Sam M. McCall, Ph.D, CPA, CGFM, CIA, CGAP
City Auditor

HIGHLIGHTS

Highlights of City Auditor Report #0919, a report to the City Commission and City management

September 30, 2009

AUDIT OF CITY WATER INFRASTRUCTURE

Overall, Underground Utilities has appropriate processes, procedures, and systems in place to account for, manage, and maintain the City's water infrastructure and to properly plan for needed replacements and expansions. Areas were identified where enhancements are needed.

WHY THIS AUDIT WAS CONDUCTED

The City's water infrastructure is comprised of 27 active production wells; 8 elevated storage tanks; 1,224 miles of water mains; 73,440 water laterals that connect mains to customer premises; 6,949 fire hydrants; and 24,489 system and control valves. The City's water utility was established in 1907. Much of the current infrastructure has been installed gradually over time as the City grew and new areas were developed.

This audit was conducted to evaluate the processes, procedures, and systems used to (1) physically account for and manage infrastructure components; (2) maintain the infrastructure; (3) ensure new infrastructure is properly designed, constructed, and installed; (4) plan for and replace infrastructure components at the end of their useful lives; and (5) plan for and fund infrastructure expansion due to City growth and increased demand.

WHAT WE RECOMMENDED

We found that several improvements and enhancements were made in recent years. Our audit identified areas where further improvements and enhancements are needed. Accordingly, we made recommendations to:

- Improve and enhance the tracking and physical accounting for water infrastructure in the GIS software application.
- Improve and enhance the use of the Mobile Work Management System to schedule, manage, and document maintenance activities.
- Develop a viable plan for replacement of the City's aging downtown water infrastructure.

We also made recommendations in several other areas relating to the City's water infrastructure.

To view the full report, go to:
http://www.talgov.com/auditing/auditreports.cfm

For more information, contact us by e-mail at auditors@talgov.com or by telephone at 850/891-8397.

WHAT WE CONCLUDED

Overall, we found that Underground Utilities adequately accounts for and maintains the City's water infrastructure. For the most part, adequate processes are in place to ensure new infrastructure is properly designed and installed, and to ensure replacements and expansions are properly and adequately planned and funded.

We noted that Underground Utilities made several improvements and enhancements in recent years. As noted below, our audit identified areas for further improvements and enhancements.

Physically accounting for and tracking infrastructure components. Processes need to be developed to ensure all new infrastructure is properly recorded and tracked in the GIS. Also, steps need to be taken to identify critical and useful component attributes and to ensure those attributes are recorded in the GIS for subsequent infrastructure additions.

Maintaining Infrastructure. Enhancements are needed to allow for the generation of proper, logical, consistent, and informative data through the Mobile Work Management System. In addition to revising and enhancing the process for recording maintenance activities, that system should be used to plan and document sandblasting of fire hydrants and manual flushes of water mains. Efforts should be made to ensure isolation valves are exercised at prescribed frequencies and to timely repair backup equipment at City water wells in order to ensure an adequate water supply in the event City power is temporarily unavailable.

Properly designing, constructing, and installing new infrastructure. Procedures should be developed to ensure applicable projects for new infrastructure are designed or reviewed by the Water Resources Engineering staff. Better records are needed to document inspections of water infrastructure additions.

Planning infrastructure replacements. A viable plan for replacing and upgrading the City's aging downtown water infrastructure should be developed. Once developed, efforts should be made to replace that infrastructure in accordance with that plan.

Several additional improvements and enhancements are needed for water infrastructure and are identified for management's consideration and disposition.

We would like to thank the staff of the various Underground Utilities divisions for their assistance during this audit. We would also like to express our appreciation to Information System Services staff for their assistance with applicable software programs and applications.

Office of the City Auditor

Water Infrastructure

AUDIT REPORT #0919

September 30, 2009

CITY OF TALLAHASSEE
OFFICE OF THE CITY AUDITOR

Copies of this audit report #0919 may be obtained from the City Auditor's web site (http://www.talgov.com/auditing/auditreports.cfm), by telephone (850 / 891-8397), by FAX (850 / 891-0912), by mail or in person (City Auditor, 300 S. Adams Street, Mail Box A-22, Tallahassee, FL 32301-1731), or by e-mail (auditors@talgov.com).

Audit conducted by:
T. Bert Fletcher, CPA, Senior Audit Manager
Sam M. McCall, Ph.D, CPA, CGFM, CIA, CGAP, City Auditor

Table of Contents

This page intentionally left blank.

Water Infrastructure

Sam M. McCall, Ph.D, CPA, CGFM, CIA, CGAP
City Auditor

Report #0919 ***September 30, 2009***

Executive Summary

Our audit showed, overall, Underground Utilities adequately accounts for and maintains the City's water infrastructure. For the most part, adequate processes are in place to ensure new infrastructure is properly designed and installed, and to ensure replacements and expansions are properly and adequately planned and funded. Several improvements and enhancements were made in recent years. Our audit identified areas for further improvements and enhancements, including (1) tracking and physically accounting for water infrastructure in the GIS; (2) using the Mobile Work Management System to schedule, manage, and document maintenance activities; and (3) developing a viable plan for replacement of the City's aging downtown water infrastructure. In addition, we made recommendations for several other areas relating to the City's water infrastructure.

This audit focused on various processes, procedures, and systems relating to the City's water infrastructure, including accounting for, managing, installing, and maintaining that infrastructure.

This audit addressed the City's potable water system (water) infrastructure, including mains, water laterals, valves, hydrants, wells, and elevated storage tanks. The audit focused on processes, procedures, and systems used by Underground Utilities to (1) physically account for and manage infrastructure components; (2) maintain the infrastructure; (3) ensure new infrastructure is properly designed, constructed, and installed; (4) plan for and replace infrastructure components at the end of their useful lives; and (5) plan for and fund infrastructure expansion due to City growth and increased demand. The processes, procedures, and systems in effect during the time of our audit fieldwork in winter and spring 2009 were reviewed. Records of activity in recent years were also reviewed. Capital projects established for expansion and

The City's water infrastructure is comprised of various components.

replacement of the City's water infrastructure were also considered in this audit.

The City's water infrastructure is comprised of:

The City's current water infrastructure was installed gradually over time as the City grew.

- 27 active production wells;
- 8 elevated storage tanks;
- 1,224 miles of water mains;
- 73,440 water laterals (represents pipe sections connecting mains to customer premises);
- 6,949 fire hydrants;
- 24,489 system and control valves; and
- Other miscellaneous components comprised primarily of various fittings.

Capital project expenditures for water infrastructure in fiscal year 2008 totaled $9.1 million.

The City's water utility was established in 1907. Much of the current infrastructure has been installed gradually over time as the City grew and new areas were developed. New infrastructure is added by a combination of City crews, City contractors, and private developers. Costs incurred under capital projects established for the City's water infrastructure totaled $9.1 million in fiscal year 2008. The primary external regulating authorities are the Florida Department of Environmental Protection and Northwest Florida Water Management District.

Overall, processes, procedures, and systems are adequate to ensure the installation and maintenance of an appropriate water infrastructure and to provide for proper replacement and expansion.

Our audit showed, overall, Underground Utilities adequately accounts for and maintains the City's water infrastructure. For the most part, adequate processes are in place to ensure new infrastructure is properly designed and installed, and to ensure replacements and expansions are properly and adequately planned and funded. Several improvements and enhancements were made in recent years, including:

- Conversion from a "paper map" tracking system to a geographic information systems (GIS) software application to account for

and pictorially show the City's water infrastructure as components on a map;

Significant improvements and enhancements were made in recent years.

- Implementation of the Mobile Work Management System for scheduling and managing maintenance and repair work on the City's water infrastructure; and
- Replacements of certain aging and deteriorated water mains, valves, and services.

We identified issues that indicate the need for further improvements and enhancements in the management of the City's water infrastructure. Accordingly, recommendations (classified by audit objective) were made within this report for:

Physically Accounting for and Tracking Infrastructure Components:

Various issues were identified that indicate the need for further improvements and enhancements.

- Ensure new infrastructure additions are properly recorded and tracked in the GIS.
- Capture and record critical and useful component attribute data in the GIS.
- Use the GIS as the primary system for tracking all water infrastructure components.
- Ensure complete and accurate fire hydrant data is captured and recorded in the GIS as part of the ongoing "GIS data cleansing" project.
- Properly reflect all water meters and automatic flush stands in the GIS.

Maintaining Infrastructure:

- Consistently, logically, and properly collect informative maintenance data through the Mobile Work Management System.

- Provide enhanced and additional reports on maintenance activities to management for oversight purposes.

- Review and resolve "old" outstanding maintenance work orders.

- Use the Mobile Work Management System to plan and document sandblasting and painting of fire hydrants.

- Document manual flushes of water mains and the quantities of water used in those flushes.

- Increase efforts to exercise isolation valves at the frequency established by City procedures.

- Timely repair backup equipment at City water wells so that an adequate water supply is available in the event City power is temporarily unavailable.

- Ensure contracted engineers performing required structural inspections of elevated storage tanks are currently licensed.

Properly Designing, Constructing, and Installing New Infrastructure:

- Properly design or review projects involving installation of new water infrastructure.

- Prepare better records to document inspections of water infrastructure additions.

- Perform required water quality tests before new infrastructure is placed into service.

- "Self-permit" water infrastructure additions as required by the FDEP.

- Refer to complete material specifications when ordering and purchasing water infrastructure components.

Planning Infrastructure Replacements:

- Develop a viable plan to replace and upgrade the City's aging downtown water infrastructure.

- Resume the City's fire hydrant replacement program upon finalization of applicable funding determinations and related decisions.

Other:

- Establish documented procedures for various processes and activities.

We would like to thank staff in the various Underground Utilities divisions for their assistance during this audit. We would also like to express our appreciation to Information System Services staff for their assistance with applicable software programs and applications.

This page intentionally left blank.

Water Infrastructure

Sam M. McCall, Ph.D, CPA, CGFM, CIA, CGAP
City Auditor

Report #0919 ***September 30, 2009***

Objectives

The purpose of this audit was to determine if Underground Utilities properly installs, tracks, maintains, replaces, and expands the City's potable water system infrastructure.

The objectives of this audit were to determine (1) whether adequate and complete records are maintained that enable Underground Utilities to effectively and efficiently track, monitor, and manage the City's potable water system (water) infrastructure; (2) whether Underground Utilities has a process in place to ensure that the City's water infrastructure is appropriately maintained in accordance with industry standards and state regulations; (3) whether Underground Utilities has a process in place to ensure that additions and changes to the City's water infrastructure (expansions, relocations, and replacements) are properly designed, constructed, and installed as prescribed by City specifications and controlling state regulations; (4) whether Underground Utilities has an adequate process for planning, funding, and providing for replacement of certain water infrastructure components at the end of their useful service lives; and (5) whether Underground Utilities has an adequate process for planning and funding water infrastructure expansion due to City growth and increased demand.

Scope

This audit focused on the current water distribution infrastructure and related processes.

Water infrastructure addressed by this audit included mains, service lines (also known as water laterals), valves, fire hydrants, wells, and elevated storage tanks. For the most part, water meters were excluded from the scope of this audit as they are being replaced under the current Smart Metering Project. Sewer, wastewater, and stormwater infrastructure, as well as "reuse distribution" infrastructure, were also excluded from the scope of this audit.

For the infrastructure included in the scope of this audit, we reviewed Underground Utilities' processes established to install (construct), maintain, and account for the related components. Processes and programs for planning needed expansion and replacements were reviewed. The audit focused on the processes

that were in effect during the time of our audit fieldwork, which was conducted primarily in winter and spring 2009. Records of activity in recent years were also reviewed. Capital projects established for the expansion and replacement of the City's water infrastructure were considered in this audit.

(NOTE: Technical areas which audit staff was not qualified to address were excluded from the scope of this audit. For technical areas that were addressed in this audit, audit staff relied, at least in part, on understandings and explanations provided by knowledgeable individuals, primarily Underground Utilities engineering, operational, and maintenance staff, in the completion of audit procedures.)

Methodology

We conducted various audit procedures to address the stated audit objectives. Those procedures included making audit observations, conducting interviews of knowledgeable personnel, and inspecting and analyzing applicable records and reports. Specific audit methodologies and procedures included the following:

We identified and reviewed processes, made observations at selected locations, interviewed knowledgeable staff, and analyzed recorded activity.

- We identified and reviewed federal and state regulations that pertain to and govern the City's water infrastructure.
- We reviewed the current Master Water Plan established for the City, as well as the ongoing update of that plan.
- We reviewed the "consumptive use permit" issued by the Northwest Florida Water Management District (NWFWMD), which specifies the quantities of water the City is authorized to produce.
- We researched various information on the Internet regarding water infrastructure, including physical characteristics of different materials used for infrastructure and "main replacement" programs established by other governments.

- We made site visits to observe various water infrastructure and related processes pertaining to maintenance, accountability, and installation.

- We identified the records and software applications used to document and account for the various water infrastructure components. We conducted various tests and analyses of those records, as well as interviews of applicable staff, to determine the composition of the City's water infrastructure, as well as, the accuracy and completeness of those records.

Numerous processes, items, and records were reviewed, observed, and analyzed.

- We identified and analyzed records and software applications used in the maintenance of water infrastructure components.

- We determined if applicable maintenance staff were licensed in accordance with controlling regulations.

- We reviewed records pertaining to recent installations, relocations, and replacements of water infrastructure to ascertain if proper inspections and procedures were performed for the purpose of ensuring installed materials and installation methods met City specifications and state requirements.

- We reviewed the process for acquiring water infrastructure materials and components to determine if items purchased for installation by City crews met City specifications and industry standards.

- We observed and inspected the inventory of water distribution infrastructure components (pipe, valves, and hydrants) maintained at the City's Municipal Supply Center (MSC) to determine whether those components met City specifications and whether the inventory was adequately stored and protected.

- We identified and reviewed capital projects and processes pertaining to expanding, relocating, and replacing City water infrastructure.

- We analyzed leak activity documented in the City's maintenance system to identify water infrastructure that may be in need of replacement.

The auditor performing the described audit procedures was not a trained or educated engineer. As a result, reliance was placed on assistance and explanations provided by knowledgeable individuals (primarily Underground Utilities engineering, operational, and maintenance staff) in the completion of some of those procedures. Accordingly, the basis for our audit conclusions relating to technical areas included in the scope of this audit is knowledge and understandings obtained through interviews and discussions with knowledgeable Underground Utilities staff, in conjunction with reviews of applicable technical materials and observations of items or processes.

To complete the audit procedures, audit staff relied, in part, on the explanations and assistance provided by knowledgeable Underground Utilities staff.

We conducted this audit in accordance with the International Standards for the Professional Practice of Internal Auditing and Generally Accepted Government Auditing Standards. Those standards require we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

The City of Tallahassee Water Utility was established more than one hundred years ago, in 1907. In April 2008, the water, gas, and stormwater utility functions were consolidated into a single department, Underground Utilities. Oversight, management, and maintenance of the City's water infrastructure are responsibilities of that new department.

The City's water utility was established approximately 100 years ago.

Composition. Our analyses performed in winter 2009 showed the City's water infrastructure was comprised of the following components:

The current infrastructure consists of 27 wells, 8 elevated storage tanks, 1,224 miles of mains, 73,440 water laterals, 6,949 fire hydrants, and 24,489 valves.

- 27 active production wells.
- 8 elevated storage tanks (excluding the water storage tank at Purdom Power Plant which is used exclusively by that plant with the generation of electricity).
- 1,224 miles of water mains.
- 73,440 water laterals, representing pipe sections connecting water mains to residential or commercial premises or to fire hydrants.
- 6,949 fire hydrants.
- 24,489 system and control valves (excluding valves on individual service lines).
- Other miscellaneous components comprised primarily of various fittings (e.g., bends, caps, sleeves, taps, etc.).

Although in existence since 1907, much of the current City water distribution infrastructure has been installed gradually over time as the City grew and new areas were developed.

Infrastructure description. The following provides selected descriptive information on the various water infrastructure components.

The oldest of the City's 27 active wells was established in 1939 and the newest in 2008; new wells are planned.

Wells. The oldest of the City's 27 active wells was established in 1939 and the newest was established in 2008. In addition to these 27 active wells, the City has four abandoned wells that are no longer used to produce water. Underground Utilities currently has plans to establish a new well on Old St. Augustine Road to meet increased demand and provide system reliability in the area north of Southwood. Consideration is also being given to establishment of a second new well to help meet demand of developments near Ox Bottom Road. Current funding concerns may delay the final design and construction of that second well.

The 27 active City wells produced 11.2 billion gallons of water in 2008.

The City's consumptive use permit issued by the NWFWMD allows the City to make a combined (all wells) average annual withdrawal of 33.7 million gallons per day, with a maximum combined withdrawal of 59.3 million gallons on any one day and 1.4 billion gallons in a single month. For the most recent calendar year (2008), Underground Utilities reported that it withdrew a combined total of 11.2 billion gallons from all City wells.

The oldest of the City's eight elevated storage tanks was established in 1947 and the newest in 1995.

Storage Tanks. The oldest of the City's eight elevated storage tanks was placed into service in 1947 and the newest was placed into service in 1995. The combined capacity of the eight tanks is almost 5.2 million gallons. Underground Utilities is currently designing a new storage tank to augment the water supply for the area north of Southwood. Construction of that tank is planned to start in 2010.

City mains are comprised of PVC, cast iron, ductile iron, asbestos cement, and other materials.

Mains. City water mains range in size (diameter) from 2 inches to 16 inches, with 2, 4, 6, 8, 10, and 12-inch the most prevalent sizes. Based on Underground Utilities records, the City's 1,224 miles of water mains are made of the following materials:

- Polyvinyl chloride (PVC) – 566 miles.
- Cast Iron – 241 miles.
- Ductile Iron – 135 miles.
- Asbestos Cement – 91 miles.
- Unknown and other – 191 miles.

A small portion (approximately 20 miles) of the 1,224 miles of main are shown by Underground Utility records as owned by Florida State University (FSU) or unnamed private entities.

The City currently uses ductile iron, PVC, or HDPE pipe for new mains.

The City's current specifications for new mains provides for ductile iron for relatively larger mains and PVC or high density polyethylene plastic (HDPE) for relatively smaller mains. Cast iron and asbestos cement mains are no longer manufactured or used by the City for new water infrastructure installations. (Our research shows that asbestos cement was discontinued due to health concerns; but to date there has been no positive link of those mains to health problems and our research shows that there currently is no

health or regulatory reason to replace existing asbestos cement mains.)

Water Laterals. An individual water lateral represents a pipe segment between the main and the applicable service. A "service" can be a residential or commercial/industrial premises or a fire hydrant. More than one water lateral (or pipe segment) can be used for an individual service. For example, most fire hydrants are served by two laterals. The first lateral runs from the main to the hydrant valve, and the second runs from the hydrant valve to the hydrant.

Our analysis of Underground Utilities records show the 73,440 water laterals consist of the following types:

- 58,381 domestic (or residential).
- 11,819 fire hydrant (i.e., provides water from a main to a fire hydrant).
- 2,218 commercial and industrial.
- 838 fire (i.e., serves a fire suppression system, such as a building sprinkler system).
- 184 other (e.g., service lines installed to flush mains or provide irrigation services to a premises).

The majority of water laterals are comprised of copper and ductile iron.

A small percentage (1.6%, or 1,185 segments) of the 73,440 water laterals are shown by Underground Utilities records as owned by unnamed private entities.

Current City specifications provide that copper, ductile iron, and HDPE pipe be used for new water laterals.

The majority of water laterals are comprised of copper (e.g., serving residential and commercial premises) and ductile iron (e.g., serving fire hydrants). The City's current specifications for new water laterals provides for continued use of ductile iron for hydrants, but allows for high density polyethylene plastic (HDPE) pipe in addition to copper pipe for other (generally smaller) size service lines.

Fire Hydrants. Of the 6,949 fire hydrants reflected in Underground Utilities records, 6,179 are shown as owned by the City. Records

A few of the 6,949 fire hydrants in GIS are owned by non-City entities

show the remaining hydrants are owned by Talquin Electric Cooperative (514 hydrants), FSU (98 hydrants), and unnamed private entities (158 hydrants). The owners for the unnamed private entities include shopping malls and other commercial entities.

Standards for new hydrants specify various characteristics, including size of the valve opening, thread type, and "hydrastorz" couplings.

While various size and type hydrants have been installed over the years, the City's current specifications identify certain manufacturer models to be used for new installations and replacements. Each of the identified models must meet certain requirements; including size of main valve opening (5 ¼ inches), thread type (national standard threads), and other characteristics, such as a factory installed "hydrastorz" coupling to allow a quick connection by the fire department.

Valves. Valves are classified into two primary categories – system valves and control valves. Of the 24,489 total valves shown by Underground Utilities records, 24,004 are system valves and 485 are control valves.

Most of the City's valves are system valves used to control and isolate the flow of water through the system.

System valves are used to control the flow of water through pipes. In simple terms, they are used to turn water on and off. Strategically placed system valves can be used to isolate sections of the City's water distribution network. For example, in the event of a major leak or needed repairs, isolation valves can be used to turn water off in the impacted areas without disrupting service in other areas. The four primary types of system valves include (1) gate valves, (2) ball valves, (3) butterfly valves, and (4) curb cock valves. The most common types in the City's water distribution network are gate and ball valves.

Control valves are used to preclude contaminated water from entering the system.

Control valves are used primarily to preclude contaminated water from infiltrating the system (backflow valves) and to purge the system of stagnant water (blow off valves).

Installations. Traditionally, water infrastructure expansion and replacement has been performed by a combination of City crews, City contractors, and private developers. For example, City crews or contractors hired by the City may be used to install new

Water infrastructure is installed by a combination of City crews, City contractors, and private developers.

infrastructure as part of a road improvement project. On the other hand, a private developer may have water infrastructure installed when developing a new neighborhood. Upon completion of that development, the City will take ownership of that infrastructure. Regardless of the method, Underground Utilities is responsible for ensuring the infrastructure is properly designed and installed using appropriate materials.

Underground Utilities divisions. Underground Utilities is comprised of various divisions and sections. Those divisions and sections critical to the scope of our audit included the following:

Several Underground Utilities divisions were critical to the scope of this audit.

- Construction and Operations – responsible for installing new infrastructure and various maintenance and repair activities relating to mains, water laterals, valves, and fire hydrants.
- Gas Operations and Regulatory Compliance – exercises water valves (maintenance activity) at the same time that gas valves are exercised.
- Water Quality – responsible for water production and operation, maintenance, and repair of City wells and storage tanks.
- Water Resources Engineering – responsible for design and inspection of new infrastructure, establishing specifications for new infrastructure, and determining future needs relative to expansion and replacement.
- Business and Technology Development – maintains and updates the water infrastructure depictions and attributes in the Geographic Information System (GIS) and maintains the Mobile Work Management System. (These two systems are described in the following section.)

Software applications. There were two software applications critical to the scope of this audit, each described below.

Geographic Information System (GIS). The GIS depicts the water infrastructure components described previously (wells, storage

tanks, mains, water laterals, valves, fire hydrants, and fittings) in a pictorial geographical display (i.e., pictorially as components on a map). In addition to the pictorial depictions, various attributes for each component are captured in that software. The GIS displays are linked to official drawings (termed "tie sheets") of the infrastructure prepared by engineers and/or technical staff at the time the infrastructure was installed or modified.

The GIS and Mobile Work Management System are used to account for and manage work performed on much of the City's water infrastructure.

The GIS provides for a physical accounting and depiction of the City's water infrastructure. It serves as a valuable tool to Underground Utilities staff in the management and maintenance of the City water infrastructure. The City converted to the GIS in June 2002. Prior to that time the City used a paper map system to track and account for water infrastructure.

The primary regulatory authorities are the Florida Department of Environmental Protection and the NWFWMD.

Mobile Work Management System. This system is used to manage and document various work performed on the water infrastructure. Work orders are created in and dispatched through the system to applicable staff for various activities, including repairs, inspections, and other maintenance tasks. Employees that perform the applicable tasks document the completion of that work within the system (i.e., on the dispatched system work orders).

Water infrastructure capital project expenditures in 2008 totaled $9.1 million.

Regulatory authorities. The primary authority that controls and regulates the City's water distribution infrastructure is the Florida Department of Environmental Protection. In addition, the Northwest Florida Water Management District (NWFWMD) performs certain regulatory and permitting functions.

Water infrastructure project costs. As shown in the following table, costs incurred under capital projects established for the City's water infrastructure in fiscal year (FY) 2008 totaled $9.1 million.

Table 1 – FY 2008 Project Expenditures

CATEGORY	Number of Projects	FY 2008 Expenses	Description
Main and Valve Replacement/Upgrade	29	$2,936,239	Replacements of mains and valves, including upgrades and adjustments during road improvements.
Wells and Tanks	17	$2,296,249	Design and construction of new wells, upgrades to equipment, carbon bed (filter) replacements, renovations, inspections and cleanings, security system improvements, etc.
New Services	3	$559,740	Installing new services to customers.
Minor Main Extensions	8	$149,911	Extension of mains into new areas.
Maintain Existing Infrastructure	5	$634,218	Flushing mains, painting hydrants, and exercising and adjusting valves.
Meter Changeout Program	1	$197,962	Replacing meters.
Reuse/Reclamation	8	$1,193,414	Costs associated with reclaiming and reusing water.
New Hydrants	2	$75,807	Installing new hydrants.
Replace Old Services	1	$778,994	Replacing old service lines (water laterals).
Repaving Streets and Roads	1	$348,043	Repairing roads and streets damaged during repairs on underground pipes and fittings.
TOTAL	**75**	**$9,170,577**	

Overall Summary

Overall, adequate records, processes and procedures are in place to account for and ensure a proper and reliable infrastructure; areas for further improvements and enhancements were identified.

The results of audit procedures showed, overall, Underground Utilities adequately accounts for and maintains the City's water infrastructure. For the most part, adequate processes are in place to ensure new infrastructure is properly designed and installed, and to ensure that replacements and expansions are properly and adequately planned and funded. Some of those processes and procedures are the result of recent improvements and enhancements. We also identified issues that are indicative of the need for further improvements and enhancements to the management of the City's water infrastructure. Those issues, and related processes and procedures, are addressed in the following sections of this report.

Accounting for the City's Water Distribution Infrastructure (Objective 1)

A GIS application is used to account for and provide pictorial displays of the various water infrastructure components.

Overview. A complete and accurate physical accounting and representation of City water infrastructure is essential to efficient and effective maintenance and management of infrastructure components. In addition to tracking specific locations of individual components, an accurate and complete system provides useful information as to a component's material type, size, age, status (active or abandoned), etc. That information is critical for various reasons, including:

- Tracking components for service and maintenance.
- Timely locating components during emergencies (e.g., major leaks or catastrophes).
- Providing information needed to plan for expansions and replacements (e.g., based on infrastructure age, service history, material type, etc.).

Component attributes can be tracked in the GIS.

As noted previously, in regard to physically accounting for and tracking the various components of the City's water infrastructure, Underground Utilities uses a GIS application. That application captures and stores geographically referenced data and associated attributes that can be displayed graphically (i.e., pictorially as components on a map). That geographically referenced data and

related attributes can be edited, updated, analyzed, and managed through the software's tools and applications. The GIS application is much more efficient than the former paper map system used by the City prior to June 2002.

While we found the GIS to be a useful, efficient, and effective tool for tracking and physically accounting for water infrastructure components, we noted that further improvements and enhancements are needed, as explained in the following.

RECOMMENDED IMPROVEMENTS AND ENHANCEMENTS

Additional enhancements should be made to ensure that new and upgraded infrastructure is added to and reflected in the GIS. The City's relatively recent conversion from a paper map system to the GIS has significantly enhanced Underground Utilities' ability to efficiently track and account for the City's water infrastructure components. We commend Underground Utilities for that conversion. As explained in the following, additional enhancements will further improve the ability to track those components for maintenance and other purposes.

City standards require official drawings of new infrastructure be prepared and provided as a source for updating the GIS.

Regardless of whether new infrastructure is installed by City crews or by City or developer contractors, an official drawing of the additions must be prepared. For most installations, City standards specify those official drawings must be prepared by a registered land surveyor, licensed in Florida. Those drawings reflect added components, including their dimensions, material type, and actual location. The Underground Utility uses the term "As-Built" to define those drawings.

For new infrastructure components installed by developer or City contractors, the developer or contractor is responsible for having the As-Built drawings prepared and submitted to the City. Those drawings are generally submitted by the developer/contractor to the Water Resources Engineering Division and to the Business and Technology Development Division. For new infrastructure components installed by City crews, the City uses a contracted registered land surveyor to prepare the As-Built drawings. Those

drawings are also provided to the Business and Technology Development Division. After review and approval, staff of the Business and Technology Development Division use the As-Built drawings as the basis for recording the new infrastructure and related attributes into the GIS.

For relatively minor installations of new infrastructure by City crews, As-Built drawings are sometimes not obtained from the contracted registered land surveyor. Instead, City crews installing the new infrastructure prepare official "field drawings" that identify and reflect the added components and related attributes. Similar to the As-Built drawings, those field drawings are to be submitted to the Business and Technology Development Division and used to record the related infrastructure components and attributes into the GIS.

Regardless of whether an official As-Built or a field drawing, the drawings provide critical information for tracking and accountability purposes, especially since many infrastructure components are concealed and hidden (e.g., buried water mains and valves).

Contrary to the intent of the described procedures, our audit showed the GIS was not always updated for new infrastructure additions. As shown in the following, those instances include installations by contractors as well as by City crews.

- For seven sampled projects managed and overseen by Water Resources Engineering and for which As-Built drawings were provided by applicable contractors/developers installing the new infrastructure, we determined:

  – For two projects, none of the new infrastructure was added to the GIS. The projects included additions of several sections of 8-inch mains and related valves and a fire hydrant. The City received the applicable As-Built drawings in April 2007 and early October 2008. Our audit analysis was performed in early February 2009. Accordingly, periods of 4 and 21

Improved controls are needed to ensure the GIS is properly updated to reflect new infrastructure installations.

months had elapsed since the City's receipt of those drawings.

- For two other projects, most of the new infrastructure was entered into the GIS. However, several components were not entered and/or the related attribute data was not recorded or was recorded incorrectly. This included (1) various valves and hydrants not being recorded, (2) not recording main and valve diameters, and (3) recording the incorrect model type for hydrants.
- The new infrastructure for the remaining three projects was properly and accurately entered into the GIS.

- For seven additional sampled projects in which City crews installed the infrastructure and for which As-Built drawings were provided by the City's contracted registered land surveyor, we determined:
  - For four projects, none of the new infrastructure was added to the GIS. The projects included various main extensions in different areas within the City and installation of related valves, water laterals, and fire hydrants. As of the date of our audit fieldwork in early February 2009, periods ranging from 5 to 15 months had elapsed since the City's receipt of the As-Built drawings.
  - For two other projects, most of the new infrastructure was correctly entered into the GIS. However, a few water laterals were not entered for one project and the material and diameter of 400 feet of main was not entered for the other project.
  - The infrastructure for the remaining project was properly and accurately entered into the GIS.

Infrastructure additions not added to GIS included installations by City crews as well as by City/developer contractors.

- For 12 sampled projects where new infrastructure was installed by City crews and for which field drawings were sometimes prepared (instead of As-Built drawings), we determined:
  - For five projects the applicable components and related attributes had not been entered into the GIS. New additions not entered included 6-inch main sections (replaced old 2-inch mains) and 12-inch main sections (replaced 10-inch mains). As of the date of our fieldwork, periods ranging from 6 to 11 months had elapsed as of the dates the respective field drawings were prepared.
  - The infrastructure for the remaining seven projects was properly and accurately entered into the GIS.

Underground Utility staff acknowledged that improved controls were needed to ensure infrastructure additions are entered into the GIS.

Responsibility for ensuring new infrastructure is recorded in the GIS should be assigned to a project manager.

To ensure an accurate and complete depiction and physical accounting of City water infrastructure, we recommend that a formal process be established for identifying and tracking external and internal projects involving the addition of new components to the infrastructure. Such a process should include assigning responsibility to a designated employee (e.g., project manager) for ensuring the new infrastructure is properly and accurately entered into the GIS. Consideration should be given to development and use of a formal checklist by applicable staff (e.g., the project manager) to document their verification that the infrastructure was recorded in the GIS. Management should periodically confirm the process is being followed.

(NOTE: In our discussions on the above-described issue, Water Resources Engineering Division staff indicated some instances where new infrastructure does not get added to the GIS may be attributable to a lack of formal procedures that specify when As-Built or alternative drawings are to be obtained for installations that are not part of an approved capital project or for which no formal letter of agreement is executed with a private developer.

Accordingly, to help ensure appropriate drawings are obtained for all infrastructure additions involving water mains, hydrants, valves, and related fittings, we recommend a formal procedure be established that requires private developers, that do not execute formal letters of agreement with the City, to provide appropriate As-Built or field drawings.)

Tracking key or critical component attributes enhances the ability to adequately and properly manage the City's water infrastructure.

Additional efforts should be made to ensure that critical attribute data is recorded in the GIS for subsequent water infrastructure installations. As described previously, various attributes of infrastructure components can be recorded and tracked in the GIS. While not necessary to capture all attributes, capturing and recording certain "key" (critical) attributes for applicable components enhances the Underground Utilities' capability to manage and maintain those components. Critical attributes include, for example, material type, size (i.e., pipe diameter), installation date, owner (City or other entity), status (active or abandoned), length (e.g., for main segments), and subtype (e.g., gate or ball valve).

The City's water infrastructure has been installed over the last 100 years as the City has grown and expanded. Records documenting many of those expansions are either no longer available or lack sufficient data relating to critical attributes. Accordingly, for the most part, the GIS reflects a lack of critical attribute data for many existing infrastructure components. In addition, as procedures have not been developed to specify what constitutes critical attributes, we found some recent infrastructure additions for which critical attributes (or what likely represents critical attributes) are not recorded in the GIS.

We met with knowledgeable Underground Utilities staff to identify infrastructure component attributes that are essential for managerial and maintenance purposes. We classified those attributes into two categories: (1) "critical" and (2) "useful" but not critical. We then summarized and analyzed recorded attribute data in the GIS. We found that many of the critical and useful attributes were recorded in the GIS, and the recorded values were logical and appropriate.

Key attribute data was often not captured or retained over the last 100 years as the water infrastructure grew and expanded; accordingly, GIS does not reflect all critical attributes for many components.

However, we noted instances where critical and other useful attributes were not recorded, or the recorded values were not logical or appropriate. Those instances included, but were not limited to, the following:

- Installation dates were not recorded for the vast majority of components.
- Diameter was not recorded for various valves, mains, water laterals, and hydrants.
- Depth was not recorded to reflect the distance between certain buried components (mains, water laterals, and valves) and the surface.
- Joint type was not recorded for most mains.
- Pipe classification and pressure rating were not recorded for mains.
- Transmission mains (large diameter mains that provide water to smaller mains from which service taps are made) were not consistently designated.
- By pass ability (whether or not a valve could be isolated from the system through a by pass valve) was not designated for many system ball valves.
- Direction to turn valves (for opening and closing) was incorrect or not recorded for the majority of the valves.
- Whether valves were normally open or closed was not designated for a significant portion of valves.
- Whether or not a hydrant had an associated hydrant valve (i.e., can be used to isolate the hydrant) was not designated for a significant number of hydrants.
- Whether hydrants had hydrastorz couplings (allows for fast connection to a fire hose) was not designated for a significant number of fire hydrants.
- Model type was not recorded (or not logical based on other attributes) for many hydrants.

- Material type was not shown for a significant number of water laterals.

Underground Utilities has undertaken several actions to capture critical and useful attribute data; the success of those actions for existing infrastructure will be limited due to various circumstances.

In a positive and proactive effort to address these circumstances, Underground Utilities has undertaken several actions as described in the following:

- A "GIS data cleansing" project was established and funded, whereby Underground Utilities staff is currently correcting the GIS for incomplete and inaccurately recorded components and attributes based on physical observations. That project is generally limited to completing and correcting data for components that can be physically observed (e.g., hydrants and some valves).
- The Underground Utilities' current contract for updating the City's Master Water Plan includes provisions for the contractor to assist the City in determining actual or estimated "installation dates" for existing components, and updating the GIS for those determinations. That process will likely not address other incomplete or inaccurate attributes.
- For recent infrastructure additions, efforts were made to record many of the critical and useful attributes. However, as shown by our analyses, instances are still occurring where critical attributes are not recorded.

Underground Utilities should identify critical and useful attributes and require those attributes to be recorded for each new component subsequently added to the City's water infrastructure.

We acknowledge and commend Underground Utilities for these actions and efforts. Notwithstanding, because of the noted limitations and circumstances, it is likely that much of the attribute data for previously installed components (i.e., over the last 100 years) will remain incomplete.

To address the lack of complete and accurate attribute data going forward, we recommend Underground Utilities formally identify/designate critical and useful attributes for each component, and require those attributes to be recorded in the GIS (and systems succeeding the GIS) for each component added to the City's water infrastructure subsequent to the adoption of that process (i.e., for "new" components). Under that process, contractors, developers,

and City staff installing new infrastructure should be responsible for providing the required attribute data. Checklists should be developed and used by the Business and Technology Development staff to assist in ensuring critical and useful attribute data is properly captured and recorded.

Emphasis should be given to the on-going efforts to identify and record approximate installation dates for existing components.

We recommend that Underground Utilities also emphasize the successful completion of on-going efforts to identify and record approximate installation dates for existing components as part of the on-going Master Water Plan update. As noted in a subsequent issue within this report, installation dates are useful in determining ages of the components for purposes of determining their expected useful lives. That information is useful for planning and budgeting infrastructure replacements. (Note: In meetings subsequent to the completion of our audit fieldwork, Underground Utilities staff stated that these efforts were being made but their initial success was limited to a lack of sufficient data in some instances to provide reasonable approximations of installation dates. Nonetheless, efforts are continuing to develop approximations of installation dates where adequate date is available.)

Consideration should be given to using the GIS as the primary system to track and account for wells, storage tanks, and privately owned backflow valves. Some water infrastructure components are currently tracked and accounted for in systems or records separate from the GIS. Specifically:

Separate records are used to track comprehensive data for water wells, storage tanks, and backflow valves.

- For City water wells and elevated storage tanks, the Water Quality Division maintains separate Excel documents that identifies each well and tank and various critical and useful attributes related to those components. While similar data is recorded in the GIS, we found the Excel records to be more comprehensive. Some of the attributes identified and tracked on the Excel records but not in the GIS include storage tank location, installation dates, production and storage capacities, existence of auxiliary back-up equipment, casing and bowl diameters, stored chemicals, and complete and accurate elevation and depth data. Accordingly, to obtain complete and

accurate information on water wells and storage tanks requires access and use of the separately maintained Excel records.

- To protect the City's potable water supply from contamination, certain water customers must install backflow control valves on their premises to preclude undesirable water from flowing back into the City's system in the event of an accident or catastrophe. For example, without a backflow control valve, swimming pool water (treated with chemicals not suitable for drinking) at a private residence could flow back into the City's water supply in the event of a sudden loss of pressure in the City's water distribution system. Applicable customers are required to have their backflow control valves checked annually to ensure they are operational. The Water Quality Division is responsible for tracking those valves and ensuring they are inspected annually.

  The Water Quality Division uses a separate Access database to identify and track those valves and the annual inspections. Those records reflect approximately 13,700 valves. Comprehensive data is maintained in the Access database regarding attributes and inspections. For the most part, those valves and related attributes are not tracked in the GIS (i.e., the GIS reflected only 272 backflow control valves at the time of our fieldwork).

While the separate Excel and Access records used to track water wells, storage tanks, and backflow control valves are effective, it will likely be more efficient to track that information in the GIS. Advantages of using the GIS as the primary record include:

Due to various advantages and efficiencies, consideration should be given to using the GIS as the primary system to track wells, storage tanks, and privately owned backflow valves.

- All water infrastructure components are identified and tracked in a single system, thereby making it easier and more efficient for management and staff to access and review infrastructure data and status.
- All components can be pictorially displayed (i.e., as noted, privately owned backflow control valves are generally not shown in the GIS).

- Controls and procedures/requirements applicable to the GIS will help ensure data integrity and accuracy of recorded information for all infrastructure components.

Accordingly, we recommend Underground Utilities consider using the GIS as the primary record for water wells, storage tanks, and privately owned backflow control valves.

Overall, the GIS Data Cleansing Project has been successful in enhancing the accuracy of the City's water infrastructure components as reflected in the GIS.

The Underground Utilities' proactive efforts have significantly enhanced accountability for certain infrastructure components through the on-going "GIS data cleansing" project; additional efforts should be made during that process to ensure complete and accurate data for fire hydrants is captured and recorded in the GIS. As previously noted, Underground Utilities established the GIS data cleansing project as part of its proactive efforts to enhance accountability of City water infrastructure components. (Certain sewer and gas infrastructure components are also included in the project.) Under this project, the City area containing water (and other) infrastructure was segregated into 191 square miles. A two-man Underground Utilities crew is visiting each square mile. During those visits, the crew travels all streets and related areas for the purpose of observing and identifying each visible or locatable infrastructure component (i.e., specialized tools are used when necessary to locate buried valves). The crew determines if each observed component is correctly depicted in the GIS as to description, location, and certain attributes. For components not depicted in the GIS or for which identifiable attributes/location data is incomplete or incorrect, the crew captures and provides the appropriate information to the Business and Technology Development Division. Staff in that division then enters the corrected information in the GIS. As of June 12, 2009, Underground Utilities reports reflect that the two-man crew had surveyed 120 of the 191 square miles, with appropriate corrections/updates made to the GIS for those surveyed areas.

We commend Underground Utilities for these efforts. This project has resulted in significant improvements to recorded data for the City's water, sewer, and gas infrastructure. However, our visit to

a selected area (square mile), for which the two-man crew had already completed its physical observations and corrections, showed that some fire hydrants and related attributes were not identified or corrected in the GIS. Specifically, for 11 sampled fire hydrants, we found:

Enhanced efforts should be made to capture and record complete and accurate hydrant data for areas not yet surveyed.

- Attribute data including barrel diameter, height to nozzle, model, year manufactured, and existence of a hydrant valve and hydrastorz coupling was not recorded in the GIS for one hydrant.
- For four hydrants, the GIS indicates hydrant isolation valves exist when our observations and review showed those valves do not exist. (Underground Utility staff participated in these observations and determinations.)
- For four hydrants the model type was not recorded in the GIS.
- For two hydrants the year manufactured was not recorded or was recorded incorrectly.
- For one hydrant the recorded barrel diameter was incorrect.
- For one hydrant the recorded manufacturer (indicates type of hydrant) was incorrect.

The described exceptions pertained to 9 of the 11 sampled fire hydrants. In these instances, it was not apparent if the two-man crew did not observe and/or capture the hydrant or related attribute data, or if the attribute information was captured but inadvertently not entered into the GIS. Regardless, for remaining areas to be observed, we recommend that additional efforts be made to ensure complete and accurate hydrant data is captured and entered into the GIS as appropriate. Based on current Underground Utilities reports, there are approximately 3,000 hydrants to be surveyed in the remaining 71 square mile sections not yet visited by the two-man crew. We also recommend Underground Utilities consider sending staff back to sample hydrants already surveyed to determine whether or not our findings in the sampled square mile were isolated or representative of all hydrants surveyed to date.

A process should be established to timely remove preliminary meter depictions in the GIS when the actual water meters are installed.

Underground Utilities should develop a process to provide for timely removal of preliminary (or "virtual") meter depictions in the GIS after the actual meters are installed and depicted for the applicable premises. In certain instances (primarily new subdivisions), As-Built drawings showing the new infrastructure components are prepared and provided to the Underground Utilities Business and Technology Development Division after the primary infrastructure components (e.g., water mains, hydrants, system valves) are installed along roadways and other right-of-ways, but before the actual premises (e.g., new houses or other facilities) are built. In many of those instances, the completed As-Builts show where meters will be installed, although the actual premises have not yet been established (e.g., built). To maintain a current system, Business and Technology Development Division staff determined it prudent to record (or depict) the pending meter installation in the GIS. That recording, or preliminary depiction of a pending meter installation, is termed for purposes of this report as a "virtual" meter.

When a premises exists, the recording of the actual meter installation in the GIS is an automated process. For an individual premises, that automatic recording in the GIS occurs when:

- The premises is established (e.g., house is built);
- A service point (i.e., connection to the City's water supply) is physically created at the premises and a meter is installed;
- An account is created in the City's PeopleSoft Customer Information System (utility accounting and billing system) for that premises and service point; and
- An automated interface is run between the PeopleSoft Customer Information System and the GIS.

While this practice is reasonable and appropriate, there is no automated process to remove the "virtual" meters after those occurrences. Our review and discussions with staff show there are approximately 6,000 virtual meters reflected in the GIS for which

the actual meters are also shown in the GIS. (To put this in perspective, the GIS reflected 88,703 water meters at the time of our audit fieldwork.)

To avoid a pictorial depiction of two meters (one a virtual meter and the other the actual meter) at the same premises when only one meter exists for that premises, we recommend a process be developed to timely remove virtual meters from the GIS.

The GIS needs to be updated to reflect all automatic flush stands.

The GIS should be updated to reflect all "automatic flush stands" installed by Underground Utilities. Underground Utilities installed automatic flush stands on certain mains with low water "turn over." Those mains generally have dead ends (i.e., one end does not further connect with the City's water supply) and relatively few service lines (i.e., only a few customers using water). Without the automatic flush stands, the water in those mains would typically "sit" and not turn over frequently (become stagnant). The automatic flush stands are designed to open and flush water through the "dead end" of the main on a periodic basis, usually daily. That flushing serves to keep the water fresh and palatable.

At the time of our audit fieldwork, Underground Utilities had installed 18 automatic flush stands on dead end mains in strategic locations throughout the City. We found that seven of those 18 stands were not reflected (depicted) in the GIS. To provide accurate and complete accountability, as well as to enhance staff's ability to efficiently locate, service, and repair those components, we recommend Underground Utilities add (accurately depict) those seven automatic flush stands to (in) the GIS.

Infrastructure Maintenance and Repairs – Mains, Laterals, Valves, and Hydrants (Objective 2)

Overview. Maintenance and repair is performed by Underground Utilities to keep water mains, laterals, valves, and fire hydrants in good working condition. For the most part, the Mobile Work Management System is used to manage and document the maintenance and repair work performed on those components. That system was placed into service in July 2006.

Maintenance and repair activities vary by component. Those activities include:

Various maintenance activities are performed on the water infrastructure, including flushing and pigging mains; inspecting, exercising, lubricating, and packing valves; inspecting and sandblasting/painting fire hydrants; and repairing leaks.

- "Flushing" and "pigging" mains to purge the mains of stagnant or discolored water, sediment accumulations, or other undesirable materials. Flushing typically involves running relatively high volumes or pressures of water through the mains and forcing the undesired water/materials from the system through an opening (e.g., hydrant or flush stand). Pigging involves placing and running a physical device through the mains to remove the undesired materials. Flushing and pigging are performed on an "as needed" basis, with flushing being the most common of the two processes. Because the City traditionally has good water quality, pigging mains is a relatively infrequent maintenance activity (last performed in 2002 on certain mains in the City's northwest quadrant).
- "Inspecting," "exercising," "lubricating," and "packing" valves to ensure their continued operation and proper function. Inspections involve observing valves and related housing (valve boxes) to identify issues, such as accumulation of dirt or trash that hinders access and/or potentially reduces the valves' service lives. Exercising a valve involves actual turning of the valve (i.e., opening and closing) to identify any maintenance or service issues, such as the need for lubricants, new packing (i.e., to preclude leaks), new parts, or new valves. Exercising valves also extends the valves' service lives. Florida Department of Environmental Protection (FDEP) administrative rules require that water isolation valves be exercised in accordance with a written maintenance program established by the water supplier (i.e., City of Tallahassee).
- "Inspecting," "repairing," and "sandblasting/painting" fire hydrants. Inspections involve checking the overall operating condition of the hydrants. Inspections are done on a routine basis and include:
  - Making sure valves turn and do not leak.

  - Checking steamer caps (where fire hose is connected) for cracks and damages.
  - Putting anti-seize lubricant on steamer caps.
  - Checking water flows and water pressures.

  Examples of typical hydrant repairs and maintenance include:

  - Replacing valves and internal parts.
  - Fixing leaks.
  - Raising hydrants to allow sufficient ground clearance for the Fire Department to turn a wrench more efficiently when opening the valve.

  Fire hydrants are sandblasted and painted on an "as needed" basis.

Different work groups are responsible for the various maintenance and repair activities.

- "Repairing" leaks on mains and water laterals.

  In regard to leak repairs, Underground Utilities operations and maintenance staff stated that routine "leak detection surveys" of the City's buried water mains are not conducted. Staff indicated in recent years different vendors have provided leak detection demonstrations using acoustic leak detection devices (i.e., devices manufactured for the purpose of detecting and locating leaks in buried water mains). However, staff indicated those demonstrations showed currently available leak detection devices are not efficient or cost effective in locating leaks that may occur in the City.

Different Underground Utilities work groups are assigned responsibility for the described maintenance and repair activities. For example, one work group performs inspection activities while a different work group performs repairs.

Overall, adequate and appropriate maintenance and repair activities are performed; certain enhancements and improvements are needed.

Overall, we found that Underground Utilities actively conducts routine and scheduled maintenance activities and repairs as needed. As explained in the following, we determined improvements and enhancements are needed to ensure those activities are timely performed, efficiently scheduled, and properly documented.

(NOTE: All fire hydrant inspections and maintenance activities are currently performed by Underground Utilities. Responsibility for those services may be transferred to the Fire Department upon finalization of certain determinations and decisions by City management, as explained on pages 75 and 76 of this report. Underground Utilities may or may not continue to perform hydrant inspection and maintenance services if the Fire Department assumes that responsibility. Several recommendations are made in the following issues in regard to Underground Utilities hydrant inspection and maintenance processes. In the event Underground Utilities no longer performs some of those activities, our audit recommendations should be implemented, as appropriate, by the Fire Department.)

RECOMMENDED IMPROVEMENTS AND ENHANCEMENTS

Work orders were not always completed in a manner to provide proper, logical, consistent, and informative data.

Underground Utilities staff have made advances in documenting and coordinating maintenance and repair activities through implementation of the Mobile Work Management System; certain enhancements are needed to ensure that system provides proper, logical, consistent, and informative data. As previously noted, Underground Utilities implemented the Mobile Work Management System (Mobile System) in July 2006. The system allows for management and staff to create and dispatch system work orders for various maintenance and repair activities. The dispatched work orders are completed within the system by the staff performing the applicable maintenance and repair work. The system thereby provides a mechanism for scheduling, dispatching, and managing/monitoring maintenance and repair work. Implementation of the system has greatly enhanced the ability of management and staff to control, monitor, and track maintenance activities.

As part of our audit, we analyzed the various system work order types, including (1) valve inspections, (2) hydrant inspections, (3) water repairs, and (4) hydrant repairs. All 25,138 work orders

completed since the inception of the system in July 2006 through the date of our fieldwork in early March 2009 were analyzed for logic, reasonableness, consistency, and completeness. Our analyses disclosed that work orders were sometimes not completed in a consistent and logical manner to clearly demonstrate the problems identified and work performed. Instances included:

The actual problem identified and work performed was not always recorded on completed work orders.

- Numerous (440) repair and inspection work orders were completed (some recently) without recording data in the "actual problem" or "work performed" **fields**. Those instances limited Underground Utilities management's determination of identified problems and/or work performed by staff. Also, 740 valve inspection work orders were completed (some recently) without the "access" field being completed. The lack of information in that field precluded management from determining the valve condition and/or problems relating to valve access.

- The Mobile System provides specific descriptive **attributes** for maintenance staff (performing the work and completing the work orders) to choose from when completing various fields on a work order. For example, for a water repair work order some (but not all) of the available options to document work performed include "repaired main," "repaired service," "replaced service," and "replaced valve." These attributes are critical in providing adequate documentation of the problems identified and work performed.

  Our analyses of the available attributes and the Underground Utilities' use of those attributes to document inspection and repair activities in the Mobile System showed significant inefficiencies, inconsistencies, and inadequacies. Specifically:

Available attributes were not adequate and/or were inappropriately and inconsistently used to document inspection and repair activities in the Mobile System.

  – For inspection work orders, the system does not allow for selection of attributes to demonstrate identification of multiple problems that are found. For example, staff currently cannot show on an individual valve inspection work order that there is both a leak and a need to adjust the valve box.

- The system does not allow for staff to document performance of more than one task on an individual work order. For example, a valve inspection crew cannot document on an inspection work order that a valve was both "surveyed" and also that the valve box was "raised" or "lowered."
- The same attributes are sometimes used to describe different tasks. For example, for a valve inspection work order "surveyed" is sometimes used by staff to document that a valve was inspected and exercised and also sometimes used to document that a valve was inspected but not exercised.
- The use of some fields and attributes is not consistent. For example, for valve inspections, maintenance crews use the "access" field to sometimes show the overall condition ("good," "fair," or "poor") of the valve and other times to show problems identified (e.g., valve box "missing lid" or "covered" by pavement).
- For water and hydrant repair work orders, certain attributes available and sometimes used by maintenance crews to describe work performed are inadequate. For example, "repaired" or "replaced" are sometimes used but do not describe what component or item was repaired or replaced (while other available attributes such as "replaced service" and "repaired main" do describe the component/item replaced or repaired).
- Attributes do not exist to describe certain types of work commonly performed. For example, no attribute is available to show when maintenance crews "raise hydrants" to allow more efficient access and valve opening by the Fire Department.
- In some instances, inappropriate attributes are used to describe work performed for hydrant repair work orders. For example, while "inspected" is a logical description for work performed for a hydrant inspection work order, it is not appropriate to reflect work performed for a hydrant

repair work order. However, we identified instances where that attribute was used to describe work performed for a hydrant repair work order.

– For water repair work orders, unique attributes are available to document leaks resulting from accidental cuts or hit lines (e.g., hit by a vehicle). However, in some instances, leaks resulting from accidents or hit lines were documented as "leaks" (and other times as "cut lines"). The more descriptive attribute for those circumstances would be "cut lines" (with "leaks" used to describe leaks resulting from circumstances other than accidents or hit lines).

We acknowledge that there are system capabilities that provide a mechanism to address some of the described inadequacies and inefficiencies. Specifically:

– There is a system "comment" field that can and is used by staff sometimes to more fully describe problems/issues identified and work performed.

– When inspection crews identify certain problems, they often create separate repair work orders that are tied through the system to the initial inspection work order.

Those system capabilities lesson the impact of the described inadequacies and inefficiencies. However, the available "comment" field is not consistently used and does not provide uniform descriptions. In addition, while the system may tie a repair work order back to an inspection work order, it still requires review of multiple work orders to ascertain the circumstances resulting from a single inspection. Accordingly, enhancements are still needed.

The applicable component inspected or repaired was not always adequately documented in the Mobile System.

- The specific **component** (main, valve, service line, etc.) inspected or repaired was sometimes not identified on the system work order. Components are identified in the GIS by a unique identifying number, termed the "facility ID." When a Mobile System work order is created, the applicable facility ID should be recorded in the field created to identify the

component inspected or repaired. While a component facility ID was entered for most system work orders, we noted terms such as "unknown" or "new" were sometimes entered in that field. For example, for the 1,071 valve inspection work orders completed during the period October 2008 through early March 2009, the terms "unknown," "new," and "locate" were used 46 times for the facility ID. We acknowledge that in some instances it may not be practicable to identify the facility ID for the component inspected/repaired (e.g., component not yet recorded in the GIS). We also acknowledge that in some instances where a facility ID was not entered, the maintenance staff recorded a street location on the work order. Regardless, the lack of a recorded facility ID on the system work order limits management's ability to efficiently (1) identify the applicable component, (2) obtain accurate summary information on the number of individual components inspected/repaired, and/or (3) obtain an accurate count of how many times a specific component has been inspected or repaired.

In some instances where inadequate, inappropriate, or incomplete attribute data was recorded on Mobile System work orders for selected fields, there was sufficient information existing in other fields to make a reasonable determination of the problems identified and work performed. However, in numerous other instances sufficient data was not available in other fields to make a reasonable determination of problems identified and/or work performed.

Appropriate, descriptive attributes should be identified and created to allow adequate documentation of the various maintenance activities in the Mobile System; applicable staff should be trained on the proper and consistent completion of system work orders using those attributes.

Accordingly, to address the described issues and circumstances, we recommend that staff in the Underground Utilities Construction and Operations Division (responsible for maintenance and repair) and Business and Technology Division (administers and maintains the Mobile System) jointly identify and create more appropriate descriptive attributes for each work task, problem category, and work order type. In addition, consideration should be given to revising the Mobile System and process for completing system work orders to:

- Require completion of all critical fields (e.g., including fields identifying work performed and actual problem).
- Allow for documentation of multiple problems on an individual work order.
- Allow for documentation of multiple work tasks on an individual work order.
- Ensure consistent use of attributes to describe similar problems and similar work tasks.
- Preclude use of the same attribute to describe different problems or different work tasks.
- Provide for consistent and logical uses for each data field.
- Adequately describe work performed (e.g., identify the component inspected or repaired and describe each task performed).
- Preclude use of inappropriate and illogical attributes (e.g., not allow "inspected" to be a task attribute for a repair work order).
- Require recording of the facility ID when a facility ID exists for the applicable component.

Upon completion of those recommended actions, management should ensure that maintenance staff creating and completing system work orders are properly trained as to the revised attributes, processes, formats, and requirements.

System reports generated for management should be revised to show "actual problem" instead of "reported problem."

Summary activity reports currently generated from the Mobile Work Management System should be modified to provide more useful information; additional reports should be generated to reflect summary activity pertaining to valve and hydrant inspections. As part of our analyses we reviewed summary reports currently produced from the Mobile System to assist Underground Utilities management in monitoring and overseeing the maintenance function. As explained below, we determined that existing reports should be modified and that additional reports should be generated for management.

- Weekly management reports produced for water and hydrant repair work orders should be revised to reflect "actual" problem rather than "reported" problem. Reports on completed "water repair" and "hydrant repair" work orders are generated from the Mobile System on a weekly basis and provided to Underground Utilities supervisory and managerial staff. Those reports reflect crews performing the work and the completed work orders. For each completed work order, the reports show component repaired, reported problem, and repair work performed. While that information is useful, it would be more meaningful if the reports reflected "actual problem" instead of "reported problem." The reported problem is what was initially ascertained as a problem that resulted in the creation of the work order. The actual problem is the actual circumstances as determined by repair crews. The actual problem is sometimes different from the reported problem. For example, the initial issue (reported problem) may be reported (documented on the work order) as a service leak, but the actual problem subsequently determined to be a main leak, or vice versa. Reports reflecting actual problems will provide more meaningful information for management and supervisory staff responsible for monitoring and managing maintenance of the water infrastructure.

- Periodic reports reflecting the number of isolation valves and hydrants inspected should be produced and provided to applicable Underground Utilities management. Among other maintenance and repair activities, the Mobile System is used to document inspections of water isolation valves and fire hydrants. Crews performing those inspections create and complete work orders for each valve or hydrant inspected. To assist management in monitoring and evaluating the quantity of inspections completed, system reports are generated to reflect the number of completed inspections and the crews performing those inspections on a periodic (e.g., weekly) basis. However, those reports do not reflect the number of individual valves or hydrants inspected, only the number of completed inspection

System reports should be generated to reflect the number of individual valves and hydrants inspected during a given period.

work orders. Our analysis showed that multiple inspection work orders were often created and completed for an individual valve (e.g., there were 9,231 valve inspection work orders created and completed for approximately 6,500 valves during the period July 2006 through early March 2009). Accordingly, we recommend that reports also be prepared and provided to management to show the number of individual valves and hydrants inspected. Such reports would further assist management in allocating resources (e.g., staff assignments) and determining if valves and hydrants are being inspected at an appropriate rate (e.g., at a rate that will allow all components to be inspected during a specified period, such as four years).

System reports should be generated to reflect various results and activities relating to valve and hydrant inspections.

- In regard to valve inspection work orders, periodic reports should be produced and provided to applicable Underground Utilities management that reflect the number of water isolation valves that were successfully exercised, the number that were not successfully exercised, the specific problems or issues identified during the inspection process, and work tasks performed as a result of the inspections. As part of each valve inspection, applicable maintenance crews exercise (open and close) the valve to determine if it operates properly and to assist in identifying any existing problems (e.g., leaks). In some instances the valves are successfully exercised and in other instances the valves are not successfully exercised. Inspections may identify various problems, such as leaks, inaccessible valves, missing valve box covers, accumulation of dirt or trash, etc. In addition to exercising the valves, various work tasks may be performed including, for example, vacuuming dirt and trash from the valve box, adjusting the valve box, or making minor repairs. Periodic reports reflecting the results of valve inspections would provide useful information as to the overall status of valves, as well as the significance of problems identified during the valve inspection and exercise process. Similar reports reflecting the results of hydrant inspections would also be useful to management in determining problems identified during hydrant inspections.

We recommend that the current reports be revised to reflect actual problems and that additional reports, as described above, be generated and provided to management.

Management should review outstanding work orders and remove those determined to be no longer valid.

Management should review "old" outstanding system work orders to determine if (1) maintenance work remains to be done, (2) work orders should be completed for work that has been performed, and/or (3) work orders should be deleted for work that is no longer necessary. As part of our analysis, we identified all system work orders that had been outstanding for periods exceeding 50 days at the time of our fieldwork in March 2009. We found there were 6,066 outstanding "preventive maintenance" work orders for fire hydrants that should be removed from the system. Those work orders were created in May 2008 and dispatched to the Fire Department during the period that department was conducting inspections and certain maintenance of fire hydrants. As Underground Utilities currently performs all hydrant inspection and maintenance activities (and creates and completes system work orders for that work), those 6,066 outstanding work orders should be removed from the system.

In addition to those outstanding fire hydrant preventive maintenance work orders, we identified the following system work orders, applicable to Underground Utilities, which had been outstanding for more than 50 days:

- 202 valve inspection work orders.
- 22 hydrant repair work orders.
- 20 hydrant inspection work orders.
- 6 water repair work orders.

We recommend that Underground Utilities staff review those work orders and take appropriate actions to complete any outstanding work, complete work orders for work that has been done, and/or delete work orders if the work is no longer appropriate. Additionally, we recommend that periodic (e.g., weekly or monthly) reports be generated and provided to management for work orders that have been outstanding for excessive periods. (As

part of that process, management should define what constitutes an "excessive period".) Management should follow up on work orders reflected on those reports to ensure necessary work is done and the system is properly updated based on the applicable circumstances.

The Mobile System should be used to schedule and document sandblasting and painting of fire hydrants.

Underground Utilities should consistently and properly use the Mobile Work Management System to document the sandblasting and painting of fire hydrants. As previously noted, the Mobile Work Management System was placed into service in July 2006. We found that the majority of maintenance and repair activities for water infrastructure components are now managed and accounted for through work orders created in that system. However, at the time of our audit fieldwork, we noted that hydrant maintenance staff was not consistently using that system to schedule, document, and monitor the sandblasting and painting of fire hydrants. During the period November 2008 through mid-March 2009, staff had only used that system to document part of the work done during a three-day period in mid-February 2009. For the remaining part of that period (before and after the three-day period), inefficient and sometimes inaccurate maps and logbooks were instead used (e.g., those records did not always identify the hydrants sandblasted/painted and sometimes showed the same hydrant as being sandblasted and painted on multiple days).

We acknowledge that current staff has been performing this maintenance activity only since November 2008. Yet, as current records and processes were shown to be inconsistent and inaccurate, we recommend Underground Utilities management follow through to ensure applicable staff are properly trained and commence use of the Mobile Work Management System to correctly and consistently schedule, document, and monitor sandblasting and painting of fire hydrants.

Records should be prepared or maintained to document manual flushes of water mains and the quantity of water used during those flushes. Water mains are flushed to clean mains of sediments, discolored water, or other undesirable elements. Typically, flushing is done on mains where there is relatively little

The Mobile System should be used to document manual main flushes and the quantities of water used during those flushes.

activity, such that the water "sits" and does not "turn over" frequently. That circumstance usually occurs on a relatively long main section with few customers and a "dead end" (i.e., one end of the main stops and is not interconnected to other part of the City's water distribution system). The majority, if not all, of those mains are flushed automatically by "automatic flush stands" installed at the main's dead end section. Automatic flush stands are usually set to flush at specific times each day. Meters are attached to capture the amount of water that is flushed by those devices.

Mains are also typically flushed whenever there is repair work performed. For example, when a leak occurs, the main gets "flushed" after the repair work is completed to purge any sediments or materials that may have accumulated during the leak repair or other work. Those flushes are typically done manually through opening of a nearby fire hydrant. Mains may also be flushed manually for reasons other than repair work, such as extensions of mains into new service areas or when water quality issues occur in mains that are not equipped with automatic flush stands. Regardless of the reasons, we found that records are generally not prepared to document those manual flushes or the quantities of water used during those flushes. The lack of such records precludes Underground Utilities from demonstrating those necessary flushes were performed or accounting for water used during that process.

To better document maintenance activities and to assist the City in accounting for water produced by City wells but not billed to customers (as required by the NWFWMD), we recommend that the manual flushes be documented in the Mobile Work Management System. This could be accomplished through creation of a new work order type for manual flushes (e.g., for flushes not related to repair work) or by adding new attributes to existing work order types (e.g., for flushes performed in connection with repair work).

The current inspection rate will not ensure all valves are inspected and exercised on a four-year rotation as prescribed by City procedures.

Management should monitor the frequency that isolation valves are exercised and identify efficiencies and methods that will allow those valves to be inspected and exercised at least once every four years as prescribed by Underground Utilities procedures. Florida Department of Environmental Protection (FDEP) regulations provide that water isolation valves shall be exercised in accordance with the equipment manufacturer's specifications or in accordance with a written preventive maintenance program established by the water supplier (i.e., the City of Tallahassee). In accordance with this regulation, Underground Utilities established written procedures providing that all water isolation valves be inspected and exercised on a four-year rotation (each valve exercised at least once every four years).

In our review of the GIS, we identified 16,885 water system valves designated as isolation valves. Because valve inspections and related maintenance activities (including exercising valves) help ensure the longevity of valves and identify problems (e.g., leaks and inoperable valves), it is important that inspections be completed at a reasonable frequency (i.e., four years as determined by the City.) However, our analysis of activity in the Mobile Work Management System shows, at the rates valves were inspected and maintained over the last 32 months, it will take at least seven years to inspect all water isolation valves. Issues identified during our site visits and discussions with staff, which may be contributing to the current inspection rate, included the following:

- While performing the inspections and maintenance work, the inspection staff has to identify the valve in the GIS and create and complete a work order in the Mobile Work Management System. This is done using a single laptop computer. As inspection staff cannot view both the GIS and Mobile Work Management System simultaneously, they physically write information in a logbook to keep track of data as they navigate between the two systems. That process is time consuming.

- The inspections crews have additional responsibilities in addition to inspecting and exercising water valves. Those other activities include:
    - Inspecting and exercising gas isolation valves (e.g., for efficiency purposes all water isolation valves and key gas isolation valves are inspected and exercised during the visit to a single location, such as a street intersection.)
    - Valve inspection/maintenance crews assist in responding to and repairing cut gas lines and respond to areas with concerns regarding low water pressures.

Management should monitor the valve inspection process to determine if it can be made more efficient.

We acknowledge that the current valve inspection/exercise process was recently revised upon the combination of the water and gas utility functions into a single utility. As a result, the inspection/exercise staff is still in the process of determining the most efficient and effective methods for completing their work. Notwithstanding these circumstances, we recommend that Underground Utilities management closely monitor the inspection/exercise process. To the extent resources are available or processes can be revised, management should make adjustments to ensure valves are inspected on the prescribed four-year rotation. To reduce staff time in documenting their work, consideration should also be given to creating a system interface between the GIS and the Mobile System that allows work orders to be created directly from the GIS.

Written procedures for certain maintenance activities should be established and provided to applicable staff; existing written procedures should be enhanced.

Written procedures pertaining to water infrastructure maintenance should be enhanced. We found that Underground Utilities established written procedures for some, but not all, maintenance and inspection activities. We also found that enhancements and updates are needed to existing written procedures. The specific circumstances and our recommendations are addressed in the following.

- Procedures for the periodic exercising of isolation valves were established by Underground Utilities as required by Florida Department of Environmental Protection (FDEP) regulations.

Those procedures provide that all City water isolation valves shall be surveyed (inspected) and exercised on a four-year rotation. The procedures describe the maintenance process and information that must be recorded to demonstrate the work performed (e.g., dates surveyed and exercised, other tasks performed, and repairs made). Overall, we found the procedures adequate and comprehensive. However, we noted modifications and additions are needed based on the following:

– Procedures currently indicate there are 12,500 water isolation valves, but our analysis of the GIS shows there are 16,885 water isolation valves in the City's water infrastructure

– The procedures do not define what constitutes a water isolation valve. As explained by Underground Utilities staff, those valves include system valves that can be used to isolate multiple customers from water services. Valves that can only isolate one customer from water services are not considered isolation valves. Meter isolation valves, hydrant isolation valves, and fire line isolation valves also are not considered water isolation valves for purposes of this maintenance process. (NOTE: Although not considered water isolation valves, valve inspection crews do inspect and exercise hydrant isolation valves as part of their maintenance activities.)

To ensure a clear and appropriate understanding of the water isolation valves to be exercised, we recommend that the written procedures be updated to reflect the definition and correct number of those valves

Written procedures for exercising isolation valves should be updated to reflect the actual number of valves and to define what constitutes an isolation valve.

- Written procedures have not been established for fire hydrant inspections. Although not required by FDEP regulations, such procedures would be beneficial to Underground Utilities, especially in the event of a sudden unexpected turnover in current staff. Areas that would be appropriate to address in such procedures include:

- Hydrants to be inspected (i.e., fire hydrants owned by the City and not hydrants owned by others such as Talquin Electric, FSU, or private entities).
- The total number of hydrants to be inspected.
- Frequency of the inspections (e.g., industry standards provide that hydrants should typically be inspected annually).
- Staff positions designated to perform hydrant inspections.
- Process and requirements for documenting hydrant inspections in the Mobile Work Management System.

Written procedures should be established for hydrant inspections, main flushes, and periodic generation of system reports.

We recommend that appropriate written procedures be established and made available to applicable management and staff.

- Written procedures have not been established to address flushing of water mains. While also not required by FDEP regulations, such procedures would be beneficial to the Underground Utilities, especially in the event of a sudden unexpected turnover in current staff. Areas that would be appropriate to address in written procedures include descriptions of the circumstances and events that necessitate main flushing, the processes that should be used to flush the mains, and the information that should be captured, recorded, and maintained when mains are flushed. We recommend that appropriate written procedures be established and made available to applicable management and staff.
- Written procedures should be established to specify standard reports to be generated from the Mobile Work Management System. Several reports are currently generated and provided to management on a weekly basis to show certain maintenance activities and the crews conducting those activities. As addressed previously, we recommend that other reports be produced. To ensure consistent and proper production of appropriate reports, we recommend that written

guidelines/procedures be established that identify the reports to be produced and the frequency of generation (e.g., weekly).

Updating and establishment of written procedures as recommended will help ensure consistency in the performance of applicable maintenance activities.

OTHER ISSUES

During our audit we identified or became aware of other issues directly impacting maintenance of the City's water infrastructure. Those issues are addressed below.

Many water isolation valves in the downtown area are no longer exercised due to the deteriorated condition of the downtown water infrastructure.

Many water isolation valves located in the downtown area are no longer exercised. During our discussions, Underground Utilities maintenance staff indicated that 60% to 70% of the water isolation valves in the downtown area are no longer exercised during the valve inspection process. Based on the boundaries of the described "downtown" area, this means that approximately 2,000 valves are not being exercised. As explained by staff, turning (exercising) those valves often results in leaks because of the older age of the infrastructure in the downtown area. Accordingly, rather than causing leaks or additional repair issues, the valves are not exercised. Staff also stated that replacement of those valves was not currently a reasonable alternative, as it would be more appropriate and efficient to replace them when the entire downtown infrastructure (i.e., mains, services lines, valves, and fittings) is replaced and upgraded. Replacement of the downtown infrastructure and our related audit recommendations are addressed further in this report under "Infrastructure Replacement".

The City is taking actions to ensure applicable staff are properly licensed by the state-mandated deadline.

Beginning May 1, 2011, operations and maintenance staff fulfilling certain roles must be licensed by the FDEP. New FDEP regulations require employees performing the following activities to be licensed by May 1, 2011:

- Cleaning (swabbing, pigging, scraping, or air purging/flushing) water mains.
- Tapping water mains (tapping represents the act of connecting a new service line to a main).

- Depressurizing or dewatering or disinfecting existing mains.
- Dewatering, cleaning, or disinfecting finished water storage tanks.
- Adjusting automatic pump controls or automatic control valves that regulate water system flows or pressures.

Depending on the role/activity, applicable individuals must be licensed as either a "water distribution operator" or an "electronic control system operator." To be licensed, applicants must (1) have a high school diploma or equivalent, (2) have a minimum amount of work experience, (3) complete an FDEP approved training course, and (4) pass an examination administered by FDEP.

We found that Underground Utilities is aware of these requirements and has initiated actions to have the proper staff licensed by May 1, 2011. For example, Underground Utilities management is in the process of identifying and providing training to staff that must be licensed. Several trainings have been held to date. Management is also communicating with FDEP as to the types and level of licenses that will be required based on City operations. We commend the City for these proactive measures and recommend that appropriate actions be continued to ensure the proper staff is licensed as required.

Infrastructure Maintenance and Repairs – Wells and Storage Tanks (Objective 2 continued)

Overview. Various maintenance is performed on City water wells and elevated storage tanks by the Underground Utilities Water Quality Division. Maintenance activities are governed, to some extent, by Florida Department of Environmental Protection (FDEP) regulations. The maintenance activities are documented on different records and reports.

For purposes of this report, we segregated the maintenance activities into those performed at water wells and those performed at elevated storage tanks.

Maintenance activities performed for water wells include annual meter calibrations, checks of auxiliary power sources, and daily site visits by licensed well operators.

Water Wells. FDEP regulations specify and require several maintenance activities relating to water production wells. Those activities are to be performed by or under the direction of the Water Quality Division, and include:

- Water meters at each well are "calibrated" annually to ensure the accurate measurement of drinking water produced and pumped into the City's water distribution system. The Water Quality Division hires a private company (currently the Avanti Company) to perform the annual calibrations. Adjustments (or calibrations) are made to any meters found not to be making accurate measurements.
- Auxiliary power sources, installed to provide backup power for pumping water, were installed at strategic wells to ensure an adequate water supply in the event of a major power failure. Those auxiliary power sources are "exercised under load" on a monthly basis.
- Daily visits are made to each active production well by qualified staff (licensed well operators). During those daily visits, the well operators perform various maintenance activities. Those activities include, for example:
  - Checking equipment (pumps, motors, valves, meters, pipes, etc.) and the general well site area (building and grounds) to ensure proper operation and identify any operational or safety concerns.
  - Collecting and testing water samples.
  - Observing and testing chemical concentrations and residuals.

  Appropriate repairs and maintenance are completed or scheduled as the results of those visits.

Maintenance activities performed for elevated storage tanks include annual inspections, periodic cleanings and paintings, and periodic checks for structural integrity by licensed engineers.

Storage Tanks. Maintenance activities performed on elevated storage tanks by or under the direction of the Water Quality Division are described below. Some of those activities are required and governed by FDEP regulations.

- Annual inspections are performed to identify any needed repairs or maintenance actions. The Water Quality Division hires a private vendor (currently Corrpro Waterworks) to conduct these inspections. The vendor provides inspection reports to the City showing the results of their inspections. The primary areas addressed by these inspections include:
  - Foundations (check for settling, cracks, or deterioration).
  - Exterior and interior tank coating (check for coating failure).
  - Water level indicator (check condition).
  - Overflow pipe (check covers, screens, and seals).
  - Access ladder (check for loose bolts and rungs).
  - Fall protection devices, including slide rails, cages around access ladder, and fences on catwalks (check operational status).
  - Tank roof (check for holes, rust, and accumulation of water in low spots).
  - Air vents (check screens, sealed edges, and seams).
  - Access hatches (check locks, hinges, bolts, and gaskets).
  - Tank lighting (check condition and operation).
  - Water quality (visually observe water in tank for cleanliness and foreign matter).
  - Cathodic protection (check adequacy of components and system protection). (Note: Cathodic protection is a commonly used practice to protect water storage tanks from corrosion by making the tank surface the cathode of an electrochemical cell.)
  - Security (check operation and condition of fences, gates, and access doors).

Repairs (as well as paintings) are made or scheduled based on these inspections.

- Each storage tank is cleaned at least once every five years. Storage tanks are painted based on evaluated condition, typically every 15 years. The City contracts with private entities to perform those cleanings and paintings. Activities performed include:
  - Removing bio-growths, sludge, calcium/iron manganese deposits, etc.
  - Removing dirt, oil, grease, mildew, rust, etc. by high pressure water or abrasive (e.g., sand) blasting.
  - Priming and painting tanks as well as related structures (e.g., ladders, foundations, columns, catwalks).
  - Caulking.
- Each storage tank is checked for structural integrity and coating integrity every five years. As required by FDEP regulations, this work must be performed under the charge of a professional engineer licensed in the State of Florida. The same entity hired to perform the five-year cleanings performs these inspections.

Certain aspects of the water production and distribution systems are monitored through the SCADA system.

In addition to the above maintenance activities unique to wells and storage tanks, Underground Utilities monitors the water production and distribution system through the Supervisory Control and Data Acquisition (SCADA) system. That system allows staff at selected locations to monitor (and in some cases control):

- The status of well pumps (i.e., on or off).
- Water pressures and flow rates.
- Water levels in storage tanks.
- Chemical levels in the water.
- Critical alarms.
- The status of certain well motors and equipment (e.g., whether a well is operating off standard or auxiliary power sources).

Overall, we found required and appropriate maintenance activities were performed for water wells and elevated storage tanks. Applicable staff was generally licensed as required and appropriate and adequate records were prepared to reflect the performance and results of the maintenance activities. Adjustments and repairs were properly made or scheduled based on inspection results. However, as explained in the following, we determined some improvements and enhancements are needed.

RECOMMENDED IMPROVEMENTS AND ENHANCEMENTS

Efforts should be made to ensure timely repairs and resolutions of problems that preclude availability of backup engines and generators at City wells. FDEP regulations require the public water supplier (City) to run its auxiliary power sources under load (i.e., normal capacity) at least monthly. This practice helps ensure that backup power is available to provide adequate supplies of drinking water during a major outage of the primary power source.

Various issues precluded the Water Quality Division from running and testing backup equipment at frequencies required by FDEP regulations.

The City established auxiliary power sources at 20 active production wells. That auxiliary (backup) equipment consists of auxiliary engines or generators. Auxiliary engines can be used to pump the water from the well and into the distribution system when the primary pump is not operational due to a loss of power. Generators can be used to generate alternative power (electricity) to run the primary pumps in the event City power (electricity) is temporarily unavailable. Both auxiliary equipment and generators are operated using diesel fuel. We found the City has a process to run the auxiliary engines and generators on a monthly basis. Those test runs are documented by the water well operators on their daily logbooks and on monthly reports prepared for each well.

Our review of those records showed the backup equipment for 9 of 20 wells was not always run monthly. For those nine wells, we identified periods ranging from two to nine consecutive months during the past year in which the backup equipment was not run. In response to our audit inquires, Water Quality Division staff provided the following reasons for those circumstances:

- Equipment had broken gear drives which had to be replaced.
- Construction of new roofs at the well precluded running the equipment, as the exhaust from that equipment was placed through the roof; thereby the backup equipment's exhaust system was temporarily unavailable.
- Engines malfunctioned.
- Exhaust and muffler systems or components had to be replaced.
- Design or electrical problems precluded running the equipment.
- The coolant water and drain lines for some equipment had to be rerouted.

We do not dispute these reasons or circumstances. Notwithstanding, inoperable or problematic backup equipment limits the ability of Underground Utilities to provide an adequate water supply in the event City power is temporarily unavailable. We recommend that efforts be made to ensure more timely repair and resolution of problems and issues that preclude use of backup equipment.

For subsequent structural inspections, the Water Quality Division should use the State's website to ensure licensure status of contracted professional engineers.

Additional measures should be taken to ensure required five-year inspections of elevated storage tanks are performed under the charge of a professional engineer who is currently licensed in the State of Florida. FDEP regulations require inspections of elevated storage tanks for structural and coating integrity at least once every five years by personnel under the charge of a professional engineer licensed in Florida. We found the required inspections were performed for the City's eight elevated storage tanks over the last five years. Two companies performed those inspections and provided their reports to the Water Quality Division reflecting the inspection results. The reports submitted by the companies were stamped with a State of Florida Professional Engineer seal. Through the State of Florida Department of Business and Professional Regulation, we ascertained the licensure status of the professional engineers for the two firms. Our review showed, that at the dates the inspections were performed for three storage tanks, the applicable engineer did not have a current State

of Florida license. That engineer and the applicable company were based out of Montana. We did note that the engineer was properly licensed in the years prior and subsequent to the years in which those three inspections were performed. Accordingly, the lack of current licensure may have been attributable to oversight on behalf of the engineer and/or his company.

For those instances, the City most likely received adequate and professional inspections. Notwithstanding, we recommend the Water Quality Division ensure that professional engineers overseeing future inspections are licensed as required by FDEP regulations. The State of Florida Department of Business and Professional Regulation website can be used for that determination.

Written procedures and guidelines should be established for the various well and storage tank maintenance activities and processes.

Written procedures and guidelines should be established for certain maintenance activities. FDEP regulations do not mandate written procedures or guidelines for most of the required well and storage tank maintenance activities. (FDEP regulations do specify that water well meters be calibrated in accordance with the manufacturer's specifications or in accordance with a written preventive maintenance program.) Nonetheless, written procedures and guidelines are beneficial to the City, especially in the event of significant or sudden unanticipated absences or turnover of staff. Accordingly, we recommend the establishment of written procedures and/or guidelines to address:

- Annual calibrations of water well meters.
- Exercising well backup equipment.
- Staffing water wells.
- Periodically (annual and five-year) inspecting, cleaning, and painting elevated storage tanks.
- Documenting the various maintenance activities.

Such written procedures will help ensure consistent and appropriate performance of well and storage tank maintenance activities.

OTHER ISSUES

During our audit we identified or became aware of other issues directly impacting the City's water wells and storage tanks. Those issues are addressed below.

Underground Utilities petitioned and received a variance to the FDEP-prescribed on-site staffing requirements for wells.

The City has petitioned FDEP for a variance to well staffing requirements. FDEP regulations require wells to be staffed by qualified operators for certain periods and times. The staffing requirements for an individual well depend on the water treatment process and quantities of water produced. Based on the City's treatment processes and maximum quantities of water permitted to be produced from each well, the City's staffing requirements under those FDEP regulations range from (1) one hour a day for six days a week to (2) 16 hours a day for seven days a week. The regulations allow FDEP to grant reductions in those staffing requirements for wells under electronic surveillance or electronic control.

Our reviews of water well operator logs and discussions with Water Quality Division staff showed that the City has implemented an alternative staffing program. Under that alternative program, the City water well operators are making daily visits to each active well (seven days a week), with a minimum 15-minute visit per well each day. This alternative program results in less time at wells when compared to the described FDEP standard requirements. Water Quality Division management indicated that this alternative staffing program was approved in prior years (informally) by the FDEP. No official documentation of that approval was provided.

Notwithstanding this informal prior approval, Water Quality Division management indicated that FDEP subsequently questioned the appropriateness of the City's alternative staffing program. As a result, in August 2008 (prior to the start of our audit) the City submitted a "Petition For Variance" to FDEP. In that legal petition, the City explains that an alternative staffing program is justified on the basis that:

- The City has 27 individual wells, but they operate as a complete integrated program.

- The City uses the SCADA system to monitor each well site for significant activities, which lessens the need for staff to be on-site for extended periods.
- The wells with granular activated carbon and sand filtering systems do not necessitate continuous on-site operation.
- There is no public safety benefit in increasing current on-site staffing to the FDEP-prescribed standard requirements.
- Meeting the FDEP-prescribed staffing standards exceeds what is necessary to ensure proper operation and would be cost prohibitive (i.e., additional staff and vehicle costs) in relation to the public benefits derived.

In the Petition For Variance, the Water Quality Division requests approval of an alternative staffing program that is slightly different from the current staffing program used by the Water Quality Division. On August 6, 2009, the FDEP granted the City a variance to the staffing requirements. The granted variance provided for the staffing as requested by the City, with relatively minor adjustments. We recommend the City commence with its planned implementation of the approved alternative staffing program.

Although not required, installation of aviation warning lights on certain elevated City water tanks should be considered. Federal Aviation Agency (FAA) rules require that aviation warning lights be placed on water tanks that are 200 feet or higher. They do not require that tanks with heights below that 200-foot threshold be fitted with aviation warning lights (i.e., unless another reason exists that warrants such lighting, such as close proximity to a runway or flight path). Our discussions and review showed there is only one tank that is 200 feet or higher, and aviation lights are installed on that tank as required.

Underground Utilities should determine if it is cost-beneficial and appropriate to install aviation lights on each of the City's elevated storage tanks.

We discussed this matter with the City's Aviation Department operations manager. The operations manager indicated while FAA rules do not require the City's water tanks (below 200 feet in height) be fitted with aviation warning lights, it would be prudent

for the City to place such lights on each of the City's elevated water tanks. This would appear to be especially important in the event of an aircraft emergency during a nighttime flight, possibly more so for small aircraft as opposed to larger commercial aircraft. Water Quality Division staff indicated that they would be receptive to installing lights on all storage tanks, but noted two concerns: (1) costs to implement and (2) costs and effort to maintain (e.g., change bulbs). Also, they noted there is an inherent safety risk factor, as tanks must be physically accessed to install and maintain the lights.

We recommend Underground Utilities consult with the Aviation Department, and FAA as needed, and compare the costs versus the benefits of installing and maintaining aviation warning lights for each of the City's elevated water storage tanks. If such lighting is determined appropriate and not cost-prohibitive, aviation warning lights should be installed.

Three large dead trees threatening a well site were removed in response to our audit inquiry.

Three large dead trees were removed after a determination was made during our site visit that the trees threatened one of the City's water wells. As part of our audit, we made site visits to selected water wells and storage tanks to observe and ascertain the adequacy of maintenance activities. One inherently appropriate maintenance activity is ensuring the infrastructure is reasonably safeguarded from physical threats. Overall, we found reasonable and appropriate measures were taken to protect City water wells and storage tanks from those threats. However, at one well we observed three large dead pine trees adjacent to the fence surrounding the well site. Although outside the fence, those trees were in an area, such that if they fell (e.g., during a storm) in a certain direction, the fence and the building in which the well is located could be damaged. Those trees, which were located on City property, were removed subsequent to our initial site visit and in response to our audit inquiry. Maintenance staff should enhance their observations and efforts to ensure physical threats to wells are timely addressed.

Bottom sections of an access ladder were removed to deter unauthorized access to an elevated water storage tank.

An additional measure was taken to control unauthorized access to the City's elevated storage tank in Woodville after our audit observations. Several methods are used by Underground Utilities to control access to the City's elevated water storage tanks. Those measures include fences with locked gates, locked doors, ladder guards (devices attached to a portion of a ladder that hinders access and use of the ladder), and removal of the bottom sections of ladders such that the ladder cannot be easily accessed and used to climb to the tank and surrounding catwalk. During our site visits to the eight storage tanks, we noted that appropriate and reasonable measures were generally installed and in place at each tank. However, for the tank at Woodville, we found the bottom section of the ladder (section adjacent to the ground) was attached. Although the grounds of the tank are secured by a fence and locked gate, an unauthorized person circumventing that fence could easily have used the ladder to climb to the tank and catwalk. Based on our notification of this situation, the Water Quality Division removed that bottom ladder section subsequent to our initial site visit. We recommend that staff increase efforts to identify instances where access should be better controlled.

Infrastructure Installation and Materials (Objective 3)

Overview. To ensure an adequate infrastructure, Underground Utilities established specifications for materials and processes used in installations of new or replacement water infrastructure. Those specifications are maintained and updated as appropriate by the Water Resources Engineering (WRE) Division. Other functions performed by the WRE Division to ensure an adequate and appropriate water infrastructure include (1) designing water infrastructure additions/replacements, or reviewing and approving designs prepared by other entities (e.g., developers), and (2) inspecting project job sites to ensure the additions, replacements, and modifications are appropriate (e.g., proper materials and installation methods were used).

The WRE Division ensures proper installation of new infrastructure through preparation and review of engineering designs/plans and physical inspections at construction sites.

As explained in a previous section of this report, new infrastructure components are installed by a combination of City crews, City contractors, and private developers. Infrastructure may be installed by City crews or by City contractors as part of extensions of water services into new areas or in connection with various capital projects. Capital projects involving water infrastructure additions vary in size and scope. For example, water infrastructure may be replaced and relocated during major or minor road improvement projects, or new mains may be installed as part of projects to upgrade areas with older and inadequate infrastructure components. Contractors are generally used by the City for larger capital projects.

New infrastructure is installed by a combination of City crews, City contractors, and private developers.

Private developers typically install new water infrastructure during development of new subdivisions and neighborhoods. When those developments are completed, the City typically takes ownership of the installed infrastructure.

Regardless of the entity (City crews, City contractors, or private developers) installing new infrastructure, Underground Utilities is responsible for ensuring the infrastructure is properly designed and installed using appropriate methods and materials.

Based on our understanding obtained through discussions with knowledgeable Underground Utilities staff and the results of various audit procedures, we determined that, overall, the City has an adequate and appropriate process for ensuring proper infrastructure additions and replacements. However, we noted certain areas where enhancements and improvements are needed. Those areas are addressed in the following.

RECOMMENDED IMPROVEMENTS AND ENHANCEMENTS

Processes should be developed to ensure applicable projects involving installation of new water infrastructure by City crews are designed or reviewed by Water Resources Engineering. During our audit, concerns were expressed that the WRE Division was not always provided the opportunity to design or review

The WRE Division has not always been involved in designing or reviewing new infrastructure installed by City crews.

projects involving water infrastructure installations by City crews. Those concerns were expressed by staff in both the Construction and Operations Division and the WRE Division. With the requested assistance of staff in those divisions, we identified 11 projects completed by City crews where the WRE Division did not design or review the projects. Those 11 projects included water main upgrades in various areas, including:

- Frenchtown.
- Various locations between Gaines Street and Florida A&M University.
- Locations west of FSU.
- Several roads that connect to the Woodville Highway.

Not involving the WRE Division in those projects increased the risks (1) the projects were not properly designed and (2) long-term plans and needs were not addressed. For example, not involving the WRE Division in a project could result in City crews installing a 6-inch replacement main in an area where a WRE determination was made that 8-inch mains are needed in the near future. The lack of WRE involvement in the noted projects can be attributed to a lack of procedures or processes that provide for WRE design or review of water infrastructure installations by City crews.

WRE Division involvement helps ensure proper and appropriate infrastructure additions.

Our meetings and discussions with staff of both divisions showed plans are being developed to ensure proper involvement by the WRE Division in future "in-house" infrastructure projects (i.e., installations by City crews). As part of those plans, we recommend that responsibility for ensuring proper design and review be assigned to designated positions (e.g., project managers). Consideration should be given to development of a standard project checklist for use by those positions (project managers) to help ensure and document proper design or review by WRE staff.

Formal records should be prepared to adequately demonstrate WRE inspections of water infrastructure additions. WRE staff is responsible for inspecting each project that involves additions or

modifications to the City's water infrastructure by private developers or City contractors. Those inspectors make project site visits to ensure:

Better records should be prepared to adequately document inspections and inspector conclusions.

- Installed materials meet technical specifications prescribed by the WRE "Standard Specifications for the Design and Construction of Water and Wastewater Facilities."
- Construction methods and results are appropriate.
- The new infrastructure passes hydrostatic (pressure) tests.
- Disinfections are done and water quality tests are performed and passed before the new infrastructure is placed into service.

Other than water quality laboratory reports (performed after disinfection procedures are completed), we found that formal reports were not prepared to document the inspections or the conclusions of the inspectors. The primary records of the inspections were entries made by the individual inspectors in their daily inspection logs. The recording of data and information in those logs varied by inspector and sometimes, for an individual inspector, by project. We found those records often did not clearly demonstrate the inspection work performed or that new infrastructure was comprised of required materials or properly installed. For example:

- For 5 of 12 sampled projects, the inspectors did not document whether required pressure test were performed or, if performed, the tests results (i.e., passed or failed).
- None of the inspection records (i.e., entries in inspection logbooks) for 12 sampled projects documented that the inspectors ensured all inspected materials met required specifications and that the materials (components) were properly installed.
- The inspector's logbooks sometimes indicated a problem was identified but did not clearly indicate that the applicable issues (problems) were satisfactorily resolved.

A standard checklist or similar record should be established and used to document WRE inspections and resulting conclusions and approvals.

- The daily inspection logs of one inspector for calendar year 2008 were not located and provided for our review. Staff indicated this log was likely misplaced during a physical relocation of the WRE offices.

We acknowledge that the City's final acceptance of the new infrastructure is evidenced by "final acceptance letters" sent to private developers and by the City's "final pay request" for projects done pursuant to approved capital projects. Those records imply that the WRE has found the infrastructure acceptable and appropriate. Nonetheless, to better document inspections and inspector conclusions, we recommend that the WRE create and use a standard inspection form/checklist that formally documents the final inspection and approval of the infrastructure by WRE. Information to address on that form/checklist should, at a minimum, include:

- Inspector's assertion that materials were found to meet required specifications.
- Inspector's assertion that installation methods and processes were determined to be acceptable and appropriate.
- Inspector's assertion that required pressure tests were performed and passed (including dates and results of those tests).
- Inspector's assertion that the new infrastructure was properly disinfected and water quality was found to be acceptable before the infrastructure was placed into service (including dates and times of applicable disinfections/flushes and water quality tests).

The forms/checklists should be signed and dated by the individual inspectors that conducted the inspection and their supervisor, the WRE senior engineer, who is a licensed professional engineer in the State of Florida. Such records will enable the WRE to better demonstrate work performed to ensure water infrastructure additions and modifications are proper.

In addition to the forms/checklists, we recommend the resolution of identified problems be better documented in the inspectors' logbooks.

For infrastructure additions by City crews, responsible supervisory staff should assert that proper materials and processes were used and required tests performed; those assertions should be documented.

Independent inspections should be performed and/or formal records prepared to determine/demonstrate that water infrastructure additions by City crews (and the recently hired contractor) are proper as to materials and installation methods.

In the previous issue we noted that WRE staff conducts project site visits to ensure water infrastructure additions by private developers and City contractors are proper. However, similar reviews are not performed for water infrastructure additions by City crews (i.e., "in-house additions"). In response to our inquiry on that matter, Underground Utilities stated in-house additions are "self-policed," as City crews are aware of material and installation requirements, thereby negating the need for separate independent inspections (e.g., by WRE or other qualified staff). We do not dispute the professional judgment of Underground Utilities on this matter.

Notwithstanding, the current process does not provide a means to demonstrate accountability and responsibility for the proper installation of the new infrastructure. Accordingly, we recommend that formal records be prepared for each in-house infrastructure addition that documents the "installing" staff's assertions as to:

- Use of materials that meet specifications established by the WRE for City water infrastructure.
- Proper installation methods and processes as prescribed by WRE and FDEP standards for water infrastructure construction.
- Performance of required pressure tests (or justified reasons for not performing those tests).
- Conduct of required disinfections and water quality tests, and receipt of acceptable test results, prior to placing the new infrastructure into service.

The supervisory staff within the Construction and Operations Division, responsible for ensuring the proper installation of the applicable infrastructure, should make those documented assertions.

Management should formalize its process for inspecting infrastructure additions by the recently hired contractor - R.A.W.

(NOTE: Subsequent to the completion of audit fieldwork in this area, Underground Utilities contracted with a firm to complete some infrastructure additions that were traditionally completed by City crews. The contracted firm is R.A.W. Construction, LLC (R.A.W.). In our discussions, Underground Utilities stated that Construction and Operations Division staff inspect the additions by R.A.W., but acknowledged that formal inspection records are not prepared and retained to document (1) the installations were proper as to materials used and methods of construction or (2) that required pressure tests and water disinfections were performed. Accordingly, for the same reasons disclosed above, we recommend that formal records be prepared documenting Underground Utilities' determinations that installations by R.A.W. are proper. Those inspection records should be signed and dated by the applicable inspector and applicable supervisory staff.)

While required water quality tests were generally performed, we noted no records were available to show testing was performed for one 836-foot main extension.

Additional efforts should be made to ensure required water quality tests are performed (and passed) before new infrastructure is placed into service. Our review of 35 projects involving installation of new water infrastructure showed appropriate water quality tests were typically performed, with "passing" results, before the additions were placed into service. However, for one 836-foot main extension into a new service area, there was no evidence (i.e., water quality test reports) that the water was tested to ensure it was "clean" prior to the main being placed into service. Water quality testing was performed subsequent to our audit request (and subsequent to the main being placed into service). That subsequent testing showed the water is clean.

The lack of the required test prior to the main being placed into service was likely an inspector oversight. If a standard inspection document with required documented assertions as recommended in the previous issues had been used, it is likely that this oversight would have been detected prior to the main being placed into

service. We recommend efforts be enhanced to ensure required testing is performed before new infrastructure is placed into service.

Water infrastructure additions were not always "self-permitted" as required by FDEP regulations.

Processes should be developed to ensure applicable water infrastructure additions are "self-permitted" as required by FDEP regulations. To help ensure proper water infrastructure additions, FDEP regulations require that plans and designs for additions be reviewed and "permitted" by the appropriate authority. The FDEP is the primary permitting authority. As allowed by state statute, the FDEP delegated that authority to the City for infrastructure additions involving water distribution mains that are 12 inches or less in diameter. The delegation order issued by FDEP requires the City to report all "self-permitted" installations to FDEP on a monthly basis.

In our review of new water infrastructure additions, we identified 12 projects required to be permitted (11 by the City and one by the FDEP). The one project under FDEP's permitting jurisdiction (new City water well) was permitted as required. The City similarly permitted eight of the remaining 11 projects. However, no permits were prepared for the other three projects. Each of those three projects involved extensions of existing water mains and services into new areas.

Notwithstanding the lack of permits for those three projects, we found that the WRE Division properly reviewed the designs and inspected the installations under existing processes and procedures. Accordingly, there was no indication that the applicable infrastructure was not properly installed. However, not permitting these projects resulted in the installations not being reported to the FDEP as required by the FDEP self-permitting authorization (i.e., delegation) order.

The WRE acknowledged these circumstances and initiated corrective actions during our fieldwork by establishing internal procedures by which every project will now be certified to be compliant with FDEP regulations, and the applicable City self-permit or FDEP permit attached to and retained with the project

plans. We recommend that the WRE Division ensure compliance with these new procedures.

Complete specifications should be used in ordering and purchasing water infrastructure components.

Complete specifications should be used in acquisitions of water infrastructure components. As part of our audit, we reviewed specifications used in ordering and purchasing selected water infrastructure components for use by City crews when installing or replacing water infrastructure. Components reviewed included:

- Mains made of ductile iron and polyvinyl chloride (PVC).
- Copper pipe used for service lines (water laterals).
- Gate valves.
- Fire Hydrants.

The appropriate specifications were identified in the Underground Utilities' "Standard Specifications for the Design and Construction of Water and Wastewater Facilities." Documents reviewed to determine if those specifications were used when acquiring those components included contracts, the PeopleSoft Financials System (i.e., specification attributes used for purchase orders), and vendor invoices.

We found the material specifications included in the reviewed documents were appropriate. However, the specifications were not complete. For example:

- For ductile iron mains, the specifications used in acquisitions did not address required interior and exterior coating attributes.
- For PVC mains, the specifications used in acquisitions did not address required laboratory and factory approvals/certifications.
- For copper pipe, the specifications used in acquisitions did not address required thickness ("standard dimension ratio").
- For hydrants, the specifications used in acquisitions did not address required factory installed strorzs (i.e., a storz allows for quick connections of a firefighting hose).

With the assistance of knowledgeable Underground Utilities staff, we reviewed various components on hand at the City's Municipal Supply Center (MSC), which was the City department ordering and purchasing those components on behalf of Underground Utilities. We did not identify any inappropriate materials during that review. Notwithstanding, the WRE Division agreed with our assessment that complete specifications should be used when ordering and purchasing water infrastructure components. As an example of the significance of requiring complete specifications, the WRE Division cited an instance where WRE inspectors identified an inappropriate component (water main) in a project constructed by a private contractor. In that instance, the City rejected the water main because it did not contain required laboratory and factory approvals/certifications. The contractor had to replace the inappropriate main with a main meeting the required specifications.

Not using complete specifications when ordering and purchasing water infrastructure components increases the risks inappropriate components will be installed. Appropriate and complete specifications should be used in future acquisitions. Accordingly, we recommend:

- Attribute specifications within the PeopleSoft Financials System for water infrastructure components be updated to directly refer to specifications established in the WRE "Standard Specifications for the Design and Construction of Water and Wastewater Facilities" for those components.

- Subsequent purchase contracts for water infrastructure components contain provisions that require the contractor to provide components that meet the applicable specifications established in the WRE "Standard Specifications for the Design and Construction of Water and Wastewater Facilities."

If implemented, those actions should help ensure applicable vendors are aware of all applicable City specifications and provide only components meeting those specifications.

Additionally, as recommended by the WRE Division, suppliers (vendors) should be required to submit documentation (shop drawings/material submittals) to demonstrate that their materials comply with City specifications.

Infrastructure Replacement – Mains, Valves, and Laterals (Objective 4)

The City shares a concern of aging and deteriorating water infrastructure with many other local governments.

Overview. One objective of our audit was to ascertain the City's process for planning, funding, and providing for replacement of certain water infrastructure components. Our primary focus was on water mains and, to a lesser extent, the attached water laterals and valves. Fire hydrant replacements were also addressed (see the subsequent section of this report). We did not address replacements of water wells or elevated storage tanks.

A successful infrastructure program inherently includes replacement of components at or near the end of their useful (service) lives. Various factors impact the service lives of water infrastructure. Those factors include:

- Age of the components.
- Material type.
- Environment (e.g., soil type and load pressures).
- Aggressiveness of the water.

Depending on the factors and circumstances, water mains and components can be expected to last more than 100 years. Staff in the WRE Division indicated that, overall, the City's environment is conducive to a relatively long-lasting water infrastructure.

Notwithstanding the expected longevity of City water infrastructure, we found the City shares many characteristics with other local governments as to the aging and potential deterioration of its water infrastructure. While much of the City's infrastructure was added in recent decades, there are portions that are likely nearing 100 years old. The older sections are generally believed to be the "downtown" section of the City, and some nearby areas.

We determined that Underground Utilities has a proactive program for replacing and updating aged and deteriorated water

infrastructure (mains, valves, and services). Evidence of that program as identified by our audit included:

The City has been proactive in upgrading and replacing old and deteriorated infrastructure.

- The Underground Utilities Construction and Operations Division recently replaced certain older and somewhat deteriorated 2-inch mains in certain areas (primarily in Frenchtown, but also some areas near FSU and between Gaines Street and FAMU) with newer and larger mains (e.g., primarily 6-inch mains). While one reason for those replacements was to improve water flows and pressures, replacing the older and deteriorated mains was also a stated reason. More of those replacements and upgrades are planned as time and resources permit.
- The Underground Utilities Construction and Operations Division recently replaced and upgraded approximately three miles of water main on Woodville Highway due to the deteriorated condition of that main based on a history of breaks and leaks.
- The Underground Utilities has established recurring and non-recurring capital projects for replacement of water infrastructure, including:
  - Water main replacements/upgrades - $635,000 budgeted for FY 2009 (a recurring capital project).
  - Replacement of old water services - $640,000 budgeted for FY 2009 (a recurring capital project).
  - Water valve replacements - $150,000 budgeted for FY 2009 (a recurring capital project).
  - Water main repairs (includes replacing mains that are broken) - $517,000 budgeted for FY 2009 (a recurring capital project).
  - Various water infrastructure upgrades and replacements to be performed during unspecified City/County/state funded roadway improvement projects (annual amounts budgeted for this range from $1.2 to $1.4 million; also a recurring capital project).

  - Other water infrastructure upgrades and replacements during specific (non-recurring) capital projects, such as planned redevelopment of Gaines Street ($1.7 million budgeted to replace and upgrade water infrastructure during that project).
  - Needed replacements and upgrades that are identified through the City's Master Water Plan. (Among other things, this recurring project includes upgrades to water "distribution piping." Funding through FY 2013 totals $12.8 million, with annualized disbursements budgeted between $2 million and $2.5 million.)

  Amounts expended under these various capital projects in the first eight months of FY 2009 totaled approximately $4 million.

- In November 2008, Underground Utilities executed a contract with an engineering firm (Malcolm Pirnie, Inc.) to update the City's Master Water Plan. The update was in process but not completed at the end of our audit fieldwork. The contract specified five areas of concern to be addressed as part of the update, including (1) Downtown, (2) Welaunee area, (3) Woodville, (4) Wakulla County, and (5) the area near Highway 90 and west of Capital Circle. Among other things, contractual terms provide for preparation of successive five-year implementation plans for improvements to the City's water distribution system, as well as needed replacement and rehabilitation projects. The contractor is also to help identify the approximate age of the City's water infrastructure in areas where the age is not currently documented. And lastly, the contractor is to provide City staff a short list of future distribution improvements, including areas that are deficient or in need of repair.
- Underground Utilities established a capital project for developing and implementing an "Asset Management Plan" for the City's wastewater, water distribution and production, storm water, and gas infrastructures. The intent is development of a system that integrates data from existing software applications

(e.g., GIS, PeopleSoft Financials and Project Management modules, Mobile Work Management System, and utility inventory system) for use in planning for and managing those infrastructures, including component replacements. That project was in the initial stages at the time of our audit fieldwork (i.e., a contract for consulting engineering services to assist Underground Utilities in this endeavor was being negotiated at the end of our fieldwork).

We commend Underground Utilities for those plans and actions for upgrading and replacing old and deteriorated water infrastructure. Our recommended enhancement to those plans and actions is addressed below.

RECOMMENDED IMPROVEMENTS AND ENHANCEMENTS

There is a concern with the aging and deteriorated condition of water infrastructure in the downtown area.

We recommend that Underground Utilities develop a viable plan to replace and upgrade the downtown water infrastructure over a reasonable period. As determined from our discussions with staff and as demonstrated by some of the proactive efforts described above, Underground Utilities is concerned with the condition of the City's downtown water infrastructure (e.g., the downtown area is one of the five areas of concern specified in the contract for updating the City's Master Water Plan). Our audit identified the following additional indications of significant water infrastructure deterioration in the downtown and certain nearby areas:

- Underground Utilities maintenance staff no longer exercise many valves in the downtown area, as experience shows turning (exercising) those valves causes leaks due to their deteriorated condition. (See page 49 of this report.)
- A pictorial display of leaks since July 2006 show that most leaks occur in the downtown and certain nearby areas. (See Appendix A to this report.)

Previously described circumstances show Underground Utilities is aware of this issue. To date, no definitive plan for replacing and

upgrading that infrastructure has been prepared. Based on our understanding obtained through interviews of WRE and other Underground Utilities staff, applicable areas that should be addressed in development of a viable replacement plan include:

A viable replacement plan should be developed for the downtown water infrastructure.

- Definition of the "downtown area" and identification of the specific locations within that area for which the infrastructure needs replacement.
- The expected costs and method of funding the replacements.
- The most efficient and appropriate replacement method.
- A timeframe and schedule for replacement (e.g., it may be prudent and cost-effective to perform the replacements concurrently with planned road resurfacings, and at times when there will be the least disruption to customers).

Because of its significance, we encourage Underground Utilities to follow through on initial efforts and develop a viable plan for replacing and upgrading the downtown water infrastructure. Additional replacement plans for other areas should be developed to the extent the updated Master Water Plan shows there is a similar need. Consideration should be given to amending the current contract for the City's Master Water Plan update to assist the City in developing such plans.

Infrastructure Replacement – Fire Hydrants (Objective 4 continued)

Overview. As described in the background section of this report, the City currently has in excess of 6,900 fire hydrants. While installation dates generally are not documented for the majority of those hydrants, many were installed several decades ago. If properly maintained, these hydrants will likely last for many more years. Notwithstanding, Underground Utilities established a hydrant replacement program to replace older and outdated (i.e., less efficient) hydrants. During our audit, we became aware that the replacement program has been temporarily suspended for the reasons described in the following.

OTHER ISSUES

The Underground Utilities established a hydrant replacement program.

The hydrant replacement program has been temporarily suspended until final determinations are made as to (1) the funding source and (2) whether Underground Utilities will continue to maintain and replace hydrants or a contract will be executed with a private (non-City) entity for those services.

For periods prior to our audit, hydrant inspection and maintenance activities were shared by the Fire Department and Underground Utilities (formerly the Water Utility). At the time we started our audit, Underground Utilities staff was performing all hydrant inspections and maintenance activities, including hydrant replacements.

The hydrant replacement program has been suspended until a decision is made as to the future funding source for hydrant maintenance and replacements, and the entity (Underground Utilities or private contractor) to perform those services.

As part of those activities, Underground Utilities established a program to replace older 4½ inch (size of valve openings) hydrants with newer 5¼ inch hydrants meeting specifications prescribed in the Underground Utilities "Standard Specifications for the Design and Construction of Water and Wastewater Facilities." Discussions with applicable staff indicate that program was implemented several years ago. The older 4½ inch hydrants were replaced when those hydrants broke or were damaged (e.g., vehicle accidents), and when funds and resources were otherwise available to make the replacements. Historical records were not available to clearly demonstrate the number of hydrants replaced through that program and current records (Mobile Work Management System) just show hydrants "replaced," which includes replacement of hydrants other than older 4½ inch hydrants. Based on our review of available records, it appears that approximately 190 hydrants may have been replaced under that program during the period July 2006 through early March 2009.

The hydrant replacement program was suspended in March 2009. Management indicated that the program was temporarily being halted until a determination was made as to (1) whether a new funding source would be established to fund hydrant maintenance and replacements and (2) whether the Underground Utilities would continue to perform fire hydrant maintenance and replacements or a

private (non-City) entity would perform those services pursuant to a contract executed by the Fire Department.

Those pending decisions are the result of a recent study and proposal that provides for fire hydrant maintenance and replacements to be funded from the City's fire services fee. Hydrant maintenance and replacements have traditionally been funded from Underground Utilities (formerly Water Utility) resources obtained through charges to customers for water consumption. If the fire services fee is used, those replacements will instead be funded by charges to customers for fire protection services. If this proposal is adopted, the Fire Department will be the City entity responsible for managing and funding hydrant maintenance and replacements. Under that scenario, the Fire Department may contract with Underground Utilities to perform hydrant maintenance and replacements, or execute a contract with a private entity to perform those services.

Accordingly, until the noted determinations and decisions are made, the fire hydrant replacement program has been suspended. We recommend that the applicable department (Fire Department and/or Underground Utilities) resume the replacement program when City management makes its final determinations and decisions. To document the effectiveness and results of that program, we also recommend a method be established to accurately document hydrant replacements under that program. (For example, applicable descriptions and/or attributes should be added and used on hydrant replacement work orders within the Mobile Work Management System to designate those replacements.)

Infrastructure Expansion (Objective 5)

Overview. The final objective of our audit was to determine if Underground Utilities has an adequate process for planning and funding expansion due to City growth and increased demand. We found that the City plans for expansion through its Master Water Plan, which is updated periodically. The plan was last updated in 2004. As addressed in the previous section of this report, the plan is currently in the process of being updated pursuant to a contract

The City's Master Water Plan is used to identify needs and plan for future expansion of the City's water infrastructure.

with an engineering firm (Malcolm Pirnie, Inc.). The contract provides for an updated Master Water Plan that includes:

- Development of a long-term supply and distribution plan.
- Successive five-year implementation plans for system improvements.
- Development of a GIS-based water model (represents an update to the existing water model) that can be used to project system needs based on potential growth and water demand and supplies.
- Development of projected flows and future demands on the water system, considering historical and projected populations, and possible future expansions of service areas.
- Alternatives for future wells and storage tanks to meet current and upcoming populations.
- Future supply alternatives.
- Recommendations for placements of future facilities, including tanks, wells, and main upgrades.
- Projected capital project needs, as well as operational and maintenance costs resulting from capital improvements.

As noted previously, the contract for the above was initiated at the time we started our audit and was still in progress at the end of our audit fieldwork. It is our opinion, from a non-engineering perspective, that if the contractor fulfills the contractual obligations and the City follows through with appropriate capital projects, the City should meet its future infrastructure needs.

Conclusion

Our audit showed that Underground Utilities generally has adequate and appropriate processes and procedures to (1) account for and track water infrastructure components; (2) properly and adequately maintain the City's water infrastructure; (3) ensure infrastructure additions are properly designed, constructed, and installed; (4) replace components at the end of their useful lives, and (5) plan and fund for future needs. We found that significant enhancements have been made in recent years.

Overall, adequate and proper processes are in place to account for and manage the City's water infrastructure; we found areas where further improvements and enhancements are needed.

Notwithstanding those adequate processes and procedures and recent enhancements, we did identify, with the assistance of Underground Utilities staff, issues which indicate that further enhancements and improvements are needed. Other related issues were also identified. Accordingly, recommendations were made within this report to:

- Ensure new infrastructure additions are properly recorded and tracked in the GIS.
- Capture and record critical and useful component attribute data in the GIS.
- Use the GIS as the primary system for tracking and physically accounting for all water infrastructure components.
- Ensure complete and accurate fire hydrant data is captured and recorded in the GIS as part of the ongoing "GIS data cleansing" project.
- Properly reflect all water meters and automatic flush stands in the GIS.
- Consistently, logically, and properly collect informative maintenance data through the Mobile Work Management System.
- Provide enhanced and additional reports on maintenance activities to management for oversight purposes.

Recommendations were made to address identified issues.

- Review and resolve "old" outstanding maintenance work orders.
- Use the Mobile Work Management System to plan and document sandblasting and painting of fire hydrants.
- Document manual flushes of water mains and the quantities of water used in those flushes.

- Increase efforts to exercise isolation valves at the frequency established by City procedures.

- Timely repair backup equipment at City water wells so that an adequate water supply is available in the event City power is temporarily unavailable.

- Ensure contracted engineers performing required structural inspections of elevated storage tanks are properly licensed.

- Properly design or review projects involving installation of new water infrastructure.

- Prepare adequate records to document inspections of water infrastructure additions.

- Perform required water quality tests before new infrastructure is placed into service.

- "Self-permit" water infrastructure additions as required by the FDEP.

- Refer to complete material specifications when ordering and purchasing water infrastructure components.

- Develop a viable plan to replace and upgrade the City's downtown water infrastructure.

- Resume the City's fire hydrant replacement program upon finalization of applicable funding determinations and related decisions.

- Establish documented procedures for various processes and activities.

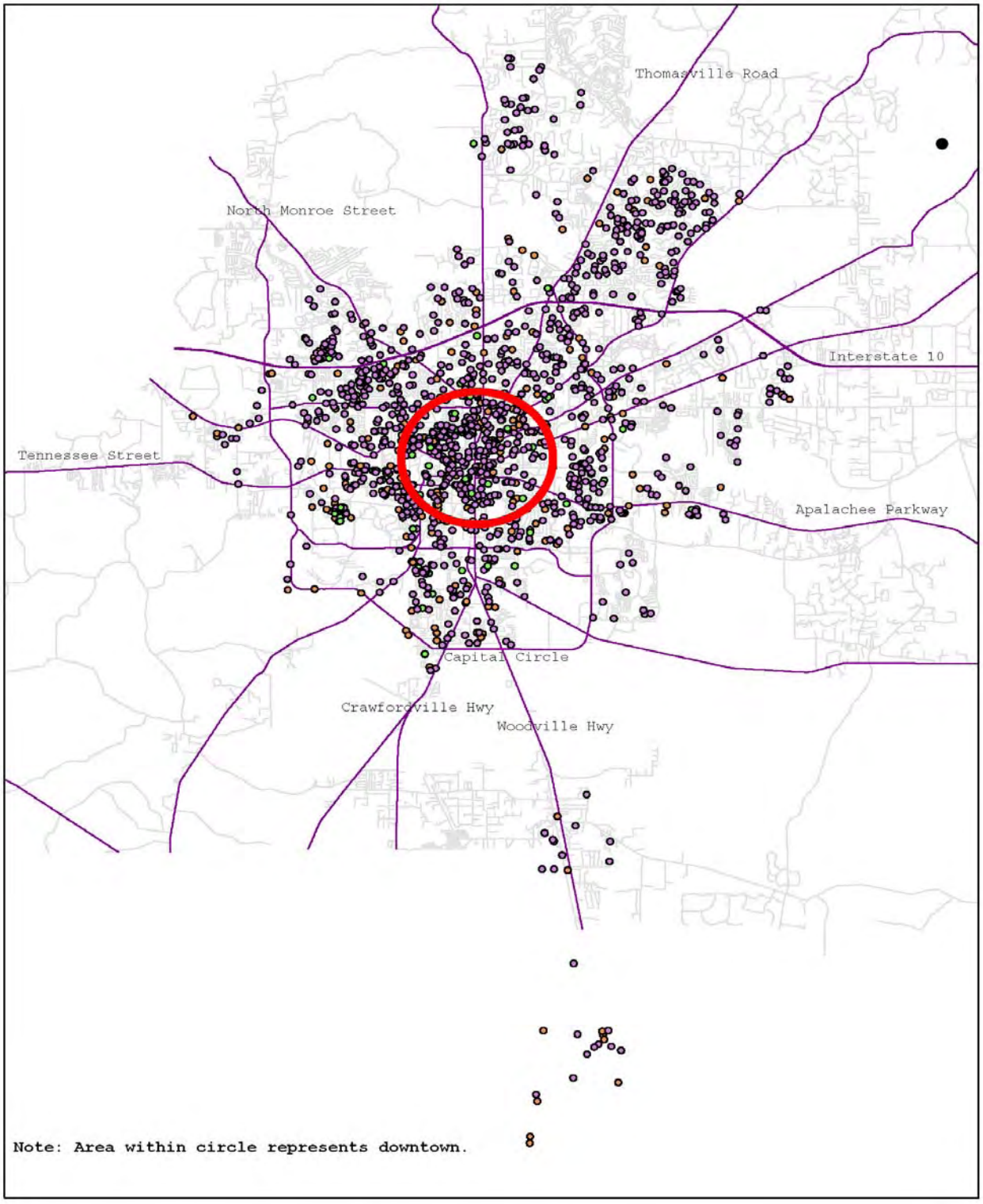
We would like to thank staff in the various Underground Utilities divisions for their assistance during this audit. We would also like

to express our appreciation to Information System Services staff for their assistance with applicable software programs and applications.

Appointed Official's Response

City Manager: I am very pleased with the results of this audit. The report reflects management's commitment to ensure the reliability of the Water Infrastructure by using technology to improve efficiency and effectiveness. The most important factor is the obvious commitment to enhanced customer service and staff's collaborative effort to implement the action plan. I thank the audit staff for their thorough analysis.

Appendix A – Identified Leaks



This page intentionally left blank.

Appendix B – Action Plan

Action Steps	Responsible Employee	Target Date
A. Objective: Ensure new infrastructure is added to and tracked in GIS		
1. A formal process will be established to identify and track external and internal projects involving the addition of new components to the water infrastructure. That process will include assigning responsibility to a project manager for ensuring new components are added to the GIS. A quality assurance/quality control process (QA/QC) will be developed and used to verify and document that new components are added to the GIS.	Tim Potter Jerry Walden JJ Meadows	April 2011
2. Formal procedures will be developed that specify As-Built drawings are required for water infrastructure additions installed by private developers, even when the developer does not execute a formal letter of agreement with the City.	Jim Lee JJ Meadows	April 2011
B. Objective: Ensure critical and useful component attributes are tracked in GIS		
1. Critical and useful attributes for each component type will be identified/designated.	Tim Potter Jerry Walden JJ Meadows	April 2011
2. For all subsequent infrastructure additions, the designated critical and useful attributes will be recorded in the GIS. A QA/QC process will be developed and used to assist staff in ensuring the designated critical and useful attributes are captured and recorded in the GIS for new infrastructure additions.	JJ Meadows	October 2011
3. Efforts to identify and record "known" or "approximate" component installation dates as part of the on-going Master Water Plan update will be emphasized.	JJ Meadows	October 2011

Action Steps	Responsible Employee	Target Date
4. Efforts will be enhanced to capture and record accurate and complete fire hydrant attribute data in connection with the on-going "GIS data cleansing" project.	Tim Potter David Nichols	January 2010
5. Staff will revisit a sample of hydrants previously surveyed during the "GIS data cleansing" project to ascertain if the audit findings, relating to incomplete/inaccurate recording of data for surveyed hydrants, were isolated or representative of work completed to date. If representative of work completed to date, hydrants will be resurveyed to capture and record accurate and complete data in the GIS.	JJ Meadows	July 2010
C. Objective: Ensure efficient tracking of all infrastructure components		
1. The GIS will be used as the primary record to account for and track critical and useful attributes for water wells and storage tanks.	Jane Clark JJ Meadows Jim VanRiper (ISS)	January 2011
2. The GIS will be used as the primary record to account for and track privately owned backflow control valves.	Jane Clark JJ Meadows Jim VanRiper (ISS)	January 2011
3. A process will be developed to timely remove "virtual" water meters when the actual meters are installed at applicable premises.	JJ Meadows Jim VanRiper (ISS)	July 2011
4. All automatic flush stands will be added to and reflected in the GIS.	Tim Potter JJ Meadows	January 2010
D. Objective: Ensure proper, logical, consistent, and informative data in the Mobile Work Management System		
1. The Mobile Work Management System and process for completing work orders in that system will be revised to: • Identify/designate "critical fields" for each work order type.	Tim Potter Stephen Mayfield David Nichols	July 2011

Action Steps	Responsible Employee	Target Date
• Require completion of all critical fields for each work order, including "work performed" and "actual problem." • Allow for documentation of multiple problems and multiple tasks on an individual work order. • Provide for use of the same attribute to identify similar problems and tasks. • Preclude use of the same attribute to describe dissimilar problems and work tasks. • Preclude use of inappropriate or illogical attributes to describe tasks performed. • Eliminate use of generic descriptions such as "repaired" or "replaced." • Require recording of a facility ID when a facility ID exists for the component worked on.		
2. Staff creating and completing system work orders will be trained on the revised processes and methods developed pursuant to the previous action plan step.	Tim Potter Stephen Mayfield David Nichols	July 2011
3. The 6,066 invalid preventive maintenance fire hydrant work orders will be deleted from the system.	David Nichols	January 2010
E. Objective: Ensure appropriate and useful managerial reports from the Mobile Work Management System		
1. Current reports produced for water and hydrant repairs will be revised to reflect the "actual" problem.	Tim Potter David Nichols	April 2010
2. Periodic reports will be generated and provided to management reflecting the number of isolation valves inspected and the number of hydrants inspected during designated periods.	Tim Potter Blas Gomez David Nichols	January 2012
3. In regard to valve inspections, periodic reports will be generated and provided to management reflecting:	Stephen Mayfield David Nichols	October 2011

Action Steps	Responsible Employee	Target Date
• The number of valves successfully exercised. • The number not successfully exercised. • The specific problems or issues identified during the inspections. • Work tasks performed as the results of the inspections.		
4. A determination will be made as to what represents an "excessive period" for a work order to remain open in the system without any recorded activity. Periodic reports will be generated reflecting work orders that have been outstanding for the defined excessive period. Based on review of those reports, appropriate actions will be taken to ensure work is completed, the system is updated to reflect completed work, and/or invalid work orders are deleted.	Tim Potter David Nichols	April 2010
F. Objective: Ensure tracking of maintenance activities		
1. The Mobile Work Management System will be used to schedule, document, and monitor sandblasting and painting of fire hydrants.	David Nichols	January 2010
2. The Mobile Work Management System will be used to document manual flushes of water mains and the quantities of water used during those flushes.	Tim Potter David Nichols	October 2010
G. Objective: Ensure proper and timely maintenance of isolation valves		
1. Management will monitor the frequency at which water isolation valves are being exercised. As resources are available processes, procedures, and methods will be modified and/or enhanced to ensure those valves are exercised on the established rotation.	Stephen Mayfield Blas Gomez	January 2012
2. Staff will explore the feasibility of an interface between the Mobile System and the GIS, such that work orders can be generated directly from the GIS.	David Nichols Jim VanRiper (ISS)	April 2011

H. Objective: Ensure consistent and proper maintenance activities		
1. Written procedures for the exercising of water isolation valves will be enhanced to (1) define isolation valves that should be exercised and (2) accurately identify the number of those valves.	Stephen Mayfield Blas Gomez	January 2012
2. Written procedures will be established that address (1) fire hydrant inspections, (2) flushing of water mains, and (3) standard reports that should be generated periodically from the Mobile Work Management System.	Tim Potter David Nichols	October 2010
I. Objective: Ensure availability of backup engines and generators at City wells		
1. A contract will be executed with a vendor to provide for timely responses (i.e., within 2 hours) in instances where backup engines and generators are not functional, including provision of rental equipment as needed.	Jane Clark	June 2009 *
J. Objective: Ensure proper and consistent maintenance of wells and storage tanks		
1. Prospective vendors will be required to provide proof of licensure status when submitting their proposals in response to requests for services.	Keith Starbuck	October 2009
2. Written procedures will be established that address (1) annual calibrations of water well meters; (2) exercising well backup equipment; (3) staffing water wells; (4) periodically inspecting, cleaning, and painting storage tanks; and (5) documenting various maintenance activities.	Keith Starbuck	March 2010
K. Objective: Ensure appropriate safety measures are implemented		
1. Discussions will be held with the Aviation department, and the FAA if needed, to ascertain if aviation lights are appropriate for each of the City's elevated storage tanks. If a determination is made that lights are needed for certain tanks currently without such lights, a plan will be developed to install the appropriate lights.	Jamie Shakar	March 2010

L. Objective: Ensure appropriate infrastructure additions		
1. Plans and processes requiring proper involvement by the WRE Division for "in-house" infrastructure additions will be finalized. A standard checklist will be developed for use by project managers to verify and document proper involvement (e.g., design or review) by WRE Division staff.	Sal Arnaldo Tim Potter	March 2010
M.Objective: Ensure appropriate inspections are performed and documented		
1. A standard inspection form/checklist will be developed and used by WRE inspectors to formally document their final inspection and approval of new infrastructure additions installed by contractors and private developers. Areas (e.g., inspector assertions and related data) specified in the audit report will be addressed on that form/checklist. The completed form/checklist will be signed and dated by the applicable inspector and the supervising WRE senior engineer.	Jerry Walden	March 2010
2. WRE inspectors will better document, in their inspector logbooks, the resolution of identified problems.	Jerry Walden	January 2010
3. A standard inspection form/checklist will be developed and used for "in-house" infrastructure additions. That form will be used to document staff's assertions as to (1) use of proper materials and installation methods, (2) performance of required pressure tests, and (3) conduct of required disinfections and water quality tests. That form/checklist will also be used to document the results of the required pressure and water quality tests.	Tim Potter	April 2010
4. A process will be developed to inspect infrastructure additions installed by the contractor on behalf of the City. Once developed, that process will address (1) use of proper materials and installation methods, (2) performance of required pressure tests and related results, and (3) conduct of required disinfections and water quality tests and related results.	Tim Potter	April 2010

N. Objective: Ensure projects are permitted as required		
1. Each applicable project will be self-permitted in accordance with the delegation order issued by the FDEP. A copy of the applicable City self-permit will be attached to and retained with project records.	Jim Lee	March 2010
O. Objective: Ensure acquisition of appropriate materials and components		
1. Attribute specifications in the PeopleSoft Financials System for each approved water infrastructure material and component will refer to the Underground Utilities' "Standard Specifications for the Design and Construction of Water and Wastewater Facilities" (i.e., for the required attributes).	Nico Lauw Holly Holland	January 2010
2. Subsequent purchase contracts for water infrastructure components will refer to the complete specifications established in the WRE "Standard Specifications for the Design and Construction of Water and Wastewater Facilities" as the required attributes.	Nico Lauw Holly Holland	January 2010
3. Subsequent purchase contracts for water infrastructure components will require suppliers to submit documentation (shop drawings/material submittals) to demonstrate their materials comply with City specifications.	Nico Lauw Holly Holland	January 2010
P. Objective: Ensure replacement of deteriorated and older infrastructure		
1. A plan will be developed for replacement of the City's downtown water infrastructure. That plan will (1) define the downtown area, (2) specify the locations within that area for which the infrastructure should be replaced, (3) project the costs of replacement, (4) identify funding to be used for replacement, (5) identify the most efficient and appropriate replacement methods, and (6) include a schedule and timeframe for completing the replacement.	Blas Gomez	October 2010
2. To the extent that funding is available, the current contract with Malcolm Pirnie for the update to the City's Master Water Plan will be amended to include assistance in development of the "downtown water infrastructure replacement plan" addressed in the previous action plan step.	Blas Gomez	February 2010

3. To the extent that funding is available, the downtown water infrastructure improvements will be initiated in accordance with the plan developed pursuant to the previous action plan steps.	Blas Gomez	October 2011
4. Underground Utilities will resume the hydrant replacement program, if appropriate based on City decisions regarding funding and the appropriate entity to perform hydrant maintenance.	Tim Potter	October 2011
5. If the hydrant replacement program is resumed by Underground Utilities, a method will be established to track replaced hydrants (i.e., under that program) in the Mobile Work Management System.	Tim Potter	October 2011

*Per department, action plan step has been completed as of indicated date. Completion will be verified during the audit follow-up process.

Appendix C – Photos

WELLS

Example - Well House Building

Example - Well Pump and Motor

Example – Generator at well site used for back up power source in the event City power is temporarily unavailable

Example – Auxiliary Engine at well site for back up power source in the event City power is temporarily unavailable

ELEVATED STORAGE TANKS

Example No. 1 – Elevated Storage Tank
(1,000,000 gallon capacity)

Example No.2 – Elevated Storage Tank
(600,000 gallon capacity)

WATER MAINS

Example – Ductile Iron Main - 20 foot sections (8 inch)

Example – PVC Main – 20 foot sections (6 inch)

WATER LATERALS

Example – HDPE Pipe for Water Laterals (various sizes)

HYDRANTS

Example – Standard 5 ¼ inch fire hydrant

VALVES

Example – System Gate Valves (10 inch)

Example – System Ball Valve (2 inch)