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Capital Region Water

CONSULTING ENGINEER'S ANNUAL REPORT

Water System

September 30, 2019

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ACRONYMS AND ABBREVIATIONS

AWWA	American Water Works Association
CCL4	Fourth Drinking Water Contaminant Candidate List
CEAR	Consulting Engineer's Annual Report
CIP	Capital Improvement Plan
CRW	Capital Region Water
Cr-6	Hexavalent Chromium
cVOC	Volatile Organic Compounds
DBP2	Stage 2 Disinfectants and Disinfection By-Products Rule
EPA	U.S. Environmental Protection Agency
FY	Fiscal Year
HAA	Haloacetic Acid
LT2	Long-Term 2 Enhanced Surface Water Treatment Rule
MCL	Maximum Contaminant Level
MGD	Million Gallons per Day
mg/L	Milligrams per Liter
NRW	Non-Revenue Water
O&M	Operations and Maintenance
PADEP	Pennsylvania Department of Environmental Protection
PFBS	Perfluorobutanesulfonic Acid
PFHpA	Perfluoroheptanoic Acid
PFHxS	Perfluorohexanesulfonic Acid
PFNA	Perfluorononanoic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctanesulfonic Acid
TBD	To be determined
TOC	Total Organic Compound
THM	Trihalomethane
UCMR4	Fourth Unregulated Contaminant Monitoring Rule
µg/L	Micrograms per Liter

1 INTRODUCTION

Arcadis U.S., Inc. (Arcadis) prepared this Water System Consulting Engineer's Annual Report (CEAR) for Capital Region Water (CRW) as required by the Trust Indenture between CRW and the Bank of New York Mellon Trust Company, N.A. originally dated January 1, 1991 and Amended and Restated as of April 1, 2014 and May 1, 2018. This CEAR is being submitted to comply with the following requirements, as outlined in the Indenture:

Section 7.12:

> *"It shall be the duty of the Consulting Engineers, in addition to the other duties described elsewhere in this Indenture, to prepare and file with the Authority and with the Trustee on or before 90 days prior to the beginning of each Fiscal Year thereafter, a report setting forth the following:*
>
> *a. Their advice and recommendations as to the proper maintenance and repair of the operating and water delivery infrastructure of the Water System during the next Fiscal Year;*
>
> *b. Their advice and recommendations as to the Capital Additions that should be made during the next Fiscal Year and their estimate of the amounts of money that should be expended for Operating Expenses and their estimate of the amounts of money necessary for such purposes; and*
>
> *c. Their finding whether the operating and water delivery infrastructure of the Water System have been maintained in good repair and sound operating condition and their estimate of the amount, if any, required to place such operating and water delivery infrastructure in such condition and the details of such expenditures and the approximate time required therefor."*

CRW's fiscal year runs from January 1 through December 31 of each year. The Water System includes the Dr. Robert E. Young Water Services Center Water Treatment Facility, Susquehanna River Raw Water Intake, the DeHart Dam Reservoir, finished water reservoirs (Upper Reservoir, Lower Reservoirs 1 & 2), pump stations, pumping equipment, transmission and distribution mains, and related equipment servicing the City of Harrisburg (City) and portions of the Borough of Penbrook, Susquehanna Township, and Lower Paxton Township, all located in Dauphin County, Pennsylvania.

1.1 Report Methodology and Limitations

In preparing this CEAR, existing records and documents prepared by or on behalf of CRW were reviewed to understand, assess, and report on the technical information contained therein as it relates to the FY 2019 CEAR. The major relevant documents provided by CRW and reviewed as part of the CEAR include, but are not necessarily limited to, the following:

- 2019 Organizational Chart
- 2018 Water Allocation Permit Compliance Report
- 2018 Subfacility Report for Clarks Creek DeHart Dam
- 2018 Drinking Water Consulting Engineer's Annual Report

- 2018 Water Loss Audit for Finished Water
- 2019 Drinking Water Quality Report
- 2019 Drinking Water Division Monthly Report
- 2018 DeHart Dam Annual Safety Inspection Report
- 2017 DeHart Dam Assessment Report
- 2018 Primary Facility Report
- Monthly Water System Reports (December 2018 and May 2019)
- Historic Actual Water System Expenses (FY 2017 and FY 2018)
- Budgeted FY 2019 Water System Expenses
- Correspondence with the U.S. Environmental Protection Agency (EPA) and the Pennsylvania Department of Environmental Protection (PADEP)

In addition, limited visual site inspections of the following components of the Water System were conducted on August 21, 2019:

- DeHart Dam, Reservoir Control Building, and Chemical Feed Facility
- Susquehanna River Raw Water Pump Station
- Dr. Robert E. Young Water Services Center Treatment Facility
- Gate House Pump Station
- Union Square Industrial Park Booster Station
- Lower Finished Water Reservoirs 1 & 2

The review also included discussions with representatives of CRW and performance comparisons to other comparable water systems and related industries.

This CEAR summarizes the findings of the visual inspections at the time they were conducted, and the findings of the data reviewed and discussions with CRW up to the date of the issuance of the CEAR. Changed conditions occurring or becoming known after such date could affect the material presented and the conclusions reached herein to the extent of such changes.

Arcadis has not independently verified the accuracy of the information provided by CRW and others. However, we believe such sources are reliable and the information obtained to be appropriate for the analysis undertaken and the conclusions reached herein. In addition, the scope of our review did not include any pending or threatened litigation against CRW. CRW has stated that there is pending litigation related to its water operations (one claim of unspecified damages alleging CRW's failure to properly maintain water and sewer lines causing personal injury).

In completing this CEAR for CRW, Arcadis is not serving in the role of a "municipal advisor" under the regulations of the Securities and Exchange Commission. As such, Arcadis is not recommending any action regarding municipal financial products or the issuance of municipal securities, and is not acting as a registered municipal advisor to CRW and does not owe a fiduciary duty to CRW pursuant to Section

15B of the Securities Exchange Act of 1934, as amended by the Dodd-Frank Wall Street Reform and Consumer Protection Act, with respect to the information and material prepared in connection with this CEAR. CRW should discuss any information and material prepared in connection with this CEAR with any and all internal and external financial and other advisors that they may deem appropriate before acting on this information and material.

2 WATER SYSTEM MANAGEMENT

2.1 Overview of the Water System

The primary source of drinking water for the Water System is the William T. DeHart Dam and Reservoir located 20 miles northeast of the City in the Clarks Valley Watershed. The Dam and Reservoir collect water from a 22-square-mile watershed. The Susquehanna River provides CRW with a backup water supply and currently is only used in case of severe drought, emergency, or routine short-term operational exercise. The Susquehanna River had been used as a primary water source up until construction of the DeHart Dam in 1940.

Components of the Water System were first established in 1839 when the Commonwealth of Pennsylvania granted the City permission to withdraw water from the Susquehanna River to serve City residents in the central part of the City. Over the years, numerous upgrades and expansions were undertaken to meet new regulations and to expand services City-wide and to other municipalities located in Dauphin County.

As was noted in the 2019 Drinking Water Quality Report and 2018 Water Allocation Permit Compliance Report, the Water System includes almost 230 miles of water mains ranging in size from 6-inches to 42-inches in diameter, approximately 1,800 fire hydrants, approximately 5,370 main valves, and approximately 20,330 service valves. The sources of supply, pumping and treatment facilities are summarized in Table 2-1.

Table 2-1: Summary of Major Water System Facilities

Facility	Item	Capacity
DeHart Dam and Reservoir	Full Storage Capacity Reservoir Yield Allocation	6.0 billion gallons 10.5 MGD 13.5 MGD
Susquehanna River Intake	Source Allocation Pumping Capacity	15 MGD (Secondary) 30 MGD
Dr. Robert E. Young Water Services Center Treatment Facility	Design Flow	20 MGD
Upper Reservoir	Storage Capacity	28 MG
Lower Reservoir #1	Storage Capacity	6.0 MG
Lower Reservoir #2	Storage Capacity	6.0 MG
Susquehanna River Pump Station	Pumping Capacity	14,000 GPM (with one pump out of service)
Gate House Pump Station	Pumping Capacity	8,700 GPM (with one pump out of service)
Union Square Industrial Park Booster Station	Pumping Capacity at: -Triplex Constant Pressure -Fire Pump	 750 GPM 1,000 GPM

2.2 Management and Staffing

The Water System was originally managed, owned, and operated by the City of Harrisburg (City). In 1990, the Harrisburg Authority, which has since been renamed Capital Region Water, purchased the Water System from the City and at the same time entered into a 1990 Management Agreement with the City for continued management and operation of the Water System.

In 2011, a fiscal emergency was declared for the City due to severe financial distress and a state receiver was appointed. Financial distress resulted in a shortage of experienced and qualified personnel needed to operate, manage, and administer the Water System, and a loss in access to capital markets. As a result, the Commonwealth's Office of Receiver, the City, and the Harrisburg Authority agreed to terminate the 1990 Management Agreement. With this termination, codified by the Transition Agreement dated November 4, 2013, the Harrisburg Authority (later renamed Capital Region Water) accepted operational and management control of the Water System.

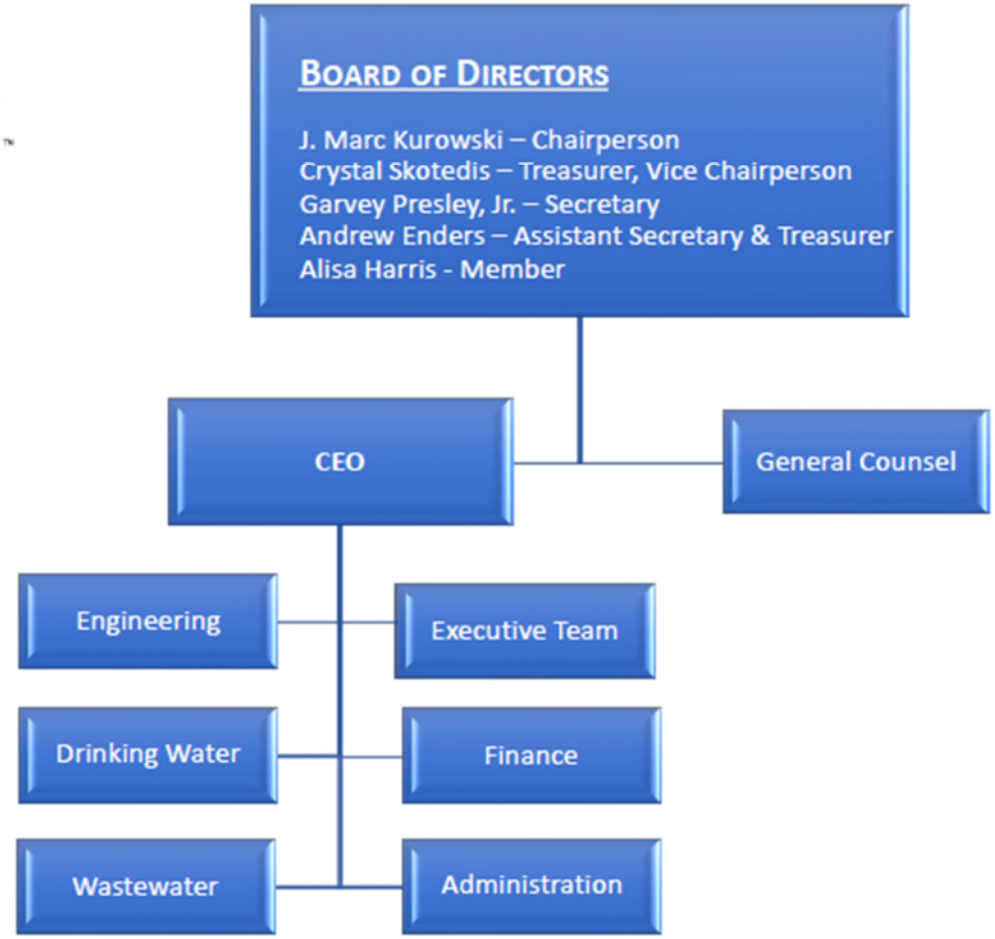
CRW is governed by a five-member Board of Directors. A management team headed by the Chief Executive Officer is responsible for technical and administrative operations of CRW, as well as the implementation of programs, policies, and procedures, and the execution of contracts upon approval by the Board. In addition to providing drinking water services, CRW also provides wastewater services. CRW operates as one entity; however, CRW separately tracks and records the provision of services associated with each of the utilities that it manages and operates.

CRW's organizational chart is made up of five departments as well as an Executive Team. The five departments are as follows: Drinking Water Operations, Wastewater Operations, Administration, Engineering, and Finance. An overview of the current organization structure of CRW is shown in Figure 2-1.

Figure 2-1: CRW Management Level Organizational Chart

CAPITAL REGION WATER

Organizational Structure



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2.2.1 Administration, Engineering, Finance, and Operations Departments

The Drinking Water Operations and Wastewater Operations Departments are responsible for operation and maintenance (O&M) of facilities, permit compliance, tracking and reporting, energy management, monitoring, long-term planning, repair and construction, and assistance in budget preparation and tracking. The Drinking Water Operations Department includes plans for 38 positions, with 36 positions filled as of September 2019. The Drinking Water Operations organizational chart is provided in Figure 2-2.

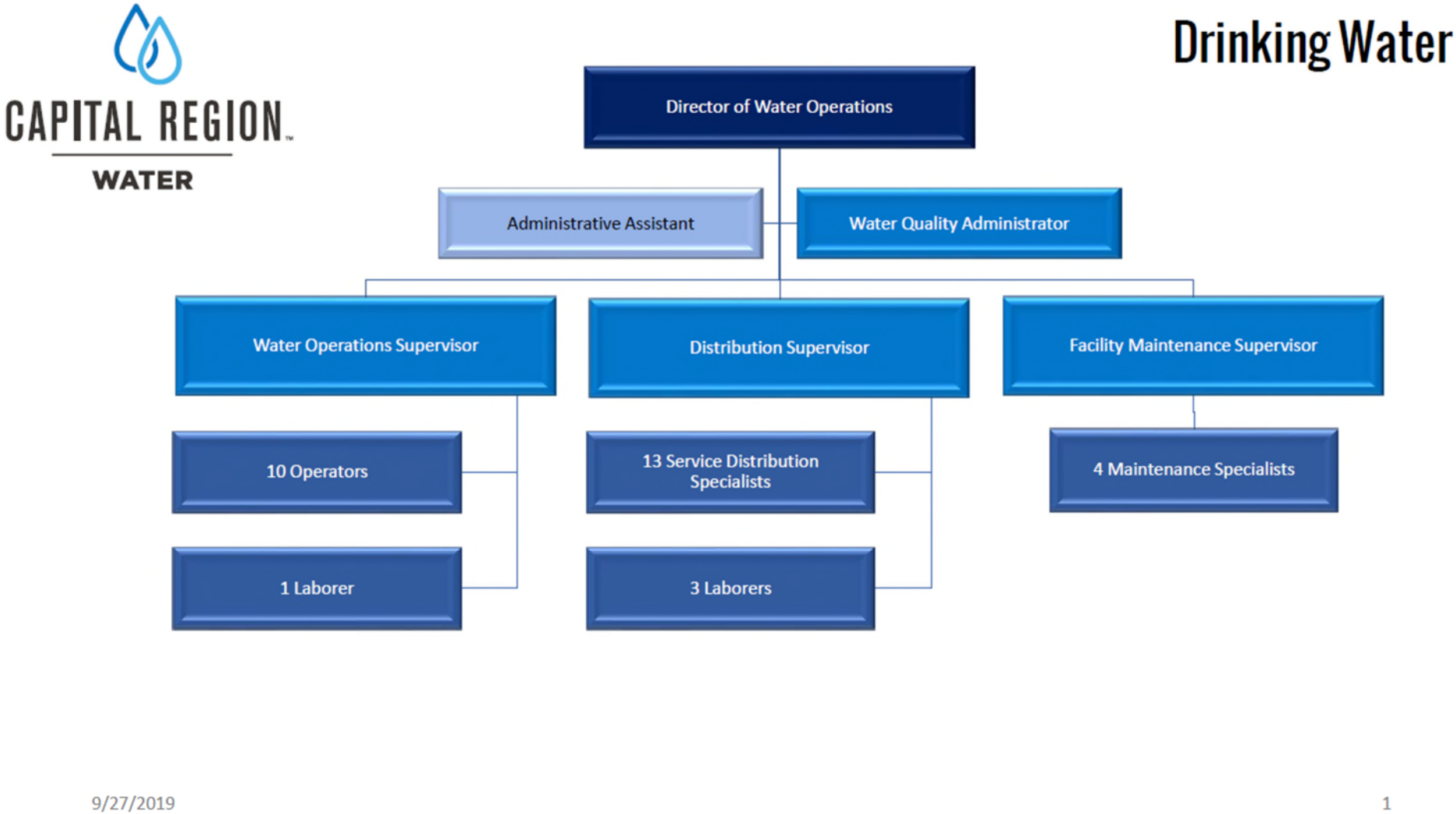
The Administrative Department provides office management, information technology, human resources, insurance, risk management and safety programs, and administrative support services. The Engineering Department provides engineering support, project coordination, GIS coordination, wet weather coordination, and asset management services. The services currently provided by the Finance Department include accounting, billing and collections, customer service, and payroll. An Executive Team provides sustainability and strategic planning as well as community outreach and communications.

It is understood that CRW plans to staff the Administrative Department, Engineering Department, Finance Department, an Executive Team with a total of 48 positions (12 for Administration, 9 for Engineering, 22 for Finance, and 5 for Executive), and as of September 2019, 43 of the 48 positions have been filled. Personnel expenses associated with these departments are allocated to each of the utilities based on budgeted time allocated to each of the services.

In summary, CRW's FY 2019 Drinking Water System budget includes estimated costs associated with the current and planned employees dedicated to the Drinking Water System and the Water System's share of costs associated with the planned positions under the Administrative, Engineering, and Finance Departments as well as the Executive Team, which all provide support to CRW's water and wastewater utilities. These employees are all employees of CRW, with the majority belonging to a collective bargaining unit.

The organizational structure of CRW provides strong opportunities for economies of scale through the sharing of administrative, engineering, finance, and executive services between the water and wastewater utilities. The structure is generally consistent with similar-sized, combined utilities and it appears that all required Drinking Water System functions of CRW are adequately staffed.

Figure 2-2: Drinking Water Operations Division Organizational Chart

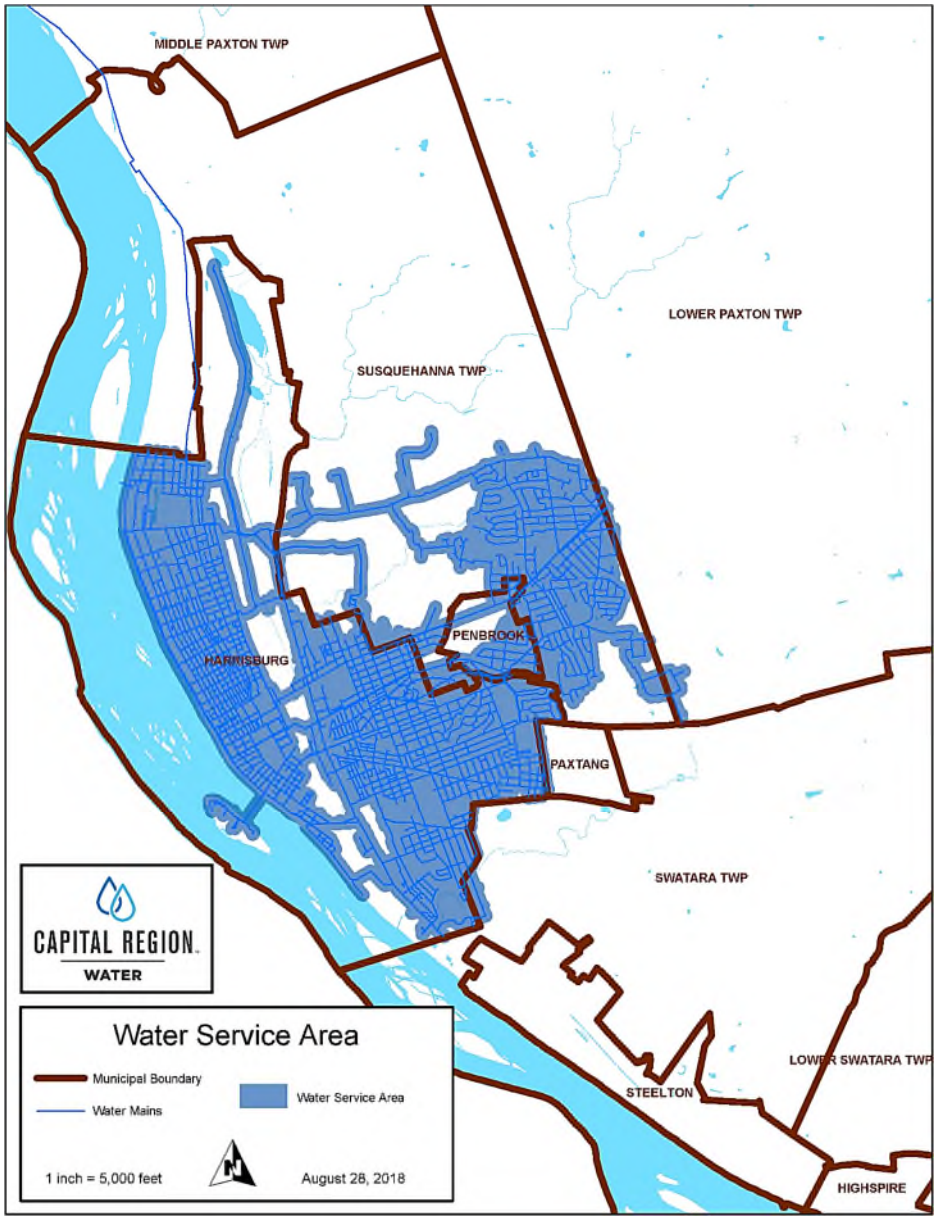


3 WATER SYSTEM PERFORMANCE

3.1 Service Area

The service area of the Water System includes the City and portions of Penbrook Borough, Lower Paxton Township, Swatara Township and Susquehanna Township. Except for some distribution system piping and related equipment, the majority of CRW's water assets are located within the municipal boundaries of the City. Figure 3-1 below shows the water system infrastructure map.

Figure 3-1: Water System Infrastructure Map



3.2 Customer Base

CRW maintains approximately 20,200 active meter connections within its service area, with the majority located within the City. The remainder are primarily located in Susquehanna Township and Penbrook Borough. CRW maintains only one domestic connection in Lower Paxton Township. The total estimated population served by the Water System is approximately 61,300.

A summary of the total number of connections and the total metered water consumption based on CRW records for fiscal year 2018 is shown in Table 3-1.

Table 3-1: FY 2018 Customer Accounts and Metered Water Use

Description	Accounts	Consumption (1,000 gal.)
City of Harrisburg:		
Residential	14,868	777,880
Commercial	1,732	500,474
Industrial	22	238,445
Public / Institutional	72	102,219
Total	16,694	1,619,018
Suburban Communities:		
Residential	3,405	179,079
Commercial	116	62,430
Industrial	1	34,050
Public / Institutional	3	57
Total	3,525	275,616
Total	**20,219**	**1,894,634**

Source: FY 2018 Customer and Billing Data provided by CRW

3.3 Water Supply and Demand

Pursuant to its Water Allocation Permit (Permit # WA-22-53B) issued by PADEP, CRW maintains a 13.5 million gallon per day (MGD) water supply allocation from the DeHart Dam and Reservoir and a 15.0 MGD secondary allocation from the Susquehanna River. However, the DeHart Dam has an estimated safe yield of 10.5 MGD. The design flow capacity of CRW's water treatment facility is 20.0 MGD. No changes to the water allocation permit or CRW's water treatment capacity are currently anticipated.

Average metered daily consumption was approximately 5.19 MGD in FY 2018, and peak day water production was 12.5 MGD in FY 2018. CRW has noted that peak day demands are often a result of refilling tanks following a day of being offline for scheduled repairs or capital projects. In addition, non-revenue water (NRW) has reduced from 27 percent in FY 2017 to 22 percent in FY 2018 but remains high at an average daily rate of approximately 1.49 MGD of the average daily finished water production. It should be noted that the Pennsylvania Public Utility Commission considers losses greater than 20.0 percent of total water production to be excessive. Regardless, it appears that CRW currently has sufficient access to raw water supplies and has the storage and treatment capacity to meet demand. A summary of the current water supply and demand statistics are shown in Table 3-2.

Table 3-2: Water Supply and Demand

Description	Million Gallons Per Day	
Water Supply	**FY 2017**	**FY 2018**
Water Supply Yield		
-Primary	10.50	10.50
-Secondary	15.00	15.00
Water Treatment Capacity	20.00	20.00
Water Demand		
Average Metered Daily Consumption	5.23	5.19
Peak Day Water Production	12.70	12.50
Non-Revenue Water	1.91	1.49
Total Average Daily Water Production	7.16	6.72
Performance Ratios		
Non-Revenue Water as a % of Water Production	27%	22%
Average Daily Production as % of Treatment Capacity	36%	34%
Peak Day Production as % of Treatment Capacity	64%	63%

Sources: FY 2018 Customer and Billing Data, 2018 Water Loss Audit Report and 2018 CRW Annual Water Supply Report

3.4 Water Quality

Water quality is regulated by the Federal Safe Drinking Water Act and enforced through laws and regulations administered by the PADEP. CRW publishes an Annual Drinking Water Quality/Consumer Confidence Report as required by the United States Environmental Protection Agency (EPA). The Drinking Water Quality Report provides general information on the Water System and the results of water quality tests on drinking water for that calendar year as compared to permitted maximum contaminant levels (MCLs). CRW's 2019 Drinking Water Quality Report (which reports the results for calendar year 2018) concluded that CRW's treated water quality is good and continues to consistently exceed national quality standards.

In addition, water samples are taken and tested by a certified laboratory for the DeHart Dam influent, the finished water, and the distribution system for the following parameters: pH, total alkalinity, temperature, iron, total dissolved solids, and total hardness. The DeHart Dam and finished water are also routinely monitored for turbidity and total organic carbon. Finished water is also tested for fluoride, aluminum, chlorine residual levels, and orthophosphate levels. Orthophosphate levels are also monitored in the distribution system. A summary of the key test results for 2018, as published in CRW's annual Drinking Water Quality Report or reported by CRW's certified laboratory, and their comparison to established MCLs is provided in Table 3-3.

Table 3-3: Drinking Water Quality

Contaminant	Units	MCL	Levels Detected (2017)	Levels Detected (2018)
Barium	ppm	2	0.036	0.012
Chlorine (Distribution Disinfectant Residual)	ppm	4	0.89 – 1.20	0.92 – 1.31
Fluoride	ppm	2	0.82	0.65
Nitrate	ppm	10	Not detected	Not detected
Total Trihalomethanes	ppb	80	33.96	41.6
Haloacetic Acids	ppb	60	25.51	38.7
Arsenic	ppb	10	Not detected	Not detected
Radium-226	pCi/L	5	0.117	0.117
Chlorine (Entry Point Disinfectant Residual)	ppm	Min. of 0.2	0.64 – 2.40	0.82 – 2.22
Fecal Coliform or E.coli	ppm	0	0	0
Turbidity	NTU % samples below 0.3 NTU	1 95%	0.077 100%	0.1 100%
Lead	% samples below 15 ppb	90%	100%	100%
Copper	% samples below 1.3 ppm	90%	100%	100%

Sources: 2019 Drinking Water Quality Report

As shown in Table 3-3, the drinking water quality of the Water System consistently meets MCLs. CRW had one non-compliant quarter in 2018 when a second quarter disinfection by-product (DBP) test result was reported late to DEP, resulting in a reporting violation. While the original sample was taken within the required timeframe, the lab was unable to test the sample and report the results within the reporting time requirement.

EPA has launched several initiatives including the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2) and Stage 2 Disinfectants and Disinfection By-Products Rule (DBP). LT2 is designed to reduce disease incidence associated with *Cryptosporidium* and other disease-causing microorganisms, while DBP2 protects against exposure to by-products of the treatment process. As part of the LT2, CRW's two water sources, the DeHart Dam and the Susquehanna River, were previously tested for *Cryptosporidium*. Testing conducted to date shows no indication of this organism at the DeHart Dam, and as such is classified as "Bin1". Data from the second round of LT2 monitoring detected higher levels of *Cryptosporidium* in the Susquehanna River, and as such, was classified as "Bin 2" in 2019 and requires an additional 1-log treatment when the river is in use. With respect to the DBP rules, water

samples taken from the distribution system have historically shown little indication of the presence of Total Trihalomethanes and Five Haloacetic Acids.

CRW's copper and lead survey analyses, which have been completed once every three years since 2007, have shown that copper and lead concentrations at residential taps remain well below MCLs. These results verify the success of CRW's corrosion control program, which includes the addition of soda ash and caustic soda to raise pH levels in water supply to promote corrosion control. Orthophosphate is a key component of corrosion control in combination with the pH control strategy as evidenced by historic sampling results.

3.5 Future Safe Drinking Water Regulations

Regulations affecting the Water System continue to become more stringent. The following serves to summarize the status of several key regulatory actions that could impact CRW's operations, with each being described in more detail in the following paragraphs:

- Third Six-Year Review
- Fourth Unregulated Contaminant Monitoring Rule (UCMR4)
- Hexavalent Chromium (Cr-6)
- Proposed Long-Term Lead and Copper Rule
- Proposed Carcinogenic Volatile Organic Compounds (cVOC) Rule
- Proposed Perchlorate Rule
- Proposed Per- and Polyfluoroalkyl Substances (PFAS) Rule

3.5.1 Third Six-Year Review

The EPA is required to conduct a review of drinking water regulations every six years. As part of this process, the EPA evaluates all the existing drinking water regulations and determines if a revision is necessary based on new information regarding health effects, analytical methods, occurrence, and treatment data. The results from the Third Six-Year Review were published in January 2017. The EPA determined that eight contaminants were eligible for regulatory revision: chlorite, *Cryptosporidium*, *Giardia lamblia*, haloacetic acids (HAA5), heterotrophic bacteria, *Legionella*, total trihalomethanes (TTHM), and viruses. Higher disinfectant residuals may be required to address some of these contaminants, particularly in premise plumbing; however this would need to be balanced with potentially increased disinfection byproduct (DBP) formation and lower maximum contaminant levels (MCLs) for DBPs.

This decision begins a process of public comment, data collection, and review focusing on:

- Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules,
- Surface Water Treatment Rule,
- Interim Enhanced Surface Water Treatment Rule, and
- Long Term 1 Enhanced Surface Water Treatment Rule.

The Third Six-Year Review also noted a number of contaminants with on-going health assessments that may be candidates for regulatory revision in the future.[1]

The EPA considered fluoride as a part of the Third Six-Year Review and concluded that additional information on health affects was available. However, fluoride was found to be a lower priority in comparison to other contaminants and is not being considered for revision at this time. Fluoride regulatory revisions may be considered in the future.

Finally, as a part of the Third Six-Year Review, the EPA considered twelve other regulated contaminants, specifically lead, copper, *E. coli*, total coliforms, 1,2-dichloroethane (ethylene dichloride), 1,2-dichloropropane, benzene, carbon tetrachloride, dichloromethane (methylene chloride), tetrachloroethylene (PCE), trichloroethylene (TCE), and vinyl chloride, in the review. However, these regulations did undergo a detailed assessment as they are the subject of recent, ongoing, or pending regulatory action.

3.5.2 Fourth Unregulated Contaminant Monitoring Rule

The Unregulated Contaminants Monitoring Rule (UCMR) was designed to evaluate and prioritize contaminants for inclusion in federal drinking water regulations to protect public health. The rule intends to document the occurrence of the contaminants on the Candidate Contaminant List (CCL) to determine if future regulation is warranted.

The Fourth Candidate Contaminant List (CCL4) was finalized in November 2016 and includes 97 chemicals or chemical groups and 12 microbiological contaminants. The list includes, among others, pesticides, disinfection by-products, chemicals used in commerce, waterborne pathogens, pharmaceuticals, and biological toxins.

Seventeen contaminants from the CCL4 were included in the Fourth UCMR (UCMR4), which was finalized in December 2016. Nine cyanotoxins, one cyanotoxin group, plus three brominated haloacetic acid groups were also included in the draft, bringing the total to 30 contaminants (see Table 3-4). UCMR4 monitoring extends from 2018 through 2020.

Some states are currently requiring notification and action if manganese levels from samples collected under UCMR4 are above the current EPA lifetime health advisory level of 0.3 mg/L in drinking water. Additionally, in 2019, Health Canada finalized a lowered aesthetic objective of 0.02 mg/L (20 µg/L) for manganese to minimize the occurrence of discolored water and an enforceable maximum acceptable concentration (MAC) of 0.12 mg/L (120 µg/L), which may encourage additional states in the U.S. to adopt lowered guidelines. CRW has conducted two rounds of manganese sampling but to date have only received results for the first sampling event on May 21, 2019 with a measurement of 0.531 ug/L.

[1] Alpha/photon emitters, arsenic, atrazine, benzo(a)pyrene (PAHs), beta/photon emitters, cadmium, chromium, di(2-ethylhexyl)phthalate (DEHP), ethylbenzene, glyphosate, mercury, nitrate, nitrite, o-dichlorobenzene, p-dichlorobenzene, polychlorinated biphenyls (PCBs), radium, simazine, uranium

Table 3-4: UCMR4 Contaminants

Contaminant Type	Specific Contaminants
Cyanotoxins	Microcystin-LA, Microcystin-RR, Microcystin-LF, Microcystin-YR, Microcystin-LR, Microcystin-LY, Nodularin, Cylindrospermopsin, Anatoxin-A
Cyanotoxin Group	Total microcystins
Metals	Germanium, Manganese
Pesticides and Manufacturing Byproduct	Alpha-hexachlorocyclohexane, Profenofos, Chlorpyrifos, Tebuconazole, Dimethipin, Total permethrin (cis- & trans-), Ethoprop, Tribufos, Oxyfluorfen
Brominated Haloacetic Acid Disinfection Byproduct Groups	HAA5, HAA6Br, HAA9 [2]
Alcohols	1-butanol, 2-propen-1-ol, 2-methoxyethanol
Semivolatile Organic Chemicals	Butylated hydroxyanisole, o-toluidine, Quinoline

3.5.3 Hexavalent Chromium

The EPA has an enforceable drinking water standard of 100 micrograms per liter (µg/L) for total chromium, which is the sum of the concentrations of all states of the metal chromium (Cr), including chromium III and chromium VI (Cr-6). The EPA released a draft human health assessment for Cr-6 in 2010, and the date for issuance of a final assessment has not yet been published. Issuance of a final assessment would be required prior to the EPA establishing a new drinking water regulation for Cr-6. As a part of the Third Six-Year Review, the EPA declined to review the existing Cr standards due to the ongoing human health assessment. A draft assessment for Cr-6 is expected in 2020. Additionally, it is unknown if EPA will develop a separate regulation for Cr-6 or continue regulating total chromium only.

In the interim, EPA is requesting voluntary Cr-6 sampling of finished water at points-of-entry and at maximum residence time sampling locations. CRW conducted voluntary Cr-6 sampling in January and December of 2017; results were non-detectable. On December 10, 2018 CWR completed Cr-6 sampling of the finished water at AWTF and River Pump Station (the spot in our distribution system with high water age) and results were 0.39 ug/L and 0.15 ug/L respectively. Sampling was repeated again on April 12, 2019 with both locations recording a <0.10 ug/L result. CRW has not collected a second sample in 2019 but plans to do so in October 2019. CRW has indicated it intends to continue testing for CR-6 twice annually.

[2] HAA5 (dibromoacetic acid, dichloroacetic acid, monobromoacetic acid, monochloroacetic acid, trichloroacetic acid); HAA6Br (bromochloroacetic acid, bromodichloroacetic acid, dibromoacetic acid, chlorodibromoacetic acid, monobromoacetic acid, tribromoacetic acid); HAA9 (bromochloroacetic acid, bromodichloroacetic acid, chlorodibromoacetic acid, dibromoacetic acid, dichloroacetic acid, monobromoacetic acid, monochloroacetic acid, tribromoacetic acid, and trichloroacetic acid).

3.5.4 Proposed Long-Term Lead and Copper Rule

In 2014, the EPA engaged a group of stakeholders, the Lead and Copper Rule Working Group (LCRWG), to provide advice and recommendations on key areas related to the Lead and Copper Rule. The working group released final recommendations in August 2015. Key recommendations from the working group include:

- Separating the requirements for copper.
- Establishing a voluntary tap sampling program and household action level for lead.
- Requiring proactive lead service line replacement programs.
- Developing stronger public education for lead and lead service lines.
- Strengthening corrosion control treatment and water quality parameter monitoring requirements.

The report was approved by the full National Drinking Water Advisory Council in November 2016. In 2017, EPA conducted a peer review of draft scientific modeling approaches to inform an approach to health-based limits in the future regulation. However, it is unlikely that the EPA will establish a health-based standard for lead given disagreement on the modeling approach. In early 2018, the EPA solicited comments on proposed regulatory revisions from state and local governments and representative national organizations. The areas of potential revisions largely mirrored recommendations provided by the LCRWG. In April 2019, the EPA announced that draft revisions to the Lead and Copper Rule were expected to be released this summer and will include a three-step process to prioritize the "most-corrosive" lines for replacement following a large-scale effort to map, monitor and model corrosion in lead pipes still in use throughout the U.S. While EPA did note in June that a draft rule has been provided to the EPA Office of Management for review, a draft regulation has not yet been released. Regardless of the timing of the draft, it is anticipated that EPA will limit the comment period to a maximum of 60-days and move forward with a final rule very quickly, possibly sometime in 2020.

3.5.5 Proposed Carcinogenic Volatile Organic Compounds Rule

In 2011, the EPA discussed regulating several cVOCs, some currently regulated and some unregulated, as a group. The preliminary list consisted of sixteen cVOCs, including benzene, carbon tetrachloride, PCE, TCE, vinyl chloride, 1,2-dichloroethane, 1,2-dichloropropane, dichloromethane, 1,1-dichloroethane, 1,3-butadiene, aniline, benzyl chloride, nitrobenzene, oxirane methyl, 1,2,3-trichloropropane, and urethane. The EPA later indicated that four additional cVOCs were being considered as potential substitutes to the original sixteen cVOCs and included 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, 1,2-dibromo-3-chloropropane (DBCP), and 1,2-dibromoethane (EDB). However, it appears that this concept has posed several challenges, and EPA may not move forward with a cVOC Rule as originally anticipated. The EPA is, however, actively assessing 1,2,3-trichloropropane, which is extremely carcinogenic. They are currently waiting on occurrence data from small systems before making a regulatory determination. New Jersey adopted an MCL of 0.03 µg/L for 1,2,3-trichloropropane in later 2018; however, it is unknown if other states with higher occurrence will follow suite.

3.5.6 Proposed Perchlorate Rule

In 2011, the EPA announced that it is going to move forward with plans to develop a national standard for perchlorate. Perchlorate is both a naturally occurring and man-made chemical that is used to produce rocket fuel, fireworks, flares, and explosives. It can also be present in bleach and in some fertilizers. Perchlorate removal is most often achieved using ion exchange. The EPA completed a peer review process on the Biologically Based Dose Response Model in January 2017, which was conducted to assist the EPA in deciding if and at what level perchlorate is to be regulated. In September 2017, the EPA announced its intention to conduct a second peer review process on the revised model and draft approach for the development of a maximum contaminant level goal (MCLG) for perchlorate. In May 2019, the EPA released a draft rule for perchlorate in drinking water, proposing to set both the MCL and maximum contaminant level goal (MCLG) at 0.056 mg/L. Three alternatives were included for consideration: 1) MCL and MCLG of 0.018 mg/L, 2) MCL and MCLG of 0.90 mg/L, or 3) withdraw regulation of perchlorate. The EPA accepted comments on the proposal through July 2019 and is currently considering these as they develop a final rule.

3.5.7 Proposed Per- and Polyfluoroalkyl Substances (PFAS) Rule

Per- and polyfluoroalkyl substances (PFAS) are man-made chemicals that are used in a variety of industries and consumer products such as carpeting, apparels, upholstery, food paper wrappings, fire-fighting foams and metal plating. PFAS are prevalent in the environment and studies have shown them at extremely low levels have adverse human health effects. Under the Third Unregulated Contaminant Monitoring Rule (UCMR3), EPA collected data for chemicals that are suspected contaminants in drinking water but do not have health-based standards set under the Safe Drinking Water Act. In the UCMR3, there were six PFAS included for monitoring including:

- perfluorooctanesulfonic acid (PFOS)
- perfluorooctanoic acid (PFOA)
- perfluorononanoic acid (PFNA)
- perfluorohexanesulfonic acid (PFHxS)
- perfluoroheptanoic acid (PFHpA)
- perfluorobutanesulfonic acid (PFBS)

Monitoring information collected under UCMR3 supports the regulatory determination process. In February 2019, the EPA released a PFAS Action Plan to address PFAS in the environment and protect public health. Key actions from the plan, related to drinking water include the following: 1) EPA is moving forward with identifying an MCL for PFOA and PFOS under the regulatory determination process, 2) EPA will propose nationwide drinking water monitoring for PFAS under the next UCMR monitoring cycle (i.e., UCMR5), and 3) EPA will work to develop risk communication materials for federal, state, and local partners to use with the public. The anticipated timeframe for national drinking water regulatory determination for PFOA and PFOS is 2019. In addition, EPA is finalizing draft toxicity values for two additional PFAS: GenX and PFBS. GenX is an unregulated PFAS chemical compound that is a byproduct of manufacturing processes, and it is not currently on the UCMR4 monitoring list. Final toxicity

assessments for PFBS and GenX are expected in 2019, and draft toxicity assessments for five additional PFAS are expected in 2020.

While there are no current federal MCLs for PFAS, states including New York and New Jersey have already taken action to regulate PFOA and PFOS in drinking water and many other have established guidelines for additional PFAS as shown in Table 3-5.

Table 3-5: Current PFAS Guidelines by State

Value (ng/L):	GenX	PFBA	PFHpA	PFOA	PFNA	PFBS	PFHxS	PFOS
USEPA				70[a]				70[a]
California				14				13
Connecticut			70[b]	70[b]	70[b]		70[b]	70[b]
Maine								
Massachusetts			70[b]	70[b]	70[b]	2000	70[b]	70[b]
Michigan				70[a]				70[a]
Minnesota		7000		35		2000	27	27
New Jersey				14[c]	13[d]			13[c]
New York				10[c]				10[c]
North Carolina	140							
Vermont			20[b]	20[b]	20[b]		20[b]	20[b]

a. The concentrations of PFOA and PFOS measured individually or combined.

b. The concentrations of PFHpA, PFOA, PFNA, PFHxS, and PFOS measured individually or combined.

c. Proposed MCL (note for New York, MCLs will go into effect after a 60-day public comment period ending September 24, 2019)

d. Promulgated MCL.

CRW is aware of PFAS and the potential impacts to their system. CRW tested finished water for PFAS under the UCMR3 in December 2015 and independently in 2019. DEP performed tests in 2019. All test results were below detection limits.

3.5.8 Summary

Discussions with CRW indicated that it is not aware of any proposed regulation which would have a material impact on its operations. CRW has been in discussion with the PADEP regarding the potential need to increase the spillway of the Dam to meet 1990 regulations, which require spillway capacity equal to the maximum storm flow. PADEP is currently evaluating requirements and once finalized, CRW would have 10 years to implement any necessary improvements. As such, the spillway project remains on CRW's capital improvement plan (CIP) with the design work commencing in 2019.

The review of potential future regulations indicated that at this time the proposed regulations are not anticipated to have a material impact on CRW operations. It is, however, recommended that CRW continue to monitor potential revisions to the Lead and Copper Rule. Although any revisions may not take effect for several years, the revisions may have significant impacts, ranging from increased sampling to proactive public education and lead service line replacement. Though PADEP has not established any requirements for PFAS, it is recommended that CRW track any activity at the State level and closely follow Congress's actions particularly regarding several bills which could designate PFAS as a hazardous substance under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

4 WATER SYSTEM CONDITION

4.1 Overview

CRW staff aim to ensure the entire Water System is properly operated and maintained. The cost to provide routine and preventative maintenance is included in CRW's annual operating budget. CRW uses a proactive preventative maintenance program and a systematic replacement policy for inventory parts to minimize downtime.

Additionally, CRW is developing a comprehensive asset management program for the drinking water systems which will further enhance preventative maintenance and increase system reliability. KCI Technologies is supporting the asset management program development. Asset registries have been developed for all CRW treatment plants, pumping stations, storage facilities, and the DeHart Dam facility. CRW has developed a risk register for CRW's buried assets and established high-level replacement, rehabilitation, and condition assessment cost estimates. CRW has commissioned a pilot study of water main condition assessment technologies currently underway. Results will inform CRW's approach to systematic condition assessment.

Development of the Wastewater Collection System Asset Management Plan is underway, and completion is forecasted for December 2019. The plan will provide CRW with strategies for operations, maintenance, capital investments, and funding. A parallel Asset Management Plan for the drinking water system will follow.

4.2 Condition Assessment

Arcadis conducted a limited condition assessment of the key components of the Water System on August 21, 2019, which included a review of existing information provided by CRW, discussions with CRW staff, and visual observations during field visits. Based on the type of facilities, available documents related to the facilities, and previous experience with similar facilities, a representative sample of facilities was inspected on a limited basis to visually confirm the information provided, identify any apparent capital improvement needs, and discuss reliability and O&M performance with the operation and maintenance staff. No field investigations were conducted for buried infrastructure.

The condition assessment of the facilities in the Water System was based on numerical ratings for the following criteria:

- Appearance of mechanical, structural, and electrical components
- Reliability
- O&M performance
- Capacity
- Regulatory compliance

Based on the evaluations using the above categories, an overall risk rating was assigned to each of the major assets. The risk ratings for each of the five categories above are outlined in Table 4-1.

Table 4-1: Summary of the Rating System

Numerical Rating	Interpretation of Rating	Description
1	Little to no risk	Relatively new and in good physical and operating condition.
2	Some risk	Good condition, no known capital requirements.
3	Moderate risk	Aged or worn but generally in good operating condition may require capital investment within five years.
4	Significant risk	Operational but nearing end of life and / or requires investment to bring to full operating condition.
5	High risk	Should be on high priority for renewal and / or replacement.

The following presents a summary of the risk ranking for each of the major facilities based on a review of the available information and limited visual inspections.

Table 4-2: Major Assets Risk Rating

Major Asset	Risk Rating
DeHart Dam and Reservoir	3.0
Dr. Robert E. Young Water Services Center	2.0
Upper Reservoir	2.0
Lower Reservoir #1	2.1
Lower Reservoir #2	2.1
Susquehanna River Pump Station	1.2
Gate House Pump Station	2.0
Union Square Booster Station	1.4
Transmission Mains	
• Mountain Line	3.0
• Susquehanna Line	1.1
• Plant-Gate-House-Reservoir Line	1.7
Distribution System	2.9
Overall System Rating	**2.0**

Overall the Water System is in good condition and the risk rating had no change over the year prior; however, some components are aged and will require investigation and capital investment to preserve the asset and maintain high quality water and adequate delivery of services.

An arc flash study is recommended for the water system in order to be in compliance with current NFPA 70E and OSHA 1910 (Subpart S) regulations. CRW intends to implement arc flash studies in 2020 out of the water treatment plant O&M budget.

The following subsections provide a summary of the current condition of the major components, the rationale for the risk scores assigned, and the improvements needed to address moderate, significant, and high risks.

4.2.1 DeHart Dam, Reservoir Control Building, and Chemical Feed Facility

CRW routinely monitors and evaluates the DeHart Dam to ensure operational efficiency and regulatory compliance. These regulations include annual inspections, followed by a PADEP on-site review. CRW submitted its last DeHart Dam Annual Safety Inspection Report to the PADEP in November 20183 Based on a review of the 2018 DeHart Dam Annual Safety Inspection Report, it appears that the Dam is being properly maintained and that the Dam and Carsonville Weir are stable and in good condition. O&M recommendations resulting from the report were insignificant in nature and some of them have already been addressed and completed. The implemented O&M tasks include the management of vegetation encroaching the embankment on the upstream and downstream faces of the dam and vegetation clearing along the mountain line pipeline route. Out of the approximately 12 to 16 miles of pipeline that require vegetation clearing, 8 miles have been cleared to date, with 4 more miles planned for 2020. Recommendations that still need to be completed include the installation of staff gauge south of Ogee spillway training wall, annual lubrication and exercising of sluice gates at the outlet works, assessment of the structural integrity of the bridge across the spillway chute, application of joint sealant and top layer of concrete replacement to the spillway channel floor, and the monitoring of concrete deterioration along the spillway. The report also noted that CRW maintenance staff have been proactive in implementing the recommendations included in the 2018 Dehart Dam Annual Safety Inspection Report.

After the Water Services Center pH chemical upgrades are finalized, the pH chemical options for DeHart application will be vetted to choose the best option for Transmission Main corrosion control while working to also benefit the Water Services Center Treatment.

In addition to O&M items above, the 2018 DeHart Dam Annual Safety Inspection Report identified several known and probable dam safety deficiencies. These included the following:

- Lack of Embankment Seepage Control and Collection System. The existing embankment does not have a comprehensive system to filter and collect all seepage, and adjacent soils need to meet filter compatibility requirements to prevent soil particle migration or internal erosion that can lead to failure of the dam embankment under certain reservoir level and associated seepage conditions. In the summer of 2018, a comprehensive geotechnical evaluation was conducted on the existing embankment to determine its filter compatibility requirements. A report including the geotechnical evaluation findings is scheduled to be submitted later this year.

[3] DeHart Dam Annual Safety Inspection Report, prepared by Gannett Fleming, dated November 2018.

- Insufficient Spillway Capacity. The existing spillway at Dehart Dam is not capable of passing the Probable Maximum Flood (PMF) Spillway Design Flood[4].
- Questionable Structural Adequacy of the Spillway Channel. Due to the use of channel slab construction that is no longer common practice, and the limited footprint of the existing underdrain system, the structural integrity of the slabs can be compromised if water from spillway channel flows is able to penetrate beneath the slabs. Evidence of undermining and deterioration of the existing spillway slabs and walls was noted during the inspection.
- Insufficient Drawdown Capacity. The Dehart Dam does not have adequate drawdown capacity per the PA code that is intended to ensure that the reservoir could be lowered as a risk reduction measure in the event of a developing incident or failure mode.

A conceptual cost estimate was provided in the DeHart Dam Assessment Report dated February 2017 that evaluated seven alternatives to addressing the deficiencies described above. The cost estimates ranged from approximately $26.4 million to $30.9 million. The report also recommended that an exploration program be developed to develop a more precise cost estimate associated with the selected dam rehabilitation alternative. Currently the rehabilitation dam design is on hold while awaiting the revised probable maximum precipitation (PMP) and probable maximum flood (PMF) study currently being developed by PADEP. The DeHart Dam rehabilitation project consist of preliminary design and laboratory investigations, along with permitting, final design, bidding, and construction. Anticipated project completion is in 2023. The recommended capital and incremental O&M needs for the DeHart Dam that have been included in the CIP are shown in Table 4-3.

Table 4-3: DeHart Dam Improvement Needs

Description	Classification
Mountain Line Clearing	Capital Addition
Mountain Line Repairs	Capital Addition
Corrosion Control Chemical Feed System	Capital Addition
Staff Gauge Installation	O&M
Embankment Vegetation Control	O&M
Spillway Channel Joint Sealant	O&M
Dam Rehabilitation	Capital Addition

4.2.2 Dr. Robert E. Young Water Services Center Treatment Facility

The Dr. Robert E. Young Water Services Center (WSC), located at the intersection of Pine Drive and Stanley Drive on the City's municipal border with Susquehanna Township, treats raw water conveyed from either the DeHart Reservoir or the Susquehanna River. It also contains CRW's customer services

[4] Review of the embankment and spillway is ongoing and will be assessed for future capital budgets.

office and maintenance garage. It utilizes chemical addition, flocculation, coagulation, sedimentation, filtration, and disinfection to produce the Water System's finished water.

Based on the 2018 and 2019 Drinking Water Quality Reports, the water provided by the plant was of high quality and consistently exceeded performance requirements as determined by State and Federal regulations. In addition, PADEP gave the filter plant a "satisfactory" performance rating for its ability to consistently produce high quality water and provide long term reliability in its 2016 Filter Performance Evaluation Report, an improvement from their previous rating of "needs improvement" in the 2012 Report. Nonetheless, PADEP identified the following issues and concerns requiring investigations or improvements:

- Excessive media loss in filters 401 and 402 (Filters have been rebuilt)
- Perform quarterly turbidimeter calibrations at a minimum (CRW now performs quarterly turbidimeter calibrations)
- Develop a Giardia Inactivation/CT action level (CRW has determined a Giardia Inactivation action level and has developed response procedures for plant operators).
- Post backwash turbidity spike; include data for post backwash turbidity on backwash data sheet.
- Miscellaneous standard operating procedure and administrative improvements such as debris removal, attainment of a generator, SCADA screen or computer in filter building (CRW has addressed these concerns or is in the process of resolving them).

The chlorine disinfection system at the WSC has several safety features, including automatic shut-off valves, and exhaust fans. However, an accidental discharge of a chlorine cylinder would create a significant safety hazard. At the request of the EPA, CRW completed a feasibility study and design for installing a chlorine gas scrubber that would be capable of collecting and neutralizing chlorine gas from ban accidental 1-ton tank discharge. Project is currently under construction, with an anticipated date of completion being the end of 2019.

The plant appears to be in good overall physical condition. However, some capital investments will be required within the next five years in response to PADEP comments and some additional O&M expenditures should be incurred to improve the resiliency of its operation and satisfy the expectations of the regulatory agency.

The controls associated with the filters are antiquated and should be replaced to allow better control and monitoring of the filter process. A Filter Upgrade Project has been awarded to American Filter Service Corp. for $376,441.87 and will improve operational performance in the Filtration Process. Due to six of the eight filters experiencing an underdrain deficiency, the project will replace all filter media during the underdrain repairs. All of the eight filter walls and troughs have been drained and cleaned at the time of this report. The Filter Upgrade Project is to begin construction by October 2019.

During the site inspection, a variety of improvements were noted to have been performed in the last year. The plant is upgrading all the lighting to LED and plans to have it completed in 2020. Dehumidification in pipe gallery has been repaired. The old dehumidification system had a 25-year-old wiring issue and when fixed, it solved the dehumidification problem in the pipe gallery. Additionally, the CRW's 10-year plan includes seal coating the walls in the pipe gallery and pipe tunnel areas to prevent effervescence build-up on walls. Finally, the facility has been cleaned and a noticeable improvement in general housekeeping was noted.

The scheduled Auxiliary Power improvements project is currently in the final completion stage and is scheduled to achieve final completion in September 2019.

During the site inspection CRW indicated several recommended/planned O&M improvements at the facility including the following: painting of raw water pipe cross connection between A and B sources; and finished water flow meter replacement. Additionally, the clear well at the facility is planned for inspection (concurrent with Lower Reservoir inspection) in late 2019 or 2020.

CRW is constructing a Liquid Fluoride Chemical Feed System driven by the inconsistency with fluoride dry feed system and safety concerns due to fluoride dust escaping the units. Chemical dosing is currently erratic and unstable; therefore, a liquid solution system is being implemented to solve safety and operational/maintenance issues. Pumping Solutions, Inc is performing the construction of this work with substantial completion anticipated in October 2019.

The recommended capital and incremental O&M needs for the plant that have been included in the CIP are shown in Table 4-4.

Table 4-4: Water Treatment Facility Improvements

Description	Classification
WSC Chlorine Scrubber Project	Capital Addition
WSC Filter Repairs and Console Replacement	Capital Addition
WSC Lighting Upgrades	O&M
WSC Liquid Fluoride Chemical Feed System	Capital Addition
Miscellaneous Mechanical O&M Improvements including piping and valve replacement, painting, pump replacement, and flow meter replacement	O&M

4.2.3 Finished Water Reservoirs

The Water System utilizes three reservoirs to store finished water for distribution throughout its service area. The reservoirs are located at Reservoir Park within the City and serve two different pressure districts.

The Lower Reservoir consists of two six-million-gallon circular tanks constructed in 2002. This facility serves consumers who are generally located west of Eighteenth Street within the City. The Lower Reservoir has an overflow elevation of 504 feet and connects to the distribution system through a supply pipe which ranges in size from 30 to 36 inches in diameter. The last interior inspection of the Lower Reservoir tanks was completed in 2010. A subsequent inspection of the Lower Reservoir and WSC Clear Well is scheduled for late 2019 or early 2020. The inspection is intended to review and document the condition of the tanks. Arcadis did not visit the vault containing the discharge piping because the vault is a confined space. The tanks appear to be in good overall condition based upon exterior inspection; however, the concrete on the exterior walls has extensive hairline cracks with efflorescence and extensive discoloration caused by a biological film. The tanks are scheduled for power washing in 2020 and may require recoating to prevent further deterioration of their exteriors. CRW should monitor the cracks to ensure that water is not penetrating to the wire wrapping.

The Upper Reservoir is an underground reinforced concrete reservoir constructed in 1927. It has a storage capacity of 28.0 million gallons and is divided into two compartments. The Upper Reservoir serves the Water System's high-pressure zone. It supplies water to customers located east of Eighteenth Street within the City and in portions of Penbrook, Susquehanna, Swatara, Paxtang Borough, and Lower Paxton. During our site visit in 2017, CRW was in the process of completing an inspection of the reservoir. The inspection identified multiple leaks in the reservoir and included recommendations for repairs. The CRW Upper reservoir rehabilitation project was completed in early 2019.

The recommended capital and incremental O&M needs for the Finished Water Reservoirs are shown in Table 4-5.

Table 4-5: Finished Water Reservoir Improvements

Description	Classification
Lower Reservoir - Inspection, Clean and recoat exteriors. Make additional repairs identified by inspections.	Capital Addition
Regular Reservoir Inspections	O&M

4.2.4 Susquehanna River, Gate House, and Union Square Pump Stations

CRW's Water System utilizes three pumping stations to convey water and maintain adequate distribution system pressure. The Susquehanna River Pump Station is located within the City, between Front and River Streets, north of Graham Street, and is used to transfer raw water from the Susquehanna River to the Dr. Robert E. Young Water Services Center. The facility draws water from the river via an inlet tunnel connected to four wedge wire screens located in the river. It was constructed in 1994. CRW typically exercises the equipment at the facility once per year for a ten-day period because of CRW's preference for utilizing water from the DeHart Reservoir. Overall, the facility appears to be in good condition and able to perform adequately. Piping in the lower level of the pump station is showing signs of minor corrosion; it is recommended that this piping be visually inspected annually and painted at the first signs of structural corrosion.

The Gate House Pump Station is located at the City's Reservoir Park and is used to transfer finished water from the Lower Reservoir or the Dr. Robert E. Young Water Services Center to the Upper Reservoir. It was constructed in the 1920s. The most recent significant upgrade was in 1994. CRW typically operates at least one pump for 12 hours each day, and the lead pump is rotated on a quarterly basis to balance pump runtime between the pumps. The facility appears to be in good condition and able to perform adequately. Within the last year, CRW started to prep interior walls and piping for new paint, but the job was larger than expected and CRW could not self-perform the work. CRW is planning to publicly bid out the remainder of the painting work in October 2019. Additionally, one of the pumps is being rebuilt.

The Union Square Industrial Park Booster Station is located within Susquehanna Township along Susquehanna Township's municipal border with Lower Paxton Township and is used to increase the water pressure within the outer reaches of CRW's distribution system, which serves the Union Square Industrial Park. It was constructed in the mid-1990s. CRW rarely operates the facility because the

system pressure is adequate for normal demands. The facility appears to be in good condition and able to perform adequately. During our site inspection one of the downspout splash blocks was tilted back toward the building and maintenance is to repair in 2019. Additionally, some paint chipping in interior of building was observed on the ceiling and piping. It is recommended that this painting system be visually inspected annually and painted at the first signs of further deterioration.

The recommended capital and incremental O&M items for these facilities are included in Table 4-6.

Table 4-6: Pump Station Improvements

Description	Classification
Union Square PS – Monitor and Repaint Interior of Building	O&M
Gate House PS – Pump Repair	Capital Addition

4.2.5 Water Transmission System

CRW has several water transmission mains. The most important transmission mains are the DeHart Dam raw water line, known as the Mountain Line, the raw water transmission main connecting the Susquehanna River Pump Station to the Dr. Robert E. Young Water Services Center, and the finished water transmission main connecting the Dr. Robert E. Young Water Services Center to Reservoir Park.

The Mountain Line is a reinforced concrete and pre-stressed concrete cylinder pipeline that was placed into service in 1940. The portion of the pipeline through the Dauphin Narrows was relocated by the Pennsylvania Department of Transportation in 1965 when it was widening State Route 22 / 322.

CRW retained Pure Technologies Ltd. to investigate the Mountain Line in 2016 using its Smartball™ leak detection technology. The draft Condition Assessment 42- and 36-Inch Raw Water Transmission Main Report, dated August 2017 was reviewed. The report noted that three leaks were identified in the inspected portions of the Primary Transmission Main, and zero leaks were found on the A-Line and B-Line. Recommendations for the long-term management of the transmission main were included in the condition assessment and included the following:

- Calibration testing including excavation of pipe segment with anomalies to qualify the distress detected.
- Complete an electromagnetic inspection of the B-Line.
- Confirm the air release valve in Chamber #4 at Station 118+55 on the B-Line is properly working.
- Verify there is a pipeline feature located at Penwood Road and Antoine Street where a Type 3 anomaly was identified.
- Electromagnetically re-inspect the Raw Water Transmission Main every 5 to 7 years to monitor the rate of distress.

Following the condition assessment in 2017, CRW performed the recommended calibration testing to address the identified anomalies, however the recommendations that involved destructive testing of the pipeline were not performed due to being detrimental to operations.

The Susquehanna River transmission main is a pre-stressed concrete cylinder pipeline that was placed into service in 1994. The Susquehanna River PS and associated transmission main are operated once per year for a 10-day period to exercise the equipment as recommended by PADEP. In 2017 the

Susquehanna River PS was operated for 10 days and provided the full flow to the WTP. The 2017 operational exercise was helpful in draining and maintaining the Mountain Line. In 2018 CRW operated the Susquehanna River PS to provide 50% of the capacity to the WTP with the remaining 50% capacity coming from the DeHart Dam. This strategy is an operational exercise to utilize the full capacity of the plant.

The finished water transmission main from the Dr. Robert E. Young Water Services Center was installed in 1994 and constructed out of 36-inch diameter prestressed concrete cylinder pipe. The transmission main is approximately 3,400 feet in length and connects to the existing 30-inch diameter ductile iron pipe transmission main to Reservoir Park at the intersection of 18th Street and State Street. This main is arguably the most critical main in the Water System. CRW has indicated that there are no known issues with the pipe and that it has corrosion control measures in place. The physical condition of this pipe is unknown. CRW is committed to annual execution of condition assessment utilizing internal workforce and contracted specialty services (currently $100,000/year).

4.2.6 Water Distribution System

CRW's water distribution system includes approximately 230 miles of water main distribution pipe, 1,800 fire hydrants, 5,370 main valves, and 20,330 service valves.

Delivered Water Quality:

CRW provides the PADEP with monthly reports on the quality of its delivered water and publishes an Annual Drinking Water Quality / Consumer Confidence Report, as required by the EPA. The Drinking Water Quality Report provides the results of water quality tests on CRW's drinking water for the year as compared to permitted MCLs. CRW's 2019 Drinking Water Quality Report (which reports the results for calendar year 2018) concluded that CRW's water quality continues to consistently exceed national quality standards.

CRW has a routine sampling plan. Its day-shift plant operators collect more than the minimum number of routine total coliform samples required from sites of commercial customers including customers located where the longest detention time is expected. CRW also maintains a detectable disinfection residual in its distribution system verified by the same sampling program used to monitor the absence of total coliform organisms in the water. It also monitors for disinfection by-products as required by the EPA and has been in compliance since 2012.

CRW maintains records of aesthetic water quality complaints and their resolution. It reports the number of water complaint calls in the Water Division Monthly Report. Aesthetic complaints are infrequent and most often a consequence of CRW's hydrant flushing program.

CRW monitors 30 sites triennially in accordance with a sampling plan as required by the EPA for systems complying with the lead and copper rule. In addition, CRW flushes its distribution system at all hydrants beginning in the spring of each year, and starting with the finished water storage and working to the outskirts of the distribution system.

CRW's delivered water quality program appears to be consistent with Section 4.1 of American Water Works Association (AWWA) Standard G200 - Distribution Systems Operation and Management, based

upon a limited review of documentation and an interview with the Director of Water Operations on August 21, 2019.

Distribution System Management:

CRW maintains the water in its finished water storage reservoirs at levels high enough to avoid low pressure complaints from customers. It monitors the water levels in the reservoirs but does not otherwise monitor the pressure in the distribution system. It posts "boil water" notices on its web site for repairs or maintenance causing loss of pressure to customers.

CRW has updated its Cross-Connection Control Manual in compliance with Part VII, Cross-Connection Control / Backflow Prevention of the PADEP Public Water Supply Manual. Program implementation requires appropriate municipal ordinances and up to five years to educate customers, have customers install backflow preventers as appropriate, and to initiate a backflow device testing program. CRW is unconcerned about organic solvents permeating into the system through PVC piping because it does not have any PVC piping in its system.

In 2016 CRW initiated a leak detection program that includes full system leak detection on an annual basis. The leak detection program involves evaluation of mains and service lines and preparation of meter calibration reports to summarize findings. Small and Large Meter Testing Programs are incorporated as part of the leak detection program to ensure accurate readings are being taken and water loss is minimized.

Programs have indicated most meters are in good calibration and do not require replacement; however, some large meters with performance issues are prioritized for replacement. Large meters that are expected to be replaced that have turbine technology, are of Neptune brand, are older than 15 years of age, or otherwise have a condition that makes replacement financially favourable over testing. On average, CRW can replace approximately 25 large meters per year. In addition, CRW replaces between 300 and 400 small meters per year due to inaccurate readings, freezing, and theft. It is anticipated that CRW will utilize most existing small meters for at least several more years before a larger scale replacement project is initiated.

It is recommended that CRW conduct a compliance field audit of all 250 large meter accounts and all accounts with fire meters within the system with the primary purpose of ensuring compliance with CRW's Rules and Regulations. The Rules and Regulations require a properly working accurate and testable meter that cannot be by-passed without notification. With the filling of a Meter Account supervisor position and contracted assistance, CRW seeks to begin improving enforcement within the program in Fall 2020.

A three-year comparison of the amount of NRW, as well as the number of water main breaks for the Water System is shown in Table 4-7. CRW has demonstrated a trend in reducing NRW.

Table 4-7: Non-Revenue Water and Water Main Breaks

Year	Water Produced (MGD)	Non-Revenue Water (MGD)	Non-Revenue Water %	# of Water Main Breaks
2016	7.42	2.06	27.8%	22
2017	7.16	1.91	26.7%	23
2018	6.72	1.49	22.2%	19
Average	**7.10**	**1.82**	**25.6%**	**21.3**

Sources: 2018 Water Loss Audit Report for Finished Water and 2018 Main Break Water Loss Report

The amount of NRW includes authorized usage attributable to fires, line flushing, street cleaning, lab testing, etc., as well as NRW attributable to a number of factors such as meter accuracy, finished water reservoir leaks, water main leaks, private service connection leaks, and potential theft or unmetered connections. Additionally, CRW has created a position for a Meter Account Supervisor which is currently vacant, but once filled the auditor may further reduce NRW.

CRW recently implemented a valve exercising program and has acquired new equipment to exercise valves. This program will help CRW satisfy AWWA G200 Paragraph 4.2.5. Currently two staff members, working four days per week work to exercise the valves in the system. Since this program started, CRW has exercised 200 valves in 2016, 397 valves in 2017, and 401 in 2018 totalling to 998 valves of the approximately 3,500 valves in the system. CRW reports valves replaced, valves exercised, and valves repaired on Exhibit I, Distribution System Activities, in its Water Division Monthly Report. CRW has identified valve replacement among the projects in its CIP. Approximately 90 percent of the valves in the system are thought to be operational.

CRW attempts to test all hydrants annually. Hydrants tested, replaced, and repaired are shown in Exhibit I, Distribution System Activities, in its Water Division Monthly Report. More than 99 percent of the hydrants in the system are thought to be operational. In 2018, 71 damaged hydrants were returned to normal operating condition by either repair or replacement.

CRW ensures that only NSF / ANSI Standard 61 approved coating and linings are used throughout its distribution system whenever new material is installed. However, much of the system predates the standard. Many service connections still have lead goose necks where they connect to the mains. CRW has completed the Lead Assessment (incorporating their water service line index cards into their GIS) to allow for reporting and analysis of materials and assumptions based on dates and locations. The lead gooseneck replacement consists of CRW's internal policy to remove them when they are excavated for any reason regardless if they are private or not, that includes a long-term plan of removing them with new main installations, which CRW is actively doing. There is no program for any removals beyond that because CRW does not have confirmation of any locations, just assumptions and they are privately owned.

CRW meters the finished water entering the distribution system to determine peak flows and maximum day peak flows. Most of the customer meters in the system were replaced between 1999 and 2002.

CRW believes that a great deal of the reduction in NRW is attributable to in-house leak detection and repair program that began in January 2016. Small and large meters were tested according to the AWWA Manual M6 and replacement protocols for no lead brass are being followed.

The distribution system is capable of delivering the maximum day demand and satisfying fire flow requirements based upon information obtained from records and interviews. However, no hydraulic model results or reports were reviewed. CRW does record information related to main breaks including location, pipe material, diameter, type of break, and soil type. Most breaks are reported to be random except for one particular neighbourhood that has aggressive soils. CRW does not have an external corrosion monitoring plan.

CRW reviews construction projects for potential impacts on its Water System. It has records for projects completed since the 1990s but not for earlier periods.

CRW's distribution system management program appears to be consistent with Section 4.2 of AWWA Standard G200 - Distribution Systems Operation and Management, based upon a limited review of documentation and an interview with the Director of Water Operations on August 21, 2019.

Facility Operation and Maintenance:

CRW has been inspecting storage reservoirs on a five to eight-year cycle. CRW maintains the treated water in its finished water storage reservoirs at levels high enough to avoid low pressure complaints from customers. The reservoirs draw down and refill approximately 10.0 percent on a daily basis. This is relatively low turnover, but it is mitigated by the excellent quality of the water being delivered. In 2018 CRW depth tested the chlorine residual of both reservoirs during the year and the results showed that the chlorine residual was consistent at all water levels tested, which indicated that there was no significant degradation of water quality within the reservoirs. Furthermore, CRW is capable of increasing the turnover rate of the reservoirs if it suspects there may be degradation of water quality in the reservoirs.

CRW maintains a standard operating procedures document binder where all written standard operating procedures are compiled in one location. It has written operating procedures for the Susquehanna River Pump Station but not for its other pumping stations. Its SCADA system records operational conditions. It has written maintenance procedures for all three of its pumping stations. CRW has poor records as to the history of its distribution system pipelines. The average age of the distribution system is unknown as records regarding installation dates of pipes is not available for about 40 percent of the distribution system. Where records are available, they indicate an aged system, with over 90 percent of the records showing an installation date prior to the 1960s, and almost half of those installations occurring over 100 years ago. A nominal replacement rate of 12,500 linear feet per year (~1% of the system) might be justified based upon the age and size of the system. However, for a long-term program, more information is needed to determine the required extent of main replacements.

CRW's distribution system operation and maintenance program appears to be consistent with Section 4.3 of AWWA Standard G200 - Distribution Systems Operation and Management, based upon a limited review of documentation and an interview with the Director of Water Operations on August 21, 2019.

Documentation:

CRW continues to update and expand its GIS system including integration with its City Works asset management program. CRW's plan is consistent with Section 5.1 "Documentation required" of AWWA Standard G200. It is recommended that CRW continue to expand this program.

The recommended capital and incremental O&M needs for the distribution system are shown in Table 4-8. All capital items have been included in the CIP.

Table 4-8: Distribution System Improvements

Description	Classification
Water Main Assessment to Prioritize Replacements	Capital Addition
Water Main Replacement	Capital Addition
Water Meter Replacement Program	Capital Addition
Meter Account Supervisor	O&M
Backflow Prevention	O&M

Note: See narrative prior to this table for added descriptions.

5 CAPITAL IMPROVEMENT PLAN

5.1 Overview

CRW prepares a CIP that identifies the major planned projects and initiatives for the Water System. The CIP includes projects that are required to meet future regulations, replace aging infrastructure, enhance or expand services to customers, provide resiliency and redundancy, and increase cost effectiveness and efficiency. While certain projects are required by regulations or needed to maintain proper operations others are discretionary in that the project is being undertaken to meet CRW's established goals, but are not necessarily critical to the continued operation of the Water System. As such, the schedule for implementation of discretionary projects is often subject to change.

A review of CRW's long-term CIP, its past accomplishments, and the current observed condition of key assets was completed to assess the overall condition of Water System, and to identify potential capital improvements that should be considered for implementation by CRW in FY 2020. The following presents a summary of the findings of our review.

5.2 CRW Updated Five-Year Capital Improvement Plan

A summary of the recommended CIP for CRW for the period FY 2020 through FY2024 that reflects the capital improvements that were identified and recommended based on the document reviews, visual inspections, and discussions with CRW as part of this report, are shown in Table 5-1.

5.3 Discussion

CRW's capital plan is in general alignment with Arcadis' observed requirements for the Wastewater System. CRW generally has a good understanding of capital project needs and should prioritize projects based on urgency and affordability. CRW may proceed to reschedule and reprioritize various projects to balance the capital needs over the next several years. It is recommended that CRW update its cost estimates and capital funding plans for these projects as additional information becomes available.

Table 5-1: Capital Improvement Plan

Location	Description	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Raw	Mountain Line Clearing	$ 404,000	$ -	$ -	$ -	$ -
Raw	Mountain Line Repairs	$ 187,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000
Raw	DeHart Bridge Repair/Replacement	$ 992,000	$ 5,000,000	$ 10,000,000	$ 5,000,000	$ -
Raw	DeHart Corrosion Control Chemical Feed System	$ -	$ 60,000	$ -	$ -	$ -
Raw	DeHart Tower Roof Replacement	$ -	$ 60,000	$ -	$ -	$ -
Raw	Alternative DeHart Power (AWIA)	$ -	$ 100,000	$ -	$ -	$ -
Treatment	WSC Flocculation Equipment Update	$ -	$ 100,000	$ -	$ -	$ -
Treatment	WSC Filter Console Replacement/Automation	$ -	$ 400,000	$ -	$ -	$ -
Treatment	WSC Sedimentation Basin Railings	$ -	$ -	$ -	$ 190,000	$ -
Treatment	WSC Gas Furnace Replacement (Chemical Building)	$ -	$ 150,000	$ -	$ -	$ -
Treatment	Upper Reservoir Valve Vault Improvements	$ -	$ -	$ 200,000	$ -	$ -
T&D	West Reservoir Water Main Solution	$ -	$ 300,000	$ -	$ -	$ -
T&D	Transmission Main Check Valve	$ -	$ -	$ 125,000	$ -	$ -
T&D	Cameron Street Weater Main	$ 3,619,000	$ 7,000,000	$ 7,000,000	$ 7,000,000	$ 7,000,000
T&D	Water Main Assessment	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000
T&D	Water Main Replacement	$ 2,455,000	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 2,500,000
Misc	Bottle Filler Station & Building	$ 150,000	$ -	$ -	$ -	$ -
Misc	Replacement Bucket Truck	$ -	$ 125,000	$ -	$ -	$ -
Misc	Service Truck Replacement	$ -	$ 50,000	$ -	$ 50,000	$ -
Misc	Equipment Garage	$ -	$ -	$ -	$ -	$ 500,000
Misc	Large Water Meter Replacement	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000
Misc	Minor Capital Improvement Plan	$ 640,000	$ 252,500	$ 445,000	$ 225,000	$ 200,000
	Total	**$ 8,697,000**	**$ 16,422,500**	**$ 20,595,000**	**$ 15,290,000**	**$ 10,525,000**

[1] Project costs are presented in 2019 dollars.

[2] Minor Capital Improvement Plan line item includes two security projects at the WSC (fencing and CCTV/Facility Access).

6 OPERATIONS AND MAINTENANCE EXPENSE REVIEW

6.1 Overview

The Trust Indenture (Section 7.12) requires CRW to adopt a Water System budget each year sufficient to meet all of CRW's projected financial obligations for the upcoming fiscal year. CRW typically adopts a finalized budget in November, two months prior to the start of the new fiscal year. CRW utilizes the capital plan and O&M recommendations in this CEAR to assist in establishing the budget. However, it should be noted that this CEAR only serves to provide advice and recommendations regarding capital additions and the amount of funds that should be expended to meet incremental O&M expenses.

6.2 Historical Water System Expenses

A summary of CRW's historical actual O&M expenses for FY 2017 and FY 2018 and the budgeted O&M expenses for FY 2019 are shown in Table 6-1. These expenses were reviewed to and determined to be in general alignment with overall O&M needs of the Water System.

Table 6-1: Historical Water System O&M Expenses

	Historical		Budget
Description	FY 2017	FY 2018	FY 2019
O&M Expenses:			
Salaries and Wages	1,947,469	2,031,684	2,140,826
Benefits and Taxes	1,024,115	1,112,045	1,149,551
Contracted and Professional Services	917,742	594,807	844,165
Repairs, Maintenance, and Supplies	388,342	414,118	602,685
Electricity	198,739	174,637	197,366
Chemicals	228,529	239,319	275,807
Sewerage	432,237	463,760	467,000
Insurance	361,160	339,585	341,495
Administrative Fee	2,631,523	2,569,403	3,175,648
Shared Services	-	-	-
Other Operating Expenses	499,847	564,244	395,995
Total Annual O&M Expenses	**8,629,704**	**8,503,602**	**9,590,538**

Source: Historical actual expenses in FY 2017 and FY 2018 and budgeted expenses in FY 2019 provided by CRW

6.3 Additional Operations, Maintenance, and Repair Costs

Several recommendations regarding the addition of O&M expenses in FY 2020 for the proper maintenance, repair, and operation of the Water System should be considered for implementation by CRW, as discussed in Section 4 of this report. The estimated costs associated with these recommended items is shown in Table 6-2.

Table 6-2: Summary of Additional O&M Costs

Location	Description	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
WSC	Lighting Upgrades	15,000	5,000	5,000	5,000	-
WSC	Misc Mechanical O&M Improvements	430,000	215,000	215,000	215,000	215,000
DD	Embankment Vegitative Control	5,000	5,000	5,000	5,000	5,000
DD	Spillway Channel Joint Sealant	-	-	25,000	-	-
T&D	Upper and Lower Reservoir Inspections	5,000	-	-	-	10,000
T&D	Add Meter Account Supervisor	90,000	90,000	90,000	90,000	90,000
T&D	Backflow prevention consistent with PADEP	5,000	5,000	5,000	5,000	5,000
	Total	**$550,000**	**$320,000**	**$345,000**	**$320,000**	**$325,000**

Note: All amounts shown in Table 6-2 are in 2019 dollars.

7 CONCLUSIONS

Set forth below are the principal conclusions which Arcadis has reached regarding our review of the Water System:

1. The Water System is generally being managed in a professional and prudent manner, with an appropriate regard for the level of service afforded to its customers. Based on our review of the data and limited visual inspection, the Water System achieved an overall rating of 2.0, indicating that it is generally in good physical and operating condition. However, certain components are aged or worn and will require capital investment within the next five years.
2. The Water System has consistently produced high quality water and, with the exception of one violation for late reporting of DBP results, is compliant with its permits and State and Federal regulations.
3. CRW's water supply and treatment capacity is sufficient to meet the current and near-term projected needs of the service area.
4. CRW's capital plan is in general alignment with Arcadis' observed requirements for the Water System. CRW has a good understanding of additional capital projects needed. Lack of historical records creates challenges for the exception of the prioritization of specific water distribution line replacements, and CRW should endeavor to refine the list of projects based on ongoing engineering analysis.
5. CRW is working diligently to maintain the condition of the Water System. The Water System is generally being maintained and operated in accordance with generally accepted utility standards and overall the Water System is in good repair and operating condition.
6. Neither CRW nor Arcadis is aware of any pending regulations that would have a material impact on its operations. It is, however, recommended that CRW continue to monitor potential revisions to the Lead and Copper Rule. Although any revisions may not take effect for several years, the revisions may have significant impacts, ranging from increased sampling to proactive public education and lead service line replacement. Though PADEP has not established any requirements for PFAS, it is recommended that CRW track any activity at the State level and closely follow Congress's actions particularly regarding several bills which could designate PFAS as a hazardous substance under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Furthermore, CRW has been in discussions with PADEP regarding the potential need to increase the spillway of the Dehart Dam to meet the 1990 regulations, which require spillway capacity equal to the maximum storm flow.
7. Based on the available information, Arcadis recommends CRW implement additional O&M efforts as described in this report, including the following:
    a. At the Water Service Center Treatment Facility, inspect the clear well, continue LED light replacement project, and complete miscellaneous mechanical O&M improvements.
    b. Hire a Meter Account Supervisor.
    c. Implement a backflow prevention program

   d. Continue lead gooseneck replacement as they are encountered and update Lead Assessment on GIS as necessary.

8. The additional O&M needs identified for the Water System are anticipated to require additional O&M budget funding in FY 2020. Depending on whether CRW completes those maintenance items in-house or with outside contractors, the cost of the items are expected to run approximately on average $183,000 per year, beginning in FY 2020.
9. An arc flash study is recommended for the water system in order to be in compliance with current NFPA 70E and OSHA 1910 (Subpart S) regulations. CRW intends to evaluate the need, scope, and budget for arc flash studies after completion of the improvement projects currently in the CIP.
10. It is recommended that a CRW compliance field audit of all 250 large meter accounts and all accounts with fire meters is conducted within the system with the primary purpose of ensuring compliance with CRW's Rules and Regulations.

This CEAR summarizes the work completed up to the date of the issuance of this CEAR. Changed conditions occurring or becoming known after such date could affect the material presented to the extent of such changes. Arcadis has no responsibility for updating this CEAR for changes that occur after the date of this report.

In preparation of this CEAR, Arcadis has relied upon financial, engineering and operational data, and assumptions prepared by and / or provided by CRW. In addition, information and projections have been provided by other entities working on behalf of CRW. We believe such sources are reliable and the information obtained to be appropriate for the review undertaken and the conclusions reached in this CEAR. To the best of our knowledge, information, and belief, the information does not omit material facts necessary to make the statements herein. However, Arcadis has not independently verified the accuracy of the information provided by CRW and others. To the extent that the information is not accurate, the findings and recommendations contained in this CEAR may vary and are subject to change.

Arcadis devoted effort in making such opinions consistent with that degree of care and skill ordinarily exercised by members of the same profession currently practicing under same or similar circumstances and the time and budget available for its work in its efforts to endeavor to provide such opinions. The opinions are based on information provided by and consultations with CRW. No responsibility was assumed for inaccuracies in reporting by CRW or any third-party data source used in preparing such opinions. Arcadis' opinions represent its professional judgment. Neither Arcadis nor its parent corporation, or their respective subsidiaries and affiliates, makes any warranty, expressed or implied, with respect to such opinions.

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