Water Utilities

901-A Texas Street, Denton, TX 76209 (940) 349-8452 Fax (940) 349-8951

Memorandum

DATE: **October 23, 2017**

TO: **Public Utilities Board Members**

FROM: **P.S. Arora**

SUBJECT: **Texas WET Magazine Article**

The Water Environment Association of Texas publishes the Texas WET magazine. In the October issue of the magazine, the attached article on the Denton Wastewater Collection System Asset Management Program (AMP) was published. The AMP article is also highlighted on the front cover of the magazine.

The Wastewater Collections department started developing this program with much greater effort in 2008, and has a fully functioning AMP since 2014. The AMP uses the ESRI GIS, Cityworks, Infoworks, and Infomaster computer models to produce a risk based, prioritized plan for every sewer line in the wastewater collection system. Capacity addition projects, existing sewer line replacement/rehabilitation projects, sewer line cleaning, root control, grease control etc. all activities are a product and component of the AMP.

Staff has done numerous presentations and several webinars on the Denton AMP in the EPA sponsored conferences, Water Environment Association of Texas annual conferences, as well as in the Water Environment Association national conference.

Texas WET

LEADERSHIP FOR THE WATER ENVIRONMENT IN TEXAS

Official Publication of the Water Environment Association of Texas

Issue 4 • 2017

TECH TALK

DENTON LEVERAGES TECHNOLOGY TO PROACTIVELY WORK SMARTER

weftec®
the water quality event™

INSIDE

Young Professionals Corner | Section Reports | Association Update

1825 Fort View Road, Suite 106, Austin, TX 78704-7654 Address Service Requested

DENTON LEVERAGES TECHNOLOGY TO PROACTIVELY WORK SMARTER

INTRODUCTION

The City of Denton has been improving the management, operations and maintenance of its wastewater collection system for over twenty-five years. From the development of ESRI GIS mapping and Cityworks CMMS in the 1990's, through the more recent implementation of Innovyze's Infomaster software, the City has leveraged information solutions to proactively manage its wastewater collection system assets. Today, Wastewater Collection Staff are fully engaged using mobile applications to plan, execute and document all work on the collection system. They not only have intelligent maps at their fingertips but can access historical data covering previous work, condition, and performance on every line segment. Today, the city has increased proactive cleaning and inspection significantly reducing reactive maintenance and their associated SSOs.

The first sewer lines in Denton were constructed on the major streets around the Court House square in the early 1900s. Since then the wastewater collection system has expanded to meet the City's steady population growth to its current population of over 131,000. Today the City's collection system consists of over 500 miles of sewer lines ranging in size from 4 to 48 inches in diameter. The system is divided into five sewer sheds with the Pecan and Hickory sewer sheds serving larger portions of the City. All wastewater flows are processed by the Pecan Creek Water Reclamation Plant, which treats about 15 million gallons per day.

TECHNOLOGY EVOLUTION

The City's wastewater collection system is composed of thousands of different infrastructure assets that represent a substantial capital investment of nearly $0.5B.

Each asset was designed and constructed to meet prescribed performance objectives in support of the overall wastewater system's performance goals. However, as assets age, they deteriorate and their performance diminish over time requiring increased operation and maintenance attention. As assets continue to deteriorate, they become unreliable and require repair, rehabilitation, or complete replacement.

The City of Denton's wastewater collection system asset management program has been evolving since the 1990's as paper maps were converted to an Esri Geographical Information System (GIS). The new GIS not only provided base mapping but provided a series of collection system attribute data that could be tied to individual assets. The new digital inventory provided the initial platform to build the current information management system. In the late 1990's the City added Pipeworks as a work management or computerized maintenance management (CMMS) program for the collection system. Pipeworks, which later evolved into CityWorks allowed the City to manage and track all operation and maintenance work activities on an asset by asset basis. The City built workflows and processes around the Cityworks platform for routine operations and maintenance of

the collection system. CityWorks is a GIS centric software which shares the asset data base with the Esri software providing seamless integration with GIS. Every activity of the Collections Department is recorded as a work order in Cityworks. The results provide decades of historical data on collection system performance, condition, and maintenance requirements.

Also in the late 1990's the City developed a hydraulic model for the collection system to evaluate the capacity requirements of each pipeline segment. Initially compiled and calibrated in Hydroworks software, the model was later converted to Infoworks as the modeling software evolved. The hydraulic model provides an analysis of current collection system capacity deficiencies as well as planning for new capacity needs associated with system growth. The model is run on a regular basis and updated every five years to support the City's impact fee analysis.

The City now had essential information tools in place to better manage the life cycles of their assets; inventory (Esri GIS), Capacity (Infoworks), and performance/maintenance (Cityworks). This technology foundation created the opportunity to implement the Water Environment Research Foundation (WERF) collection system prioritization system computer model SCRAPS (Sewer Cataloguing Retrieval And Prioritization System). The SCRAPS model uses existing pipeline data to compute the probability that a pipeline may fail structurally, operationally, or hydraulically using Bayesian probability theory. The City implemented SCRAPS in 2008 and it provided a strategy focusing their CCTV inspection based on the likelihood of failure (LoF), consequence of Failure (CoF) and overall risk of failure (RoF). SCRAPS results drove CCTV inspection to those areas of the collection system, which presented the highest risk.

As Denton's WCS asset management program continued to involve, the City implemented Innovyze's Infomaster and CapPlan which integrates GIS information, Cityworks data, CCTV video, PACP (Pipeline Assessment Certification Program) condition databases, hydraulic modeling, and other related information to prioritize inspection, point repair, rehabilitation and replacement of sewer lines. Infomaster output provides a prioritized action plan based on the most current performance and inspection data.

Implementation of asset management information technology has been a challenge for many wastewater utilities with as many failures or false starts as successes. There were three key factors which helped support Denton's successful implementation and utilization of technology over the past two decades:

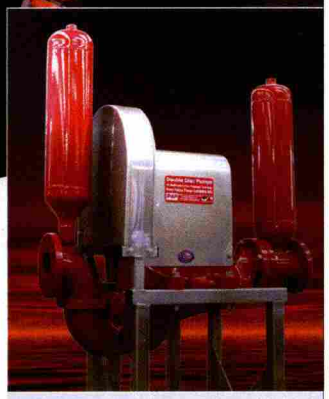
1. Sound leadership from Wastewater Department Management, which drove the vision for the asset management programs and provided the required support for its continuous technology improvement.
2. Individual champions within the various operation and maintenance groups who realized the benefits that technology would offer. These champions enthusiastically encouraged and supported the comprehensive utilization of technology by all employees
3. A utility coordinator who bridged the technology gap with engineering and operations staff, maintained system reliability and integrity, and constantly looked for ways to improve information solution applications

PVP Double Disc Pumps™ operate up to 10 times longer and cost up to 70% less to maintain. When you factor in the total life cycle expense (labor costs, maintenance and repair), you will find PVP's Double Disc Pumps are a better value. Our pumps offer...

- PVP pumps operate at lower speeds with no sacrifice in performance: Lower wear rate = Longer life.
- Our *Maintain-in-Place* design reduces downtime and lowers maintenance costs.
- Seal-less, gland-less, oil-less design lowers operating costs.
- PVP pumps can run dry indefinitely without damage.
- Fewer moving parts means less need for repairs or maintenance.

PVP Penn Valley Pump® Water Environment Federation Innovative Technology Award DOUBLE DISC PUMP™

Toll Free: 800-311-3311 • PennValleyPump.com



The PVP Life Cycle Cost Advantage

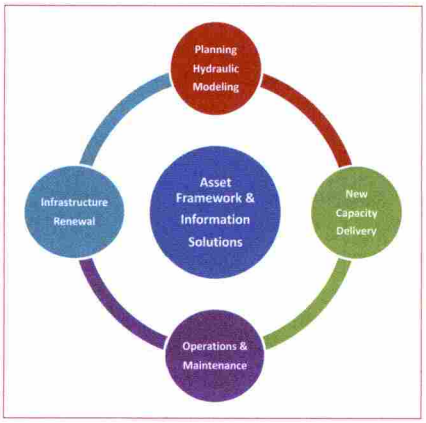
Are you operating rotary lobe or progressive cavity pumps? Then you are familiar with their repair and maintenance costs.

Learn the facts. Contact us today and discover how PVP's positive displacement pumps are your most cost-effective, long-term value.

Represented by:

SWEET SOUTHWESTERN ENVIROMENTAL EQUIPMENT TECHNICIANS

Phone: (972) 489-2951
Web: cjcortez@sbcglobal.net



Denton's Asset Management Program is built on a foundation of continuous improvement

The City has developed an effective CCTV screening process using Jet cleaning cameras

PROACTIVE WORK STRATEGIES

The City's proactive asset management program is built on a foundation of the right people and business processes supported by technology. Four of the key proactive work strategies used by the City are:

1. **Targeted Cleaning**

   Proactive cleaning is the corner stone of the City collection system asset management program. The City's targeted cleaning program has dramatically reduced the number of main line chokes or blockages and their associated SSOs. Based on the analysis of historical work orders and results of the SCRAPS analysis, the City prioritized its entire system into three cleaning cycles. The cleaning cycles are the designated scheduled cleaning frequency of either 1, 5, or 10 years. The specific lines in each cleaning cycles form individual sewer basins. The general cleaning process is to always clean from upstream to downstream in each cleaning cycle basin. The pipe lines in the 1 year cleaning basins were identified through the evaluation of choke frequency, proximity to food establishments and apartments with history of sewer line chokes, and other reactive work order data. These lines have typically been inspected with CCTV and are often candidates for future repair and replacement. Currently there is approximately 276,600 linear feet or 10% of the gravity mains included in the 1-year cleaning basin. The 1-year basin pipelines lines are typically shorter line segments generally scattered across the City.

   There is a dedicated cleaning truck and crew to the 1-year cleaning basin that tracks their progress across the basin through Sewer Basin Cleaning work orders. Through the mobile application, the cleaning crew easily tracks their completed work and identifies the next lines to be cleaned.

   The 5 and 10 year cleaning basins lines were established using priority ranking from the SCRAPS model results. There is approximately 841,000 linear feet of pipe in the 5-year cleaning basin and 1,775,000 linear feet in the 10 year basin which represent roughly 30% and 60% of the gravity mains respectively. The 5 year cleaning basin generally runs through the heart of the City while the 10 year cleaning basin includes the newer lines in the areas surrounding the City. The 1, 5, and 10 year cleaning basin are routinely reevaluated based on cleaning data, choke history, and other work order history. This annual update process keeps cleaning priorities targeted on those lines that can potentially cause the most problems.

   The two flush or jet truck crews assigned to the 5 and 10 year cleaning basins map their work and progress through the mobile Cityworks application and are empowered to make decisions on which lines to clean within the basin. If the cleaning crews are called to support another cleaning operation in another part of town, they can generate a new Sewer Cleaning Work Order in the same vicinity when they're ready to pick up routine cleaning on their basin again.

   In addition to the 1, 3, and 5 year cleaning basins, the City maintains a list of hot spot or recurring cleaning locations that are cleaned on a more frequent basis up to twice per month. The current list has 37 locations, which are regularly updated as additional trouble locations are identified. A dedicated hot spot cleaning truck targets high grease load areas and also provides routine cleaning of the City's 27 lift station wet wells. The dedicated hot spot cleaning truck can also be used to support the one-year cleaning basin crew and other special cleaning needs.

2. **Root and Grease Control**

   Wastewater Collections also manages two specialized maintenance activities targeting those lines with root or grease issues. The pipelines that represent a higher risk of root intrusion were identified by overlaying the tree canopy over the sewer lines in GIS. The City's cleaning trucks are equipped with root cutters that can remove roots as they are identified. Roots are identified and removed as part of the routine cleaning process. The City also maintains a contract with Dukes Root Control Inc. to chemically treat lines with persistent root intrusion. Dukes currently chemically treats approximately 40,000 linear feet of sewer lines ranging from 6 to 15 inches in diameter. The chemical treatment will effectively prevent root build up in the line for three years or more.

   Grease from commercial and residential customers is always a major cause of chokes in every sewer system. The City's ongoing FOG program provides for inspection of commercial grease traps and also provides educational material to help prevent grease from entering the collection system. Lines with grease accumulation are identified through the routine cleaning and cleaning jet camera videos. Grease issues can also be identified in response to line chokes. The City uses the Dukes Jet Power II degreasing chemical on lines that have been identified with significant grease issues. These lines can be chemically degreased on a one time basis or added to the hot spot cleaning list for recurring grease treatment. The root and grease control programs are actively tracked through Cityworks work orders and mapped in GIS to review work history and effectiveness.

3. **Quick Cam Screening**

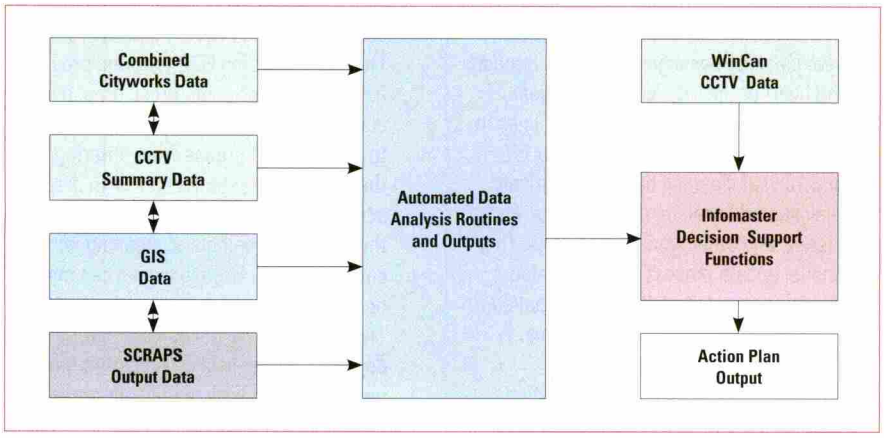
   In 2015 the City initiated a process of using a sewer jet camera to capture a screening video of all of the lines cleaned in the 5 and 10 year cleaning basins. Quick Cam screening is generally not performed on the 1 year cleaning basin lines. These lines have either received full CCTV or are being scheduled for full CCTV video though SCRAPS and InfoMaster prioritization. The self-contained sewer jet cameras attached to the standard cleaning nozzles are used to confirm that the cleaning was complete since routine cleaning can take multiple passes to remove grease and debris. The jet camera

unit contains a SD video card to capture the video files which is fully protected within a sealed camera compartment. The City's Quick Cam process takes the routine cleaning video to the next level. The Quick Cam video is typically of sufficient quality to complete a condition screening of the pipeline and has significantly increased the City's knowledge of collection system condition.

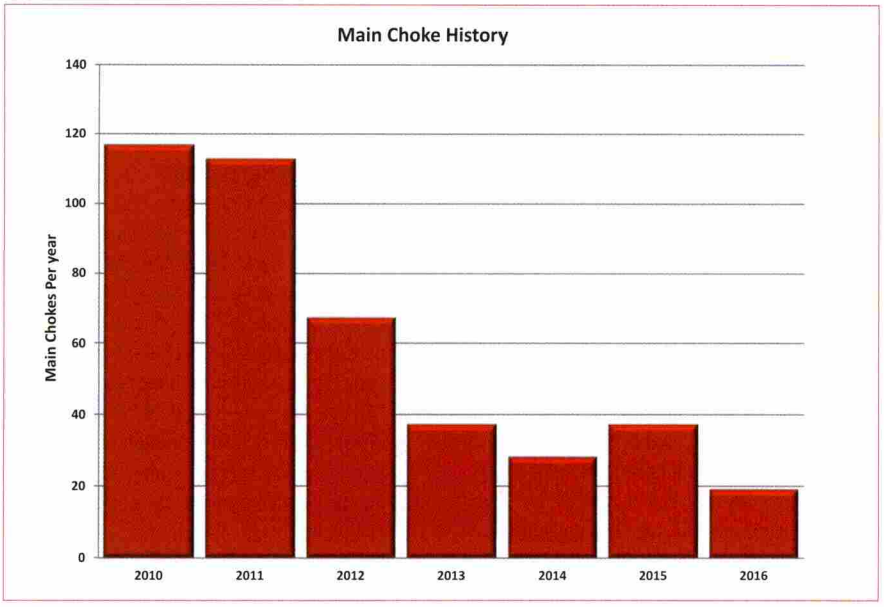
The City has developed a procedure to collect, review, and analyze the Quick Cam video that either indicates the pipe is in good condition or recommends additional action like a full CCTV inspection. Not only has the Quick Cam process determined that a lot of the City's pipes are in good condition, but it has also improved the effectiveness of the City's full CCTV program focusing full CCTV on lines with identified defects.

KPI	KPI Metric	FY16 Performance
Main Replace Total	16,000 lf/yr	16,121 lf
Point Repairs	120	132
Sewer Line Degrease	175,000 lf/yr	258,639 lf
Basin Cleaning - 1YR 5YR 10YR	175,000 lf/yr 175,000 lf/yr 175,000 lf/yr	211,035 lf 233,158 lf 224,043 lf

Table 1



Denton's Asset Information Solution prioritizes, manages, and tracks all maintenance work



The City has significantly reduced the number of blockages or chokes freeing up time for proactive maintenance

4. Extending Asset Life

A key component of the City's targeted CCTV inspection program is to identify pipelines with limited number of defects suitable for point repairs in lieu of full line replacement. Based on the full CCTV results and the Infomaster decision matrix, the sewer lines identified in the model result are programmed for either open cut replacement, or internal point repairs to fix defects which impact limited areas of the pipe.

The City has two in-house pipe repair crews to handle new sewer taps, open cut point repairs, force main breaks, chokes, and manhole inspections and repairs. The City completed over 130 open cut point repairs in 2016, which extended the useful life of repaired mains lowering their overall life cycle costs.

PROOF IN THE RESULTS

The City's comprehensive use of its asset information systems provides real time reporting on all of the work associated with collection system operations and maintenance. Staff can track their performance against their annual key performance metrics on a daily basis. Performance metrics are reviewed by in a weekly manager's meeting along with CCTV and capacity analysis results. As indicated in table 1, the Staff significantly exceeded their performance metrics in 2016.

As indicated in the figure to the left, the City significantly reduced the number of main chokes or blockages from nearly 120 in 2010 and 2011 to less than 20 chokes in 2016. This exceeded their customer service level of 1 choke per 1,000 customers per year. The Number of SSOs has also significantly dropped over the years with the City's proactive maintenance program. By reducing the reactive work associated with main chokes and SSOs, the collection systems operations and maintenance staff can focus more time on preventive inspections, cleanings, repairs and replacements. In FY2016, the City logged 81,313 hours of maintenance work on the collection system. The proactive maintenance work orders accounted for 72,317 hours or 89% of the work. While many cities are striving to get their reactive work percentage below 50%, Denton has their reactive work down to 11% of the total maintenance man-hours.