VILLAGE OF WATERBURY ASSET MANAGEMENT PILOT

Linking CUPSS with GIS for Asset Management

The Vermont Agency of Natural Resources and the Village of Waterbury, a small drinking water system, collaborated on an asset management pilot project. The goal of the pilot was to populate CUPSS, the EPA-developed asset management program, using ArcGIS for a more efficient way to enter many hundreds to thousands of assets. The use of GIS to spatially locate and attribute assets for use in CUPSS has never been done successfully. The effort was successful, but not without challenges.

Executive Summary

In June 2012, the Vermont Agency of Natural Resources and the Village of Waterbury collaborated on an asset management pilot project. A great deal was gained from implementing an asset management (AM) program at a medium-sized Vermont drinking water system, though small by national standards. Throughout this process, the asset management team, consisting of state employees, water system operator, public works director, town manager, and others, had to overcome a number of hurdles from data collection to software programs to communication in order to ultimately reach the goal of implementing an asset management program for the Village. Lessons learned from this project will help inform the future direction of an AM program for water and wastewater systems in Vermont.

Using a combination of resources, including the 10-step process combined with the 5 core questions of AM, we worked with the Village of Waterbury drinking water system to create an AM program. We modified this process for our own purposes, breaking it into 6 phases. After the Village agreed to the MOU and a temp employee was hired to lead this project, the first phase was to meet with system managers and operators to create an AM team and discuss the feasibility of the project. The data acquisition and entry phase was the most time consuming and daunting part of the process. Within this phase, there were several steps including: obtaining and digitizing record drawings of water assets; manual collection of assets within the treatment plant; GPS verification of digitized assets; assessing the value and condition of assets; and, finally, uploading the data to the CUPSS program. Next it took approximately two months to assess the value and condition of the assets and fill in any missing information in the database. Concurrent with the data collection, verification and valuation step, was to discuss Waterbury's level of service (LOS) agreement. Another significant phase of the project was, after the majority of assets were entered into CUPSS, TeAM met to discuss asset risk ranking. One of the benefits of an AM program is the generation of a risk rating table, ranking assets from most critical to least. The next phase involved collecting and inputting financial information into the CUPSS program. In the final phase of the project, we met with the entire TeAM to transfer the final database over to the system and train them to use the CUPSS program.

In the end, the result is a database of over 2700 assets and their associated condition, location, and cost. This is a huge advantage to the Village of Waterbury both from a maintenance standpoint and from a financial standpoint. We also included the GIS data which will allow their Town Planner to produce maps and utilize the spatial data.

One of the main outcomes of this project was that we learned a great deal about what it is like to implement an asset management program at a small community water system in Vermont. While we felt this project was successful, there are some lessons learned that will inform the direction of an AM program in Vermont. The main lesson learned from this project concerned the difficulties associated with creating a link between ArcGIS and CUPSS. Linking GIS and CUPSS has never been done or even, to our knowledge, tried, so we were attempting something many people nationally, including EPA, are very interested in. Additionally, significant thought should go into determining which asset management system is best for the utility prior to starting an AM program. Along with determining the appropriate asset management program, there is a need to determine exactly which assets the utility would like to manage. The information should be useful, but at the same time it should be manageable. Another

important lesson learned through this process was that the more involvement and ownership the utility has, the better the process will work and the more vested they will be using the program. One final lesson learned from doing this project was to start small. It is very easy to become overwhelmed with the detailed upfront data collection phase.

A change in the way water and wastewater utilities in Vermont think about their financial management is desperately needed. There is a necessity to help these systems become more financially independent, establish better funding strategies, and more efficiently use their limited resources. We, as a state agency can act as a catalyst in moving this effort forward. There is significant interest in asset management systems throughout the country as evidenced by the thousands of CUPSS users throughout the nation and the interest expressed by numerous local, regional and national organizations that have asked us to speak about our experience with this project.

Now that the project is complete, we have a much better idea of the process and the work it takes to implement an asset management program at a small Vermont drinking water utility. Although projects in the future may not have as much direct state involvement, it will be much easier for us to offer technical assistance to municipalities who wish to implement an asset management program.

Village of Waterbury Asset Management Pilot Project

Purpose

The purpose of this document is to provide an overview of the Waterbury asset management (AM) pilot project. A great deal was gained from implementing an asset management program at a medium-sized Vermont drinking water system, though small by national standards. Throughout this process, the asset management team, consisting of state employees, water system operator, public works director, town manager, and others, had to overcome a number of hurdles from data collection to software programs to communication in order to ultimately reach the goal of implementing an asset management program for the Village. Lessons learned from this project will help inform the future direction of an AM program for water and wastewater systems in Vermont.

Background

What is asset management?

The Environmental Protection Agency (EPA) defines asset management as "a process for maintaining a desired level of customer service at the best appropriate cost". It is designed to aid water and wastewater systems in making decisions for how to most efficiently use their limited resources. An asset management program is developed to minimize the total cost of asset ownership by helping to determine when to repair, rehabilitate or replace the asset. The average life of the asset, along with its replacement costs are taken into account when making these choices. Managing hundreds, sometimes thousands, of assets is a daunting task. Many systems will simply wait for an asset to fail before it is replaced. This is not always the best method. Unexpected failures can lead to large debts for a small system. The development of an asset management program will inform the system when certain repairs or maintenance are needed and assist in developing a long-term funding strategy for larger assets.

There are 5 core questions that are generally accepted as part of the asset management process. Figure 1 below shows the 5 core questions along with follow-up questions. These 5 questions are translated into an AM process that hopefully leads to a more efficient and cost-effective management system for utilities, and thus happier customers.

The first step in the process involves compiling data to create an asset inventory which describes each asset's location, age, condition, cost and size among other things. This step can take a significant amount of time but it is one of the most important steps because it informs each subsequent part of the process.

The second step is to develop a level of service agreement which outlines how a system will maintain health and safety, comply with federal and state regulations, address customer concerns, manage costs, and preserve asset condition. Communicating these standards to customers and regulators will help to maintain a high quality of service while continuing to manage costs.

The next step involves determining which assets are the most critical using their likelihood of failure and cost. Once these are identified, a list with assets ranked by risk, highest to lowest, is generated. The system can use this list to determine which assets are the most critical to the system and at the highest risk of failure in order to optimize the useful life of their assets.

Finally, the system managers, including operators and governing boards, can use this information to develop a long-term funding strategy. With the asset management program in place, managers will be able to look 10 or more years into the future and begin planning for larger capital improvement projects. This will result in less emergency situations and more thoughtful, planned replacement of infrastructure.

Why is asset management important and what are the benefits?

Due to changing technical, managerial and financial conditions in water and wastewater industries, there is an increasing need for utilities to be proactive in setting up a long-term management plan. For instance, problems can occur when a community experiences significant increases or decreases in its population, or when more strict governmental regulations are put in place. Many utilities are facing challenges with an aging infrastructure originally constructed 40, 50, even 100, years ago. These issues combined with a loss of knowledge from personnel retirements, and public resistance to rate increases, results in a growing need to make every dollar count.

1. What is the current state of my assets?
   - What do I own?
   - Where is it?
   - What condition is it in? What is its performance?
   - What is its remaining useful life?
   - What is its remaining economic value?
2. What is my required level of service (LOS)?
   - What is the demand for my services by my stakeholders?
   - What do regulators require?
   - What is my actual performance?
3. Which assets are critical to sustained performance?
   - How does it fail? How can it fail?
   - What is the likelihood of failure?
   - What does it cost to repair?
   - What are the consequences of failure?
4. What are my best O&M and CIP investment strategies?
   - What alternative management options exist?
   - Which are the most feasible for my organization?
5. What is my best long-term funding strategy?

Figure 1. The 5 Core Questions of Asset Management

Initiating an AM program will result in a multitude of benefits for the utility and their customers. It can result in increased knowledge of the location of assets, more efficient operations, an improved emergency response for customers, and better communication with customers (New Mexico Environmental Finance Center, 2006). Asset management can increase a utilities' confidence in decision-making over the life of each asset resulting in a lower overall cost of ownership. This saves the utility, as well as the customer, money. Using concrete numbers for the replacement cost and expected useful life of assets not only will increase confidence in deciding which capital improvement projects need to be done and when, but **will also justify the need for investment to the governing body and public**. While the initial process may take a substantial amount of time and effort, the long-term benefits gained from moving through this process greatly outweigh the drawbacks.

The Waterbury Pilot Project

Why we began this project in Vermont

The idea to do a pilot project here in Vermont came after attending an asset management workshop in 2007. Vermont's experiences working with many loan recipients revealed a significant lack of financial IQ, especially for the small or medium-sized water systems; and almost no systems formally conducting asset management. There are many systems that come to the funding program for significant system repairs that could have been managed better had AM been utilized. The fact is, all assets fail. Many operators, and water boards, are thinking about immediate system needs but are not spending much time thinking about long-term capital investments. Although this concept of long-term planning for larger utilities is an industry accepted standard in other parts of the US, as well as in other countries worldwide (particularly in Australia and New Zealand), it is not a widely used practice in Vermont for any sized system (Albee and Rose, 2012). There is a growing need to help Vermont systems become more financially independent and more efficient with their limited funds. There was also need to determine which AM tools would be appropriate for VT system to use given our systems are much smaller than the national average.

In the FY2009 Intended Use Plan (IUP) the Drinking Water and Groundwater Protection Division (DWGWPD) set aside $40,000 to conduct this pilot. The funds were designed to hire a temporary employee to work with the Village, purchase GPS equipment that would work for the project and potentially purchase a laptop for the Village. In early 2012, the pilot started to come together after a number of delays, including flooding from Tropical Storm Irene in the summer of 2011 of the Village's downtown. Flooding also included State offices, among them the Drinking Water and Groundwater Protection Division (DWGWPD). Once the Memorandum of Understanding (MOU) with the Village was signed, the DWGWPD hired a temp and began work on the pilot in June of 2012.

The DWGWPD chose to work with the Village of Waterbury for many reasons, the most important being their willingness to participate in this pilot. Waterbury had the advantage of being a medium-sized community water system, with relatively good records, and used both groundwater and surface water sources. The Village hoped to get a GIS map of their system as they use GIS for town-wide planning efforts. Additionally, they anticipated some retirements within the next couple of years and wanted to get that 'institutional knowledge' out of their heads and into a database. They also acknowledged that the system has some changing demographics and needed to address those needs. We, as the newly formed AM team, went into this project with the idea that this would be a big project and that we would provide as much assistance as necessary to complete the project. One of the goals of the pilot was to determine what it would be like for utilities to move through the entire asset management process.

We also wanted to test the applicability of EPA's free asset management computer program called Check-Up Program for Small Systems, or CUPSS ("Basic Information"). This software was designed for small to medium-sized water and wastewater utilities to provide a comprehensive management of a system's physical assets, daily O&M tasks and finances. The program has a user friendly interface and does not require an internet connection which is ideal for many Vermont utilities.

CUPSS, however, does have some drawbacks. Because it is user-friendly, there is not a lot of flexibility with how to input and export data. This can make it difficult to work with and manipulate large datasets. It also does not easily link with mapping programs such as ArcGIS. These issues came to a head in the midst of our pilot project and they will be discussed in the Lessons Learned section below.

Project steps overview

Using a combination of resources, including the 10-step process combined with the 5 core questions of AM shown in Figure 2 (Albee and Rose), we worked with the Village of Waterbury drinking water system to create an AM program. We modified this process for our own purposes, breaking it into 6 phases. After the Village agreed to the MOU and a temp employee was hired to lead this project, the first phase was to meet with system managers and operators to create an AM team and discuss the feasibility of the project. Team Asset Management, or TeAM as it was later called, was formed at the first meeting in Waterbury which included the temp, and 1-3 other state employees, the water system operator, public works director, town manager and a few others. The majority of the project was completed over a period of 8 months, from June 2012, to February 2013.

The data acquisition and entry phase was the most time consuming and daunting part of the process. Within this phase, there were several steps including: obtaining and digitizing record drawings of water assets; manual collection of assets within the treatment plant; GPS verification of digitized assets; assessing the value and condition of assets; and, finally, uploading the data to the CUPSS program. Each asset that was collected had to have certain attributes associated with it that corresponded with what CUPSS requires. The initial digitization of approximately 185 record drawings and their field verification along with the manual collection of over 200 vertical plant assets, took about 3 months of tedious effort.

Next it took approximately two months to assess the value and condition of the assets and fill in any missing information in the database. During this period, we had regular meetings with the water system to ask questions about newer improvements and to determine how they wanted their assets entered. Upload of the dataset was pushed back to the end of the project because we learned that once the data is in the CUPSS there is limited editing capability within the program. After doing a number of test uploads to determine what would make the dataset satisfactory, we then applied that knowledge to the remaining datasets.

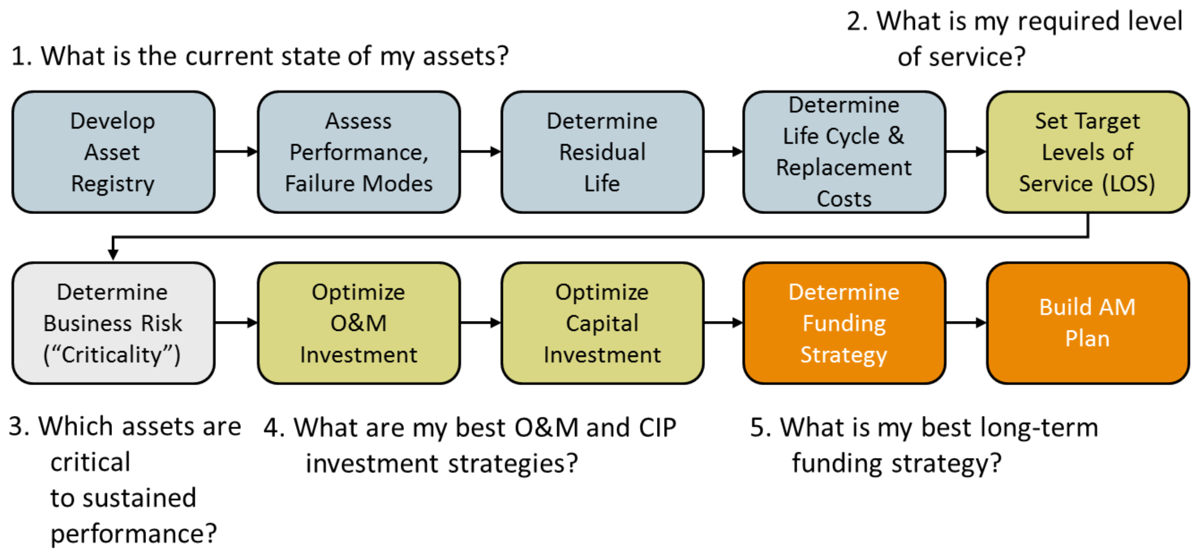

Figure 2. The integration of the 5 Core Questions with the 10 Step Process of asset management (Albee and Rose, 2012)

Concurrent with the data collection, verification and valuation step, was to discuss Waterbury's level of service (LOS) agreement. This meant asking the operators and managers to discuss which services they would be able to provide to customers and regulators alike. This process was helped along by the creation of a LOS worksheet which included an example LOS goals and how often they would be measured (see appendix A). After a few weeks of deliberation on their own, DWGWPD met with them to finalize these goals and were able to write them into the final asset management plan.

Another significant phase of the project was, after the majority of assets were entered into CUPSS, TeAM met to discuss asset risk ranking. One of the benefits of an AM program is the generation of a risk rating table, ranking assets from most critical to least. This table takes data entered for each asset such as age, condition, estimated useful life, consequence of failure, etc., to determine a risk rating—low, moderate, high—which will then influence that asset's ranking and its recommended replacement date. There is some ability of affect the risk rating, but if assets are truthfully attributed, the risk rating should be accurate. When we met with TeAM to get their thoughts on what they felt were their highest risk assets they ended up being very different from what CUPSS projected. This was an eye opening moment, especially for the Town Manager. TeAM then discussed some of the ways to refine the list, but ultimately, it is what it is.

The next phase involved collecting and inputting financial information into the CUPSS program. There were certain aspects of the plan that required input and information from the water system bookkeeper. This delayed the project at some points while the system gathered the information we requested. Once the financial information from the previous year was supplied, we were able to enter it into CUPSS quickly. The tricky part of entering this information was that it needed to be split into the categories CUPSS provided, which isn't necessarily consistent with the way the system categorizes their finances. Once the financial data was input, CUPSS provided an analysis of the utilities finances, projecting expenses and revenues for the coming decade or more. It struck a chord with the AM team when they saw the amount of money required to maintain their assets based on the CUPSS data.

In the final phase of the project, we met with the entire TeAM to transfer the final database over to the system and train them to use the CUPSS program. We discussed with the Village where they wanted to manage the data and they decided they wanted it on a separate machine from their SCADA system. Having a separate computer, such as a laptop, will enable the Village to work closely with the finance department to enter information and to update data in real-time. CUPSS was downloaded from the EPA website ("Basic Information") and the database was transferred to their computer. Because CUPSS does not allow networking, all data had to be stored on one laptop and cannot be changed by more than one person at a time.

In the end, the result is a database of over 2700 assets and their associated condition, location, and cost. This is a huge advantage to the Village of Waterbury both from a maintenance standpoint and from a financial standpoint. We also included the GIS data which will allow their Town Planner to produce maps and utilize the spatial data. The degree to which the town will use this information is now up to them. The hope is that this information will continue to be maintained and improved over the coming years to make their daily processes more efficient and raise their confidence levels in long-term decision making.

Lessons Learned

One of the main outcomes of this project was that we learned a great deal about what it is like to implement an asset management program at a small community water system in Vermont. While we felt this project was successful, there are some lessons learned that will inform the direction of an AM program in Vermont.

The main lesson learned from this project concerned the difficulties associated with creating a link between ArcGIS and CUPSS. We hoped this pilot would give us an indication of the possibility to use GIS and CUPSS to initiate an AM program. Linking GIS and CUPSS has never been done or even, to our knowledge, tried, so we were attempting something many people nationally, including EPA, are very interested in. ArcGIS is very useful in creating an overall map of a water system with the location of each asset displayed. ArcGIS also makes it easy to enter large amounts of data at one time. The way CUPSS is currently designed, it doesn't support GIS integration, but we attempted to overcome that. Because both programs can communicate with Microsoft Excel, we were able to indirectly transfer data from ArcGIS to CUPSS. This was extremely helpful in taking all of the digitized assets, including their 30-40 attribute fields, from the tabular GIS format to the Excel-based batch upload form provided by CUPSS. Once the data was correctly formatted in Excel, it could be uploaded to CUPSS. One drawback to this method is communication is one-way—CUPSS will not allow data to be exported in any format, especially into an Excel format. Although a GIS map of assets is extremely helpful, the full database cannot be continuously maintained in GIS using the CUPSS system. Unless there are significant upgrades to the CUPSS program, GIS cannot be used in conjunction with CUPSS except for initial data entry. There are several asset management programs that are designed to be used in conjunction with ArcGIS, however, these can cost a fair amount of money and require GIS-savvy water system personnel. When dealing with these smaller Vermont systems in the future, we do not think it is necessary to develop a GIS database, unless there is a specific desire for spatial georeferencing of data.

Additionally, significant thought should go into determining which asset management system is best for the utility prior to starting an AM program. For example, a very small system with few employees, might consider using a simple spreadsheet to maintain their assets. A larger city with many thousands of assets, may find it necessary to purchase a more sophisticated system. By knowing the limitations of CUPSS, we are now better equipped to assist water and wastewater systems with making asset management program decisions.

Along with determining the appropriate asset management program, there is a need to determine exactly which assets the utility would like to manage. In the Waterbury project, this issue went was discussed over a number of meetings. The question of which assets to manage was introduced to the TeAM in mid-September, yet there was still a lingering debate over the type of assets that were to be managed by mid-November. Specifically, the debate concerned whether or not to include each curb stop, service line and water meter in the database. The addition of these assets would add over 1600 assets to the inventory which would take significantly more time to maintain but would allow for easier management of their physical location and condition. In the end, they decided that it would be best to upload all of the assets to CUPSS because of the benefit it would provide with operational procedures (ex. maintaining replacement dates).

In the future, the following questions should be answered by the utility prior to any data collection:

- To what level of detail do we need to manage assets?
- Is it important to keep track of the components of larger assets?
- Do we need to input all low-value assets, like curbs stops, into CUPSS?
- Should we define a cost threshold for which assets to manage?

The information should be useful, but at the same time it should be manageable. Other possible solutions to this problem would be to maintain groupings of assets in CUPSS based on age, location, condition or type. Additionally, managing assets that are more than a certain cost threshold is another approach. On the downside, these solutions can throw off overall operational costs. Regardless of the size or capabilities of the system, these are important questions to consider.

Another important lesson learned through this process was that the more involvement and ownership the utility has, the better the process will work and the more vested they will be using the program. The utility must be engaged in this process and recognize the benefits of an AM program in order for the program to be successful. Because we had the resources, we provided as much assistance as possible to the Village, including a willingness to keep the project moving. This meant we conducted all data collection and entry, provided the framework and technical support for the program, and were responsible for setting up meetings to move the process along. This level of involvement from the state may not be possible in the future. Luckily, the Village of Waterbury personnel were fairly engaged and committed to this effort, so the result was positive. We feel like, if they had to put forth the bulk of the work, the project might not have been as successful. We learned it might be better for the municipality to develop their own program so that they feel a greater sense of ownership. Many operators are busy and don't feel as though they can put forth the time and effort to complete a project of this size, thus some may turn to consulting firms to complete the process. This may be a good option for some larger municipalities, however, the more initial leg-work they do, the more they understand the process and the more likely they are to maintain the program.

One final lesson learned from doing this project was to start small. It is very easy to become overwhelmed with the detailed upfront data collection phase. We were able to work through this issue because we had a full time person to devote to the project, but for a small municipality this may be challenging. One way to approach this issue is to focus on the larger or most expensive assets. Once these are being managed successfully, the utility can begin to add things like smaller, shorter-lived assets, work orders and regular maintenance tasks. Eventually the utility will develop a comprehensive database of all assets and they can begin using this to manage predicted failures and plan for larger capital improvement projects. This option may take longer but it is more likely to get started if it is broken up into more manageable steps.

Conclusions

A change in the way water and wastewater utilities in Vermont think about their financial management is desperately needed. There is a necessity to help these systems become more financially independent, establish better funding strategies, and more efficiently use their limited resources. We, as a state agency can act as a catalyst in moving this effort forward. There is significant interest in asset management systems throughout the country as evidenced by the thousands of CUPSS users throughout the nation and the interest expressed by numerous local, regional and national organizations that have asked us to speak about our experience with this project.

Now that the project is complete, we have a much better idea of the process and the work it takes to implement an asset management program at a small Vermont drinking water utility. Moving forward, we will follow up with Waterbury to see if they are using the program or if they need any further assistance. Although projects in the future may not have as much direct state involvement, it will be much easier for us to offer technical assistance to municipalities who wish to implement an asset management program.

Works Cited

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Appendix A

Level of Service Worksheet

Developing a Level of Service (LOS) Statement

What is Level of Service (LOS)? The best way to understand LOS may be to think of a worst case scenario. Imagine a water system that struggles to keep the necessary chemicals ordered, has water loss over 60%, has major water leaks monthly and is unable to locate or close valves to prevent draining their storage tank, has not replaced meters in 30 years, and has no idea how to start addressing their problems. Because of these issues, the water system has difficulty with compliance and receives customer complaints regularly, even though water rates are low. How would you score or rate their LOS? Not very high, right?

Benefits of level of service agreement:

1. Communicates Utilities operation
2. Helps identify critical assets
3. Helps assess overall utility performance
4. Direct link between costs and service
5. Internal guide for utility
6. Communicates energy efficiency and water conservation goals

A. Health, Safety, and Security	
a. How would you rate your past performance in providing safe drinking water consistently to the public without interruption?	
b. How secure is your water system from accidental or intentional contamination?	
c. What is your ultimate LOS goal for health, safety, and security?	
d. What action can you take to improve?	
B. Conservation, Compliance Enforcement	
a. How often are you out of compliance with regulations?	
b. Are your operators properly certified?	
c. What is your method to stay aware of and prepare for new regulations?	
d. Have you developed a source water protection plan to assess and reduce threats to your water?	
e. Do you detect and record changes in water quality over time or throughout the year (possibly due to seasonal impacts)?	
f. Do you have goals for aesthetic water quality improvements, like iron/manganese deposits or sulfur smells?	

g. Do you discharge from your treatment plant into impaired streams? If so, are you complying with waste load allocations if they have been identified in a Total Maximum Daily Load?	
C. Service Quality and Cost	
a. Do you share your LOS statement with your customers?	
b. How do you track and respond to customer needs/complaints?	
c. Can the current process be improved?	
d. How quickly do you want to respond to customer outage?	
e. What actions can you take to be most cost effective, not only today, but in the future? Meaning, cutting costs now and deferring maintenance may only result in higher costs in the future to replace or repair assets.	
f. If you need to improve your LOS in some areas, how much will the improvements cost and how will you fund them? Ask yourself, not only can your community afford the improvements, but also can you afford not to make them?	
D**. Asset Preservation and Condition**	
a. What is your plan to properly maintain your assets and insure that they are in reliable working condition?	
b. What areas within your system and assets are most important to insure you will be able to provide the best LOS possible?	
c. When you consider sustaining a preferred LOS, are you taking into account asset age and life cycles, asset conditions, funding availability, etc.?	
d. An AM Plan should answer these questions. How often will you revisit your LOS statement to make sure to capture changes such as funding availability (growth and decline), regulatory requirements, demand of customers (increases/decreases in customers), and physical deterioration (addressing water loss/maintenance)?	
e. Are you making the most of your O&M activities so that you can meet your LOS goals?	
f. Overall, how would you rate your current LOS? How will you track needed changes and record improvement or needs improvement?	

Level of Service Agreement
Example 1
Water System

1. All federal and state water quality regulations will be met.	Is it measurable? *Yes* How often would you measure? *Monthly Compliance Reports*
2. Water Losses shall be less than 10%.	Is it measurable? *Yes* How often would you measure? *Compare master meter readings to billings quarterly*
3. The system will maintain a minimum pressure of 40 psi.	Is it measurable? *Yes* How often would you measure? *Pressure readings monthly*
4. There will be fire flow available for 100% of the customers within the system.	Is it measurable? *Yes* How often would you measure? *Tested quarterly*
5. No adverse event, unless related to electrical failure or severe weather condition, will cause the customers to be without water for more than 8 hours at a time.	Is it measurable? *Yes* How often would you measure? *Review events yearly*
6. EPA's secondary standards related to aesthetics shall be met by the system.	Is it measurable? *Yes* How often would you measure? *Yearly CCR report*
7. Rates will be reviewed on an annual basis and raised as needed to ensure full cost recovery.	Is it measurable? *Yes* How often would you measure? *Yearly by review committee*
8. The water source shall be monitored by the water system on a bi-monthly basis, and there shall be no E. coli detected in the source waters.	Is it measurable? *Yes* How often would you measure? *Bi-Monthly lab reports*
9. All customer complaints will be investigated within 2 business days of reporting the complaint.	Is it measurable? *Yes* How often would you measure? *Review complaint logs monthly*

(Taken from AMKAN Textbook)

Questions to think about when developing your own LOS Goals

a. Are you meeting all state and federal requirements?
b. What is your percent water loss?
c. Is the minimum pressure requirement being met?
d. How quickly are complaints investigated?
e. Notify customers of the LOS agreement. How well the water system is meeting the requirements each year?
f. Max amount of time a customer can go without water?
g. What are you doing to conserve energy? Water?
h. How is water quality?

Goals	Service Area (Health & Safety, Conservation, etc.)	How/ how often is it measured?	Performance Target
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10			