

Consulting Engineer's Report

Operation of the Authority's Water
System by the City of Bethlehem

(2024 Operations)
(2025 Adopted Budget)

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Prepared for:

Bethlehem Authority
Bethlehem, Pennsylvania
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Introduction

Purpose and Scope

The Bethlehem Authority (the Authority) owns source water properties and the water treatment and distribution system facilities that serve the City of Bethlehem, Pennsylvania (the City) and portions of eleven (11) surrounding municipalities. The City leases (from the Authority), operates, and maintains these water system facilities.

A full description of the Authority including listing of current Board Members, Staff, and monthly meeting minutes, may be found at the Authority website: www.bethlehemauthority.org. The Authority was founded in 1938 as Pennsylvania's first municipal authority. The Authority website includes a History of the Water System, a description of the Wild Creek and Penn Forest Reservoirs located in the Pocono Mountains, and a description of the Authority's award-winning Watershed Forest Management of the nearly 23,000 acres of property. The City of Bethlehem Water & Sewer Resources website also provides a brief history and potable water quality reports which may be found at www.bethlehem-pa.gov/water-sewer-resources.

Colliers Engineering & Design, Inc. is the appointed consulting engineer for the Authority. As consulting engineer, Colliers Engineering & Design's responsibilities include reviewing the City's budget for operation of the water system facilities, reviewing insurance coverage, preparing a written report on the condition and operation of the water system by the City during the preceding year, and setting forth recommendations for the ensuing years.

Through this 2024 Annual Report, Colliers Engineering & Design provides an account of:

- The financial condition of the Authority and City Water Fund during the last fiscal year as reflected by information supplied by the Authority and the City;
- The budget for the current fiscal year for the Authority and the City Water Fund along with pertinent observations and recommendations;
- The physical condition of the water system;
- The general operation and maintenance of the water system during the past year;
- List of recommendations with respect to operations, maintenance, improvements and finances for the ensuing fiscal year;
- List of recommendations as to any renewal and replacement or change in operating policies that may be advisable;
- The 2020 Annual Report had a specific focus on system wide security improvements.

- In late 2021, the Authority authorized a Confidential Water Systems Security Improvements Feasibility Study. The Authority and City continue to work toward the implementation of recommended security improvements.
- The 2022 Annual Report stated a specific concern on increasing trends for system unaccounted-for water (water loss). In 2023, the City retained a Consulting Firm to complete an Unaccounted-For Water Study.

The information used for this report was obtained from Authority and City records, from discussions with personnel, and through visual inspection of many of the system facilities. Investigations for this report do not include an independent check of records, audits, and regulatory compliance or operational testing.

Executive Summary

Colliers Engineering & Design has been working closely with the Authority and the City to assess the physical condition and current operation of the water system facilities. This effort originally began in September 2016 and has followed each year through 2024 with a tour of the water filtration plant, the Wild Creek & Penn Forest reservoirs, and nearly all of the significant water infrastructure facilities.

Colliers Engineering & Design reviewed the City of Bethlehem 2025 Operating & Capital Budget, which resulted in the issuance of the Fiscal Certification for 2025 dated January 9, 2025 and the Insurance Certification for 2025 dated December 19, 2024. We corresponded with the City staff in March 2025 and reviewed the draft report on March 28, 2025. We reviewed the 2024 year-end financial data and the capital projects and initiatives completed by the City. During our discussions with the City staff and tour of the facilities, we did not find any major deficiencies which require immediate attention. Based upon the above described efforts, we offer the following statements:

Colliers Engineering & Design has reviewed the financial condition of the Authority and the City of Bethlehem Water Fund during the prior fiscal year 2024 and the current 2025 Budgets of the Authority and City. We have observed the physical condition and current operation of the water system to which we provide observations and recommendations.

In general, Bethlehem Water System is in a "State of Good Repair"; the Authority and City have the financial resources to continue the proper operation and maintenance of the Water System.

Financial Operations

Overview

The finances of the Authority and the City Water Fund are discussed in this section. The Authority has legal title to the water system's assets, including the watershed lands. It leases the assets to the City pursuant to a Contract and Lease dated January 1, 1992, which has been updated periodically pursuant to various borrowings. The relationship between the City and the Authority is further governed by a trust indenture which, among other things, establishes reserve funds for repairs and maintenance and provides for the orderly payment of the system's debt obligations. The Authority, in cooperation with the Trustee, is responsible for management of all reserve funds/trust indenture funds, payment of all debt service costs, and management of the watershed lands and certain other properties related to the water system.

The Authority's income includes the lease rental payments from the City's water fund pursuant to the Contract and Lease. The lease rental payments are fixed so as to be sufficient for payment of the Authority's debt service requirements related to the water system's various borrowings. The Authority's income also includes timbering revenues, sale of carbon credits, and interest on investments and other property rentals and leases. The Authority will continue to evaluate options for renewable energy generation projects as they may arise. The Authority will also gain future revenue from the sale of carbon credits.

The City is responsible for managing the water system, operating and maintaining all water system facilities, and complying with regulatory requirements. Financially, the City is responsible for setting water rates and charges (with the approval of the Pennsylvania Public Utilities Commission) to meet all financial requirements including operating and maintenance expenses, and the lease rental payments due under the Contract and Lease.

As additional security for the Authority's borrowings, the City has guaranteed payment of debt service. As guarantor, the City has ultimate responsibility for the repayment of the water system's debt obligations.

Monies for capital additions and long-term maintenance to the system can be provided from Authority reserves, if they are available, or from the City, or from borrowings which are proposed and administered by the Authority and approved by City Council. The Authority works closely with the City and financial advisors to plan for 10-year capital financing and the retirement of old debt.

In 2022, the Authority refinanced the long-term debt. The savings in debt service resulting from refinancing of the Authority long term debt was applied to support additional debt to help fund the 10-Year Capital Plan. A copy of the Final Transaction Statistics and Aggregate Debt Service dated August 17, 2022 may be found in Appendix 11.

Water Rates

The City serves retail customers inside and outside of the City. The rates charged to the customers outside of the City and the service they receive are regulated by the Pennsylvania Public Utility Commission (PUC). It has been the practice of the City to charge inside-City customers the same rates approved by the PUC for outside-City customers. The current Schedule of Rates is summarized in Appendix 1. The City completed work on a year-long water consumption Demand Study in 2019. The City filed with PUC on July 31, 2020, for a new rate increase which was approved by the PUC on April 15, 2021. The average rate class increase approved was 8.4%, which went into effect on June 1, 2021.

Authority Finances

The Authority's administrative operating budget for 2025, and a small Authority Capital Budget, as approved in December 2024 are set forth in Appendix 2. As noted above, the Authority is partly reliant upon the City to fund its operating budget. The Authority's capital budget has been funded from other sources, including past grants, carbon credit revenues, and Authority reserves.

City Water Fund Budget Finances

A summary of the City Water Fund revenues and expenses are shown in Table 1 which is reported on an all cash basis. This table shows that income (revenues minus expenses) from 2023 operations ended with a net gain of \$2,959,729. The estimated 2024 operations ended with a net gain of \$2,343,453 (see footnotes). The revenues and expenditures for FY 2021 through 2024 City financial reports are summarized in Appendix 4.

Table 1
Water Fund Revenues and Expenses
2023 Operating Fund

	BUDGET	YEAR-END RECEIPTS AND DISBURSEMENTS
REVENUES	\$23,106,909	\$24,639,907.25
EXPENDITURES	\$23,106,909	\$21,680,177.91
NET (REV – EXP)	\$0	\$2,959,729.34
2023 YEAR-END CASH BALANCE		\$8,726,194.44

2024 Operating Fund

	BUDGET	YEAR-END RECEIPTS AND DISBURSEMENTS
REVENUES	\$23,515,903	\$24,643,508.72
EXPENDITURES	\$23,515,903	\$22,300,055.67
NET (REV – EXP)	\$0	\$2,343,453.05
2024 YEAR-END CASH BALANCE		\$13,892,571.44

2024 Water Capital Fund

	2024 BUDGET	YEAR-END RECEIPTS AND DISBURSEMENTS
2024 BEGINNING OF CASH BALANCE		\$1,809,170
REVENUES	\$9,761,144	\$7,247,654.75
EXPENDITURES	\$9,761,144	\$6,788,307.48
NET (REV – EXP)	\$0	\$459,347.27
2024 YEAR-END CASH BALANCE		\$2,361,260.91

- (a) Numbers rounded to the nearest hundred
- (b) Year-end receipts and disbursements on cash basis

Appendix 3 includes a 2025 Water Capital Budget of \$11,073,236, which lists the capital projects approved to be funded in whole or in part during 2025 (see page titled “2025 Water Capital Fund – Fund Analysis Summary”). Other water capital items noted in Appendix 3 address normal replacements and renewals required to maintain the water distribution system itself and numerous items to improve, protect, and maintain water supply, treatment, transmission, pumping, and storage facilities. The items in the 2025 Water Capital Budget should be implemented in 2025 and beyond to maintain the integrity of the system, improve operating efficiencies and/or meet regulatory requirements.

The 2024 Water Capital Budget was financed in large part by approximately 2023 Year-end \$600,000 from the Authority’s Bond Redemption and Improvement Fund (BRIF) and approximately \$2.44 million from a capital appropriation from the City’s operating fund.

In 2024, the City's Operating Fund revenues were more than expenditures by 9.5%, while Water Capital Fund revenues exceeded expenditures by 6.3%. However, the cash balance of each fund at year's end combines for \$16,253,832.35, some of which can be used for 2025 capital projects. The City maintains a minimum unassigned cash balance in each fund.

The City and Authority worked with their Financial Planning Advisors in 2022, and considered four refinancing scenarios. The final selected strategy is presented in the 10-Year Water Capital Plan and Capital Financing Plan dated last revised February 2025 (included in Appendix 10). The 10-Year Water Capital Plan is a working document which is to be updated annually with the City Director of Water and Sewer Resources, the Bethlehem Authority Finance Committee, and the Bethlehem Authority Executive Director. Due to the 1994 debt refinancing to fund the Penn Forest Dam reconstruction project the annual debt service is currently a major portion of operating expenditures. The goals of the new 10-Year Capital Plan are to: emphasize pay-as-you-go funding together with grant funding and additional borrowing; minimize debt financing cost; minimize increases in debt service payments; balance investment needs throughout entire system; and level annual capital budgets.

In 2022, the Authority refinanced the long-term debt with the intent to maintain a level annual debt payment and free up capital reinvestment to provide additional capital funds over the coming years. The goal is to better match debt terms to asset life and provide additional annual capital funds without increasing current annual debt service payment amounts. This will allow the City to better implement the 10-year Capital Plan and more aggressively replace/upgrade critical infrastructure and linear assets (distribution piping).

Physical Plant Conditions

General

The Bethlehem water system comprises many different components, including approximately 22,500 acres of watersheds, 9.9 billion gallons of reservoir impoundments, 20.6 miles of dual raw water transmission mains, a water filtration plant (WFP) with permitted capacity of 28.6 million gallons per day, 530 miles of potable water transmission and distribution mains, 30.5 million gallons of potable water storage facilities, 5 booster pump stations, 4 major pressure control valve stations, 3 independent well systems and consecutive systems (East Allen Township), 14,800 valves, 3,705 hydrants, and 37,104 customer service lines and meters. A full and detailed Description of Water Facilities, dated March 29, 2016, is presented in Appendix 7 of this report.

Description of Facilities

Appendix 7 includes a brief description of the water system facilities which was written in 2016. The City commissioned a Distribution System Comprehensive Planning Study (CPS) which was completed in December 2014 as part of the Long-Term Infrastructure Improvement Program (LTIIP). The LTIIP was approved by the Pennsylvania Public Utilities Commission (PUC) and was last amended in 2022. The LTIIP was retired at the end of 2022. The City's CPS is complimentary to the 10-Year Capital Plan and was last revised in February 2025.

In 2018, the City staff reviewed these prior long term infrastructure studies for the water system and developed a new 10-Year Capital Plan Spreadsheet; the latest, from February 2025, is provided in Appendix 10 and includes a list of the system improvement projects planned through 2034. This list of projects, forecasted implementation, and needed capital will act more as a working document to be reviewed and updated annually.

Water System Tour & Observations

The consulting engineer takes a tour of selected water system facilities each year for the purpose of providing general observations of the system and recommendations to the City for its capital and operating budget process. Colliers Engineering & Design toured the water system with the Authority and City Staff. This effort began October 1, 2024 at the Wild Creek Dam, Wild Creek Dam Intake Building, Penn Forest Dam, and Penn Forest Dam Intake Building.

On October 8, 2024 the tour proceeded to the Shady Lane Well House, Country Squire Estates Well System, East Allen Gardens Pump House, the Frank's Corner Pump Station, and the Weil Street Pump Station. The tour proceeded to the Howertown Pressure Reducing Valve Station, the Wil-Mar Wellhouse, the Airport Road Booster Pump House, the 5th & William Street Booster Station, the Mountaintop Booster Station, and the South Side Pump Station.

On November 15, 2024, the tour proceeded to the Water Filtration Plant. Several additional photos of the completed Water Filtration Plant security fence and gate were provided by the City. Appendix 9 includes photos and brief descriptions of the various facilities toured.

Water Filtration Plant

The Water Filtration Plant (WFP) was put into operation in the fall of 1994. The treatment plant was originally sized for 42 million gallons per day (MGD). The filtration beds were upgraded between 2005 and 2008, which greatly improved the treatment performance. However, the current PADEP permit for the filter plant allows a maximum flow of 28.6 MGD. The water filtration plant currently treats an average maximum day of 20 MGD, and average daily of 15 MGD, and an average night-time rate of just less than 8 MGD.

We met with the water filtration plant Operations Supervisor on October 31, 2023. They reiterated that the plant is now 30 years old and is starting to show its age in some areas such as the roof and filter basement concrete beam spalling. Based upon mechanical equipment wear, they have recommended a program of sequential renovation throughout the WFP.

Projects recently completed in 2024 include the following:

1. Rebuilding (1) plant service water pump;
2. Continued vegetation control plan around plant property;
3. Update SCADA UPS;
4. Integrate updated data telemetry software (WIMS);
5. Additional roof repairs;
6. Motorized gate;
7. Air compressor replacements (two).

The water filtration plant supervisors have planned for the following 2025 projects:

1. Repairing existing local WFP security cameras;
2. Digitalizing data logs (WIMS);
3. Lower roof replacement.

The City completed a Disinfection Alternatives Study to evaluate renovating the chlorine gas system and/or developing an alternative disinfection system. The City will be appropriating funds for the implementation of a sodium hypochlorite generation facility to provide safe, cost effective water disinfection (10-Year Capital Plan 2029 design & 2030 construction). There has also been evidence of leaking (mineral deposits) from the sand filter beds into the rooms below which will need to be addressed. The caustic soda storage tank and room was renovated in 2023.

Overall, the filtration plant is well maintained, very clean, and in good repair. PADEP now requires the system operator (City) to hire a specialty independent firm to test all filter beds on three (3) year cycle (ten beds over three years).

Water System Control Center

The City operates a Water System Control Center in which the SCADA (supervisory control and data acquisition) data from throughout the water system is reported back to the control center. The water control system operator can monitor the levels in all storage tanks, conditions at PRV stations, et cetera. The operator can remotely turn on booster pumps to fill the water storage tanks as well. The City continues to implement improvements to the SCADA system as facilities are upgraded.

In 2018, the City completed an investigative study to improve SCADA communications. In 2019 as part of the conversion of 911 Service from the City to Northampton County, the City moved the Water System Control Center operations to Water Filtration Plant in Lehigh Township, Northampton County. We believe further improvements to the SCADA communications will be required for the implementation of improved security systems throughout the water system, particularly for the remote watershed facilities.

Watersheds

The approximately 22,500 acres of land owned by the Authority in both Carbon and Monroe Counties are maintained by the City's staff at Wild Creek. The Authority and the City are actively working with local governments, conservation organizations, and the State to manage the watersheds in a sustainable manner with the primary goal of maintaining and possibly improving the high quality of the pristine drinking water supply. The City has also initiated a Source Water Protection Plan through the auspices of the PADEP, as designed by the PA Rural Water Association, and has been approved by the DEP. An annual meeting is held to review and update this plan.

The Authority continues to actively manage the forest through a timbering plan meant to improve the quality of the timber in the watershed, thus improving the watershed and ultimately the quality of the water, while gaining modest revenues to support the program. In 2012, the Authority and the Nature Conservancy completed a Forest Management Plan (FMP) which allowed its watershed properties to be certified as sustainable by the Forest Stewardship Council, the preeminent certification standard in the world. This allows the carbon stored in the forests to be sold on the carbon exchange market. The Forest Management Plan update is expected to be completed in the fall of 2025.

The Wild Creek Dam and the Penn Forest Dam facilities are well-maintained and receive annual inspections by an outside consulting firm. These reports are submitted to PADEP. In 2021 the City completed and submitted a 10 Year Dam report to the Pennsylvania Division of Dam Safety under the guidance of a consulting engineer. This was a multi-year effort demonstrating the integrity of the Dams and their key features. All submitted objectives were accepted; however, the Wild Creek downstream outlet inspection was not completed due to low visibility at the base of the reservoir.

The Penn Forest Reservoir Dam was rebuilt in 1998 and is tributary to the Wild Creek Reservoir Dam, originally constructed in 1939. The Penn Forest Reservoir is released to maintain the Wild Creek Reservoir full. As such, both reservoir levels are monitored and used to predict drought conditions and are included as part of the City's monthly reports to the Authority. The Wild Creek Reservoir raw water intake screens are alternately cleaned annually. The Wild Creek Flow Meter Building includes

two (2) 36-inch diameter venturi flow meters, and the building has the ability to be used for chemical pre-treatment if necessary. These facilities are clean and in good repair.

The Tunkhannock Creek diversion facility is utilized to supplement raw water to the Penn Forest Reservoir. The intake building is clean and in good repair. The stop-logs which protect the intake bar screens are scheduled to be replaced in 2025. The intake screens are cleaned semi-annually. The stream weir structure can become clogged with grasses and must be cleared as needed during the growing season and after storms.

The Tunkhannock Creek raw water transmission main includes 47,000 feet of 30-inch and 42-inch lines and a pressure reducing valve station. This station is located in a remote area. The PRVs appear to be operating properly, but needs improved maintenance.

Raw Water Transmission

The raw water transmission lines were initially installed in 1939 as part of the original Wild Creek Dam project and included a 30-inch and 36-inch diameter line to the City. This project also included two (2) rock bored tunnels at Wire Ridge and Blue Mountain. In the 1960s, a redundant parallel 42-inch line was constructed from Blue Mountain to the site of the current filtration plant. In 1997, a parallel redundant 42-inch line was constructed to convey water from Wire Ridge south portal to Blue Mountain north portal.

No parallel raw water transmission facilities exist should these tunnels become compromised by a natural or man-made event. In addition, these tunnels cannot be taken out of service for full inspection and/or maintenance.

We scheduled specific tours of the raw water transmission lines and the tunnel access points in April 2019 and January 2020 to inspect the interior of the tunnel upstream portal chambers, and a few valve chambers along the route to the water filtration plant. New technology may allow for the in-situ evaluation of the tunnels and raw water transmission lines without interruption of service. These technologies have been evaluated in terms of cost benefit verses focused improvements to the emergency interconnection facilities with adjacent water supply systems. The raw water transmission line tunnel portals and H-valve concrete chamber vaults need repair and maintenance.

PRV Control Stations

The water system has nineteen pressure reduction valve (PRV) stations throughout the system, of which many are no longer utilized. The Pennsylvania Avenue PRV Station was renovated in 2011, is in continual service, and is in good repair. The Howertown primary PRV was rebuilt in 2023 and the bypass PRV was rebuilt in 2024. The future projects include replacement of the Howertown flow meters and installation of an additional 16-inch PRV. The Race Street PRV station was relocated as part of road improvements. The Stefko & Pembroke PRV station is currently inactive; however, the below-grade large station was very dirty and in disrepair. We recommend that minor repairs and regular cleaning be implemented by the City for all PRV stations.

Booster Pumping Stations

The Water System includes three large booster pumping stations to lift the gravity-fed finished water in the distribution system up South Mountain, and to balance pressures of the system in South Bethlehem and the Saucon Valley service area.

The 5th & William Street Booster Station renovation was completed in 2016, with two (2) new redundant 900 gpm pumps, flow meter, electrical service, motor control, emergency generator, and building renovations. This booster station is in good repair; however, the meter pit had standing water in it. We recommend that a permanent vault drain be installed to keep the meter pit dry. The fenced area around the emergency generator was full of dry leaves which can be a fire hazard. In addition to clearing the leaves, we recommend that the large adjacent tree be removed to both eliminate the leaves issue and avoid possible damage to the pump station from the tree or limbs falling in a storm event.

The South Side Booster Pump Station was originally built in the 1950s. Full renovation and pump replacements were completed in 2018 with two (2) new redundant 1,000 gpm pumps, flow meter, electrical service, motor control, emergency generator, and building renovations. In 2023, new Cla-Val equipment was installed with hydraulic & electrical closure controls to dampen water hammer effects.

The Mountaintop Booster Pump Station (formerly Fire Pump Station) was built in 1959. A full renovation of the pump station was completed in August 2021 with two (2) new redundant 1,000 gpm pumps, flow meter, electrical service, motor control, emergency generator, and building renovations. This renovation also included discharge control valves with hydraulic & electrical closure controls to reduce water hammer pressure wave.

Two minor booster pump stations include the Frank's Corner PS (East Allen Township) and the Weil Street PS (Salisbury Township). Frank's Corner PS was built in 1997 and includes domestic pumps, fire pump, and emergency generator in a metal building. The Weil Street PS is a package steel below grade pump station with 25 gpm pumps built in 2015. Both stations are in good repair.

Finished Water Storage

The Water System includes seven (7) finished water storage tanks throughout the distribution system. All tanks, but one, are located on South Mountain (see figures at end of this chapter). The 5.0 million gallon (MG) Northeast Standpipe (1991 steel) is located on the Northampton Community College campus in Bethlehem Township and has been recently refurbished. The 1.0 MG South Side High Level (1959 steel) tank adjacent to the Fire PS was recently power-washed and cleaned. The 5.0 MG Southeast Low Service Water Tank (1965 steel) is located on William Street and has recently been modified with new control valves and put back online. The 0.5 MG South Mt. High Service (1959 steel) tank located in South Mountain Park has been recently refurbished. The City has been sequentially upgrading/repainting water tanks as part of their program to enter into contracts with a utility maintenance firm for three of the seven water storage tanks. The 5 MG Southeast Tank was added to this program in 2021 and was refurbished in 2022.

The 12 MG South Side Low Service Reservoir located behind St. Luke's Hospital was originally constructed in 1890 but has been refurbished over the years with a synthetic liner and cover. The

adjacent 5.0 MG steel Southwest Low Service steel tank was built in 1993 and needs roof structure repairs/replacement and recoating of the entire tank as confirmed by inspection in 2018. The 2.0 MG Southwest High Service Reservoir is a two-cell concrete structure which is in disrepair and is currently scheduled to be replaced in 2026. The current 2 MG tank replacement is being designed in 2025 with a 1 MG tank reservoir. The Southwest Low Service tank was taken out of service in 2023. We also recommend that the City accelerate the schedule for tank refurbishment through contracts with utility maintenance firms.

East Allen Township Well Stations

The Authority acquired the assets of the former East Allen Township Municipal Authority in 2013, including four (4) separate well systems serving residential subdivisions: East Allen Gardens (1971), County Squire (1970), Wil-Mar (1969) and Shady Lane (1971). The systems include groundwater wells and well pumps for source water, chemical treatment and disinfection, below grade finished water storage, and booster pumps for distribution pressure. Each system can be supplied with trucked-in potable water should the wells be temporarily affected by drought or mechanical failure. The City completed the Shady Lane replacement Well & Booster Station in 2018. The City received the Country Squire Well No. 3 Operating Permit from PADEP in October 2019. The East Allen Gardens Well House was converted to be a Booster Pump House in 2023, and the well was disconnected.

These independent water systems are in a minimal state of repair. The Comprehensive Planning Study recommends several long-range plans to expand the water distribution system northward in East Allen Township to integrate these water systems and eliminate the well sources. However, the pace of such progress will be driven by future development in East Allen Township.

The City completed installation of emergency generators at the Shady Lane, Country Squire Systems and Wil-Mar System in 2021. The pilot program for manganese treatment has been completed at the Shady Lane System and received a PADEP operating permit in 2017, and is currently in service. The City constructed the Mud Lane water main extension to the East Allen Gardens system in 2022 and the wells have been grouted and abandoned. The wells have not been in use since January 2023.

Emergency Interconnections

The Water System has seven (7) emergency interconnections with adjoining water systems. The Comprehensive Planning Study (pages 4-23) estimated the total theoretical capacity of all emergency interconnections as 5+ MGD. Many of these interconnections have never been utilized and/or tested. This issue is a significant concern since the average daily demand of all customers may be as great as 15 MGD.

Based upon our prior recommendations, the Authority commissioned an Emergency Water Supply Feasibility Study which was completed in October 2018. The hired consultant evaluated the interconnections and other alternatives to supplement emergency water. The executive summary recommended a condition assessment of the raw water transmission tunnels and further evaluation of improvements/replacements of the emergency interconnections with adjacent water systems. The preliminary capital requirements for these projects are significant. The Authority commissioned an Emergency Interconnection Evaluation Study in 2020 which was completed on December 9, 2021

and Accepted by the Authority in March 2022. The Authority and City are meeting with the adjacent water systems to jointly implement the interconnection study recommendations and have agreed with LCA to budget for the design of inconnection upgrades in 2025.

Ongoing Initiatives

Forest Management

The Authority conducts an annual timbering program following its Forest Management Plan. This timbering program generally brings between \$10,000 and \$100,000 a year in revenue, depending on the quality and quantity of the harvested timber. In 2021, the Authority appointed Highland Forestry Management as its forestry consultant (forester), replacing Woodland Management Services, who had been the Authority's forester since 2010. The forester selects areas of the watershed that are suitable for sustainable timber harvesting and the Authority contracts with reputable timber contractors to harvest the selected timber stands.

In addition, the forester monitors spongy moth infestations and other invasive plants and insect species. The forester periodically recommends strategic spraying efforts to limit the negative impact of insect and invasive species to the forest health and future forest management activities.

Wind Energy

In 2013, the Authority authorized Atlantic Wind, LLC (AW) to install six temporary and one permanent wind measuring towers on its property in Penn Forest Township as part of a feasibility study to determine if a wind turbine farm could be developed for the purpose of producing electricity. All temporary MET towers have been removed and the project appeared to be feasible. In 2022, AW terminated the License and Lease Agreement with the Authority as they no longer wish to pursue the project. The Authority has assumed the rights to the project and continues to pursue the negative zoning decision appeals through the courts.

GIS/GPS and UAV

The Authority had retained Maser Consulting (now doing business as Colliers Engineering & Design) to assist in the purchase, licensing, and training for an unmanned aerial vehicle (UAV). This equipment is currently being used by the Authority Special Police to aid in recognizance and enforcement of watershed property trespass and other watershed related issues. It is anticipated that the geographical information system (GIS) and global positioning system (GPS) technology will provide a means for the Authority to better manage the 22,500 acres of watershed land assets in the office and in the field.

The CED GIS services team made a presentation to the Bethlehem Authority at their March 13, 2025 Board Meeting outlining the history of the GIS system upgrades and implementation for both the Authority and the City. The presentation discussed potential next steps of work towards a fully shareable asset management GIS platform.

Watershed Land Survey

In response to a property dispute with an adjacent land owner, the Authority retained Maser Consulting (Now Colliers Engineering & Design, Inc.) and sub-consulting partner, Arthur A. Swallow Associates, LLC, to research and evaluate many of the deeds and survey warrants associated with the original watershed land acquisition of the late 1920s. Some of these deeds and warrants date

back to the 1790s. A program for research and physical property survey of the watershed property is being considered to support the accuracy of the GIS database system of the Authority. The Authority continues to utilize Colliers Engineering for GIS services.

Risk and Resilience Assessment

The City completed a Risk and Resilience Assessment (RRA) in accordance with America's Water Infrastructure Act (AWIA) in 2020 (will be completed every 5 years). This was followed by an update of the City's Emergency Response Plan incorporating the findings of the RRA. Both were completed in 2021. The purpose of the RRA is to evaluate vulnerabilities, risks, and consequence of failure of water system assets with respect to man-made, malevolent, and natural hazards. The RRA makes recommendations on security enhancements and actions to improve resilience of the system. Prior risk and vulnerability analyses, such as the 2003 US-EPA Vulnerability Assessment and a 2017 and 2020 Department of Homeland Security (DHS) Infrastructure Survey Security and Resilience Reports have been taken into consideration. A desktop emergency response exercise was held by the City water staff in September 2023.

A US EPA audit was conducted of the water system and the City's operations in February of 2025. The written report of the EPA audit is not expected until the Summer of 2025.

Hydroelectricity

The Authority and City may revisit in the future a study of the feasibility of installing equipment in certain pipelines for the purpose of generating electricity.

Solar Power System

The Authority and the City continue to evaluate the feasibility of installing solar power generating equipment at the Water Filtration Plant as part of the City's sustainability initiatives. New technology may also allow for the potential use of floatable solar on the Wild Creek and Penn Forest reservoirs.

Emergency Interconnection Assessment and Improvements

In July of 2020, the Authority commissioned an Emergency Interconnection Evaluation Study. The goal of the study is to determine if the Authority's maximum day demand of up to 15 MGD could be reliably provided through existing and/or improved interconnections with the neighboring utilities of Lehigh County Authority (LCA), Easton Suburban Water Authority (ESWA), Northampton Borough Municipal Authority (NBMA), Upper Saucon Water & Sewer, Hellertown Borough Authority, Bath Borough Authority, and Salisbury Township. This Study included flow and pressure testing of the Bethlehem Water System and the neighboring utilities systems. This information was used to calibrate Bethlehem's WaterGEMS water distribution system model. The Emergency Interconnection Evaluation Study was completed in December 2021 and accepted by the Authority in March 2022. The City's 2025 Capital Budget includes \$500,000 for design of the system interconnection improvements.

Reduce Unaccounted-For Water

The percent unaccounted-for water (water loss) in the water system has been significantly above industry standards since 2018. In 2023, the unaccounted-for-water decreased slightly. The City commissioned an Unaccounted-For Water Study by AECOM to evaluate previous efforts to address unaccounted-for-water and recommend program(s) to implement additional leak detection efforts to reduce the percentage of unaccounted-for throughout the water in the distribution system. A

final draft of the report was issued April 28, 2023. The City has begun implementation of the recommendations provided in the Unaccounted-For Water Study. The 2024 unaccounted for water continues to trend downward (see Table 3).

System Wide Security Improvements

The Authority requested a specific focus and assessment of the existing security measures in place throughout the water system. The Authority requested that we make specific recommendations for security improvements. Colliers Engineering & Design (CED) was aware that the Authority had previously invited US DHS to conduct security assessments. CED invited DHS to conduct additional assessments as part of the Annual Tour. CED also retained our teaming partner, Instrumentation Controls & Energy Engineering, LLC (IC&EE) to take part in the Annual Tour and provide their security recommendations based on our joint experience with other water system clients.

On November 17, 2020, the DHS Agent met at the Authority's office to review the preliminary findings. The DHS Cybersecurity and Infrastructure Security Agency (CISA) utilizes a standardized model, the Security Assessment at First Entry (SAFE). *SAFE is designated to assess the current security posture and identify options for facility owners and operators to mitigate against relevant threats. It is not intended to be an in-depth security assessment.* This DHS SAFE Studies reports were provided to the City and Authority in November of 2020. The DHS model includes many questions which are used to score the facility's current commendable actions and practices, as well as vulnerabilities and options for consideration of improvement. A significant positive score item listed is the Bethlehem Authority Police and their patrol of the Watershed and the professional relationship to the City Police Department and other first responders throughout the distribution system.

As a follow-up to this security assessment, the Authority approved the Colliers Engineering & Design Confidential Water Systems Security Feasibility Study in September 2021. This Feasibility study was completed and presented to the Authority in Executive session and Accepted in March 2022. The City is working to implement the improvements recommended in the security assessment and feasibility study.

Projects recently completed in 2024 and prior; include the following:

1. WTP perimeter fence and gate;
2. WC fence and gate along Pohopoco;
3. Mountaintop pump station fence extension;
4. 0.5 mg tank fence repair;
5. Howertown PRV tree removal;
6. Pa Ave tree removal PRV;

The water filtration plant supervisors have planned for the following 2025 projects:

1. WTP gate control via card reader;
2. WC gate control via card reader;
3. WC fence along the side property lines – begin prep work in 2025 (planning//remove trees); budget for fence starting in 2026;
4. 5th & Wm pump station fence extension;
5. East Allen Township well station enclosures;

6. 5th & Wm pump station tree removal;
7. Airport Rd booster pump tree removal;
8. Howertown PRV tree removal;
9. Pa Ave PRV tree removal

Access control and cameras – System-wide effort (22 facilities identified):

1. Issue RFP for design services 2025
2. Design/implement beginning in 2026

System Maintenance and Operations

Maintenance

Maintenance of the water system is an ongoing activity of the City. Each facility has particular maintenance requirements unique to the type of facility. The following paragraphs discuss the maintenance activities conducted on the various types of water system facilities.

Watersheds

Routine monitoring and maintenance activities associated with fire roads and watershed security were conducted by City staff. The Authority continued its Patrol Officer (PO) Program. The special police patrolling is done from an enforcement perspective. The PO continues to develop relationships with many local area residents, municipal officials, and conservation and sporting organizations, as well as other law enforcement agencies, to further the "eyes and ears" philosophy and learn what is occurring on the property. In addition to a full-time officer in charge, the Authority has four (4) part-time watershed police officers for weekends and evening hours. We recommend that the City and Authority watershed staff continue to work together to improve their communication regarding matters of watershed security. The Authority has also installed a number of cameras which have helped increase security in the watershed properties.

Security has been increased by the visible patrols around Authority lands at unpredictable times, not just during normal work hours. The Authority purchased an unmanned aerial vehicle (UAV) with a high-resolution camera at the beginning of 2017, to assist in security patrolling and supplement efforts of implementing graphical information system (GIS) technology for watershed mapping and monitoring forestry issues such as spongy moth infestation.

Dams and Intakes

The Wild Creek and Penn Forest reservoir dams are routinely monitored including the Penn Forest interior dam access tunnel. Each dam receives an annual inspection by a geotechnical engineer as part of the PADEP requirements. The Wild Creek Reservoir raw water intake structure has two (2) complete sets of intake screens which are alternately cleaned, one set each year, with the change-over of each raw water transmission lines to the water treatment plant.

Transmission

Routine maintenance of the transmission system mains, appurtenances, and rights-of-way is ongoing. Pressure monitoring has been completed, and the past studies indicated that there does not appear to be any significant capacity deficiencies in the lines.

New technology may allow in situ inspection of the rock bore tunnels and large diameter water transmission lines without taking them out of service. We recommend the City explore this type of investigation for these critical assets of the water system. The large transmission valves on the north side of Blue Mountain are exercised regularly to alternate the raw water flow in the redundant lines. The valves south of Blue Mountain are exercised yearly between 50% & 75% of fully closed. Only the two valves at the Blue Mountain southern portal are not exercised because the deep portal is flooded.

Treatment

The City maintains the Water Filtration Plant in accordance with documented procedures appropriate for the processes, equipment, and structures involved. The Maintenance Supervisor provided a description of the ongoing maintenance at the plant. A third party, Water Service Professionals, is on-site annually to do thorough testing on filter media. Each filter must be tested every three years. As such, three or four filters are tested each year. The City received an Area Wide Optimization Program (AWOP) Award at the 2024 Water Works Operators' Association of Pennsylvania (WWOAP) Conference. The Water Filtration Plant also received "an overall Commendable performance rating for its ability to remove and inactivate waterborne pathogens through optimized filter plant performance" from PADEP in its November 2023 Filter Plan Performance Evaluation.

Storage

The City has been sequentially upgrading/repainting water tanks as part of their program to enter into contracts with utility maintenance firms. Three of the seven tanks have been completed. During our tour, the maintenance and operations of the storage facilities appear to be satisfactory (except for the 2 MG Concrete Tank and the roof of the 5 MG Southwest Tank). The City added the 5 MG Southeast Tank (William Street) to the program in 2021 and full refurbishing was completed in 2022. Design/Replacement of the 2 MG with a 1 MG tank is scheduled for 2025/2026. The 0.5 MG South Mountain Tank will be scheduled for chemical cleaning in 2025.

Distribution

Maintenance of the distribution system included hydrant flushing, painting/repair, valve exercising, and the ongoing meter replacement program. The City has initiated an improved hydrant maintenance program and tracking system through the use of state-of-the-art software and field equipment and has assigned an individual to oversee this activity. The target maintenance schedule is as follows: one fifth (1/5) of the distribution system valves are exercised each year; fire hydrants receive maintenance in a three (3) year cycle; fire hydrants are flushed in a two (2) year cycle. The City also maintains the various pressure regulating and water pumping facilities in accordance with established procedures and waterworks practices.

The City purchased equipment to do in-house leak detection and has an active leak detection program that is performed year-round. This program has helped to reduce the City's unaccounted-for water. The City purchased a twin turner valve maintenance trailer, including computer and mapping software that is synchronized with the City's GIS software, to be utilized in a system-wide valve maintenance and exercising program. Distribution pipe breaks are tracked based on location and frequency. This data is one criterion for scheduling water line replacements.

The Accelerated Meter Replacement program has provided more accurate billing for customers and has increased revenues for the City. The strategy targets the largest water consuming customers and largest sized metered customers first. The program has increased the investment in the numbers of meters replaced each year working from the larger to smaller meters:

<u>Year</u>	<u>Meters Replaced</u>
2014	577
2015	1,074
2016	1,416
2017	1,192
2018	1,235
2019	1,380
2020	955
2021	1,077
2022	1,559
2023	4,145
2024	4,408
Total	18,441

The 18,441 meters replaced represents 49.61% of the total 37,173 customer meters. The City has also implemented Advance Metering Infrastructure (AMI) for remote meter reading. There are now a total of four (4) AMI towers in service. Currently 17,300 water meters can be read remotely through the tower signal reception. The AMI implementation allows for real-time data for more accurate data and faster response to abnormal water use or loss.

The Maintenance Score Card is used to track and report the efforts of the City's distribution system maintenance department. For the 2024 calendar year we received the following scorecard data from the City:

Water Main Breaks	53
Water Service Lateral Leaks/Replacements	74
Hydrants maintained/valves exercised	2,552
Main Line Valves Exercised	1,026
Distribution System Flushing (Hydrants Flushed)	1,798
Leak Detection (Miles Surveyed)	357

Because reducing the unaccounted-for water is a priority, The City commissioned an Unaccounted-For Water Study by AECOM to review of the City's past efforts to address unaccounted-for-water and recommend program(s) to further evaluate, implement additional leak detection efforts, and reduce the percentage of unaccounted-for throughout the water in the distribution system. A first draft of the report was issued in February 2023. We recommend that the leak detection and the effort to resolve unaccounted-for water be continued in 2025.

The 2018 Amended Long-Term Infrastructure Improvement Program (LTIP) documented that 40% of the 534 miles of waterlines, 43% of the valves, and 38% of the fire hydrants were installed before 1960. Some water lines and valves were installed before 1920. We are also aware that the largest water transmission lines from the Wild Creek Reservoir and the two single bore rock tunnels were installed between 1939 and 1940. As such, we recommend that the Authority and City work towards increasing capital investment in replacement of the oldest and most critical assets of the water system.

The City received a \$2.875 Million PennVest Grant for lead service line replacements. Since 2022, approximately 413 lead service lines to residential properties were replaced. The City plans to apply for more lead service line replacement funding in the future. EPA/PADEP Lead and Copper Rule currently requires the creation of a baseline lead service line inventory by October 2027.

Master Planning

In 2018, the City Staff first created the 10-Year Capital Plan Spreadsheet. The 10-Year Capital Plan Spreadsheet is to be a working document to be reviewed and updated annually. The 10-Year Capital Plan Spreadsheet which was last updated in February 2025 is included in Appendix 10.

Customers Served/Service Area

At the end of 2024, the City provided water service to 37,173 domestic, commercial, industrial, institutional, and other customers in the following municipalities:

City of Bethlehem	Hanover Township (Lehigh County)
Bethlehem Township	Hanover Township (Northampton County)
Freemansburg Borough	Salisbury Township
Fountain Hill Borough	Lower Nazareth Township
East Allen Township	Lower Saucon Township
Allen Township	Upper Saucon Township

The number of customers in each customer class and the changes over the last six years are shown in Appendix 5. The total population served is approximately 122,067 (includes all systems, extrapolated from Lehigh Valley Planning Commission 2020 year-end data, an increase of 0.4%).

The City staff is very quick to respond to any interruption of service. We are not aware of above average customer complaints and/or PUC action notices in terms of customer service. Bethlehem water is generally regarded as the best-tasting water regionally.

Water Production/Consumption

In the 2024 calendar year, 5.011 billion gallons of water, or an average of 13.69 MGD, was delivered to the Water Treatment Plant from Wild Creek. Other minor water sources include: East Allen Well Systems, including Bath Borough Authority through the Route 512 interconnections, which delivered 0.049263 billion gallons of water, or an average of 0.135 MGD. Total metered consumption by customers and other accounted for usage totaled 3.617 billion gallons, or an average of 9.911 MGD. A summary of Water Consumption by Municipality and Customer Category is shown in Tables 2 and 3, respectively.

The Percent Unaccounted Water listed in Table 3 below increased from 26% in 2019 to 30% in 2020 and 2021 but has decreased in 2024 to about 23%. The Delaware River Basin Commission (DRBC) and the PA Public Utilities Commission (PUC) have issued a policy statement that: "Levels of unaccounted-for-water should be kept to within reasonable amounts. Levels above 20% have been considered by the Commission to be excessive." Unaccounted Water continues to be an issue.

The City started using the PUC Method for calculation in addition to the AWWA Method. As part of the 2020 PUC rate case, the City is committed to addressing the unaccounted water issue. A system-wide unaccounted-for water study was conducted in 2022 with the final revised study report issued April 28, 2023. The City has reviewed the recommendations provided in the Unaccounted-For Water Study and has begun implementing many of the cost effective recommendations which include consolidation and correction of the water audit procedures for more consistent annual reporting. The City has replaced large commercial/industrial customer meters which will now be replaced on a 10-year replacement schedule. The City has implemented a more aggressive residential meter replacement program, 20,000 customers are now on the AMI system which allows for increased monitoring of water consumption (new residential meters are now on a 20-year replacement schedule). The City has expanded its use of leak detection monitoring equipment with over 50 instruments distributed throughout the system to check fThe prior increasing trend of percent unaccounted from 2017 to 2022 has leveled off, the 22.8% for 2024 is a slight improvement from 2023 at 23.8%.

Staffing

The Bureau of Water Supply and Treatment budget for 2025 includes 68 positions, not including one (1) contract Water Engineer. Salaries for 43 positions are split 50/50 with the sewer fund; 25% are paid 100% by the water fund. The water fund also pays partial salaries for three (3) IT positions and 12 service center positions in the General Fund. The Bureau of Water Maintenance will have 33 staff positions. The personnel in the two bureaus perform other duties in addition to operating/maintaining the system. Appendix 6 provides a breakdown of manpower in each division.

The Director, Departmental Business Manager, Manager of Commercial Operations, Water Quality Manager, Microbiologist, Laboratory Technician, and Customer Service Staff in the Water and Sewer Resources Department are budgeted for approximately 50% of their time to the Bethlehem water system.

Insurance

The City maintains an insurance policy to protect the water system against loss or damage by fire or other casualty, and against public liability. A list of the facilities insured by the City is shown in Appendix 8 for informational purposes. The City has reviewed and updated this list to include new facilities and exclude any abandoned facilities. The revised list of assets was included in the January 9, 2025 Authority Engineer Certification of Insurance.

Asset Management

The City developed and refined over many decades its Hardy-Cross hydraulic pipe network model for analyzing the existing water distribution system, future expansions, and efficiency improvements to the system. The City has also implemented graphic information system (GIS) mapping for much of the water distribution system.

We recommend that the Authority and City work together to fund the full development of the GIS system map to include the finished water transmission lines, water filtration plant, the raw water transmission lines, and the full watershed land and physical assets. The Authority is considering future funding for GIS platform for the watershed properties.

The US EPA has published its Asset Management Guidelines which include the five major planning and analysis components:

- Asset Inventory/Mapping and Condition Assessment
- Level of Service Goals
- Criticality/Prioritization – Risk Assessment
- Life Cycle Costing
- Long Term Funding Strategy

As stated above, the City has already made strides toward asset mapping. We recommend that this component be developed further to include complete mapping and asset inventory in each major facility. This would include asset numbering and identification. The next step would be asset condition assessment including such attributes as type, size, material, age of asset, and more. This exercise also includes determining the remaining life and value of an asset and/or the energy use of an asset.

The Business Risk Exposure (BRE) is a method of calculating (scoring) the nature and level of exposure that a utility is likely to confront through the potential failure of a specific asset. Key questions of this process include:

- Which assets are most critical to the sustained function of the system?

- What is the likelihood of each of these assets failing?
- What are the consequences if each asset fails?

Probability of Failure (PoF) involves assessments of mortality, financial inefficiency, and deficient capacity. Ratings of 5 to 1 are scored for each asset as: imminent to improbable.

Consequence of Failure (CoF) involves assessment of severity of loss a system would incur as a result of failure of a particular asset (public health, safety, environmental impacts, cost of repair, litigation exposure, etc.). Ratings of 5 to 1 are scored for each asset as: catastrophic to insignificant disruption.

Criticality (BRE) Combined Rating= Probability of Failure (PoF) x Consequence of Failure (CoF)

Multiplier		Consequence (Cost) of Failure				
Probability of Failure	X	1	2	3	4	5
	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
5	5	5	10	15	20	25

Vulnerability is a component of risk and should also be considered. The above described analysis provides a vetting process to determine which assets are critical in terms of both probability and consequence of failure. It is these assets which need the most attention for maintenance and capital funding. We believe BRE may be more objective and strategic than the previously completed “Pair-Wise” analysis within the Comprehensive Distribution Planning Study.

The following components of Life Cycle Costing lead to improved O&M programs, repair/replacement schedules, and capital improvement plans. Finally, after the needs are clearly identified, the Long-Term Funding Strategy can be implemented.

We recommend that the Authority and City pursue implementing a full asset management strategy over the next several years to better maintain a sustainable water system. An asset management plan would aid in the critical decision process for funding maintenance and facility replacement capital projects while providing the justification for potentially taking on more long-term debt financing.

TABLE 2
Revised 3/2025
Average Daily Water Consumption (Gallons/Day GPD)

Municipality	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
City of Bethlehem	6,097,500	6,172,900	6,441,201	6,458,623	6,432,657	6,075,211	6,012,081	6,019,856	6,264,504	6,076,294	6,000,639
Bethlehem Twp	935,700	952,900	961,400	939,638	937,726	898,952	888,101	893,852	901,749	896,434	903,996
Hanover Twp (Northampton)	955,600	978,400	1,003,901	996,105	1,006,332	984,353	1,023,709	1,012,394	1,062,780	1,077,915	1,098,908
Hanover Twp (Lehigh)	275,100	302,300	324,400	325,094	350,660	334,158	293,274	341,016	393,665	377,743	354,843
Fountain Hill Borough	393,200	394,200	425,400	412,851	413,219	392,009	374,007	370,236	364,523	369,668	377,002
Freemansburg Borough	130,900	157,300	137,500	187,873	154,571	121,637	153,119	121,292	150,340	150,166	148,007
Salisbury Twp (& Alex Court)	90,400	86,500	86,600	92,924	88,956	89,022	79,092	74,613	72,083	72,209	71,980
Upper Saucon Twp	109,200	115,400	121,600	102,439	107,563	109,745	136,893	107,977	107,513	105,047	117,190
East Allen Twp ¹	123,900	110,900	214,000	202,257	204,820	201,165	211,269	223,552	249,188	137,254	262,843
Lower Saucon Twp	425,400	416,000	421,800	407,722	421,624	371,463	393,931	409,078	399,175	383,806	368,646
Allen Twp	13,800	13,200	13,200	19,327	19,944	18,796	21,319	21,965	23,691	26,344	34,417
Lower Nazareth Twp	-	-	1,200	4,170	5,439	6,463	7,703	8,400	7,706	6,318	5,688
Total Consumption	9,550,800	9,700,000	10,152,400	10,149,023	10,143,511	9,602,974	9,594,498	9,604,231	9,996,917	9,679,198	9,804,159

1) Includes Well Systems and RT512 Consecutive System

TABLE 3
Revised 3/2025
HISTORICAL SUMMARY OF WATER CONSUMPTION
BY CUSTOMER CLASSIFICATION AND DEMAND
Bethlehem Water System
Average Daily Water Consumption/Demand (mgd)

Customer Classification	2014	2015	2016*	2017**	2018	2019***	2020	2021	2022	2023	2024
Domestic	5.55	5.64	5.61	5.69	5.52	5.37	5.59	5.443	5.662	5.289	5.454
Commercial	1.64	1.69	1.79	1.78	1.93	1.75	1.71	1.834	1.993	2.096	2.107
Industrial	0.99	0.99	1.32	1.29	1.30	1.22	1.14	1.2257	1.278	1.201	1.150
Institutional	0.67	0.69	0.77	0.77	0.78	0.69	0.55	0.553	0.588	0.609	0.621
Public	0.17	0.14	0.13	0.13	0.09	0.13	0.11	0.215	0.146	0.134	0.104
Bulk Sales	0.53	0.54	0.53	0.50	0.52	0.45	0.50	0.479	0.469	0.457	0.442
Other	1.46	1.62	1.49	1.40	1.38	1.33	1.54	0.933	0.961	0.962	0.789
Accounted for Usage	11.01	11.31	11.64	11.54	11.53	10.93	11.14	10.681	11.097	10.748	10.667
Total Inflow to Plant	13.57	14.36									
Source of Supply			14.26	13.68	14.67	14.83	15.83	15.124	15.081	14.1	13.825
Unaccounted-for Water	2.56	3.05	2.62	2.13	3.14	3.90	4.70	4.443	3.984	3.352	3.158
Percent Unaccounted (%)	18.9%	21.2%	18.4%	15.6%	21.4%	26.3%	29.7%	29.40%	26.4%	23.8%	22.84%

*Starting in 2016 "Total Inflow to Plant" will be "Sources of Supply" from Main Bethlehem System, well systems and Rt. 512 Consecutive System.

**Starting in 2017 "Total Inflow to Plant" will be "Sources of Supply from Main Bethlehem System, well systems, Rt. 512 Consecutive System and water purchased from ESWA through Hecktown Rd Interconnection.

**Starting in 2017 "Unaccounted for Water" is now termed "Water Loss" and "Percent Unaccounted for Water" is now termed "% Water Loss."

***The City's bulk meters have been calibrated. The City began investigating the increase of unaccounted water in 2019.

Recommendations

As a result of the reviews made during preparation of this Annual Report, we offer the following recommendations for consideration by the Authority and the City:

High Priority Recommendations (Security & Regulatory Compliance)

- Security Improvements:** The United States Department of Homeland Security (DHS) assisted Colliers Engineering & Design and our subconsultant in touring specific and strategic water system facilities to assess the current security systems and make recommendations for security system improvements throughout the Bethlehem Water System. The DHS documents and our security recommendations are considered confidential and have been previously provided under separate cover. As a follow-up to this security assessment, the Authority approved the Colliers Engineering & Design (CED) Confidential Water Systems Security Feasibility Study in 2021. This Feasibility study was completed, presented to the Authority in Executive session, and accepted in 2022. Several of the initial security improvements projects have been completed in 2023 & 2024, such as the fencing around the Water Filtration Plant with motorized gate, and fencing across the frontage of the watershed campus along Pohopoco Drive. 2025 security improvements include motorized entrance gate at the watershed, additional fencing along the sides of the watershed property from Pohopoco Drive. Future improvements include security cameras and key card employee access for all water system facilities. Additional fencing along the sides of watershed property from Pohopoco Road back toward WC dam will be addressed in phases over a few years as funding and resources allow. We also recommend that a specific Cybersecurity Assessment evaluation of the City's current IT systems be commissioned. CED recommends that the security improvements recommendations be implemented by the City as part of 10-year Capital Planning. The February 2025 10-Year Capital Plan includes funding for the initial 2025 security enhancement design and implementation through 2034.
- Reduce Unaccounted for Water & Meter Replacement:** The percent unaccounted-for-water had increased above industry standards, as reported in years 2018-2021. In 2022, 2023, and 2024 the unaccounted-for-water decreased, however it remains above 20%. CED recommends that the City increase their efforts to investigate meter accuracy, ramp up leak detection efforts, and track unaccounted for water on a quarterly basis. The City has been implementing the recommendations provided in the Unaccounted-For Water Study which was completed in April 2023. The City has deployed active leak detection monitoring devices throughout the system. Better accounting and monitoring, as well as improved metering has reversed the trend of the annual unaccounted for water data. The City has begun an aggressive program of customer water meter replacement starting with the larger commercial and industrial high-water users as mandated by the Public Utility Commission. In 2016 to 2018, 2,000 large customer meters were replaced. In 2023, the City also began a 6-year program to replace 4,000 meters per year at \$2M annually. By 2028 approximately 26,000 of the 37,000 customer meters will be replaced. The meter replacement program

improves accuracy, reduces unaccounted for water, and improves water revenue. CED recommends that this program continue each year for the replacement of all water customer meters throughout the system. The 10-Year Water Capital Plan includes significant funding toward this goal through 2028. Future funding will be required beyond 2028.

3. **2 MG Southwest Reservoir Replacement:** CED has previously recommended that the City replace the 2 MG concrete Southwest High Service Reservoir as soon as possible and accelerate the refurbishment and maintenance contract for the remaining finished water storage tanks. The City completed a replacement feasibility study in 2020. The City has engaged a consulting firm to design and permit the replacement of the 2 MG SW Reservoir with a 1 MG tank in 2025 for construction in 2026. Adding the remaining tanks to the asset management maintenance contract will occur over several years and is included in the February 2025 10 Year Capital Plan.
4. **Service Line & Lead Service Line Replacement:** Due to the issuance of the USEPA Copper Rule Revision (LCRR) and Improvements (LCRI) and supporting PADEP And PUC regulations, the City must update the service line inventory, develop a lead service line identification and replacement plan. The LRCI must be submitted to PADEP by November 2027, validate the accuracy of methods used to identify non-lead service lines by 2034, and develop a plan to replace all lead service lines and galvanized steel service lines by 2037. The City has completed a \$2.875M PennVest Grant project to replace lead service lines, which replaced 413 lead service lines between 2022 and 2024. CED recommends that the City and Authority work to revise the 10-year Capital Plan to provide the additional funding required to meet these regulated deadlines. The City will be hiring a consultant to assist with SL inventory and LSLR program in 2025.

Intermediate Priority Recommendations (Water Asset Resiliency)

5. **GIS Water System Model & Asset Management:** CED recommends the Authority and City work toward completion of their combined GIS model for the entire water system and watershed assets. The City has retained a GIS consultant to upgrade the GIS platform for all underground utilities. We recommend that the Authority expand on this effort to connect the City's GIS water distribution model to the transmission lines up to and including the watershed. CED recommends the City implement full Asset Management based upon the EPA guidelines. This process will vet the most critical assets for a targeted long-range capital improvement plan.
6. **Emergency Water Supply & Interconnections:** The Authority commissioned the Emergency Water Supply Feasibility Study which was completed in October 2018. The shortfall of working emergency sources is a significant concern. In 2020, the Authority commissioned an Emergency Interconnection Evaluation Study which was accepted by the Bethlehem Authority Board in 2022. The Authority and City have been meeting with the adjacent water systems to jointly implement the interconnection study recommendations.

The City has engaged a consultant to design the first phases of the inter-connection plan. The February 2025 10 Year Water Capital Plan includes funding for design improvements to emergency interconnections are planned for 2026-2031. CED recommends that the Authority and City work together on a plan to increase the funding to implement the emergency interconnection program.

7. **Water Distribution Line Replacement:** The City continues its replacement program of water distribution lines throughout the system. In a system with facilities well over 100 years old, it is important that a systematic, annual replacement program be implemented. The City has improved its extensive leak survey and system analysis to determine areas of water mains that are most susceptible to leaks. There were 600 feet of water main replaced in 2023 and 1,160 feet of main extensions installed in 2023. There were three water main replacement projects completed in 2024 for a total of 5,200 LF of new water main. A total of 2,000 LF of new water main is planned for replacement in 2025. The 10-Year Water Capital Plan includes \$1 million in funding for distribution system upgrades and repairs for 2025. CED recommends the City increase funding of this program over the next decade to replace at least 2.0% of the water main distribution system each year, a goal to replace all water system water mains in 50 years which would require an investment of \$12M to \$15M per year. CED recommends future funding to accelerate water main replacement.

Long Term Annual Recommendations (Recurring)

8. **Water Filtration Plan Improvements:** CED recommends the City continue to improve/replace critical equipment at the water filtration plant. The Water Filtration Plant Staff are aggressively replacing critical equipment for the now 25-year old system. Water Filtration Plant capital upgrades are budgeted on an annual basis. CED recommends that the City continue towards the planned chlorination system replacement with safer modern disinfection systems. The replacement chlorination system is currently planned for design in 2029 and construction in 2030.
9. **Long Term Capital Funding:** The Authority and City have worked with their respective financial planning consultants to create the 10-Year Water Capital Plan and Capital Improvement Program Funding Plan. CED recommends that the Authority and City continue their efforts to monitor the current Funding Plan and its implementation to best balance capital project funding and debt management; and to allow additional new capital funding of City water system improvement projects. Future refinancing is targeted for 2026 prior to the 1998 Bond debt service retiring in 2028.
10. **Risk & Resilience:** In March of 2020, the City completed a Risk and Resilience Assessment (RRA) in accordance with America's Water Infrastructure Act (AWIA) of 2018. This assessment is required to be updated every 5 years and is scheduled to be completed again by the end of March 2025. CED recommends that the City continue efforts to reduce vulnerability of the Bethlehem Water System.

11. **Water Transmission Tunnels:** CED recommends that the Authority and City continue to explore the new technologies for in-situ inspection of the water transmission lines and rock bore tunnels constructed as early as 1939. In-situ inspection of the water transmission piping and robotic camera analysis of the two tunnels is possible. However, this work is expensive, and the tunnel access will require upfront capital investment.
12. **Watershed Maintenance:** CED recommends the City Staff improve their regular maintenance and repair of all facilities in the watershed system, specifically: access roads and fire lanes need to be better maintained for use by the Authority Special Police, and other authorized personnel. The Tunkhannock Creek intake stop-logs should be reinstalled to protect the bar screens from damage. The stop log replacement is planned for 2025. The raw water transmission line tunnel portals and H-valve concrete chamber vaults need repair and maintenance.
13. **Distribution System Maintenance:** The City has implemented a program to systematically exercise valves throughout the entire water system every five years and annually exercise fire hydrants through flushing as part of the maintenance program. CED recommends that this program continue to ensure proper operation of the distribution system, the detections of problems, and to avoid fire protection limitations.
14. **Watershed Management & Alternative Energy Opportunities:** CED recommends that the Authority continue its efforts to maximize the potential of all of its assets through the Watershed Management Program. The Authority continues its annual sale of green energy credits, strategic sale of timber program and the development of alternative energy. CED recommends that the Authority and the City consider opportunities related to alternative energy sources for and on its facilities including wind energy, hydro power, and solar power.



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