Asset Management and Asset Inventory Report Guidance

2010

Kentucky Division of Water's guidance on Asset Management and Asset Inventory Report, as required by 401 KAR 5:006

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Chapter 1: Asset Management

Purpose and Need

All wastewater systems are made up of assets, some that are buried assets and some that are visible. These are the physical components of the system and can include: pipe, pumps, treatment facilities, and any other components that make up the system. There are definite challenges that wastewater utilities face when managing their assets. Several of these challenges are due to shrinking workforce, determining the best time to rehabilitate/repair/replace aging assets, increasing demand for services, overcoming resistance to rate increases, diminishing resources, rising service expectations of customers, increasing regulatory requirements, increasing operation and maintenance costs, responding to emergencies as a result of asset failures and protecting assets. However, there is an approach to managing the assets of the system that can assist the utility with making better decisions on managing these aging assets. The goal of asset management is defined as meeting a required level of service in the most cost-effective way through the creation, acquisition, operation, maintenance, rehabilitation, and disposal of assets to provide for present and future customers.

Wastewater utilities rely primarily on revenues from user rates to pay for infrastructure improvements. However, many utilities have not been generating enough revenues from user charges and other local sources to cover their full cost of service, including operation and maintenance costs and needed capital investments. As a result, utilities have deferred maintenance and postponed needed capital improvements due to insufficient funding. According to EPA's gap analysis, maintaining utility spending at current levels could result in a funding gap of up to $444 billion between projected infrastructure needs and available resources (U.S. Environmental Protection Agency, The Clean Water and Drinking Water Infrastructure Gap Analysis, EPA-816-R-02-02; September 2002). However, EPA also estimates that if utilities' infrastructure spending grows at a rate of 3 percent annually over and above inflation, the gap will narrow considerably and may even disappear. EPA's report concludes that utilities will need to use some combination of increased spending and innovative management practices, such as asset management, to meet the projected needs. Cost estimates for wastewater system needs in Kentucky are several billion dollars, while the existing state and federal funding sources can only meet a fraction of this need. These sources of funding are not expected to increase, and in many cases, are declining. Therefore, approaches to reducing the gap between what is needed and what funds are available are being adopted. In addition, funding agencies want assurance that the millions of dollars in annual state and federal funding are being invested in the most appropriate and cost-effective projects and provided to systems that have adequate financial, technical, and managerial capacity to protect that investment throughout the life expectancy of the improvements being financed.

Asset Inventory Report Requirement

To address these challenges and improve system management, the Cabinet is has developed an asset inventory report requirement to suit the planning needs of some regional planning agencies that are not expanding. 401 KAR 5:006, Section 4 requires regional planning agencies to submit an asset inventory report if it has been ten (10) years since the regional planning agency has submitted a regional facility plan or asset inventory report. The first core component of asset management is the asset inventory which is probably the most straightforward of all and arguably the most important as it underlies all other aspects of asset management. The development of an asset inventory report involves cataloging existing assets, assessing the asset condition, performance and reliability, identifying critical assets and developing strategies to manage them. The final component involves determining the best manner in which to fund the operation and maintenance, repair, rehabilitation, and replacement of assets. The report shall include a completed form and copies of supporting documentation. An asset inventory is a critical tool that wastewater systems can utilize to effectively and sustainably manage and maintain aging assets. The Cabinet will also utilize asset inventory report to identify potential funding gaps between projected infrastructure needs and spending for wastewater utilities in Kentucky and provide a more comprehensive assessment of the capital needs in the state for the EPA Clean Watershed Needs Survey (CWNS).

Benefits of Asset Management and Inventory

One clear advantage of asset inventory for regional planning agencies is its usefulness as a planning tool. This planning approach allows communities that face population growth or decline or other changes to be proactive, not reactive, to changing needs and helps them make better financial decisions. Some communities, particularly small communities which lack the economies of scale associated with a large customer base, have a difficult time in meeting the cost of installing and maintaining infrastructure and associated funding challenges. The financial impact of the need to address aging infrastructure will be greater for communities who face a significant challenge to sustain and advance their achievements in protecting public health and the environment. In today's economic environment, it is essential for utilities to effectively manage and maintain their assets. These new tools will also allow the wastewater utilities in these communities to operate on a "business model" for long term sustainability to help address the issues of new and stricter regulatory requirements, growing increased service demands, aging infrastructure, and limited state and federal funding. A community, wastewater utility should care about managing its assets in a cost effective manner for several reasons 1) these types of assets represent a major public or private investment; 2) well-run infrastructure is important in economic development; 3) proper operation and maintenance of a utility is essential for public health and safety; 4) utility assets provide an essential customer service; and 5) asset management promotes efficiency and innovation in the operation of the system. The intent of asset management is to ensure the long -term sustainability of wastewater utilities. By helping make better decisions on when it is most appropriate to repair, replace, or rehabilitate particular assets and by developing a long-term funding strategy, the utility can ensure its ability to deliver the required level of service perpetually.

Intended Audience

This guidance is intended to be a starting point for any wastewater system. This guidance contains all the basic elements of asset management, but does not go into extreme depth on any of the topic areas. The guidance is structured for systems that will not be able to handle extremely sophisticated asset management techniques at this time. A system should be able to jump right into asset management and start doing it without a tremendous amount of preparation or resources. Over time, a system will increasingly improve its asset management program and will increase its knowledge base and the quality of its data. A system may wish to increase its level of sophistication and may input a greater degree of resources, personnel or money, as it improves over time. For systems that wish to have a more robust asset management program, there are many guides and resources that can help achieve a higher-level program. Some systems may form cooperative arrangements with other systems that would allow them to eventually achieve an even higher level of sophistication. However, the most important thing is for a system to get started on a more systematic manner of operating its utility. Asset management is firmly rooted in common sense and good business practices. As such, any activities the system undertakes in the area of asset management will improve the system's overall operation. The more sophisticated and cohesive the program, the more improvement, but improvement will occur even at a lower level of asset management activity. Utilities do not need to worry about making mistakes with asset management. Asset management is meant to be on-going and improved over time. If the program is not working properly or needs to be changed, the system can change it.

Guidance Purpose and Use

This guidance was developed following revisions to regulation 401 KAR 5:006 "Wastewater planning requirements for regional planning agencies." This guidance is intended for engineers, planners, owners, managers, and operators of wastewater systems, local officials, technical assistance providers and state personnel in an effort to help them meet the requirements of regulation 401 KAR 5:006. The Cabinet strongly encourages coordinated efforts and/or oversight between target audience members during the composition of an asset inventory. This guidance is to be used in combination with regulation 401 KAR 5:006. Regional planning agencies submitting an asset inventory report should obtain a copy and be familiar with regulation 401 KAR 5:006. There may be additional methods or options for meeting the regulatory requirements other than those discussed herein. However, understanding regulation 401 KAR 5:006, following this guidance and submitting a report will facilitate a more effective and timely review. The Division suggests that users read each section in its entirety to gain a general understanding of the reporting process and determine the type of reporting needs applicable to their circumstance. The contents of this guidance provides general information regarding asset management and includes, Section 1 which generally defines what asset management is and outlines the five core questions framework for implementing asset management, Section 2 which outlines how to follow-up and continue step towards implementing asset management and Section 3 which describes how to build an asset management team. The information presented in this guidance has been compiled from various sources.

Section 1: What is Asset Management?

The purpose of this guide will help you understand:

- What asset management means.
- The benefits of asset management.
- Best practices in asset management.
- How to implement an asset management program.

There are many challenges faced by wastewater system including, but not limited to:

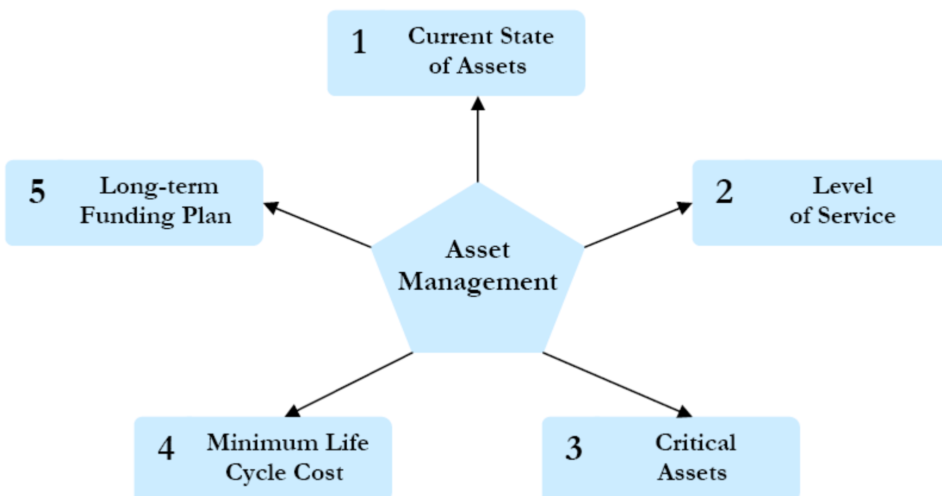
- Determining the best or optimal time to rehabilitate, repair and replace aging assets;
- Increasing demand for services.
- Overcoming resistance to rate increases.
- Diminished resources.
- Rising service expectations of customers.
- Increasingly stringent regulatory requirements.
- Responding to emergencies as a result of asset failures; and protecting assets.

The benefits of asset management include, but are not limited to:

- Prolonging asset life and aiding in rehabilitate/repair/replacement decisions through efficient and focused operations and maintenance.
- Meeting consumer demands with a focus on system sustainability.
- Setting rates based on sound operational and financial planning.
- Budgeting focused on activities critical to sustained performance.
- Meeting service expectations and regulatory requirements.
- Improving response to emergencies.
- Improving security and safety of assets

A good starting point for any size wastewater system is the five core questions framework for implementing asset management. This framework walks you through all of the major activities associated with asset management and can be implemented at the level of sophistication reasonable for a given system. These five core framework questions provide the foundation for many asset management best practices. Several asset management best practices are listed for each core question on the following pages. Keep in mind that these best practices are constantly being improved upon. The flow chart below shows the relationships and dependencies between each core framework question.

Flow Chart: The Five Core Questions of Asset Management Framework



1. Current State of Assets

The first step in managing your assets is knowing their current state. Because some of this information may be difficult to find, you should use estimates when necessary. Over time, as assets are rehabilitated, repaired or replaced, your inventory will become more accurate.

You should ask:

- What do I own?
- Where is it?
- What is its condition?
- What is its useful life?
- What is its value (e.g., original and replacement cost)?

Best practices include:

- Preparing an asset inventory and system map.
- Developing a condition assessment and rating system.
- Assessing remaining useful life by consulting projected-useful-life tables or decay curves.
- Determining asset values and replacement costs.

Each of these question are discussed in more detail below.

- **What do I own?**

The most fundamental question a utility owner, manager, or operator can ask, is what assets do I have? It is absolutely critical for a utility to understand what it owns. It is pretty hard to manage something effectively if you don't know what that "something" consists of. Although "what do I own" is a seemingly straightforward question, it is not always easy to answer. The difficulties arise from several factors: some of the assets are underground and can't be seen; assets generally are put in at different times over a long period of time; records regarding what assets have been installed may be old, incomplete, inaccurate, or missing; and staff turnover in operations and management may limit the historical knowledge of system assets. Given these difficulties it will probably not be possible to form a complete asset inventory the first time the system attempts to do so. It is important to recognize that the system is only trying to form the best inventory it can and develop an approach to adding to or improve the database over time. To develop the initial inventory, several approaches can be used and these are listed below.

However, the utility should be as creative as possible with other approaches to obtaining this information.

- Determine who was operating, managing and/or owning the system at the time of the major construction periods (when a large number of assets were put in.) Interview these individuals and gather as much information as possible regarding their recollections of what assets were installed and where they were installed. If there are maps of the system, these can be used during the discussions.
- Examining any as-built or other engineering drawings of the system.
- Visual observations of above-ground or visible assets (e.g., pumps, manholes, treatment works)
- Interviewing community residents who may have lived in the area during construction and who are familiar with the construction activities (especially helpful in very small towns in which the residents may have been actively involved in developing the utility)
- Estimates on buried assets using above ground assets as a guide (e.g., using manholes to estimate locations, size, and type of pipe between the manholes)

Several approaches may be necessary to get a good start on the asset inventory. A utility should use as many approaches as it deems necessary to get the best initial inventory of assets.

- **Where are my assets?**

The next question in inventorying the assets is where are they? Once you know what you have, it is important to know where they are. This component involves two steps: 1) mapping the assets and 2) putting a location in the inventory. In terms of mapping, the most important factor is to have a visual picture of the asset locations, especially the buried assets. The step involves a map which can be as simple (hand drawn) or as complex (Geographic Information System) as the system is capable of. The second step involves putting a location in the asset inventory indicating where the asset is located. Generally, this would be a street name, street address, or building location such as pump or treatment building. The addresses should be as specific as possible. That way, assets can be grouped together based on their location. It is important to be able to group assets by their category (i.e., all pumps, all collection lines) and by their location (all assets on Main Street.) In this manner, the system can answer various questions about their system, such as, “If I replace the pipe on Main Street, what other assets are associated with that pipe that may also have to be replaced?” “If I replace a component in the treatment building, what other assets might be impacted?" The location of the asset should be included along with the other inventory data to allow the types of querying discussed above.

It is best to start with any maps you m ay have readily available, and work with your operator to determine what you know about the system. A good starting point is to take a look at the maps the wastewater system currently owns, such as engineering "as built", community planning maps, etc. If your system has ever contracted with an engineering firm to conduct an assessment or design improvements, chances are you may already have a map of your system. For most projects engineering firms will include engineering drawings of the system that includes a description of the pipes and where they are located. Others may just include a map known as an "as built" that will depict the part of the system where work has been done. If you have several "as-builts," as a result of several projects over a period of time, you may want to consider obtaining copies and creating your own mosaic map by fitting and taping the "as-builts" together to create a large map of the system. If the system does not have a regular map or "as -built" map available, a potential alternative would be to contact your local city or county government office or Area Development District. If you have a computer and Internet connection you may try creating a map yourself using mapping Web Sites. The following are web address to the three Web Sites that are useful viewing and printing small area street maps: (1) Google http://maps.google.com/; (2) MapQuest http://www.mapquest.com/; and (3) Yahoo http://maps.yahoo.com/. Understanding what map scale is appropriate for the project is crucial because, (1) you want the map to display as much of the detailed information as possible, and (2) you want to make sure that your assets, such as pipe lengths, are accurately displayed on the map.

- **What is the condition of my assets?**

After the assets are determined and located on a map, it is important to know the condition of the assets. A condition assessment can be completed in many different ways, depending on the capability and resources of the system. It is critical that utilities have a clear knowledge of the condition of their assets and how they are performing. All management decisions regarding maintenance, rehabilitation, and renewal revolve around these two aspects. Not knowing the current condition or performance level of an asset may lead to the premature failure of the asset, which leaves the utility with only one option: to replace the asset (generally the most expensive option). There are many ways to assess the condition of the assets. For example, some assets can be visually assessed, wastewater lines can leak tested, etc. Sometimes the only suitable way to assess an asset is to compare its performance (repair history) to its expected life.

- **What is the remaining useful life of my assets?**

All assets will eventually reach the end of their useful life. Some assets will reach this point sooner than other assets. In addition, depending on the type of asset, it will either reach that point through amount of use or length of service. For example, a pump will wear out sooner if it is used more and will last longer if it is used less. The actual age of the pump is not as important as the amount of work the pump has done. On the other hand, pipe assets wear out based more on the length of time in the ground. If a pipe is in the ground for decades it has had considerable time to contact the soil around it and may start to corrode. There are many additional factors that will affect how much useful life a given asset has. Factors such as poor installation, defective materials, poor maintenance, and corrosive environment will shorten an asset's life, while factors such as good installation practices, high quality materials, proper routine and preventative maintenance, and non- corrosive environment will tend to lengthen an asset's life. Because of these site-specific characteristics, asset life must be viewed within the local context and the particular conditions of that utility. Cast Iron pipe may last 100 years at one facility and 30 years at another. It is best to make judgments on asset life based on past experience, system knowledge, existing and future conditions, prior and future operation and maintenance, and similar factors in determining useful life. In the absence of any better information, a system can use standard default values as a starting point. However, over time, the system should use its own experiences to refine the useful lives. As an example, if a given utility routinely replaced a system component every 5 years because that was as long as that asset lasted, then 5 years should be used as life, not a standard default value. However, if the system only had its pipe in the ground for 20 years and had no knowledge of how long it could be expected to last, it could use a manufacturers predicted useful life of the asset. However, as time goes on, if the system did not notice any reduction in the integrity of the pipe after 40 years, the useful life could be increased from 50 years to say 75 to 100 years. If the system started seeing a reduction in the pipe integrity (lots of breaks due to corrosion) at 40 years, it should keep the useful life closer to 50.

- **What is the Value of the Assets?**

Generally, when utilities consider the value of assets, they think about the initial installation cost. This cost has no other importance than historical information or it can be used by a system that depreciates the costs of assets over time. However, the installation cost does not have a direct bearing on what it will cost to replace that asset when it has reached the end of its useful life. The asset may not be replaced by the same type of asset (e.g., cast iron pipe may be re placed by PVC pipe) or it may be replaced by a different technology entirely (e.g., a chlorination system replaced by an ultraviolet disinfection facility). Furthermore, costs of various assets may change drastically over time, such that the cost of installing pipe in 1960 in no way reflects the costs of installing pipe 50 years later in 2010. Some prices may increase, such as materials, while technological advances may decrease other costs. The real value of the asset is the replacement cost using the technology the system would employ to replace them. If the system has asbestos cement pipe now, but would replace the system with PVC pipe, the real value of the assets is the cost of replacement using PVC and the installation cost associated with PVC. Although the idea behind an asset value is relatively simple, obtaining costs for the asset replacement is not as easy. Small utilities may not have the expertise to estimate replacement costs. In these cases, the utility should either estimate in the best manner possible or leave this portion of the inventory blank for the initial stages of the asset management strategy. This information can be added later as the system gathers additional information or expertise. If estimation is done, the possible approaches include:

- If the system has had recent improvements, such as pipe replacement, information regarding the cost per linear foot can be used.
- If a neighboring system that is similar has had work done, costs obtained in their project may be used.
- Engineering, construction and/or manufacturers that complete a large number of construction projects per year may be able to provide estimates.
- Some organizations periodically publish unit costs for construction. These costs can be used as a starting point and revised as necessary to cover costs in other areas. If costs are typically higher in a particular area, they can be raised, if costs are typically lower, the prices can be decreased.

Over time, as more systems begin completing asset management strategies, a users group can be formed that will allow wastewater utilities to share information, such as unit costs/replacement costs with each other.

- **Asset Inventory and Recordkeeping**

Once you have determined what you own, and where it is, its time to catalog that data in some format. There are many ways in which this can be done.

1. Commercially Available Asset Management Database

For larger systems with a planning budget and dedicated personnel, a software package written specifically for the purpose of Asset Management can be used. There are many types of Asset

Management software available. A simple internet search with a search engine such as Google for "Utility Asset Management Database" will point you in the right direction. Since this software is written specifically for Asset Management, it is designed to allow the input data to be searched and printed, has pre -designed reports, can track budgets and the performance of asset functions. This type of software is manufactured by a company that understands the many needs of utilities and provides customer support.

2. Database Software

Ideally, all systems would have a database to manage their asset inventory. If the software created specifically for Asset Management is not realistic, a general database software is the next best option. Many manufacturers produce database software, some are available for purchase at office goods and computer stores, some are available for purchase and download, some are available for free.

Creating a database is not typically self -explanatory. However, there are courses available for learning about databases at most colleges and some high schools that are relatively short and inexpensive. Also, many communities may have a student or someone with database knowledge that would be willing to assist with this project. Once the database is created and tested, maintaining and updating the data can be accomplished by any member of the utility. Some examples of database software that are readily available include, MySQL, Microsoft Access, Oracle, FoxPro, and Open OfficeBase.

3. Spreadsheet Software

Another method of creating an inventory, is to create a spreadsheet that lists every asset in the utility's inventory. Spreadsheet software is standard on most computers. However, there are many disadvantages to using a spreadsheet. Spreadsheets have very limited searching capabilities. Creating a spreadsheet inventory will essentially create a list of assets that can be printed. It is not as dynamic as a database and is not recommended.

4. Handwritten

If software and computers are not readily available, the utility should have a written inventory of all the assets they own. This handwritten list should be edited as the system grows and changes. A handwritten inventory is even less desirable than a spreadsheet inventory, but is better than no inventory at all.

- **Conducting and Organizing the Asset Inventory**

These are not “one time” activities; it will be important to reevaluate and update this information annually or whenever the utility’s needs change. An asset inventory should be considered a dynamic and evolving planning document that that requires continual review and modification during the course of each year. Asset inventory practices—such as maintaining an up-to-date asset inventory, periodically assessing the condition of the assets, and estimating the funds necessary to maintain the assets at an acceptable level each year is highly recommended. Utilities can refine data collection practices by training its employees on how to record data in a standard format and may choose to align their data collection with their ongoing maintenance and replacement activities. There are many options regarding how to manage the asset inventory data including commercially available software for asset inventory, generic database software, spreadsheet software and hand written inventory. The key with the inventory is to structure it to provide the information the system needs in an easy to retrieve fashion. If the data is not easily obtainable, the system will not use it and the inventory ceases to have value or as much value as it can.

2. Level of Service

Knowing your required "sustainable" level of service will help you implement an asset management program and communicate to stakeholders what you are doing. The required level of service is the basis for justifying you user rates. Quality, quantity, reliability, and environmental standards are elements that can define level of service and associated system performance goals, both short- and long-term. You can use information about customer demand, data from utility commissions or boards, and information from other stakeholders to develop your level of service requirements. Your level of service requirements can be updated to account for changes due to growth, regulatory requirements, and technology improvements.

You should ask:

- What level of service do my stakeholders and customers demand?
- What do the regulators require?
- What is my actual performance?
- What are the physical capabilities of my assets?

Best practices include:

- Analyzing current and anticipated customer demand and satisfaction with the system.
- Understanding current and anticipated regulatory requirements.
- Writing and communicating to the public a level of service "agreement" that describes your system's performance targets.
- Using level of service standards to track system performance over time.

3. Critical Assets

Because assets fail, how you manage the consequences of failure is vital. Identifying critical assets will help you make decisions about resource allocation and about maintaining or improving your sustainable level of service. Not all assets are equally important to the system's operation; some assets are highly critical to operations and others are not as critical. Furthermore, critical assets are completely system specific. Certain assets or types of assets may be critical in one location but not critical in another. A system must examine its own assets very carefully to determine which assets are critical and why. Critical assets are those you decide have a high risk of failing (old, poor condition, etc.) and major consequences if they do fail (environmental damage, public health hazards, permit violations, major expense, system failure, safety concerns, etc.). You can decide how critical each asset is and rank them accordingly. Many wastewater systems may have already accomplished this type of analysis in vulnerability assessments.

You should ask:

- How can assets fail?
- How do assets fail?
- What are the likelihoods (probabilities) and consequences of asset failure?
- What does it cost to repair the asset?
- What are the other costs (social, environmental, etc.) that are associated with asset failure?

Best practices include:

- Listing assets according to how critical they are to system operations.
- Conducting a failure analysis (root cause analysis, failure mode analysis).
- Determining the probability of failure and listing assets by failure type.
- Analyzing failure risk and consequences.
- Using asset decay curves.
- Reviewing and updating your system's vulnerability assessment (if your system has one).

- **Determining criticality**

In determining criticality, two questions are important. The first is how likely the asset is to fail and the second is the consequence if the asset does fail. Criticality has several important functions, such as allowing a system to manage its risk and aiding in determining where to spend operation and maintenance dollars and capital expenditures. As a first step in determining criticality, a system needs to look at what it knows about the likelihood that a given asset is going to fail. The data available to assist in this determination is: asset age, asset condition, failure history, historical knowledge, experiences with that type of asset in general, and knowledge regarding how that type of asset is likely to fail. An asset may be highly likely to fail if it is old, has a long history of failure, has a known failure record in other locations, and has a poor condition rating. An asset may be much less likely to fail if it is newer, is highly reliable, has little to no history of failure and has a good to excellent condition rating. The following paragraphs describe each of the components that can go into a determination of likelihood of failure. Any additional information or resources that a system has to supplement these components should be considered also.

- *Asset Age:* The asset's age can be a factor in determining likelihood of failure, but should not be a sole factor. Over time, assets deteriorate, either from use or from physical conditions such as interaction with water or soil, and are more likely to fail. There is no "magic age" at which an asset can be expected to fail. An asset's useful life is highly related to the conditions of use, the amount of maintenance, the original construction techniques, and the type of material it is constructed out of. A piece of ductile iron or cast iron pipe may last 75 to 100 years in one application, 150 years in another, and 50 years in yet another. Rather than being a sole predictor of likelihood of failure, age should be supplemental to other information. If there are no other issues with an asset than its age, the likelihood of failure can still be relatively low even if the asset is quite old. For example, if the system has a cast iron pipe in the ground that was installed well, using good materials and it has never had a history of failure, even though it is 75 years old, it does not need to have a high likelihood of failure.
- *Asset Condition:* One of the most important factors in determining an asset's likelihood of failure is the condition of the asset. As the asset's condition deteriorates, it will become much more likely to fail. It is important, therefore, to make the best attempt possible to give the assets a reasonable condition assessment. The condition assessment should also be updated over time, so that criticality can likewise be updated. Assets given a poor or fair condition rating are more likely to fail than those given an excellent

or good rating. When the asset condition is combined with other factors, the utility can begin to make predictions regarding the likelihood of a given asset failing.

- *Failure History:* It is important to monitor when assets fail and record the type of failure that occurred. This information should be as specific as possible to assist the system in understanding its failure modes. Systems should track when the asset failed (or at least when the failure was discovered), how the failure was determined (customer report, operator observation, lack of service in that part of the system, etc.), type of failure (rupture, mechanical failure, small leak), specific location of failure, and any field observations that may help explain the failure (lack of bedding sand, subsidence of soil, overheating, etc.). Systems should track failure history on all of the asset categories. Past failure is not a complete predictor of future failure, but it can provide some indication of the likelihood of future failure, especially if detailed information on the failures is collected and reviewed. If the asset failed because its construction was poor or the pipe was severely corroded, it is likely to fail again unless some action was taken to correct the problem. If the asset failed because a construction crew ruptured the pipe, it is not likely to fail again if this is the only failure the pipe had once construction in the area is completed. If a pipe has failed several times in the past few years, it would be more likely to fail. If the pipe had never failed, it would be less likely to fail.
- *Historical Knowledge:* If the system has any additional knowledge regarding the asset, it should be considered in the analysis of likelihood of failure. The type of information may include, knowledge of construction practices used in the system at the time the system was constructed or knowledge of materials used in the system.
- *General Experiences with the Asset:* Although likelihood of failure is site specific, some guidance regarding likelihood of failure can be gained by examining experience with that type of asset in general. For example, if there is a history of a certain type of pump failing frequently after 2 years of use, and a system has that type of pump and it is currently 18 months of age, the asset may be given a higher likelihood of failure than it would be if there was no general experience of this type.
- *Knowledge of How the Asset is Likely to Fail:* Failure is defined as the inability of an asset to do what its users want it to do. In that regard, asset failure can be any time the asset is not able to meet the level of service the system wants. Passive assets (such as pipes) decay over time and active assets (pumps, motors) decay with use. Passive and active assets do not fail in the same manner so they must be considered differently. In the case of passive assets, the types of considerations in failure mechanism include: soil

characteristics, groundwater level and characteristics, physical loads, bedding conditions, pipe attributes, internal corrosion, and temperature conditions. A system must examine its individual circumstances to see which of these mechanisms may be likely to be at work in its particular case. If the system is subjected to severe weather extremes, pipes may break due to freezing. If the system was installed with poor construction techniques, the pipe may fail due to poor soil support beneath the pipe or due to inadequate bedding allowing rock to contact the pipe. If the soils are highly corrosive for the pipe, the failures may be due to corrosion of the pipe wall creating holes in the pipe. Once a system understands how its assets fail when they do fail, it can determine how likely others may be to fail. In the case of active assets, failure mechanisms can be related to hours of use, amount or lack of preventative maintenance, climatic conditions, replacement of worn parts, improper alignment, and the amount of lubrication or cooling of parts. Active assets, such as pumps, may fail because they are not given proper maintenance or lubrication. The factors discussed above can be taken together to predict how likely an asset is to fail. The ability to produce a more sophisticated failure rating is dependent on the amount and quality of data available. **It may be necessary to start with a more basic analysis and then increase the sophistication over time as the system managers and operators gain more knowledge and experience regarding what information should be gathered and evaluated.** In terms of the consequence of failure, it is important to consider all of the possible costs of failure. The costs include: cost of repair, level of service impact, repair/replacement costs related to collateral damage caused by the failure, legal costs related to additional damage caused by the failure, environmental costs created by the failure, and any other associated costs or asset losses. The consequence of failure can be high if the costs of repair are significant. Further discussion of each of these factors is presented below.

1. *Cost of Repair:* When an asset fails, it will be necessary to repair the asset to restore it to the proper level of service. Depending on the type of the asset and the extent of the failure, repair may be simple or extensive. The cost repairing failed asset should be considered in the analysis of the consequence of failure. If the asset can be repaired easily and without a tremendous cost, then there is a lower consequence. If the cost of repair is higher, then the consequence of the failure is also greater.

2. *Social Costs Related to the Loss of the Asset:* When an asset fails, there may be an inconvenience to the customer. In some cases, this inconvenience may be minor, while in other cases, the social costs may be much higher. If a pipe must be repaired in a

residential area, there may be a few customers who are out of service for a short period of time. This outage would constitute an inconvenience, but would not be a severe situation. On the other hand, if repairing the failed asset requires the whole system to be shut down, the inconvenience to the customers is much greater. In the first example, the cost of the consequence of failure related to the level of service is low. In the second case where the whole system must be shut down to make the repair, the level of service is much higher.

3. *Repair/Replacement Costs Related to Collateral Damage Caused by the Failure:* When an asset fails, in some cases damage may be caused to other assets unrelated to the wastewater system. Examples of this type of damage include the following: a pipe failure occurs causing a sinkhole which then causes damage to the foundation of a building or a house or causes major sections of a road to collapse. In addition, cars may be damaged in the sinkhole. The damage from the pipe failure without the sinkhole would be fairly minimal. With the sinkhole, there is collateral damage including the road, the building or house, or cars. Another example would be a sewer pipe leak that leaks sewage into a home or yard or onto a schoolyard or playground. In this type of case, a significant amount of cleaning will be required to restore the building, house or property. The utility will be held responsible for this collateral damage, so the level of service costs related to this type of failure need to be considered.

4. *Legal Costs Related to Additional Damage Caused by Failure:* In some cases, individuals or businesses may sue the utility for damages or injuries caused by an asset failure. These costs would be in addition to the costs of repairing and replacing damaged property or other assets.

5. *Environmental Costs Related to the Failure:* Some types of asset failures can cause environmental impacts. The costs related to these impacts may not always be easy to assess in monetary terms. However, some attempt should be made to establish some type of monetary value to the environmental consequences. An example of an environmental cost related to a failure would be a sewer pipe that leaked sewage into a waterway or onto land. A value, either monetarily or qualitatively, would need to be placed on this type of consequence. A failure that could result in raw sewage being discharged into waterbodies could be given a higher consequence than a failure that would have the potential to cause a more limited environmental impact.

6. *Reduction in Level of Service* The assets must be in working order to deliver the level of service desired by the system and its customers. If the assets fail, the ability to deliver

the desired level of service may be compromised. An asset that has a major impact on the ability to meet the level of service would be considered more critical to the system than an asset whose failure would not have a significant impact on the level of service.

7. *Other Costs Associated with Failure or Loss of Asset:* The costs in this category are any other costs that can be associated with an asset failure that are not adequately defined within the categories above. Some examples costs included in this type of category include loss of confidence in the wastewater system or loss of the system's image. Other examples include: loss of income related to the inability to provide service for a period of time, loss of the service itself, or health impacts to workers or customers. In assessing the consequence or cost associated with the asset failure, the system should consider all the costs associated with all of the categories above.

- **Assessing Criticality**

Assessing criticality requires an examination of the likelihood of failure and the consequence of failure as discussed above. The assets that have the greatest likelihood of failure and the greatest consequences associated with the failure will be the assets that are the most critical. The next most critical assets will fall into three main categories:

- Assets that have a very high likelihood of failure with low consequence
- Assets that have a very high consequence with a low likelihood
- Assets that have a medium likelihood and medium consequence

The remaining assets that have low consequence and low likelihood will be the least critical assets. The worksheet on the following page can be used to determine the criticality of each of the assets. The value of probability of failure can be entered on the rows and the value of consequence can be entered on the columns. Where the rows and columns intersect, is the value for criticality of that asset. This criticality assessment is a simplistic approach that constitutes a reasonable start for a wastewater system. Over time, the criticality analysis can be more robust. Or if a system has sufficient data and resources to assess criticality in a more sophisticated way initially, it can start at a higher level than this approach.

Asset:________________
Date:_________________

Circle the row and column that matches the ranking for both probability and consequence.
Where the two intersect becomes your risk.

Multiplied		**Consequence (Cost) of Failure**				
		1	**2**	**3**	**4**	**5**
Probability of Failure	**1**	*1*	*2*	*3*	*4*	*5*
	2	*2*	*4*	*6*	*8*	*10*
	3	*3*	*6*	*9*	*12*	*15*
	4	*4*	*8*	*12*	*16*	*20*
	5	*5*	*10*	*15*	*20*	*25*

1	Very Low
2	Low
3	Moderate
4	High
5	Very High

Risk = Consequence x Probability = ____

- **Criticality Analysis Over Time**

The condition of the asset will change over time as will the consequences related to failure. Costs of repair may go up, the community may grow, new roads may be built or similar factors may occur that cause the consequence of failure to change. Therefore, it is necessary to periodically review the criticality analysis and make adjustments to account for changes in the likelihood of failure and the consequence of failure. The criticality analysis must be kept current to date to ensure that the utility is spending its time and resources on the appropriate assets as discussed in the next section. Also, the analysis must consider when assets are to be replaced. If an asset that was deemed critical due primarily because of its likelihood of failure and is replaced with a new asset, the criticality number will go down since the likelihood of failure is much less.

8. Minimum Life Cycle Cost

Knowing what minimum life cycle costs are will help your system move from a passive “fix-it-when-it-breaks” posture to an active program of preventive maintenance and timely asset replacement. Operations and maintenance (O&M), personnel, and the capital budget account for an estimated 85 percent of a typical wastewater system expenses (EPA, April 2008). Asset management enables a system to determine the lowest cost options for providing the highest level of service over time. You want to optimize the work O&M crews are doing, where they are doing it, and why. An asset management program helps make risk-based decisions by choosing the right project, at the right time, for the right reason.

You should ask:

- What alternative strategies exist for managing O&M, personnel, and capital budget accounts?
- What strategies are the most feasible for my organization?
- What are the costs of rehabilitation, repair, and replacement for critical assets?

Best practices include:

- Moving from reactive maintenance to predictive maintenance.
- Knowing the costs and benefits of rehabilitation versus replacement.
- Looking at lifecycle costs, especially for critical assets.
- Deploying resources based on asset conditions.
- Analyzing the causes of asset failure to develop specific response plans.

This component is one of the most complex of all of the components of asset management. It is difficult for a small system to gather all of the data necessary for a sophisticated analysis of life cycle costing.

- **Options for Dealing with Assets Over Time**

There are four basic options for dealing with the actual assets over time:

1. Operate and maintain the existing assets
2. Repair the assets as they fail
3. Rehabilitate the assets or schedule periodic operation and maintenance

4. Replace the assets

These options are intimately connected to each other. Choosing to do more or less of one impacts how much of the others is done, whether or not the other is done at all, or the time frame in which one of the others is done. For example, choosing to spend more on operating and maintaining assets will decrease the need to repair the asset and will extend the useful life of the asset. Choosing to rehabilitate an asset will eliminate the need to replace the asset in the short term and will increase the amount of time until the asset ultimately needs to be replaced. The rehabilitation will also reduce the amount of operation and maintenance that needs to be done and reduce the need for repairs.

Each of these options has its own costs and considerations. The expenditure of funds becomes a balance between monies spent in each of these four categories. The purpose of asset management is to try to determine the optimal way to spread the money between each of these categories, while maintaining the level of service desired.

Generally, the most expensive option is replacement of the assets. Therefore, keeping the assets in service longer, while still meeting level of service conditions, will usually be the most economical for the utility over the long term. The three other options: maintenance of the asset, repair of the asset, and rehabilitation are options that can be used to keep the asset in service longer. Each of the options is discussed further in the sections below.

- **Asset Operation and Maintenance**

Operation and maintenance (O&M) functions relate to the day -to-day running and upkeep of assets and are particularly relevant to short -lived dynamic assets (such as pumps) where deterioration through lack of regular maintenance may result in rapid failure. Properly operating and maintaining assets is critical to the success of the overall program. Operation and maintenance is directly linked to Level of Service and Critical Components. The following are some key points regarding the importance and process of establishing O&M procedures:

- Establishing standardized O&M procedures achieves maximum asset life and reduces O&M costs.
- Standardizing O&M procedures helps utility personnel to operate all assets within acceptable operational levels and ensures that each person is following the same routines.
- By standardizing the operations of all assets, maximum asset life can be obtained (assuming that periodic maintenance is performed as required).

O&M procedures can be categorized as operational, maintenance and (where applicable) laboratory. Operational procedures can be classified as:

1. Standard Operating Procedure: most common, typically used during normal operations, day-to-day;
2. Alternate Operating Procedure: Used when operational conditions require that an asset or process be modified or taken off -line, scheduled, periodic; and
3. Emergency Operating Procedure: used in emergency conditions, incorporated into overall emergency plan developed for facility.

Maintenance procedures can be classified as:

1. Corrective Maintenance Procedures: used by field technicians for the breakdown and repair of assets that are malfunctioning (e.g., replace broken bearing);
2. Preventative Maintenance Procedures: developed to prevent breakdown and prolong asset life (lubrication or overhaul); and
3. Reliability-centered Maintenance Procedures: developed to assist maintenance managers in predicting asset failures and lessening effects on facilities (asset condition monitoring or failure modes and effects analyses).

Laboratory procedures can be classified as:

1. Equipment-related Procedures: developed on the basis of how to operate the equipment and what maintenance and/or calibration the equipment requires; and
2. Sampling-related Procedures: developed around sampling routines and specify to the laboratory technician when, where, and how samples should be taken.

Several choices exist for who develops O&M procedures.

1. New facilities or assets: engineering firm or designer, supply vendors, contract professional technical writer; and
2. Existing facilities or assets: existing staff, technical writer.

In order to develop O&M procedures the reference materials must be located. Reference materials include O&M Manuals, process and instrumentation drawings, vendor submittals, specifications, pictures, design data, design drawings, as-built drawings, and interviews with experienced staff.

Developing operational procedures includes:

1. Titling the procedure appropriately, so it is easily identified.
2. Introduction: lists associated information such as the reason for the procedure, responsible parties, desired outcomes, safety procedures, special equipment requirements and notification requirements
3. Steps and/or Activities: Step 1, Shut power off at the breaker located on the south wall labeled Pump #1
4. Note any cautions or hazardous conditions with each step or activity before the activity is performed

Maintenance procedures are generally developed using vendor-supplied information. Using a template with fields for the vendor to complete, such as the Work Maintenance Management System (WMMS), has proven successful for many utilities.

Two factors can adversely affect the development of procedures.

1. Costs. The costs of developing procedures in a new facility are typically covered in the capital improvement plan (CIP) budget. If this budget is limited, facility managers must determine which procedures are critical and work with their staff and an outside source, if needed, to develop the critical procedures first. Remaining procedures can then be spread out over time to minimize budgetary effects.
2. Time. The other key factor is time. For an existing facility where staff may already be stretched thin, it becomes impractical to include the development of O&M procedures into daily routines. The use of a third-party O&M group, or even a dedicated staff member can reduce the time requirements on the O&M staff while developing procedures.

The benefits of developing and implementing effective and useful O&M procedures far outweigh the effects on the facility and staff. If standard procedures are not implemented system wide, O&M procedures will be created on an ad-hoc basis, which can lead to fluctuations in process efficiencies, discord between operations and maintenance, increased asset downtime, wasting of chemicals and energy, and other similar problems.

The greatest reward for developing O&M procedures is that all operations activities, maintenance activities, and laboratory activities are backed by management and standardized across all shifts by all personnel. This ensures management consistency of personnel activities, product quality, and O&M costs. The application of standardized maintenance procedures can reduce asset downtime and ensure lifetime productivity. The application of standardized laboratory procedures is essential for a good quality- assurance/quality-control program.

- **Operation and Maintenance and Critical Assets**

One of the purposes for identifying critical assets is to allow the utility to make more informed decisions regarding the use of its operation and maintenance dollars. As discussed previously, the most critical assets are those assets that are likely to fail and have a significant consequence if they do fail. Therefore, it is most advantageous to the utility to spend the greatest portion of its operation and maintenance budget on assets that are critical to the overall operation of the utility. These assets have the greatest chance of costing the utility money if they fail.

- **Repair of Assets**

In addition to operating and maintaining the assets, systems will need to plan for the repair of assets as they fail. Systems need to consider how long they will keep an asset in service prior to replacement of the asset. To some extent, repair and replacement items are off-setting. If more resources (personnel and money) are spent on repair, there will be a decreased need for replacement. On the other hand, if greater resources are applied to replacing the assets, fewer resources will be applied to repair. There is a balance between how much to spend in each category: maintenance, repair, and replacement to achieve the most efficient system. As an example, consider a car. If a new car is purchased every year, the car's owner will probably spend little to nothing on repair but will have an extremely high cost of purchase. If another owner decides to keep his car and repair everything that breaks on the car in order to keep it running, this owner will have a very low bill for replacement cost but will have a very high repair bill. Most likely, the repair bill will significantly increase over time as the car ages. Neither of these extremes would be the most cost effective approach to owning and operating a car. In the first case, the replacement cost is too high and in the second case, the repair costs are too high. The most efficient approach would lie in between these extremes, with repair taking place until costs are prohibitive at which point the asset – the car – would be replaced. In developing a wastewater system repair schedule, the utility must determine its own approach to repairing verses replacing assets. The utility will need to decide when it is spending more money (including personnel hours) to repair the asset than it would cost to replace the asset.

- **Rehabilitation of Assets**

When an asset fails, or approaches failure, the typical thought process is that of replacing the asset with a new asset. There is another option for some wastewater system assets; assets may be rehabilitated rather than an outright replacement. Rehabilitation brings the assets back to a useable condition without actually replacing them. In many cases, it may be cheaper to rehabilitate the asset rather than replacing it, it may extend the useful life span of the asset considerably and may reduce other impacts related to asset replacement. An example of a rehabilitation approach is slip lining wastewater pipes that are nearing the end of their useful life. The pipe can be lined without having to dig the original pipe out of the ground, thus possibly reducing the costs of installation and the inconvenience of the construction.

- **Replacement of Assets**

Eventually, all assets will need to be replaced. They will reach a point where the asset can no longer be kept in service through maintenance or repair or where the asset is no longer capable of meeting the desired level of service. At that point, the asset will need to be replaced. Replaced assets can either be part of a replacement schedule or a capital improvement plan. In both cases, the assets are replaced. The main difference is that the replacement schedule includes those items that are routinely replaced, smaller dollar replacements, and items replaced using the wastewater system revenues or reserve funds. The capital improvement plan identifies major expenditure items that do not routinely occur and generally require outside funding for at least a portion of the project. Further information regarding each of these types of replacements is presented below.

- **Replacement Schedule**

A replacement schedule should be developed that indicates those assets that will be replaced within the planning period that will be funded out of system revenues. The schedule will contain assets that are smaller dollar amount or routinely recurring and should include assets that will be paid for out of system revenues. An example of this type of asset is a pump station. This schedule can also be expanded to include programmed maintenance or repair, making it a repair and replacement schedule. The types of activities that can be included here are major, programmed repair elements, such as annual inspections and overhauls or inflow and infiltration detection every 3 years. This schedule does not replace the operation and maintenance schedules discussed above. It merely reflects those elements that are major budget items and that will occur routinely, but much less often than daily, weekly, or monthly. These are generally items that are annually or greater in schedule and that constitute a major budget expenditure. The schedule should include all of the recurring and non-recurring items for a planning period. The Repair and Replacement Schedule should be updated annually.

The type of information to include on a Repair and Replacement Schedule includes:

1. Year

2. Item
3. Description
4. Estimated Cost
5. Method of Estimation
6. One time or Recurring
7. Time Period of Reoccurrence

It is absolutely critical that the items in the Repair and Replacement Schedule be entered into the rate setting process. These items must be funded out of system revenues, so they must be accounted for in the annual budget and in the rates. The Schedule will probably not be uniform from year to year in terms of amount of expenditure. To address this issue, the system may wish to set an annual annuity payment to cover the Repair and Replacement Schedule expenses over the long term. Some years, the payment would be greater than that year's expenses, so money would go into a Repair and Replacement Reserve. Other times, the amount collected would be less than required so the additional funds would come from the reserve account. The annual annuity set would have to be sufficient to cover all of the expenses over the period. It may need to be increased over time if expenses increase and it can be decreased if it turns out too much money was dedicated to this purpose.

- **Capital Improvement Planning (CIP)**

A long-term capital improvement plan should look at the utility's needs for the future. Ideally, the planning period would be at least 20 years, with a minimum of 5 years. It is understood that the specific expenditures and needs of the utility in the latter years, say 15 to 20 years, are more speculative than the needs for the first 5 to 10 years, particularly the first 5 years. However, the inclusion of the needs for this longer time period will provide a better opportunity for the wastewater system to plan for its capital needs. There are several categories of capital improvements that must be considered. The categories are listed below.

1. **Capital Needs Related to Future/Upcoming Regulations:** The state and federal regulatory agencies periodically issue new rules and regulations that may require wastewater systems to invest in new technologies to meet the requirements. The capital needs may be related to treatment facilities, distribution system changes, connections with other sources, development of new sources, or any other type of capital project to meet the standard. Systems ought to be aware of upcoming

regulations and consider the costs that may be associated with compliance so that money can be set aside to help pay the costs.

2. **Capital Needs Related to Major Asset Replacement:** Some assets can be repaired within the repair and replacement schedule, while others will be major expenditures that will have to be replaced under the capital improvements program. Assets such as storage tanks, treatment facilities, and major portions of the collection system could fall into this category.
3. **Capital Needs Related to System Expansion:** Over time, the system may expand due to growth in the area or through serving customers who were previously on on-site systems. This type of expansion may involve new collection pipes or advanced treatment.
4. **Capital Needs Related to System Consolidation or Regionalization:** Some systems may find it advantageous to consolidate or regionalize with other nearby systems. In some cases, this type of regionalization may involve additional assets, such as collection or treatment facilities.
5. **Capital Needs Related to Improved Technology:** Systems may wish to replace assets because the technology of the assets originally installed is out of date and needs to be modernized or because technology improvements will allow improved customer service or enhanced efficiencies. An example of this type of capital needs is a SCADA system that electronically monitors the system's operations. System managers need to consider all of these types of needs when developing a long term Capital Improvement Plan. Each item needed by the system for each of the applicable categories for a planning year time horizon needs to be identified. At a minimum, the following information should be identified for each item:

- Description of the project
- Brief statement regarding the need for the project
- Year project needed
- Is the year needed flexible or absolute
- Estimate of capital project cost
- How costs were estimated
- Funding source(s) considered/available for this type of project

- o Changes in overall operations that may occur as a result of the project (include operator requirements, additional O&M costs, regulatory changes, any efficiency that may be gained, etc.)
- o Impact of the project on level of service

As stated previously, the CIP should cover a planning period. It should be updated regularly. If there are no needs in a particular year, the CIP can reflect this. Some of the expenses related to capital improvements may be funded out of the system's revenues rather than solely outside sources. If system revenues are to be used either to offset costs or as a debt repayment stream, the budgets and rates must reflect the costs.

- **Annual Review of Asset Replacement Projects**

Asset replacement projects will be included in the Repair and Replacement Schedule and the Capital Improvement Plan. It is a good idea to review both of these documents on an annual basis to determine if all of the listed projects are indeed necessary. Sometimes another look at the project list may reveal that some projects can safely be pushed back for several years or may not be needed due to changing conditions. The projects were projected out several years in advance, so conditions may have changed eliminating or reducing the need for the project. Alternatively, the projects may also have changed in terms of specifically what technology or approach is best. As an example, the system may have anticipated growth in a certain area and budgeted for line extensions into that area 10 years into the future. However, over time, it may turn out that development did not occur or the patterns were different than expected. The collection line project can then be eliminated from the budget. The types of questions to examine in the completion of this type of review include the following:

1. Is the reason/need for the project still valid?
2. Have the costs changed since originally projected?
3. Is there a better approach or a better technology that can be used to address the need?
4. Can the project be safely delayed?
5. Does the project need to be completed sooner?
6. Is there a method of rehabilitation that could be used rather than replacement to save costs?
7. Would it be more reasonable to reduce the level of service than increase the asset's capability?

8. Will funding be available for the project?

The overall repair and replacement schedule and Capital Improvement Plan should be revised to reflect regularly completion of the current year projects or the new completion schedule for those, any changes to the list of projects, and to add the additional years at the end of the project period to keep the list up.

9. Long-term Funding Plan

Developing an effective long-term funding strategy is critical to the implementation of an asset management program. Knowing the full costs and revenues generated by your wastewater system will enable you to determine your system's financial forecast. Your system's financial forecast can then help you decide what changes need to be made to your system's long-term funding strategy.

You should ask:

- Do we have enough funding to maintain our assets for our required level of service?
- Is the current rate structure sufficient for the system's long-term needs?

Some strategies to consider:

- Adjusting the rate structure.
- Funding a dedicated reserve from current revenues (i.e., creating an asset annuity).
- Financing asset rehabilitation, repair, and replacement through borrowing or other financial assistance.

The sources of funding for the overall operation and maintenance of a wastewater system, including asset repair, replacement, and rehabilitation include the following:

1. System revenues from:

- User fees
- Hook up fees
- Late fees
- Penalties
- Reconnect charges
- Developer impact fees

2. System reserve funds

- Emergency reserves
- Capital improvement reserves
- Debt reserves

3. System generated replacement funds:

- Bonds
- Taxes

4. Non-System revenues:

- State grants
- State loans
- Federal grants
- Federal loans
- State or federal loan/grant combinations
- **Rates and Asset Management**

System revenues are a major component of an asset management plan. The system revenues will fund the operation and maintenance of the system; generally there are no outside funding sources for routine operation and maintenance of a wastewater utility. In addition, the rates will need to fund reserve accounts for emergencies, repairs, and debt coverage (for any loans.) A well developed rate structure will take into account needs for the wastewater system for the current year as well as needs for the wastewater system in future years, through reserve accounts. For example, if the wastewater system is anticipating a new regulation that will require additional treatment, the system should be collecting money through the rates to help pay for the needed equipment. The rate structure should also anticipate routine replacements of parts, particularly those parts that wear out regularly. For example, if the system replaces its screen every 5 years, the rates should cover this expense, rather than seeking state or federal funding to cover these types of needs. If a system engages in asset management as it sets rates, the rates may increase as the system moves from traditionally being underfunded (i.e., collecting insufficient revenues to cover all expenses) to being properly funded. However, rates that are set based on sound asset management principles are very defensible to the public. Asset management brings transparency to the process so that it is clear what the rate is based on. The more clearly the rate can be defended, the more likely it is to be accepted by the public. There are many sources of rate setting assistance, including trainings and free rate setting programs. Any approach that includes all costs of operation, considers the long-term view, includes reserve accounts, and considers conservation or other utility goals is acceptable.

The objective in preparing long-term financial forecasts is to outline the organization's future financial requirements based on all information relating to asset creation, maintenance, renewal/rehabilitation and disposals. Three questions must be answered when preparing the strategy:

1. What funds are needed to acquire, operate, maintain and renew the asset?
2. When will the funds be required?
3. How do these types of funds affect the utilities rates?

There are five types of expenditures that a utility needs to plan for. Each type of expenditure has a typical funding source associated with it as well.

Expenditures and Funding

Expenditure Type	**Description Funding**	**Source**
Operational	Activities which have no effect on asset condition but are necessary to keep the asset utilized appropriately (i.e. power costs, overhead costs, etc.).	Annual Budget, Rates, Revenue
Maintenance	The ongoing day-to-day work required to keep assets operating at required service levels (i.e. repairs, minor replacements).	Annual Budget, Rates, Revenue
Renewal	Significant work that restores or replaces an existing asset towards its original size, condition or capacity.	Annual Budget, Rates, Revenue, Grants, Loans
New Work, Development (e.g., tap-on fees, impact fees, etc), Capital Projects	Works to create a new asset, or to upgrade or improve an existing asset beyond its original capacity or performance, in response to changes in usage, customer expectations, or anticipated future need.	Annual Budget, Rates, Revenue, Grants, Loans
Disposal	Any costs associated with the disposal of a decommissioned asset.	Annual Budget, Rates, Revenue

Section 2: Implementing Asset Management- Follow-up and Continuing Steps

The five core questions framework for asset management is the starting point for asset management. Beyond planning, asset management should be implemented to achieve continual improvements through a series of "plan, do, check, act" steps.

- Plan: Five core questions framework (short-term), revise asset management plan (long-term).
- Do: Implement asset management program.
- Check: Evaluate progress, changing factors and new best practices.
- Act: Take action based on review results.

A system should be able to jump right into asset management and start doing it without a tremendous amount of preparation or resources. Over time, a system will increasingly improve its asset management program and will increase its knowledge base and the quality of its data. A system may wish to increase its level of sophistication and may input a greater degree of resources, personnel or money, as it improves over time. However, the most important thing is for a system to get started on a more systematic manner of operating its utility.

Asset management is firmly rooted in common sense and good business practices. As such, any activities the system undertakes in the area of asset management will improve the system's overall operation. The more sophisticated and cohesive the program, the more improvement, but improvement will occur even at a lower level of asset management activity.

Utilities do not need to worry about making mistakes with asset management. Asset management is meant to be on-going and improved over time. If the program is not working properly or needs to be changed, the system can change it.

- **The Sustainable Process**

As such, as long as the system is operational, the system should be engaged in asset management. The system must view this process as never ending. The asset management program should improve and change over time, as the system' s needs change but it will never be something that is "complete" and should not be thought of in that way.

- **The Asset Management Plan**

The system may wish to compile its approaches to asset management into a single document discussing each element and how that is handled. However, the document must be flexible and should contain an explanation of how the system is doing each component, not the actual data obtained from each component. The actual data should be in a format that is continually changeable (e.g., computer data base, map that can be drawn on, etc.)

The Asset Management Plan should be thought of as a “road map” to explain how the system is going to develop and implement each component and how the system will continue with asset management over the long-term, but should not be thought of as “the answer.”

The Asset Management Plan should also be written in such a way that all levels of the organization can make use of it. It can also be made available on the web to customers of the organization. The document provides information to the customers on exactly how the system is being run and creates more confidence in the proper operation of the system and the applicability of the rates that are charged.

The data that is part of the Asset Management Plan should be updated continually as the system performs its operational duties (e.g., as breaks are repaired information is gathered.) This type of updating should not require the overall plan to be revised. The Asset Management Plan should be reviewed periodically (annually or biannually or perhaps every 3 years) to determine if the overall methodology used for each component has changed in any way. If so, the document should be revised and redistributed. If not, the document can be left in its current status until the next review.

The Asset Management Plan document does not need to be lengthy. The goal is to make it easy to understand and useable by the employees or volunteer members for the utility.

Section 3: Building an Asset Management Team

This section is meant to provide understanding regarding how forming and having a team can help your wastewater system successfully implement an asset management program and assemble a successful asset management team. Asset management requires:

- Support and involvement of local officials who have the authority and willingness to commit public resources and personnel to maintain community assets.
- A commitment of time and money to make cost-effective asset decisions (spending some money in the short-term to save more money over the long-term).
- A team made up of key decision makers.

1. Making the Commitment

Asset management requires an investment in time and resources. Asset management is not a 1-year project, or even a 5-year project. It is a continual, fundamental change in the way infrastructure assets are managed. Successful asset management programs are characterized by a commitment to:

- Spending time and money to implement the program.
- Focusing on making cost-effective asset decisions.
- Providing a sustainable level of customer service for the community.

To achieve this level of commitment, asset management is implemented by a team that is:

- Supported by political leaders who have the authority and willingness to commit public resources and personnel.
- Made up of key decision makers who represent the departments involved with asset management.

2. Creating and Maintaining an Asset Management Culture

Thinking about your assets differently can be the first step towards having a sustainable wastewater system. With the limited resources of most systems, shifting away from reacting to events and towards making strategic plans can lead to real savings. Asset management focuses on the long-term life cycle of an asset and its sustained performance, not on the day-to-day aspects of the asset. It involves a shift in a wastewater system's philosophy characterized by:

- Changing the management culture.

- Understanding that all asset decisions are investment decisions.
- Focusing on continual improvement driven by results (sustainability).

Changing the culture requires champions who use a team approach to promote and articulate the benefits of asset management. The champions are the motivating force behind the team that can consist of operators, managers, elected officials, and stakeholders. Each team member fulfills a role and function in implementing an effective asset management program.

3. Components of a Successful Asset Management Team

The composition of the team should have the authority and resources to answer the core questions that lead to asset investment decisions. An asset management team:

- Is flexible and encourages critical thinking.
- Creates opportunities for sharing ideas and information through open and transparent debate.
- Works through problems and shares the success, not the blame.
- Fosters an atmosphere that builds trust and develops partnerships.
- Uses existing elements of asset management as a basis for the program.
- Starts implementation during planning to achieve early gains.

The following section describes the personnel, departments, and organizations that are good candidates for an asset management team; however, highly effective teams can consist of as few as two members. In the case of a very small system, there may be only one person who will implement an asset management program. Do not let the size of your team prevent you from getting started. The team approach works because it brings together the right people to coordinate and drive asset management activities.

Key Team Members	**Role and Knowledge Base**
Wastewater system operators and engineers (including upper management)	• Knowledge of the current state of wastewater system assets. • Ability to describe the costs and benefits of changes to infrastructure assets. • Experience with the current capital improvement plan and the operations and maintenance strategy.
Local and elected officials (e.g., mayor, county judge	• Authority to commit resources. • Knowledge of the political landscape.

executives, councils)	• Ability to create new financing mechanisms.
Accountants	• Ability to help estimate the replacement cost of assets. • Knowledge of the existing financing strategy, potential financial resources and challenges, and the need for rate changes.
IT Specialist (e.g., Area Development Districts)	• Ability to determine the most practical way to collect, store, and present the information needed to make strategic decisions.
Treasurer	• Ability to implement new financing mechanisms (e.g., bonds, loans, and other debt instruments) and create dedicated reserve accounts.
Other Relevant Departments and Stakeholders	
Other infrastructure managers and utilities (e.g., roads, sewers, and electric)	• Ability to coordinate activities that affect multiple infrastructure sectors and help establish new opportunities for collaboration.
Neighboring water and wastewater districts	• Share lessons learned, exchange best practices, and enter into new collaborative efforts. Regional and national experts can share innovative ways on how other water systems have overcome their challenges.
Community members	• Knowledge of current and future service expectations. • Ability to reinvest in shared assets. • Desire to preserve the community's assets as the ultimate beneficiaries of a sustainable water service.