Paper 304-2011

Using SAS® Enterprise Guide® to Provide Water and Conserve Electricity for SAS Global Forum Attendees!

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ABSTRACT

Did you enjoy your shower this morning? Say "thank you" to SAS® Enterprise Guide® for making our utility data accessible and useful.

This presentation describes the progress from "What's SAS®?" to "Significant Contribution!" that has been accomplished at the Las Vegas Valley Water District for our utility operations and long-term rehabilitation planning. Join me for a look at real world utility data and software applications. Learn how Las Vegas Valley Water District was able to leverage information from across the company to find opportunities to save water, reduce the guesswork of rehabilitation, reduce failures, get important information faster and more accurately, and improve data quality. In the process, you also learn a bit about water delivery and the important factors of this capital-intensive business, which may help you understand your own water department issues at home.

You can change the course of the future with SAS® Enterprise Guide®.

INTRODUCTION

A water utility may not be your first thought for a company that can make use of the power of SAS® software®. Admittedly we aren't creating models of our systems or creating marketing campaigns and testing their effectiveness, but Enterprise Guide® software is an extremely useful tool in our environment helping us to know more about our business and to make improvements. Like others, we're very interested in reducing expenses, increasing revenue, and managing more effectively.

The Las Vegas Valley Water District (LVVWD) is a not-for-profit agency chartered under the State of Nevada to supply water to unincorporated Clark County and the City of Las Vegas. LVVWD delivers 80% of the water in the Las Vegas Valley which is 107 billion gallons a year. There are 349,181 accounts bringing in $320 million in annual revenue.

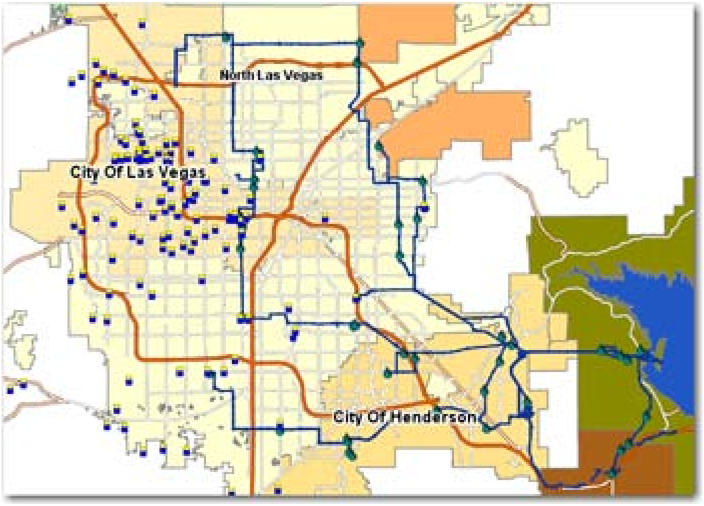

Figure 1. Map of Las Vegas Area

Water in the desert southwest is a scarce commodity and must be managed effectively. 90% of our water comes from the Colorado River, and 10% is groundwater extracted from wells in the Las Vegas Valley. Both are susceptible to drought. The surface of Lake Mead dropped over 100 feet in the past 10 years….It's now less than half full.

Drought was reducing water storage at the same time that growth was vastly increasing the population of Las Vegas. As the responsible water delivery agency, we're in the middle of two opposing forces finding the balance that makes it all work….and then the recession hits, giving revenue and expenses an even higher profile and subject to much more scrutiny.

SAS® software is used as a stand-alone product in our company. There's no central SAS® software server, no data warehouses, no collective company-level measures, and only two people using Enterprise Guide® software in completely separate efforts. The Information Technology Department loads the software on our computers with a local server, then it's up to us to put it to use. You might wonder why we have SAS® software in this situation; and I'll tell you that without Enterprise Guide® software, I couldn't do my job nearly as effectively. Like many analysts, I create information from data. Since we don't have centralized data and quality control processes, we have to create that for ourselves.

Welcome to our world!

TURNING ON SAS® SOFTWARE

The first time we saw the SAS® software products, they were so vast we didn't know what we would use it for. Fortunately, we found a need. In the water business, we try to project the next day's water demand, how much water people will be using tomorrow, and we weren't as successful as we wanted to be. After seeing SAS® software, we thought that they might be able to develop a model that would predict better than the methods we had been using. The SAS® software representatives came and worked on site with us and used Enterprise Guide® software to do the project showing us a perfect tool, manipulating data in a step-by-step process, for our environment.

At LVVWD, we're extensively automated. We have a geographic information system, a customer information system, a work order management system including purchasing and inventory, a financial system, a human resources system, a property and asset record system, a fleet management system, and on and on. The company philosophy is to install and operate best-of-breed software systems and integrate between them when we need to pass data. Each system is primarily the tool of one Department. The software may be used throughout the company, but the real purpose of the software is to accomplish the work that department focuses on. Each of these software systems were installed in different years during our fastest growth (2000 – 2008) when more flexible capability was needed.

Fortunately, a standard platform was chosen to host all of these applications, and they were all set up in one Oracle database.

Las Vegas grew from about 500,000 people in 1990 to 1.5 million people by 2007 with the vast majority of those people being LVVWD customers. Think about that kind of growth. 4,000 people a month were moving into town. Houses were being built further and further from the center of town, and water infrastructure had to keep pace to support the growth. Our company was staffed and focused on engineering and installation of new pipe, pump stations, and reservoirs; every year commissioning and turning on new facilities and making them work as part of the whole system.

Building a pump station or reservoir (Figure 2) is a multi-million-dollar expense paid for by bonds. Once you build the facility, dollars now have to be expended to operate and maintain it. Concrete reservoirs don't require much ongoing expense, but the pump stations need energy to move water. Energy costs exceed $1 million a month.

In the middle of all this growth and software installation, the Asset Management Division was created. Our job is to plan for the rehabilitation and replacement of existing water district facilities. We currently own 4,400 miles of pipe to deliver water to customers. To get water into those pipes and to wherever its destination is, we have 71 pump stations at various locations around the valley and 37 reservoirs holding 900 million gallons of water. Every day, at this time of year, LVVWD delivers 250 million gallons of water. In the summer that increases to over 400 million gallons. If we installed all of the facilities we own today, it would cost $4 billion.

Figure 2. Reservoir Construction

Water facilities in a community have to be reliable. How would you feel if you turned on your tap and no water came out? Water facilities in a desert community have to be reliable and be an excellent example of good stewardship to promote high levels of community water conservation. Water resources are finite and we have to make the most of the water we are allotted from the Colorado River and from the groundwater. We can't just take however much we want.

As Asset Management, we need to be able to answer such questions as:

- How often are we having pipeline failures and is that problem increasing?
- How do we know when to replace pipelines?
- How much is it going to cost in future years for all of our rehabilitation and replacement?
- How efficiently are our pumps moving water?
- When is it cost effective to rebuild a pump?
- How much of the water that we pay for and put into the pipes is reaching the customer and getting billed?

All of these are great questions for a water agency to have answers to because our job isn't to just have water available to you today. It's to make sure this community has affordable water for years into the future. The choices we make today and the planning we do, can greatly affect the reliability of water delivery and the cost of water delivery in the future.

To answer these questions requires data from many of those individual software applications that only resides in the tables for that software, not as real data you would like to work with, but as transactional information.

Enterprise Guide® software is perfect to develop information in this type of situation. We need data we can work with to get first one answer, then another, then twist the data and use it in a wholly different way. We cannot use static reports created by someone for us.

So now that Enterprise Guide® software is loaded on my computer and the Information Technology people have walked away, it's time to get serious, learn to use it, and make a difference. I have to admit that it took three months to figure out how to get connected to the Oracle schemas and tables. The simplest of tasks can stop you dead in your tracks when you don't know what you don't know and your Information Technology people don't know what the software is expecting.

SAS® Support is my ultimate hero. They sent me the information I needed and were very helpful communicating in small words and great detail to someone who knew nothing. The problem wasn't theirs, but they took the time to get on the phone with me and walk me through finding the database name as it was defined on my computer (which was, of course, different than the name everyone called it…even the database administrators). The preciseness of computers is inviolate and you will do it their way.

After that little hurdle, the rest is history!

MAKING PROGRESS

If you're learning on your own, the best steps to follow are to use any tutorials available to get familiar with the software or read the manual. Then dive in by choosing a problem you want to solve, something you want to know, and keep it simple. One of the first things we needed to work with was that 4,400 miles of pipe.

- What's it made of?
- How much length do we have of each diameter and material
- When was it installed?
- How much are we installing each year?

Those are fairly simple questions. Find the table that contains the data and use a query to summarize the information. Even to accomplish that, there are a number of problems you can run into. Today's software applications are built as massive relational databases and you rarely ever get the data you want from just one table. Enterprise Guide® software is very easy to understand compared to understanding the data you're looking at, what the different fields are and what tables you need to connect with to get the rest of the data you want.

There are tools to help you with these challenges. Some applications have a data dictionary that explains all the fields and the table connections. Your company might have built a data dictionary showing you all the applications with their tables and fields. If so, learn to use it. It will be your best friend. If you don't have that resource then find the person, application user or Information Technology person, that understands the software and how the tables fit together and ask questions.

If you don't have that option, then start exploring the data. Double clicking on a table opens it in Enterprise Guide® software and you can see the data to determine if it's what you're looking for. Choose likely table names and poke around. Often it can help to go into the application from the front end and find the data you're looking for. Look at the information around it and the title of the page it's on. Those will give you clues about which table names to look in. When I want to find how much water someone used and I look in the application, I find that I see it on the water bill. So if I look at billing tables from the back end, I should be able to find the data I'm looking for.

Always beware that you might not be seeing all the tables. I only see tables that I have permission to read. Fortunately in my environment, that's every table in applications that I have front end access to. If you don't have access to tables that you need, you'll have to get permission from whoever in your company has the authority to allow you access.

Once you know which tables you need, you also have to understand how to properly join the tables to get the information you're looking for. Always check the number of records after running a query to determine if you lost or gained records unexpectedly. If you did, review your query and your join and explore your data to determine what happened. Then you can make a knowledgeable choice about how to proceed.

One tip that I found to be invaluable when I first started was to take baby steps. Do one thing at a time in your queries. Join one table at a time, make one calculation, re-code one field, or use one new task. Do only what you're comfortable recognizing as correct when you look at the results. Memory is not an issue, correct results are. Many would advocate for elegantly, streamlined process flows that fit neatly on one screen done in as few steps as possible. I don't know who will eventually use my processes, so I translate and combine data in simple steps that would be easier for someone unfamiliar with what I've done to follow. That makes very large process flows.

It's surprising how much you can learn initially from solving a simple problem and executing simple queries. Our pipe segments are in one table, but most of the attribute data is numeric codes, so I have to join to the table that translates the code to a word, "ductile iron pipe", to create information that others will understand. The length of the pipe segments are in another table.

In the end, the company gets a picture of historical pipe installation (Figure 3) that clearly shows the growth in Las Vegas. It is basic information, but you have to get the basics before you can build what you really want.

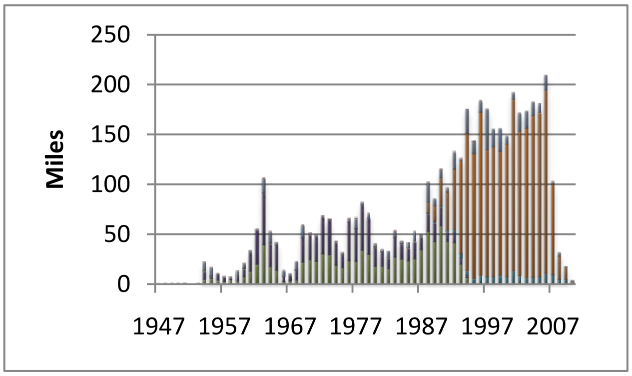

Figure 3. Length of Distribution Pipe by Year Installed

INFORMATION CREATION AND STANDARDS FOR PROCESSES

Once you understand how to work in your data environment and manipulate data with Enterprise Guide® software, you've got a good shot at answering all kinds of questions and taking your use of SAS® software to the next level. With the pipe data, now that we can visually see what we have, we want to know:

- When is the pipe going to need replacement?
- How much pipe will be replaced annually?
- What will it cost?

We have other software that projects the distribution of pipe life, so in this case I use Enterprise Guide® software to make sure I get equivalent data, data extraction using the same criteria, every year. Consistent, repeatable processes are our most valuable use of Enterprise Guide® software. I would hate to try to figure out every year how to get the "right" data. Before SAS® software I used MS Excel, which is a great product, just not for complex data processes.

Even with Enterprise Guide® software, it's harder than you might think to get the same data year after year. Some of the difficulty is due to data quality, some to documentation, and some to changes in data storage.

If you're working alone or in a small group, you have less people to bounce ideas off of and to cross-check the work. My pipe information is produced annually. By the time I get back to using that process, I don't remember much about it. I review the process a step at a time to make sure it's still correct, I didn't miss anything, and I didn't learn something new that needs to be incorporated. All of those are reasons to change this process that I thought was so perfect the last time I used it, particularly learning something new. When you haven't got standard, clean data, you're guaranteed to learn new information that will affect your processes, sometimes every year.

It's important to think about how you're going to accomplish your work year after year. When you first start, and only have a few process flows, it's easy to find the right one and remember your logical thought process. In an ad hoc environment, eventually you'll have a long list of processes you created and named very obviously at the time. But later it won't be quite so clear which one was for which purpose.

When no one is imposing standards on you, you need to create your own. You should consider developing your own good practices for:

- Process documentation
- Data quality issues
- Storage and organization of data developed

These are challenges I've been addressing in the past year as a latest round of improvements. I now have many base projects and three or four additional files created from the base that were all used to answer different questions.

You need to choose a method to document your projects so you know what they do. Eventually, a perfect file name is not enough.

When using previous projects, start by reviewing the details and adding an extended note at the top of the process flow (Figure 4) explaining in plain language the purpose of the project, a process description describing where the data comes from (which applications) and what the main process flow is, particular data in the application necessary to the process that might need to be checked when the results don't look right, where data is exported to for others to use, and any further processing needed after the file is exported (example in Appendix A). Then there's a section to document changes to the process. These are generally important things I've learned after I created the process. It's also helpful information when reviewing old, exported data to understand why it's not the same as the process produces now. I freely admit that I'm a data pack rat and keep almost every scrap of data I ever produced.

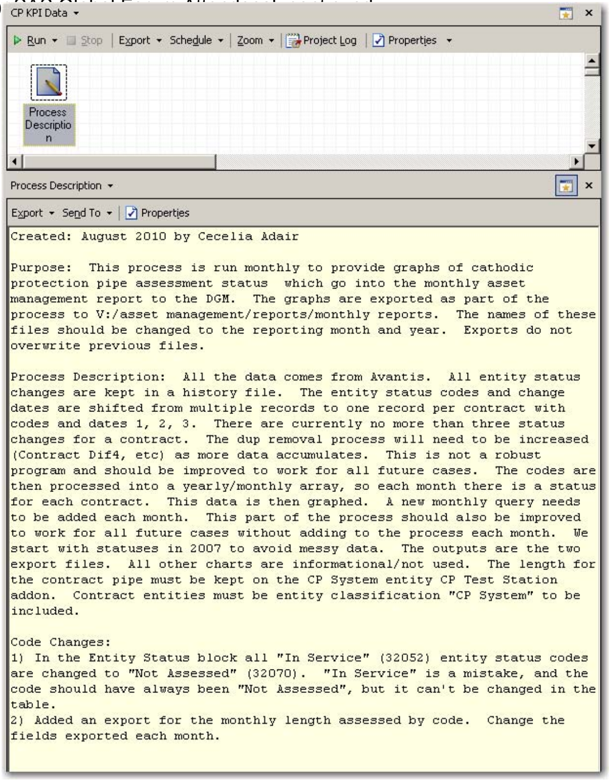

Figure 4. Note to Document Project

Data quality is determined by real people in your organization. That means your data is unfortunately human. I have one process whose only purpose is to clean and extract data from our work management system so the engineers will have consistent data to identify categories of equipment with excessive costs and analyze preventive maintenance effectiveness. When building a project, more of my time is taken reviewing data and compensating for inconsistencies and unexpected codes than on any other part of the project. It's exploratory work requiring an inquiring mind. Don't rely on what people who think they know the data will tell you about the data. It often isn't so.

You have to choose what you're going to do about bad data...ignore it, filter it out, or replace it. When you're working with transactional systems, you can't go in and fix the original information to suit your needs. The Department is getting the information they need, and my use of the information is secondary. I choose what I do about bad data based on how I'm using the data and what information I need to produce. You may want to have standard rules in your environment.

When building complex processes, many interim files are generated normally in your SASUSER folder. Some of the processes ultimately produce data sets that are important information that will need to be used as a basis for other projects. It's worthwhile to think about where you generate data sets and how you name them. I have a big hard drive, but it does fill up, and periodically I need to delete files to make space. It would be a good practice to set up a separate folder to store data sets that are used in other processes or at least give them a special name so they're easy to spot. Once you decide on your procedure, you just have to remember to follow it.

Standard methods quickly became important for projecting future pipe replacement. As Asset Management we needed methods to use every year to identify at-risk pipe, assess its actual condition, and recommend replacement. Long-term and short-term replacement planning processes support our needs and are done through separate software modules. Short-term planning focuses on which pipes are likely to be degrading and will need replacement in the next few years. This is pipe that is at the end of its life. The hope is that's at least 100 years, but there are always situations where it degrades faster. Most of our pipe is very young, so short-term replacement needs are currently small.

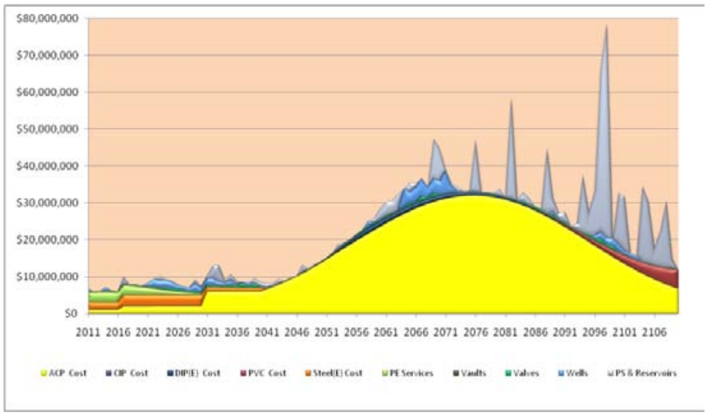

Figure 5. Long-Term Planning

Long-term planning (Figure 5) displays how much pipe to replace every year for the next hundred years to enable choosing replacement and funding strategies. Pipe on average costs $1 million/mile to install. Our important opportunity at the moment is to plan how to afford pipe replacement year after year when we have many miles of pipe reaching its age limit at the same time. When pipe is degraded it will break much more often and we'll lose more water…loss of revenue…impact to conservation goals…disruption to the community. Our goal is to find strategies and ensure funding for strategies that will balance the amount of pipe replacement that occurs each year, so the loss of water and disruption will be contained at a reasonable level. From a statistical point of view, this is possible. To do it as a practical matter, we always have to be choosing the right pipes to replace.

Short-term planning requires all the detailed data on every segment of pipe (such as diameter, installation date, length, material, etc) or the pipe cannot be included in the analysis. Pipe was being installed in the ground long before there were data systems to track it, so not all pipes have all the data needed; but most of them do.

For this data quality dilemma, we choose to filter out the pipes without all the information needed. In our data, the lack of information tends to be sporadic, and there are so many pipe segments (over 350,000) that dropping a few isn't going to hurt the process. Long-term planning uses summarized pipe data, the length of pipe by material installed each year.

To make each of these processes work, pipe data is gathered from the geographic information system and pipe failure data is collected from the work management system. Failure data is manually reviewed to match it to a particular pipe. Our Enterprise Guide® software processes keep these sets of data in sync allowing Asset Management to present consistent information that others will use for planning.

SIGNIFICANT CONTRIBUTIONS

In a utility, new business functions are not often needed and when created are viewed with a bit of suspicion. Our Asset Management Division had to earn respect to gain equal footing and have our recommendations taken seriously. We had to shed light on situations that hadn't been apparent and get attention and funding to solve issues with information that was solid. Turning data into information with Enterprise Guide® software is at the core of our success. Following are a few examples of what we've been able to accomplish.

REDUCE REHABILITATION GUESSWORK

Electricity is one of our most expensive costs. Anything we can do to reduce electricity use is highly desirable. The major electric use is in pump stations. We power the lights, monitoring equipment, coolers, etc., all the things you would expect in an industrial building; but the single type of item that seriously uses electricity is the pumps moving the water to the next reservoir.

Water is very dense and it takes significant force to move it uphill. Water is generally being moved several miles horizontally and 100 ft vertically up to the next pressure zone. Imagine carrying a bucket of water that far. Pumps have an impeller (think propeller inside a pipe) that rotates and pushes the water. Water is generally thought of as a nice substance; but water over time wears down rocks. So too does water over time wear down an impeller. Eventually the wear on the impeller causes it to require more electricity to move less water (higher cost of goods sold) and it becomes worthwhile to spend $25,000 to rebuild the pump because we will recoup that money in three and a half years from energy savings.

The question that has to be answered is, "when is the pump inefficient enough to warrant the expense of rebuilding?"

Historically, this question has been answered using best guess somewhat based on age. More recently, this was improved by running a pump test for suspect pumps that give specific pressure and flow information that can be graphed against the original ideal pump curve (plot of pressure and flow). This works great but is very hard to schedule. Every day there is a pumping schedule that is optimized to get the right amount of water to the right reservoirs at the least cost. The pump to be tested must be running only by itself, so the schedule has to be disrupted. Starting pumps is also more expensive than once they're running, and starting causes physical wear and tear. The pump test did help us make better choices, but we only were able to test a few pumps…only those we thought had serious problems.

We have 278 pumps. There was still huge potential to rebuild pumps that didn't need it or to miss pumps for years that were unknowingly failing early and wasting electricity dollars.

It turns out that we collect pressure and flow data from pumps continually into a Supervisory Control and Data Acquisition (SCADA) system. Think of a regular transactional data base on crack. It collects readings every 45 seconds from all the field devices. That's 25,000 data fields for our system. Among all that data we just needed to find the specific situations we were looking for, when each pump in the system was running by itself for at least one hour. Sounds simple, but because of how data is stored, it takes a lot of manipulation to compare pumps by hour and tell when each is running alone. Configuration at the pump stations is also a challenge. Some pump stations have seven pumps, and some have two. Some pump stations have pressure transmitters that directly supply the pressure reading needed and some have to be calculated based on how much water is in the reservoir that the pump is drawing water from.

At the start of the project, it was a nightmare. We knew Enterprise Guide® software is the perfect tool to solve the problem because it's so flexible. The approach taken was to break the problem down and solve the individual situations. We gathered all the data fields from all the pump stations and grouped them into like configurations; then developed solutions for each. At that point we were able to identify the similarities and create the conditional processing that allows the individual process flows to be run as one process flow. It still requires some manual intervention. There is an extensive configuration sheet in MS Excel to identify the fields needed at each pump station, and each pump station is a separate run of the process flow. There're always more improvements possible.

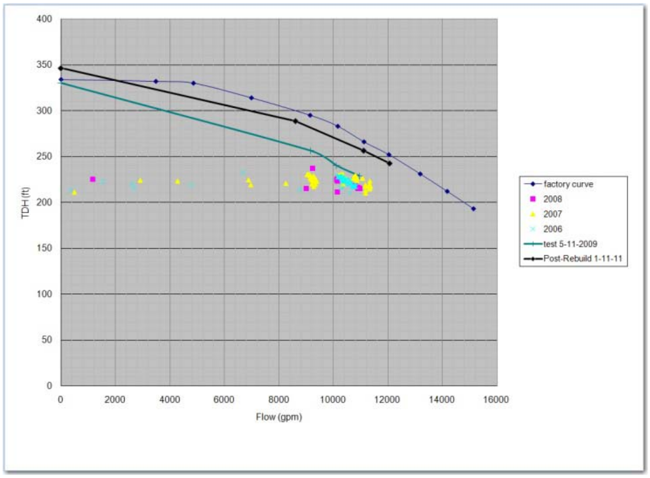

Figure 6, Multi-year Pump Curve

This process is now run annually and takes about a half an hour to produce data for every pump in every pump station. An engineer plots the data in existing pump curve files, and now there is the beginning of a historical trend for every pump. Not only can we tell whether an individual pump is currently degraded enough to rebuild, we can tell how fast they're moving toward that rebuild point. Such information helps engineers identify situations that potentially require other improvement work.

REDUCE FAILURES

Service lines are the small pipe that extends from the water main in the street up to the home or business. There's a known problem with these lines. The ones made of polyethylene fail at about 24 years of age as opposed to 50 years for copper service lines. Failures of the polyethylene lines happen much more frequently in the summer, to the extent that summer is known as "leak season". Most of the Distribution Maintenance Crews are dedicated to fixing service line leaks for the entire summer, May to October. Enterprise Guide® software was instrumental in analyzing the information and developing projections for the remaining polyethylene service lines to show how many failures can be expected in the future, what year the problem will peak, and how many crews would be needed for repair.

Last year the concept was proposed that many of these service line failures are caused by the wells which are turned on each May to provide sufficient water delivery capability for the summer. No one believed this was true, but we started an investigation from multiple directions. The known failure mechanism for polyethylene service lines is that when the water in the lines is warm (in summer) the chlorine in the water, used to keep the water disinfected, chemically interacts with the polyethylene material and breaks it down. Pressure in the service line physically causes the service line to crack and begin leaking when the polyethylene is sufficiently degraded.

Pressure recording devices were put in various locations to monitor for excessive pressure spikes, and SCADA pressure data was reviewed to see if system pressures had generally increased after starting the wells. Enterprise Guide® software was used to analyze the maintenance work orders to look for increasing trends in pressure zones with wells as opposed to those with no wells.

Normally failure data is trended on a monthly basis which didn't appear helpful. Once we changed to trending on a weekly basis, the effect of the wells on service line failures was so obvious that statistical analysis wasn't needed to show the result. This knowledge gave us the framework to proceed.

Pressure monitoring was unable to identify the overall trend, but turned out to be very helpful at solving individual causes and testing solutions. The number of wells turned on in problem zones was reduced, daily well start-up times were staggered, and valves that opened too fast (causing pressure spikes) were replaced. As each solution was implemented, the weekly failure monitoring clearly showed the effectiveness of the changes. Across the summer, a total reduction of 100 service line failures was achieved which is a savings of $150,000 in manpower, materials, and equipment not to mention the savings in water loss.

PREVENTING REVENUE LOSS

Water meters are our cash registers. The water that passes through the meter from one month to the next is the amount of water that gets billed to customers. Just as pumps degrade over time, so do meters. When meters degrade, they don't fully register all the water passing through them. We're delivering more water than a customer would actually get billed for.

As Asset Management, we perform a water audit every year to determine how much water was received into our system, how much water was billed, and where did the rest of the water go. When water is put into a pipe system, you would expect it will all eventually get to the other end, to the customer, and get billed; but it doesn't. Pipes leak, service lines leak, mains break, meters aren't always accurate and even newly installed pipes lose a small amount of water.

Just as the most economic point to rebuild pumps must be determined, the most economic point to replace customer meters must be determined. The best method to judge the meters is to randomly sample the system by removing customer meters and testing them on accurate equipment in the shop to determine the percent of under-registration (lost water). Some testing is done, but it is a very small sample and would have been completely invalid to use.

The first year the water audit was done, we arrived at a total amount of water that was unaccounted for. The percent of under-registration was guessed based on industry literature. Not a great solution, but it gave us a ballpark number for loss from meters and loss from pipes. Prior to then, we had no idea at all. A reasonable guess can help you move forward.

By the time the second annual water audit occurred, an intern realized that we had all the data needed to make a better solution. The billing history, including the quantity of water used, goes back for several years. This history also contains which meter is installed at a service, when it was installed, and when a meter was replaced. By choosing a set meter replacement year (find all the accounts with meter replacements in 2006), comparing the total water used by those accounts in 2005 and 2007, normalizing by the increase in water use of accounts without a replacement, using Enterprise Guide® software we were able to develop the percent under-registration for meters of different age groups. This was a number based on a very large sample set we could be confident of.

Having created an Enterprise Guide® software project that was extracting information from all the billing meters, we immediately extended the project to take the next step and gain significant benefit from the work. It was helpful to know the past loss of revenue from billing meters to point out the importance of replacing them at an appropriate age (15 – 20 years), but what about the future.

Twenty years ago, Las Vegas was just moving into its greatest growth. If LVVWD does not keep up the meter replacements, the loss of revenue in the future (Figure 7) is going to significantly increase. Just by sharing the information developed with the Meter Shop management, they were influenced to improve (Figure 8) and raise the priority of their replacement program. They always had a twenty-year meter replacement program, but had not been executing it consistently because the number of meters it applied to and the amount of loss created was small.

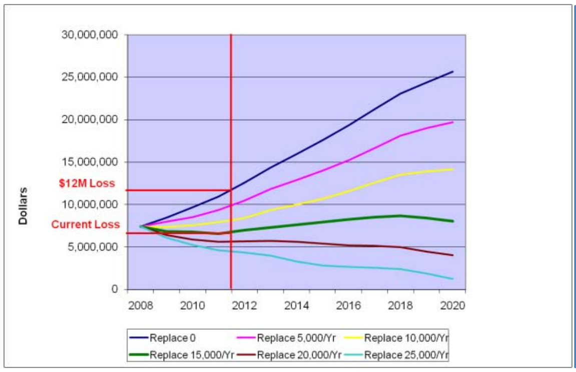

Figure 7. Projected Water Loss

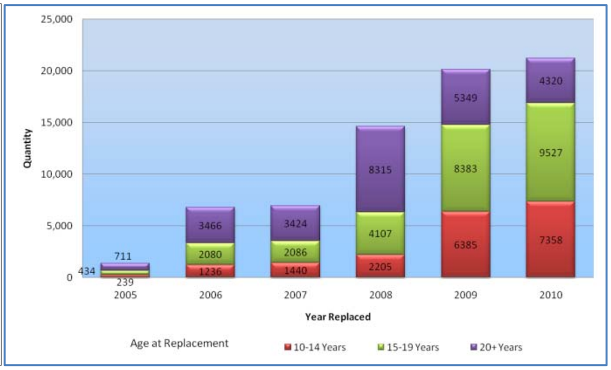

Figure 8. Meters Replaced Annually

FASTER, MORE ACCURATE INFORMATION

Once begun, the water audit became "must have" information, but it was only produced on an annual basis. Our Deputy General Manager wanted to get reliable data on unaccounted water every month. The problem was that billed water quantities was an extraction from the customer system into another table which doesn't occur until four months after a billing month. The January billed water wouldn't show in the data table until May. The data for any period is only moved once, so it has to wait until all the billing for January days is complete (end of February), and then has to wait for billing changes to be called in, fixed, and settle down (another two months).

Writing code is not my favorite activity, but sometimes you have to stretch. Meters are read every day, and bills are produced every day. For water accounting purposes, there needs to be a summation of all water used in January so it can be compared with the water that enters the system in January. Writing code was the only way to accomplish this one. Each bill has to be processing into an average daily quantity of water used, the number of days the bill was for, and how many days of the bill belonged to each month. Back-billing can be done for up to three years. A multi-year array, stuffing data from each bill into its appropriate bucket and adding them all up works. It's not fast, but it works.

Water accounting information is now reported monthly. A side benefit is that accounting information is more accurate, and so far that accuracy is in our favor. Over time, more water gets accounted for. We also have an ongoing trend that could point out major system failures. When water is leaking from the pipes, it doesn't always surface. Large sub-surface leaks are how sinkholes form.

CONCLUSION

Enterprise Guide® software makes a huge difference for our organization and it can for yours too. If you haven't ventured far with it yet, make that effort by solving one problem at a time. Learn a new feature or task each time you take on a new project. Follow these steps to improve your use of Enterprise Guide® software:

- Use tutorials or read the manual
- Choose a simple problem to solve.
- Explore your data resources.
- Create basic information then build on it.
- Create your own standards to work by.
- Plan your storage of developed information.
- Name your project descriptively.
- Document your projects.
- When data isn't available or quality isn't good, make a reasonable guess to begin moving forward.

Take advantage of all the other avenues of learning SAS® has to offer. Sign up for the SAS® newsletters. They give you information in bite-sized pieces that add to your knowledge. Read about the code tips. Many of those codes are available in Enterprise Guide® software and the explanation helps you understand better how it works. You can also learn about functions you might be able to put to use in the future. Read SAS® books. Attend the SAS® free webinars. They all give you more tricks for your bag which you can use to be a data hero for your company.

Our Asset Management Division rose from being a small group within the Operations Department to working directly for the Deputy General Manager for Engineering and Operations…direct recognition of the value of our contributions.

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RECOMMENDED READING

- SAS® Publishing News (e-newsletter)
- SAS® Training Report (e-newsletter)
- SAS® Programming for Enterprise Guide® Users

CONTACT INFORMATION

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