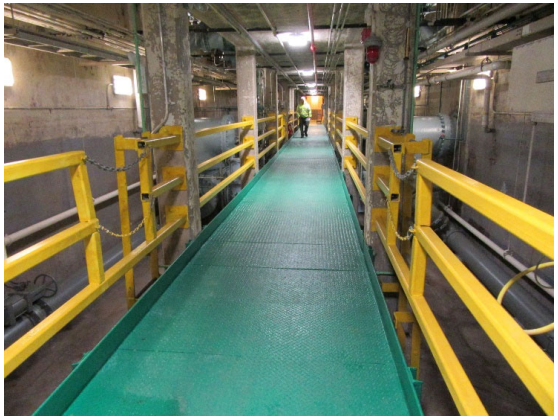
2022 ALLENTOWN WATER SYSTEM MASTER PLAN

9/19/2022

LCA Board of Directors Meeting

Agenda

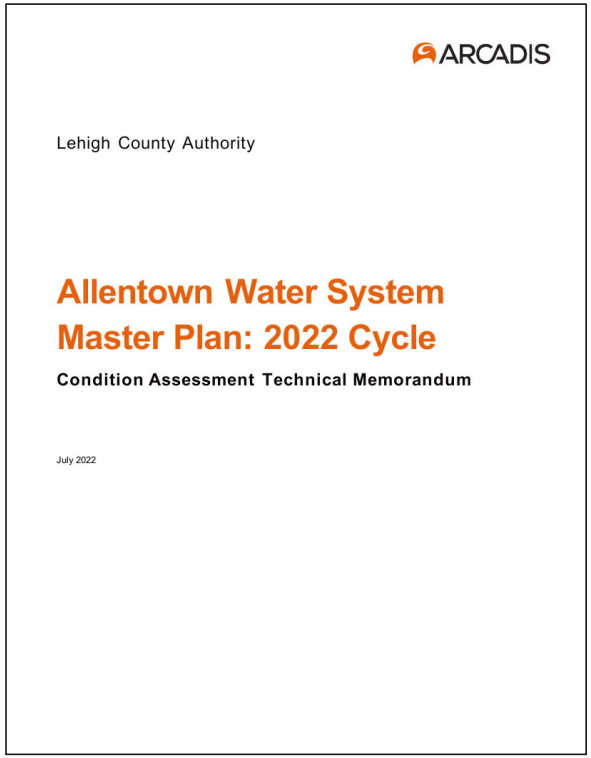
- Scope and Methodology
- Key Findings
  - Condition Assessment
  - Water Quality and Treatment Evaluation
- Capital Improvement Plan
- Q & A



Scope and Methodology

Allentown Water System Master Plan

- Assess current condition and remaining useful life of the water system infrastructure (excluding distribution system piping)
- Identify prioritized projects that reduce risk, improve reliability, and enhance operations
- Develop a capital improvement plan (CIP) that encompasses a 50-year planning period and addresses short- and long-term needs



Methodology

- Review of completed projects
- Review of Projects underway
- Revised Summary of Recommendations
- Revised Asset Spreadsheet Tool

- WTP Evaluation
- Distribution System WQ Review
- Identify Key Limitations
- Recommended Solutions

- Prioritized Projects
- Project Descriptions
- Opinions of Probable Cost

CIP Development

- Recommended improvements were grouped into projects and prioritized
  - Near Term (0-5 and 5-10 Yrs)
  - Mid Term (10-25 Yrs)
  - Long Term (25-50 Yrs)
- Developed opinions of probable project cost
  - AACE Class 5 cost estimate
  - Includes design, bidding, inspection, and legal/financial/admin (unless otherwise noted)

Project	Near Term Yrs 0-5	Near Term Yrs 5-10	Mid Term Yrs 10-25	Long Term Yrs 25-50
	2025 Dollars	2030 Dollars	2040 Dollars	2060 Dollars
Water Filtration Plant				
Filter Upgrades[4]	$ 5,750,000			$ 9,000,000
Prefreatment / Sedimentation / Fluoride		$ 9,500,000	$ 5,000,000	$ 16,500,000
Clarifier Influent Modifications[3]	$ 3,100,000			
High Lift VFDs/Pumps	$ 3,750,000			$ 9,000,000
Elec Improvements/Pumps		$ 5,000,000	$ 1,000,000	$ 9,500,000
Big Lehigh Screens and PAC	$ 8,750,000			$ 9,000,000
Little Lehigh Intake and Screens	$ 2,500,000	$ 8,500,000		$ 13,000,000
Concrete/Brick Repairs[5]	$ 625,000			
SCADA Replacement[7]			$ 1,000,000	$ 2,000,000
Pump Stations			$ 11,000,000	$ 6,000,000
Reservoirs and Tanks	$ 1,875,000			
Rehab Buried Concrete Reservoirs				$ 46,000,000
Rehab Tanks and Reservoirs			$ 4,000,000	$ 6,000,000
Roof Replacements[4]	$ 500,000		$ 1,000,000	$ 6,000,000
Total	**$ 26,900,000**	**$ 23,000,000**	**$ 23,000,000**	**$ 132,000,000**

Condition Assessment

Projects Completed Since 2017

East Side Reservoir Gate House - 2018 (New Roof, Gutters, Fascia)

FACILITY / PROCESS	PROJECTS COMPLETED	FACILITY / PROCESS	PROJECTS COMPLETED
Water Filtration Plant		**28th St Tanks**	Storage Tank Rehabilitated
Pretreatment	Replaced chemical feed systems (NaOH, alum, PaCl, sodium hypochlorite pumps and tanks)	**East Side Reservoir**	Gate House Roof Replaced
Sludge Handling	Rehabilitation of Sludge Transfer Building structure and roof	**Halstead St PS**	Roof Replaced, #1 pump rebuilt, building rehabilitated
Utilities-Electric	480V Switchgear is tested and maintained on a yearly basis	**Halstead St Tank**	Repaired cracked foundation and modified the overflow pipe
Other Plant Utilities	SCADA system upgrade, Security System completed	**Little Lehigh Creek Intake A**	Building rehabilitated, upper and lower sections of traveling screen repaired
16th Ward PS	Roof Replaced	**Little Lehigh Creek PS**	All motors rebuilt, 2 pumps rebuilt, added insulated bearings, all but one VFD replaced
16th Ward Tank	Storage Tank Rehabilitated	**Schantz Spring Tank**	Hypo equipment replaced, storage tank rehabilitated, gate house roof replaced
19th Ward PS	Roof Replaced, #1 pump rebuilt, purchased new #2 pump	**South Mountain Reservoir**	Gate House Roof Replaced
19th Ward Tank	Storage Tank Rehabilitated	**Wash Water Tank**	Tank Rehabilitated, New altitude valve
28th St PS	Roof Replaced	**Westmount PS**	System replaced in 2019

Projects to Be Completed by End of 2023

28th Street Tank and Standpipe (Mixers to be installed)

FACILITY / PROCESS	PROJECTS
Water Filtration Plant	
Finished Water Pumping-Main	Rehabilitation of High Lift Pump No. 3, variable frequency drives for High Lift Pump Nos. 1 and 2, general High Lift Pump electrical equipment, High Lift Pump HVAC equipment (air handlers, boilers, and hot water heaters), and the High Lift Pump building structure
Utilities-Electric	Filter effluent valve replacement and UPS
Other Plant Utilities	Chemical Fill Station
28th St Tanks	Mixers to be installed
Little Lehigh Creek Intake A	Rehabilitation of HVAC equipment
South Mountain Reservoir	Gate House process mechanical and process control equipment along with reservoir concrete structure to be rehabilitated (2023)
Westmount PS	Door and Frame to be replaced

Act 537 Planning Impact on the WFP

- First ever Regional Act 537 Plan is due to DEP in 2025
- *NEW* planning module projections for the Allentown Wastewater Treatment Plant (KIWWTP) through 2050:
  - 2020 Connection Management Plan (DEP approved) = 1.50 MGD
  - 2021-2025 Interim Act 537 (DEP approved) = ~3.12 MGD
  - 2026-2050 Projections (to be submitted in 2025) = ~2.75 MGD
  - ~7.37 MGD of new sewage flow generated by 2050
  - Since 1/17/20, ~1.54 MGD of new planning modules have been processed by LCA
  - What are the implications at the Water Filtration Plant and other water system components?

Water System Reliability – Big Lehigh

537 Sewer Planning

Suburban Div Water Supply Study

Possible New Adjacent System Interconnects

Increasing Demand

Big Lehigh Reliability Risks
- Taste and Odor
- Manual screen
- Screen access during floods
- Contamination
- Drought

Little Lehigh Reliability Risks
- Screen Failure
- Clogged Pumps
- Contamination
- Drought

Springs Reliability Risks
- Turbidity Events
- Contamination
- Drought

Finished Water Reservoirs Storage
- Short-term Buffer

Strategic Review of Risks & Strategy to meet Reliability Goals

Little Lehigh Intakes

- Process mechanical equipment in fair condition
- Design velocity of the intake channel exceeds current design standards. Leaves/debris may bypass and clog low lift pumps.
- Lack of redundancy
- Screening major metal components and lower screen components were replaced (2020 & 2021). Roofs (2015). Concrete repairs (2021).

Date of Install: 1928 / 1953

Last Capital Project: 2015, 2020, 2021

Big Lehigh Screens and PAC

- Operational limitations
  - No way to address taste and odor events
  - Screens are difficult to access/clean
- Big Lehigh improvements will increase resiliency of water supply
- As the Master Plan process evolved, further emphasis on this source has materialized

Date of Install: 1989

Last Capital Project: 1995 / 2014

Low Lift Pumps

- Pumps approaching end of useful life
- Pumps periodically rebuilt to defer replacement
- Low lift pump capacities do not align well with existing demands and will be evaluated when pumps replaced
- VFDs replaced in house
- Raw water piping forced the installation of sewer siphons

Date of Install: 1997

Last Capital Project: 2021

High Lift/Schantz/Crystal Pumps & VFDs

- VFDs are no longer supported by manufacturer
- High Lift motors may not meet current design requirements
- Pumps approaching end of useful life
- Pumps periodically rebuilt to defer replacement
- Existing High Lift pump capacities do not align well with existing demands and will be evaluated when VFDs replaced
- Ongoing project to replace High Lift VFDs and Motor #3

High Lift

Date of Install: 1959

Last Capital Project: 2022

Schantz

Date of Install: 1953

Last Capital Project: 2017

Crystal

Date of Install: 1995

Last Capital Project: 2016

Electrical Improvements

- Electrical equipment approaching end of useful life
- Difficulty obtaining spare parts

Date of Install: 1997

Last Capital Project: 1997

Flocculation/Sedimentation/Fluoride

- Operational limitations
  - Equipment approaching end of useful life

Date of Install: 1998

Last Capital Project: N/A

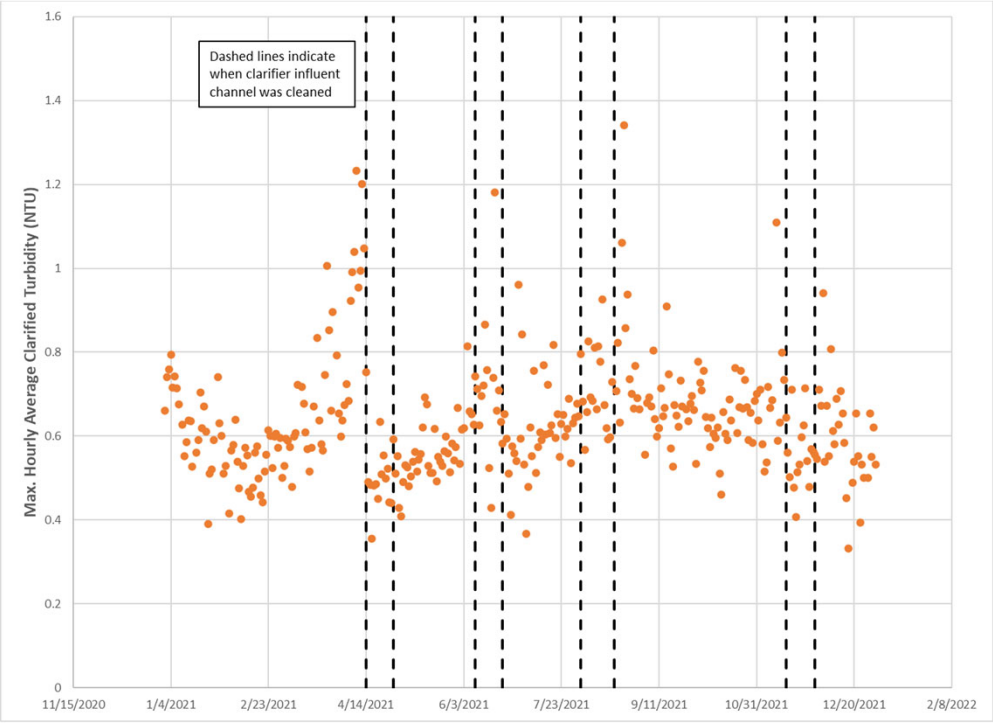
Water Quality and Treatment Evaluation

2016-2017 Evaluation

- An extensive water quality and treatment evaluation was conducted in 2016-2017, as part of the 2017 Master Plan Cycle. The following limitations were identified:
  - Limited options for achieving additional Cryptosporidium reduction
  - Limited CT at higher flow rates
  - Need for raw water chlorination
  - Poor clarification performance
  - Floc buildup in the clarifier influent channel
  - Filter performance issues
- Most of these limitations have been resolved

Sludge Buildup in the Clarifier Influent Channel

- Floc is settling in the clarifier influent channel because the velocity is well below the recommended minimum
- Historical data indicate that the floc (sludge) buildup impedes clarification performance
- The channel is currently cleaned four times per year
- It is recommended that the channel be modified to increase the velocity to within the recommended range



Disinfection Byproduct Concentrations

- TTHM and HAA5 concentrations have historically been well below the MCLs
- Three of the four quarterly compliance samples are collected at finished water reservoirs when water is flowing in (low water age)
- Water flows out of the reservoirs when the WTP is offline (two days per week); some of the water flowing out could have a much higher age than the compliance samples
- DBP formation tests were conducted to estimate the maximum DBP concentrations in the reservoirs

Parameter	0 days	5 days	10 days	14 days	19 days	28 days	MCL
TTHM	18.7	42.2	58.0	63.1	61.8	67.9	**80**
HAA5	19.0	23.5	28.7	29.8	32.5	36.9	**60**

Carbon Dioxide Feed System

- A carbon dioxide (CO_2) feed system was recently installed for reducing the rapid mix pH when the raw water pH is above 8
- There have been times when the rapid mix pH was not reduced to the target value (approx. 7.8) even when the CO_2 feed system was operating at the maximum rate
- This problem may have started after the original CO_2 diffuser broke and was replaced with a different diffuser; the diffuser was again replaced and there have been no issues in meeting the rapid mix pH target with the current diffuser
- Further difficulties in meeting the rapid mix pH target could be resolved by:
  - Installing a more efficient diffuser
  - Running both the lead and lag CO_2 feed systems
  - Installing a second CO_2 feed point

Other Water Quality and Regulatory Considerations

Perfluorinated Compounds

Compound	Crystal Spring (ng/L)	Schantz Spring (ng/L)	Little Lehigh (ng/L)	Proposed PA MCL (ng/L)	Federal HAL or MCL (ng/L)
PFOA	6.6	2.8-4.1	3.2	14	HAL = 0.004 MCL by Fall 2022
PFOS	6.4	ND-3.1	2.3	18	HAL = 0.02 MCL by Fall 2022
PFBS	3.1	1.9-2.3	1.5	N/A	HAL = 2000
GenX	ND	ND	ND	N/A	HAL = 10

- PFOA and PFOS results to-date have been well below the proposed PA MCLs; however, Crystal Spring and the Little Lehigh have only been sampled once
- Federal MCLs for PFOA and PFOS could be lower than the proposed PA MCLs; EPA has issued new (non-enforceable) HALs for PFOA/PFOS that are well below current detection limits (2-4 ng/L)
- New federal HALs have also been issued for PFBS and GenX; however, GenX has not been detected in LCA source waters, and the HAL for PFBS is much higher than the measured values

Unregulated Contaminants

UCMR 4 (samples collected in 2018) included…

- 10 cyanotoxins
- HAA9
- Various pesticides, SVOCs, alcohols, and metals

Only manganese and HAA9 were detected in the UCMR 4 monitoring

- Manganese concentrations were more than an order of magnitude less the secondary MCL
- The highest HAA9 result was 35 µg/L, little more than half of the current MCL for HAA5
- Although no cyanotoxins were detected in the finished water from the WTP (3 sampling events), cyanotoxins may occasionally be present in the Little Lehigh or the Big Lehigh; maintaining a high log inactivation rate for Giardia will generally provide excellent protection against microcystin

UCMR 5 will focus almost entirely on PFAS

Capital Improvement Plan

CIP

Project	Near Term Yrs 0-5	Near Term Yrs 6-10	Mid Term Yrs 11-25	Long Term Yrs 26-50[11]
	2025 Dollars	2030 Dollars	2040 Dollars	2060 Dollars
Water Filtration Plant				
Little Lehigh Intake and Screens	$ 700,000	$ 10,000,000		$ 12,900,000
Big Lehigh Screens and PAC		$ 7,900,000		$ 9,000,000
Low Lift VFDs/Pumps		$ 5,100,000		$ 9,300,000
Pretreatment / Sedimentation / Fluoride	$ 200,000	$ 8,900,000	$ 4,500,000	$ 16,500,000
Clarifier Influent Modifications[5]	$ 3,100,000			
Filter Upgrades[6]	$ 5,750,000			$ 8,900,000
High Lift VFDs/Pumps		$ 6,200,000		$ 14,000,000
Elec Improvements		$ 2,900,000	$ -	$ 5,200,000
Schantz Temporary Generator Connection	$ 700,000			$ -
Concrete/Brick Repairs[7]	$ 625,000			
SCADA Replacement[8]			$ 1,100,000	$ 2,200,000
Pump Stations			$ 1,600,000	$ 6,200,000
Tanks and Reservoir Gate Houses	$ 700,000			
Rehab Buried Concrete Reservoirs[9]				$ 46,200,000
Rehab Tanks[10]			$ 4,000,000	$ 6,200,000
Roof Replacements[5]	$ 500,000		$ 1,000,000	$ 6,200,000
Total	**$ 12,300,000**	**$ 41,000,000**	**$ 12,200,000**	**$ 142,800,000**

General Notes:

1. Project costs have been escalated at an annual 3% inflation rate.
2. Estimates are consistent with an AACE Class 5 construction cost estimate. AACE Class 5 estimates are typically accurate on the low range between -20% & -50% and on the high range between +30% & +100%.
3. Project costs include construction, design engineering and bidding, engineering during construction, and legal/financial/administration.
4. Finished water clearwells are not part of the CIP.
5. Clarifier influent channel project is estimated to be in the range of $1.4 to $3.1 million based on project details which require further evaluation.
6. Near term (0-5 year) project cost from the LCA 2023-2027 CIP.
7. Near term (0-5 year) project cost provided by LCA.
8. Project cost based on 2020 SCADA cost provided by LCA.
9. As the scope of improvements is not currently known, $5M allowance for each reservoir - South Mountain, East Side and Huckleberry Ridge.
10. As the scope of improvements is not currently known, $2M allowance for all tanks.
11. As the scope of improvements is not currently known, amounts shown are allowances based on half the near-term project cost estimated in the 2017 Master Plan escalated to 2060 dollars.

Near Term Recommendations

Project	Cost		Reliability	WQ Concerns	O&M
	0 – 5 Years (2025 Dollars)	6-10 Years (2030 Dollars)			
Little Lehigh Intake and Screens	$0.7M	$10.0M	X	X	
Big Lehigh Screens and PAC[1]		$7.9M	X	X	
Low Lift VFDs[2]/Pumps		$5.1M	X		X
Pretreatment / Sedimentation/Fluoride	$0.2M	$8.9M	X		X
Clarifier Influent Channel[3]	$3.1M		X	X	X
Filters	$5.8M		X	X	X
High Lift VFDs[2] / Pumps		$6.2M	X		X
Electrical Improvements		$2.9M	X		X
Schantz Temporary Generator Connection	$0.7M		X		
Concrete/Brick Repairs	$0.6M		X		
Tanks and Reservoir Gate Houses	$0.7M		X		X
Roof Replacements	$0.5M		X		

[1] PAC Powdered Activated Carbon. Further analysis on operational strategy required.

[2] VFD Variable Frequency Drive

[3] Clarifier influent channel project is expected to be in the range of $1.4 to $3.1M based on project details which require further evaluation.

Q & A