Kline's Island Sewer System Regional Flow Management Strategy

City of Allentown
Lehigh County Authority
South Whitehall Township
Coplay-Whitehall Sewer Authority
Salisbury Township
Borough of Emmaus
Hanover Township (Lehigh County)
Lower Macungie Township
Borough of Alburtis
Borough of Macungie
Upper Macungie Township
Lowhill Township
Weisenburg Township
Upper Milford Township

August 1, 2018

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Acronym List

AO	Administrative Order
CCTV	Closed Circuit Television
COA	City of Allentown
CWSA	Coplay Whitehall Sewer Authority
FEB	Flow Equalization Basin
I/I	Inflow and Infiltration
KISS	Kline's Island Sewer System
KIWWTP	Kline's Island Wastewater Treatment Plant
LCA	Lehigh County Authority
LF	Linear Feet
LMT	Lower Macungie Township
MGD	Million Gallons per Day
NWT	North Whitehall Township
O&M	Operations and Maintenance
PADEP	Pennsylvania Department of Environmental Protection
PTP	Pre Treatment Plant
PVC	Poly Vinyl Chloride Pipe
RCP	Reinforced Concrete Pipe
RDII	Rainfall Derived Inflow and Infiltration
SCARP	Sewer Capacity Assurance and Rehabilitation Program
SCPS	Spring Creek Pump Station
SRP	Source Reduction Program
SSES	Sanitary Sewer Evaluation Study
SSO	Sanitary Sewer Overflow
SWT	South Whitehall Township
UMT	Upper Macungie Township
UMiT	Upper Milford Township
USEPA	United States Environmental Protection Agency
VCP	Vitrified Clay Pipe
WLI	Western Lehigh Interceptor
WLSP	Western Lehigh Sewerage Partnership
WWTP	Wastewater Treatment Plant

1. Overview

1.1. Background

For purposes of this document, the City of Allentown (COA), Lehigh County Authority (LCA), and each party's respective municipal signatories, all of whom are named in the Administrative Orders addressed by this submission, are referred to as a "Signatory" or collectively as "Signatories."

In addition, LCA and its municipal signatories in 2009 entered into memorandum of understanding to form the Western Lehigh Sewerage Partnership (WLSP) to address these matters cooperatively where possible. Members of the WLSP are LCA, Upper Macungie, Lower Macungie, Upper Milford, Weisenberg and Lowhill townships, and the boroughs of Alburtis and Macungie. Some portions of this document and appendices refer to the WLSP's past or planned work to represent the collective work of the partnership.

Flow issues in the primary components of the Kline's Island Sewer System (KISS) and activation of the Kline's Island Wastewater Treatment Plant (KIWWTP) high flow bypass outfall (Outfall 003) led to USEPA to issue two Administrative Orders (2007 and 2009) and the Pennsylvania Department of Environmental Protection (PADEP) to cause implementation of a connection management program in portions of the system in 2009. Progress related to these three actions have been regularly reported to both agencies since 2010, both in written annual/semi-annual reports and in regular meetings. Signatories have offered several independent strategies and plans to USEPA and PADEP, several of which were received positively by the regulators. Consistent with the 2009 Administrative Order's requirement for cooperative management of flows, USEPA and PADEP have requested a Regional Flow Management Strategy developed in collaboration among the Signatories that guides the development and implementation of each Signatory's individual sewer I/I reduction plan.

The USEPA has identified the following as critical components of the Regional Flow Management Strategy:

- Collection System Operation and Maintenance
- System Characterization
- Inflow and Infiltration Removal
- Flow Monitoring

1.2. Purpose and Use

This Regional Flow Management Strategy is intended to guide the development and implementation of Signatories' individual sewer I/I reduction plans so that they provide results that support the achievement of both municipal and regional goals for sewer system performance. This Strategy reflects broad-based commitments of action, collaboration, and cooperation.

Each Signatory has prepared and included in the Appendices its own I/I Reduction Plan and Operation and Maintenance Plan.

Each Signatory will provide information to LCA (as the operator of the KIWWTP and most of the primary conveyance components of the KISS) to prepare any required regular and/or special progress reports as may be requested in the future by USEPA or PADEP.

2. Physical Inventory and Attributes

The KISS service area is shown in Figure 1-1Figure 3-1. The KISS consists of 933 miles of sewer pipe from 14 municipal entities as shown in Table 2-1.

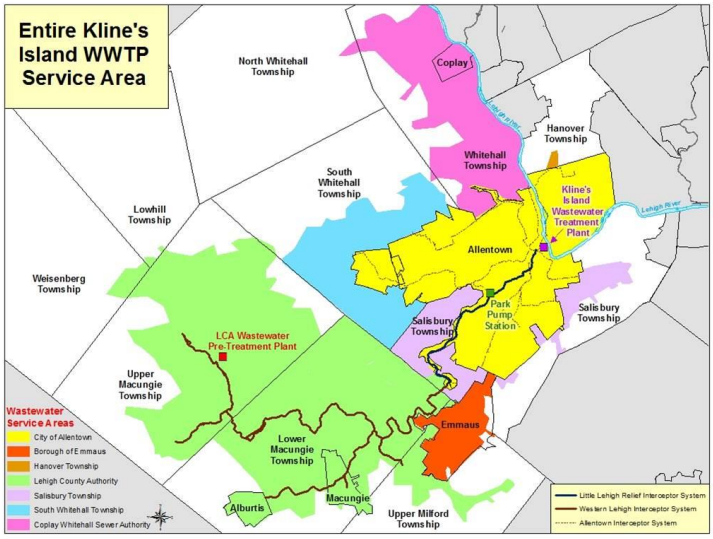


Figure 1-1 - KISS Service Area

Table 2-1 - Sewer Mileage per Signatory

SIGNATORY	Total Miles of Sewer	Percentage of Total
Allentown	285	30.55%
Coplay Whitehall	125	13.40%
Lower Macungie	123	13.18%
South Whitehall	118	12.65%
Upper Macungie	117	12.54%
Salisbury	69	7.40%
Emmaus	45	4.82%
LCA	18	1.93%
Macungie	11	1.18%
Alburtis	8	0.86%
Upper Milford	8	0.86%
Weisenburg	4	0.43%
Hanover	1.8	0.19%
Lowhill	0.2	0.02%

2.1. City of Allentown

The COA's KIWWTP and its tributary collection system has been in operation since 1929 protecting water quality and public health within the Lehigh Valley.

Beginning in the late 1950s and continuing through the late 1960s, COA entered into service agreements with surrounding municipalities and authorities for conveyance of wastewater through COA-owned trunk sewers and for treatment of wastewater at the KIWWTP. The first signatory agreement was executed with the Borough of Emmaus in 1959. Signatory agreements were subsequently executed with Coplay-Whitehall Sewer Authority, Salisbury Township and South Whitehall Township in 1965, and in 1969 a signatory agreement was executed with LCA. Due to the need to treat flow from the signatories together with growth within the city, the KIWWTP was expanded to an average flow capacity of 28.5 mgd in 1968 and to 40 mgd in 1978, which is the current average flow capacity of the KIWWTP. The corresponding peak flow capacity of the KIWWTP is 87 mgd.

The KIWWTP is comprised of the following major components: influent screens, main and auxiliary influent pumps, aerated grit chambers, primary clarifiers, intermediate pump station, plastic media trickling filters, intermediate clarifiers, rock media trickling filters, final clarifiers, chlorine contact tank and chlorine feed system, effluent pumping system, sludge pumping, sludge thickening, anaerobic digestion, sludge dewatering, and odor control facilities.

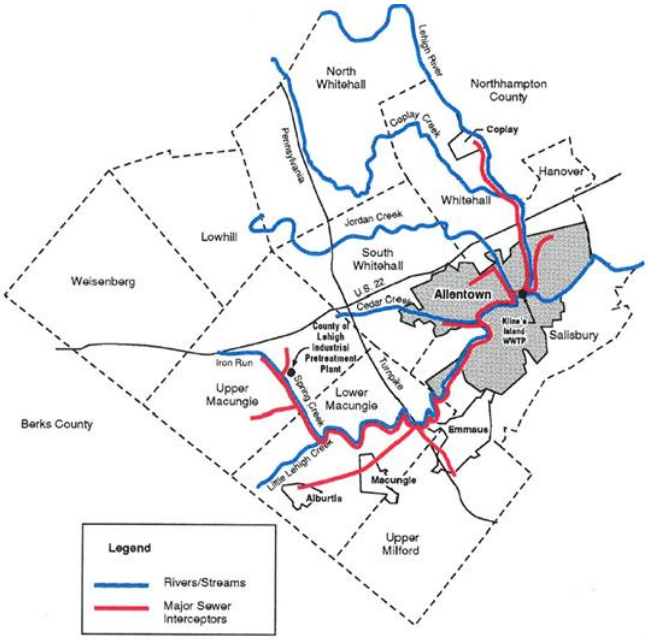
At the time the original signatory agreements were executed, wastewater was conveyed to the KIWWTP by a total of seven COA-owned trunk sewers:

- Lehigh River Trunk Sewer
- Front Street-Union Street Trunk Sewer
- Jordon Creek Trunk Sewer
- Little Lehigh Creek Trunk Sewer
- Emmaus Trunk Sewer
- Trout Creek Trunk Sewer
- District No. 29 Trunk Sewer

As a condition of the construction grant obtained in the mid-1970s to expand the KIWWTP's capacity from 28.5 mgd to 40 mgd, COA and the Signatories were required to perform Sewer System Evaluation Surveys (SSESs). As part of COA's SSES

performed during the period, the hydraulic conveyance capacity of each trunk sewer was calculated and compared to the estimated capacity required for the year 2025. Based on this analysis, the sewer signatories subsequently constructed the following relief sewers which are owned and operated by the signatories:

- LCA Little Lehigh Creek Relief Sewer
- South Whitehall Relief Sewer
- Salisbury Relief Sewer
- Coplay-Whitehall Lehigh Sewer
- Coplay-Whitehall Jordan Sewer



The collection system currently consists of: (1) 285 miles of COA-owned sewer pipe, of which 242 miles is 4 to 10-inches in diameter, 22 miles is 12 to 21-inches in diameter and 21 miles is 24 inches and larger in diameter; (2) 7,199 COA-owned manholes and 382 privately owned manholes; and (3) 33,359 connections to COA-owned sewers and 18 connections to privately owned sanitary sewers. The table below presents a detailed breakdown of sanitary sewers by diameter and length

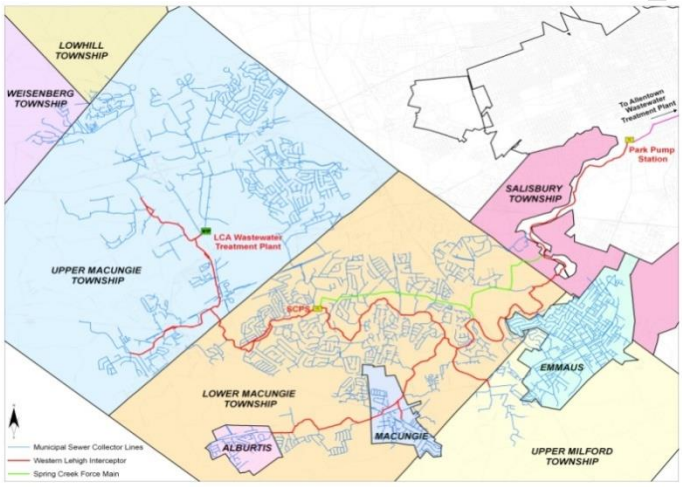
Table 2-2 - COA Sewer Inventory

Sewer Diameter (inches)	Sewer Length (feet)	Sewer Diameter (inches)	Sewer Length (feet)
4	10	21	11,566
6	1,745	24	53,805
8	1,155,844	27	10,026
10	117,748	30	9,891
12	34,165	33	2,017
14	1,517	36	28,613
15	31,579	39	1,922
16	703	42	4,977
18	34,613	54	245
20	2,577	60	936

Sewer pipe type includes reinforced concrete, vitrified clay, polyvinyl chloride (schedule 40, SDR 26 and SDR 35), cast iron, ductile iron, terra cotta, and reinforced poured in place concrete with tile floor.

2.2. Lehigh County Authority

In 1972, Lehigh County and LCA placed into service a sanitary sewer interceptor system in western Lehigh County to convey wastewater from the Boroughs of Alburtis and Macungie and the Townships of Upper and Lower Macungie to Allentown's Allentown/Emmaus Interceptor. Today, the system additionally serves portions of the Townships of Weisenberg, Upper Milford, and Lowhill, and portions of the Borough of Emmaus. The interceptor system, known as the Western Lehigh Interceptor (WLI), consists of 18 miles of gravity sewers ranging in size from 8-inch to 36-inch diameter pipe, one relief pumping station and force main (Spring Creek Road Pump Station), and five meter stations. Wastewater from the WLI discharges into the Allentown/Emmaus Interceptor at Keck's Bridge. The Allentown/Emmaus Interceptor flows from Keck's Bridge to its downstream confluence with the Cedar Creek Interceptor and Little Lehigh Interceptor. The Little Lehigh Interceptor begins at this confluence and serves as the final conveyance step in the transport of wastewater to KIWWTP. The Allentown/Emmaus Interceptor, Cedar Creek Interceptor, and Little Lehigh Interceptor are owned by Allentown.



In 1981, Allentown compelled LCA to remove a portion of LCA's peak wet weather flows from Allentown's Little Lehigh Interceptor. LCA built and now operates and maintains relief facilities along the Little Lehigh Creek to address intermittent hydraulic overloading of the Little Lehigh Interceptor: Park Pump Station and Force Main, and the Keck's Bridge Relief Interceptor between Keck's Bridge and Park Pump Station. The Park Pump Station and Force Main were placed in operation in the fall of 1983 to supplement capacity in the Little Lehigh Interceptor and pump it through a force main to a location approximately 1000 linear feet (lf) upstream of the KIWWTP. In August 1986, LCA completed construction of the Keck's Bridge Relief Interceptor to relieve overflows during storm events in existing interceptors in the Keck's Bridge area and to allow for future development in LCA service areas. The capacity of Park Pump Station was increased in 1986 to accommodate additional flows from the Keck's Bridge Relief Interceptor.

In 1998, the Spring Creek Pump Station (SCPS) began operation. This relief pumping system includes 2,500 feet of 20-inch diameter force main and 11,900 feet of 24-inch

diameter force main which bypass approximately 24,000 linear feet of the WLI in Lower Macungie Township. The pump station is designed to pump up to 7 MGD during peak flow periods typically associated with severe rain events.

In 2005, the SCPS force main was extended through the installation of 19,250 LF of 24-inch force main from Millrace Road to connect with the 42-inch Little Lehigh Relief Interceptor near the intersection of Devonshire Road and Keystone Avenue (approximately 2,000 feet downstream of Keck's Bridge. This extension relieved hydraulic loading on that section of the WLI between manholes L-66 and L-1.

LCA also operates a pretreatment plant (PTP) in Upper Macungie Township that treats the industrial wastewater from the Fogelsville industrial corridor in the upper quarter of the LCA service area as well as the residential wastewaters from the areas upstream of the pretreatment plant.

In 2009, LCA built a 3 MG Flow Equalization Basin (FEB) immediately upstream of the PTP to capture and hold increased flows during significant rain events. Since then, this concrete above ground tank has been responsible for most of the improvement in wet weather performance in LCA's WLI and in Allentown's Little Lehigh and Jordan Creek Interceptors.

2.3. South Whitehall Township

The sanitary sewer system is operated under the jurisdiction of the Township Board of Commissioners.

The oldest portions of the sewage collection system date to the mid-1930s. Sewer pipe materials include Vitrified Clay Pipe (VCP), concrete, cast iron, ductile iron, and PVC. The system serves approximately 6,700 customers and includes nearly 118 miles of sanitary sewer pipe ranging in size from 6 to 30-inches in diameter. All sewage flows through the system by gravity – the Township does not own or operate any sewage pumping stations. The system is currently arranged into six (6) sub-basins, and each is metered for billing purposes, as well as to monitor inflow and infiltration. All flow from the Township (except for one drainage area that flows through the Coplay-Whitehall Sewer Authority system) is transported directly to the City of Allentown sewage collection system for ultimate treatment at the Kline's Island WWTP.

The sanitary sewer collection system is maintained by the Township Public Works Department. Employees routinely flush and televise the sewer mains looking for defects, grease, and root blockages. When a problem is discovered, the crew uses a pressurized water jet flusher to eliminate the grease and blocks, and debris is vacuumed for later disposal. When defects in pipes or manholes are identified, they are prioritized for repair

depending on severity. Township staff is available on a 24-hour basis each day of the week to respond to any emergency situation in the sewage collection system.

2.4. Coplay-Whitehall Sewer Authority

The Coplay Whitehall Sewer Authority (CWSA) is a Pennsylvania Municipal Authority created in 1963 by Whitehall Township and the Borough of Coplay under the Pennsylvania Municipal Authorities Act of 1945, as amended. The sole purpose for the CWSA's creation is to provide public sanitary sewer service to the customers (currently 13,850) located within the Whitehall Township / Coplay Borough service area. The CWSA's system is a collection and conveyance system which by Inter-municipal Agreements connects to the City of Allentown's conveyance system for treatment of its effluent at the KIWWTP. The Authority is governed by a 7 member Board, 4 members appointed by Whitehall Township and 3 members appointed by Coplay Borough.

The CWSA's original system was constructed during 1965 and 1966 and for the most part consists of 8-inch diameter vitrified clay (VCP) collection mains and reinforced concrete pipe (RCP) interceptors. Since completion of the original system in 1966, there have been system additions constructed by the CWSA through Act 537 Plans, and main extensions by Developers that were then turned over to the CWSA for future maintenance and repair as required. CWSA's system currently includes 3,311 manholes, 1 pumping station, and 124.80 miles of pipe ranging in size from 6-inch to 36-inch in diameter. Sewer pipe type includes vitrified clay, reinforced concrete, polyvinyl chloride (schedule 40, SDR 35 and SDR 26,) cast iron, ductile iron and reinforced concrete cylinder pipe.

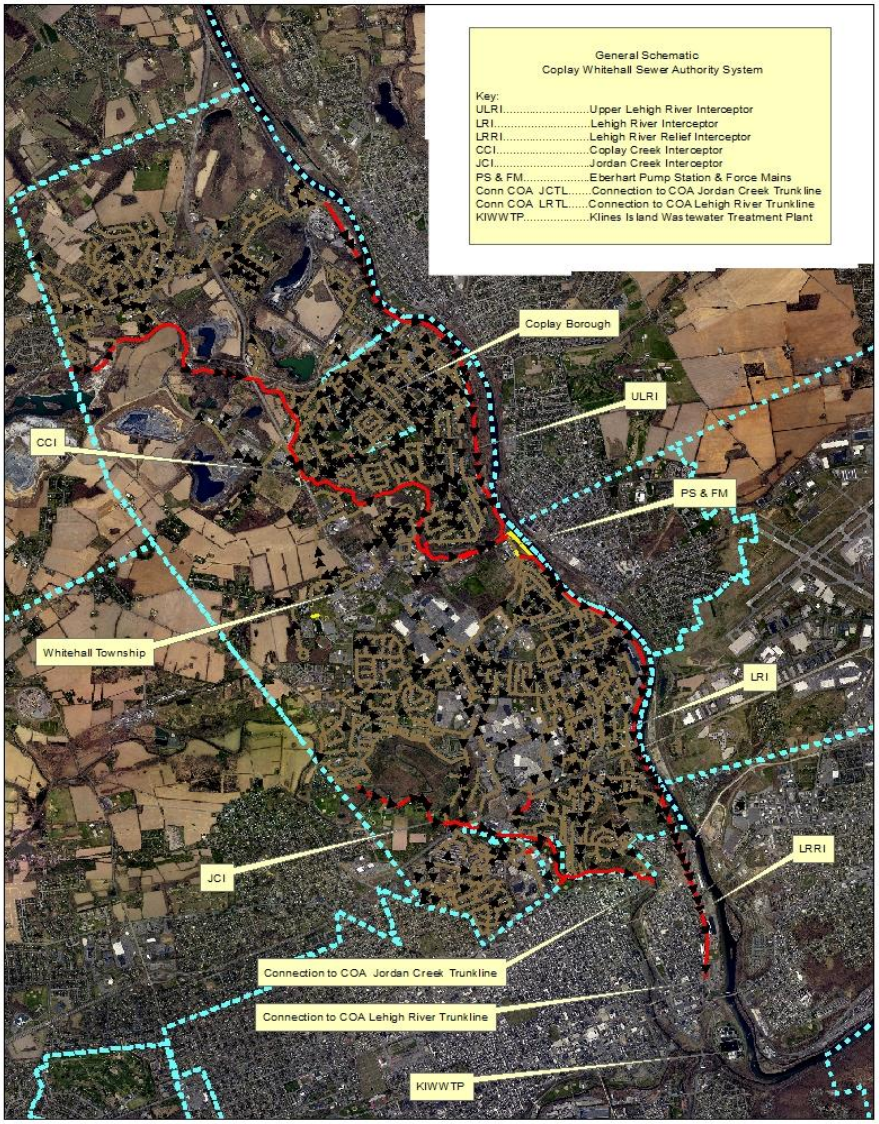


Figure 2-2 - CWSA Service Area

Table 2-3 - CWSA Sewer Inventory

Pipe Diameter (inches)	Pipe Length (Feet)	Pipe Length (Miles)
6	345	0.065
8	551,105	104.376
10	18,610	3.525
12	7,925	1.501
15	3,113	0.590
16	4,938	0.935
18	31,974	6.056
20	4,388	0.831
24	8,695	1.647
27	9,415	1.783
30	14,353	2.718
36	4,082	0.773
Total	658,943	124.800

In addition to the typical 8-inch VCP and PVC collector mains, the CWSA's system includes the following key conveyance components:

- Jordan Creek Interceptor & Metering Station
- Coplay Creek Interceptor
- Lehigh River Interceptor & Metering Station consisting of different sections as follows:
    - Lehigh River Relief Interceptor
    - Lehigh River Interceptor
    - Upper Lehigh River Interceptor
- Eberhart Pump Station & Force Main

The CWSA has entered into Inter-Municipal Agreements with neighboring South Whitehall Township (SWT) and North Whitehall Township (NWT), which provide for the connection to CWSA's system for conveyance of effluent originating from sections of each of these Townships through the CWSA system for treatment at the KIWWTP. SWT

and NWT each have two connections to the CWSA System. SWT connects to CWSA at the SWT's Jonathan and Quail Metering Stations and then utilize CWSA's Jordan Creek Interceptor. NWT connects to the CWSA System at the Quarry and Omrod Metering Stations and then discharge to CWSA's Coplay Creek Interceptor.

The Eberhart Pump Station is located midway along the Lehigh River Interceptor. The Coplay Creek Interceptor and Upper Lehigh River Interceptor flows are tributary to the Eberhart Pump Station, and these flows are then pumped and discharged to the Lehigh River and Lehigh River Relief Interceptor and connect to the COA's Lehigh River Trunk line and ultimately to the KIWWTP. The second CWSA connection to the COA is through the CWSA's Jordan Creek Interceptor to the COA's Jordan Creek Trunkline. The CWSA does not utilize any section of the Western Lehigh Interceptor or any other facilities owned by others that service the western portion of Lehigh County.

2.5. Salisbury Township

The Township of Salisbury is a first-class Township located in the south-central part of Lehigh County and is separated into two unconnected parcels due to annexation in the early 1900's. The Township has a population of approximately 13,501 based on the latest census and covers 11.3 square miles. The Township is generally characterized as a residential community with selected areas designated for commercial and industrial development. The remaining areas are reserved for parks, recreation or public use.

The Township of Salisbury owns, operates and maintains a sanitary sewer collection system under direct control of the Township elected five-member Board of Commissioners. The Township's sanitary sewer system serves approximately 4,381customers and is comprised of approximately 358,912 linear feet of gravity sewer pipe ranging in size from 8-inch to 18-inch in diameter. The sewer system utilizes two sewage pump stations and approximately 4,681 linear feet of 4", 6" and 8" force main to transport flow from low lying areas to the gravity mains, as well as, 335 linear feet of 1-1/2-inch low pressure sewer main. The majority of the developed areas of the Township are served by public sewer service. Most of the Township's sewage is treated KIWWTP.

2.6. Borough of Emmaus

The Borough of Emmaus is governed by a seven member Borough Council. The Borough covers approximately 2.9 square miles and is located in the south-central portion of Lehigh County. The Borough's municipal neighbors include the City of Allentown and the Townships of Lower Macungie, Salisbury, and Upper Milford. The Borough's population is 11,211, as of the 2010 census. Land use in the Borough of Emmaus is

mostly residential, although it does include a significant number of retail/commercial businesses and industrial uses, along with park and conservation areas. There is limited open land area in the Borough available for new development, but there are many opportunities for modernizing and/or re-purposing of existing developed property.

The Emmaus sewer system currently serves approximately 3,958 residential, 280 commercial, 51 industrial, and 15 municipal connections. The sanitary sewer system is owned by the Borough and operated by the Public Works Department under a full time Borough Manager and a full time Public Works Director.

The Emmaus sewer system consists of approximately 45 miles of 8-inch to 15-inch gravity collector sewers and approximately 5 miles of 18-inch to 24-inch gravity interceptor sewers. The system includes approximately 1,045 manholes. The original 1961 sewer lines were constructed with 5-foot sections of gasket joint vitrified clay pipe (VCP) and 4-foot diameter precast concrete manholes. Beginning in the 1970s, pipe extensions were constructed using 18-foot sections of polyvinyl chloride (PVC) gasket joint pipe.

There are two small areas of the Borough that are served by low pressure sewer systems. In these areas, grinder pumps, owned by the individual customers, discharge their flow to the gravity collector sewer system via small diameter low pressure lines. There are no publicly owned pump stations in the Emmaus sanitary sewer system.

There is a Borough-owned sewage meter station located at the downstream end of each of four primary gravity flow basins. Due to geographical constraints, wastewater from a small number of Borough customers does not flow through the master sewer meters but drains directly to downstream systems owned by Salisbury Township, Lehigh County Authority, or the City of Allentown. Similarly, flow from several properties in the surrounding townships is transported through the Borough system to downstream interceptors. The accounting of these flows for inter-municipal transportation and treatment billing is handled administratively.

2.7. Borough of Alburtis

The Borough of Alburtis is governed by a seven member Borough Council. The Borough covers approximately 0.7 square mile and is located in the southwestern portion of Lehigh County. It is surrounded by Lower Macungie Township. The population is approximately 2,300 based on current census data. The Borough is characterized generally as a residential community although it does support retail commercial business and industrial districts. A general breakdown of land use based on zoning districts indicates residential development accounts for about 75% of the land use while

commercial and industrial accounts for about 20% of the land use. The remaining 5% is used for community facilities and parks.

The Borough of Alburtis sanitary sewer system is owned by the Borough of Alburtis. The collector system comprises approximately 8.04 miles of sanitary sewer pipe. The sewer system serves approximately 60% of the Borough and contains 42,480 linear feet of 8-inch through 12-inch sewer main and 220 manholes and one wastewater pumping station. The initial sanitary sewer system was constructed between 1968 and 1972. Extensions to the public sewer system were added primarily by development growth over the years accounting for its present size. Currently the Borough system customer base consists of 929 residential, 26 commercial and 1 Industrial customer.

The Borough sewer system drains to the Alburtis-Macungie Trunkline into the WLI to KIWWTP.

2.8. Borough of Macungie

The Borough of Macungie is governed by a seven member Borough Council. The Borough covers approximately 1.0 square mile and is located in the southwestern portion of Lehigh County. It is primarily surrounded by Lower Macungie Township except on the south side where it borders Upper Milford Township. The population of the Borough is 3,074 based on the 2010 census. The Borough is characterized generally as a residential community although it does support retail commercial business and industrial districts. A general breakdown of the Borough land use based on zoning districts indicates residential development accounts for about 75% of the land use while commercial and industrial accounts for about 18% of the land use. The remaining 7% is used for community facilities and parks.

The Borough of Macungie sanitary sewer system is owned and operated by the Borough. The collector system comprises approximately 11.4 miles of sanitary sewer pipe. The sewer system contains 60,330 linear feet of 8-inch through 10-inch sewer main and 315 manholes. The initial sanitary sewer system construction began in 1968 and was completed in 1972. Extensions to the public sewer system were added primarily by development growth over the years accounting for its present size. Currently the Borough system customer base consists of 1654 residential, 83 commercial and 3 Industrial customers.

The Borough sewer system drains to the Alburtis-Macungie Trunkline into the WLI to KIWWTP.

2.9. Lower Macungie Township

Lower Macungie Township (LMT) is a first class township governed by a five member Board of Commissioners. LMT covers 22.46 square miles and is located in the southwestern portion of Lehigh County. The population, based on current information available, is 31,964. LMT is characterized as a residential suburban community. A general breakdown of LMT land use based on zoning districts indicates residential development accounts for about 34% of the land use while commercial and industrial development makes up about 19%. The remaining 48% is divided among agriculture and public uses or is undeveloped.

The LMT sanitary sewer system is owned and operated by Lower Macungie. The collector system comprises approximately 126 miles of sanitary sewer pipe. The sanitary sewer system based on the current Act 537 boundary serves approximately 78% of LMT and contains approximately 666,800 linear feet of 8-inch through 16-inch sewer main and 3,500 manholes. There are no pumping stations in the LMT sewer system. The original sanitary sewer system was constructed in 1968 and completed in 1972. Extensions to the public sewer system were added over the years by various LMT sponsored projects as well as through development growth which accounts for its present size. Currently the LMT system customer base consists of 8,971 residential and 24 commercial/industrial customers.

Most of the LMT sewer system drains, through a number of connection points, into the WLI to KIWWTP. There are several connection points in the LMT system that drain to either the South Whitehall Township or Salisbury Township sanitary sewer systems.

2.10. Upper Macungie Township

Upper Macungie Township (UMT) is a second class Township governed by a three member Board of Supervisors. UMT covers 26.24 square miles and is located in the western portion of Lehigh County. The population, based on current information available, is approximately 23,884. A general breakdown of the land use within UMT shows that residential development accounts for about 23% of its land use while commercial and industrial development make up about 31% with the remaining 46% of the land divided among agriculture and public uses or is undeveloped.

The UMT sanitary sewer system is owned and operated by Upper Macungie Township. Note that the former Upper Macungie Township Authority (UMTA) was an operating authority which owned and operated the UMT sewer system at the time of issuance of the Administrative Order, but was subsequently dissolved in 2016. The collector system comprises approximately 157 miles of sewer pipe and includes six wastewater pumping stations. The sanitary sewer system based on the Act 537 boundary serves approximately

64% of UMT and contains approximately 829,000 linear feet of sewer pipe, 3,200 manholes, and six pumping stations and appurtenances. The original sanitary sewer system was installed in 1968 and was completed in 1972. Extensions to the public sewer system were added over the years by various UMT/UMTA projects as well as through development growth in UMT which accounts for its present size. Currently the UMT system customer base consists of 6,498 residential, 373 commercial and 8 industrial customers.

Most of the UMT sewer system drains, through two connection points, into the WLI to KIWWTP.

2.11. Lowhill Township

Lowhill Township is located the northwestern section of Lehigh County, adjoining Weisenberg and Upper Macungie Townships. In June of 2016, the sanitary sewer system in Lowhill Township was acquired by LCA, who now owns and operates the system. A service agreement has been executed with Upper Macungie Township Authority to allow the flow of wastewater through their system to the WLI. The Lowhill Township system consists of 3,052 feet of 8-inch PVC gravity pipeline and 587 feet of 2-inch PVC force main through which 43 connections discharge into the Upper Macungie Township collector system and ultimately into the LCA WLI system.

2.12. Weisenberg Township

Weisenberg Township is located in the northwestern section of Lehigh County, adjoining Lowhill and Upper Macungie Township. The sanitary sewer system in Weisenberg Township is owned and operated by LCA. In an agreement dated April 19, 1990, Weisenberg Township designated LCA as the operating agent for the Pointe West and Pennsylvania State University wastewater systems in the Township. Also in an agreement with Upper Macungie Township dated April 19, 1990, Upper Macungie Township agreed to accept the wastewater from the Pointe West Development. The agreement provided for repair and/or elimination of I/I by Weisenberg Township.

In an agreement dated April 22, 2002, the Township conveyed ownership of the wastewater systems to the LCA.

There are 149 customers being served in Weisenberg Township with a system consisting of almost 21,000 feet of pipeline which discharge flows through Upper Macungie Township and the WLI to KIWWTP. Over 97% of the system is 8-inch pipe and 3% is

2-inch force main. The system is 99% PVC and 1% DIP. No new connections are expected within Weisenberg Township.

2.13. Upper Milford Township

Upper Milford Township (UMiT) is located in southern Lehigh County, adjoining Emmaus Borough, Lower Macungie Township and the Borough of Macungie. The sanitary sewer system in UMiT is owned and operated by LCA pursuant to a sewer service agreement dated January 1, 1982. UMiT designates the areas of the UMiT where sewer service will be provided and approves the allocation granted.

Currently, there are over 800 customers being served in the UMiT sewer system consisting of over 70,000 feet of pipe, including 29,000 lf of low pressure pipe installed to serve the Vera Cruz area of the Township. Over 55% of the system is 8-inch pipe, 45% is either 2-inch force main, low pressure force main, or 10-inch. The system is 95% PVC and the remainder is DIP. The majority of the system was constructed in the 1980s with the low pressure system constructed in 2012 and 2013. The system consists of collection systems discharging into the Emmaus Borough system, into the Lower Macungie Township system and into the WLI to KIWWTP.

2.14. Hanover Township

Hanover Township, Lehigh County is a Home Rule Township governed by a five member Board of Supervisors. The Township covers 4.25 square miles and is located in the northeastern portion of Lehigh County. The population, based on current information available, is approximately 1,571. A general breakdown of the land use within Hanover Township, Lehigh County shows that the Lehigh Valley International Airport covers 52% of the Township, and the remainder is predominantly commercial and industrial. The residential portion is minimal and houses 426 residential units with one apartment complex with 240 units.

The Township sewer system connected to the KISS services the southern portion of the Township and discharges to the COA sewer system through one metering station located at 700 Lloyd Street, Allentown PA.

The Hanover Township, Lehigh County sanitary sewer system is owned and operated solely by Hanover Township, Lehigh County and is administered by the Council of Hanover Township, Lehigh County. The collector system comprises approximately 1.8 miles of sewer pipe and includes one metering station. The sanitary sewer system based on the Act 537 boundary serves approximately 30% of Hanover Township, Lehigh

County and contains approximately 9,448 linear feet of sewer pipe. This area of the Hanover Township, Lehigh County sewer system drains, through one connection point, into the City of Allentown conveyance system, which in turn flows through City wastewater treatment facility. The flows through the one metering point are approx. 45,000 gallons per day.

There have been no extensions to the public sewer system over the recent years, which accounts for its present size. Hanover Township does expect future projects that will require an extension of the system which would provide more flow through the system. Currently the Hanover Township, Lehigh County system customer base consists of 15 residential, 240 apartment units and 22 commercial customers.

3. System Flow Characterization

3.1. Past Flow Characterizations

Flow and rainfall data were collected in Allentown in 2008 and used to calibrate a hydraulic planning model of the City of Allentown sewer system.

Flow and rainfall data were collected by the WLSP in 2009 and used to calibrate a hydraulic planning model of the WLSP sewer system. Figure 3-1 displays the locations of the gravity flow monitors and rain gauges, as well as the pump stations and municipalities' boundaries.

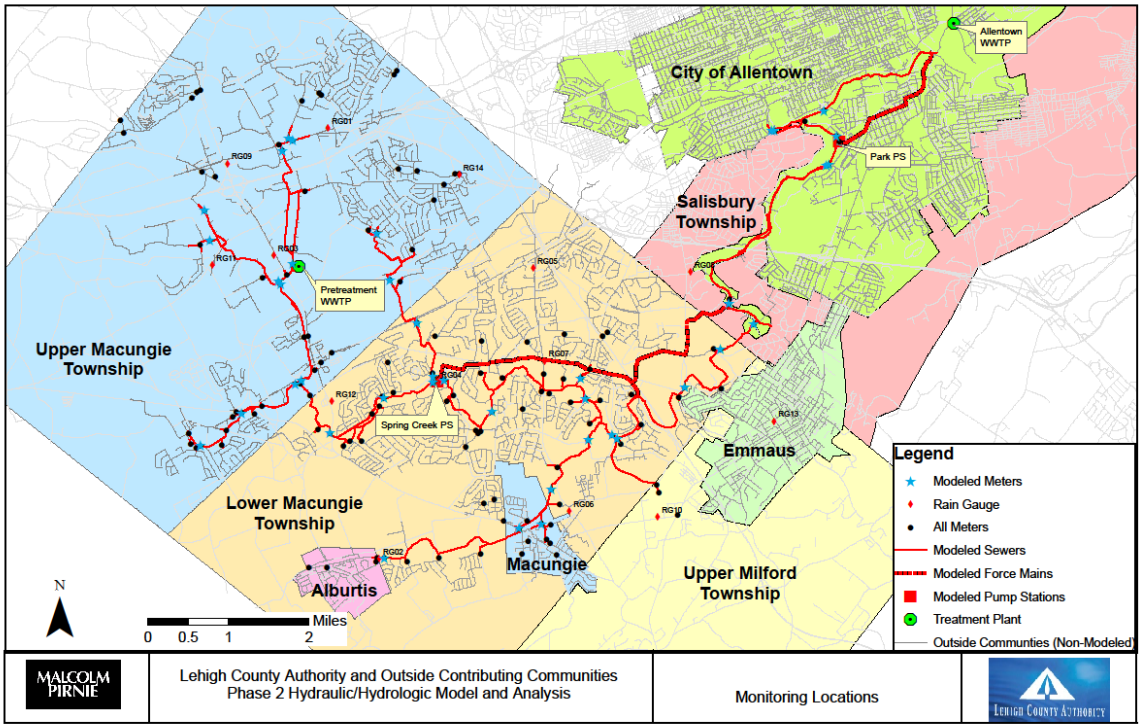


Figure 3-1: Monitoring Locations for the WLSP's Sanitary Sewer System

In 2014, the WLSP planning-level model was combined with the Allentown hydraulic model to create a single hydraulic model called the Kline's Island Sewer System (KISS) Model. This model confirmed that portions of the primary conveyance components were experiencing high hydraulic grade lines in conveying dry-day flows and, accordingly, had limited ability to convey significant peak wet-weather flows. It should be noted that while this modeling work was completed in 2014, it used data gathered in 2008 and 2009, which must be updated to reflect updated system conditions since that time. See Section 3.4 for more details on Flow Characterization Updates planned as part of this strategy.

3.2. I/I Reduction Since 2009

All Signatories have conducted I/I identification and reduction activities since 2009. These have been detailed in the semiannual reports to USEPA. As EPA stated in their letter of November 2, 2017, the "ongoing efforts to reduce inflow and infiltration (I/I) and to generally upgrade and maintain the infrastructure in the area served by Kline's Island have been effective."

3.3. Permanent Flow Monitoring (Sewer Billing Meters)

There are 33 permanent meters at the municipal boundaries that have historically been used for billing purposes. These sewer billing meters (SBM) are owned and operated by the individual Signatories. These meters provide jurisdictional level monitoring of dry-day and wet-weather sewage flows for the City and its Signatories which will be used for system characterization, ongoing flow management, RDII analysis, and model recalibration efforts. These meters use a wide variety of metering technologies and data capture systems, and some meter stations may need to be updated. Cooperative efforts are underway to ensure SBM accuracy and develop protocols for installation upgrades, data capture, reporting for billing purpose, and for reporting for wet-weather events that produce flows at the KIWWTP greater than 60 MGD.

3.4. Flow Characterization Updates

Additional development flows have been added to the KISS by all Signatories since the last system flow characterization in 2008. Additionally, source reduction and capacity improvements that improve levels of protection and reduce the frequency of SSOs have also been undertaken. An updated flow characterization of the primary KISS components is necessary to understand the current average dry day and peak wet weather flow demands on the primary regional conveyance components of the KISS. The primary KISS components are:

- LCA FEB
- Western Lehigh Interceptor
- Spring Creek Pump Station
- Park Pump Station
- Allentown Emmaus Interceptor
- Little Lehigh Relief Interceptor
- Little Lehigh Interceptor
- Jordan Creek Parallel Interceptor
- Main KIWWTP Lift Station
- Cedar Creek Interceptor
- South Whitehall Relief Interceptor

- Jordan Creek Trunk Sewer
- Lehigh River Trunk Sewer
- District 29 Trunk Sewer
- Trout Creek Trunk Line
- Salisbury Relief Sewer

This flow characterization work will:

- Quantify the dry- and wet-day impacts of new development flows added since 2008
- Quantify the dry- and wet-day effectiveness of the I/I reduction work conducted since 2008
- Quantify the dry- and wet-day effectiveness of capacity improvements made since 2008

To accomplish this, a program of flow monitoring, rainfall monitoring, future flow projections, and dynamic hydraulic modeling will be conducted. Much of the metering needed for this work can be provided by the Signatories' SBMs provided they are capable of meeting the data quality objectives. This monitoring and modeling work is expected to take 18 months to complete, with the majority of this time dedicated to flow data collection to recalibrate the KISS Model. This completion time frame assumes adequate rainfall and antecedent precipitation conditions will occur during this time period.

This Flow Characterization Update will be conducted as soon as possible, but will begin no sooner than 2019 to allow for the prioritized SBM evaluations and upgrades described in Section 3.3 to be completed. If any SBMs are unable to be upgraded in time for this Flow Characterization Update to begin, temporary flow meters will be used to capture flows at the jurisdictional level.

A similar flow characterization update as described above will also be undertaken at some future date to be determined based on the success of the SRPs and other I/I remediation efforts, future flows, possible SSOs, and other factors. This future flow characterization update will provide information critical to the determination of need, size, and extent of future capital improvements needed at KIWWTP or the conveyance system.

3.5. Anticipated Growth and Impact on Dry and Wet Weather Flows

Flow projections will be added to the KISS Model to evaluate depth of dry and wet weather flows within the various primary conveyance components of the KISS. Concurrent with the flow metering and modeling, sewage growth forecasts for all areas served by the KISS will be conducted by each of the Signatories in conjunction with modeling efforts.

4. Operations and Maintenance Programs

Each of the Signatories has developed an Operations and Maintenance (O&M) Plan for its individual sewer system. These O&M Plans ensure that the I/I Source Reduction Plans are integrated with supporting operation and maintenance strategies to maximize the life cycle of critical assets and to minimize maintenance-related overflows. The goal of these O&M Plans is to:

- Maintain the intended hydraulic level of protection and level of service in the sewers.
- Mitigate the impact of sanitary sewer overflows when they do occur.
- Achieve these goals in the most economically efficient and sustainable manner possible.

The O&M program components vary between Signatories because of differences in sewer inventory. Where applicable, the O&M Plans cover:

- Pump stations and force mains
- Gravity sewers
- Laterals
- Lower pressure sewers

Within each O&M Plan section, the following topics are generally covered:

- Purpose
- Overview
- Goals and Performance Measures
- Preventative Maintenance
- Reactive Maintenance
- SOPs
- Equipment and Spare Parts
- Staffing
- Information Management

The individual Signatory O&M Plans are in the Appendices.

5. Inflow and Infiltration Source Reduction Programs

Each of the Signatories has developed an Inflow and Infiltration Source Reduction Plan (SRP) for its individual sewer system. The goal of these SRPs is to:

- Define excessive inflow and infiltration
- Identify and locate sources of excessive inflow and infiltration
- Reduce sources of excessive inflow and infiltration in sewer collection systems through rehabilitation of sewer mains, taps, laterals, cleanouts, manholes, and manhole covers/frames
- Reduce sources of excessive inflow and infiltration by eliminating private property clearwater connections and reducing leakage in upper laterals
- Achieve these goals in the most economically efficient and sustainable manner possible.

SRP projects vary between Signatories because of differences in sewer inventory, leakage sources, and preferred rehabilitation and programmatic approaches. Within each SRP Plan is listed each Signatory's anticipated SRP projects, along with anticipated purpose, scope, cost, schedule, and effectiveness, where known.

The individual Signatory SRPs are in the Appendices.

6. Progress Reporting

6.1. Annual Progress Reports

Each Signatory will report its activities and progress individually to LCA by March 1st for compilation into the annual PADEP Chapter 94 report.

Appendix A: CITY OF ALLENTOWN O&M PLAN

Appendix B: LCA, LOWHILL, WIESENBURG, AND UPPER MILFORD O&M PLAN

Appendix C: SOUTH WHITEHALL TOWNSHIP O&M PLAN

Appendix D: COPLAY-WHITEHALL SEWER AUTHORITY O&M PLAN

Appendix E: SALISBURY TOWNSHIP O&M PLAN

Appendix F: BOROUGH OF EMMAUS O&M PLAN

Appendix G: BOROUGH OF ALBURTIS O&M PLAN

Appendix H: BOROUGH OF MACUNGIE O&M PLAN

Appendix I: UPPER MACUNGIE TOWNSHIP O&M PLAN

Appendix J: LOWER MACUNGIE TOWNSHIP O&M PLAN

Appendix K: HANOVER TOWNSHIP O&M PLAN

Appendix L: CITY OF ALLENTOWN I/I SOURCE REDUCTION PLAN

Appendix M: WESTERN LEHIGH SEWER PARTNERSHIP SEWER CAPACITY AND REHABILITATION PROGRAM IMPLEMENTATION PLAN

Appendix N: SOUTH WHITEHALL TOWNSHIP I/I SOURCE REDUCTION PLAN

Appendix O: COPLAY-WHITEHALL SEWER AUTHORITY I/I SOURCE REDUCTION PLAN

Appendix P: SALISBURY TOWNSHIP I/I SOURCE REDUCTION PLAN

Appendix Q: BOROUGH OF EMMAUS I/I SOURCE REDUCTION PLAN

Appendix R: HANOVER TOWNSHIP I/I SOURCE REDUCTION PLAN