Water Services Department Water Production and Wastewater Treatment Equipment Maintenance

March 27, 2023

Report Highlights

Maintenance Sign-Off

Maintenance repair documentation could be strengthened by adding a supervisor sign-off.

Equipment Maintenance

Maintenance was being performed on critical assets. However, equipment maintenance criteria could not be matched to the maintenance performed.

Equipment Inventory

An inventory of all Water Services Department equipment has not been performed.

Executive Summary

Purpose

Our purpose was to determine if the City of Phoenix Water Services Department (WSD) has an effective process to ensure that preventative maintenance on all critical infrastructure is scheduled and completed as required by the manufacturer.

Background

WSD provides drinking water to almost 1.7 million customers Citywide, and treats wastewater for over 2.6 million customers in the Phoenix metropolitan area. The water and wastewater service area for the City of Phoenix encompasses approximately 540 square miles. The City's primary sources of drinking water are surface water and groundwater. Some of the wastewater that Phoenix treats comes from five valley cities that jointly own the 91st Avenue Wastewater Treatment Plant.

WSD relies on the work of nearly 1,500 employees to manage its major assets, which include: eight water treatment plants; nearly 300 pump, well, lift, and pressure stations; 7,000 miles of water main lines; 5,000 miles of sewer main lines; 54,000 fire hydrants; and, 94,000 manholes.

As part of the process of delivering high-quality water, and treating wastewater to ensure public health, WSD staff conducts repairs, inspections, and maintenance on much of the equipment. These processes are queued and documented using the Oracle Utilities Work and Asset Management (WAM) application.

Results in Brief

Overall, WSD had controls to ensure assets received maintenance and to monitor if maintenance was performed, but verification of repairs was not documented except for periodic audits of work orders.

WSD's queueing and monitoring process for asset maintenance helps mitigate the risk of maintenance not being performed and assets not functioning correctly. Additionally, a process for periodic auditing of a sample of work orders is in place. When a technician performs equipment maintenance, the work is marked completed in WAM. However, per WSD management, supervisor sign-off is not required to indicate the completion of a work order. Accordingly, WAM is not currently configured to document any supervisor verification that maintenance or repairs occurred.

Maintenance records in WAM showed maintenance was performed regularly for the assets reviewed. However, Water could not prove that the maintenance being performed satisfied the manufacturer's requirements.

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WSD maintains a library of manufacturer-recommended maintenance for equipment placed into service. We obtained a list of all maintenance performed on assets. During testing, we attempted to tie maintenance criteria to the maintenance records present in WAM and found that documents maintained in the document library were not tied to any of the assets selected for testing. We could not determine if the maintenance work documented in WAM was sufficient to adequately maintain the highest-risk equipment.

WSD management estimates that the WAM equipment listing is only 60% - 80% complete, and a recent inventory of equipment has not been performed.

SAP is the general ledger system for the City. For financial reporting purposes, SAP serves as the system of record. SAP is not able to queue work orders, so WSD uses the WAM system for these purposes. WSD estimated that WAM was approximately 60% - 80% complete. At a minimum, 20% of WSD assets were not yet present in WAM. A recent inventory of equipment has not been performed to validate this estimate. Per WSD management, a reconciliation between WAM and SAP is planned but has not yet occurred. Because the inventory records are not complete, WSD could not provide evidence that all equipment is properly maintained.

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Department Responses to Recommendations

Rec. #1.1: Update the Water Document Library to include appropriate maintenance criteria for WSD assets.	
Response: The Water Services Department will form a committee to define the primary document library for maintenance manuals and to document the business processes of keeping these manuals updated with new manuals for new assets and removing old manuals when those assets are no longer in service. The department will begin a reconciliation process starting with the two most critical asset groupings.	**Target Date:** March 23, 2024
Explanation, Target Date > 90 Days: The Water Services Department needs to determine what is the primary document library, develop the business process, and then a reconciliation of the materials can be performed. Given the magnitude of WSD assets this will take a year to complete.	

Rec. #1.2: Ensure that maintenance criteria align with actual maintenance performed on WSD assets.	
Response: The Water Services Department will provide the process that documents how maintenance criteria for new assets aligns with the maintenance to be performed on the new asset.	**Target Date:** June 23, 2023
Explanation, Target Date > 90 Days: N/A	

Rec. #1.3: Add supervisor sign-off to critical asset repairs and maintenance to ensure the work has been performed adequately.	
Response: The work order audit procedure will be updated to include Water Production and WWTP supervisors auditing/reviewing and sign-off of twenty (20) work orders each month for assets that are identified as the most critical assets.	**Target Date:** June 23, 2023
Explanation, Target Date > 90 Days: N/A	

Rec. #2.1: Perform a full inventory count of WSD equipment and reconcile to WAM.	
Response: The Water Services Department will perform a full inventory count of WSD equipment and will reconcile WAM.	**Target Date:** June 23, 2025
Explanation, Target Date > 90 Days: The WSD is in the process of procuring a vendor. The vendor will take 12 months to perform the inventory (due June 2024). WSD will then have to review the information and reconcile the WAM system (due June 2025).	

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Rec. #2.2: Work with Finance to define the roles and processes to update asset information in SAP.	
Response: The Water Services Department will define the roles and processes to update asset information in SAP.	***Target Date:*** June 23, 2023
Explanation, Target Date > 90 Days: N/A	

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1 – Equipment Maintenance Testing

Background

To ensure that the most critical equipment was properly maintained, we worked with WSD management to identify the highest-risk asset categories to test. These categories were identified as follows:

Types of Equipment Tested

Equipment Type	Purpose
Pumps	Moves water, wastewater, and other chemicals through the system.
Site Valves	Allows the ability to shut off or turn on the movement of liquids through the system.
Blowers	Channels air from a fan and directs it to a specific location.
Motors	Drives pumps and other automated devices.
Centrifuges	Separates solids from liquids.
Cranes	Moves a heavy item.
Fans	Device that moves air.
Basins	Area of collection of a liquid.
Conveyors	Moves items from one area to another.

All equipment sampled was from the highest risk categories.

We verified that maintenance was performed on a random selection of equipment in the preceding asset categories by comparing maintenance recorded in WAM to manufacturer operations and maintenance manuals maintained in the WSD Document Library (library). As an additional test, we judgmentally selected ten manufacturer manuals and WSD Standard Operating Procedures (SOPs) from the library in place as of May 18, 2022, to test for adequate maintenance.

Results

Overall, WSD had controls to ensure assets in WAM received maintenance and to monitor if maintenance was performed, but verification of repairs was not documented.

WSD uses WAM to track assets and the associated required maintenance. Documented procedures identify how to update WAM when new assets are placed in service, including the maintenance requirements. Through a well-functioning work queueing system and monitoring dashboards, WSD can ensure assets in WAM requiring maintenance are queued to the respective team to complete. Per WSD management, supervisor sign-off is not required to indicate the completion of a work order. Only the technician that performed the work marks the maintenance as completed. Accordingly, WAM is not currently configured to document any supervisor verification that maintenance or repairs occurred. Over the past five years, 11,107 maintenance tasks were completed for the high-risk asset categories selected for testing. WSD's queueing and monitoring process helps mitigate the risk of maintenance not being performed and assets not functioning correctly, but could be strengthened by adding supervisor-level verification that repairs were performed.

WSD recently implemented a process for periodic auditing of a sample of work orders.

To further enhance the monitoring function for asset maintenance, WSD recently revised a policy requiring an audit of work orders designed to check that the work listed as performed in WAM had been accomplished according to the work order. The WAM Team provides a report to the auditing division who selects from the report using a random methodology. The sample size will vary according to the population, and the frequency of audits can vary as well, with at least quarterly being a requirement. Follow-up and reporting is performed with the Assistant Director for each respective division. Through the date of this report, only a small sample of WAM work order audits had been performed, and appeared to follow the policy as directed. WSD identified no audit exceptions.

Maintenance records in WAM showed maintenance was performed regularly. However, due to the lack of documented maintenance criteria, we could not conclude if the maintenance satisfied the manufacturer's requirements.

WSD maintains a library of manufacturer-recommended maintenance for equipment placed into service. When an asset is entered in WAM, staff are responsible for establishing the maintenance activities based on these criteria. We obtained a list of all maintenance performed on assets. During testing, we attempted to tie maintenance criteria to the maintenance records present in WAM. We selected a 49 assets out of approximately 58,000 that were randomly selected among the equipment categories identified by WSD management as the highest risk. Both scheduled and unscheduled maintenance occurred on all assets selected for testing as identified by fields in WAM. We attempted to conduct attribute testing according to the manufacturer's recommended maintenance levels from documentation maintained by WSD in its

Document Library. However, no documents were maintained that tied to the assets we selected for testing.

Since we were unable to trace maintenance activity to the document library, we selected a sample of maintenance documents and tried to trace them to work done on the associated assets. From WSD's Document Library, we judgmentally selected ten manuals and WSD SOPs and agreed the maintenance criteria contained therein to maintenance performed on corresponding assets in WAM. Five of the ten documents could be cross-referenced, and the maintenance documented in WAM matched the criteria from the WSD Document Library. Four of the other documents did not identify maintenance criteria; however, the assets still had maintenance performed. One document did not correlate to any asset present in WAM.

Having documented maintenance criteria that is consistent with the manufacturer or industry requirements will help WSD staff ensure that the maintenance activities in WAM are consistent with those requirements, mitigating the risk that assets are not properly maintained.

Recommendations

1.1 Update the Water Document Library to include appropriate maintenance criteria for WSD assets.

1.2 Ensure that maintenance criteria aligns with actual maintenance performed on WSD assets.

1.3 Add supervisor sign-off to critical asset repairs and maintenance to ensure the work has been performed adequately.

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2 – Inventory of WAM Equipment

Background

In order to determine if the City of Phoenix Water Services Department (WSD) has an effective process to ensure that preventative maintenance on all critical infrastructure is scheduled and completed in accordance with the manufacturer's recommended intervals, the WAM equipment listing has to be complete. We interviewed key personnel to obtain an understanding of how WAM assets are entered, and we obtained a listing from WAM of all equipment contained therein and obtained a report of all WSD assets maintained in the City's financial system SAP. SAP is the general ledger system for the City. For financial reporting purposes, SAP serves as the system of record. SAP is not able to queue work orders, so WSD uses the WAM system for these purposes. We selected a sample of assets from WAM to trace to SAP to determine the completeness of the asset population.

Results

WSD management confirmed that the WAM equipment listing is not complete, and that a recent inventory of equipment has not been performed.

We obtained a listing of all assets contained in the WAM database. We also obtained a report from SAP for all Water assets. Per WSD management, SAP is the system of record for financial reporting purposes, but WAM is used for asset management and maintenance purposes. Each database had approximately 58,000 and 50,000 total assets, respectively. We judgmentally selected ten assets from WAM to trace to SAP so we could validate that the WAM equipment listing was complete. None of the assets could be traced from WAM to SAP, either by description or by asset number. The asset numbering convention differed between the two systems, with WAM having seven digits and SAP having six digits. Per WSD management, a reconciliation between WAM and SAP is planned but has not yet occurred. In addition, they estimated that the asset inventory in WAM was only 60% - 80% complete and that, at minimum, 20% of WSD assets were not yet present in WAM. Moreover, a recent inventory of equipment has not been performed. Without a complete population of assets, there is a risk that some assets could not be captured in the maintenance queue and could be at risk of receiving inadequate maintenance. Because the inventory records are not complete, WSD could not provide evidence that all equipment is properly maintained.

Recommendations

2.1 Perform a full inventory count of WSD equipment and reconcile to WAM.

2.2 Work with Finance to define the roles and processes to update asset information in SAP.

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Scope, Methods, and Standards

Scope

This audit encompassed all WSD equipment in service as of June 23, 2022.

The internal control components and underlying principles that are significant to the audit objectives are:

- Control Activities
  - Management should design control activities to achieve objectives and respond to risks.
  - Management should design the entity's information system and related control activities to achieve objectives and respond to risks.
- Monitoring Activities
  - Management should establish and operate monitoring activities to monitor the internal control system and evaluate the results.

Methods

We used the following methods to complete this audit:

- We interviewed WSD management and staff.
- We reviewed WSD policies.
- We tested WAM equipment and maintenance.
- We performed data validation procedures on WAM and SAP ledgers.

Unless otherwise stated in the report, all sampling in this audit was conducted using a judgmental methodology to maximize efficiency based on auditor knowledge of the population being tested. As such, sample results cannot be extrapolated to the entire population and are limited to a discussion of only those items reviewed.

Data Reliability

We assessed the reliability of WAM data by (1) performing electronic testing, (2) reviewing existing information about the data and the system that produced them, and (3) interviewing agency officials knowledgeable about the data. We determined that this data, although incomplete, was sufficiently reliable for the purposes of this audit.

Standards

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that 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 that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. Any deficiencies in internal controls deemed to be insignificant to the audit objectives but that warranted the attention of those charged with governance were delivered in a separate memo. We are independent per the generally accepted government auditing requirements for internal auditors.

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