BOROUGH OF ALBURTIS SEWER AUTHORITY
UPPER MACUNGIE TOWNSHIP AUTHORITY
LOWHILL TOWNSHIP

LEHIGH COUNTY AUTHORITY

# Sewer Capacity Assurance & Rehabilitation Program

# *Program Approach Outline*

## Western Lehigh Sewerage Partnership

October 2009


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# Contents

## List of Tables



## List of Figures



## Appendices

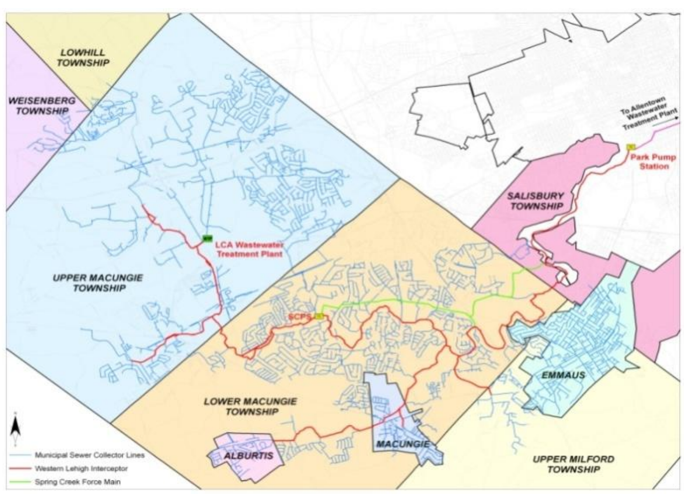
# 1. Introduction

Peak flow issues in the Lehigh County Authority (LCA) sewer conveyance systems and in the collections systems connected to it (namely Upper Milford Township, Weisenberg Township, Lower Macungie Township (LMT), Upper Macungie Township (UMT), Lowhill Township, Alburtis, and Macungie) have caused the Pennsylvania Department of Environmental Protection (PADEP) to begin reviewing sewer system extensions in each of these communities. Pursuant to communications with PADEP and in accordance with Chapter 94 requirements, LCA and the above municipalities and, where applicable, their wastewater authorities, have elected to prepare and implement a corrective action plan to collectively address the problems within each of these sanitary sewer systems. LCA and the above named LCA signatory parties have formed the Western Lehigh Sewerage Partnership (WLSP) to jointly investigate and develop an appropriate corrective action plan. The Sewer Capacity Assurance and Rehabilitation Program described in this outline will address both PADEP concerns and other related long-term wastewater needs for the Partners.

Since initial formation of the WLSP, the United States Environmental Protection Agency issued a Compliance Order to all municipal dischargers to the City of Allentown's Klines Island wastewater treatment plant. The technical requirements of that order are also addressed in this Program.

## 1.1. System Overview

All told, there approximately 262 miles of sewer mains in the above municipalities and LCA's system that discharge through the Western Lehigh Interceptor. Approximately 18,000 wastewater connections served by these systems.




### 1.1.1. Lehigh County Authority

In 1972, Lehigh County and Lehigh County Authority 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 the City of 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) System, 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 the City of Allentown Wastewater Treatment Plant at Kline's Island. The Allentown/Emmaus Interceptor, Cedar Creek Interceptor, and Little Lehigh Interceptor are owned by the City of Allentown.

LCA also owns, operates, and maintains relief facilities along the Little Lehigh Creek to address intermittent hydraulic overloading of the Little Lehigh Interceptor: Park Pumping Station and Little Lehigh Relief Force Main, and the Keck's Bridge Relief Interceptor between Keck's Bridge and Park Pumping Station. The Park Pumping Station and Little Lehigh Relief 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 immediately upstream of the Kline's Island Wastewater Treatment Plant. In August 1986, the 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 Pumping Station was also increased in 1986 to accommodate additional flows from the Keck's Bridge Relief Interceptor.

In 1998, the Spring Creek Road Pump Station (SCRPS) 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 10,250 LF 24-inch SCRPS force main extension from Millrace Road to the 42-inch Little Lehigh Relief Interceptor near the interception of Devonshire Road and Keystone Avenue (approximately 2,000 feet downstream of Kecks Bridge) was completed. This extension relieved hydraulic loading on that section of the WLI between manholes L-66 and L-1.

### 1.1.2. 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 the Lehigh County Authority 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 400 properties being served in the UMiT sewer system consisting of over 40,000 feet of pipe. Over 94% of the system is 8 inch pipe, 5% is 2 inch force main and less than 1% is 10 inch. The system is 95% PVC and the remainder is DIP. The majority of the system was constructed in the 1980s. The system consists of collection systems discharging into the Emmaus Borough system, into the Lower Macungie Township system and into the LCA WLI Interceptor system.

In 2009, an additional 21 EDUs will be connected in the S. 7th St. area. Sewering the Vera Cruz area of the Township is in final design phase. The project includes construction of 4.65 miles of low pressure force main and 276 grinder pumps to connect 299 existing EDUs.

### 1.1.3. 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 the Lehigh County Authority. In an agreement dated 4/19/1990, 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 4/19/1990, 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 4/22/2002, the Township conveyed the wastewater systems in Service Area 1 and Service Area 2 to the LCA. Service Area 1 is the Pointe West system which discharges into the Upper Macungie Township collection system. The 4/19/1990 agreement between Upper Macungie Township and Weisenberg Township was transferred to LCA. Service area 2 is a separate system which is not part of the LCA Western Lehigh Interceptor system.

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 Interceptor system. 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.

### 1.1.4. Upper Macungie Township and Upper Macungie Township Authority

Upper Macungie Township is a second class Township governed by a three member board of supervisors. UMT covers 24.5 square miles and is located in the southwestern portion of Lehigh County. The population, based on current information available, is approximately 17,390. A general breakdown of the land use within UMT shows that residential development accounts for about 22% of its land use while commercial and industrial development make up about 26% with the remaining 31% of the land divided among agriculture and public uses or is undeveloped.

The UMT sanitary sewer system is owned and operated by the Upper Macungie Township Authority (UMTA). UMTA is an operating authority managed by a five member board appointed by the Supervisors. The collector system comprises approximately 139 miles of sewer pipe and includes seven wastewater pumping stations. The sanitary sewer system based on the Act 537 boundary serves approximately 55% of UMT and contains 735,445 linear feet of 8-inch through 24-inch sewer main, 3,060 manholes and seven 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 UMTA projects as well as through development growth in UMT which accounts for its present size. Currently the UMTA system customer base consists of 5690 residential, 305 commercial and 7 industrial customers.

A breakdown of the of the UMTA sewer system by material, pipe size, length and age are as follows:

| **Material** | **Pipe Size** | **Length** | **Year** |
|---|---|---|---|
| Vitrified Clay Pipe | 8” to 15” | 139,000’ | 1968-1982 |
| Reinforced Concrete Pipe | 15” to 18” | 2,700’ | 1968-1972 |
| Ductile Iron Pipe | 8” to 24” | 34,000’ | 1968-Present |
| PVC / C900 | 8” to 24” | 540,500’ | 1982-Present |
| Low Pressure Force Main (PVC) | 1¼” to 3” | 17,700’ | 1998-Present |

### 1.1.5. Lower Macungie Township

Lower Macungie Township is a first class township governed by a five member Board of Commissioners. LMT covers 22.5 square miles and is located in the southwestern portion of Lehigh County. The population, based on current information available, is approximately 31,000. 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 50% of the land use while commercial and industrial development makes up about 17%. The remaining 33% is divided among agriculture and public uses or is undeveloped.

The LMT sanitary sewer system is owned and operated solely by the LMT and administered by the Board of Commissioners. The collector system comprises approximately 122 miles of sanitary sewer pipe. The sanitary sewer system based on the current Act 537 boundary serves approximately 55% of LMT and contains 644,100 linear feet of 8-inch through 16-inch sewer main and 3,567 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 Lehigh County Authority conveyance system which in turn flows through the City of Allentown sewer system to the city wastewater treatment facility. There are several connection points in the LMT system that drain to the South Whitehall Township. Segments of the LMT sewer system which drain to South Whitehall Township are not included in the SCARP.

A breakdown of the of the LMT sewer system by material, pipe size, length and age follows:

| **Material** | **Pipe Size** | **Length** | **Year** |
|---|---|---|---|
| Vitrified Clay Pipe, Polyvinyl Chloride Pipe and Ductile Iron Pipe | 8” | 605,000’ | 1968-Present |

| | | | |
|---|---|---|---|
| Vitrified Clay Pipe, Polyvinyl Chloride Pipe and Ductile Iron Pipe | 10” | 30,000’ | 1968-Present |
| Vitrified Clay Pipe, Polyvinyl Chloride Pipe and Ductile Iron Pipe | 12” | 1,800’ | 1968-Present |
| Vitrified Clay Pipe, Polyvinyl Chloride Pipe and Ductile Iron Pipe | 15” | 5,700’ | 1968-Present |
| Ductile Iron Pipe | 16” | 400’ | 1968-Present |

### 1.1.6. Borough of Alburtis and Borough of Alburtis Sewer Authority

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 2,100 based on current census data. The Borough is characterized generally as a residential community although it does supports 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 Sewer Authority and is operated 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 833 residential, 26 commercial and 1 Industrial customer.

The Borough’s sewer system drains directly to the Lehigh County Authority conveyance system which in turn flows through the City of Allentown sewer system to the city wastewater treatment facility. A breakdown of the of the Borough sewer system by material, pipe size, length and age follows:

| Material | Pipe Size | Length | Year |
|---|---|---|---|
| Vitrified Clay Pipe | 8” | 28,304’ | 1968-1982 |
| Vitrified Clay Pipe | 10” | 3,584’ | 1968-1972 |
| Vitrified Clay Pipe | 12” | 555’ | 1968-1972 |
| Cast Iron Pipe | 8” | 645’ | 1968-1972 |
| Cast Iron Pipe | 10” | 287’ | 1968-1972 |
| Cast Iron Pipe | 4” | 339’ | 1968-Present |
| Polyvinyl Chloride Pipe | 8” | 25,776’ | 1982-Present |

### 1.1.7. 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 3,039 based on the 2000 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 serves approximately 65% of the Borough and contains 60,330 linear feet of 8-inch through 12-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 directly to the Lehigh County Authority conveyance system which flows through the City of Allentown sewer system to the city wastewater treatment facility. A breakdown of the of the Borough sewer system by material, pipe size, length and age follows:

| Material | Pipe Size | Length | Year |
|---|---|---|---|
| Vitrified Clay Pipe | 8” | 32,114’ | 1968-1982 |
| Vitrified Clay Pipe | 10” | 1,675’ | 1968-1972 |
| Cast Iron Pipe | 8” | 645’ | 1968-1972 |
| Cast Iron Pipe | 10” | 120’ | 1968-1972 |
| Polyvinyl Chloride Pipe | 8” | 25,776’ | 1982-Present |

### 1.1.8. Lowhill Township

Lowhill Township is located the northwestern section of Lehigh County, adjoining Weisenberg and Upper Macungie Township. The sanitary sewer system in Lowhill Township is operated by the Upper Macungie Township Authority through a service agreement. There are being served in Lowhill Township that eventually discharge to the LCA system. The Lowhill Township system consists of 3,052 feet of 8” PVC gravity pipeline and 587 feet of 2” PVC force main through which 43 connections discharge into the Upper Macungie Township collector system and ultimately into the LCA system.

## 1.2. Satellite System Obligations to LCA

There are a number of contractual and regulatory obligations of the signatory systems to LCA that compels actions by LCA on the signatories to ensure the LCA system is able to meet its regulatory requirements. LCA has a number of agreements in place to deal with accepting the wastewater from the municipalities that discharge from their collection systems to LCA’s Western Lehigh Interceptor system. Following are excerpts from those agreements that set forth an obligation to deal with inflow and infiltration in both types of relationships.

### 1.2.1. April 1, 1983 Agreement- LCA and its Signatories

§4.02 - Hydraulic Flow. If for any calendar year a Municipality's average hydraulic flow which shall be defined as the hydraulic flow as determined under the provisions of Section 3.o2 plus its pro rata share of the service area infiltration and inflow, exceeds the hydraulic flow allocations as set forth in this Agreement, then the Municipality shall pay penalty charges as follows…..

§5.03 - LCA and the Municipalities agree to pursue the removal of infiltration and inflow ("I/I") as part of the ongoing operation and maintenance of their respective systems…

### 1.2.2. August 4, 1987 Agreement (Post-1985 Allocation) - LCA and its Signatories

§3.02 - The Municipalities and LCA agree to cooperate in the institution of a coordinated program of inflow and infiltration (I/I) detection and removal. Any Municipality which fails to comply with the provisions of this program shall not have access to the allocation available under this Agreement. Determination of failure to comply shall be by vote of the Municipalities, excluding the accused Municipality, as provided in §2.09.

## 1.3. LCA Obligations to City of Allentown

There are a number of contractual requirements that LCA has toward the City that compel actions on the part of LCA to ensure the LCA system is able to meet its contractual obligations. LCA has agreements with the City of Allentown for transmission of some of its wastewater through City transmission mains and as well as for treatment of wastewater at the City's Kline's Island Treatment Plant. Although the December 29, 1981 Agreement between the City and various municipal entities that discharge to the City system (including LCA) is generally the governing agreement, the 1981 Agreement specifically states that if an issue is not addressed in the 1981 Agreement, in the case of LCA the pre-existing 1969 Agreement would govern. Since the 1981 Agreement does not have specific language dealing with inflow and infiltration, the following excerpts from the 1969 Agreement establish the Authority obligation to the City to deal with inflow and infiltration.

§4 - The City and LCA agree that the sewage and wastes discharged by any user into a City sewer line shall not contain storm water, roof or surface drainage…..

§11 - …LCA further agrees that it will cause to have enacted and enforced ordinances, resolutions, rules and regulations governing sewer connections and the admission of sewage into the sewers, which ordinances, resolutions, rules and regulations shall conform with existing ordinances, rules and regulations of the City and further agrees to cause to be enacted and enforced additional ordinances, resolutions, rules and regulations to conform with future ordinances, rules and regulations adopted by the City to govern the admission of sewage into the Allentown Collection System or Treatment Plant… .

## 1.4. Program Purpose

The purpose of this Sewer Capacity Assurance and Rehabilitation Program (SCARP) Approach Outline is to define a formal methodology to be used by the Partners (namely Upper Milford Township, Weisenberg Township, LCA, Lower Macungie Township (LMT), Upper Macungie Township (UMT), Upper Macungie Township Authority, Lowhill Township, Alburtis, Alburtis Sewer Authority, and Macungie) for planning, evaluating, prioritizing, and conducting sewer rehabilitation, conveyance expansion, and/or storage construction in a coordinated and consistent manner. The SCARP will be the mechanism by which the Partners achieve mutually agreed upon objectives and meet regulatory requirements in a timely, fiscally responsible, and cost effective manner.

As described in earlier paragraphs, the Partners recognize that the problems faced by partner community with respect to its sanitary sewer system are, for the most part, the same as those problems faced by the other partners. By acknowledging that the problems faced in one community eventually negatively impact the other parties, the Partners have agreed to take a unified regional approach to addressing these common problems. By acting in a coordinated manner, the common problems experienced by all of the Partners can be addressed in the most effective and efficient manner. This regional approach:

- Offers lower costs due to both economy of scale and the ability to apply resources and experience from multiple communities.
- Reduces the regulatory burden by nearly an order of magnitude.
- Increases the likelihood of success by ensuring all actions are complementary and mutually supported.
- Reduces the conflict between the parties that tends to arise when multiple communities try to independently solve their portion of a regional problem.

The Partners will develop and execute a memorandum of understanding (MOU) that will reference this SCARP Program Approach Outline and will commit the Partners to working together on all program activities through the investigative phase of the program.

Following completion of the investigative phase of the project, definitive information relative to the hydraulic and physical condition of the entire sewer collection system will be available. At the commencement of the implementation phase of the program, a second MOU will be considered for the balance of the SCARP.

In the event a partner elects not to participate in the Partners second MOU, a description of the plan for achieving their independent program objectives will be separately provided by said community.

## 1.5. Program Approach Outline Purpose

This Sewer Capacity Assurance and Rehabilitation Program Approach Outline (SCARP Approach Outline) is intended to outline the proposed planning, data gathering, and evaluation steps needed to determine the SCARP Improvements Plan, which will consist of two complementary plans: a Capital Improvement Plan and a Long-term Asset Management Plan.

This SCARP Approach Outline is the first of several SCARP planning and management documents that will be prepared. As the SCARP progresses, the availability of new information will promote further analysis and study that will undoubtedly require refinement of the SCARP. Phasing of the planning and management documents described in this SCARP Approach Outline is necessary because of the current overall lack of information and the time needed to collect the data necessary to properly define and quantify the problem(s), to evaluate methods of redress, and to determine the corrective actions required to achieve the goals of the SCARP and comply with regulatory requirements. The anticipated planning and management documents to be prepared for this SCARP are:

- SCARP Approach Outline (this document)
- SCARP Program Management Plan - Investigation Phase
- SCARP Objectives Evaluation
- SSES Workplan
- SCARP Improvements Plan
- SCARP Program Management Plan - Implementation Phase
- Annual Reports

The work involved in each of the various steps of the SCARP, the underlying logic and rationale for their sequence, and their place in each of the planning and management documents is more fully described in Section 3. Section 4 describes a methodology for the determination of future capacity allocation. The components, sequence of activities, and schedule of each report are elaborated in Section 5.

## 1.6. Regulatory Process Management

This SCARP Approach Outline is the first of several SCARP documents that will be submitted to PADEP. The following documents will be submitted to PADEP for action as noted:

- SCARP Approach Outline (this document) – for review, comment, and acceptance by PADEP
- SCARP Objectives Evaluation – for review and comment by PADEP

- SSES Workplan – for review and comment by PADEP
- SCARP Improvements Plan – For review, comment, and acceptance by PADEP
- Annual Reports

Each member of the WLSP has Act 537 and Chapter 94 planning and reporting responsibilities. Since the WLSP will be acting in concert (at least through the investigation phases of the SCARP), a streamlined regulatory process is desirable.

The SCARP Approach Outline (this report) constitutes a major sewerage planning change for each of the Partners. Accordingly, each municipal entity will issue a resolution adopting the SCARP Approach Outline as a 537 amendment. All WLSP resolutions will accompany the SCARP Approach Outline as a single deliverable to PADEP for review, comment, and acceptance.

All subsequent documents to be submitted to PADEP as part of the SCARP will be submitted in a similar manner. The SCARP Objectives Evaluation and the SSES Workplan will be submitted for regulatory review and comment only. The findings and recommendations from both of these documents will be detailed in the final planning document submission, the SCARP Improvements Plan, which will be submitted for PADEP review, comment, and acceptance in the same fashion as the SCARP Approach Outline; each municipal entity will issue a resolution adopting the SCARP Improvements Plan as a 537 amendment, and all WLSP resolutions will accompany the SCARP Improvements Plan as a single deliverable to PADEP.

# 2. Drivers, Problem Definition, and Objectives

## 2.1. Drivers

WLSP stakeholders participated in a number of workshops to identify program drivers, develop problem definition, and develop a list of preliminary objectives. The stakeholders are the individual communities and their associated authorities (where appropriate), as listed below:

- Lehigh County Authority
- Upper Milford Township
- Weisenberg Township
- Lower Macungie Township
- Upper Macungie Township
- Upper Macungie Township Authority
- Lowhill Township
- Borough of Alburtis
- Borough of Alburtis Sewer Authority
- Borough of Macungie

The drivers identified by the stakeholders as well as relevance to each stakeholder are summarized below:

- Keeping base infiltration flows controlled to help keep baseline flows below a yet to be defined rate to avoid having infiltration trigger expensive treatment expansions/upgrades
- Reducing peak flows at Klines Island WWTP to eliminate bypass
- Keeping peak flows below a yet to be defined rate to try to avoid triggering expensive treatment expansions/upgrades
- Preventing Sanitary Sewer Overflows (SSOs) in interceptors between Park Pump Station (PPS) and Klines Island WWTP
- Preventing SSOs in Western Lehigh Interceptor (WLI) and Little Lehigh Interceptors (LLI).
- Preventing SSOs in individual collection systems

- Providing aging collection systems with consistent and effective asset management practices that provide long term sustainability.

## 2.2. Generalized Problem Definition

Each of the Partners generally acknowledges that there are base flow and wet weather flow problems in their respective sewer collection systems. While each of the Partners has to a greater or lesser extent investigated their individual flow problems, the available information is not adequate to conduct broadly effective sewer rehabilitation or conveyance enhancements or to implement sophisticated long-term asset management programs as described in Section 3.8. The process for collecting the information necessary to define and quantify base and wet weather flow problems is summarized in Section 3 of this SCARP Approach Outline.

Several flow related problems beset the Partners. These are:

- Peak wet weather flows within some of the satellite WLSP systems may exceed their trunk lines' capacity, causing SSOs and/or sewage backups into basements (SIB). The current level of service (LOS) provided by each system individually, and by the total system as an integrated sanitary sewer system is undefined; therefore, the LOS gap is not quantified; therefore, this aspect of the problem is ill-defined.
- Peak wet weather flows, to which all of the Partners contribute, exceed the capacities of the WLI, LLI, and PPS, causing SSOs. The current level of service provided by these major conveyance components is ill-defined; therefore, this aspect of the LOS gap is not quantified; therefore, the problem is ill-defined.

- Peak wet weather flows, including flow from all of the Partners, exceed the capacity of the Klines Island WWTP headworks, causing bypasses of wet weather diluted sewage flows from the normal wastewater treatment processes. The current level of service provided is undefined; therefore, the LOS gap is not quantified; therefore, the problem is ill-defined.
- Infiltration, to which all of the Partners contribute, is consuming base capacity intended for planned 537 growth, and continued growth without significant reductions in baseline flows via infiltration reductions will trigger expensive upgrades at Kline Island WWTP to comply with recent DRBC regulations.
- Some system components are deteriorated, leak badly, and require rehabilitation or replacement. Structurally sound and leak-free sewers will require rehabilitation in the future to sustain their value, and these less compromised components require different

operation and maintenance attention than typically traditionally provided to sustain their life cycles.

The problem descriptions provided above contain a number of common elements that must be addressed before the problems can be properly defined and plans developed for resolution. The most important element is definition of the current and desired level of service. The current wet weather level of service of a system is generally defined by the ability of the system to contain and convey flows during periods of stress (i.e., high groundwater coincident with record period storms). During the investigative phase of this program, information about the sewer collection systems will be collected that will be used to define the current level of service. Once the levels of service are accurately defined, the rehabilitation, replacement, and expansion improvements strategies required to close any gap will be determined.

## 2.3. Preliminary Objectives

Based on the drivers and problem descriptions developed to date, the following preliminary SCARP objectives have been developed:

- Reduce peak wet weather flows to minimize the need for capacity expansion of the Western Lehigh Interceptor and the Little Lehigh Interceptor and their appurtenant components for system demands through 2030.
- Reduce peak wet weather flows from WLSP systems to help City of Allentown prevent bypasses from triggering expansions and upgrades at Klines Island WWTP and to prevent City of Allentown from claiming the bypasses are caused by the Partners.
- Reduce baseline flows to help prevent Partners from triggering treatment plant expansions and upgrades.
- Eliminate wet weather SSOs and SIBs in all systems within the yet to be defined level of service goals.
- Secure long term sustainability of all components of the sanitary sewer systems.

These preliminary objectives may be modified based on the extent of the problems (once they are quantified) and the cost and time needed to address them as described in Section 3.8. Additional goals may also be added as knowledge of the system increases and the need for further objectives are identified.

# 3. SCARP General Path Forward

## 3.1. Overview

As stated in Section 2, there is general recognition by the Partners that there are dry and wet weather related flow problems throughout the sanitary sewer system. These problems have caused capacity problems in the trunk lines, interceptors, pump stations and treatment plants. The exact nature, extent, and causes/sources underlying these problems are not currently defined. Without a thorough understanding of the underlying problems, it is not possible to develop an effective plan for addressing the recognized capacity issues. The SCARP activities as described in this Section will provide the information necessary to address the currently experienced problems and serve as the mechanism by which all Partners will meet the preliminary objectives described in Section 2. This Section outlines the overall SCARP program by introducing the steps of the SCARP, including management, planning, investigation, evaluation, and implementation.

The purpose of each major step of the SCARP is introduced below:

***SCARP Management Planning -*** Establish management plans for the investigative and implementation phases of the program. The management plans will identify the responsibilities and authorities of each WLSP with respect to participating and funding of the SCARP. They will address commitments of labor, equipment, consultants, and other resources to the demands of the SCARP schedule.

***SCARP Objectives Evaluation –*** Quantitatively define wet and dry weather flow performance characteristics necessary to define the current level of service.

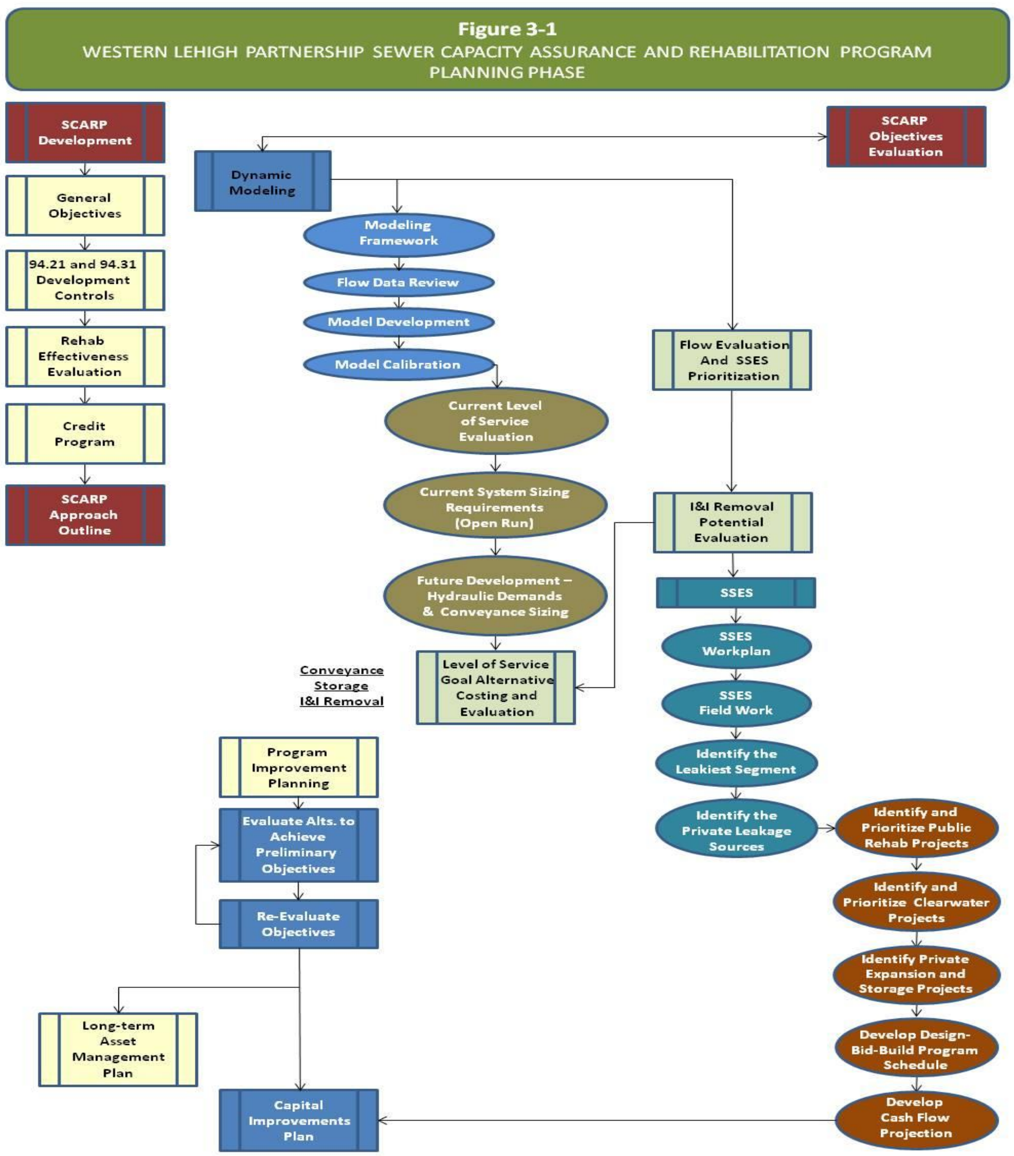
***Sanitary Sewer Evaluation Study (SSES) Workplan –*** Develop a plan describing the field activities to be performed to collect the information necessary to identify specific areas and defects in segments of the sewer system that will require rehabilitation.

***SCARP Improvements Planning –*** Evaluate and develop capital improvement and long-term asset management plans to achieve the final SCARP objectives.

***Annual Reports and Closeout –*** Document actual implementation and effectiveness of the SCARP.

The remainder of this Section generally describes each component of the SCARP including relevance, purpose, methodologies, procedures, and relationship and sequences to other SCARP components. Most of these components will be reported or presented in one or more of the deliverables described in Section 1.6. Figure 3-1 shows the relationship and sequence of the SCARP components. The anticipated actual contents and schedule of each report is provided in Section 5.

**Figure 3-1: SCARP Planning Phase Elements**



## 3.2. SCARP Objectives Evaluation Steps

The first steps of the SCARP are focused on defining current system performance and to begin to assess what it might take to achieve various preliminarily considered objectives. The first steps are primarily data gathering and modeling steps that include collecting the information necessary to evaluate base and wet weather flows, defining the current level of service, and conducting hydraulic evaluations to determine if the preliminary objectives described in Section 2 can be achieved.

As described in Section 2.0, the information used to establish the preliminary SCARP objectives included institutional O&M knowledge, a limited amount of flow data, and wet weather flow observations. As there is very little empirical data available upon which to base SCARP objectives, these data will need to be collected at the onset of the program to verify the overall feasibility of the preliminary objectives. Once accurate and relevant data is collected and evaluated, the preliminary objectives will be reviewed and, if appropriate, revised. The information to be collected and used for validation of the preliminary objectives and, if necessary, development of final SCARP objectives is described in the following paragraphs.

### 3.2.1. Flow Evaluation Including I/I Removal Potential

In 2008, LCA retained the services of ADS, Inc. to conduct two individual flow metering programs. The program completed in March 2008 included installation of 16 ultrasonic flow meters including 6 in the LCA WLI, 1in Macungie, 1 in Alburtis, 1 in Upper Milford Township, 3 in Upper Macungie Township and 4 in Lower Macungie Township. The program completed in early November 2008 included installation of 17 ultrasonic flow meters including 4 in the LCA WLI, 3 in Macungie, 1 in Alburtis, 1 installed in Upper Milford Township, 4 in Upper Macungie Township, 3 in Lower Macungie Township and 1 in Weisenberg Township. The data collected as part of these flow monitoring programs helped to confirm that there are areas of the system that are significantly impacted by I/I. However, the location of the leakiest segments are not currently known and therefore cannot be systematically prioritized.

In March 2009, LCA initiated a comprehensive flow monitoring program that extended through September 2009. Included in the program is installation of 148 ultrasonic flow meters and 14 rain gages. Of the 148 flow meters, 10 were installed in Macungie, 4 were be installed in Alburtis Borough, 4 were installed in Upper Milford Township, 2 were installed in Emmaus, 50 were installed in Upper Macungie Township, 47 were installed in Lower Macungie Township, 22 were installed on LCA’s Western Lehigh Interceptor, and 10 were installed in the Little Lehigh and Cedar Creek Interceptors.

Two quality assurance (QA) reviews on the first and last submittals of the flow data will be conducted. The initial QA review will check that the data being collected is valid and suitable for the RDII analysis phase and will provide recommendations for improving data suitability as needed. The final review will confirm the suitability of the full dataset for purposes of the RDII analysis. The reviews will address such issues as meter imbalance, sensor failure, low flow/level situations, velocity gain adjustments, and loss of storm peaks. The reviews will include data from 148 meters and flow balance analysis for 68 network balance points. The features and benefits of the QA review and RDII analysis are summarized in Table 1. A time series data management system will be used to store and evaluate all flow and rainfall data. All data will be validated to identify questionable flow meter and rain gauge data.

**Table 3-1:
Features and Benefits**

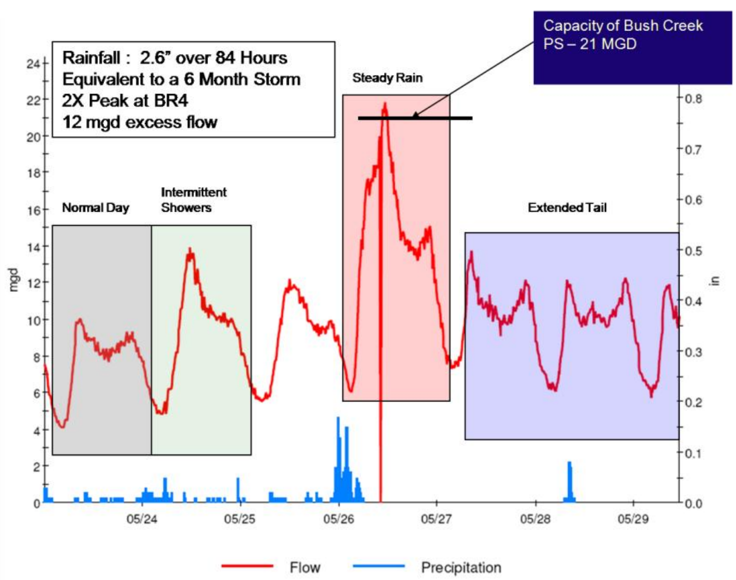
| Problem | Probability/ Frequency of Occurrence | Risk/Consequence | Feature/Solution | Benefit |
|---|---|---|---|---|
| Meter network imbalance | 40% | Data from one or more meters cannot be used | Calculate flow balances on intermediate data deliverables | Identify problems during collection period and address the issues |
| Sensor failure | 10% | Meter down time; no data collected by failed meter | Independent review of data; a "second set of eyes" | Greater percentage of valid data for analysis and modeling |
| Low flow/low level | 20% | If levels are low, velocity-level meters can under-report flow | Identify low level situations and recommend appropriate technology | Greater confidence in meter accuracy; additional valid data |
| Velocity gain adjustment | 15% | Velocity readings adjusted to balance meters; can result in inaccurate flows | Compare velocity adjustments and verify their necessity | Assurance that velocity adjustments are field verified and valid |
| Loss of storm peaks | 20% | Automated software can remove storm peaks; inaccurate RDII analysis | Compare raw data to edited data | Recover deleted storm peaks for more accurate RDII analysis |

The goals of the 2009 Comprehensive Flow Study program are to:

- Determine the nature and extent of the various types of inflow and infiltration in each sewer basin.
- Identify the sources/locations of various types of infiltration and inflow.

The results of the 2009 Comprehensive Flow Study will be used to:

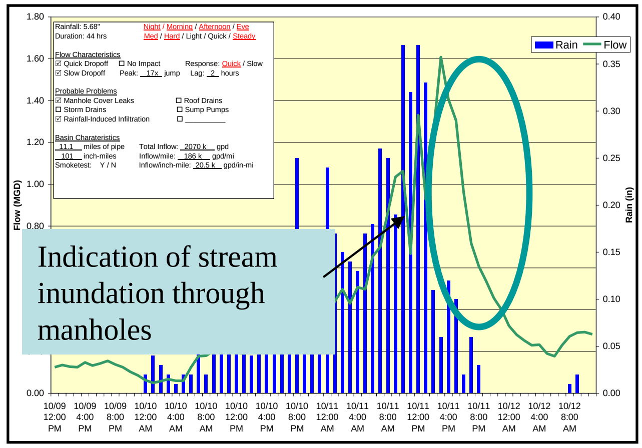
- Quantify the baseline and seasonal infiltration rates for each catchment.
- Identify the types and amounts of I/I for each catchment. Within each flow basin, interpretation of the flow hydrographs will yield the identity of potential I/I sources.
- Identify the SSES activities to be included in the SSES Workplan for each catchment. Using the flow monitoring data, the most effective and efficient methods of inspection can be selected to identify the sources of infiltration or inflow. Not all SSES activities need to be performed in each catchment.
- Determine the peak flows throughout the system and where they occur. The comprehensive flow monitoring network will record the peak flows at many points throughout the system.
- Pinpoint the locations of hydraulic restrictions in the system's interceptors and trunklines. The peak flows will be compared to the maximum allowable load to the interceptors, pump stations, and treatment plants to establish how much I/I must be removed to meet the level of service goals and to confirm that it is realistic to expect I/I source removal efforts (i.e., sewer rehabilitation) to achieve the desired performance levels.




- Serve as the basis for the calibration and validation of future dynamic hydraulic modeling efforts.

### 3.2.2. SSES Prioritization

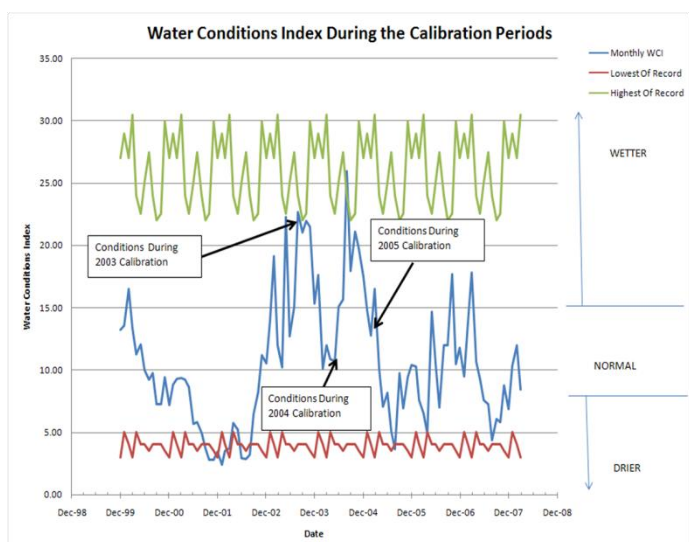
Analysis of the flow hydrographs described in Section 3.2.1 will provide insight into the sources of I/I in each catchment. Different sources of I/I have different flow signatures. For example, high peaks in the hydrograph over a short duration are evidence of sources of inundation or inflow. SSES activities in the workplans for these catchments will include strategies that specifically identify inflow and inundation sources as well as cross connections with storm sewer systems as well as illicit storm and/or groundwater connections to the sewer system by private property connections. Conversely, hydrographs illustrating peaks that are sustained over a long duration are evidence of sources of rainfall induced infiltration. Hydrographs may also indicate a combination of infiltration and inflow within the same catchment. In summary, the hydrograph for each catchment will be used to select the initial SSES activities.




The hydrographs will also be used to prioritize catchments for SSES activities. In addition to identifying the types of I/I sources present in a catchment, the hydrograph will also be used to determine the actual amount of I/I entering the system under wet and dry weather conditions. Each catchment will be prioritized based on the amount of wet weather I/I entering the system. The activities to be performed as part of each SSES is described in Section 3.7.

## 3.3. Dynamic Modeling

A dynamic hydraulic model (e.g., XP-SWMM, InfoWorks) will be developed for the system to assess sewer capacity, to better understand current system performance during record period storm events, to assess where potential capacity improvements (e.g., pump station upgrades, construction of relief or replacement interceptors, storage) might need be needed, and to estimate what impact I/I reduction projects might have on overflows and basement backups. The



existing GIS system contains asset information that when combined with the results of the 2009 Comprehensive Flow Study will serve as the backbone for a hydraulic/hydrologic model.

The flow data and rainfall data collected during flow monitoring will be utilized to calibrate and validate the dynamic model for both dry and wet weather conditions. This calibration will include storm data that can be reasonably extrapolated to the LOS goal.

Once calibrated, the model will be used to determine current system performance (i.e., what type of storm events under what type of groundwater conditions cause the system to overflow). The model will also be used to determine what reductions in flows are needed to achieve the LOS goal.

Year 2040 future flow conditions will be projected and analyzed. Existing and future system assessments /evaluations will employ continuous simulations of historic rainfall and groundwater records to develop design storms based on peak flow frequency analysis of actual events.

Critical to the development of the model plan will be coordination with any ongoing modeling efforts by the City of Allentown. The interconnected nature of the WLSP's systems and the Allentown collection systems requires an integrated approach to model development, calibration, and long-term planning usage. Meetings with Allentown's modeling team to ensure similar procedures are developed and applied will be required.

### 3.3.1. Flow and Rainfall Monitoring Data Review

A detailed review of the flow and rain data collected during the 2009 Comprehensive Flow Study to ensure the data are useful for calibration and verification will be conducted. Base (dry weather) flow patterns will be generated for each of the flow meters which will be used in conjunction with rain events and water consumption values to calculate I/I influence. Wet weather events will be defined and classified according to local Intensity/ Duration/Frequency (IDF) curves.

### 3.3.2. Collect and Review Additional System Information

Additional system information will be used to complete the model development and calibration. This will include:

- Census Data: In the absence of water consumption data, population data will be used to estimate dry-weather flow allocations. Readily available census data will be collected in GIS format.
- Land Use/Zoning Mapping: Information will be used in conjunction with the water consumption data to determine current and future dry weather loads.

- Water Consumption Information: Water consumption information will be collected for a winter quarter period. Water consumption data will be used to allocate dry-weather flows to each of the modeled subbasins. The water and/or sewer billing data will also be reviewed and processed to calculate the average daily sanitary flow for each parcel. Missing or inconsistent information will be documented and presented for review. For parcels without adequate billing records, the land use mapping, populations, or building square footage will be used to estimate the average flow.
- Contributing Community Information: This information includes wastewater collection system assets (sewer, manholes, force mains, etc.), scanned or hard-copy as-built drawings, service boundaries, parcel data, census data, and land use/zoning. The quality and quantity of available data from the Partners may be insufficient or inadequate, so field work/survey may need to be conducted.

These additional data will provide information to adequately represent sewer drainage areas, base wastewater (dry weather) flow contributions, and future development potential.

### 3.3.3. Model Development

The dynamic model developed for use in the SCARP will have hydrologic and hydraulic modeling capabilities. The hydrologic model provides the basis for generating wet weather flows for routing in the hydraulic model. Analysis of meter data from small, upstream catchments will be used for development of typical diurnal flow patterns that will be applied throughout the model. Using the catchment delineations, a model network will be defined. At a minimum, the model will include:

- All pipes in the WLSP system 10-inches and greater
- Interceptors from the Park PS to the head of the Klines Island WWTP
- Lift stations and force mains
- Other hydraulic controls structures within the 10-inch and greater network
- All known structural sanitary sewer overflow (SSO) locations
- Areas served by 8-inch diameter sewers will be added where necessary to define known chronic problem areas or expand the model to sufficient detail for I/I and capacity planning.

### 3.3.4. Model Calibration

The model will be calibrated using data collected at 50 flow meter locations and 10 rain gage locations throughout the collection system. It is anticipated that four wet weather events will be used for model calibration, and two wet weather events will be used for model verification. Calibration will be comprised of:

- **Dry weather calibration:** Calibration of the model to dry weather flows or inter-wet weather events, including diurnal patterns and seasonally varying groundwater infiltration. The following will be compared:
  - Verify that the model is routing dry-weather flows correctly. If the modeled flow data does not closely match the monitored flow data, the model will be reviewed for possible connectivity errors.
  - A continuous simulation will be performed to adjust parameters such as infiltration rates that are more directly affected by inter-event hydrologic conditions. Such continuous simulation will be done by simulating the entire monitoring period or selected portions of the monitoring period to predict the pre and post storm conditions at each of the meter locations.
  - Compare the measured and modeled flow depths, adjusting Manning's n as needed, or identifying the cause of discrepancies (e.g., downstream blockage, manhole friction losses, local flow effect).
  - Interviews with key collection system operation staff to find known capacity problems as well as locations of other service-related problems, such as roots and grease
- **Wet weather calibration:**
  - Calibration of the model will be completed for up to four storm events at the flow meters throughout the collection system. These events will cover a range of events from smaller storms to significant storm events.
  - The calibration will be completed by adjusting additional parameters to simulate the rainfall-induced flow response of the system for each storm event. Hydrologic parameters will be adjusted as needed to generate volume and peak flow.
  - Peak flow, total volume and surcharge depth model to monitor comparisons will be made in order to develop a robust tool for future flow projections and I/I alternative analyses.
- **Wet weather validation:**
  - Once the model is calibrated, a period of up to one year *not used for the* calibration will be simulated to assess the validity and robustness of the model calibrations dependent on available flow data sets.
  - The model validation period will be taken from available historic data. The use of a storm of record will be considered if sufficient comparative data are available (e.g., flow data, customer complaint data, etc.).
  - Model results will be compared to available data to assess the model calibrations.

## 3.4. Current Level of Service Assessment

Until completion of the 2009 Comprehensive Flow Study, adequate data will not be available to define the levels of service currently provided in each catchment. Having an accurate understanding of current conditions is paramount to understanding if the current level of service provided in each catchment is consistent with utility performance goals.

Until actual data are available, the current level of service can only be broadly estimated. It is likely that the current level of service provided by the system is somewhat below the level desired by the Partners. In this event, an evaluation will be performed to identify the alternatives needed to narrow the gap between current and desired levels of service.

It is envisioned that the current level of service will be established for the following groupings:

- Trunk lines within townships and boroughs
- LCA trunklines tributary to the Western Lehigh Interceptor
- Western Lehigh Interceptor/Spring Creek Road Relief Pump Station
- Little Lehigh Interceptor/Spring Creek Road Relief Pump Station
- Park Pump Station, the Little Lehigh Interceptor immediately downstream of the Park Pump Station, and the Cedar Interceptor immediately downstream of the confluence of the Little Lehigh and Cedar Creek Interceptors.

The dynamic model will be used to determine the current level of service for each portion of the system. The calibrated model will be used to conduct a detailed system analysis and identify deficiencies in existing system components. The first step will be to perform an existing system performance analysis for dry weather and wet weather conditions using 50 years of historic rainfall records. Statistical analyses will be performed to determine the peak flow and peak overflow volume frequency event. The selected level of control events will be used for subsequent tasks to assess and evaluate the system's level of service: the combination of rainfall and antecedent moisture conditions under which portions of the system overflow. It also shows where immediate capacity and other service-related problems potentially exist. This existing system analysis will define capacity issues and bottlenecks within the systems, including the existing gravity sewers from Keck's Bridge to Kline's Island WWTP. The current Level of Control Assessment will include:

- System performance (overflow frequency, volume, and location) during wet weather events using a continuous simulation of approximately 50 years of hourly rainfall data collected from a nearby weather station
- System performance during dry weather conditions using a continuous simulation described above. The analysis will focus on select dry weather intervals.
- System performance under peak wet weather flows using a continuous simulation where all hydraulic bottle necks are removed (open system) to eliminate all surcharging and flooding
- Statistical comparison of the overflow volume and frequency as well as the open system peak flow to determine the recurrence intervals for up to five historic events and to determine a desired level of control event for system improvement analysis

The system performance evaluations will be conducted for five selected storm events and will include a wet weather capacity assessment to identify the hydraulic bottlenecks of the existing system. The five events, determined from the continuous simulation described above, will be used on an open system model to determine the peak wet weather flows in each of the gravity sewers. The resulting sewer peak flow will be compared to its flowing full capacity to identify hydraulic bottlenecks in the system for the wet weather events.

## 3.5. Current System Sizing Requirements

The calibrated model and the Current Level of Service Assessment will be used to develop alternatives for providing necessary relief to any areas identified as capacity limited under existing conditions. This will involve an evaluation of system performance during wet weather events using the historic level of service events where all hydraulic bottle necks are removed (open system) such that all surcharging and flooding is eliminated. Estimates of I/I removal required to eliminate capital improvements will also be made using the model. The system performance evaluation will be conducted using the five selected storm events to identify the appropriate size of the conveyance if no storage or I/I reductions are made. The capital costs of these capacity increases will be estimated as well as any projected benefits (increased level of service).

## 3.6. Future Development – Hydraulic Demands and Conveyance Sizing

Future populations and additional wastewater flows (both dry and wet weather) into the WLSP systems will be projected so that the evaluation of alternatives for capacity management recognize the impact of these loadings too. Estimated future population and employment/industrial growth will be estimated through Year 2040, and will include estimates for the following communities:

a. Allentown
b. Emmaus
c. LCA and LCA signatory communities
d. Salisbury Twp.
e. South Whitehall Twp.

This will require collection of all available growth projections (primarily through each municipality's existing 537 Plan projections), outlining of appropriate additional areas that will be added to the WLSP service area either through development growth or acquisition/annexation, and projecting both dry and wet weather flows. It is anticipated that wet weather flows will be based on calibrated model parameters, slightly modified to reflect core assumptions such as ongoing increases in I/I over the planning horizon due to continued sewer deterioration.

Using the 2040 development projections, an analysis will also be completed for each event considered to determine how much I/I would need to be removed to eliminate overflows and minimize capacity limitations, and the required system improvements to convey wet weather flows without any I/I reductions.

Where necessary, additional service areas will be added and new facilities necessary to convey flows to the system will be incorporated into a baseline future model.

## 3.7. SSES Steps

Upon conclusion of the activities described in Section 3.2 through 3.6, the following information will be known for all catchments:

- Volume of baseline infiltration prioritized by catchment.
- Volume of rainfall derived I/I (RDII) contributed by each catchment, and likely cause (nature) of the catchment's RDII.
- Level of service for each catchment.
- Segments of the system that are undersized for current or anticipated future flows.
- Locations of anticipated wet weather SSOs.
- I/I volume and peak inflow reduction needed to eliminate capacity expansion or storage now and at all points through 2040.

This information will be used to define SSES activities for each catchment impacted by I/I. Review of flow monitoring data and flow hydrographs will identify the nature and extent of infiltration or inflow experienced in each catchment, but not the actual locations of the leaks. The goal of the SSES activities described in this Section is to specifically identify neighborhoods, pipe segments, or private properties contributing the highest levels of infiltration and or inflow. The following steps will be followed to successfully execute all SSES activities.

- Develop the SSES Workplan
- Conduct the SSES Fieldwork
- Identify Leakiest Public Sewers
- Identify Private Leakage Sources

Each of these steps are described in greater detail in the following sections.

### 3.7.1. SSES Workplan

An SSES Workplan will be developed for each catchment. The purpose of the workplan is to ensure that all SSES activities are planned and executed in a consistent and efficient manner. The workplan will be the mechanism by which all field personnel will consistently collect, record, and store all field collected data. In addition to addressing administration and management concerns, the workplan will define the SSES activities to be performed in each catchment. Each workplan will define the procedures, techniques, data capture and management tools, analysis methods, and QA/QC steps to be used by each WLSP for each type of SSES activity to be performed. The potential SSES activities that will be prescribed by the workplans include smoke testing, basement inspections, stormwater observations, post-storm trunkline walks, wet weather CCTV work, weiring, and manhole inspections. Not all SSES activities described above will be used in each catchment.

In addition to including written policies and procedures for performing the work, the workplans will ensure that the SSES activities performed by each WLSP is performed in a consistent manner that will yield the data necessary to select the appropriate rehabilitation/replacement strategies.

### 3.7.2. SSES Fieldwork

Field personnel will conduct the SSES activities as described in each SSES Workplan. The information collected during this step will serve as the basis for selecting rehabilitation or replacement strategies to address the identified defects. The SSES activities potentially included in each workplan are described in the following paragraphs.

#### 3.7.2.1. Smoke Testing

In the event flow meter data indicate that direct inflow sources exist (e.g., cross-connected roof leaders or storm drains, badly leaking manholes/covers), additional investigation will be necessary to find these particular sources. Smoke-testing will be utilized for its effectiveness and low cost in locating inflow sources without traps or check valves (i.e., it won’t locate sump pumps, or roof drains connected to soil pipes with P-traps).

Alternatively, dye testing may also be used to verify suspected cross connections in the event smoke testing is not practical or in an effort to confirm sewer connections on a small scale basis.

#### 3.7.2.2. Basement Inspections

In the event flow meter data indicate that direct inflow sources such as cross connected sump pumps or punctured floor drains exist, it will be necessary to conduct basement inspections. Basement inspections will be conducted to specifically identify households containing illegal connections to the sewer system. These connections often take the form of punctured floor drains, punctured riser pipes, and cross connected sump pumps.

#### 3.7.2.3. Above-Grade Stormwater Observations

It is also helpful to physically inspect the system during wet-weather events. On-site observations will be conducted in catchments that are heavily impacted by direct inflow sources and of manholes in the streets impacted by sheet runoff or manholes in easement areas that may become inundated by elevated stream levels. Manholes will also be opened to see if there is any overtly obvious significant increases in flows resulting from direct inflow sources.


#### 3.7.2.4. CCTV Inspections During Rainfall

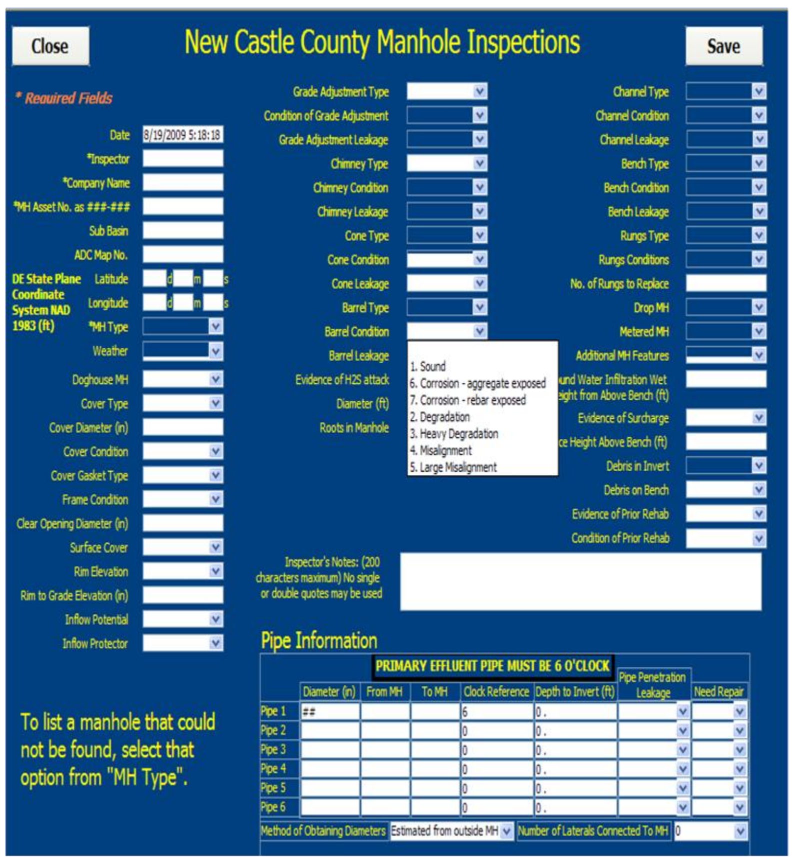
Closed circuit television inspection is the best, albeit most difficult and expensive method of conducting gravity system condition assessments where sources of RDII are suspected. Standardized coding of defects using the NASSCO PACP system will be used to reduce the subjectivity of data evaluation.

### 3.7.2.5. Nighttime Flow Weiring

Given the age of the collection system, it is anticipated that rainfall-induced infiltration (RII) will likely be identified as a major contributor of flow in some catchment areas. For these catchments, night-time weiring work will be conducted during elevated groundwater conditions to identify which sections do and do not leak. While nighttime weiring is, strictly speaking, a measurement of infiltration, it is also a good surrogate indicator of RII.

### 3.7.2.6. Manhole Inspections

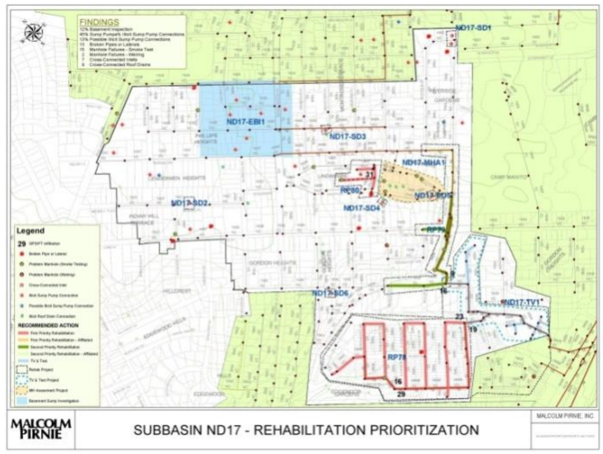
Manhole inspections will be conducted on every manhole utilized during weiring and smoke testing. These inspections will be used to not only collect structural information, but to also assess the hydraulic condition of these manholes. The elevated groundwater conditions that are preferred field conditions for weiring work will also reveal if any of the inspected manholes are subject to infiltration. This work will gather structural and hydraulic information and provide even greater inspection coverage of the manholes in each sewer basin. This work will be considered preliminary only, as experience has shown that groundwater levels rise dramatically after sewer main and lateral rehabilitation, and manholes that previously appeared to be watertight in fact leak significantly once the lower lying components are sealed.



Finally, manhole inspections will be conducted in areas along streams to identify manholes that either become inundated during stream flooding or have evidence of overflow or surcharge. Data on manholes exhibiting evidence of surcharge will be used to support truthing of modeling.

### 3.7.3. Identify Leakiest Public Sewers

From the SSES work, the actual hydraulic condition of sections of the public sewer system will be clearly understood and the location of leakage will be documented. The data collected during the SSES activities will be used to organize the leaking segments on a neighborhood by neighborhood basis. Leaking defects that are anticipated to be identified within the domain of the WLSP (public sewers) include cross connections between the sanitary and stormwater system, leaking pipe joints, collapsed and broken piping, illicit connections to private systems, deteriorated manholes, and manholes that are subject to inundation due to stream flooding or sheet flow generated by impervious surfaces.




### 3.7.4. Identify Private Leakage Sources

SSES activities will also locate illicit connections to the public sewer system as well as private clearwater sources. The sewer ordinance of each WLSP will be used to determine whether a suspect connection is illicit. If the connection is not permitted in accordance with the sewer ordinance, the owner of the illicit connection will be required to eliminate the connection or obtain a permit for its operation. Private leakage sources detected during the performance of basement and CCTV investigations may include clearwater connections such as roof drains, cross-connected sump pumps, leaking building drains, and area drains.

The cost and political inexorabilities of a private clearwater disconnection program will be weighed. Similarly, an evaluation of the financial and political costs and benefits of addressing those portions of leaking laterals owned by the property owner will also be conducted.

## 3.8. Program Improvements Planning Steps

The purpose of these steps of the SCARP are to identify the rehabilitation needs, replacement needs, expansion requirements, costs of improvements, and schedule for implementing a program to achieve the SCARP objectives. This will be accomplished by evaluating the various combinations of methods and costs to achieve the preliminary objectives, revising the preliminary objectives to yield final SCARP objectives (if necessary), prioritizing projects, developing a design and construction schedule, and projecting a cash flow plan that constitutes a reasonable Capital Improvements Plan, and developing of a long-term Asset Management Plan to maximize the overall life-cycle of all assets.

### 3.8.1. Evaluate Alternatives to Achieve Preliminary Objectives

There is no one path forward that will achieve the preliminary objectives. All of the information necessary for this analysis will be available following development of the hydraulic model, identification of likely I/I sources, and identification of the actual sanitary sewer leakage locations through implementation of the SSES Workplan (Section 3.7.

It is likely that the path forward to meeting the level of service goals will not consist solely of either I/I reduction or capacity enhancements. The SSES and modeling data will be used to build and analyze the feasibility of alternatives that include combinations of I&I source removal, storage, and conveyance expansion for addressing the preliminary objectives and level of service goals.

From the SSES work, sections of the public sewers system will be prioritized for replacement or rehabilitation based on their leakage, location, and cost:benefit ratio. From the SSES work, an evaluation of the impact of flows from privately owned clearwater connections such as roof drains, cross-connected sump pumps, leaking building drains, and area drains and the cost and political inexorabilities of a private clearwater disconnection program will be weighed. Similarly, an evaluation of the financial and political costs and benefits of addressing those portions of leaking laterals owned by the private property owner will be conducted.

Methods for rehabilitation and replacement of public sewers that will be considered as part of this evaluation will include, but are not limited to, replacement of pipe segments, pressure testing and chemical grouting, cured-in-place pipe lining, cured-in-place lateral lining, and removal of other illegal connections to the sewer system including sump pumps, roof drains, etc. Estimates of the potential amount of I/I that can be removed upon implementation of a rehabilitation program utilizing each of the methods above will also be prepared.

The hydraulic model will be used to evaluate what combinations of I&I source removal, storage, and conveyance expansion best meet future flow conditions for storm return frequencies of 1, 5, 10 and 20 years and an I/I creep rate of 0.5% per year. These alternatives will be developed using the model and costed for both capital and operating costs. The model will be used to analyze the following scenarios:

a. System improvements, including storage tank locations/sizes and trunkline/interceptor/relief pump station expansion and paralleling requirements, that would be needed assuming no I/I is removed.

b. Impact of system capacity restored as a result of eliminating sources of I/I and/or construction of system improvements on future development and demand for service.

c. Amount of I/I that will need to be removed to reduce/eliminate the need for storage or increased conveyance capacity.

d. Impact of alternative on sanitary sewer overflows for the various return frequencies.

e. Effect of the alternatives on City of Allentown flows.

The alternatives analysis described above will be used to determine the rehabilitation, replacement, and expansion requirements to meet the preliminary objectives. Included in these analyses will be the physical reality that much of the existing piping systems will require rehabilitation or replacement with the next 30-50 years. The rehabilitation, replacement, storage, and expansion alternatives identified to meet the preliminary objectives will be ranked based on effectiveness, constructability, timeliness, capital cost, and lifecycle cost.

### 3.8.2. Re-evaluate Objectives

The analysis conducted in the previous section will be the first real attempt by the Partners to identify actual strategies and life cycle costs for achieving the preliminary objectives. The identified strategies will undergo an analysis of cost versus effectiveness to identify the strategies that have the greatest "bang for the buck". It is likely that the most attractive strategies will not be perfectly aligned with the preliminary objectives. The preliminary objectives will need to be reviewed and if necessary revised based on the specific political and financial considerations of each WLSP. It is intended that "knee-of-the-curve" cost: benefit evaluation will be used to drive selection of the final LOS objectives.

Upon re-evaluation of the objectives, new or modified final SCARP objectives will be confirmed by each WLSP. The MOU will be amended to include the final SCARP objectives as well as the overall strategy for achieving the objectives.

### 3.8.3. Develop Capital Improvements Plan

As previously stated, the overall strategy for achieving the SCARP objectives will likely reflect a balance between storage, conveyance expansion, I/I reduction via public sewer rehabilitation, I/I reduction through private sewer rehabilitation, and clearwater removal.

From a capital expense perspective, it is obvious that the required improvements will not be simultaneously implemented. All planned improvements will need to be sequenced to reflect available capital resources. The Capital Improvements Plan will be the mechanism for implementing the recommended improvements. This Capital Improvement Plan will have the following components:

- I/I Mitigation: Based on the hydraulic modeling analysis, flow metering data evaluation, and SSES results and engineering experience, a comprehensive I/I mitigation plan that will prioritize areas for follow-up SSES investigation and I/I mitigation based on comprehensive data and modeling analyses will be proposed. This portion of the plan will provide a target I/I removal percentage.
- Capacity and Storage: Augmenting the I/I mitigation activities will be recommended capacity and storage improvements for the conveyance systems that will provide sufficient capacity (assuming the target I/I reductions are achieved) for a selected, cost-effective level of service.
- Implementation of Final Future Alternative Analysis: A phased Implementation Plan that will outline an achievable program that will address existing and projected future capacity needs.
- Costs: Estimated life-cycle costs, including O&M, will be developed for the recommended Improvements Plan.

A schedule for the needed improvements based on an estimate of I/I removal, future flows and growth of the service area will be prepared. A sewer rate model specific to the Partners will be developed and used to determine if sewer rate increases are required to support the desired improvements. In the event the cost of the needed improvements exceeds capital generated by an acceptable increase in sewer rates, the improvement implementation schedule will be revised to reconcile these competing demands.

Once the iterative process of rectifying the implementation schedule and capital funding has been completed, a Capital Improvement Plan (CIP) will be finalized. The Capital Improvements Plan will define the needed improvements, implementation schedule, cash flow demands by WLSP, and any needed changes to the existing sewer rate structure to support the implementation schedule.

### 3.8.4. Develop Long-term Asset Management Plan

An Asset Management Plan will be developed and implemented that is complementary to the Capital Improvements Plan and ensures that the improvements defined by the Capital Improvements Plan are integrated with supporting operation and maintenance strategies to maximize the life cycle of critical assets. In essence, the combination of the Long-term Asset Management Plan and the CIP will effectively provide a common CMOM Plan for all the Partners. The Asset Management Plan will address utility organization, business processes, information and technology systems, design standards, operating and maintenance procedures to ensure that these important elements can support the overall

SCARP objectives within the available financial resources. The Asset Management Plan is intended to be a living document with revisions occurring at biannual frequency.

The long term Asset Management Plan will include:

**Engineering**

- System Inventory Procedures
- System Mapping Procedures
- New Sewer System Design Standards
- New Sewer Construction inspection Standards and Procedures
- Rehabilitation Inspection Standards and Procedures
- Continuing Sewer System Assessment Procedures
- Scheduled Manhole Inspection Procedures
- Flow Monitoring Procedures
- CCTV Procedures
- Gravity System Defect Analysis Procedures
- Service Lateral Investigation Procedures
- Pump Station O&M Procedures
- Pumping Station Scheduled Inspection Procedures
- Pumping Station Performance and Adequacy Evaluation
- Force Main Assessment Procedures
- Sanitary Sewer Overflow Reporting, Notification and Record Keeping Procedures
- Un-permitted Discharge Reporting, Notification and Record Keeping Procedures
- Emergency Operation and Maintenance Procedures

**Management**

- Training Programs
- Safety Programs
- Confined Space Entry Procedures
- General Safety Procedures
- Traffic Management Procedures

**Operations and Maintenance**

- Wet Well Cleaning Procedures
- Odor and Corrosion Control Procedures
- Air Relief and Vacuum Relief Valve Maintenance Procedures
- Standby Power Operations Procedures
- Emergency Operating Procedures
- Grease Trap Inspection and Enforcement Procedures
- New Connection Tap-in Procedures
- Line Location for Third Parties Procedures
- Pumping Station Maintenance Procedures
- Force Main Maintenance Procedures
- Valve Exercise Procedures
- Gravity Line Hydraulic Cleaning Procedures
- Gravity Line Mechanical Cleaning Procedures
- Gravity Line Root Control Procedures
- Manhole Preventative Maintenance Procedures
- Maintenance of Rights of-Way and Easements Procedures

## 3.9. Annual Reporting

To document the progress of the SCARP, the Partners will prepare a joint Annual Report for submission to PADEP. With respect to the SCARP, program progress will be measured by improvements made with respect to the following criteria:

- Project Implementation
- Rehabilitation Effectiveness
- Level of Service Performance Measurement

### 3.9.1. Project Implementation

In accordance with the Capital Improvement Plan, projects will be scheduled for implementation and completion on an ongoing basis. The Annual Report will track the progress of projects scheduled for implementation or completion. SCARP success will initially be based on the ability of the Partners to maintain the implementation schedule.

### 3.9.2. Rehabilitation Effectiveness

Rehabilitation project specific effectiveness monitoring will be conducted to:

- Quantify the I/I removal effectiveness of the rehabilitation projects.
- Quantify the cost-benefit of the various rehabilitation methods.
- Fine tune or refocus the selection of rehabilitation techniques based on these findings.

For many of the rehabilitation projects, flow meters will be installed to gauge project specific effectiveness. Two metrics will be used to determine the effectiveness of projects designed to eliminate I/I:

1. Reduction in total system volume resulting from a rain event - Total system volume resulting from a rain event is calculated by totaling the hourly flow volumes measured during the I/I period.
2. Reduction of peak flow rate during a rain event - Peak flow rates are determined by reviewing the hourly data collected during each rain event and identifying the highest measured flow rate.

The above metrics will be based on actual post-rehabilitation flow monitoring data. Ideally, flow monitoring will be conducted in each project area for six months prior to the start of rehabilitation and for six months after completion of rehabilitation in order to capture data from a significant number of storms. At least six storms are anticipated to be captured by the flow monitoring both before and after rehabilitation.

The Control Basin Method (CBM) of analysis will be used to analyze the pre- and post-rehabilitation flow data. The CBM is a correlation between the metrics of the basin undergoing rehabilitation and the "simultaneous" metrics from a control basin. Scatter plots are generated with the metric values from the control basin on the x-axis and the corresponding metric values from the rehabilitation basin on the y-axis. Pre-rehabilitation data is plotted separately from post-rehabilitation data and both sets are linearly regressed. The percentage difference between the slope from the pre-rehab regression and the slope from the post-rehab regression yields the percentage reduction due to rehabilitation.

If the control basin is well selected (i.e. it exhibits similar physical condition, I/I characteristics, groundwater and rainfall conditions, and is geographically close to the rehabilitation basin), the relationship between the two basins is linear because it is a direct comparison of metrics which occurred during the same storm event.

Percent reduction is determined by the measuring the difference between the pre-rehabilitation and post-rehabilitation trend lines.

### 3.9.3. Level of Service Performance Measures

When source removal work is a featured part of a sewer capacity assurance and rehabilitation program, it is impossible to predict exactly how much work will be required to meet the level of service program performance goals. The only way to demonstrate that the improvements have met the goals is to project flow monitoring results collected after the system improvements have been implemented to the level of service event using dynamic modeling.

It is anticipated that the Program Improvements Plan will be broken into at least two phases, with flowmetering, recalibration of the system model, and level of service performance evaluations conducted after each phase. It is anticipated that the first phase will be 8-12 years in duration.

At the end of each phase, the model will be updated to reflect physical changes to the system such as the storage tanks and in-line storage, relief line or line expansion, flow diversions, and system extensions. The model will be recalibrated using flow meter data collected from the inter-phase flow monitoring. Additionally, the period during which these data are collected will be cross referenced to the water conditions index to ensure that the model is recalibrated using flow data subject to appropriate water conditions index to ensure an appropriate level of consistency is achieved between the 2010 Model and the subsequent models. The newly calibrated model will be used to characterize improved system performance under the new flow regimes derived from the I/I source removal projects and to determine the Level of Service provided by the Partners systems at the end of each phase.

# 4. Future Capacity Allocation

PADEP has implemented a review process for all proposed new subdivisions for connection to the Western Lehigh Interceptor and have stipulated that, under their PA Code 94.21 authority, each Partner must implement a corrective action plan that addresses hydraulic overloads and specifies how new connections will be responsibly managed. As stated in 94.21.a.3, the written corrective action plan must include, but not be limited to, a program for control of new connections to the overloaded sewerage facilities and a schedule showing the dates of each step toward compliance. This SCARP Approach Outline constitutes the required corrective action plan.

Accordingly, the procedure described in the following paragraphs will be used to control new connections to the sewer system to ensure that new development does not outpace capacity assurance and flow reduction measures taken by the Partners.

## 4.1. Development Flow Credits

New connections to the system will be allowed as measurable reductions in flows, through a combination of I/I reduction, capacity increases, or storage, are achieved. In the interim, proposals for new connections will continue to be received and reviewed by all Partners; these will be conditionally approved using existing review and approval procedures, with the codicil that they may not be connected to the sewer system until flow is made available, as described below.

As capital projects are completed, benefits to peak flow conditions in the sewer system will be realized. Capacity increases will reduce flow levels in critical lines and, properly done, will not cause flow levels to unacceptably increase in other portions of the sewer system. Storage will reduce peak flow volumes in critical lines. Rehabilitation and clearwater removals will reduce the I/I demands placed on the sewer system. However, there may be a delay in measured response as the system is currently surcharged (pressurized) and leakage removed, stored, or conveyed may be replaced by leakage from other sources not currently able to enter the system due to pressurization, or by flows that are currently leaving the sewer via SSO that, once I/I flows are reduced, will now stay in the sewer.

Reduction in flows from rehabilitation and clearwater removals and in flow levels from storage and capacity increases will be largely applied directly to reducing the current hydraulic overload. A portion will be made available to new connections, as described below.

### 4.1.1. Source Reductions via Rehabilitation

To determine the actual effectiveness of rehabilitation, post-rehabilitation flow monitoring will be conducted to measure the amount of I/I eliminated from the system using the Control Basin Method (CBM) described in Section 3.9.2. Both the volume of flow eliminated and the peak flow rate reduction achieved will be calculated. The point of calculation of reduction between the control basin data and the rehabilitated basin data will be four times the average daily dry day diurnal peak rate. Thirty percent of the lower of these two reductions will be applied to a Development Flow Credits Account.

Because determination of actual flow benefits won't be completed until at least six months after completion of the project, and to continue to foster economic growth, a method that applies some portion of the anticipated flow reduction earlier will be used. The anticipated effectiveness of each rehabilitation project can be estimated based on previously conducted rehabilitation work. The anticipated reduction for each project will be documented in a memo that includes a documented basis for flow reduction. One third of the anticipated flow credit will be applied to a Development Flow Credits Account at project award, and this front loaded credit will be deducted from final, actual flow credit applied upon completion of rehabilitation effectiveness determination.

### 4.1.2. Source Reductions via Clearwater Removals

Source reduction for clearwater removals will be dependent on the nature of the clearwater disconnection. Cross connected sump pumps have been demonstrated in past investigations to deliver an average of 6 gallons per minute during storm events. (Actual rates of discharge vary from 0 gpm to 70 gpm, but when averaged out over the duration of storm events, they average 6 gpm. This has been confirmed via post disconnection analysis using CBM methods describe in the above section.

Leaking building drains deliver widely different rates of I/I. For the purposes of this SCARP, it will be assumed that they deliver two-thirds the rate of a cross connected sump pump: 4 gpm. (Sump pumps deliver flow at pressure and are able to discharge into surcharged sewers).

Roof drains, driveway drains, and area drains rate of discharge is a function of the area serviced by the drain. For the purposes of the SCARP, flow removals from these clearwater connections will be calculated by multiplying the areas served by the depth of the 2 year- 24 hour storm (inches).

Thirty percent of these source water reductions will be applied to a Development Flow Credits Account upon successful disconnection.

### 4.1.3. Peak Flow Reductions via Storage

Peak flow reductions provided by additionally provided storage in off-line tank storage will be the volume of the tank. Peak flow reductions provided by additionally provided storage in in-line pipe storage will be measured using the dynamic model run under a 2 year-24 hour storm event using an Alternating Block synthetic storm distribution. One third of the flow credit will be applied to a Development Flow Credits Account at project award, and this front loaded credit will be deducted from final, actual flow credit applied upon completion of construction.

### 4.1.4. Peak Flow Reductions via Capacity Increases

Peak flow reductions provided by additionally provided capacity increase (e.g., relief interceptor, interceptor replacement with larger diameter pipe, interceptor lining with lower Mannings coefficient materials, relief pump station/force main) will be measured using the dynamic model run under a 2 year-24 hour storm event using an Alternating Block synthetic storm distribution. The calculation of benefit will be the difference in SSO volume under the current system performance (as provided by the model described in Section 3 versus SSO volume with the new storage in place.

One third of the flow credit will be applied to a Development Flow Credits Account at project award, and this front loaded credit will be deducted from final, actual flow credit applied upon completion of construction.

### 4.1.5. Conversion of Peak Flow to EDUs for Development Flow Credits

I&I reductions and flow capacity improvements will be appropriately measured at peak flow periods. This accounts for both normal peak diurnal flow peaks (approximately 2.0x for residential flows, 3.0x for commercial flow, and highly variable/business-specific for industrial flows) and 2.0x increases for I&I flows. For the purposes of the development flow credits, commercial flows will be calculated with a 5.0 peaking factor, residential flows will be calculated with a 4.0 peaking factor, and industrial flows on a case-by-case basis.

For example, a 10 unit subdivision with a 300 gallon per day per unit base wastewater load is proposed. This equals a base load rate of 3000 gallons per day. Using the proposed residential peaking factor of 5, that would in turn equal 15,000 gallons per day peak flow rate. It is this peak flow rate that deducted from any development flow credits achieved by WLSP efforts.

## 4.2. Storage and Conveyance Measures Underway

### 4.2.1. Iron Run Pump Station and Flow Equalization Basin

For the last few years, LCA has been designing a third high flow sewage relief pumping station (the first two being the Park Pump Station and the Spring Creek Road Pump Station) to alleviate overflows from the upper third of the Western Lehigh Interceptor during extreme rainfall events. This new pump station, coined the Iron Run Pump Station (IRPS), is designed to be located just downstream of the LCA wastewater pretreatment plant (WWPTP). Designed to take treated flow from the WWPTP and pump it into the existing force main of the Spring Creek Pump Station and discharge the flow into the Little Lehigh Interceptor downstream of Kecks Bridge and upstream of the Park Pump Station, this station would reduce or eliminate overflows between the LCA WWPTP and Spring Creek Pump Station. Since its original conception, however, broader issues regarding overflows in the Little Lehigh Interceptor and the downstream components of Allentown's conveyance system have added design objectives that the IRPS cannot meet. Recent modeling to demonstrate the efficacy of the IRPS shows that while overflows in the Western Lehigh Interceptor and Little Lehigh Interceptor will decrease, overflows in the Little Lehigh Interceptor near Park Pump Station will increase with the operation of the Iron Run Pump Station . See Appendix A.

Concurrent with the design of the IRPS has been a separate effort to increase the flow equalization capabilities at the LCA WWPTP. LCA recently completed modeling that indicates a flow equalization basin (FEB) located at the head of the LCA WWPTP would perform similarly to the IRPS with regard to SSO volume reductions between the WWPTP and the Spring Creek Pump Station; unlike the IRPS, the FEB does not increase overflows near Park Pump Station. As shown in Appendix A, modeling predicted that the FEB would store approximately 2.3 MG during the March 27, 2005 storm (a 2-year 24 hours storm that caused several overflows in the WLI system). To provide for additional growth in Upper Macungie Township, a 3.0 MG FEB was proposed as the hydraulic basis of design.

Because the FEB meets the goals of the IRPS without increasing overflows near Park Pump Station, is half the cost of the IRPS, and better supports the possible conversion of the LCA WWPTP to a direct discharge WWTP, a 3.0 MG FEB will be constructed at the head of the LCA WWPTP. This FEB is currently being designed, with the facility slated to come on line in Fall 2010. This FEB will postpone or eliminate the need to construct the IRPS.

#### 4.2.1.1. FEB Development Credit Calculation

Per Section 4.1.3, 10 percent of the total 3.0 MG benefit (300,000 gallons) will be applied to the Development Flow Credits Account at storage project award, which is anticipated in November 2009, and PADEP receives the 537 Plan Amendment resolutions adopting this SCARP Program Approach Outline,. This front loaded credit will be deducted from the final 30 percent credit (900,000 gallons) applied upon completion of construction. The remaining 70% of the FEB benefit will be applied to SSO/flow reduction. These flows need to be adjusted per Section 0 for final application to residential, commercial, and/or industrial flows (for example, for the Coke development).

## 4.3. Development Flow Credit Reporting

The WLSP will prepare and submit to PADEP a Development Flow Credit Report semiannually (April 30th and October 30th) reporting what source reduction or peak flow reduction work has been planned, awarded, implemented, and measured. These reports will include supporting calculations for each project, including projections of likely benefits, pre- and post- rehabilitation/construction flow monitoring data, efficacy analyses, modeling results, and any other supporting proofs of project benefits. These will be presented in a single table that lists all projects included in the SCARP. The first of these will be the FEB.

A second table reporting new proposed connections to WLSP system and demonstrating available flow credits will also be prepared; LCA will be responsible for tracking both credits and their distribution and reporting these to PADEP.

### 4.3.1. PADEP Approvals

To facilitate responsible development and redevelopment, PADEP will have 60 calendar days to reject the flow credits or request additional supporting information. If no response is received from PADEP within 60 days of receipt of the semiannual report, the credits and their application to the listed residential, commercial, and industrial developments at the rates shown in the report will be automatically approved.

Connections will not be made to the WLSP system without the above PADEP approval of available flow credits.

# 5. Management and Implementation Documents

This Section describes the deliverable documents that will be submitted to PADEP over the planning and implementation phases of the SCARP. A project schedule for the investigation and planning phase of the program is shown in Figure 5-1.

## 5.1. Program Management Plan - Investigation Phase

### 5.1.1. Purpose

The management plan for the investigative phase will be developed following finalization of the Program Approach Outline and execution of the MOU. One common management plan for all Partners will be developed for the investigation phase of the program which includes the activities described in Section 3.2 through 3.7. The purpose of the Program Management Plan developed for the investigative phase of the project will be to define, coordinate, and manage the SCARP efforts of each WLSP.

### 5.1.2. Components

For the investigative phase of the SCARP program, it is envisioned that one common Program Management Plan will be developed for all Partners. The Program Management Plan will include:

***Introduction and Purpose*** – Description of the Partners, system components, and the MOU. Also included will be definition of program drivers, problem definition(s), primary objectives, and secondary objectives.

***Administration and Management Plan*** – Description of how the Partners will work together to complete the investigation phase of the SCARP. The plan will include definition of roles and responsibilities of each WLSP, resource allocation, identification of written agreements between Partners, and description of reporting requirements. During the investigative phase, a benefit of developing one program for all Partners is that each WLSP will be committing fewer resources than if implementing individual programs. The strength of each WLSP with respect to management, administration, operations, and engineering will be considered when assigning resources from each WLSP to the program.

***Financial Plan*** – The estimated budget for the investigative phase of the program will be identified. As the program progresses, the budget will be periodically revised to reflect changing conditions and a greater understanding of program requirements. The management plan will also identify the financial obligations of each WLSP including definition of program budgets, financial obligations of each WLSP, and description of methodologies for managing budget change.

***Risk Management Plan*** – Throughout the investigative and implementation phases of the program, a risk register will be maintained and revised as necessary to identify project risks that could impede the achievement of the program objectives. The risk register will also include identification of program risks and mitigation strategies.

***Schedule*** – An overall program schedule will be developed and used to monitor program progress.

***Reporting Requirements -*** Throughout the investigative and implementation phases of the program, periodic progress reports will be distributed to the Partners and an Annual Report to PADEP. Report templates will be developed to maintain consistency of content.

***Public Relations*** – Throughout the investigative and implementation phases of the program, plans for obtaining and maintaining public support for the program will be developed. Opportunities for public communications and education include program websites, community fliers, and newspaper articles.

### 5.1.3. Sequence and Schedule

Development of the Program Management Plan – Investigative phase will begin in the fourth quarter of 2009. A draft of the plan will be submitted to PADEP in the first quarter of 2010 for information purposes and comment only; as this is largely an internal workplan, no acceptance or approval from PADEP will be required. Critical to completion of the management plan will be execution of the MOU and agreements between the Partners defining fiscal responsibility.

## 5.2. Program Objectives Evaluation

### 5.2.1. Purpose

This document will define current system performance and begin to assess what it might take to achieve various preliminarily considered objectives. In the event it is determined that the current system performance cannot meet the current desired level of performance, the preliminary objectives will be revised and the improvements to meet the revised objectives in both the near and long-term will be identified.

### 5.2.2. Components

The deliverable for the Program Objectives Evaluation will contain the following Sections:

***Flow Evaluation and I/I Removal Potential*** - Presentation of the flow data, discussion of model development and calibration, and findings with respect to base flows, wet weather flows, locations of hydraulic restrictions, quantification of the baseline and seasonal infiltration rates for each catchment, identification of the types and amounts of I/I for each catchment.

***SSES Prioritization*** **–** The catchments will be prioritized based on the amount of I/I entering the system. The activities to be included in each catchment's SSES Workplan will be identified.

***Dynamic Modeling*** – A description of the model including its framework, development, and calibration will be provided.

***Current Level of Service*** **–** The level of service for each catchment and for the groupings described in Section 3.4 will be established.

***Current System Sizing Requirements*** – Development of alternatives for providing necessary relief of any area identified as capacity limited under existing conditions.

***Future Development – Hydraulic Demands and Conveyance Sizing*** – Future 2040 growth projections, hydraulic loads, and capacity requirements will be calculated. An assessment of the potential improvements necessary to provide adequate future capacity will be performed.

### 5.2.3. Sequence and Schedule

The 2009 Comprehensive Flow Study is currently in progress with scheduled completion in the fourth quarter of 2009. Collection of accurate data during wet weather periods of differing intensities, durations, and frequencies will be critical to accurate hydraulic model calibration. The hydraulic model will be calibrated using the 2009 data in the 2010. Current level of service, current system flow sizing requirements, and sizing for future flow demands will be defined by the end of 2010.

## 5.3. SSES Workplan

### 5.3.1. Purpose

The SSES Workplan will describe the actual SSES activities (as described in Section 3) to be performed in each catchment.

### 5.3.2. Components

Workplans will be developed for selected catchment based on the recommendations provided at the conclusion of Program Objectives Evaluation. It is anticipated that a single workplan will be developed to encompass all catchments. For each catchment included in the SSES, the SSES Workplan will contain the following Sections:

***Hydraulic Condition Assessment*** – Description of the scope of activities to be performed including but not limited to smoke testing, night-time weiring, above-grade stormwater observations, and basement inspections.

***Physical Condition Assessment*** – Description of the scope of activities to be performed including but not limited to manhole and CCTV inspection. The information collected during this assessment will be used to collect information necessary for the design of the rehabilitation strategy to be implemented.

***Standard Procedures and Protocols*** – Written procedures to be used for all activities will be prepared. Procedures will be prepared for the planning, data collection, and analysis phase for each SSES activity. Standard tools will be developed for all activities including procedures for collecting information, inspection forms, data bases, and interfaces will be developed to ensure that all Partners are performing and documenting the SSES activities in a consistent, efficient, and effective manner.

***Cost Estimate*** – Detailed cost estimates for SSES activities for each catchment will be presented.

***Schedule*** – Detailed schedule for performing hydraulic and physical condition assessment activities. Included in the schedule will be tasks for review and analysis of SSES data.

### 5.3.3. Sequence and Schedule

The comprehensive SSES Workplan will be completed for Spring 2010. All SSES activities will be completed within two years of approval of the SSES Workplan by PADEP. Critical to the success of SSES Workplan development and implementation will be coordination and consistent data collection, evaluation, and storage between the Partners and SSES engineers and contractors.

## 5.4. Program Improvements Planning

### 5.4.1. Purpose

The Program Improvements Planning phase of the SCARP will identify the rehabilitation needs, replacement needs, expansion requirements, costs of improvements, and schedule for implementing a program to achieve the SCARP objectives within the desired level of service.

### 5.4.2. Components

The Program Improvements Plan will consist of two documents; the Capital Improvement Plan and the Long-term Asset Management Plan. The anticipated sections to be included in each plan are summarized below:

1. Capital Improvement Plan

    a. **Objectives** – In addition to the SCARP objectives, additional objectives will be developed that address administration, operations, financial, engineering, and information technology.

    b. **Prioritization of Recommended Improvements** – The recommended improvements developed as described in Section 3 will be grouped into projects and prioritized.

    c. **Cost Analysis** – The capital and life cycle costs for the prioritized projects will be developed.

    d. **Implementation Schedule** – The prioritized projects will be scheduled for implementation based on available funding.

    e. **Impact on Sewer Rate Structure** – The impact of the cost analysis and implementation schedule on the existing sewer rate structure will be evaluated. Sewer rates necessary to fund the recommended improvements will be calculated and the existing sewer rate structure will be adjusted as necessary.

2. Long-term Asset Management Plan

    a. **Objectives** – In addition to the SCARP objectives, additional objectives will be developed that address administration, operations, financial, engineering, and information technology.

    b. **Administration and Management** – Definition of authorship responsibilities for the required standard policies and procedures.

    c. **Standard Procedures** – Written Standard policies, procedures, and programs for the Engineering, Management, and Operations and Maintenance groups within each WLSP.

    d. **Implementation Schedule** – Schedule for developing the policies and procedures, review of existing policies and procedures, and overall implementation of the Long-term Asset Management Plan.

### 5.4.3. Sequence and Schedule

The Capital Improvement Plan and Long-term Asset Management Plan will be completed by Summer 2012. Critical to development of the Capital Improvement Plan will be the Long-term Asset Management Plan. In addition to the improvements required for the collection system, the asset management plan will identify other improvement needs that encompass the entire organization including information technology, administration, and operations. All of these improvement needs must be addressed by the Capital Improvement Plan.

## 5.5. Program Management Plan - Implementation Phase

### 5.5.1. Purpose

A management plan for the implementation of the Capital Improvements and Long-Term Asset Management Plan will be developed by each LCP simultaneous to the Program Improvements Planning steps described in Section 3.12. While each Partners will develop their own plan, many elements of the plan will be developed jointly with the other Partners as appropriate. The purpose of the Program Management Plan developed for the implementation phase of the project will be to define, coordinate, and manage the SCARP efforts of each WLSP.

### 5.5.2. Components

For the implementation phase of the SCARP program, it is envisioned that one common Program Management Plan will be developed for all Partners. The Program Management Plan will include the following sections:

***Introduction and Purpose*** – Description of the Partners, system components, and the amended MOU. Also included will be definition of program drivers, problem definition(s), primary objectives, and secondary objectives.

***Administration and Management Plan*** – Description of how the Partners will work together to complete the implementation phase of the SCARP. The plan will include definition of roles and responsibilities of each WLSP, resource allocation, identification of written agreements between Partners, and description of reporting requirements. A breakdown of the responsibilities with respect to authoring the policies and procedures defined in Section 3.12.4 will also be provided.

***Financial Plan*** – The estimated budget for the implementation phase of the program will be identified. As the program progresses, the budget will be periodically revised to reflect changing conditions and a greater understanding of program requirements. The management plan will also identify the financial obligations of each WLSP including definition of program budgets, and description of methodologies for managing budget change.

***Risk Management Plan*** – Throughout the implementation phases of the program, a risk register will be maintained and revised as necessary to identify project risks that could impede the achievement of the program objectives. The risk register will also include identification of program risks and mitigation strategies.

***Schedule*** – An overall program schedule will be developed and used to monitor program progress.

***Reporting Requirements -*** Throughout the implementation phases of the program, periodic progress reports will be distributed to the Partners and an Annual Report to PADEP. Report templates will be developed to maintain consistency of content.

***Client Relations*** – Throughout the implementation phases of the program, plans for obtaining and maintaining public support for the program will be developed. Opportunities for public communications and education include program websites, community fliers, and newspaper articles.

### 5.5.3. Sequence and Schedule

The Management Plan for the implementation phase will be developed in conjunction with the CIP and Long-term Asset Management Plan and will be maintained for the duration of the SCARP program.

## 5.6. Annual Reports

### 5.6.1. Purpose

The Annual Reports will provide PADEP and Partners a way to monitor SCARP progress and effectiveness.

### 5.6.2. Components

The Annual Report will include the following components:

***Performance Measures Summary*** – Summary of the success of the signatory parties with respect to the metrics established for each performance measure. This section will also include descriptions of new/revised performance measures, associated metrics, scores, and strategies to improve success.

***Improvements Summary*** – Summary of the improvements implemented throughout the year. A project description including scope, schedule and budget will be included for each completed and on-going project summary. The improvements described in this section will include projects described in the Capital Improvements Plan as well as those described in the Asset Management Plan.

***Implementation Schedule*** – A schedule will be prepared which illustrates projects and programs planned for continuation, initiation, or completion in the upcoming year. The schedule will include anticipated start dates, durations, and project/program dependencies.

***Rehabilitation Effectiveness*** – For all completed rehabilitation or replacement projects designed to eliminate I/I, an estimate of the volume of I/I eliminated will be provided.

***Redevelopment Flow Credits*** – Based on the effectiveness of rehabilitation as documented above, a summary of the flow credits calculated in accordance with the method described in Section 4 and with the semiannual reports provided under Section 4.3 will be provided.

### 5.6.3. Sequence and Schedule

Annual Reports will be submitted to PADEP by March 31st of each year, with the first report due March 31, 2011.

**Figure 5-1 Planning Phase Schedule**

# APPENDIX A

## Malcolm Pirnie Memo, dated ______, entitled FEB Memo