CITY OF PHILADELPHIA

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ROB DUBOW
Director of Finance

March 15, 2023

TO THE PRESIDENT AND MEMBERS OF THE COUNCIL OF THE CITY OF PHILADELPHIA:

There has been transmitted to the Council the proposed Twenty-Seventh Supplemental Ordinance (the "Twenty-Seventh Supplemental Ordinance") to the Restated General Water and Wastewater Revenue Bond Ordinance of 1989, as supplemented and amended (the "General Ordinance"). Unless otherwise noted, the capitalized terms contained herein shall have the same meanings assigned to them in the General Ordinance. The Twenty-Seventh Supplemental Ordinance specifically authorizes the issuance and sale of one or more series or subseries of tax-exempt or taxable water and wastewater revenue bonds and revenue refunding bonds of the City of Philadelphia (the "City") in the aggregate principal amount not to exceed Nine Hundred Forty-Five Million Dollars ($945,000,000) (the "Bonds"); and in the event that the Bonds are issued with original issue discount, the Bond Committee, or a majority of them, is thereby authorized to increase the aggregate principal amount of the Bonds so issued, by the amount of such original issue discount.

In connection with the proposed issuance of the Bonds, the City has engaged the firm of Black & Veatch Management Consulting, LLC (the "Consultant"), an independent consulting firm. The Consultant has compiled data from the City and the Philadelphia Water Department (the "PWD") in order to enable the Consultant to make projections with respect to the issuance of the Bonds and the refunding program of the PWD, and has compiled relevant data and made projections to ascertain the adequacy of the revenues of the water and wastewater System to support the financial report required by Section 8 of Act No. 234 of October 18, 1972, as amended, known as The First Class City Revenue Bond Act (the "Act").

The Consultant has broad experience in the analysis of utility systems of a similar magnitude and scope as the water and wastewater System of the City and has a favorable reputation for competence in this field of work. The Consultant has reviewed in depth the financial operations of the water and wastewater System of the City and has collaborated with officers and employees of the PWD and the Office of the Director of Finance in the preparation of its report.

The report of the Consultant dated December 20, 2022 (the "Consultant's Report") is attached to this report and forms the basis for the statements and opinions contained herein. The Consultant's Report has been reviewed and approved by both the Office of the Director of Finance and by the PWD. The reports are transmitted herewith in compliance with Section 8 of the Act and Section 5.04(c) of the General Ordinance pursuant to which the Bonds are to be issued.

On the basis of the Consultant's Report and the schedules and summaries therein contained and in compliance with Section 8 of the Act and Section 5.04(c) of the General Ordinance, the undersigned Director of Finance of the City of Philadelphia hereby submits this financial report:

1. The New Money Bonds are to be issued for the purpose of providing funds for (i) paying, or reimbursing the City, for costs of (a) constructing, acquiring, reconstructing and renovating wastewater treatment plants and related facilities and equipment for the sewer system; (b) constructing, acquiring, reconstructing and renovating water treatment plants and related facilities and equipment for the water system; (c) constructing, acquiring, reconstructing and replacing water, wastewater and stormwater pipes, pumping stations and related facilities; (d) purchasing equipment and apparatus of a capital nature for the System; (e) constructing, acquiring, reconstructing and renovating storm water management and mitigation improvements and facilities and other improvements and facilities in furtherance of the City's Combined Sewer Overflow (CSO) Long Term Control Plan Update (referred to as the Green City, Clean Waters Program) dated September 1, 2009, as permitted under the Act and the General Ordinance; and (f) purchasing vehicles that serve the water or wastewater system, all as included in the capital budgets of the City; (ii) paying or defeasing all or any portion of the Obligations issued under or in connection with the City's Water and Wastewater Revenue Bond Commercial Paper Program to be established under the Twenty-Fifth Supplemental Ordinance to the General Ordinance; (iii) paying the costs of any Enhancement Agreements; (iv) paying any other Project Costs as such term is defined in the Act; (v) making the deposits referred to in Section 6 hereof including, without limitation, the establishment of a debt reserve account or series subaccount within the Sinking Fund and any other fund permitted by the General Ordinance; and (vi) paying the issuance costs of such Bonds (collectively, the "Project").

2. The Refunding Bonds are to be used to: (i) refund and redeem, from time to time, (A) all or any portion of the New Money Bonds (as so refunded and redeemed, "Refunded New Money Bonds") and (B) any Refunding Bonds previously issued pursuant to this Supplemental Ordinance (as so refunded and redeemed, the "Refunded Refunding Bonds" and, together with the Refunded New Money Bonds, the "Refunded Bonds"); (ii) if applicable, pay the costs of Enhancement Agreements; (iii) pay any other Project Costs as such term is defined in the Act; (iv) make the deposits referred to in Section 6 hereof; and (v) pay the issuance costs of such Bonds.

3. The revenues pledged to secure payment of the Bonds will be derived from all rents, rates, fees and charges imposed or charged for the connection to, or use or produce of or services generated by the water and wastewater System to the ultimate users or customers thereof, all payments under bulk contracts with municipalities, governmental instrumentalities or other bulk users, all subsidies or payments payable by Federal, State or local governments or governmental agencies on account of the cost of, operation of, or the payment of the principal of or interest on moneys borrowed to finance costs chargeable to the water and wastewater System, all grants, payments and contributions made in aid or on account of the water and wastewater System exclusive of grants and similar payments and contributions solely in aid of construction and all accounts, contract rights, and general intangibles representing the foregoing, and any and all other revenues derived from the water and wastewater System constituting Project Revenues.

4. On the basis of actual and estimated future annual financial operations of the water and wastewater System, all as detailed in the Consultant's Report, the water and wastewater System will, in my opinion, yield pledged Project Revenues over the amortization period of the Bonds sufficient to comply with the Rate Covenant contained in the General Ordinance and to meet the payment or deposit requirements of (a) all expenses of operation, maintenance, repair and replacement of the water and wastewater System, (b) all reserve or special funds required to be established out of such revenues, (c) the principal of and interest on all bonds outstanding under the General Ordinance (including the Bonds), as the same shall become due and payable, for which such Project Revenues are pledged, and (d) any state taxes assumed by the City to be paid on such bonds and such surplus requirements as may be fixed by the General Ordinance.

5. The Project Revenues forming the basis for the statement set forth in paragraph 4 above comply with the requirements of the definition of Project Revenues contained in Section 2 of the Act.

6. Based on its investigations, the Consultant found that the water and wastewater System is in good operating condition or that adequate steps are being taken to return the System to good operating condition.

For the purposes of paragraph 4 above, you are advised that no State taxes on any of such Bonds have been or are being assumed by the City.

Respectfully submitted,

Rob Dubow
Director of Finance

Philadelphia Water Department

Consulting Engineer's Report

For the Twenty-Seventh Supplemental Ordinance

December 20, 2022

BLACK & VEATCH

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Special Notice

Acceptance of this report, or use of any information contained in this report, by any party receiving this report (each a "Recipient") shall constitute an acknowledgement and acceptance by such Recipient of, and agreement by such Recipient to be bound by, the following:

(1) This report was prepared for the City of Philadelphia Water Department ("Client") by Black & Veatch Management Consulting, LLC ("Consultant") and is based on information not within the control of Consultant. In preparing this report, Consultant has assumed that the information, both verbal and written, provided by others is complete and correct. Consultant does not guarantee the accuracy of the information, data or opinions contained in this report and does not represent or warrant that the information contained in this report is sufficient or appropriate for any purpose.

(2) This report should not be construed as an invitation or inducement to any Recipient or other party to engage or otherwise participate in the proposed or any other transaction, to provide any financing, or to make any investment. Recipient acknowledges and agrees that it is not reasonably feasible for Consultant to conduct a comprehensive investigation and make definitive determinations for the compensation provided and without thorough verification of the information upon which the Services were performed, and therefore Consultant can offer no guarantee or assurances that any facts, observations, analysis, projections, opinions, or other matters contained in the report will be accurate, either at the time the report is issued or at any other time.

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ACRONYM OR TERM	DEFINITION
The Act	The First Class City Revenue Bond Act
AMF	Average Monthly Flow
AMI	Advanced Metering Infrastructure
AMR	Automatic Meter Reading
AWIA	2018 America's Water Infrastructure Act
AWWA	American Water Works Association
Basis2	Basis2 billing system used by Water Revenue Bureau
BCWSA	Bucks County Water and Sewer Authority
Black & Veatch	Black & Veatch Management Consulting, LLC or Black & Veatch Corporation
BLS	The Philadelphia Water Department's Planning and Environmental Services Division's Bureau of Laboratory Services
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
BOD_5	Biochemical Oxygen Demand (five day)
BRC	Biosolids Recycling Center
BRIC	Building Resilient Infrastructure and Communities
Capital Account Deposits	Deposits to the Water Department's Capital Account of the Construction Fund
CBOD	Carbonaceous Biochemical Oxygen Demand
$CBOD_5$	Carbonaceous Biochemical Oxygen Demand (five day)
$CBOD_{20}$	Carbonaceous Biochemical Oxygen Demand (20 day)
CCAP	Climate Change Adaptation Program
CCR	Consumer Confidence Report
CCTV	Closed-Circuit Television
CFAP	Capital Facilities Assessment Plan
CFE	Combined filter effluent
CIP	Capital Improvement Program

ACRONYM OR TERM	DEFINITION
CIPIT	The Philadelphia Water Department's Capital Improvement Program Information Tracking
Clean Air Act or CAA	The Federal Clean Air Act
CIS	Customer Information System
City	The City of Philadelphia
City Charter	Philadelphia's Home Rule Charter
CMMS	Computerized Maintenance Management System
COA	Consent Order and Agreement
CRU	Central Receiving Unit
CSO	Combined Sewer Overflow
DAF	Dissolved Air Flotation
DBP	Disinfection Byproducts
DCS	Distributed Control Systems
DSU	The Philadelphia Water Department's Development Services Unit
DELCORA	Delaware County Regional Water Authority
DMA	District Metered Area
DRBC	Delaware River Basin Commission
DRR	The Pennsylvania Department of Environmental Protection's Disinfection Requirements Rulemaking
EAP	Evaluation and Adaptation Plan
Energy Plan	The Philadelphia Water Department's Utility-Wide Strategic Energy Plan
ER	Ecological restoration
ERTs	Encoder, Receiver, and Transmitter units
FEMA	Federal Emergency Management Agency
FPL	Federal Poverty Level
FWWIC	Fairmont Water Works Interpretative Center
FY	Fiscal Year
GA	Greened Acre
GARP	Greened Acre Retrofit Program

ACRONYM OR TERM	DEFINITION
General Ordinance	The Restated General Water and Wastewater Revenue Bond Ordinance of 1989 and the amendments and supplements thereto, including those set forth in the First, Second, Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, Tenth, Eleventh, Twelfth, Thirteenth, Fourteenth, Fifteenth, Sixteenth, Seventeenth, Eighteenth, Nineteenth, Twentieth, Twenty-First, Twenty-Second, Twenty-Third, Twenty-Fourth, Twenty-Fifth, and Twenty-Sixth Supplemental Ordinances
GCCW	The Philadelphia Water Department's Green City, Clean Waters Program
GHG	Greenhouse gas emissions
GIS	Geographic Information Systems
gpd	Gallons per day
Greened Acre	Unit of measure used to track runoff managed by green infrastructure under the COA
GSI	Green Stormwater Infrastructure
HVAC	Heating, ventilation, and air conditioning
IFE	Individual filter effluent
ILI	Infrastructure Leakage Index
IS&T	The Philadelphia Water Department's Information Services and Technology Unit
IWBC	The Philadelphia Water Department's Industrial Waste & Backflow Compliance Unit
kWh	Kilowatt hours
L&I	The City of Philadelphia's Department of License & Inspection
lb	Pound
LCR	The Lead and Copper Rule
LCRR	The Lead and Copper Rule Revisions
LIHWAP	Low-Income Household Water Assistance Program
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
LTCPU	The Philadelphia Water Department's Combined Sewer Overflow Long-Term Control Plan Update
M1 Manual	AWWA Principles of Rates, Fees and Charges Manual, 7th Edition
Mcf	Thousand cubic feet

ACRONYM OR TERM	DEFINITION
MCL	Maximum contaminant level
MDF	Maximum Daily Flow
MDMS	Meter Data Management System
MEL	The Philadelphia Water Department's Materials Engineering Laboratory
MG	Million gallons
MGD	Million gallons per day
mg/L	Milligrams per liter
MoP 27	WEF's Financing and Charges for Wastewater Systems Manual of Practice 27, 4th Edition
MRDLs	Maximum residual disinfectants levels
MS4	Municipal Separate Storm Sewer System
M/W/DSBE	Minority, Woman, or Disabled-Owned Enterprise
MWh	Megawatt hours
NACWA	National Association of Clean Water Agencies
NASSCO	National Association of Sewer Service Companies
NOx	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric turbidity units
O&M	Operations and Maintenance
OEO	The City of Philadelphia's Office of Economic Opportunity
OHR	The City of Philadelphia's Office of Human Resources
OIT	The City of Philadelphia's Office of Innovation and Technology
OOW	The Philadelphia Water Department's Planning and Environmental Services Division's Office of Watersheds
OPAL Project	Optimize Procurement Accounting & Logistics Project
P&ES	The Philadelphia Water Department's Planning and Environmental Services Division
P&R	The Philadelphia Water Department's Planning and Environmental Services Division's Planning and Research Unit
PADEP	Pennsylvania Department of Environmental Protection

ACRONYM OR TERM	DEFINITION
PAHAF	Pennsylvania Homeowners Assistance Fund
Partnership	The Partnership for Safe Water Program
PBS	Philadelphia Biosolids Services Company
PCBs	Polychlorinated Biphenyls
PCB PMP	Polychlorinated biphenyl Pollutant Minimization Plan
PCB	Polychlorinated Biphenyl
PCSMP	Post Construction Stormwater Management Plans
PDPH	The City of Philadelphia Department of Public Health
PENNVEST	Pennsylvania Infrastructure Investment Authority
PFAS	Per-and Polyfluoroalkyl Substances
PHA	Philadelphia Housing Authority
PLFs	Performance limiting factors
PMA	Philadelphia Municipal Authority
PMP	Pollution Minimization Plan
PPC	Preparedness, Prevention, and Contingency Plan
ppd	Pounds per day
ppb	Parts per billion
ppm	Parts per million
PST	Primary Settlement Tank
PTB	Preliminary Treatment Building
PWD	The Philadelphia Water Department
QCP	Quality Certification Program
Rate Board	The City of Philadelphia's Water, Sewer and Storm Water Rate Board
Rate Ordinance	The Water, Sewer and Storm Water Rate Board Ordinance
Report	The Consulting Engineer's Report for the Twenty-Seventh Supplemental Ordinance, December 9, 2022
RFI	Request for Information
RSF	The Rate Stabilization Fund
RTC	Real Time Control
RTCR	The Revised Total Coliform Rule

ACRONYM OR TERM	DEFINITION
SAP	The Philadelphia Water Department's Sewer Assessment Program
SCADA	Supervisory Control and Data Acquisition
SDWA	Safe Drinking Water Act of 1974
SIUs	Significant Industrial Users
SMIP/GARP	Stormwater Management Incentive Program/Greened Acre Retrofit Program
SRA	Scientific and Regulatory Affairs section within the Bureau of Laboratory & Environmental Services – Environmental Services unit
SRF	Sewer Rental Factors
SRS	The Philadelphia Water Department's Surveillance and Response System
Study Period	Six-Year Study Period covering FY 2019 through FY 2024
SWMP	Stormwater Management Plan
Synagro	Synagro Technologies, Inc.
T&D	Transmission and Distribution
TAP	Tiered Assistance Program
TAP-R	TAP Rate Rider Surcharge Rate included with the water and sewer quantity charges
TCR	Total Coliform Rule
TMDL	Total Maximum Daily Loads
TRC	Total Residual Chlorine
TSS	Total Suspended Solids
UCMR	The Unregulated Contaminant Monitoring Rule
UESF	Utility Emergency Services Fund
USEPA	The United States Environmental Protection Agency
WAS	Waste Activated Sludge
Water Department	The Philadelphia Water Department
WEF	Water Environment Federation
Vicinity	Vicinity Energy Philadelphia
WIFIA	Water Infrastructure and Finance Innovation Act
WPCP	Water Pollution Control Plant

ACRONYM OR TERM	DEFINITION
WQBEL	Water Quality Based Effluent Limit
WRB	The City of Philadelphia's Water Revenue Bureau
WRP	The Water Revitalization Plan
WTP	Water Treatment Plant
WWMPU	Wastewater Master Plan Update
VOCs	Volatile Organic Compounds
µg/L	Micrograms per liter

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1.0 Introduction

1.1 Purpose

The purpose of this report ("Report") is to summarize the findings of the study performed by Black & Veatch Management Consulting, LLC, and Black & Veatch Corporation (collectively "Black & Veatch") related to the water and wastewater systems of the Philadelphia Water Department ("Water Department" or "PWD"), a self-supporting enterprise fund utility that is a department within the City of Philadelphia ("City"). In accordance with the City's requirements, the Water Department must submit a report providing an independent review of the water and wastewater systems to obtain approval for capital budget appropriations and debt authorization. As such, this Report is provided to help the City establish capital budget-level appropriations and support development of the Twenty-Seventh Supplemental Ordinance, authorizing the issuance of up to $945 million of water and wastewater revenue bonds by the City, to be enacted under the First Class City Revenue Bond Act (the "Act"), and the Restated General Water and Wastewater Revenue Bond Ordinance of 1989 and the amendments and supplements set forth in the First through Twenty-Sixth Supplemental Ordinances (together the "General Ordinance").

Subject to the limitations set forth herein, this Report was prepared for the City by Black & Veatch and is based on information not within the control of Black & Veatch. Black & Veatch has not been requested to make an independent analysis, to verify the information provided to it, or to render any independent judgment of the validity of the information provided by others. As such Black & Veatch cannot, and does not, guarantee the accuracy thereof.

In conducting the analysis and in forming an opinion of the projection of future operations summarized in this Report, Black & Veatch has made certain assumptions with respect to conditions, events, and circumstances that may occur in the future. The methodology utilized by Black & Veatch in performing the analysis follows generally accepted practices for such projections. While Black & Veatch believes the assumptions are reasonable and appropriate, and the projection methodology valid, actual results may differ materially from those projected, as influenced by the conditions, events, and circumstances that occur, that are unknown now and/or which are beyond the control of Black & Veatch. To the extent that the information provided to Black & Veatch by the City changes or is inaccurate, the conclusions presented in this Report may vary and are subject to change.

This Report should be read in its entirety for a complete understanding of the findings presented and the underlying assumptions used.

1.2 Scope of Work

This Report presents the results of the financial plan of the water and wastewater systems, which are based on a review of the Water Department's financial data, records, and other information. The Report also addresses the organization and management, system infrastructure condition, adequacy of system capacity, operations and maintenance ("O&M") practices, staffing levels of the water and wastewater systems, and includes a review of the proposed Capital Improvement Program ("CIP") of the Water Department.

This Report includes an anticipated issuance of Water and Wastewater Revenue Bonds in fiscal years ("FY") 2024 and 2025 to fund a portion of the FY 2023 to FY 2028 six-year CIP, make deposits to the Debt Reserve Account as required, and fund the issuance costs of the proposed bonds. Black & Veatch performed a financial feasibility analysis reflecting the requirements of the General Ordinance for the six-year period of FY 2023 through 2028.

In the preparation of this Report, the Black & Veatch team performed site visits and conducted inspections of major water and wastewater facilities during the month of September 2022. Black & Veatch reviewed the current condition, and operation and maintenance of the water and wastewater systems. Our general field observations were visual, above-ground examinations of selected areas which we deemed adequate to comment on the condition but were not in the detail which would be necessary to reveal conditions with respect to safety, geologic or environmental conditions, codes, permits or applicable regulations. We also met with key Water Department staff during September through November 2022 to discuss facility and system planning, regulatory compliance, staffing, the CIP, and the overall mission of the Water Department. Staff interviewed during our studies included representatives from each of the seven divisions within the Water Department: Finance; Operations; Engineering and Construction; Communications and Engagement; Administration and Human Resources; Planning and Environmental Services ("P&ES"); and Information Services & Technology ("IS&T"). Black & Veatch also reviewed publicly available information and reports as provided by the Water Department.

1.3 Black & Veatch Qualifications

The Black & Veatch Group of companies are global engineering, construction and consulting firms specializing in utility engineering and utility financial management. The firm's experience includes the planning, design, operational analysis and construction of water, wastewater, and energy generation and transmission systems. In addition, the firm has extensive experience in assisting utilities with the management and financial aspects of utility operations. Black & Veatch has worked for utilities owned by municipalities ranging in size from small villages to large metropolitan regions, investor-owned utilities, industrial and commercial businesses, and agencies of the United States and international government agencies.

Professionals from Black & Veatch Management Consulting, LLC, which provides services in such areas as utility rate studies, property valuation, depreciation rate studies, financial analysis and planning, non-audit accounting, management and operations analysis, and the preparation of consulting engineering

reports for official statements, conducted the financial feasibility review. Black & Veatch has performed various financial studies for the City of Philadelphia Water Department continuously since 1972, including the preparation of engineering reports for the Water and Sewer Revenue Bonds, issued under both the General Water and Sewer Revenue Bond Ordinance of 1974, as amended, and supplemented, prior Water and Wastewater Revenue Bonds issuances under the General Ordinance, as well as various rate proceedings. We are familiar with the Water Department's financial affairs as they relate to revenues, expenses, rates, and other financing matters. We were most recently involved in the Special Rate and Annual Tiered Assistance Program ("TAP") Rate Rider proceedings completed in June 2022. As a result of these rate hearings, the City of Philadelphia's Water, Sewer and Storm Water Rate Board ("Rate Board") approved schedules of water and wastewater rates for retail service for fiscal year 2023, which are currently in effect. The City also adopted rates applicable to wholesale water and wastewater rates for this same period.

Personnel from Black & Veatch's Government & Water Utilities Business Segment conducted the physical evaluation of the Water Department's water and wastewater systems. This segment provides study, design, and construction services in all facets of the water and wastewater fields. Water system engineering experience of this business unit includes the design of a broad variety of facilities such as source of supply, pumping stations, treatment plants, and transmission and distribution ("T&D") systems. Wastewater system engineering experience includes design of collection, interceptor, and trunk sewers; pumping stations; treatment systems; and sludge disposal facilities; as well as stormwater management including green infrastructure design, implementation, and construction program management. The Government & Water Utilities Business Segment also has extensive experience in operator training, plant management studies, and preparation of O&M manuals for both water and wastewater systems.

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2.0 Organization and Management

2.1 Organization and Structure

The City of Philadelphia owns and operates the water and wastewater systems serving the City and 10 wholesale wastewater contract customers and one wholesale water contract customer, as a self-supporting enterprise fund utility. On April 17, 1951, the Philadelphia Home Rule Charter ("City Charter") established the Water Department as one of the City's ten operating departments. The Water Department is responsible for the planning, construction, operation, and maintenance of the water, wastewater, and stormwater systems; for complying with regulatory requirements; for rate setting and stakeholder engagement; budgeting and detailed cost accounting; and preparation of financial statements for the systems. The City's combined Comprehensive Annual Financial Report includes the data from the Water Department's annual statements.

The Water Revenue Bureau ("WRB"), which is a division within the City's Revenue Department, is responsible for billing, collection, and customer accounting for the water and wastewater systems. The City's Revenue Commissioner oversees the activities of the WRB, while the City's Finance Director has the ultimate oversight of the WRB.

The City's audit function is the responsibility of the Office of the City Controller. Legal matters affecting the Water Department are the responsibility of the City Solicitor's office. There is one Divisional Deputy City Solicitor and five City Attorneys assigned directly to the Water Department under the direction of the City Solicitor's office with additional support as needed.

The Water Commissioner, who is appointed by the City's Managing Director with approval of the Mayor, leads the Water Department. In June 2019, the City appointed Mr. Randy Hayman as Water Commissioner. Prior to his appointment, Commissioner Hayman served for over 15 years as General Counsel for two major municipal water/wastewater utilities, the Metropolitan St. Louis Sewer District and DC Water, and was a partner at a major environmental law firm.

Figure 2-1 shows the Water Department's current Organizational Chart. The Water Department consists of six divisions: Finance; Operations; Planning and Environmental Services; Engineering and Construction; Administration and Human Resources; and Communications and Engagement. Additionally, the Director of Policy and Strategy reports directly to the Commissioner but this position has been vacant for several years. This position is responsible for developing strategies for compliance with environmental regulations and permit negotiations. The Water Commissioner is currently working internally and with the City Solicitor's Office to assess the adequacy of existing resources to collaboratively fill this role. The Information Systems & Technology Division is part of the City's Office of Innovation and Technology ("OIT"); this unit reports to both OIT and the Water Commissioner.

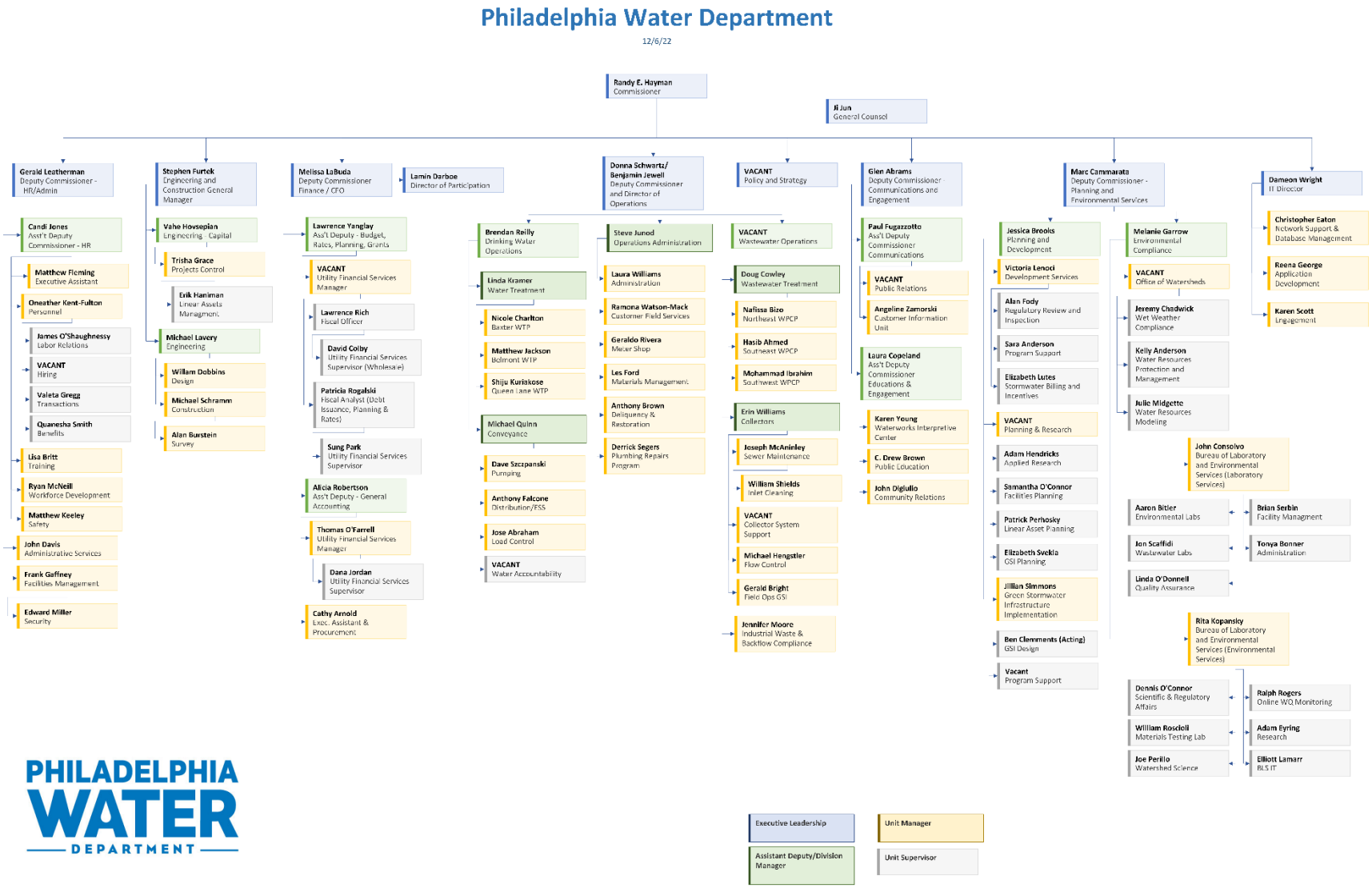

Figure 2-1 Organizational Structure

Each Division is led by an experienced Deputy Water Commissioner or General Manager, who assists the Commissioner with the management of the Water Department. Each Division consists of units and subunits or sections responsible for carrying out specific functions. Senior management is actively involved in industry associations such as the American Water Works Association ("AWWA"), Water Environment Federation ("WEF"), National Association of Clean Water Agencies ("NACWA"), the Clean Water Council, and the U.S. Water Alliance, with several staff members contributing to manuals that document best practices in the field of water, wastewater, and stormwater management.

As of January 2023, there will be changes at the Deputy Commissioner level for both the Operations and Finance Divisions. The Deputy Commissioner of Operations, Ms. Donna Schwartz, will retire in January 2023 after over 35 years at the Water Department. Her successor, Mr. Benjamin Jewell, was named in October 2022 to allow for dual incumbency and a transition period. Deputy Commissioner Jewell most recently reported directly to Ms. Schwartz as the Water Engineering Assistant Manager of Wastewater Operations. His 15 years of experience in the Operations Division will provide a strong foundation as he transitions into his new leadership role.

The Deputy Commissioner of Finance, Ms. Melissa La Buda, is leaving the City and returning to the private sector effective December 31, 2022. The Water Commissioner appointed Assistant Deputy Commissioner Mr. Lawrence Yangalay as Acting Deputy Commissioner as of November 28, 2022, to lead the Finance Department while a search for permanent replacement is conducted. Mr. Yangalay has been with the City of Philadelphia for 15 years and is well qualified for this role.

As of September 30, 2022, the Water Department had approximately 2,585 approved positions and 2,099 employees, representing a vacancy rate of 19%. Of these, the American Federation of State, County, and Municipal Employees Union District Councils 33 and 47 represent 1,474 and 409 employees, respectively. The Water Department's 216 upper management, supervisory, senior engineering, and part time personnel are not eligible for union membership. The City's most recent labor agreements with District Council 33 and District Council 47 cover the period of FY 2022 through FY 2024.

In addition to the above employees, the Water Department funds positions in OIT, WRB and the Department of Public Health ("PDPH"). This includes approximately 87 budgeted positions in OIT (61 of which are assigned to IS&T, 25 to WRB and one to the Law Department), 200 in WRB and one in PDPH. These positions are accounted for in the Water Department's Operating Budget.

The vacancy rate represents a historically high level and a substantial increase from the vacancy rates reported at the end of FY 2020 and FY 2021 of 12% and 15%, respectively. The level of vacancies was discussed with Water Department management as presented throughout this report. In general, management reports that resignations resulting from COVID combined with retirements and typical turnover, as well as the approval of new positions to support key initiatives created the vacancies. The current job market has made it even more difficult to attract candidates than in the past, resulting in insufficient numbers of applicants to fill the vacancies. This is attributed to compensation packages, which under current City policy are subject to civil service requirements and City-wide compensation leveling. Generally, City compensation is not viewed as competitive with that of the private sector. The City also

has a residency requirement for employees. With these perceived deterrents and the civil service hiring process, which can take longer than the public sector, filling vacancies will take time to resolve.

The Division of Administration and Human Resources is collaborating with management across divisions to develop and implement strategies to both attract and develop more candidates, as discussed in Section 2.1.5 of this report. In the meantime, the Water Department is meeting level of service goals and compliance requirements utilizing overtime and contractor support as needed. Contractor support has historically been focused on professional services and emergency maintenance activities, not routine maintenance activities. Shifting to utilize more maintenance contracts to supplement routine maintenance would represent a substantial change in operating approach. However, the Water Department recognizes the need for a long-term solution to the hiring challenges as well as the need to maintain levels of service in the face of the high vacancy rate. As discussed in later sections, the Water Department is developing and implementing a range of approaches to address both short- and long-term staffing needs.

The following sections provide an overview of the Water Department's key divisions and the WRB.

2.1.1 Operations Division

The Philadelphia water, wastewater and stormwater systems are among the largest and oldest municipal systems of their kind in the country. Operation and maintenance of these systems requires continuous attention for the following reasons:

- The public drinking water must be safe and comply with both the Safe Drinking Water Act of 1974 ("SDWA") regulations of the U.S. Environmental Protection Agency ("USEPA") and requirements of the Pennsylvania Department of Environmental Protection ("PADEP").
- The effluent from the wastewater treatment plants and the combined sewer overflows discharged to the Delaware River must meet the requirements set forth in the plants' National Pollutant Discharge Elimination System ("NPDES") permits.
- The City must maintain and operate the water and wastewater treatment plants, the water and sewerage conveyance systems, and the pumping facilities in an acceptable manner that assures cost-effective and continuous performance with minimal adverse impacts to the public and the environment.
- The treatment, disposal and distribution of sewage sludge and other residuals must be in accordance with governing federal and state regulations and Water Department policy.

The Operations Division is responsible for the day-to-day operations and maintenance of the water, wastewater, and stormwater systems. The Division's current leadership includes a Deputy Commissioner of Operations and two Water Engineering Assistant Managers responsible for the water system and wastewater system, respectively. This Division includes the following key operating units, each of which will be discussed in more detail in Sections 4 and 5 of this report:

- Water Treatment

- Water Conveyance
- Wastewater Treatment
- Wastewater and Stormwater Collection
- Operations Administration
- Industrial Waste & Backflow Compliance

Based upon our interviews, site inspections and information review, we believe that the Operations Division is effectively organized for responding to the myriad of routine issues and emergency situations affecting operations and maintenance. The structure provides for a smooth flow of communication to and from the division level, unit levels and operating groups. Each facility has a plant manager who is supported by engineers and superintendents who manage the technical group leads and routine operations and maintenance activities. Management places great emphasis on holding regularly scheduled staff meetings with superintendents and technical group leaders to communicate plans and receive feedback.

The Operations Division has developed a strong technical staff to supervise its operations and maintenance program. As of September 30, 2022, there were approximately 1,584 approved positions and 270 vacancies in the Operations Division. This represents a slight increase in approved positions and a continued trend of increasing vacancies as compared to recent years. As discussed throughout this report addressing the level of vacancies across the Water Department is a priority. Based on consistent operational performance that meets or exceeds regulatory requirements, as well as discussions with management, it is our opinion that there is adequate staffing within the Operations Division to meet current system requirements. However, it is imperative for long-term sustainability to address key vacancies in shift positions (operators and laboratory technicians), trades and skilled labor positions.

In addition to executing day-to-day operations and ensuring regulatory compliance, the Water Department must provide sufficient forward-looking engineering and planning to address aging infrastructure and to ascertain future operating requirements likely to emerge from upcoming drinking water and environmental regulations. To provide for efficient decision making, the Operations Division has implemented procedures focused on identifying all capital improvements and replacement/rehabilitation project needs at each of its major facilities. The Operations Division identifies projects on a master list by facility and projects needs for a six-year capital planning period.

With many of the Water Department's assets nearing the end of their expected service life and the continued promulgation of new and highly probable future regulations, prudent advanced planning and engineering is essential to ensure regulatory compliance and attainment of level of service goals. To address these challenges the Operations Division interacts and works closely with the Planning and Environmental Services Division and the Engineering and Construction Division in planning for the future capital improvements and operational changes. These Divisions support Operations in the following key areas:

- Undertaking long-range planning and engineering.
- Coordinating delivery of regulatory agency requirements.
- Producing analytical results required to demonstrate permit and regulatory compliance.
- Preparing construction documents and managing design consultants.
- Coordinating construction projects.
- Establishing capital budgets and maintaining the current CIP.

Based upon our observations and discussions with key staff, we find that the Operations Division coordinates effectively with the Planning and Environmental Services Division and the Engineering and Construction Division. This is demonstrated by the on-going and highly collaborative water and wastewater master planning initiatives which are led by the Planning and Environmental Services Division with significant input from the Operations Division and the Engineering and Construction Division. These initiatives are discussed in more detail in Sections 4.3 and 5.3 of this report.

The managers of the Operations, the Planning and Environmental Services, and the Engineering and Construction Divisions have responded capably to the water and wastewater systems' needs. They possess qualifications and experience commensurate with their responsibilities which enable them to deliver reliable, cost-effective water, wastewater, and stormwater services to the Water Department's customers, making them well-positioned to meet projected needs in the coming years.

2.1.2 Planning and Environmental Services Division

The Planning and Environmental Services Division consists of six units that are responsible for conducting planning and engineering evaluations, applied research and laboratory services to inform regulatory compliance, capital program development and operational enhancements. This division recently experienced two organizational changes. In the fall of 2021, the Bureau of Laboratory Services (“BLS”) was subdivided into two distinct operating units, the Laboratory Services Unit, and the Environmental Services Unit. Additionally, in October of 2022, two civil service positions, Water Engineering Assistant Managers, were added to support the Deputy Commissioner in the overall management of the Division. These positions are also referred to as Assistant Deputy Commissioners. The Assistant Deputy Commissioner of Environmental Compliance manages the Office of Watersheds and the two Bureau of Laboratory and Environmental Services Units, while the Assistant Deputy Commissioner of Planning & Development manages the Planning and Research, Green Stormwater Infrastructure Implementation, and Development Services Units. The creation of this new organizational structure right-sizes the reporting structures, will provide an opportunity to streamline the services provided by each of the units, and will allow the Deputy Commissioner to focus on new and emerging challenges and initiatives. As of September 30, 2022, there were approximately 288 employees with 52 vacancies within this division. Provided below are descriptions of the units:

2.1.2.1 Office of Watersheds Unit

The Office of Watersheds ("OOW") Unit supports the Combined Sewer Overflow ("CSO"), Municipal Separate Storm Sewer System ("MS4"), Source Water Protection and Climate Change Adaptation programs. The objective of the unit is to attain comprehensive achievement of the goals and regulatory requirements for these programs. This includes developing a holistic and innovative planning approach for protecting and restoring the City's watersheds and water resources.

OOW is primarily responsible for tracking and maintaining compliance with the Water Department's:

- CSO Long-Term Control Plan Update ("LTCPU") in accordance with the Consent Order and Agreement ("COA");
- Stormwater Management Plan ("SWMP") as required under the MS4 permit; and
- Source Water Protection Plans for the Schuylkill and Delaware Rivers.

To achieve these overarching objectives, OOW is comprised of three functional groups: Wet Weather Compliance, Water Resources Modeling and Water Resources Protection and Management as described below.

- Wet Weather Compliance is comprised of three teams: Compliance Reporting & Analysis; Permit Compliance & Planning; and Monitoring, Analysis & Research. These teams focus on ensuring near and long-term compliance with the regulatory obligations of the COA and the MS4 permits.
  - The Compliance Reporting & Analysis team tracks progress toward meeting permit benchmarks, coordinates the compilation of required planning documents and annual reports, and ultimately ensures that the Water Department maintains compliance.
  - The Permit Compliance & Planning team focuses on the regulatory obligations related to "greened acres," the unit of measure used to track runoff managed by green infrastructure under the COA.
  - The Monitoring, Analysis & Research team primarily focuses on field-based monitoring of Green Stormwater Infrastructure ("GSI") and the development of new and innovative monitoring technologies.
  - Key recent and on-going initiatives include leading the transition of updating the greened acres calculation methodology, assessing impacts of the draft MS4 Phase I Permit and supporting negotiations with PADEP, leading the COA Adaptive Management and Costing Revaluation, and leading the development of a stormwater review and inspection application for private facilities.
- Water Resources Modeling utilizes modeling and monitoring tools to support project development and demonstration of performance.
  - The Hydraulic and Hydrologic Modeling team develops and maintains the models of the watersheds and sewer system to support planning and alternatives analyses related to the COA, wastewater master plan and storm flood relief projects, and to track progress toward the mass load pollutant reductions required under the COA.

- The Water Quality Compliance Modeling team develops and maintains tributary and tidal waters water quality models that are used to assess the impacts of COA projects on receiving stream water quality as well as salt line intrusion impacts from both changes in Delaware River Basin flow management activities and potential sea level rise scenarios. The models are also used to inform compliance with existing regulations, and support planning for regulatory changes.
- Key recent and on-going initiatives include assessing wholesale customer impacts on the system capacity and CSOs, model updates to incorporate new or proposed GSI installations and modeling of proposed capacity enhancements associated with the COA Adaptive Management and Costing Revaluation.

- Water Resources Protection and Management is comprised of three teams: Watershed Protection, Climate Change Adaptation, and Watershed Field Services.
  - The Watershed Protection team focuses on implementation of the Source Water Protection Plans and the Watershed Control Program Plans for the Queen Lane and Baxter Water Treatment Plants ("WTP"). This team works with regional watershed groups to monitor and assess the impact of actual and potential risks on the region's drinking water sources and to identify mitigation strategies to protect Philadelphia's water supply. This team is responsible for surface water quality monitoring in streams throughout the City's watershed, for investigating new and innovative technologies to protect Philadelphia's water supply, and for tracking and assessing basin wide policies and risks related to drinking water supply management.
  - The Climate Change Adaptation Program ("CCAP") performs comprehensive risk assessments with the goal of developing adaptation strategies and informing Water Department programs and plans. CCAP and the Water Department are committed to working with other City agencies, local and regional stakeholders, industry experts and officials from all levels of government to address actionable approaches to climate change.
  - The Watershed Field Services team conducts various watershed field-based activities ranging from floatables control to organizing large-scale watershed clean up events in accordance with the MS4 permit.
  - Key recent and on-going initiatives include completion of the Climate-Resilient Planning and Design Guidance Manual, as discussed in Section 2.2, coordination of the Water Department's review and response to the Delaware River Basin Commission's use attainability evaluation and associated social and economic review and leading the Water Department's assessment of the potential impacts of proposed/potential per-and polyfluoroalkyl substances ("PFAS") regulations.

2.1.2.2 Bureau of Laboratory & Environmental Services – Laboratory Services

The Bureau of Laboratory Services ("BLS") is the Water Department's environmental laboratory responsible for providing analytical services to meet water, wastewater, and stormwater regulatory monitoring requirements and to support various Water Department compliance and research initiatives. BLS is an accredited laboratory with the Commonwealth of Pennsylvania under Act 25, Chapter 252 for

the analysis of environmental samples. BLS also oversees three process control laboratories, one at each of the Water Department's three Water Pollution Control Plants ("WPCPs").

BLS – Laboratory Services focuses on traditional laboratory services and is comprised of the following sections: Environmental Laboratories, Wastewater Laboratories, Quality Assurance, Central Receiving Administrative, and Facilities.

- The Environmental Laboratories are comprised of the Water Analysis & Metals, Aquatic Biology, General Analysis and Organics laboratories. These laboratories analyze 2,500 water and wastewater samples monthly for chemical and bacteriological parameters. As the Water Department regulations and analytical instrumentation evolve, BLS-Laboratory Services strives to stay positioned to support the Water Department by providing analytical support at the levels required for modeling, research, and regulatory monitoring. To this end, Environmental Laboratories continues to expand its analytical capabilities and is currently developing analytical capability to monitor PFAS compounds.
- The Wastewater Laboratories are responsible for the daily compliance monitoring and reporting at the three WPCPs. Capital projects for the renovation of these laboratories at the three WPCP are currently in design.
- Quality Assurance is responsible for developing and implementing policies and procedures that ensure the laboratories unit produce accurate and replicable results, complete required documentation, and operate in accordance with their accreditation requirements.
- The Central Receiving Unit ("CRU") is the first stop for all samples brought into BLS. Wastewater, drinking water, compliance, and research samples are all delivered to CRU with a formal Chain of Custody. The CRU inspects all samples for acceptance, maintains the official Chain of Custody and enters all sample information into the Laboratory Information Management System (LIMS).
- The Administrative and Facilities sections are responsible for the administrative and building maintenance activities inherent in operating a laboratory.

2.1.2.3 Bureau of Laboratory & Environmental Services – Environmental Services

BLS – Environmental Services is responsible for managing compliance with the water quality requirements under the federal Safe Drinking Water Act and state regulations. They also provide customer response, distribution surveillance, surface water monitoring and materials testing services. This unit is comprised of four sections: Scientific and Regulatory Affairs ("SRA"), Online Water Quality Monitoring, Watershed Sciences, and Materials Testing and Certification.

- SRA personnel collect approximately 1,200 drinking water samples each month from the water treatment plants, storage reservoirs, and distribution system. SRA personnel also respond to drinking water quality issues as reported through the Water Department's customer contact center, helping customers solve water quality problems within their homes and facilities.

  SRA leads the Water Department's lead and copper sampling and compliance program. With the recent release of the Lead and Copper Rule Revisions ("LCRR"), SRA is partnering with Applied Research to

develop and implement a LCRR compliance program. The breadth of the program will require significant additional resources to address the expanded sampling, testing, outreach and lead service line inventory and replacement requirements. BLS-Environmental Services is engaging consultant support to assist with the LCRR compliance planning. LCRR compliance is a major initiative for BLS and the Water Department, as discussed in Section 2.2.

- The Online Water Quality Monitoring section conducts drinking water quality surveillance and investigations in the water distribution system using 40 online real-time water quality monitoring instrument panels placed at strategic locations within the drinking water distribution system. This online monitoring system serves as the foundation of the Water Department's Surveillance and Response System ("SRS").
- The Watershed Sciences section focuses on stream water quality monitoring, aquatic life assessments, and the operation and monitoring of the Fairmount Fish Ladder. These scientists work closely with the OOW's data collection efforts required for the annual reports specified under the MS4 and CSO program permits.
- Materials Testing and Certification is responsible for testing products used by the Water Department and other City agencies. While its focus is on testing products used in construction of the Water Department's infrastructure, it also tests items such as tools, fasteners, and paint for adherence to specifications and performance.

  The section uses a Quality Certification Program ("QCP") to obtain quality materials for the Water Department's construction projects. The objective of the QCP is to protect the quality of major infrastructure materials and products by requiring adherence to accepted principles of quality control at the point of manufacture. To be eligible for supplying listed products to the Water Department, the supplier must achieve certification by Materials Testing and Certification. Qualifications include an approved quality control manual and evidence that the manufacturing staff consistently follow the manual. Materials Testing and Certification staff perform periodic on-site audits of manufacturing facilities. The Materials Analysis Laboratory also serves as the laboratory for the City's Procurement Department, testing a wide variety of purchased materials for conformance to specifications.

2.1.2.4 Planning and Research Unit

The Planning and Research ("P&R") Unit's primary mission is to direct and coordinate strategic planning and associated research in support of each of the Water Department's program areas. There are four functional units within P&R: Linear Asset Planning, Facilities Planning, GSI Planning and Applied Research.

- Linear Asset Planning is comprised of two groups: Water System Planning and Sewer System Planning. These groups identify and develop capital plans to renew the water distribution system and the sewer collection system.
  - The Water System Planning group is comprised of the Water Planning and Transmission System Planning. Water Planning is responsible for planning linear replacement projects in support of the goal of increasing the water main replacement rate from the current rate of approximately 20 miles

per year to 42 miles per year. The CapPlan™ water model is used to identify water main replacement projects for inclusion in the CIP. This group also coordinates with the Applied Research group in support of the Water Department's lead service line replacement initiative. Transmission System Planning is responsible for the renewal and replacement of transmission mains as well as improving system redundancies across the conveyance network.

- The Sewer System Planning group is comprised of Sewer Planning and Flood Risk Management. Sewer Planning provides support to the Sewer Assessment Program ("SAP") through review of sewer inspection data and identification and prioritization of sewer repair or replacement projects. Flood Risk Management uses hydrologic and hydraulic models and cost-benefit analyses to develop conceptual alternatives to mitigate existing and potential future flood impacts, as well as to address flooding issues that are raised by customers.

- Facilities Planning leads the Water Department's long-term planning efforts associated with the water and wastewater treatment plants, pump stations and storage facilities.
  - The Water and Wastewater Facilities Planning groups provide a holistic approach to the facility planning efforts which includes assessing and planning to meet future demands and changing climatic conditions as well as the identification of emerging technologies to address future regulations and operational challenges. Current initiatives include coordinating the transition from planning to implementation of the Water Revitalization Plan ("WRP") and leading an update to the 2016 Wastewater Master Plan. These plans will provide a road map for capital investments via a 25-year capital improvement plan and are discussed more detail Sections 4.3 and 5.3 of this report.
  - The Capital Planning group coordinates the planning of major capital improvement projects and is re-establishing the facilities' asset management program through the verification and updating of asset inventories at the Water Department's facilities. Capital projects over $2 million that include a process change and/or address a new regulation undergo a collaborative planning process and alternatives analyses to identify the best fit solution based on a common suite of prioritization criteria.
  - The Energy Program within this group is responsible for the implementation of the Utility Wide Strategic Energy Plan, including development of new energy initiatives, tracking of key performance indicators, coordinating with City initiatives, and integrating energy considerations and priorities into the planning of large capital projects. Recent initiatives include efforts to increase biogas use at Southwest WPCP and enhance performance of the Northeast WPCP Co-Gen facility and Southeast WPCP solar array.
- Green Stormwater Infrastructure Planning is responsible for advancing the Water Department's ability to plan projects through the development of partnerships, policies, and implementation mechanisms. They are also responsible for identifying public GSI and ecological restoration ("ER") projects to meet regulatory compliance requirements and to protect collection system infrastructure as well as the City's ecological assets.

- The GSI District Planning team is responsible for identifying, prioritizing, and initiating Water Department led projects. GSI District Planners coordinate with stakeholders to align GSI implementation with external planning efforts and to leverage resources. They work closely with the GSI Design Program to provide project management support and to ensure planning objectives are fulfilled.
- The Policy and Partnership team is responsible for developing partnerships with strategic stakeholders for the purposes of maintaining GSI program targets and core functions of the department. Facilitating conversations across agencies and groups helps to ensure that resources are leveraged appropriately.
- The ER Planning team is responsible for identifying and prioritizing project opportunities for stream restoration, infrastructure protection, and regulatory compliance credit. ER Planners also conduct risk assessments for infrastructure such as exposed linear assets, manholes, and outfalls.
- The Data Analytics team serves the Unit and division by providing technical expertise in Geographic Information Systems ("GIS"), various databases, and other data analytic tools. They provide services such as data management and reporting, mapping and graphic renderings, and site analysis for GSI.

- Applied Research is responsible for identifying new processes and approaches and conducting research for the development and application of new technologies in the Water Department's business and operations. This group consists of two programs, the Demonstration Planning Program and the Research and Knowledge Management Program.
  - The Demonstration Planning Program is responsible for onsite pilot efforts at both the wastewater and water treatment plants. Recent initiatives include piloting of pre-oxidation processes and high-rate filtration to support permitting of the planned Belmont WTP expansion, completion of a bench-scale study of Nuvoda MOB, an emerging technology for wastewater ammonia removal, and planning for a 2-year piloting effort to support the design of the Queen Lane WTP reconstruction.
  - The Research and Knowledge Management Program is responsible for desktop analysis of technologies, assistance with capital planning projects, compliance with wastewater treatment plants air permits, and coordination with professional organizations and national research initiatives. Recent initiatives include the completion of the air permitting for the planned pretreatment treatment facility at Northeast WPCP, an evaluation of digester mixing technology for a proposed capital improvement and working with BLS to develop and implement the LCRR Compliance Plan.

2.1.2.5 Green Stormwater Infrastructure Implementation Unit

The Green Stormwater Infrastructure Implementation Unit provides engineering design services for GSI and ER projects in support of the City's CSO and MS4 compliance obligations and to protect Water Department infrastructure and the city's ecological assets. The Unit has two functional groups: GSI Design and Program Support.

- The Design group is responsible for managing design contracts for GSI and ER projects from initiation through the completion of construction documents. The engineers in this group oversee GSI and ER

project designs and support the construction inspectors in their oversight of projects. They also coordinate with other units and other City departments to ensure that the project designs are compatible with operations, maintenance, and construction requirements and procedures. This group is currently focused on completing designs needed to meet the COA Year 15 Greened Acre metric.

- The Program Support group provides procedural, technical, landscape design, and administrative support to the Design group. Program Support develops and maintains the Water Department's design standards and specifications for GSI and ER, completes landscape reviews, oversees the landscape installation contract for all GSI and ER projects, provides CAD drafting services, and provides administrative support for the Unit's professional services contracts.

2.1.2.6 Development Services Unit

The Development Services Unit ("DSU") is the Water Department's primary point of contact with the development community and is responsible for ensuring that new development meets stormwater regulations and utility design standards. The Unit provides comprehensive services to the development community and private property owners by providing consistent customer service and ensuring transparent and predictable regulations. This unit is comprised of three groups, Regulatory Review and Inspection, and Program Support and Enforcement, and Stormwater Billing and Incentives.

- The Regulatory Review and Inspection group is responsible for the implementation of the Department's regulations as it relates to development project compliance. Staff in this group are responsible for reviewing engineering plans and conducting inspections to ensure that stormwater management practices are correctly designed, installed, and maintained on-site, and that proposed water and sewer connections are completed in accordance with requirements.
- Program Support and Enforcement is the policy and administrative arm of the Unit. This group is responsible for overseeing a variety of functions in support of the Unit implementation including planning and developing regulatory enhancements and engineering design improvements, data management, leading public outreach initiatives and inter-governmental affairs, and enforcement of active and post-construction projects.
- Stormwater Billing and Incentives provides services that support routine stormwater billing and implements incentive programs designed to encourage implementation of stormwater retrofits on private property. Stormwater billing related activities include parcel data management, generation of monthly stormwater user fee billing and adjustment files, and reviews of applications for credits or appeals. The Water Department incentivizes implementation of stormwater retrofits by offering property owners credits for managing stormwater. This group also manages grant programs that incentivize stormwater retrofits on non-residential properties. Maintaining or increasing participation in these programs is a priority as private stormwater retrofits are one of the mechanisms by which the Water Department achieves greened acres. This group recently completed Stormwater Connect, a web-based portal designed to "connect" property owners to stormwater vendors to facilitate the identification of potential projects/solutions and ultimately get more private retrofit projects into the pipeline.

2.1.3 Engineering and Construction Division

The primary responsibility of the Engineering and Construction Division is to implement the Water Department's CIP. The Division consists of the Design, Projects Control, and Construction units and had 343 approved positions with 89 vacancies, as of September 30, 2022. The Division is preparing for the planned increase in capital project implementation through a combination of increased in-house forces, reorganization of the Projects Control Unit, and use of consultant support as needed, including utilizing a Program Manager to support WRP project implementation.

Typically, the Operations Division or the Planning and Environmental Services Division identify and forward operations-related or long-term planning related projects to Engineering and Construction. The projects receive a project number and are entered into the Water Department's Capital Improvement Program Information Tracking ("CIPIT") system. The Engineering and Construction Division works collaboratively with Operations and Planning and Environmental Services to prioritize and schedule the identified projects and uses CIPIT to track the lifecycle of the projects.

2.1.3.1 Design Unit

The Design Unit performs all engineering functions associated with the design of projects in the Water Department's CIP. The Design Unit designs (or manages the design) and submits the projects to Operations and Planning and Environmental Services for review and approval. Approved designs are forwarded to the Projects Control Unit for public bidding.

The Design Unit has three groups (Plant Design, Water and Sewer Design and Administrative Engineering Services). The Unit maintains its service levels despite vacancies by employing outside consultants to supplement the in-house staff as necessary. A representative list of the group's activities follows:

- Evaluates and designs new and rehabilitation projects.
- Provides input into maintenance, renovation, and reconstruction issues.
- Reviews and coordinates designs prepared by consultants.
- Reviews shop drawings and reviews requests by contractors for deviations from plans and specifications.
- Provides engineering assistance to Operations Division during disruptions in water and wastewater service.
- Coordinates with other agencies such as the Pennsylvania Department of Transportation, Philadelphia Streets Department, Philadelphia Redevelopment Authority, Southeastern Pennsylvania Transportation Authority, and private utilities.

2.1.3.2 Projects Control Unit

This unit is comprised of the Projects Control, Records, GIS, Act 537, and PA One-Call groups.

- The Projects Control Unit is responsible for developing, maintaining, tracking, and coordinating the CIP as well as overseeing the bidding process prior to forwarding projects to the Construction Unit. Operations and Planning and Environmental Services submit projects to Projects Control to facilitate prioritization, scheduling and budget development over a six-year horizon. Longer-term projects are documented for incorporation into future CIPs. Large complex capital projects (non-linear projects greater than $2,000,000) go through a comprehensive and participatory planning process which includes project development meetings with project stakeholders, standardized documentation, alternatives analysis and prioritization, as well as conceptual project development prior to inclusion in the CIP.
- The Records group provides, or coordinates services related to private development projects including one-call services, sharing of engineering records, inspection of new connections to water and sewer mains, and assessing sewer system capacity for new development in association with Act 537 compliance.
- The GIS group is responsible for maintaining the Water Department's ArcGIS database, including the asset layers and the quality control of geolocations in the GIS database. The GIS group digitally houses the Water Department's engineering records which are a critical element of all utility planning and operations.
- The PA One-Call group works in coordination with the Records group to respond to requests for marking of Water Department underground utilities. One-Call staff perform the markings in the field based on the information provided by the Record Group.
- The Act 537 group works in coordination with the Records group and PADEP to assess sewer system capacity for new development.

2.1.3.3 Construction and Survey Unit

The Construction Unit assumes responsibility for all projects upon issuance of the construction notice-to-proceed and provides full time inspection of projects. In-house staff perform all construction management. For large projects, outside consultants may also assist with construction management activities. Responsibilities include assurance of contractor compliance with design contract documents, processing change orders if necessary, responding to requests for information and handling payment requests from contractors. The Construction Unit also provides surveying services to assist contractors with construction site stake out and compliance with surveying procedures. In addition, the Construction Unit prepares as-built drawings of water main replacement and sewer reconstruction projects.

2.1.4 Finance Division

The Finance Division is responsible for the development of water and wastewater revenue requirements and rates, the preparation and control of operating budgets, annual financial reporting, the management of capital financing programs, the monitoring of customer revenue and rate programs, and the general accounting of operating and capital funds. In addition, the division handles fixed asset accounting, procurement of goods and services, and preparation and follow-up on documentation related to federal and state assistance including low-interest loans and grants, where applicable. The Division also promotes

performance management measurement and reporting. Retail rate requests and related miscellaneous customer fees are subject to the authorization of the Rate Board.

A Deputy Commissioner who reports directly to the Water Commissioner oversees the Finance Division and is supported by two Assistant Deputy Commissioners who respectively manage the Budget, Rates, Planning & Grants unit, and the General Accounting unit. The units' responsibilities are presented below. The authorized staffing level for the Division is 61, with nine (9) vacancies as of September 30, 2022.

The Finance Department is heavily involved in the recently initiated comprehensive upgrade to the City's financial systems. The initiative known as Optimize Procurement Accounting & Logistics ("OPAL") project, will impact every aspect of the City's financial systems and, as such, will require input and significant collaboration from the Finance Department, and information from Finance to ensure that Water Department financial processes and needs are integrated into the new system design. Both units within Finance will participate in this multi-year effort with system development ongoing through 2024 followed by testing and full implementation, which is targeted for 2027.

The Finance Department is also responsible for collaborating with both the City's Office of Economic Opportunity ("OEO") and Water Department management to ensure compliance with the Philadelphia Home Rule Charter, the General Provision of the Philadelphia Code, the Mayor's Executive Order EO_1-21 and other federal, state, and local laws as related to minority, women and disabled owned enterprises ("M/W/DSBE") participation and workforce diversity. The Deputy Director of Participation is the liaison to OEO and has the primary responsibility of tracking and reporting participation commitments and actual level of participation achieved. The Deputy Director of Participation also works with managers throughout the Water Department to identify opportunities for inclusion of qualifying subcontractors.

Table 2-1 presents a summary of the level of participation achieved in recent years. The FY 2022 results have not been released by OEO, but the Deputy Director of Participation indicated that the Water Department has achieved the goal of 33%.

Table 2-1 Summary of M/W/DSBE Participation Goals and Results

FISCAL YEAR	TOTAL DOLLARS COMMITTED	PARTICIPATION RESULTS	PARTICIPATION GOAL
2019	$71,540,646	33.30%	30%
2020	$87,870,851	35.53%	30%
2021	$63,731,183	38.25%	33%
2022	Not available	>33%	33%

2.1.4.1 Budget, Rates, Planning & Grants Unit

This unit is responsible for long-range financial planning, debt issuance, wholesale rate agreements, grant accounting, budget development, cost of service evaluations, performance metrics, annual financial reporting, cash management and procurement. This unit is leading the Water Department's efforts to

expand the use of federal funding for the capital program. This includes recent applications for Water Infrastructure Finance and Innovation Act ("WIFIA") financing for several projects identified in the WRP and Federal Emergency Management Agency ("FEMA") Building Resilient Infrastructure and Communities ("BRIC") funding for Cohocksink Storm Flood Relief Phase 6.

2.1.4.2 General Accounting

This unit is responsible for payroll and certain accounts payable.

Highly capable individuals staff key management positions within the Finance Division. In Black & Veatch's opinion, the Finance Division's organization allows it to efficiently respond to financial needs from the other divisions of the Water Department as well as working with other City departments and entities outside of the City government to meet the financial needs of the utility.

2.1.5 Administration and Human Resources Division

The Administration and Human Resources Division provides administrative and human resources planning services to the various divisions and their respective units. This Division is leading the Water Department's initiatives to address the persistent challenge of identifying, hiring, and maintaining a qualified workforce. The three units in this division are Human Resources (Personnel, Training, Workforce Development, Safety), Administrative Services, and Facilities Management. Authorized staff for the division was 198 with 42 vacancies as of September 30, 2022.

- Personnel is comprised of a hiring team, discipline team and benefits team. The hiring team works closely with hiring managers to identify needs and navigate the civil service hiring process. Personnel seeks opportunities to attract qualified talent by working to open key positions beyond the traditional in-house promotional track and refining or tailoring job descriptions, qualifications, and compensation to reflect unique positions within the Water Department as compared to more generic City titles. Personnel is centralizing the tracking of attendance and discipline related metrics to ensure consistent implementation of Water Department and City policies. This unit is expanding to meet the needs of the Water Department with the addition of five hiring coordinator positions in FY 2022 and two additional positions in FY 2023 to support centralization of tracking of key metrics.
- The Training Unit is responsible for implementing training programs for the existing workforce including department wide training such as supervisor training, safety training, conflict resolution training and sexual harassment training. The Training Unit is working with unit managers across the Water Department to identify additional or targeted training needs.
- Workforce Development is a recently created standalone unit charged with addressing the increasing difficulty the Water Department has identifying and hiring qualified candidates. A primary initiative is enhancing and expanding the Water Department's existing Apprentice Program. This program has typically focused on attracting high school students into the skilled trades. The Water Department is expanding this program to participants in other areas of need, such as science technicians, operators, and surveyors. Additional efforts focus on providing opportunities for existing staff (laborers and semi-skilled laborers) to develop skills to advance to the next level. One such effort focuses on training

existing staff toward achieving a commercial driver's license ("CDL") to increase the pool of CDLs, which is a key position of concern in Conveyance and Collector Systems. Workforce Development engages hiring managers in these initiatives through two independent advisory groups for skilled trades and technical/professional staff. This allows the managers to provide input as to their needs, feedback on how the program is working and suggestions on potential areas for improvement.

- The Safety Unit utilizes industrial hygienists to build training programs and support Water Department safety committees in their goal to assure a safe work environment. Increasing the breadth and success of the Safety Unit has been an on-going initiative in recent years. The unit currently has 10 approved positions including 2 apprentices. The COVID-19 Pandemic shifted the focus of this unit dramatically, but in FY 2022 the focus has returned to enhancing workplace safety to reduce work-related injuries and improve overall safety numbers to pre-pandemic levels or below.

  As noted in Table 2-2, the number of paid days lost has generally increased in recent years. This trend is concerning to the Water Department management who are committed to promoting a safe work environment for all employees. Management recognizes that implementing COVID protocols distracted from traditional safety training, which in combination with the high level of vacancies and resulting increased workload and/or overtime potentially contributed to higher injury rates over the past few years. They also noted that the planned centralization of tracking of safety and injured on duty information will promote consistency in reporting and implementation of work policies, both of which will increase the reliability of the paid days lost metric.

Table 2-2 Safety Record

FISCAL YEAR	PAID DAYS LOST
2019	6,844
2020	8,043
2021	8,231
2022	11,422

Source: PWD MMR FY 2020-21, FY 2022 provided by PWD Finance

- The Administrative Services unit is comprised of staff that focuses on managing the workspace utilized by the Water Department, primarily the Water Department's offices at Jefferson Tower. An example of recent work performed by this unit includes the renovation of the 4th floor of Jefferson Tower to accommodate an expanded Planning & Environmental Services staff. This unit also manages the contracts for office equipment such as copiers, phones, and other miscellaneous office supplies.
- The Facilities Management unit consists of skilled staff that focus on maintaining other Water Department facilities. Responsibilities include general maintenance activities such as painting, maintenance of heating, ventilation, and air conditioning ("HVAC") systems, and other general maintenance activities necessary to keep the facilities in good working order.

2.1.6 Communications and Engagement

The Communications and Engagement Division supports and enhances the stakeholder engagement services performed by the Water Department's other divisions to provide better service to the public. Communications and Engagement plays a critical role of representing the work performed by the Water Department to the public and representing the interests of the public to the Water Department. The division is led by a Deputy Commissioner supported by two Assistant Deputy Commissioners who oversee the Communications and Customer Information units and the Education, Engagement and Government Affairs units. The roles and responsibilities of these units is discussed in more detail in the following sections. Authorized staff for the division was 111 with 24 vacancies as of September 30, 2022.

2.1.6.1 Communications

The Communications Unit is responsible for the Water Department's media relations, digital communications, and graphic design.

- The Public Relations Group oversees the Water Department's communications with the press to provide effective message delivery. The Water Department takes a proactive approach to informing the press about its mission. The Unit routinely sends topical press kits to the media to address subjects such as illegal use of fire hydrants, drought, and seasonal variations in the frequency of water main breaks. In addition, this group develops content for use across different communications channels.
- The Digital Communications Team manages the Water Department's external facing websites and social media channels in accordance with the department-wide Digital Strategy. On-going work includes building a comprehensive/consolidated web presence and enhancing digital outreach capacity with email and text message. The team coordinates with other City agencies to manage Water Department web content on City websites.
- The Graphic Design Team supports the initiatives of the Water Department by providing visual communication design services for both external and internal audiences. Two major focus areas of the team include: developing and maintaining Water Brand Architecture and developing graphics for public-facing campaigns.

2.1.6.2 Customer Contact Center

The Communications and Engagement Division is responsible for the combined Water Department and Water Revenue Bureau customer contact center. Contact center staff field customer inquiries related to a variety of issues such as billing inquiries, service issues (e.g., flooding or taste and odor), service requests, requests for information on Water Department initiatives, or other similar requests. The inquiries are logged into Cityworks® and routed to the appropriate unit for follow-up. While staff were typically trained to be able to handle a variety of issues, the Division has assigned specialists to four specific topics (service, emergencies, billing, and customer assistance programs) to help with managing appropriate responses to issues. The goal is to expediate inquiry resolution and to enhance the customer experience.

The call center transitioned to a hybrid work mode in 2020 due to the pandemic. Consistent with Water Department policy, staff continue to be allowed to work remotely up to two days a week. As part of this

on-going transition, management is working to develop performance standards and measurements for the customer contact representatives.

2.1.6.3 Education

This unit is responsible for carrying out the Water Department's public education outreach programs, particularly programs that bring information and educational materials about the Water Department's initiatives to schools, neighborhood groups, community events, and the individual water customer. The Public Education Unit has been responsible for the Water Department's publications and extended outreach programs geared toward providing a better understanding of urban watersheds, and the part each citizen and industry plays in protecting these valuable resources.

Communications and Engagement manages the Fairmount Water Works Interpretive Center ("FWWIC"). The venue, located within the historic Fairmount Waterworks and opened in 2003, traces the history of the Schuylkill River, and illustrates the complicated relationship between human civilization and the river. The Center is staffed by environmental educators and features interactive exhibits on the urban watershed, a freshwater mussel hatchery demonstration exhibit, and flexible, multi-purpose spaces that host a variety of changing exhibits. The Center was impacted by severe flooding from the remnants of Hurricanes Isaias in 2020 and Ida in 2021. While the Center was closed for clean-up, FWWIC educators provided virtual, online, and exterior site-based programs to schools, home school groups, partners, and community organizations. Educational activities inside the Center have since resumed. Considering its location on the Schuylkill River and anticipated climate change impacts, the Center has started resiliency planning and evaluating how the space is utilized.

2.1.6.4 Community Engagement

The Community Engagement team is responsible for building public support for the Water Department's infrastructure investments. The Team generates public support through community outreach, public participation and partnership-building and capacity building with local organizations. By creating tools that inform, educate, and inspire action, the Community Engagement Team helps to implement the Water Department's initiatives, while furthering environmental stewardship of the City's waterways. On-going initiatives include the implementation of Green City Clean Waters, Rain Check, and the stormwater regulations and credits support program.

A new priority for this unit is developing an engagement campaign for the WRP. Community Engagement is working with a consultant, the Wes Curry Group, and P&R to develop an engagement strategy and materials to introduce the WRP. The WRP will impact every Water Department customer over the 25-year implementation period. Customer impacts will include increased water rates and potential construction-related inconveniences such as changing traffic patterns, noise, and community aesthetics. As such, it will be vital that the public and the communities are aware of the projects, their timing, impacts, and ultimately, their resulting benefits to the community.

The division has successfully worked with the Mayor's Office, Department of Public Health, and Department of Revenue to develop policies that benefit sensitive populations. They provide advertising

campaigns for assistance programs like the Tiered Assistance Program, Low-Income Household Water Assistance Program ("LIHWAP") and Pennsylvania Homeowners Assistance Fund ("PAHAF"), and assistance clinics to help with filling out applications. The division is also collaborating across agencies to develop agreements and data integration solutions to help automatically enroll eligible customers into multiple assistance programs.

The Deputy Commissioner of Communications and Engagement notes that additional community engagement is desirable for the Water Department going forward to increase community awareness of assistance programs, infrastructure improvement projects and community benefits. And to provide a forum for the communities to raise awareness of their needs and priorities. Four additional positions for Community Engagement are proposed for FY 2024.

2.1.6.5 Government Affairs

A key priority of Communications and Engagement is reestablishing the Government Affairs Program. Government Affairs will advise legislative and regulatory affairs and monitor local, state, regional, and federal legislation and regulatory initiatives that impact the policies, plans, and operations of the Water Department. The unit will establish and maintain communication and working relationships with federal and state regulatory agency officials and local, state, and federal legislators, representing the Water Department on various councils and committees, and conducting regular briefings for legislator and their staff on issues of importance to the Water Department. This unit is currently unstaffed with one city planner vacancy and the potential for two additional positions in the future.

2.1.7 Information Science & Technology

The IS&T unit located within the Water Department and is part of the OIT. The IS&T unit is led by a General Manager, who directly reports to the OIT, and at the functional level also reports to the Water Commissioner. The IS&T unit provides software, hardware, network support, and other technology-related services for the water, sewer, and stormwater utility operations. The FY 2023 budget included 61 OIT positions assigned to and funded by the Water Department.

Personnel focused on critical operational tasks such as monitoring and maintaining the treatment plants' Supervisory Control and Data Acquisition ("SCADA") and Distributed Control Systems ("DCS") are not part of the IS&T unit. IS&T consists of three teams:

- System Team: This team is responsible for the operations, maintenance and planning activities associated with the physical network and server environment, database management and new technologies.
- Business Team: This team focuses on IS&T portfolio management (historical, current, and planned applications), development and management of business requirements and documentation; and project management.
- Applications Team: This team is responsible for applications development, maintenance, and production support.

IS&T is supporting a key element of Water Department's Security Initiative, cyber security, through the following initiatives:

- Conducting Cyber Security Assessment to assess the security of IT systems department-wide. An assessment of the networks and software maintained by IS&T is complete, currently, working with the water and wastewater treatment plants to assess their systems and needs, and will move on to other operating units next.
- Implementing security monitoring to assess network and server soundness.
- Providing dedicated IS&T professional at each facility to manage servers, DCS/SCADA system and other hardware and software needs. Historically, Operations staff performed these functions.
- Information collected through the Cyber Security Assessments will form the baseline for the development of a Department-wide Cyber Security Program.

2.1.8 Water Revenue Bureau

Established under the City Charter, the WRB reports to the Revenue Commissioner and ultimately to the Office of the Director of Finance. The WRB has responsibility for the billing and collection of water, wastewater and stormwater revenue for services provided by the Water Department. WRB responsibilities also include enforcement of payments and customer relations pertaining to payment for services. There are 221 budgeted positions in WRB in FY 2023.

WRB utilizes the Basis2 billing system ("Basis2") to generate bills and track payments. Consistent with the Water Department's cyber security initiatives, WRB, through a consultant, is currently updating Basis2 with the latest security features. The Basis2 system is scheduled for replacement, the timing is subject to the completion of the OPAL Project.

The WRB and the Water Department both monitor billing and collection of revenues and collaborate on many initiatives relevant to both parties. Important on-going areas of collaboration include:

- Outreach and management of customer assistance programs, as discussed below,
- Implementation of the Advanced Metering Infrastructure ("AMI") installation as related to both customer installations and data integration, and
- Compilation of the annual water audit.

Effective coordination between the two entities will promote efficiency in the billing and collection of water revenues along with increased customer participation in assistance programs and enhanced overall customer satisfaction.

As noted above, a key activity of the WRB is the management of customer assistance programs including TAP, Senior Citizen Discount, payment agreements along with other assistance programs. The WRB oversees the process of assistance program application intake including the review and approval of applications as well as the assignment of customers to the most affordable program alternative. With the Rate Board's July 2022 decision, and as a result of the settlement agreement between the Public

Advocate, the Water Department, and WRB, the TAP application and recertification processes are being reviewed to reduce the number of denials as well as turnover within the program. To date, the following changes to the application review process have been implemented: 1) Extended application time frame from 60 to 120 days; 2) Recertification frequency changed from once annually to once every three years; and 3) Updated internal guidance for customer documentation reviews.

As of June 2022, approximately 10,100 customers were enrolled in the TAP and 25,000 were enrolled in the Senior Citizen Discount Program.

Recently, the Water Department in collaboration with WRB implemented principal arrearage forgiveness on pre-TAP program delinquencies for all enrolled TAP customers, effective July 1, 2022. Forgiveness occurs on monthly whereby a credit of 1/24th of the customer's Pre-TAP Arrears amount will be added to the account after each full TAP Bill payment. Additionally, in June 2022, the Water Department issued all current TAP customers a one-time lump sum credit of principal forgiveness equivalent to the number of TAP payments made divided by twenty-four.

2.2 Strategic and Management Initiatives

The Water Department's mission is as follows:

The Water Department's primary mission is plan for, operate, and maintain both the infrastructure and the organization necessary to purvey high quality drinking water, to provide an adequate and reliable water supply for all household, commercial, and community needs, and to sustain and enhance the region's watersheds and quality of life by managing wastewater and stormwater effectively.

In fulfilling its mission, the utility seeks to be customer-focused, delivering services in a fair, equitable, and cost-effective manner, with a commitment to public involvement.

In the wake of leadership changes at the executive and senior management levels and the COVID pandemic, which changed the way the industry does business and the expectation for access to safe drinking water, the Water Department is poised to initiate a strategic planning process in the latter half of FY 2023. In the meantime, they have many important initiatives underway. The following sections discuss the priority initiatives identified by the Water Department for the FY 2023 to FY 2024 period.

2.2.1 Utility Master Planning

The Water Department continues to conduct comprehensive master planning to identify system improvements necessary to maintain aging infrastructure, meet existing and future regulatory requirements, address climate change and maintain level of service goals. The Water Department has recently completed the WRP and is transitioning to the implementation of that plan, has initiated the WWMPU and has expanded linear asset renewal goals. These initiatives are summarized here and presented in more detail in Sections 4.3.5 and 5.3.1 of this report.

The WRP is a 25-year plan that identifies infrastructure improvement projects and defines a corresponding CIP that will rehabilitate, rebuild, or replace nearly all the major water treatment, pumping

and storage facilities which have been in operations for over 70 years. The projects identified will also enhance system resiliency by creating redundancy and flexibility within the T&D system. The WWMPU is being developed through a highly collaborative process that includes asset replacement evaluation, regulatory environment review, energy evaluation, climate change adaptation, and alternatives evaluation. The WWMPU is scheduled for completion in late 2024. Key outcomes will be an actionable 25-year CIP and a gap analysis that identifies additional planning needs related to the WPCPs but are outside of the scope of the WWMPU, such as wet weather management, biosolids management and emerging initiatives. In addition to these facilities master plans, the Water Department is committed to increasing the rate of rehabilitation and replacement of linear assets and is invested the in systematic prioritization and planned renewal of these assets.

2.2.2 Climate Change Planning and Adaptation

With major assets located along major rivers and tidal estuaries and in floodplains, the Water Department is inherently vulnerable to potential impacts from climate change and extreme weather events. The Water Department's CCAP was established in 2014 with the objectives of assessing the impacts that climate change will have on the Water Department's infrastructure and reducing the risks and associated expenses from those impacts by identifying and implementing effective, achievable adaptation strategies. CCAP performs comprehensive risk assessments using localized climate change projections to develop adaptation strategies that inform Water Department programs and long-term plans, major investments, and operational and design standards. Recent achievements include completing the Climate-Resilient Planning & Design Guidance document and facilitating the adoption of a Department-wide policy requiring its use, to the extent feasible, in the planning, design and construction of all projects. CCAP is also conducting facility-specific risk assessments to identify climate impacts and potential mitigation strategies with on-going efforts at the Southwest WPCP and Baxter WTP. CCAP staff are engaged in local, state, and federal climate change committees and communities to stay current on the latest developments in climate change science and adaptation planning.

2.2.3 Security of the System

The Water Department remains committed to securing the water and wastewater system infrastructure and continues to implement security improvements in accordance with the 2002 Vulnerability Assessments, the 2018 America's Water Infrastructure Act ("AWIA") assessments, and as needed to enhance security. Improvements implemented to date have focused on preventing, monitoring, or detecting access to key facilities, maintaining critical operations during potential emergency situations, and monitoring for and responding to potential contamination of the raw and treated water supplies. The Water Department actively monitors the drinking water supply through extensive daily sampling throughout the treatment process and distribution system. On-line water quality monitoring at key locations in the distribution system and the SRS provide additional monitoring and response capabilities.

A current priority is enhancing the security of the information technology systems, software, hardware, and networks that are vital to the operations of the system and the overall management of the utility. This initiative is being implemented at the facility level through cyber security upgrades to existing

systems and software, and at the utility level though a comprehensive security assessment and implementation of monitoring and hardening technologies to deter and detect unauthorized access to the Water Department's information technology systems.

2.2.4 Enhanced Public Engagement

The Water Department's mission includes a commitment to public involvement. To this end, the Water Department seeks to expand an already robust targeted engagement effort to a utility-wide engagement program. The expanded program will engage the public in financial, infrastructure, public health, and environmental initiatives to increase awareness and seek input. Enhancing engagement can advance support for Water Department initiatives and help integrate public or community needs into these initiatives. The Water Department will build from successful engagement efforts implemented under the Green City, Clean Waters Program ("GCCW"), AMI and affordability initiatives and apply lessons learned to expand engagement to include traditional infrastructure improvement projects, water quality/compliance initiatives and budgeting and rate setting considerations. Near-term priorities for public engagement include an outreach campaign for the WRP and continued efforts to raise awareness of the City's affordability programs.

2.2.5 Affordability

The Water Department works closely with the Mayor's Office, the Department of Public Health, and the Department of Revenue to ensure that all Philadelphians have access to safe drinking water by implementing some of the industry's most progressive affordability initiatives and policies. These initiatives provide tiered income-based bills, debt relief, senior citizen discounts, extended delinquency grace periods, and payment plans. The Water Department and their partners are committed to enrolling all qualifying customers into assistance programs by raising awareness, simplifying application processes, increasing accessibility, and facilitating automatic enrollment across City and state assistance programs. As previously noted, the Water Department recently implemented principal arrearage forgiveness on pre-TAP arrears for all enrolled TAP customers effective July 1, 2022.

2.2.6 Water Accountability

The Water Accountability initiative proactively addresses non-revenue water loss, promotes a high-level of efficiency in the water delivery and billing processes, and performs the strategic planning necessary to implement lasting improvements in water and revenue loss reduction. The Water Department accounts for all delivered water as either consumption or losses. Losses may be either: 1) apparent losses due to customer meter inaccuracies, billing errors or unauthorized consumption; or 2) real losses due to physical losses related largely to leakage within the distribution system. These two components make up the Water Department's non-revenue water. The Water Department's Water Accountability initiatives focus on the recovery of this uncaptured revenue through a variety of activities including annual water audits, customer meter management, revenue protection and leak detection. The on-going implementation of AMI technology, which is targeted for completion by January 2025, will support the Water Accountability Initiative through enhanced meter reading and data management processes, providing the Water

Department with better information related to real-time system performance and enhanced tools to identify leakage and tampering. Section 4.3.4 of this report further discusses these programs.

2.2.7 Workforce Development

The Division of Administration and Human Resources is collaborating with management in the City Office of Human Resources ("OHR") and across Water Department divisions to implement strategies to address the persistent challenge of identifying, hiring, and maintaining a qualified workforce, as discussed in Section 2.1.5. The Human Resources Unit is working with OHR to expand recruiting for key positions beyond the traditional in-house promotional track and to refine job descriptions, qualifications, and compensation to reflect unique positions within the Water Department as compared to more generic City titles.

The Workforce Development Unit is collaborating with hiring managers to expand and enhance the apprenticeship program, to develop career development pathways for existing employees and to identify new and creative ways to increase the candidate pool for existing and future vacancies. The Water Department recently completed an employee survey to gauge the morale of the workforce and identify opportunities to enhance employee satisfaction and retention. Resulting initiatives/offering will not only increase retention but should have the added benefit of increasing attractiveness to perspective employees.

2.2.8 Key Compliance Initiatives

Full compliance with public health and environmental regulations is always a top priority for the Water Department. As regulations are constantly evolving the focus of the Water Department's efforts shift to address current regulatory drivers. The regulatory initiatives discussed herein are at the top of the priority list in the near-term.

- LTCPU and COA – this 25-year compliance program and commitment to enhancing the City's watershed and neighborhoods continues to be a key compliance initiative driving investment in the WPCPs, collection system and GSI. As the program is approaching the half-way milestone, the Water Department is revisiting the foundational data and assumptions that informed the prioritization and selection of CSO mitigation strategies. The goal of this Adaptative Management and Costing Revaluation is identify the best fit solutions that are both protective of the environment and fiscally and socially responsible as discussed in Section 5.2.1.
- LCRR – the Water Department is working collaboratively across divisions to develop a compliance plan for the LCRR, which includes public education, extensive water quality monitoring at privately owned facilities, treatment evaluations, and lead service line inventory and replacement planning. Compliance deadlines and required sampling begin in early FY 2025. It is anticipated that implementation of the program will require additional staff, consulting resources and capital resources.
- NPDES Permits – the WPCP discharge permits and the MS4 permit are in the renewal phase. The Water Department is invested in working co-operatively with PADEP to establish permits that are both protective of the City's watersheds and fiscally achievable. In tandem with these efforts the Water

Department is actively engaged with the Delaware River Basin Commission ("DRBC") Aquatic Life Use Attainability Analysis, the results of which could influence the inclusion of the ammonia discharge limits in the WPCP permits. These efforts are discussed in Sections 5.2.2, 5.2.3 and 5.3.2.

2.3 Findings and Observations

Based on our interviews with management, site reviews and document reviews, Black & Veatch has formed the following opinions:

- The Water Department's organizational structure provides for efficient system operations and maintenance, and the divisional and sub-divisional structure provides for delegation of management authority and responsibility through various levels and work units.
- A good working internal relationship exists among divisions to facilitate execution of all phases of the Water Department's responsibilities.
- The Water Department continues to fill senior staff retirements with experienced professionals and succession planning for future retirements is in progress.
- Senior management professionals that oversee critical operating, engineering, financial, planning, and support functions have worked at the Water Department for many years, and this institutional knowledge and experience provides stability as the Water Department moves forward with key initiatives.
- The Water Department recognizes and is proactively addressing their primary organizational challenge of high vacancy rates through a combination of traditional and innovative solutions. Continued investment in these solutions and re-establishment of staffing levels are critical to the continued achievement of compliance requirements, proactive maintenance goals, planned infrastructure improvements, and the overall sustainability of the organization.

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3.0 Financial Requirements

3.1 Overview

The Water Department is a self-supporting enterprise fund dedicated to providing high-quality water and wastewater services (which includes stormwater services) to the City's residents and businesses. To provide these services and fulfill all its regulatory obligations, the Water Department fully funds its operations through rates and charges imposed on its customers and wholesale customer base. Service to customers located outside the City is on a contractual wholesale basis.

Black & Veatch evaluated the adequacy of overall system revenues to meet projected revenue requirements for FY 2023 through FY 2028 ("Study Period"). In July 2022, the Rate Board adopted a final decision via a Special Rate Proceeding and TAP Rate Rider Annual Adjustment proceeding that approved increased rates and charges for FY 2023. Based upon the Special Rate Proceeding, the Rate Board adopted a base rate revenue adjustment for FY 2023 of approximately 5.37%. In addition, the TAP Rate Rider proceeding established an updated TAP Rate Rider surcharge ("TAP-R") to recover customer discounts associated with the Department's Tiered Assistance Program. The resulting rates and charges went into effect on September 1, 2022, and the associated revenue projections for retail service customers are based on these adopted schedules of rates for water and wastewater service for FY 2023.

Beyond FY 2023, the Water Department needs additional annual operating revenue increases to meet the Water Department's projected expenses, complete necessary capital projects, comply with the rate covenants of the General Ordinance, and meet targeted financial metrics. Shown later in this Report, Table 3-9 provides a projected statement of revenues and expenses for the six-year Study Period. The table shows the adequacy of revenues and the feasibility of issuing future revenue bond issues in FY 2024 and FY 2025, consistent with the requirements of the General Ordinance and predicated on the assumptions described in this Report.

The following section presents the results and summarizes the financial plan for the overall system during the Study Period. The financial data used in the analyses presented herein are from the Water Department's historical audited financial statements through FY 2021, preliminary unaudited FY 2022 financial results, the approved operating and capital budgets for FY 2023, and proposed capital budget for FY 2024.

The Water Department operates on a modified accrual basis of accounting. As such, the Water Department records revenues upon receipt. The exceptions to this are revenues from other governments, which the Water Department accrues as billed, and interest which the Water Department accrues as earned. With respect to expenditures, the Water Department records these as expenses on an encumbrance basis, except debt service and personnel costs (salaries, pension, medical, etc.).

3.2 Existing Rates and Rate Methodology

The Rate Board is an independent rate-making body responsible for fixing and regulating water, wastewater, and stormwater rates. The Rate Board was established by ordinance on January 20, 2014 ("Rate Ordinance"), following an approved November 2012 ballot referendum, and consists of five members appointed by the Mayor. Members serve staggered terms and continue to serve until the Mayor appoints a replacement.

In December 2015, under the Rate Ordinance, the Rate Board established processes and procedures for public comment on proposed rates and charges. It promulgated regulations for rate hearings and determination of rates and charges consistent with the City Code. On November 11, 2022, the Rate Board approved updates to their regulations, which are anticipated to become effective following the required regulatory process as of this Report's writing.

The Rate Ordinance includes the following standards for the establishment of rates:

- Rates and charges shall be fixed to provide a minimum of 100% of funding for operating expenses, other City fund charges, and debt service from current revenues with reasonable sums to cover unforeseeable or unusual expenses, reasonably anticipated cost increases, or diminutions in expected revenue.
- Rates and charges may be fixed to stabilize customer costs over a reasonable number of years and include anticipated changes in operating and capital costs, including personnel cost changes and other cost inflation.
- In fixing rates and charges, the Rate Board shall recognize the importance of financial stability to customers, consider the Water Department's Financial Stability Plan and evaluate the impact of the Rate Board-approved rates and charges on planned improvements, operating expenses, debt service coverage, financial reserves, credit ratings, and future rates and charges.
- In determining the level of current funding of capital expenditures and minimum levels of reserves, the Rate Board shall consider all relevant information presented, including, but not limited to, peer utility practices, best management practices and projected impacts on customer rates.
- Rates and charges shall be developed following sound utility rate-making practices and consistent with the current industry standards for water, wastewater, and stormwater rates. Industry standards include AWWA's *Principles of Rates, Fees and Charges Manual, 7th Edition* ("M1 Manual") and the WEF's *Manual of Practice 27, Wastewater Financing & Charges for Wastewater Systems, 4th Edition* ("MoP 27"); and
- Whenever the Water Department has proposed changes to its rates and charges, the Rate Board shall issue a written report incorporating the information used to approve, modify, or reject the proposed rates and charges. The Rate Board shall approve the proposed rates and charges unless the Rate Board finds that the Water Department has proposed rates and charges that are inequitable or have not been reasonably supported by the information provided to the Rate Board by all participants in the rate-setting process. If the Rate Board has rejected or modified the proposed rates and charges, the Rate

Board's report shall identify the impacts of the approved rates and charges on planned improvements, operating expenses, debt service coverage requirements, reserve fund levels, and future rates and charges.

- The Rate Board's decision must be made no later than 120 days from the Water Department's filing of proposed changes. If the Rate Board is unable to act on the proposed rates and charges within that time frame, the Water Department may establish emergency rates and charges temporarily pending a final determination by the Rate Board.

The Rate Ordinance requires the Water Department to provide supporting documentation (including financial accounting and engineering data) to the Rate Board as it relates to:

(i) Establishing revenue requirements necessary to meet the Water and Wastewater System's immediate and long-term operating and capital needs

(ii) Maintaining the utility's financial stability (with reliance upon the Financial Stability Plan); and

(iii) Providing a fair allocation of costs among customer groups based upon cost-of-service principles.

As noted early, the FY 2023 rates were approved via the Special Rate and Annual TAP Rate Rider Adjustment Proceedings following the Rate Board Determination in June 2022. The resulting water, sewer, and stormwater rates, applicable to retail customers, including residential, commercial, industrial, charities and schools, the Philadelphia Housing Authority ("PHA"), and municipal service, became effective September 1, 2022, and are presented in Table 3-1. Rates for wholesale water and wastewater service also became effective September 1, 2022. The existing FY 2023 rates serve as the basis for the "base" level of revenue projections used in this Report.

In addition to the existing General Service rates presented in Table 3-1, reduced rates apply to certain properties or special customer groups such as charitable institutions, schools, eligible senior citizens, the PHA, qualified Community Gardens, and the Philadelphia Land Bank. The Water Department also establishes charges for municipal and private fire protection and dischargers of high-strength wastewater service.

Customers enrolled in the TAP whose income falls below Federal Poverty Level ("FPL") guidelines or qualify for special hardship consideration receive bills based upon a percentage of their income. The lost revenue associated with providing discounted bills to TAP customers is recovered via the TAP Rate Rider, which adds an incremental surcharge to the water and sewer quantity charges.

Service to customers located outside the City is provided on a wholesale basis through contracts with various municipalities, authorities, and townships. The respective contracts for service to each wholesale customer set forth the present bases for charges. There are currently 10 wholesale wastewater customers and one wholesale water customer.

Community Legal Services of Philadelphia ("CLS") serves as the Public Advocate in proceedings before the Rate Board. As of the writing of this Report, Black & Veatch understands that the appeal filed by CLS with

the Court of Common Pleas of Philadelphia County (Civil Docket Case ID 180800527) following the 2018 Rate Proceeding was settled on October 19, 2022. As part of the settlement agreement between CLS, the Water Department, the Revenue Department, the Rate Board, and the City, the Rate Board agreed to amend its regulations. Black & Veatch understands that there are no direct financial impacts and has not assumed any negative future impact because of the settlement of CLS' appeal.

Table 3-1 General Service Water and Wastewater Rates (Effective September 1, 2022)

Water	
Description	**FY 2023**
Monthly Water Service Charge ($/bill)	
Meter Size (Inches)	
5/8	$4.97
3/4	$5.37
1	$6.57
1-1/2	$8.96
2	$12.59
e	$20.20
4	$36.45
6	$68.70
8	$104.91
10	$153.42
12	$253.19
Total Water Quantity Charges ($/Mcf)	
Monthly Water Usage	
First 2 Mcf	$49.99
Next 98 Mcf	$46.02
Next 1,900 Mcf	$35.88
Over 2,000 Mcf	$34.94

Mcf - Thousand cubic feet
sf - square feet
BOD - Biochemical Oxygen Demand
SS - Suspended Solids
lb - pounds
mg/l - milligrams per liter

Notes:
Quantity charges include TAP-R surcharge
Non-Residential Stormwater Charges includes Condominiums

Wastewater		
Description		**FY 2023**
Monthly Sanitary Sewer Service Charge ($/bill)		
Meter Size (Inches)		
5/8		$7.50
3/4		$9.57
1		$14.05
1-1/2		$24.75
2		$38.19
e		$68.87
4		$117.03
6		$230.71
8		$365.13
10		$526.96
12		$958.27
Total Sanitary Sewer Quantity Charges ($/Mcf)		
Monthly Usage		
All Billable Water Usage		$36.20
Groundwater Charge		$12.58
Sanitary - Surcharge Rates ($/lb)		
BOD ($/lb in excess of 250 mg/l)		$0.391
SS ($/lb in excess of 350 mg/l)		$0.406
Residential Stormwater Charges		
Monthly Stormwater Management Service Charge		
Charge Per Parcel		$16.17
Monthly Billing & Collection Charge		
Charge Per Bill		$1.88
Non-Residential Stormwater Charges		
Monthly Stormwater Management Service Charge		
Gross Area	($/500 sf)	$0.778
Impervious Area	($/500 sf)	$5.492
Monthly Billing & Collection Charge		
Charge Per Bill		$2.44

3.3 Projected Revenues under Existing Rates

Operating revenues of the Water Department consist of several components and are projected separately for the water and wastewater systems. Operating revenues for the water and wastewater systems include charges for water and wastewater service to several customer classes. Wastewater service revenues include revenues for both sanitary sewer and stormwater services. Table 3-2 shows the projected operating and other income of the Water Department for FY 2023 through FY 2028 under the Department's current rate schedules for water and wastewater service applicable to General Service customers (effective September 1, 2022).

Table 3-2 Revenue Under Existing Rates

Line No.	Description	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
	Combined System Revenues ($000s)						
	Water Operations						
1	Retail Customers	284,704	286,881	289,256	291,765	291,363	290,604
2	Private Fire Protection	4,042	4,358	4,684	5,034	5,034	5,034
3	Public Fire Protection	7,114	7,114	7,114	7,114	7,114	7,114
4	Wholesale	3,310	3,329	3,329	3,329	3,329	3,329
5	**Total Water Operations**	**299,170**	**301,683**	**304,383**	**307,243**	**306,841**	**306,082**
	Wastewater Operations						
6	Retail Customers	246,192	251,312	253,852	256,211	255,972	255,424
7	Wholesale	38,888	35,924	35,924	35,924	35,924	27,055
8	Excess Strength Service Charge	6,224	6,286	6,286	6,286	6,286	6,286
9	Stormwater	188,987	191,970	191,975	191,493	190,969	190,459
10	**Total Wastewater Operations**	**480,291**	**485,492**	**488,037**	**489,914**	**489,151**	**479,223**
	Other Income						
11	Interest Income (a)	3,237	3,314	3,356	3,555	3,694	3,824
12	Other Operating Revenues	15,539	13,977	12,409	10,246	8,534	6,935
13	**Total Other Revenue**	**18,776**	**17,291**	**15,766**	**13,801**	**12,228**	**10,759**
14	**Total Water Department Revenue**	**798,236**	**804,466**	**808,187**	**810,957**	**808,220**	**796,064**

(a) Includes interest income on Revenue and Rate Stabilization Funds.

3.3.1 Retail Customers

The Retail Customer group, shown on Lines 1, 6, and 9 of Table 3-2, consists of residential, commercial, industrial, senior citizens, charitable institutions, schools, and the PHA. Projected water and wastewater gross billings are developed by applying the existing schedules of rates to normalized projections of water sales, number of customers, number of billable parcels, and billable gross and impervious area for respective classes based upon an analysis of historical trends.

From FY 2020 to FY 2022, the Water Department saw an average annual increase in retail water accounts of 0.86% while experiencing an average annual decrease in overall billed water volume of 0.48%. FY 2023 to FY 2026 projected account and bill water volume reflect the 3-year average account growth and the application of the 3-year average annual change in consumption per account for each customer type. Accounts and billed water volume are projected to remain stable during FY 2027 and FY 2028 for all customer types, except for 5/8-inch residential customers, which have exhibited an on-going decrease in

usage per account since 2015. To approximate the anticipated continuation of this trend in residential billed water volume, a 0.70% reduction is applied to the 5/8-inch residential customers' usage per account during FY 2027 to FY 2028.

In addition to the above, Black & Veatch notes one anticipated change to the commercial customer type.

Vicinity Energy Philadelphia ("Vicinity"), consistently a top 10 customer for PWD, is currently working towards building their own facility to provide process water for their steam plant operations. In FY 2021, Vicinity amounted to $7.5 million in combined water, sewer, and stormwater revenue (0.99% of the Water Operating Fund's total revenue). When Vicinity reduces its overall water usage, they will still receive some water service along with sewer and stormwater services associated with their facilities. To address the pending change, the projected FY 2024 commercial customer billed volume reflects a reduction of 90,000 thousand cubic feet ("Mcf"), and the projected FY 2024 Sewer-Only billed volume is increased by 90,000 Mcf.

For stormwater, the projection of billable gross and impervious area reflects the average annual decrease of 4.6 million square feet of gross area and 3.7 million square feet of impervious area per year as an allowance for additional stormwater credits issued by the Water Department during the projection period.

Revenues under existing rate levels from Retail Service customers, which are comprised of the above-mentioned accounts, reflect an adjustment to the projections of gross billings to anticipated cash receipts based on an analysis of historical annual billings and receipts. These revenues reflect cumulative collections of approximately 96.98% of annual billings. The Water Department assesses retail customers who contribute high-strength wastewater with an extra-strength surcharge based on monitored strength. Line 8 of Table 3-2 summarizes the revenue from these customers.

3.3.2 Wholesale Customers

The Wholesale Water Charges on Line 4 are associated with Aqua Pennsylvania, Inc. ("Aqua"), which commenced taking service from Philadelphia in FY 2002. Aqua's charges include a commodity charge applicable to metered water usage for recovering power and chemical costs and a fixed charge to recover all other allocable operation and maintenance expenses and capital-related costs. Aqua's contract covers up to 9.5 million gallons per day ("MGD") of maximum day capacity for a term of 25 years, which ends in 2026 under the current agreement. Wholesale water revenues are projected using the estimated billed water volume estimated based on the historical three-year average for Aqua.

The Water Department has ten wholesale wastewater contracts with multi-year terms; customers include Abington, Aqua Pennsylvania Wastewater, Inc.[1], Bucks County Water and Sewer Authority ("BCWSA"), BCWSA - Bensalem, Delaware County Regional Water Authority ("DELCORA"), Lower Merion and Lower Moreland Townships, Lower Southampton, BCWSA - Springfield, and Upper Darby. Based on their current agreements, BCWSA - Bensalem, Lower Merion and Upper Darby make capital contributions to the Water

[1] In December 2019, Aqua Pennsylvania Wastewater, Inc. purchased Cheltenham Township's sewer system. The Water Department's contract was transferred to Aqua PA Wastewater in conjunction with the sale.

Department for their allocated share of investment in treatment and collection system facilities used to provide wastewater service to the customer. The Water Department applies contract rates for wastewater service monthly, and the rates generally consist of charges for O&M expenses, certain capital costs associated with the collection and treatment facilities used in providing the service, and a management fee. Aqua PA Wastewater, Inc., Lower Southampton, BCWSA - Springfield, Abington, Lower Moreland Townships, and DELCORA contract rates consist of charges for O&M expenses and capital costs associated with the LTCPU in accordance with their contract terms. The Water Department actively manages the wholesale service agreements to recover the costs associated with the wholesale service.

To project revenues for wholesale customers under existing rates, Black & Veatch applied the contracted rates per the latest agreements to estimated wastewater billed volumes and loadings based on the historical three-year average for each customer. Additionally, Black & Veatch adjusted revenues to reflect pending changes to wholesale wastewater customers agreements:

(i) Beginning in FY 2024, revenues for wholesale wastewater customers reflect a planned update to the allocation of LTCPU costs based on the Water Department's updated hydraulic & hydrologic ("H&H") modeling. Under the updated calculations, wholesale customers will be apportioned approximately 4% of LTCPU costs based on each community's respective share. The updated calculation methodology is estimated to reduce wholesale wastewater revenues by approximately $2.9 million per year.

(ii) DELCORA has informed the Water Department their intent to build their own treatment facility and is anticipated to no longer be a wholesale wastewater customer beginning in FY 2028 when their agreement with the City expires. The resulting lost revenue associated with this change is estimated at $9 million per year based on the current contract rates.

As of the writing of this Report, Black & Veatch understands that the Water Department intends to inform all wholesale wastewater customers of the change in calculation methodology during December 2022. Further, the Water Department intends to implement the change in wholesale allocation methodology following the next rate proceeding before the Rate Board. It is unknown if DELCORA's plan to leave the system will be influenced by pending changes in LTCPU cost allocation.

Based on the current contract expiration dates, and per discussions with Water Department staff, Black & Veatch understand that contract negotiations with BWSCA – Springfield Township, BWSCA – Bensalem, and Abington Township will begin early next calendar year, and negotiations with Upper Darby Township are anticipated to start early thereafter. With these negotiations, the Water Department plans to standardize agreements with each customer to the extent practical.

3.3.3 Other Income

Other Income of the Water Department consists of interest and other operating revenues. Interest income recognizes the income earned on the Revenue Fund and the Rate Stabilization Fund. Projections of interest income for the Study Period are based on the projected average balances in these funds and are available to meet the Water Department's revenue requirements throughout the Study Period. Black

& Veatch has assumed an interest rate of 1.0% in estimating interest income on the various operating funds and accounts. Line 11 of Table 3-2 presents the total interest income available to the Revenue Fund.

Other operating revenues, shown on Line 12 of Table 3-2, include penalties on overdue bills, income from permits and licenses, and other miscellaneous sources. Other operating revenue also reflects discounts associated with the Department's affordability programs, including the TAP and Utility Emergency Services Fund ("UESF") grants. TAP discounts are recovered via the TAP-R surcharge rates, which are adjusted via an annual reconciliation proceeding. For the purposes of this study, Black & Veatch has projected changes in TAP discounts will increase in alignment with the projected revenue adjustments.

3.4 Projected Revenue Requirements

The annual revenue requirements of the Water Department consist of operating expenses, including services provided to the Water Department by other City departments, debt service on all obligations issued by the Water Department, interim financing via the Commercial Paper Program, projected Capital Account Deposit Amounts, along with payments to the City General Fund. In addition, revenues must be adequate to meet applicable rate covenants, as set forth in the General Ordinance.

3.4.1 Operating Expenses

Operating expenses consist of all costs of the Water Department necessary and appropriate for the operation, maintenance, and administration of the Combined System during each fiscal year; this includes services of the Water Department divisions (i.e., Finance, Operations, Planning and Environmental Services, Construction and Engineering, etc.) and support provided by other City departments (i.e., WRB, OIT, City Legal, the Rate Board, etc.) as well as fringes for water fund employees (i.e., pensions and benefits). Table 3-3 summarizes the general O&M expense categories used by the Water Department for budgeting and reporting purposes.

Table 3-3 Operating Expense Categories

CLASS	CATEGORY	DESCRIPTION
100	Personal Services	Expenses related to salaries, fringe benefits, pension costs, overtime, and other employee-related costs
200	Purchase of Services	Expenses related to contracts or services from outside entities, including electricity and natural gas service
300	Materials and Supplies	Miscellaneous materials and supplies, including water treatment chemicals
400	Equipment	Costs of heavy equipment, trucks, vehicles, boats, trailers, and other related items.
500	Contributions, Indemnities, & Taxes	Includes payments made by the Law Department on behalf of the Water Department for liabilities, claims, and property damages. This category also includes taxes and other contributions.
800	Payments to Other Funds	O&M payment to the General Fund associated with the direct interdepartmental services provided to the Water Department by other City Departments

Projections of operating expenses for the Combined System for FY 2023 through FY 2028 are presented in Table 3-4.

Table 3-4 Projected Operating and Maintenance Expense

LINE NO.	DESCRIPTION	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
Combined System ($000s)							
1	Personal Services	172,675	181,131	193,552	202,480	210,588	219,669
2	Pension and Benefits	143,762	149,631	158,182	163,929	168,640	174,021
3	**Subtotal**	**316,437**	**330,761**	**351,735**	**366,409**	**379,229**	**393,690**
	Purchase of Services						
4	Power	17,993	19,927	19,927	20,225	20,529	20,837
5	Gas	6,934	8,250	8,250	8,374	8,500	8,627
6	SMIP/GARP	25,125	20,125	20,125	25,125	25,125	25,125
7	Other	154,688	175,354	185,886	194,460	203,433	212,825
8	**Subtotal**	**204,740**	**223,656**	**234,188**	**248,184**	**257,587**	**267,414**
	Materials and Supplies						
9	Chemicals	36,926	52,679	65,227	72,682	80,990	90,247
10	Other	25,108	27,058	28,871	30,225	31,643	33,127
11	**Subtotal**	**62,033**	**79,737**	**94,098**	**102,908**	**112,633**	**123,374**
12	Equipment	4,292	5,842	6,392	6,816	7,268	7,749
13	Indemnities and Transfers	10,854	11,340	11,791	12,128	12,481	12,851
14	**Subtotal Expenses**	**598,357**	**651,336**	**698,204**	**736,445**	**769,197**	**805,078**
15	Liquidated Encumbrances	(33,666)	(39,998)	(43,663)	(46,274)	(49,086)	(52,119)
16	**Total Expenses**	**564,691**	**611,338**	**654,541**	**690,171**	**720,111**	**752,959**

Black & Veatch based projected FY 2023 operating expenses on the Water Department's adopted budget and adjusted it down to reflect anticipated expenditures based upon a comparison of prior year budgets and actual expenditures by functional division and budgetary object class within each division as well as for the services provided by other City Departments. Operating expense projections are further adjusted to account for liquidated encumbrances each fiscal year. Over the past three fiscal years, the Water Department has spent 91% of budgeted costs on average.

Beyond FY 2023, Black & Veatch's projections over the Study Period include the recognition of the following:

(i) The potential impact of an anticipated escalation in costs due to inflation; and

(ii) Anticipated increases in actual expenditures to account for increased staffing levels, the continued shift of staff salaries from the capital budget to the operating budget, additional support services, materials equipment, and anticipated increases in chemical, electricity, and natural gas costs, etc.

Table 3-5 summarizes the annual escalation factors applied to the cost categories as outlined below, based upon the Water Department's experience as well as a review of relevant capital and producer price indices.

Table 3-5 Annual Escalation Factors

COST CATEGORY	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
Labor	3.25%	3.0%	3.0%	3.0%	3.0%
Power and Gas	0.0%	0.0%	1.50%	1.50%	1.50%
Chemicals	0.0%	23.82%	11.43%	11.43%	11.43%
Services, Materials, and Supplies	7.77%	6.70%	4.69%	4.69%	4.69%
Public Property Leases	2.79%	2.54%	1.72%	1.72%	1.72%
Equipment	10.12%	9.41%	6.63%	6.63%	6.63%
Transfers	7.77%	6.70%	4.69%	4.69%	4.69%

For costs associated with pensions, pension obligations, and benefits, Black & Veatch incorporated projections provided by the City.

To project FY 2024 to FY 2028 costs, Black & Veatch incorporated anticipated increases in expenses based on budget estimates provided by the Water Department for additional personnel and associated benefits, chemicals, power and gas costs, materials and supplies, services, and equipment. These additions add up to approximately $33.3 million in anticipated costs in FY 2024, which then grow to about $71.3 million in FY 2028 after application of the factors noted above.

To help manage required revenue adjustments from FY 2024 to FY 2025, the Water Department has temporarily reduced the Stormwater Management Incentive Program/Greened Acre Retrofit Program ("SMIP/GARP") budget from $25 million to $20 million. The budget is anticipated to be restored in FY 2026. Given the importance of this program in supporting long-term compliance under the COA, Black &

Veatch understands that the Water Department will shift available funds from other activities when available.

The Water Department is experiencing increased costs associated with inflationary pressures and the need for increased resources and services that will put pressure on current and future revenue needs. Such pressures will necessitate the Water Department closely monitoring O&M expenses in the context of the utility's overall performance.

3.4.2 Capital Improvement Program Financing

3.4.2.1 Capital Improvements

The Water Department's CIP reflects planned improvements to the Combined System required to meet regulatory requirements and maintain existing levels of service. The CIP includes water treatment and wastewater treatment facility improvements, distribution system rehabilitation, large meter replacement including the implementation of Advanced Metering Infrastructure ("AMI"), new billing system, storm flood relief, reconstruction of the sewer collection system, and green stormwater infrastructure.

The Water Department's CIP is an appropriations-based projection that is not inflation-adjusted and contains contingencies (for projects other than WRP related, including those proposed as part of an application currently being considered by WIFIA as well as those which are funded by the Pennsylvania Infrastructure Investment Authority ("PENNVEST"). An appropriation-based budget means that the Water Department budgets the full amount of a proposed project in the year it is expected to be contracted. This type of budgeting does not reflect the actual cash expenditures as the project is executed. As such, the overall annual CIP encumbrances must be estimated along with project expenses and evaluated against available monies in the Construction Fund, which is discussed further below.

The resulting CIP Encumbrances as adjusted for inflation, carryforward, and removal of contingencies, as well as the resulting project expenses, which account for program level project durations, are reflected in Table 3-6.

Table 3-6 Capital Improvement Program

LINE NO.	DESCRIPTION	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
Combined System ($000s)							
1	Engineering and Administration (a)	14,321	12,806	11,587	10,367	9,148	7,929
2	Plant Improvements	255,000	393,000	295,000	262,000	315,000	450,000
3	Distribution System Rehabilitation	123,060	157,100	240,100	135,100	128,100	120,100
4	Large Meter Replacement	5,000	5,000	5,000	5,000	5,000	5,000
5	Billing System	-	-	-	30,000	30,000	30,000
6	Storm Flood Relief	15,000	15,000	15,000	15,000	15,000	15,000
7	Reconstruction of Sewers	72,860	80,000	86,000	91,000	96,000	102,000
8	Green Infrastructure	83,000	90,000	90,000	170,000	170,000	170,000
9	Vehicles	12,000	12,000	12,000	12,000	12,000	12,000
10	**Total Improvements**	**580,241**	**764,906**	**754,687**	**730,467**	**780,248**	**912,029**
11	Inflation Adjustment (b)	-	-	30,188	59,239	97,425	154,916
12	**Inflated Total**	**580,241**	**764,906**	**784,874**	**789,707**	**877,673**	**1,066,945**
13	Rollforward Adjustments	(100,885)	82,940	56,614	36,983	(17,674)	(37,949)
14	**Total Inflated Adjusted CIP Budget**	**479,356**	**847,846**	**841,488**	**826,690**	**859,999**	**1,028,995**
15	Contingency Adjustment	(49,261)	(72,342)	(72,589)	(101,842)	(76,131)	(78,151)
16	**Annual Encumbrances**	**430,095**	**775,504**	**768,900**	**724,848**	**783,868**	**950,844**
17	Project Expenses (c)	337,627	513,964	606,056	757,393	791,263	865,518
18	Annual Net Encumbrances	92,469	261,541	162,844	(32,545)	(7,396)	85,326

(a) Reflects shift in capital related salary costs from capital to operating budget.

(b) Allowance for inflation of 4.0 percent per year after fiscal year 2024.

(c) Reflects annual drawdown of capital budget appropriations based on project durations and annual encumbrances.

3.4.2.2 Debt Service

Table 3-7 summarizes the existing and proposed debt service payments during the Study Period. For the analyses conducted herein, Black & Veatch worked with the Water Department and the City's financial advisors ("Financial Advisors") to estimate anticipated bond issue sizes, interest rates for a 30-year term, and issuance costs.

The Water Department has a goal of continuing to pursue the lowest-cost financing options for the CIP. As part of this effort, the Water Department includes PENNVEST loans as a funding source. PENNVEST provides low-interest loans and grants for new construction or improvements to publicly or privately-owned drinking water, stormwater, or sewerage treatment facilities. PENNVEST loans, if awarded, will be parity debt. To cover contractor costs between the time of the invoice(s) and the PENNVEST reimbursement, the Water Department leverages its Commercial Paper ("CP") program along with available cash funding to pay these invoices in the interim. Debt Service also includes interest on the Water Department's CP program, which is considered part of senior debt in accordance with the General Bond Ordinance.

In addition to pursuing PENNVEST loans, the Water Department is currently negotiating with the USEPA to secure a WIFIA loan to further support the implementation of the WRP. WIFIA loans, if awarded, will be parity debt. The Water Department has proposed a master agreement that will support projects over the

next several fiscal years. If approved, the WIFIA loan will provide low-interest financing for approximately 49% of select WRP-related construction costs. The Water Department expects to close the first tranche of financing in early calendar year 2023. Debt service projections associated with the pending WIFIA loans, including the matching funding requirements, were provided by the Financial Advisors.

Existing debt service requirements include all Water and Wastewater Revenue Bonds and Revenue Refunding Bonds issued prior to July 1, 2022, the Water and Wastewater Revenue Bond Series 2022C (issued during FY 2023 in August 2022), PENNVEST and CP.

Future debt service projections reflect the following anticipated revenue bonds issues and associated interest rate assumptions:

- FY 2024 - $460 million at 5.5%
- FY 2025 - $485 million at 5.5%
- FY 2026 - $555 million at 6.0%
- FY 2027 - $480 million at 6.0%
- FY 2028 - $700 million at 6.0%

Projected debt service for the above-anticipated issues reflect the following assumptions:

- 30-year term
- Bond issuance in August of each fiscal year
- Level debt service payments with interest-only payments during the first fiscal year of the bond amortization
- Bond issuance cost of 0.61% in FY 2024 to FY 2026 and 1.00% each year thereafter
- No debt service reserve requirement

As of the date of this Report, the Water Department has no subordinate debt.

Table 3-7 Existing & Future Debt Service Requirements

LINE NO.	DESCRIPTION	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
Combined System ($000s)							
Revenue Bonds							
1	Existing (a)	187,747	185,847	183,090	183,088	183,091	166,318
	Proposed						
2	Fiscal Year 2023 (b)	-	-	-	-	-	-
3	Fiscal Year 2024 (c)		21,083	31,650	31,650	31,650	31,650
4	Fiscal Year 2025 (d)			22,229	33,371	33,371	33,371
5	Fiscal Year 2026 (d)				27,750	40,320	40,320
6	Fiscal Year 2027 (e)					24,000	34,871
7	Fiscal Year 2028 (e)						35,000
8	**Total Proposed**	**-**	**21,083**	**53,880**	**92,771**	**129,341**	**175,213**
9	**Total Revenue Bonds**	**187,747**	**206,930**	**236,970**	**275,860**	**312,432**	**341,531**
PENNVEST Loans							
10	PENNVEST Loans (f)	10,935	12,031	16,329	23,721	29,283	32,313
Commercial Paper							
11	Commercial Paper	900	900	900	900	900	900
WIFIA							
12	WIFIA	-	17	956	4,812	8,532	16,153
13	**Total Debt Service**	**199,582**	**219,878**	**255,154**	**305,292**	**351,146**	**390,897**

(a) Projected debt service amounts include debt service for all Water and Wastewater Revenue Bonds and Revenue Refunding Bonds issued prior to July 1, 2022 and the Water and Wastewater Revenue Bond Series 2022c (issued in August 2022).

(b) Projected debt service for the Water and Wastewater Revenue Bond Series 2022c (issued in August 2022) included with Existing Bonds.

(c) Projected debt service amounts assume interest only payment for the first year of the bond authorization based on 5.50% interest rate; and assume issuance during the first quarter of the fiscal year.

(d) Projected debt service amounts assume interest only payment for the first year of the bond authorization based on 5.50% interest rate; and assume issuance during the first quarter of the fiscal year.

(e) Projected debt service amounts assume interest only payment for the first year of the bond authorization based on 6.00% interest rate; and assume issuance during the first quarter of the fiscal year.

(f) Includes projected PENNVEST Loans.

3.4.3 Sources and Uses of Funds

Table 3-8 summarizes the sources and uses of funds for financing the Combined System CIP. Line 1 of the table shows the projected total revenue bond principal amounts projected to be issued FY 2023 through FY 2028 to finance the proposed capital improvements of the Combined Water and Wastewater Systems.

As shown in Lines 2 through 4, in addition to funding capital construction costs, the bond issuance proceeds in FY 2023 are also used to fund deposits into the Debt Reserve Account as required and pay the costs of bond issuance. With the issuance of the 2022C Revenue Bonds, a series of certain amendments, referred to as "Springing Amendments," as contained in the Twenty-First Supplemental amendment to the General Ordinance became effective. As detailed in the Water and Wastewater Revenue Bonds, Series 2022C Official Statement dated August 9, 2022, one of the Springing Amendments allows the Water Department to issue revenue bonds without making deposits to the Debt Reserve Account and without having to establish series specific debt reserve subaccount. As such, no deposits to

the Debt Reserve Account are assumed following the issuance of the 2022C Revenue Bonds. As discussed previously, the projected bond issuances are consistent with the stated issuance assumptions. Proposed bonds issued during FY 2024 to FY 2028 assume no debt service reserve requirement.

The Construction Fund is summarized on Lines 6 through 16, with proceeds from revenue bonds presented on Line 7, with WIFIA loan and related matching funding presented on Lines 8 and 9. PENNVEST Loan proceeds are presented on Line 10. The Capital Account Deposit and Transfer from the Residual Fund account for most of the Water Department's cash-funded capital and are presented on Lines 11 and 12.

Table 3-8 Projected Flow of Funds – Construction Fund and Debt Reserve Account

LINE NO.	DESCRIPTION	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
Combined System ($000s)							
Disposition of Bond Proceeds							
1	Proceeds From Sale of Bonds	338,465	460,000	485,000	555,000	480,000	700,000
	Transfers:						
2	Debt Reserve Account (a)	8,500	-	-	-	-	-
3	Cost of Bond Issuance (b)	1,965	2,806	2,959	3,386	4,800	7,000
4	Construction Fund (c)	328,000	457,194	482,042	551,615	475,200	693,000
5	**Total Issue**	**338,465**	**460,000**	**485,000**	**555,000**	**480,000**	**700,000**
Construction Fund							
6	Beginning Balance	523,680	614,674	720,396	783,674	841,627	802,225
7	Transfer From Revenue Bond Proceeds	328,000	457,194	482,042	551,615	475,200	693,000
8	WIFIA Proceeds	-	9,063	20,772	47,939	58,563	59,127
9	WIFIA Match Funding Proceeds	-	9,338	20,958	47,915	58,497	59,246
10	PENNVEST Loan Proceeds	54,874	83,354	78,438	75,465	51,373	30,493
11	Capital Account Deposits	23,383	24,295	25,242	26,226	27,249	28,312
12	Transfers from Residual Fund	16,700	29,800	34,400	58,100	72,800	86,100
13	Interest Income on Construction Fund	5,663	6,642	7,483	8,086	8,178	8,476
14	**Total Available**	**952,300**	**1,234,359**	**1,389,730**	**1,599,020**	**1,593,488**	**1,766,979**
15	Net Cash Financing Required	337,627	513,964	606,056	757,393	791,263	865,518
16	**Ending Balance**	**614,674**	**720,396**	**783,674**	**841,627**	**802,225**	**901,461**
Capital Program Net Encumbrances							
17	Beginning Balance	454,669	507,672	614,431	649,351	730,403	641,195
18	Annual Encumbrances (excluding PENNVEST & WIFIA)	390,629	577,611	575,956	720,354	564,519	823,998
19	Project Expenses (excluding PENNVEST & WIFIA)	(337,627)	(470,851)	(541,037)	(639,302)	(653,728)	(728,817)
20	**Ending Balance**	507,672	614,431	649,351	730,403	641,195	736,375
21	Allowance Commitments Prior to Bond Issue	96,268	95,993	120,059	94,087	137,333	134,146
22	Target Balance	603,940	710,424	769,410	824,489	778,528	870,521
Debt Reserve Account							
23	Beginning Balance	189,723	199,328	200,423	204,721	212,113	217,676
24	Transfer From Bond Proceeds	8,500	-	-	-	-	-
25	Transfer From Residual Fund (d)	1,105	1,096	4,298	7,392	5,562	3,030
26	Debt Reserve Release	-	-	-	-	-	-
27	**Ending Balance**	**199,328**	**200,423**	**204,721**	**212,113**	**217,676**	**220,706**
28	Interest Income on Debt Reserve Account	1,945	1,999	2,026	2,084	2,149	2,192

(a) Amount of Debt Reserve Account estimated based on outstanding and proposed debt service payments.

(b) Cost of bonds issuance reflects actual cost in FY 2023, assumed 0.61 percent of issue amount in FY 2024 to 2025, and assumed 1.0% of issuance in FY 2026 to FY 2028.

(c) Deposits equal proceeds from sale of bonds less transfers to Debt Reserve Account and Costs of Issuance.

(d) Transfer from Residual Fund to provide PENNVEST share of Debt Reserve Requirement.

Under the General Ordinance, as amended by Springing Amendments contained in the Twenty-First Supplemental Ordinance, which came into effect upon the issuance of the 2022C Bonds, the annual Debt Reserve Account balance must equal the maximum future annual debt service for outstanding bonds of a series for which a Debt Reserve Requirement was specified, as well as any outstanding interest associated with the CP program. The Debt Reserve Requirement associated with PENNVEST loans is funded from the Residual Fund, as reflected on Line 25. As noted earlier, no Debt Reserve Requirements are assumed for any future revenue bond issuances at this time.

Per City funding policy, the Water Department needs to maintain sufficient funds (including revenue sources from current year rates, bond proceeds, other loans, and accumulated interest) in the Construction Fund such that outstanding project encumbrances do not exceed available funding. This is best illustrated by comparing the ending balance for the Construction Fund, as presented on Line 16, against the Target Balance shown on Line 22, which accounts for new CIP Encumbrances and Project Expenses for each fiscal year excluding PENNVEST and WIFIA funded projects.

The General Bond Ordinance provides for two transfers: Interest Earnings Payment, which is transferred as a Deposit to the City General Fund, and the Capital Account Deposit. The Capital Account Deposit is shown on Line 11, and the Residual Fund Transfer is found on Line 12. Both the Interest Earnings Payment to the City General Fund Deposit and Capital Account Deposit are further discussed below.

Interest income on annual average balances in the Construction Fund and the Debt Reserve Account is shown in Lines 13 and 28. The interest earnings in the Construction Fund, which primarily consists of bond proceeds, are not available to the Revenue Fund as a part of the overall project revenues available for meeting the annual revenue requirements of the Water Department. An assumed interest rate of 1.0% is used to determine the interest income for FY 2023 through FY 2028.

3.4.3.1 Capital Account Deposit

The General Ordinance establishes a Capital Account as an account within the Construction Fund. The Water Department must use amounts in the Capital Account to fund renewals, replacements, and improvements to maintain adequate water and wastewater service to the areas served by the system. The City covenants under the General Ordinance require the Water Department to make one deposit to the Capital Account as of June 20th of each fiscal year in an amount not less than one percent of the total net plant investment in water and wastewater facilities (the "Capital Account Deposit Amount"). The projected level of the annual Capital Account Deposit Amount reflects 1.0% of the projected net plant investment in water and wastewater facilities in the prior year. Black & Veatch started with the FY 2022 net plant investment and inflated it by 3.9% per year to project the FY 2023 to FY 2027 net plant investment.

3.4.3.2 City General Fund Deposit

Under the General Ordinance, the Water Department may make an annual payment to the City General Fund from the Residual Fund in an amount not to exceed the lower of $4,994,000 and annual interest earnings on the Debt Reserve Account. Accordingly, the Water Department annually transfers applicable interest earnings to the Residual Fund.

3.5 Adequacy of Projected Revenues to Meet Projected Revenue Requirements under the General Ordinance

Table 3-9 presents a statement of projected revenues and revenue and rate covenant requirements for water and wastewater operations for FY 2023 through FY 2028 under the stipulations of the General Ordinance. The table provides an indication of the adequacy of system revenues, and the feasibility of the issuance of bonds to support the FY 2024 and FY 2025 CIP, as well as estimated future anticipated revenue bond sales during the Study Period.

Projections of annual operating revenue for water and wastewater service shown on Lines 1 and 2 of Table 3-9 include revenue from retail and wholesale customers under the rate levels in effect as of September 1, 2022, as previously presented in Table 3-2. Lines 4 through 8 of Table 3-9 indicate the estimated additional service revenue required in each fiscal year to meet revenue requirements and rate covenant compliance during the Study Period.

As indicated on Line 31 of Table 3-9, the adopted rates effective September 1, 2022, and proposed future revenue increases beyond FY 2023 are projected to be adequate to satisfy the basic City Charter, and Rate Ordinance requirements based on the assumptions and conditions described previously. The proposed revenue increases should provide the Water Department sufficient revenues to meet all operating expenses of the water and wastewater systems, debt service requirements on all obligations issued for the water and wastewater systems, and certain payments to the City General Fund, as well as other specific bond ordinance covenants.

In addition to meeting the requirements listed above, the City has covenanted under the General Ordinance that during each fiscal year, it will, at a minimum, impose, charge, and collect in each fiscal year such water and wastewater rents, rates, fees, and charges as shall yield net revenues which shall be equal to at least:

(i) 1.20 times the debt service requirements for such fiscal year (excluding principal and interest payments in respect of Subordinated Bonds);

(ii) 0.90 times the debt service requirements for such fiscal year (excluding principal and interest payments in respect of Subordinated Bonds), provided that Net Revenues shall be calculated to exclude any transfers from the Rate Stabilization Fund; and

(iii) 1.00 times the sum of the following:

a. the debt service requirements for such fiscal year (including debt service requirements in respect of Subordinated Bonds)

b. amounts required to be deposited into the Debt Reserve Account during such fiscal year

c. the principal or redemption price of and interest on General Obligation Bonds payable during such fiscal year

d. debt service requirements on interim debt payable during such fiscal year, and

e. the Capital Account Deposit Amount for such fiscal year (less any amounts transferred from the Residual Fund to the Capital Account during such fiscal year).

Beyond the requirements of the General Ordinance, the Water Department has adopted the following financial targets based on the 2018 Rate Determination:

- Maintain a target balance of approximately $135 million in the Rate Stabilization Fund,
- Maintain a target balance of $15 million in the Residual Fund,
- Meet a target of 1.30 senior debt service coverage ratio, and
- Provide 20% cash financing of capital improvement projects.

To comply with the General Ordinance covenants and work toward meeting the target financial metrics discussed above, additional water and wastewater service revenues, above the increase in rates which were in effect on September 1, 2022, are necessary during the Study Period. Lines 4 through 8 of Table 3-9 reflect such requirements in the revenue projections. As shown on Lines 25 and 30 of Table 3-9, implementing the additional revenue adjustments projected for the Study Period allows the Water Department to satisfy City Charter and Rate Ordinance requirements.

The Water Department utilizes the Rate Stabilization Fund and necessary revenue increases to manage its debt service coverage on its senior lien bonds to meet the required 1.20 level each year. As shown on Line 25 of Table 3-9, senior debt service coverage is projected to be 1.25 in FY 2024 and FY 2025 and 1.30 for the remainder of the Study Period. This reflects the Water Department's intent to increase coverage, generating more cash funding for capital while helping to mitigate revenue adjustments in the short term.

Lines 32 through 39 of Table 3-9 present the Flow of Funds in the Residual Fund for the Study Period. As indicated on Line 39 of Table 3-9, the Residual Fund end-of-year fund balance remains above $15.0 million from FY 2023 through FY 2028. In accordance with the General Ordinance, the Water Department may use funds in the Residual Fund for the following purposes: (1) to pay operating expenses; (2) to fund transfers to any fund or account other than the Revenue Account and the Rate Stabilization Fund; (3) to pay principal and interest on any revenue bonds and general obligation debt; (4) for the payment of amounts due under capitalized leases or similar obligations; and (5) to fund required transfers to the City's General Fund. One of the most prudent uses of such funds is for capital program financing in future years. Accordingly, for purposes of this Report, we have indicated the annual transfers of available Residual Fund balances to the Construction Fund in the amounts shown on Line 36 of Table 3-9.

Table 3-9 Projected Revenue and Revenue Requirements

LINE NO.	DESCRIPTION			FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
Combined System ($000s)									
Operating Revenues									
1	Water Service - Existing Rates			299,170	301,683	304,383	307,243	306,841	306,082
2	Wastewater Service - Existing Rates			480,291	485,492	488,037	489,914	489,151	479,223
3	**Total Service Revenue - Existing Rates**			**779,460**	**787,175**	**792,421**	**797,157**	**795,992**	**785,305**
	Additional Service Revenue Required								
	Year	Percent Increase	Months Effective						
4	FY 2024	12.75%	10		81,915	101,034	101,637	101,489	100,126
5	FY 2025	8.80%	10			64,171	79,094	78,978	77,918
6	FY 2026	12.70%	10				101,362	124,010	122,345
7	FY 2027	7.90%	10					70,956	85,770
8	FY 2028	9.00%	10						86,050
9	**Total Additional Service Revenue Required**			**-**	**81,915**	**165,204**	**282,093**	**375,433**	**472,210**
10	**Total Water & Wastewater Service Revenue**			**779,460**	**869,090**	**957,625**	**1,079,250**	**1,171,425**	**1,257,515**
	Other Income (a)								
11	Other Operating Revenue			15,539	13,977	12,409	10,246	8,534	6,935
12	Debt Reserve Account Interest Income			-	-	-	-	-	-
13	Operating Fund Interest Income			1,877	1,983	2,026	2,195	2,269	2,329
14	Rate Stabilization Interest Income			1,360	1,330	1,330	1,360	1,425	1,495
15	**Total Revenues**			**798,236**	**886,380**	**973,391**	**1,093,051**	**1,183,654**	**1,268,274**
Operating Expenses									
16	**Total Operating Expenses**			**(564,691)**	**(611,338)**	**(654,541)**	**(690,171)**	**(720,111)**	**(752,959)**
Net Revenues									
17	Transfer From/(To) Rate Stabilization Fund			6,000	(100)	100	(6,000)	(7,000)	(7,100)
18	**NET REVENUES AFTER OPERATIONS**			**239,545**	**274,942**	**318,950**	**396,880**	**456,543**	**508,215**
Debt Service									
	Senior Debt Service								
19	Outstanding Bonds			(187,747)	(185,847)	(183,090)	(183,088)	(183,091)	(166,318)
20	PENNVEST Loans			(10,935)	(12,031)	(16,329)	(23,721)	(29,283)	(32,313)
21	Projected Future Bonds			-	(21,083)	(53,880)	(92,771)	(129,341)	(175,213)
22	Commercial Paper			(900)	(900)	(900)	(900)	(900)	(900)
23	WIFIA			-	(17)	(956)	(4,812)	(8,532)	(16,153)
24	**Total Senior Debt Service**			**(199,582)**	**(219,878)**	**(255,154)**	**(305,292)**	**(351,146)**	**(390,897)**
25	**TOTAL SENIOR DEBT SERVICE COVERAGE (L18/L24)**			**1.20 x**	**1.25 x**	**1.25 x**	**1.30 x**	**1.30 x**	**1.30 x**
26	Subordinate Debt Service			-	-	-	-	-	-
27	Transfer to Escrow			-	-	-	-	-	-
28	**Total Debt Service on Bonds**			**(199,582)**	**(219,878)**	**(255,154)**	**(305,292)**	**(351,146)**	**(390,897)**
29	**CAPITAL ACCOUNT DEPOSIT**			**(23,383)**	**(24,295)**	**(25,242)**	**(26,226)**	**(27,249)**	**(28,312)**
30	**TOTAL COVERAGE (L18/(L24+L26+L29))**			**1.07 x**	**1.12 x**	**1.13 x**	**1.19 x**	**1.20 x**	**1.21 x**
31	End of Year Revenue Fund Balance			16,580	30,770	38,554	65,361	78,147	89,006

Table 3-9 Projected Revenue and Revenue Requirements (Continued)

LINE NO.	DESCRIPTION	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
Combined System ($000s)							
Residual Fund							
32	Beginning of Year Balance (c)	16,102	15,033	15,057	15,063	15,082	15,017
33	Interest Income	155	150	150	150	150	150
	Plus:						
34	End of Year Revenue Fund Balance	16,580	30,770	38,554	65,361	78,147	89,006
35	Deposit for Transfer to City General Fund (b)	1,945	1,999	2,026	2,084	2,149	2,192
	Less:						
36	Transfer to Construction Fund	(16,700)	(29,800)	(34,400)	(58,100)	(72,800)	(86,100)
37	Transfer to City General Fund	(1,945)	(1,999)	(2,026)	(2,084)	(2,149)	(2,192)
38	Transfer to Debt Reserve Account	(1,105)	(1,096)	(4,298)	(7,392)	(5,562)	(3,030)
39	**End of Year Balance**	**15,033**	**15,057**	**15,063**	**15,082**	**15,017**	**15,042**
Rate Stabilization Fund							
40	Beginning of Year Balance (c)	138,989	132,989	133,089	132,989	138,989	145,989
41	Deposit From/(To) Revenue Fund	(6,000)	100	(100)	6,000	7,000	7,100
42	**End of Year Balance**	**132,989**	**133,089**	**132,989**	**138,989**	**145,989**	**153,089**

(a) Includes other operating and nonoperating income, including interest income on funds and accounts transferable to the Revenue Fund and reflects projected contra revenue credits for Affordability Program Discounts (TAP Costs).

(b) Transfer of interest earnings from the Debt Reserve Account to the Residual Fund as shown in Line 36 to satisfy the requirements for the transfer to the City General Fund shown on Line 38.

(c) FY 2023 beginning balance is estimated based on preliminary FY 2022 results.

Lines 40 through 42 of Table 3-9 present the flow of funds of the Rate Stabilization Fund from FY 2023 through FY 2028. The balance of funds projected in the Rate Stabilization Fund at the end of FY 2023 amounts to $132,989,000. The Water Department has indicated the need to maintain a combined balance in the Rate Stabilization and Residual Funds to provide for working capital needs and has established a Rate Stabilization Fund balance target of $135 million, as previously noted. The projection of revenues for FY 2023 to FY 2028 recognizes the levels required to meet projected revenue requirements and debt service coverage covenants and to maintain the end of FY 2024 and FY 2025 Rate Stabilization Fund and Residual Fund cumulative balance to provide for adequate cash reserves.

Cash reserves represent the financial resources the Water Department can access to deal with cash flow needs, as impacted by volatility in expenses or disruption in revenues. The Water Department's unrestricted cash includes the Rate Stabilization Fund and Residual Fund. The term "unrestricted" applies to funds readily available for any financial need, as opposed to restricted funds with a specified use (e.g., Debt Reserve Account). Beyond FY 2026, Black & Veatch recommends that the Water Department increase the Rate Stabilization Fund balance, acknowledging the target established in the 2018 Rate Determination. Reserve levels will need to be adjusted commensurate with increases in operating expenses to provide the necessary funding in the event of an emergency.

Projected FY 2023 to FY 2028 additional service revenues require Rate Board authorization of the requisite rate increases.

3.6 Findings and Observations

Based upon the assumptions recognized in this Report regarding the estimated future annual financial operations of the Water and Wastewater Systems, Black & Veatch offers the following opinions:

- Increased costs associated with inflationary pressures and the need for increased resources and services will put pressure on current and future revenue needs. The Water Department will need to closely monitor system revenues and system O&M expenses in the context of the utility's overall performance.
- The projected reduction in consumption associated with Vicinity (a top 10 customer), the continued longer-term trend toward overall decreases in water consumption levels coupled with changing collections patterns for customers will put pressure on the Water Department's required revenue adjustments and associated rates in both the near and long-term. The Water Department will need to closely monitor overall system revenues in the face of an evolving situation and in context of the utility's overall performance.
- The assumed debt service terms and interest rates for estimated future revenue bonds were provided by the Water Department's financial advisors, PFM Financial Advisors, LLC, and Acacia Financial Advisors.
- The anticipated FY 2024 and FY 2025 bonds issues are estimated at a total par amount of $945 million (subject to change), with final maturities occurring in 2054 and 2055, at an annual interest rate of 5.5% (subject to change) to finance the cost of improvements to the System.
- The Water Department will establish, maintain, and collect such charges in future years as necessary to provide revenues sufficient to meet its revenue requirements including: (i) costs associated with operations and maintenance of the System; and (ii) debt service payments and coverage for its existing debt obligations and the future bonds being contemplated under the proposed Twenty-Seventh Supplemental Ordinance.
- The Water and Wastewater Systems will yield pledged Project Revenues (including projected revenue increases indicated in this Report) over the amortization period of the proposed bond issuances, sufficient to meet the payment or deposit requirements of all expenses of operation, maintenance, repair and replacement of the Water and Wastewater Systems; all reserve funds required to be established out of such Project Revenues; the debt service requirements for existing and proposed bond financings for which such Project Revenues are pledged; and, the Rate Covenant set forth in Section 5.01 of the General Ordinance.
- The Net Revenues are currently sufficient to comply with the Rate Covenant and are projected to be sufficient (provided the projected revenue increases indicated in this Report are implemented) to comply with the Rate Covenant for each of the two fiscal years following the fiscal year in which the Bonds are issued, which is inclusive of the requirement that the system should yield Net Revenues excluding amounts transferred from the Rate Stabilization Fund into the Revenue Fund of at least 90% of the Debt Service Requirements (excluding debt service due on any Subordinated Bonds) during each fiscal year.

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4.0 Water System

4.1 Introduction

The Water Department has provided safe drinking water to the City of Philadelphia for over 200 years. Over that period, the Water Department expanded the system in size and complexity to meet the demands of a rapidly growing city, protect public health, and meet ever evolving regulatory requirements. Through continuous investment, the water system advanced from two pump stations with a network of wooden pipes to a complex treatment and conveyance system, including three treatment plants, numerous pump stations and storage facilities, and over 3,700 miles of water mains. Figure 4-1 shows the water system service areas and major facilities.

Much of this existing infrastructure has been in service since the mid-1900s when the last major plant and pump station improvements were completed. For the past 70 years, the Water Department has continued to provide adequate amounts of safe drinking water by maintaining and upgrading that infrastructure.

The decade beginning in 2020 marks a significant transition for the Water Department, a transition from maintaining and upgrading to rebuilding the water system. Through the implementation of the WRP, the Water Department will invest an estimated $2.5 billion over the next 25-years to rehabilitate, rebuild, or replace most of the existing water system infrastructure.

4.2 Water Supply

The Water Department presently supplies water to Philadelphia and portions of Montgomery County and Delaware County. The Water Department provides service to Montgomery and Delaware Counties under a June 2000 agreement with Aqua Pennsylvania, Inc., a subsidiary of Aqua America, Inc., which provides for the sale of treated water at a rate of up to 9.5 MGD.

On average, the Water Department obtains approximately 56% of the water supply from the Delaware River and 44% from the Schuylkill River. These withdrawals are authorized under water allocations granted to the City of Philadelphia by the PADEP and a water entitlement by the Delaware River Basin Commission (“DRBC”). The DRBC is an interstate agency responsible for regulation of water resources in the Delaware River Basin. It is accountable to the states of Delaware, New Jersey, New York, and Pennsylvania, and to the federal government.

The Water Department participates with the DRBC on drought and flow management planning, and the Water Department is prepared to address future drought conditions should they occur. A 1983 Agreement among the states dependent on the Delaware River established patterns of division for the Basin's resources during formally declared drought periods. Through this agreement and the resulting drought management plans, the Water Department has effectively managed drought emergencies declared in the past and expects to effectively address future drought emergencies. The Water

Department participated in flow management planning with the DRBC as an advisor to Pennsylvania on the Supreme Court Consent Decree Parties Flow Working Group for the Delaware River. This effort led to the parties signing a Flow Management Plan that ensures adequate supplies for all users and provides protection against salt line migration, which is a significant concern for the Water Department.

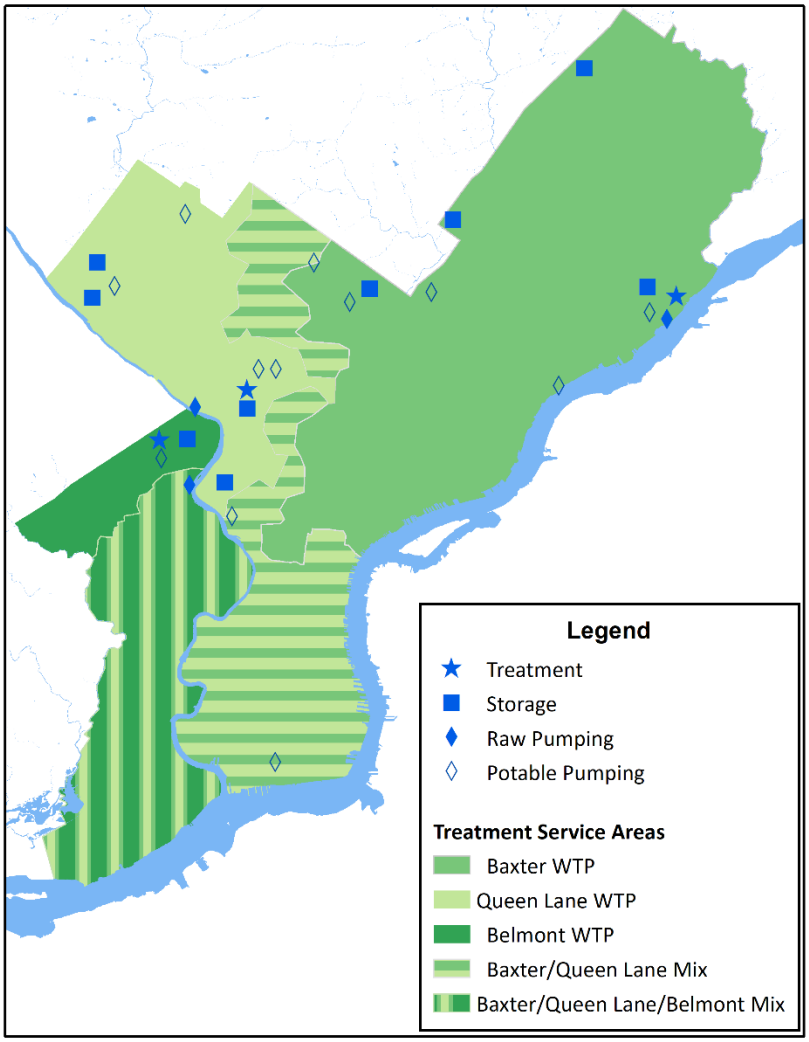

Figure 4-1 Water System Overview

The Water Department's ability to draw water supply from both the Schuylkill and the Delaware Rivers provides flexibility and additional drought protection as it is not dependent on a single source of supply. The current permit for water withdrawal with PADEP allows for the withdrawal of 423 MGD and 258 MGD from the Delaware River and Schuylkill River, respectively. These allocation limits are well above the treatment capacities of the Water Department's three treatment plants. As of November 2022, Philadelphia County, which includes most of the Water Department's customers, was not under a drought watch or warning as declared by the PADEP.

4.2.1 System Capacity

The Water Department delivers water through an integrated system that reflects the PADEP allocation and DRBC entitlements, and contains raw water intake capability, treated water capacity, and storage capacity commensurate with those entitlements. The total rated capacity of the three water treatment plants is 546 MGD. The capacities of other elements within the water supply system appear in Table 4-1. Compared with these capacities, the average annual daily treated water supplied in FY 2021 and FY 2022 were 227 and 231 MGD, respectively.

Table 4-1 Water System Capacities

FACILITY	RAW WATER PUMPING CAPACITY	ALLOCAITON, MAXIMUM DAILY WITHDRAWAL	HYDRAULIC TREATMENT CAPACITY	TREATMENT CAPACITY FOR PARTNERSHIP FOR SAFE WATER	TOTAL WATER STORAGE CAPACITY (MILLION GALLONS)	
					RAW WATER	TREATED WATER
	MGD	MGD	MGD	MGD		
Queen Lane Plant	200		150	140	207	85
Belmont Plant	170		110	86	83	42
Schuylkill Supply		258				
Baxter Plant*	480		420	320	170	207
Delaware Supply		423 per PADEP				
Distribution System**					-	216
System Totals	**850**	**681 per PADEP**	**680**	**546**	**460**	**550**

* There are capital projects underway for the Baxter Plant Clearwell which, when completed, will change the treated water storage capacity.

**Includes treated water stored at East Park Tank(s), Roxborough Basins and Standpipes, Somerton Standpipes, Fox Chase Tank, and Oak Lane Reservoir.

4.2.2 Population Served

The population served by the Water System is approximately 1,576,251 based on the 2021 Census Bureau estimate. Overall, this indicates only slight population growth within the City compared to the 2010 Census (1,526,006), however growth for the service area is generally expected to be flat through the year 2030. The Water Department also holds one wholesale contract with Aqua Pennsylvania, Inc. Based on this information, it is Black & Veatch's opinion that the water treatment, storage, and distribution facilities are of adequate capacity to provide for the present and foreseeable future requirements.

4.3 Water System Compliance and Planning Initiatives

The Water Department works to maintain continuous compliance with all drinking water regulations and adapt to regulatory requirements as they evolve. This Section describes the Water Department's water quality initiatives, compliance with present regulations, and the on-going planning initiatives and actions to meet anticipated future regulations, water system demands, and Water Department goals.

4.3.1 Partnership for Safe Water

The Water Department signed a voluntary agreement with the USEPA to participate in the Partnership for Safe Water Program (the "Partnership") in January 1996. Through this agreement the Water Department committed to reducing turbidity, an industry standard measure of water quality and water treatment effectiveness. The Water Department joined approximately 300 other water treatment utilities in evaluating and assessing their water treatment procedures against extremely stringent performance goals. The self-assessments and other reviews focused on improvements that did not require incurring substantial capital or operating expenditures. Through these efforts, the turbidity of Philadelphia's drinking water is consistently about five times lower than required by state and federal requirements. Adherence to the stringent water quality standards of the Partnership result in less available treatment capacity (546 MGD) when compared to the total hydraulic capacity (680 MGD). Recent peak demands are still well within the Partnership capacities for each treatment plant.

In 1998, Philadelphia became the first major city in the U.S. with multiple drinking water plants to receive an USEPA Director's Award for meeting Phase III Partnership for Safe Water requirements, including completion of a self-assessment and peer review. The Water Department continues to meet or exceed all Phase III requirements. This represents a tremendous accomplishment and has resulted in overall lower turbidity of its finished drinking water and enhanced public health protection. These efforts have also enabled the Water Department to meet the requirements of the Long Term 2 Enhanced Surface Water Treatment Rule ("LT2ESWTR").

In the spring of 2011, the Water Department extended its commitment to the protection of public health and the Partnership process by becoming a charter member of the Partnership for Safe Water's Distribution System Optimization program. This program builds upon the self-assessment and optimization pillars of the Water Treatment Program but focuses on the distribution system. Recognizing that water quality changes from the time the water leaves the plant to when it reaches the customer tap, this program encourages and assists utilities in evaluating their distribution system operations and developing strategies for improvement. The program emphasizes improving distribution system integrity, particularly in the areas of water quality, hydraulic reliability, and physical security. The cornerstone of the program is the self-assessment through which the utilities identify limiting factors to develop an improvement plan.

The Water Department completed the Phase II data collection and reporting requirements and the Phase III self-assessment, which included identifying areas for system optimization that do not require capital improvements by focusing on the nineteen (19) Partnership defined performance limiting factors ("PLFs"). The Water Department compiled the results of the assessment into a series of summary reports identifying potential improvements within specific operational areas and distributed the reports to the appropriate operating unit for consideration and integration in future operations as appropriate.

4.3.2 Regulatory Requirements

The water operations of the Water Department are subject to the requirements of the Safe Drinking Water Act ("SDWA") of 1974, as amended in 1986 and 1996. The Water Department has an extensive

water quality monitoring program to ensure compliance with the SDWA regulations and assess the potential impacts of proposed future regulations.

The Water Department's treated water quality, as reported to the public annually in the Water Quality Report, meets all existing drinking water regulations. Several of the key regulations that drive the Water Department's treatment and distribution system operations are summarized in the table below.

Table 4-2 Drinking Water Compliance Summary

RULE	KEY REQUIREMENTS	COMPLIANCE STATUS/ACTIVITIES
Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rule ("D/DBPR")	Regulates levels of disinfectants and disinfection by-products ("DBPs") by defining maximum residual disinfectants levels ("MRDLs"), maximum contaminant levels ("MCLs") for DBPs and a treatment technique for total organic carbon removal.	In compliance Routinely monitors total organic carbon removal through the WTPs and tests for the presence residual disinfectants and DBPs at defined compliance locations within the distribution system.
Long Term 2 Enhanced Surface Water Treatment Rule ("LT2ESWTR")	Regulates levels of turbidity in the finished water and requires implementation of enhanced treatment based on the level of *Cryptosporidium* or *E. coli* in the source water.	In compliance All plants meet the turbidity requirements. Queen Lane and Baxter meet additional treatment requirements by maintaining the very low levels of turbidity in the combined and individual filters effluents ("CFE" and "IFE") required to achieve the CFE and IFE credits, and by implementing Watershed Control Program Plans as a back-up to the CFE and IFE credits. The Water Department strives to meet the CFE and IFE at all three plants.
Lead and Copper Rule ("LCR")	90% of samples taken from customer taps must have lead and copper levels less than the action levels of 15 parts per billion ("ppb") of lead or 1.30 parts per million ("ppm") copper. Exceeding the action levels triggers implementation of treatment techniques to reduce corrosion.	In compliance Completed required sampling in June through September of 2022. 90% of homes measured less than 2 ppb of lead and 0.219 ppm of copper. Adds zinc orthophosphate to the filter effluent to inhibit corrosion in the distribution system.
LCR Revisions ("LCRR")	Maintains the action levels, increases the sampling requirements, requires	Planning for compliance

RULE	KEY REQUIREMENTS	COMPLIANCE STATUS/ACTIVITIES
	sampling in schools and day care facilities effective January 2025 and requires an inventory and plan for replacement of lead service lines due October 2024.	BLS and P&R have engaged consultant support and are developing compliance plans and compiling the inventory. Existing lead service line replacement program offers residents replacement services in conjunction with planned water main replacements. Awaiting guidance document from PADEP.
Revised Total Coliform Rule ("RTCR")	Requires water systems to meet treatment technique requirements for total coliform, defines an MCL for *Escherichia coliform* ("*E. coli*") throughout the distribution system and sets requirements when treatment technique is exceeded.	In compliance Routinely monitors and tests for the presence of total coliforms and *E. coli* from over 60 representative RCTR compliance locations within the distribution system.
PADEP Disinfectant Requirements Rule ("DRR")	Coupled with the RTCR and requires the maintenance of a minimum level of disinfectant (0.20 mg/L chlorine) within the water distribution system.	In compliance Routinely monitors and reports residual chlorine at RCTR compliance monitoring locations.
Consumer Confidence Report ("CCR") Rule	Requires the issuance an annual report to convey source water, treated water quality and compliance information to consumers.	In compliance Issues a Water Quality Report annually. The report goes beyond the requirements and provides educational information regarding source water protection and the water treatment process, along with information about research and public outreach initiatives.
Unregulated Contaminant Monitoring Rule ("UCMR")	USEPA requires monitoring of unregulated contaminants and uses the data to inform future rule making.	In compliance Completed UCRM-1, 2, 3 and 4 monitoring and published the results as required and is scheduled to conduct UCRM-5 monitoring in calendar year 2023.

In addition to maintaining compliance with the adopted regulations as summarized above, the Water Department actively participates in the rule making process regarding potential new regulations. Currently, the regulation of PFAS compounds is under consideration at both the state and federal levels. The USEPA has issued Health Advisory levels and is engaged in the rule making process, while the PADEP has issued a proposed final MCL. The Water Department is actively participating in these rule-making processes and assessing the potential impacts of various outcomes on future treatment needs.

4.3.3 Water Security

The Water Department continues to implement the recommendations of the Vulnerability Assessments conducted water system-wide in 2002. These recommendations included the installation of physical security measures (e.g., fencing and alarm systems), the use of security guards at critical facilities, cyber security measures, emergency generators, conversion from gaseous chlorine to liquid sodium hypochlorite, and real-time water quality monitors at key locations in the treatment process. The last phase of the planned security improvements included integration of the new access systems and training. The contract was bid in FY 2018 and is underway but delayed due to supply chain issues.

The Water Department's SRS is a comprehensive and integrated system to detect, confirm, respond to, and remediate water quality contamination in the distribution system. The primary components of the SRS are on-line water quality monitoring, enhanced response sampling and analysis procedures, customer complaint surveillance, enhanced security monitoring, and public health surveillance. The final component of the program is the Consequence Management Plan, which defines in detail how the Water Department will respond to a contamination event. The Water Department, particularly BLS, which maintains the SRS, continues to organize, and perform annual drills and exercises to ensure that frontline staff remain ready and trained to respond to water quality incidents.

Cyber security is the current security focus Department-wide. All three WTPs received or will receive security updates for their respective DCS/SCADA systems in FY 2023. The operational and data management networks at the plants are included in the on-going IS&T security assessment which will define the current state, identify needs, and form the foundation of future enhancement plans. Each plant will also have a dedicated OIT technician to support routine and non-routine IT system, software and hardware needs of these facilities.

4.3.4 Water Accountability

The Water Accountability Committee of the City of Philadelphia exists to promote a high level of efficiency in the water delivery and billing processes and to perform the strategic planning necessary to implement lasting improvements in water and revenue loss reduction. The committee is a multi-functional team including personnel from the Water Department and the WRB. The Water Loss Control Program strives to reduce the volume of non-revenue water. Major elements of this program are compilation of the annual water audit, progressive leakage management, customer meter management and revenue protection.

4.3.4.1 Annual Water Audit

The Water Department utilizes industry standard water audit methodology published by AWWA to assess the efficiency of the water system. The method accounts for all water as either consumption or losses (apparent or real). Apparent Losses are the paper losses due to customer meter inaccuracies, data handling error, and unauthorized consumption. These losses cause water utilities to lose a portion of the revenue to which they are entitled and to understate the total consumption of the customer population. Real Losses are physical losses, largely leakage. These losses inflate the marginal water production costs

for water utilities. Table 4-3 presents a summary of the annual water audit results for FY 2019 to FY 2021. The FY 2022 water audit will not be complete until January or February 2023.

The Infrastructure Leakage Index ("ILI") gives a measure of leakage control and is the ratio of the current level of leakage to the technically low-level believed achievable based on the physical and operational characteristics of the system (unavoidable level). ILI can be used to benchmark system performance and track progress towards system efficiency goals. The Water Department's ILI shows an increasing trend and indicates that there are opportunities to increase the efficiency of the water system. The planned increase in water main repair/replacement rates and on-going leakage abatement efforts should achieve reductions in leakage and improved system efficiency. Additionally, the implementation of AMI will allow near-real time capture of usage data helping to address real losses through the identification of potential unauthorized usage or high/unusual usage accounts that may indicate leakage. The enhanced capture and management of usage data will also enhance billing accuracy and thus help to reduce apparent losses.

Table 4-3 Water Audit Results

METRIC	FY 2019	FY 2020	FY 2021
Water Supplied, MGD	221.7	220.6	226.7
Billed Consumption, MGD (may include some unmetered consumption)	129.4	126.0	124.2
Non-Revenue Water, MGD	92.4	94.7	102.6
Percent Non-Revenue Water by Volume (%)	41.7	42.9	45.2
Percent Non-Revenue Water by Cost (%)	16.0	16.9	17.7
Unbilled Authorized Consumption, MGD	5.9	5.8	6.0
Unbilled Authorized Consumption Costs, $ millions	$1.64	$1.65	$1.69
Apparent Losses, MGD	16.5	12.7	14.5
Apparent Losses Costs, $ millions	$47.10	$38.50	$40.20
Real Losses, MGD	69.9	76.2	82.1
Real Losses Costs, $ millions	$8.25	$9.20	$9.97
Infrastructure Leakage Index, dimensionless	9.7	10.8	11.4

Source: Philadelphia Water Department Water Audit FY 2019-21

4.3.4.2 Leakage Management

The Water Department manages leakage via a combination of traditional leak detection and repair activities (find and fix approach) and by advanced technologies such as pressure management (predict and prevent approach) and highly sensitive leak detection applications for large water mains. The Leak Detection Survey program has operated successfully within the Water Conveyance Unit for over thirty years. Leak detection crews use state-of-the-art technology (leak correlator and correlating leak loggers) to proactively survey the water distribution system for hidden leaks. Summary results of this program are presented in Table 4-4.

Table 4-4 Leak Detection Program Key Metrics

SERVICE PARAMETER	FY 2019	FY 2020	FY 2021
Leak Survey (miles of pipeline)	746	904	802
Number of Leaks Abated	728	699	594
Leakage Abated (MGD)	41.7	34.9	37.4

Source: Philadelphia Water Department Water Audit FY 2019-21

The Leak Detection Squad within Water Conveyance continues to prioritize leak detection and evaluate new technologies for conducting surveys. In recent years, addressing leak referrals to locate known leaks and participating in collaborative efforts with Load Control and Flow Control in combination with a reduced workforce due to COVID-19 and on-going vacancies have limited the availability of staff for proactive leak detection surveys.

The Leak Detection Squad is investigating new technologies for surveying small and large diameter mains. The Squad recently found success in isolating a leak based on satellite data shared by neighboring Aqua Pennsylvania. The data identified an area with a potential leak; Leak Detection then utilized acoustic meters to locate the leak for abatement. The AMI implementation also shows promise for providing information to assist in identifying potential leaks. Real-time water usage data and trends can be compared to district master meters to identify losses within distribution zones.

4.3.4.3 Advanced Metering Infrastructure

The Water Department is currently in the process of converting its metering system to AMI. This requires existing Encoder, Receiver, and Transmitter units (“ERTs”) on all meters city-wide to be changed out to AMI-compatible ERTs. AMI will allow for regular, consistent transmission of water usage data to a Meter Data Management System that will allow the Water Department and customers real-time access to customer water usage data. Existing Automated Meter Reading (“AMR”) readings were monthly, while AMI readings will be provided on an hourly basis. Additional benefits will include leakage identification, meter tamper indication, and more accurate customer use identification.

The Water Accountability Unit is responsible for managing a contract with Sensus for the installation of the communication network and the ERTs for residential properties. Delays have been experienced with the ERT installation caused initially by COVID limiting access to residences and by on-going component shortages. AMI installations are performed by a combination of in-house and contracted resources, with the contractor generally responsible for residential meters and Meter Management responsible for large meters and difficult to access residential meters. Installation is running at 50% of the planned rate, however, the supply issues are seen as easing, which would allow a ramp up in the installation rate. The Water Department anticipates the installation will run through 2024.

Current Status of installations:

- Large meters: 58% complete
- Residential meters: 40% complete

The AMI project has also triggered a reassessment of right sizing and right typing of the larger meters and the development of meter selections that are more compatible with AMI technology. Ultrasonic meters are currently being tested as a potential replacement for the traditional compound meters deployed at commercial and industrial facilities.

Finally, through the AMI installation program the Water Department is leveraging the presence of personnel at a customer site to identify and inventory the service pipe materials currently in place. The resulting data will be an integral component of the lead service line database required under the LCRR.

4.3.4.4 Revenue Protection Program

The Revenue Protection Program focuses on recovering uncaptured billings from compromised and delinquent customer accounts. Management estimates that it has been successful in recovering over $50 million in billings since its inception. Each year the program pursues targeted groups of accounts perceived as areas of missed water consumption and billings.

In recent years the major focus of the program has been "zero consumption" accounts; the majority of which have occurred due to tampering. Table 4-5 presents the annual amount of revenue billings identified through this program over the past several years but does not represent actual cash collections.

Table 4-5 Revenue Protection Program Summary – Termination of Unauthorized Accounts

FISCAL YEAR	WATER RECOVERED, MGD	RECOVERED BILLINGS
2019	2.76	$4,434,623
2020	1.64	$2,627,137
2021	1.22	$1,954,405
2022	1.31	$2,096,490
Total	**6.93**	**$11,112,655**

Source: Philadelphia Water Department Water Audit FY 2019-20, FY 2021-22 provided by PWD Operations Administration

During the Pandemic any residential delinquencies that were turned off pre-pandemic, were turned on for health the health and safety of the public. There was also a moratorium on shutoff for non-payment. Shutoffs for non-residential customers resumed on October 25, 2021. Shutoffs for residential customers resumed on July 26, 2022.

In 2022, the delinquency limit for shutoffs was raised from $150 to $1,000 as part of the Water Department's Affordability Initiatives. This change delays shutoffs, giving customers greater opportunity to enroll in a payment assistance program. However, the consequence is that once a customer reaches the trigger and staff is dispatched for a shutoff, the service will be terminated unless 50% of the amount

owed (at least $500) is paid upon staff arrival. It is anticipated that this level of on-site repayment may be prohibitive, thus reducing collections at the door prior to shut-off. The Water Department's intent is that customers that qualify for enrollment in a payment program will do so and not be subject to shutoffs. Those that do not enroll or do not qualify would still be subject to shutoff.

4.3.5 Water System Planning

The Water Department has several on-going initiatives that are specific to assessing the long-term needs of the water supply, treatment plants, and distribution system.

4.3.5.1 Water Revitalization Plan

In the 1950s and 1960s, the Water Department invested significantly in its Water System, which included the expansion and addition of rapid sand filters at the three water treatment plants and improvements to pumping and storage systems. Through capital and operating funds, the Water Department has maintained these facilities for approximately 70 years. Many of the facilities are now reaching the end of their expected service life. To address this, the Water Department recently completed the WRP, which identifies projects and defines a corresponding CIP that will rehabilitate, rebuild, or replace all the major water treatment, pumping and storage facilities over the next 25 years. The adoption of this plan marks a major shift in the Water System CIP with the Water Department transitioning from maintaining and upgrading the system to rebuilding or replacing major system infrastructure.

The plan identified 400 individual projects. Some of these projects were previously identified and are on-going, such as the Baxter Clearwell Upgrades and the Torresdale Finished Water Pump Station Expansion and Rehabilitation. Other major projects in the plan include:

- George's Hill Pump Station Construction and East Park Booster Pump Stations Rehabilitation
- Lardner's Point Pump Station Replacement
- New Redundant Schuylkill River Crossing
- Baxter and Belmont WTP Finished Water Storage Replacement
- Baxter WTP Upgrade to include UV Disinfection
- Belmont New WTP and Belmont Existing Plant Upgrade to include UV Disinfection
- East Oak Lane Pump Station and Reservoir Rehabilitation
- Queen Lane WTP Reconstruction

In addition to these projects there are many T&D main projects that must be completed to enhance system flexibility and allow for re-routing of flow during construction. There are also on-going improvement projects that will be required to maintain the existing system and continue to meet level of service goals and regulatory compliance until the WRP projects are complete.

The development of the WRP was a collaborative effort between P&R, Water Treatment Operations, Load Control, and Engineering and Construction. Implementing the projects while continuing to operate the existing facilities and meet level of service goals will require extensive, on-going coordination.

The WRP will also require significant increase in capital investment over the 25-year planning horizon. The FY 2023-2028 budget includes several WRP projects with an estimated budget of $1.05 billion. The Water Department intends to finance these projects through a combination of Bond sales and state and federal loans.

4.3.5.2 Linear Asset Planning

To address the aging water distribution system infrastructure, reduce main breaks, and increase system efficiency, the Water Department has a goal of increasing the water main repair/replacement rate to 42 miles per year. A rate of 42 miles per year starting in FY 2024 will allow for the replacement of all cast iron mains within 50 years and the entire system within 75 years. The goal to meet 42 miles by 2024 was set in 2018 and anticipated increasing the replacement by 2 miles per year, however COVID slowed bidding of main replacements in 2020 and 2021. There is currently a backlog of projects ready for bid, thus the Water Department anticipates that significant progress towards meeting the 42 miles per year goal will be made in FY 2023 and FY 2024.

P&R uses an integrated capital planning approach that utilizes a risk model tool which incorporates the likelihood and consequence of failure to assist in identification and prioritization of distribution main replacement. The likelihood of failure takes into account pipe material, manufacture type, contractor, age of asset, environmental factors, and recorded past events. The consequence factor considers public health and safety, impacts to neighborhoods and public infrastructure, and disruption to the larger Water Department distribution system. GSI projects in target areas and sewer main rehabilitation/replacement can also drive water main replacement/renewal. GSI Implementation, P&R and Design coordinate to identify opportunities for project integration.

Once assets are identified for replacement/renewal the project is transitioned to Engineering and Construction for incorporation into the CIP and subsequent design, bid, and construction of the assets.

4.4 Water Treatment Plants

The three water plants serving the City are geographically located based on their respective source of supply. The Baxter plant, the largest of the three, is located proximal to the Delaware River; the Queen Lane and Belmont plants are located on the Schuylkill River. All three plants are conventional treatment plants that utilize the following treatment processes: raw water sedimentation and pre-oxidation, rapid mix/flocculation, sedimentation, filtration, and disinfection.

The plants consistently produce high quality drinking water, that meets all State and Federal regulatory standards and the more stringent requirements of the Partnership. The Water Department had no water quality violations in FY 2022.

The utilization level of the water treatment plant's capacity is a significant factor in the Water Department's ability to continue to make major improvements to treatment infrastructure, since it enables treatment subsystems to be taken out of service and rehabilitated or upgraded while still meeting demands. The rehabilitation and renewal process involves several phases; an initial planning phase where needed improvements are identified and defined, a design phase where detailed designs are prepared, a procurement phase where design contracts are let for public bidding and award decisions are made, and a construction phase where the project is constructed. The projects in the pipeline at each of the plants are detailed in the individual plant sections below, by project number and title. The upgrades that are currently in the pipeline address a range of treatment plant subsystems and facility improvements.

In September 2022, the Black & Veatch Team visited all three water treatment plants to conduct site reviews and interviews of plant management. The site reviews allowed for observation of the facility and on-going/recently completed capital projects. The interviews provided an opportunity to discuss on-going initiatives, challenges, and successes with plant management. Several initiatives or topics are relevant to all three plants as summarized below.

- Recently created positions:
  - A new engineering position dedicated to coordination with Engineering and Construction, including review of plans during the design phase, observation of construction activities, and review of as-builts. While Engineering and Construction still has primary responsibility for these activities, this new position will allow for greater Operations engagement in the planning and execution of capital projects which will increase the likelihood of a successful project.
  - A Maintenance Coordinator Position dedicated to advancing the use of MAXIMO® to schedule and track all maintenance activities and associated costs. Expanding the use of MAXIMO® will facilitate routine maintenance, repair, and replacement planning, as well as the development of maintenance and life cycle costs to inform future repair versus replacement decisions.
- Staffing and succession planning are significant challenge for all operating units.
  - A particular challenge for the water plants is filling shift work positions, including operators and science technicians for the plant control laboratories. Skilled trades positions (mechanics, electricians, and instrument techs) are also difficult to fill. Plant managers are working closely with Personnel and Workforce Development to address these challenges.
  - Anticipated retirements and succession planning is a related concern. With trades group leaders at or nearing retirement eligibility, plant managers and superintendents are working to identify and develop candidates for promotion to these key positions.
- The Water Department has not had contracted landscaping services since COVID disrupted the contract in place at the time. As a result, crews have the added responsibility of landscape maintenance. Several of the facilities have extensive grounds, thus this is a significant addition to their

workload. While these tasks are generally completed on overtime, they can distract from plant and process focused maintenance activities.

- The last of the planned physical security enhancements have been substantially implemented at all three plants. Remaining tasks are related to systems integration associated with security camaras and lighting, card access control systems, and in-plant communication systems, as well as installation of permanent entry gates and fencing. Staff training is also being conducted.
- The DCS/SCADA systems at each plant have been or will be upgraded to the latest versions to replace obsolete components and facilitate cyber security upgrades.
- Supply chain issues for materials, supplies, equipment, and chemicals continue to make procurement a challenge. This has increased operating costs and requires greater advanced planning and ordering to avoid delays.

4.4.1 Baxter Water Treatment Plant

The Baxter Plant draws water from the Delaware River and sends treated water to the Torresdale Pumping Station for distribution to the northern and central parts of the City. The Baxter Plant is the largest of the three water plants with a capacity rating of 320 MGD as established under the Partnership requirements. The filter production levels in the past 4 fiscal years have averaged 132 MGD, with a peak production level in FY 2022 of 178 MGD. Annual peak demand was thus met with the plant operating at approximately 50% of its capacity rating.

Table 4-6 Baxter Annual Filter Output

	DAILY OUTPUT (MGD)	
FISCAL YEAR	AVERAGE	MAXIMUM
2019	133.1	169.7
2020	128.7	163.5
2021	131.0	156.6
2022	135.7	178.0

Source: Load Control Unit Annual Report FY 2019-22, Table 1

4.4.1.1 Plant Operations & Maintenance

The Baxter Plant had 60 authorized positions with seven (7) vacancies as of September 30, 2022. In addition to the new Project Engineer and Maintenance Coordinator positions, the plant transferred the role of an allocated Electrician position to Day Operator to allow for better management of chemical deliveries.

A significant operational challenge at Baxter has been the frequent monitoring of the existing clearwell basin required because of openings found adjacent to manhole covers in the top of the basin. The openings have been repaired; however, given the occurrence of these openings has been an on-going issue, plant staff are required to monitor the turbidity of the clearwell effluent every 15 minutes and must report any deviation to PADEP within 1 hour. Additionally, the underwater inspections are routinely conducted to ensure the integrity of the basin. The existing clear well basin will be taken out of service

once the new clearwell basins 1 and 2 are fully operational and all test periods have been completed. Construction of the basins was substantially complete as of October 2022. The Water Department anticipates the new basins to be on-line in winter 2022/23.

The plant is newly designated as a large generator for Resource Conservation and Recovery Act ("RCRA") purposes. Recent projects involving the upgrades to chemical subsystems have required the disposal of substantial volumes of chemical residuals. These upgrades are continuing, and the plant will retain this designation until all chemical subsystem related projects are completed. On a related matter, the release of 27,000 gallons of hydrofluosilicic acid in 2020 will be remediated in conjunction with a planned improvement to the zinc orthophosphate storage and feed system upgrades, which started construction in October 2022.

4.4.1.2 Capital Improvement Projects

As mentioned above, the completion of Clearwell Basins 1 & 2 will be a key milestone for the plant and the Water Department. The new basins will replace an existing basin that is beyond its expected service life and presents a water quality risk. The much-anticipated completion of this highly complex project will significantly increase the reliability of the Water Department's largest water treatment plant.

This section summarizes the improvement projects that are in the capital improvement project pipeline. The WRP anticipates additional upgrades being performed at the Baxter Plant including treatment and storage improvements. These improvements are planned for FY 2027 and beyond and not reflected herein.

Projects substantially complete:

- (60007, 60008) Drinking water system security improvements and staff training
- (61098) Replacement of the fluoride storage tanks and chemical feed system
- (61106, 61107, 61108) Clearwell Basins 1 & 2
- (61111) Replacement of Flocculator Shafts and Bearings

Projects under construction:

- (61118) Filter Replacements (12)
- (61120) Carbon Feed System Betterment
- (61122, 61145, 61146) Zinc Orthophosphate Storage and Feed System Replacement
- (61124) Filter Post Weir Alternative Chlorine Application Point Addition
- (61131) DCS Backup Filter Control System Addition

Projects in Projects Control:

- (61101) Filter Piping Annulus Rehabilitation (operating budget funded)

- (61126, 61150) Clearwell Basin Replacement-Tanks 3&4
- (61128, 61151) Sludge Pump Chamber Betterment
- (61129) Backwash Pumps and Motor Replacements
- (61132) Filter Drains and Influent Valves Replacement
- (61143) Trolley Cranes Betterment
- (61153) North Pre 96" valve replacement and North sedimentation betterment

Projects in Design Phase:

As of November 2022, there were 26 projects in CIPIT identified as being in design. The projects include but are not limited to a new process laboratory, raw water basin and influent conduit improvements, improvements to the flocculation and sedimentation basins, filter replacements, upgrades to chemical storage and feed systems, improvements to the backwash system, rehabilitation of the filter gallery pipes, improvements to the facility structures, and replacement of motor controls and the DC/SCSADA system.

4.4.2 Belmont Treatment Plant

The Belmont Water Treatment Plant draws water from the Schuylkill River, serves as the source of supply for West Philadelphia and has a capacity rating of 86 MGD as established under the Partnership requirements. The filter production levels in the past 4 fiscal years have averaged 42.5 MGD, with a peak production level of 48.1 MGD. Annual peak demand was thus met with the plant operating at approximately 56% of the capacity rating.

Table 4-7 Belmont Annual Filter Output

	DAILY OUTPUT (MGD)	
FISCAL YEAR	AVERAGE	MAXIMUM
2019	43.3	48.1
2020	42.8	47.9
2021	42.7	47.6
2022	40.9	47.7

Source: Load Control Unit Annual Report FY 2019-22, Table 1

4.4.2.1 Plant Operations & Maintenance

The Belmont Plant had 56 authorized positions with eight (8) vacancies as of September 30, 2022. The vacancies are evenly distributed across the groups and are mostly in entry level positions. Plant management has had success with the Apprentice Program in the past and is invested in continued participation in the program to identify future candidates for entry level trades and operator positions.

Treatment challenges were experienced related to the unusually dry summer in 2022, requiring additions of carbon, permanganate, and the use of cationic polymer for filtration.

A new Belmont Plant is one of the key projects identified in the WRP. A piloting phase was recently completed to demonstrate the effectiveness of dual media filtration at higher rates than currently practiced, per PADEP requirements. Alternative oxidation scenarios were also evaluated. The pilot plant was staffed and operated by Planning and Research. The Water Department intends to acquire a permanent piloting facility to enable performance of treatment studies at the other plants as well.

4.4.2.2 Capital Improvement Projects

This section summarizes the improvement projects that are in the capital improvement pipeline. The WRP anticipates additional upgrades being performed including construction of a new plant, upgrade of the existing plant, storage upgrades and on-site piping betterment. Except for two projects that recently entered the design phase, these improvements are generally planned for FY 2028 and beyond and not reflected here-in.

Projects substantially complete:

- (60007, 60008) Drinking Water System Security Improvements and Training
- (62112) Rehabilitation of Sedimentation Tanks and Flocculation System
- (62138) Sodium Hydroxide Tank Industrial Coating Replacement

Projects under construction:

- (62105) Carbon Mixers and Dust Collection System Betterment
- (62123) Replacement of Sodium Hypo Loop Feed System
- (62127) Replacement of Wash water Pumps and Motors at Belmont WTP
- (62133) Rehabilitation of 9 Filters at Belmont WTP
- (62134) Filter Building Dehumidification System Betterment
- (62143) Belmont Structural Embankment Betterment

Projects in Projects Control:

- (62129) CFE Sluice Gates and RM Isolation Valves Betterment
- (62148) Sodium Hypochlorite Tank Betterment

Projects in Design Phase:

As of November 2022, there were 27 projects in CIPIT identified as being in design. These projects include but are not limited to a process laboratory betterment, filter replacements, upgrades to chemical storage and feed systems, improvements to the backwash system, filter gallery piping replacement, improvements to the facility structures, and capacity enhancements for the rapid mix and filter-to-waste processes.

4.4.3 Queen Lane Treatment Plant

The Queen Lane Plant draws water from the Schuylkill River and serves as the main distribution point for service to center City and northwest Philadelphia, west of Broad Street and east of the Schuylkill River. The Queen Lane Plant has a capacity rating of 140 MGD, established under the Partnership requirements. The filter production levels in the past 4 fiscal years have averaged 53 MGD, with a peak production level of 84 MGD. Annual peak demand was thus met with the plant operating at approximately 60% of the capacity rating.

Table 4-8 Queen Lane Annual Filter Output

	DAILY OUTPUT (MGD)	
FISCAL YEAR	AVERAGE	MAXIMUM
2019	49.5	74.3
2020	52.6	66.8
2021	56.9	84.0
2022	54.4	69.9

Source: Load Control Unit Annual Report FY 2019-22, Table 1

4.4.3.1 Operations and Maintenance

A total of 59 positions are budgeted for FY 2023; four (4) of these are new positions. As of September 30, 2022, there were 14 vacancies, including in labor and electrician categories, which are considered critical by the Plant. Shift coverage is also reported to be a challenge.

The south clearwell has been out of service for much of the year for capital improvements (roof replacement and crack repair). This reduced the on-site storage capacity by 50%. There have been no issues with meeting plant performance objectives, and Baxter and Belmont have been able to compensate for the reduced production.

Plant staff are replacing the turbidimeters on all 40 filters, upgrading to the latest model, HACH 5300.

4.4.3.2 Capital Improvement Projects

This section summarizes the improvement projects that are in the capital improvement pipeline. The WRP anticipates demolition and reconstruction of the Queen Lane Plant. This will be the final project of the 25-year effort and as such is not reflected here-in.

Projects substantially complete:

- (60007, 60008) Drinking water system security improvements and staff training

Projects under construction:

- (63082) Replacement of the backwash pumps, valves, actuators, and vacuum breakers.
- (63083) Repair of cracks in the south clear well and replacement of the roof

- (63075) Corrosion Protection for Filter Building Piping
- (63099) Flocculation/Sedimentation Basins Industrial Coating and Drain Valve Replacement

Projects in Projects Control:

- (63077, 63100) Hydrated Lime Storage and Feed System Addition
- (63079) North Side Backwash Valves Replacement
- (63088) Sluice Gates Motorized Valves Betterment
- (63093, 63094) Filter Replacements (24)
- (63095) Filter Air Scour System – noted as out for bid

Projects in Design Phase:

As of November 2022, there were 18 projects in CIPIT identified as being in design. The projects include but are not limited to filter replacements, upgrades to chemical storage and feed systems, valve and actuator replacements, switchgear replacement, transformers betterment, and improvements to the plant facilities.

4.5 Water Conveyance

The mission of the Water Conveyance Section is to reliably and efficiently transport and distribute water on demand, preserving quality and providing service focused on customer satisfaction. To accomplish, sustain and improve this, the Water Conveyance Section must: Operate and maintain the water pumping stations, operate and maintain the water distribution system, provide engineering monitoring and performance testing of the water system, and initiate, review, and track system improvements.

The Section is organized into 4 units – Distribution, Load Control, Pumping, and Water Accountability. The Unit had 344 authorized positions as of September 30, 2022, with 41 vacancies and a vacancy rate of 12%. Approximately 70% of both the approved positions and the vacancies were in the Distribution Unit, with the Pumping Unit having the highest vacancy rate of 20%.

Conveyance has been highly engaged in the WRP development and will continue to be integral to the implementation. Load Control has and will continue to advise as to the integration of the projects with respect to the ability to continue to provide the required level of service through balancing of supplies from the various plants and storage facilities and rerouting the water through the distribution system as necessary.

As part of the security initiatives being pursued across the water system, additional cameras and fencing have been installed at storage facilities. Online water quality monitoring continues as part of the SRS, with monitoring stations located at key locations into and out of reservoirs and in the distribution network. Additionally, the Load Control SCADA system is planned for replacement; the estimated cost is $6 Million. This will allow for the installation of upgraded cyber security features.

4.5.1 Distribution Unit

The Distribution Unit oversees the maintenance of the water T&D network and appurtenances (valves, hydrants). The Unit is also responsible for responding to emergencies, conducting leakage surveys, assuring the functionality of fire hydrants, and completing customer connects and disconnects. As of September 30, 2022, the Unit reported 266 authorized positions and 28 vacancies. Many of the vacancies are cyclical by nature, the result of turnover in upper-level positions, promotions to fill the next level vacancies and ultimately a trickle down to vacancies in entry level positions. When staffing levels slide, meeting service levels becomes challenging as the vacancies reduce the number of crews available for repairs. Heavy Equipment Operators and Water Distribution Repair Worker vacancies are considered critical.

Major components of the distribution system include approximately 3,179 total miles of pipeline (400 miles of transmission and 2,779 miles of distribution mains), 25,140 hydrants, and 94,173 valves.

Key performance metrics tracked by the unit are shown in Table 4-9.

Table 4-9 Distribution Unit Performance Metrics

SERVICE PARAMETER	FY 2019	FY 2020	FY 2021	FY 2022
Breaks Repaired	778	596	759	779
Discontinuance Orders Completed	220	274	280	310
Valves Repaired	40	62	38	31
Connections	101	103	145	106
Leak Survey (miles of pipeline)	747	796	560	478
Hydrants Repaired	1,032	3,558	5,113	3,303

Source: PWD MMR FY 2019-21, FY 22 QMR Final Draft

Relative to the total miles of water system piping, the break rate for FY 2021 was 241 per 1,000 miles, comparable to the five-year average rate of 242 per 1,000 miles and lower than the historical average of 248 per 1,000 miles as reported in the Philadelphia Water Audit FY 2021.

A preventive maintenance program that involves both field investigations as well as systematic scheduling of repairs and replacements is in place for the pipeline infrastructure. The Distribution Unit conducts leak surveys, examinations of portions of repaired mains to determine the root cause of breaks, and corrosion control studies as part of the preventative maintenance program. Contractors are typically utilized for the large main work and where specialized equipment is needed and may also be assigned emergency repair work.

Fire hydrant availability has remained consistently high, at 99.7%. This speaks to the continued success of the inspection and repair program, leading to 3,303 repairs, 350 hydrant locks installed, and 5,723 hydrants painted in FY 2022. The hydrant locking devices help to reduce instances of hydrant tampering while retaining operability by authorized personnel. The total number of hydrants in the system was reported at 25,142; center compression locks are installed on 15,667 hydrants.

4.5.2 Load Control Unit

The Load Control Unit is comprised of four squads Operations, Hydraulic Investigations, Water System Modeling & Analysis, and Systems & Special Projects. As of September 30, 2022, the Unit had 28 approved positions and three (3) vacancies. The unit is facing challenges recruiting new hires for the rotating shift arrangement in the Operations squad and qualified engineers for the Hydraulic Investigations, Modeling & Analysis, and Systems squads.

- The Operations Squad is a continuously manned operation responsible for the operations of all finished water transmission and storage systems to ensure reliable delivery of finished water to customers. Operational control of water delivery is exercised through a central SCADA system. This squad also manages energy demands and coordinates scheduling of maintenance and rehabilitation projects across the water system to ensure continued adherence to service level goals.
- The Hydraulic Investigations team performs a variety of testing and investigative functions within the distribution network and coordinates disinfection and de-chlorination activities in the transmission system. This group also supports new meter replacement projects and meter testing.
- The Modeling and Analysis team is responsible for management, updating and oversight of the water system hydraulic model. This function is essential to the Capital Program planning and coordination process and central to the management and tracking of all valves in the system. This team also provides expert pump-curve analysis support to determine pump selections for new installations.
- The Systems and Special Projects group is responsible for the maintenance and programming of the SCADA system. This team also monitors and maintains the corrosion control system within the distribution network and conducts leak detection projects within the distribution network. Hydrant based leak detection has been deployed as a pilot with limited success. The Unit is investigating the new technologies including potential for a satellite-based system that that has shown promise in a neighboring utility.

  Energy demand related performance measures for the load control are provided in Table 4-10.

Table 4-10 Load Control Unit – Water Conveyance Unit Electrical Demand

PERFORMANCE MEASURE	FY 2019	FY 2020	FY 2021	FY 2022
Average Daily Delivered Water, MGD	221.8	220.5	226.7	227.0
Total Power Consumption, million kilowatt-hours	114.1	112.9	114.7	117.7
Total Billing Demand, Kilowatts	141.843	148.370	150.602	166.633
Total Expenditures for Power, $	$5,958,171	$6,077,364	$5,828,800	$6,584,235
Cost per million gallons pumped (raw & treated water)	$73.6	$75.31	$70.44	$79.47

Source FY 21 Load Control Unit Annual Report, FY 22 provided by Load Control

4.5.3 Pumping Unit

The Pumping Unit maintains all raw and finished water pump stations, raw water intakes, finished water reservoirs, system storage tanks, and standpipes. As of September 30, 2022, the Unit had 50 approved positions and 10 vacancies. Key performance metrics for the pumping operation are provided in Table 4-11. The consistently high pump availability is attributable to a successful preventive and pro-active maintenance approach (% planned work in the table). The efficiency of conversion of electrical input to water output (% station efficiency) has remained steady over the past decade at about 77%, reflecting right-sizing of pumping equipment to match the system demand.

Table 4-11 Pumping Unit Performance Metrics

PERFORMANCE MEASURE	FY 2019	FY 2020	FY 2021	FY 2022
% Pump Availability	92.3	94.2	95.2	94.8
% Station Efficiency (wire to water)	77.4	78.2	78.3	76.7
% Planned Work (a productivity measurement)	94.2	95.6	97.1	97.7

Source: PWD MMR FY 2019-21, FY22 QMR Final Draft

The Unit utilizes MAXIMO® as its asset management platform. A consistently high level of maintenance performance has been achieved with existing personnel.

4.5.4 Water Accountability Unit

The Water Accountability Unit provides engineering analyses, planning support, and business process improvements for the Water Department's water conveyance, customer metering, billing, and data analytics functions. The Unit undertakes a variety of efforts to reduce wasteful water losses and implement process improvements across operational divisions. The unit has five authorized permanent positions for FY 2023 with two temporary positions.

The major initiatives of this group are project management and oversight of the installation of AMI across the customer base, conducting water audits to account for water loss and coordinating with Load Control on leakage abatement, as discussed in Section 4.3.4. This unit also collaborates with Operations Administration on developing data management solutions and evaluating new metering technologies.

The Water Accountability Unit has identified additional initiatives that will support improving the efficiency of the metering and billing processes. These will resume as staffing levels increase.

4.6 System Storage and Pumping Facilities

The Water Department provides finished water storage at each treatment plant. There are also six other treated water storage reservoirs, standpipes, or basins in the system.

4.6.1 Finished Water Reservoirs

The principal finished water reservoirs and capacities are listed below. Additional system storage for finished water is provided by the Fox Chase elevated storage tank (1.5 million gallons [“MG”]), the two Somerton standpipes (10 MG), and the two Roxborough standpipes (11 MG).

East Park	90.0 MG
Oak Lane	72.8 MG
Roxborough (Upper & Lower)	28.5 MG

4.6.1.1 Capital Improvement Projects

The storage facility capital projects in the pipeline are a mix of traditional improvement projects and projects identified as part of the WRP. Three WRP projects are currently in design, as discussed below.

Projects under construction:

- (64121) Oak Lane Reservoir Influent Valve Replacement
- (60013) Security Fencing at Upper Roxborough Reservoir

Projects in projects Control:

- (64070) Lower Roxborough Filtered Water Basin Industrial Coating Replacement

Projects currently in the design phase:

As of November 2022, there are eight storage facility projects in CIPIT identified as being in design. These include industrial coating and corrosion systems replacements, a water quality related effluent pipe addition, and betterment projects.

4.6.2 Pumping Stations

Raw and Finished water pump stations arranged by the source of supply are presented in Table 4-12. The Delaware division grouping is dedicated to the Baxter plant and the Schuylkill division grouping to the Belmont and Queen Lane plants.

Table 4-12 Pumping Stations

DELAWARE DIVISION	SCHUYLKILL DIVISION
East Oak Lane	Belmont High Service
Fox Chase Booster	Belmont Raw Water
Lardner's Point	Chestnut Hill
Torresdale Low Service	East Park Booster
Torresdale High Service	Queen Lane High Service
Torresdale Raw Water	Queen Lane to Roxborough
West Oak Lane	Queen Lane Raw Water
	Roxborough High Service
	Navy Pumping Station

4.6.2.1 Capital Improvement Projects

The rehabilitation or reconstruction of pumping stations system-wide is a key element of the WRP, with these projects generally scheduled to be completed in the next five to ten years. To this end, the majority of the pumping station capital projects in design are identified as being part of the WRP (15 out of 20 projects).

Not technically a WRP project, the first of the major pump station project to be implemented is the Torresdale Pumping Station Mechanical/Facility Betterment Project. This project was observed during the Torresdale Pump Station Site Visit and is anticipated to be complete in four years.

Projects in construction or substantially complete:

- (64081) Rehabilitation of West Oak Lane Pumping Station
- (64093, 64117, 64118, 64119) Torresdale Filter Water Pumping Station Mechanical/Facility Betterment
- (64071) Belmont Raw Water Pumping Station Standby Generator
- (64109) Belmont Raw Water Pumping Station façade, Roof, Doors and Windows
- (64076) West Oak Lane Pumping Station Standby Generator

Projects in Project control:

As of November 2022, there were no pump station projects in Projects Control

Projects in Design:

As of November 2022, there are 23 pump station projects in CIPIT identified as being in design, most of which are identified as WRP projects. These include the betterment or replacement of most of the existing raw, finished and in-system pump stations as well as the construction of a new pump station associated with the Schuylkill River Crossing project.

4.7 Operations Administration

Operations Administration provides administrative and customer support services to all operating units within the Operations Division. It consists of six units including Operations Administration, Customer Field Services, Metering, Materials Management, Delinquency and Restoration Services, and Plumbing Repairs. There were 203 budgeted positions and 31 vacancies in Operations Administration as of September 30, 2022. The majority of the vacancies are in Materials Management and Delinquency and Restoration.

4.7.1 Operations Administration

Operations Administration has the responsibility of maintaining records, tracking, and purchasing all the materials and supplies, energy sources (electricity and natural gas) and vehicles and preparing and tracking the Operating Budget for the Operations Division. This unit also prepares the Operations Division annual report and bi-weekly reports, tracking and reporting progress towards level of service goals.

4.7.2 Customer Field Services

Customer Field Services is responsible for the initial field inspection of customer requests or complaints including service line installations, hydrants, vacancies, charities, and any action that involves first in-person contact with the customers.

The unit uses Cityworks® maintenance management system to track and record the completions of various customer requests and service work orders. Cityworks® is used primarily by the Water Department's field units that work on street-side assets associated within the conveyance and collector systems. The software is used to track service requests taken from the Call Center, as well as work orders for system maintenance and repair generated within the field units. The Water Department is in the process of upgrading to a new version of the software. Available data will be stored in the Cloud for improved access.

4.7.3 Metering

The Metering is responsible for the installation, testing, replacement, and sizing of all meters, and issuance of various permits for new connections. The customer meter population is approximately 486,000 meters. The unit's key activities and responsibilities are presented below:

- Testing - The Metering Unit operates meter test equipment and performs routine meter accuracy testing.
- Replacement – Faulty meters and equipment are replaced. The Water Department generally replaces meters ranging from one to two inches in size every 10 years to maintain accurate registration. Meters from three to six-inches have a 4-year replacement interval, and those from eight to ten-inches are replaced on a 2-year frequency. This increasing frequency of replacement for the large meters provides a higher level of accuracy and performance.
- Sizing - The Metering Unit has undertaken a concerted look at changing out large meters that are functionally inappropriate for the application. Large meter management results in benefits to both the

customer and the Water Department. Meter downsizing results in a decrease to the customer's monthly water service charge, while replacing misapplied or improperly sized meters typically results in increased flow registration and related volumetric billings.

- AMI installations –Metering is installing AMI units for commercial and industrial properties and difficult to access residential properties. The Metering also completes the AMI installs where both a new meter and AMI unit is needed. Metering is on schedule to complete commercial and industrial installations and will continue to support the residential installations through the completion of the project. Metering staff also are trained to identify and record the service line material in support of the lead service line inventory. Finally, the Metering can install tamper-proof equipment and remote shut-off valves on meters that have been flagged for tampering based tampering history or on use profile.

4.7.4 Materials Management

The Materials Management unit ("MMU") handles inventory and distribution of the supplies and equipment for the Water Department. There are seven field storerooms and one in Center City. MMU accounts for over 12,000 items that are inventoried twice annually as mandated by the City Charter. Items are located according to the specific needs of field units and treatment plants.

As of September 30, 2022, there were 42 positions budgeted with nine (9) vacancies. Management is in the process of succession planning for the retirement of three individuals in the future.

4.7.5 Delinquency and Restoration Services

Delinquency and Restoration Services is responsible for the suspension of delinquent water accounts. This unit also restores service after payment is received.

The Water Department experiences on-going instances of tampering and unauthorized usage. Delinquency and Restoration Services supports recovering uncaptured billings from the compromised customer accounts as part of the Revenue Protection Program.

During the COVID-related shutoff moratorium, staff were temporarily transferred to Metering to help with AMI installations. As of September 30, 2022, there were 50 approved positions and 12 vacancies in the unit, however given the reduced number of shutoff requests this has not caused many issues in meeting level of service goals.

4.7.6 Plumbing Repairs

Plumbing repairs handles the repair of laterals and customer lines. Plumbing repairs has seen a 100% increase in the cost of materials due to inflation and supply chain issues. Procurement contracts will need to be amended to account for increases in material costs. Lead times for equipment are also longer.

4.8 Findings and Observations

The findings and observations presented in this chapter provide the basis for our overall conclusion on the condition of the Water System. We have reviewed the general state of the major facilities of the Water System including their condition, operation, and performance. We have also reviewed the general operations and performance of the linear assets. We present our findings using the following three ratings:

- *Good*: The facility is in condition to provide reliable operation in accordance with design parameters and requires only routine maintenance or minor improvements.
- *Adequate*: The facility is operating at or near design levels, however, non-routine renovation, upgrading, and repairs are needed to ensure continued reliable operation.
- *Poor*: The facility is not being operated within design parameters. Major renovations are required to restore the facility and assure reliable operation. Major expenditures for these improvements may be required.

Based on onsite tours of the major facilities and the interviews with Water Department management conducted in September through November of 2022, and a review of annual reporting and key performance measures associated with FY 2022, it is our opinion that:

- The Water System is generally in good operating condition, or the Water Department is taking adequate steps to return it to good operating condition; and
- The approved capital improvement budget for FY 2023 and the proposed capital program for FY 2024 through FY 2028 should provide adequate funds to sustain the system in good operating condition, meet compliance obligations and address emergency situations.

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5.0 Wastewater System

The Philadelphia Water Department's wastewater system currently serves the City of Philadelphia, and parts of Bucks, Montgomery, and Delaware Counties. The population served by the Wastewater System was approximately 1,603,797 based on the 2020 Census and decreased to 1,576,251 based on the 2021 Census Bureau estimate. Additionally, the Wastewater System provides wholesale service to ten outlying municipalities. The service area is distributed over 364 square miles, with 230 square miles in suburban communities and 134 square miles in the City, and consists of three drainage districts, each served by a treatment plant as indicated in Figure 5-1.

The wastewater collection system consists of approximately 3,727 miles of total collector system piping, 20 pumping stations (17 wastewater and 3 stormwater) of these 3 are owned by others but operated by the Water Department), 95,091 manholes, 25 storm relief structures, and 71,825 stormwater inlets. The collection system is approximately 55% combined sewer system comprised of 767 miles of sanitary, 757 miles of storm, and 1,852 combined sanitary/storm sewers. The sewers range in size from 8-inch diameter to 21 feet by 24 feet arch-shaped conduits primarily constructed of brick, vitrified clay, or reinforced concrete.

5.1 Wholesale Customers

The Water Department has contracts for wastewater treatment service with ten neighboring municipalities and authorities. The contracts stipulate the billing of charges based on wastewater strength and volume. As illustrated in Figure 5-1, parts of Bucks and Montgomery Counties contribute to the Northeast WPCP; parts of Montgomery and Delaware Counties contribute to the Southwest WPCP; and Springfield Township of Montgomery County contributes to the Southeast WPCP. Table 5-1 summarizes the contract limit flows and actual flows by receiving plant.

[This spacing is intentional]

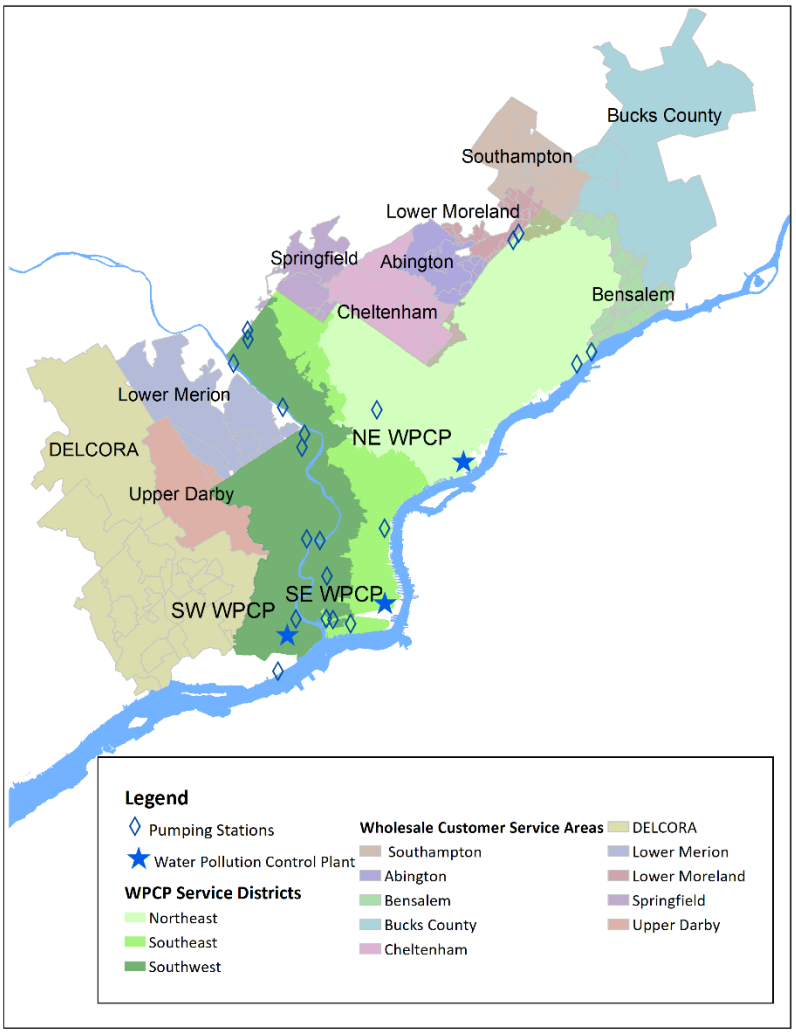

Figure 5-1 WPCP Service Districts and Whole Customer Service Areas*

*Note: Cheltenham's collection system is owned and operated by Aqua Pennsylvania Wastewater, Inc. Bensalem's and Southampton's collection systems are owned and operated by Bucks County Water and Sewer Authority.

Table 5-1 Wholesale Suburban Flows to the WPCPs

	AVERAGE DAILY FLOW (MGD)				
PLANT	ANNUAL MAXIMUM (CONTRACT LIMIT)	FY 2019	FY 2020	FY 2021	FY 2022
Northeast WPCP	56.6	46.8	39.0	38.7	37.8
Southeast WPCP	1.0	0.5	0.4	0.4	0.3
Southwest WPCP	84.7	49.6	40.2	42.5	37.6
Total	**142.3**	**96.9**	**79.6**	**81.6**	**75.7**

Source: FY 2009 to FY 2022 Contract Customer Report as provided by PWD Finance Staff

5.2 Consent Order Agreement and Relevant Regulatory Permits

The Water Department's combined sewer system is subject to regulatory requirements associated with discharges from the combined sewer system, WPCPs and separate storm sewer system, as well as for air emissions from the WPCPs. These regulatory mechanisms are listed below and discussed in the sections that follow.

- LTCPU COA
- WPCP NPDES Permits
- MS4 NPDES Permit
- Title V Major Source Operating Permits-Clean Air Act ("Title V") Permit

5.2.1 Consent Order Agreement

The Water Department entered a COA with PADEP on June 1, 2011. The COA formalized the Water Department's LTCPU, also known as the Green City, Clean Waters program, as how the Water Department will reduce CSOs to achieve compliance with the CSO Control Policy. This policy requires the capture of 85% of combined sewage that would otherwise overflow from the combined sewer collection system during wet weather events on an annual average basis.

Under the COA, the Water Department committed to invest in green and traditional infrastructure, including wastewater treatment plant capacity increases, interceptor lining and collection system improvements, which will cumulatively achieve the required 85% capture by the year 2036, or year 25 of the COA. The infrastructure improvements to be implemented under the COA will eliminate and remove no less than the mass of pollutants (Biochemical Oxygen Demand ("BOD"); Total Suspended Solids ("TSS"); and fecal coliform bacteria) that would be removed by the capture of 85% by volume of combined sewage collected in the Combined Sewer System during precipitation events on a system-wide annual average basis.

To track the progress toward compliance with the 25-year program goals, the COA includes interim performance standards which must be achieved at five-year intervals as summarized in the Water Quality Based Effluent Limit ("WQBEL") Table below (see Table 5-2).

Table 5-2 WQBEL Performance Standards – COA TABLE 1

METRIC	UNITS	BASELINE VALUE	CUMULATIVE AMOUNT AS OF YEAR				
			5	10	15	20	25
[plant name] WPCP upgrade: Design	% complete	0	(1)	(1)	(1)	100%	100%
[plant name] WPCP upgrade: Construction	% complete	0	(1)	(1)	(1)	100%	100%
Miles of interceptor lined	miles	0	2	6	14.5	14.5	14.5
Overflow Reduction Volume (2)	MG per year	0	600	2,044	3,619	5,985	7,960
Total Greened Acres	Greened Acres	0	744	2,148	3,812	6,424	9,564
Equivalent Mass Capture -TSS	%	62%	Report Value	Report value	Report value	Report value	85%
Equivalent Mass Capture - BOD5	%	62%	Report value	Report value	Report value	Report value	85%
Equivalent Mass Capture - Coliform bacteria	%	62%	Report value	Report value	Report value	Report value	85%

(1) Performance Standards for "percent complete" for the WPCP upgrade design and construction projects were not available at the time of the COA. The Water Department provided these targets to the PADEP along with the Facility Concept Plans for the WPCPs in June 2013. The targets for "percent complete" may be incorporated into COA Table 1 though a formal modification process that may be accomplished by the PADEP via the issuance of a revised NPDES permit.

(2) Overflow Reduction Volume means the difference between the volume of overflow in million gallons per year for the condition prevailing at the time of the report and the volume of overflow in million gallons per year for the baseline year. The baseline year is represented by Philadelphia's physical systems as they were configured on January 1, 2006. Both volumes will be determined from modeling, using climatic data representing the same "typical year" for Philadelphia as determined in the LTCPU development process, and a hydrologic/hydraulic model calibrated with flow data collected for verification of actual performance.

The COA also defines required deliverables, which range from wet weather facilities plans, to GSI monitoring and maintenance plans and the development of water quality models, as well as the submittal of an Evaluation and Adaptation Plan ("EAP") at five-year intervals to document progress toward the defined WQBEL targets.

The COA outlines civil penalties to be assessed should the Water Department be unable to meet the WQBEL performance standards or other requirements related to submission of periodic deliverables; record keeping, and planning, design, and construction requirements. Penalties for not meeting the incremental performance standards start at $25,000 per month per violation for the first six months and could increase up to $100,000 per month per violation should the Water Department remain in violation for 13 months or more. Additionally, there are penalties that could reach up to $2,000 per day per violation for failure to submit timely and adequate plans, reports, and other deliverables.

5.2.1.1 Compliance Status

The Water Department requested an extension for meeting the Year 10 targets and submitting the Year 10 EAP citing Force Majeure resulting from the COVID-19 Pandemic which delayed the completion of some projects. PADEP granted extensions to December 31, 2021, and May 30, 2022, respectively. The City is in compliance with the COA WQBEL, modeling, monitoring, and reporting requirements, as documented in the Year 10 EAP submitted to PADEP in May 2022 and summarized below.

- Upgrade of Water Pollution Control Plants (Design and Construction): The Wet Weather Facility Plan for the three WPCPs was submitted to PADEP by the June 1, 2016 deadline and provides details on scheduling, cost and anticipated construction completion dates for the projects listed in the Facility Concept Plans. In accordance with this Plan, the Water Department completed the following Year 10 projects and initiatives at the Northeast WPCP (note: no projects were identified for this reporting period for Southeast and Southwest WPCPs or the Collection System):
  - High Flow Management System,
  - Gravity Sludge Thickeners, and
  - Operate Primary Sedimentation Tanks with Minimal Sludge Blanket.
- Miles of interceptor lined: Requires lining streamside interceptors within the Cobbs and Tacony-Frankford watersheds to improve stream quality and aesthetics during dry weather. As of December 2021, 9.2 miles of interceptor have been lined, which surpasses the Year 10 target. Additionally, 2.6 miles of lining projects are in construction or projects control, and another 3.3 miles are in design. These projects position the Water Department for compliance with the Year 15 target.
- Reduction of CSO volume: Tracks the reduction of total CSO volume relative to the baseline year of 2006. The Water Department has met the Year 10 requirement of 2,044 MG of overflow reduction by achieving 3,080 MG of reduction as of December 2021. Traditional and green infrastructure projects contributed to exceeding the volume reduction target.
- Total Greened Acres: A Greened Acre ("GA") is an indicator of the volume of stormwater managed by green stormwater infrastructure, based on the design for the project. For example, one GA is equivalent to one inch of managed stormwater runoff from one acre of drainage area. The Water Department recently collaborated with PADEP to modify the GA calculation to account for the volume of runoff infiltrated or slowly released into the collection system in addition to the volume stored within a given GSI practice. The revised methodology is consistent with PADEP design guidance and Water Department field monitoring results and provides a more realistic estimate of the volume of runoff managed. The result of the revision was a one-time adjustment in the number of GAs achieved. As reported in the Year 10 EAP the cumulative GAs was adjusted from 2,196 GAs to 2,531 GAs, in both cases exceeding the Year 10 target of 2,148 GA.

  The Water Department currently has $73 million budgeted in FY 2023 and $80 million for each of FY 2024 and FY 2025 for construction of GSI that will be self-owned, operated and maintained. Additional greened acres will be achieved through private development.

- Equivalent Mass Capture: Using the presumption approach outlined in the National CSO Control Policy, the goal is to reduce the impact of TSS, BOD, and fecal coliform bacteria on local waterways equivalent to the capture and treatment of 85% of CSOs. In compliance with the reporting requirement for this metric, the Water Department reported the following percent captures in the Year 10 EAP: 77.5%, ~100.0%, and 77.1%, for TSS, BOD, and fecal coliform bacteria, respectively.

5.2.1.2 Adaptative Management and Costing Revaluation

The COA takes an adaptive management approach to meeting the program goals thereby allowing the Water Department to review and revise the approach over time to ensure environmental, financial, and regulatory metrics are met in an efficient and sustainable manner. To this end, the Water Department recently initiated an Adaptative Management and Costing Revaluation initiative with the goals of:

- Reassessing and updating as needed the cost assumptions and approaches used in the development of the LTCPU project costs and prioritization, originally completed over 10 years ago,
- Reprioritizing project alternatives considering updated costs and goals,
- Identifying the best fit solutions that are protective of the environment and fiscally and socially responsible.

The Water Department anticipates that over the next 15 years, compliance with the COA will significantly increase capital and operating expenditures related to its Combined Sewer Overflow Program. As of the most recent projections, the total cost of the 25-year program is approximately $4.5 billion, of which approximately $3.5 billion are capital-related costs and $1 billion are O&M costs. The FY 2023 budget for COA capital expenditures is just under $1 billion. The intent of this initiative is to identify the best mix of projects to meet the requirements of the COA and the goals of GCCW while limiting the cost impact of the program.

5.2.2 National Pollutant Discharge Elimination System Permits

The NPDES permits for the Northeast, Southeast, and Southwest WPCPs all became effective September 1, 2007, and expired August 31, 2012. As required, the Water Department submitted renewal applications in February 2012, and continues to operate under the administratively extended 2007 permits until new permits are issued. PADEP recently reset the renewal process by requesting that the Water Department submit new permit applications. The Water Department is compiling the information required and anticipates application submittal in calendar year 2023 followed by a negotiation period and public comment period.

The NPDES permits have requirements that address the following:

- Effluent water quality (as summarized in Table 5-3) and associated monitoring, record keeping, and reporting requirements
- Plant Operations and Maintenance plans
- CSO Program requirements including outfall monitoring, Nine Minimum Controls implementation and LTCP development and implementation

- Wet-weather operations
- On-site Stormwater management and monitoring requirements for a plant's stormwater outfall system
- Industrial pre-treatment program requirements
- PCB management requirements
- Management requirements, penalties and liabilities and other responsibilities

Plant compliance with the NPDES permits is discussed within Sections 5.5, 5.6 and 5.7 of this report.

Table 5-3 Current NPDES Key Effluent Limitations

EFFLUENT CHARACTERISTIC	NORTHEAST WPCP	SOUTHWEST WPCP	SOUTHEAST WPCP
		(Average Monthly)	
$CBOD_5$ (mg/l)	25	25	-
$CBOD_5$ (lbs/d)	36,430	19,800	-
$CBOD_{20}$ (lbs/d)	71,760	35,830	33,600
$CBOD_5$ (% removal)	86	89.25	-
$CBOD_5$ (% removal at flows > MDF)		(See footnote 2)	
BOD_5 (mg/l)	-	-	30
BOD_5 (lbs/d)	-	-	19,650
BOD_5 (% removal)	-	-	86
BOD_5 (% removal at flows > MDF)		(See footnote 3)	
TSS (mg/l)	30	30	30
TSS (lbs/d)	52,540	50,400	28,025
TSS (% removal)	85	85	85
TSS (% removal at flows > MDF)		(See footnote 4)	
pH	6-9	6-9	6-9
Fecal Coliform (per 100 ml) [(1)]	200	200	200
Total Residual Chlorine (mg/l)	0.5	0.5	0.5
Average Monthly Flow - AMF (MGD)		monitor/report	
Maximum Daily Flow – MDF (MGD)		monitor/report	
Maximum Daily Flow – MDF recognized for calculating % removals at high flow day events (MGD)	315	300	168

[(1)] Geometric mean

[(2)] If a calendar month includes one or more days where flows exceed the MDF, a value of 86% and 89.25% respectively at the Northeast WPCP and the Southwest WPCP may be used for those days for calculating CBOD5 percent removal.

[(3)] If a calendar month includes one or more days where flows exceed the MDF, a value of 86% at the Southeast WPCP may be used for those days for calculating BOD5 percent removal.

[(4)] If a calendar month includes one or more days where flows exceed the MDF, a value of 85% may be used for those days for calculating TSS percent removal.

5.2.3 Municipal Separate Storm Sewer System Permit

The Water Department is operating under a MS4 Phase I permit issued in September 2005 with an expiration date in September 2010. As required, the Water Department submitted a renewal application in March 2010, and continues to operate under the administratively extended permit until PADEP issues a new permit. Elements of the MS4 permit include:

- Sediment Total Maximum Daily Load ("TMDL") for Wissahickon Creek
- Polychlorinated Biphenyl Pollutant Minimization Plan ("PCB PMP") for the MS4
- Stormwater Management Program:
  - Source Identification
  - Discharge Management, Characterization, and Watershed-based Assessment and Management Program for three watersheds (Pennypack, Poquessing and Wissahickon)
  - Detection, Investigation, and Abatement of Illicit Connections and Improper Disposal
  - Monitoring and Control of Pollutants from Industrial Sources
  - Monitoring and Control of Stormwater from Construction Activities
  - Good Housekeeping and Best Management Practices

The Water Department and PADEP are actively negotiating a new MS4 permit. PADEP publicly noticed a draft permit for the Water Department in July 2017 and discussions have been underway since. The draft permit included substantial increases in required management activities, which if adopted will require a significant increase in the resources dedicated to the MS4 Program by the Water Department as well as other city agencies. The additional requirements included in the draft permit that are still being negotiated include, but are not limited to:

- Expanded applicability of stormwater management requirements to all City operational activities and on-site storm water infrastructure at City-owned facilities within the MS4 area
  - includes on-site sewer system mapping, operations and maintenance, and infrastructure management,
  - pollution prevention practices for operations activities, and
  - employee and contractor training programs
- A new measurable goal for street sweeping with an increase in miles per year
- Expanded Litter Awareness and Litter Control programs
- Development and implementation of a Pollutant Reduction Plan to reduce sediment loading to impaired waterways by 10% within 5-years

A foundational tenet of the USEPA MS4 program is that the pollution reduction requirements are consistent with the Maximum Extent Practicable ("MEP") standard. MEP addresses the need to balance

water quality outcomes with feasibility and financial capacity. The Water Department is documenting the potential resource requirements associated with meeting the draft permit requirements in preparations for on-going discussions with PADEP. Of particular concern are:

- the level of participation and resources that will be required of other City departments and/or the potential for the Water Department to have to provide additional supporting resources, and
- the feasibility and magnitude of costs associated with the implementation of capital projects required to achieve compliance with the Pollutant Reduction Plan.

5.2.4 Title V Major Source Operating Permits

The Federal Clean Air Act sets forth requirements for the regulation of certain air emissions including the control of VOCs and nitrogen oxides ("NOx") emissions from major stationary sources. These regulations require, in part, that all sources of VOC and NOx quantify their emissions. The three WPCPs and Biosolids Recycling Center ("BRC") are sources of VOCs and NOx.

The Northeast WPCP has a Title V Major Source Operating Permit which requires bi-annual reporting for NOx and VOC emission and contains requirements regarding odor emissions. The Water Department must report any detection of a malodorous air contaminant outside the facility property line. Permit requirements consist of monitoring and reporting. The permit does not stipulate any limitations.

The gravity sludge thickeners at Northeast WPCP were constructed in accordance with a Title V consent order agreement. Upon completion of the construction, the Water Department submitted an amended Title V permit to Air Management Services in May 2020. No comments have been received, and the Water Department is working under the assumption that the amended permit is approved.

The Southwest WPCP operates under a Synthetic Minor operating permit. The Southeast WPCP does not have an overarching air-related permit.

The BRC Title V permit is classified as a Natural Minor operating permit and is responsibility of the Philadelphia Biosolids Services, LLC ("PBS").

Since 2008, no odor violations have been reported at the Northeast WPCP, Southeast WPCP, or Southwest WPCP.

5.3 Wastewater System Initiatives

The Water Department through P&R, OOW and Wastewater Operations is actively engaged in long-range planning to address aging infrastructure, climate change, potential future regulations, and energy management.

5.3.1 Wastewater Master Planning

The Water Department completed a draft Wastewater System Master Plan in 2016. The general objective of the Master Plan was to develop a roadmap for long-term wastewater system improvements, including

elements of the COA and LTCPU that had already been agreed to with PADEP. The Master Plan outlined projected capital improvements associated with addressing the core elements of wet weather management, asset management, regulatory compliance, and utility of the future. The plan was based on the conditions, assumptions and goals prevailing at the time with the intent that it would be revisited and updated as needed every five years. The identified capital improvements that resulted from the master planning effort were incorporated into the Water Department's overall CIP as appropriate.

The Water Department recently initiated an update to the 2016 Wastewater Master Plan. The objective of the WWMPU is to develop an implementable capital improvement plan for the wastewater treatment plants that addresses aging infrastructure, future regulatory requirements, energy efficiency and projected sea level rise. The WWMPU is being developed through a collaborative process led by P&R with support from representatives from Wastewater Operations, OOW, BLS and Design and direction from steering committee comprised of Executive Staff. The development of the plan is broken in five main evaluations:

- Asset Replacement Evaluation,
- Regulatory Environment Evaluation,
- Energy Evaluation,
- Climate Change Adaptation Evaluation, and
- Alternatives Evaluation.

The WWMPU is scheduled for completion in late 2024. Key outcomes will be an actionable 25-year CIP and a gap analysis that identifies additional planning needs related to the WPCPs but are outside of the scope of the WWMPU, such as wet weather management in the collection system, biosolids management and emerging initiatives.

In a related but separate planning initiative, the Water Department is planning to increase rates of rehabilitation or replacement of sewer lines to achieve 20 miles per year. Sewer rehabilitation or replacement projects have typically been reactive to a known failure, coupled with water main replacement, or identified as having an existing or imminent failure through Closed-Circuit Television ("CCTV") inspection results. Through the Sewer Assessment Program, the Water Department is considering expanding the preventative maintenance program to include sewers with defects identified through CCTV that indicate the pipe is likely to fail in 5 to 10 years.

5.3.2 Nutrient Management Initiatives

The Water Department has been an on-going and active stakeholder in DRBC's on-going designated use attainability studies which seek to assess the feasibility and costs associated with achieving enhanced aquatic life supporting water quality standards in the Delaware River Estuary. It is anticipated that DRBC's studies will inform the inclusion of nutrient (nitrogen or ammonia-nitrogen) limits in the NPDES permits for the three WPCPs. Depending on the magnitude of those limits, the Water Department could be

required to implement capital improvements such as enhanced nutrient removal processes at the three WPCPs.

The Water Department is proactively assessing operational and process changes as well as capital improvements to reduce the effluent ammonia loading from the WPCPs. One such project currently under design for the Southwest WPCP will remove ammonia from the return centrate flow from BRC prior to introduction to the plant. The centrate is a low flow waste stream with high ammonia concentrations. As such, the project offers the potential to achieve substantial reduction in the Southwest WPCP discharge. The Northeast WPCP is conducting studies to assess potential ammonia removal through the optimization of the step feed aeration process. P&R is conduiting bench studies in advance of potential pilot studies of alternative removal technologies, such as Nuvoda MOB, an emerging technology for ammonia removal. The implications of potential ammonia limits will be a primary regulatory consideration in the WWMPU.

5.3.3 Energy Initiatives

The Water Departments Strategic Energy Plan focuses on the achievement of four goals: carbon footprint/greenhouse gas ("GHG") emissions reduction, renewable energy generation and use at its facilities, resource recovery and energy efficiency gains. Consistent with these goals, energy evaluations and sustainable energy management at the wastewater treatment plants are primary considerations of the WWMPU.

The Water Department has a variety of energy-related projects in various stages of investigation, development, and implementation, including the following:

- Renewable Energy Generation:
  - Biogas Cogeneration: A facility at the Northeast WPCP captures methane gas generated by anaerobic digestion and utilizes the gas in a 5.6-megawatt cogeneration facility. The facility's performance and return on investment has been less than anticipated due to maintenance issues and associated costs. The Water Department is seeking support from the Philadelphia Energy Authority which has expertise with the administration of larger energy management and efficiency projects.
  - Solar power generation: At the Southeast WPCP, the Water Department's photovoltaic solar system continues to generate approximately 300,000 kilowatt hours ("kWh") of AC power per year. The Energy Team is working with plant operations to address recent challenges with system operations.
- Resource Recovery:
  - The Water Department continues to accept used aircraft de-icing fluid from the Philadelphia International Airport directly into the anaerobic digesters at Southwest WPCP to enhance digester gas production.
  - Southwest WPCP utilizes digester gas for plant heating processes and for use at the third-party biosolids processor, Synagro. The Energy Team is working with Southwest WPCP to identify additional uses for the biogas generated on-site.

- Energy Efficiency:
  - The Water Department is seeing gains achieved through department-wide adoption of conservation practices such as lighting evaluations and replacements, facility audits and incorporation of energy efficiency considerations into all new capital projects.

5.4 Water Pollution Control Plants Overall Operations

The Water Department owns and operates three WPCPs, Northeast, Southeast and Southwest. All three are conventional secondary treatment plants with activated sludge treatment. Operation of the facilities is supported by computerized monitoring and control systems and an onsite process control laboratory. The on-site laboratories are managed by BLS. Process data can be viewed from dedicated operator stations and through web-based systems. These systems can be used to trend real time process data in conjunction with sample analyses to support operational decisions. Most unit processes have some degree of automation, but operators must still monitor the process to adjust setpoints; and manually adjust those systems which are manual. Monitoring for permit compliance is scheduled by BLS, with sample analyses conducted at the on-site laboratory or the BLS Central Laboratory Facility with some external contract laboratory support.

These facilities exceed requirements for treatment efficiency and were recognized by the National Association of Clean Water Agencies ("NACWA") in 2021 with either Platinum or Gold Peak Performance awards. The Southeast WPCP received a 22-year Platinum Award recognizing 22 calendar years of perfect NPDES compliance, while the Southwest and Northeast WPCPs received Gold Awards recognizing perfect compliance in 2021.

The Black & Veatch Team conducted site visits at each of the plants in September 2022. The site visits included interviews with plant management and facility tours to observe the condition of the facilities and the recently completed, on-going or planned capital improvements. Projects in design, procurement, or construction were reviewed and these are in line with goals outlined in the last master plan including, wet weather management, asset replacement, regulatory compliance, and "Utility of the Future". Most projects are aimed at replacing aging assets or upgrading facilities to reduce maintenance demands / improve facility operability. However, many of the larger projects in the pipeline and discussed during site tours were directly related to meeting the requirements of the LTCPU or are associated other improvements to improve effluent quality and reduce environmental impact generally.

Day-to-day operation of the plants was also discussed during the site visits. Some common operational challenges were identified during these discussions. All facilities cited succession planning as a major and immediate concern due to potential retirements in the short term. Consistent with the other units, the Northeast and Southwest WPCPs are experiencing high vacancy levels, particularly for maintenance personnel (trades and semi-skilled labor). Additionally, it appears that insufficient coordination between the BRC and the WPCPs has resulted in delays in accepting the biosolids, creating challenges for the operations of the WPCPs. It is our opinion that continued delays could impact plant capacity or performance. The Water Department is in discussion with BRC to address this challenge.

Projects and plant operations for individual facilities are discussed in greater detail in the following sections.

5.5 Northeast WPCP

5.5.1 Service Area

The Northeast WPCP receives a mix of residential, commercial, and industrial wastewater from north and northeast Philadelphia, eastern Montgomery, and southern Bucks Counties, as shown in Figure 5-1. The Northeast WPCP receives water treatment residuals from the Baxter Water Treatment Plant through the collection system. A substantial portion of the collection system includes combined sewers. The Water Department has committed to reducing CSOs by reducing hydraulic bottlenecks within the collections system which will ultimately increase flow and loadings experienced by the Northwest WPCP during wet weather events.

5.5.2 Capacity and Performance

The Northeast WPCP is rated to treat a maximum of 210 MGD as monthly average flow, 315 MGD as daily average flow, and 435 MGD as a peak instantons flow. In compliance with the COA, the Water Department, completed construction of the high flow management system in 2018 increasing the plant's total permitted peak instantaneous capacity from 435 MGD to 650 MGD. The facility continues to comply with all discharge permit requirements.

In FY 2022 the Northeast WPCP treated an annual average flow of 182 MGD and a maximum daily flow of 380 MGD. A review of regulatory reporting indicates that permit requirements associated with $cBOD_5$ and TSS removal were met and that permitted effluent limits of concentrations and loads associated with $cBOD_5$, TSS, and Fecal Coliforms were not exceeded.

5.5.3 Treatment Processes

Raw wastewater enters the facility through a combination of low-level and high-level gravity sewers and is screened. The combined flow is then de-gritted in detritor tanks prior to being split between two sets of primary sedimentation tanks. Primary sludge is pumped to the gravity sludge thickener facility. Primary effluent flows on to the step feed activated sludge process which consists of seven aeration tanks and two sets of secondary sedimentation tanks. Primary effluent from the two sets of primary clarifiers enter the step feed aeration tanks from opposite sides. The flow split is controlled by gates which can adjusted seasonally or as needed to manage elevated flows. Aeration tanks are aerated with blowers and fine bubble diffusers. After secondary settling the effluent flows to two chlorine contact basins which are dosed with sodium hypochlorite for disinfection before discharge to the Delaware River. Waste activated sludge is pumped from the underflow of the secondary sedimentation tanks to sludge thickening.

The high flow management system allows for the diversion of primary effluent in excess of what can be treated with the step feed activated sludge system. This diversion runs from one of the primary effluent channels to the chlorine contact tanks. This is to allow for a reduction the discharge of untreated

wastewater by increasing the flow through primary treatment and disinfection during wet weather events.

Primary sludge is thickened with four gravity thickeners and waste activated sludge is thickened with twelve dissolved air flotation thickeners. These thickened sludges are blended and fed to eight anaerobic digesters where solids are stabilized, and biogas is produced. Biogas can be sent to the Cogeneration System as discussed in section 5.5.4 or utilized for on-site heating. Excess biogas can be flared. Digested biosolids are pumped to the sludge transfer station for holding and are ultimately transported by barge to BRC. Concentrated scum, screenings and grit are hauled to the Southwest WPCP and ultimately landfilled.

Residuals from the Baxter water treatment plant include substantial amounts of iron hydroxides which bind phosphorus and are removed with residuals. This results in the need for the Northeast WPCP to feed phosphoric acid at a low dose to prevent phosphorus limited conditions, which would inhibit the biological process.

Most unit processes have some degree of automation, but operators must still monitor the process to adjust setpoints; and manually adjust those systems which are manual. Automated systems include raw influent pumps, bar screens and associated systems, influent flow splitting to the primary sedimentation tanks, blower, and air flow control valves for DO control in the aeration tanks, return sludge pumps, sodium hypochlorite dosing, scum gates at sedimentation tanks, sludge thickening systems, and digester feeding.

5.5.4 Cogeneration System

Biogas produced in the anaerobic digesters is sent to a 5.7 MW biogas cogeneration facility. Biogas is first cleaned and dried to condition it for combustion. Cleaned biogas is blended with natural gas and fed to four gas engines. Electricity is generated by these engines and waste heat is recovered by a propylene glycol heat exchange system. Energy is provided directly to the Northeast WPCP while waste heat is used to heat the anaerobic digesters. Historically this system has produced about two-thirds of the facility's electricity needs. In the past several years these processes have provided about $2.5 million in cost avoidance though this number has dropped over time due to a downward trend in natural gas and electricity prices. However, recent changes in energy prices could alter this trend.

The facility is owned by BAL Green Biogas I, LLC on land owned by the City of Philadelphia. In 2011 the facility was leased to the Philadelphia Municipal Authority. All lease obligations are covered by the City of Philadelphia as Water Department operational expenses pursuant to a sub-lease agreement with the Philadelphia Municipal Authority. The Sublease will expire September 25, 2029, unless the Philadelphia Municipal Authority uses its option to renew for an eighteen-month term.

The facility is operated by Water Department staff and maintenance is provided by Ameresco through a maintenance contract. When balancing expenses (lease obligations, maintenance, operations, natural gas purchases, and insurance) against cost avoidance, the total expense of the facility has increased in the

past several years to $4.0 million (2017-2020 average) from $1.9 million (2015-2016 average) (2021 Biogas Cogeneration Facility Financial Analysis).

5.5.5 Facility and Utility Maintenance Projects

Below are lists of the projects discussed with Northeast WPCP staff during the site visit, with the project numbers and names listed as accessed November 2022. Several of these were substantial topics of conversation at the time of the site visit as they will either ease operational or maintenance burdens or allow for improved treatment or capacity to meet COA goals.

Projects Under Construction or Substantially Completed:

- (71086, 71087) New Gravity Thickeners at NEWPCP
- (71104) Upgraded Balfour Street Plant Entrance at NEWPCP
- (71102, 71107, 71108, 71109) Pretreatment Facility at NEWPCP Addition
- (71112, 71118) Return Sludge Line FST 2
- (71113) Chillers and Hot Water/Glycol Pipeline Replacement
- (71116) Replacement of sludge gas piping
- (71123, 71146) Digester Dewatering and Maintenance
- (71127, 71144) Boiler Replacement at STB and PTB

Projects in Project Controls:

- (71088) Acquisition of Properties for Plant Addition
- (71120) PLC Software, Programming, and Hardware Replacement
- (71085) Lighting (Phase 1) Replacement
- (71096) Replacement of Interior and Exterior Doors throughout the Facility

Projects in Design:

As of November 2022, there were 26 projects in CIPIT identified as being in Design. The projects address a range of process and facility needs including but not limited to replacement of piping, tanks and mechanical equipment, switchgear and control station enhancements, replacement of the process control laboratory, and betterment of the plant road and a pier.

A major point of discussion during the site visit was the maintenance requirements required by the commissioning of the new gravity thickener facility. The project has been substantially complete but awaiting completion of punchlist items since 2019. The primary startup issues and maintenance burdens are associated with the primary sludge pumps. Plant management's conclusion is that the pumps, which were selected for efficiency, are not robust enough for a challenging application like primary sludge. Despite maintenance challenges, the primary sludge pumping project is perceived to have been successful in its goals. This project allows for primary sludge to be pumped at a higher rate, increasing the

performance of the primary sedimentation tanks at high flows, and reducing odors. While the project is meeting goals, the excessive maintenance needs consume valuable maintenance staff resources and detract from routine maintenance of other equipment. A better solution is needed to promote reliability of the process and efficiency of the utilization of staff resources.

Digester cleaning was discussed extensively as historically this maintenance activity presented a substantial burden to plant staff. Various contracting and contractor issues contributed to routine cleanings falling behind schedule. These issues have been resolved and management is confident that contract mechanisms are in place to ensure future cleanings will be performed as scheduled. A project which has recently moved into design is the sludge screening facility which is expected to reduce the frequency of cleaning of the digesters necessary. This will reduce costs associated with cleaning contracts and increase digester volume and usable uptime, which will in turn improve digestion and gas production.

Several projects are related to increasing the treatment capacity and treatment performance of the facility at high flow. The new preliminary treatment building will increase capacity and screening performance during high flow events. This project has a land acquisition element which has been resolved, and it is expected that this project will move into construction shortly. Lastly the effluent pumping station addition and effluent conduit betterment project has recently entered design and will increase the hydraulic capacity of the facility particularly during high tide and high flows, which are independent conditions that can occur separately or at the same time.

5.5.6 Operations and Maintenance

In FY 2023, there are 132 authorized positions at the Northeast WPCP including administration, operations, and maintenance. Three daily operational shifts ensure the plant is staffed and operated continually. As of September 30, 2022, there were 19 vacancies or 14% of the authorized positions. Staffing challenges are especially acute for the maintenance groups and present a significant challenge as related to achieving maintenance goals. It is noted that these staffing numbers do not include on-site laboratory staff.

During the site visit, operational and maintenance challenges were discussed. Many maintenance issues stem from the difficulties hiring maintenance staff and the resulting high vacancy rate. This seems to be pushing the facility maintenance away from a preventative maintenance approach towards a more reactive stance. For example, diffuser and aeration system cleaning and maintenance is an in-house activity, but this has been deferred due to staffing challenges. One recent effort to address the staffing challenges was a shift in the start time from 7:30 am to 6:30 am. This change moves the start time at the Northeast WPCP closer to those at other Water Department facilities and is expected to improve the desirability of the positions. Management is also exploring utilization of contractors to address maintenance activities that are being deferred due to lack of staff.

Other operational challenges are largely related to issues with biosolids removal from the site. There were frequent instances in the past year when the barge which takes digested sludge to the Biosolids Recycling Center was full and not being taken away to unload. This is outside of the control of Northeast

WPCP operational staff and leads to digester overflow recycling to the plant headworks. The internal solids recycle leads to increased solids inventory in the process which stresses the treatment processes and could lead to increased effluent solids. This also increases the loading on thickening processes and the anaerobic digesters, which combined with digester downtime for cleaning, seems to have led to decreased biogas yields. Better coordination with the biosolids recycling center was being explored by the Department to mitigate these impacts.

5.6 Southeast WPCP

5.6.1 Service Area

The Southeast WPCP receives a mix of residential, commercial, and industrial wastewater from non-contiguous sections of Philadelphia and Montgomery Counties, as shown in Figure 5-1. The Southeast WPCP receives water treatment residuals from the Queen Lane Water Treatment Plant through the collection system. A substantial portion of the collection system includes combined sewers. The Water Department has committed to reducing CSOs by reducing hydraulic bottlenecks within the collection system which will ultimately increase flow and loadings experienced by the Southeast WPCP during wet weather events.

5.6.2 Capacity and Performance

The Southeast WPCP is rated to treat a maximum of 112 MGD as monthly average flow, 168 MGD as daily average flow, and 224 MGD as peak flow. To comply with the COA the Water Department needs to increase the peak capacity of the facility, which, per the 2013 Facility Concept Plan is a planned permitted peak flow increase of 50 MGD (from 224 MGD to 274 MGD) through a combination of process and hydraulic improvements. The facility continues to comply with permitted discharge requirements and the facility was awarded a NACWA 22-year Platinum Award for calendar year 2021. In FY 2022 the Southeast WPCP treated an annual average flow of 81 MGD and a peak flow of 273 MGD. A review of regulatory reporting indicates that permit requirements associated with BOD_5 and TSS removal were met and that permitted effluent limits of concentrations and loads associated with BOD_5, TSS, and Fecal Coliforms were not exceeded.

5.6.3 Treatment Processes

Raw wastewater enters the facility through a single low-level gravity sewer. All influent flow passes through mechanically cleaned coarse bar racks and is then lifted by a common influent pump station. Raw wastewater then flows through course bar screens and subsequent grit removal. Prior to primary treatment flow passes through two flocculation tanks. Flocculated wastewater then flows through four rectangular primary sedimentation tanks where primary sludge is removed to a storage tank and then pumped to the Southwest WPCP.

Primary effluent flows to the conventional activated sludge process which consists of eight conventional reactors and twelve secondary sedimentation tanks. Waste activated sludge is pumped to a storage tank before pumping to the Southwest WPCP. Primary and waste activated sludge are pumped to the

Southwest WPCP in separate force mains. Secondary effluent is dosed with sodium hypochlorite with adequate disinfection residence time provided in the conduit between the WPCP and the discharge location. Effluent is pumped as needed (due to high flows and/or high tide conditions) for discharge to the Delaware River.

Scum from the primary and secondary clarifiers is concentrated and hauled to the Southwest WPCP where they are ultimately landfilled with scum from that facility. Similarly, screenings and grit from preliminary treatment are hauled to the Southwest WPCP and ultimately landfilled.

Residuals from the Queen Lane water treatment plant include substantial amounts of iron hydroxides which bind phosphorus and are removed with residuals. This results in excessive removal of phosphorus and the need for the Southeast WPCP to feed phosphoric acid to prevent phosphorus limited conditions, which would inhibit the biological process.

Most unit processes have some degree of automation, but operators must still monitor the process to adjust setpoints; and manually adjust those systems which are manual. Automated systems include influent and effluent pumping stations, primary sludge pumping, final clarifier scum collection, return and waste activated sludge pumping, and sodium hypochlorite dosing.

5.6.4 Facility and Utility Maintenance Projects

Below are lists of the projects discussed with Southeast WPCP staff during the site visit, with the project numbers and names listed as accessed November 2022. Several of these were substantial topics of conversation at the time of the site visit as they were either responses to equipment failures or are expected to ease operational or maintenance burdens.

Projects Under Construction or Substantially Completed:

- (72069) Sludge Force Main Replacement under the Schuylkill River
- (72072) Return Activated Sludge Line Replacement
- (72075) Final Sedimentation Tank Improvements
- (72086) Pave Roadway
- (72088) Elevated Water Tank Industrial Coating Replacement
- (72091) Compressor Building Roof Replacement and Equipment Storage Structure Betterment
- (72095) Replacement of Influent Pumping Station Transformers

Projects in Project Controls:

- (72089) Screen and Grit Building Betterment

Projects in Design:

As of November 2022, there were 7 projects in CIPIT identified as being in design. The projects address a range of process and facility needs including but not limited to tank railing replacement, betterment of

the primary sedimentation tanks, scum equipment, various process switchgear betterment and motor controls, as well as control laboratory replacement.

Several projects discussed during the site visit resulted from equipment issues. Notably the Influent Pump Station Transformers needed to be replaced due to the failure of a transformer which created a redundancy issue for influent pumping. The top layer of coating on the flights and chains in secondary sedimentation tanks started failing shortly after installation. As a result, this project has been extended to allow Design to investigate the issue.

Other projects were related to asset condition, but which would also reduce operational and maintenance burdens. The oldest sections of the force mains which convey sludge to the Southwest WPCP are being replaced. The removal of sludge from the facility by these force mains is essential to stable operation and effluent compliance of the Southeast WPCP. Additionally, major improvements to the screening and grit systems and the scum concentrator were discussed. The scum concentrator betterment project had moved back down into design from project controls during the fiscal year so that operations could provide more input on the equipment selection based on recent experiences.

The Betterment of the Influent Pump Station project is a recently initiated, high priority project that is expected to reduce downtime and increase the flexibility of the pump station to allow better utilization of the capacity of the downstream processes. A future project to increase influent pumping capacity is in the conceptual stages, however constraints both within and around the existing pump station present a challenge and added complexity to this project.

5.6.5 Operations and Maintenance

In FY 2023, there are 68 authorized positions at the Southeast WPCP including administration, operations, and maintenance. Three daily operational shifts ensure the plant is staffed and operated continually. As of September 30, 2022, there were 10 vacancies. These vacancies are spread out between operations and maintenance and are not substantial issue of concern, though upcoming retirements and succession planning still present a concern. It is noted that these staffing numbers do not include on-site laboratory staff.

The combination of adequate staffing levels and plant condition at the Southeast WPCP allow the maintenance staff to focus primarily on preventative maintenance.

5.7 Southwest WPCP

5.7.1 Service Area

The Southwest WPCP receives a mix of residential, commercial, and industrial wastewater from western Philadelphia, eastern Delaware, and southeastern Montgomery counties as shown in Figure 5-1. The Southwest WPCP receives water treatment residuals from the Belmont Water Treatment Plant through the collection system and wastewater treatment residuals from the Southeast WPCP via two pipelines which convey separately primary and secondary sludge. The Southwest WPCP is the only facility to

receive hauled septage which is monitored by the on-site laboratory and the Industrial Waste Unit. A substantial portion of the collection system includes combined sewers. The Water Department has committed to reducing CSOs by reducing hydraulic bottlenecks within the collection system which will ultimately increase flow and loadings experienced by the Southwest WPCP during wet weather events.

5.7.2 Capacity and Performance

The Southwest WPCP is rated to treat a maximum of 200 MGD as monthly average flow, 300 MGD as daily average flow, and 400 MGD as peak flow. To comply with the COA the Water Department plans to increase the peak capacity of the facility, which, per the 2013 Facility Concept Plan, will be a peak flow increase of 60 MGD, from 400 MGD to 460 MGD, in 2031. The Water Department is undertaking studies to increase facility capacity to as much as 540 MGD. The facility continues to comply with permitted discharge requirements. In FY 2022 the Southwest WPCP treated an annual average flow of 174 MGD and a peak flow of 516 MGD. A review of regulatory reporting indicates that permit requirements associated with $cBOD_5$ and TSS removal were met and that permitted effluent limits of concentrations and loads associated with $cBOD_5$, TSS, and Fecal Coliforms were not exceeded.

5.7.3 Treatment Processes

Raw wastewater enters the facility through a combination of low-level and high-level gravity sewers and from the DELCORA force main. Low-level gravity flows are lifted with screw pumps. The combined influent flows through the screening and grit removal equipment. Prior to primary treatment there are flocculation tanks. Flocculated wastewater then flows through five rectangular primary sedimentation tanks where primary sludge is removed and combined with primary sludge from the Southeast WPCP.

Primary effluent flows to the high purity oxygen activated sludge process which consists of ten high purity oxygen reactors and twenty secondary sedimentation tanks. Pure oxygen is supplied to the headspace of the high purity oxygen reactors by two cryogenic distillation towers and two liquid oxygen storage tanks. Waste activated sludge is pumped from underflow of the secondary sedimentation tanks and combined with waste activated sludge from the Southeast WPCP. Secondary effluent is dosed with sodium hypochlorite with adequate disinfection residence time provided in the conduit between the WPCP and the discharge location. Effluent is pumped as needed (due to high flows or high tide conditions) for discharge to the Delaware River.

Combined waste activated sludge from the Southeast and Southwest WPCP are thickened with eight dissolved air flotation thickeners. Thickened waste activated sludge is then blended with the combined primary sludge and fed to twelve anaerobic digesters where solids are stabilized and biogas is produced. Biogas can be utilized for on-site heating or as fuel for sludge dryers at BRC. Excess biogas can be flared. Digested biosolids are pumped to BRC for dewatering and sludge drying. Scum from the primary and secondary clarifiers are stabilized with lime and landfilled along with grit from preliminary treatment.

Residuals from the Belmont water treatment plant include substantial amounts of iron hydroxides which bind phosphorus and are removed with residuals, resulting in substantial removal of phosphorus and low effluent phosphorus concentrations. Centrate from the biosolids recycling center is returned to the

influent pump station. Because this centrate contains the nitrogen from the digestion of biosolids from all three WPCPs, the nitrogen loading to the Southwest WPCP is higher than the other two WPCPs and the discharged ammonia and total nitrogen concentrations are elevated in comparison.

Most unit processes have some degree of automation, but operators must still monitor the process to adjust setpoints; and manually adjust those systems which are manual. Automated systems include aeration tank oxygen feed, return sludge pumping, activated sludge wasting, secondary scum collection, effluent sodium hypochlorite dosing, effluent pumping, primary sludge pumping, dissolved air flotation thickening, digester tank feeding.

5.7.4 Capital Improvement Projects

Below are lists of the projects discussed with Southwest WPCP staff during the site visit, with the project numbers and names listed as accessed November 2022. Several of these were substantial topics of conversation at the time of the site visit as they will either ease an operational or maintenance burden or allow for improved treatment or capacity to meet COA goals.

Projects Under Construction or Substantially Completed:

- (73060) Installation of High Efficiency Lighting - Southwest WPCP
- (73063) Gallery Tunnel Improvements at SWWPCP
- (73064) Concrete Repairs and Coating of Aeration Tanks at SWWPCP
- (73066) Dissolved Air Flotation System Improvements at SWWPCP
- (73073) Replace Sludge Return Line at Aeration Tanks at SWWPCP
- (73074) Oxygen Facility Betterment
- (73075) Replace Digester Gas Underground Piping and Rehab of PTB Elevator
- (73082) New Scale Facility Addition
- (73084, 73101) Screening Collection and Conveyance Betterment
- (73085, 73098, 73099) Scum System Betterment
- (73092) Disinfection System Betterment
- (73093, 73100) Facility Access Gates Betterment

Projects in Project Controls:

- (73108) Replace Scum Skimmers for Final Sedimentation Tanks
- (73078) Switchgear at IPS Replacement
- (73080) Switchgear at Access Building Replacement
- (73083) Underground Process Oxygen Piping Replacement

Projects in Design:

As of November 2022, there were 28 projects in CIPIT identified as being in design. The projects address a range of process and facility needs including primary and final sedimentation tank improvements, addition of sidestream ammonia treatment for the BRC centrate, conversion of the pure oxygen system, replacement of the process control laboratory, effluent and outfall aeration tank mixers, station, sludge pumps and the plant water and sludge feed systems.

A substantial number of projects were on-going at the Southwest WPCP and were discussed during the site visit. A prominent change to the capital projects in the pipeline was that several projects associated with improvements to the cryogenic oxygen production were replaced or repurposed with projects associated with a new vacuum pressure swing adsorption ("VPSA") facility. This will produce oxygen for the existing process but at a substantially reduced maintenance burden for lower operating costs overall. Additionally, the improvements to the screening facilities were mentioned as having a substantial benefit to operations as it will reduce the time spent managing screenings.

Several projects discussed were driven by treatment capacity or effluent quality drivers. The primary sedimentation tank addition and the addition of two final sedimentation tanks will increase the plants treatment capacity in line with the COA. A complementary future project is the addition of two aeration tanks which should enter the design process shortly according to plant staff. Additionally, projects associated with the new centrate de-ammonification process were discussed as these will reduce the ammonia concentration in the plant discharge substantially in an efficient way and demonstrate the Water Department's commitment to ammonia reduction.

5.7.5 Operations and Maintenance

In FY 2023, there are 127 authorized positions at the Southwest WPCP including administration, operations, and maintenance. Three daily operational shifts ensure the plant is staffed and operated continually. As of September 30, 2022, there were 18 vacancies. Vacancies are relatively higher in the maintenance groups as compared with operations positions. It is noted that these staffing numbers do not include on-site laboratory staff.

Despite the difficulty hiring maintenance staff, deferring of preventative maintenance due to staffing and reactive maintenance needs was not highlighted as a concern to the degree discussed at the Northeast WPCP.

5.8 Biosolids Recycling Center

The Biosolids Recycling Center ("BRC") is located adjacent to but across I-95 from the Southwest WPCP. Liquid biosolids are pumped to the BRC from the Southwest WPCP and transported by barge to the BRC from the Northeast WPCP. The undigested sludge from the Southeast WPCP is transferred to the Southwest WPCP for digestion, thus the biosolids sent to the BRC represent all the biosolids produced by the three WPCPs. The site has been used for biosolids processing since 1989 when it was known as the Sludge Processing and Distribution Center. At that time the facility was operated by the City, with

biosolids dewatering and composting occurring onsite. Since 2008 the City has been in contract with the Philadelphia Municipal Authority ("PMA") to operate the BRC. The PMA in-turn entered into the Biosolids Service Contract with PBS. Under this contract PBS (in a joint venture with Synagro) designed and built a thermal drying facility and currently operates the biosolids receiving, dewatering, drying and reuse operations. The City assumes all obligations under the Biosolids Service Contract and pays the PMA for those obligations as an operating expense of the Water Department. The contract will expire October 13, 2028, unless the City uses its option to renew for a five-year.

The Water Department monitors the performance of the BRC to ensure that PBS is in compliance with the terms of the Biosolids Service Contract. In FY 2022 the BRC received and processed 68,380 dry tons of biosolids. PBS continues to meet all contractual requirements and the venture is viewed as a success by the Water Department as it facilitates compliance with state and federal environmental regulations at a cost savings. However, BRC operations can cause operational problems for the WPCPs, such as if the biosolids are not transferred from the Northeast WPCP in a timely manner. Inability to reliably discharge biosolids to BRC could impact operational costs at or capacity of the WPCPs. Biosolids management challenges also translate to lowered digester gas production and the need to utilize more natural gas. The Water Department is currently developing procedures and protocols to improve coordination and address the concerns of involved stakeholders.

5.9 Wastewater Collection and Pumping

The Collector Systems Unit operates and maintain the City's extensive urban sewer network. This includes the sanitary, storm and combined sewers, pump stations, metering chambers and associated infrastructure. Collector Systems also has responsibility for maintaining Water Department owned green stormwater infrastructure. Through these activities Collector Systems supports the maintenance requirements outlined in NPDES CSO, and MS4 Permits. The section is subdivided into four units:

- Sewer Maintenance
- Flow Control
- Collector System Support
- Green Stormwater Infrastructure Operations

5.9.1 Sewer Maintenance Unit

The Sewer Maintenance Unit maintains the City's network of sewers which includes all storm, sanitary, and combined sewers and the associated inlets, manholes and outfalls. The Waterways Restoration Team and Defective Connections Group also reside within this Unit. The authorized staff level for the unit in FY 2023 is 344. As of September 30, 2022, there were 72 vacancies, including critical vacancies for skilled and semi-skilled laborers, brick masons, sewer maintenance inspectors and equipment operators. Sewer Maintenance is compensating for the high level of vacancies through overtime assignments and contractor support. In addition, the Unit is currently restructuring its data support team to better

accomplish the massive task of ticket completion to address a severe backlog due to the inability to hire for the clerk positions.

- **Sewer Maintenance** responsibilities include repairs to the sewers, manholes, inlets, and other structures within the sewer system as well as cleaning and relieving choked sewers and outlet piping for choked storm inlets. The total length of collector piping reported for FY 2022 is 3,727 miles. This Unit conducts routine and request based visual pipe inspections, sewer excavations, repairs and cleaning, and maintenance of distribution and underdrain pipes associated with GSI. Table 5-4 provides a summary of the Sewer Maintenance work order history.

Table 5-4 Sewer Maintenance Performance Metrics

MAINTENANCE CATEGORY	FY 2019	FY 2020	FY 2021	FY 2022
Sewers Laterals Examined	5,107	3,879	3,566	3,419
Inlets Reset and Reconstructed	6,046	5,210	5,239	5,723
Sewer Excavations/Repairs	243	205	157	212

Source: Sewer Maintenance Unit

- **Inlet Cleaning** is primarily responsible for the routine and response driven inspection and cleaning of over 71,000 stormwater inlets, the maintenance of inlet covers (retrieving, replacing, and locking), and the clearing of choked inlet traps. This unit is also responsible for the inlets and associated inlet protection for all Water Department owned GSI. Inlet Cleaning has an authorized staff of 121 with 28 vacancies as of September 2022 representing a vacancy level of 23%, note that these counts are included the total staffing numbers for the Sewer Maintenance Unit presented above. Critical vacancies include semi-skilled laborers and heavy equipment operators. Table 5-5 contains a summary of inlet cleaning performance metrics.

Table 5-5 Inlet Cleaning Performance Metrics

MAINTENANCE CATEGORY	FY 2019	FY 2020	FY 2021	FY 2022
Inlets Cleaned*	111,979	93,453	106,627	102,129
Service Request Response Time (days)**	1.3	1.4	1.5	2.2

Source: *FY21&22 Combined Sewer and Stormwater Annual Reports, ** PWD MMR FY2019-21, FY22 QMR Final Draft

- **Waterways Restoration Team** is responsible for maintenance activities associated with natural and improved waterways. This includes general inspection, debris and bulk trash removal, culvert cleaning, plunge pool filling, bank stabilization, and outfall repair. The primary objectives of these maintenance activities are to remove debris that could block streamflow or cause water quality concerns.

Table 5-6 Waterways Restoration Performance Metrics

MAINTENANCE CATEGORY	FY 2019	FY 2020	FY 2021	FY 2022
Debris Removed (tons)	1,070	618	613	525

Source: FY22 Combined Sewer and Stormwater Annual Reports

- Defective Connections Group performs a variety of tasks with the goal of identifying, tracking, and eliminating directly connected sanitary discharges into the storm system in conformance with MS4 permit requirements. This group works with OOW and the Industrial Waste Unit to target areas for dye testing based on observation of dry weather discharges from storm sewer outfalls and stream water quality. Within the target areas, individual homes and buildings are tested for the presence of sanitary laterals connected to the storm sewers. The Water Department Plumbing Repair Programs Unit is responsible for abating defective laterals that are detected. It is estimated that since inception the program has eliminated 230 million gallons per year of sanitary sewer flow from being discharged to City creeks and streams.

Table 5-7 Defective Connections Performance Metrics

MAINTENANCE CATEGORY	FY 2019	FY 2020	FY 2021	FY 2022
Illicit Connections Found	120	73	33	30

Source: FY22 Combined Sewer and Stormwater Annual Reports

5.9.2 Flow Control Unit

The Flow Control Unit is responsible for the operation and maintenance of the combined sewer overflow system, the remote wastewater and stormwater pumping stations, the remote odor control facilities, the wastewater metering chambers, the tide gates and the rain gauge network. The unit also performs all CCTV sewer inspections and contracted seasonal operation of the Water Department's floatables removal boat. As of September 30, 2022, the Flow Control Unit had 97 authorized staff with 16 vacancies. Critical vacancies are Electronic Technicians positions which account for 12 of the vacancies.

- The CSO Unit performs operation and maintenance activities to support on-going compliance with the LTCPU and the CSO program. This unit uses the Real Time Control ("RTC") center at its Fox Street facility to monitor 176 CSO points in its collection system. The combined system also consists of 89 tide gates associated with CSOs, 26 storm relief structures (diversion chambers), 5 siphons, related wastewater control devices, and a city-wide remote monitoring system. Primary objectives of the Flow CSO Unit are to maximize the in-system storage during wet-weather events and to minimize the occurrence of dry-weather overflows through proactive maintenance, inspections, and analysis of real-time flow data.

  The CCTV Unit is comprised of the two groups, dedicated to sewer systems inspections and GSI inspections, respectively. In addition, the Unit utilizes contract resources to conduct inspections for specific projects. This allows the City crews to focus on planned proactive sewer inspections while the contractors conduct project-based inspections. The GSI inspections focus on subsurface components of GSI and are conducted on new construction projects and in-service sites as pre-maintenance

inspections to inform maintenance needs. All City CCTV technicians are National Association of Sewer Service Companies' ("NASSCO") Pipeline Assessment Certification Program certified. The CCTV group is highly impacted by vacancies in the Electronic Technician position, this has resulted in a greater reliance on contract services an under utilizations of Water Department owned CCTV trucks.

The Water Department's Sewer Assessment Committee reviews all new field information monthly to identify and prioritize repair and replacement projects. The Water Department currently focuses on identifying sewer segments with NASSCO level 5 structural defects for repair or replacement, however, future plans call for evaluating NASSCO level 4 (pipeline has severe defects and is likely to fail in 5 to 10 years) defects for potential preventative maintenance lining projects.

A recent inspection history is provided in Table 5-8.

Table 5-8 CCTV Inspections Record

CATEGORY	FY 2019	FY 2020	FY 2021	FY 2022
Sewer Inspections (miles)	42.2	34.2	24.9	38.2
GSI Inspections (# completed)	1,725	1,033	1,551	837

Source: FY22 Combined Sewer and Stormwater Annual Reports

- **Wastewater/Stormwater Pumping Unit** maintains the 16 sanitary pumping stations (15 Water Department-owned and 1 owned by others but operated by the Water Department) and 3 stormwater pumping stations (1 Water Department owned and 2 owned by others but operated by the Water Department). The wastewater pumping stations range in capacity from 0.2 MGD to 195 MGD, and the stormwater pumping stations range in capacity from 6 MGD to 832 MGD. All of the pumping stations are automated and remotely monitored. Each station has backup power in the form of dual electric feed, permanent onsite emergency generators, or access to portable generators. Staff routinely practice preventive and predictive maintenance. Pump availability metrics are presented in Table 5-9

Table 5-9 Pumping Unit Performance Metrics

METRIC	FY 2019	FY 2020	FY 2021	FY 2022
% Main Pump Availability	97.3	98.0	100.0	97.7

Source: PWD MMR FY2019-21, FY22 QMR Final Draft

Flow Control also operates and maintains two remote odor control facilities, wholesale customer meter, and a city-wide rain gauge network. Metering chamber operational metrics are presented in Table 5-10.

Table 5-10 Metering Chambers Metrics

METRIC	FY 2019	FY 2020	FY 2021	FY 2022
% Metering Chambers Operational	93.5	92.2	95.7	95.6

Source: PWD MMR FY2019-21, FY22 QMR Final Draft

5.9.3 Collector System Support

The primary function of the Collector System Support Unit is to provide technical expertise to the operating units through engineering evaluations and studies. The unit is comprised of two groups, Investigations and Operations, with a combined 13 authorized positions and two (2) vacancies, as of September 30, 2022.

- Investigations Group conducts root cause analyses of sewer failures, reviews inspection data to inform sewer repair and replacement planning and provides field information in support of updates to the sewer system GIS database.
- Operations Group supports maintenance and capital planning for the collection system, the instrumentation used to monitor the system and the pump stations. As part of this activity, the Collector System Support Unit manages the Unit's multi-sensor sewer inspection contract and is currently developing a root control contract.

5.9.4 Green Stormwater Operations

The Green Stormwater Operations Unit ("GSO") is responsible for the operations, maintenance, and management of Water Department-owned GSI practices in both the combined and separate sewersheds. GSI assets, referred to as stormwater maintenance practices ("SMPs"), are complex systems with surface vegetative components (i.e., hydrophilic vegetation, engineered soils) and traditional inlets and pipe networks integrated into systems that are capable or infiltrating or slow-releasing managed stormwater back into the combined sewer system. The operations and maintenance of these facilities are implemented via a combination of city forces and contract services.

This unit has grown substantially in recent years to meet the maintenance and management demands of the Water Department's growing GSI inventory and is anticipated to continue to grow as more SMPs are installed. As of September 30, 2022, GSO had 41 authorized positions with 21 vacancies and is comprised of Field Operations and Technical & Administrative Support groups. The high vacancy rate is reflective of new positions added for FY 2023.

- Field Operations consists of grounds and facilities maintenance staff responsible for SMP site maintenance and install, replacement or repair tasks as needed. Field operations staff also manage equipment and materials delivery, storage, and bulk materials inventory (i.e., aggregate, soils, mulch, deicer). Aside from traditional landscape and facility maintenance equipment, GSO Field operations staff are equipped with SUVs, pick-up trucks and specialized equipment that provide capacity to plow porous surfaces, deliver bulk material or plant material to sites and transport large amounts of debris to disposal facilities. Staff also participate in site observation and tracking roles and work with the PowerCorps_PHL GSI crews on joint projects. SMP subsurface inspections and maintenance activities are performed by Sewer Maintenance and Flow Control. Field Operations completed over 7,500 surface inspections in FY 2022 as detailed in Table 5-11.

Table 5-11 GSO Key Performance Metrics

METRIC	FY 2019	FY 2020	FY 2021	FY 2022
SMPs Maintained	1,003	1,195	1,187	1,498
Post-Construction GSI Pipe Inspections (miles)*	-	-	-	4.8
Post-Maintenance GSI Pipe Inspections (miles)*	-	-	-	10.6
Total GSI Pipe Inspections (miles)	17.4	17	17.5	15.4
Pre-Maintenance Inspections (Surface)	3,709	2,358	2,165	3,704
Dry Weather Inspections (Surface)	2,356	2,090	2,976	3,699
Wet Weather Inspections (Surface)	178	280	150	93
Vegetated Area Maintained (acres)	8.3	10.3	13.8	20

*Only Total GSI Pile Inspection mileage was reported prior to FY 2022
Source: Combined Sewer and Stormwater Annual Reports as provided by GSO

- **Technical & Administrative Support** staff serve in roles as procurement specialists, contract managers, trainers, and leads for coordination with GSI Implementation, OOW, Construction, Projects Controls, Finance, and other Operations Division units. They also have responsibilities for compliance reporting, design reviews, and setting goals and objectives for unit or sub-unit levels of operation. Administrative support staff consist of scientists, engineers and technicians that specialize in data collection, site inspection, asset management and aspects of direct contractor oversight. GSO also employs in-house consultant staff to support data tracking (labor statistics, database maintenance and optimization), reporting (weekly work order statistics, existing asset updates) and logistics management (i.e., work order automation) tasks.

5.9.5 Capital Projects

Noteworthy capital projects within Wastewater Collection and Pumping are list below. This list does not include any on-going or planned sewer reconstruction/lining projects or GSI projects.

Projects Under Construction or Substantially Completed:

- (75031, 32) Central Schuylkill PS Rehabilitation – substantially complete
- (75040) Rehabilitation of Rennard Street Sanitary Pump Station

Projects in Project Controls:

- (75028, 29) Linden Ave P.S. Betterment
- (75051) Ford Road Sanitary Pump Station Betterment
- (75045,63) Mingo Creek Pumping Station Betterment

Projects in Design:

As of November 2022, there were 12 projects in CIPIT identified as being in design. The projects address improvements at nine pump stations. The 42nd Street Pumping Station replacement was identified as a priority project to increase wet weather conveyance capacity, reduce CSOs and raise the controls to protect against flooding impacts.

5.10 Toxics Reductions and Control

The Industrial Waste & Backflow Compliance Unit ("IWBC") integrates two programs, Industrial Waste and Backflow Prevention, whose primary activities are field-based inspections of private facilities for compliance purposes. The two groups also share a common mission: to prevent contamination and reduce pollution though enforcement of Water Department regulations. As of September 30, 2022, there were 27 permanent positions assigned to IWBC with five (5) vacancies. Additionally, there are three approved intern positions. The vacancies are in graduate engineer and technician positions, which limits the Unit's ability to complete required inspections. In addition, the Unit needs more dedicated administrative support and has requested an additional administrative position for FY 2024. The two compliance programs have extensive data management, reporting and notification requirement, and there is a backlog of information to be processed. The Unit utilizes employees that are on limited duty assignments to support these efforts to the extent they are able.

5.10.1 Industrial Waste

The primary function of the Water Department's Industrial Waste group is to ensure compliance with federal industrial pretreatment standards. The NPDES permits require the Water Department to regulate industrial waste discharged to the wastewater collection system. The unit handles a wide variety of additional assignments discussed in this section.

- The Pretreatment Program is an USEPA mandated and approved program. The program is designed to protect the WPCPs from potentially high strength or toxic industrial discharges. A formal permitting system addresses federal requirements and the permissible discharges to the WPCPs. Permittees are subject to federal (categorical) and local limits, as applicable, which consider the facilities' potential for adversely impacting the performance, compliance, and sludge disposal options of the Water Department's treatment plants. In FY 2022 there were approximately 122 permitted categorical and significant industrial users. Permitted industries are required to self-monitor and report, thus provide the bulk of data used by the Industrial Waste group to ascertain compliance with effluent standards. The Industrial Waste group samples and inspects each permitted user at least once annually. For FY 2022, the industrial user compliance rate was 78%, which is lower than previous years. EPA uses compliance rate as a measure of the success of the pretreatment program, with the goal being 100% compliance.

  The EPA will require electronic reporting for the Pretreatment Program in calendar year 2025. The Water Department is preparing for this conversion and has included development of the appropriate data management and reporting tool in the FY 2024 budget.

- The Surcharge Program is how the Water Department recovers the cost of treatment high strength waters. Industrial Waste oversees the assessment of the surcharge for wastewater that exceeds 250 mg/l BOD or 350 mg/l TSS in strength. In FY 2022, the Industrial Waste group collected 924 samples for the billing of surcharge industrial customers. Table 5-12 presents the surcharge revenues for recent years.

Table 5-12 Surcharge Revenues Assessed

REVENUE ASSESSED	FY 2019	FY 2020	FY 2021	FY 2022
Surcharge	$5,347,434	$5,828,037	$6,490,466	$6,383,258

Source: PWD MMR FY2019-21, FY22 QMR Final Draft

- The septage hauling program allows for the discharge of septage to the Southwest WPCP. The Industrial Waste group administers a permit program for septage haulers and samples all loads prior to discharge. The Water Department prohibits industrial/chemical haulers from discharging into the sewer collection system.
- Sewer rental factors ("SRF") provide customers with a credit for metered water that is not discharged to the wastewater system. Industrial Waste receives, reviews, modifies, and approves applications for SRFs and then continues to review the accounts to determine whether the historical conditions that resulted in the permit still align with current operating conditions.
- Industrial Waste administers the Polychlorinated Biphenyls Pollutant Minimization Plan ("PCB PMP"), which was created to meet the requirements of the Delaware River PCB Total Maximum Daily Loads ("TMDL"). The PCB PMP identifies sources of PCBs that could potentially enter the Water Department's wastewater or stormwater systems. Activities under this plan include monitoring the sewer system to determine the source of PCB discharges and assessing City parcel sites that are potential PCB sources with the goal of minimizing or eliminating PCB discharges to the wastewater or stormwater systems. The Water Department inspected 96 sites in FY 2022, some of these have been identified as locations of concern or to address information gaps.
- Industrial Waste also samples the separate storm sewer outfalls as part of the Water Department's defective lateral detection and abatement program. There are approximately 434 stormwater outfalls. In FY 2022 Industrial Waste inspected 118 outfalls of those 66 were sampled for fecal coliform bacteria due to observed dry weather flows. The Industrial Waste group works with the Sewer Maintenance Unit to attempt to locate illicit sources if fecal coliform is detected and the presence of sewage is suspected.
- Industrial Waste responds to accidental spill incidents and addresses the unauthorized dumping of hazardous materials into the sewer system. In FY 2022, the Industrial Waste group responded to approximately 167 spill incidents where it assisted with preventing the spill from entering the sewer system or mitigating the impact of any spill on the Water Department's operations.

5.10.2 Backflow Compliance

The primary focus of the Backflow Compliance group is to maintain and enforce the Water Department's drinking water Cross Connection Control Program as required under state and federal laws. The Water Department's Regulation 403 prohibits backflow of contaminants into the public water supply through cross connections. The Backflow Compliance group enforces this regulation in collaboration with the Department of Licenses & Inspections ("L&I") and the Department of Public Health. Enforcement activities include inspection of permitted backflow prevention assemblies, tracking of required third-party annual inspection reports and maintenance of lists of approved backflow assemblies and certified private backflow inspection technicians. In FY 2022, L&I issued 1,165 new permits for the installation of backflow prevention assemblies. Backflow Compliance received over 6,728 third party inspection reports and conducted 2,766 inspections of high-risk facilities.

Public education is integral to the success of the Cross-Connection Control Program. The Backflow Compliance group has developed web-based educational materials that provide general information on cross connections and backflow prevention and compliance as well as detailed lists of approved prevention assemblies and approved backflow prevention technicians.

5.11 Findings and Observations

The findings and observations discussed in this chapter provide the basis for our overall conclusion on the condition of the Wastewater System. We have reviewed the general state of the major facilities of the Wastewater System including their condition, operation, and performance. We have also reviewed the general operations and performance of the linear assets. We present our findings using the following three ratings:

- *Good*: The facility is in condition to provide reliable operation in accordance with design parameters and requires only routine maintenance or minor improvements.
- *Adequate*: The facility is operating at or near design levels, however, non-routine renovation, upgrading, and repairs are needed to ensure continued reliable operation.
- *Poor*: The facility is not being operated within design parameters. Major renovations are required to restore the facility and assure reliable operation. Major expenditures for these improvements may be required.

Based on onsite tours of the major facilities and the interviews with Water Department management conducted in September through November of 2022, and a review of annual reporting and key performance measures associated with FY 2022, it is our opinion that:

- The Wastewater System is generally in good operating condition, or the Water Department is taking adequate steps to return it to good operating condition; and
- The approved capital improvement budget for FY 2023 and the proposed capital program for FY 2024 through FY 2028 should provide adequate funds to sustain the system in good operating condition, meet compliance obligations and address emergency situations.

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6.0 Capital Improvement Program

6.1 Overview

The City of Philadelphia utilizes a formal capital programming and budgeting process in which the Water Department participates, along with all other elements of City government. The resulting Capital Program covers a six-year period with detailed budget for the first year. The Water Department reviews both program and budget commitments each year and modifies the Capital Program as necessary.

The Water Department projects included in the six-year Study Period based on the adopted 2023 capital budget and the proposed budget for FY 2024 through FY 2028 involve planned expenditures of $4.535 billion in 2024 dollars. The program covers the Water Department's costs for design and construction of improvements related to the water, wastewater, and stormwater systems. The program also covers the costs of administrative, engineering and construction personnel who work on these projects. As of the date of this report, the Water Department has developed a preliminary budget for the next 6-year CIP planning period for FY 2024 to FY 2029. The updated CIP planned expenditures will increase by approximately $1.0 billion as compared to the prior planning period, bringing the total CIP to $3.3 billion. The draft proposed program will be submitted to the City Planning Commission in January 2023.

6.2 Fiscal Years 2023 – 2028 Capital Improvement Program

The Water Department began preparation of its capital budget for FY 2023 through FY 2028 in October 2021, when all divisions were supplied with documentation to complete and return to the Projects Control Unit reflecting their budgetary requests for the next fiscal year. The Water Department has developed and installed a computerized budgeting system to enable each division to prepare budget requests based on historical and current experience. The Water Commissioner reviewed all budget proposals with the assistance of the Projects Control staff and submitted the Water Department’s proposed FY 2023 budget to the City’s Planning Commission in December 2021. The Mayor approved the Water Department’s Capital Budget and included it as part of his proposed budget to the City Council in March 2022.

The Water Department began preparation of its capital budget for FY 2024 through FY 2029 in October 2022, when all divisions were supplied with documentation to complete and return to the Projects Control Unit reflecting their budgetary requests for the next fiscal year. The Water Commissioner reviewed all budget proposals with the assistance of the Projects Control staff and submitted the Water Department’s proposed FY 2024 budget to the City’s Planning Commission in November 2022.

The total adopted FY 2023 and proposed FY 2024 to FY 2028 capital budget of $4.535 billion reflects a 14% increase over the FY 2023 to FY 2028 capital budget approved by City Council in June 2022. The increase in budgeted capital improvements is manageable within the current staffing and organizational structure utilized by the Water Department. Table VI-1 summarizes key capital programming areas. Presented In the sections that follow is a brief discussion of each.

Table 6-1 Capital Improvement Program FY 2023 to FY 2028 (in thousands of dollars)

Line No.	Description	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
Combined System ($000s)							
1	Water & Wastewater Plants and Facilities	255,000	393,000	295,000	262,000	315,000	450,000
2	Sewer and CSO System Improvements	72,860	80,000	86,000	91,000	96,000	102,000
3	Water Conveyance System Improvements	123,060	157,100	240,100	135,100	128,100	120,100
4	Flood Relief	15,000	15,000	15,000	15,000	15,000	15,000
5	Stream Restoration	10,000	10,000	10,000	10,000	10,000	10,000
6	Green Stormwater Infrastructure	73,000	80,000	80,000	160,000	160,000	160,000
7	Vehicles and Equipment	12,000	12,000	12,000	12,000	12,000	12,000
8	Meters	5,000	5,000	5,000	5,000	5,000	5,000
9	Engineering and Administration	14,321	12,806	12,806	12,806	12,806	12,806
10	New Billing System	-	-	-	30,000	30,000	30,000
11	**Total Improvements**	**580,241**	**764,906**	**755,906**	**732,906**	**783,906**	**916,906**

6.2.1 Water & Wastewater Plants and Facilities

Included in this category are upcoming improvements to water and wastewater treatment facilities, pumping stations, and storage facilities. This category also includes the water treatment plant and pumping station upgrades and expansions identified in the WRP and wet weather capacity expansions to the wastewater treatment facilities in accordance with the LTCPU and associated COA. The Water Department's planning documents identify all the various improvement projects and rehabilitation/replacement projects. Several of the included projects are identified in other sections of this Report.

6.2.2 Sewer and CSO System Improvements

This category includes replacement of old and deteriorating sanitary, stormwater and combined sewers, as well as the construction of new sanitary sewers to serve new or previously un-sewered developments. The budget includes expansion of the sewer replacement program from the current rate of 12 miles per year to 20 miles per year. A portion of this budget is dedicated to the lining of interceptor sewers in accordance with the LTCPU and COA requirements.

6.2.3 Water Conveyance System Improvements

This category encompasses the replacement of existing water mains throughout the City. This on-going effort replaces aged mains to reduce the likelihood of water main breaks and has the added benefit of reducing leakage. The funding level is based on the current replacement goal of 40 miles of water main in FY 2023 and 42 miles per year starting in FY 2024. This representants an increase from the current rate of 18 to 20 miles per year. The design and initial construction phases of the Schuylkill River Crossing project anticipated to be complete in FY 2029, a key WRP project, are also included in this category. Finally, the on-going installation of AMI citywide is included in this category. This project is behind schedule do to supply chain issues and is anticipated to be complete in FY 2025.

6.2.4 Flood Relief

Projects included in this category involve the construction of new storm flood relief sewers or storage tanks in flood-prone areas. Planned projects will address flooding in the Germantown, Northern Liberties, Ludlow, and South Kensington neighborhoods. The Water Department has applied for a FEMA BRIC grant to fund Phase 6 of the Cohocksink Storm Flood Relief Project in South Kensington. This marks the last phase of a decade long project that will mitigate flooding by doubling the combined sewer system conveyance capacity through a combination of new sewer infrastructure and GSI.

6.2.5 Stream Restoration

Stream restoration projects improve natural stream channels throughout the City, protecting the collection system infrastructure that runs adjacent to the streams, controlling excessive erosion and enhancing water quality and aquatic habitat.

6.2.6 Green Stormwater Infrastructure

This category includes all of the Water Department constructed and owned GSI projects to be implemented in accordance with the LTCPU and COA. The budget includes both the construction of the GSI to meet the Year 15 (FY 2026) COA target for greened acres and the design of additional GSI to meet the Year 20 target (FY 2031). As discussed in Section 5 and reflected in the budget, the required rate of GSI implementation will increase in the later years of the LTCPU implementation.

6.2.7 Vehicles and Equipment

This budget category includes expenditures for the replacement or purchase of new vehicles and heavy equipment. This includes all vehicles and heavy equipment utilized by Water Department staff in the daily execution of their duties, including but not limited to: crew trucks, dump trucks, excavators, CCTV trucks and vactor trucks.

6.2.8 Meters

This budget category includes an allowance for the routine replacement of large water and sewer meters. This includes wholesale water and sewer master meters as well as large commercial and industrial water meters.

6.2.9 Engineering and Administration

This budget category provides for the funding of personnel within the Water Department who are involved with the implementation of the CIP. This includes the majority of the staff within the Engineering and Construction Division. Per City policy, salaries for staff supporting the CIP are being transitioned from the Capital budget to the Operating budget.

6.2.10 New Billing System

This category is a preliminary placeholder estimate for the anticipated replacement of the Basis2 billing system. Replacement of Basis2 will not occur prior to the completion of the City's Project OPAL. As previously discussed in Section 2.1.4, Project OPAL involves the City-wide replacement of the City's accounting, procurement, and financial systems.

6.3 Summary and Findings

As noted earlier, the current proposed capital program for FY 2023 to FY 2028 represents an approximately 14% increase from the previous approved program. This increase is related to increased activity and updated pricing for projects in the following areas:

- Approximately $1 billion in water treatment, pumping and storage related improvements, associated with the WRP,
- Approximately $720 million for water conveyance system improvements, reflecting an increase in targeted replacement and repairs to 42 miles per year,
- Approximately $1 billion in COA related costs including expanded green stormwater infrastructure assets as well as wet weather conveyance and treatment capacity expansions, and
- Approximately $652 million in additional sewer reconstruction and replacement costs, flood control and stream restoration. These costs reflect an increase in the target annual replacement goal from the current rate of 12 miles per year by an additional mile each year and accounts for new pricing for these types of projects.

The Water Department's FY 2023 to FY 2028 CIP represents a move from primarily rehabilitation related efforts to substantial system replacement and upgrades to major facilities to create resiliency and redundancy as well as the continued expansion of green infrastructure facilities to meet the City's water, sewer and stormwater needs from both a regulatory and service perspective.

7.0 Findings and Observations

The City of Philadelphia requires the submittal of an independent review of the Water Department's water and wastewater systems to support approval of the Water Department's capital budget appropriations and obtain funding authorization. Black & Veatch has prepared this Consulting Engineer's Report, which summarizes the findings of engineering and financial studies related to the Water and Wastewater Systems of the City, to meet the City's requirements in this area, as outlined in the Restated General Water and Wastewater Revenue Bond Ordinance of 1989, and the amendments and supplements thereto as set forth in the First, Second, Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, Tenth, Eleventh, Twelfth, Thirteenth, Fourteenth, Fifteenth, Sixteenth, Seventeenth, Eighteenth, Nineteenth, Twentieth, Twenty-First, Twenty-Second, Twenty-Third, Twenty-Fourth, Twenty-Fifth, and Twenty-Sixth Supplemental Ordinances.

The analyses and projections developed herein utilize certain assumptions with respect to conditions that may occur in the future. While these assumptions are believed to be reasonable for the purpose of this Report, they are dependent on future events and, therefore, actual events may differ from those assumed. Additionally, the development of assumptions and applicable projections relies on certain information provided by others. While these sources and the application of information are believed to be reliable, the information has not been independently verified and there are no assurances offered with respect thereto. To the extent that future conditions differ from those assumed herein or provided by others, the actual results will vary from those developed and presented as the projected operating results.

Black & Veatch prepared this Report solely for the benefit of and use by the City for the discrete purposes set forth herein. The City did not request Black & Veatch to provide, and Black & Veatch does not offer to provide, nor did or will it provide, any services constituting the services of a "municipal advisor" as defined by the Securities Exchange Act of 1934, as amended by the Dodd–Frank Wall Street Reform and Consumer Protection Act (Pub.L. 111-203, H.R. 4173) and regulations promulgated thereunder, or any successor statute or provisions thereto. Accordingly, Black & Veatch is not a municipal advisor registered with the U.S. Securities and Exchange Commission.

This Report is qualified in its entirety by, and should be considered in light of, these limitations, conditions, and considerations.

Based on this Consulting Engineer's Report and subject to the limitations therein, we offer the following findings and observations:

1. Based on onsite physical inspections and investigations of major system facilities, conducted in September and October 2022, combined with discussions with key Water Department staff at that time and subsequently through November 2022, it is our opinion that the Water and Wastewater Systems are in generally good operating condition, or the Water Department is taking adequate steps to return them to good operating condition. The capital improvement budget for FY 2023 and the

proposed capital program for FY 2024 through 2028 should provide adequate funds to sustain the systems in good operating condition and meet compliance obligations.

2. The assumed debt service terms and interest rates for estimated future revenue bonds were provided by the Water Department's financial advisors, PFM Financial Advisors, LLC, and Acacia Financial Advisors.

3. Proceeds from the issuance of bonds proposed during the Study Period are anticipated to: (i) finance portions of the Water Department's capital improvement program for FY 2023 through 2028; (ii) make deposits to the Debt Reserve Account and (iii) pay the issuance costs of the proposed bonds.

4. Project Revenues pledged to secure the proposed bonds are to be derived from the following sources: all rents, rates, fees, and charges imposed or charged for the connection to, or use or product of or services generated by the Water and Wastewater Systems to the ultimate users or customers thereof, all payments under bulk contracts with municipalities, governmental instrumentalities or other bulk users, all subsidies or payments payable by Federal, State or local governments or governmental agencies on account of the cost of operation of, or the payment of the principal of or interest on moneys borrowed to finance costs chargeable to the Water and Wastewater Systems, all grants, payments, and contributions made in aid or on account of the Water and Wastewater Systems exclusive of grants and similar payments and contributions solely in aid of construction and all accounts, contract rights, and general intangibles representing the foregoing.

5. Based on actual and estimated future annual financial operations of the Water and Wastewater Systems, it is our opinion that the Water and Wastewater Systems will yield pledged Project Revenues (including projected revenue increases indicated in this Report) over the amortization period of the potential bonds sufficient to meet the payment or deposit requirements of:

    a. All expenses of operation, maintenance, repair and replacement of the Water and Wastewater Systems,

    b. All reserve funds required to be established out of such Project Revenues,

    c. The principal or redemption price of and interest on all Existing Bonds and all Bonds issued under the General Ordinance, as the same become due and payable, for which such Project Revenues are pledged, and

    d. The Rate Covenant set forth in Section 5.01 of the General Ordinance.

    The Project Revenues forming the basis for this projection comply with the requirements of the definition of "Project Revenues" contained in Section 2 of the Act.

6. The Net Revenues are currently sufficient to comply with the Rate Covenant and projected to be sufficient (including projected revenue increases indicated in this Report) to comply with the Rate Covenant for each of two fiscal years following the fiscal year in which the proposed bonds are issued.

7. It is our opinion the rates and charges for use by the Water and Wastewater Systems should be sufficient to yield Net Revenues (excluding amounts transferred from the Rate Stabilization Fund into the Revenue Fund during, or as of the end of, such fiscal year) at least 90 percent of the Debt Service Requirements (excluding debt service due on Subordinated Bonds) in such fiscal year. The levels of additional service revenue projected for the Study Period are anticipated to provide for the debt service coverage and requirements of the Insurance Covenants.

8. In our opinion, water and wastewater rents, rates, and charges, including projected increases are within generally acceptable ranges for such services.