

AECOM

PROPOSAL SUBMITTED TO: BETHLEHEM AUTHORITY



EMERGENCY WATER SUPPLY INTERCONNECTION EVALUATION

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June 19, 2020

Stephen Repasch, Executive Director
Bethlehem Authority
Room B-311
10 East Church Street
Bethlehem, PA 18018

RE: Request for Proposal: Emergency Water Supply Interconnection Evaluation

Dear Mr. Repasch:

AECOM is pleased to present our Proposal to Bethlehem Authority to conduct an Emergency Water Supply Interconnection Evaluation. We have assembled a team with the experience and capabilities necessary to meet the needs of the Authority and the customers you serve. Our project director, Chris Curran, lead the AECOM team during the Emergency Water Supply Study and is a resident of the City and within 5 minutes of City Hall to facilitate communications with both Authority and City resources during the project. Our Project Manager and your principal contact will be Zachary Keegan, PE who brings over 15 years of engineering experience in the Water industry and a history of delivering successful projects for Bethlehem. He will be supported by a team of professionals experienced in all engineering aspects of water treatment, hydraulic, distribution and design. Our project team offers the following advantages to the Authority:

Familiarity with the Authority's Emergency Water Supply Needs. Having completed the Emergency Water Supply Feasibility Study, AECOM uniquely understands the City's need for alternate water supplies during catastrophic events and the specific analysis needed to evaluate interconnections with surrounding water systems.

Experience with the Interconnecting Utilities and Regulators. AECOM has established relationships with Easton Suburban Water Authority, NBMA, Saucon Township, Lehigh County Authority and PADEP which is critical to effective coordination during this multi-agency evaluation. Our previous work with the interconnecting authorities during the Emergency Water Supply Feasibility Study gives AECOM a functional understanding of the operations and characteristics of these water systems and the importance of good communication during an interconnection evaluation.

Knowledge of Bethlehem's Water Distribution System and Hydraulic Model. AECOM has a strong understanding of the intricacies of Bethlehem's water distribution system and hydraulic model based on previous work and will leverage this experience to fully evaluate interconnection concepts including a review of booster pumps, pressure relief and water quality concerns that are critical for a long-term effective interconnect to mitigate any extended interruptions in water supply from the reservoirs and filtration plant. It is important to understand the

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holistic system and its vulnerabilities as a whole when assessing a change in source water.

Over the last 10 years, we have delivered quality projects for the Authority and the City's Water & Sewer Resources Department and we appreciate this opportunity to continue our support. If you have any questions or need additional information, please do not hesitate to contact me at 610.832.8829 or chris.curran@aecom.com.

Very truly yours,
AECOM Technical Services, Inc.

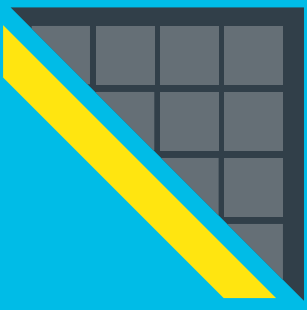
Christopher T. Curran, PE
Associate Vice President
Project Director

TABLE OF CONTENTS

SECTION 1

Qualifications and Experience




SECTION 1

QUALIFICATIONS AND EXPERIENCE

AECOM is pleased to present our proposal for the Emergency Water Supply Interconnection Evaluation. We take pride in the work that has been done for the City of Bethlehem thus far and will continue to bring the most innovative solutions built on the following:

Familiar with the Authority's Emergency Water Supply Needs:

- Having completed the Emergency Water Supply Feasibility Study, AECOM uniquely understands the City's need for alternate water supplies during catastrophic events and the specific analysis needed to evaluate interconnections with surrounding water systems.
- AECOM has proven experience delivering quality projects for the Authority and the City's Water & Sewer Resources Department and we will continue to focus on helping Bethlehem optimize its water systems.

Experience with Interconnecting Utilities and Regulators

- AECOM has established relationships with Easton Suburban Water Authority, NBMA, Saucon Township, Lehigh County Authority and PADEP which is critical to effective coordination during this multi-agency evaluation.
- Our previous work with the interconnecting authorities during the Emergency Water Supply Feasibility Study gives AECOM a functional understanding of the operations and characteristics of these water systems and the importance of good communication during an interconnection evaluation.

Knowledgeable of Bethlehem's Water Distribution System and Hydraulic Model

- AECOM has a strong understanding of the intricacies of Bethlehem's water distribution system and hydraulic model based on previous work and will leverage this experience to fully evaluate interconnection concepts including a review of booster pumps, pressure relief and water quality concerns that are critical for a long-term effective interconnect to mitigate any extended interruptions in water supply from the reservoirs and filtration plant. It is important to understand the holistic system and its vulnerabilities as a whole when assessing a change in source water.

AECOM BACKGROUND

AECOM is one of the nation's premier engineering, design, environmental, and planning firms, providing technical experience and creative excellence to a

#ENR2019

TOP 500 WATER

- 2 Water
- 2 Water Supply
- 2 Dams and Reservoirs
- 2 Wastewater Treatment Plants
- 2 Water Treatment, Desalination Plants
- 2 Water Transmission Lines and Aqueducts
- 3 Sewer and Waste

We are proud to be recognized as #2 in Water and Water Supply Services by Engineering News-Record's (ENR'S) Top 500 Design Firms' rankings.

broad range of clients and markets. As a member of the Fortune 500 List.

AECOM is one of the most respected professional service providers in the world. AECOM has 65,000 employees, based in over 100 countries, which permits tremendous flexibilities and capabilities in staffing across multiple technical disciplines for almost any project requirement. AECOM focuses its expertise as needed on projects of all scales, assembling the combination that best suits the individual task and site. We blend global knowledge, local experience, technical excellence, innovation and creativity to offer our clients unparalleled possibilities. AECOM has an established reputation of providing our clients with technically sound and responsive solutions to their problems.

AECOM has the people, experience and knowledge to successfully and expeditiously execute your emergency water interconnection evaluation

Because of AECOM's emphasis on local offices providing services to regions or states, our staff understands local regulatory agencies and applicable environmental and community regulations. We provide an advantageous combination of vast worldwide experience and local presence: the expertise of thousands of professionals in all disciplines, and the ability to apply that expertise to local, state- or region-specific issues. AECOM has repeatedly earned top rankings in Engineering News Records' (ENR) Top Design Firms Ranking.

LOCAL PRESENCE

Services under this contract will be managed from AECOM's Conshohocken, Pennsylvania which includes over 350 professional staff, including engineers, designers, planners, drafters, surveyors, geologists, GIS specialists, environmental professionals, construction review / management, and support staff.

Our contact information is:

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Associate Vice President
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Conshohocken, PA 19428
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chris.curran@aecom.com

Pennsylvania Ave PRV Building

The Conshohocken office is a full-service public works engineering and planning group specializing in all facets of municipal planning and engineering. A large percentage of our client base consists of municipal agencies, so our staff is well-versed in the issues that municipalities face on a daily basis as that is their primary focus. For many of our municipal clients, we are a one-stop shop for all of their needs. Our general services range from initial scoping and planning to design and construction. The Conshohocken office will be primarily supported by staff in our Newark, Delaware and Philadelphia, Pennsylvania offices. Subject matter technical leaders hydraulic modeling, water quality and pumping systems are available from across the country should any specific technical input be required.

In addition to our unsurpassed global presence, AECOM's emphasis on local offices providing services to regions or states, allows our staff to understand local regulatory agencies and applicable environmental and community regulations.

Water System Expertise – AECOM's team has extensive experience in every pertinent aspect of water distribution from both the hydraulic and water quality perspectives necessary for an effective and robust interconnection strategy.

AECOM KNOWS BETHLEHEM

We have performed work for the Authority under the Emergency Water Supply Study, therfore we are familiar with this project and the Authority's goals for this project.

AECOM was requested to develop an alternatives analysis to evaluate raw water supply vulnerabilities and identify options to provide resiliency to the water system. As part of the study, AECOM evaluated multiple alternatives for providing robust fault tolerance to the Authority's water system in the event of unforeseen service interrupting events. Alternatives considered permitting requirements, easement acquisitions, intergovernmental opportunities and challenges, capacity constraints and preliminary capital costs.

AECOM identified a number of known and potential vulnerabilities in the Authority's raw water supply system. If one of these vulnerabilities were to become compromised and cause an outage to the raw water supply system, the Authority would not have an alternative supply to meet the system demands of 15 MGD.

AECOM evaluated a number of alternatives to provide 15 MGD to the Authority's supply territory under an emergency condition. These alternatives included: improving existing and implementing new interconnections with neighboring systems; bypassing of the Wild Creek Reservoir to enable withdrawal from either reservoir; constructing redundant tunnels through Blue Mountain and Wire Ridge mountains; and providing new water supply sources and the necessary treatment including groundwater wells, the Lehigh River, and Beltzville Reservoir. The results of this evaluation provided the Authority with a plan to provide the most reliable and cost-effective approach to providing system resiliency including a combination of phased improvements to achieve a suitable emergency water supply approach.

> Staff from AECOM, working with LCA representatives, successfully performed a preliminary evaluation of the three existing Bethlehem-Allentown water interconnects. Further analysis of these interconnects by AECOM will help serve the region's water needs during emergency situations.

Phil DePoe, PE
LCA Capital Program Manager

OVERVIEW OF QUALIFICATIONS

AECOM completed the 2018 Bethlehem Authority Emergency Water Supply Feasibility Study to evaluate alternative emergency water sources to maintain raw water supply and system transmission capacity during catastrophic events. We identified several alternate emergency supply sources including enhancement of existing interconnections with neighboring water systems. The highest ranked alternative was enhanced interconnections with Lehigh County Authority (LCA), the Easton Suburban Water Authority, (ESWA) and Northampton Borough Municipal Authority (NBMA). However most of the existing interconnections have not been used for many years and some have never been tested so AECOM recommended a baseline evaluation of the existing interconnects before any improvements are considered further.

COORDINATION WITH INTERCONNECTING AUTHORITIES AND PA DEPARTMENT OF ENVIRONMENTAL PROTECTION (PADEP)

A critical part of this interconnection evaluation is efficient communication and coordination between the Authority, City, interconnecting water authorities and PA DEP. AECOM has completed several projects with multi-authority coordination and/or PA DEP. AECOM developed good working relationships with the ESWA, NBMA, Saucon Township and LCA during the Emergency Water Supply Feasibility Study and will continue this productive style of coordination with all interconnected water authorities during this evaluation.

AECOM has completed several other multiagency water and wastewater projects in the Lehigh Valley and we will leverage these experiences to coordinate the information exchange, meetings and site visits with project stakeholders.

WATER SYSTEM FLOW TESTING AND HYDRAULIC MODELING

Hydrant Flow Testing – AECOM knows that to develop a better understanding of the interconnected water system, field testing provides a direct measure of hydraulic conditions and pipe conditions as well as providing valuable data used for calibrating the hydraulic models used to gauge conditions system wide. AECOM has vast experience not only in conducting the field tests required but also in directing others to conduct the tests using strict protocol to maintain a high level of quality in the collected data. As part of Detroit's Capital Improvements Program Management, AECOM has conducted over 400 hydrant flow tests and over 150 C-Factor using AECOM staff and has prepared contract documents for another 450 hydrant tests and 200 C-Factor tests to be conducted by

subcontractors this summer. AECOM developed applications for field crews to enter data using handheld devices to facilitate data entry and provide instant validation of the data. The results of these tests are used to identify hydraulic deficient sections of water main and for calibration of their hydraulic model.

Hydrant Modeling– AECOM has extensive experience using computer modeling to evaluate and analyze water distribution systems. Using these models, we can identify deficiencies in water system being analyzed, and recommend solutions on a case-by-case basis to solve any identified problems. During the Emergency Water Supply Feasibility Study, AECOM modified the Authority's WaterGEMS model to assess the HGL in Bethlehem for different combinations of interconnection supplies during maximum day demand. Detailed discussions were held with LCA and ESWA to estimate the HGL in their system and the HGL from other utilities was estimated based on maintaining a minimum pressure of 50 psi at the interconnection. Using the WaterGEMS model, AECOM identified cases where booster stations are needed because simulated HGL of the connected utility was less than the HGL of the Authority's system.

Water Quality Considerations– Water quality of the interconnections is typically a concern related to the frequency and duration of the interconnection use. With short term usage, mitigating the anticipated reduced chlorine residuals would be the primary concern and chlorine boosters would likely be required. If longer term usage is required, considerations may include: chlorine boosters; corrosion control; and Trihalomethanes (THM) depending on potential water age issues. AECOM models water age at the extents of system interconnections as an indicator of potential water quality issues.

The Project Team's Modeling Lead, Lindle Willnow, is AECOM's Global Practice Coordinator for Hydraulic Modeling and recently served as chair of AWWA's Engineering Modeling Applications Committee. He brings 30 years of modeling experience to the team. Mr. Willnow has conducted a wide range of modeling services for water distribution systems including development and calibration of new models, use of existing models to assess impacts of development, assessing transmission capabilities and needs, and water hammer analyses

CONCEPTUAL INTERCONNECTION DESIGN

It is not enough to have a stated quantity of flow available from a neighboring utility. Fluctuations in demands and differences in topography mean that the hydraulic gradelines are likely much different in the respective systems. Supplying water from one utility to another means that pumping may be needed to lift the hydraulic gradeline to match the connected utility or that the pressure may have to be reduced. Many of the existing interconnections have pipe diameters that are too small to convey the flow rates that may be required to supply all of Bethlehem's demands during an emergency supply condition. For this reason, AECOM recommends increasing the diameter of water mains at connections to 12-inch to reduce head losses and minimize energy costs. For example, Northampton Borough operates at a higher HGL than Bethlehem so a pressure reducing valve would be required while most other connections will require pumping to lift the HGL from 23 feet to as much as 125 feet.

Another consideration is the permanence of these connections. For a short duration outage, temporary pumping may be

sufficient with hydrant connections at the interconnection site. For the interconnections to be available immediately, permanent installation would be needed though these could be implemented using self-enclosed, package pumping stations.

Booster Stations – Water supplied to the Authority's system via new or enhanced interconnections may require booster pumps to maintain system pressure. AECOM regularly designs booster pump stations for clients looking to address distribution system pressure / demand issues or to extend service areas. We have successfully worked with package station vendors and developed stand-alone pump station buildings depending on the site constraints and client needs. The hydraulic analysis of the system is essential to evaluate system head conditions. The Authority's WaterGEMS model could be used to evaluate the dynamic conditions of the system under different operating scenarios, help mitigate potential water hammer issues and ensure the pump system will deliver the flow and pressure during peak conditions.

> Construction was recently completed on AECOM's design of a 8 MGD water booster pump station for Pennsylvania American Water in Norristown, PA. The new booster pump station utilizes variable frequency drives, allowing for the accommodation of a variety of pumping condition requirements.

REFERENCES & PROJECT EXPERIENCE

AECOM is proud to present the following projects along with their references that will help speak to the simialr work our team has performed:

1

Emergency Supply Feasibility Study, Bethlehem, PA

Contact:
Edward J. Boscola, PE, Director - Water and Sewer Resources
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T: (610) 865-7207

2

Dover Water Distribution System Modeling and Water System Study, Dover, DE

Contact:
Jason Lyon, PE, Department of Public Works Manager, Water and Wastewater
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T: (302) 736-7025

3

On-Call Water Sytems Services, Pittsfield, MA

Contact:
Ricardo Morales, Commissioner of Public Services/Utilities
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T: (413) 499-9330

4

Newburyport Clearwell Response, Newburyport, MA

Contact:
Paul Colby, Former Superintendent of Water Operations
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T: (978) 994-6321

5

Pennsylvania American Water, Various Sites, PA

Contact:
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1 EMERGENCY WATER FEASIBILITY SUPPLY STUDY, Bethlehem, PA

Client
Bethlehem Autority

Related Services
Distribution System Hydraulic Modeling
Distribution Water Quality Modeling
Water Source Investigations
Conceptual Water System Design
Cost Estimating

Project Timeline
2017- 2018

Key Personnel
Chris Curran, PE
Lindle Willnow, PE
Patrick Morrison, PE
Jacob Rainwater, PE
Christopher Walker, PE

Client Reference
Edward J. Boscola, PE
Director – Water and Sewer Resources
City of Bethlehem
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T: 610-865-7207

The Bethlehem Authority (Authority) owns a public water system that is operated by the City of Bethlehem's Department of Water and Sewer Resources. The system serves approximately 116,000 customers via approximately 36,000 service connections in the City and 11 surrounding municipalities. The Authority owns approximately 22,400 acres of protected watershed property and two high quality raw water supply reservoirs, and the pipelines and other water system facilities to transmit, treat and distribute the water to its customers in the Lehigh Valley. In 2014, a natural gas pipeline was proposed that would travel through Authority watershed property. This caused the Authority and the City to re-evaluate their water supply and transmission facilities in the event they became compromised by a catastrophic failure of the NG pipeline if it were built, or if another type of event, such as a natural disaster, caused a similar failure of the facilities.

AECOM was requested to develop an alternatives analysis to evaluate raw water supply vulnerabilities and identify options to provide resiliency to the water system. As part of the study, AECOM evaluated multiple alternatives for providing robust fault tolerance to the Authority's water system in the event of unforeseen service interrupting events. Alternatives considered permitting requirements, easement acquisitions,

intergovernmental opportunities and challenges, capacity constraints and preliminary capital costs.

AECOM identified a number of known and potential vulnerabilities in the Authority's raw water supply system. If one of these vulnerabilities were to become compromised and cause an outage to the raw water supply system, the Authority would not have an alternative supply to meet the system demands of 15 MGD.

As part of the Emergency Water Feasibility Study, AECOM evaluated a number of alternatives to provide 15 MGD to the Authority's supply territory under an emergency condition. These alternatives included: improving existing and implementing new interconnections with neighboring systems; bypassing of the Wild Creek Reservoir, which usually operate in series, to enable withdrawal from either

EMERGENCY WATER FEASIBILITY SUPPLY STUDY *CONTINUED*

Bethlehem, PA

reservoir; constructing redundant tunnels through Blue Mountain and Wire Ridge mountains; and providing new water supply sources and the necessary treatment including groundwater wells, the Lehigh River, and Beltzville Reservoir. The results of this evaluation provided the Authority with a plan to provide the most reliable and cost-effective approach to providing system resiliency including a combination of phased improvements to achieve a suitable emergency water supply approach.

2 DOVER WATER DISTRIBUTION SYSTEM MODELING AND WATER SYSTEM STUDY
Dover, DE

Client
City of Dover Department of Public Works

Related Services
Distribution System
Hydraulic Modeling
Distribution Water Quality Modeling

Project Timeline
2011-2013

Key Personnel
Chris Curran, PE
Christopher Walker, PE
Patrick Morrison, PE

Client Reference
Jason Lyon, PE,
Department of Public Works Manager, Water and Wastewater
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Utilizing an existing InfoWater 7.0 Water Model, AECOM actively manages the City of Dover's hydraulic model of the distribution system and simulates distribution system improvements to aid in planning and design.

The City's water system is supplied by fifteen deep wells, seven shallow wells, 6 elevated storage tanks ranging in size from 0.25 MG to 1 MG, and 176 miles of distribution main up to 20 inch in size. The current average water demand is approximately 5.5 Million Gallons per day (MGD) with peaks as high as 9 MGD during the summer.

Recent modeling efforts have included:

- Evaluation of locations for an additional 1 MG Water Storage Tank and the impact to distribution system. Suggestions in control logic where developed to mitigate water age concerns that otherwise could have developed.
- Modeling the hydraulic impact of future development scenarios on the water distribution system including a 3,200 gpm demand for an energy plant and a 30,000 gpd demand from another significant industrial user.
- Evaluating the addition of a 1.5 MG elevated storage tank in the Garrison Oaks Technical Park (GOTP) and the proposed demand impacts on the distribution system and fire flow availability. Evaluate the new GOTP Tank filling cycles, pressure gradients, expected water turnover, and storage tank recovery time for the future demand scenarios and during fire conditions. Distribution and water supply infrastructure improvement recommendations were developed to allow for adequate water supply to the tank and GOTP during peak demand conditions from the Industrial Park.
- Modeling the well pump system curve for the proposed 550 gpm Piney Point Well. AECOM used this information as the design basis for a new well and treatment plant to serve the City.

Proposed 1 MG Elevated Tank Rendering

DOVER WATER DISTRIBUTION SYSTEM MODELING AND WATER SYSTEM STUDY *CONTINUED*

Dover, Delaware

The evaluation of the various tank locations considered water distribution system impacts including flow and fire protection, as wells as, water age and disinfection by-product formation. Below is a screenshot of the water age implications throughout the distribution system.

For the proposed Industrial Park, the water model indicates that Dover's existing system will require upgrades to maintain system pressure, provide required fire flows, maintain flow velocities, and meet demand continuously. A few upgrades were discussed including interconnections with new transmission mains.

Benefits Realized by the Client

- Evaluate distribution system improvements
- Assess capabilities of water distribution system for future demands.
- Assist with comprehensive planning.
- Simulate available flow, water age and pressures throughout the system.

3 ON-CALL WATER SYSTEM SERVICES
Pittsfield, MA

Client
City of Pittsfield

Related Services
Distribution System Hydraulic Modeling
Water System Interconnections
Water Source Evaluation
Booster Pumping
Water Distribution System Design

Project Timeline
2005 - Present

Key Personnel
Lindle Willnow, PE
Ron Mastrogiacomo, PE
Victoria Zabierek, PE

Client Reference
Ricardo Morales
Commissioner of Public Services/Utilities
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T: (413) 499-9330

AECOM, under a multi-year contract, is providing on-call services for various water projects in Pittsfield. The city's drinking water system, which serves a population of 42,000, includes six supply reservoirs, two water treatment plants with a total capacity of approximately 15 mgd, 241 miles of distribution pipelines, two flow control stations, five pumping stations, and five water storage tanks. Many of the projects under this contract involve water infrastructure improvements including treatment, distribution, and storage; emergency response planning; dam inspection, emergency action plan development / updates, and upgrades; and regulatory compliance support. Since 2005, AECOM has executed over 110 task orders. Task order contracts undertaken by AECOM to date include:

AECOM has worked with Pittsfield to provide redundant storage in two elevated pressure zones. We have also worked with neighboring communities that receive water from Pittsfield either on a continuous or seasonal basis.

Distribution and Storage

- Development of a hydraulic model of the water distribution system, including several updates.
- Development of an initial distribution system evaluation monitoring plan and report as required by the U.S. EPA's Stage 2 disinfection and disinfection by-product rule.
- Conceptual design, alternative analysis, final design, and construction services for replacing the Coltsville flow control station, including design of a new hydropower turbine that will produce up to 1,400 kW-hr per day of power The project included the addition of two tees and a butterfly valve in the 24-inch diameter pre-stressed concrete cylinder pipe (PCCP) Cleveland transmission main, which carries approximately 75 percent of the drinking water into the city of Pittsfield. The design included four hot taps of the existing transmission main to allow installation of two line stops and a bypass to allow the new work to be installed while maintaining flow into the city. The main was located in the middle of a major four-lane highway in the city requiring special coordination with the

ON-CALL WATER SYSTEM SERVICES *CONTINUED*

Pittsfield, MA

Massachusetts Department of Transportation, preparation of traffic management plans, and around-the-clock work to minimize traffic impacts. The project also included 650 feet of new 18-inch diameter transmission mains, 400 feet of new 16-inch distribution piping, and 700 feet of new 12-inch distribution system piping.

- Design and construction services for the installation of 5,400 feet of 12 inch and 8 inch water main on Hancock Road, including a new bridge crossing and an above grade crossing at a culvert crossing.
- Design and construction services for the replacement of 6,000 feet of water main and 1,200 feet of sewer on multiple roads throughout Pittsfield.
- Design and construction of the cement lining of 1,000 feet of 8 inch cast iron water main on West Housatonic Street.
- Design and construction services of a new 2 million gallon pre-stressed wire-wound concrete tank on Benedict Road.
- Rehabilitation of the two steel water storage tanks and one pre-stressed wire-wound concrete water storage tank and design of the rehabilitation of their interior and exterior coating systems and security improvements.
- Reviewed effectiveness of Pittsfield's water distribution system corrosion control program, which included a review of the potential impacts with the interconnection with the Town of Lenox.
- Evaluated potential locations for new storage tank for the Western Pressure Zone. Conducted detailed evaluations to select design characteristics of potential site at municipal airport.

Water Treatment

- Design and construction services for replacing an automatic transfer switch at the Cleveland water treatment plant and Ashley water treatment plant.
- Review of the city's procedure for calculating disinfection contact time in its water transmission mains.
- Evaluation of alternative coagulants at the Cleveland and Ashley water treatment plants to reduce the amount of aluminum being discharged into the sewer.
- Water treatment plant evaluation of the Cleveland and Ashley water treatment plants, which have reported capacities of 15-MGD and 8-MGD, respectively. The water treatment plants use the first generation of the Krofta Sandfloat dissolved air flotation technology.
- Piloting of the third generation Krofta Sandfloat technology at the Ashley water treatment plant.
- Design of a new chemical storage building at the Ashley Water Treatment plant.

4 NEWBURYPORT CLEARWELL RESPONSE
Newburyport, MA

Client
City of Newburyport

Related Services
Distribution System Hydraulic Modeling
Water System Interconnections
Water Source Evaluation
Booster Pumping
Water Distribution System Design

Project Timeline
2011- 2012

Key Personnel
Lindle Willnow, PE
Ron Mastrogiacomo, PE

Client Reference
Paul Colby, Former Superintendent of Water Operations
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In the fall of 2008, AECOM conducted an underwater inspection of the City of Newburyport's clearwell as part of a Water Treatment Plant Evaluation. Several structural deficiencies were identified in the clearwell prompting AECOM to develop emergency repairs in the wet to stabilize the clearwell. AECOM then worked with the City to develop a phased approach to upgrading the water treatment plant with the first phase consisting of constructing a new clearwell and pump station. During the design, frequent underwater inspections were conducted, and additional repairs implemented.

During construction of the Phase 1 upgrade in 2011, however, it was noted that the structural condition of the existing clearwell began to deteriorate quickly. While performing routine inspections, a diver observed that the cracks in the walls, floor and ceiling of the clearwell appeared to be getting worse and new cracks were appearing. Significant in-situ repairs were not practical because the clearwell could not be taken offline for an extended period. Finished water quality remained high, but the concerns over catastrophic failure of the clearwell required that an emergency action plan specific for a loss of the clearwell be developed, and remain in place until the new clearwell could be activated

When Newburyport's clearwell was in danger of catastrophic failure, AECOM prepared contingency plans for alternate supplies. Revised phasing plan allowed construction to proceed carefully to avoid damage to clearwell.

AECOM assisted the City with developing an emergency plan and coordinating with emergency responders, surrounding communities, the contractor, and the Massachusetts DEP. Responses were developed to address potential small failures (that could be fixed in less than 48 hours) or catastrophic failures. Agreements were set up with local emergency by-pass pump providers and on-call contractors; local water providers were contacted to determine how to distribute bottled water if needed; and local communities with interconnections were contacted to determine how much water they could provide and how readily it could be provided.

NEWBURYPORT CLEARWELL RESPONSE *CONTINUED*

Newburyport, MA

AECOM utilized Newburyport's WaterGEMS water distribution system model to assess the feasibility and logistics of obtaining emergency supply from two neighboring utilities. Newburyport's model was combined with the model of each adjacent system's model separately and model runs were conducted to assess system pressures and available fire flows with the interconnection active. Attention was paid to amount and duration of flow that could be available from the interconnections.

Further damage to the tank was prevented by minimizing vibration from construction equipment and traffic on the adjacent road. The top of the clearwell was heated through the winter to prevent the impact of a freeze thaw cycle. When the new tank structure was nearing completion, a work-around strategy was developed which allowed the new clearwell to be put on-line sooner than initially planned. This strategy utilized the new clearwell structure but in concert with the old backwash and finished water pumps, essentially "fast-tracking" the decommissioning of the old clearwell and backwash holding tank. This fast-tracking not only greatly minimized risk to the City but also saved cost by accelerating the project schedule and eliminating the need to procure temporary by-pass pumps and associated piping.

5 PENNSYLVANIA AMERICAN WATER
Norristown, PA

Client
City of Newburyport

Related Services
Interconnections
Booster
Trans mains
Hydraulic modeling
PRV Stations

Project Timeline
2011- 2012

Key Personnel
Chris Curran, PE
Kevin Pampuch
Chris Walker, PE
Patrick Morrison, PE

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Project Manager
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AECOM has performed work on a variety of Pennsylvania American Water (PAW) projects which includes:

Forrest Avenue Booster Pump Station:

The Forrest Avenue Booster Pump Station (BPS) increases system pressure from the Norristown Main Service gradient to serve the higher Suburban Main Service/Forrest gradient. Current capacity of the Forrest Avenue BPS matches the 2010 maximum daily demand for the system. Planned and approved developments within the limits of the station's service zone will result in a higher demand and the capacity needed from the Forrest Avenue BPS is expected to total 6.5 MGD by 2025, which is beyond the current station capacity. AECOM updated an existing hydraulic model of the system to simulate the new operational conditions for the pump station and determine pumping needs to satisfy future demands. Ultimately, the supply would also need to consider the Norristown-Royersord Interconnect which extends the present distribution service area.

The existing pump station was replaced under this project. The new station, a pre-engineered, packaged above-ground pump station. The station was set on a concrete foundation, with a field installed gable roof and brick exterior. The booster pump station is capable of delivering 6.5 MGD at 184 feet

Forrest Avenue Booster Pump Station

TDH to meet maximum demand conditions, with two pumps operating at 3.25 MGD each. Under more typical ADD conditions, the booster station delivers 5.0 MGD at a TDH of 173 feet via a VFD drive. In addition, the new pump station allows delivery of a total of 8.0 MGD at 196 feet TDH at maximum flow.

The project included the completion of all work required to prepare complete sets of bidding documents and all relevant permit applications.

In addition to the BPS and piping construction, AECOM designed the site grading, drainage, safety, security, etc. for the BPS. The design included all electrical, controls, and instrumentation required to monitor and operate the BPS through the PAWC SCADA system.

PENNSYLVANIA AMERICAN WATER *CONTINUED*

Various Sites, PA

AECOM assisted in the bidding of the pre-engineered, packaged above-ground pump station and the general construction bidding.

Norristown-Royersford Interconnect:

Water demand estimates have shown that that the Royersford District will face a supply deficit in coming years. Specific estimates predict a deficit of 1.35 MGD by 2025. Similar evaluations of PAW's nearby Norristown District determined that it has a surplus supply of approximately 2.63 MGD through 2025. **Based on this information and the close proximity of these districts, the PAW proposed an interconnect between the two systems to provide up to 1.5 MGD to the Royersford District. AECOM performed hydraulic modeling of the distribution system to determine the necessary pumping conditions to deliver the flow through the proposed interconnect and design a pressure reducing station to protect the infrastructure within the Royersford distribution system.**

Providence Road Booster Pump Station: The Providence Road BPS was constructed in 1966. Required improvements to the existing station would involve replacement of all major components except the structure, which would be about the same cost as replacing the existing station, and involve a significant risk of service outages and extra work discovered during construction. Due to the critical nature of this station, PAW determined it was not possible to take it out of service to perform this work; therefore, the existing pump station had to be replaced. The new station was a pre-engineered, packaged above ground pump station. The station was set on a concrete foundation and included a split face block façade and field installed gable roof. A new generator to run the facility at full capacity was installed in a split face block enclosure and equipped with critical silencer and integral fuel tank. The BPS was capable of delivering 5.0 MGD at 175 feet TDH to meet maximum demand conditions, with two pumps operating at 2.5 MGD each.

Transmission Main: To get the water to the Royersford district, approximately 10,500 linear feet of 16
inch main was installed via conventional open cut excavation within existing road rights-of-way and two sections of horizontally directionally drilled fusible C-905 PVC pipe. The first drill of 400 feet involved a 72 inch culvert crossing and the second drill of 1,300 involved crossing 25 feet under the Perkiomen Creek as well as avoid 60 inch and 48 inch sanitary sewer interceptors. PAW also required approximately 2,000 linear feet of 8 inch main be increased to 12 inch main to enhance system flows.

The design scope of work included completion of all work required to prepare complete sets of bidding documents and all relevant permit applications for three separate projects: the transmission main, BPS procurement and BPS installation and site improvements. AECOM designed the site grading, drainage, safety, security, etc. for the BPS including all electrical, controls, and instrumentation required to monitor and operate the BPS through the PAW SCADA system. We assisted in the bidding of all three projects as well as provided construction management.

SECTION 2

Project Team






SECTION 2

PROJECT TEAM

The AECOM team is extensively experienced in water treatment, hydraulics, distribution and design. Our Project Director Chris Curran, Technical Lead Lindle Willnow and Design Engineer Patrick Morrison all completed the Bethlehem Emergency Water Supply Feasibility Study which gives them a unique understanding of the City's need for alternate water supplies and the specific analysis needed to evaluate interconnections with surrounding water systems.

The organization chart on the following page illustrates the proposed project organization and the individuals selected for the team. Our project team is available to begin work for the Authority immediately upon selection and Notice to Proceed. The team's strength lies both in its diversity and depth of technical talent. Our organization is streamlined to provide responsiveness, cost efficiency, and access to the best technical resources.

We propose outstanding local managers and technical professionals who have demonstrated their ability to provide high-value, customer-oriented service.

PROPOSED STAFF

Services under this contract will be managed from AECOM's Conshohocken, Pennsylvania which includes over 350 professional staff, including engineers, designers, planners, drafters, surveyors, geologists, GIS specialists, environmental professionals, construction review / management, and support staff. The following key staff will be critcal to the success of this project:

AECOM is committed to providing a team that aligns with Bethlehem's goals for this project - that is why we are have strategically selected five technical experts who have previously worked on the Emergency Water Supply Study including;

- **Chris Curran, PE**
- **Lindle Willnow, PE**
- **Patrick Morrison, PE**
- **Jacob Rainwater, PE**
- **Christopher Walker, PE**

Chris Curran, PE
Project Director

Chris is the Water Business Unit Leader for the Greater Pennsylvania Area. Mr. Curran has over 20 years of experience in water / wastewater, environmental, and water resources engineering, including project management services and expertise with water main relocation, water treatment,

transmission and pumping stations projects. **Chris has served as a technical lead of a handful of similar projects including the Bethlehem Emergency Water Supply Study, Dover Water Distribution System Modeling and Water System Study, and several Pennsylvania American Water projects.**

Zachary Keegan, PE
Project Manager

Zachary brings over 15 years of engineering experience in the Water industry and a history of delivering successful project for Bethlehem. He will be supported by a team of professionals experienced in all engineering aspects of water treatment, hydraulics, distribution and design. **Zach has previous experience working with the City of Bethlehem on a number of projects including the Resiliency and Risk Assessment and various wastewater projects.**

Lindle Willnow, PE
Technical Lead

Lindle is a technical manager and leader of AECOM's Hydraulic Modeling technical practice work group. He has 28 years of experience in all aspects of the planning and design of large water treatment plants, water pumping and conveyance and distribution facilities. Mr. Willnow is an experienced expert in computer modeling and hydraulics, particularly concerning water distribution hydraulics and water quality. **Lindle was chosen for this project because of his knowledge of the Bethlehem distribution system and existing model as well as the hydraulics of the adjoining distribution system from our initial work. In addition, Lindle brings experience with Hydraulic Modeling on similar projects including Pittsfield Massachussetts On-Water System Services and Newburyport Massachussets Clearwell Response.**

Jacob Rainwater, PE
Interconnection Evaluation and Conceptual Design

Jacob has over 15 years of diverse experience in environmental consulting and extensive work in design, project management, engineering services during construction and environmental permitting and compliance for water and wastewater projects. **Jacob served as the Project Manager on the Bethlehem Emergency Water Supply Study and a number of similar projects that can be found in the resumes section.**

Patrick Morrison, PE
Interconnection Evaluation and Conceptual Design

Patrick is experienced in water storage and distribution, and conveyance. Based on his experience as a engineer for the 2018 Emergency Water Supply Study, Mr. Morrison understands the City's need for an interconnection evaluation, and he will support the concept design. Mr. Morrison's project tasks during the 2018 study included: design of alternatives; assistance with cost estimation; preparation of workshop presentation; and preparation of the final report summarizing the findings of the team. Given his role in the 2018 study, Mr. Morrison has a working knowledge of both the overall objective of the interconnection evaluation as well as the finer details of the interconnection locations and stakeholders. **Patrick has been instrumental in the Bethlehem Emergency Supply Study, Dover Water Distribution System Modeling and Water System Study and Various Pennsylvania American Water projects.**

Victoria Zabierek, PE
Distribution System Hydraulic Modeling

Victoria is a project engineer with 9 years of experience in various water and wastewater engineering projects including; water and wastewater treatment, water pumping and distribution facilities. **Victoria's experience has made her proficient in many modeling software programs such as InfoWater, Water/SewerGEMS.** She has been part of AECOM's Hydraulic Modeling Group working directly with Lindle for the past 6 years.

Christopher Walker, PE
Water Quality Considerations

Chris has 14 years of experience with expertise in water treatment processes / water chemistry; water treatment facilities design; analysis, modeling, and design of water distribution systems and water storage facilities. **Chris will be a technical resource for this project, related to water quality considerations associated with interconnection of water supplies.**

Kevin Pampuch
Conceptual Pumping/PRV Station Design

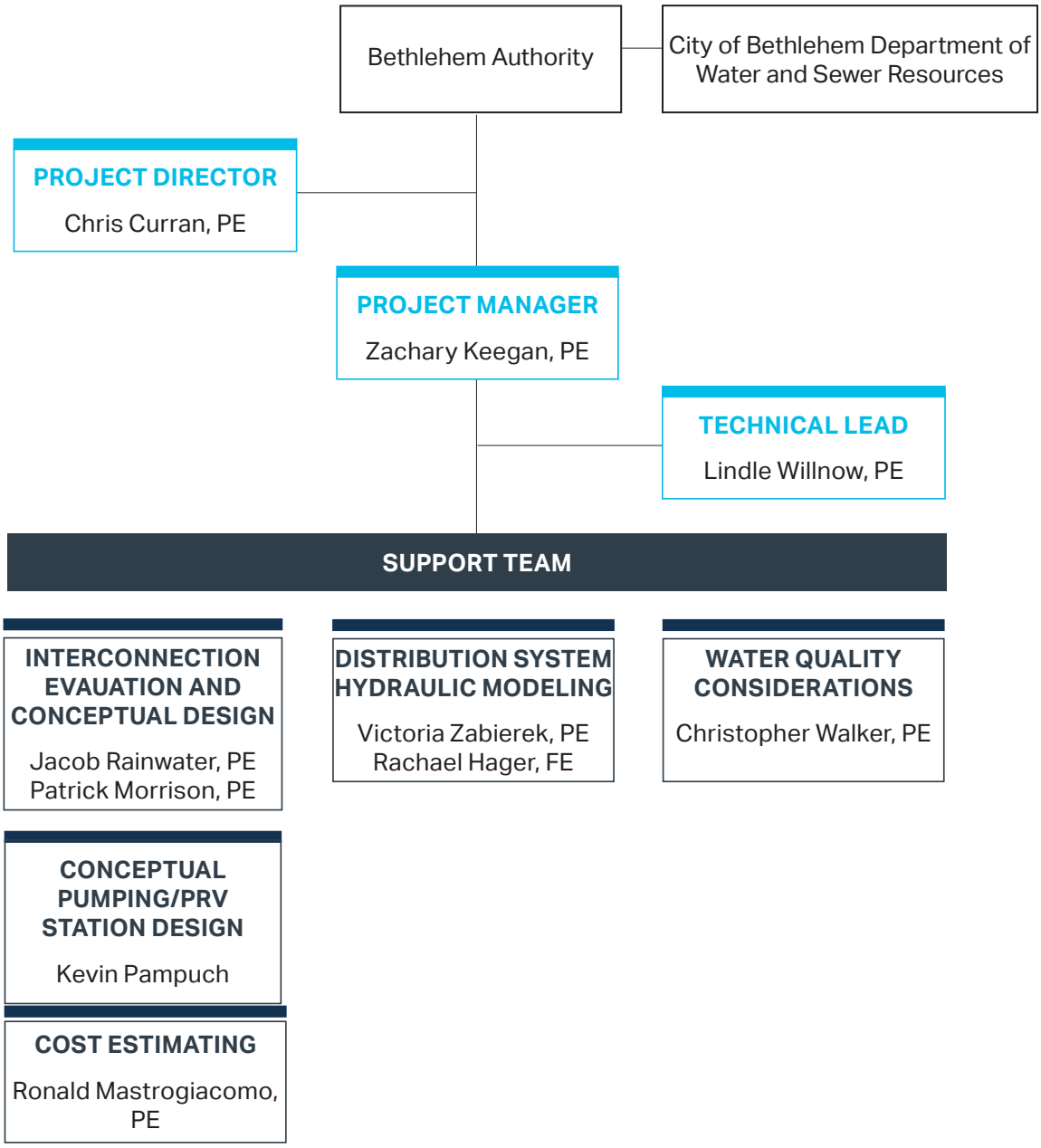
Kevin has served as Project Engineer for municipal, industrial, and privately owned projects for more than 30 years. He has extensive experience in the design of potable water pumping, filtration, chemical treatment, elevated storage tanks and distribution facilities. **Kevin was chosen for this project because he will leverage his previous experience to evaluate pumping and PRV needs at interconnections and will produce feasible concept layouts.**

Ronald Mastrogiacomo, PE
Cost Estimating

Ron is a chief estimator responsible for preparing capital cost estimates, reviewing estimates, and estimating policy and procedures throughout the company. He has 30 years of experience in the design and construction management of water, wastewater, and civil projects. **Ron's expertise in cost estimating on similar projects has made him the right selection for this project.**

ORGANIZATION CHART

AECOM has hand-selected the following professionals for their technical experience and expertise to provide the most collaborative team for the City of Bethlehem:



SECTION 3

Scope of Services






SECTION 3

SCOPE OF SERVICES

As a result of a 2014 proposal to construct a natural gas (NG) pipeline that would travel through Authority watershed property in Carbon County, the Authority and the City re-evaluated the reliability of their water supply and transmission facilities. Should any of these facilities become compromised by an event like the catastrophic failure of the NG pipeline (if it were built) or by another event, such as a natural disaster, alternate sources of supply and or transmission would be needed to maintain operations.

PROJECT UNDERSTANDING

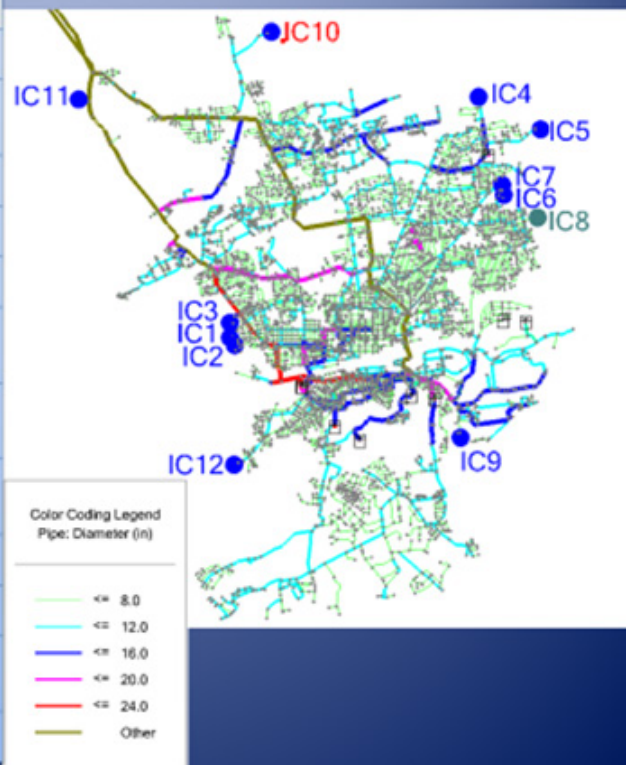
An Emergency Water Supply Feasibility Study (Study) was completed by AECOM utilizing input from the Authority, the City, regulatory agencies, and surrounding municipalities. This feasibility study provided a high level overview that evaluated multiple alternatives for providing robust fault tolerance to the Authority's water system and provide 15 MGD to the Authority's supply in the event of unforeseen service interrupting events. Alternatives included in the feasibility study were enumerated in terms of advantages and disadvantages, permitting requirements, easement acquisitions, intergovernmental opportunities and challenges, capacity constraints and preliminary capital costs. Alternatives evaluated by AECOM included: improving existing and implementing new interconnections with neighboring systems; bypassing of the Wild Creek Reservoir; constructing redundant tunnels through Blue Mountain and Wire Ridge; and providing new water supply sources including groundwater wells, the Lehigh River, and Beltzville Reservoir. Of the options identified, the interconnections (Shown on Figure 1) were the most favorable alternative and AECOM recommended a more thorough evaluation of the existing interconnections to identify any additional capital improvement projects needed as well as validate the selection of the most suitable emergency water supply approach.

The enhanced interconnections recommended by AECOM included bolstering existing interconnections with Lehigh County Authority (LCA), the Easton Suburban Water Authority, (ESWA) and

Northampton Borough Municipal Authority (NBMA) as well as establishing new connections with these utilities as well as with Bath, Hellertown and Upper Saucon Township. Many of the existing interconnections have not been used for many years, some have never been tested, while others are potential connections. For these reasons, AECOM recommended a baseline evaluation of the existing interconnects before any improvements are considered further.

Locations of Interconnections

Inter-connect No.	Zone	Notes	Utility
1	Bethlehem - Main	Allentown- W Broad and Hanover Interconnect	Allentown
2	Bethlehem - Main	Allentown- Central Park West and Florence Interconnect	Allentown
3	Bethlehem - Main	Allentown- Club and Tremont Interconnect	Allentown
4	Bethlehem - Main	Easton Interconnection Heckton Rd.	Easton
5	Bethlehem - Main	Easton Interconnect Green Pond Rd	Easton
6	Bethlehem - Main	Easton - Tamarind Dr. and Scherman Blvd (potential)	Easton
7	Bethlehem - Main	Easton - Scherman Blvd at Wm Penn Hwy (potential)	Easton
8	Bethlehem - Main	Easton - Sapphire Lane and Carter Road (potential)	Easton
9	Bethlehem Main - Southside	Hellertown Connection	Hellertown
10	East Allen Township	Bath Interconnects	Bath
11	Howertown South	Northampton Borough Interconnect - Savage Rd.	NBMA
12	Southside High Level	Salisbury Twp.. Interconnect	Salisbury

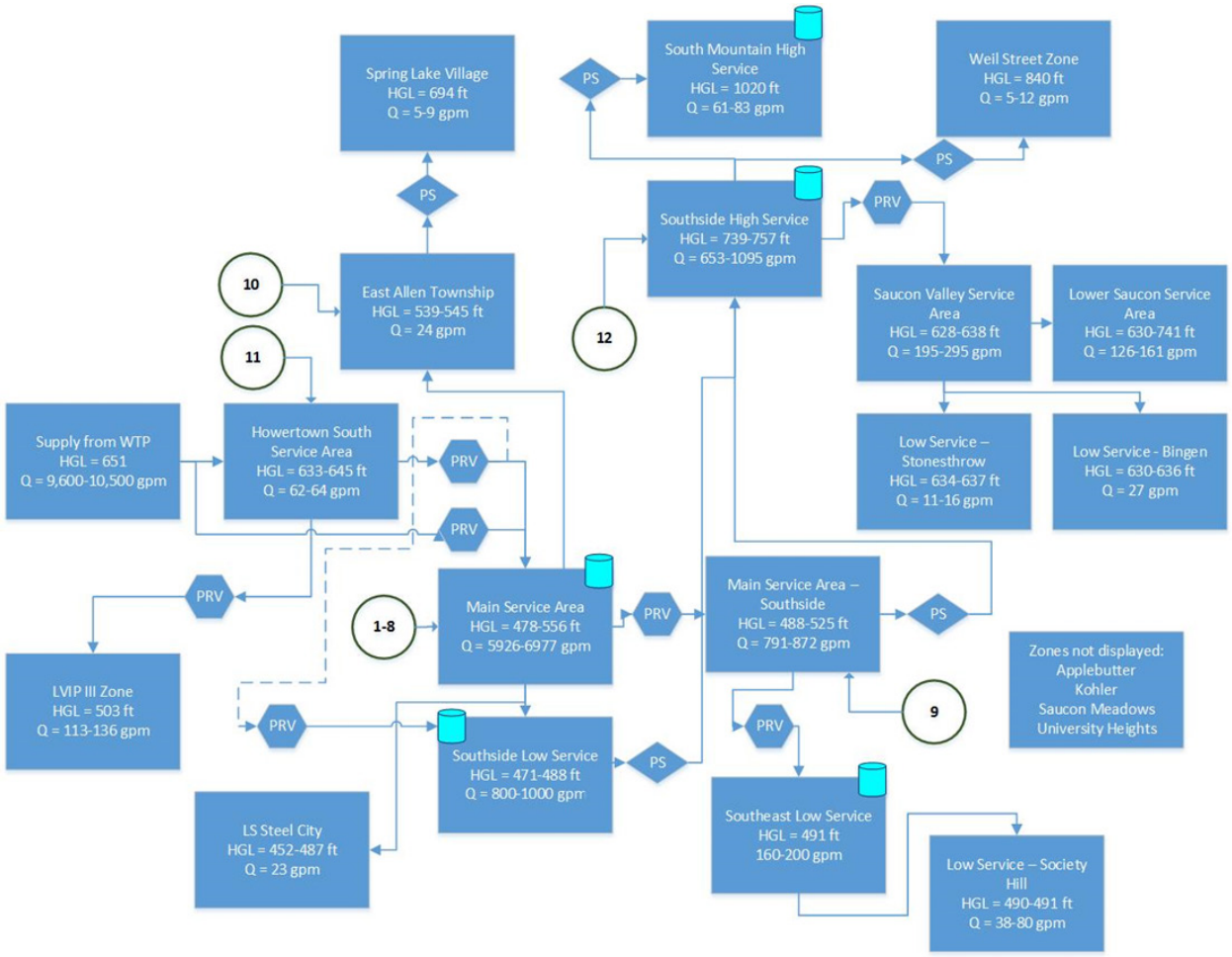


3.1: Locations of Interconnections

Bethlehem has interconnections in several different pressure zones in various states of implementation. Some are active with contracted supplies, some are active with unspecified supplies, some are potential

Because of the nature of the Bethlehem system with multiple pressure zones, simply having a connection between the system may not be sufficient to supply all demands for Bethlehem. AECOM has a strong working knowledge of the pressure zones and their associated demands and with the hydraulic implications of making connections to various zones.

Supplies from external utilities must account for the multiple pressure zones in Bethlehem. Additional pumping and or pressure regulation may be needed to get water to where it is needed. AECOM understands the spatial demand distribution and facilities used to control flow through the system.



3.2: City of Bethlehem Water Distribution System Flow Schematic

Provision of adequate water supply to meet all demands within Bethlehem during an emergency will require activation of multiple interconnections with other utilities. Some connections will require pumping to match the hydraulic gradeline in Bethlehem while other could require pressure reduction.

In addition AECOM will design to improve interconnections with LCA, ESWA and NBMA and assess the potential to provide a multidirectional interconnection with Upper Saucon Township. AECOM will direct evaluations of the baseline conditions of these interconnections with LCA, ESWA and NBMA to assess the operational status and potential flow rates and pressures that are available at each location. These evaluations will involve coordination with each system's operations and engineering departments as well as the PA Department of Environmental Protection (PADEP) regarding regulatory issues. The result of these efforts will be a revised set of recommendations accompanied with conceptual designs of improvements for the physical interconnections as well as recommendations for system improvements in the Authority's and in the connected systems.

The following are three main tasks for the evaluation:

- Task 1 - Flow Testing Work Plan and Witnessing
- Task 2 - Interconnection Analysis and Hydraulic Modeling
- Task 3 - Conceptual Design of Interconnections and Booster Stations

TASK 1 FLOW TESTING WORK PLAN AND WITNESSING

Efforts in this task will include developing the work plan for testing, witnessing and assisting the City and other utilities with the testing, and coordination with Upper Saucon on the potential interconnection with that system. The goal of hydrant testing will be to achieve flow rates from open hydrants that approach the maximum flow rate planned for the interconnection.

1. Testing existing primary interconnections (LCA, Easton , and NBMA). These locations will require hydrant flow testing in both systems. If possible, the interconnection may be activated (while isolated from the rest of the system to assess the flow potential through the interconnection and measurement of pressures. Also if possible, the impact on Bethlehem's system can be assessed through use of temporary pumping (such as fire pumper truck) from one system into Bethlehem.
2. Testing potential interconnections – These locations will require hydrant flow testing as close to the potential interconnection location as possible using at least one hydrant for flow and at least two hydrants to static and residual pressure measurements. Connections to be assessed include:
   3.1. LCA (Hanover Township, Emmaus Ave.)

Key Data to be Collected:

- Static System Pressures at Interconnection - Both Utilities
- General Site Conditions
- Flow Rate (s) and Hydrant Discharge
  - pH
  - Temperature
  - TOC
  - Chlorine Residuals
- SCADA readings of tank levels, pumped flow rates, measured pressures
- Reported pump status and control valve settings

3.2. Easton (Scherman Blvd., Sapphire Lane)

3. Testing LCA East Side Reservoir connection – For this connection, testing will occur in Allentown near the Eastside reservoir and possibly near other locations where the transmission main from the reservoir may connect with LCA's existing system. This approach would significantly alleviate impacts to the eastern Allentown service area and likely deliver a higher pressure since only one transmission main would supply water to the point of delivery. The costs of the extended piping would have to be balanced with the potential savings related to a proposed booster pump station and overall number of interconnection improvements with LCA. This would be an additional task that could be done if desired by the Authority, but presently outside our scope of services and budget). *This is an additional task - not included in scope of services*

TASK 1.1 DEVELOP WORK PLAN FOR FLOW TESTING

AECOM will develop separate, detailed Flow Testing Work Plans for each of the three primary interconnecting Authorities (NBMA, Easton, LCA). This would involve coordination with each Authority on the specific details of the testing and will be tailored to the existing conditions in each system. In general, each plan will include the following actions to be taken prior to testing:

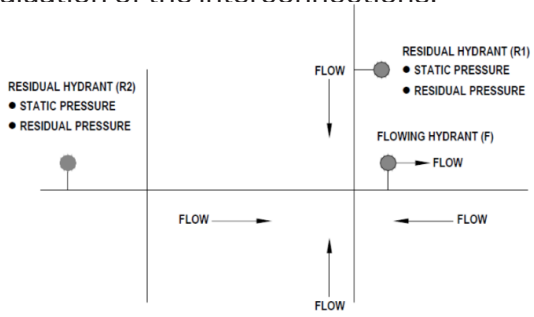
- System-Wide Conditions
    - Note any changes in system operations and/or pumping and storage facilities that have been put in place since development of the study
    - Confirm settings of control valves and automated controls
    - Identify changes in system operations to be in place during testing
    - Record current demands and note trends and changes in available supplies
    - Evaluate each system's typical water quality parameters (pH, type of disinfectant, corrosion control chemicals, TOC, temperature, etc.). Consider regulatory and chemical issues relative to intermixing of supplies when considering test method.
- Interconnection Specific Conditions
    - Assess availability of SCADA sensors near the interconnections that record pressures
    - Assess condition and location of system assets near connections. For existing connections, evaluate existing valves and meters. For all connections, identify locations of hydrants and valves that could be accessed during testing.
- Testing Equipment Review
    - Review equipment availability and condition. Coordinate equipment rental, if needed.
    - Develop testing procedures including safety procedures, minimum acceptable pressures, disposal of water, time of day and QA/QC requirements

Hydrant flow testing will entail opening hydrants and measuring flows discharged from the hydrants while measuring pressures at nearby hydrants before, during and after the hydrant flow. In addition, readings from system SCADA sensors will be collected to supplement the field data. Tests

will be scheduled to account for existing demands, staff schedules, and potential impacts on customers in the vicinity of the test locations.

TASK 1.2 OBSERVE AND ASSIST DURING FLOW TESTING

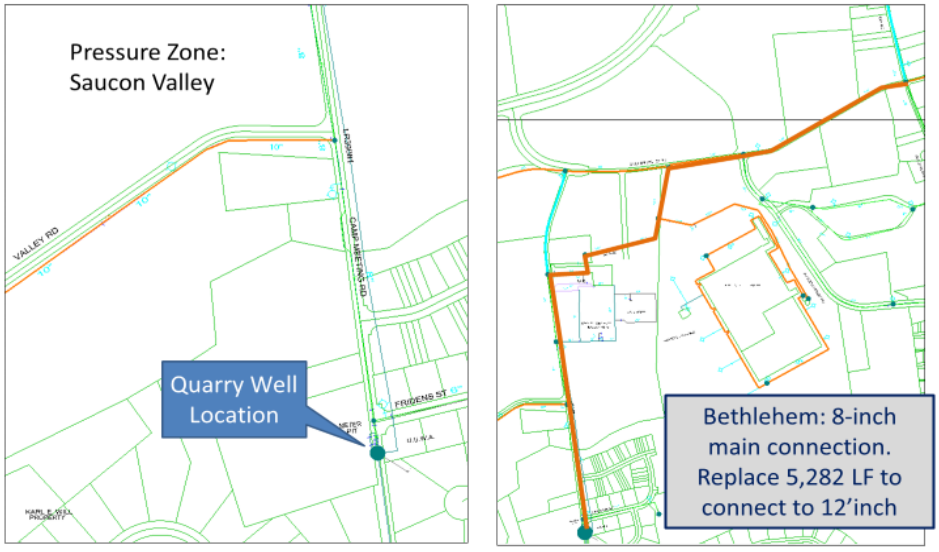
AECOM will work closely with the City as the City staff performs the flow testing and also measure flows and pressures. Where possible, AECOM will also work with the connected utilities as they conduct testing in their systems. Locations for simultaneous pressure measurements will be identified by AECOM for at least three locations during each flow test to record static pressure and residual pressure. Where allowable, interconnections will be activated, and pressures will be measured in both systems. At other locations, a hydrant will be opened as close to the interconnection as possible. At each test, flow rates will be measured with pressure readings taken before, during and after opening the flowing hydrant. At the start of each day's testing, AECOM will review the planned testing locations, go over testing protocol which includes equipment calibration, review of safety procedures, and overall communication plans. On the initial testing date, AECOM will witness flow testing to review field protocols for data collection, monitor data collection, and review daily breakdown procedures. On subsequent dates of testing, AECOM will be available to advise on modifications that arise from changed field conditions. As the testing progresses, AECOM will work with the City and connected utilities to obtain SCADA readings from Authority and connecting utility systems. The SCADA data will be assessed for validity and applicability to the evaluation of the interconnections.



3.3: Typical Flow Testing Schematic

TASK 1.3 COORDINATION WITH UPPER SAUCON TOWNSHIP ON POTENTIAL INTERCONNECTION

The potential supply from Upper Saucon Township is at the site of the former Zinc mine and supply pump located at the Eastern Industries site on Camp Meeting



3.4: Interconnect No. 13: Upper Saucon Quarry Wells at Campmeeting Rd.

Road where the existing blending station is located. Depending on the amount of flow supplied, the infrastructure requirements in Bethlehem will vary. Higher supply rates may require larger pipes and pumping within Bethlehem. There is also potential finished water supply from Upper Saucon's finished water system to Bethlehem four (4) interconnects with Bethlehem and booster stations would be required based on relative HGLs. AECOM will coordinate with Upper Saucon Township to review potential supply quantities and the actual requirements for this option. Coordination will be conducted with Bethlehem regarding the interconnection and internal infrastructure requirements to further refine this option.

TASK 1.4 COORDINATION WITH LCA ON EASTSIDE RESERVOIR CONNECTION *(additional task, not included within the Scope of Services)*

The AECOM coordinates with LCA on the logistics adding a new transmission main between LCA's Eastside reservoir and the Florence Avenue interconnection. AECOM will perform a site walkover with LCA Staff to review pipeline routes and internal connections and further refine this option.

3.5: Lehigh County Authority: Potential Pipe Route from Eastside Reservoir to Florence Connection

Upper Saucon Township Connection Options

1. Low flow (<400,000 gpd)
   - Use four existing connections each with booster station
2. Limited Flow (2<MGD)
   - Booster station at Quarry Well
   - Serve Saucon Valley zone
   - Add 5,300 LF of 12" main
3. Higher Flow Rates (2-4MGD)
   - Booster station at Quarry Well
   - Fill Southside High Service Reservoir
   - Add 23,500 LF of 16" main
   - Booster Station at Saucon Valley PRV Station

LCA Eastside Connection

1. Evaluate potential routes for piping from closest reservoir to existing Florence Ave Inter-connection
2. Consider additional connec-tions within the LCA system to bolster their system
3. Consider overland routes vs. routes through existing streets
4. Identify potential stream crossings or other locations with special permit require-ments
5. Potential benefit of increased supply to reduce overall inter-connection improvements with LCA at multiple locations and elimination of booster pump

TASK 2: INTERCONNECTION ANALYSIS AND HYDRAULIC MODELING

Using the results of the field testing and further communications with the associated utilities, AECOM will refine the hydraulic modeling analysis of the existing and potential interconnections to better define the piping and equipment requirements for each connection. In addition, the potential long and short term water quality impacts of the connections will be reviewed. The subtasks included with this task include the following:

Coordination with Utilities

AECOM will work with modeling staff at the connected utilities to establish the parameters and scenarios for assessing the interconnections. The results will be reviewed considering acceptable levels of service for the utility. If activation of the interconnection has the potential for adverse impacts on the supplying utility, additional modifications may be considered to improve the feasibility of the interconnection and reduce impacts.

Hydraulic Modeling of Interconnections

The collected field data from SCADA and the flow tests will be compiled and reviewed for use in hydraulic models of the City's system and of the connected utilities' systems. AECOM will conduct the modeling efforts using the City's WaterGEMS model while coordinating with the other utilities to set up and run their own modeling scenarios using their models. The modeling scenarios will simulate the proposed flow rates from the connected utilities. AECOM will update the modeling scenarios evaluated for the Emergency Water Supply Study to account for changes within the Bethlehem system and incorporate the field testing results. These scenarios will be re-run to assess the conditions within the Bethlehem system.

Assess Water Quality Impacts of Interconnected Supplies

AECOM will work with adjoining Authorities to obtain water age information from their models at the point of interconnection to then assess overall water age to City customers using the Bethlehem model from these supplies during interconnect periods. We would limit the water quality evaluation to water age alone as other analyses would require a more intensive sampling program than warranted for this level of evaluation. AECOM will create extended period simulations of connected systems to set up water age. Adjust model controls to allow storage tanks to have continuous fill and draw each 24 hour period. The model results will be reviewed to assess locations where significant differences in water age could be expected from current conditions to the potential interconnected scenarios.

Goals for Updated Recommendations

1. Combined interconnected supply of up to 13.5 mgd
2. Reduced pressure losses through interconnecting piping
3. Account for local site conditions
4. Avoid unacceptably low pressures in supplying system
5. Account for seasonal operation changes in supplying utilities
6. Adjust internal facilities (PRV's, pump stations, tank settings)
7. Account for water quality differences and increased water age from distant sources

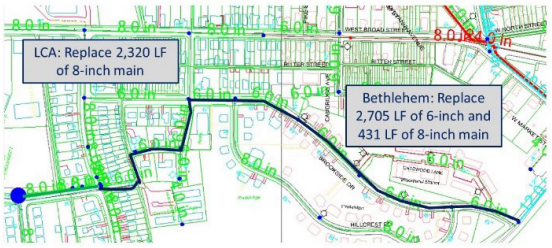
If extended period simulation (EPS) model for Water age is not feasible, AECOM will conduct desktop analysis to estimate age based on pipe velocities and lengths from sources to interconnections and within Bethlehem.

Update Recommendations based on Site Investigations

AECOM will revisit the Study's initial recommendations on interconnect capacity and refine its initial recommendations and budgetary costs to reflect the better understanding of hydraulic conditions at the interconnections. We will use the field testing as an opportunity to assess existing surface and subsurface conditions as well as site power and telemetry options. We will walk the pipe routes to determine available trench locations.

The set of interconnections selected for development in conceptual design will be capable of supplying up to 15MGD to Bethlehem for an extended duration while addressing hydraulic impacts on both systems. These selected interconnections will be chosen based on impacts on both utilities, likelihood of approval, constructibility, among other criteria. Once selected, we will present the updated recommendations in a technical memorandum for discussion with Bethlehem and then proceed to concept design.

Lehigh County Authority:
Central Park West and Florence



3.6: Interconnect No. 2 Lehigh County Authority: Central Park West Florence

TASK 3: CONCEPTUAL DESIGN OF INTERCONNECTIONS AND BOOSTER STATIONS

Using the updated recommendations developed in Task 2, AECOM will develop Conceptual Designs for each Interconnection. The conceptual designs will include layout sketches showing piping routes between transmission mains in either system plus more detailed sketches of the flow meters and pumping and/or pressure regulating stations that may be needed at the interconnection. In addition to these sketches, detailed listing of the infrastructure requirements of the interconnections will be prepared along with a summary description of the interconnection.

Conceptual sketches for the interconnections will be prepared on uniform layout pages using GIS data on the City's and connected utility's water main infrastructure along with other available background layers.

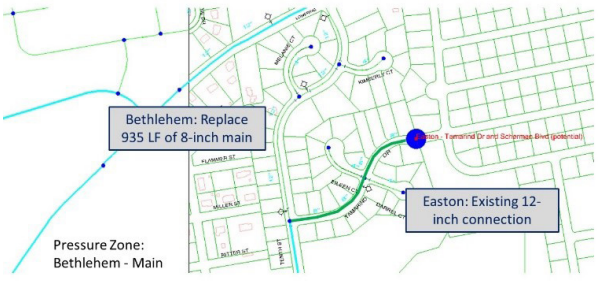
Considerations for Existing Interconnections

1. Increase diameter to 12 inch from closest transmission main (greater than 12 inch diameter)
2. Condition of existing meter vault
3. Locations for other facilities (if required)
4. Identify available electrical power
5. Assess other utilities above and below ground

Pertinent details of the interconnections will be listed on the layout sheets. Subsurface utility scanning and available parcel research can be completed under separate proposal if desired to further refine the concept designs, but is not included in the present Scope of services.

At a minimum, each interconnection will include flow meters, isolation valves, bypass lines, hydrants for testing, telemetry and electrical connections. Critical components, such as flow meters, will be housed in vaults with heating to prevent freezing, and sump pumps (or gravity drains) to prevent inundation. If necessary, facilities for chemical feed, such as disinfectant or corrosion control, would be included. At interconnections requiring pumping and/or control valves, the station conceptual layouts will be included in the sketches. AECOM will discuss the typical pump station to be used. Options include packaged pump stations that could be buried in a preconstructed vault or in a self-enclosed structure to which simple piping connections are needed. Alternately, the interconnection could be piped up to allow bringing portable pumps to the site during times when the interconnection is active.

Figure B-8: Interconnect No. 6: Easton: Tamarind Dr and Scherman Blvd. (Potential)



3.7: Interconnect No. 6: Easton: Tamarind Dr and Scherman Blvd. (Potential)

AECOM will communicate with the local electrical utility to determine that sufficient power is available at the site or identify additional electrical requirements to deliver power to the site. Options for portable power generation and/or use of renewable resources will also be explored.

Quantity takeoffs for each interconnection will be developed for preparation of preliminary opinions of probable construction costs. The concept designs will consider additional interconnection infrastructure improvements that could make the interconnections bidirectional allowing Bethlehem to supply water to the adjacent system as well with mutual benefits to both interconnection partners. Based on discussions with the utilities, AECOM will preliminarily define the divisions of responsibility, scope and cost with each interconnection partner.

Considerations for Potential Interconnections

1. Identify routes for 12-inch diameter piping from closest transmission main (greater than 12-inch diameter)
2. Condition of existing surface treatments (pavement, etc.)
3. Locations for meter vault and other facilities (if required)
4. Identify available electrical power
5. Assess other utilities above and below ground

DESCRIPTION OF FINAL WORK/DELIVERABLES

AECOM will coordinate all activities, including requests, and review of pertinent documents, agreements, maps, etc. with the Authority, the City and neighboring utilities. We will include the Authority and the City in all discussions, meetings, site visits, etc. with other entities as required during the course of the Evaluation work. In the course of the concept design development, AECOM will prepare the following deliverables for review by the Authority and the City:

Task 1

- City of Bethlehem Testing Work Plan
- LCA Testing Work Plan
- EESWA Testing Work Plan
- NBMA Testing Work Plan
- Upper Saucon Township Testing

Work plans for Bethlehem and neighboring utilities may be submitted as a single package for review.

Task 2

- Updated Recommendations Memorandum

Task 3

- Concept Design Drawings

All deliverables will be submitted as a draft for review and comment and then as a final version after comments have been addressed. The deliverables for Tasks 1 and 2 will be submitted as technical memoranda with the final versions included the final Concept Design. The Concept Design drawings and Report will be submitted as a single package. These will be submitted in the following formats: Adobe Acrobat (pdf), Microsoft Word (docx), and three hard copies.

SECTION 4

Hourly Rates and Cost Estimate






SECTION 4

HOURLY RATES AND COST ESTIMATES

The following year 2020 billing rates include general overhead, profit and nominal expenses. These billing rates are updated annually. Individual billing rates are determined using our direct salary costs and set multipliers for field and office staff. Charges for contract personnel under our supervision and using our facilities will be billed according to the hourly rate corresponding to their classification. Communication, transportation, and any special equipment required or requested for the project will be billed as a direct expense unless otherwise noted. Transportation costs will be billed by computed mileage using the most current GSA approved rate.

HOURLY RATES

Classification	Hourly Rate
Senior Principal Professional	$170.00 - $260.00
Principal Professional	$160.00 - $210.00
Project Professional / Construction Manager	$140.00 - $180.00
Senior Professional	$100.00 - $155.00
Staff Professional	$75.00 - $135.00
Staff Designer	$50.00 - $125.00
GIS	$75.00 - $120.00
Project Field Technician	$65.00 - $125.00
Administrative Staff	$60.00 - $115.00
Survey Crew (2 Person)	$140.00 - $185.00
Survey Crew (3 Person)	$180.00 - $245.00
Contract Services and Equipment Rentals	1.1 times our cost

NOT-TO-EXCEED COST ESTIMATE

AECOM proposes to perform the scope of services described above on a Time and Materials Not to Exceed basis for **$55,500** per the terms of a mutually agreeable Consulting Engineer Services Agreement. The proposed fee will not be exceeded without written approval from the Authority. The proposed cost per task and total resource hours are presented in the following table:

Task	Hours	Fee
1. Flow Testing Work Plan	62	$9,000
2. Interconnection Analysis and Hydraulic Modeling	200	$23,800
3. Conceptual Design of Interconnections and Booster Stations	162	$22,700
TOTAL	**424**	**$55,500**

ASSUMPTIONS

The following assumptions have been made by AECOM regarding this proposed scope of services:

- The Authority will handle all public notifications associated with the field testing.
- All field testing will be conducted by utility staff. AECOM will have observers at each test site to assist with test preparation and data collection. AECOM staff will not operate any installed equipment.
- Interconnection Flow Tests are assumed to be hydrant testing to achieve flow rates from open hydrants that approach the maximum flow rate planned for the interconnection. Other flow test methods such as temporary pumping across the interconnection are not proposed.
- Flow test witnessing is assumed to require two 8 hour days from one AECOM Staff Professional and will include flow test witnessing of 3 existing interconnections with LCA, 2 existing and 2 potential interconnections with ESWA and 1 existing interconnection with NBMA.
- All equipment to be used for testing will be supplied by Bethlehem and/or or the neighboring utility. This equipment should have been recently calibrated.
- SCADA data for the dates of testing will be supplied by the Authority as well as the neighboring utility. Operating logs will also be supplied to provide supplemental information on system operations.
- Water quality data will be provided by the City and interconnecting authorities. Additional sampling and water quality analysis of potential water supplies are not included.
- The water filtration plant and existing system booster pumping stations are not a specific focus of the study as we assume redundancies already exist with the unit operations and pumping. Impacts of the interconnections on existing operations of these facilities will be identified by AECOM.
- GIS data supplied by Bethlehem and neighboring utilities is reasonably up to date. Site investigation by AECOM will be limited to site walkovers.
- Booster pump station conceptual evaluations will be limited to prefabricated systems such as those provided by EFI. Masonry enclosures and roofing systems can be provided for improved architectural appearance.

- AECOM will limit the Saucon Township evaluation to the hydraulics alone. Provisions for treatment and the generation of opinions of probable cost for any necessary treatment for hardness will be under separate authorization.
- The proposal excludes evaluation of water treatment alternatives, electrical/structural/ architectural design, and evaluation of interconnection agreements.
- The proposed fee assumes the evaluation of up to 6 booster pump stations based on our understanding of the interconnection conditions.
- Project meetings, coordination with interconnecting authorities and regulators is assumed to be conducted via conference calls due to unknown restrictions related to COVID-19.
- Opinions of Probable Cost will be based on vendor quotes and recent bid tabulations from local projects.

APPENDIX

Resumes






Chris Curran, PE
PROJECT DIRECTOR

Education
MS, Environmental Engineering, Pennsylvania State University
BS, Civil Engineering, Virginia Polytechnic Institute and State University

Years of Experience
23

Licenses/Registration
Professional Engineer, DE, MD

Affiliations
Water Environment Federation
American Public Works Association
Pennsylvania Water Environment Association

Mr. Curran has more than 23 years of experience in water, wastewater, environmental, and water resources engineering, including project management services for water and wastewater treatment design, cost estimating, and construction administration.

Project Experience

Wastewater Treatment Evaluation, Bethlehem, PA. Project Director for the evaluation and recommendation of treatment improvements to address an administrative limit on Plant capacity of 20 MGD and assess the impact of pending nutrient regulations on facility needs. Project will assess alternate phased approaches including Chemically Enhanced Primary Treatment, granular activated sludge, side stream treatment of high strength centrate flows with bio-augmentation and aeration improvements along with wet weather management.

Forrest Avenue Booster Pump Station (BPS) and Royersford Interconnect, Pennsylvania American Water Company, Norristown, PA. Project manager for design of new BPS and piping including site grading, drainage, security, safety, and electrical, controls, and instrumentation required to monitor and operate the BPS through the SCADA system. Providing bidding assistance and engineering/construction administration services during construction. The BPS will be capable of delivering 6.5 MGD at 184 feet TDH to meet maximum demand conditions, with two pumps operating at 3.25 MGD each. Under more typical ADD conditions, the booster station will deliver 5.0 MGD at a TDH of 173 feet through a VFD. The new pump station will allow for and delivery of a total of 8.0 MGD at 196 feet TDH at maximum flow.

Water Modeling Support, City of Dover, DE. Project Manager for InfoWater modeling evaluation of new hydraulic components to the distribution system. 1 MG and 1.5 MG elevated storage tanks have been modeled to evaluate optimal location, impact on pressure and fire flow, and impacts to well pumps and water age / quality issues in distribution system.

Pennsylvania American Water Company, Lake Spangenberg Water System, Lackawanna County, PA. Managed engineering for restoration project of the system's source water supply and treatment systems. Redesign of multiple groundwater production systems including three active wells and one inactive well along with the associated metering and SCADA equipment. Design included a new water treatment plant facility with a clear well and pumping station to provide proper treatment and maintenance of system pressures.

Emergency Water Supply Study, Bethlehem Authority, Bethlehem, PA. Project director/lead for emergency raw water supply and system resiliency study of a 17 MGD system. Investigation evaluated a new surface water supply source with transmission and treatment, redundancy for two sections of one-mile long rock single tunnels, auxiliary groundwater supply and treatment, expansion of interconnect capabilities with multiple adjoining systems, redundant supply piping from two source reservoirs, and a combination of approaches to achieve overall cost benefit and system resiliency.

South Well Field Water Treatment Plant Improvements, Newark, DE. Project Director/ design lead of initial alternative evaluation to provide resiliency to overall water supply system by investigating expansions to groundwater wells, increase surface water supplies and interconnects. Study lead to improvements to a 3 MGD water plant with a shallow tray air stripper system, intermediate clear well / booster pump station, new pH adjustment system, finished water clear well and other site improvements to treat supply wells impacted by elevated volatile organic compounds.

19th Ward Pump Station and Force Main, Reading, PA. Project director for the improvements to a pump station to eliminate a CSO. Project included pump station improvements to meet new flow conditions and the installation of a parallel 16" DIP force main through park land, under the Schuylkill River and railroad, and to minimize impacts to community. Alignment evaluations reduced impacts from multiple utility conflicts within railroad tunnel and provided construction cost savings.

Water Main Relocation Design, Aqua Pennsylvania, King of Prussia, PA. Assisted AQUA in the abandonment and relocation of existing water mains associated with a PA Turnpike expansion project. Provided design of concrete thrust blocking to support wet tapped tie-in points where the proposed restrained joint ductile iron pipe ties into the existing mains and "cut and plug" locations where solid plugs will be placed in existing line segments to be abandoned. Design pressures within the line were based on an operational pressure of 180 psi plus a factor of safety. Further modifications required the design of thrust collars for the installation of two temporary line stops on 36" and 42" diameter steel water mains to control flow during construction activities and allow for proper sequencing of the work.

20" Water Main Repairs, Suez Water, Wilmington, DE. Managed repair of two major leaks of 1908 vintage cast iron pipe. Project challenges included working within Amtrak right-of-way along the Northeast Corridor, working adjacent to a superfund site, and within to tidal wetlands. Provided coordination with Contractor, EPA, Amtrak, New Castle County, DNREC, and the superfund property owner to facilitate repairs of main and addition of valving at a location with limited access. All dewatering fluids were treated through an on-site treatment system prior to discharge into the County sewer.

Piney Point Well and Treatment Building, City of Dover, DE. Project manager for design of a production well and treatment building. Included a new well located in the Piney Point Aquifer with a target flow of 1,000 gpm, new well house/treatment building, chemical feed systems, chlorine contact chambers, and distribution main to connect into the existing system. The new well pump was integrated into the City's InfoWater model to observe impacts and provide well pumps design basis. The site was located in the City-owned Schutte Park so the aesthetics of the treatment building were very important to the City. The design package was used by the City to procure a Design-Build Contractor to finalize the design, secure permits and construct the facility.

Denneys Road Water Main, City of Dover, DE. Project manager for 12" water main and appurtenance relocation in conjunction with a DelDOT bridge replacement project. Considerations included review and coordination of design with DelDOT bridge drawings, limited right-of-way, an existing interceptor sewer, and adjacent wetlands along with complying with Office of Drinking Water's stream crossing requirements.

Long Point WTP Upgrade, Dover, DE. Project manager for alternative analysis and retrofit design for improvements to an existing groundwater fed treatment plant. Improvements included demolition of existing ozone system and replacement with iron and manganese removal, chemical feed upgrades to enhance operations and residuals management for a 3 MGD capacity.

New Street Water Main Replacement, City of Dover, DE. Project Manager for the survey and design of a 1,300 LF 8-inch water main including multiple service connections over three City blocks.

Water Main Extension, Town of Centreville, MD. Design of a 3,500-linear foot water main extension project to enhance fire flow capabilities and allow for the decommissioning of a well that is presently used for emergency conditions. Evaluated future storage tank sizing and location. Design services include the development of bid documents and assistance during bidding.

Design of a Six-Mile Water System Extension, Confidential Client, Barksdale, WI. Provided water service to properties with contaminated wells due to former operations at an adjacent industrial facility. Specific items included permitting, WaterCAD® modeling of the proposed system, coordination with regulators and two municipalities, six directional drills, booster pumps and construction details to protect improvements from a deep frostline.

Zachary Keegan, PE, CFM, LEED, AP
PROJECT MANAGER

Education
MS, Technology Management, Villanova University, 2009
MS, Civil Engineering, Villanova University, 2009BS, Civil Engineering, Temple University, 2004
BS, Biology, Pennsylvania State University, 2001

Years of Experience
15

Licenses/Registration
Professional Engineer: PA, MD, DE AP BD & C
Certified Floodplain Manager

Mr. Keegan is a Senior Engineer and Project Manager specializing in Water/Wastewater planning and design, Green Stormwater Infrastructure (GSI) design, H&H modeling, and flood mitigation. He has a history of delivering successful project for Bethlehem including Chlorine Risk Management Plans and various wastewater projects.

Project Experience

City of Bethlehem, Water Treatment Plant and Wastewater Treatment Plant Risk Management Plan Updates, Bethlehem, PA. Managed a project to conduct on-site risk management plan (RMP) compliance audits at both the water treatment plant and wastewater treatment plant and compile the five-year RMP updates for submission to the US Environmental Protection Agency per 40 CFR Part 68. Reviewed and updated the facilities' standard operating and maintenance procedures, safety and training programs, off-site consequence analyses, and site records related to the gaseous chlorine systems that triggered the need for RMPs.

City of Bethlehem, Act 537 Plan Review Project, Bethlehem, PA. Project Manager for the evaluation and recommendation of treatment improvements to address an administrative limit on Plant capacity of 20 MGD and assess the impact of pending nutrient regulations on facility needs. Project will assess alternate phased approaches including Chemically Enhanced Primary Treatment, granular activated sludge, side stream treatment of high strength centrate flows with bio-augmentation and aeration improvements along with wet weather management.

Springfield Water and Sewer District Chlorine Risk Management Plan Update, Springfield, MA. As a Technical Lead, submitted a five-year RMP update US Environmental Protection Agency per 40 CFR Part 68. Conducted a site visit to review and update SWSC's standard operating and maintenance procedures, safety and training programs, off-site consequence analyses, and site records related to the gaseous chlorine systems that triggered the need for RMP's.

Delaware County Regional Water Quality Control Authority, Sludge Thickening, Grease Concentration, and Odor Control System Replacement Evaluation, Chester, Pennsylvania. Evaluated alternatives to replace a failing dissolve air flotation waste sludge thickening system of a 44-mgd publicly owned treatment works. Estimated the quantity and quality of waste sludge and truck-delivered grease to be processed, defined the required system performance criteria, and requested technical information from vendors of several sludge thickening, grease concentration, and odor control technologies. Conducted site visits with DELCORA plant operators to other wastewater facilities that implemented each of the alternative technologies. Evaluated alternatives based on system several criteria including performance data, operator effort, power and chemical feed requirements, and estimated life cycle cost. Presented full evaluation and a construction sequence and cost opinion for the selected alternatives in alternatives analysis report format. DELCORA subsequently contracted to design and oversee the construction of the selected sludge thickening alternative. fire flow, and impacts to well pumps and water age / quality issues in distribution system.

Delaware County Regional Water Quality Control Authority, 44-mgd Wastewater Treatment Plant Design Engineering, Chester, Pennsylvania. Managed project schedules, budgets, staffing, and deliverables of several design contracts. Completed contract drawings, technical specifications, and bidding documents for the rehabilitation of three CSO outfall regulators to maximize the capture efficiency to the treatment plant. Identified and evaluated CSO control alternatives and co-authored DELCORA's

long-term CSO control plan update. Completed contract drawings, Zachary Keegan, PE, CFM, LEED APProject Manager: WastewaterEducationMS, Technology Management, Villanova University, 2009MS, Civil Engineering, Villanova University, 2009BS, Civil Engineering, Temple University, 2004BS, Biology, Pennsylvania State University, 2001Years of Experience: 15RegistrationsProfessional Engineer: PA, MD, DELEED AP BD & CCertified Floodplain ManagerGeneral Engineering Services forWater/ Wastewater Treatment FacilitiesCity of Philadelphia Water DepartmentAECOM23 technical specifications, and bidding documents for the replacement of 700 existing fine bubble diffuser panels within the aeration tanks of a 44 mgd publicly owned treatment works. Conducted a pre-bid meeting with contractors, issued bid package addendums, reviewed shop drawings, performed on-site inspections, and recorded as-built conditions to be incorporated into the drawings. Maintained and update an EPA SWMM model of the DELORA combined sewer system consisting of 30 miles of sanitary and combined sewers in the city, several additional sewer service areas treated by DELCORA's Western Regional treatment plant, and 26 combined sewer overflow (CSO) outfalls. Simulated CSO frequency and volume using locally recorded rainfall data and prepare overflows summaries for inclusion in DELCORA's Chapter 94 report.

Monroe Energy, LLC, Industrial Wastewater Discharge Permitting, Trainer, Pennsylvania. Compiled analytical and wastewater flow data for the refinery facility and submitted an industrial wastewater discharge permit application to the local publicly owned treatment works (POTW). Under the NPDES program, POTWs are required to develop and enforce an industrial wastewater pretreatment program to assure compliance with federal pretreatment standards by significant dischargers of pollutants to their POTW. Met with POTW permitting representatives to refine the data contained in the permit and negotiate the terms of agreement. Pending discharge permit approval, Monroe Energy plans to reduce its overall wastewater treatment and disposal costs by decommissioning the industrial wastewater treatment facility and diverting all effluent to the municipal wastewater collection system.

Township of Perryville, Wastewater Treatment Plant Flooding Investigation and Engineering Analysis, Perryville, Maryland. Recorded sequence batch reactor (SBR) operational data, equipment settings, and anecdotal information from plant operators at a new 1.65 mgd nominal capacity wastewater treatment plant that had experienced manhole overflows during wet weather events. Performed takeoff from as-built drawings and final operation and maintenance manuals to construct and calibrate an EPA SWMM model of the plant hydraulics and test various high flow scenarios and identify the root cause of flooding. Identified SBR operational controls that had been changed and not properly reset during plant commissioning and that was causing the SBR system to hydraulically overload downstream piping and treatment systems. Recommended capital improvements, equipment settings, and operational changes necessary to minimize the potential for future flooding. Presented findings to township commissioners so that they could seek corrective action from the building contractor.

Pennsylvania Department of Environmental Protection, Groundwater Quality Monitoring and Drinking Water Replacement Design, Harleysville, Pennsylvania. Managed the project schedule, budget, staffing, invoicing, and deliverables of a contract to identify a viable drinking water supply strategy for 26 impacted residents and to monitor groundwater quality at a site contaminated with 1,1-dichlorothene (1,1-DCE), 1,1,1-trichloroethane (1,1,1-TCA), and 1,4 dioxane. Submitted a formal project work plan and project cost estimate based on the initial scope of work and managed change orders to equests for proposal, reviewed bids, and procured subcontractors to supply impacted residence with bottled drinking water, to perform routine maintenance of residential water filters, and to drill a potential drinking water source well. Provided feasibility and costing information to support the PA DEP in preparing a drinking water supply analysis of alternatives and preferred remedy. Installed, sampled, and seven-day pump tested new drinking water supply wells, in accordance with the PA DEP new source sampling requirements for groundwater sources for community and nontransient noncommunity water systems. Submitted a hydrogeologic report, conceptual design plans, and design narrative for a proposed drinking water treatment facility and distribution piping with capacity for up to 40 residences. Met with township officials for concept design review and to identify the roles of the PA DEP and the township in owning and operating the proposed community drinking water supply system.

Lindle Willnow, PE
TECHNICAL LEAD

Education
MEngSc, Civil Engineering, National University of Ireland
BS, Civil Engineering, University of Missouri - Rolla
BA, Environmental Studies, Cornell College

Years of Experience
33

Licenses/Registration
Professional Engineer, VT, CT, RI, MA

Affiliations
American Water Works Association
New England Water Works Association
American Society of Civil Engineers

Mr. Willnow is a technical leader and global coordinator of AECOM's Hydraulic Modeling technical practice group. He is one of the firm's most experienced experts in computer modeling and hydraulics, particularly concerning water distribution hydraulics, water quality and transients, and water and wastewater treatment plant hydraulics. He has experience in all aspects of the planning and design of large water and wastewater treatment plants, water pumping and distribution facilities, and wastewater and CSO collection systems. His expertise includes design of pumps, piping, air valves, surge protection and flow distribution.

Project Experience

Bethlehem Authority, Emergency Water Supply Alternatives Feasibility Study, Bethlehem, PA. Conducted hydraulic modeling analysis of interconnection alternatives for supplying treated water to the City during loss of treated water supply. Coordinated with interconnected utilities' representatives regarding hydraulic implications of interconnections in adjacent systems. (2018)

City of Pittsfield, On-Call Water System Services, Pittsfield, MA. Managed the development of a 6,300-pipe H2OMap hydraulic model of the water distribution system. Oversaw the development of the model from GIS data and the development of a field verification program for calibrating the model. Evaluated needed improvements to a system flow control station, addition of in-line hydroturbine, and management of the hydraulic impacts of a tank rehabilitation program. Led the hydraulic modeling efforts to evaluate the water distribution system to identify areas with inadequate levels of service in terms of water pressures and available fire flows for water system master plan. [1997-2020]

City of Newburyport, Emergency Clearwell Repairs, Newburyport, MA. Led the hydraulic analyses of Newburyport's and adjacent system's hydraulic models to assess emergency supplies in case of clearwell failure. Coordinated field testing to update and calibrate models. Combined models to conduct analyses.

Springfield Water and Sewer Commission, West Parish Filtration Plant Clearwell Indicative Design, Springfield, MA. Lead hydraulic engineer for development of the indicative design of a new clearwell for the WPF which includes new filter effluent piping connecting to the existing treatment facilities and finished water piping connecting to the mains supplying water to the Provin Mountain Storage Tanks. [2020]

Springfield Water and Sewer Commission, West Parish Filtration Plant Facilities Plant, Springfield, MA. Lead hydraulic engineer for development of the hydraulic analysis of the existing and proposed treatment facilities during evaluation of treatment capacity expansion to 80 mgd. [2018-2019]

Springfield Water and Sewer Commission, Raw Water Hydroturbine Feasibility Study, Springfield, MA. Conducted hydraulic modeling analyses to assess the feasibility of adding hydroturbines on the 42-inch raw water pipeline between Cobble Mountain and the Sedimentation Basin and WPF plant. [2019]

Springfield Water and Sewer Commission, Wastewater Treatment Plant Design Build Operate, Springfield, MA. Providing technical assistance and review for the development of the hydraulic profile of the modifications and additions to the Commission's WWTP. [2019-2020]

Detroit Water and Sewerage Department, Capital Improvements Program Management Organization, Detroit, MI. Hydraulic modeling task leader for

evaluation of distribution system piping for levels of service to assess pipe condition and select pipes for intervention by replacement or rehabilitation. Directed water system condition assessment program consisting of hydrant flow and C-Factor tests, leak detection and valve exercising. [2017-2020]

Detroit Water and Sewerage Department, Water Distribution System Detailed Modeling, Detroit, MI. Lead modeling manager for development of a system-wide hydraulic model of water distribution system with over 160,000 pipe segments using Innovyze's InfoWater. System operations modeled using links to system's SCADA system. Two-Phased approach quickly develops transmission system model for planning with all-pipes model for operational analyses. [2011-2014]

Massachusetts Water Resources Authority, John J. Carroll Water Treatment Plant Technical Assistance, Marlborough, Massachusetts. Managed a technical assistance contract for the first two years of operation of the 405-mgd John J. Carroll water treatment plant. Managed task orders for evaluation of the plant's' power systems, design of the ozone contactor pressure relief valves, evaluation of infiltration/inflow in the plant's sewer system, assessment of arc flash hazards, addition of a closed-loop cooling system for the plant's ozone generators, and preparation of a concept design to add GAC or membrane filters at the plant. Managed the work of 13 subconsultants and providing O&M and start-up services assistance as part of the construction management of the John J. Carroll water treatment plant. [2006-2007]

McLoughlin Point Wastewater Treatment Plant, Capital Region Victoria, BC, 2015-2019. Lead hydraulic modeler for 412 MLD advanced WWTP. Assisted in plant layout and development of bypass strategies due to capacity limits on secondary treatment. Oversaw CFD analyses of key plant locations, including flow distribution to primary treatment facilities, biologically active filters, and disk filters. Oversaw transient analyses of residuals conveyance system. [2018-2019]

Great Lakes Water Authority, Water Works Park WTP Yard Piping Replacement, Detroit, MI. Lead hydraulics engineer for the replacement of yard piping and flow meters for 320-mgd WTP. Evaluated alternative piping layouts and diameters to replace 50-100 year old piping. Used system-wide hydraulic model to assess impact of piping alternatives and construction staging on water distribution system. [2018-2019]

Great Lakes Water Authority, Springwells WTP Reservoir Fill Valve Design, Detroit, MI. Lead hydraulics engineer for the design of new valves to be used to fill finished water reservoirs at 540 mgd WTP during plant outage for filter rehabilitation. Valves will reduce system pressures by 60-70 psi. Used system-wide hydraulic model to assess impact of reservoir fill rates on water distribution system hydraulics and water age. [2016-2020]

Transmission System Transient Modeling, Groundwater Reduction Program, San Jacinto River Authority, Texas. Technical Manager for development of a transient model in Bentley's HAMMER of 158 miles of proposed transmission mains conveying up to 127 mgd of treated surface water to communities to reduce groundwater consumption. Transient impacts of pump shutdown and startup, valve closure and pipe break are being analyzed to develop design guidelines for high service pumping station and transmission system. [2011]

Blue Plains Wastewater Treatment Plant, DC Water, Washington, DC. Led hydraulic analyses of dual-purpose clarifiers for the 887-mgd advanced WWTP and for enhanced clarification facility for storm flows. Provided technical review of hydraulic aspects of multiple designs by others for program management team. Modeled plant water system and transients at tertiary backwash system. [1988-2018]

Water Distribution System Model, Cleveland, OH. Managed the development of a 57,000-pipe H2ONet hydraulic model of the water distribution system in Cleveland, Ohio. Integrated modeling software with a geographic information system and a relational database. Developed and managed work plans for developing the project database, integrating it with the city's SCADA system, and managing subcontracts. Developed the conceptual database design and oversaw the implementation of the design as an ArcInfo 8.1 SDE geodatabase. Developed and monitored a field measurement program used to calibrate the model for hydraulics and water quality. [1999-2002]

Jacob Rainwater, PE

INTERCONNECTION EVALUATION AND CONCEPTUAL DESIGN

Education
MS, Civil and Environmental Engineering, Princeton University
BS, Civil Engineering, Geneva College

Years of Experience
16

Licenses/Registration
Professional Engineer, PA, NJ

Affiliations
Water Environment Federation
Pennsylvania Water Environment Association

Mr. Rainwater is a project manager with experience in managing the planning, design, and construction phases of wastewater and water infrastructure projects.

Project Experience

West Earl Township, Water Distribution System Hydraulic Modeling, Lancaster County, PA. Modeled future hydraulic conditions of the water distribution system to determine the feasibility of providing water to a proposed Pennsylvania Power and Light facility. Prepared a final report detailing recommended system revisions to accommodate conditions.

Cecil County, Water Study, Cecil County, MD. Reviewed previous water studies and investigated available alternatives for future water supply to the proposed growth area. Provided recommendations to meet future water demands within the region.

Presbyterian Home, Well Pump and Water Transmission Main Evaluation, Quarryville, PA. Selected the well pump and water transmission main for a new public water supply well at the Presbyterian Home. Evaluated the treatment system for its ability to treat a new raw water source based on water characteristics.

Columbia Water Company, Water Treatment Plant Feasibility Study, Columbia, PA. Conducted a feasibility study for a new 6.0-mgd water treatment plant. Completed a site evaluation, determined potential water treatment technologies and preliminary site layout, and evaluated the site's overall suitability as a future treatment plant site.

Town of Woodsboro, Diatomaceous Earth Filter Treatment System Design, Woodsboro, MD. Provided the preliminary design for a new diatomaceous earth filter treatment system for the water supply.

Water Treatment Plant Upgrade, Borough of Chambersburg, PA. Project manager for the design and construction of upgrades to 6.0 mgd water treatment plant. Upgrades included new filter underdrains and media, a new static mixer, and various piping changes to improve plant operations.

City of Baltimore, Ashburton Water Filtration Plant Design, Baltimore, MD. Assisted with design of new hypochlorite disinfection facilities for the 140-mgd main chlorination booster station at the water filtration plant.

West Earl Water Authority, Elevated Hydrosphere Water Storage Tank Preliminary Design, Lancaster County, PA. Provided preliminary design for a 300,000-gallon elevated hydrosphere water storage tank.

West Earl Water Authority, Water Distribution System Study, Lancaster County, PA. Modified a WaterCAD hydraulic model of the existing and proposed water distribution system. Determined projected demands, selected pump capacity, and set storage tank elevation.

Pennsylvania Department of Conservation and Natural Resources, Swatara State Park Water and Sewer Alternatives Study, Lebanon and Schuylkill Counties, PA. Identified and evaluated alternatives for providing water and sewer service to undeveloped land in park. Completed a report with recommendations based on cost, reliability, and compatibility with overall park features.

Borough of Mount Joy, Sanitary Sewer and Water Main Design and Cost Estimate, Mount Joy, PA. Prepared preliminary design and probable opinion of construction cost for 1,100 feet of 8-inch-diameter sanitary sewer and 1,500 feet of 8-inch-diameter water main on Market Street.

Mount Joy Borough Authority, Water Line Replacement Design and Construction, Lancaster County, PA. Project manager and lead engineer for the design and construction of approximately 1,500 feet of water line removal and replacement.

Mount Joy Borough Authority, Water Treatment Plant Upgrade Design, Mount Joy, PA. Designed a 1.5-mgd upgrade to a water treatment plant which included an upgrade to water pumps, new standpipe clearwell tanks, and a new high-service pumping station with hypochlorite disinfection system.

Mount Joy Borough Authority, Nutrient Reduction Alternatives Study, Mount Joy, PA. Evaluated alternatives for reducing nutrient concentrations in the treatment plant discharge and provided a cost comparison to nutrient credit acquisition through agricultural best management practices. Worked with a local farmer to establish nutrient credit calculation methods that are consistent with Pennsylvania's Chesapeake Bay Nutrient Reduction Program.

Town of Mount Airy, Hydraulic Model Development, Mount Airy, MD. Assisted with development of a hydraulic model to evaluate water distribution system upgrade alternatives required to serve 267 single-family residences and 256 townhouses.

Berkeley County, Fire Flow Hydraulic Model Development, Berkeley County, WV. Assisted with the development of a hydraulic model of water distribution system alternatives to provide fire flow protection for the Brookfield Estates proposed residential subdivision.

Town of Port Deposit, Rock Run Booster Pumping Station Design, Port Deposit, MD. Investigated water pumping and storage schemes and provided recommendations for the design of the booster pumping station. Subsequently designed the 550-square-foot pumping station including two alternating 56-gpm variable frequency drive pumps capable of operating in parallel during periods of peak demand, a 1000-gpm variable speed fire duty pump for use in closed water distribution system, and emergency generator.

Town of Mount Airy, Fire Protection Study, Mount Airy, MD. Reviewed proposed residential sprinkler system layouts and hydraulic calculations and evaluated the ability of the water distribution system to supply adequate fire protection.

Borouth of Akron, Well System Evaluation, Akron, PA. Analyzed the drinking well system and recommended ways to maximize operational efficiency.

Borough of Lititz, Filter System Design, Lititz, PA. Provided preliminary design for a new filter system at a 3.0-mgd water treatment plant and assisted in the final design of new filters, a clearwell, and pumps.

Town of Woodsboro, Diatomaceous Earth Filter Treatment System Design, Woodsboro, MD. Provided the preliminary design for a new diatomaceous earth filter treatment system for the water supply.

Borough of Akron, Nitrate Removal System Design, Akron, PA. Completed the preliminary and final design and cost opinion of a nitrate removal system for a 350,000-gallon-per-day water treatment facility. Evaluated the hydraulic capacity of well pumps based on system conditions. Designed instrumentation and emergency generator upgrades.

Harrison Township, Richwood Water Reclamation Facility and Groundwater Discharge System Design, Harrison Township, NJ. Managed the design of the water reclamation facility and provided engineering consulting to the township and team of developers involved with the project.

Harrison Township, Water Reclamation Facility Nutrient Removal Design, Harrison Township, NJ. Project engineer for the preliminary design of a new 375,000-gpd membrane bioreactor and nutrient removal water reclamation facility for treatment of wastewater to be disposed of via subsurface drip irrigation.

High Hazard Dam Inspection, Borough of Chambersburg, PA. Project manager for the annual inspection of the Borough of Chambersburg's Long Pine Run Dam.

Borough of Shippensburg, Wastewater Treatment Plant Upgrade Funding Application, Franklin County, PA. Project manager for completion of an application package to the Pennsylvania Infrastructure Investment Authority for funding of an approximately $5 million wastewater treatment plant upgrade.

Kevin Pampuch
CONCEPTUAL PUMPING/PRV STATION DESIGN

Education
BS/Mechanical Engineering/Old Dominion University/1987

Years of Experience
30

Mr. Pampuch has served as Project Engineer for municipal, industrial, and privately owned projects. He has designed wastewater collection and conveyance systems. He has designed potable water pumping, filtration, chemical treatment, elevated storage tanks and distribution facilities. He has evaluated the performance of existing systems and implemented designs to improve the function of these systems. He has extensive experience in the design of pumping, piping, and control systems. His environmental experience covers all aspects of investigation, report preparation, federal, state and local permitting, design, estimating, and construction review activities. Mr. Pampuch has provided Construction Management services and Start-up of mechanical process systems on a variety of projects.

Project Experience

Pennsylvania American Water Company, Shippenville Pump Station and Force Main, Shippenville, PA. Project Engineer for the design and permitting of a triplex suction lift pumping station, 8,400 LF of force main and upgrade of 1,200 LF of gravity sewer interceptor.

Pennsylvania American Water Company, Norristown Royersford Interconnect, Norristown, PA. Project Engineer for design, permitting and CM/CI services for an interconnection between two service districts to increase reliability and transfer excess capacity to a higher demand area. Project included a new 5.0 MGD pre-fabricated booster pumping station (BPS) to replace an existing 3.0 MGD BPS, 12,000 linear feet of 16" water main including two horizontal directional drills of 300 and 900 feet, 2,000 linear feet of 12" main, new emergency generator, SCADA controls, associated piping and valving, and site work at the BPS site.

Wastewater Treatment Plant Influent Pump Station Improvements, Town of Port Deposit, MD. Project Engineer providing part time inspection services for Cecil County Department of Public Works for renovation of a wastewater pump station including installation and maintenance of temporary by-pass pumping systems, demolition of existing equipment and electrical gear, wet well investigation and evacuation of solids and grease, replacement of three submersible dry pit pumps, suction and discharge piping and valves, replacement of controls with modern PLC based control equipment and instrumentation. Since the County requested part time review due to budgetary concerns, Mr. Pampuch was selected to perform inspections based on his years of experience with design, start-up and troubleshooting pump stations, wastewater treatment plants and other industrial equipment. He has the ability to readily identify potential items of concern and openly communicates with the contractor and client to assure that a quality product is provided that meets the project intent. Inspection services are being provided within the client's target budget.

Interceptor Improvements, Pennsylvania American Water, Clarion, PA. Project Engineer for the design, permitting and construction administration of approximately 7,400 LF of sanitary sewer interceptor improvements under a Consent Order and Agreement with PADEP. This project consisted primarily of removal and replacement of existing sewers utilizing by-pass pump equipment due the presence of bed rock at the surface in this mountainous area. Where possible, new alignment was Kevin PampuchMECHANICAL PROCESSFirm AECOMYears of Experience30EducationBS/Mechanical Engineering/Old Dominion University/1987Mr. Pampuch has served as Project Engineer for municipal, industrial, and privately owned projects. He

has designed wastewater collection and conveyance systems. He has designed potable water pumping, filtration, chemical treatment, elevated storage tanks and distribution facilities. He has evaluated the performance of existing systems and implemented designs to improve the function of these systems. He has extensive experience in the design of pumping, piping, and control systems. His environmental experience covers all aspects of investigation, report preparation, federal, state and local permitting, design, estimating, and construction review activities. Mr. Pampuch has provided Construction Management services and Start-up of mechanical process systems on a variety of projects. AECOM5 selected to simplify the construction and minimize the need for continuous by-pass pumping. State Highway road crossings were traversed using boring and jacking methods to minimized disruption to traffic. Numerous stream crossings necessitated DEP permitting.

Multiple Sewage Pumping Station Improvements, Anne Arundel County, MD. Construction Management services for renovations to the Marley Avenue, Seventh Street, Harbor Drive, Sea Breeze, and Creek Road Sewage Pumping Stations. Provided daily oversight of a Resident Project Representative (RPR), day-to-day communication with the County's project manager, conducted progress meetings and prepared meeting minutes, reviewed potential change orders and processed final change orders utilizing standard County forms and procedures. Reviewed contractors' requests for payment and prepared final recommendations to the County. Along with the contractor, County representatives and the inspector, performed conditional acceptance reviews and prepared punch lists for final completion. Presently working with the County representative to close out the project.

Sewer Infrastructure Improvements, Governor Bacon Health Center, DE. Project Engineer for renovation of a campus-wide sewage collection system. Began with the investigation of the existing collection system which consisted of portions of the original system dating back to the 1940's and subsequent attempted improvements brought on by changes in the overall use of the campus. Investigation methods included weir testing, smoke testing, CCTV inspections, bypass pumping, and cleaning and inspection of several pumping stations. Deficiencies, such as leaking manholes, broken pipes, improperly abandon pipes, malfunctioning pump stations and inflow sources such as open laterals where buildings were torn down and roof collector down spouts were corrected. One pump station that was not necessary was eliminated entirely. Other existing unused portions of the gravity collection system were eliminated. Overall renovation of the collection system resulted in a significant reduction of sewage flow from the facility which helped lessen the total flow being pumped to the Delaware City Wastewater Treatment Facility. A rehabilitation design was developed and implemented realizing an average daily flow reduction of 90,000 gallons.

London Grove Township Municipal Authority, West Grove, PA. Project Engineer. Performed design and construction oversight for water and wastewater improvements within the Township including a $3M water storage facility and booster pumping station. Assisted with the design of a lagoon treatment and spray irrigation facility as well as numerous pumping stations and force mains. Recently provide design and construction oversight of Phase 1 of a 600,000 gallon lagoon treatment and spray irrigation facility valued at $12M including a new sewage lift station and transmission force main, plus upgrades to an existing pump station, permitting, bidding and construction administration of six separate contracts.Bucks County, PA. Design of municipal sewage pumping stations for the Saddle Ridge sewage collection system.

Ron Mastrogiacomo, PE

COST ESTIMATING

Education
BS, Civil Engineering
Northeastern Univerisity, 1976
Years of Experience
43

Licenses/Registration
Professional Engineer: Massachusetts #40575
AACE Certified Planning and Scheduling Professional

Affiliations
American Society of Professional Estimators (ASPE)
Association for the Advancement of Cost Engineering International (AACE)

Mr. Mastrogiacomo is a chief estimator responsible for preparing capital cost estimates, reviewing estimates, and estimating policy and procedures throughout the company. He also is assistant director of the A-E division, managing the group's daily activities, scheduling resources, and planning and coordinating projects throughout the company. He has 30 years of experience in the design and construction management of water, wastewater, and civil projects. Ron has been involved in the preparation of designs, specifications, and estimates and the construction supervision of complex transportation and infrastructure systems. He is also responsible for analyzing submitted construction and design schedules, as well as updating ongoing scheduled projects.

Project Experience

City of Pittsfield, On-call Water System Services, Pittsfield, Massachusetts. Provided a capital cost estimate for improvements to the Ashley Dam and gatehouse restoration.

City of Newburyport, Bartlett Pond Pump Station (Phase II Water System Improvements), Newburyport, Massachusetts. Provided cost estimates for the 1-mgd Bartlett Pond gate house pump station. Also estimated costs for static mix options, for chemical cleaning, and for a pump station and maintenance facility.

Greater Vancouver Regional District, Lions Gate Wastewater Treatment Plant - Sludge Thickener No. 2 System, North Vancouver, BC. Provided 20% design estimate of cost. The project included these elements: screening, lamella settler, stacked secondary clarifiers, tertiary filtration, sludge thickening, dewatering, odour control, and power generation. [Construction value: over $170 million]

City of Detroit, Raw Wastewater Pump Station - Engineering, Design, Construction, and O&M Services, Detroit, MI. Developed a construction and resource allocation schedule for the design and construction of a 750-mgd pump station. [8 months]

Massachusetts Turnpike Authority, New East Side Interceptor, Boston, MA. Developed a design schedule and resource distribution and conceptual construction schedule for the new East Side interceptor, part of the Central Artery/Tunnel project, including monthly updates of schedule, cost, and variance. [2 years]

Massachusetts Water Resources Authority, Caruso Pump Station - Planning, Design, and Construction, East Boston, MA. Reviewed and updated the construction contractor's schedule, monitored progress, and developed construction streamlining measures for the East Boston pump station project.

New York City Department of Environmental Protection, Jamaica Water Pollution Control Plant - Study, Design, and Construction, New York, NY. Developed a construction critical path method schedule of work for improvements to the 100-mgd Jamaica water pollution control plant, along with contract plans and specifications and conceptual estimate.an annual budget required for the maintenance and repair or replacement of identified assets.

US Agency for International Development, Wastewater Engineering Phase I and II, Alexandria, VA. Participated in a major wastewater improvement program involving process development; alternatives evaluations for effluent disposal, sludge management, and expansion of treatment facilities; environmental assessments; soil, water, and groundwater investigations; surveys for facility sites and pipeline routes; and preliminary designs for proposed treatment facilities. Prepared work

plan CPM schedule, work breakdown structure, organizational breakdown structure, and cost control system. Estimated the capital construction costs, including present worth analysis, of various alternatives. [2 years]

Massachusetts Water Resources Authority, Various Wastewater Projects, Greater Boston, MA. Provided design schedules and updates for multidisciplinary projects for the MWRA including the Mill Cove emergency siphon, the North Dorchester Bay combined sewer overflow program, and various facility designs for the upgrade and expansion of the wastewater treatment plant at Deer Island.

New York City Department of Environmental Protection, Owls Head Water Pollution Control Plant - Study, Design, Construction, and Program Management, New York, NY. Provided a critical path analysis for construction at the 120-mgd Owls Head water pollution control plant. Reviewed monthly construction schedules submitted by the contractor and met with contractor and owner to resolve delays. Evaluated and suggested sequence and logic changes to save construction time. [32 G/E 1.5 years]

District Water and Sewer Authority, Blue Plains Wastewater Treatment Plant Emergency Procurement Proposal, Washington, DC. Developed a master design-build schedule for AECOM and several subcontractors for a proposed temporary dewatering facility at the wastewater facility.

Massachusetts Water Resources Authority, Deer Island Secondary Designs (DP-40), Boston, MA. Prepared and updated a monthly schedule for design work at the wastewater treatment plant.

City of Thunder Bay, Wastewater Treatment Plant, Thunder Bay, Ontario. Provided and managed engineer's opinion of cost for renovating WWTP of damage caused by flooding. Estimate summaries were parceled by areas, disciplines, and process. Flood damage estimate was over $30 million.

Massachusetts Water Resources Authority, North Dorchester Bay Combined Sewer Overflow Tunnel and Reserved Channel Facilities, Boston, MA. Resident representative for the installation of permanent sewer flow meters**.**

Borough of Chamberburg, Chambersburg Wastewater Treatment Plant Improvements, Chambersburg, PA. Provided cost estimates at 30%, 90% and 100% design stages for over $42 million of plant improvements.

Town of Nantucket, Wastewater and Landfill Facilities, Nantucket, MA. Resident inspector for the installation of a force main, emergency sewer beds, improvements to a pump station, and construction of a landfill entrance road and drop-off facilities in Nantucket.

Town of Cochituate, State Park Utilities Construction, Cochituate, MA. Resident representative and construction inspector for a lift station, and installed utilities at a state park in Cochituate.

Town of Burlington, Water and Sewer Projects, Burlington, MA. Provided supervisory construction services as a resident representative for a water distribution system and sewer mains.

Puerto Rico Aqueduct and Sewer Authority, Wastewater Program Management, Puerto Rico. Scheduled maintenance and repair for more than 85 wastewater treatment facilities throughout Puerto Rico. Developed conceptual estimates for the proposed construction. [8 months]

City of Danbury, Wastewater Treatment Plant Design and Construction Services, Danbury, CT. Developed a construction schedule for the wastewater treatment plant.

South Essex Sewerage District, Danvers-Beverly Relief Interceptor, MA. Resident representative for the installation of a 60-inch-diameter trunk line and roadway resurfacing.

Massachusetts Water Resources Authority, Sewer and Combined Sewer Overflow Master Plan and Facilities Plan, Boston, MA. Developed a time-line design schedule, capital cost estimates, and updates for the MWRA's combined sewer overflow program, involving changing the baseline of the work to incorporate the client's change of scope. [1 year

Christopher Walker, PE

Water Quality Considerations

Education
MS, Environmental Engineering, University of Delaware
BS, Physics, Dartmouth College

Years of Experience
14

Licenses/Registration
Professional Engineer, PA

Mr. Walker's expertise includes water treatment processes/water chemistry; water treatment facilities design; analysis, modeling, and design of water distribution systems and water storage facilities; hydrogeologic substrata data investigation/ interpretation for groundwater supply; environmental remediation design, water/wastewater residuals management; and municipal wastewater treatment plant design.

Project Experience

Pennsylvania American Water Company, Shippenville Pump Station and Force Main, Shippenville, PA. Modeled in SewerGems® the performance of a triplex suction lift pumping station, 8,400 LF of force main and upgrade of 1,200 LF of gravity sewer interceptor. Sewer Model was the basis for design.

Water Evaluation Study, Newark, DE. Developed and prepared an alternative analysis of water supply options to increase production of the current system by 1 MGD. Alternatives considered upgrades to an existing groundwater system with VOC concerns, upgrades to a surface water plant, and introduction of new production wells along with blending within a raw reservoir.

Long Point WTP Upgrade, Dover, DE. Developed and prepared an alternative analysis and retrofit design for improvements to an existing groundwater fed treatment plant. Improvements included demolition of existing ozone system and replacement with iron and manganese removal, chemical feed upgrades to enhance operations and residuals management for a 3 MGD capacity.

West Virginia Public Service District, Design, Permitting, Construction, and Operation of Granular Activated Carbon (GAC) Treatment Units for Community Water Supply, WV. Lead project design engineer. An emerging contaminant was detected in public drinking water above recently released U.S. Environmental Protection Agency (EPA) lifetime drinking water Health Advisory in the area of Wood County, West Virginia. This was a very high profile project requiring a comprehensive strategy and experienced team to execute a design-build approach and deliver an expedited solution to lift the drinking water ban. AECOM designed and built the addition of two GAC treatment systems to remove Perfluorooctanoic Acid (PFOA) from the existing public water facilities. AECOM prepared a design and permit package in six weeks by working with multiple stakeholders: the Mayor, City public works department, regulatory agencies (EPA, WVDHHR, DOH), utility companies, and the client to expeditiously achieve significant milestones including having an operational system within six weeks of mobilization. Installed treatment systems for two separate well locations to remove trace levels of PFASs to below analytical detection limits. System capacities ranged from 700 gpm to 1,200 gpm. Project activities included preparing permit applications, preparing design drawings and specifications, construction management, facility startup, and operations.

Water Modeling Support, Dover, DE. Utilizing an existing InfoWater 7.0 Water Model, actively manage the City of Dover's hydraulic model and simulate distribution system improvements to assist in comprehensive planning and design. The City of Dover's water system is supplied by fifteen deep wells, seven shallow wells, 6 elevated storage tanks ranging in size from 0.25 MG to 1 MG, and 176 miles of distribution main up to 20 inch in size. The current average water demand is approximately 5.5 Million Gallons per day (MGD) with peaks as high as 9 MGD during the summer. Work has included: 1) the evaluation of locations for an additional 1 MG Water Storage Tank and its impact on distribution system and included suggestions in control logic

to mitigate water age concerns that otherwise could have developed. 2) Modeling the hydraulic impact of future development scenarios on the water distribution system including a 3,200 gpm demand for an energy plant. 3) Evaluating the addition of a 1.5 MG elevated storage tank in the Garrison Oaks Technical Park (GOTP) and the proposed demand impacts on the distribution system and fire flow availability. This included evaluating tank filling cycles, pressure gradients, expected water turnover, and storage tank recovery time for the future demand scenarios and during fire conditions. 4) Modeling the proposed 550 gpm Piney Point Well on water system performance. This information became the design basis for a new well and new water treatment plant to serve the City.

Lake Spangenberg Water System, Pennsylvania American Water Company, Lackawana County, PA. Design engineer for a restoration and modernization project of the system's source water supply and treatment systems. Work included the redesign of multiple groundwater production systems including three active wells and one inactive well along with the associated metering and SCADA equipment. Design includes a new water treatment facility with a clear well and high service pumps to provide proper chlorine contact time, emergency storage, and to maintain uniform distribution system pressures. AECOM developed all permitting material including both State and Local permit packages and coordinated subsurface investigations and studies of the site along with performing all surveying.

Water Distribution Model/Feasibility Study/Design of Arsenic Removal Water Treatment Plant, Town of Centreville, MD. Developed a WaterGEMS® model to simulate Town's water distribution system and analyzed potential system upgrades necessary to address fire flow needs and water storage needs within the framework of an arsenic compliance strategy. Researched and analyzed arsenic compliance options for Town. A feasibility study was prepared recommending cost effective capital and operational measures for the Town. Recommendations led to a full-scale design of a 1.44 MGD arsenic removal water treatment plant. Design utilized chemical oxidation to remove soluble iron and arsenic by forming ferric hydroxide precipitates which are removed with a catalytic sand media pressure filtration system. Responsibilities included process and mechanical design of treatment facility, development of construction specifications and plans, and composition of design engineer's report for Maryland Department of the Environment permit approval.

Water Treatment Plant Upgrades/Water Distribution Model, Frederica, DE. Designed fluoridation upgrades to 0.72 MGD water treatment plant. Upgrades include chemical room addition, piping modifications, programmable logic control, and safety measures for fluoridation of well water. Developed a WaterGEMS® model to simulate the Town's water distribution system and performed capacity assessments for future proposed developments as well as determined optimum location for site of new 400,000 gallon elevated storage tank. A water system evaluation report was prepared.

Water Facility's Need Analysis and Design of Water Treatment Plant, City of Lewes, DE Board of Public Works. Reviewed the alternatives from a prior study by previous consultant and added new alternatives. Evaluation considered: relocating the water treatment facilities, using air stripping and aeration, comparing lime and caustic for pH control, evaluating pumping regimes with only well pumps and with added finished water booster pumps, as well as analyzing potential interconnection with a neighboring water company. Construction and operational costs were developed and evaluated for each of the proposed options. Based on the AECOM report, a WTP was designed proximal to the existing well field with updated well pumps and controls. Additionally future provisions for an interconnection with neighboring water company system and to a future elevated water tower were provided.The new WTP includes an office, bathroom, and three chemical injection rooms for caustic, gaseous chlorine, and sodium fluoride. An updated control system and an alarm notification system is also provided.

Tidewater Utilities Northwest District Water Model, Middletown, DE. Developed a WaterCAD® model for a private water company's northern most water district in Delaware. The water district includes three well fields with each well field having their own water treatment plant and water storage. The water district's average production was 0.26 MGD. The model provided a tool to assess the capacity of the water distribution system, to evaluate system hydraulics during summer demand peaks, to determine elevated water storage requirements, to assist with water quality investigations, as well as to validate long-rang capital improvement projects.

Patrick Morrison, PE

Interconnection Evaluation and Conceptual Design

Education
BS, Environmental Systems Engineering, Pennsylvania State University

Years of Experience
6

Licenses/Registration
Professional Engineer, DE

Mr. Morrison is an Environmental Engineer experienced in water storage and distribution, wastewater treatment and conveyance, environmental remediation, Erosion and Sediment Control plan design, NPDES permitting, and Post-Construction Stormwater Management plan design. He is responsible for preparation of design calculations, drawings, specifications, technical reports, cost estimates, and permit applications. Mr. Morrison has experience providing construction phase services.

Project Experience

Emergency Water Supply Feasibility Study, Bethlehem Authority, Bethlehem, PA (2018-Present): Evaluated alternatives to provide a backup water supply for the community in the event of an emergency that would impact Bethlehem's current system. Options evaluated included: new raw water sources, expansion of interconnects, groundwater production wells, bypass of existing raw water system, and redundant tunnels to support the existing transmission route. Project tasks included: design of alternatives; assistance with cost estimation; preparation of workshop presentation with client and stakeholders; and preparation of a final report summarizing the findings of the team.

Elevated Water Storage Tank, Pennsylvania American Water Company, Kane, PA and Lewisburg, PA (2012-2014): Provided design and permitting services for the construction of two elevated water storage tanks (500,000 and 600,000 gallons) for Pennsylvania American Water Company. Design tasks: included preparation of design memorandums, technical specifications, plan drawings, and required permits (DEP and NPDES). Provided construction administration support and served as the primary client contact during construction. Construction administration tasks included: review, approval, and management of all shop drawings and submittals. Also held routine progress meeting, site inspections, and coordinated construction issues with contractor and client.

South Well Field Water Treatment Plant Upgrades, City of Newark, DE (2019-present): Performed design tasks for upgrades to the City of Newark's South Well Field (SWF) Water Treatment Plant. This project involves design upgrades to remove tetrachloroethylene (Perchloroethyline, PCE, or PERC) from raw water at the SWF Water Treatment Plant utilizing low profile air strippers. The project designed for a production rate of 2.0 million gallon a day (MGD) allowing for future expansion 3.0 MGD. The SWF water treatment plant has an ultimate production capacity of 3.0 (MGD) and currently provides roughly 1.165 MGD or 36% of the City of Newark's drinking water. Upgrades included: shallow tray air stripper units housed in a new building with sub-floor intermediate clear well; vertical turbine pumps; a chemical feed equipment; various process and yard piping; and a 250,000 finished water storage tank.

Spruance Groundwater Treatment Plant Upgrades, Confidential Client, Richmond, VA (2011-2014, 2017-Present): Performed design tasks for upgrades to the existing 125 gpm groundwater treatment plant and collection system targeting the removal of multiple constituents of concern including perfluorooctanoic acid (PFOA) and hexamethylphosphoramide (HMPA). This upgrade provided for the expansion of plant and collection system capacity to 360-430 gpm. The upgrade design included: a new treatment building, granular activated carbon (GAC) building, solids management building, 51 extraction wells and roughly 13,000 feet of dual contained transmission piping. Design tasks included: technical research of equipment including well pumps and dual-containment piping; design of extraction wells and transmission piping system, cost estimation, preparation of report sections and appendices, coordination of tasks with integrated

design team; and technical review of deliverables. Assisted with the preparation of the 30, 60, and 90% design packages for client. Provided construction support during GWTP start-up and prepared Operations and Maintenance Manual. Provided design support for upgrades to the GWTP during operation including pilot testing to add and treat additional water from a separate section of the site, East Ditch.

Drinking Water System Security Improvements Project, Philadelphia Water Department, Philadelphia, PA (2017-Present): Provided construction phase services as the design engineer to support the construction of security system improvements at multiple Philadelphia Water Department (PWD) facilities. Project tasks included managing of subcontractors along with review and coordination of shop drawings and RFIs.

Operation and Maintenance Support for Oily Wastewater Treatment Plant (WWTP), PECO Energy, Philadelphia, PA (2014-2017): Provided on-going Operation and Maintenance (O&M) assistance for an oily wastewater treatment facility operated on behalf of a major utility. The wastewater treatment facility treats manhole water from various utility manholes in the Philadelphia PA area. Tasks include preparation of weekly inventory reports, Bi-annual compliance reports, and ordering of equipment and supplies for operators.

Parkway Basin Sewer Rehabilitation, Washington Suburban Sanitary Commission (WSSC), Laurel, MD (2013-2014): Performed sewer pipeline and manhole assessments following NASSCO standards. Reviewed Closed-Circuit Television (CCTV) video footage to locate and assess defects. Prepared detailed assessment reports and provided recommendations for appropriate rehabilitation techniques including: cured-in-place pipe lining, removal and replacement, joint grouting, and sectional lining. Individual segment reports were used to complete a detailed concept finalization report.

Composite-Elevated Water Storage Tank, City of Dover, DE (2012-2014): Prepared Design-Build request for proposal (RFP) documents for a 1.5 million gallon composite-elevated water storage tank for the City of Dover. Design tasks included: site layout, tank design, cost estimation, technical specifications, preparation of RFP documents, and technical research of alternatives for client.

Piney Point Well and Treatment Building, City of Dover, DE (2012-2013): Staff Engineer assisted in the design of a production well and treatment building. The design included a new well located in the Piney Point Aquifer with a target flow of 1,000 gpm, new well house/treatment building, chemical feed systems, chlorine contact chambers, and distribution main to connect into the existing system. The new well pump was integrated into the City's InfoWater model to observe the impacts and provide well pumps design basis.

Victoria Zabierek, PE

DISTRIBUTION SYSTEM HYDRAULIC MODELING

Education
BS, Civil and Environmental Engineering, University of Massachusetts - Lowell, 2007

Years of Experience
12

Licenses/Registration
Professional Engineer, New Hampshire #15112

Ms. Zabierek is a hydraulic modeling Engineer with 12 years of experience in various water and wastewater engineering projects including; water and wastewater treatment, water pumping and distribution facilities, and wastewater and CSO collection systems. She is proficient in many modeling software programs such as InfoWater, InfoSWMM, InfoWorks, Delft3D, Water/SewerGEMS, PCSWMM, H2Onet, PHP, and EPANET.

Project Experience

City of Marco Island, Marco Shores Alternative Water and Sewer Improvements, Marco Island, Florida. Updated the existing InfoWater model to simulate the proposed upgrades to connect Marco Shores potable water system service area to the Marco Island potable water system. Analyzed projected delivery pressures to Marco Shores customers under Average Day, Maximum Day, Peak Hour, Maximum Day with Fire Flow conditions for 2016 and 2035 system demand conditions. Performed extended period simulation to estimate the age of water supplied to Marco Shores. Provided recommendations based on hydraulic evaluation.

Town of Westborough, Hydraulic Analysis for Revisions to Discharge Piping of Indian Meadows Well and Otis Street Wells, Westborough, Massachusetts. Updated the existing WaterGEMS model to include the proposed revisions. Conducted a hydraulic analysis to evaluate the impacts the proposed revisions had on the existing distribution system.

City of Pittsfield, Benedict Road Water Storage Tank Design, Pittsfield, Massachusetts. Updated the distribution system H2O Map hydraulic model for the Northern Pressure Zone, incorporated the Benedict Road tank and identified the delineation of the Northern Pressure Zone and Central Pressure Zone in the area of the Highland pump station. Reviewed historic operating data and the current pressure zone delineation in the model. Assisted the city with recording static pressure readings over a four-day period under different operational scenarios. Ran the hydraulic model with the new tank and new pressure zone delineation. Evaluated and recommended changes to improve the operation of the Northern Pressure Zone.

Lynnfield Water District, Hydraulic Model Update and Subdivision Reviews, Lynnfield, Massachusetts. Updated the existing WaterGEMS hydraulic model to include new developments, water main replacements, and current water system demands. Evaluated the available yield of the system relative to existing and projected average day demands and maximum day demands. Reviewed available yield versus demand for current and projected future demand conditions. Verified the existing WaterGEMS hydraulic model using existing field flow tests. Reviewed and evaluated approximately six proposed subdivisions within the Lynnfield distribution system. Conducted a hydraulic analysis of the proposed impacts each subdivision would have to the water distribution system. Reviewed the project proponents' water utility plans and provided any resulting recommendations.

Aquarion Water Company, Asset Management Plan, Millbury, Massachusetts. Incorporated piping inventory in the WaterGEMS hydraulic model and GIS shapefiles. Prioritized pipe assets using asset management principles and identified deficiencies based on the overall pipe rating. Reviewed water distribution system to identify critical water system components and critical service areas. Developed an annual estimate of recommended reserves and an annual budget required for the maintenance and repair or replacement of identified assets.

Bondsville & Fire Water District, Water Distribution System Study, Bondsville, Massachusetts.
Evaluated the overall distribution system and supply sources relative to the ability to meet current and future demands and provided prioritized recommendations for future implementation. Created and verified the water distribution system hydraulic model in WaterGEMS modeling software based on fire flow information. Evaluated projected water demands relative to available supply and system storage requirements.

Town of Shrewsbury, Water Distribution System Study Update, Shrewsbury, Massachusetts.
Conducted fire flow tests for calibration and verification of the hydraulic model. Completed an asset management analysis of the distribution system piping and aboveground water system assets. Updated an existing WaterGEMS hydraulic model, identified piping in need of rehabilitation, repair or replacement, and prioritized improvements.

Rachael Hager, FE

DISTRIBUTION SYSTEM HYDRAULIC MODELING

Education
PhD, Mechanical Engineering, UC-Berkeley, 2018
MS, Civil Engineering, UH-Manoa, 2012
BS, Civil Engineering, UW-Madison, 2010

Years of Experience
1

Licenses/Registration
Future Engineer

Rachael Hager, FE has performed hydraulic analysis for the Mongolia Advanced Water Purification Plant (AWPP), North & South County Regional Wastewater Treatment Facility in Collier County, and the Stockton, CA Regional Wastewater Control facility. In these projects she has used AECOM's PHP (Plant Hydraulic Profile) and WaterGems hydraulic models to evaluate the performance and feasibility of various scenarios and plant designs. In addition, she has worked on updating and calibrating the Massachusetts Water Resource Authority (MWRA) water distribution system using ICM InfoWorks to match CSO activation volumes and frequencies.

Project Experience

Stockton, CA Region Wastewater Control Facility. Using AECOM's PHP (Plant Hydraulic Profile) software, Excel calculations, and Bentley's WaterGEMS to analyze the hydraulic profile of the facility.

Mongolia Advanced Water Purification Plant. Using AECOM's PHP (Plant Hydraulic Profile) software, Excel calculations, and Bentley's WaterGEMS to analyze the hydraulic profile of the facility.

Collier County North & South County Water Reclamation Plants in Florida. Using AECOM's PHP (Plant Hydraulic Profile) software to analyze current hydraulic profile through the facility.

Massachusetts Water Resource Authority, Combined Sewer Overflow (CSO) Post Long Term Control Plan Evaluation . Calibrating an ICM InfoWorks model to evaluate the volume and frequency of CSO activations modeled to the meter data. Calibrating an ICM InfoWorks water quality model to compare the modeled and sampled Enterococcus concentrations in the in Upper Mystic River/Alewife Brook. Calibrating a Delft3d water quality model to compare the modeled and sampled Enterococcus concentrations in the Charles River.

San Francisco Public Utilities Commission Sewer System Improvement Program. Post-processing results from a Delft3d model to analyze water quality statistics.

AECOM

About AECOM

AECOM is the world's premier infrastructure firm, delivering professional services throughout the project lifecycle – from planning, design and engineering to consulting and construction management. We partner with our clients in the public and private sectors to solve their most complex challenges and build legacies for generations to come. On projects spanning transportation, buildings, water, governments, energy and the environment, our teams are driven by a common purpose to deliver a better world. AECOM is a Fortune 500 firm with revenue of approximately $20.2 billion during fiscal year 2019. See how we deliver what others can only imagine at aecom.com and @AECOM.

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