Cryptosporidium*. The IESWTR reduces the CFE turbidity standard to 0.3 NTU in 95% of samples taken at least once every 4 hours, with no single sample exceeding 1 NTU. Recognizing that the CFE may mask the performance of an individual filter, a maximum IFE turbidity of 0.5 NTU was established. The IFEs require continuous monitoring in 15 minute intervals with no two consecutive measurements exceeding 0.5 NTU, with the exception of the first 4 hours returning to service. The turbidity standards enacted through IESWTR assure that conventional filtration systems will be able to provide 2-log (99%) *Cryptosporidium* removal.

5.1.1.3 Long-Term 2 Enhanced Surface Water Treatment Rule

In January 2006 the first regulation based on source water quality, the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), was promulgated by EPA and made effective in March 2006. LT2ESWTR requires public water systems with surface water sources or groundwater sources influenced by surface water to monitor for *Cryptosporidium* at all intakes for two years. The results of the monitoring period categorize the public water system into one of four 'Bins.' In the intial monitoring period, PWD Belmont and Baxter WTPs were categorized into Bin 1, and Queen Lane was categorized into Bin 2. LT2ESWTR Bin classifications are detailed in Section 1.1 of this report.

To meet LT2ESWTR requirements based on Bin status, PWD achieved the additional 1-log removal credit by meeting CFE and IFE turbidity TT at the Queen Lane WTP for 0.5-log credit each. The CFE 0.5-log credit is earned through achieving turbidity less than or equal to 0.15 NTU in at least 95% of CFE samples taken every 4 hours. To achieve the IFE 0.5-log credit, turbidity must be less than 0.15 NTU in at least 95% of monthly individual filter samples taken continuously in 15 minute intervals, excluding a 15 minute period after filter backwash. No IFE can have a measured turbidity greater than 0.3 NTU in two consecutive measurements taken 15 minutes apart. PWD meets these requirements at all three WTPs, Belmont, Queen Lane and Baxter. PWD receives 0.5-log back up credits for development and implementation of its WCP. PWD Source Water Protection Program is responsible for carrying out the watershed protection efforts detailed in the Watershed Control Plan.

5.1.2 Total Coliform Rule and Revised Total Coliform Rule

The Total Coliform Rule (TCR) of 1989, made effective in December 1990, established a maximum contaminant level (MCL) based on the presence or absence of total coliform in the distribution system. The Revised Total Coliform Rule (RTCR), made effective on April 1, 2016, replaced the TCR and strengthened microbial protection by setting a MCL for *E. coli*, a total coliform treatment technique, and requirements for assessment and corrective actions when monitoring results show a public water system may be vulnerable to contamination.

5.2 Existing Water Quality

The EPA uses several indicators for the presence of microbial contaminants, including fecal coliform, *E. coli*, and turbidity. This section provides a summary of these parameters, along with pH, in PWD's water supply. Figure 13 shows the legend for the boxplots presented later in this section. For each year, a bold line represents the median value of all Queen Lane intake data for the parameter of interest. The upper and lower limits of the box represent the 25th and 75th percentile values, respectively. The difference between the 25th and 75th percentile values is known at the interquartile range (IQR) and is graphically represented by the box. Data below the 25th percentile or above the 75th percentile forms the plots' bottom and top whiskers, respectively, while outliers that fall outside the permitted range of the whiskers are shown by a circular marker.

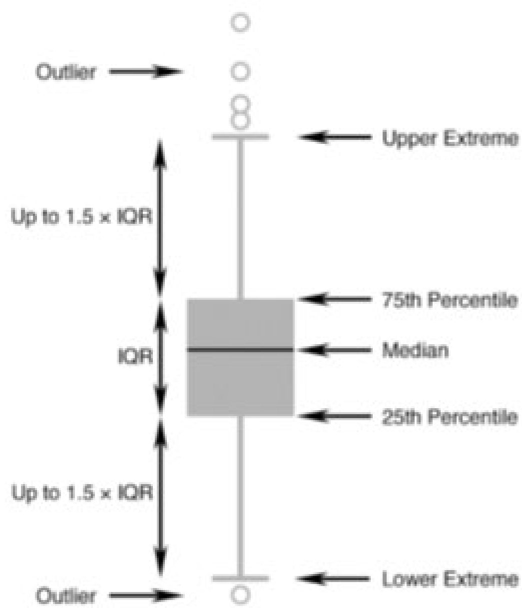

Figure 13 Legend for Boxplot Figures

5.2.1 Fecal Coliform and *E. coli*

The EPA uses several indicators for the presence of microbial contaminants, including fecal coliforms and *E. coli*. The presence of fecal coliform and *E. coli* indicate the water may be contaminated with human or animal waste containing microbial organisms such as bacteria, viruses and protozoans that may cause gastrointestinal illness, and pose significant health risks for young children and immune-compromised individuals.

The national drinking water standard goal for fecal coliform and *E. coli* in any drinking water sample is zero. This is typically achieved through the conventional drinking water treatment process. In ambient surface water, or raw water, PADEP has established seasonal water quality criteria for bacteria (PA Code Ch. 93.7). For the period May 1 through September 30, water quality standards require that the geometric mean of a group of at least five samples collected on non-consecutive days over a 30-day period not exceed 126 *E. coli* CFU (colony forming unit) per 100 mL. In addition, there should not be greater than a 10% excursion frequency of 410 CFU per 100 mL for the samples collected in the same 30-day interval. During the non-swimming season, water quality criteria for fecal coliform apply. The maximum fecal coliform level during the non-swimming season is a geometric mean of 2,000 CFU per 100 mL. For the purposes of this Watershed Sanitary Survey, bacteria results are not evaluated against surface water quality criteria; samples summarized below are collected on a monthly basis, and do not represent the geometric mean of five non-consecutive samples within a 30-day period.

Summary statistics for fecal coliforms and *E. coli* at Queen Lane WTP intake from 2020-2024 are presented in Table 24 and Table 25. Throughout this period, the Colilert-18 Quanti-Tray method was used to analyze fecal coliform and E. coli samples. Typically, dilutions were not performed. As such, there are several values of >2419.6 MPN/100 mL, the maximum count available using the Colilert-18 method. For these right-censored samples, the actual value may be greater than 2419.6 MPN/100 mL.

Table 24 Fecal Coliform Summary Statistics at the Queen Lane Intake, 2020-2024

Year	Mean (MPN/100mL)	Min (MPN/100mL)	Max (MPN/100mL)	Median (MPN/100mL)	n
2020	378.6	12.2	>2419.6	154.1	52
2021	431.3	9.7	>2419.6	95.9	52
2022	453.6	22.3	>2419.6	208.1	52
2023	492.9	18.7	>2419.6	111.55	52
2024	503.1	79.8	>2419.6	307.6	41

The mean concentration of fecal coliforms measured from 2020 to 2024 ranged from 378.6 MPN/100mL to 503.1 MPN/100mL at the Queen Lane WTP intake. The concentration of fecal coliforms ranged from a minimum of less than 9.7 to a maximum of more than 2,419.6 MPN/100mL.

Table 25 *E. coli* Summary Statistics at the Queen Lane Intake, 2020-2024

Year	Mean (MPN/100mL)	Min (MPN/100mL)	Max (MPN/100mL)	Median (MPN/100mL)	n
2020	460.2	19.9	>2419.6	148.3	51
2021	488.9	8.5	>2419.6	149	52
2022	519.7	13.5	>2419.6	307.6	52
2023	492.5	20.3	>2419.6	122.95	52
2024	490.3	104.6	>2419.6	325.5	41

The mean concentration of *E. coli* measured from 2020 to 2024 ranged from 460.2 MPN/100 mL to 519.7 MPN/100mL. The concentration of *E. coli* ranged from a minimum of 8.5 to a maximum of more than 2,419.6 MPN/100mL.

The ranges of both fecal coliforms and *E. coli* span several orders of magnitude, which can be attributed to higher levels of bacteria in the rivers during and following rainfall events. Boxplot summaries of fecal coliform of *E. coli* data for the same time periods at the Queen Lane WTP intake are presented in Figure 14 and Figure 15.

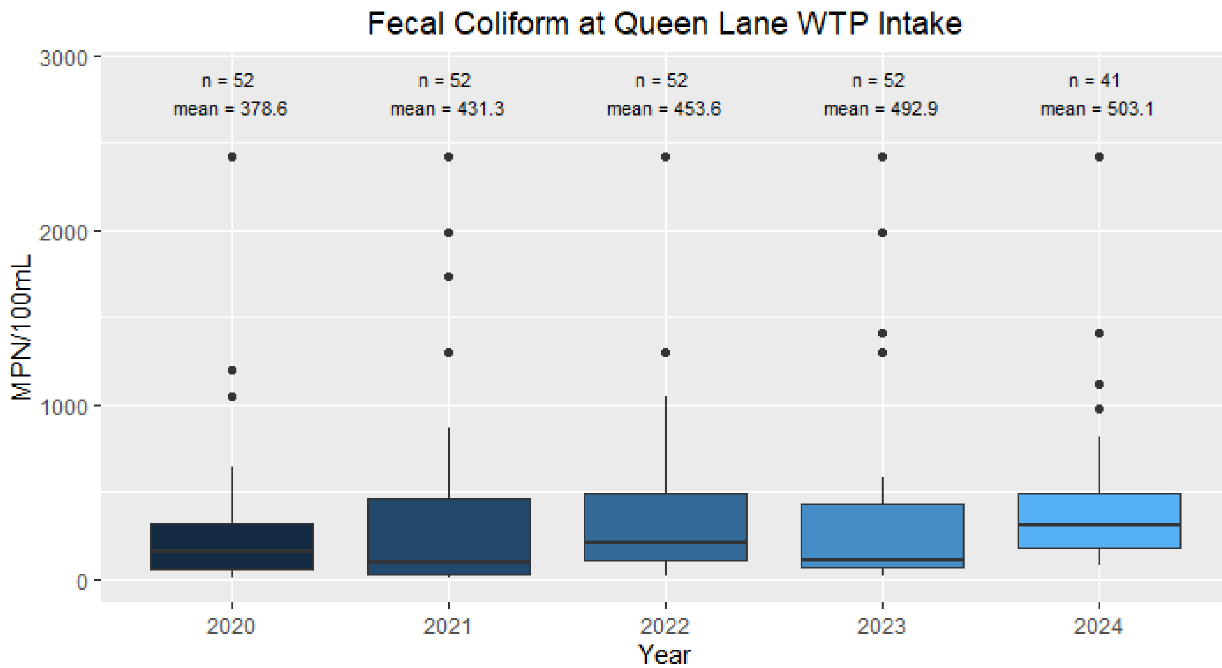

Figure 14 Fecal Coliform at the Queen Lane Intake, 2020-2024

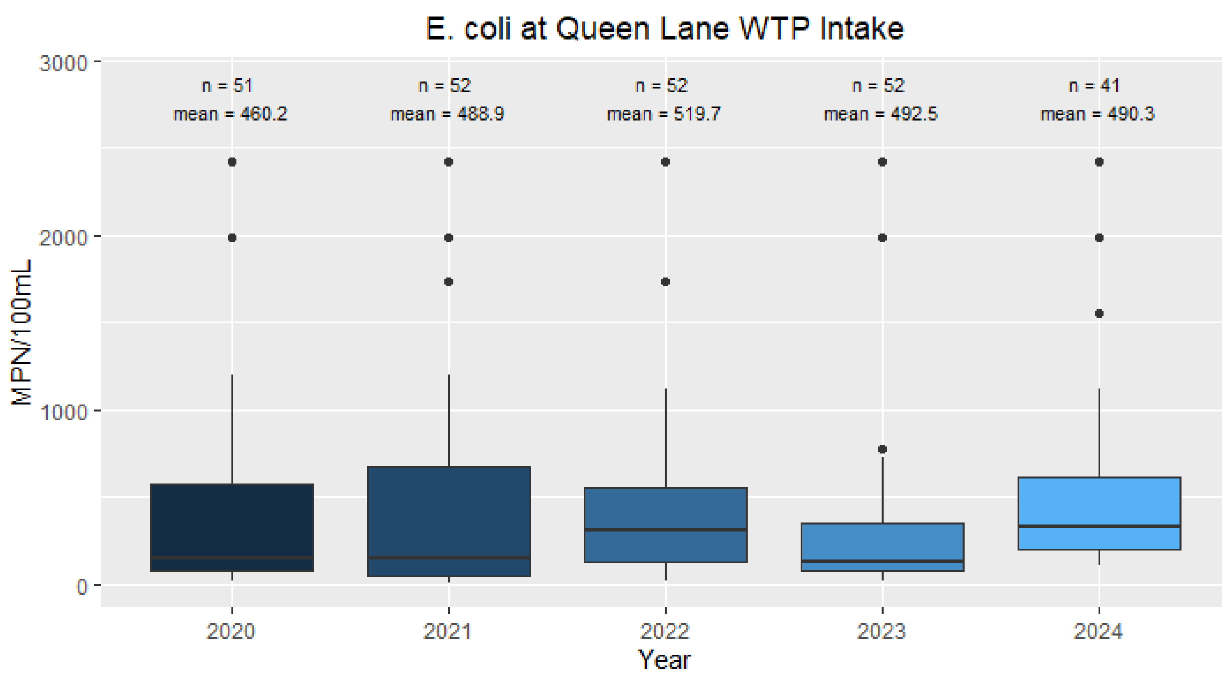

Figure 15 *E. coli* at the Queen Lane Intake, 2020-2024

Summary statistics for fecal coliforms and *E. coli* at the Baxter WTP intake from 2020-2024 are presented in Table 26 and Table 27. Throughout this period, the Colilert-18 Quanti-Tray method was used to analyze fecal coliform and E. coli samples. Typically, dilutions were not performed. As such, there are several values of >2419.6 MPN/100 mL, the maximum count available using the Colilert-18 method. For these right-censored samples, the actual value may be greater than 2419.6 MPN/100 mL.

Table 26 Fecal Coliform Summary Statistics at the Baxter Intake, 2020-2024

Year	Mean (MPN/100mL)	Min (MPN/100mL)	Max (MPN/100mL)	Median (MPN/100mL)	n
2020	187.6	8.5	1299.7	84.65	52
2021	332	17.5	>2419.6	81.2	52
2022	328.5	3.1	>2419.6	84.4	52
2023	383.1	11	>2419.6	97.2	52
2024	395.3	3	>2419.6	161.6	41

The mean concentration of fecal coliforms measured from 2020 to 2024 ranged from 187.6 MPN/100mL to 395.3 MPN/100mL at the Baxter WTP intake. The concentration of fecal coliforms ranged from a minimum of less than 3 to a maximum of more than 2,419.6 MPN/100mL.

Table 27 *E. coli* Summary Statistics at the Baxter Intake, 2020-2024

Year	Mean (MPN/100mL)	Min (MPN/100mL)	Max (MPN/100mL)	Median (MPN/100mL)	n
2020	199.2	1	980.4	75.9	51
2021	329.6	21.6	>2419.6	113.45	52
2022	367.1	2	>2419.6	108.35	52
2023	383	12	>2419.6	118.25	52
2024	440.2	6.3	>2419.6	159.7	41

The mean concentration of *E. coli* measured from 2020 to 2024 ranged from 199.2 MPN/100 mL to 440.2 MPN/100mL. The concentration of *E. coli* ranged from a minimum of 1 to a maximum of more than 2,419.6 MPN/100mL.

The ranges of both fecal coliforms and *E. coli* span several orders of magnitude, which can be attributed to higher levels of bacteria in the rivers during and following rainfall events. Boxplot summaries of fecal coliform of *E. coli* data for the same time periods at the Baxter WTP intake are presented in Figure 16 and Figure 17.

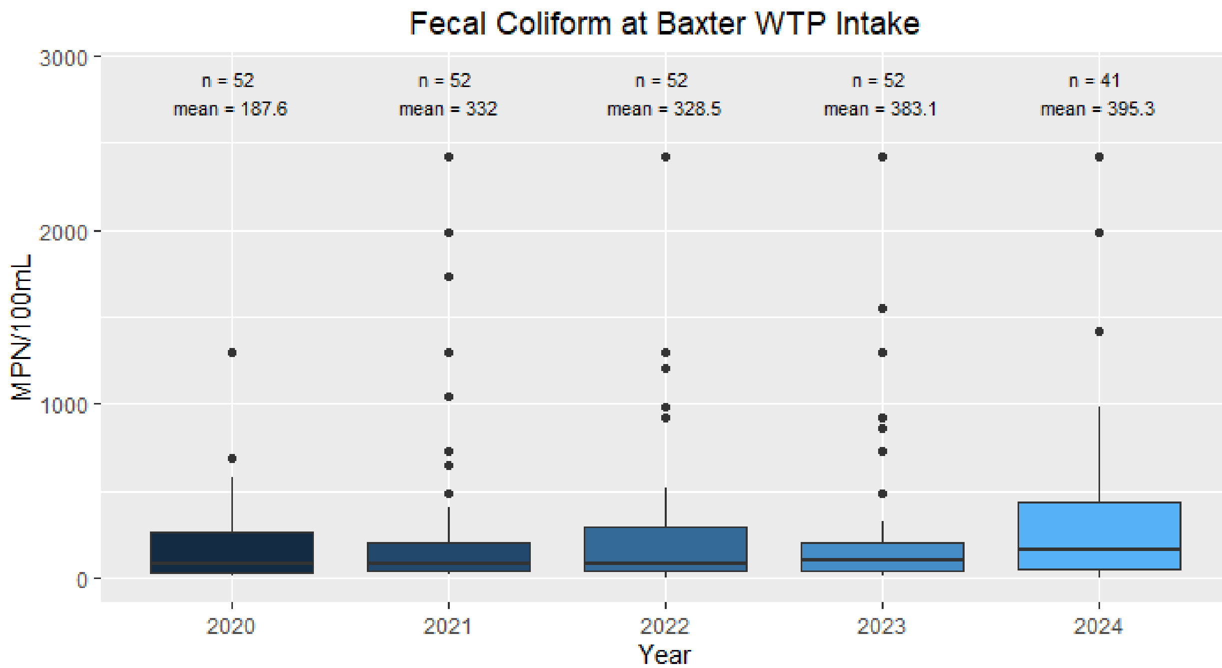

Figure 16 Fecal Coliform at the Baxter Intake, 2020-2024

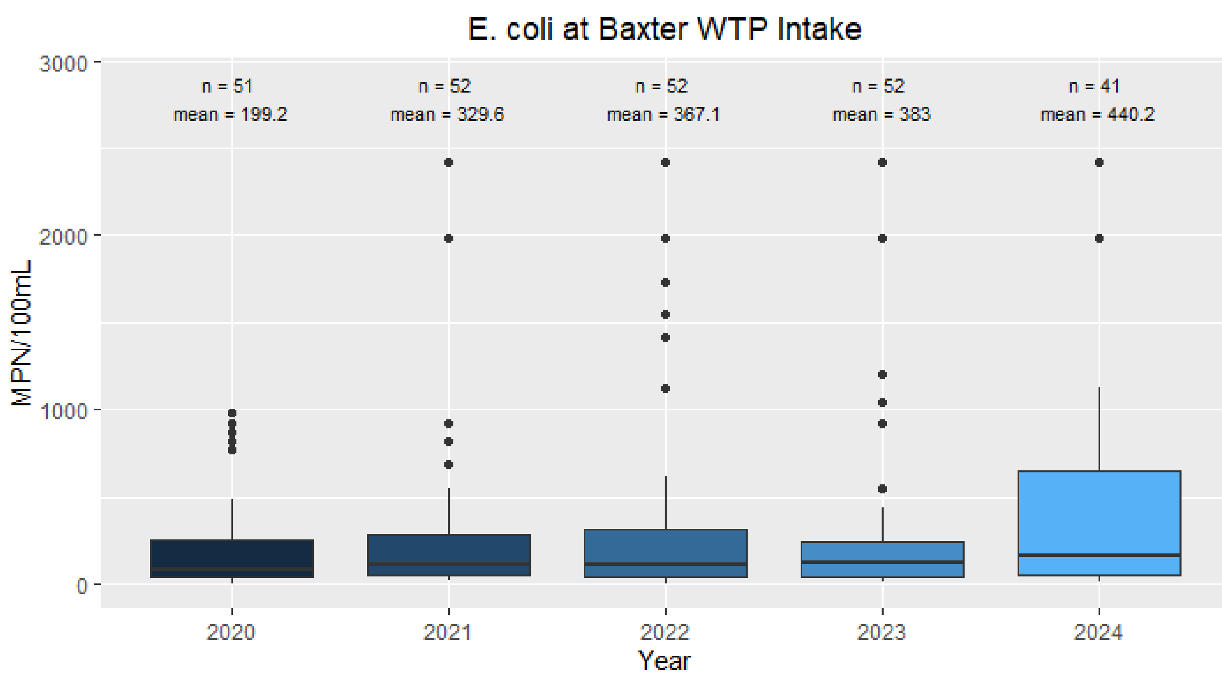

Figure 17 *E. coli* at the Baxter Intake, 2020-2024

5.2.2 Turbidity

Turbidity is a measure of the light that penetrates a sample of water and therefore is an indicator of the presence of light blocking fine particles. Turbidity is caused by runoff from roads, construction, erosion, and agriculture. Turbidity increases significantly during rainfall events. The particles that increase turbidity in water provide a growth site for bacteria and other microbial pathogens including *Giardia* and *Cryptosporidium*. Turbidity can also interfere with the disinfection process that eliminates illness-causing microbial contaminants.

Table 28 summarizes the turbidity measured in samples collected at Queen Lane intake from 2020 to 2024, and Figure 18 shows a boxplot summary of the turbidity each year at Queen Lane. The mean level of turbidity in the source water at Queen Lane during this period ranged from 2.4 to 11.9 NTU. The maximum recorded turbidity at the Queen Lane intake during that time period is 286 NTU. Turbidity is regulated under the SWTR and is used as a performance measurement at Queen Lane WTP under LT2ESWTR. These rules are further detailed in Section 5.1.1.

Table 28 Turbidity Summary Statistics at the Queen Lane Intake, 2020 to 2024

Year	Mean (NTU)	Min (NTU)	Max (NTU)	Median (NTU)	n
2020	11.9	0.917	286	2.44	52
2021	4.4	0.959	20.2	2.675	52
2022	5.6	0.901	74.6	2.465	52
2023	7.5	0.81	99.9	2.26	52
2024	2.4	0.63	10.7	1.7	41

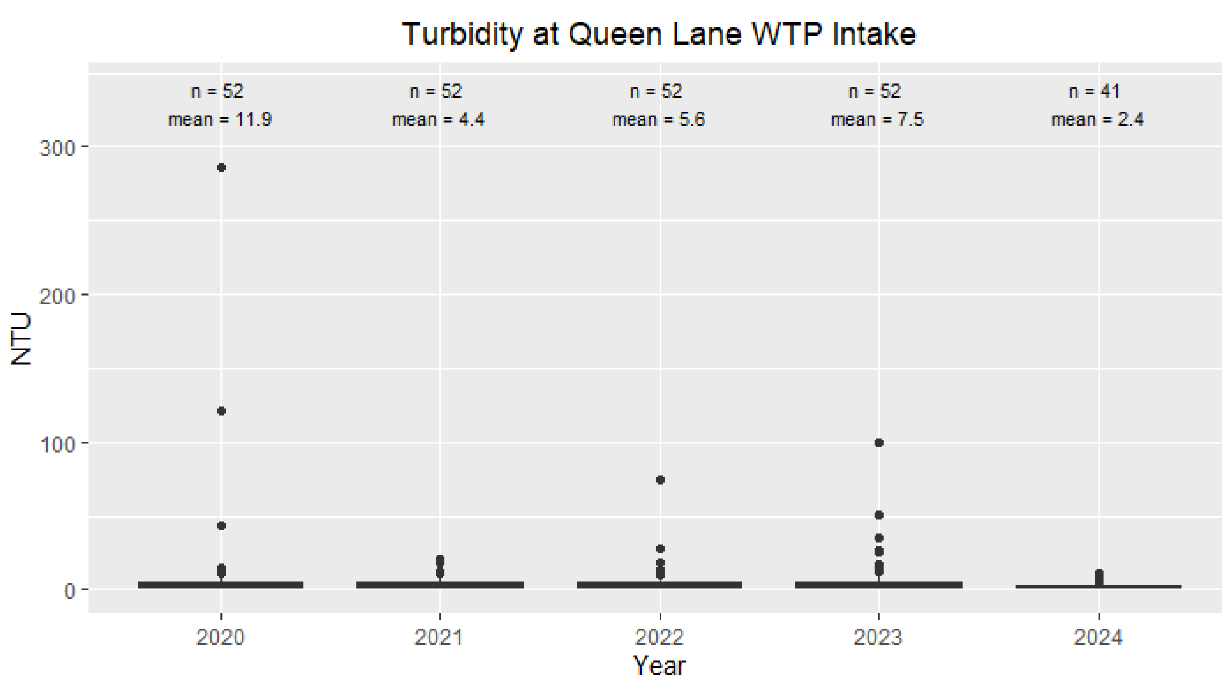

Figure 18 Turbidity at the Queen Lane Intake, 2020-2024

Table 29 summarizes the turbidity measured in samples collected at the Baxter intake from 2020 to 2024, and Figure 19 shows a boxplot summary of the turbidity each year at the Baxter intake. The mean level of turbidity in the source water at the Baxter intake during this period ranged from 6.5 to 10.9 NTU. The maximum recorded turbidity at the Queen Lane intake during that time period is 74.5 NTU. Turbidity is regulated under the SWTR and is used as a performance measurement at Queen Lane WTP under LT2ESWTR. These rules are further detailed in Section 5.1.1.

Table 29 Turbidity Summary Statistics at the Baxter Intake, 2020 to 2024

Year	Mean (NTU)	Min (NTU)	Max (NTU)	Median (NTU)	n
2020	6.8	2.12	21.2	5.265	52
2021	10.9	1.02	45.6	8.185	52
2022	10.9	3.29	74.5	8.1	54
2023	8.3	1.46	71	5.47	52
2024	6.5	1.59	20.2	4.94	41

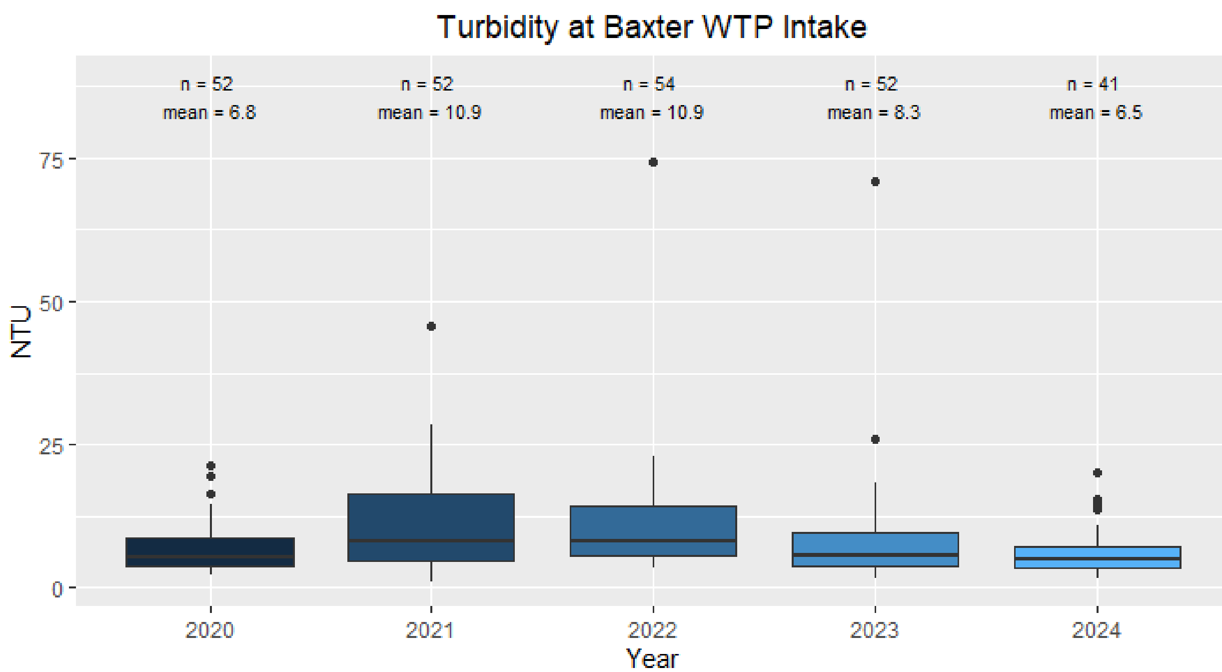

Figure 19 Turbidity at the Baxter Intake, 2020-2024

5.2.3 pH

pH has been identified as a parameter of potential concern for some of Philadelphia's watersheds, primarily because of algal effects on the dissolved inorganic carbon (DIC) composition of stream water. Algae take up CO_2 during photosynthesis and shift the composition of DIC toward the alkaline carbonates. PADEP water quality criteria are bounded by daily minima and maxima of 6.0 and 9.0, respectively. Changes in pH may play a role on stability during sorption of *Cryptosporidium parvum* by nanoparticles (Roberts et al., 2009).

Table 30 summarizes pH values observed at the Queen Lane intake from 2020 to 2024, and Figure 20 shows the variability of pH observations for each year. Because these monthly samples are taken during late morning to early afternoon throughout the year, these data do not express the full variability of diel pH fluctuations.

Table 30 pH Summary Statistics at the Queen Lane Intake, 2020-2024

Year	Mean	Min	Max	Median	n
2020	7.8	7.12	8.24	7.86	52
2021	7.9	7.38	8.71	7.905	52
2022	7.8	7.49	8.48	7.815	52
2023	7.7	7.37	8.29	7.74	52
2024	7.7	7.32	8.33	7.66	41

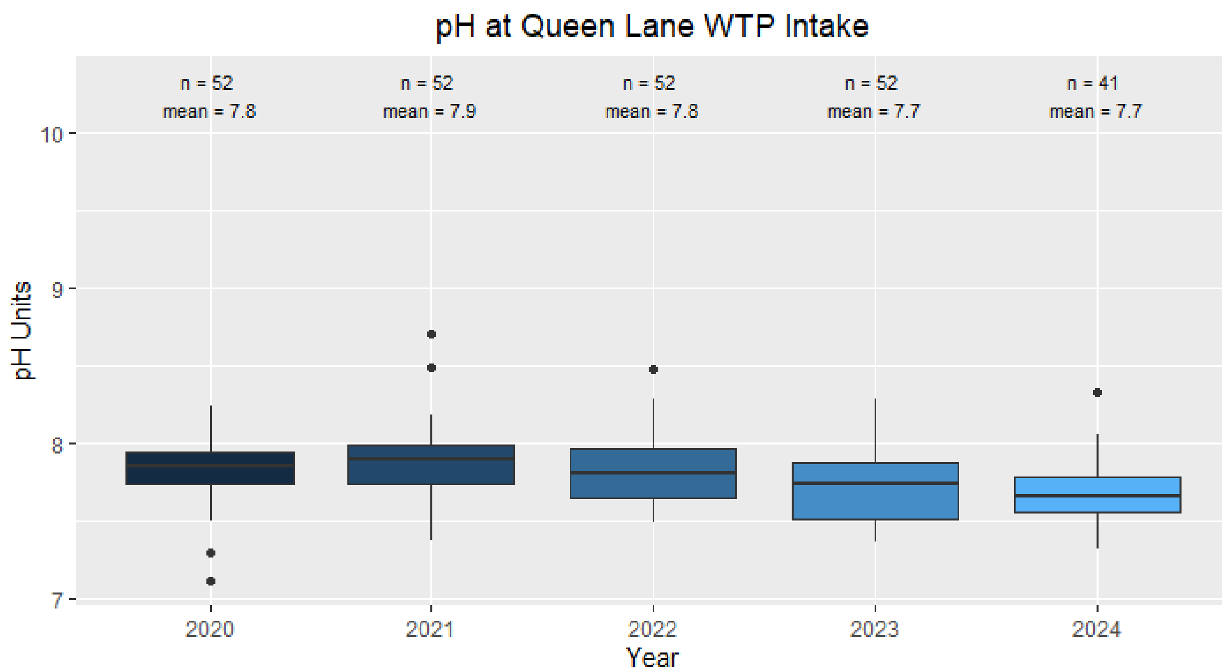

Figure 20 pH at the Queen Lane Intake, 2020-2024

Table 31 summarizes pH values observed at the Baxter intake from 2020 to 2024, and Figure 21 shows the variability of pH observations for each year. Because these monthly samples are taken during late morning to early afternoon throughout the year, these data do not express the full variability of diel pH fluctuations.

Table 31 pH Summary Statistics at the Baxter Intake, 2020-2024

Year	Mean	Min	Max	Median	n
2020	7.8	7.12	8.24	7.86	52
2021	7.9	7.38	8.71	7.905	52
2022	7.8	7.49	8.48	7.815	52
2023	7.7	7.37	8.29	7.74	52
2024	7.7	7.32	8.33	7.66	41

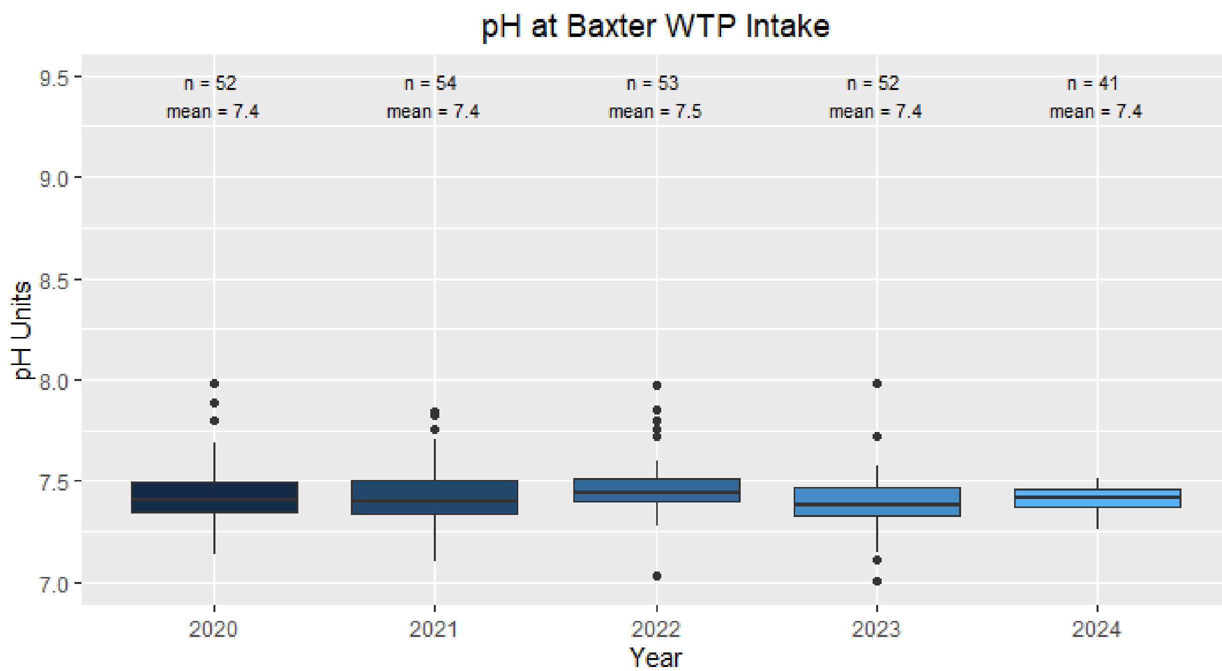

Figure 21 pH at the Baxter Intake, 2020-2024

5.3 Evaluation of Ability to Meet Drinking Water Regulations

PWD is committed to maintaining the highest possible drinking water quality. To reduce the risk of illness from microbial contamination, PWD maintains treated drinking water turbidity levels that exceed federal and state standards and has received the 10 Year Director's Award from the Partnership for Safe Water. PWD communicates information on drinking water quality to its customers through the Annual Water Quality Report.

5.3.1 Partnership for Safe Water

PWD has been a member of the Partnership for Safe Water (PSW) Treatment Optimization Program for nearly 30 years. On January 2, 1996, PWD signed the Partnership Agreement with EPA to show commitment to the PSW Treatment Optimization Program. Through voluntary program participation, PWD works to further reduce the potential health risks from *Cryptosporidium*, *Giardia*, and other microbial contaminants by assessing and continuously improving treatment plant filtration performance. PWD signed a similar agreement with the Pennsylvania Department of Environmental Protection (PADEP) in July of 1998 to show commitment to achieving and maintaining the highest possible drinking water quality.

Phase I of the Treatment Optimization Program was completed in 1996, with the signing of the PSW Participation Agreement. In 1998, PWD submitted baseline turbidity data for Phase II, and established a Steering Committee and Partnership Task Force to guide the self-assessment process. Inspection and evaluation teams visited each WTP and wrote a detailed report provided to the plant manager. A workshop was held on October 29, 1996 to review and prioritize potential and actual limiting factors cited by the inspection and evaluation teams. The final Phase III Self-Assessment report of the Queen Lane, Baxter, and Belmont WTPs was submitted to PSW in September 1998.

Since 1998, PWD average finished water turbidity has been at or below 0.06 NTU. PWD received the EPA Director's Award in 1999 for the completion of the Phase III self-assessment. In 2008, the Baxter, Queen Lane, and Belmont WTPs were honored by the EPA and PADEP with the 10 Year Director's Award for achieving and maintaining turbidity levels less than 0.1 NTU for 10 years.

5.3.2 LT2ESWTR Removal Credits

As a result of LT2ESWTR sampling, Queen Lane and Baxter received a Bin 2 classification as explained in Section 1.1. Since both plants use conventional treatment processes, and automatically receive a 3-log removal credit, an additional 1-log removal credit is required. PWD achieved the additional 1-log removal credit by meeting CFE and IFE turbidity TT at the Queen Lane and Baxter WTPs for 0.5-log credit each, detailed in section 5.1.1.3.

5.3.3 Annual Water Quality Report

Every year, the Philadelphia Water Department distributes the annual Drinking Water Quality Report to all customers. This is required of all water utilities by the Federal Safe Drinking Water Act, and it provides the customer with information on the quality of their drinking water. The EPA requires certain fundamental information to be in this report. It must include the source of the drinking water, the susceptibility to contamination of that source, the level of contaminants in the drinking water and the EPA health standards for comparison, the likely source of contaminants, the potential health effects of any violations and the system's actions to restore safe drinking water, a message to vulnerable populations on avoiding *Cryptosporidium*, education information on nitrate, arsenic and lead if a concern to the system, and additional sources of information. Water systems may also enhance their reports with additional information pertaining to drinking water.

Although extensive information about PWD's source water protection efforts is available to the public online and through reports posted on the Watershed Protection and Regulatory Reporting websites, for the customer not actively seeking information about their drinking water, PWD provides source water protection information straight to the customers through the annual drinking water quality report. The most recent report shares information on source water protection efforts and the Delaware Valley Early Warning System. These reports are also published to the Philadelphia Water Department website on an annual basis.

5.4 Recommended Water Quality Monitoring Program

The PWD Bureau of Laboratory Services (BLS) is a state-of-the-art laboratory that performs a variety of water quality analyses on samples collected from the water supply, drinking water treatment plants, distribution system and wastewater treatment plants. BLS is comprised of several specialized laboratories including the:

- Organics Laboratory – analyzes for different classes of organic compounds
- Inorganics Laboratory – analyzes for a full suite of general water quality parameters, trace metals and nutrients
- Aquatic Biology Laboratory – expertise in microbiology, biology, and algae
- Materials Engineering Laboratory and Materials Analysis Section – expertise in performing quality testing of materials comprising PWD infrastructure
- Quality Assurance Unit - ensures the proper execution of analytical methods and accuracy of results
- Watershed Team – responds to fish kills and conducts evaluations of the water quality and ecological conditions in the watershed
- Cross Connection Control Program – responds to potential contamination associated with cross connections and maintains records and back flow protections

BLS has extensive knowledge in water quality monitoring. Recommended monitoring projects from all divisions of PWD can be implemented through BLS.

Section 6. Conclusion and Recommendations

Priority sources of *Cryptosporidium* and pathogens in the Schuylkill River watershed upstream of Philadelphia were identified in the WCP. For the Watershed Sanitary Survey (WSS), PWD compiled updated data from a number of publicly available data sources on WWTPs, CSOs, wildcat sewers, sewerage planning, agricultural land cover, and livestock populations. Through the SAN and PADEP, PWD collects additional detailed data on priority sources outside PWD jurisdiction including changes in WWTP flows and system upgrades. After review of the data collected for the Watershed Sanitary Survey, PWD believes wastewater discharges, runoff from agricultural land and wildlife continue to be priority sources.

The first priority source is discharges from WWTPs. There are 104 WWTPs discharging 80.73 MGD to the Queen Lane AOI and 89 WWTPs discharging 48.12 MGD to the Baxter AOI. Of these, at least 33 WWTPs discharging a total of 27.8 MGD use UV disinfection. Although PWD does not have jurisdiction over upstream WWTPs, PWD will continue to track changes flow and treatment technology of upstream dischargers in partnership with the SAN pathogens workgroup and PADEP. CSOs, wildcat sewers and discharge to septic system may also contribute *Cryptosporidium* and pathogens to the watershed. However, with limited data, there is great uncertainty associated with these sources.

The second priority source is runoff from agricultural land use. The Queen Lane AOI is 27.1% agricultural land cover. Although this is a slight decrease of 0.5% from 2016-2019, there was an approximately 28.5% decline in cattle in calves and a 16.6% decline in hogs and pigs from 2017-2022. The Baxter AOI is 15.2% agricultural land cover. The datasets from 2016 to 2019 show no change in agricultural land cover. From 2017-2022 there is a decline of 31.7% in cattle and calves, and increase of 70.3% in hogs and pigs, and an increase of 30.3% in horses and ponies in the Baxter AOI.

PWD will continue to prioritize agricultural BMP projects that manage stormwater and reduce pathogens and other contaminants from entering the waterways by leveraging funding with watershed partners through the SRRF. Additionally, designated funding in the watershed from the DRWI and the NRCS-RCPP is also expected to increase support and implementation of agricultural BMPs.

The third priority source is from wildlife. PWD identified geese as mechanical vectors of *Cryptosporidium* in a source tracking study with Lehigh University. Although watershed-specific data is not available to track changes in geese populations, PWD manages populations at priority areas in the city and communicates the importance of managing geese populations in drinking water supply areas to protect water quality.

PWD recommends continuing the following:

- Taking a partnership approach to achieve WCP goals. The Schuylkill Action Network will continue to act as the forum for watershed partners to discuss, promote, and achieve a variety of source water protection related goals.

- Utilizing the SAN Pathogens workgroup as a forum for tracking changes and upgrades in WWTP discharges upstream of Queen Lane on the Schuylkill River watershed.
- Utilize the PADEP to track changes and upgrades in WWTP discharges upstream of Baxter in the Delaware River watershed.
- Contributing funding to the SRRF to implement WCP control measures, including agricultural BMPs on farms.
- Contribute funding and staff expertise to grow and support the new Delaware River Improvement Partnership (DRIP) and its Farm Forward initiative.
- Participate in the DRBC Subcommittee on Source Water Protection
- Track updates for publicly available data sources used in source water protection planning, particularly as it pertains to regulatory reporting timelines.

Section 7. References

Crockett, C.N. 2007. “The Role of Wastewater Treatment in Protecting Water Supplies Against Emerging Pathogens.” *Water Environment Research* 79.3: 221-32. Print.

Dunn, John P. and Jacobs, Kevin J., "Special resident Canada goose hunting seasons in Pennsylvania - management implications for controlling resident Canada geese" (2000). Wildlife Damage Management Conferences -- Proceedings. Paper 45. http://digitalcommons.unl.edu/icwdm_wdmconfproc/45

PENNVEST. *PENNVEST Project Search.* http://www.pennvest.pa.gov

Philadelphia Water Department (PWD). 2011. *Long Term 2 Enhanced Surface Water Treatment Rule Watershed Control Program Plan*. <phillywatersheds.org/doc/Sourcewater/PWD_Watershed_Control_Plan_final.pdf>

Philadelphia Water Department (PWD). *2010. Schuylkill River Hydrology and Consumptive Use.* < phillywatersheds.org/doc/Sourcewater/PWD_Water_Budget_Report.pdf>

Philadelphia Water Department (PWD). 2013. *2013 Annual Status Report Watershed Control Program Plan.* < phillywatersheds.org/doc/2013%20PWD%20Watershed%20Control%20Plan%20Annual%20Status%20Report.pdf>

Philadelphia Water Department (PWD). 2014. *2014 Annual Status Report Watershed Control Program Plan.* <phillywatersheds.org/doc/PWD%20WCP%202014%20Annual%20Status%20Report_January%202015.pdf>

Philadelphia Water Department (PWD). 2017. *2017 Annual Status Report Watershed Control Program Plan.*

PRNewswire. "Governor Wolf Announces $130.7 Million Investment in Water Infrastructure Projects in 8 Counties." 22 Apr 2015 <www.prnewswire.com/news-releases/>

PRNewswire. "Pennsylvania Governor Rendell Announces $129 Million Investment in Water Infrastructure Projects in 33 Counties." 21 Jul 2010. <www.prnewswire.com/news-releases/>

PRNewswire. "Governor Corbett Announces $84 Million Investment in Water Infrastructure Projects in 14 Counties." 26 Oct 2011. <www.prnewswire.com/news-releases/>

PRNewswire. "Pennsylvania Governor Corbett Announces $99 Million Investment in Water Infrastructure Projects in 20 Counties." 20 Jul 2011. <www.prnewswire.com/news-releases/>

PRNewswire. "Governor Rendell Announces $174 Million Investment in Water Infrastructure Projects in 21 Counties." 9 Nov 2010. <www.prnewswire.com/news-releases/>

PRNewswire. "Governor Corbett Announces $115 Million Investment in Water Infrastructure Projects in 17 Counties." 25 Apr 2012. <www.prnewswire.com/news-releases/>

Roberts, M. G., Bart Faulkner, C. SU, J. Griffitts, J. Groves, and J. Ferguson. The Effect of pH on Stability and Sorption of Cryptosporidium parvum Oocysts by Nanoparticles. Presented at The Soil Science Society of American Annual Meetings, Pittsburg, PA, November 01 - 05, 2009.

Schuylkill County Municipal Authority. *Schuylkill County Municipal Authority Current Construction Projects.* www.scmawater.com

Water Research Foundation. *Detecting and Managing Protozoa Factsheet*. Accessed Jul. 10, 2015. <www.waterrf.org/knowledge/microbials/FactSheets/Microbials_Protozoa_FactSheet.pdf>

Stuckey, MH. 2008. Development of the Water-Analysis Screening Tool used in the Initial Screening for the Pennsylvania State Water Plan Update of 2008. USGS. OFR 2008-1106

U.S. Fish and Wildlife Service (USFWS). 2005. Final Environmental Impact Statement (FEIS) on Resident Canada Goose Management. U. S. Department of the Interior, Washington, D.C. USA.

U.S. Fish and Wildlife Service (USFWS). 2014. Waterfowl population status, 2014. U.S. Department of the Interior, Washington, D.C. USA. http://www.fws.gov/southeast/birds/PDF/statusreport2014_final_7-24-14.pdf

Serie, Jerry and Hindman, Larry. 1997. U.S. Fish and Wildlife Service (USFWS). "Atlantic Population of Canada Geese Status and Management

Appendix

Table 32 List of WWTP Facilities in the Queen Lane AOI

NPDES	Facility Name	2024 Average Discharge, MGD*	Permitted Discharge, MGD**	County
PA0246956	ALSACE MANOR STP	0.03	0.07	BERKS
PA0070351	AMITY TWP WWTP	1.46	2.20	BERKS
PA0026646	ANTIETAM VLY STP	1.05	1.23	BERKS
PA0022543	BALLY STP	0.18	1.00	BERKS
PA0024023	BERNVILLE STP	0.25	0.28	BERKS
PA0084638	BOYERTOWN BORO/ IW	0.03	0.04	BERKS
PA0085669	CENTERPORT STP	0.03	0.06	BERKS
PA0086771	CENTRE TWP DAUBERVILLE STP	0.03	0.08	BERKS
PA0086525	CENTRE TWP KINGSGATE E STP	0.01	0.01	BERKS
PA0246654	CENTRE TWP MA-HILLCREST ESTATES STP	0.01	0.03	BERKS
PA0087581	CENTRE TWP MUN AUTH - JORDAN CROSSING STP	0.00	0.02	BERKS
PA0033995	COUNTY OF BERKS WWTP	0.21	0.50	BERKS
PA0026972	EXETER TWP STP	2.11	7.10	BERKS
PA0021636	FLEETWOOD BORO STP	0.60	0.70	BERKS
PA0085782	GOLDEN OAKS GC	0.02	0.05	BERKS
PA0266124	GREEN HILLS ESTATES	0.00	0.03	BERKS
PA0021601	HAMBURG BORO STP	0.76	1.50	BERKS
PA0052400	IRISH CREEK VILLAGE MHP-WELL 2 TREATMENT PIT	0.02	0.01	BERKS
PA0031135	KUTZTOWN BOROUGH WWTP	1.10	1.50	BERKS
PA0070149	LEESPORT BOROUGH AUTHORITY WWTP	0.38	0.50	BERKS
PA0246921	LENHARTSVILLE STP	0.02	0.04	BERKS
PA0085171	LYONS BORO MUN AUTH WTP	0.19	0.30	BERKS
PA0070271	MAIDENCREEK TWP STP	0.50	0.80	BERKS
PA0260151	MAXATAWNY TWP MUNI AUTH	0.04	0.14	BERKS
PA0033766	NORTH HEIDELBERG STP	0.07	0.10	BERKS
PA0024961	OLEY TWP STP	0.31	0.40	BERKS
PA0260975	RICHMOND TOWNSHIP-VIRGINVILLE WWTP	0.01	0.02	BERKS
PA0051900	ROBESON TWP STP	0.02	0.30	BERKS
PA0031062	ROBESONIA WERNERSVILLE STP	0.77	1.40	BERKS
PA0028649	SINKING SPRING STP	0.78	1.25	BERKS
PA0043052	SPRING TWP STP	1.31	2.00	BERKS
PA0088251	UPPER BERN TOWNSHIP WWTP	0.09	0.16	BERKS
PA0246611	UPPER TULPEHOCKEN TWP WWTP	0.02	0.07	BERKS
PA0086142	WASHINGTON TWP STP	0.21	0.25	BERKS
PA0028975	WOMELSDORF STP	0.25	0.48	BERKS
PA0026638	WYOMISSING VLY JT SA STP	2.48	4.00	BERKS

NPDES	Facility Name	2024 Average Discharge, MGD*	Permitted Discharge, MGD**	County
PA0056847	EAST ROCKHILL TOWNSHIP WWTP	0.05	0.11	BUCKS
PA0058271	HIGHLAND PARK STP	0.11	0.15	BUCKS
PA0042021	MILFORD-TRUMBAUERSVILLE WWTP	0.64	0.80	BUCKS
PA0020460	PENNRIDGE WASTEWATER TREATMENT AUTHORITY WWTP	3.00	4.33	BUCKS
PA0050482	FREEDOMS FOUNDATION STP	0.00	0.02	CHESTER
PA0056731	HISTORIC SALEM VILLAGE STP	0.00	0.00	CHESTER
PA0025437	NORTH COVENTRY STP	0.88	2.01	CHESTER
PA0027154	PHOENIXVILLE BORO STP	1.93	4.00	CHESTER
PA0028614	SPRING CITY BORO STP	0.44	0.61	CHESTER
PA0043974	VALLEY FORGE SEWER AUTHORITY WWTP	7.09	11.75	CHESTER
PA0248185	JACKSON TOWNSHIP AUTHORITY	0.19	0.50	LEBANON
PA0021075	MYERSTOWN STP	1.53	2.00	LEBANON
PA0086967	MYERSTOWN WATER AUTH	0.00	0.00	LEBANON
PA0064149	ARCADIA WEST INDUSTRIAL PARK WWTP	0.02	0.04	LEHIGH
PA0070254	LYNN TWP WWTP	0.06	0.08	LEHIGH
PA0026867	ABINGTON WWTP	3.26	3.91	MONTGOMERY
PA0023540	BERKS-MONTGOMERY MORYSVILLE STP	0.25	0.32	MONTGOMERY
PA0055671	BERWICK PLACE STP	0.08	0.15	MONTGOMERY
PA0024376	BOYERTOWN BORO STP	0.44	0.75	MONTGOMERY
PA0020397	BRIDGEPORT BORO STP	0.43	0.90	MONTGOMERY
PA0057673	CANDLEWYCK ESTATES STP	0.00	0.02	MONTGOMERY
PA0026794	CONSHOHOCKEN BORO AUTH	1.20	2.30	MONTGOMERY
PA0026816	E NORRITON PLYMOUTH /NORRISTOWN	6.10	8.67	MONTGOMERY
PA0244295	FRANCONIA WWTP	0.05	0.15	MONTGOMERY
PA0050989	FREDERICK LIVING-MAIN PLANT	0.02	0.05	MONTGOMERY
PA0244171	GLANRAFFIN CREEK REMEDIATION PROJECT	0.03	0.12	MONTGOMERY
PA0050521	GREEN LANE MARLBORO JT AUTH	0.20	0.20	MONTGOMERY
PA0057061	IVY RIDGE STP	0.01	0.02	MONTGOMERY
PA0051934	KING ROAD STP	0.88	1.70	MONTGOMERY
PA0050105	LOWER FREDERICK TWP STP	0.15	0.50	MONTGOMERY
PA0055875	MACOBY CREEK STP	0.19	0.40	MONTGOMERY
PA0056413	MAINLAND STP	0.83	0.90	MONTGOMERY
PA0050911	MARLBOROUGH ELEM SCH STP	0.00	0.00	MONTGOMERY
PA0026085	MATSUNK STP	3.25	5.50	MONTGOMERY
PA0057819	NEW HANOVER TWP AUTH STP	0.70	1.93	MONTGOMERY
PA0033880	NEW HANOVER UPPER FREDERICK ELEM SCH STP	0.00	0.01	MONTGOMERY
PA0026964	OAKS WWTP (LOWER PERKIOMEN VALLEY)	8.46	14.25	MONTGOMERY
PA0054810	PERKIOMEN CROSSING STP	0.03	0.05	MONTGOMERY

NPDES	Facility Name	2024 Average Discharge, MGD*	Permitted Discharge, MGD**	County
PA0012891	PERKIOMEN WWTP	0.00	0.12	MONTGOMERY
PA0058041	POSSUM HOLLOW STP	0.22	0.70	MONTGOMERY
PA0026786	POTTSTOWN WASTEWATER TREATMENT PLANT	6.11	12.85	MONTGOMERY
PA0021512	ROYERSFORD STP	0.29	0.70	MONTGOMERY
PA0020303	SCHWENKSVILLE BORO WWTP	0.18	0.30	MONTGOMERY
PA0244040	SHELLY SQUARE STP	0.00	0.01	MONTGOMERY
PA0024180	SWAMP CREEK STP	1.89	2.30	MONTGOMERY
PA0058467	THE AMERICAN COLLEGE (630 ALLENDALE RD)	0.00	0.00	MONTGOMERY
PA0029441	UPPER DUBLIN WWTP	0.90	1.10	MONTGOMERY
PA0023256	UPPER GWYNEDD TWP STP	3.28	6.40	MONTGOMERY
PA0026131	UPPER MERION TWP. AUTH-TROUT R	3.48	6.00	MONTGOMERY
PA0020532	UPPER MONTGOMERY JOINT AUTHORITY STP	1.07	2.00	MONTGOMERY
PA0057606	UPPER SALFORD TWP - FARMHOUSE STP	0.00	0.00	MONTGOMERY
PA0050393	VALLEY GREEN STP	0.15	0.22	MONTGOMERY
PA0026298	WHITEMARSH TOWNSHIP STP	1.02	2.00	MONTGOMERY
PA0064157	BOROUGH OF NEW RINGGOLD WASTEWATER TREATMENT FACILITY	0.01	0.04	SCHUYLKILL
PA0024015	CRESSONA BORO AUTH STP	0.36	0.72	SCHUYLKILL
PA0061310	MARIAN HIGH SCHOOL-TREATMENT PLANT 301	0.00	0.04	SCHUYLKILL
PA0027693	MINERSVILLE BOROUGH MUNICIPAL AUTHORITY	0.37	1.00	SCHUYLKILL
PA0063878	NORTHEASTERN SCHUYLKILL JOINT MUN. AUTH.	0.15	0.25	SCHUYLKILL
PA0021547	ORWIGSBURG MUN SEW AUTH	0.70	0.90	SCHUYLKILL
PA0061328	PLUM CREEK MUN AUTH	0.00	0.03	SCHUYLKILL
PA0062634	SAMMYS MOBILE HOME PARK	0.00	0.01	SCHUYLKILL
PA0029017	SCHUYLKILL HAVEN BOROUGH	1.12	2.80	SCHUYLKILL
PA0064211	SCHUYLKILL VALLEY SEW AUTH	0.19	0.55	SCHUYLKILL
PA0042170	SCMA DEER LAKE WWTP	0.61	1.00	SCHUYLKILL
PA0276189	SCMA-MAHANOY WWTP	0.00	0.49	SCHUYLKILL
PA0027006	TAMAQUA BORO	0.77	2.60	SCHUYLKILL
PA0032077	TUSCARORA STATE PRK - WWTP	0.00	0.03	SCHUYLKILL
Total		**80.75**	**142.98**	

*2024 daily average flow includes data from 1/1/2024 – 11/30/2024 depending upon available data in EPA ECHO database, search performed 12/1/2024

**Data from EPA ECHO database, search performed 12/1/2024

Table 33 List of WWTP Facilities in the Baxter AOI

NPDES	Facility Name	2024 Average Discharge, MGD*	Permitted Discharge, MGD**	County
PA0058343	BEDMINSTER WWTF	0.22	0.30	BUCKS
PA0058840	BERRY BROW WWTP	0.04	0.05	BUCKS
PA0050598	BETHEL BAPTIST CH	0.00	0.01	BUCKS
PA0027294	BRISTOL BOROUGH WPC PLANT	1.67	2.70	BUCKS
PA0026450	BRISTOL TOWNSHIP STP	3.71	2.25	BUCKS
PA0053929	BUBBAS POT BELLY STOVE RESTAURANT STP	0.00	0.01	BUCKS
PA0053279	BUCKINGHAM SPRINGS STP	0.05	1.00	BUCKS
PA0052761	BUCKINGHAM VALLEY NURSING CENTER STP	0.01	0.01	BUCKS
PA0052353	BUCKINGHAM VILLAGE WWTP	0.19	0.24	BUCKS
PA0021181	BUCKS CNTY WATER & SEW AUTH/GREEN ST STP	0.53	1.40	BUCKS
PA0058505	CASEY'S TAVERN STP	0.00	0.00	BUCKS
PA0025917	CHALFONT-NEW BRITAIN TOWNSHIP JT SEWAGE AUTHORITY	0.00	0.02	BUCKS
PA0244147	CHAPMAN CORNERS WWTP	0.01	0.02	BUCKS
PA0056421	COUNTRY CROSSING STP	0.08	0.64	BUCKS
PA0021741	DUBLIN BORO STP	0.34	0.75	BUCKS
PA0055263	EXECUTIVE CENTER CONDO ASSN STP	0.00	0.00	BUCKS
PA0050148	FISH CREEK STP	0.66	0.85	BUCKS
PA0052787	FLATLAND CHURCH STP	0.00	0.00	BUCKS
PA0021172	HARVEY AVENUE STP	1.29	1.60	BUCKS
PA0052035	HERITAGE HILLS WWTP	0.00	0.33	BUCKS
PA0058548	KEELERSVILLE CLUB STP	0.00	0.00	BUCKS
PA0051250	KINGS PLAZA STP	0.27	0.43	BUCKS
PA0026166	LOG COLLEGE STP	3.62	8.93	BUCKS
PA0026468	LOWER BUCKS WWTP	8.21	10.00	BUCKS
PA0026701	MORRISVILLE BOROUGH STP	3.04	7.10	BUCKS
PA0245399	MORRISVILLE KTC WWTP	0.00	4.01	BUCKS
PA0051292	MORRISVILLE WATER FILTRATION PLANT	0.06	0.15	BUCKS
PA0244066	PENNLAND FARMS-TREATMENT BUILDING	0.04	0.06	BUCKS
PA0020290	QUAKERTOWN WWTP	2.56	3.10	BUCKS
PA0058858	REEVE TRACT WWTP	0.01	0.02	BUCKS
PA0057991	ROTHSTEIN TRACT STP	0.00	0.00	BUCKS
PA0244236	THE ENCLAVE WWTP	0.02	0.06	BUCKS
PA0051586	TOHICKON FAMILY CAMPGROUND WWTP	0.00	0.03	BUCKS
PA0056758	TRADESVILLE WWTP	0.21	0.33	BUCKS
PA0053244	VALLEY QUEEN APARTMENT STP	0.00	0.00	BUCKS
PA0058742	WARMINSTER NAWC WWTP	0.00	1.20	BUCKS
PA0056880	WATER FILTRATION PLANT	0.24	1.18	BUCKS

NPDES	Facility Name	2024 Average Discharge, MGD*	Permitted Discharge, MGD**	County
PA0050466	VETERANS CENTER STP	0.22	0.33	BUCKS COUNTY
PA0021199	BEAVER MEADOWS MUNICIPAL AUTHORITY	0.12	0.18	CARBON
PA0061182	BIG BOULDER WWTP	0.03	0.23	CARBON
PA0063428	BLUE MOUNTAIN SKI AREA	0.08	0.28	CARBON
PA0062472	BLUE MOUNTAIN VIEW ESTATES STP	0.02	0.03	CARBON
PA0063711	CENTRAL CARBON MUN. AUTH. WWTP	1.04	1.60	CARBON
PA0061905	HICKORY RUN TURNPIKE PLAZA	0.02	0.04	CARBON
PA0021873	JIM THORPE BORO WWTP	0.49	0.92	CARBON
PA0062243	NESQUEHONING REGIONAL STP	0.35	0.65	CARBON
PA0070220	NIS HOLLOW EST STP	0.01	0.02	CARBON
PA0063487	SCHLEICHER DUANE TRAILER PARK PA-0063487	0.05	0.10	CARBON
PA0060879	SPRINGDALE GARDENS	0.01	0.01	CARBON
PA0021555	WEATHERLY BOROUGH	0.00	0.60	CARBON
PA0060411	THORNHURST WWTF	0.07	0.07	LACKAWANNA
PA0021580	CATASAQUA MUN SEW AUTH	1.15	2.25	LEHIGH
PA0063282	FAIRLAND SEWER COMPANY, INC.	0.03	0.04	LEHIGH
PA0036102	HEIDELBERG HGTS STP	0.05	0.06	LEHIGH
PA0062880	KIDSPEACE - ORCHARD HILLS CAMP-PUMP HOUSE	0.02	0.15	LEHIGH
PA0051799	LEHIGH CARBON COMM COLLEGE WWTP	0.01	0.04	LEHIGH
PA0034029	LEHIGH CNTY AUTH-SAND SPRINGS WWTP	0.04	0.07	LEHIGH
PA0055131	LEHIGH VALLEY ZOO-WELL 1 CHLORINATOR	0.00	0.02	LEHIGH
PA0052132	PARKLAND SCH DIST OREFIELD MID SCH	0.01	0.03	LEHIGH
PA0052426	SCHNECKSVILLE N. WATER & SEWER	0.07	0.07	LEHIGH
PA0020176	SLATINGTON WWTP	0.93	1.50	LEHIGH
PA0060593	LAUREL LAKES WWTF	0.06	0.09	LUZERNE
PA0063533	AQUA BLAKESLEE TOBYHANNA TOWNSHIP WWTP	0.19	0.30	MONROE
PA0061662	ARROWHEAD SEWER CO INC	0.13	0.53	MONROE
PA0061921	BROOKDALE DRUG AND ALCOHOL WWTP	0.00	0.05	MONROE
PA0061352	DEL WATER GAP WWTP	0.09	0.18	MONROE
PA0020168	E STROUDSBURG BORO WATER DEPT	1.20	2.25	MONROE
PA0061786	MANWALAMINK STP	0.17	0.70	MONROE
PA0060089	MIDDLE SMITHFIELD TWP WWTP	0.30	1.00	MONROE
PA0062294	PAWC POCONO DISTRICT	0.04	0.05	MONROE
PA0061719	PINECREST WWTF	0.04	0.50	MONROE
PA0060895	POCONO MTNS CORP CTR EAST	0.01	0.01	MONROE
PA0029220	SNYDERSVILLE DINER	0.00	0.01	MONROE
PA0060763	WINONA LAKES	0.02	0.05	MONROE
PA0030023	ACADEMY OF THE NEW CHURCH STP	0.04	0.07	MONTGOMERY
PA0046868	CHAPEL HILL WWTP	0.16	0.28	MONTGOMERY

NPDES	Facility Name	2024 Average Discharge, MGD*	Permitted Discharge, MGD**	County
PA0053180	EUREKA WWTP	1.14	2.40	MONTGOMERY
PA0026247	HATFIELD TWP STP	7.16	6.98	MONTGOMERY
PA0026182	LANSDALE BORO STP	1.77	3.20	MONTGOMERY
PA0052094	ORCHARD DEV STP	0.07	0.15	MONTGOMERY
PA0028568	BANGOR WASTEWATER TREATMENT PLANT	1.59	1.60	NORTHAMPTON
PA0020206	BATH BORO AUTH	0.38	0.51	NORTHAMPTON
PA0063231	LEHIGH TWP MUN AUTH-PENNSVILLE	0.01	0.06	NORTHAMPTON
PA0063240	LEHIGH TWP MUN AUTH-PENNSVILLE	0.16	0.30	NORTHAMPTON
PA0041742	NAZARETH BORO MUNI AUTH WWTP	1.27	1.60	NORTHAMPTON
PA0064297	PORTLAND BOROUGH	0.03	0.11	NORTHAMPTON
PA0043915	RIVER ROAD UTILITIES STP	0.05	0.07	NORTHAMPTON
PA0063827	WEST PENN PINES MHP STP	0.02	0.06	SCHUYLKILL
PA0061603	EAGLE LAKE COMM ASSOC WWTP	0.13	0.50	WAYNE
Total		**48.12**	**81.67**	

*2024 daily average flow includes data from 1/1/2024 – 11/30/2024 depending upon available data in EPA ECHO database, search performed 12/1/2024

**Data from EPA ECHO database, search performed 12/1/2024