

Asset Management in Practice:

Lessons Learned from Hillsborough County

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[EDITOR'S NOTE: This is the second in a three-part series. The first paper, which appeared in the September/October 2006 issue, examined the Hillsborough County sewer inventory and condition assessment. This article presents the findings of the work. In the final article, the County's gravity sewer asset management program will be discussed.]

Located northeast of Tampa Bay, on the central Gulf Coast of Florida, Hillsborough County has a population well over 1.1 million. As with much of the state, Hillsborough County has experienced significant rapid growth in the past decade. For years, wastewater and water service demand outpaced projections. Although new home starts have dropped off substantially, it is expected the next growth cycle is on the horizon. In anticipation, four major wastewater treatment plant expansions are under way, and one new water treatment facility is nearing construction.

Hillsborough County Water Resource Services (WRS) was originally formed by centralizing several franchise utilities. Although approximately one third could be considered contemporary, some of the infrastructure goes back many decades. Records show there is still a small amount of wooden pressure pipe in service. With a substantial amount of aging infrastructure,

run-to-failure and reactive maintenance strategies were clearly no longer acceptable ways of doing business. WRS took initiative to develop a proactive infrastructure management philosophy.

For the past six years, WRS has been implementing an advanced asset management strategy. After successfully introducing an enterprise-wide, sophisticated Computerized Maintenance Management System (CMMS) as the heart of a larger Comprehensive Asset Management System (CAMS), the WRS has spent the last two years collecting data on system assets through its Asset Inventory and Assessment (AI&A) program.

Asset Inventory and Assessment Program Overview

In addition to determining the actual physical condition of infrastructure, it has become increasingly critical to have accurate location data for linear assets. Competition for space within rights of way increased as more utilities, such as telephone, cable, and fiber optics, attempt to occupy the limited space. WRS's Asset Inventory and Assessment (AI&A) Program is intended to catalogue the condition and location of all system assets.



In order to meet the aggressive deadlines desired by WRS, the AI&A program was separated into four projects:

- Gravity System Inventory and Condition Assessment. This project includes collecting GPS (x, y and z) coordinates for manholes and sewer cleanouts, inspecting manholes and miles of gravity sewer, cleaning and in-line closed circuit television inspection of gravity lines, evaluating the condition of each line and manhole, and populating the GIS and asset management software with information gathered.
- Pressure Pipe Appurtenance Inventory. The tasks of this project include locating and obtaining x and y coordinates for the County's valves, hydrants, large meters and blow-offs using GPS equipment and populating the GIS and asset management software with information gathered.
- Water and Wastewater Plant and Pumping Station Equipment Inventory and Condition Assessment. Tasks include inventory and condition assessment of all real estate, structures, and the mechanical and electrical equipment. Work under this project is performed predominantly by WRS personnel.
- Pressure Pipe Condition Assessment. Building on the information gathered in the Pressure Pipe Appurtenance Inventory, the tasks of this project include refining pressure pipe locations, preparing a database of historical pipe failures, performing increasing levels of analyses beginning with predictive failure, exhumation and laboratory testing of those pipe sections predicted to have the highest probability of failure. This information will be loaded into the CAMS which will be used proactively to alert field maintenance personnel when pipes have reached the end of their useful life or otherwise need repair.

This paper presents preliminary results of the Gravity Sewer Inventory and Condition Assessment project as well as some of the key lessons learned and benefits realized by the County thus far.

Background

The Gravity System Inventory and Condition Assessment is furthest along in its development and implementation and is the most labor intensive. The work has been contracted out to InfraMetrix LLC (InfraMetrix) of Tampa, Fla.

During this two-year project, InfraMetrix will conduct an inventory and assessment of the County's 1,300-mile gravity sewer system. Of greatest importance, InfraMetrix will classify the maintenance and structural condition of the inspected manholes and pipelines and prioritize them for cleaning and more

detailed in-line CCTV inspection. The scope of the project includes 1.5 million feet of cleaning and in-line CCTV representing about 22 percent of the County's sewer system.

At project completion, the County will have survey grade GPS coordinates for its manholes and cleanouts, a zoom inspection and condition assessment of each manhole and pipeline, cleaned and inspected with in-line CCTV equipment the pipelines that require maintenance and repair, and GIS and CAMS databases populated with current physical and condition attributes.

This comprehensive scope of services will provide an opportunity to learn and develop best practices not only for the three other WRS projects, but for all future CAMS programs. It is anticipated that many challenges encountered in the field are expected to apply across the program to all phases.

The primary objective of the Gravity Sewer Inventory and Condition Assessment project is to verify and update the County's current sanitary sewer system information, and to compile a comprehensive understanding of the physical characteristics and condition of all of the underground sanitary sewer assets. The condition assessment will provide important information on the current operation and maintenance and structural condition of the County's manholes and pipelines. All of the information collected in the field using the CUES-IMX truck mounted zoom camera, including the results of the condition assessment of manholes and pipelines, will be entered into a personal database for integration into the County's GIS and CAMS databases. The zoom inspection vehicle will provide the level of detail and picture quality needed to perform a thorough assessment of the condition of the County's manholes and pipelines.

The videos and data captured during the zoom camera inspection of the sewer system will provide the required attribute information and data integration solution that will permit meaningful, reliable, credible and easy access to data for:

- Infiltration and inflow assessments
- Maintenance and structural needs assessments
- Sanitary sewer system risk and predictive failure modeling
- Hydraulic modeling
- Regulatory compliance including NPDES, CMOM and GASB-34
- Operation and maintenance and capital improvement program planning.

In addition to these applications for the gravity sewer data, the zoom camera videos collected may also provide additional value in case of a hurricane event. Should the County experience a hurricane that results in debris entering the sewer system or structural damage, the visual documentation of the pre-storm condition of the sewer system will prove to be valuable informa-

tion for documenting the effects of the hurricane to FEMA when filing for disaster reimbursement. The added value of this unique understanding of the condition of the sewer system could save the County thousands of dollars should a disaster strike.

Prior to initiating the field work, InfraMetrix developed an implementation plan that included written descriptions of the project procedures and protocol for County approval. The scope of work of a 1,000 manhole and pipeline pilot project was included in the implementation plan. The purpose of the pilot study was to demonstrate field activities, video quality, condition assessment output, GIS and CAMS data transfer and project deliverables.

In September 2006, InfraMetrix conducted the pilot project. The pilot project was used to demonstrate the field and office procedures and provide the County with an opportunity to modify the implementation plan before a significant amount of data and information was collected.

During the pilot project and early stages of the project, the need for some refinements to procedures became evident. As a result, InfraMetrix made minor adjustments to the data collection and office procedures to customize the field and office activities to best fit the County's needs.

In January 2007, InfraMetrix initiated the County-wide program.

Preliminary Findings GPS Survey

InfraMetrix has collected GPS coordinates for 21,801 manholes and 4,180 cleanouts. About 8 percent of the manholes visited are either buried or the survey crews could not locate them. To address this issue, the survey crews are returning to each location to make one additional attempt to find these manholes before they are reported to the County. A plan is being developed to address the manholes that were not located.

It is difficult to determine how many sewer cleanouts exist within the County's sewer system since the County has only been keeping records for approximately 10 years. Cleanouts are typically located one foot behind the sidewalk line. Survey crews have observed that cleanouts become covered by grass, making them difficult to locate. InfraMetrix is currently evaluating different approaches for locating cleanouts with the expectation that a greater majority of cleanouts are located and surveyed by the end of the project.

Zoom Camera Inspection of Manholes and Pipelines

The zoom inspection of manholes and pipelines is being conducted beginning in the northern- and southern-most extremities of the County moving toward the center. Most of the inspected manholes and pipelines are of recent vintage. The inspected manholes have been constructed of precast concrete and most of the pipelines have been constructed of PVC material.

The zoom camera crews have inspected 11,409 manholes and 12,061 pipelines (2.6 million feet) as of the end of August. It is anticipated that the zoom camera inspection of the sewer system will be completed on

schedule with five crews inspecting an average of 30 manholes and connecting pipelines per day per crew.

The field crews have encountered inflow shields and there have been minimal instances where the manhole covers were found broken or broken during removal. The County has provided InfraMetrix with spare covers to replace the defective ones.

Manhole and Pipeline Condition Assessment

The manhole and pipeline videos (zoom and in-line camera) are being reviewed by a team of Pipeline Assessment Certification Program (PACP) viewers. The viewers consider safety issues, structural defects, evidence of previous infiltration and inflow, active infiltration sources, and debris accumulation recorded by the video cameras to determine an internal condition grade for the manholes and pipelines in accordance with the defect codes for a modified Manhole Assessment Certification Program (MACP) for manholes and PACP for pipelines. Each manhole and pipeline is given an internal structural condition grade and an operation and maintenance (O&M) and construction condition grade.

After the internal condition grade is determined, an external grade is assigned to each manhole and pipeline. The external grade considers:

- Soil conditions
- Evidence of surcharging
- Groundwater table
- Evidence of previous failure
- Pipe slope and depth
- Evidence of subsidence
- Evidence of corrosion

- Location — grass, pavement, near wetlands
- Evidence of surface depression
- Difficult to access

The external grade provides a basis for evaluating other factors that may influence the risk and impact of backups, overflows and failures. The County intends to give the manholes and pipelines with the highest internal and external grade priority.

The certified PACP viewers have assessed the condition of 9,739 (85 percent) of the inspected manholes and 10,303 (85 percent) of the inspected pipelines. The condition assessment has found that approximately 20 percent of the manholes and pipelines have been assigned an O&M grade of 3 or greater and 5 percent of the manholes and 2 percent of the pipelines have been assigned a structural grade of 4 or 5. Statistically speaking, these percentages are lower than expected. The lower-than-expected results may be attributed to the fact that the County has an annual cleaning program and is successfully managing its maintenance needs and that the precast concrete manholes and PVC pipe have been properly constructed and are well within their intended life expectancies.

A final review of these results is performed to develop a list of cleaning and in-line CCTV recommendations.

Clean and CCTV

Cleaning and in-line CCTV recommendations are submitted to the County's Program Manager and to the County monthly for approval. A total of 316,412 linear feet of pipe has been recommended for cleaning. This represents approximately 16 percent of the assessed zoom camera inspected pipelines.

Only 11,579 linear feet of pipe has been recommended for in-line CCTV. This represents approximately 0.4 percent of the assessed zoom camera inspected pipelines.

Data Management

One of the greatest challenges of this project was to develop and implement an efficient and effective strategy for data management. The data management effort was divided into four areas consistent with the type data collected.

During the pilot project, daily processes and software applications were developed to manage collected survey, inspection and condition assessment data. In order to ensure compliance with existing County systems, InfraMetrix conducted a number of data source reviews and process design sessions with the County and its Program Manager. Using input from these sessions, systems were developed to manage data for the duration of the project.

Field data and the results of the condition assessment are provided to the Program Manager on a monthly basis.

Lessons Learned

The Gravity Sewer Inventory and Condition Assessment project is achieving the objectives that were developed during the planning phase of the AI&A Program. Once the two-year project is completed, the County will have performed an inventory of its 1,300-mile sanitary sewer system and addressed the immediate and near-term maintenance needs and assessed the structural needs of its buried infrastructure. As a result of the action

taken and updated condition information the risk of failures (overflows, structural, etc.) will be minimized. When the project is completed, the County will have easy access to current condition data through its GIS and CAMS databases which will be used to support maintenance and capital planning and improve system performance.

Some of the key lessons learned and benefits realized by the County include:

- **Pilot project adjustments proved to be beneficial.**

The pilot project demonstrated the field and office procedures described in the project implementation plan. Minor modifications to these procedures resulted from the pilot project. The adopted modifications addressed manhole inspection procedures, reporting of significant defects (blockages or structural), and the protocol for making recommendations and obtaining timely approval for manhole cleaning, pipe cleaning and pipe cleaning with in-line CCTV. These changes will result in repeatable and consistent manhole inspections and timely approval and execution of cleaning and CCTV to ensure that the project is completed on time.

Benefits: The pilot project provided the County with an opportunity, before a significant amount of data and information was collected, to customize the field data collection, analysis, approval process and project deliverables to best fit the County's needs. The implementation plan was updated and a copy of the final plan was provided to all project team members.

- **Locating and gaining access to manholes and pipelines on private property.**

Locating, uncovering and accessing manholes on private property has been time consuming and challenging. In some instances, crews could not gain access to the private property (no one home, locked gates, dogs, etc.). Many manholes could not be located and others were buried or inaccessible. A few were covered by structures such as utility sheds. InfraMetrix and the County devised procedures to help crews gain access and locate manholes on private property and the County is providing assistance in uncovering buried manholes.

Benefits: The GPS coordinates obtained for each manhole will prove to be beneficial in the future for routine maintenance or in case of emergency. Locating the manholes and pipelines on private property has also allowed the County to assess the maintenance and structural condition of these manholes and pipelines, clean and televise manholes and pipelines as required and determined the risk of failure for the gravity sewers located on private property.

- **Refining notification to customers.**

Understanding the critical need to inform customers of the project and associated activities occurring in their neighborhoods, several methods were devised to provide notification. Initially, a notice of the AI&A program was included with customers' bills. Magnetic signs are used on vehicles identifying

	Inspected	Assessed	O&M 3-5	%	O&M 4,5	%	PCG 4-5	%
Manholes	11,409	9,739	2,190	22	361	4	514	5
	Inspected	Assessed	O&M 3-5	%	O&M 4,5	%	PCG 4-5	%
Pipelines	12,061	10,303	1,978	19	1,478	14	184	2

Inframatrix and their subcontractors as agents of WRS. Crews also carry letters, in both English and Spanish, on WRS letterhead, signed by the director explaining the project and naming all companies involved in the field work. In addition, door hangers are used to notify residents prior to pipes being cleaned. A refinement was made to door hanger verbiage to notify residents of the potential for splashing from toilets due to back pressure from jet washing equipment.

Benefits: The customer notification procedures have served dual purposes: they have given customers information about the overall AI&A program and have also alleviated potential security concerns about inspection vehicles and field crews needing access to private property. The door hangers have also helped communicate what should be done in the home during sewer cleaning activities.

- **Keeping the GIS and CAMS database up to date.** During the project, the County has continued updating its mapping to include manholes and pipelines not included in the original database. Procedures have been developed for keeping track of the status of inspection, type of inspection (zoom or in-line CCTV), O&M and structural condition and date of last action, and these attributes have been added to the database to manage the history of each asset. Simultaneously, WRS published and finalized a complete update to its Technical Specifications and Technical Manual for Subdivision and Site Development. These documents contain all technical and procedural requirements for submittals, construction materials and methods, and final certification of infrastructure which is to be owned and maintained by WRS. A need was identified to obtain all information from new developer installed projects necessary to populate the CAMS database. WRS developed a spreadsheet listing all information required. The completed data is to be submitted with record drawings at final certification. A cooperative effort is currently under way between WRS and representatives of the development industry to develop methods for submittal of all needed information while minimizing burden on developers and their engineers. The same data submittal will be required of WRS staff and their consultants on Capital Improvement Program (CIP) projects.

Benefits: The updated GIS and CAMS databases will provide the County with easy access to current information regarding the maintenance and structural condition of its sanitary sewer manholes and pipelines. This information will be used to support maintenance and capital planning to improve system performance and regulatory compliance.

- **Identifying field tasks to improve efficiency.** During the early stages of the project, InfraMatrix identified tasks that could improve effectiveness of the project and presented its findings to WRS. The first recommended task was cleaning of manholes. Although few, some manholes had enough material build-up on internal walls, probably caused by previous surcharges, to potentially plug pipes if the debris and grease were to be washed back into the pipe. It was decided that cleaning crews could address manhole cleaning while in the field cleaning sewer lines. WRS agreed to the benefit and added the task. InfraMatrix identified a time-saving procedure to assist WRS repair crews. The original data required to be delivered includ-

ed only zoom camera videos. When repair needs were identified, WRS crews would have to retrieve the videos and review them prior to mobilizing for repairs. The suggestion was made that still photos of defects be provided to allow crews to identify the repair required and tools needed for the job. WRS agreed to the benefit and added the task.

Benefits: The County has been able to achieve other benefits not anticipated when the request for proposals was issued.

Conclusions

Hillsborough's comprehensive approach to performing an inventory and condition assessment of its 1,300-mile sanitary sewer system is proving to be a worthwhile endeavor.

- The use of the zoom cameras for initial pipe line assessment has saved significant time.
- The analysis of zoom camera data has been effective in determining the status of each pipe and when it is appropriate to proceed to the more detailed method, CCTV, on a given pipeline.
- The project is providing the County with inventory and condition data that will support an efficient and cost-effective asset management program designed to minimize the risk of failures and improve the performance of the gravity sewer system.
- InfraMatrix has been able to minimize the involvement of County field staff and the impact of this aggressive field effort over the two-year contract period to the County's sewer customers.

The field work associated with this project is nearing the midpoint of completion. After the normally expected startup issues associated with a program of this magnitude, work is progressing better than expected. The project is scheduled for on-time completion in May 2008.

The County anticipated that 22 percent or 1.5 million feet of its pipelines would require cleaning and in-line CCTV. Although the field crews have not inspected some of the older neighborhoods, the sewer system appears to be in better shape than expected. Only 16 percent of the pipelines inspected with the zoom camera require cleaning and less than 1 percent of the pipelines require in-line CCTV. No pipes requiring immediate attention have been identified. If these findings stay true, all of the pipelines rated PACP 3 or greater will be cleaned and televised during this project. An important conclusion drawn from this information is that the remaining useful life of the sewer system is better than anticipated.

The scope of work of this project is being performed for less than the cost of performing cleaning and in-line CCTV alone and will provide the services and data needed to effectively manage the needs of the County, reduce the risk of unexpected failures and improve system performance.

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