



City of Annapolis
Water & Sewer System Evaluation
Final 10-Year Plan

January 2019

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1. Goals, Policies and Procedures

1.1 Goals and Policies of the Ten-Year Water and Sewerage Plan and County Water and Sewer Master Plan

The City of Annapolis (City) is located in Anne Arundel County, Maryland. Title 9, Subtitle 5, Annotated Code of Maryland requires each County to develop water supply and sewerage systems in accordance with a County Master Plan which specifies the extent, adequacy, sizing, staging, and other characteristics of such facilities so that they are in compliance with State laws relating to air pollution, water pollution, environmental protection, and land use. It further specifies that the extension and expansion of such water supply and sewerage systems shall be consistent with the County's General Development Plan (GDP) and adopted Land Use Plan. Anne Arundel County (AACO) is required to include the City of Annapolis in the Water and Sewer Master Plan.

Additionally, the City, although not required by Maryland State Law, has voluntarily elected to adopt a Ten-Year Water and Sewerage Plan consistent with the requirements of all counties in Maryland and coordinated with the AACO Master Plan. The following was added to the City Ordinance:

16.04.080 - Ten-Year Water and Sewerage Plan.

The City of Annapolis Public Works Administration shall adopt a Ten-Year Water and Sewerage Plan required under Title 9, Subtitle 5, of the Environmental Article of the Annotated Code of Maryland. As required by State law, the plan shall be incorporated into the Master Plan developed by Anne Arundel County.

The purpose of the Ten-Year Water and Sewerage Plan is to provide for the orderly development, expansion and maintenance of water and sewerage systems in the City of Annapolis and to accomplish the following objectives:

1. *Be coordinated and consistent with the County Master Plan as required by State Law.*
2. *Further the health and welfare of citizens residing or working in the City of Annapolis through the development of adequate water and wastewater systems, including the following:*
 - a. *Ensure a dependable and ample supply of water for drinking and other household uses, irrigation, and recreation, for present and future populations.*
 - b. *Dispose of wastewater in a manner that will not degrade, and where possible, improve the surface and groundwater quality of the City of Annapolis.*
 - c. *Correct sanitary and water supply problems by using the most effective and economical technologies and methods.*
3. *Schedule and set priorities for water and wastewater projects in the Capital Improvement Program based on an evaluation of facilities usage, the need for maintenance, upgrade and/or expansion, public health considerations, and planned growth patterns consistent with the Comprehensive Plan based upon a current infiltration and inflow and water plant study.*

Any change in the fees set forth in the subsections below must reflect the actual cost of providing services as established by an annual review of the actual cost of providing water and sewer services (operating and capital) and where applicable, a concurrent rate study.

(Ord. No. O-25-09, § I, 9-14-2009)

1.2 City Planning Objectives

The City outlines specific land use, environmental, social, and economic objectives in the 2009 Annapolis Comprehensive Plan. The relevant objectives to this Ten-Year plan are noted below.

1.2.1 Land Use and Economic Development Objectives¹

- a. Directing growth to key redevelopment opportunity areas.
- b. Conserving the character of downtown and the City communities including, where appropriate, their mixed-use business and residential character.
- c. Responding effectively to long term environmental challenges.
- d. Encouraging economic growth with land use policies that retain and expand existing businesses and promote the emergence of new businesses in locations that provide optimal benefit to the community.

1.2.2 Water Resources²

- a. Protect and conserve the existing Water Supply and Distribution Systems.
- b. Enhance the Wastewater Collection and Treatment Systems.
- c. Maintain Water Resource Management Areas.

1.3 Water and Sewer Service Policies

The City of Annapolis provides clean, safe water and sewer service to residents of the City, the United States Naval Academy (sewer only) and a relatively small number of residents located outside the City. Per City Code 16.04.050, a person constructing a residential or commercial structure may request water and sewer service from the City of Annapolis Director of Public Works.

1.3.1 Out-of-City Services

If the proposed service for a property is outside of the City limits then the City Council must approve the extension prior to proceeding.

For non-City Customers the following list provides information on the procedure for making a physical connection.

- The applicant must demonstrate to DPW that adequate public facilities (APF) requirements have been met for DPW recommendation.

¹ See Chapter 3 of the 2009 Annapolis Comprehensive Plan.

² See Chapter 9 of the 2009 Annapolis Comprehensive Plan.

Applicants need to support their position that they have addressed the requirements for APF. At a minimum, they need to provide a brief Water and Sewer APF report that includes the projected average and peak daily water and sewer flows, the results of the fire flow test, the explanation of how they are supplementing the flow to address APF requirements and any supplemental information, including the computations that will help support their position.

- Water and/or Sewer Service Agreement approved by City Council (prepared by Law Office after DPW recommendation) and executed.
- Proof that the Agreement has been recorded among the Land Records of Anne Arundel County (AACO).
- If easements to the City are necessary as included on the exhibit accompanying the Service Agreement, separate easement with plat, metes & bounds description, and easement agreement must be completed and recorded among the Land Records of AACO by the developer/property owner.
- Department of Neighborhood & Environmental Programs (DNEP) "Tap Sheet" with Capital Facility, Connection & Tap Charges/Fees.

1.3.2 Privately Owned Individual Systems

An individual water supply or individual sewerage system is not permitted for new construction within the City (Ordinance 17.11.410). A limited number of existing privately own water supply and sewerage systems were moved into the City limits through annexations and will be shifted to City service as water and sewer services are extended to those areas. Rules and regulations governing these systems are determined by the Anne Arundel County Department of Health.

1.4 Asset Evaluations

In recent years, the City has completed a *Water and Sewer Systems Study* and hydraulic models to provide a basis for assessing the capacity and hydraulic deficiencies in the water distribution and sewer collection systems. In addition to these initiatives, in order to obtain a more comprehensive understanding of water and sewer assets, the City is completing a water and sewer system evaluation project using the principals of asset management (Evaluation Project). This will allow for improved prioritization of investments based on risk analysis (as a function of likelihood and consequence of asset failure). To date, the Evaluation Project has resulted in the development of recommended and prioritized pipeline renewal projects based on asset condition (that drives likelihood of failure) and consequence of failure ratings.

The findings of the Evaluation Project for the water distribution system are covered in Section 3. Similarly, Section 4 includes the findings associated with the City's sewer collection system.

1.5 Organization

The City Department of Public Works Administration is organized as shown in Figure 1. Engineering and Construction manages the capital program for the City. Utilities maintain the water distribution, wastewater collection, and stormwater systems. The Water Treatment Plant is its own group within the City.

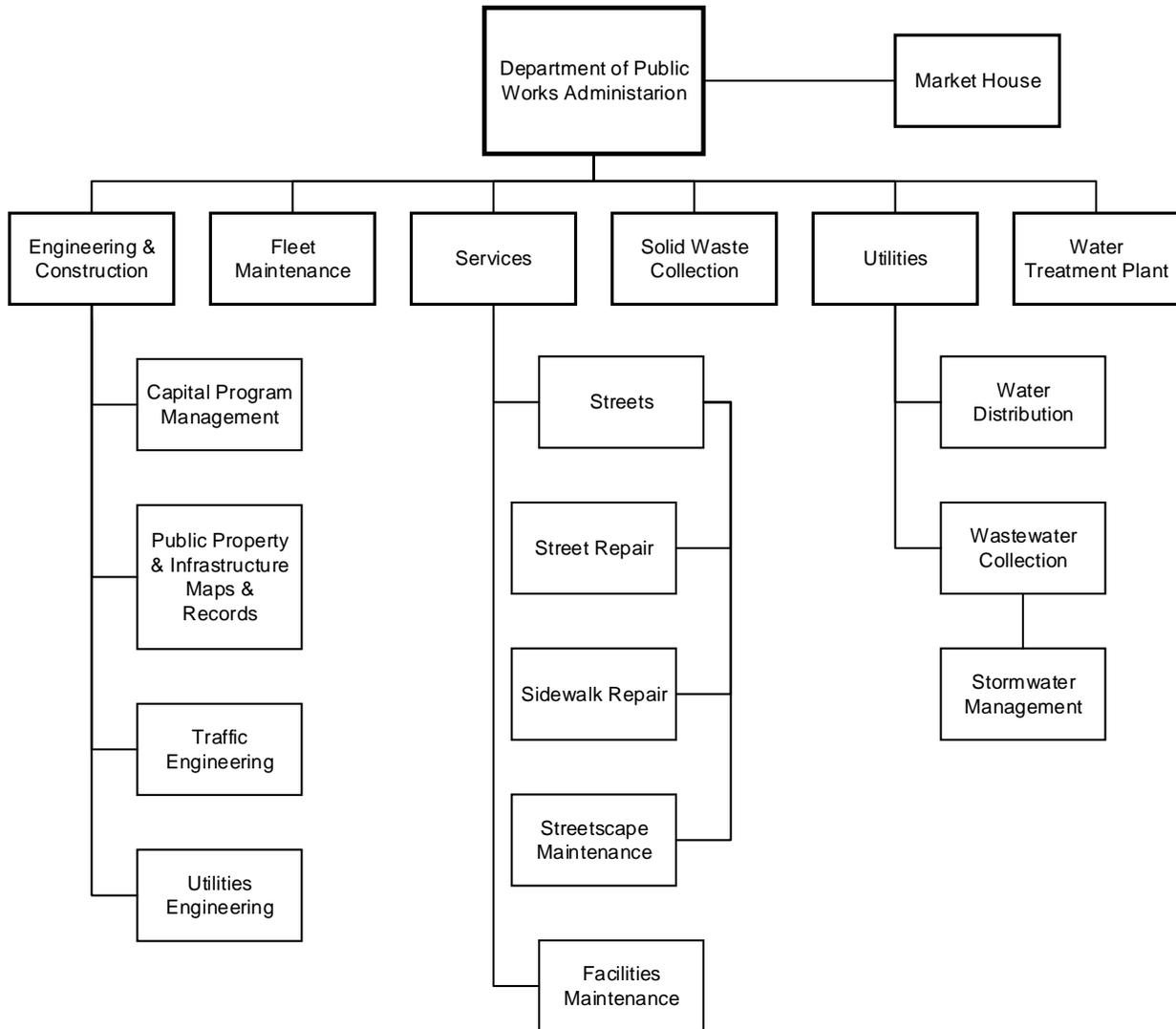


Figure 1: DPW Organizational Chart

1.6 Definitions

Asset - Anything of value such as an area of land, or a building, or an item of plant or equipment or infrastructure that provides service potential or future economic benefits over a period greater than one year and has a cost which is not "immaterial".

Asset Management - A systematic approach to the procurement, maintenance, operation, rehabilitation and disposal of one or more assets. It integrates the utilization of assets and their performance with the business requirements of asset owners or users.

Community Sewerage System - Any system, whether publicly or privately owned, serving two or more individual lots for the collection and disposal of sewage or industrial wastes of a liquid nature, including various devices for the treatment of such sewage and industrial wastes.

Community Water Supply System - A source of water and a distribution system, including treatment and storage facilities, whether publicly or privately owned, serving two or more individual lots.

Consequence - The outcome of an event or situation expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain.

Failure - The termination of the ability of an item to perform its required function. A condition at which a structure ceases to fulfill its functional purpose (such as leakage) or reaches a limit state (deflection, cracking). Usually failures do not involving full collapse because most structures are considered unsafe or unusable well before they collapse.

Individual Sewerage System - A single system of sewers and piping, treatment tanks or other facilities serving only a single lot and disposing of sewage or individual wastes of a liquid nature, in whole or in part, on or in the soil of the property, into any waters of this State or by other methods.

Individual Water Supply System - A single system of piping, pumps, tanks or other facilities utilizing a source of ground or surface water to supply only a single lot.

Infrastructure - Major capital works constructed to provide a framework for social and economic development. Roads, Rail, Ports, Electricity, Gas, Water and Wastewater utilities are examples of infrastructure as related to strategic asset management.

Land Use - The formulation of the future use of land resources, including any improvements to be made thereon. Land use planning is conducted at several levels of government by bodies such as urban planning authorities and regional planning authorities.

Likelihood - From a purely risk standpoint, the probability of something happening. From a statistical standpoint, it is the relative frequency of the occurrence of an event measured by the number of cases or alternatives favorable to the event, to the total number of cases or alternatives. From a clinical viewpoint, a probability assignment is a numerical encoding of the relative state of knowledge.

Project - A unique process, consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an object conforming to specific requirements, including the constraints of time cost and resources. Quite often an individual project can form either part of a larger project or program structure. An undertaking with a defined beginning and objectives by which completion is identified. A project may be completed using one contract or a number of contracts. A building or engineering undertaking from inception to completion, involving a number of interrelated activities. Any proposal that requires the weighing up of costs and benefits in order to meet a desired objective. The term is not restricted to a capital project.

Rehab/Rehabilitation - Extensive work intended to bring an asset up to a new standard or to alter it for a new use (refurbishment or upgrading).

Service Area - Area served by, or potentially served by, a system of sanitary sewers connected to a treatment plant, or a water distribution system under the control of a single unit or agency.

Useful Life - The estimated period of time over which a depreciable asset is expected to be able to be used, or the benefits represented by the asset are expected to be able to be derived from.

2. Background Information

The City of Annapolis provides clean, safe water and sewer service to residents of the City, the United States Naval Academy (sewer only) and a relatively small number of residents located outside the City. The City serves approximately 12,550 water accounts and 11,300 sewer accounts with an estimated population of 38,000. This chapter provides additional background information related to the water and sewer systems of the City.

2.1 Aquifers

Groundwater drawn from eight deep wells located near the water treatment plant supply the City's water system. Water is pumped from three Coastal Plain aquifers – the Magothy, Upper Patapsco and Lower Patapsco aquifers. These aquifers slope downward from northwest to southeast and, where situated below Annapolis, are protected by confining layers of relatively impermeable, clayey soil.

The Magothy aquifer is recharged where it crops out, an area of approximately 70 square miles in Anne Arundel County and another eight square miles in Prince Georges County. Possible exposures to the Magothy aquifer in the form of rock outcroppings have been reported in Bowie, which is approximately 10 miles west of Annapolis. Possible surface exposures to the deeper Patapsco aquifers would be more likely found further west and northwest, in the Columbia/BWI area. A study conducted jointly by the City and Anne Arundel County in 2003 concluded that there are no immediate threats to the raw water quality. A 2007 Study by the Maryland Geological Survey found that sufficient ground water is available to supply the projected demand through 2040; however ground water supply should continue to be monitored in order to plan for any shortfalls or threats that may arise in the future.

2.2 Groundwater Quality

The City facilities use only water from deep well aquifers as a water supply source. No Federal or State standards have been established for raw ground water (in the ground). There are standards that apply to a public drinking water source, but these are applied within the water distribution system, not in the ground. However, there are regulations concerning discharge of pollutants to ground water. The Water Resources Administration in the State of Maryland Department of the Environment (MDE) is responsible for the regulation of these discharges.

2.2.1 Wellhead Protection Studies

The Federal government requires each State to conduct assessments for the susceptibility of public drinking water sources to various contaminants. Source Water Assessments have been completed for all of the County's facilities and including the City of Annapolis wells located in Anne Arundel County. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are; 1) delineation of an area that contributes water to each source; 2) identification of potential sources of contamination within the areas; and 3) determination of the susceptibility of each water supply to contamination.

The County contracted URS Corporation in 2001 to study the Annapolis and Glen Burnie well sites. The study is comprised of two component parts. The first is the source water area assessment and the second component is a framework for developing proper land management tools for groundwater protection. The Wellhead Protection Plan for the City of Annapolis Study Area, Glen Burnie Study Area and Broad Creek Pressure Zone was completed in June 2003 by URS Corporation. The confined aquifer wells in the Annapolis area were assessed as having low susceptibility to contaminants originating at the land surface due to the protected nature of confined aquifers.

2.3 Population and Land Use³

2.3.1 Population

The 2010 Census counted 38,394 City residents, or 16,136 occupied households with an average household size of 2.3 people. In the years since the 2010 Census, the Maryland Department of Planning estimates that the City grew by another 462 people as of 2014. Over the past century, Annapolis has enjoyed a moderate, but steady growth in its population. A spike in growth occurred with major expansion through annexation in the 1950s. The growth rate from the 2000 Census to the 2010 Census was 7 percent. The average ten year growth rate over the past three decades was measured as six percent.

A slowing growth rate had also been predicted due to the built-out nature of this mature city. There has been some recent infill and redevelopment activity seen in the City's housing. Even with the redevelopment of Inner West Street to include higher density residential units and small infill sites around the City, however, it is likely that the population grow approximately at the same rate. Market conditions, as well as City land use policies, will determine if this will continue beyond the above mentioned projects.

2.3.2 Land Use

The City's geographic location on the Annapolis Neck Peninsula between the South River and Severn River leaves little room for physical expansion. Existing development outside of Annapolis, combined with the expansion of Parole on the western edge, leave Annapolis with few options for growth outside of present boundaries.

Beginning about 40 years ago, major commercial real estate development on the edge of the city and historic changes in the nature of retailing generally, impacted the City's commercial base, as it did many other communities across the nation. These trends created competition for traditional in-town retailers and impacted the commercial real estate market. However, after several decades of restructuring, Annapolis remains a vibrant commercial center and is positioned to capitalize on the energy and vitality created both within its borders and in the adjoining areas. The expansion of Westfield Mall, the continued growth and development of the Anne Arundel Medical Center, and the new Annapolis Towne Centre at Parole all point to the economic vitality of the Annapolis area, of which Annapolis is the center.

³ From 2009 Annapolis Comprehensive Plan with updated data from recent US census and by City Planning and Zoning Department.

For decades, Annapolis has promoted and supported development policies that are in balance with its geographic constraints and area-wide development trends. The City has optimized land use within its borders, promoted a mix of commercial and residential redevelopment of underutilized land, and conserved and revitalized downtown and its residential districts.

Existing land use acreages are shown in Table 1 and Figure 2. Residential land uses (multi-family, single family, and townhouse dwellings) account for approximately 53 percent of the total land area.

Table 1: Existing Land Use Acreage, 2017

Land Use Category	Acreage	Percent of Total
Commercial	337	7.47%
Industrial	31	0.69%
Institutional	408	9.05%
Maritime	98	2.17%
Mixed Use	21	0.46%
Recreation & Open Space	327	7.25%
Residential	2371	52.56%
Vacant	164	3.63%
Roadways	754	16.71%
Total	4511	100.00%

Source: City of Annapolis

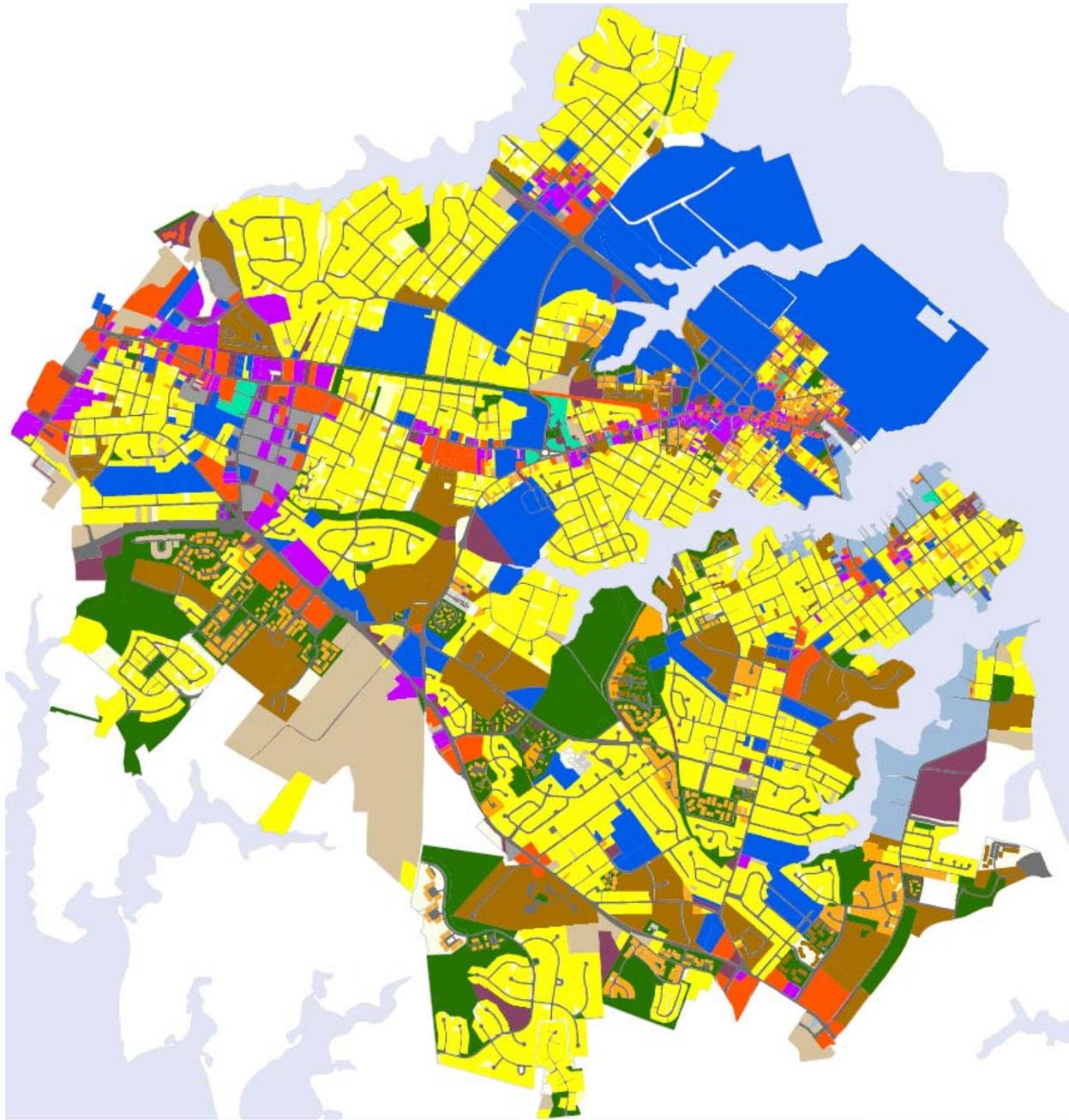


Figure 2: 2017 Land Use (City Department of Planning and Zoning)

3. Water Supply Systems

3.1 General Information

The City provides clean, safe water and sewer service to the residents of the City, the United States Naval Academy (USNA) (sewer service only), and a relatively small number of residents located outside the City.

The City water service extends to about 38,000 people through 12,200 water service accounts. Figure 3 shows the high level descriptive statistics for the City’s major water service infrastructure.

1.5 billion gallons of potable water produced per year	8 Million Gallons per Day (MGD) water treatment capacity	137 miles of water pipes
1 water treatment plant	5 elevated water storage tanks ⁴	2,900 water valves
8 groundwater wells (3 aquifers)	2 1-MG ⁵ /each finished water storage tanks	1,240 fire hydrants

Figure 3: High Level Descriptive Statistics for the City Of Annapolis Water Assets

A high level representation of the City’s water treatment and distribution network is shown in Figure 4.

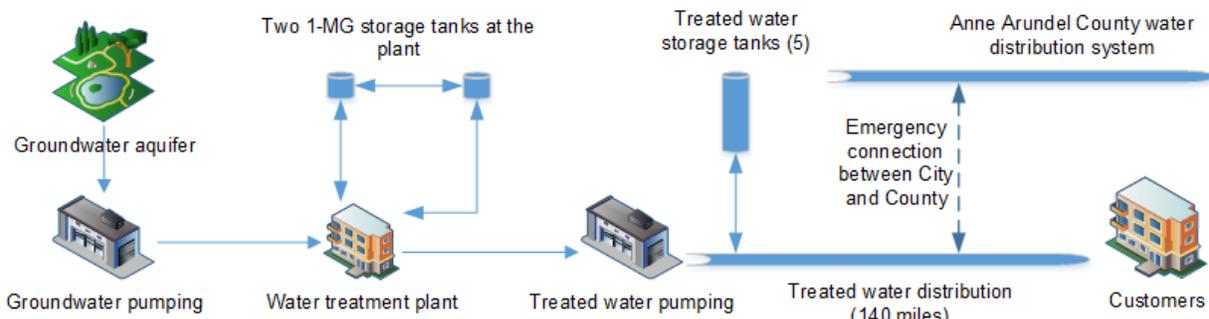


Figure 4: Main Components of the City Of Annapolis Water Treatment and Distribution Network

3.1.1 Groundwater Pumping

⁶Groundwater drawn from eight deep wells located near the water treatment plant supply the City’s water system. Water is pumped from three Coastal Plain aquifers – the Magothy, Upper Patapsco,

⁴ 5.5 MG total and 4.0 MG usable capacity.

⁵ These covered finished water storage tanks are located at the City’s water treatment plant.

⁶ Modified excerpt from 2013 Anne Arundel County Water and Sewer Master Plan & 2009 Annapolis Comprehensive Plan.

and Lower Patapsco aquifers. These aquifers slope downward from northwest to southeast and, where situated below Annapolis, are protected by confining layers of relatively impermeable, clayey soil.

The City groundwater wells and average gallons per day production capacities are listed in Table 2. The total average water production rate shown in Table 2 is 3,938,770 gallons per day.

Table 2: City Of Annapolis Groundwater Wells

Source Name	Average 2015 Production, gpd ⁷	Aquifer Formation	Total Depth, feet	Capacity, gpm ⁸	Tax Map
Annapolis Well 2	213,655	Magothy	258	608	44
Annapolis Well 5	350,580	Magothy	248	900	44
Annapolis Well 6	365,574	Magothy	242	940	44
Annapolis Well 7	402,707	Magothy	345	932	44
Annapolis Well 10	597,218	Upper Patapsco	520	1,209	44
Annapolis Well 11	408,869	Upper Patapsco	495	1,241	44
Annapolis Well 12	753,685	Lower Patapsco	1171	1,895	44
Annapolis Well 14	428,020	Lower Patapsco	1093	2,115	44
TOTAL	3,520,308	All	-	9,930	-

3.1.2 Water Treatment

The Annapolis Water Treatment Plant (WTP) provides water to the City’s water customers and is located along MD 450 just east of I-97 within Anne Arundel County limits. The WTP has a hydraulic capacity of 8.0 MGD. Treatment consists mainly of iron removal via injection of chemicals that cause the iron and other minerals in the raw water to coagulate and settle out, followed by filtration and chlorination/fluoridation. With the completion of two raw water wells (in 2010) in the Lower Patapsco aquifer, the WTP now has a total of eight wells in three aquifers.

The WTP main filtration process building is over 85 years old and, while it was well constructed, the existing WTP is at the end of its useful life. To address this, the City is building a new 8 MGD WTP (for an estimated total project cost of \$35 million) adjacent to the existing facility under the FY12 and FY13 Capital Improvement Programs (CIPs). The new WTP is operational with final construction completed in 2018.

⁷ gpd stands for gallons per day.

⁸ gpm stands for gallons per minute.

3.1.3 Storage and Distribution

The existing water system facilities include four distribution pumps at the WTP (four in the new WTP), five elevated water storage tanks with overflow elevation of 173 feet, and approximately 140 miles of water mains that range in size up to 24-inch.

The elevated tanks include a standpipe on Jefferson Street, an elevated tank on the Naval Academy Stadium site, two elevated tanks at the intersection of Janwal Street and Barbud Lane, and an elevated tank on Edgewood Drive at the site of the Back Creek Nature Park. The combined total volume of the water tanks is 5.5 MG, though useable storage volume is approximately 4.2 MG. The storage volume and type of these storage tanks are shown in Table 3.

**Table 3: City of Annapolis Water Distribution System
Storage Tank Types and Effective Volumes**

Storage Tank Name	Storage Tank Type	Storage Tank Useable Volume (MG)
Bembe	Elevated multi-column	1.00
Farragut	Elevated spheroid	0.50
Janwall #1	Elevated multi-column	0.50
Janwall #2	Elevated composite	1.50
Jefferson	Standpipe	0.73
TOTAL	-	4.23

In addition, the WTP has two 1 MG finished water storage tanks (useable with backup power). The City is also completing a new Supervisory Control and Data Acquisition (SCADA) system for the distribution tanks that will better communicate data back to the WTP, including tank levels that allow control of the WTP distribution pumps.

The City water distribution system serves all areas within the City limits and also extends outside the City to supply areas including parts of Loretta Heights to the west, Lindamoor and Dreams Landing north of Weems Creek, and the Chesapeake Harbor complex to the southeast of city limits. Figure 5 shows the City's water service area.

Water Pressure Across the City Water Service Area

The whole water service area is essentially served as a single pressure zone with a nominal hydraulic grade line of 173 feet. Most of the City is served with adequate water pressure at the current levels. The southern parts of the City (areas adjacent to Forest Drive prior to Hillsmere Drive) are higher in elevation, up to 125 feet above sea level, and experience lower water pressure and/or use individual booster pumps. Future development or any additional demand in these areas are evaluated with respect to the availability of sufficient water pressure and fire flow and are required to modify and/or add systems to assure adequate water service.

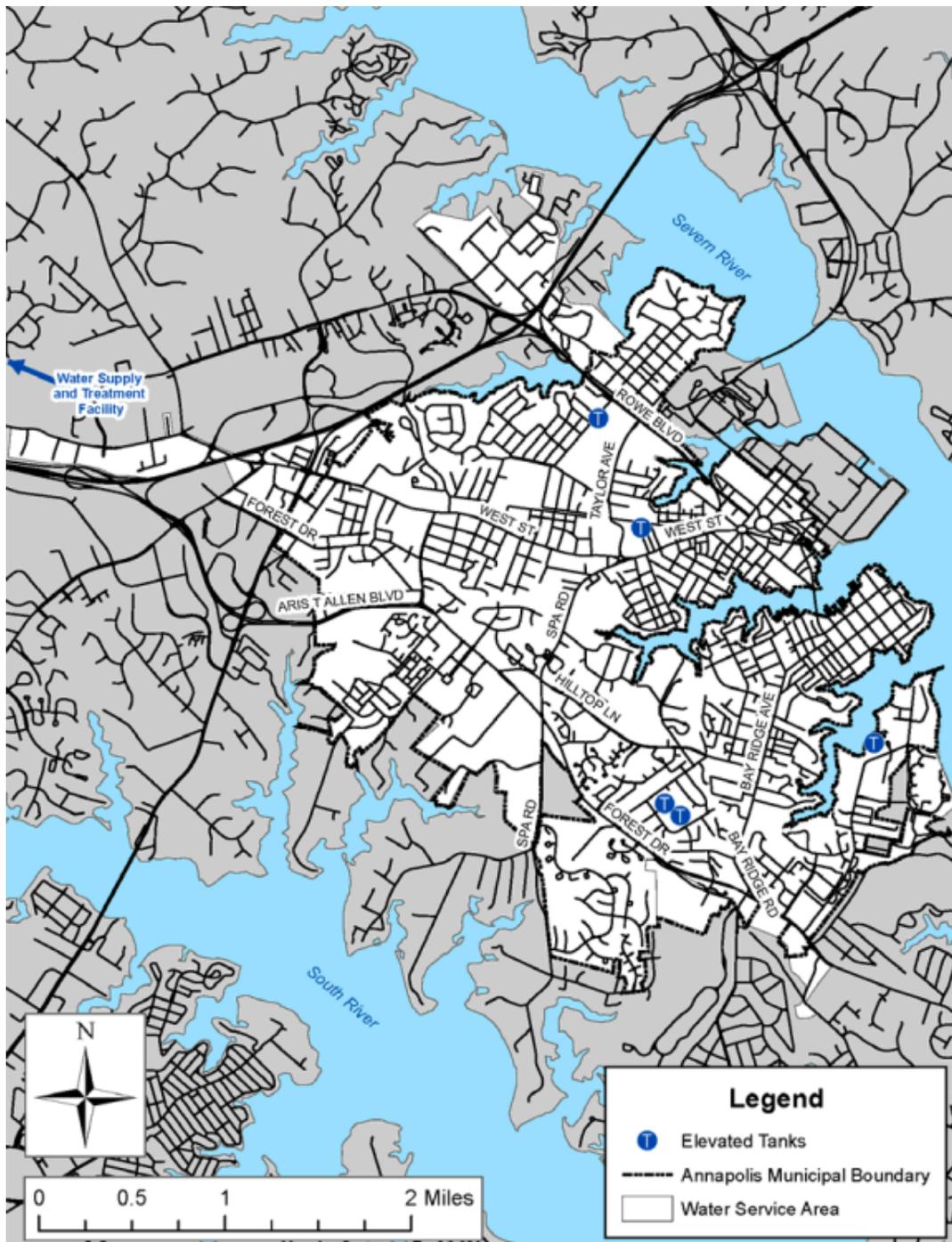


Figure 5: City Of Annapolis Water Service Area
(Provided by City MIT)

3.1.4 Water Distribution System Installation Profile

As noted above, the City operates a water distribution network of 137 miles. Figure 6 shows the approximate miles of water pipes that were installed per decade since the early 1900s.

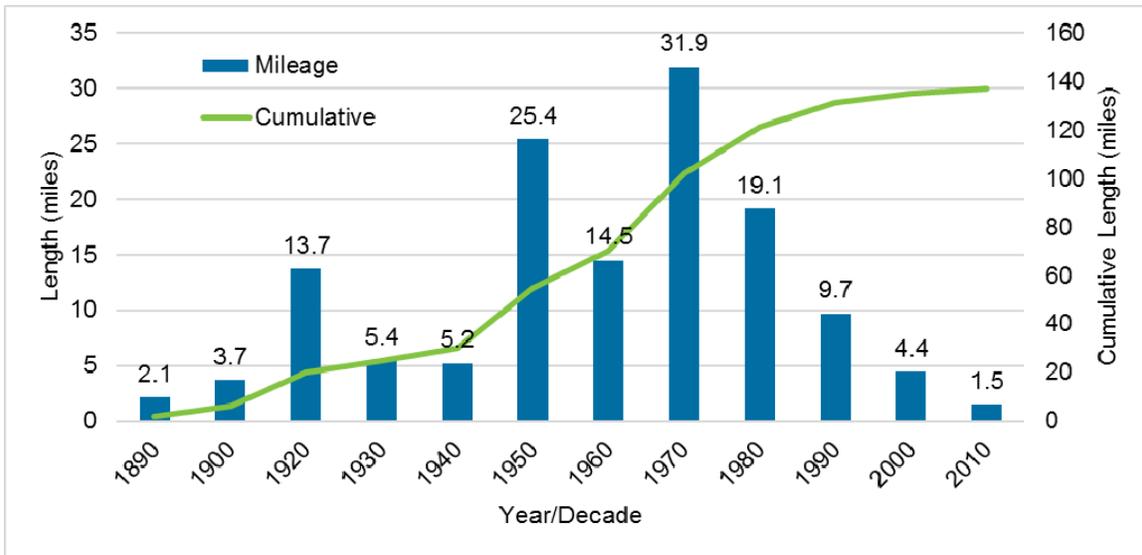


Figure 6: City of Annapolis Miles of Water Distribution Pipe Installed per Decade

As seen in Figure 6, the City has experienced most of its growth between 1950 and 1980. During this interval, 91 miles of the City’s water distribution system was installed.

3.1.5 Condition of Water Pipes

A desktop condition assessment has been performed for the City’s water pipes as part of the Evaluation Project. The desktop condition assessment model determines the condition ratings of the water pipes based on:

- Pipe age
- Pipe material & manufacture year (which help determine life expectancy and initial pipe wall thickness)
- Soil corrosivity based on USDA/USGS¹⁰ data
- Average operating pressure based on the hydraulic model and surge model analysis City as performed in 2014¹¹
- Work order history.

The results of the desktop condition model for the City’s water pipes are shown in Figure 7.

¹⁰ USDA: United States Department of Agriculture; USGS: United States Geological Survey

¹¹ Pipes experiencing negative pressure in the 2014 surge analysis report have been penalized by reducing their expected useful lives by 20 percent.

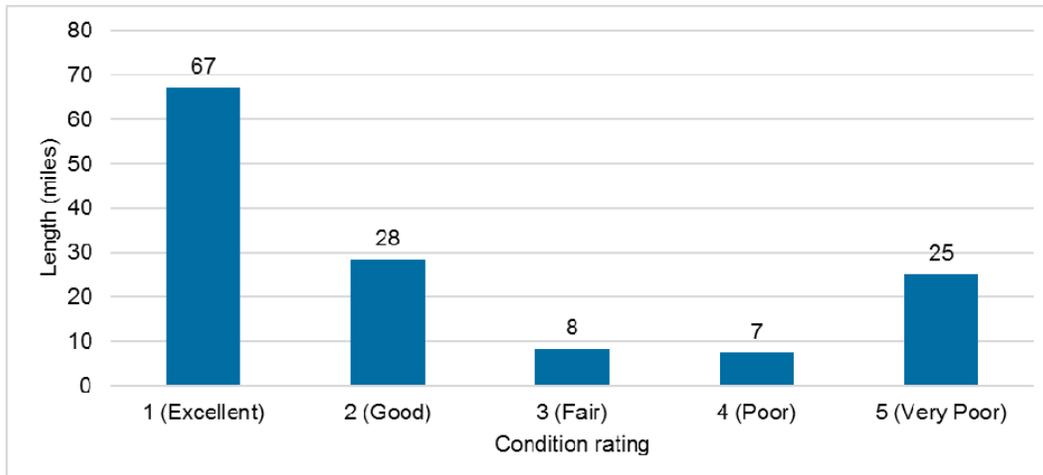
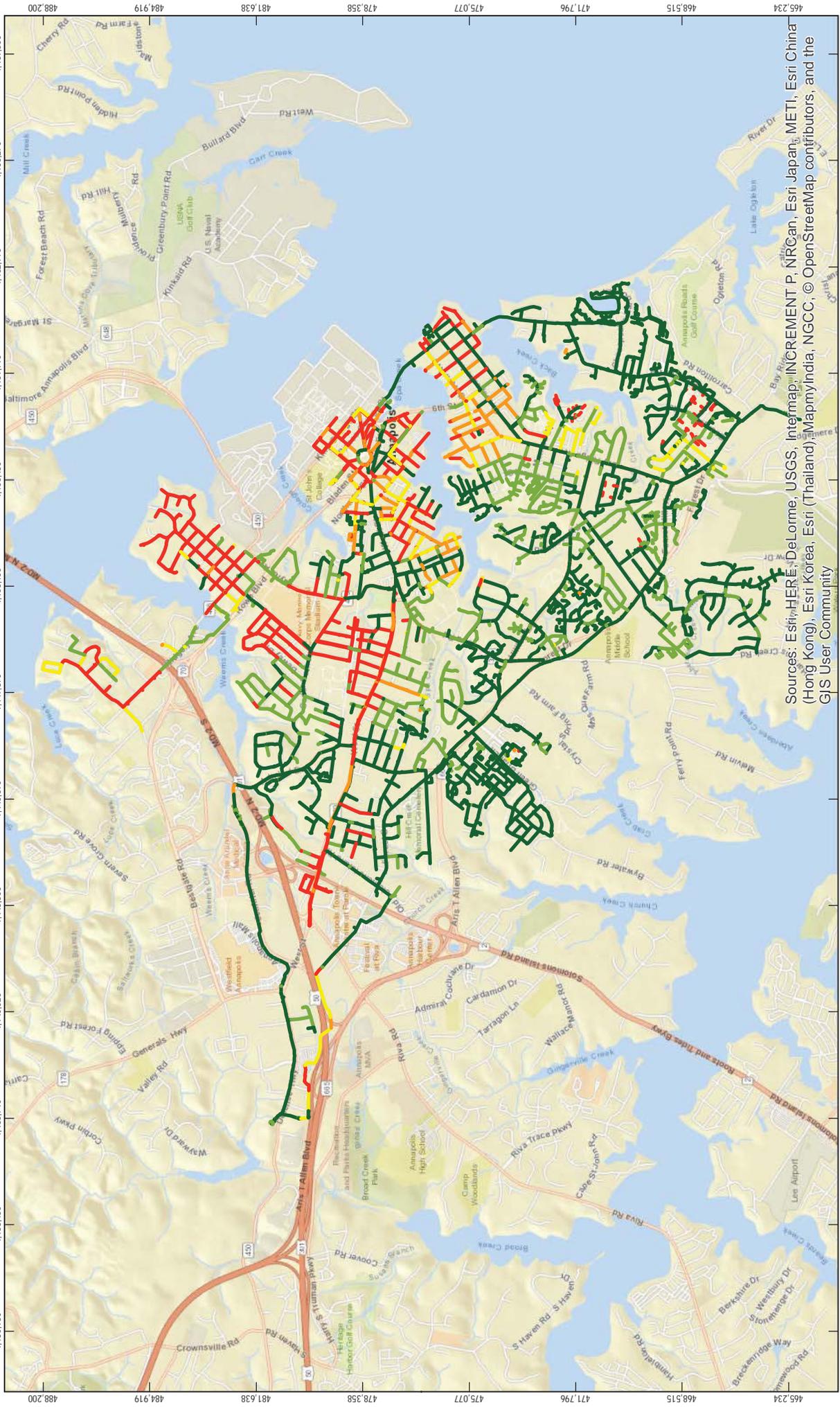


Figure 7: City of Annapolis Water Distribution Pipe Mileage by Condition Rating (a Rating of 1 Indicates Excellent and a Rating of 5 Indicates Very Poor Asset Condition)

Figure 7 shows that vast majority of City's water pipes (~95 miles) have a condition rating of 1 (excellent/new) and 2 (good). Approximately 25 miles of City's pipes have registered a condition rating of 5 (very poor).

The desktop assessment condition ratings across the City's water pipes are shown in Figure 8. The pipes in very poor condition, according to the desktop condition modelling effort, are among the first batch of candidate assets for renewal.

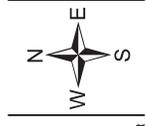


Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

Paper Size ANSIA

0 2,450 4,900
Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Maryland FIPS 1900 Feet



Condition Rating

1 2 3 4 5

GHD CLIENTS | PEOPLE | PERFORMANCE

City of Annapolis

City of Annapolis	Job Number	86-18182
Water/Sewer Buried Asset Evaluation	Revision	A
Buried Water Asset Condition Ratings	Date	02 Oct 2018

Figure 8: City of Annapolis Map of Water Pipes by Condition Rating

3.1.6 Consequence of Failure of Water Pipes

A desktop consequence of failure assessment has been performed for the City's water pipes as part of the Evaluation Project. The desktop consequence of failure assessment model determines the consequence of failure ratings of the water pipes based on pipe diameter, location, and proximity to attributes such as buildings, roads, historic district, etc. The results of the desktop consequence of failure model for the City's water pipes are shown in Figure 9.

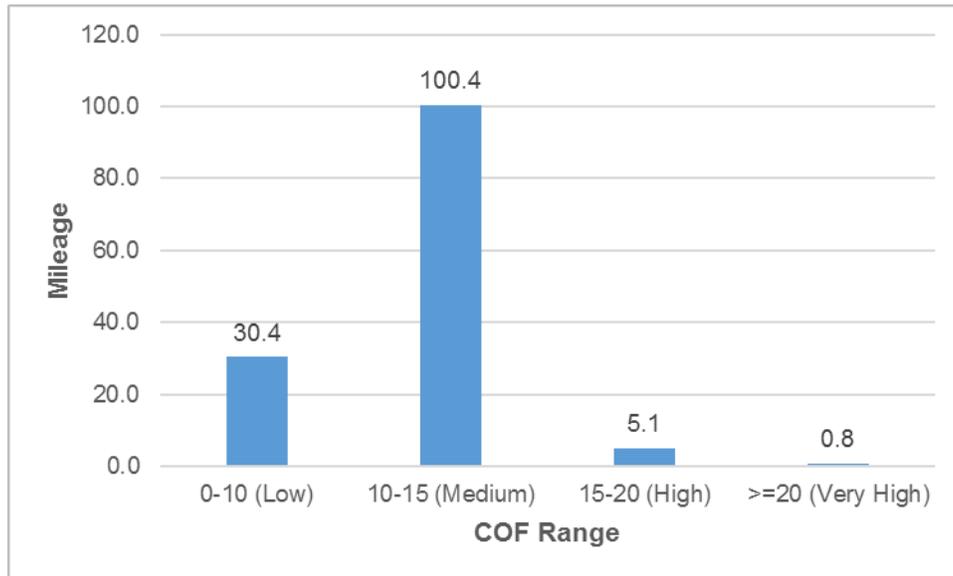
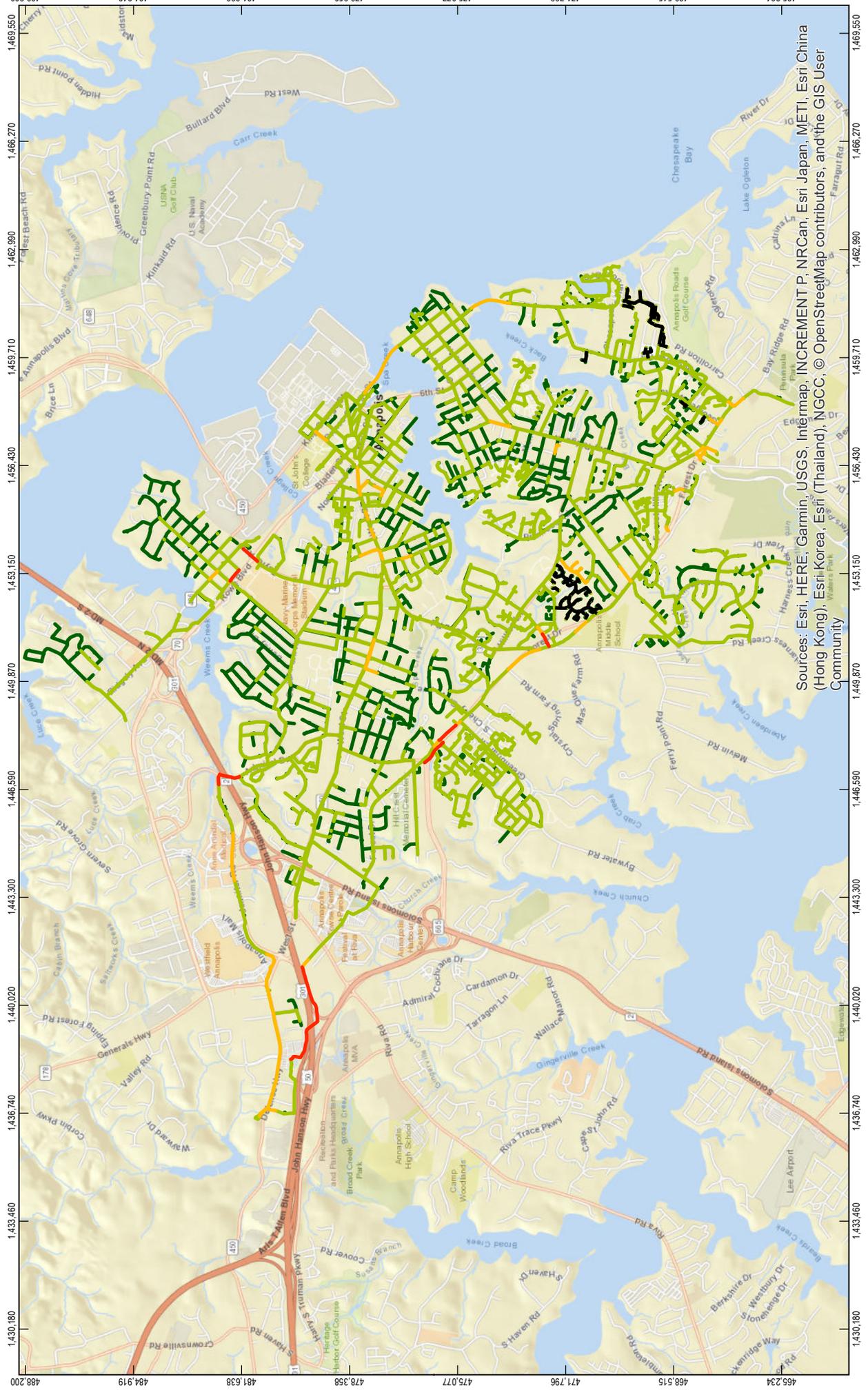


Figure 9: City of Annapolis Water Distribution System Pipe Mileage by Consequence of Failure Rating

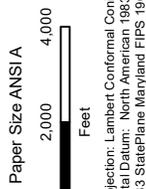
As shown in Figure 9, 30 miles of City's water pipes have a consequence of failure rating of less than 10 (low). About one mile of City's water pipes have registered a consequence of failure rating of 20 and above (very high). A majority of the City's water pipes have medium COF ratings.

Figure 10 shows a map of the City's water pipes by their consequence of failure ratings. The pipes in high consequence of failure areas, according to the desktop condition modelling effort, are among those that will be closely monitored.



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

- Consequence of Failure Rating**
- 0-10 (Low) —
 - 10-15 (Medium) —
 - 15-20 (High) —
 - >=20 (Very High) —
 - Private Lines —



Map Projection: Lambert Conformal Conic
 Horizontal Datum: North American 1983
 Grid: NAD 1983 StatePlane Maryland FIPS 1900 Feet

City of Annapolis
 Water/Sewer Buried Asset Evaluation
 Buried Water Asset COF Ratings



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Job Number 86-18182
 Revision A
 Date 18 Dec 2018

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Figure 10: City of Annapolis Map of Water Pipes by Consequence of Failure Rating

3.2 Future Demand Projections

The 2010 Census counted 38,394 City residents, or 16,136 occupied households with an average household size of 2.3 people. The City population estimate for 2014 (by the US Census Bureau) is 39,000 and expected to increase to 42,600 by year 2035. The City is primarily developed. The majority of the water demand (69 percent) is for residential use with the remaining 31 percent being for commercial and institutional use as there is no industrial water use¹². However, redevelopment of property and several annexations from the County have occurred in recent years. The projected water demands for the City from 2010 to 2025 are shown Table 4. These projections account for the fact that even though the population has increased over the last few years, the average water demand has decreased from 3.89 MGD in 2011 to 3.54 MGD in 2015 due to several factors including increased usage of water saving fixtures.

Table 4: City of Annapolis Water Demand Projections

Year	Average Daily Flow (MGD)	Maximum Daily Flow (MGD)
2015 (Actual)	3.54	5.1
2020	3.6	5.3
2025	3.7	5.5

The City has been allocated an average daily use of 5.5 million gallons by the MDE with an average daily supply of 11.96 million gallons during the month of maximum use. These allocations level are sufficient for the City's projected needs through 2025 and beyond. Assuming the largest well is out of service, and pumping the other wells at the noted rate for 24 hours per day, the available pumping capacity is estimated to be 11.6 MGD. This is sufficient to meet the City's maximum daily flow needs at least through 2025 and for several decades to come at the City expected future water demand projection increase of 0.01 MGD per year¹².

3.3 Privately Operated Facilities

The USNA owns and operates its own wells, water treatment plant, and distribution system that serve most of the Campus. The USNA system is interconnected with the City's system at one tie-in location for emergency backup purposes only. Information on the USNA wells is shown in Table 5, as described in the 2013 Anne Arundel County Water and Sewer Master Plan.

Table 5: USNA Groundwater Wells

Well Name	Average Water Production Rate, gpd	Aquifer Formation	Well Depth, feet
USNA well 15	1,750,000	Patapsco	593
USNA well 16	1,750,000	Patapsco	598
USNA well 17	1,750,000	Patapsco	693

Private wells serve a high percentage of the Anne Arundel County (AACO) Annapolis Neck peninsula since AACO does not currently have public water service beyond the intersection of Forest Drive and Chinquapin Round Road. There are a limited number of AACO properties that are served by City water on the peninsula, but there are a significant number of households,

¹² 2017 draft water supply capacity management plan cover letter

particularly in the Lower Neck area, that continue to rely on private wells, some of which are of poor quality. The County has and continues to evaluate methods to extend service to these areas.

3.4 Drinking Water Standards

3.4.1 Brief History of Federal Drinking Water Regulations

In 1974, the Safe Drinking Water Act (PL93-523) was passed. Through this Act, the Environmental Protection Agency (EPA) was required to establish national drinking water standards, which became effective June 24, 1977. Most implementation and enforcement responsibilities were given to the State.

In 1986, Congress passed the Safe Drinking Water Act Amendments, which formalized the implementation process, setting definite goals and deadlines for EPA to establish additional water quality standards.

In 1996, the Safe Drinking Water Act was re-authorized. There were three major changes to this Act. First, a more realistic schedule for the establishment of new water quality standards was adopted. Second, a requirement for certain utility owners to protect groundwater sources through “wellhead protection studies” was included. Finally, the 1996 Act required most water system owners to distribute water quality information to all of their customers through a “Consumer Confidence Report”.

3.4.2 State Regulatory Agency

The MDE has responsibility for all aspects of groundwater resource management (including policies to ensure the Safe Drinking Water Act requirements are met), as well as the inspection of public water supply systems. This includes assuring utility owners properly completed wellhead protection studies and the issuance of permits for the appropriation of groundwater. It also includes the routine monitoring of water systems through site inspections and water quality analysis.

The Maryland Department of Health and Mental Hygiene assists MDE by performing lab analyses and managing a program to certify water quality laboratories. The Maryland Geological Survey assists MDE by monitoring groundwater levels and pumping trends as well as testing for certain constituents in the groundwater supply such as radionuclides.

As indicated previously, a wellhead protection study including the City wells was completed in 2003 and concluded that there are no immediate threats to the City's raw water quality and little chance of any change to this condition in the future.

Additionally, monitoring and testing the public water supply is a continual effort for the City. As the EPA establishes new water quality regulations and standards, MDE provides direction to the City on implementation of the federal drinking water standards.

Lastly, the City completes and distributes an annual Water Quality Report. The Reports can be accessed on the City's website by visiting <http://www.annapolis.gov/government/city-departments/public-works/annual-drinking-water-reports>.

3.4.3 Primary and Secondary Standards

The EPA has established a set of primary and secondary drinking water standards for municipal water systems. Enforceable by law, the primary drinking water standards set limits for certain contaminants that can be found in public water systems: microorganisms, disinfection byproducts, disinfectants, organic and inorganic chemicals, and radionuclides. The maximum contaminant level (MCL) or treatment technique (TT) is given for each contaminant, which is enforceable by law. The maximum contaminant level goal (MCLG) is also defined but is not enforceable by law. In order to comply with these standards, the required sampling and analyses vary greatly. Some analyses are required on a daily basis for every water system, while other analyses are performed only once every three years, and only on the largest systems.

Secondary standards are unenforceable federal guidelines regarding certain substances that may affect the general quality of potable water. These standards are suggested as recommended levels that result in a generally accepted water quality. Above these levels, the taste, color, and odor generally become objectionable to the general public.

As of the date of the report the City has not experienced any violation of primary contaminants MCLs. It is only necessary for the City to treat for the secondary contaminants of iron and manganese.

The EPA in conjunction with state and local agencies and institutions continually evaluates the drinking water standards to promote human health and safety. The EPA issues new water quality rules periodically, requiring the City's monitoring and testing efforts to continually evolve. EPA's current National Primary and Secondary Drinking Water Standards can be found at www.epa.gov/safewater/contaminants.

3.5 Financial

3.5.1 General

Table 6 provides the financial statistics for the City water fund based on the adopted FY 2016 Operating Budget.

Table 6: City of Annapolis Water Fund Financial Management Statistics

Item	Adopted FY 2017	Adopted FY 2018	Adopted FY 2019
<u>Revenues</u>			
Water Charges	7,215,467	7,170,000	8,187,500
Capital Facilities	524,000	523,600	554,000
Money and Property	50,000	50,000	10,000
Total; Water Fund Revenues	7,789,467	7,743,600	8,751,500
<u>Expenditures</u>			
<u>Water Plant</u>			
Salaries and Benefits	1,259,966	1,311,590	1,259,138
Operating	814,408	665,000	663,000
<i>Subtotal</i>	2,074,375	1,976,590	1,922,138

Item	Adopted FY 2017	Adopted FY 2018	Adopted FY 2019
<u>Water Distribution</u>			
Salaries and Benefits	925,498	979,070	1,106,856
Operating	525,411	535,900	584,500
<i>Subtotal</i>	1,450,909	1,514,970	1,691,356
<u>Non-Allocated Expenses</u>			
Contributions			
Debt Service	2,923,228	2,887,609	2,775,630
Other Financing Uses and Transfers	1,131,694	1,360,508	1,580,815
Transfer to Fleet Replacement Fund			12,000
<i>Subtotal</i>	4,054,922	4,248,117	4,368,445
Total Uses of Funds	7,580,205	7,739,676	7,981,939
Projected Change in Fund Balance	209,262	3,924	769,561

3.5.2 Charges and Assessments

In 2010, the City completed a comprehensive water and sewer rate study that included recommendations for changes to the rates, capital and connection charges and the rate structure. The City currently reviews and updates their water and sewer rates and charges on an annual basis. An outside consultant assists the City with the evaluation and typically submits their report for use in the upcoming fiscal year's budget. For more details on the charges and assessments, refer to the Finance Department page on the City website or visit the City Municipal Code online at https://library.municode.com/md/annapolis/codes/code_of_ordinances?nodeId=AP_FEES_SCHED_ULEFY2019.

3.5.3 Capital Improvement Program

The City utilizes a six-year Capital Improvement Program (one year actual with five year projection) for planning the necessary expansions and renewals to the water and wastewater infrastructure.

All plans for major water and sewer projects financed by the City must be reviewed and approved by the City Council. Table 7 lists the current water capital improvement projects within the City.

Table 7: City of Annapolis Water Capital Improvement Projects¹⁴

Project Title	Project Number	Description
Water Tank Rehabilitation	71002	This project provides for water tank painting, repairs and retrofits of valves, foundations, structures and site improvements to the five elevated water tanks used for storage of the City's water supply. Tanks are painted in a cyclic order, and periodic repairs and retrofits of the altitude valves, structures and site improvements are made to the tanks.

¹⁴ With funding for FY19 through FY24 per Adopted FY2019-2024 Capital Improvement Program (<https://www.annapolis.gov/DocumentCenter/View/10464/Fiscal-Year-2019-Adopted-Capital-Budget-and-Capital-Improvement-Program-FY2019---FY2024-PDF>)

Project Title	Project Number	Description
Water Distribution Renewal	71003	The existing water distribution grid is aging, as is evidenced by the frequent failures. The City's Water and Sewer Comprehensive Analysis Plan was recently developed using typical asset management practices incorporating both probability and consequence of failure factors. The Plan establishes risk to every asset and outlines the priority water distribution system rehabilitation capital needs for the next 5 years. This CIP project includes design and construction of identified priority projects. The Plan also identifies additional planning work and assessment strategies necessary to refine prioritization of water distribution infrastructure upgrades into the future.

3.5.4 Water Distribution System Recommended Improvement Areas

To support water distribution system renewal project (CIP# 71003), the Evaluation Project has determined the recommended improvement areas shown in Table 8 and illustrated in Figure 11.

Eleven improvement areas have been developed for the water pipes based on the desktop condition ratings. The projects' execution should be prioritized based on the output of the consequence of failure model and the other planned utility or pavement renewals.

The renewal recommendations in the improvement areas total about \$79 million in 2019 dollars including costs associated with both design and construction. Over 17 years (2019 through 2035), the annual average cost is estimated at just under \$5 million per year, including the renewal needs identified in the 2014 hydraulic study performed by the City, which total about \$5 million.

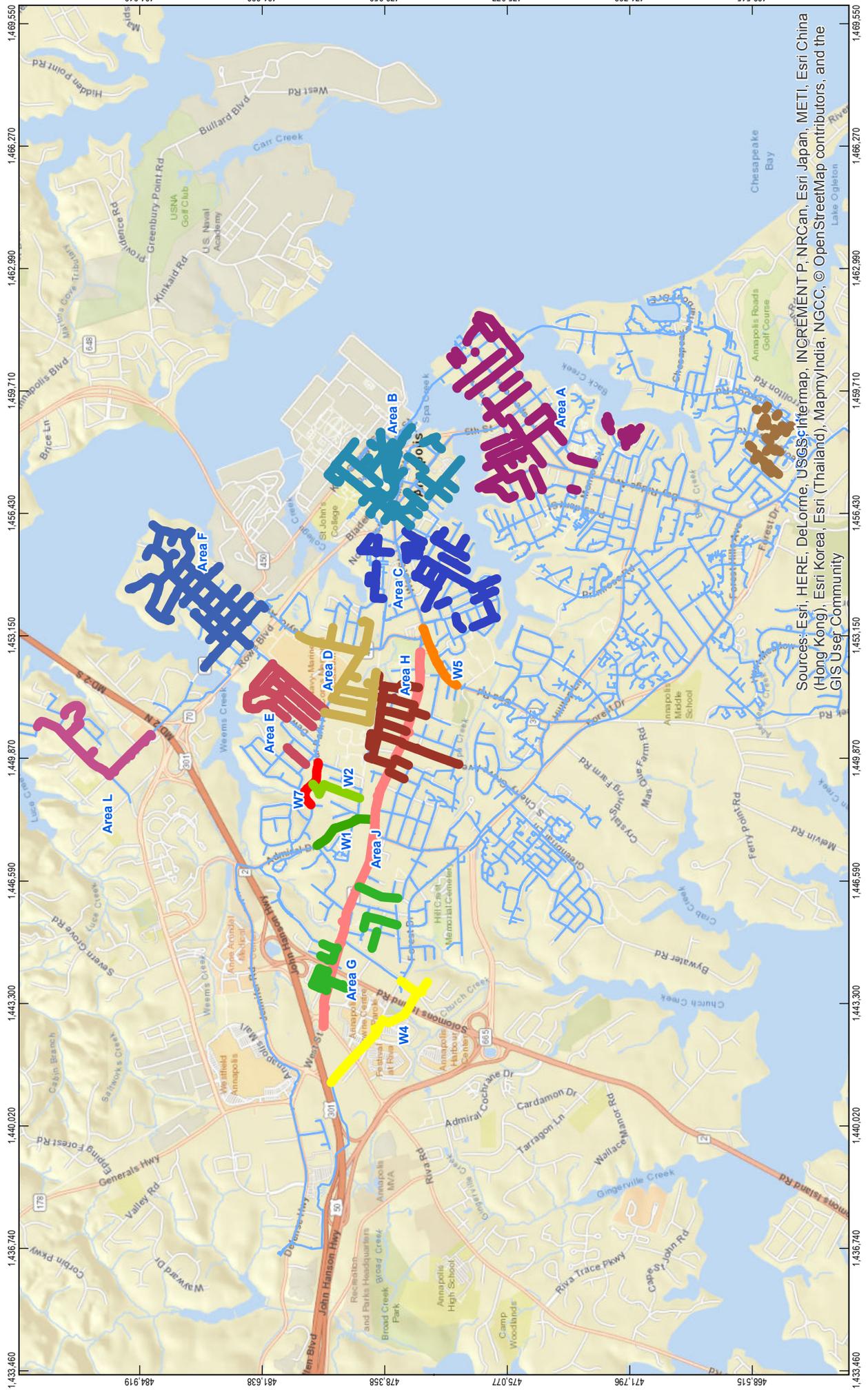
Table 8: City of Annapolis Water Distribution Recommended Projects

Area	Length (feet)	Length (miles)	Estimated Cost (2019)	Average Cost per LF ¹⁶
A ¹⁷	23,321	4.4	\$11,880,000	\$509
B	21,030	4.0	\$11,540,000	\$549
C	15,829	3.0	\$8,640,000	\$546
D	9,694	1.8	\$5,280,000	\$545
E	10,361	2.0	\$4,990,000	\$482
F	22,789	4.3	\$11,420,000	\$501
G	6,921	1.3	\$2,860,000	\$413
H	10,748	2.0	\$5,310,000	\$494
J	19,472	3.7	\$12,940,000	\$665
K	3,137	0.6	\$1,090,000	\$347
L	6,094	1.2	\$2,780,000	\$456
TOTAL	149,396	28	\$78,730,000	\$527

The investment profile associated with the improvement areas is shown in Figure 12. During the planning stage for each project, further project splits may be needed to manage the biannual expenditures per the CIP Funding. The project costs shown in the investment profile are distributed to account for the time it takes to plan, design, permit, and construct.

¹⁶ Unit costs in downtown, Eastport, and along West Street are 10 percent higher due to traffic rerouting or other access difficulty related issues. This affects areas A, B, C, and J.

¹⁷ Covers Eastport area. Eastern Ave, Fifth St, and parts of Chesapeake Ave are in City's pavement schedule for 2016-2017. City has recently replaced some pipes (between First and Sixth St) on Chesapeake Ave to take advantage of the natural gas pipe installation work BGE has performed.



Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

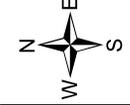
Job Number 86-18182
Revision A
Date 10 Dec 2018

City of Annapolis
Water/Sewer Buried Asset Evaluation
Buried Water Asset Projects



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Project Areas	Area W1	Area W2	Area W3	Area W4	Area W5	Area W6	Area W7
Area A	Area E	Area F	Area G	Area H	Area I	Area J	Area K
Area B	Area L	Area M	Area N	Area O	Area P	Area Q	Area R
Area C	Area S	Area T	Area U	Area V	Area W	Area X	Area Y
Area D	Area Z	Area AA	Area AB	Area AC	Area AD	Area AE	Area AF



Paper Size ANSIA
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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
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Figure 11: City of Annapolis Water Distribution System Areas Based on Pipe Condition and Consequence of Failure Ratings

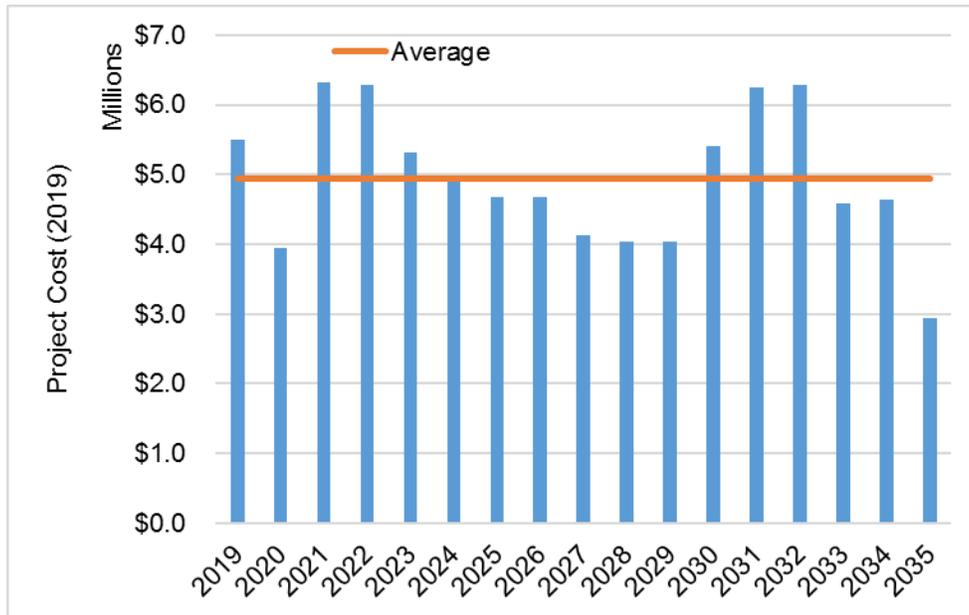


Figure 12: City of Annapolis Areas for Improvement Estimated Costs per Year Between 2019 and 2035

4. Sewage Systems

4.1 General Information

The City provides sewer service to the residents of the City, the United States Naval Academy (USNA) and a relatively small number of residents located outside the City.

The City sewer system serves about 38,000 people through 11,200 sewer service accounts. Figure 13 shows the high level descriptive statistics for the City's major sewer service infrastructure.

11,200 sewer accounts	5.0 MGD average sewer collection system flow	4,900 acre sewer service area in the City
123 miles of pipes and 3,500 manholes	1 wastewater treatment plant (co-owned with, and managed by, the County)	25 sewer lift stations

Figure 13: High Level Descriptive Statistics for the City of Annapolis Sewer Assets

4.1.1 Wastewater Treatment

The Annapolis Water Reclamation Facility (WRF) is a wastewater treatment plant jointly owned and supported by the City and Anne Arundel County, but is operated and maintained by the County. As a joint facility, it treats sanitary sewage collected from the City, County, and USNA. The plant is located off of Edgewood Road primarily within the City's limits. The plant's capacity is 13 MGD, of which the City (with the USNA) has been allotted 6.7 MGD. The effluent from the WRF is discharged to the Severn River. This facility utilizes an activated sludge process with nitrification/de-nitrification for Enhanced Nutrient Removal (ENR) level treatment.

There is sufficient space on site to increase the total capacity of the facility to as much as 17.5 MGD if necessary in the future. For Fiscal Year 2015, the average daily flow was about 8.2 MGD. Of that, approximately 4.8 MGD was received from the City and 3.4 MGD from the County. Both jurisdictions have their own collections systems and incoming connections to the facility, which are metered. The plant contains 2 on-site emergency storage basins with about 13 million gallons capacity.

With the recently completed Enhanced Nutrient Removal upgrade, the facility is now able to meet the current limits of technology of 3.0 mg/L effluent total nitrogen and 0.3 mg/L total phosphorus in the discharged treated effluent.

4.1.2 Wastewater Collection and Pumping

The City owned and operated collection system consists of a network of gravity collectors and force mains and includes 25 wastewater pumping stations. The system serves approximately 98% of the City. Flows from the USNA pass through the City collection system before reaching the Annapolis Water Reclamation Facility (WRF). The City owned and operated wastewater pumping stations are shown in Table 9.

Table 9: City of Annapolis Wastewater Pumping Stations¹⁸

Station Name	Location	Master Plan Map	Design Capacity (MGD)
Admiral Drive	Admiral Dr	S-7	0.500
Annapolis Roads Apartments	Lake Heron Dr	S-7	0.040
Awald Road	Awald Rd	S-9	0.090
Bay Front Drive	Bay Front Dr	S-9	0.060
Belmont	Edgewood Rd	S-9	2.200
Boucher Avenue	Boucher Ave	S-9	0.100
Bristol Drive	Bristol Dr	S-7	0.140
Bywater Estates	Bywater Rd	S-9	0.150
Fairfax Road (Parole)	Fairfax Rd	S-7	0.150
Hanover Street	Hanover St	S-7	0.040
Harness Creek	Harness Creek Rd	S-9	0.050
Hunt Meadows	Harness Ct	S-9	0.050
Kingsport	Greenbriar Ln	S-9	0.075
Monterey (West Annapolis)	Shiley St	S-7	0.050
Newtowne	Newtown Rd	S-9	0.160
Porter Road	Porter Rd	S-7	0.050
President Point #1	President Point Dr	S-7	0.040
President Point #2	President Point Dr	S-7	0.040
Second Street	Second St	S-7	5.000
Shearwater Drive	Shearwater Dr	S-7	0.010
Smith Avenue	Smith Ave	S-7	0.600
Sumner Road	Sumner Rd	S-7	0.110
Truxtun Park	Truxtun Park Rd	S-9	0.250
Wardour	Wardour Dr	S-7	0.040
Whiton Court	Whiton Ct	S-9	0.080

Figure 14 shows the City interceptors and pumping stations and how they work together to convey the wastewater to the Annapolis WRF.

¹⁸ Excerpt from 2013 Anne Arundel County Water and Sewer Master Plan.

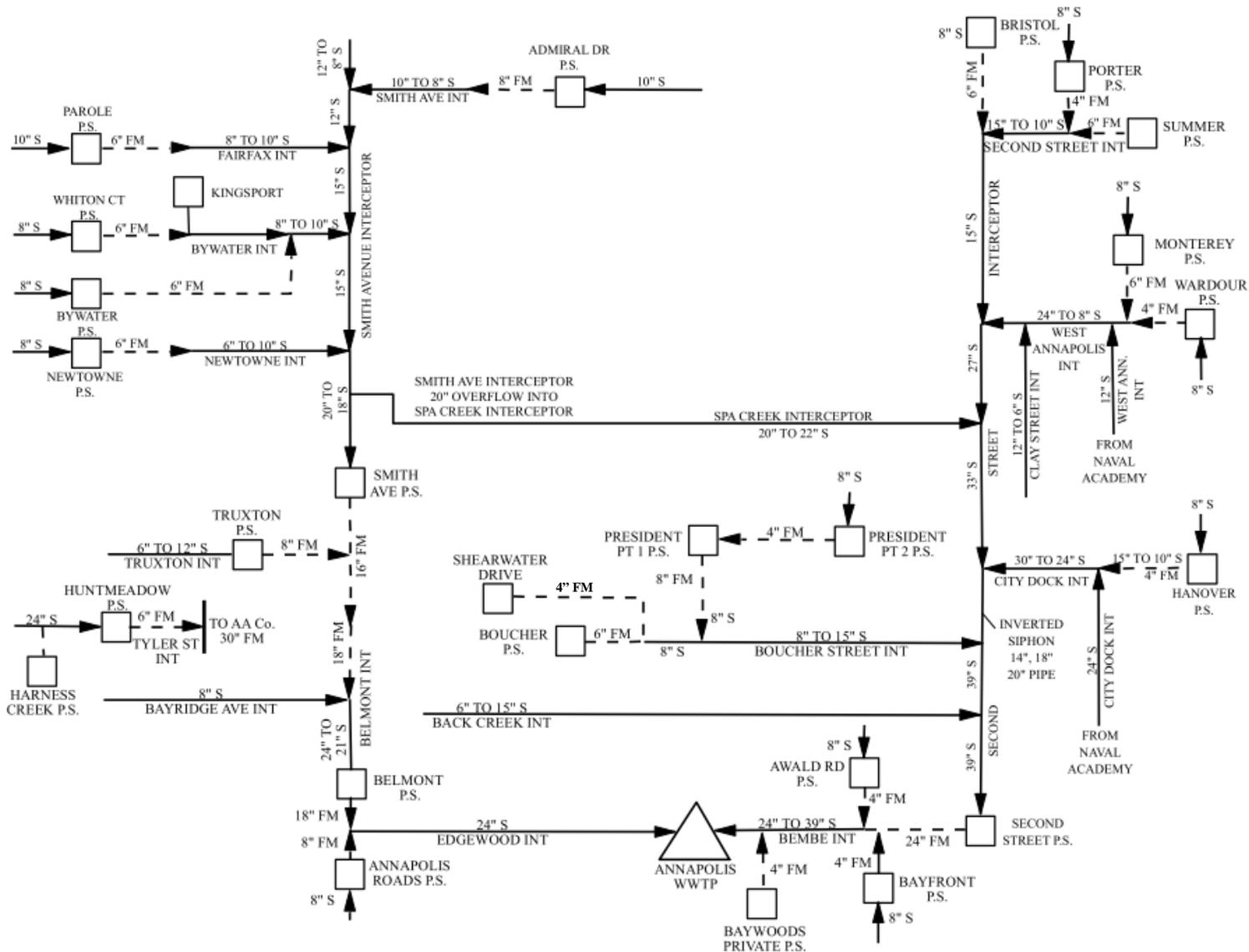


Figure 14: City of Annapolis Interceptors and Pumping Stations (from 2013 County Water and Sewer Master Plan)

The City sewer system map is shown in Figure 15.

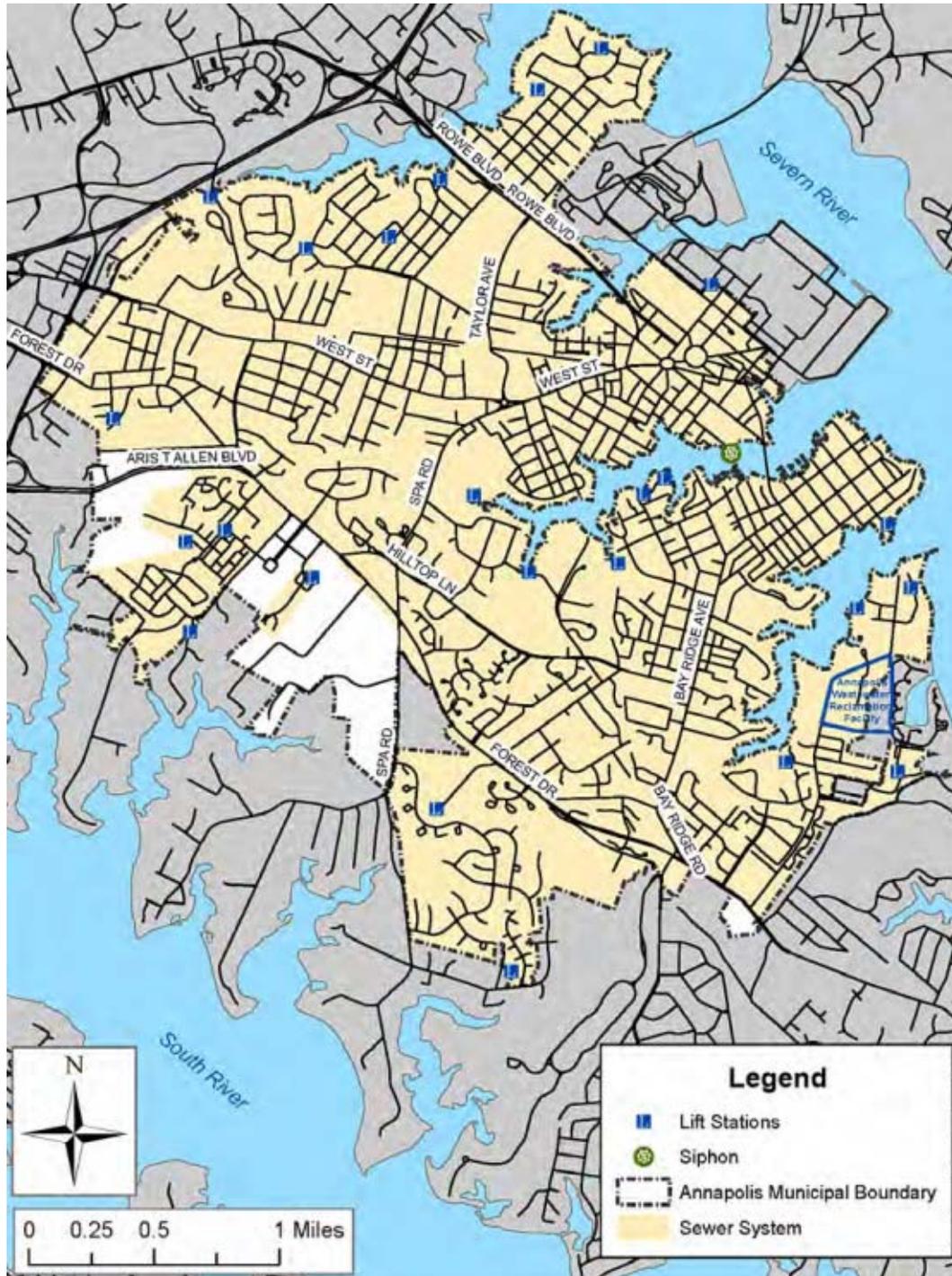


Figure 15: City of Annapolis Sewer System Map (Provided by City MIT)

4.1.3 Sewer Collection System Installation Profile

As noted above, the City operates a network of 123 miles of sewer collection piping and 25 lift stations. Figure 17 shows the miles of sewer collection pipe in-service per their installation decade.

As shown in the figure, the majority of the City's sewer pipes have been installed between 1950 and 1990 - about 77 miles over this four decade period, 1950s being especially an active growth period with over 30 miles of pipe being installed (averaging about three miles per year).

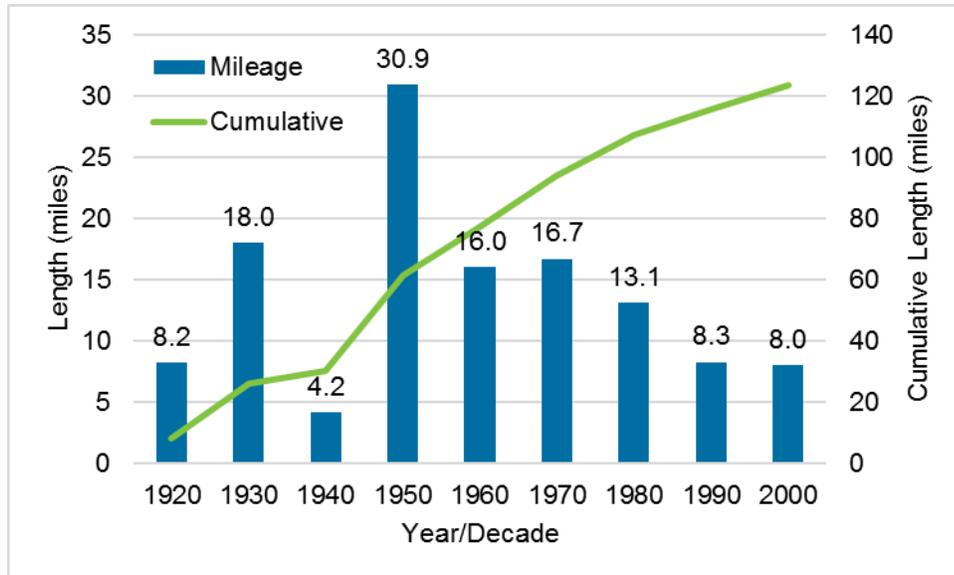


Figure 16: Miles of Sewer Collection Pipe In-Service Per Installation Decade

4.1.4 Condition of Sewer Pipes

A desktop condition assessment has been performed for the City's sewer pipes as part of the Evaluation Project. The desktop condition assessment model determines the condition ratings of the sewer pipes based on:

- Pipe age
- Pipe material
- Basement back-ups
- Work order history

The results of the desktop condition model for the City's sewer pipes are shown in Figure 17.

As shown in Figure 17, the vast majority of City's sewer pipes (~107 miles) have a condition rating of 1 (excellent/new) or 2 (very good). Just over 11 miles of City's sewer pipes have registered a condition rating of 5 (very poor).

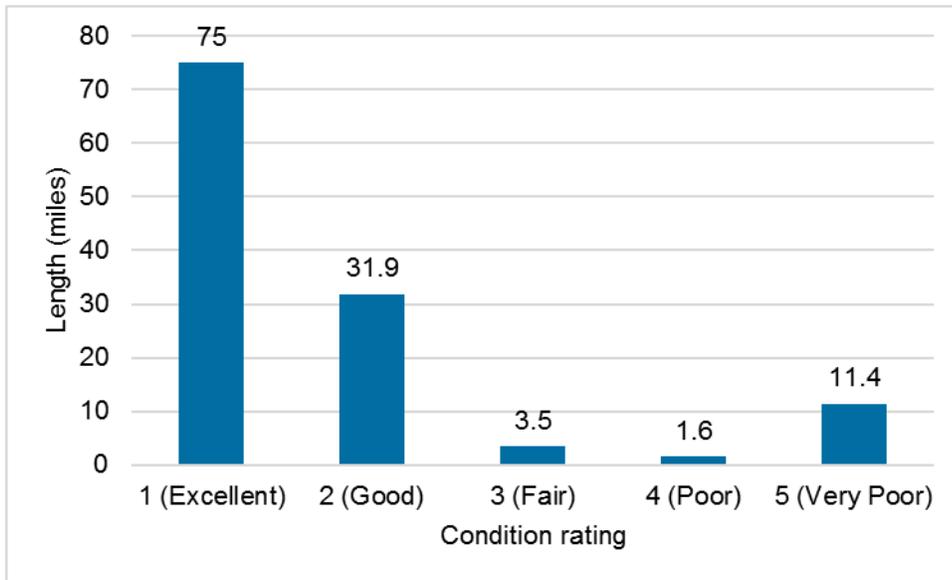
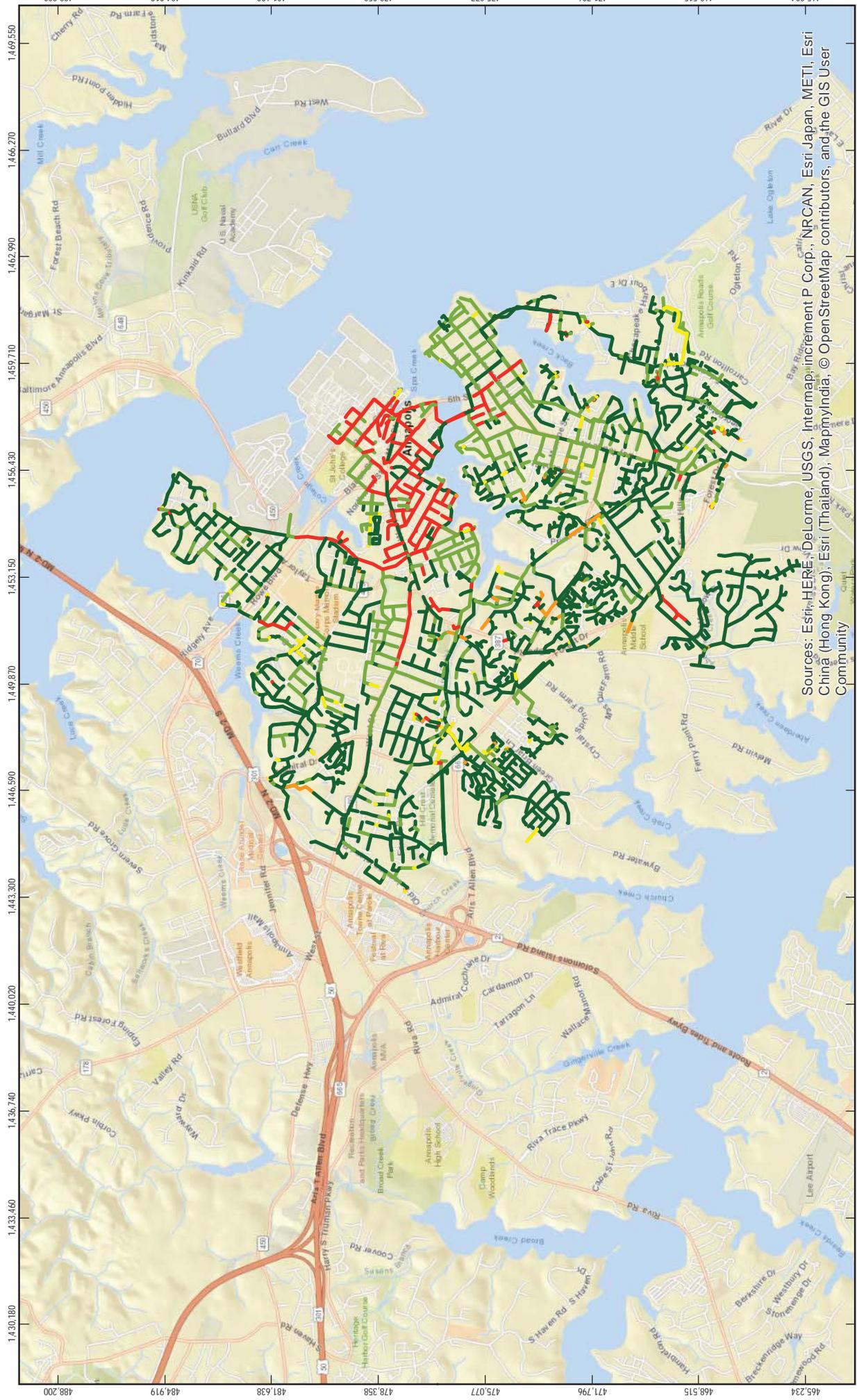
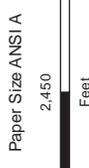


Figure 17: City of Annapolis Sewer Collection System Pipes Mileage by Condition Rating

Figure 19 shows a map of the City's sewer pipes by their condition ratings.



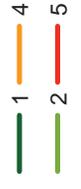
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City of Annapolis
 Water/Sewer Buried Asset Evaluation
 Buried Sewer Asset Condition Ratings

Job Number | 86-18182
 Revision | A
 Date | 28 Sep 2017

Figure 18: City of Annapolis Map of Sewer Pipes by Condition Rating

4.1.5 Consequence of Failure of Sewer Pipes

A desktop consequence of failure assessment has been performed for the City's sewer pipes as part of the Evaluation Project. The desktop consequence of failure assessment model determines the consequence of failure ratings of the sewer pipes based on pipe diameter, location, and proximity to attributes such as buildings, roads, historic district, etc. The results of the desktop consequence of failure model for the City's sewer pipes are shown in Figure 19.

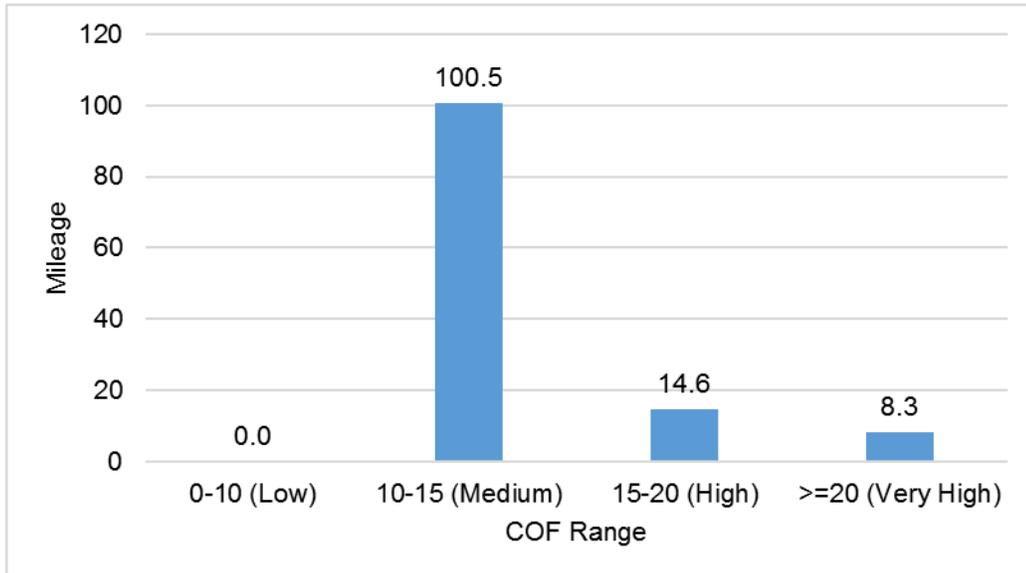
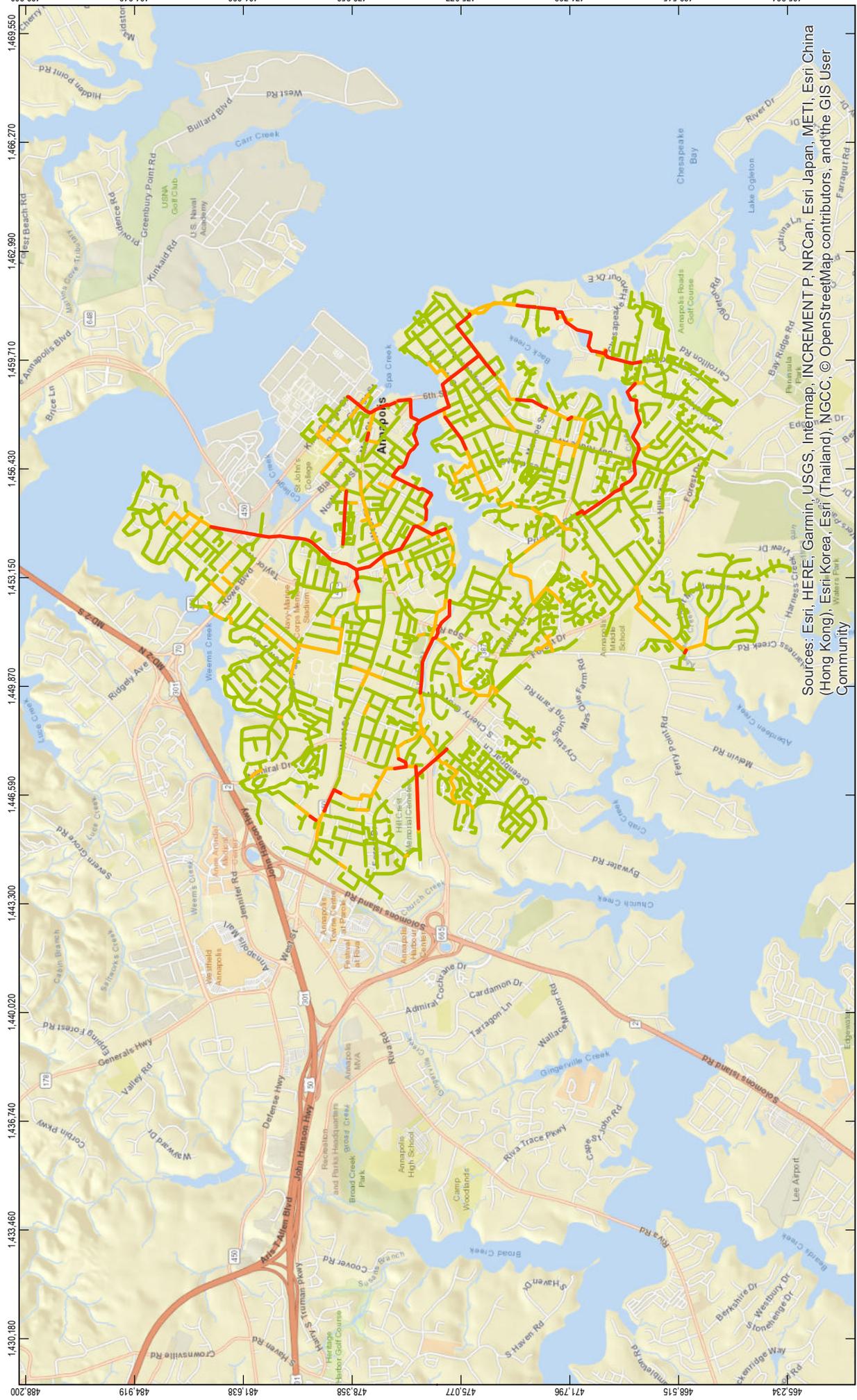


Figure 19: City of Annapolis Sewer Collection System Pipe Mileage by Consequence of Failure Rating

As shown in Figure 19, the vast majority of City's sewer pipes (~100 miles) have a consequence of failure rating between 10 and 15 (medium). Roughly 8.3 miles registered a very high consequence of failure rating. Figure 20 shows a map of the City's sewer pipes by their consequence of failure ratings.

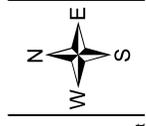


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Paper Size ANSIA

0 2,400 4,800
Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Maryland FIPS 1900 Feet



Consequence of Failure Ratings

- 0-10 (Low) █
- 10-15 (Medium) █
- >=20 (Very High) █

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Water/Sewer Buried Asset Evaluation

Job Number	86-18182
Revision	A
Date	18 Dec 2018

Buried Sewer Asset COF Ratings

Figure 20: City of Annapolis Map of Sewer Pipes by Consequence Of Failure Rating

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4.2 Future Flow Projections

The City population estimate for 2014 (by the US Census Bureau) is about 39,000 and expected to increase to 42,600 by year 2035¹⁹. The City is primarily developed. However, redevelopment of property and several annexations from the County have occurred in recent years. The recession in late 2000s and the increased use of water saving fixtures has resulted in a reduction in the average water demand (3.89 MGD in 2011 to 3.54 MGD in 2015). However, the City DPW expects that the decline in water usage has diminished and with increasing population, water use (and a result the wastewater flows) will increase slightly²⁰. The projected sewer flow rates for the City from 2020 to 2035 are shown below in Table 10.

Table 10: City of Annapolis Wastewater Flow Projections¹⁹

Year	Average Daily Flow (MGD)
2020	5.48
2025	5.62
2030	5.76
2035	5.76

The 2035 projection of 5.76 MGD average daily flow is within the City's allocated 6.7 MGD average daily flow rate treatment capacity at the Annapolis WRF.

4.3 Non-City Owned and/or Operated Facilities (USNA)

Located on the southwestern shore of the Severn River in the Annapolis Sewer Service Area, the USNA grounds are served by a wastewater collection system owned and operated by the US Navy.

Wastewater from the system is conveyed to the City sewer system and eventually to the Annapolis WRF through the City network of pipes. Between July 2014 and July 2015, the USNA has sent an average of about 684,000 gallons per day to the City's collection system at a price of \$4.21 per 1,000 gallons.

Agreements existing between the U.S. Navy, the City, and the County govern allocations and payments between the three jurisdictions.

4.4 City Pre-Treatment Program

The Department of Neighborhood & Environmental Programs (DNEP) manages the City's Wastewater Pretreatment Program. This State regulated program regulates the discharge of difficult to treat sanitary waste with the potential to cause harm to the collection system, treatment plant, utility workers or the environment. The City's Code of Ordinance (16.16.190) requires the following: *"Users shall make wastewater acceptable under the limitations established in this article before discharging to any public sewer. Any facilities required to pre-treat wastewater to a level acceptable to the City shall be provided and maintained at the user's expense. Detailed plans showing the pre-treatment facilities and operating procedures shall be submitted to the City for review, and shall be acceptable to the City before construction of the facility. The review of the plans and operating procedures shall in no way relieve the user from the responsibility of modifying the facility as necessary to produce an effluent acceptable to the City under this article. Any subsequent changes in the pre-treatment facilities or method of operation shall be reported to and be acceptable to the*

¹⁹ Per 2013 Anne Arundel County Water and Sewer Master Plan, as modified per current information.

²⁰ City water supply capacity management plan (2017 draft) cover letter

City.” The majority of the pre-treatment within the City is grease traps primarily from restaurants and other food and beverage establishments.

4.5 Capacity, Management, Operation, Maintenance (CMOM)

Collection System Capacity, Management, Operation, and Maintenance (CMOM) programs incorporate many of the standard operation and maintenance activities that are routinely implemented by the owner or operator with a new set of information management requirements in order to:

- Better manage, operate, and maintain collection systems
- Investigate capacity constrained areas of the collection system
- Proactively prevent SSOs
- Respond to SSO events

The CMOM approach helps the owner or operator provide a high level of service to customers and reduce regulatory noncompliance. CMOM can help utilities optimize use of resources by shifting maintenance activities from “reactive” to “proactive”—often leading to savings through avoided costs. CMOM programs can also help improve communication relations with the public, other municipal works and regional planning organizations, and regulators.

The City does not have a current CMOM program. However, the City is currently developing a water and sewer asset evaluation program that incorporates many of the CMOM requirements. The intent of the asset evaluation program is proactively manage the City’s collection system and improve the level of service provided to its customers. Checklists included in EPA’s “Guide for Evaluation Capacity, Management, Operation, and Maintenance (CMOM) Programs at Sanitary Sewer Collection Systems” can also be referenced

4.6 Financial

4.6.1 General

Table 11 provides the financial statistics for the City sewer fund based on the adopted FY 2019 Operating Budget.

Table 11: City of Annapolis Sewer Fund Financial Management Statistics

Item	Actual FY 2017	Adopted FY 2018	Adopted FY 2019
Revenues			
Licenses and Permits	\$80,000	\$53,000	\$100,000
Sewer Charges	\$8,260,656	\$8,270,000	\$8,226,500
Capital Facilities	\$356,000	\$386,000	\$220,000
Money and Property			\$10,000
Total; Sewer Fund Revenues	\$8,696,656	\$8,709,000	\$8,556,500
Expenditures			
<u>Water Reclamation Facility</u>			
Salaries and Benefits	\$-	\$-	\$-
Operating	\$3,800,000	\$3,800,000	\$4,000,000
Subtotal;	\$3,800,000	\$3,800,000	\$4,000,000
<u>Wastewater Collection</u>			

Item	Actual FY 2017	Adopted FY 2018	Adopted FY 2019
Salaries and Benefits	\$1,036,863	\$964,230	\$917,174
Operating	\$627,143	\$513,700	\$644,500
Subtotal;	\$1,664,006	\$1,477,930	\$1,561,674
<u>Non-Allocated Expenses</u>			
Debt Service	\$858,070		\$739,503
Other Financing Uses and Transfers	\$1,702,710	\$859,695	\$2,257,208
Transfer to Fleet Replacement Fund		\$2,055,081	\$10,000
Contingencies	\$500,000	\$500,000	
Subtotal;	\$3,060,780	\$3,414,776	\$3,006,711
Total Uses of Funds	\$8,524,786	\$8,692,706	\$8,568,385
Projected Change in Fund Balance	\$171,870	\$16,294	\$(11,885)

4.6.2 Charges and Assessments

In 2010, the City completed a comprehensive water and sewer rate study that included recommendations for changes to the rates, capital and connection charges and the rate structure. The City currently reviews and updates their water and sewer rates and charges on an annual basis. An outside consultant assists the City with the evaluation and typically submits their report for use in the upcoming fiscal year's budget. For more details on the charges and assessments, refer to the Finance Department page on the City website or visit the City Municipal Code online at https://library.municode.com/md/annapolis/codes/code_of_ordinances?nodeId=AP_FEES_SCHED_ULEFY2019.

4.6.3 Capital Improvement Program

The City utilizes a six-year Capital Improvement Program (one year actual with five year projection) for planning the necessary expansions and renewals to the water and wastewater infrastructure.

All plans for major water and sewer projects financed by the City must be reviewed and approved by the City Council. Table 12 lists the current sewer capital improvement projects within the City.

Table 12: City of Annapolis Sewer Capital Improvement Projects

Project Title	Project Number	Description
Sewer Rehabilitation and Improvements	72006	Over half of the City's sewers are greater than 50 years old and many are over 80 years old. The City's Water and Sewer Comprehensive Analysis Plan was recently developed using typical asset management practices incorporating both probability and consequence of failure factors. The Plan establishes risk to every asset and outlines the priority sewer system rehabilitation capital needs for the next 5 years. This CIP project includes design and construction of sewer rehabilitation of identified priority assets. Most of the sewer pipes needing rehabilitation can be lined using trenchless methods but others will need replacement. Sewer video inspection is required ahead of design/construction. The Plan also identifies additional planning work and assessment strategies necessary to refine prioritization of sewer asset rehabilitation into the future.

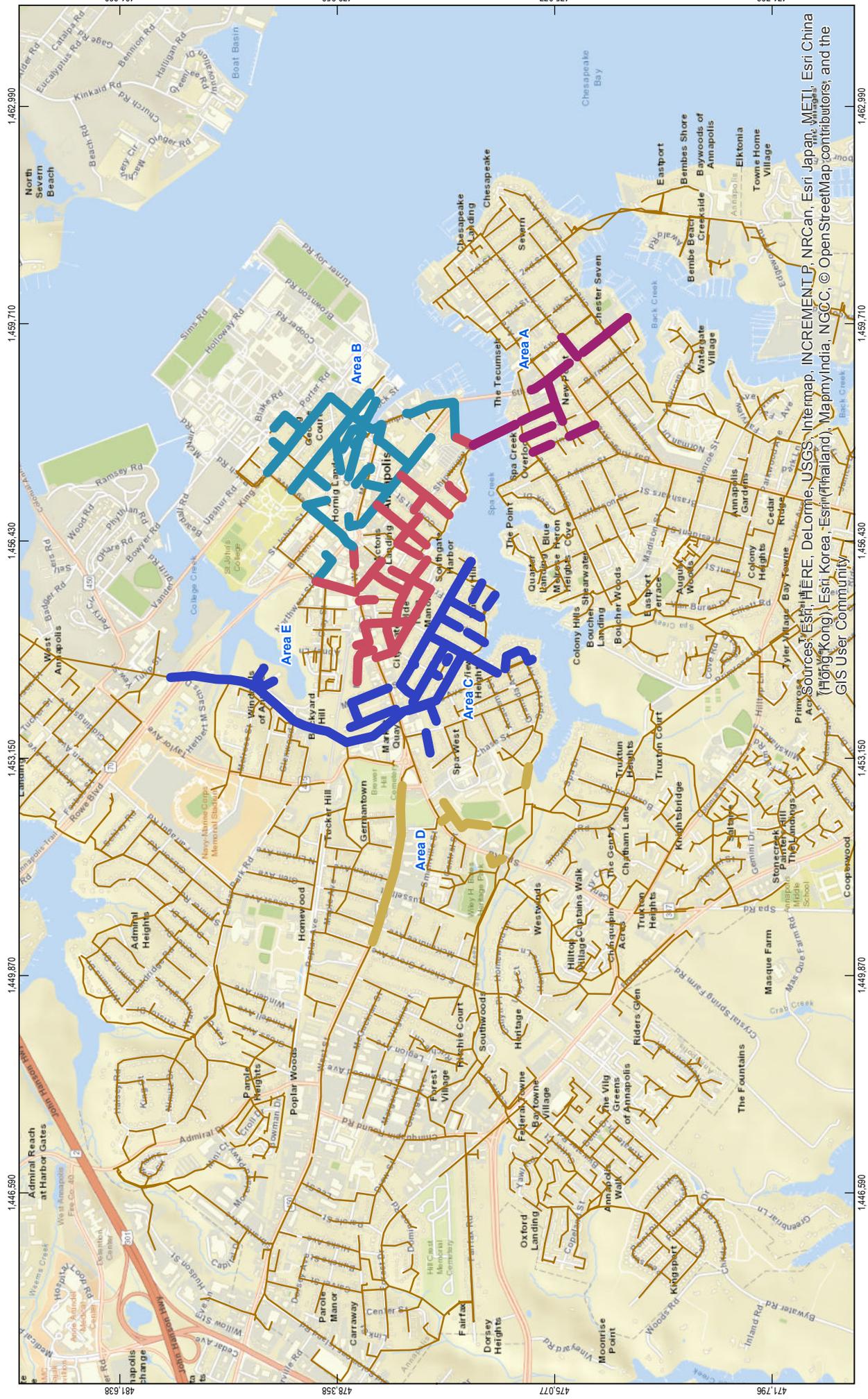
4.6.4 Sewer Collection System Recommended Improvement Areas

To support the sewer rehabilitation project (number 72006) the Evaluation Project has determined the recommended improvement areas shown in Table 13 and illustrated in Figure 21.

Table 13: City of Annapolis Sewer Collection System Areas

Project	Length (feet)	Length (miles)	Estimated Cost (2019)
A	5,898	1.1	\$1,101,000
B	14,564	2.8	\$3,564,000
C	15,757	3.0	\$3,755,000
D	4,040	0.8	\$677,000
E	10,993	2.1	\$2,210,000
TOTAL	51,252	9.8	\$11,307,000

The pipelines in areas recommended for renewal for the sewer collection system total about \$18.4 million (\$11.3 million for the recommended projects from this evaluation study and \$7.1 million for the recommendations from the 2014 Hydraulic Study) in 2019 dollars including costs associated with both design and construction and applicable overhead. The estimates are based on being able to use cured in place pipe (CIPP) technology (at \$124 per LF) on 90 percent of the contract proposed contract lengths. The five areas shown are proposed for execution over ten years. Over this period (2019 through 2028), the annual average cost is estimated at approximately \$1.7 million per year (including the renewal projects recommended in the 2014 Hydraulic Study). The investment profile associated with the priority sewer projects is shown in Figure 22. The cost projections associated with the 2014 Hydraulic Study recommended projects have been distributed between 2025 and 2029, to be completed prior to the 2030 recommended estimated in the 2014 Hydraulic Study.



LEGEND

Project Areas
 Area A (Purple)
 Area B (Teal)
 Area C (Blue)
 Area D (Yellow)
 Area E (Red)
 Sanitary Sewer Pipe (Orange)

Paper Size ANSIA
 0 1,000 2,000 Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Maryland FIPS 1900 Feet

City of Annapolis
 Water/Sewer Buried Asset Evaluation
 Buried Sewer Asset Projects

Job Number: 86-18182
Revision: A
Date: 10 Dec 2018

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Figure 21: Sewer Collection System Priority Project Areas

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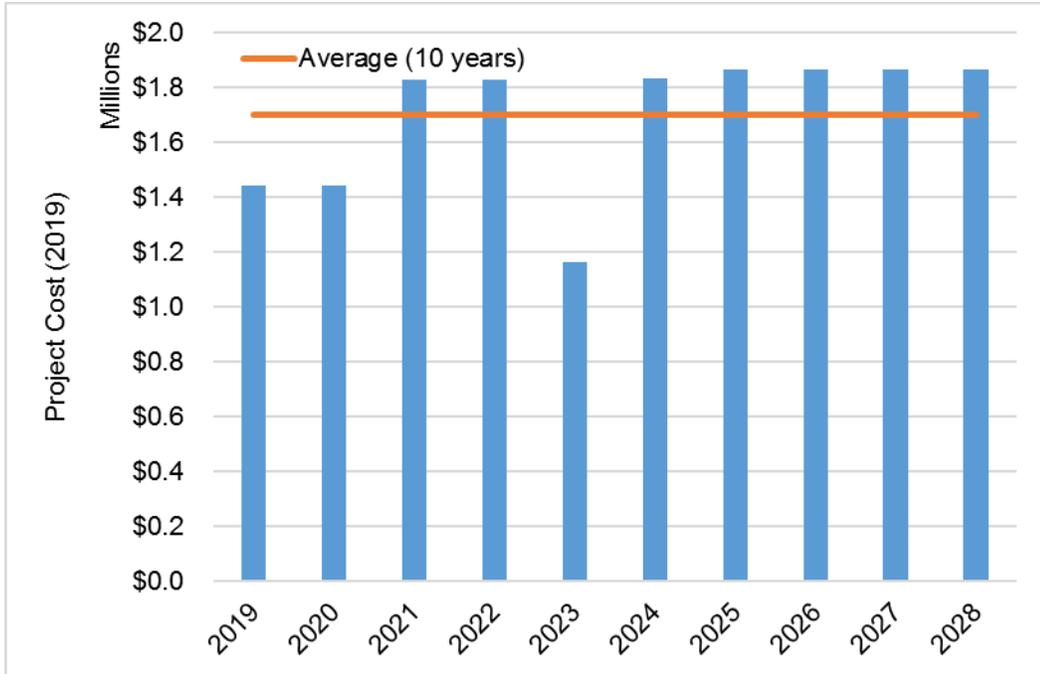


Figure 22: City of Annapolis Sewer Project Areas Estimated Costs per Year Between 2019 and 2028

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Document Status

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1	Mert Muftugil & David Kerr	David Kerr & Gage Muckleroy	On File	[Draft]	[Draft]	[Draft]
2	Mert Muftugil & David Kerr	David Kerr & Gage Muckleroy	On File	[Draft]	[Draft]	[Draft]
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