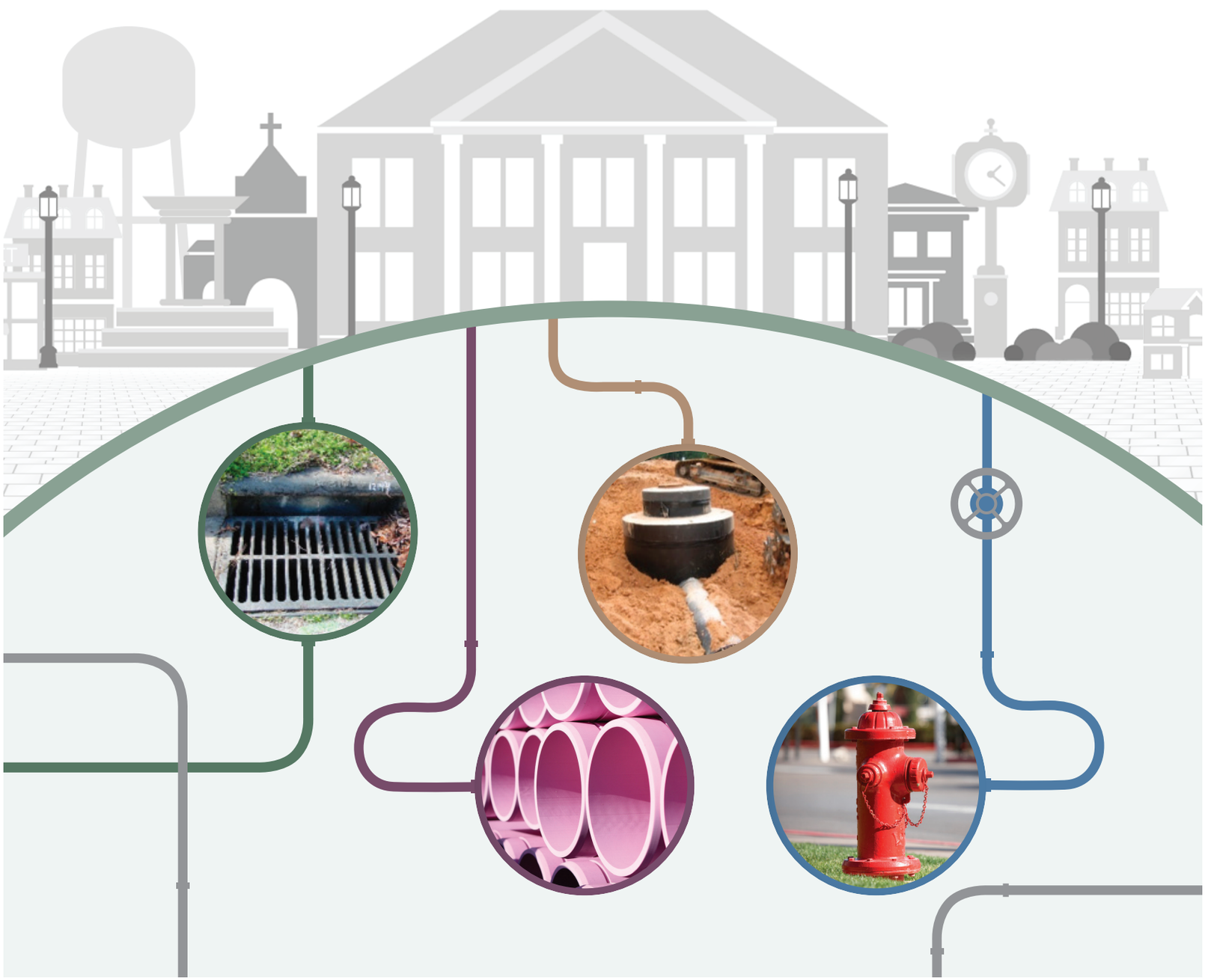
Town of Cary

BURIED INFRASTRUCTURE ASSET MANAGEMENT PLAN

2018



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FOUNDATIONS

The Buried Infrastructure Asset Management Plan is the Town's roadmap to protect its investment in our water, wastewater, stormwater and reclaimed water systems. Implementing this plan will improve reliability, reduce risk, optimize operations and maintenance (O&M) efforts and increase geographic information system (GIS) accuracy. The *Imagine Cary Community Plan* describes the Town's commitment to providing safe, reliable and cost-effective utility and stormwater services to our citizens and customers; this plan addresses continued and new asset management and rehabilitation activities that deliver on this commitment.

Asset management is the *systematic* process of *maintaining, repairing and replacing infrastructure*, in order to *provide a desired level of service* while *maximizing service life* and *minimizing life cycle cost*. Implementing asset management can lead to operational benefits such as reducing the disruption of unplanned maintenance and repairs, as well as financial benefits as long-term planning needs inform utility rate-setting processes.

This plan is structured around five core questions:

- What is the Current State of the Assets?
- What is the Required Level of Service?
- Which Assets are Critical to Sustained Performance?
- What are the O&M/Capital Improvement Strategies?
- What is the Long-Term Funding Strategy?

A chapter is allocated to answering each of these questions, with a final implementation chapter that presents a five-year task list for implementing the buried asset management program as well as detailing objectives, strategies, resources and performance measures.

WHY WE NEED ASSET MANAGEMENT

The Town's buried utility and stormwater infrastructure is relatively young but faces challenges in the coming that which will be addressed most successfully with prudent, proactive steps established in a comprehensive asset management plan. These challenges include:

- **Funding Needs of Aging and Expanding Infrastructure** - Much of the Town's buried infrastructure was installed within a short span of time between the 1970s and early 2000s; in fact, 40 percent of the buried infrastructure assets were installed within the decade of the 1990s. Spikes in asset failures would be expected within a corresponding narrow timeframe. Consistent preventive maintenance can extend the life of high-priority assets. With proper maintenance and a long-range planning perspective, the Town can smooth the transition of asset renewal, and avoid a future spike in system failures or a sudden need for much greater funding of renewal and replacement projects.
- **Development** – While a large percentage of the Town's buried infrastructure was installed by developers who bore much of the installation cost at the time of construction, the Town is responsible for future costs to maintain and rehabilitate this aging infrastructure.
- **Loss of Institutional Knowledge** – Our utility and stormwater systems have become large and complex, and long-serving Town staff who observed the construction and maintenance of our buried infrastructure over the years are now retiring. Our institutional knowledge of asset information needs to be captured digitally in widely-available data repositories such as GIS and Salesforce.

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- **Shifting Technology** – The Town's information management technologies need upgrading, such as improving GIS data quality; updating GIS schemas for each asset type; adopting new computing hardware and software (iPads to support Salesforce work order management, ArcGIS Collector software for field data collection to validate and correct asset data); and procuring and configuring analytical software tools to support rehabilitation and replacement project prioritization.
- **Multiple Departments Responsible for Buried Infrastructure Maintenance and Renewal** - Close coordination will be required between staff in multiple Town departments as well as contractors to generate the data, analysis and prioritization needed for the asset management program to be effective, including Salesforce work order data; field condition assessments; GIS, CAD and other analytical resources; and budget development. Delays in completing one task could threaten key program objectives.

GOALS

This plan is guided by specific goals for a comprehensive, effective asset management program:

1. **Prioritize to Reduce Risk** – Highest-risk assets will be prioritized for inspection, maintenance and renewal, because they have the greatest impact in mitigating unscheduled outages and reducing the overall risk of failure within the system.
2. **Optimize Maintenance & Renewal** – Identify tools that support and enhance current O&M, condition assessment and renewal activities. Prioritize these activities based on assets with the highest need, which will in turn improve overall asset reliability, extend service life and reduce emergency repairs.
3. **Reinforce Fiscal Responsibility** – Help Town staff to forecast funding needs, identify least-cost solutions and provide a rationale for infrastructure renewal decisions.
4. **Leverage Technology** – Utilize the Town's GIS as well as emergent technology initiatives like Salesforce, Chatter and Collector to capture and store institutional knowledge, as well as serve as a repository for asset management documentation.
5. **Be Sustainable and Scalable** – The Buried Infrastructure Asset Management Plan and processes will be sustainable over time as well as adaptable and scalable to other Town infrastructure types.

ASSET DATA

An accurate asset inventory is the foundation for any asset management program. Setting the parameters of the inventory relies on answering four questions:

- What qualifies as a buried infrastructure asset?
- Are assets fully represented in GIS?
- What is the physical condition of each asset?
- What are the assets' values?

The Town's buried infrastructure assets date to 1923, when the Town began a well-based water distribution system. The water, wastewater, reclaimed water and stormwater systems have each grown since then, and today the Town's water and wastewater systems serve over 180,000 people in Cary, Morrisville (which was incorporated into the Town's water and wastewater service area in 2006), Raleigh-Durham International Airport, and the Wake County portion of Research Triangle Park. Today the water system is comprised of over 1,000 miles of piping and associated valves, hydrants and appurtenances; over 900 miles of wastewater conveyance system, including manholes and force mains; over 605 miles of stormwater pipe (of this, there are 275 miles of Town-maintained pipe and 330 miles of NCDOT or privately-maintained stormwater pipe); and 55 miles of reclaimed water distribution mains, valves and appurtenances.

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Spatial data and attributes for each of the buried infrastructure types are stored in the Town's GIS. Other data needed for the asset management program are also stored in Laserfiche (record drawings), ITpipes (wastewater and stormwater video inspections), Firehouse (hydrant data and inspections), HiperPM/Salesforce (asset-related work orders), Utility Cloud (water quality data and Fats-Oils-Grease program) and Aquastar (water meter-related information). There is currently a significant number of asset records in paper form which are awaiting conversion to electronic format.

LEVEL OF SERVICE

The *Imagine Cary Community Plan's* SERVE chapter commits the Town to providing exceptional water and wastewater services to our citizens. Part of the asset management program is developing a "level of service" standard for the Town's buried infrastructure assets, including measurable performance criteria. Level of service incorporates standards for regulatory compliance, industry best practices, citizen expectations and benchmarking. For example, Cary citizens' level of service expectations for utility and stormwater services could be described as follows:

SERVICE	STEWARDSHIP
Safe and uninterrupted service	Comply with local, state, and federal regulations
Equitable rates and accurate utility billing	Protect the environment
Citizen data kept private and secure	Control noise and odor
Knowledgeable, accessible staff	Plan for the future
Timely, skilled response to citizen requests	Good regional neighbor
Transparent and fair treatment	

This plan identifies quantitative performance targets and key performance indicators which will be tracked to measure whether the Town is providing the defined level of service. These key metrics, tracked over time, provide the Town with a picture of how well the buried infrastructure asset management program is being implemented.

RISK & PRIORITIZATION

The concepts of *risk* and *prioritization* are fundamental to an effective asset management program. The Town cannot expect to have sufficient resources to eliminate the possibility of any failure of water, wastewater, reclaimed water and stormwater assets. However, the Town *can* minimize failure, and the consequences of failure, through a structured program focused on managing *risk*, and enabling a comparison of risks in different parts of the Town's buried infrastructure asset management system.

The two fundamental building blocks for defining risk are Likelihood of Failure (LOF) and Consequence of Failure (COF). Risk, LOF and COF are described in the context of the risk formula above, with the components of the formula represented as numerical rankings, perhaps on a 1-10 scale. Likelihood of Failure describes the chance of an asset failure occurring. Consequence of Failure measures the severity of the impacts if an asset were to fail. Multiplying LOF and COF together provides the overall risk score for a given asset, with higher scores indicating greater risk.

Factors influencing LOF include:

- Material
- Remaining useful life
- Repair history
- Soil type
- Inspection ratings

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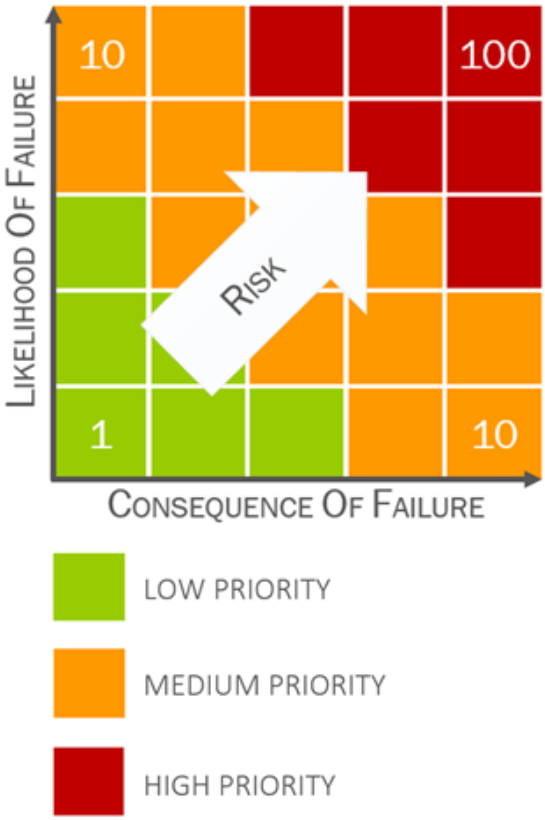
Factors influencing COF include:

- Critical customers
- Pipe diameter
- Cost to repair
- Public disruption from failure
- Location – proximity to roads, sensitive areas

Once a risk score has been assigned for each asset, the severity of the risk can be visualized in a matrix. Highest priority assets are in the red zone, medium priority assets in the orange and lowest priority assets in the green.



Critical infrastructure is vital for the operation and sustained performance of the buried infrastructure. Generally, critical assets have higher COF scores. Assets with a higher COF should be prioritized to receive appropriate maintenance and periodic condition assessment.

This plan gives special attention to areas of Town where multiple critical assets exist within the same location. GIS can be used to identify high concentrations of critical assets, which can then be factored into the risk prioritization framework.

Critical assets for each infrastructure type are listed below:

WATER SYSTEM	WASTEWATER SYSTEM	STORMWATER SYSTEM	RECLAIMED WATER SYSTEM
Raw Water Pipeline	Force Mains	Large Storm Pipes (60-inch & larger)	Gate Valves
Finished Water Line	Major Interceptor Sewers	Deep Storm Pipes (48-inch & larger, >4-ft depth)	Cooling Tower Customer Services
Aerial Crossings	Aerial Crossings	Railroad/Highway Crossings (36-in & larger)	Railroad/Highway Crossings
Railroad/Highway Crossings	Railroad/Highway Crossings	Storm Pipes Adjacent to Known Structural Flooding	Buried Creek/Lake Crossings
Isolation Valves	Buried Creek/Lake Crossings		
Critical System Valves (12-in & larger)	Inverted Siphons		
Pressure Zone Valves	Air Release Valves		
Interconnect Valves	Odor Control		
RDU Airport Master Meter			
Single Feed Water Lines (50+ services)			
Sensitive Customer Water Services			
Critical Customer Water Services			

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MAINTENANCE & RENEWAL

Both O&M activities and periodic capital improvement projects are needed to sustain the performance, reliability and function of the Town's buried infrastructure.

O&M activities, targeted toward the Town's critical buried infrastructure, yield several key benefits to protect the Town's infrastructure investments:

- Maximize buried infrastructure useful life
- Proactively address maintenance concerns prior to asset failure
- Promote operational readiness in emergencies
- Monitor buried infrastructure performance and regulatory compliance
- Monitor buried infrastructure condition

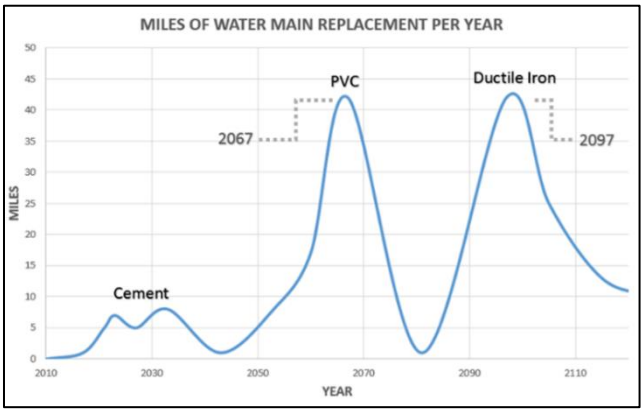
O & M

- *Daily O&M activities, primarily performed by the Public Works and Utilities departments*

Capital Improvements

- *Large scale engineering projects, primarily administered by Water Resources to address renewal of buried infrastructure*

This plan recommends O&M activities, condition assessment and renewal and replacement programs for each infrastructure type. The program's five-year task list includes both specific projects in a prioritized 10-year capital improvements plan and a 50-year buried infrastructure rehabilitation and replacement plan. While the lifespan of an infrastructure asset varies by asset type and material, the Town can expect to experience spikes in buried infrastructure replacement needs due to the high rates of new development from the 1980s through the 2000s. For example, the water system pipe installed during this period was initially polyvinyl chloride (PVC), and then ductile iron (DIP) after the Town updated its standard specifications in 1993. Below, a water system renewal curve anticipates a wave of PVC pipe replacement beginning in the 2050s and peaking in the 2060s. Three decades later, beginning in the 2080s, the DIP from this period of rapid development will see a spike in pipe replacement needs. The gap between the two peaks is due to the longer service life of DIP. The renewal curve below is based on preliminary data; the five-year asset management program task list includes refinement of the 50-year expected asset replacement schedule based on more-detailed analysis and field condition assessment.



O&M AND CAPITAL PROJECTS TO REDUCE RISK

Within the "risk" framework, buried infrastructure *renewal* can be described as carrying out projects that reduce one or both components of the risk equation – that is, the consequences or likelihood of asset failure. Risk reduction may result from O&M activities, periodic inspections, or from capital improvement projects, ranging from rehabilitation (such as lining a sewer pipe) to replacement. Assets with the highest risk scores are prioritized and addressed first; assets with low and medium risk scores are addressed as time and budget allows.

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IMPLEMENTING THE BURIED INFRASTRUCTURE ASSET MANAGEMENT PLAN

This plan's five-year task list provides a framework, activities and a timeline to achieve the asset management program goals. The task list defines action items and organizes them in an appropriate sequence. Action items are grouped and color coded based on infrastructure or task type. The implementation plan should be revisited periodically as asset management program tasks are completed and asset data improves. Additional options may become available to save time or money.

Initial tasks of this plan relate to:

- Improving the quality of GIS data for all infrastructure types.
- Implementing Salesforce work order system and reporting.
- Developing initial rehabilitation and replacement prioritization structure, to reduce risk of asset failures.
- Piloting new stormwater system maintenance and inspection practices.
- Improving the storm and sewer video inspection process by training Town staff to use NASSCO ratings for pipe and manhole inspections.

Later years of the task list will pilot new rehabilitation technologies, pilot the ESRI Collector application, bring legacy hardcopy record drawings into digital form, create a 50-year asset renewal plan and refine the project prioritization framework for all asset types. By the fifth year of the task list, Town staff will use computer software to leverage the Town's GIS and streamline the capital project prioritization process.

REPORTING

The workplan anticipates an Annual Buried Infrastructure Report. This 'report card' can be established using the key performance indicators (KPIs) to ensure the Town is progressing toward its buried infrastructure asset management program goals, and the Town's level of service standards are being met.

UPDATING THE BURIED INFRASTRUCTURE ASSET MANAGEMENT PLAN

At the end of the first five-year period, this Plan anticipates the Town will review implementation results and make adjustments for the next five-year interval. Changes could be made to objectives, strategies or program elements; the Town may also decide to allocate additional resources towards a particular objective. Future updates to the plan may also incorporate analysis of asset condition data, presentation of risk scores and an updated 50-year buried infrastructure rehabilitation and replacement plan.

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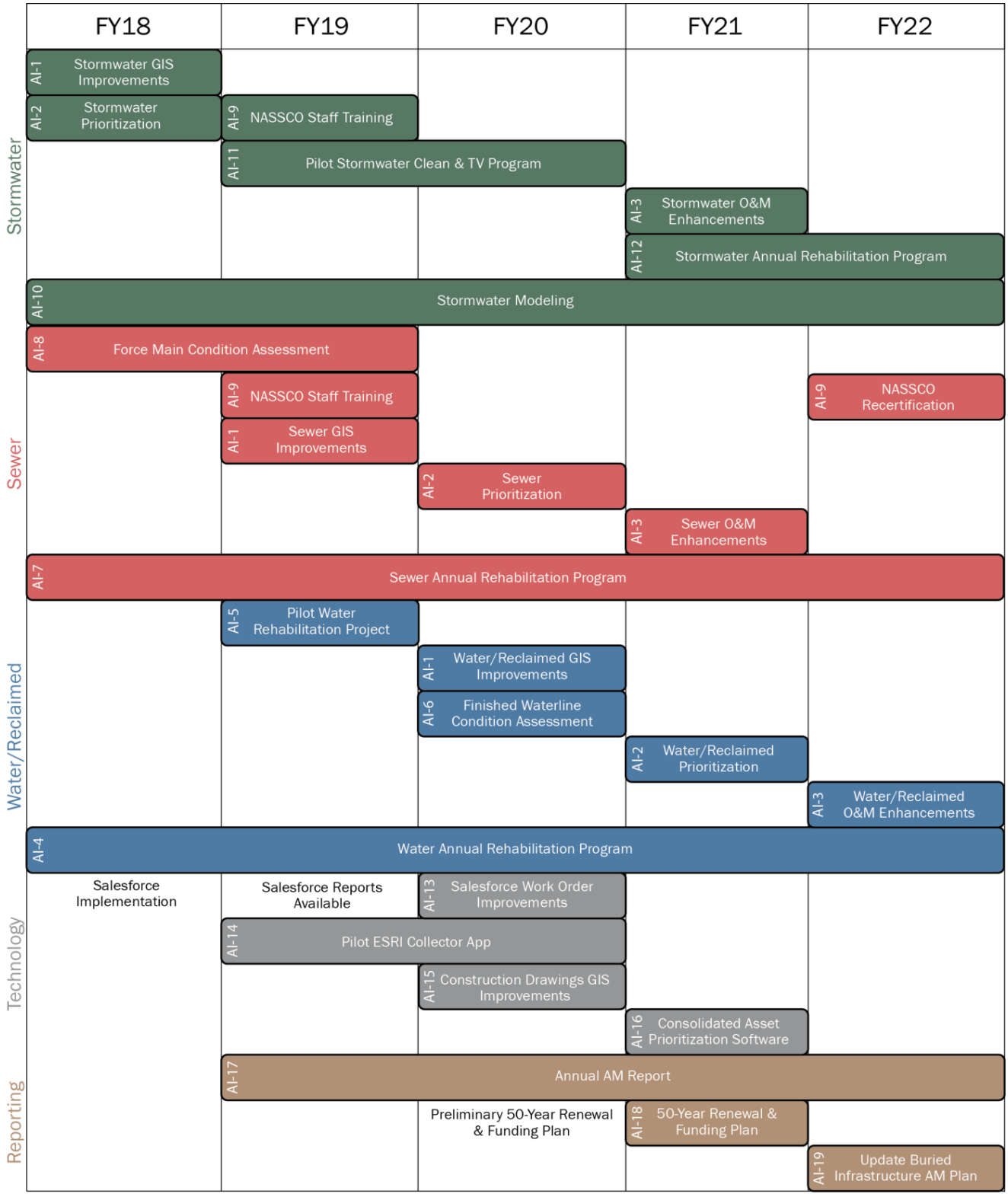
BURIED INFRASTRUCTURE FIVE-YEAR TASK LIST



1 FOUNDATIONS

OBJECTIVE

This plan serves as the roadmap for the Town's efforts towards advancing the buried infrastructure asset management program. Implementing this plan will increase reliability, reduce risk, optimize operations and maintenance (O&M) efforts, and improve the quality of our GIS data. The plan also serves as an umbrella over the numerous asset management and rehabilitation activities currently happening that enable Cary to provide exceptional service to our citizens and customers. The Town has many processes and procedures to help ensure the maintenance and reliability of its buried assets; this plan captures, consolidates and coordinates all these existing efforts into a strategic program that supports the fulfillment of the Imagine Cary Community Plan.

OVERVIEW

BURIED INFRASTRUCTURE

The Town's stationary assets fall into one of two broad categories – linear and vertical. Linear assets are those assets primarily on or below ground, such as roads, pipelines and sidewalks. Vertical assets are largely above-ground facilities, such as buildings, tanks, lift stations and other structures.

The buried infrastructure covered by this plan are linear assets related to the Town's water, wastewater, stormwater and reclaimed water utility systems; common features for each asset type include:

WATER - Water mains, valves, fire hydrants, service lines, meter boxes and blow-offs.

WASTEWATER - Gravity sewer mains, force mains, service lines and manholes.

STORMWATER - Storm pipe, culverts, inlets and manholes, as well as stormwater control measures maintained by the Town.

RECLAIMED WATER - Distribution mains, valves, service lines, meter boxes and blow-offs.

This plan does not address buried infrastructure that is not related to the Town's water, wastewater, stormwater and reclaimed water systems such as electrical conduit, transportation-related support infrastructure, or telecommunication infrastructure.

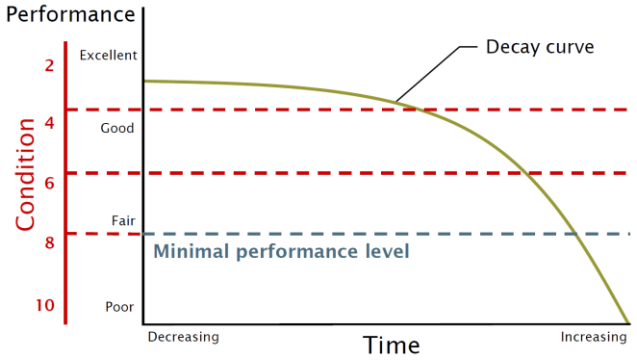
ASSET MANAGEMENT

Asset management is the systematic process of inspecting, maintaining, renewing and replacing infrastructure, to provide a desired level of service while maximizing service life and minimizing life cycle cost. Asset management is not a one-time fix, but a continuous process of planning, installing, maintaining and removing assets from service. An asset management program supports sustainable buried infrastructure and provides the following key benefits:

KEY BENEFITS
Maximize asset service life
Minimize asset life cycle costs
Increase preventive maintenance, reduce corrective maintenance
Reduce unplanned service disruption
Meet citizen level of service expectations
Inform utility rates based on long-range planning

This plan provides the foundation for the Town to maximize the years of service for each infrastructure asset while maintaining exceptional service levels. With proper O&M practices and

rehabilitation the overall life cycle cost for an asset can be minimized.



THEORETICAL DECAY CURVE

It takes less investment to maintain an asset towards the top of the decay curve soon after installation versus the amount needed at the bottom of the curve, as the condition of the asset deteriorates. By extending the asset's life, the Town saves money by deferring the purchase of a replacement asset.

WHY WE NEED ASSET MANAGEMENT

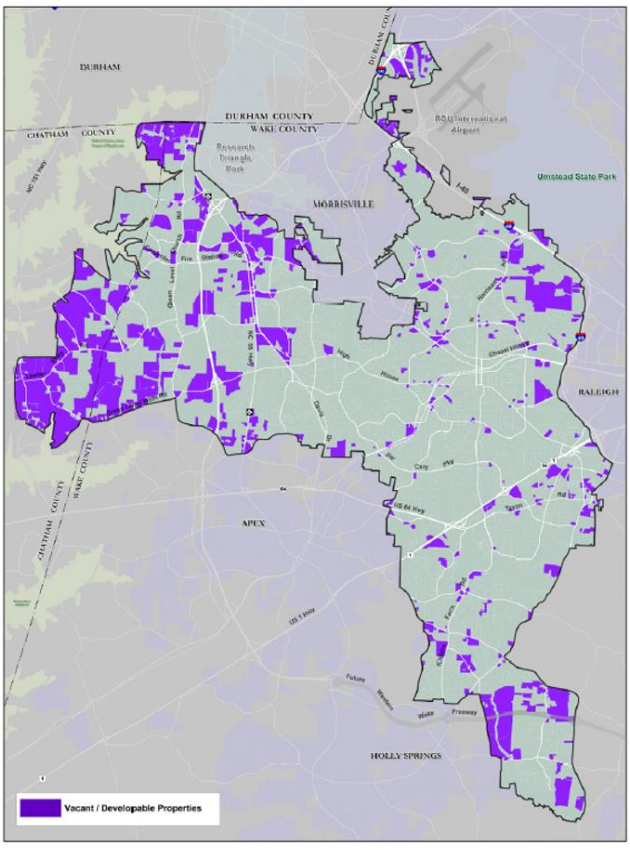
While managing buried infrastructure, the Town faces a broad range of challenges. In response, this comprehensive asset management plan defines the strategies and goals that are vital to systematically address the needs of today as well as the challenges of tomorrow. The Town's buried infrastructure is relatively young but will face challenges in the coming decades that are best addressed with prudent, proactive steps. This plan incorporates and improves upon the activities the Town is already undertaking to address these challenges and goals.

CHALLENGES

Aging & Expanding Infrastructure - The Town's buried infrastructure is relatively young and a large percentage of it was installed within a short span of time. This pronounced spike in installation date means that the Town can expect a similar spike in failures as the water, wastewater, stormwater and reclaimed water system elements reach the end of their life cycles within a narrow window of time. The Town must prepare so that rehabilitation and replacement efforts are appropriately paced as infrastructure continues to age. With proper planning, the Town can smooth the transition of asset renewal and avoid a future spike in system failures.

In addition to aging infrastructure, the geographic extent of the Town's infrastructure system is expanding. Originally the Town was a small contiguous block, but over time the boundaries have expanded dramatically. This growing network has resulted in a sprawling infrastructure system in order to service the full extent of our community.

Development – While a large percentage of the Town's buried infrastructure was installed by developers who bore much of the installation cost, the Town is responsible for the full cost of maintaining and rehabilitating this infrastructure.



UNDEVELOPED PROPERTIES IN CARY'S PLANNING AREA

FOUNDATIONS

According to 2017 estimates, only 17 percent of the Town remains undeveloped, and while development will still take place, the new construction will not produce the same pace of growth seen in the past. Ensuring the capacity and reliability of buried infrastructure in areas of redevelopment will become increasingly important as the Town approaches buildout.

Ultimately the assets will need to be replaced as they reach the end of their service life. In the absence of large-scale development generating revenue to pay for asset maintenance and rehabilitation, the Town will need to fund this work through its capital improvement budget and operating budget.

Financial Planning – As time passes, the cost to maintain and replace the Town's infrastructure has and will continue to increase. Town staff need to determine the current value and replacement costs for these assets, and then plan in order to avoid a large balloon payment as assets reach the end of their service life and must be rehabilitated or replaced within a short span of time.

Loss of Institutional Knowledge – Over the years, valuable knowledge of the Town's water, wastewater, stormwater and reclaimed water systems was primarily stored in the minds of Town staff who observed the construction and maintenance of the facilities. However, the increasing size and complexity of the buried infrastructure requires that this information is formally captured since many of the Town staff depended upon today are eligible to retire within the next 10 years. This underscores the urgent need to move institutional knowledge from the minds of staff to a common data repository accessible Town-wide.

Shifting Technology – The buried infrastructure asset management program's success depends upon the Town improving GIS data quality and updating GIS schemas for each asset type; adopting new computing hardware and software (iPads to support Salesforce work order management, ArcGIS Collector software for field data collection to validate and correct asset data); and procuring and configuring analytical software tools to support rehabilitation and replacement project prioritization. These new and concurrent technology initiatives need to be monitored, properly sequenced and successfully implemented in order to create an effective asset management program.

Funding – Proactive maintenance and renewal of buried infrastructure assets will require adequate and consistent funding sources, from both the Utility Fund and General Fund. Managing this plan will require the projection of near-term and long-term funding needs to support Town Council and Town Management funding decisions.

Staff Availability – While the Town has allocated a staff position to organize and drive the buried infrastructure asset management program within the Water Resources Department, the other stakeholders engaged in this work will come from several departments, including Public Works, Finance, Utilities, Water Resources, Transportation and Facilities, and Information Technology. Asset management has not been identified as their primary job function, but the asset management program cannot be implemented without the Salesforce work order data; field condition assessments; GIS, CAD and other analytical resources; and budget development performed by these staff. In some cases, full implementation of the recommended asset management program, particularly asset O&M enhancements, may require additional staff or contractor resources beyond what is currently allocated.

Coordination – The buried infrastructure asset management program relies upon close, ongoing coordination between staff in multiple departments and job functions to generate the data, analysis and prioritization needed for the asset management program to be effective. This plan coordinates work and task sequencing across teams to maintain reliable workflow.

FOUNDATIONS

GOALS

Prioritize to Reduce Risk – This plan prioritizes and proactively addresses the highest risk assets to mitigate unscheduled outages and reduce overall risk of failure within the system.

Optimize Maintenance & Renewal – This plan identifies tools to support and enhance current O&M, condition assessment and renewal activities. This will help target and prioritize the assets with the highest need, which will in turn improve overall asset reliability, extend service life and reduce emergency repairs.

Reinforce Fiscal Responsibility – This plan helps Town staff forecast funding needs, identify least-cost solutions and provides data and the rationale behind how funds are spent.

Leverage Technology – This plan ensures that using existing technology such as the Town's GIS, as well as emergent technology initiatives like Salesforce, Chatter and Collector captures and stores institutional knowledge. This technology will also serve as a repository for asset management documentation.

Be Sustainable & Scalable – This plan describes processes that are sustainable over time, to ensure that Town staff have the necessary tools to continue operation of the asset management program in the future. Because other Town infrastructure types (roads, sidewalks, traffic, utility treatment facilities) also have asset management challenges, it is important to ensure that the results are adaptable and scalable to these assets where appropriate.

PLAN ORGANIZATION

This plan is based on the EPA guidance for asset management best practices (*Asset Management: A Best Practices Guide*, EPA 816-F-08-014, 2008) which is structured around the following five core questions.

- What is the Current State of the Assets?
- What is the Required Level of Service?
- Which Assets are Critical to Sustained Performance?
- What are the O&M/Capital Improvement Strategies?
- What is the Long-Term Funding Strategy?

These five questions are addressed within Chapters 2 through 6 of this plan, with Chapter 1 laying the foundation for the plan and Chapter 7 describing the implementation of the plan.

Chapter 1 – Foundations

This chapter provides a plan overview including objectives, challenges, goals and the interdepartmental collaboration that developed the plan.

Chapter 2 – Asset Inventory

The first step in developing our asset management program is to catalog what and where the assets are, what their condition is, what their remaining useful life is and what their value is. This chapter discusses the existing state of the buried infrastructure including the history of the system, the current asset inventory and location, asset condition and valuation, and record storage.

Chapter 3 – Level of Service

This chapter establishes both the Town's overarching vision for how it intends to manage buried infrastructure, as well as the specific criteria used to measure its performance in achieving that vision. Included are regulatory requirements, citizen expectations, level of service characteristics and key performance indicators.

Chapter 4 – Risk & Prioritization

Because assets fail, how we manage the consequences of failure is vital. However, not every asset presents the same failure risk, or is equally critical to the system's operations. Therefore, it is important to know which assets are most required by establishing a risk framework that identifies both likelihood and consequence of failure for each asset. Failure modes, risk, criticality and asset prioritization are discussed in this chapter.

Chapter 5 – Maintenance & Capital Planning
Our asset management program will help us make risk-based decisions by determining the right action, at the right time, for the right reason. Part of this decision-making process involves understanding what the asset life cycle costs are and what activities can be put in place to minimize these costs. This chapter provides information regarding O&M, capital improvements projects, asset failure modes, life cycle costs, as well as short and long-range planning and prioritization.

Chapter 6 – Funding
We manage our buried infrastructure in a fiscally responsible way, and our asset management program will be based on sound financial decisions and an effective long-term funding strategy. Knowing the full economic costs and revenues generated by the Town's buried infrastructure will enable the Town to determine the system's financial forecast. This forecast can then be used to help decide what changes need to be made to short and long-term funding strategies. The Town budget process, current funding, long-range funding requirements, future funding options and funding plan updates are discussed in this chapter.

Chapter 7 – Implementation
This chapter discusses the plan for implementing the buried asset management program, including strategies and resources to achieve the program objectives, a five-year task list, long-term goals, action items, workflows and reporting.

PLAN DEVELOPMENT TEAM

A cross-organizational group of Town employees worked together to create this plan, lending their expertise and guidance to influence and inform its vision and strategies. Department representatives included:

PUBLIC WORKS – *Scott Hecht, Jim Hallowes, Davis Reynolds, Craig Hollister, Seth Burleson, Paul Campbell, Chad Lemke, Bill Roy, Matt Wetherell, John Holloway, Betsie Winokur*

UTILITIES – *Jamie Revels, Donald Smith, Alex Jones, Rick Jordan, Kenya D'Jon, Paul Ray, Damon Forney, Andy Russell*

WATER RESOURCES – *Steve Brown, Glen Harrell, Billy Lee, Jeff Adkins, Dan Clinton, Jan Patterson, Lynn Brilz, Dave Hallgren, Michael Mazanek, Sarah Braman, David Johnson, Courtney Licata, Marie Cefalo, Srijana Guilford*

FINANCE – *Karen Mills, Kimberly Branch, Mary Beth Huber, Gregory Jenkins, Stacey Teachey, Judy DeNardis, Ishani Padmaperuma, Precious Seabrooks, Katie Lumb, Seth Larson*

TRANSPORTATION & FACILITIES – *Paul Kuhn, Glenn Sheppard, Paul Middleton, Tim Carraway, Richard Carter*

INFORMATION TECHNOLOGY – *Leith Britt, Wilson Farrell*

TOWN MANAGER'S OFFICE – *Danielle Mahoney, Emily Barrett, Carolyn Roman, Kathryn Trogdon*

Focus groups consisting of subject matter experts from key departments provided input and guidance for each specific chapter of the asset management plan. Focus groups were organized based on the major disciplines represented in the asset management plan.

WATER – *Davis Reynolds, Craig Hollister, Seth Burleson, Alexandra Jones*

WASTEWATER – *Lynn Brilz, Donald Smith, Paul Campbell, Chad Lemke, Paul Ray*

STORMWATER – *Dan Clinton, Bill Roy, Chad Lemke, Paul Campbell, Carolyn Lewis*

RECLAIMED WATER – *Rick Jordan, Kenya D'Jon*

FINANCE – *Karen Mills, Kimberly Branch, Mary Beth Huber, Gregory Jenkins, Stacey Teachey, Ishani Padmaperuma, Precious Seabrooks, Katie Lumb, Seth Larson*

TECHNOLOGY SERVICES – *Leith Britt, Wilson Farrell*

2 ASSET INVENTORY

INTRODUCTION

An accurate asset inventory is the foundation for developing the Town's buried infrastructure asset management program. In order to populate the asset inventory, the following basic questions about the Town's buried infrastructure must be answered.

The focus of this plan is the Town's linear assets, primarily those buried underground; vertical infrastructure will be addressed as part of a future effort. For the purposes of this plan, the buried infrastructure inside of fence lines is considered part of the associated vertical infrastructure of the site. Major examples of vertical infrastructure not covered by this plan include:

- Pump Stations
- Treatment Facilities
- SCADA Infrastructure
- Advanced Meter Infrastructure (AMI) Collector Antennas

The buried infrastructure asset inventory is stored in the Town's Geographic Information System (GIS). One major advantage of storing the asset inventory in GIS is that all assets are assigned spatial data. This allows the Town to not only track what assets are part of the system, but also visually pinpoint each asset's location. Assets are tracked by the pipe, structure, or appurtenance - not the individual components these may contain. For instance, a gate valve is treated as whole unit including all ancillary items, as opposed to being separated into individual parts such as the gate valve, body, operator, valve box, valve box cover and bolts.

Condition assessment as well as the various operations and maintenance (O&M) activities that help the Town determine what the state of the buried infrastructure is, are examined in more detail in Chapter 5. Asset valuation is explored later in this chapter.

ASSET INVENTORY

The Town of Cary began as a settlement called Bradford's Ordinary in 1750. In 1854, Allison Francis "Frank" Page bought three hundred acres of land, laid out the first streets, established several enterprises and named this development Cary. The extension of the railroad through Cary enabled the Town to flourish, and the Town of Cary was officially incorporated on April 6, 1871. The Town steadily grew for the next century developing into a town of a few thousand people by the 1960's.

Decennial Census		
Year	Population	% Change
1940	1,141	-
1950	1,496	31%
1960	3,356	124%
1970	7,640	128%
1980	21,763	185%
1990	43,858	102%
2000	94,536	116%
2010	135,264	43%
Source: U.S. Census Bureau		

The catalyst for dramatic growth in Cary was the creation of the Research Triangle Park (RTP) on the Wake/Durham County line. The effect of the RTP on Cary was dramatic, as seen in the following table of U.S. Census population data. This high level of recent growth means that the majority of the Town's infrastructure has been built to modern construction standards.

Even though the Town's infrastructure is relatively young, a significant percentage of it was installed within a relatively narrow window of time. Like

population growth, buried infrastructure installation peaked in the 1990s with approximately 40 percent of the system assets being installed in that decade. Without proper planning, it is likely that as the system ages a large block of these assets will require attention at the same time.

DELIVERY OF THE FIRST PIPE FOR THE CARY-APEX WATER TREATMENT FACILITY RAW WATER PIPELINE, EARLY 1990S

UTILITY SERVICE OUTSIDE OF CARY

In addition to providing utility service within the Town limits, we also extended our services to the following entities:

- **Research Triangle Park (RTP)** - Starting in 1973, the Town began operating and maintaining the water distribution system and wastewater collection system in the Wake County portion of the RTP. Wake County maintains ownership of the actual pipes.
- **Raleigh-Durham International Airport (RDU)** - The Town began providing utility service to RDU in 1984. Water service is operated and maintained up to the master meter serving the airport. Wastewater from RDU reaches the Town system via a private pump station.
- **Morrisville** - In 2006, the Town of Cary and the Town of Morrisville agreed to a water and wastewater utility merger. With the utility merger, Cary assumed responsibility for financing, operating, maintaining, improving and expanding the water and wastewater systems serving Morrisville.

WATER SYSTEM BACKGROUND

In 1923, the Town established a municipal water system consisting of untreated ground water drawn from several deep wells, a cast iron pipe distribution system and a 100,000-gallon elevated water storage tank. This five-well water system provided an adequate quantity of water until 1950, when the pace of growth within the Town began to outpace the supply of water that the wells could provide. Between 1950 and 1965 the number of wells drilled increased to 25 as the Town worked to meet demand.

In addition to the challenge of providing an adequate supply of water to the growing population, the Town experienced water quality concerns due to the high iron levels in the potable water. Treatment to remove iron was considered in the 1940s, but no action was taken, and water quality continued to be an issue for the Town. By 1965, only 17 wells were operational as poor water quality and exhausted supply forced the Town to abandon some wells.

To address water quantity needs and quality concerns, the 1965 *'Report on New Water Supply'* produced by Moore, Gardner & Associates advised the Town to connect to the City of Raleigh water system. The Town followed through on this recommendation in 1966 with the installation of a 12-inch water main connection on Buck Jones Road. In 1975, in conjunction with the construction of the 1 million gallon Harrison elevated water storage tank, a second interconnection was made with Raleigh at Trinity Road.

During the 1980s the Town continued to rely on water supplied by Raleigh as well as from Town wells. However, to be less dependent on Raleigh and to better serve our own flourishing community, we constructed the 12 million gallon per day Cary-Apex Water Treatment Facility in 1993. The Ridgeview elevated storage tank was built a year

later, adding another 1 million gallon of storage to serve Cary's growing water system.

A 1992 *Water System Master Plan* by Diehl & Phillips, P.A., forecast the need for additional water system storage and eventual development of separate pressure zones. An update to this plan was completed by CDM in 2000, which reinforced the need for additional pressure zones and water storage to serve our expanding water distribution system. In 2001, the 3 million gallon Old Apex Road Ground Storage Tank was added to the water distribution system. Two additional water storage tanks were constructed in 2002 to support separate pressure zones. The 1 million gallon Plumtree Tank was constructed within the new Southern Pressure Zone, which began operation on April 5, 2005. The 2 million gallon Carpenter Tank was constructed within the new Western Pressure Zone, which began operation on October 18, 2005. In 2018, the 2-MG Kilmayne Tank was constructed in the Central Pressure Zone and the 2 million gallon Good Hope Tank was constructed in the Western Pressure Zone.

To ensure the continued vitality of our community, this pattern of evaluating and planning for our long-term water supply, infrastructure and facility needs has continued. The *Long-Range Water Supply Plan* from 2000 had a planning horizon of 2030, along with a Water Conservation and Peak Demand Management Plan. The 2007 *Integrated Water Resources Management Plan* (IWRMP) had a 2030 planning horizon as well. In 2013, Cary and Apex completed a *Long-Range Water Resources Plan* with a planning horizon of 2060, and this plan is currently in the process of being updated.

WATER SYSTEM INVENTORY

The water system is the largest of the Town's four major buried asset types, and includes service to Morrisville, RDU and the Wake County portion of the RTP.

What's Included

The following types of linear water assets are owned and maintained by the Town:

Water Main
1,010 Miles

Valves
25,527

Air Release Manholes & Valves
825

Control Valves
9 Locations

Fire Hydrants
9,625

Blow-offs
2,485

Service Lines
69,000

Meters *(incl. box & radio)*
69,000

ASSET INVENTORY

Master Meters

13 Locations

Sampling Stations

126

Automatic Flushing Devices

Marker Balls

What's Not Included

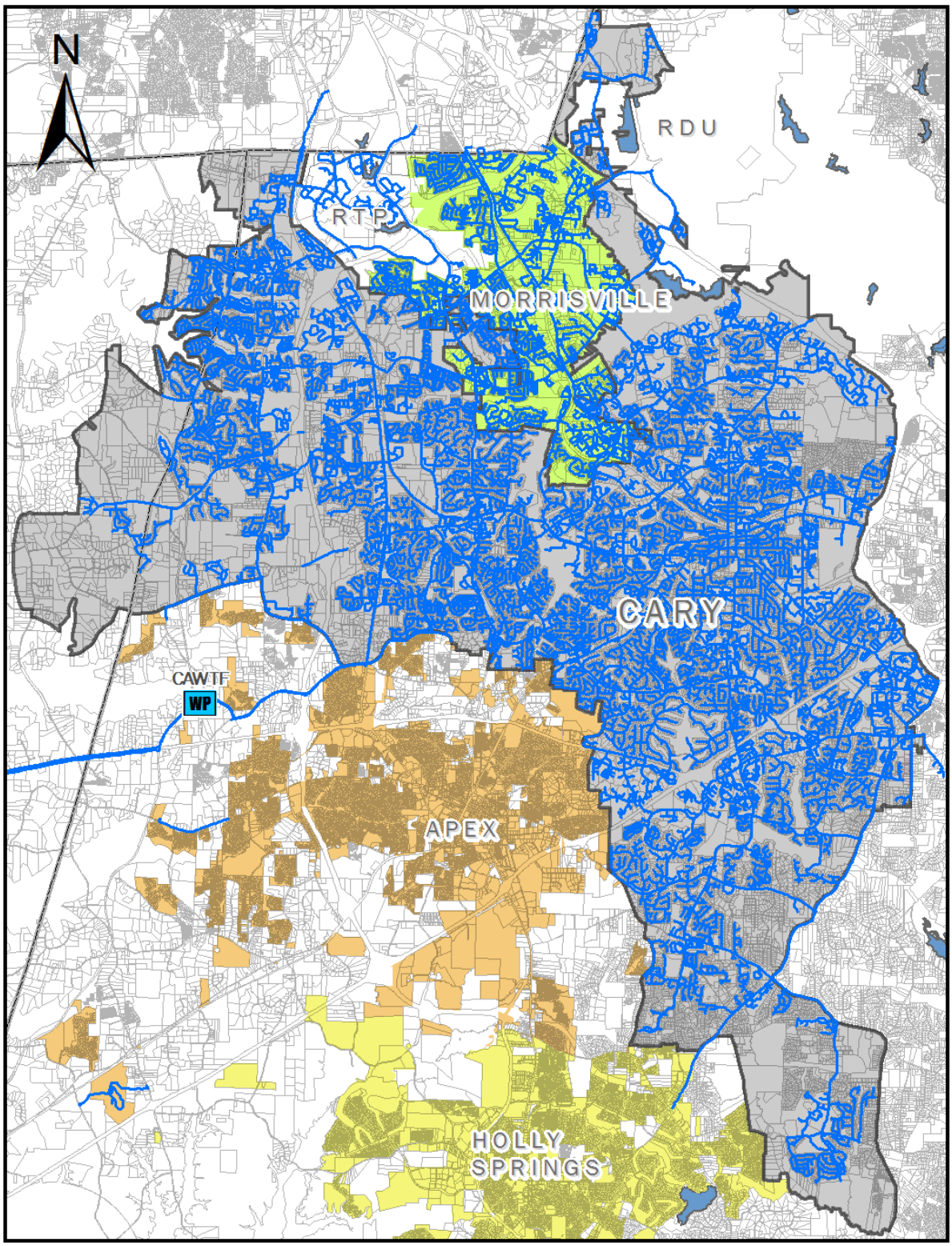
- Private water systems
- Wells
- Water service lines and related assets on the customer side of the meter box
- Fire protection lines
- Post indicator valves
- Water meters within RDU other than the master meter

Data Gaps

Significant data gaps where additional water system information is necessary:

- Install date
- Service line locations in GIS
- Cathodic protection locations in GIS

WATER SYSTEM MAP



ASSET INVENTORY

WASTEWATER SYSTEM BACKGROUND

As early as Cary's incorporation in 1871, wastewater was managed by private on-site underground septic systems. As population density increased in the downtown area, the Town installed a municipal wastewater collection system in 1923 to transport wastewater to the Coles Branch Wastewater Treatment Plant (CBWTP), located near North Dixon Avenue. The CBWTP treated wastewater for approximately 800 people with a single Imhoff cone settling tank, a sand filter and a drying bed.

To address growth, including the beginning of subdivision development, in 1954 the CBWTP was upgraded to treat 0.10 million gallons per day (MGD). As continued growth, in the early 1960s, the Town began sending the majority of its wastewater to the City of Raleigh for treatment, which continued until the completion of the North Cary Water Reclamation Facility (NCWRF) in 1984. In 1987 the CBWTP was retired, and in 1989 the Town created the south sewer service basin and built the South Cary Water Reclamation Facility (SCWRF) to meet our community's increasing needs.

As with our history of water system planning, the Town regularly conducts evaluations and projections for our wastewater system. A *Wastewater Collection System Master Plan* completed by Diehl & Phillips in 1992 projected the need for a Western Cary collection system and treatment plant and also recommended reducing inflow and infiltration (I&I) within the downtown collection system and establishing a long-term flow monitoring program.

In 2002, the Town completed its first sewer rehabilitation project. This project was the culmination of years of work to improve sanitary sewer condition assessment, tracking and inspection. The first rehabilitation projects focused primarily on structural problems within the oldest parts of the wastewater collection system.

In 2003, Hazen and Sawyer finalized an updated *Wastewater Collection System Master Plan*. This master plan, like the one from 1992, continued to recommend reducing I&I and starting a long-term flow monitoring program. At that time, the Town's wastewater collection system consisted of 518 miles of gravity interceptors, approximately 45 miles of force mains and 29 pump stations. Cary maintained three separate sewer basins: North, South and West. The West basin was pumped to the NCWRF for collection and treatment. In addition, the Town received wastewater from Morrisville, RDU and the Wake County portion of RTP.

In 2004, the Town began operating its own long-term flow monitoring program. As of 2018, the program has grown to include 33 long-term metering locations. Also, in 2004 the Town began a comprehensive interceptor cleaning, inspection and maintenance program.

In 2014, the Western Wake Regional Water Reclamation Facility began operation. This facility serves the towns of Cary and Apex with wastewater treatment, as well as effluent conveyance and discharge.

ASSET INVENTORY

WASTEWATER SYSTEM INVENTORY

The sewer collection system is the Town's second largest infrastructure network, and like the water system includes service to Morrisville, RDU and the Wake County portion of the RTP.

What's Included

The following types of linear wastewater assets are owned and maintained by the Town:

Sewer Main
840 Miles

Force Main
85 Miles

Valves
155

Air Release Manholes & Valves
175

Service Lines
61,000

Cleanouts

Manholes
25,165

Meters (incl. box & radio)
49

System Biofilters
2

Odor Control

Cathodic Protection

Marker Balls

What's Not Included

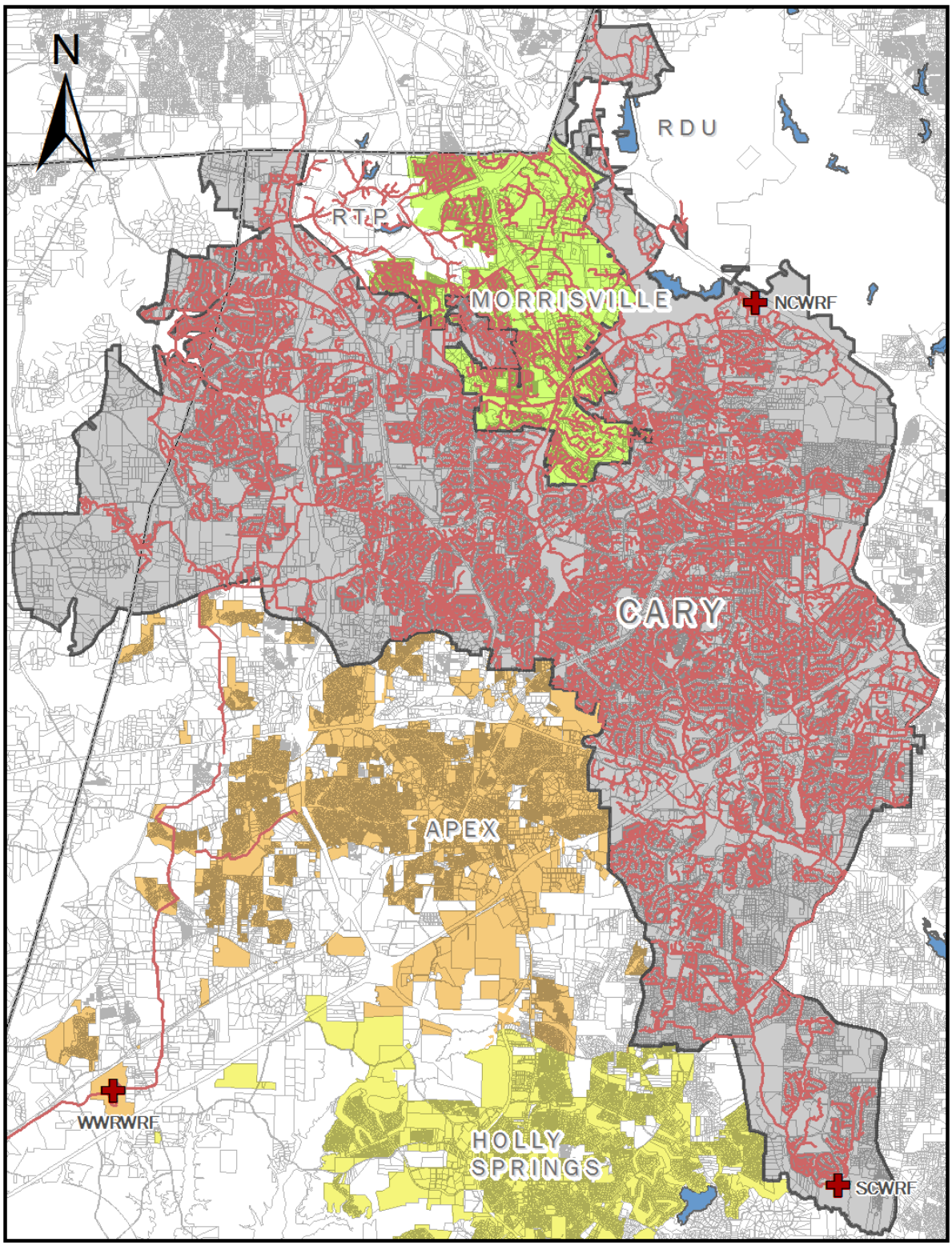
- Private sewer systems
- Septic systems
- Sewer service lines and related assets on the customer side of the cleanout
- Pretreatment facilities
- Grease traps

Data Gaps

Significant data gaps where additional wastewater system information is necessary:

- Install date
- Truss pipe location
- Service line locations in GIS
- Cleanout locations in GIS
- Cathodic protection locations in GIS
- Odor Control locations in GIS

WASTEWATER SYSTEM MAP



ASSET INVENTORY

STORMWATER SYSTEM BACKGROUND

Historically, stormwater conveyance within the Town has been handled in accordance with the stormwater standard specifications and details. However, from a regulatory standpoint, in 1972 the Town was one of the first communities in the state to adopt a floodplain management ordinance, predating the issuance of the initial Flood Insurance Rate Map (FIRM) for the area. Over time, the Town's involvement has increased further, first by assuming delegated authority from the State for erosion and sediment control in 1985, and later by acquiring a National Pollutant Discharge Elimination System (NPDES), Phase II permit in 2005.

Geographically, the stormwater system in the Town of Cary is divided north to south by two major river basins: the Cape Fear and Neuse River Basins. Approximately 29 percent of the stormwater system is in the Cape Fear River Basin, while the other 71 percent lies within the Neuse River Basin. As the Town has developed, so has the level and amount of watershed and flood studies in the area. Typically, hydrologic and hydraulic studies have only been conducted as the result of new development or for Town, federal, or state projects relating to FEMA floodplain mapping, road or watershed improvement projects. The major streams within the Town have been modeled as part of the FEMA National Flood Insurance Program. The Town, through stormwater management standards and guidelines, has maintained a consistent approach to hydrology and hydraulics within its service area. This provides the consistency needed to manage changes in watershed hydrology and hydraulics over time and allows for integration into state and/or federal modeling efforts such as FEMA floodplain mapping.

STORMWATER SYSTEM INVENTORY

There are around 600 miles of stormwater pipe in the Town. However, of that number only 270 miles are Town maintained, while the other 330 miles are either private or NCDOT owned and maintained. The Town only owns, operates, and maintains stormwater infrastructure located in the Town right-of-way, within Town easements, or on Town-owned property.

What's Included

The following types of linear stormwater assets are owned and maintained by the Town within Town property or right-of-way:

Storm Pipe
275 Miles

Culverts
3.5 Miles

Inlets
34,070

Manholes
1,305

Stormwater Control Measures
85

ASSET INVENTORY

What's Not Included

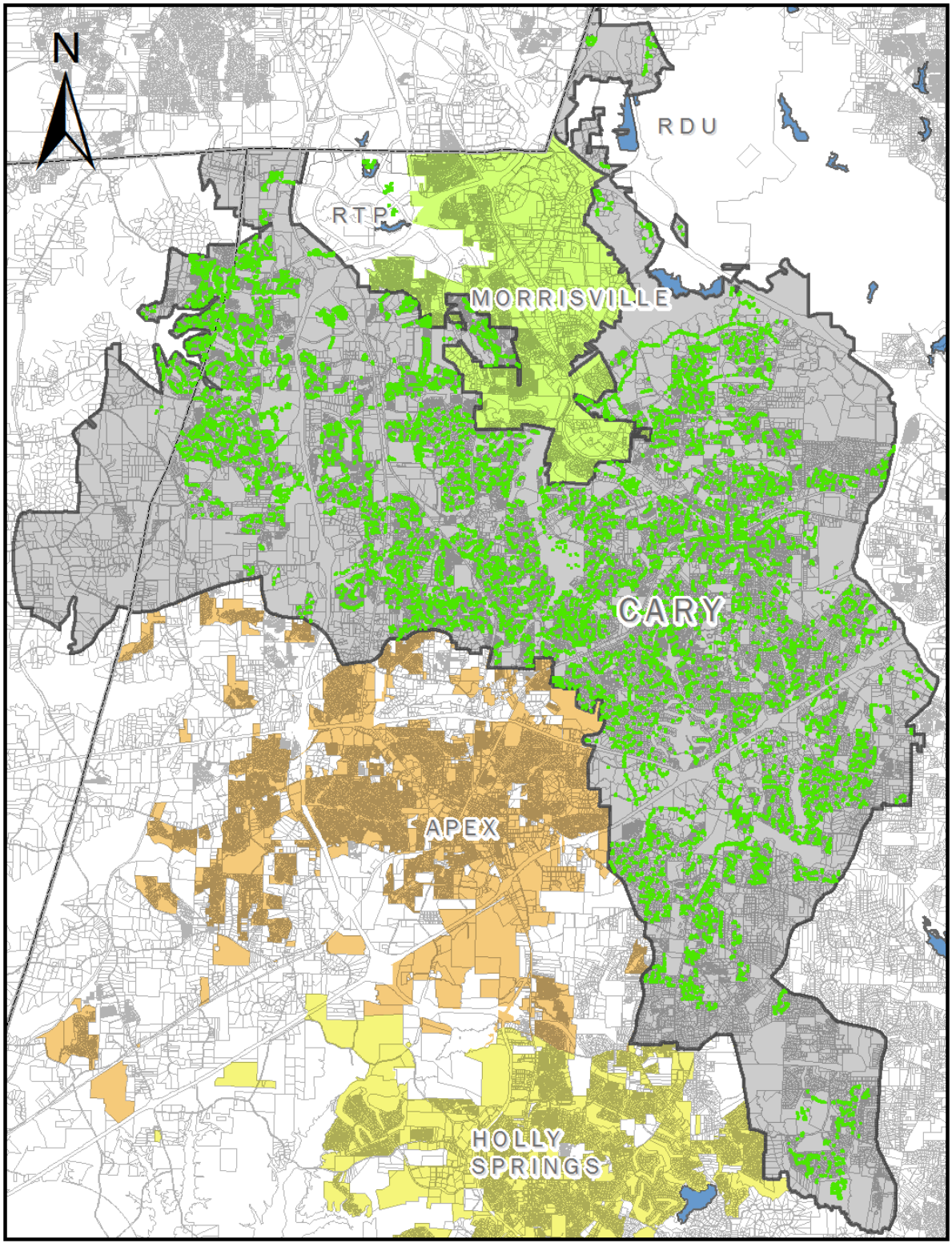
- Private stormwater features located outside of the right-of-way
- Stormwater features located within the NCDOT right-of-way

Data Gaps

Significant data gaps where additional stormwater system information is necessary:

- Install date
- Ownership information

STORMWATER SYSTEM MAP



ASSET INVENTORY

RECLAIMED WATER SYSTEM BACKGROUND

In 1996, the Town began developing a comprehensive water conservation program to help extend the life of our raw water allocation from Jordan Lake, the Town's primary water source. The program goals adopted by Council in 1997 were to provide safe reliable water service while reducing wasteful uses of water, reduce costs of infrastructure expansion and conserve a limited natural resource. Developing a reclaimed water system was one of the key strategies to help the town meet these goals, since reclaimed water could be provided for irrigation in lieu of potable water within defined service areas. The Town began distributing bulk reclaimed water in 1999, and in 2001 the Town began operation of the reclaimed water distribution system, becoming the first utility in North Carolina to supply reclaimed water to homes as well as to businesses for irrigation.

Although it is only available to a small percentage of the town's utility customers, reclaimed water is a critical component of the Town's overall water resources and helps achieve the following goals:

- Reduce potable water use
- Reduce the peak demands on the potable water system which helps defers water treatment plant expansion
- Reduce wastewater treatment plant discharge into receiving waters
- Reduce interbasin transfer (IBT)

In North Carolina, reclaimed water is regulated by the Department of Environmental Quality (DEQ) and is defined in the rules as a tertiary quality effluent that must meet specified water quality parameters as defined by the State. The rules allow reclaimed water to be used for irrigation, cooling water, toilet flushing, fire suppression, decorative ponds / fountains and industrial uses. However, the rules prohibit reuse for swimming pools, hot tubs, spas, crop irrigation and as a raw water supply for potable water systems.

The reclaimed water system is both the youngest and smallest of the Town's major buried infrastructure types. The reclaimed water system includes piped distribution systems that supply commercial facilities, single and multi-family homes, schools, Town-owned recreational complexes, as well as bulk reclaimed water distribution stations at the Town's water reclamation facilities. In 2010, the Town adopted Policy Statement 132 to ensure the continued orderly expansion and effective utilization of the reclaimed water system. This policy defined three reclaimed water service areas: North Cary, South Cary and West Cary. For new development occurring within these service areas, developers are required to extend the reclaimed water system to the area and to install reclaimed water infrastructure for irrigation, cooling towers and other potential secondary plumbing use within the property. If reclaimed water is not available to the site at the time of development, the secondary water use piping is temporarily supplied with potable water until reclaimed water is available, at which time the policy requires the supply be converted to the reclaimed system.

ASSET INVENTORY

RECLAIMED WATER SYSTEM INVENTORY

The reclaimed water system is the newest of the four major buried infrastructure asset types with initial installation dating back to 2000. Due to its young age, the reclaimed system consists entirely of materials that meet the Town's current standards.

What's Included

The following types of reclaimed water assets are owned and maintained by the Town:

Reclaimed Water Main
55 Miles

Valves
830

Air Release Manholes & Valves
65

Blow-offs
170

Service Lines
830

Meters *(incl. box & radio)*
830

Automatic Flushing Devices
1

Marker Balls

What's Not Included

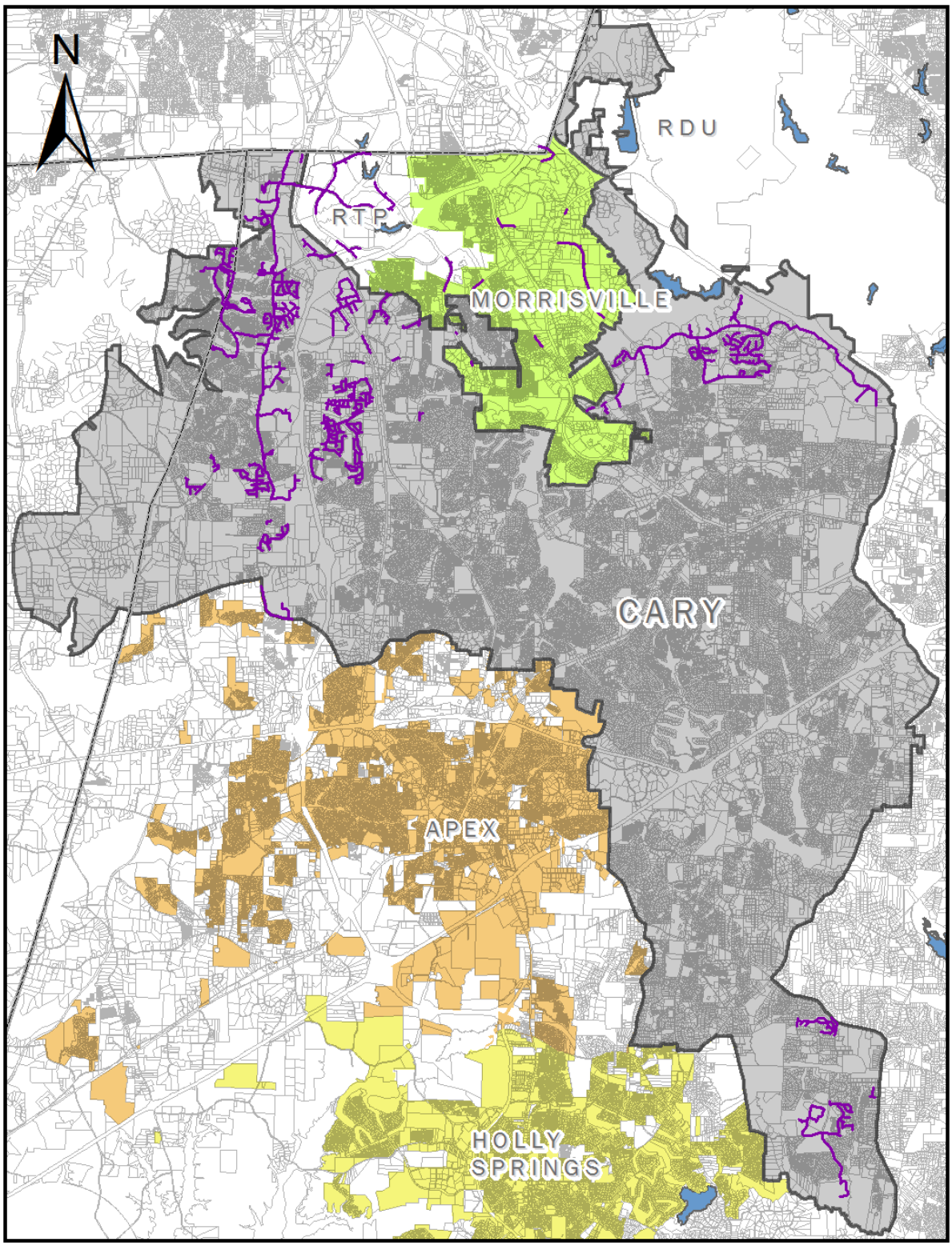
- Reclaimed water service lines and related assets on the customer side of the meter box
- Cooling towers

Data Gaps

Significant data gaps where additional reclaimed water system information is necessary:

- Install date
- Service line locations in GIS

RECLAIMED WATER SYSTEM MAP

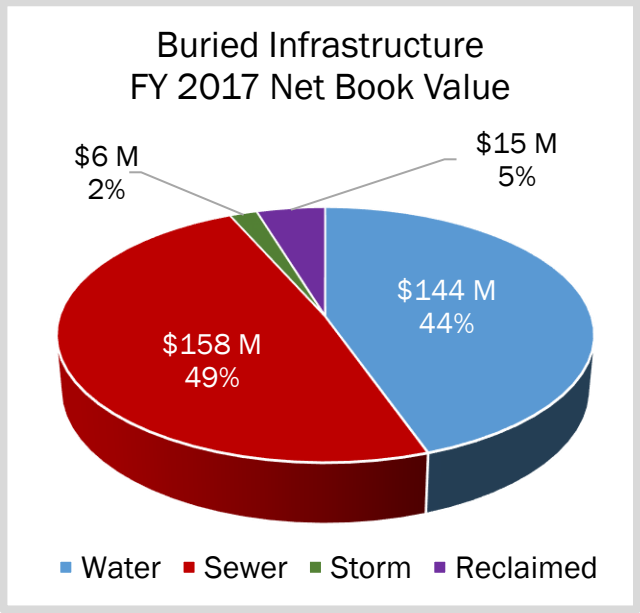


ASSET INVENTORY

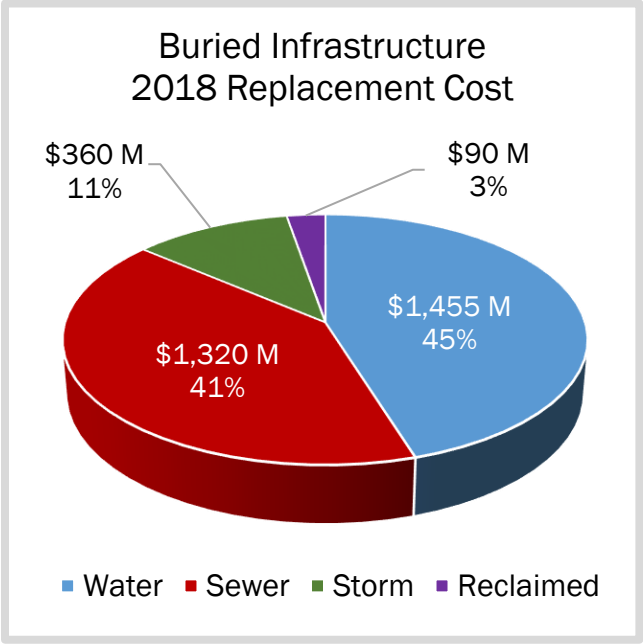
ASSET VALUATION

The value of the Town's utility and stormwater infrastructure is stored in Naviline as part of the fixed asset register. Within the register, assets are tracked collectively using line items for each of the Town's capital projects dating back to 1948. The register also includes annual line items for total water, sewer, reclaimed water and stormwater installed by private development each year.

For each line item in the fixed asset register, the original cost of installation is recorded. The original cost is then straight line depreciated based on the installation year and the expected useful life of the asset. This depreciation provides the current net book value for each asset line item. Although assets prior to 1948 are not included in the fixed asset register, these assets are beyond their expected useful life and their net book value is effectively zero.



The net book value accounts for the depreciated value due to age of the buried infrastructure. However, this does not reflect what it would cost to replace the buried infrastructure with new assets using present-day funds. A simple way to calculate an estimate for the current replacement cost of the buried infrastructure is to multiply the miles of each asset type by a replacement cost per mile of asset installed. The results of this exercise are shown in aggregate for each type of infrastructure in the following graphic. As the asset management program is implemented, the replacement costs will be further refined.



Both the fixed asset register and infrastructure replacement values are primarily based on the value of groups of assets, rather than the value of individual assets. To track buried infrastructure value on a per asset basis, the existing GIS schema will need to be updated to include attributes for original, depreciated and replacement value. The GIS Improvement Project, described in Chapter 7 (Action Item AM-1), will modify GIS to include asset value attributes. Further financial calculations can then be performed using either GIS, Salesforce, or other third-party software applications.

ASSET RECORD STORAGE

As assets become part of the Town system, records particular to the assets are collected. The Section 10000 of the Town Standard Specifications outlines the record drawing requirements for development and capital projects. Requirements include the submittal of surveyed point data in digital format for

the project as well as record drawings. In addition, throughout the course of the project a number of other project related documents are collected and stored in Laserfiche. Examples of these documents include material submittals, pay applications, O&M manuals, permits, letters of acceptance and other project related paperwork.

RECORDS RETENTION

North Carolina record retention laws dictate the minimum length of time asset documentation must be retained, although the Town has more stringent requirements for some record types.

The highest level and most important asset related documents must be retained for the life of the structure or in some cases permanently. These records include:

- Right-of-Way & Easements - Permanent
- Record Drawings – Life of Structure
- Permits – Life of Structure
- O&M Manuals – Life of Structure

Some asset related records do not have to be retained permanently or for the life of the asset and can be stored for less time. These records include:

- Project Records (Payment Applications, Change Orders, Contract, Field Reports, Testing Reports, Notice-to-Proceed, Shop Drawings) – 6 Years
- Field Inspection Reports – 6 Years
- Letters of Acceptance – 6 Years

ASSET DATA CONVERSION

The Town has a number of asset related records that are stored in obsolescent or paper forms that need to be converted to electronic media and stored in Laserfiche. Once in Laserfiche, these records will be hotlinked to the appropriate asset within ArcGIS. These records include:

- **Planning Microfiche** – The Planning department maintained a large collection of microfiche that contained the development plans and record drawings for a large amount of the Town infrastructure. This microfiche was recently scanned, and the files are stored on the Town's network drive. These files need to be reviewed for buried infrastructure-related material, and the pertinent files stored in Laserfiche and hotlinked to the appropriate assets within ArcGIS.
- **PWUT Microfiche** – Similar to Planning, PWUT has a large collection of microfiche that contains development and record drawings. A cursory inspection indicates that many of these records are redundant to the Planning microfiche. However, this collection likely contains unique records and should be scanned and reviewed against the Planning microfiche, with the best available data stored in Laserfiche and hotlinked in GIS.
- **Infrastructure Microfiche** – Water Resources also has a collection of microfiche, which contains records related to the project management of Town capital projects dating back as far as 1954. These records should be scanned and reviewed for important asset information.
- **Mylars** – The Town has a variety of mylar construction and record drawings; some were stored in Planning, some were in storage at the Operations Center, and some are stored in hanging files in the break room adjacent to Transportation & Facilities. All these mylar records have been scanned, stored in Laserfiche, and hotlinked in the Project Boundaries table in MapInfo.
- **Town Stormwater Control Measures (SCM)** – Paper records for Town SCM's are stored in three ring binders at the Operations Center and need to be scanned and filed in Laserfiche. Once stored in Laserfiche, these records can be hotlinked from the SCM feature class in GIS for quick access.

ASSET INVENTORY

DIGITAL RECORD STORAGE LOCATIONS

Digital records for the Town's buried infrastructure are currently stored in the following locations:

- **ArcGIS** - Asset inventory
- **Laserfiche** - Record drawings, permits, easements, shop drawings, O&M manuals, payment applications, project communication
- **IT Pipes** - Wastewater and stormwater television inspection information
- **Firehouse** - Fire hydrant information
- **HiperPM/Salesforce** - Workorder information
- **Utility Cloud** - Water Quality Sampling, FOG Program, Spare Parts Tracking
- **Aquastar** - Advanced meter infrastructure (AMI) information

3 LEVEL OF SERVICE

INTRODUCTION

The Town is committed to providing exceptional services to help maintain the high quality of life our citizens have come to know. Level of service (LOS) supports this commitment by establishing both the Town's overarching vision for how it intends to manage buried infrastructure, as well as the specific criteria used to measure its performance. A well-defined LOS supports the Town in leading the state in building, operating and maintaining our buried infrastructure to high standards, meeting or surpassing all regulatory requirements, as well as preserving and protecting the environment.

LEVEL OF SERVICE BENEFITS

- Provide reliable, high-quality, and affordable utility and stormwater services.
- Communicate service expectations to staff, elected officials, and the public.
- Concentrate resources on commonly defined and accepted goals.
- Establish a baseline against which to assess acceptable levels of risk.
- Meet community expectations and maintain regulatory requirements.
- Refine operations & maintenance (O&M) protocol and activities.

All types of buried infrastructure in the Town are regulated under various local, state and federal laws and requirements. In addition, there are several industry standards specific to various types of infrastructure that the Town follows. The Town's efforts to meet, and ideally exceed, the minimum threshold of these requirements is fundamental in defining the Town's buried infrastructure LOS.

WATER	
Safe Drinking Water Act	*Federal*
Water System Operating Permit	*State*
Partnership for Safe Water Standards	*Industry Standard*
WASTEWATER	
Clean Water Act	*Federal*
National Pollutant Discharge Elimination System	*Federal*
Wastewater Collection System Permit	*State*
Interbasin Transfer Certificate	*State*
Sewer Use Ordinance	*Town*
Pretreatment Program	*Town*
Partnership for Clean Water Standards	*Industry Standard*
STORMWATER	
Clean Water Act	*Federal*
National Pollution Discharge Elimination System	*Federal*
RECLAIMED WATER	
National Pollutant Discharge Elimination System	*Federal*
NC Administrative Code	*State*
FINANCE	
Revenue Bond Covenants	*Trustee*
Accounting/Reporting Regulations	*Federal, State, Local*

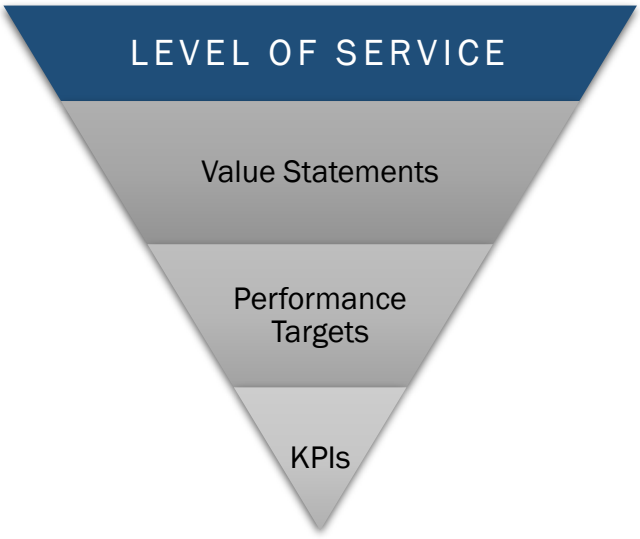
The Town's LOS is also defined by the expectations of our citizens and the neighboring communities that our buried infrastructure serves. Examining these expectations helps flesh out and further define what buried infrastructure operation and

performance looks like specifically for the Town of Cary. If the Town interviewed citizens regarding their expectations, Staff anticipates they would receive responses such as the following:

SERVICE	STEWARDSHIP
Safe and uninterrupted service	Comply with local, state and federal regulations
Equitable rates and accurate utility billing	Protect the environment
Citizen data kept private and secure	Control noise and odor
Knowledgeable, accessible staff	Plan for the future
Timely, skilled response to citizen requests	Good regional neighbor
Transparent and fair treatment	

CHARACTERISTICS

For the purposes of this asset management plan, the characteristics of the Town's LOS have been divided into three tiers. Each tier defines a more specific set of attributes within the overall LOS. However, all three tiers must be aligned with each other to be most effective.



VALUE STATEMENTS

Value statements define the overarching vision, mission and goals in qualitative terms. They are informed primarily by regulatory requirements, industry standards, Town requirements and citizen expectations. The Plan Development Team established six value statements for the Town of Cary.

VALUE STATEMENTS

- The Town provides uninterrupted and efficient utility services, at equitable rates, that are safe, reliable, and fiscally sound.
- The Town complies with all regulatory requirements, adheres to public health and safety standards, and works to protect the environment in all operations.
- The Town provides the same high-quality service across the entire service area, whether in Cary, Morrisville, RTP, or RDU.
- The Town is a 'good neighbor' to citizens and surrounding municipalities.
- The Town is interactive and transparent with citizens and has knowledgable staff that are available as subject matter experts.
- The Town protects the security of data and the privacy of its citizens.

PERFORMANCE TARGETS

Performance targets are quantitative infrastructure and operations and maintenance (O&M) goals that serve as defined thresholds for identifying whether the Town is operating in alignment with the value statements. Although performance targets are defined quantitatively, they are not guarantees of system performance but rather organizational objectives that help achieve the established LOS. Most of the performance targets have been sourced from existing Town criteria outlined in the annual budget, policy statements, standard specifications, as well as from Public Works and Utilities business plans and manuals of practice.

LEVEL OF SERVICE

KEY PERFORMANCE INDICATORS

Key performance indicators (KPIs) are chosen from among the overall pool of performance targets to serve as the key metrics that provide a 'dashboard view' of the state of the buried infrastructure. KPIs will be reported annually and compared to historical performance to help visualize the long-term effectiveness of the asset management program.

As key metrics, KPIs have been selected to ensure they meet the following criteria:

MEANINGFUL	• Relevant and provide a clear picture of performance
MEASURABLE	• Can be quantitatively measured cost effectively
CONSISTENT	• Reproducible and in alignment with industry practice
USEFUL	• Helpful and encourage improvement
UNIQUE	• Describe a specific attribute independent of other KPIs

PERFORMANCE TARGETS & KPIs

WATER SYSTEM

Performance Targets

- Exercise 25% of system valves annually
- Inspect 33% of air release valves annually
- Inspect 100% of control valves annually
- Flush 50% of fire hydrants annually
- Acoustic monitor 50% of water system annually
- Operate and test all interconnections at least once every 2-years
- Replace water meters every 17 years
- Maintain 'Unaccounted/Unbilled Water Use' below 6% of water system demand
- Maintain 40 psi at maximum day demand conditions; 30 psi at maximum hour demand conditions; 20 psi at max day demand with maximum fire flow demand (Policy Statement 129)
- Maintain a minimum fire hydrant flow of 1000-gpm at 20-psi residual in residential areas and 1500-gpm in all other areas (Section 6020, Standard Specifications)
- Conduct a month-long disinfection switchover annually
- Conduct a regulatory sampling program continually
- Maintain an average chlorine residual of at least 2-mg/L

Key Performance Indicators

- **Maintain less than 20 breaks per 100 miles of water main annually**
- **Receive less than 10 water quality complaints per 1,000 service connections annually**
- **Rehab/Replace 3.25 miles of pipe annually**

WASTEWATER SYSTEM

Performance Targets

- Clean 10% of system annually, not including repeat cleanings (FY 2018 Budget)
- Televise and inspect 8% of system annually (FY 2018 Budget)
- Inspect 100% of manholes annually
- Inspect 100% of aerial and high priority pipe every 6 months

LEVEL OF SERVICE

- Inspect 100% of force main air release valves annually
- Smoke test 2 basins of the system annually
- Acoustically assess 20% of system annually
- Conduct cathodic protection system inspections of WWRWMF effluent pipeline annually
- Maintain an overall Max Day to Annual Average Flow Ratio of less than 2.0
- Maintain system inflow at an average rate of less than 275 gal/capita/day annually (FY 2018 Budget)
- Maintain system infiltration at an average rate of less than 750 gpd per inch-diameter-mile of system pipe annually (FY 2018 Budget)

Key Performance Indicators

- **Maintain less than 2 sanitary sewer overflows (SSO's) per 100 miles of sewer main annually**
- **Receive less than 60 odor calls annually**
- **Rehab/Replace 20 inch-miles of pipe annually**

STORMWATER SYSTEM

Performance Targets

- Inspect for debris and clean (if needed) 4% of the system annually
- Televise and inspect 6% of the system annually
- Inspect 100% of Town stormwater control measures annually

Key Performance Indicators

- **Receive less than 15 citizen stormwater calls per inch of annual rainfall**
- **Rehab/Replace 200 feet of pipe annually**

RECLAIMED WATER SYSTEM

Performance Targets

- Exercise 100% of system valves annually
- Inspect 100% of air release valves annually
- Replace potable water dual check valves on properties with reclaimed water at least once every 5 years
- Conduct education and training for all new users as required by permits
- Conduct an annual reclaimed water holiday for maintenance operations during the month of February
- Audit 100% of reclaimed meters during the annual reclaimed water holiday to verify meters are reporting zero demand, except for flushing purposes
- Maintain a minimum of 0.5-mg/L chlorine residual throughout the reclaimed distribution system
- Maintain 40 psi at maximum day demand conditions; 30 psi at maximum hour demand conditions (Policy Statement 129)

Key Performance Indicators

- **Receive less than 10 reclaimed water complaints per 1,000 service connections annually**
- **Maintain less than 5 breaks per 100 miles of reclaimed water main**

4 RISK & PRIORITIZATION

INTRODUCTION

The reality of operating a buried infrastructure system is that as assets age they decline in performance. Even with regular maintenance asset performance diminishes over time and becomes more vulnerable to failure. Failure is defined as the inability of an asset to operate in the way that it was designed to perform. Entirely eliminating the possibility of failure is unrealistic and often impossible. However, a primary goal of the Town's asset management program is to minimize failure, especially for critical assets that have high consequences if a failure occurs.

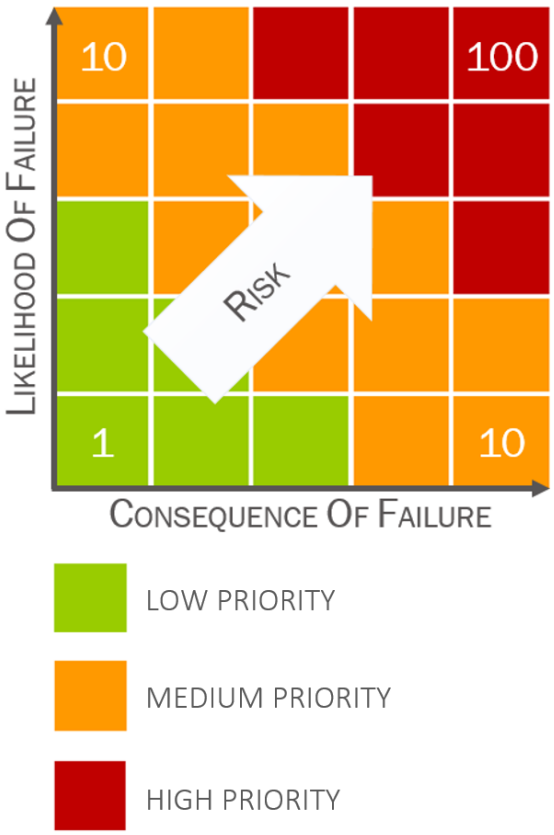
By creating risk frameworks for each infrastructure type, the Town can identify individual risk scores for each asset, based on the likelihood and consequence of failure. Critical assets are those assets that are key to the sustained performance of the buried infrastructure, and have a high consequence of failure within the risk framework. Identifying the Town's critical assets provides a foundation for prioritizing condition assessment, operations and maintenance (O&M) and other activities necessary to sustain the Town's level of service commitments.

RISK

Developing a risk framework allows for a better understanding of the impacts of failure and gives a structured approach for comparing risk across all buried infrastructure. Quantifying risk for each infrastructure type provides an informed prioritization process that not only identifies the highest risk assets, but also allows for comparison of risk reduction options.

The two fundamental building blocks for defining risk are Likelihood of Failure (LOF) and Consequence of Failure (COF). LOF describes the chance of an asset failure occurring and can be represented as a numerical ranking (e.g. 1-10) ranging from unlikely (1) to highly likely (10). COF measures the severity of the impacts if an asset were to fail and can also be expressed numerically using the same ranking system as LOF. Multiplying LOF and COF together provides the overall risk score for a given asset, with higher scores indicating greater risk.

Once a risk score has been assigned to each asset, the severity of the risk can be visualized in a matrix like the one below, and priorities can be established. Assets with high risk score numbers are the highest priority and fall into the red zone; assets in the orange are medium priority; and those

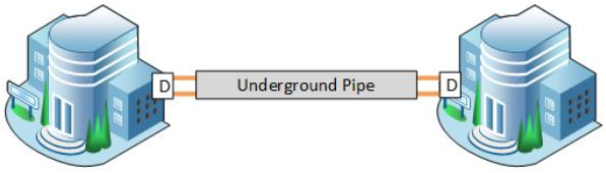


in the green are the lowest priority. Special attention should be given to assets with low or moderate risk scores, but which have high COF. Although these assets are in good condition, they should be targeted for routine monitoring, condition assessment and preventative maintenance to further reduce the risk of failure.

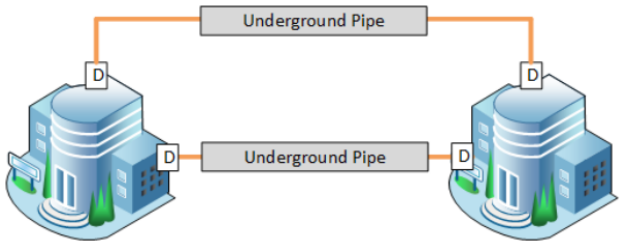
Determining risk on a per-asset basis is essential for prioritizing where effort should be spent to maintain our buried infrastructure network effectively. The degree to which risk is mitigated depends on the Town's established Level of Service (LOS), which helps establish when the risk of asset failure is greater than acceptable. The Town can then decide whether to reduce the LOF through O&M/capital intervention, reduce the COF through redundancy, or both.

REDUNDANCY & RESILIENCY

Although the terms 'redundancy' and 'resiliency' are often used interchangeably, there are several key differences between the two terms. Redundancy involves the use of duplicate assets in critical areas in order to provide a backup in the event of failure, as well as to allow for operational flexibility during day-to-day operations. Resiliency, on the other hand, defines the ability to recover and restore normal operations after a disruptive event. For resiliency to exist, there must be some level of redundancy. However, resiliency eliminates single points of failure that could still exist in a purely redundant system.



REDUNDANT SYSTEM, REDUNDANT PIPES W/ SINGLE POINT OF CONNECTION



RESILIENT SYSTEM, REDUNDANT PIPES W/ SEPARATE POINTS OF CONNECTION

Both redundancy and resiliency play a role in reducing risk, although neither directly affects the likelihood of an individual asset failing. However, both do affect the COF by supporting uninterrupted service as well as minimizing the financial and regulatory impacts in the event an asset does fail.

CRITICALITY

Critical assets are those that have a high COF and are key to supporting and maintaining the Town's established LOS Value Statements outlined in Chapter 3. Critical infrastructure is vital for the operation and sustained performance of the buried infrastructure. In terms of risk, generally the higher the asset's COF score, the more critical it is. The greater the consequences of an asset failing, the more the asset should be monitored to ensure proper maintenance, and when necessary, periodic condition assessment. This is true even for assets with a high COF but a low LOF because the impacts would be significant if a failure were to occur.

Special attention should be given to areas of Town where multiple critical assets exist within the same location. The impacts of one critical asset failing will have heightened impact due to the proximity to other critical assets, including those of another asset type. Critical assets can be identified in GIS in order to spatially identify high-concentration locations, and this can then be factored into the risk prioritization framework for each asset type.

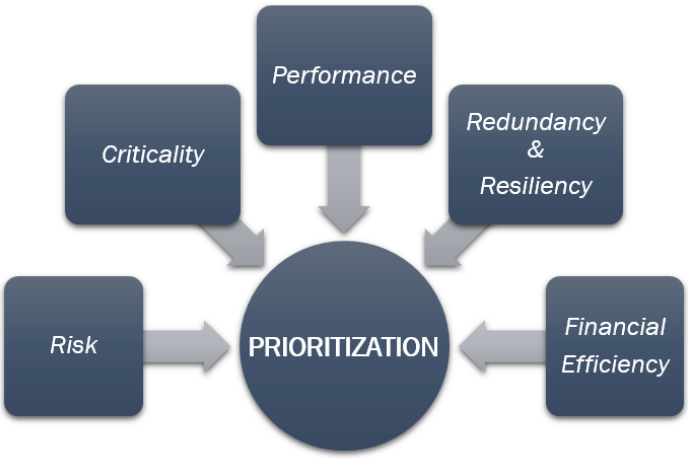
RISK & PRIORITIZATION

WATER SYSTEM	WASTEWATER SYSTEM	STORMWATER SYSTEM	RECLAIMED WATER SYSTEM
Raw Water Pipeline Finished Water Line Aerial Crossings Railroad/Highway Crossings Isolation Valves Critical System Valves (12-in & larger) Pressure Zone Valves Interconnect Valves RDU Airport Master Meter Single Feed Water Lines (50+ services) Sensitive Customer Water Services Critical Customer Water Services	Force Mains Major Interceptor Sewers Aerial Crossings Railroad/Highway Crossings Buried Creek/Lake Crossings Inverted Siphons Air Release Valves Odor Control	Large Storm Pipes (60-inch & larger) Deep Storm Pipes (48-inch & larger, >4-ft depth) Railroad/Highway Crossings (36-in & larger) Storm Pipes Adjacent to Known Structural Flooding Town-owned Stormwater Control Measures	Gate Valves Cooling Tower Customer Services Railroad/Highway Crossings Buried Creek/Lake Crossings

LIST OF CRITICAL ASSET TYPES

PRIORITIZATION

Currently, the Town takes several different approaches to how assets are prioritized for rehabilitation and replacement. Methods vary based on the infrastructure type, with water, sewer, stormwater and reclaimed water each utilizing a different framework. As part of the asset management program, each individual prioritization framework will be built to take into consideration risk scores, critical assets, performance deficiencies, redundancy/resiliency and financial efficiency. The goal is to create prioritization frameworks that operate on similar principles across the buried infrastructure, recognizing that some differences will always be necessary due to the varying requirements of each infrastructure type.



Several different software packages exist that could allow the Town to consolidate all of the prioritization frameworks under the mantle of a single solution. One such possibility is the InfoMaster Suite, created by Innovyze. Another option would be to take the existing Stormwater Prioritization Tool created for the Town by CH2M, and expand its functionality to water, sewer and reclaimed water.

In the coming sections, the current water, sewer, stormwater and reclaimed prioritization frameworks are explored in greater detail. For each asset type, the existing prioritization methods are described as well as the actions items necessary to move towards a more consistent risk based framework. These action items are all included as part of the Five-Year Task List described in Chapter 7.

RISK & PRIORITIZATION

CURRENT WATER PRIORITIZATION

Prioritization for the water distribution system is currently performed using the framework developed for the Town in 2012 by AECOM. Within this framework, each water line segment in the water system is assigned a Total Priority Score (TPS) based on repair history, life expectancy, pipe diameter, critical customers, water pressure, pipe material, land use and soil type. The water line segments are then sorted based on TPS, and the top results imported into GIS where they are overlaid with the street Pavement Condition Ratings (PCRs) and areas for renewal are selected based on these criteria.

LOF Criteria	COF Criteria
• Repair History • Life Expectancy • Water Pressure • Pipe Material • Soil Type	• Pipe Diameter • Critical Customer • Land Use

CURRENT WATER LOF & COF CRITERIA

In addition to helping with the prioritization framework, AECOM prepared a report outlining key findings as well as recommendations for future action. AECOM noted that of particular importance is the aging of the Town's fiber reinforced cement water mains, which make up greater than 10 percent of the entire water distribution system. Cement water mains have 60 to 80 years of potential service life based on industry standards, so most pipes installed during the 1950s have reached 60-years of service life and are within the 50 percent survival range for life expectancy. AECOM recommended that three miles of cement water main are replaced each year, starting in 2017, to prevent an above average number of water main breaks. This recommendation matches the Town's current replacement rate as of 2018.

CURRENT WASTEWATER PRIORITIZATION

No formal prioritization framework currently exists for the wastewater collection system. Instead, decisions regarding rehabilitation and replacement are based on annual inspection information and the engineering recommendations provided by consultants and Town staff.

The cleaning, inspection and evaluation of gravity sewer lines and associated manholes is currently divided, based on the size of the pipe, between Town staff and a contractor. Pipes 12 inches in diameter and smaller are assessed by the Town, while pipes 15 inches in diameter and larger are handled by the contractor. Because these cleaning and inspection responsibilities are divided between the Town and contractors, the evaluation and prioritization methods differ.

LOF Criteria	COF Criteria
• Defect Ratings	• None Currently

CURRENT WASTEWATER LOF & COF CRITERIA

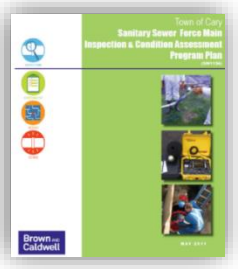
- **Prioritization, ≤12-Inch Gravity Pipe** – The Town inspects and evaluates gravity pipes and associated manholes using closed circuit television cameras (CCTV) and ranks the observed defects within the IT Pipes software. Individual defects are ranked using the Town's own 1-5 scoring method, where 1 is a minor defect and 5 is a critical defect. Based on the individual defects, the full pipe section is then designated as either 'OK' or 'Needs Rehab' within the 'Manholes TVed2' GIS workspace. Manholes are also inspected and tagged in the workspace as either 'OK' or 'Needs Rehab'. A Water Resources engineer then reviews the 'Manholes TVed2' workspace and compiles a list of pipes and manholes to be rehabilitated.

- **Prioritization, ≥15-inch Gravity Pipe** – A contractor hired by the Town inspects and evaluates gravity pipes and associated manholes and ranks the observed defects using the National Association of Sewer Service Companies (NASSCO) coding system.

  Manholes - Manholes are visually inspected and photographed and then assigned a condition rating from 1-5 (5 being the most severe) using the NASSCO Manhole Assessment and Certification Program (MACP) priority rating system. Manholes that have a condition rating of 3 or greater are prioritized for rehabilitation.

  Sewer Main - Gravity pipes are cleaned using a high-velocity jet/vacuum truck and then visually inspected for defects by means of a CCTV system using the NASSCO Pipeline Assessment and Certification Program (PACP) priority rating system. The pipe's overall priority ranking is based on the severity of the worst defect contained in the line. Therefore, a line containing a grade 5 structural collapse would be scored as a priority 5, which is the highest priority. Priority 4 and 5 pipes are prioritized for near-term rehabilitation and/or repair, while priority 3 pipes are prioritized for mid-term rehabilitation.

- **Prioritization, Force Main** – Between 2011 and 2016, the Town worked with Brown & Caldwell developing and implementing an inspection and condition assessment program for critical force mains. Many force mains received acoustic inspection and select locations also underwent additional testing using Broadband Electromagnetic (BEM) technology, ultrasonic thickness (UST) testing, CCTV inspection, physical pipe sampling and soil corrosivity evaluation. In addition to inspection and condition assessment, Brown & Caldwell prepared a report outlining key findings as well as recommendations for future action. In early 2018, the Town will initiate the next round of force main inspection and assessment with Brown & Caldwell.



CURRENT STORMWATER PRIORITIZATION

In 2017, with the help of CH2M Hill, the Town completed work on the Stormwater Condition Assessment and Rehabilitation Program (SCARP) which included a stormwater risk prioritization framework. The centerpiece of this framework is a stormwater risk prioritization tool that takes into consideration costs, risks and service delivery and will be used to make informed decisions in support of a more proactive stormwater asset management program.

Within the risk prioritization tool, each stormwater asset in Town is assigned a risk priority score. This risk priority score is calculated based on the asset's LOF and its COF. The LOF and COF for an asset are defined by the criteria shown below.

LOF Criteria	COF Criteria
• Maintenance History • Physical Condition • Performance	• Health & Safety • Service Level Attributes • Financial Impact • Disruption to Public

CURRENT STORMWATER LOF & COF CRITERIA

For a given asset, the LOF and COF categories are individually scored on a scale of 1 to 10, and the weighted average is used to determine the total LOF or COF scores. The LOF and COF scores are then multiplied together to produce the overall risk priority score for the asset, with higher numbers indicating increased risk.

In addition to creating a stormwater risk prioritization tool, CH2M prepared a report outlining key findings, as well as recommendations for future

action. A key finding of the report relates to the drivers affecting whether a stormwater asset has a high LOF or COF score. These drivers are important to consider because they identify the attributes that should be focused on when considering condition assessment and renewal options.

- LOF Drivers
  - 45 percent or less remaining useful life, especially for corrugated metal pipe, which has a short, 40-year, expected service life.
  - Pipe located near a flood area identified in the Stormwater Master Plan.
  - Pipe identified as a maintenance hot spot due to sinkholes, debris clogging, flooding or similar problems reported by staff or citizens over the last 5 years.
- COF Drivers
  - Pipe located in a floodplain, environmentally sensitive area, or roadway with utility conflicts.
  - Pipe buried deeper than 10 feet.
  - Pipe diameter that is either large (≥72") or unknown.

CURRENT RECLAIMED WATER PRIORITIZATION

As of 2018, the Town has not yet established a formal prioritization framework for reclaimed water assets. The framework created for potable water could be easily adapted and applied to the reclaimed water system. Most of the prioritization factors between potable and reclaimed water are similar; the primary differences being that the reclaimed system is much younger and smaller and therefore has significantly less critical assets than the potable water system. However, because reclaimed water is operationally treated similar to wastewater, and is a pressurized system, it is critical to monitor and maintain the system to avoid spills. For this reason, all gate valves are critical assets within the reclaimed water system, to isolate and minimize the impact of potential system failure.

FUTURE PRIORITIZATION, ACTION ITEMS

Taking into consideration the current prioritization efforts and looking towards the future, a number of actions are necessary to further refine the existing prioritization process for each asset type. Each of these action items is described in more detail as part of the Five-Year Task List in Chapter 7, Implementation.

PRIORITIZATION ACTION ITEMS	PROJECT TYPE: Water	Sewer	Storm	Reclaimed	TIMELINE	PROJECT NUMBER
GIS Improvements Project			●		FY 2018	GG1130
		●			FY 2019	AI-1
	●			●	FY 2020	AI-1, WT1276
Prioritization Framework			●		FY 2018	AI-2
		●			FY 2020	AI-2
	●			●	FY 2021	AI-2
Consolidated Asset Prioritization Software	●	●	●	●	FY 2021	AI-16
NASSCO Staff Training		●	●		FY 2019	AI-9
Water Main Condition Assessment	●				ONGOING	WT1191
Force Main Condition Assessment		●			FY 2018 – FY 2019	AI-8, SW1156, SW1202
Pilot Stormwater Clean & TV Program			●		FY 2019 – FY 2020	AI-11
Stormwater Modeling			●		ONGOING	AI-10

5 MAINTENANCE & CAPITAL PLANNING

INTRODUCTION

Operations and maintenance (O&M) is the normal support necessary to sustain the performance, reliability and functionality of the Town's buried infrastructure. These daily operations are performed primarily by the Town Public Works and Utilities departments. Capital improvement projects are periodic large-scale engineering projects that renew or replace infrastructure. Capital improvement are typically of a nature that exceeds what can be accomplished strictly through O&M. Together, O&M and capital improvement activities enable the Town to maintain the buried infrastructure network.

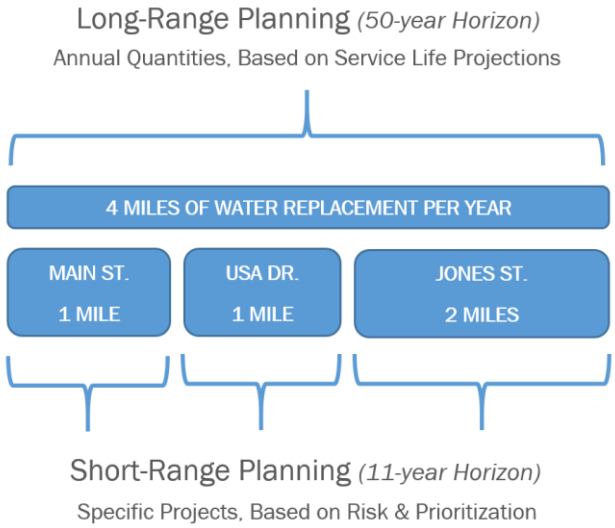
O & M

- *Daily O&M activities, primarily performed by the Public Works and Utilities departments*

Capital Improvements

- *Large-scale engineering projects, primarily administered by Water Resources to address renewal of buried infrastructure*

In the future, the Town will spend considerably more to maintain and replace aging buried infrastructure; asset management helps us spend our money wisely. In order to determine the best O&M and capital improvement investment strategies, the requirements and actions necessary to sustain the Town's buried infrastructure need to be examined on both a long-range and short-range planning horizon. Long-range planning considers large, homogeneous groups of assets and, based on service life projections, quantifies how much renewal should be programmed annually. Short-range planning takes the long-range projections, and in conjunction with the risk prioritization rankings, defines what specific projects populate the annual Capital Improvement Budget (CIB) and 10-year Capital Improvement Plan (10-year CIP).



A 50-year planning horizon for long-range projections provides sufficient insight into future buried infrastructure needs without extending our vision so far out in time as to become overly speculative. Estimating how much of each asset type should be renewed annually over this 50-year horizon ensures that specific projects programmed in the CIB and 10-Year CIP address the appropriate quantities of work. In addition, this approach allows for long-term needs to be spread over a 50-year period, rather than addressing an 11-year window (CIB + 10-Year CIP) only to encounter a large spike in infrastructure needs just outside this time frame.

Long-Range Planning	Short-Range Planning
• 50-Year Horizon • Broad Groups of Assets • Annual Renewal Quantities • Estimated Long-Range Costs	• 11-Year Horizon • Specific Assets • Specific Renewal Projects & Quantities • Detailed Project Costs

ASSET MAINTENANCE

The life cycle cost for an asset is the cumulative cost of ownership and maintenance over the entire life of the asset from acquisition, to operations and maintenance, to disposal. Minimizing these life cycle costs requires increased planning and refinement of operations and maintenance (O&M) and condition assessment activities, as well as increased coordination between the two.

OPERATIONS & MAINTENANCE

O&M activities are necessary for the long-term management and protection of the Town's buried infrastructure and provide the following key benefits:

KEY BENEFITS

- Maximize the useful life and efficiency of the buried infrastructure
- Proactively address maintenance concerns prior to asset failure
- Promote operational readiness in times of emergency
- Monitor the performance of the buried infrastructure to ensure regulatory compliance
- Assess the condition of the buried infrastructure & monitor for undiscovered failures

O&M activities are divided into two basic categories: planned maintenance (PM) and reactive maintenance (RM). PM activities are proactive measures such as cleaning and televising, valve exercising and flushing whereas RM activities are reactive measures such as emergency repairs.

The EPA estimates that PM costs one-third less than RM for the same task, so to minimize asset life cycle costs it is important to maximize the ratio of PM to RM activities. An initial O&M target for the asset management program is to meet or exceed a ratio of 75 percent planned to 25 percent reactive maintenance. By tracking O&M activities and the data collected on PM and RM times in Salesforce, current O&M practices will be further refined to optimize operational efficiency and minimize RM activities.

The Town currently performs and organizes a significant amount of O&M activities in support of the buried infrastructure. Current activities are described in greater detail in Appendix A1; proposed activities are outlined in Chapter 7.

CONDITION ASSESSMENT

Condition assessment is used to determine the level of asset deterioration and the impact this has on the risk of failure. Understanding this risk helps determine when to intervene to best avoid failures, unacceptable costs, and compromising the Town's level of service standards. Condition assessment assists with the following four key functions:

BASELINE	Establish baseline condition information
ESTIMATE	Estimate remaining useful life
MONITOR	Monitor for early detection of emerging failure trends
FORECAST	Forecast and prioritize O&M and capital improvement efforts

On a basic level, asset condition can be estimated as part of a desktop analysis looking at physical characteristics such as age, material, expected life and observed performance. Where more detailed information is necessary, direct observation and testing of the asset can be performed.

Currently, some degree of condition assessment takes place naturally as part of daily Town O&M activities. In addition, the Town hires third-party contractors to perform a variety of condition assessment activities, some annually and others intermittently. However, additional condition assessment is necessary to augment Town data

and provide a clearer picture of what the present state of the assets are.

Performing condition assessments requires resources. As such, these resources need to be applied in the most cost-effective manner to reduce life cycle costs. Location and timing of condition assessment is based on asset criticality and condition ratings to ensure that resources are focused on the most critical assets.

Current condition assessment activities are described in greater detail in Appendix A2; proposed activities are outlined in Chapter 7.

FAILURE MODES

The way in which assets fail can be broadly categorized into a number of common failure modes that the Town observes during day-to-day activities. Due to the regularity of these types of failures it is important to identify each mode, the preventive measure that best protects against failure, and the frequency with which the preventive activity should take place. Identifying strategies to address common failure modes enables the Town to protect the individual components that, left unattended, would ultimately lead to asset failure. These strategies may be executed as part of the Town's routine O&M activities, or may require condition assessment services provided by a contractor. Common examples of failure types experienced by the Town as well as the recommended preventative measures are listed in Appendix A3.

LONG-RANGE PLANNING

When developing O&M and capital improvement strategies, it is important to start with a long-range renewal plan to ensure that the direction of short-range buried infrastructure activities will lead to the desired long-term outcome. By grouping assets together into homogeneous categories, typically by asset type and material, long-range calculations can provide the estimated annual amount of buried infrastructure that needs to be renewed to maintain the Town's established level of service commitments. In order to build annual rehabilitation plans for buried infrastructure renewal, it is important to understand the fundamentals of asset service life, survival curves and renewal curves.

SERVICE LIFE & SURVIVAL CURVES

Service life is the *actual* length of time an asset remains functioning and useful. This is in contrast to the design life of an asset, which is the *expected* length of time an asset remains functioning and useful according to industry standards. Establishing service life of an asset is important when estimating the benefits and costs of a proposed project and its alternatives. Service life is impacted by a number of dynamic factors such as installation, environment, operation and maintenance. Because of this, service life varies from asset to asset, but typically falls within a standard range for specific asset types. Considering asset characteristics as well as industry standards, estimates of useful life may be established, such as for the stormwater example below.

Pipe Material	Low	Base	High
Brick	40	80	120
Casing	25	40	50
Corrugated Metal Pipe	25	40	50
Ductile Iron Pipe	40	60	100
High Density Polyethylene	60	80	120
Other	25	40	50
Polyvinyl Chloride	60	80	120
Reinforced Concrete Pipe	40	70	110
Steel Pipe	25	40	50
Vitrified Clay	35	60	100

The reality is that the service life for a given asset type is not a single static number, but individually varies across a range of values from asset to asset.

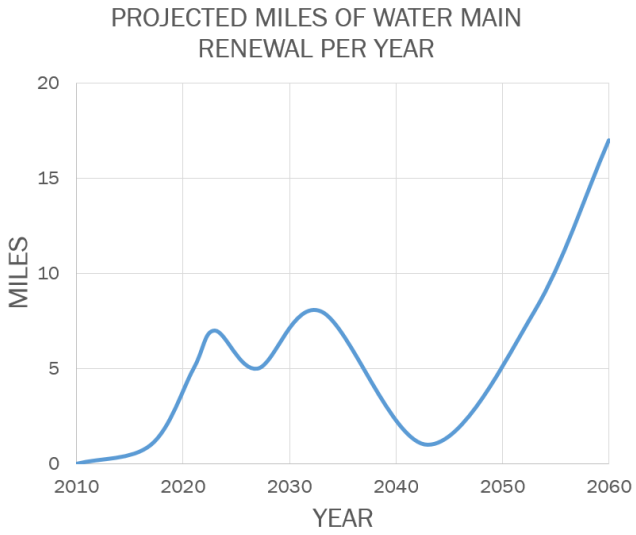
This variation in life expectancy can be defined in terms of survival rate, which quantifies what remaining percent of a group of assets are still in service over the range of service life. Survival rate can be visualized by creating survival curves to represent the 'percent surviving' over time. Early in a group of assets' service life, 100 percent of the assets are in service and none have failed. However, as time progresses, the percent of assets that remain in service diminishes.

SURVIVAL CURVE EXAMPLE

RENEWAL CURVES

Renewal curves help forecast the timing of infrastructure replacement by providing a window into the 50-year renewal horizon. If the install date for an asset is known or can be estimated, and service life is defined, then the projected year the asset should be renewed can be determined. If this exercise is repeated for every asset of a given type, then all the individual renewal projections can be combined to create a total renewal projection. This projection can then be visualized as a renewal curve, which shows the aggregate amount of work that needs to be done in each future year over the 50-year planning horizon. The shape of the curve varies by asset type and material, but a spike in future renewal needs is highly probable due to the concentrated amount of infrastructure that was installed in the Town from the 1980s through the 2000s.

The renewal curve following this paragraph is an example for the water system based on preliminary data. As the asset management program is implemented this curve will be refined, and similar curves will be generated for the other asset types.



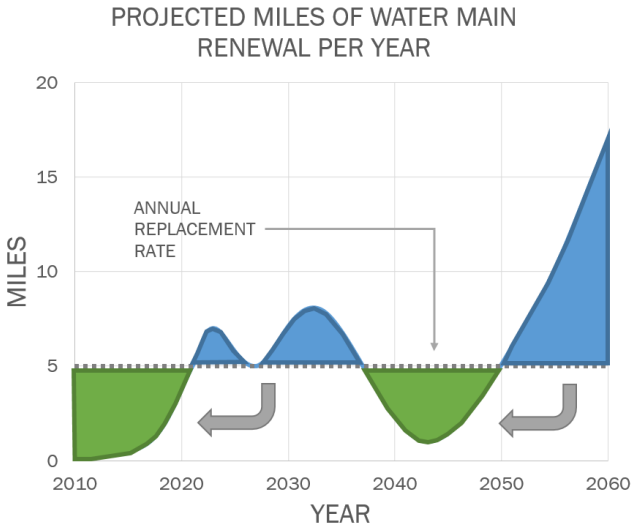
RENEWAL CURVE EXAMPLE

The simplest way to create a renewal curve is to identify the average service life of an asset type and assign that number as a uniform service life for all assets of that type. However, more sophisticated renewal curves can be created by utilizing software, such as Award's KANEW probabilistic model, in order to harness survival curves to assign varying service lives for the assets being analyzed. This method provides a more realistic distribution of service life across a group of assets.

ANNUAL REHABILITATION PLANS

Once renewal curves have been created for each type of infrastructure, annual rehabilitation levels can be established for the appropriate amount of assets to be renewed or replaced annually. A consistent level of renewal will smooth financial impacts as well as help protect the Town against significant spikes in infrastructure failure that could potentially compromise the established level of service standards. Fundamentally, a renewal rate should be selected that averages out the future peaks and valleys, and provides a consistent level of activity year-to-year. This approach, shown following this paragraph, allows the blue peaks to

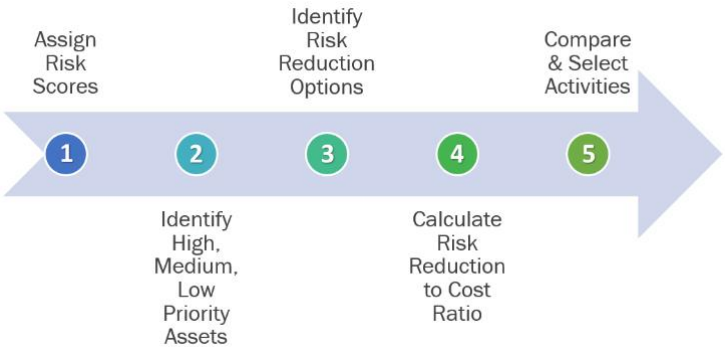
be addressed ahead of time by evenly distributing the effort over the preceding years, as shown in green.



Based on statistical analysis of pipe lifetimes for homogeneous categories of pipe, software such as KANEW, can be used to identify the appropriate quantity of buried infrastructure to renew or replace each year. As a macro level model, replacement outputs are not for specific segments of pipe, but for categories of pipe. These renewal projections are based on the amount of pipe replacement necessary to smooth the future peaks.

SHORT-RANGE PLANNING

As assets are operated, renewed and replaced it is important to identify how best to cost effectively minimize risk through the appropriate application of O&M and capital improvements. This is accomplished through the evaluation of the available risk reduction options as explored in Chapter 7, and then selecting the activities that provide the best balance between risk reduction and the associated life cycle costs.



The two primary options available to reduce the risk of asset failure and improve the condition of the Town's buried infrastructure include O&M and capital improvements. O&M activities serve as the Town's first line of defense in maintaining high quality infrastructure. However, even with proper O&M, eventually it will become necessary to renew or replace aging assets as part of a capital improvement project. Because there are many options available, providing varying degrees of risk reduction at different life cycle costs, it is important to create a level field for comparing and selecting activities.

IDENTIFYING HIGH RISK ASSETS

Following the basic risk framework outlined in Chapter 4, each asset within the buried infrastructure can be assigned a risk score. Once risk scores are assigned, assets can then be divided into one of three tiers: high, medium and low priority. The high priority tier includes those assets with the highest risk scores; those assets most at risk of compromising the Town's level of service standards. The medium and low priority tiers include the assets with lower risk scores that have diminishing effects on the Town's level of service.

IDENTIFYING RISK REDUCTION OPTIONS

Once the buried infrastructure assets have been divided into priority tiers, assets within each tier can be evaluated for O&M and capital improvement activities that best reduce risk. The assets identified as having high priority risk scores should be addressed first, with assets having low and medium priority risk scores addressed secondarily.

When looking at an asset's risk score, a review of the COF and LOF scoring provides insight into what factors are most contributing to the risk. Risk mitigation activities can then be selected that best address these contributing factors, either by reducing COF, LOF, or both. Capital improvement

projects are often the first risk mitigation option investigated, but modifications to O&M activities can also reduce risk, and usually at a lower cost.

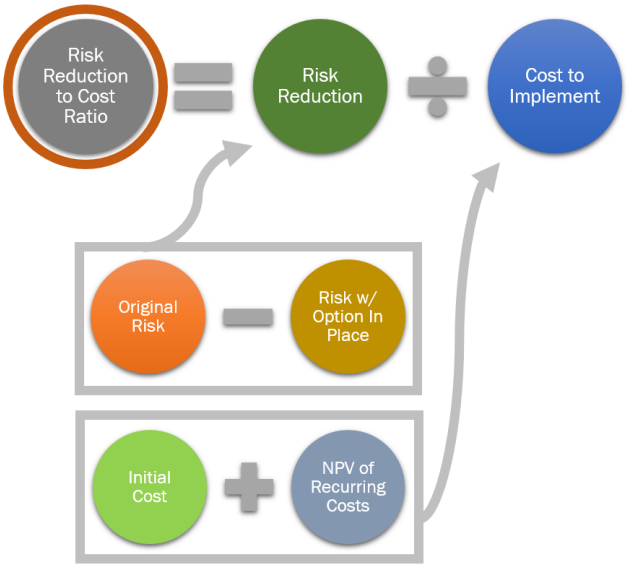
Risk Reduction Option	Reduces COF	Reduces LOF
Capital Improvements		
Rehabilitation		✓
Replacement		✓
Redundancy	✓	
Bypass	✓	
O&M		
Preventative Maintenance		✓
Inspections		✓
Standard Operating Procedures	✓	✓
Other		
SCADA Monitoring		✓
Condition Assessment		✓
Vulnerability Assessment	✓	

Appendix A4 includes examples of the types of activities that could be employed to mitigate risk, either through replacement or rehabilitation. These activities may be performed by Town staff, consultants, or independent contractors, depending on the activity.

CALCULATING RISK REDUCTION TO COST RATIO

Once a list of risk reducing options has been established, the effectiveness of each activity should be compared in order to select the best option. One method for measuring the effectiveness of an option is to quantify the risk reduction provided versus the amount the option costs to implement and maintain. This measure, known as the risk reduction to cost ratio (RRCR), provides a uniform method for comparing relative effectiveness across a range of O&M and capital improvement activities.

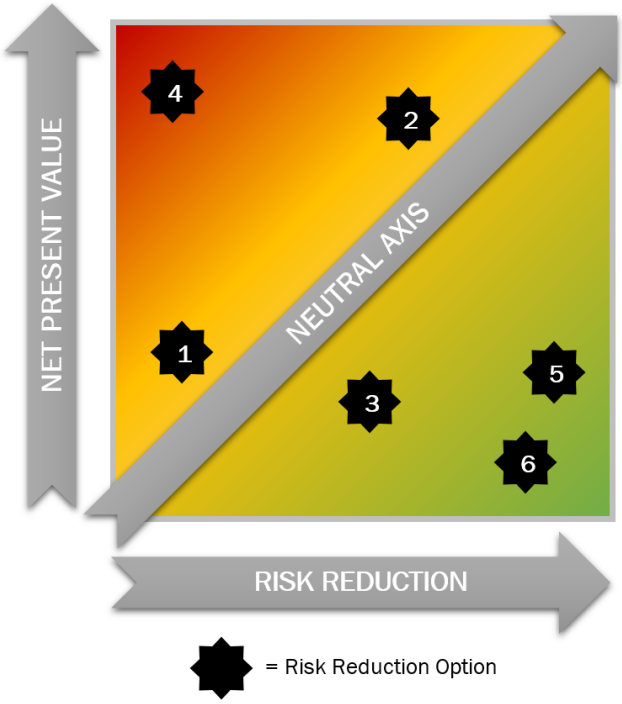
In order to calculate the RRCR, the risk reduction and implementation cost for each option needs to be quantified. Risk reduction is calculated by determining the difference between the raw risk score and the risk score once the risk-reducing option has been implemented. The implementation cost is the net present value (NPV) of the cost of implementation including all initial and recurring costs. Each option should use the same term and discount rate in order produce consistent results.



SELECTING RISK REDUCTION OPTIONS

After the RRCR has been calculated for each potential option, all of the RRCR values can be plotted to identify which activities are the most preferred. For example, in the figure below, options in the yellow (Options 1, 2, 3) along the neutral axis, provide an even balance of risk reduction to cost. Activities in the red (Option 4) are undesirable as they offer little risk reduction at a high price. Activities in the green (Options 5 and 6) are the most preferred options because they provide a high level of risk reduction at minimal cost relative to the other options.

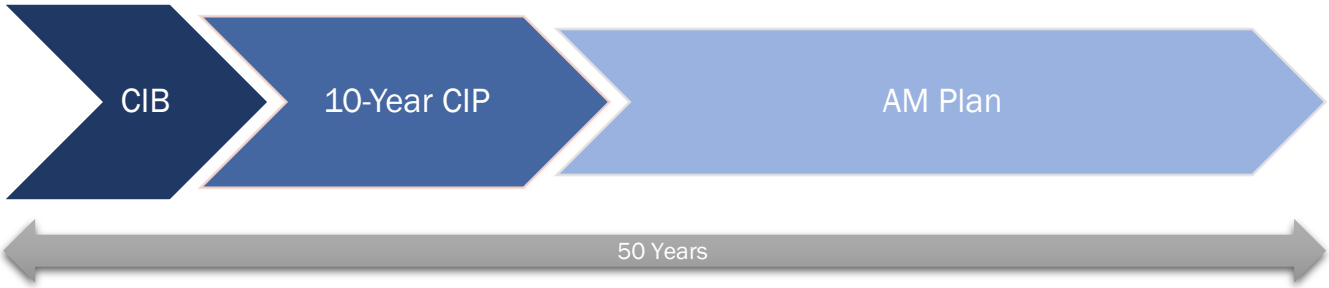
MAINTENANCE & CAPITAL PLANNING



As mentioned earlier, several different software packages exist that could assist the Town in administering an asset management framework. One of these, Innovyze's InfoMaster, is an ArcGIS-based asset management and capital planning software package that uses advanced modeling and predictive analytics to forecast when assets are expected to fail. InfoMaster takes into consideration infrastructure condition, capital and recurring costs, likelihood of failure, consequence of failure, historical incidents and maintenance in order to improve capital and operational planning. In addition, Infomaster has a life cycle cost analysis component that would allow the Town to compare projected life cycle costs for competing capital improvement, O&M and other risk reduction solutions. InfoMaster also includes a scenario comparison tool that would allow the Town to analyze various scenarios, compare different asset renewal planning strategies and select the best alternatives. Infomaster would help the Town determine the cash flow requirements for projects and minimize the total cost of ownership of buried infrastructure, ensuring the best distribution of dollars is spent on replacement and repair. The Town anticipates selecting an appropriate software package for implementation as part of the GIS Improvements Project.

Regardless of whether the Town evaluates these activities in-house or using specialized software, once preferred options have been identified, the funding for each activity needs to be secured. Activities will need to be programmed as part of the budget cycle, unless funding has already been allocated through a recurring annual rehabilitation project. General funding concepts, the CIB and the 10-Year CIP are all explored in more detail in Chapter 6. Implementation and a detailed five-year task list of activities are covered in Chapter 7.

6 FUNDING



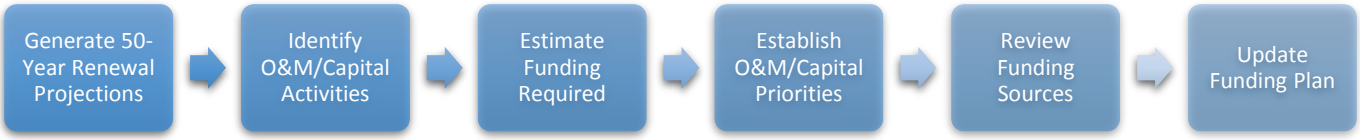
INTRODUCTION

Implementing this asset management plan will require additional staff time and sustained investment of resources, both capital and operating funds, to support the needs of the asset management program. Current budget practices already provide a strong foundation for the funding of buried infrastructure activities by taking into consideration an eleven-year planning horizon. This approach provides for the short-term as part of the annual Operating Budget and Capital Improvements Budget (CIB), as well as establishing a long-term funding strategy as part of the 10-year Capital Improvements Plan (10-Year CIP). However, to provide an improved framework for making long-range funding projections, an extended 50-year planning horizon for buried asset renewal and replacement is critical and coincides with the Town's needs and vision as described in the Imagine Cary Community Plan.

A significant percentage of the Town's infrastructure was installed in a short window of time, and is expected to reach the end of its service life in a similarly short period. Once the asset management plan is implemented, long-range renewal projections will establish the 50-year horizon, including funding that is appropriately distributed to avoid a large spike in future needs. Broadening the planning horizon will also allow for improved financial awareness of future buried infrastructure needs, both capital and operational, as well as the funding necessary to support it.

Once a 50-year horizon has been adopted, several additional steps need to be implemented, as shown below, to help ensure long-term success. Initially, the 50-year long-range renewal projections for each asset type must be accurately established as well as additional operations and maintenance (O&M) and capital improvement activities necessary to support these projections. With these O&M and capital improvement activities selected, engineering estimates for funding can be calculated by Water Resources, priorities agreed upon amongst Water Resources and Public Works/Utilities, and potential sources of funding reviewed with Finance. All these actions can then be incorporated into the buried infrastructure funding plan as a whole.

Ultimately, funding for buried infrastructure is a dynamic process involving capital investments, operating expenditures, maintenance activities and the renewal/replacement of aging assets. To adequately address all these items, the buried infrastructure asset funding plan will be periodically revisited to ensure the Town's level of service standards are maintained and the best results are produced for the Town and its citizens.

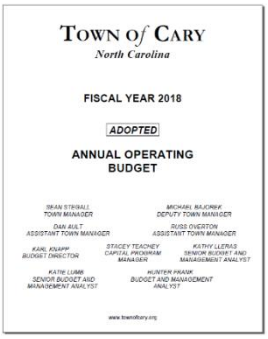


FUNDING

BUDGET PROCESS OVERVIEW

The Town of Cary's fiscal year begins on July 1 and concludes on June 30 each year. As part of the budget process, Town staff prepare an Operating Budget as well as a Capital Improvements Budget (CIB) for Town Council's consideration. The Operating Budget and CIB help support Council policy direction in the areas of service delivery, infrastructure maintenance and development, regulatory compliance, facilities planning and development, and other projects needed to further enhance the quality of life in the Town.

OPERATING BUDGET


TOWN of CARY
North Carolina

FISCAL YEAR 2018

ADOPTED

ANNUAL OPERATING BUDGET

The Town's Operating Budget is a financial plan that outlines the proposed expenditures for the coming fiscal year and estimates the revenues that will be needed to finance them. Upon approval by Town Council, the budget appropriation ordinance becomes the legal basis for expenditures in the budget year. These expenditures include Personnel Services, O&M and Capital Outlay costs. Personnel Services include total costs of all wages, salaries, retirement and other fringe benefits. O&M includes all costs other than those for salaries, benefits and capital outlay that are necessary for the provision of services offered by the Town. Capital Outlay costs include vehicles, equipment, improvements, software and furniture purchased by the Town that individually amount to an expenditure of $5,000 or more, but less than $25,000, and which have an expected life of more than one year.

Budget development is achieved through the simultaneous application of two processes. The 'Base' budget process determines revenues and expenditures needed to support current levels of service provision and ultimately produces a recommended budget that receives public comment and is considered by Town Council for adoption prior to June 30.

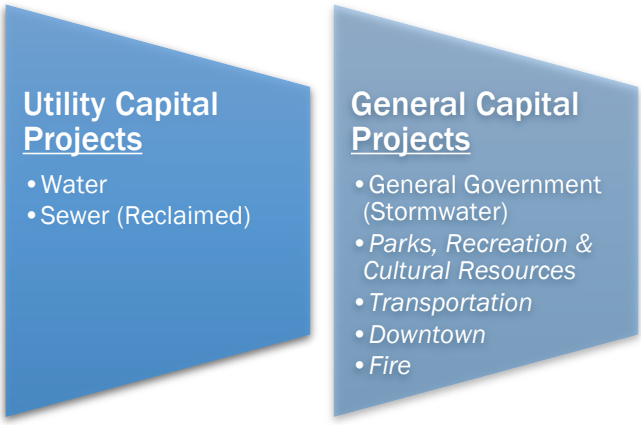
Requests for items, initiatives or positions that would increase service provision beyond current levels are considered through a quarterly 'Expansion' request process. These emerging needs are routed quarterly to department directors for consideration. The department director cohort then provides quarterly recommendations to Council for funding consideration.

CAPITAL IMPROVEMENTS BUDGET

Each year, staff prepares a capital improvements budget (CIB) and a long-range capital improvements plan (10-Year CIP) for Town Council's consideration. The Town limits (or programs) planned appropriations in the four years following the budget year to the amount of funding projected to be annually available. The identification of capital needs occurs continuously with request identification for the upcoming recommended budget being complete by February 28 each year. The identification of capital needs occurs continuously with request identification for the upcoming recommended budget being complete by February 28 each year. The Budget Office and departmental staff then work collaboratively to match funding needs and priorities with projected revenues to produce the recommended budget for consideration and adoption by Council on or before June 30.

- **Capital Improvements Budget (CIB)** - The CIB identifies revenue and expenditure amounts for each approved capital project for the fiscal year. The projects included in the CIB are typically of a value greater than $25,000 and with a useful life greater than three years. There are seven categories of capital projects identified within the CIB: Water, Sewer, General Government, Parks, Recreation & Cultural Resources, Transportation, Downtown and Fire. Buried infrastructure projects fall into three of these categories:
  - Water – Water projects
  - Sewer – Sewer and reclaimed water projects

- General Government – Stormwater projects (as well as other non-buried infrastructure project types)

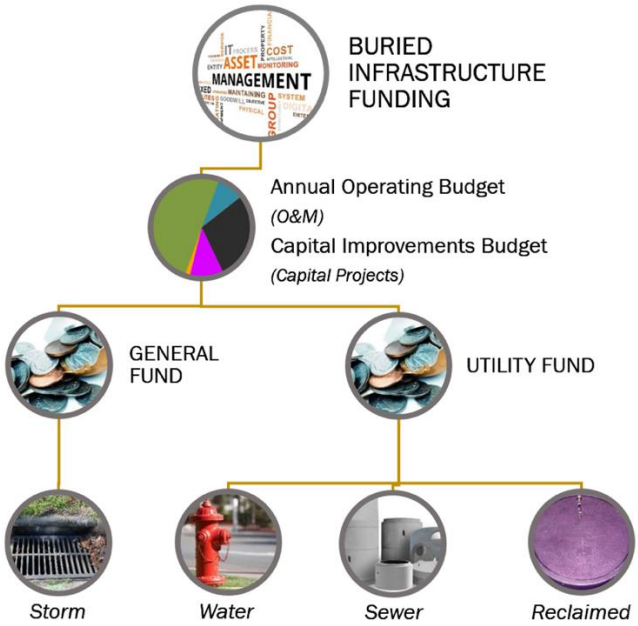


- **10-Year CIP** – While the CIB identifies capital projects for the current fiscal year, the 10-Year CIP identifies future projects for the coming 10-year horizon. A 10-year planning tool of this magnitude has two significant benefits. First, it assists the Town in identifying potential projects necessary to meet the long-term goals of the community. Second, it gives Town Council and staff a view of future infrastructure needs and assists them in understanding the level of funding necessary to fulfill those needs.

  Unlike the CIB, the 10-Year CIP figures are for planning purposes only and are not actual appropriations, but rather staff's best estimate of future project needs and costs. Projects are adjusted, and in some cases deleted, as situations and needs change throughout the course of the 10-year horizon.

CURRENT FUNDING

Funding for buried infrastructure is drawn from two sources – the Utility Fund and the General Fund. The Utility Fund supports activities associated with providing water, sewer and reclaimed services. The funding for stormwater activities, on the other hand, is drawn from the General Fund. This is, in part, because the Town does not currently operate stormwater as a utility and does not collect stormwater fees.



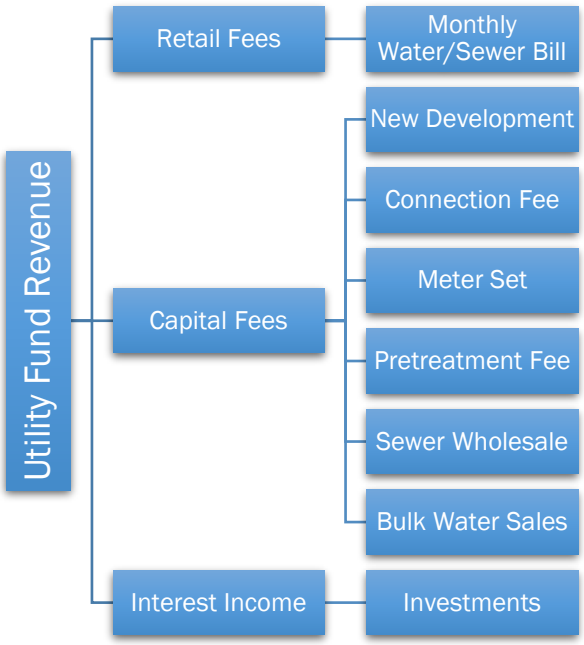
Both the Operating Budget and the CIB have funding elements related to buried infrastructure. The Operating Budget is the primary means by which personnel and O&M are funded, whereas funding for capital projects is provided for in the CIB.

UTILITY FUND

The three sources of revenue for the utility fund are retail fees for water/sewer/reclaimed services, capital fees paid by new development and investment income.

- **Retail Fees** – The Town uses a rate model to estimate revenues and establish rates for retail water, sewer, irrigation and reclaimed water. The Town sets the rates using multi-year rate smoothing to help buffer anticipated rate spikes in future years resulting from capital improvements. Because of this rate smoothing, utility rates are currently projected to increase at an average annual rate of 3 percent, rather than rising and falling as major capital improvements are implemented.

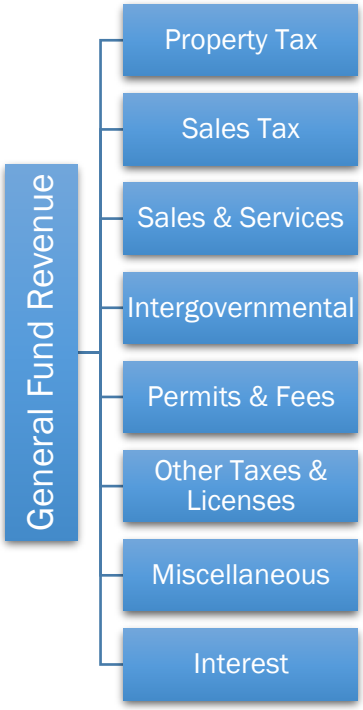
FUNDING



- **Capital Fees** – Utility-related capital fees are collected when new demand is generated through building permits for development, requests for meter installations, or requests for new or changed customer accounts. For new development, the fee is based on proposed use and size of the structure, while for existing development the fee is based on the increased demand. These charges are in addition to water and sewer tap charges.
- **Interest Income** – The Town deposits cash reserves in interest-bearing bank accounts. Though relatively small, the interest does provide an additional source of revenue for the Utility Fund.

GENERAL FUND

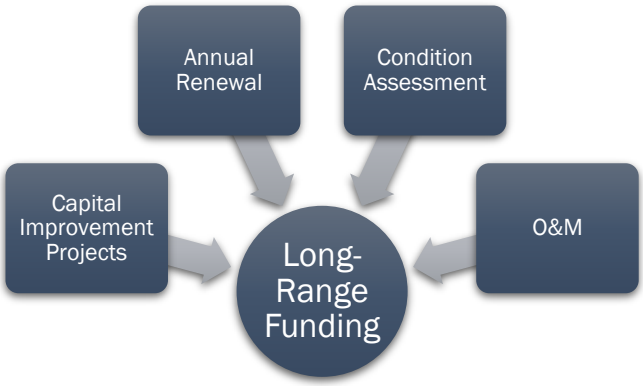
The General Fund serves as the Town's primary funding source and is used to account for all financial resources, except for those resources that are specifically required to be accounted for in a separate fund. The General Fund's primary revenue sources are property tax, sales tax, state-shared revenues and fees for service. Unlike the Utility Fund, the Town only has the ability to set the level of some of the General Fund's revenue sources (property tax, solid waste fees, permits and fees), while having little or no control over the level of others (sales tax, state shared revenues, investment earnings).



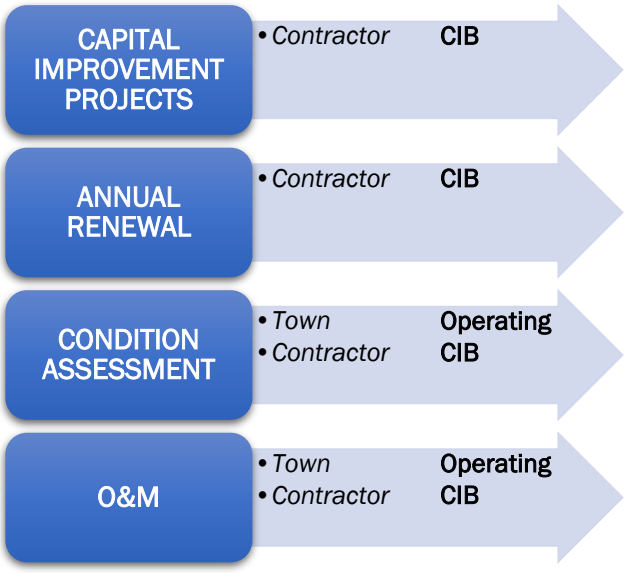
LONG-RANGE FUNDING REQUIREMENTS

There are four core activities that impact the long-range funding requirements for buried infrastructure. These four activities consist of capital improvement projects, the annual renewal programs for each type of infrastructure, condition assessment and the various routine O&M activities performed every day. To produce accurate long-range funding predictions, each of these activities must be considered individually as well as cumulatively.

FUNDING



Whether General or Utility Fund, each of the four core activities shown above can be divided according to whether funding is accounted for within the Operating Budget or the Capital Improvements Budget (CIB), as shown in the figure below. Capital improvement projects are accounted for in the CIB, and generally involve the installation of new infrastructure, typically by contractors. Annual renewal projects also reside within the CIB, and like capital improvements, are also typically performed by contractors. Condition assessment and O&M activities are provided for in the Operating Budget when performed by Town staff, but appear in the CIB if performed by contractors.



In addition to these core activities, plans for long-range funding need to consider the projections for new infrastructure identified in the water, wastewater, stormwater, and reclaimed water masterplan capital improvement recommendations. It is important to find the appropriate balance between the installation of the new infrastructure necessary to continue providing service to a growing community, with the need to renew and maintain the infrastructure the Town currently has in place. Since current Town master planning efforts already provide long-range projections for new infrastructure, broadening the planning range as part of the buried infrastructure asset management plan will largely affect the recommended amount of annual funding allocated towards infrastructure renewal, condition assessment and increased O&M activities.

INFRASTRUCTURE MASTER PLANS

Some long-range planning for buried infrastructure already occurs as part of the individual master plans periodically produced for water, sewer, stormwater and reclaimed water. Each master plan includes a list of the recommended capital projects necessary to continue providing service through build-out. Most of these capital improvement recommendations are for new infrastructure; however, there are some projects that involve replacement, upsizing, or reinforcement of existing infrastructure.

Water - 2009 Master Plan *(CH2M Hill)* with 2012 Amendment *(CH2M Hill)* and 2015 Technical Memorandum *(CDM Smith)*

Wastewater - 2013 Master Plan *(Hazen & Sawyer)* and 2015 Technical Memorandum *(CH2M Hill)*

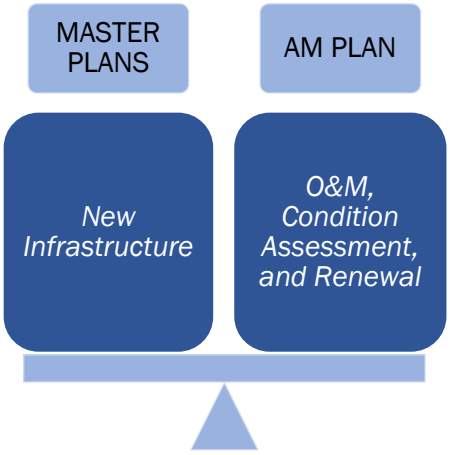
Stormwater - 2013 Master Plan *(Baker, Kimley-Horn)*

Reclaimed Water - 2013 Master Plan *(CDM Smith)* with 2017 Update *(CDM Smith)*

CURRENT INFRASTRUCTURE MASTER PLANS

FUNDING

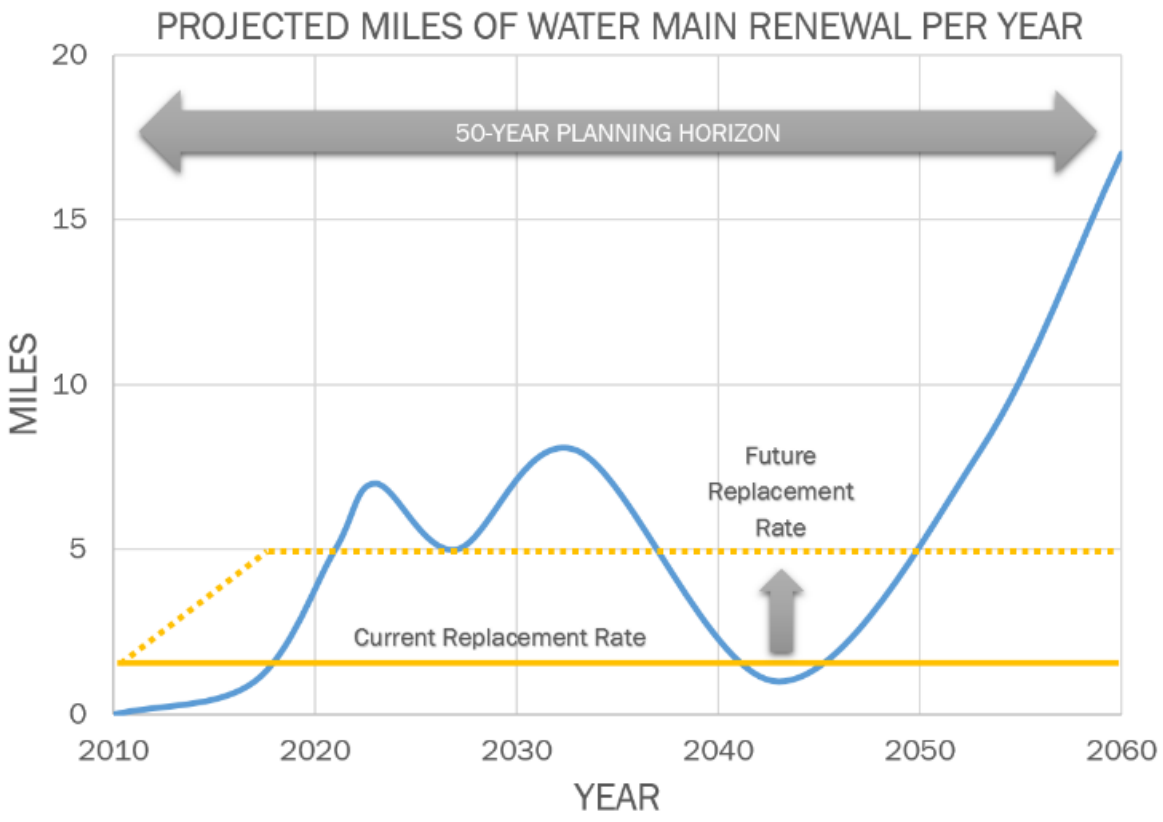
These master plan recommendations need to be coordinated to take advantage of opportunities where new infrastructure could also address high priority renewal and replacement projects. Where new infrastructure does not overlap with renewal/replacement efforts, the appropriate balance of funding needs to be established between new construction and the renewal of existing Town infrastructure.



ANNUAL RENEWAL

As discussed earlier, the Town's current funding protocol takes into consideration an 11-year horizon for buried infrastructure renewal. Under this plan, the long-range renewal projections will consider a 50-year horizon to help ensure that the 10-year CIP is forecasting enough annual infrastructure renewal. This long-range horizon is especially crucial because it provides advanced warning of potential spikes in future renewal needs. A sudden increase in assets reaching the end of their service life is quite likely due to the concentrated amount of infrastructure that was installed in the Town from the 1980s through the 2000s.

A preliminary renewal curve for the water system, shown in the figure below, provides a glimpse of a predicted future spike in water main renewal needs over a 50-year span that would otherwise be invisible using the current 11-year horizon. It is important to note, that this graphic was composed based on a single figure for life expectancy, when in



reality each pipe material type will fail across a range of years. As GIS data is improved, and the life expectancy calculations for Town assets are refined, these replacement curves will be revised and improved to become more representative of actual conditions.

All the major assets types are expected to have similar peaks in renewal needs in the future. For this reason, current renewal/replacement funding levels will need to be increased for all asset types to 'smooth' the future peaks by addressing some of them ahead of time. Using condition assessment, break history and other data, the pipe that is most likely to fail early can be identified and renewed first.

One possibility for addressing the high level of future renewal needs is to explore innovative renewal technologies. If a renewal technology could be identified that is more cost-effective than current means and methods, then the Town could address more miles of pipe per year without requiring additional funding. Or, by employing more cost-effective renewal technology and increasing funding levels, an even greater number of assets could be covered.

Piloting new technologies for renewing each asset type will be an important focus of implementing the asset management program. Not only to identify emergent renewal technologies, but also to better understand the life cycle costs associated with them. This understanding will directly inform the long-range funding of asset renewal, as well as the projected rate of renewal for each asset type.

CONDITION ASSESSMENT

Basic condition assessment work, such as video inspecting sewer mains and exercising water valves, occurs daily as part of routine staff activities. This work is already funded as part of existing operating budget, so it is the condition assessment activities above and beyond daily operations that will require additional long-range funds and planning. Condition assessment is important because it contributes to data accuracy, which in turn strengthens risk prioritization by ensuring that recorded asset information is entirely reflective of the actual condition of the assets. In addition, condition assessment provides baseline information that, over time, can be used to establish the degradation trajectory for buried infrastructure. This information is valuable in establishing how much service life remains for an asset, and when intervention to preserve the asset should take place.

Condition assessment is especially important for critical assets, where failure is least acceptable and the consequences are the highest. In this regard, additional funding for condition assessment will be necessary for the assets identified as critical by this plan, and as a result additional long-range funds will be required as well.

O&M

O&M activities are already funded and occur throughout Town as part of the annual operations budget. However, as the asset management plan is implemented, O&M activities will continue to be refined and may require additional long-range funding. This is especially true if stormwater O&M activities are to become a higher priority, in which case additional funding will certainly be necessary.

The bulk of the O&M activity funding is identified in the annual Operating Budget. However, there are not currently long-range funding projections included as part of the Operating Budget in the way that the 10-Year CIP provides long-range funding projections as part of the CIB.

FUTURE FUNDING OPTIONS

As the Town's buried infrastructure continues to expand and age, it will become necessary to adjust utility rates periodically, and potentially seek additional sources of funding to support its level of service standards. Once the buried infrastructure asset management plan has been implemented, the first steps will be taken towards establishing updated 50-year renewal projections, as well as the evaluation and adjustment of O&M and condition assessment protocol. Additional funding will be

required to act upon this new information and implement additional resources.

The following currently available funding options can provide additional financial support to the Town's existing buried infrastructure revenue stream.

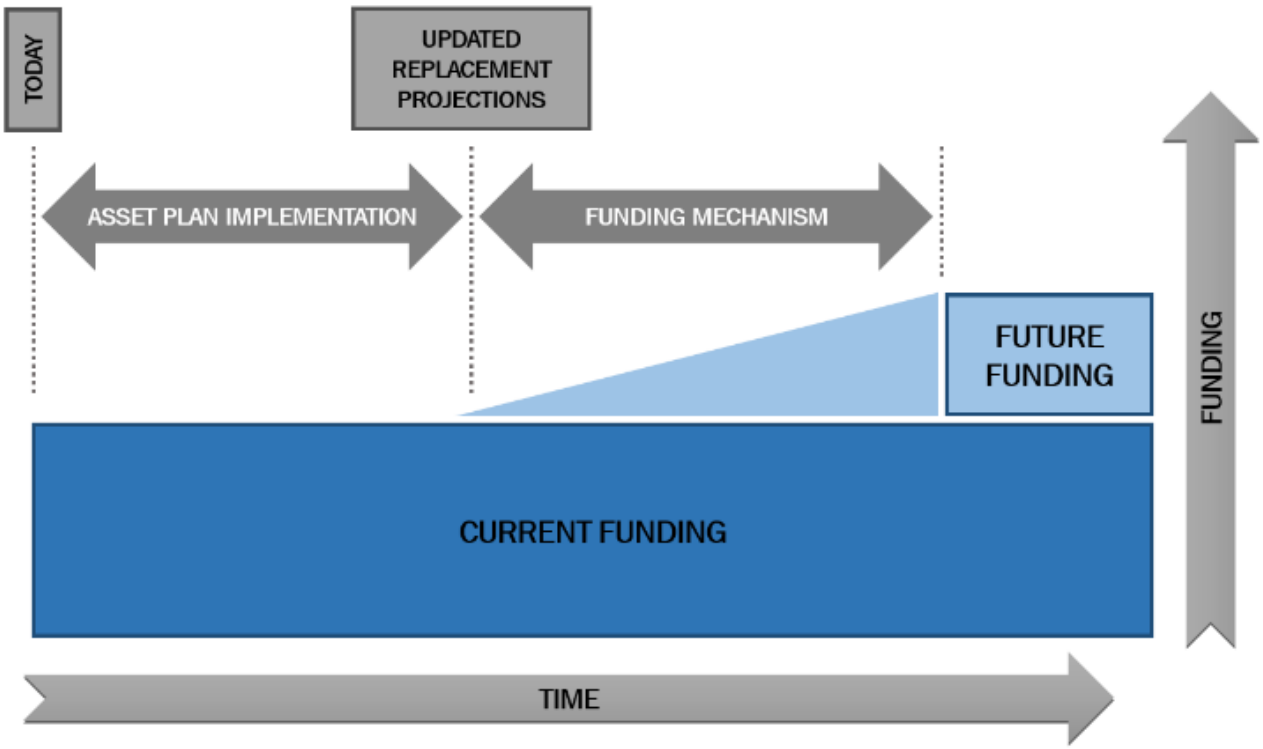
UTILITY RATE ADJUSTMENT

Historically, the Town's primary means for additional funding has been through the use of utility rate adjustments. The Town could continue to use this approach and include updated buried infrastructure renewal and operations needs when using the rate model to determine the revised utility rates for future years.

INFRASTRUCTURE REPLACEMENT CHARGE

Another possible way to designate funds for buried infrastructure is to create an infrastructure replacement charge as part of the utility bill. The charge could be structured as a flat monthly fee, in addition to the existing base fee. Revenue from this infrastructure replacement charge would populate individual funds to renew water, wastewater and reclaimed water infrastructure. If the Town were to begin operating as a stormwater utility, a similar charge could also be developed for stormwater infrastructure.

The City of Raleigh currently has separate infrastructure replacement charges for water, wastewater and reclaimed water. The charges are assessed per meter and are based on the customer's meter size. For FY 2018, the monthly service charge for an average residence was $1.50 for water, $4.50 for sewer and $1.50 for reclaimed water. The revenue from these infrastructure replacement charges is retained in two separate funds, one fund for water/reclaimed and one fund for sewer. As part of Raleigh's annual CIP process, capital improvement projects are identified that are eligible to be funded with these charges. Then, quarterly, the actual amount spent from these identified projects is transferred from the infrastructure replacement funds to the capital project funds.



FUNDING

STORMWATER FUNDING

As of early 2018, the Town has operated the stormwater infrastructure solely with funding sourced from the General Fund. However, there is the possibility that in the future the Town may require additional funds for services and improvements related to stormwater. Two potential future methods of funding include the creation of a dedicated stormwater utility or the implementation of a stormwater focused property tax increase.

STORMWATER UTILITY

Establishing a stormwater utility is an equitable, dedicated funding mechanism for Town stormwater capital improvement projects as well as O&M. The NC General Statutes authorize municipalities to create a public enterprise, establish a user fee for the services furnished [§160A-311-314] and finance the cost of the public enterprise [§160A-313]. Based on these statutes, most municipalities in North Carolina of comparable population to the Town or larger have established stormwater utilities.

Stormwater utility rates may vary based on a number of attributes, but the amount of impervious surface on a given parcel is the most common factor for determining a fee schedule. The parcel owner would be assessed based on the amount of runoff their property potentially creates, because increased runoff requires more stormwater management.

Advantages

- **New Funding Source** – Revenue generated by implementing a stormwater utility could be used as a new source of funds for the Town's stormwater management program.
- **Bondable Revenue Stream** – Bonds for capital improvements could be issued to facilitate constructing stormwater management facilities, because the revenue generated from a stormwater utility could be used to pay back bonds.
- **Improved Land Stewardship** – Land stewardship could be encouraged by providing credit to property owners who implement stormwater control measures that reduce stormwater runoff and/or improve water quality.

Disadvantages

- **Fees Perceived as Taxes** – Stormwater utility fees are often perceived as new taxes even though a fee-for-service is not a tax.
- **Additional Staff** – A stormwater utility would require additional staffing for administration.
- **Billing** – A structure for billing and collections would need to be developed and deployed. Complicating matters, there may not always be a direct alignment between the stormwater and the water/sewer/reclaimed customer lists (e.g. larger sites may have multiple water/sewer/reclaimed customers, but a single unrelated parcel owner could be the stormwater customer).
- **Public Education** - Because the public is often unfamiliar with the concepts of stormwater management, and since fees associated with a stormwater utility are generally unpopular, establishing a stormwater utility would require a public education campaign that informs citizens about the benefits to our community.
- **Impervious Area** – To establish a stormwater utility, the Town would need to determine the impervious areas for all parcels, which would require new data acquisition that would need to be updated annually.
- **Easements** – The Town would need to find a legal mechanism to accept ownership and maintenance of existing private stormwater easements, as well as draft new stormwater easements for facilities with no recorded easements.

FUNDING

PROPERTY TAX

Another potential resource for future stormwater funding is a property tax increase. The administrative cost per dollar of revenue for a stormwater utility is significantly greater than for a water or sewer utility, and a uniform property tax increase alleviates some of this administrative burden.

Advantages

- **New Funding Source** – Revenue generated by leveraging a property tax increase could be used as a new source of funds for the Town's stormwater management program.
- **Administrative Ease** - A uniform property tax increase is easier to administer than stormwater utility fees that vary based on the property.

Disadvantages

- **Potential Inequity** – With a uniform property tax increase comes the potential for imbalance between the assessed value of a property and the associated stormwater impacts. Increased property value does not always correlate with increased stormwater impacts. Furthermore, this funding option would not affect non-taxable property at all, regardless of the property value or stormwater impacts.

STATE/FEDERAL AID

One final source of potential funding that could be leveraged in the coming years are state and federal grants available specifically to assist communities with buried infrastructure needs. Grant funds can be used for several aspects of asset management including inventory, condition assessment, rehabilitation and replacement. A competitive process, funding could not be considered a guaranteed source of revenue. Some current grant possibilities include:

- DEQ Asset and Inventory Assessment Grant (http://portal.ncdenr.org/web/wi/assetinventory)
- NC Clean Water Management Trust Fund (http://www.cwmtf.net/)

UPDATING THE FUNDING PLAN

The buried infrastructure asset management plan will provide the information necessary to create a long-term strategy to fund the program. In order to incorporate these long-range funding projections into the current budget process, several intermediate steps will be necessary. Although these steps are initially required to get started, it is also expected that periodically these steps will be revisited and the needs of the buried infrastructure reassessed and refined accordingly.

Initially, Water Resources will facilitate the implementation of the buried infrastructure asset management plan which will provide the solid foundation of information necessary to assess current practices, future needs and ultimately provide revised funding projections.

Once the plan is implemented, Water Resources, Public Works and Utilities will review the current O&M and condition assessment activities and select additional activities that will improve the balance of planned vs. unplanned maintenance and ensure that critical infrastructure is receiving the proper amount of condition assessment necessary to minimize likelihood of failure.

At the same time, Water Resources will formulate the 50-year renewal projections for the buried infrastructure, based on the latest updated asset information. This will require improving the quality of the GIS

schema and asset information, such as material and installation date, to produce 50-year renewal curves that forecast the long-range funding requirements.

With O&M and Condition Assessment activities assessed and updated 50-year renewal projections in hand, Water Resources will produce cost estimates and determine the impacts on current buried infrastructure funding levels. With these funding projections established and with input from asset prioritization, Water Resources and Public Works/Utilities can review the infrastructure master plan capital improvement recommendations in conjunction with asset management priorities, and establish the desired levels of funding.

Once Water Resources and Public Works/Utilities have established the desired levels of funding for buried infrastructure, options for producing the necessary funds will need to be reviewed with the help of Finance. The results of this evaluation could point towards several different possibilities for increased funding, such as those described earlier in this chapter. Alternately, it may be determined that additional funding is not feasible, and that the buried infrastructure priorities need to be revisited.

Finally, based on the funding option(s) selected, the funding plan will need to be updated accordingly. The complexity of adjusting the funding plan will largely depend on the path selected for obtaining the additional funds. In the case of a rate adjustment, the proposed increase would track with the annual budget cycle for approval by Town Council. For more dramatic funding solutions, such as transitioning to a stormwater utility, a large degree of citizen, staff and Council involvement would be necessary, and a precise timeline is more difficult to predict. Regardless, Water Resources will work with Finance to actuate the necessary funding plan over the timeline specific to the funding option.

7 IMPLEMENTATION

INTRODUCTION

Implementation of the Town's buried infrastructure asset management plan is structured around responding to the five core goals established in Chapter 1. These goals are important because they encapsulate the Town's vision for the future of our buried infrastructure. Implementing these goals will improve reliability, reduce risk, optimize operations and maintenance (O&M) efforts and increase GIS accuracy. Implementation of this plan ensures that the Town delivers on the commitment described in the Imagine Cary Community Plan to provide safe, reliable and cost-effective utility and stormwater services to our customers.

This chapter is divided into four sections, each with a set of activities necessary to coordinate, implement and sustain this plan over the coming five years and beyond.

- **Strategies** - Identifying the strategies and action items to achieve the five core goals of this plan.
- **Task List** - Creating a five-year task list that organizes and schedules action items into a logical sequence.
- **Reporting** - Defining the annual reporting that will verify and ensure that the plan and action items are being properly executed.
- **Updating** - Establishing the expectations for periodic review and revision of this plan.

It is important to note that buried infrastructure asset management is not a single project, but rather the structure of the Town's ongoing work to maintain the buried water, wastewater, stormwater and reclaimed water infrastructure. The Town may choose to conduct multiple phases of this plan simultaneously, and should expect to repeat the cycle to improve the quality of the asset management program.

STRATEGIES

To achieve the five core asset management goals a variety of strategies must be employed, ranging from capital projects and O&M activities to staff training and reporting. The majority of these strategies will be initiated by the asset manager, with support from various Town Departments as well as independent consultants and contractors.

In the figure below, each strategy is mapped to one of the five core goals, as well as with the action item(s) necessary for successful completion. Action items are the defined projects that serve to implement the strategies and are organized and described in detail in the next section '5-Year Task List'.

PLAN GOALS	STRATEGIES	ACTION ITEMS
(1) Prioritize to Reduce Risk	Asset Prioritization Projects	AI-2
	Stormwater Modelling	AI-10
	Prioritization Software	AI-16
(2) Optimize Maintenance & Renewal	O&M Enhancement Projects	AI-3
	Stormwater Clean & TV Pilot Project	AI-11
	NASSCO Staff Training	AI-9
	Condition Assessment	AI-6, AI-8
	Rehabilitation Projects	AI-4, AI-5, AI-7, AI-12

IMPLEMENTATION

PLAN GOALS	STRATEGIES	ACTION ITEMS
(3) Reinforce Fiscal Responsibility	Develop Asset Renewal Curves	AI-18
	50-Year Renewal & Funding Plan	AI-18
(4) Leverage Technology	GIS Schema Improvements	AI-1
	Improve GIS Data Quality	AI-1, AI-15
	Salesforce Implementation & Work Order Improvements	AI-13
	Pilot ESRI Collector App	AI-14
(5) Be Sustainable & Scalable	5-Year Task List	Complete
	Annual Asset Management Report	AI-17
	Update Buried Infrastructure Asset Management Plan	AI-19

5-YEAR TASK LIST

Having reviewed the five core goals and examined the strategies and action items necessary to achieve these goals, it is essential to create a five-year task list. The task list organizes the action items necessary to improve the Town's buried infrastructure management, provides structure and ensures that not only are critical tasks identified, but also that a timeline for implementation of each action item is identified.

The task list timeline for the first five years of objectives is shown in the adjacent figure. A five-year duration has been selected to allow adequate time to perform the necessary tasks, while keeping the span short enough to allow for timely revision and readjustment. The final task is a Buried Infrastructure Asset Management Plan update, a part of which will involve updating this task list to account for the subsequent five-year period.

Action items are grouped and color coded based on asset or task type, and have been assigned approximate durations rounded to the nearest six months. Descriptions for each specific task are provided in the '5-Year Action Items' table later in this section.

IMPLEMENTATION

BURIED INFRASTRUCTURE FIVE-YEAR TASK LIST

IMPLEMENTATION

	5-YEAR ACTION ITEMS	PROJECT TYPE: Water	Sewer	Storm	Reclaimed	Technology	Reporting	TIMELINE	DEPENDENCY	DESCRIPTION	FUNDING
AI-1	GIS Improvements	●	●	●	●			FY 2018 – FY 2020	-	A series of three related projects to improve each of the GIS asset datasets, including an improved schema; identify and correct inconsistencies in the geometric network; and update owner/install information. The Stormwater GIS Improvements project (GG1130) is underway as of FY 2018; the Water GIS Improvements project (WT1276) is expected to be performed by the GG1130 contractor as a second phase during FY 2019; and the Sewer GIS Improvements project is proposed to be performed as a third phase during FY 2020.	GG1130 WT1276
AI-2	Prioritization Framework	●	●	●	●			FY 2020 – FY 2021	AI-1	Water Resources and Operations staff will collaborate to prioritize buried infrastructure asset rehabilitation and replacement projects for the next year's Capital Improvement Program based on annual reviews of calculated risk scores (product of consequence of failure and likelihood of failure scores) and review of condition data and work order history. Implementation of structured prioritization will begin with Stormwater (FY 2019), then Sewer (FY 2020) and finally Water/Reclaimed (FY 2021). Ultimately, asset management software will be used to support risk score development and project prioritization.	Infrastructure GIS Asset Data, Water (WT1276) Infrastructure GIS Asset Data, Sewer (FY 2019 Budget)
AI-3	O&M Enhancements	●	●	●	●			FY 2021 – FY 2022	AM-2	Water Resources and Operations staff will collaborate to identify and implement improvements to O&M programs for each asset type. Goals will be to (1) further develop and enhance inspection and condition assessment programs, and (2) proactively perform predictive and preventive maintenance to achieve a balance of 75% planned maintenance to 25% unplanned maintenance.	No additional funding required.

IMPLEMENTATION

	5-YEAR ACTION ITEMS	PROJECT TYPE: Water	Sewer	Storm	Reclaimed	Technology	Reporting	TIMELINE	DEPENDENCY	DESCRIPTION	FUNDING
AI-4	Annual Rehabilitation Program, Water	●						ONGOING	-	An annual project to provide for the renewal or replacement of aging small diameter water lines within the Town's water system. Areas for rehabilitation are identified by Water Resource Planning, and design and construction are administered by the Water Resources UDAC group.	Annual Water Line Upgrades capital projects (e.g. WT1282 for FY 2018)
AI-5	Pilot Water Renewal Project	●						FY 2019 – FY 2020	-	A pilot project to evaluate potential water main rehabilitation technologies.	Budgeted as part of the Water Annual Rehabilitation Program, AM-4.
AI-6	Finished Water Main Condition Assessment	●						FY 2020	-	Project to investigate water transmission piping condition using progressively complex technologies. Initial screening of candidate system segments would be followed by external visual inspections and internal measurement and assessment. Key product of this project would be water main asset condition assessments and ratings.	This project is not currently identified in the 10-Year CIP and will need to be budgeted as part of the FY 2020 budget process.
AI-7	Annual Rehabilitation Program, Sewer		●					ONGOING	-	An annual project to provide for the renewal of aging sewer lines within the Town's collection system. Areas for rehabilitation are identified by Water Resources, and design and construction are administered by the Water Resources UDAC group.	Annual Sewer System Repair/Rehabilitation capital projects (e.g. SW1334 for FY 2018)
AI-8	Force Main Condition Assessment		●					FY 2018 – FY 2019	-	This project will investigate force main condition using external visual inspections and internal measurement and assessment to produce force main condition assessments and ratings. As part of the Sanitary Sewer Force Main Inspection and Condition Assessment Program Plan, Brown & Caldwell recommended regularly inspecting active force mains every 10-15 years and the Fieldstone, Morris Branch and White Oak force mains every 5-7 years.	Force Main Inspection & Rehab FY 2008, FY 2010 (SW1156, SW1202).

IMPLEMENTATION

	5-YEAR ACTION ITEMS	PROJECT TYPE: Water	Sewer	Storm	Reclaimed	Technology	Reporting	TIMELINE	DEPENDENCY	DESCRIPTION	FUNDING
AI-9	NASSCO Staff Training		●	●				FY 2019	-	Structured contractor-facilitated instruction to train Public Works-Operations and Water Resources staff on NASSCO inspection PACP and MACP protocols for piping and manholes, respectively. Ongoing future training sessions would be facilitated by Town staff. Online recertification is required every 3 years.	Funding is proposed for the FY 2019 and FY 2022 operating budgets for training and recertification
AI-10	Stormwater Modeling			●				ONGOING	-	Hydraulic modeling, performed by a consultant, is necessary to identify performance results for the stormwater system. These results can then be used in the Stormwater Prioritization Tool to refine the Likelihood of Failure calculations.	Stormwater Condition Assessment FY 2015 (GG1130)
AI-11	Pilot Stormwater Clean & TV Program			●				FY 2019 – FY 2020	-	A project to video inspect and clean Town-owned stormwater assets. A key product will be stormwater asset condition assessments with NASSCO-compliant ratings. This 2-year pilot program may utilize Town staff, contractor resources, or a combination of both. If the Town were to perform this work, the Stormwater Condition Assessment and Rehabilitation Program project recommended that the Town purchase a jet/vacuum truck, a CCTV camera truck and a heated bay for an estimated total cost of $1,130,000. In addition, a 3-member crew would be required to operate the equipment at an estimated yearly cost of $135,000.	Stormwater Condition Assessment FY 2015 (GG1130)
AI-12	Annual Rehabilitation Program, Stormwater			●				FY 2021	AI-11	Like water and sewer, an annual rehabilitation program needs to be established for the stormwater system. Results from the Stormwater Clean & TV Program (AI-11) as well as the Stormwater Prioritization Tool (AI-1) will be used to populate an annual list of assets to be renewed.	Not currently programmed. Budget for FY 2021.

IMPLEMENTATION

	5-YEAR ACTION ITEMS	PROJECT TYPE: Water	Sewer	Storm	Reclaimed	Technology	Reporting	TIMELINE	DEPENDENCY	DESCRIPTION	FUNDING
AI-13	Salesforce Work Order Improvement Project					●		FY 2020 – FY 2021	-	The Town's deployment of the Salesforce citizen care and work order management modules will provide a repository of data for reporting and assessment of asset work history and failure modes. Once Salesforce is fully implemented and work order results become available it is likely that further refinement of the work order system will be necessary to accommodate the Town's growing asset management program.	Not currently programmed. Budget for FY 2020.
AI-14	Pilot ESRI Collector App					●		FY 2019 – FY 2021	-	The ESRI Collector App allows field staff to collect and update GIS data in the field. Piloting this technology will allow Town staff to gain familiarity with Collector, and at the same time improve GIS accuracy by allowing staff to record field gathered data directly into GIS.	No additional funding required.
AI-15	GIS Improvements, Construction Drawings					●		FY 2020	AI-1	The Town has a large collection of construction and record drawings that need to be reviewed and the corresponding assets tagged and updated in GIS.	Not currently programmed. Budget for FY 2020.
AI-16	Consolidated Prioritization Software					●		FY 2021	AI-2	Prioritization for each asset type is currently handled with asset specific software or tools. To provide consistent results across all assets, prioritization will be consolidated within a single software solution.	Not currently programmed. Budget for FY 2021.
AI-17	Annual Asset Management Report						●	Annual	-	This annual report, issued at the beginning of each fiscal year, will provide a snapshot of activity that took place over the previous year. Key content will include a current asset inventory, annual renewal quantities, significant trends, completed & upcoming projects and KPI's.	No additional funding required.

IMPLEMENTATION

	5-YEAR ACTION ITEMS	PROJECT TYPE: Water	Sewer	Storm	Reclaimed	Technology	Reporting	TIMELINE	DEPENDENCY	DESCRIPTION	FUNDING
AI-18	50-Year Renewal & Funding Plan						●	FY 2021 – FY 2022	AI-1	Once the GIS Improvements are complete for each asset type, 50-year renewal curves will be generated. With these renewal curves, anticipated renewal rates and the associated funding requirements will be established as part of a 50-year renewal and funding plan.	No additional funding required.
AI-19	Update Buried Infrastructure Asset Management Plan						●	FY 2022	-	Once the implementation activities described in the 5-Year Task List have been completed and the results checked, Water Resources will capture progress and desired adjustments in revisions to the Buried Infrastructure Asset Management Plan. Preliminarily, updates to the Plan are expected on a 5-year interval.	No additional funding required.

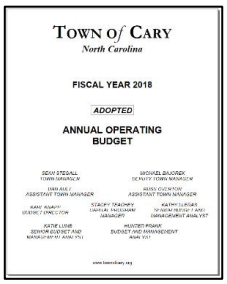
REPORTING

Once the buried assessment management tasks have been implemented, it is important to periodically check the results to ensure the desired results are being obtained. By preparing an Annual Buried Infrastructure Report, the Town's asset 'report card' can be established using the key performance indicators (KPIs) identified in Chapter 5 as well as benchmarking information gathered from other communities within North Carolina. All of this information provides a dashboard view of the buried infrastructure and helps verify whether implementation is producing the expected results and the Town's level-of-service standards are being met.

EXISTING TOWN REPORTING

A number of the Town's annual reporting documents address buried infrastructure. These reports promote goal setting and performance tracking, increase transparent information exchange and accountability, and help facilitate prompt responses to inquiries.

- **Annual Budget** – Each year the Town issues an annual budget document which includes a number of buried infrastructure related goals, initiatives, key performance objectives, key performance measures and key workload indicators. Many of the metrics that will be included in the annual buried infrastructure report were drawn from these metrics, and it will be important to ensure alignment between the two documents.

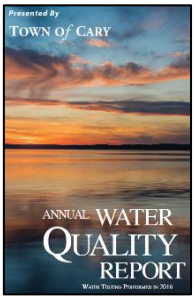

TOWN OF CARY
North Carolina

FISCAL YEAR 2018

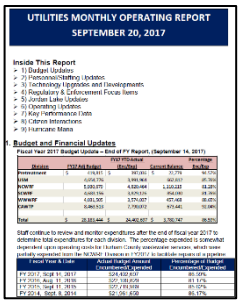
ADOPTED

ANNUAL OPERATING BUDGET

- **Annual Water/Wastewater Consumer Reports** – The Utilities Department issues annual water and wastewater consumer-focused reports each year. These reports provide information regarding water quality as well as performance and system information for water, wastewater and reclaimed water. Information should be consistent between the annual buried infrastructure report and these documents.



- **Utilities Monthly Operating Report** – In addition to the annual water and wastewater reports, the Utilities Department also issues a monthly operarting report that includes additional metrics for the utility system. The specific performance data varies, but each report provides valuable metrics that could be used in the annual buried infrastructure report.


UTILITIES MONTHLY OPERATING REPORT
SEPTEMBER 20, 2017

Inside This Report

ANNUAL BURIED INFRASTRUCTURE REPORT

Beginning in 2018, the Water Resources Department will begin issuing an annual buried infrastructure report, which will be made available at the beginning of each fiscal year. The report will provide a snapshot of activity that took place over the previous year. Key content that will be provided as part of this report include:

- Current Asset Inventory - Total quantities, annual increases, etc.
- Annual Renewal Quantities
- Completed & Upcoming Projects
- Significant Trends

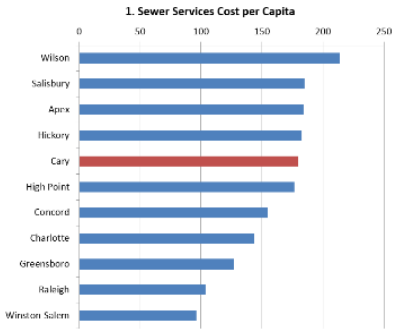
IMPLEMENTATION

- Key Performance Indicators (KPIs) – The specific KPIs are described in detail in Chapter 3.
- Reactive Maintenance (RM) vs. Preventative Maintenance (PM) Ratio – The target ratio is a 25/75 split of RM to PM.

"Benchmarking" is a subset of reporting which involves comparing specific internal metrics to those of other communities and neighbors outside of the Town. Benefits of benchmarking include:

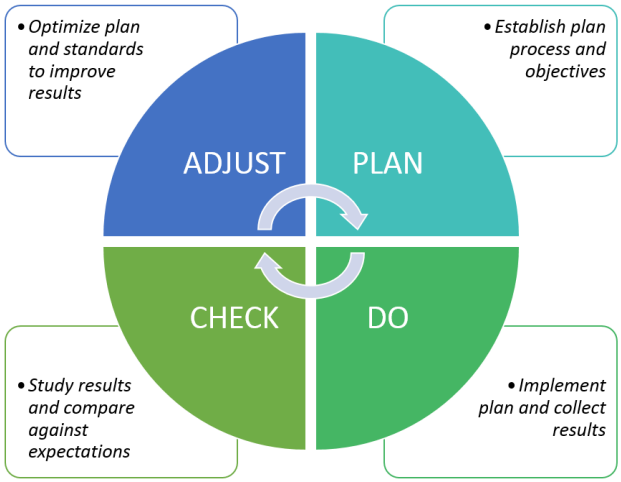
- Identifying areas of strength and weakness
- Learning best practices from other communities
- Reducing operational cost and increasing productivity
- Visualizing annual performance

Historically, the Town's primary source of benchmarking information has been drawn from an annual utility survey performed as part of the School of Government. This survey provides benchmarking for water and sewer; however, stormwater and reclaimed water have not been covered to date.



UPDATING THE PLAN

This implementation plan, and the asset management program in general, should be periodically revisited and revised as implementation tasks are completed and asset data improves. Existing actions can be refined, and additional options will become available for action. This iterative process is described as the "Plan-Do-Check-Adjust" cycle, as shown below.



Adjustments to the Buried Infrastructure Asset Management Plan can be made once the initial results have been checked using Annual Buried Infrastructure Report and the KPIs established in Chapter 3. Potential adjustments could include changes in strategies, or the assignment of additional resources towards a particular objective.

Once the implementation activities described in the 5-Year Task List have been completed and the results checked, periodically Water Resources will capture progress and desired adjustments in revisions to the Buried Infrastructure Asset Management Plan. Preliminarily, updates to the plan are expected on a five-year interval. Future updates to the plan may incorporate analysis of asset condition data, presentation of risk scores, and an updated 50-year buried infrastructure rehabilitation and replacement plan.

APPENDICES

A1 Milestones & Reports

A2 Current O&M Activities

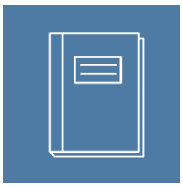
A3 Current Condition Assessment Activities

A4 Failure Modes

A5 Risk Mitigation Activities

A6 Work Flow Diagrams

APPENDIX A1 – MILESTONES & REPORTS



WATER MILESTONES

1923 Water System begins with 5 deep seated wells
1923 Academy Tank
1959 Kildaire Tank
1966 Maynard Tank
1966 Raleigh Interconnect @ Buck Jones
1973 Wake County portion of RTP added to service area
1974 Harrison Tank
1974 Raleigh Interconnect @ Trinity Road
1978 Academy Tank Removed
1984 RDU added to service area
1993 CAWTF Constructed, 12 MGD re-rated to 16 MGD
1994 Ridgeview Tank
1997 Durham Interconnect @ NC54
2000 Old Apex Ground Storage Tank
2002 CAWTF Expansion to 40 MGD
2002 Plumtree Tank
2002 Carpenter Tank
2005 Western and Southern Pressure Zones Created
2006 Morrisville Utility Merger
2007 Field Street Tank
2011 Kildaire Tank Removed
2017 CAWTP Expansion to 56 MGD

WATER REPORTS

1965 Report on New Water Supply, Moore, Gardner & Associates
1971 Wake County Water & Wastewater Engineering Study, Wake Engineering Study Group
1981 Evaluation of Alternative Sources of Future Water and Wastewater Services, Black & Veatch
1983 Report on Water Works Facilities, Black & Veatch
1985 Report on Water Works Facilities, Black & Veatch
1989 Wake County Water and Wastewater Facilities Plan, Hazen & Sawyer
1992 Water System Report, Diehl & Phillips
2000 Water System Master Plan, CH2M Hill
2000 Long-Range Water Supply Plan, CH2M Hill
2006 Pressure Zone Boundary Study, Hazen & Sawyer
2007 Integrated Water Resources Management Plan, CH2M Hill
2009 Water System Master Plan, CH2M Hill
2013 Long-Range Water Resource Plan, CH2M Hill / Brown & Caldwell

WASTEWATER MILESTONES

1923 Wastewater System begins with Coles Branch Wastewater Treatment Plant (CBWTP)
1954 CBWTP expanded to 0.1 MGD
1964 Raleigh connection @ Buck Jones Road
1984 North Cary Wastewater Reclamation Facility (NCWRF)
1987 CBWTP retired
1989 South Cary Wastewater Reclamation Facility (SCWRF)
2006 Morrisville Utility Merger
2014 Western Wake Regional Water Reclamation Facility (WWRWRF)

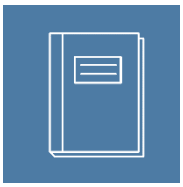
WASTEWATER REPORTS

1962 Sewage Treatment Facilities, Moore, Gardner & Associates
1971 Wake County Water and Wastewater Engineering Study, Wake Engineering Study Group
1981 Evaluation of Alternative Sources of Future Water and Wastewater Services, Black & Veatch
1989 Wake County Water and Wastewater Facilities Plan, Hazen & Sawyer
1992 Wastewater Study for the Town of Cary, Diehl & Phillips
2003 Wastewater Collection System Study and Master Plan, Hazen & Sawyer
2013 Wastewater Collection System Study and Master Plan, Hazen & Sawyer

STORMWATER MILESTONES

1972 First floodplain management ordinance adopted.
1974 Drainage basins become the geographic basis for stormwater planning and land use.
1985 Responsibility for erosion and sediment control assumed from the State.
1986 Development involving a change in zoning in a water supply watershed required to provide on-site detention of stormwater.
1988 Swift Creek Watershed Land Management Plan adopted.
1990 Stormwater plan, erosion control plan and grading permit required when more than 12,000 square feet of area is disturbed.
1993 DENR's water supply watershed rules implemented, which affected areas within 5 miles of the normal pool elevation of Jordan Lake and the Swift Creek Basin.
2000 Development no longer allowed within the floodplain as part of Flood Damage Prevention regulations.
2000 Erosion control inspections became a requirement for all single-family homes.
2000 Stormwater Management Program for Nitrogen Control adopted.
2001 Urban Transition Buffers (UTB) adopted. UTB's require a 100-foot buffer on USGS mapped surface waters and a 50-foot buffer on Soil Survey mapped surface waters in the Cape Fear River Basin as well as a 50-foot buffer on surface waters from the Neuse River Riparian Buffer based on USGS mapping.
2001 Rules established to prohibit lots from being platted in the UTB or floodplain.

APPENDIX A1 – MILESTONES & REPORTS



2004 Skimmer devices required on all sediment basins regardless of surface area.
2005 NPDES, Phase II stormwater permit received.
2006 Policy 35 adopted, which provides an opportunity for cost sharing with citizens that have problems with structural flooding.
2008 Grading limited to 25 acres at one time for residential developments with 3-8 dwelling units per acre.
2009 The Jordan Lake Nutrient Management Strategy became effective.
2011 Updated NPDES stormwater permit received.

STORMWATER REPORTS

1993 Stormwater Management Study, Daniel & Associates
1995 Stormwater Management Program Overview, Town of Cary
2005 TCAP Stormwater Management Plan, Tetra Tech
2006 Wake County Collective Stormwater Management Evaluation, CDM
2006 TCAP Basin-wide Drainage System Analysis, Dewberry
2006 Silverton Lake Watershed Study, Withers & Ravenel
2013 Stormwater Master Plan, Baker/Kimley-Horn

RECLAIMED WATER MILESTONES

1999 Bulk reclaimed water available at NCWRF & SCWRF
2001 North & South Cary reclaimed water system constructed
2012 West Cary, Phase 1 reclaimed water system constructed
2014 Bulk reclaimed water available at WWRWRF
2015 West Cary, Phase 2 reclaimed water system constructed

RECLAIMED WATER REPORTS

1997 Reclaimed Water & Wastewater Reuse Program, CDM
1999 Update to Reclaimed Water & Wastewater Reuse Program, CDM
2007 Reclaimed Water Master Plan, Black & Veatch
2013 Reclaimed Water Master Plan Update, CDM Smith

APPENDIX A2 – CURRENT O&M ACTIVITIES

CURRENT O&M ACTIVITIES	DESCRIPTION	ASSET TYPE				RESPONSIBILITY	FREQUENCY
		Water	Sewer	Storm	Reclaimed		
System Valve Exercising	Town staff currently exercise valves and record the number of turns required to close. In addition, as valves are exercised the GPS coordinates are gathered and provided to Information Technology so the valve locations may be updated in GIS. In addition, valve exercising provides staff with an opportunity to ensure that each valve is correctly left open or closed, depending on the valve. Proper exercising of water valves is important to ensure their operational readiness and ability to isolate system breaks. Without routine exercising, valves can seize up over time and not function when needed.	●			●	T	Exercise 100% of water system valves every 4 years & 100% of reclaimed system valves every year
Air Release Valve Inspection	Air release valves protect the water and reclaimed systems by discharging excess air. They also help prevent water hammering and minimize energy loss. Air release valves must be inspected regularly to ensure proper operation.	●			●	T	Inspect 100% of water air release valves every 3 years & 100% of reclaimed air release valves every year
Control Valve Inspection	The Town has a number of system control valves, such as pressure reducing valves, flow control valves and open/close valves, that allow the transfer of water in a controlled manner between pressure zones. Because these system control valves are critically important to the operation and integrity of the water distribution system they are inspected on a more frequent basis than system valves.	●				T	Inspect 100% of the control valves every year
Fire Hydrant Flushing	Fire hydrants are important to public safety and help ensure the Town's ISO ratings for fire protection. Fire hydrant inspections serve the dual purposes of flow testing hydrants to ensure adequate fire flow, as well as flushing to remove sediment from the water system.	●				T	Flush 100% of the fire hydrants every 2 years
Acoustic Leak Detection	The Town owns Gutermann acoustic leak detection equipment that allows for a dedicated crew to proactively monitor the water and reclaimed distribution systems to locate undiscovered leaks. In addition, acoustic leak detection is used reactively when a break occurs to help pinpoint the exact location of the failure.	●			●	T	Continual

** T – Town, C – Contractor*

APPENDIX A2 – CURRENT O&M ACTIVITIES

CURRENT O&M ACTIVITIES	DESCRIPTION	ASSET TYPE				RESPONSIBILITY	FREQUENCY
		Water	Sewer	Storm	Reclaimed		
Water Quality Disinfection & Flushing	The water distribution system is flushed as needed to ensure a 2-mg/L chlorine residual is maintained in compliance with State disinfection standards. The State of North Carolina encourages all water systems that add ammonia to cleanse their system annually by switching to chlorine only and flushing the system. In accordance with this recommendation, annually in the month of March the CAWTF temporarily stops adding ammonia to the disinfection process and Town crews flush the entire water distribution system.	●				T	Annually during March & as needed
Water Quality Sampling	The Town maintains 126 sampling stations throughout the water distribution system. Hundreds of water samples are collected monthly from these stations by Town staff. The samples are analyzed at the CAWTF laboratory to ensure that high quality drinking water is delivered to citizens and that regulatory requirements are met.	●				T	Continual
Interconnect Testing	The Town has metered interconnects for water transfer and mutual aid with the City of Durham, the City of Raleigh and the Town of Holly Springs. These connections to neighboring water systems allow the sharing of water supplies during droughts, peak demand conditions, short-term emergencies, or planned shutdowns of a primary supply source.	●				T	Test 100% of the interconnections every 2 years
Cross Connection Control Program	In 2003, the Town Council adopted the Cross Connection Control Ordinance and Policy Statement 137 which established the cross connection control program. The goal of the program is to protect the potable water system from contamination from non-potable water or water of questionable quality. The key feature providing this protection is the backflow prevention device on a water service located on the customer's side of the water meter. Town staff survey industrial, commercial, institutional and irrigation facilities to identify potential cross connections and protect the water system using backflow prevention devices. Town staff perform annual inspection and testing of each backflow preventer to make sure that it is properly maintained and providing maximum protection. These annual inspections are also required for all residential irrigation systems.	●				T	Continual

** T – Town, C – Contractor*

APPENDIX A2 – CURRENT O&M ACTIVITIES

CURRENT O&M ACTIVITIES	DESCRIPTION	ASSET TYPE				RESPONSIBILITY	FREQUENCY
		Water	Sewer	Storm	Reclaimed		
Critical Water Main Location	The Town has a 5-year contract with KCI to field locate water system infrastructure within critical corridors, install marker balls along the water main at regular intervals, and update GIS accordingly. This town-wide multi-year effort has so far addressed the water main along Kildaire Farm Road and Holly Springs Road. The FY 2018 Capital Improvements Budget shows future funding for the full 10-year horizon.	●				T	Continual
Meter Testing	The Finance department has a meter testing truck that has the capability to test up to 2-inch meters. This truck is not regularly used to test meters throughout Town, but rather is mobilized on-demand in response to individual meter concerns. The truck is unable to accommodate meters larger than 2-inches, so any of these larger meters must be sent to a third-party testing agency when testing is necessary.	●	●		●	T/C	As Needed
Utility Location	The Town performs utility location services for the Town-owned utility system as part of the North Carolina 811 program. This is an important service, as a large portion of utility breaks are related to accidental damage by contractors, and accurate utility location helps reduce the number of incidents.	●	●		●	T	Continual
6”-12” Sewer Main, Cleaning	The Town's wastewater collection system permit requires at least 10% of the sewer system to be cleaned each calendar year, with the intent of cleaning the entire sewer collection system within 10 years. Some historically problematic sewer lines require multiple cleanings each year to prevent sewer spills from occurring.		●			T	Continual
6”-12” Sewer Main, Video Inspection	Independent of cleaning, the Town video inspects a portion of the gravity sewer each year. Pipe defects are scored on a scale of 1 to 5 using the Town’s scoring criteria, and based on the number and severity of the defects the overall pipe segment is rated either in need of maintenance or acceptable. The video inspections and reports are stored in IT Pipes, and the overall pipe segment status is tracked in GIS.		●			T	Continual
6"-12" Sewer Main, Acoustic Analysis	The Town performs acoustic analysis using SL-RAT, an acoustic assessment tool, to quickly ascertain which sewer mains are most in need of cleaning.		●			T	Continual

** T – Town, C – Contractor*

APPENDIX A2 – CURRENT O&M ACTIVITIES

CURRENT O&M ACTIVITIES	DESCRIPTION	ASSET TYPE				RESPONSIBILITY	FREQUENCY
		Water	Sewer	Storm	Reclaimed		
15”+ Sewer Main, Cleaning & Video Inspection	The Town hires a contractor, currently Hyrdostructures, to perform cleaning and video inspection on ‘large diameter’ 15"+ diameter gravity sewer mains. The contractor delivers PACP coded video inspection reports for each sewer segment cleaned and inspected, which are then stored by the Town in IT Pipes. In addition, a full written report is provided for the entire years work, detailing areas that are recommended for maintenance, including location maps.		●			C	Continual
Force Main Cleaning & Video Inspection	Periodically, the Town hires a Contractor to perform cleaning and video inspection on sewer force mains.		●			C	Periodic
Root Foaming	The Town contracts with Duke's Root Control for annual root foaming of problematic gravity sewer mains, typically older clay lines. Duke's applies a foaming herbicide that kills roots that intrude into the sewer main through the pipe joints or service taps. The foam application has a two-year warranty, so the area of treatment is cycled each year to maintain coverage.		●			C	Annually
Sewer System Visual Inspection	A general visual observation of the entire collection system must be performed each year in compliance with permit requirements.		●			T	Annually
High Priority Sewer Inspection	High priority sewer mains, such as aerial crossings, are regularly inspected for damage. In the case of aerial crossings, the Town also inspects to ensure that the creek/stream flow is not impeded.		●			T	Inspect 100% of high priority sewer main every 6 months
High Priority Manhole Inspection	High priority manholes with elevated risk and history of SSO’s are visually inspected frequently.		●			T	Periodic
Odor Control Inspection	The Town of Cary proactively works to minimize and reduce sewer odors using carbon absorption canisters and rainpots, biofilters, scrubbers and chemical additions.		●			T	Canisters/Rainpots - Monthly FM Discharge MH's/ARV's - Biannually
Cathodic Protection Inspection	Cathodic protection is installed on some of the Town's larger metallic force mains and effluent lines such as the Beaver Creek FM, West Cary FM and the Western Wake Effluent. These cathodic protection systems must be annually inspected to ensure proper protection of the pipe.		●			C	Annually

** T – Town, C – Contractor*

APPENDIX A2 – CURRENT O&M ACTIVITIES

CURRENT O&M ACTIVITIES	DESCRIPTION	ASSET TYPE				RESPONSIBILITY	FREQUENCY
		Water	Sewer	Storm	Reclaimed		
Sewer Easement Clearing	Easements are required by permit to be properly maintained in order to allow access to the wastewater collection system for inspections, maintenance and repair activities.		●			T	Continual
Smoke Testing	Each year from June to September, the Town tests the sewer system with nontoxic smoke to help locate areas where stormwater and other surface waters are entering the system as well as reveal potential sources of sewer odor.		●			T	Annually, June - September
Flow Monitoring	Each year, the Town contracts with Frazier Engineering to perform flow monitoring of the gravity sewer collection system. The Town owns 32 flow monitors, which are in strategic locations throughout the system. Frazier maintains the flow monitors, and downloads the monthly data to a laptop, formats the results, and provides a monthly report to the Town. At the end of each year, Frazier compiles an annual report and provides a presentation to the Town outlining trends observed for the year.		●			C	Annually
Portable Flow Monitors	The Town has 11 portable flow monitors that can be installed throughout the wastewater system as needed to collect flow data in targeted areas of interest.		●			T	As Needed
Fats, Oils and Grease (FOG) Program	The Town's wastewater collection system permit requires the development of a fats, oils and grease removal program. The Town has developed and deployed a FOG program through its sewer use ordinance, which requires the installation of onsite grease interceptors for food service establishments and other developments that discharge significant fats or grease into the wastewater.		●			T	Continual
Stormwater Cleaning & Video Inspection	The current Town stormwater O&M efforts are primarily response based, focused on historically troublesome hotspots and areas identified via citizen input.			●		T	Periodic

** T – Town, C – Contractor*

APPENDIX A3 – CURRENT CONDITION ASSESSMENT ACTIVITIES

CURRENT CONDITION ASSESSMENT ACTIVITIES	DESCRIPTION	ASSET TYPE				RESPONSIBILITY	FREQUENCY
		Water	Sewer	Storm	Reclaimed		
Raw Water Pipeline Condition Assessment	In 2014, The Town of Cary hired Falcon to perform condition assessment of the existing ductile iron force mains which supply raw water from Jordan Lake to the Cary/Apex Water Treatment Facility. The 30-inch line was observed and ultrasonically tested for wall thickness in three buried locations. The 42-inch line was observed and ultrasonically tested for wall thickness at one (1) buried location and inside five (5) Air-Release Valve (ARV) vaults. No defects were observed in the 42-inch line however the 30-inch line exhibited potential signs of a minor amount of graphitization as well as evidence of separation, delamination or scouring of the cement liner along the bottom of the pipe nearest to the pump house. The trench backfill and native soils were sampled along both utility corridors for corrosion series testing. The results of this testing indicated some soils may be potentially corrosive.	●				C	Periodic, as budgeted
Cement Pipe Material Testing	The Town is currently working with F&R to perform material testing on samples of cement pipe that are recovered from water main repairs, tie-ins, taps and other activities that involve removing sections of cement pipe. Each sample is measured, photographed and then tested for cement leaching and hardness. The results are recorded in an electronic report that can then be hotlinked in GIS to the appropriate pipe section within the water system.	●				C	Continual
Sanitary Force Main Condition Assessment	This project provides for the condition inspection of sewer force mains. Brown & Caldwell has been tasked with performing video inspection, material coupon sampling, lining sampling and providing recommendations for rehabilitation methods, such as coating, slip-lining, or replacement.		●			C	Periodic, as budgeted
Stormwater Video Inspection	Stormwater pipe and culverts are video inspected every Friday by a Town wastewater crew, and on an as needed basis when problems occur.			●		T	Continual, once a week on Friday

** T – Town, C – Contractor*

APPENDIX A4 – FAILURE MODES

ASSET	ASSET TYPE: Water	Sewer	Storm	Reclaimed	FAILURE MODE	PREVENTATIVE MEASURE	FREQUENCY
Air Release Valves	●				Float hangs up on Golden Andersons with cast iron bodies	Replace with stainless steel ARV	As Identified
		●			Valve stuck open and leaking into manhole	Visual inspection	Continual
				●	Body of ARV splits	Proactively replace with stainless steel ARV	Continual
Blow-offs	●				Truflo TF500's degrade and can't be rebuilt or repaired	Replace when found	Continual
				●	2-inch blowoff meters quit reading after a year or less.	Replace	As Identified
Cathodic Protection		●			Insufficient Protection	Annual Survey	Annual 3rd Party Inspection
Culverts/Storm Pipe					Clogged with debris	Inspect	Every 5 Years
			●		Erosion	Anti-seep collar	As Needed
					Joint separation	Line	As Identified
Fire Hydrants	●				Leaded connections on the pre-1980's fire hydrants	Remove and replace	As Identified
					Failure of old Kennedy and Waterous fire hydrants	Remove and replace	As Identified
Force Mains					No ARV at high point	Add ARV	As Identified
		●			Debris build up in force main	FM inspection & cleaning	Annually
						Add pigging station Add bypass connection	As Needed
Manholes	●		●	●	Joint separation, grout loss, settling	Inspection	Every 5 Years
		●			Elevated H2S downstream of FM's and in manholes on large diameter pipe	Epoxy coat, install air exchange	As Identified
					Infiltration	Line	As Identified
Manhole Lids	●	●	●	●	Frame detaches from cone	Reattach	As Identified

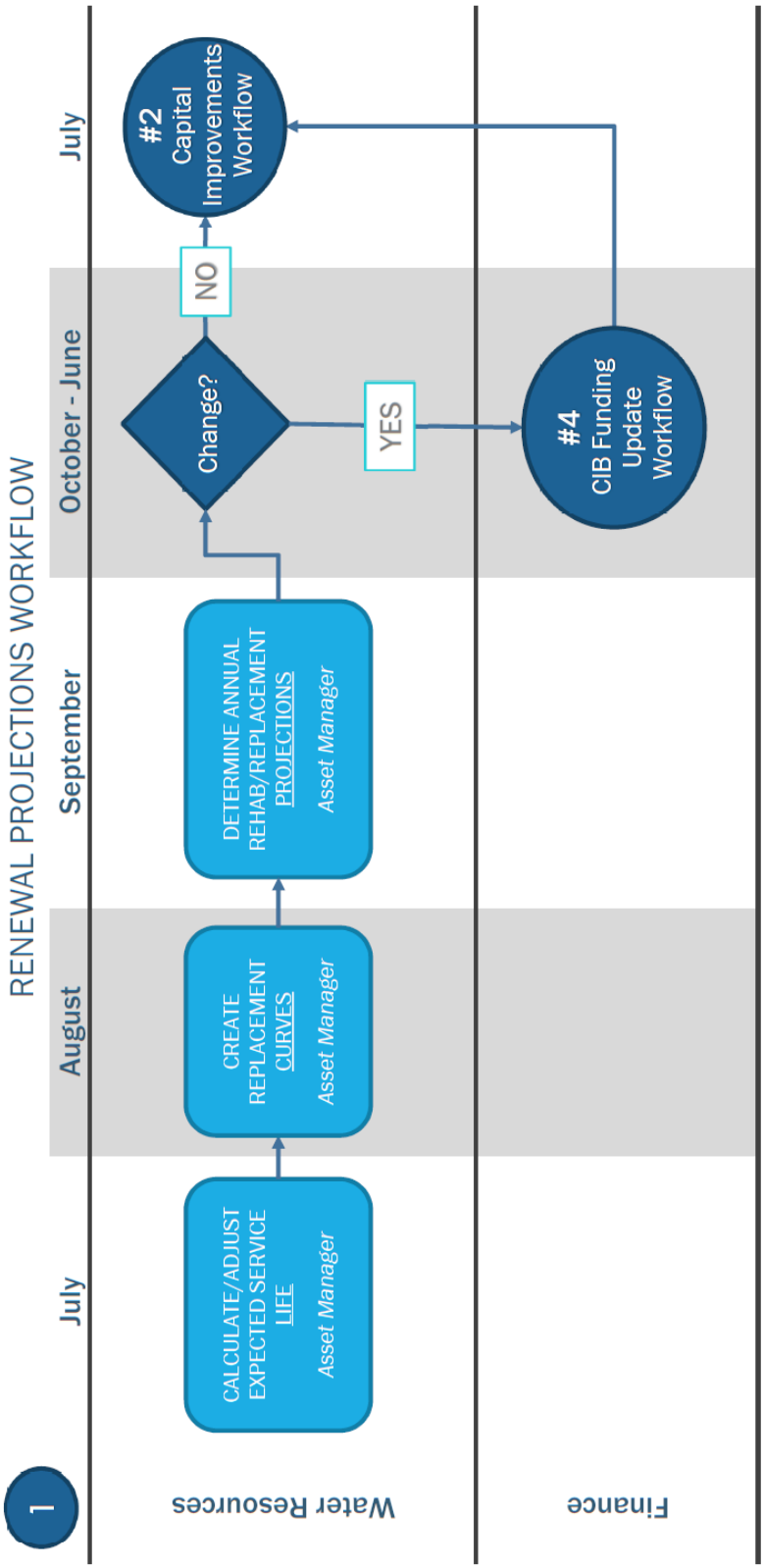
APPENDIX A4 – FAILURE MODES

					Non-watertight, in watertight application	Switch to watertight swing style lid	As Identified
	ASSET TYPE						
ASSET	Water	Sewer	Storm	Reclaimed	FAILURE MODE	PREVENTATIVE MEASURE	FREQUENCY
Meters	●	●		●	Battery failure	Replace battery	As Identified
					Inaccurate readings on SR2 meters from 2011	Replace	Continual
Service Lines	●				Tapping saddle failure	Replace	As Identified
		●			Inflow/Infiltration	Smoke test. Televise. Renew.	As Identified
				●	Clogged corporation	Adjust chemistry at the plant. Adjust corrosion inhibitor.	As Needed
Sewer Main		●			Inflow/Infiltration	CCTV Inspection	Continual
					Break/Leak	Renew/Replace Pipe	Capital Project
Stormwater Control Measures			●		Riser malfunction, vegetation mortality or mono-culture, erosion, sedimentation, media failure, emergency spillway failure, orifice clogging, animal burrows, underdrain malfunction	Inspection	Annual
						O&M Maintenance Schedule	Monthly, Quarterly, Semi-annual & Annual
Stormwater Inlets			●		Clogged	Inspect	Every 5 Years
						Proactively clean	After Large Rain Events
Stormwater Outlets			●		Clogged	Inspect	Every 5 Years
						Proactively clean	After Large Rain Events
					Erosion and undermining	Install scour pool	As Needed
Valves	●	●		●	Valve stuck open/closed	Exercise	Annually
					Inoperable butterfly valves & double disc gate valves	Replace	As Identified
Water Main	●			●	Break/Leak	Acoustic Leak Detection	Continual
					Break/Leak	Renew/Replace Pipe	Capital Project

APPENDIX A5 – RISK MITIGATION ACTIVITIES

CAPITAL RISK REDUCTION OPTIONS	PROJECT TYPE: Water	Sewer	Storm	Reclaimed	ACTIVITY TYPE	
Open-Cut Replacement	●	●	●	●	Capital	The asset is excavated and replaced directly. Where performance is insufficient, the asset should be upsized as well as replaced.
Lining	●	●	●	●	Capital	The asset is lined in place using technologies such as cured-in-place lining, spray-on lining, slip-lining, or spiral winding.
Pipe Bursting	●	●	●	●	Capital	A replacement pipe with a splitter head is pulled through the existing pipe.
Chemical Grouting		●	●		Capital	Chemical grout is injected into leaking joints or other defects.
Parallel Lines	●	●	●	●	Capital	Redundant assets are installed such as parallel lines, hydraulically parallel lines, or back feeds for water and reclaimed water systems.
Bypass Lines		●			Capital	Bypass lines are installed, such as at valves, meters or force mains to allow for operational flexibility and ease of maintenance in emergency situations.
Pigging Stations		●			Capital	Installation of a pigging station allows for the periodic cleaning (pigging) of sewer force mains.
Visual Inspection	●	●	●	●	O&M	The asset is visually inspected, either directly, or using CCTV or other camera technology.
Cleaning	●	●	●	●	O&M	The asset is cleaned of accumulated debris using jetting, flushing, pigging, or other related technologies.
Leak Detection	●	●		●	O&M	Pressurized assets are inspected for leaks using acoustic monitoring or other technologies. Gravity sewer assets can be smoke tested for a visual indication of possible sources of inflow or infiltration.
Root Removal		●	●		O&M	Root intrusions are removed through the application of a foaming herbicide or mechanical means.
Street Sweeping			●		O&M	Street debris is swept and vacuumed up off the pavement to reduce sediment accumulation within the storm system.
Vulnerability Assessment	●	●	●	●	Other	A vulnerability assessment is a risk management process used to identify, quantify and rank possible threats to buried infrastructure.
Flow Monitoring	●	●	●	●	Other	Flow is measured using flow meters to monitor the system for capacity issues.
SCADA	●	●	●	●	Other	Supervisory control and data acquisition (SCADA) is used for acquiring real-time data and providing remote control for devices such as valves, pumps and other infrastructure.
Hydraulic Monitoring	●	●	●	●	Other	Hydraulic modeling allows for computer simulation of collection, distribution and stormwater system assets. Software is used for flow simulation, detailed analysis and future planning for buried infrastructure.
FOG Program		●			Other	A fats, oils and grease (FOG) program, with key components pertaining to FOG mitigation infrastructure, public education and non-compliance enforcement.

APPENDIX A6 – WORK FLOW DIAGRAMS



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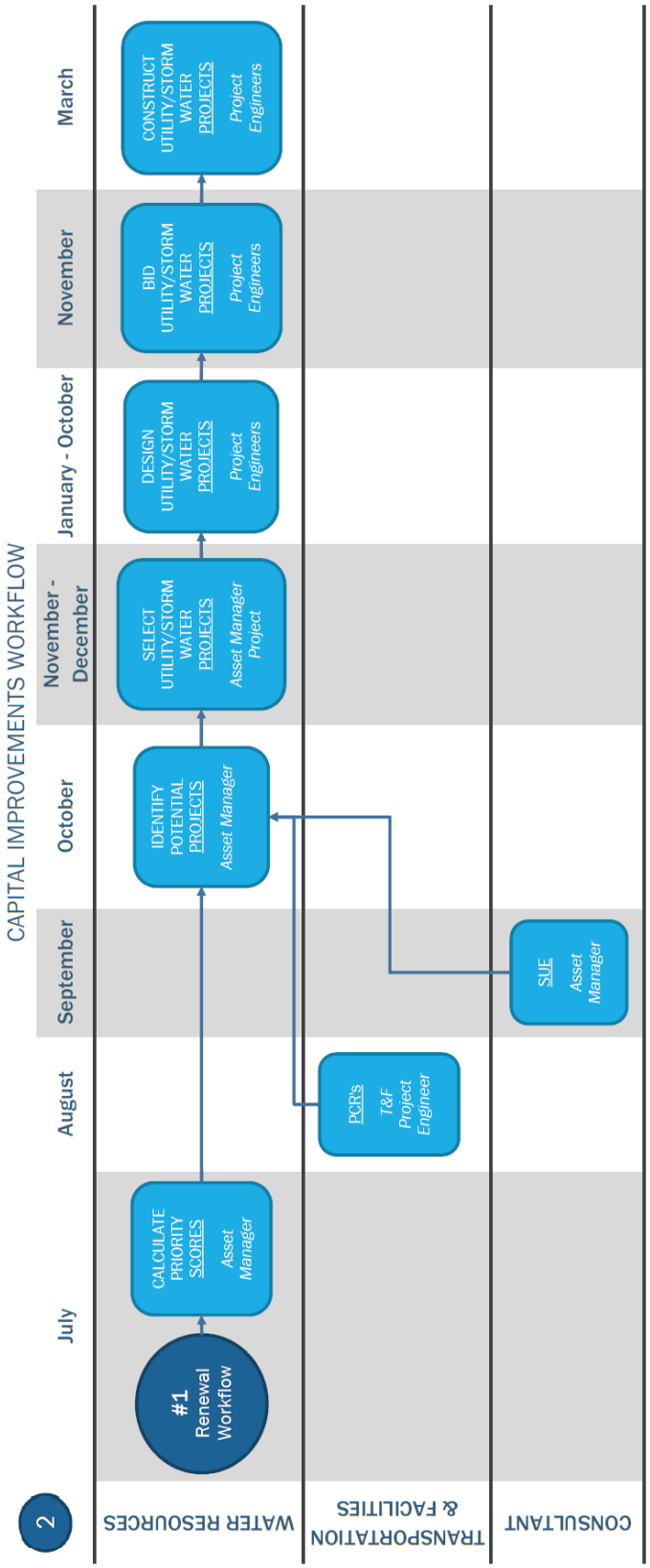

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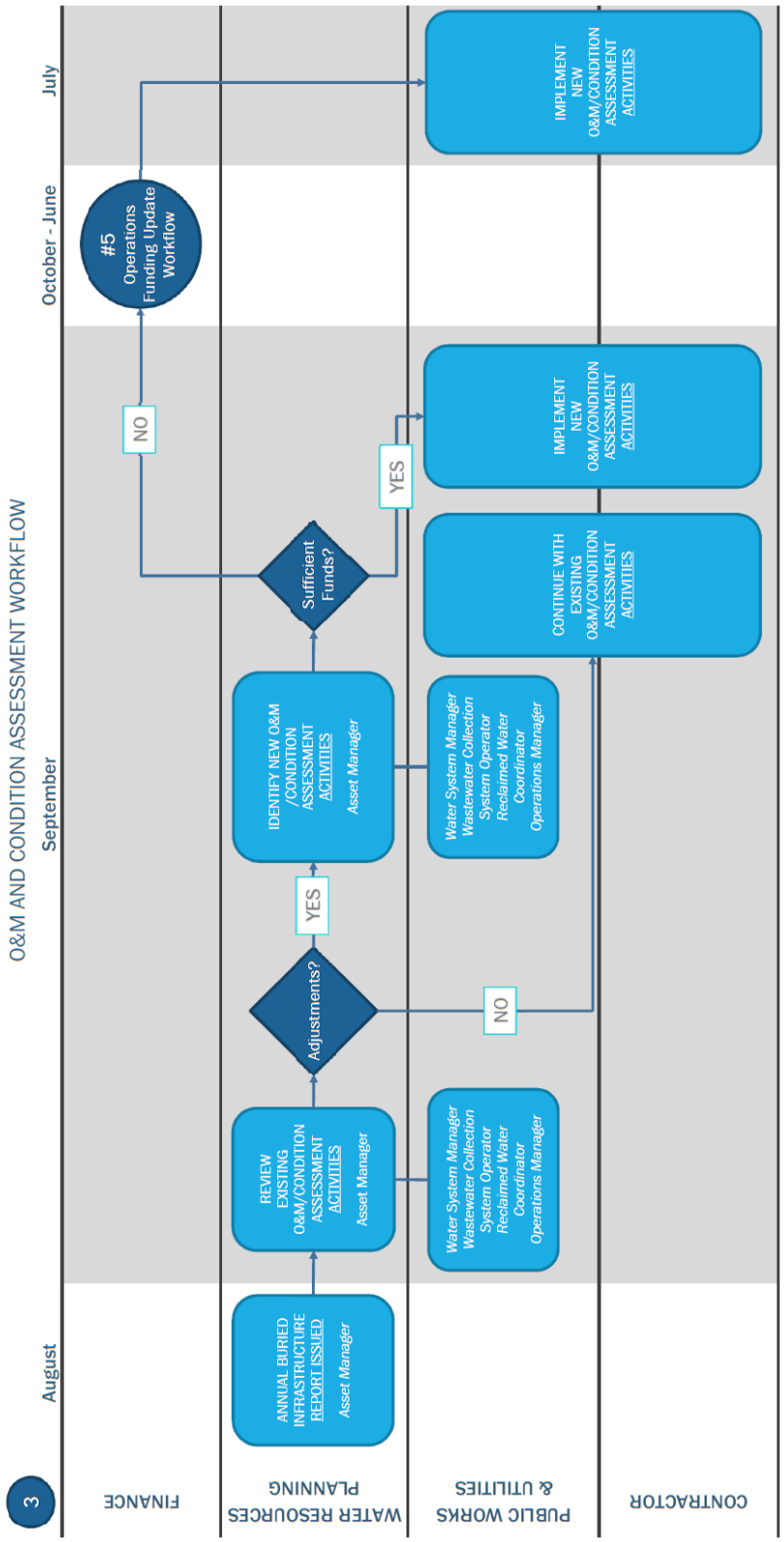

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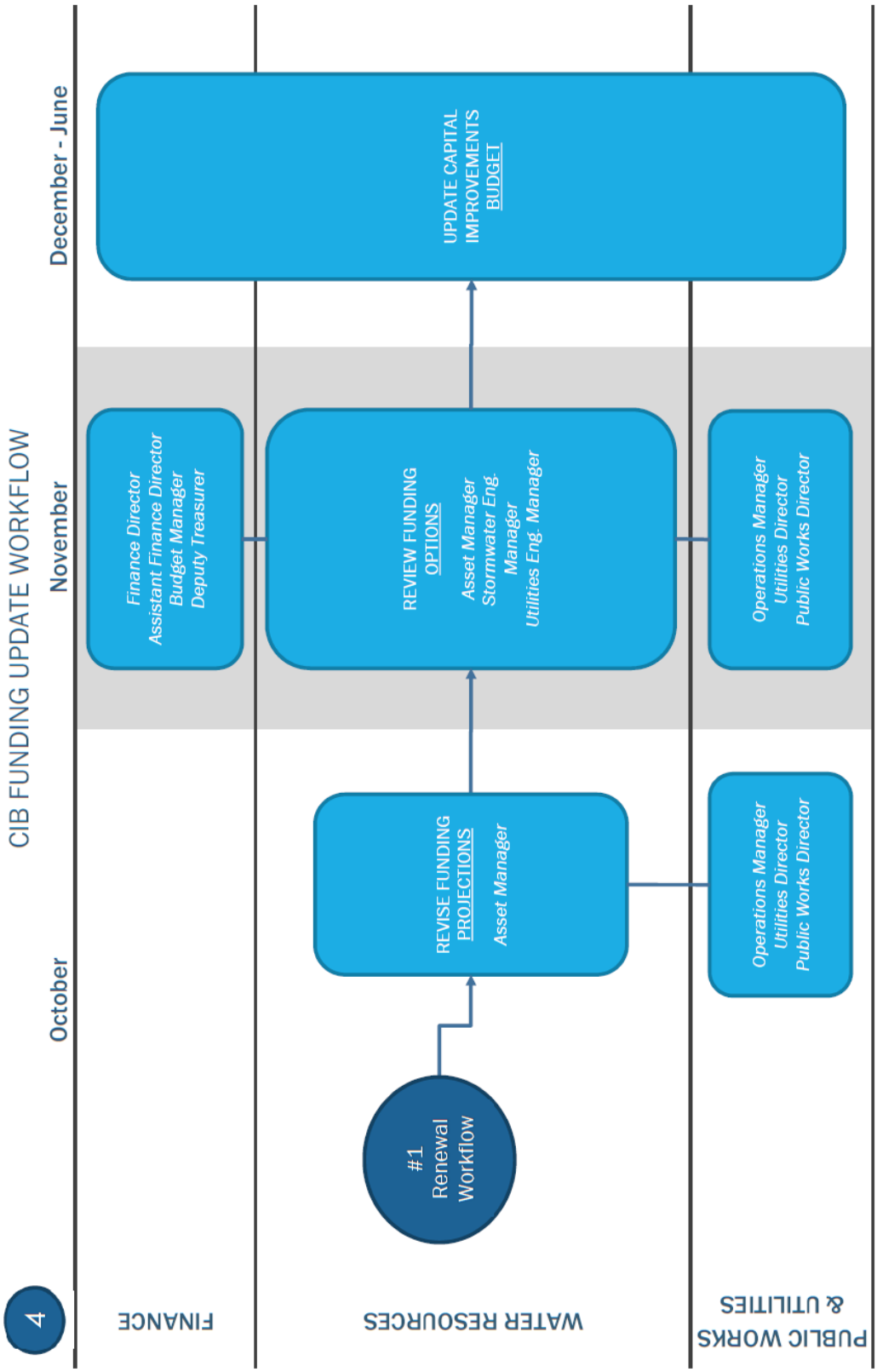

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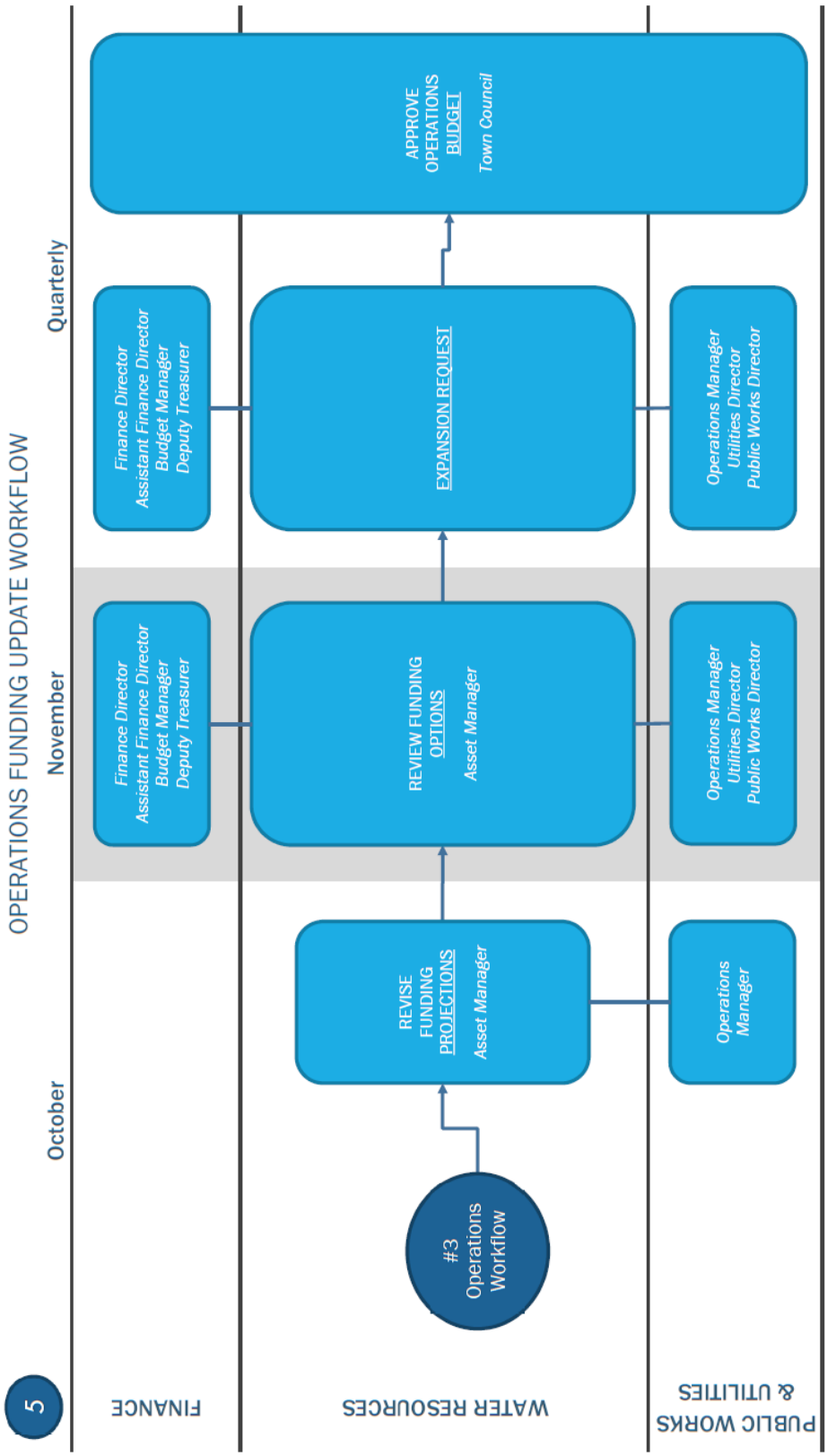

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