Washington Suburban Sanitary Commission

FINAL REPORT

Utility Benchmarking and Organizational Efficiency Review

June 13, 2016

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Background

The Washington Suburban Sanitary Commission (WSSC) provides water and sewer services to nearly 1.8 million residents of Maryland's Montgomery and Prince George's counties, which border Washington, D.C. The WSSC was stablished by the Maryland General Assembly in 1918 as a regional (bi-county) organization under Article 29 of the Annotated Code of Maryland and was recodified into Division II of the Public Utilities Article of the Annotated Code of Maryland. The WSSC ranks among the 10 largest water and sewer utilities in the country, serving over 447,000 active customer accounts and a service area of nearly 1,000 square miles. WSSC is a government agency with an annual combined operating and capital budget of approximately $1.4 billion.

WSSC's stated mission is "…to provide safe and reliable water, life's most precious resource, and return clean water to our environment, all in an ethical, sustainable, and financially responsible manner". WSSC operates and maintains an extensive array of highly automated facilities. Its two primary water filtration plants, drawing from the Potomac and Patuxent rivers, are projected to produce an average of 166 million gallons per day MGD of water. Nearly 5,600 miles of mains deliver that water to homes and businesses in Montgomery and Prince George's counties. The Commission operates three reservoirs having a total capacity of 14 billion gallons to ensure a reliable water supply for all customers each day and through all weather conditions.

Sewage treatment is currently provided by six wastewater treatment plants operated by the WSSC and the Blue Plains Advanced Wastewater Treatment Plant operated by the District of Columbia Water and Sewer Authority. Every day, an average of nearly 200 million gallons of wastewater from Montgomery and Prince George's counties moves to these facilities over 5,400 miles of sewer lines maintained by the WSSC. The six WSSC wastewater treatment plants have a combined capacity of 89.5 MGD, and WSSC is allocated 169.6 MGD of the 370-MGD Blue Plains capacity. All but two of the six WSSC facilities go beyond conventional wastewater treatment processes to provide tertiary treatment – advanced treatment processes that ensure the quality of the treated wastewater is better than the quality of the natural water to which it is returned. Of the 71.9 billion gallons of total annual sewage flow treated in FY2014, 25.9 billion gallons were treated at WSSC's wastewater plants, with the remaining 46 billion gallons treated at Blue Plains.

Approximately 15 years ago, an in-depth study was completed that recommended many changes to the Commission, including a 30% workforce reduction. While the workforce reductions were implemented, many of the other strategies either were not implemented or delayed. Over the years, infrastructure investments remained below required levels and a court ordered Consent Decree on sanitary sewer overflows was entered into in FY2005, requiring extensive capital investments by FY2018. Further, the number of residents served by WSSC continued to increase and the miles of service connections increased due to continued population growth within Montgomery and Prince George's counties. Beginning in FY2007, WSSC began to increase its workforce to meet growing service requirements as well as to re-activate needed maintenance and regulatory programs that either did not exist or were reduced by previous workforce reductions. From FY1997 to the FY2016 approved budgets, the total authorized workforce decreased by 16.8%, while the population in the two counties increased by 21.3%, water mains increased by 613 miles, the number of WSSC accounts increased by 17.5%. Water production, the basic source of revenue, remained virtually flat despite increased population and connections to the system.

Scope and Objectives

The project scope was to perform an independent review of the various water, sewer and regulatory services provided to the customers and stakeholders of WSSC, utilizing applicable industry/best-in-class benchmarking metrics.

Project objectives included:

1) Identifying standard metrics and/or best practices to determine how well a function or business operation is performing, and

2) Identifying the efficiency and effectiveness of WSSC's operations, and

3) Comparing WSSC operations to similarly situated utilities, and

4) Reviewing workforce staffing levels.

The study also included a review of the Commission's major cost drivers, the effectiveness and efficiency of WSSC's major programs, projects and services, as well as the operating and capital financial management systems and associated rate impacts to customers, consistent with providing responsible water, wastewater and other services.

Methodology

The study presented here consists of two different, but related evaluations. The first consists of overall benchmarking using available data to compare WSSC as a whole to peer utilities using industry standard metrics. The second breaks WSSC into specific business groups and evaluates current performance against best practices established by Veolia in their world-wide operations to determine potential recommendations for improvement.

Overall Benchmarking

Our overall benchmarking methodology consisted of the following:

- **Gaining an understanding of WSSC** – This was done through interviews with management and staff, review of documents and some plant walkthroughs.

- **Identification of metrics** – Industry metrics were derived from the QualServe Benchmarking program, which is a suite of metrics developed by the American Water Works Association (AWWA), the Water Environment Federation (WEF), the Water Research Foundation and industry leaders. This program, of which WSSC has been a frequent contributor, has been used for annual benchmarking of water and wastewater utilities since 2002.

- **Formation of peer utility groups** – QualServe data was gathered from utilities that are similar to WSSC in terms of size, regulation, services, location and other relevant factors. Eight peer utility groups were formed and relevant data collected for them.

- **Comparison to peers** – Comparisons using efficiency and effectiveness metrics were made, as appropriate to utility peers.

- **Effectiveness of Business Operations** – To analyze the effectiveness of WSSC, the Effective Utility Management (EUM) framework was used. This framework was developed and endorsed

by the USEPA and the trade associations serving the water and wastewater industry. An EUM framework was developed specifically for WSSC to identify metrics and targets used in the scoring.

- **Workforce Staffing Levels** – Staffing levels were assessed using multiple peer groups and efficiency metrics.

Best Practices Review

Business practices in each functional group, were assessed through a series of document reviews, data evaluation and staff interviews conducted in January through March 2016. An evaluation was then conducted using a standardized scoring system from 1 (basic performance) to 5 (industry best) to baseline current WSSC performance. To assist in identifying which business practices have the largest opportunity for improvement, a second score was identified as a near-term improvement goal. This score is determined to be where WSSC could be in less than 24 months with some additional focus and effort, given the current landscape within the organization. The difference between actual performance and the near-term performance goal forms the basis of a gap analysis that is then used to prioritize areas that have potential for additional improvement.

Findings

General Benchmarking

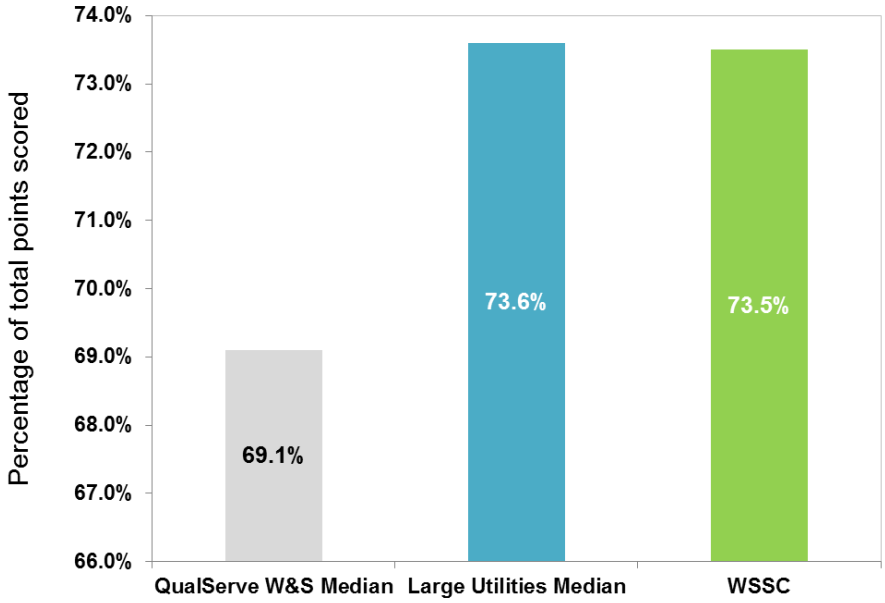
- Compared to comparably sized utilities providing water and wastewater services, WSSC's unit staffing levels are at or below median. Due to the mix of retail and wholesale services provision by large utilities this is, necessarily, a rough evaluation of staffing efficiency.

- A comparison of staffing distribution to combined water and sewer utilities and to large utilities shows that WSSC has a higher percentage of staff devoted to management activities and to Engineering and Construction. However, it has lower percentages for support activities, such as HR, legal and purchasing. Almost all of the peer utilities are owned by governmental entities that provide some management and support functions to the utility. Higher staffing levels in Engineering and Construction are partially attributable to the large number of small projects (compared to large utilities) and the labor intensity of the system development charge (SDC) program administration.

- Functional staffing comparisons (compared to large utilities) show that WSSC is at or below average for most functions, with the exception of IT and Engineering and Construction, both of which are going through a major upgrade program.

- The extent to which WSSC employs Best Practices was measured utilizing a Best Practices Index. The Best Practice Index was developed by the American Water Works Association/Water Environment Federation QualServe program (with additional support by the Water Research Foundation and the Water Environment Research Foundation) and examines practice levels in 11 management areas. WSSC's Best Practices Index was above the combined water and sewer utility median and near the large-utility median. A summary of the overall Best Practice Index grade can be found in Figure ES.1 below.

Figure ES.1 Overall QualServe Best Practice Index Comparison



- Management effectiveness was measured using an EUM framework. EUM is a water-sector collaboration of USEPA and all of the water and wastewater associations and research foundations working to improve utility management. WSSC exceeds the target for six of 10 attributes of EUM. One attribute could not be assessed due to lack of data and three attributes offer opportunities for improvement. A summary of the overall EUM Assessment is found in Table ES.1 below.

- **Table ES.1** Overall EUM Assessment

Attribute	Overall Performance
Product Quality	
Customer Satisfaction	
Employee and Leadership Training	
Operational Optimization	
Financial Viability	
Infrastructure Stability	
Operational Resilience	N/A
Community Sustainability	
Water Resource Adequacy	
Stakeholder Understanding and Support	

- Compared to large utilities, WSSC's average water and sewer bill is below average and is more affordable (average bill divided by median household income).

- WSSC has a AAA bond rating, an average bill that is below average and more affordable than large-utility peers, and an above-average cash reserve adequacy.

Best Practices Evaluation

A summary of the best practice evaluation in each business group at WSSC is presented in a "spider" graph and a gap analysis table, followed by major improvement recommendations.

The spider graphs plot each best practice against an axial spoke, with current performance scored from 1 (basic performance) to 5 (industry best) radially outward along each axis. Two lines are plotted: WSSC Current Performance and Near-Term Improvement Goals. WSSC Current Performance is the current assessment of WSSC performance as determined through the evaluation. The Near-Term Improvement Goal is a subjective assessment of where WSSC could be within 24 months, given the current landscape, through implementation of the recommendations indicated.

The gap analysis table lists the individual scores for WSSC Current Performance and Near-Term Improvement Goals in tabular format. The difference between actual performance and the near-term performance goal forms the basis of the gap analysis that is then used to prioritize areas that have potential for additional improvement. Any arithmetic difference of 2.0 or greater between actual performance and the near-term performance goal was considered significant, and any difference in scores between1.5 and 1.9 was considered potentially significant.

As a general guidance note, current performance scores normally achieved for a large utility such as WSSC would range from 3 to 5

Customer Service

Figure ES.2 Customer Service Best Practices Evaluation Summary

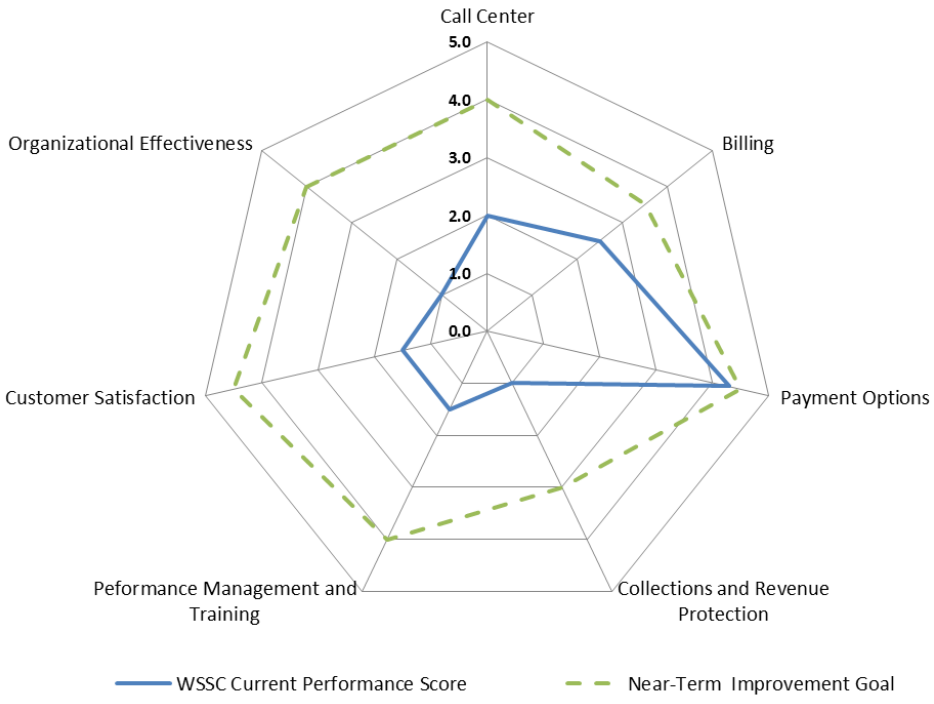


Table ES.2 Customer Service Best Practices Gap Analysis

Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
Call Center	2.0	4.0	2.0	Yes
Billing	2.5	3.5	1.0	No
Payment Options	4.3	4.5	0.2	No
Collections and Revenue Protection	1.0	3.0	2.0	Yes
Peformance Management and Training	1.5	4.0	2.5	Yes
Customer Satisfaction	1.5	4.5	3.0	Yes
Organizational Effectiveness	1.0	4.0	3.0	Yes

Customer Service Major Recommendations

- Consider implementing a customer service management system that is data driven complete with KPIs, performance metrics and targeted levels of operation for all customer service organizations, specifically adding billing and collections KPIs in addition to expanding call center metrics. This management system should include reports of operational metrics reviewed regularly by various levels of management, with high-level KPIs reported upward to the Board of Commissioners.
- Consider reorganizing Customer Relations to align resources and responsibilities toward achieving targeted levels of service. As part of this, identify responsible business leads for call center, billing and collections functions and specifically focus on removing non-call center work from the call centers.
- Consider documenting WSSC customer service policies, procedures and processes, including formalizing a process for handling escalated customer complaints and has a monthly process of analyzing root causes of complaints and reporting results to management.
- Consider cross-training all contract CSRs to allow them to handle all calls, including move-in/move-out calls to reduce customer call transfers and eliminate staffing of a special transfer queue. Once completed, consider changing the 50-50 call routing scheme to funnel calls to the next available agent.
- Consider removing claims from Customer Relations and rationalize the organizational alignment of the ECC.
- Consider modifying the call center IVR to include the option of reporting an emergency as a first option. Once completed, further consider using just one phone number for customers, as emergency calls will be routed to the ECC directly from the IVR.
- Consider using a professional utility bill print vendor service to gain operational efficiencies.

- Consider reengineering the customer refund process.
- Consider changing and expanding the marketing strategy for customer electronic billing and payment option.
- Consider instituting industry-standard KPIs.
- Consider a comprehensive review of credit and collection policies and procedures and benchmark to peer utilities.
- Consider having a dedicated field meter team that reports to Customer Service, rather than Utility Services to perform such light field work as meter reading/testing, shut-offs, turn-ons, collections, etc.
- Consider designing and implementing a quarterly, transactional, telephone-based customer satisfaction survey administered by a third-party market research firm to gain insight and analytics for analyzing and planning of customer service performance improvement initiatives.

Procurement

Figure ES.3 Procurement Best Practices Evaluation Summary

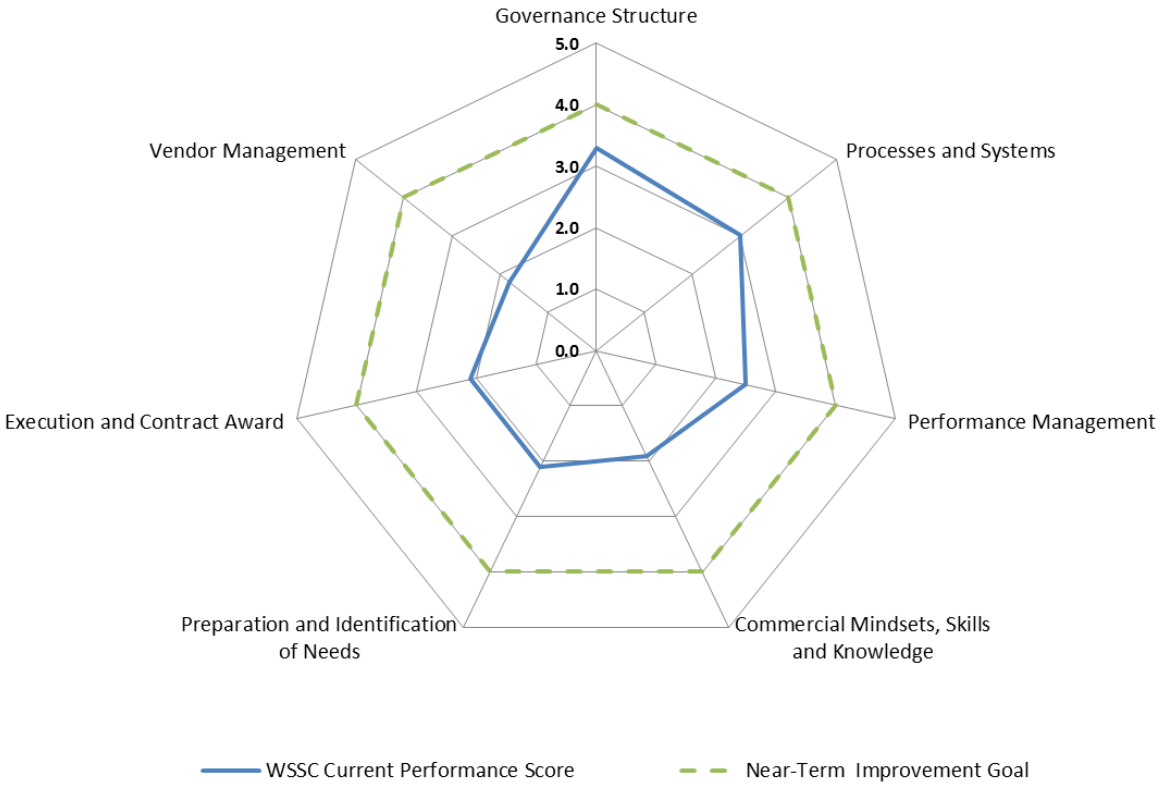


Table ES.3 Procurement Best Practices Gap Analysis

Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
Governance Structure	3.3	4.0	0.7	No
Processes and Systems	3.0	4.0	1.0	No
Performance Management	2.5	4.0	1.5	Potentially
Commercial Mindsets, Skills and Knowledge	1.9	4.0	2.1	Yes
Preparation and Identification of Needs	2.1	4.0	1.9	Potentially
Execution and Contract Award	2.1	4.0	1.9	Potentially
Vendor Management	1.8	4.0	2.2	Yes

Procurement Major Recommendations

- Fill the strategic vacant positions: Contracting Office Group Lead position, Strategic Sourcing Specialist positions.
- Clarify the roles and responsibilities of the Operations and Administration team.
- Develop and train key staff to be classified as category buyers to improve efficiency and effectiveness.
- Optimize preparation stages through enhanced collaboration with user's department and SLMBE to reduce planning and pending time.
- Develop and implement business practices that more-tightly control the approval process and approval timelines including an electronic document management system. Develop and implement a more-detailed tracking system to assist in identifying reasons for delays
- Expand the metrics to be tracked to include quality, cost, end-user satisfaction, vendors' performance, and spend compliance. Develop a contract evaluation process in collaboration with the end-users. The objective is to identify any issue in the vendor performance and plan corrective actions accordingly. For each relevant metric, establish a performance target. Develop and implement graphical charts showing performance using actual performance data. Plot data on a rolling one-year cycle to evaluate trends.
- Develop and implement robust weekly performance meetings for each group. Each meeting should be attended by key personnel and specific performance discussed using actual performance data. Focus discussion on performance gaps and understanding root causes. Develop action plans based on Specific, Measurable, Actionable, Relevant, and Time-Bound (SMART) principles, monitor progress at each weekly meeting and assign accountability to ensure plans are consistently carried through to completion
- Develop and implement business practices that include the use of industry-standard benchmarking tools such as BidNet or SmartProcure.

- Develop and implement a more-robust vendor database that includes substitutes and market intelligence.
- Develop and implement business practices that outline and assign responsibility to perform evaluation of vendor performance, such as tracking and analysis of delivery times, packaging and delivery options, as well as vendor wait times when unloading product, and forecast versus usage. Include a process to perform vendor outreach in order to foster interest and competition. Consistently and regularly reach out to non-responsive bidders to generate additional bidders/competition in the future. Utilize a scorecard as a means to provide feedback to vendors about performance. Hold regular formal vendor performance meetings.
- Develop a three-year look-ahead contract calendar that clearly identifies all of the current term and key action milestones for each contract.
- Develop and implement business practices that outline and assign responsibility to perform analysis of the market basket (spend versus forecast) to improve demand projections, and formally track historical usages.
- Improve the accuracy of cost estimates as well as structure of the cost lines on all construction contracts.

Fleet

Figure ES.4 Fleet Best Practices Assessment Summary

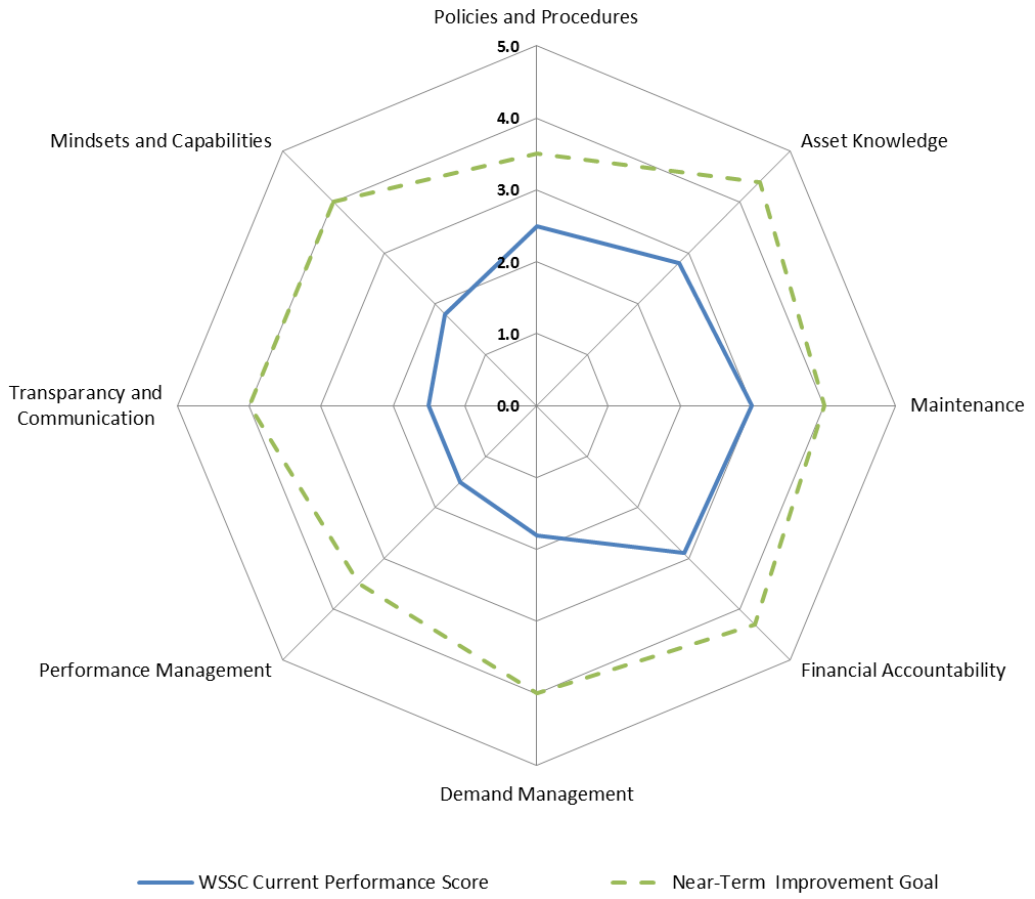


Table ES.4 Fleet Best Practices Gap Analysis

Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
Policies and Procedures	2.5	3.5	1.0	No
Asset Knowledge	2.8	4.4	1.6	Potentially
Maintenance	3.0	4.0	1.0	No
Financial Accountability	2.9	4.3	1.4	No
Demand Management	1.8	4.0	2.2	Yes
Performance Management	1.5	3.5	2.0	Yes
Transparancy and Communication	1.5	4.0	2.5	Yes
Mindsets and Capabilities	1.8	4.0	2.2	Yes

Fleet Major Recommendations

- Develop and implement a robust performance management system, including holding staff accountable for specified performance. Standardize metrics as much as possible across all workgroups. Establish a control team to manage documentation and assign accountability by reviewing all processes, procedures and documents with key stakeholders on an annual basis.
- Assign someone from Logistics to be responsible for regular QA/QC of the data. Any errors that are identified should be noted and corrected. Errors that repeat frequently should generate an email that notifies users of the error and the issue should also be brought up during meetings. Review TEAMS system fields to maximize those that can be standardized to improve simplicity and analysis. Standardize fields into drop-down menus or lists, instead of free-form text fields.
- Install in-vehicle monitoring system (IVMS) on each vehicle, providing the ability to track vehicle usage.
- Examine the maintenance shops and what work is assigned to each shop to determine if there is a lack or shortage of equipment at certain facilities as indicated by Logistics personnel. Also, evaluate productivity and capacity in each shop.
- Conduct a comprehensive evaluation of right-sizing the fleet should be performed to look for opportunities to reduce overall life cycle costs, including fuel, for vehicles in the fleet. Evaluate the potential to rent or lease specialty vehicles and equipment that are seldom used and historically carry significant repair costs.

- Develop standard vehicle specifications to allow for bulk buying, better pricing and increased simplicity. Using the TEAMS, develop metrics and dashboards that provide business cases for improvement in making vehicle and equipment purchasing decisions.

- Establish clear communication channels, both internally among Logistics and with other WSSC groups, and define how information gets circulated as well as how Logistics can collect feedback on a monthly basis. Schedule regularly meetings with all groups and internal Logistics staff to share performance data, define action items, and assign accountability.

Utility Services

Figure ES.5 Utility Services Best Practices Evaluation Summary

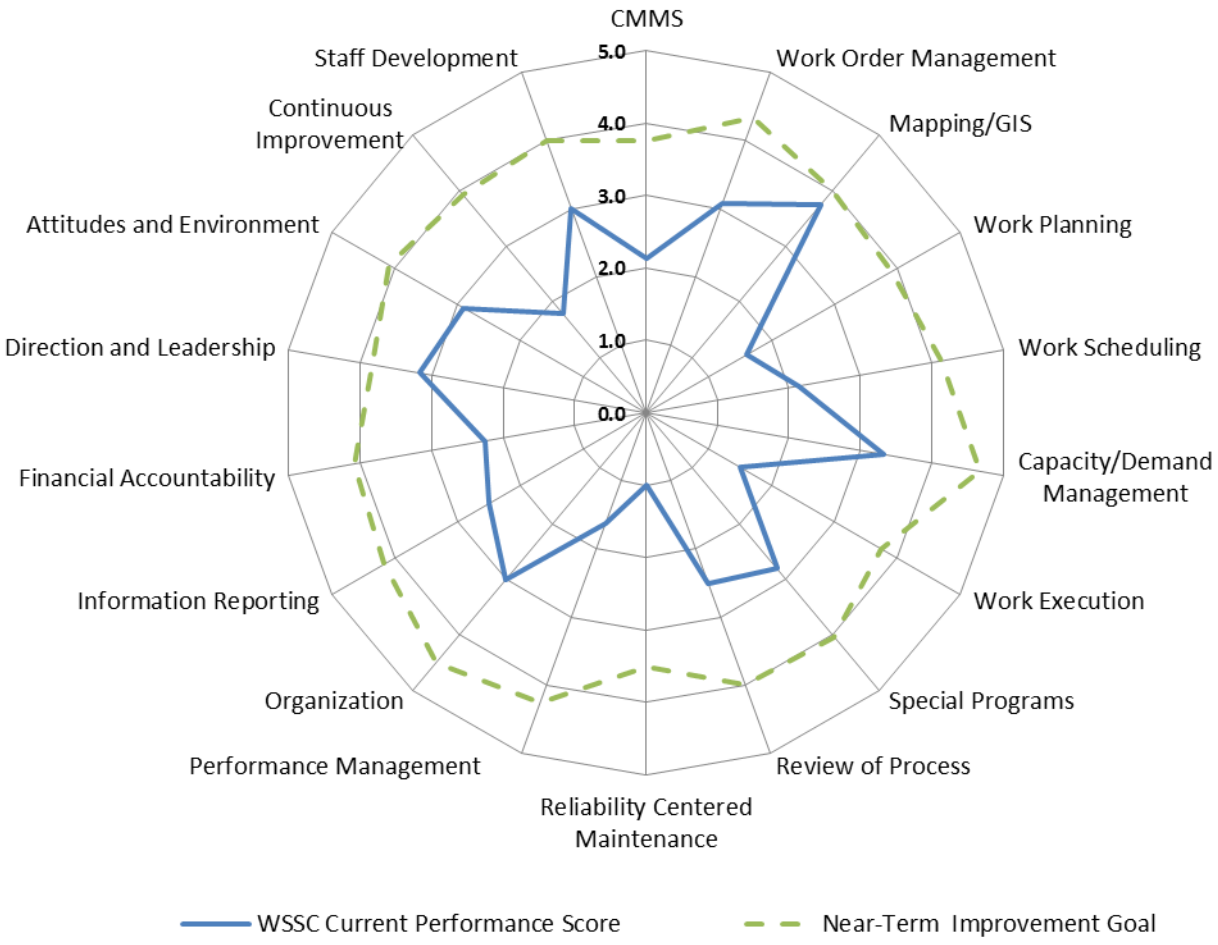


Table ES.5 Utility Services Best Practices Gap Analysis

Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
CMMS	2.1	3.8	1.6	Potentially
Work Order Management	3.1	4.3	1.3	No
Mapping/GIS	3.8	4.0	0.3	No
Work Planning	1.6	3.9	2.3	Yes
Work Scheduling	2.1	4.1	2.0	Yes
Capacity/Demand Management	3.3	4.7	1.3	No
Work Execution	1.5	3.8	2.3	Yes
Special Programs	2.8	4.0	1.2	No
Review of Process	2.5	4.0	1.5	Potentially
Reliability Centered Maintenance	1.0	3.5	2.5	Yes
Performance Management	1.6	4.3	2.6	Yes
Organization	3.0	4.5	1.5	Potentially
Information Reporting	2.5	4.2	1.7	Potentially
Financial Accountability	2.3	4.1	1.8	Potentially
Direction and Leadership	3.2	3.8	0.7	No
Attitudes and Environment	2.9	4.1	1.2	No
Continuous Improvement	1.8	3.9	2.1	Yes
Staff Development	3.0	4.0	1.0	No

Utility Services Major Recommendations

- Use the CMMS as an asset management tool. Track only work performed by WSSC personnel in CMMS. Actual labor times and material costs should be also be tracked against each work order. Conduct regular, comprehensive inventories and condition assessments for all assets. Conduct regular trend analyses on maintenance histories for critical assets.
- Develop and train staff on quality assurance/quality control (QA/QC) procedures to ensure the quality and nature of the data entered into the CMMS database.

- Develop specific business practices to outline the new job planning workflow and describe in detail each step in the process, who is responsible for performing it, and how each step in the workflow influences the others. Establish a two-week planning window that seamlessly corresponds with new job planning workflow.

- Provide one centralized planning group that evaluates all incoming work generated from both the emergency call center and internally from the Utility Enhancement and Utility Management groups. The centralized planning group should be charged with develop detailed job plans, evaluating the impacts of the work on the WSSC system as a whole and assigning work an appropriate priority level priority as well as evaluating what resources are available from all depots. This group should also have primary responsibility for the QA/QC of all data input into the CMMS database, including capture of labor and material costs. As part of a central planning section, establish scheduling responsibilities to dedicated personnel. Develop full, real-time visibility of resource location and job status to schedulers.

- Develop a new prioritization system consisting of fewer priority codes. Develop and implement a new business practice to evaluate emergency work on a case-by-case basis to minimize adverse effects to overall productivity, and assign a management-level "gatekeeper" to determine what actually constitutes an emergency and what does not.

- Develop and implement a more-technical approach to large-meter testing that focuses specifically on 20% of meters that correspond to the top 80% of revenue generation. Approach should look at factors such as statistically significant variance in usage rates, specific meter manufacturers that have been prone to historically high failure rates, age of the meter, etc. Use of bench testing rather than portable testers should be employed for more accurate results.

- Develop a more-robust water balance accounting, performed at least quarterly, in conjunction with a proactive leak detection program.

- Develop and implement a robust performance management system. Review the current list of reporting metrics for validity in management of Utility Services; eliminate those that provide no value and include additional metrics as necessary. Standardize metrics as much as possible across all workgroups. For each relevant metric, establish a performance target as well as an upper and lower control limit. Conduct an initial wrench time analysis to baseline current field productivity, and then repeat annually to gauge changes in productivity as a result of implementing a performance management system. Comprehensively review all reports currently generated and evaluate their respective usefulness as a management tool. Eliminate those of no value and develop additional reports as necessary. Once the TEAMS tool is fully implemented, then create standard reporting templates based on the revised list of reports.

- Develop and implement graphical charts showing performance using actual performance data. Plot data on a rolling one-year cycle to evaluate trends. Perform necessary statistical analysis to evaluate statistically significant departures from expectation. Develop and implement robust weekly performance meetings for each group. Each meeting should be attended by key personnel and specific performance should be discussed using actual performance data. Focus discussion on performance gaps and understanding root causes. Develop action plans based on SMART principles, monitor progress at each weekly meeting and assign accountability to ensure plans are consistently carried through to completion.

- Evaluate span of control ratios across all groups, reorganize and appoint enough supervisory level staff to maintain ratios from 1:8 to 1:12. Assign a crew leader to each field crew greater than two persons, and hold crew leaders accountable for overall performance of their respective crew.

- Develop action plans based on SMART principles, monitor progress at each weekly meeting and assign accountability to ensure plans are consistently carried through to completion.

Asset Management and Capital Improvement Program

Figure ES.6 Asset Management and Capital Improvement Best Practices Evaluation Summary

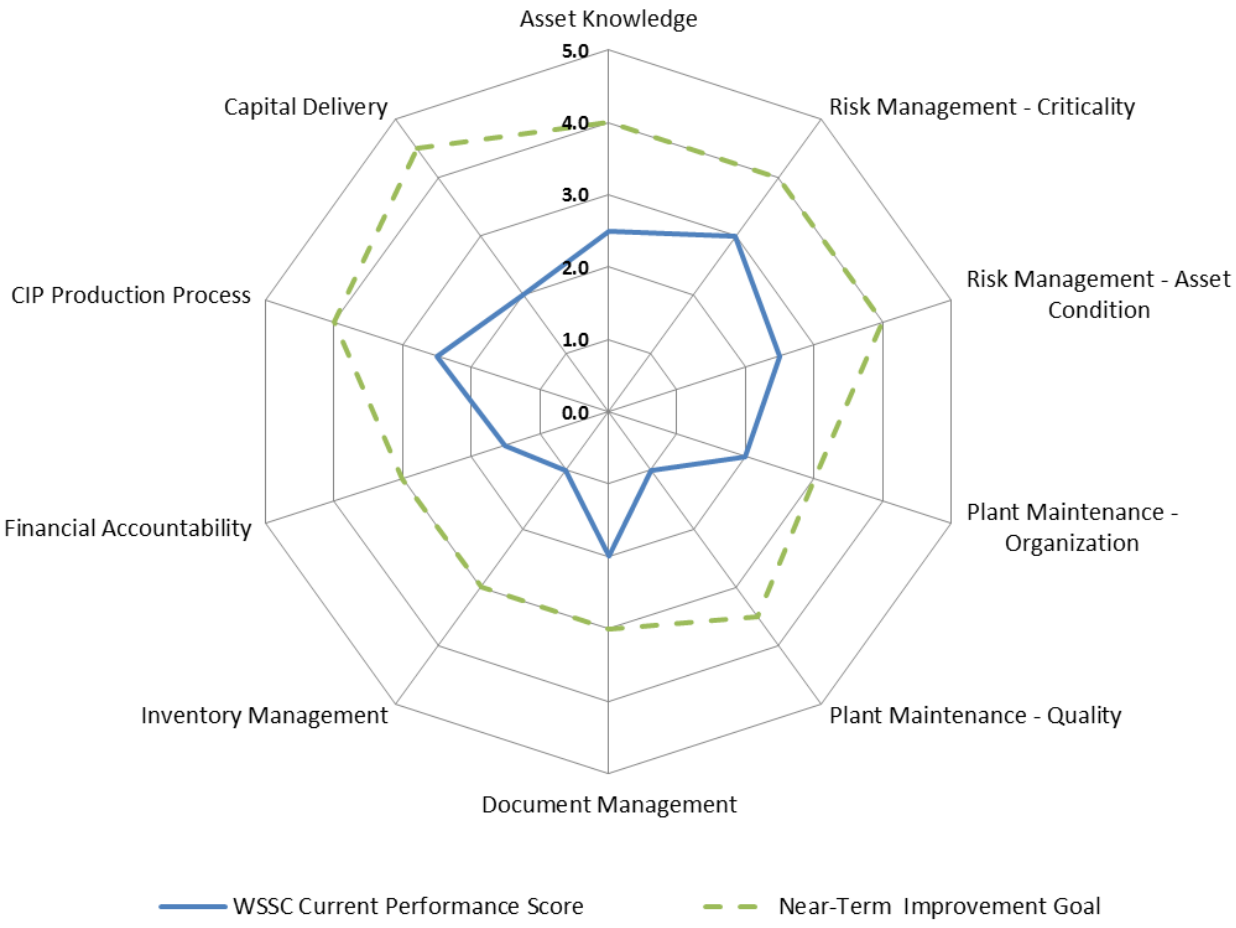


Table ES.6 Asset Management and Capital Improvement Gap Analysis

Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
Asset Knowledge	2.5	4.0	1.5	Potentially
Risk Management - Criticality	3.0	4.0	1.0	No
Risk Management - Asset Condition	2.5	4.0	1.5	Potentially
Plant Maintenance - Organization	2.0	3.0	1.0	No
Plant Maintenance - Quality	1.0	3.5	2.5	Yes
Document Management	2.0	3.0	1.0	No
Inventory Management	1.0	3.0	2.0	Yes
Financial Accountability	1.5	3.0	1.5	Potentially
CIP Production Process	2.5	4.0	1.5	Potentially
Capital Delivery	2.0	4.5	2.5	Yes

Asset Management and Capital Improvement Program Major Recommendations

- Incorporate a robust process of verifying, validating and updating the following:
    - Key asset knowledge and improving the accuracy of replacement values
    - Monetary business risk exposure and improving its use in driving operations' strategies
    - Asset condition, improving its use in driving operations' strategies, and development of a condition-based monitoring strategy
- Unify the maintenance organization and inventory management; develop a document management system, as well as a clear set of organization-based guidelines and rules for field staff to use across the Commission.
- Further develop the existing asset management plan to cover all assets and use RIVA-based needs identification. Continually refine and fully implement project prioritization with the goal of meeting CIP budget expenditure targets. Develop, document and implement a new production processes that focuses on and represents level of service in a well-defined manner.
- Develop a forum to promote efficient interfacing and interaction between Planning and Design so projects are more thoroughly planned before entering into the CIP. Develop, document and implement a new performance management system with respect to project delivery using key metrics.

Water Treatment

Figure ES.7 Water Treatment Best Practices Evaluation Summary

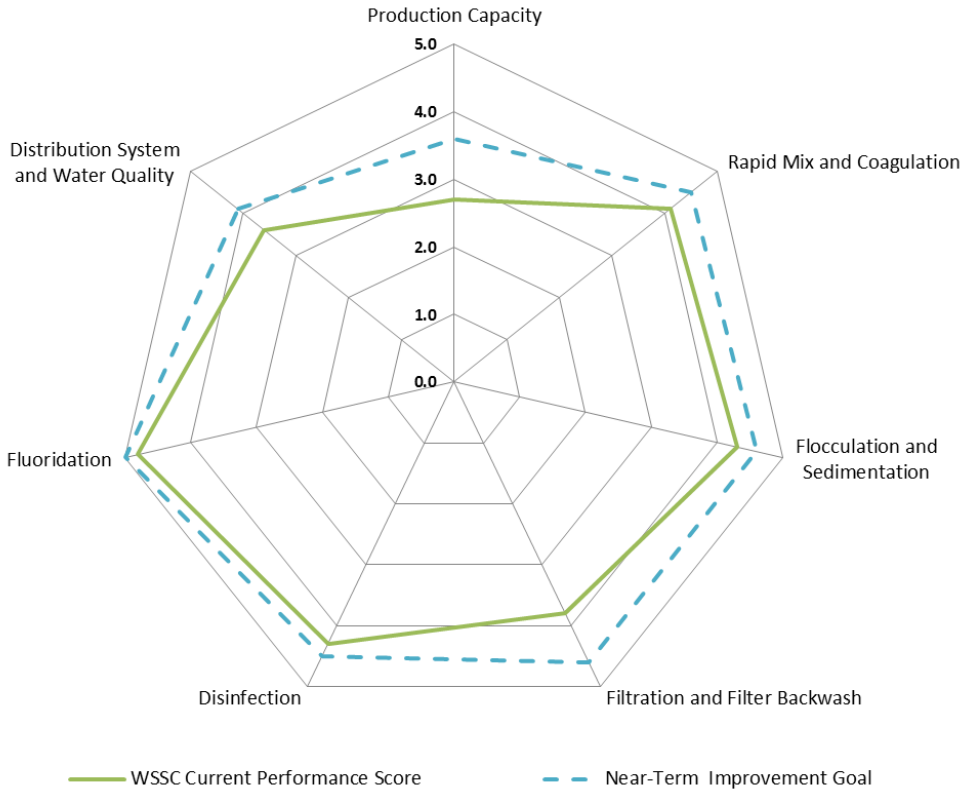


Table ES.7 Water Treatment Best Practices Gap Analysis

Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
Production Capacity	2.7	3.6	0.9	No
Rapid Mix and Coagulation	4.1	4.5	0.4	No
Flocculation and Sedimentation	4.3	4.6	0.3	No
Filtration and Filter Backwash	3.8	4.6	0.8	No
Disinfection	4.3	4.5	0.2	No
Fluoridation	4.8	5.0	0.2	No
Distribution System and Water Quality	3.6	4.1	0.5	No

Water Treatment Major Recommendations

- Develop and implement a risk-based process control plan. Develop a continuous improvement culture through workshops that engage all levels of the facility and organization Develop process control management plans that would proactively manage the treatment process, further developing key performance indicators. Implement regular process control meetings with documented meeting minutes. Develop a formal lessons learned process, based a root cause analysis. Create performance boards strategically placed at each facility to drive performance and accountability of staff. Implement a formal audit program to ensure policy and procedures are being followed.

- Place excess capacity treatment trains in standby when water demand periods are low.

- Reduce washwater usage.

- Evaluate the use of mechanical mixers, in lieu of static mixers at both plants, to more effectively achieve required coagulant mixing G values under all flow scenarios.

- Reevaluate the need to implement enhanced coagulation at the Potomac plant.

- Verify the optimum G values for flocculation and tapered mixing impacts for both plants – even though flocculation treatment appears to produce good-settling floc material, improvements might be achieved by optimizing the mixing and tapering of mixing intensities between stages.

- Conduct routine annual filter assessments including, but not limited to, filter coring, bed expansion, backwash duration evaluations, and media examinations on representative filters to maximize filter performance.

- Conduct quarterly reviews of CT compliance to identify how much actual clearwell storage is necessary for CT and how much storage capacity could be taken offline to reduce DBP formation potential and onsite chlorine residual decay. Maintain ratio of CT actual to CT required between 2 and 3.

- Conduct chlorine decay evaluations and compare to systems residuals to determine the impacts of pipeline storage and storage tanks on chlorine residual losses. Also, conduct quarterly reviews of system storage to identify how much actual storage is necessary to meet demand and how much storage capacity could be taken offline to reduce DBP formation potential and onsite chlorine residual decay.

- Conduct a thorough study, supplemented with field verification, to evaluate feeding a lower maintenance dosage of phosphates after successfully demonstrating passivation of the distribution system to continue to achieve compliance with lead and copper limits.

Wastewater Treatment

Figure ES.8 Wastewater Treatment Best Practices Evaluation Summary

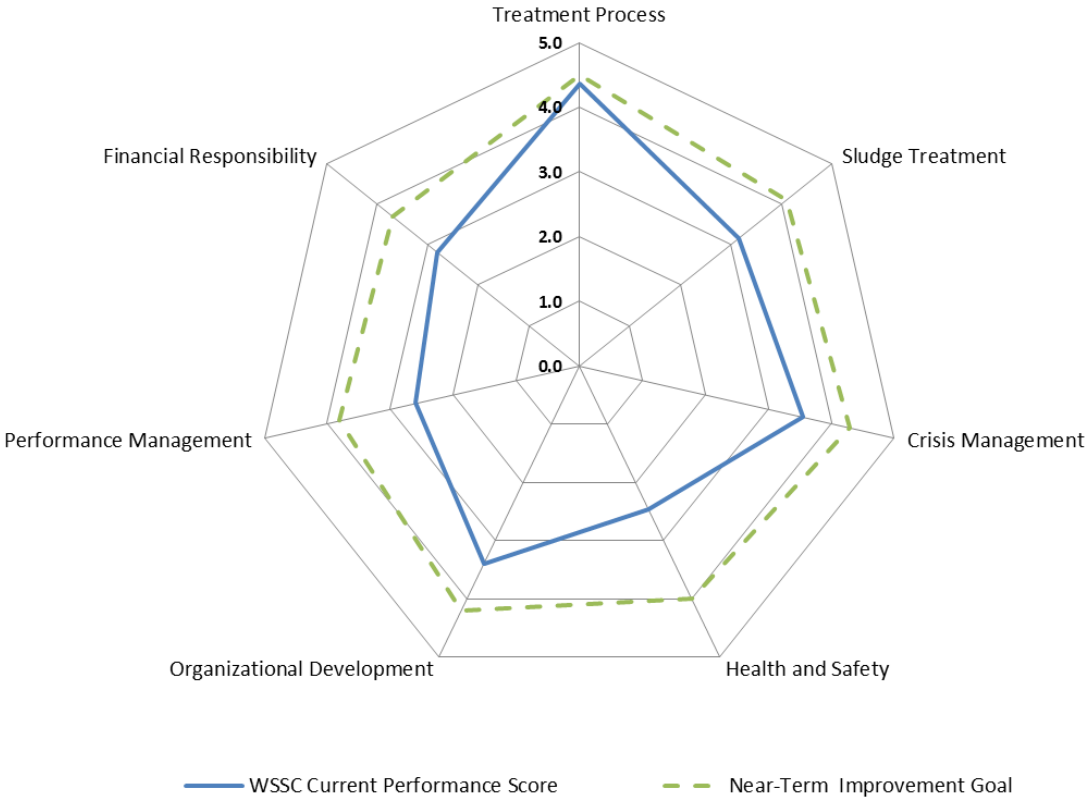


Table ES.8 Wastewater Treatment Best Practices Gap Analysis

Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
Treatment Process	4.4	4.5	0.1	No
Sludge Treatment	3.2	4.1	0.9	No
Crisis Management	3.5	4.3	0.8	No
Health and Safety	2.5	4.0	1.5	Potentially
Organizational Development	3.4	4.2	0.8	No
Performance Management	2.6	3.8	1.2	No
Financial Responsibility	2.8	3.7	0.9	No

Wastewater Treatment Major Recommendations

- Develop a continuous improvement culture through workshops that engage all levels of the facility and organization Develop process control management plans that would proactively manage the

treatment process and safety program, further developing key performance indicators. Implement regular process control meetings with documented meeting minutes. Develop a formal lessons learned process, based a root cause analysis. Create performance boards strategically placed at each facility to drive performance and accountability of staff. Implement a formal audit program to ensure policy and procedures are being followed.

- Develop onsite management and accountability of energy usage for large pieces of equipment.
- Develop a mass balance of the entire plant process, and use routinely as an operational tool.
- Develop yearly budgets with a bottom up approach, pursuing operational efficiency gains in specific process areas. Track actual expenditures against targets. Hold plant managers accountable for plant energy expenditures. Shift mindset from a culture of “compliance at all costs” to “compliance at lowest costs”.
- Reinstitue a competency-based training program for all of WSSC staff and cross-train all staff in both plant operations and light maintenance, leading to a more multi-skilled workforce.

INTRODUCTION

INTRODUCTION

Scope and Objectives

The project scope was to perform an independent review of the various water, sewer and regulatory services provided to the customers and stakeholders of WSSC, utilizing applicable industry/best-in-class benchmarking metrics.

Project objectives included:

1) Identifying standard metrics and/or best practices to determine how well a function or business operation is performing, and

2) Identifying the efficiency and effectiveness of WSSC's operations, and

3) Comparing WSSC operations to similarly situated utilities, and

4) Reviewing workforce staffing levels.

The study also included a review of the Commission's major cost drivers, the effectiveness and efficiency of WSSC's major programs, projects and services, as well as the operating and capital financial management systems and associated rate impacts to customers, consistent with providing responsible water, wastewater and other services.

Methodology

The study presented here consists of two different, but related evaluations. The first consists of overall benchmarking using available data to compare WSSC as a whole to peer utilities using industry standard metrics. The second breaks WSSC into specific business groups and evaluates current performance against best practices established by Veolia in their world-wide operations to determine potential recommendations for improvement.

Overall Benchmarking

Our overall benchmarking methodology consisted of the following:

- **Gaining an understanding of WSSC** – This was done through interviews with management and staff, review of documents and some plant walkthroughs.

- **Identification of metrics** – Industry metrics were derived from the QualServe Benchmarking program, which is a suite of metrics developed by the American Water Works Association (AWWA), the Water Environment Federation (WEF), the Water Research Foundation and industry leaders. This program, of which WSSC has been a frequent contributor, has been used for annual benchmarking of water and wastewater utilities since 2002.

- **Formation of peer utility groups** – Benchmarking data was gathered from utilities that are similar to WSSC in terms of size, regulation, services, location and other relevant factors. Eight peer utility groups were formed and relevant data collected for them.

- **Comparison to peers** – Comparisons using efficiency and effectiveness metrics were made, as appropriate to utility peers.

- **Effectiveness of Business Operations** – To analyze the effectiveness of WSSC, the Effective Utility Management (EUM) framework was used. This framework was developed and endorsed by the USEPA and the trade associations serving the water and wastewater industry. An EUM framework was developed specifically for WSSC to identify metrics and targets used in the scoring.

- **Workforce Staffing Levels** – Staffing levels were assessed using multiple peer groups and efficiency metrics.

The metrics used in benchmarking consist of efficiency measures (ratios of inputs to outputs where the input is a resource such as dollars, full-time equivalent [FTE] staff, etc.), effectiveness measures (also ratios of inputs to outputs indicative of performance, such as breaks per 100 miles) and outcome measures (typically one-number measures, such as customer satisfaction). KPIs are those metrics that are crucial to the success of an organization.

Explanatory factors are those items that impact the inputs needed to achieve the desired output or outcome that are outside the control of management. Typically these include such items as topography, system age, regulations, etc. One way to incorporate explanatory factors is through the basis for comparison. This is done through the use of peer groups (groups of utilities having similar relevant explanatory factors).

Once KPIs are computed, some of the bases of comparisons include:

- Self-comparison – Are we getting better over time?

- Comparison against peer utilities – How do we compare with other similar utilities?

- Comparison within industry – How do we compare with the water/wastewater industry?

Best Practices Review

The best practices review consisted of breaking WSSC in to the following business groups:

- Customer Service

- Procurement

- Fleet

- Utility Services

- Asset Management and Capital Improvement Program

- Water Treatment

- Wastewater Treatment

Business practices in each group, were assessed through a series of document reviews, data evaluation and staff interviews conducted in January through March 2016. An evaluation was then conducted using

a standardized scoring system from 1 (basic performance) to 5 (industry best) to baseline current WSSC performance. To assist in identifying which business practices have the largest opportunity for improvement, a second score was identified as a near-term improvement goal. This score is determined to be where WSSC could be in less than 24 months with some additional focus and effort, given the current landscape within the organization. The difference between actual performance and the near-term performance goal forms the basis of a gap analysis that is then used to prioritize areas that have potential for additional improvement.

Limitations

In conducting this study, documents, records, agreements, capital improvement programs, customer sales, financial data, and operations data were reviewed as, deemed necessary, to present the analytical results and interpretation of those results. While such documents, records, agreements, capital improvement programs, customer sales, financial data and operations data are considered to be reliable, their accuracy has not been verified.

GENERAL BENCHMARKING RESULTS

GENERAL BENCHMARKING

Staffing Levels

Staffing level benchmarking compares the number of employees that work for a utility, often excluding contractors who work in capacities similar to Full-Time Employees (FTEs), with other similar utilities. An FTE employee is equal to employee time of 2,080 hours per year based on the standard 40-hour work week in a 52-week fiscal year. Part-time and seasonal employees, if any, are converted into FTEs based on the number of hours they work in a fiscal year. The same applies to overtime.

Utilities vary radically in size and responsibility. WSSC would be in the top quartile of size in terms of the number of employees that work for it in both water and wastewater operations. One of the ways to compare different size organizations is to rationalize the number of employees to levels of activity they perform versus the number of customer accounts serviced and proportional to the total number of employees in the organization. Staffing level benchmarks are not meant to be hard and fast indicators that an area is over or understaffed. The responsibilities of a utility will help shape the size and composition of employees. Utility employees serve three major functions – administrative/governance, operations, and support services. ***If a utility is significantly worse than the median value, then it may be necessary to determine how the duties of a function affect its staffing level***. The staffing level benchmarking for WSSC involved the following:

- Comparison with peer water utilities – overall staffing
- Comparison with peer wastewater utilities – overall staffing
- Treatment plant staffing – comparison with similarly regulated utilities
- Collection system staffing – comparison with systems of similar size
- Functional level staffing – comparison with large utilities
- Other staffing comparisons utilizing QualServe measures

Staffing Levels - Water Treatment Only

For water services, WSSC was compared with a peer group of similar sized, mostly combined utilities, as indicated in Table B.1 below. For the measures presented, plumbing and gas-fitting related FTEs were excluded from the calculations, as no other utilities in this group perform those functions. These comparisons are based on a 2014 AWWA survey and are shown in Figures B.1 through B.3.

WSSC serves a large service area of over 450,000 customer accounts and over 5,500 miles of water transmission and distribution mains. Many other large utilities usually provide some level of service to wholesale customers. WSSC is staffed to serve a largely residential and commercial customer base. The following is a summary of the benchmarking effort with respect to staffing for water services:

Table B.1 Peer Utilities (Water Treatment Only)

- Houston, TX
- Dallas, TX
- Phoenix, AZ
- Miami, FL
- San Francisco, CA
- Denver, CO
- San Diego, CA
- East Bay Municipal Utility District, CA
- Fort Worth, TX
- Baltimore, MD
- Philadelphia, PA
- Fairfax County, VA
- St. Louis, MO
- Cleveland, OH
- Seattle, WA

Figure B.1 FTEs per Account (Water Treatment Only)

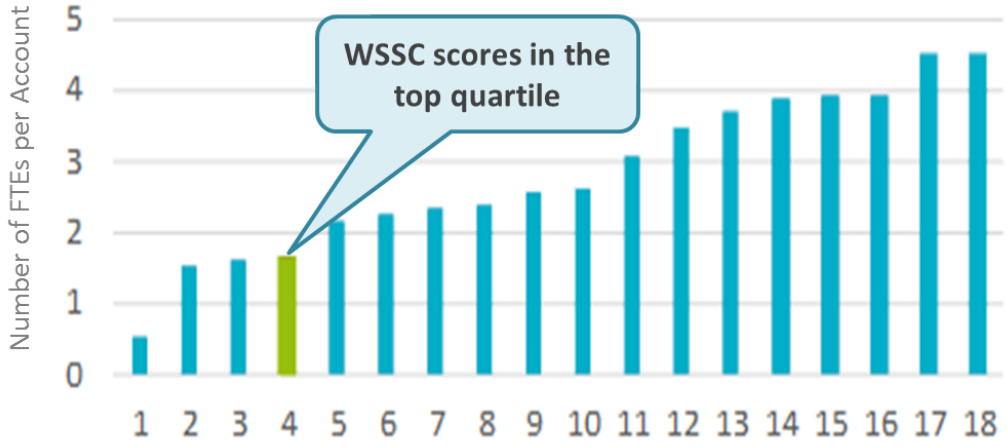


Figure B.2 FTEs per 1,000 People Served (Water Treatment Only)

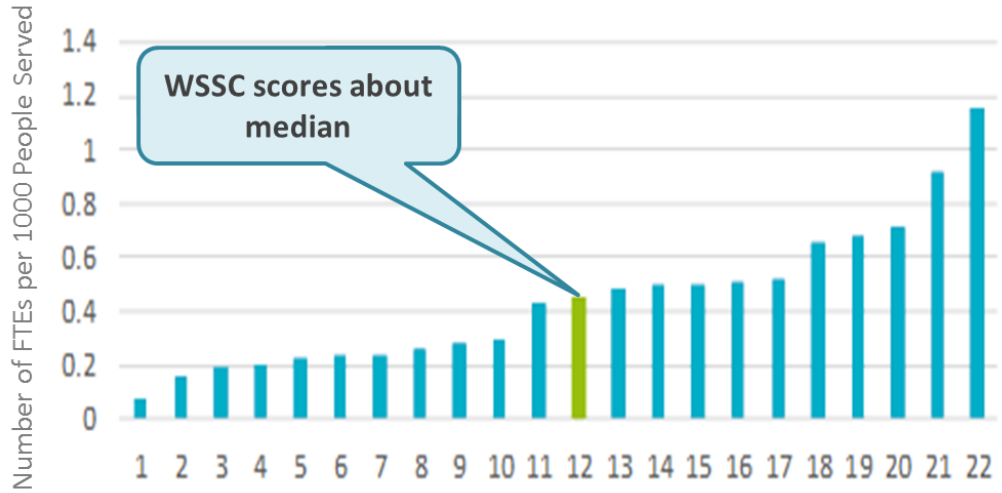
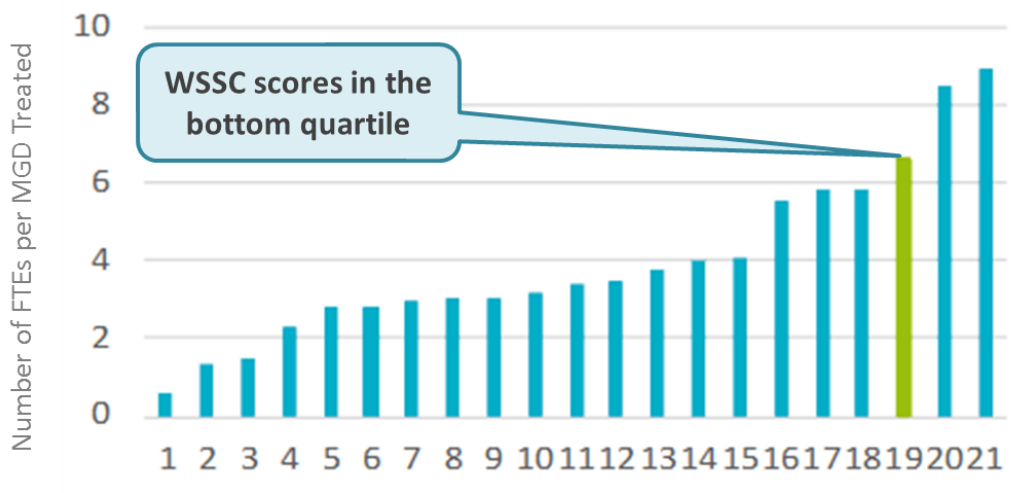


Figure B.3 FTEs per MGD Treated (Water Treatment Only)



WSSC has a larger number of water FTEs per MGD due to the fact that WSSC has a high level of conservation by customers and, while the number of customers and population served increases, consumption per capita has been trending downward, confirming that the conservation behavior incentivized by the rate structure is working.

Staffing Levels - Wastewater Treatment Only

For wastewater services, WSSC was compared with a peer group of similar sized, mostly combined utilities, as indicated in Table B.2 below. For the measures presented, plumbing and gas-fitting related FTEs were excluded from the calculations, as no other utilities in this group perform those functions. These comparisons are based on a 2014 AWWA survey and are shown in Figures B.4 through B.6.

WSSC serves a large service area of over 450,000 customer accounts and over 5,500 miles of interceptors and collection lines. WSSC operates six wastewater treatment plants of various sizes and transmits a significant portion of its wastewater to DC Water's advanced wastewater treatment plant. The following is a summary of the benchmarking effort with respect to staffing for wastewater services:

Table B.2 Peer Utilities (Wastewater Treatment Only)

- Philadelphia, PA
- Los Angeles, CA
- Miami, FL
- Washington, DC
- Houston, TX
- Denver, CO
- Baltimore, MD
- Orange County Sanitation District, CA
- Columbus, OH
- San Diego, CA
- Dallas, TX
- San Antonio, TX
- Phoenix, AZ
- Fort Worth, TX
- East Bay Municipal Utility District, CA
- San Francisco, CA

Figure B.4 FTEs per 1,000 Accounts (Wastewater Treatment Only)

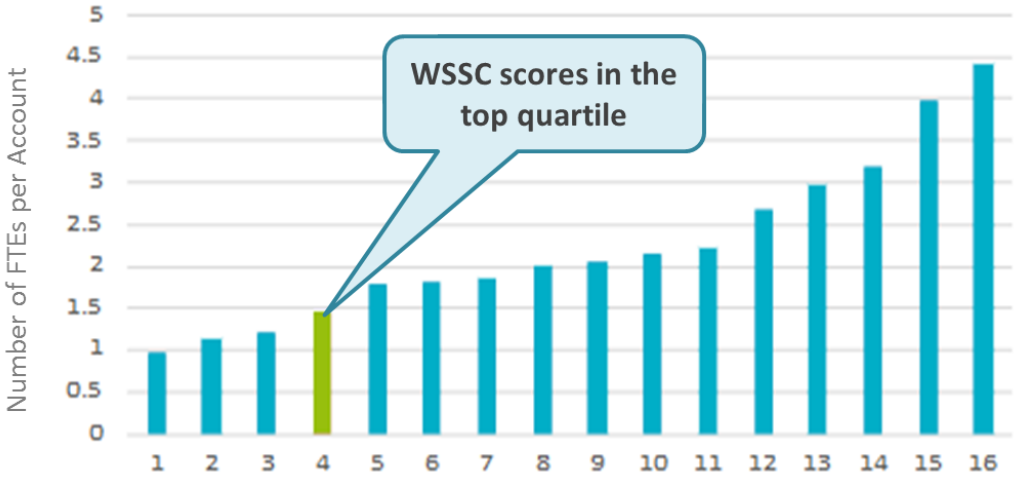
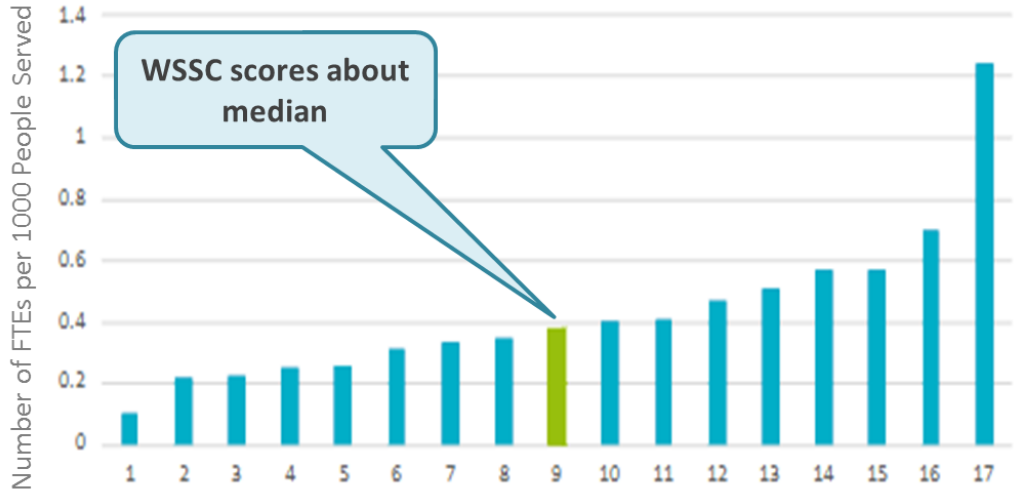


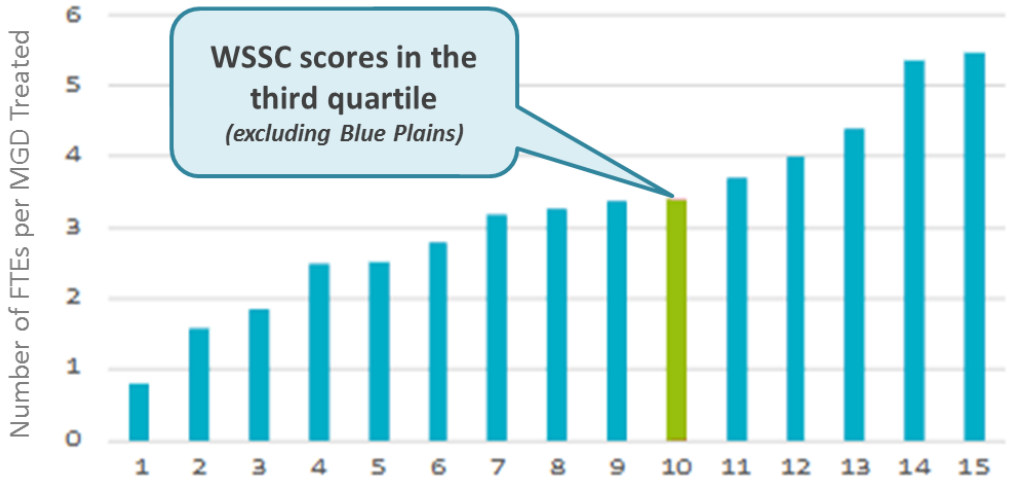
Figure B.5 FTEs per 1,000 People Served (Wastewater Treatment Only)



Many other large utilities usually provide some level of service to wholesale wastewater customers. WSSC is staffed to operate and maintain a collection system for its largely residential and commercial customer base, as well as treat wastewater where it is not feasible to convey wastewater to the Blue Plains plant for treatment.

WSSC has six wastewater treatment plants geographically dispersed in the service area. This could contribute to its above-median level of FTEs, as the economies of scale of having one or two large plants are foregone for proximity and flow needs in the areas served by those plants.

Figure B.6 FTEs per MGD Treated (Wastewater Treatment Only)



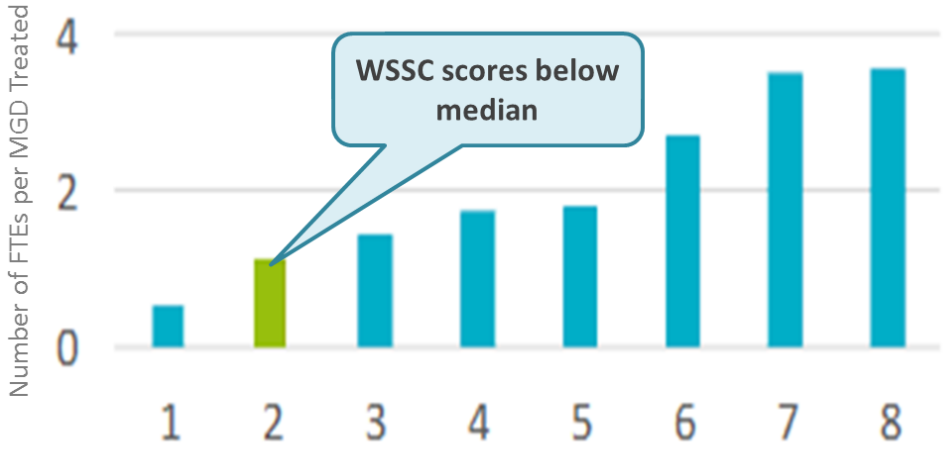
WSSC was also compared against a peer group of similarly regulated utilities – ones that have to address Chesapeake Bay discharge issues, as indicated in Table B.3 below.

Table B.3 Chesapeake Bay Peer Utilities (Wastewater Treatment Only)

- Alexandria, VA
- Hampton Roads Sanitation District, VA
- Hopewell Regional WTF Commission, VA
- Chesterfield County, VA
- Upper Occoquan Service Authority, VA
- Fairfax County, VA
- Prince William County, VA

The number of plants may lead to dis-economies of scale compared to utilities that have one or two plants to serve all of their customers. Additionally, treatment plants with larger staffing may have operators doing light maintenance in addition to their primary operations jobs. However, with all of those challenges, WSSC still ranks below median in wastewater treatment staffing levels, as indicated in Figure B.7.

Figure B.7 Treatment FTEs per MGD (Chesapeake Bay Wastewater Treatment Only)



Staffing Levels – Sewer Collection Only

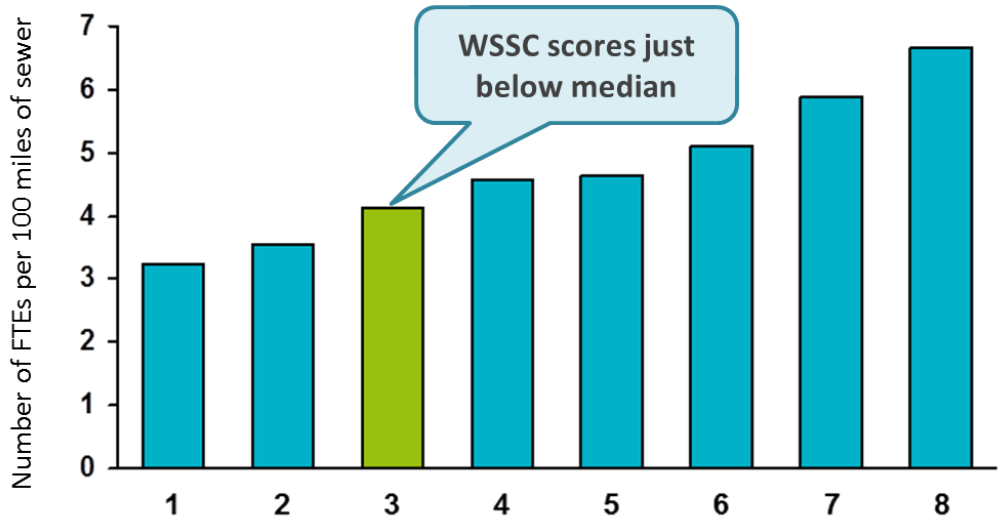
WSSC's collection system was compared against a peer group of utilities with similar size collection systems (see list below).

Table B.4 Peer Utilities (Sewer Collection Only)

- Phoenix, AZ
- Pima County, AZ
- Miami, FL
- Louisville & Jefferson County, KY
- St. Louis, MO
- Charlotte, NC
- Fairfax County, VA
- Dallas, TX
- San Antonio, TX

WSSC serves a geographically broad customer base in one of the worst traffic congestion areas in the U.S. However, it has ameliorated some of the logistical and maintenance challenges by geographically dividing the service area to better serve its customers. This could mean that compared to more geographically compact service areas other utilities may serve, WSSC may need more people to cover the distances between service calls and to maintain the collection system. However, WSSC still ranks just below the median level for the peer group for FTEs per 100 miles as indicated in Figure .B.8.

Figure B.8 FTEs per 100 miles of Sanitary Sewer (Sewer Collection Only)



Staffing Levels – Functional Area

Functional staffing benchmarking compares the percentage of total staffing for different functions and compares those percentages against other utilities. The results are based on comparisons to 18 other utilities, indicated in Table B.5, which required organizational chart allocations and overtime estimates.

Table B.5 Peer Utilities (Functional Area)

Independent
- Denver, CO
- Washington, DC
- Louisville, KY
- MWRA, Boston, MA
- Narragansett Bay Commission, RI
- Northeast Ohio Regional Sewer District, OH
- Passaic Valley, NJ
- Trinity River Authority, TX

Local Government Affiliation
- Cincinnati, OH
- Dallas, TX
- Fort Worth, TX
- King County, WA
- Los Angeles, CA
- Memphis, TN
- Miami, FL
- Nashville, TN
- New York, NY
- Philadelphia, PA

As combined organization, FTEs were allocated between water and sewer services, as well as to various functions to conduct the benchmarking. WSSC's levels are below average for most functions – public affairs, internal audit, wastewater treatment, water treatment, laboratory, pre-treatment, law, finance, procurement, fleet, HR and executive office.

The functions for which WSSC is above average in staffing levels are:

- IT – currently in a major improvement program
- Engineering and Construction – average project size smaller than peers

In some utilities, staffing shortages or hiring freezes are managed through overtime. Average overtime for these 18 utilities was 7.1%. WSSC is slightly above this average.

The WSSC personnel in each department were allocated between providing or supporting water and sewer service for comparison with QualServe functional-level performance measures.

Table B.6 Water Services Staffing Level by Functional Area

Functional Area	WSSC (FY13)	QualServe Median	Large Utility Median
Management (including. HR, IT, legal, purchasing, etc.)	19.7%	8.7%	5.2%
Water supply	2.5%	5.7%	3.5%
Water treatment	9.5%	18.6%	19.7%
Water transmission and distribution	41.4%	31.6%	28.0%
Other O&M	1.7%	7.7%	5.3%
Engineering	8.4%	7.0%	14.0%
Planning	2.7%	0.0%	2.5%
Lab service/compliance	2.6%	3.0%	4.2%
Customer service	6.4%	8.9%	11.5%
Public relations	1.2%	0.2%	0.6%
Finance	4.0%	3.1%	2.3%

Table B.7 Wastewater Services Staffing Level by Functional Area

Functional Area	WSSC FY13	QualServe Median	Large-Utility Median
Management (including HR, IT, legal, purchasing, etc.)	17.5%	8.9%	9.3%
Pretreatment programs	1.4%	2.1%	1.8%
Wastewater collection	20.4%	29.9%	24.2%
Wastewater treatment	24.0%	27.4%	27.0%
Other O&M	1.5%	9.1%	5.0%
Engineering	19.4%	5.9%	9.0%
Planning	3.3%	0.0%	1.7%
Lab service/compliance	2.3%	3.8%	4.9%
Customer service	5.7%	7.4%	10.9%
Public relations	1.1%	0.0%	1.0%
Finance	3.6%	3.2%	3.1%

When evaluating Tables B.6 and B.7, it is important to note that almost all other utilities in the peer group are owned by other governments, which, in most cases, provide some management and support services. As an independent agency, WSSC must staff to provide all of those services. Both Tables B.6 and B.7 exclude the group of employees who are involved in plumbing and gas inspections for WSSC.

These comparisons have looked at overall and functional staffing levels from a number of perspectives. Overall, WSSC appears to be at or below the median compared with its peers. Looking at functional staffing levels, most functions appear to be below average, except for IT, Engineering and Construction. IT is going through a multi-year improvement program. Engineering and Construction have smaller projects and some time consuming procedures related to the SDC program.

Organizational Assessment

There were two organizational assessment tools used to gauge how well WSSC was functioning overall – QualServe's Organizational Best Practice Index and the EUM Framework.

Organizational Best Practice Index

The Best Practice (BP) Index was conceived by utility general managers as a measure of how well a utility had implemented consensus best practices. It is conducted as a self-assessment, where each utility gives themselves a score of 1 (poor) to 5 (best) to indicate the degree to which they engage in a practice. This makes the assessment subjective, but bias can be minimized by having a team of knowledgeable people involved in the process. During the course of our interviews, we talked to multiple stakeholders about the different practice areas, to the extent possible. The BP Index consists of the elements indicated in Figure B.9.

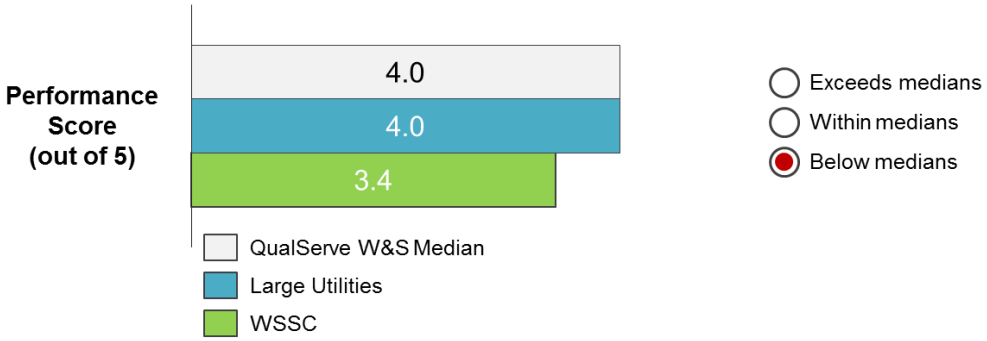
Figure B.9 Organizational BP Index Elements

Strategic Planning

Strategic planning is the process an organization uses to define the direction it is headed, the mechanism for allocation resources to pursue that direction, and the control mechanisms for guiding the implementation of the strategy. Best practices include:

- Documented strategic plan
- Analysis and selection of strategies
- Short/long-term action plans
- Performance measures
- Process for strategic plan development

Figure B.10 Strategic Planning BP Index Score



Observations for Strategic Planning include:

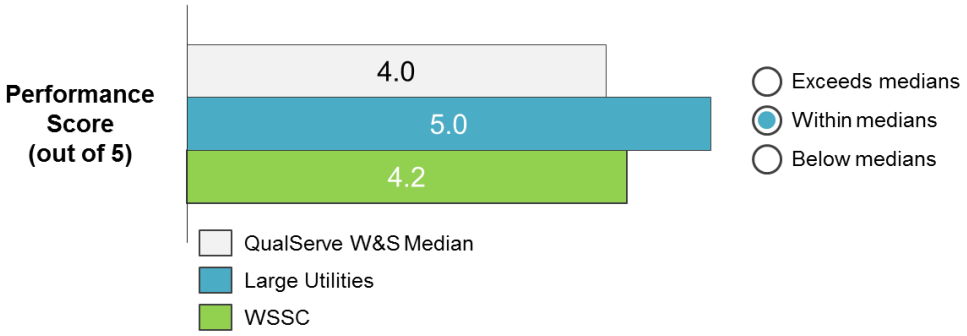
- WSSC has a strategic plan that incorporates key strategic plan elements.
  - A limited SWOT (strengths, weaknesses, opportunities, threats) analysis utilized in plan development
  - Portions of the plan are more work plan than strategy
- Performance measures that set goals and measure plan progress have been identified and are reported on a regular basis.
  - Performance measurement program could be more comprehensive
- The plan is monitored, reviewed and updated for purposes of reporting to the Board.
  - Very limited staff involvement in this process (other utilities use goal teams for succession planning and training).
- A crosswalk from plan to EUM has been performed to verify plan comprehensiveness.

Long-Term Financial Planning

Long-term financial planning addresses the development of rates, fees and charges to cover the cost of service, as well as the planning associated with O&M, asset management, capital improvement plans, financing and any other reserves that may be required. The minimum planning horizon should be five years, even if rates are implemented on an annual basis. Best practices include:

- O&M funding
- CIP funding, including impacts of projects on O&M funding
- Asset management funding plan
- Development of rate alternatives
- Target financial metrics
- Cost benefit analysis in decision-making
- Financial controls on spending
- Regular review and plan update

Figure B.11 Long-Term Financial Planning BP Index Score



Observations for Long-Term Financial Planning include:

- Medium-term (6-year) planning horizon exists.
- Planning incorporates reserve levels, debt service coverage, and debt level.

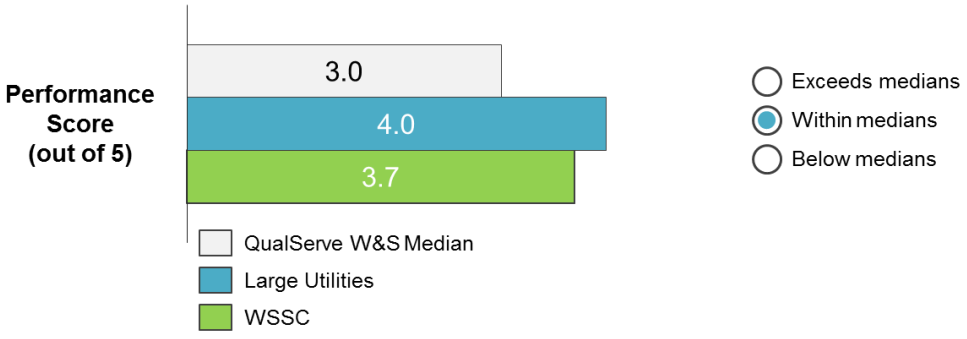
- The internal rate model is reviewed annually. A comprehensive rate study is planned (the contract has reportedly been awarded) which will look at alternative rate structures and involve a substantial public information and participation effort.
- Miscellaneous revenues are computed annually. The computation begins with time charges for fee generating activities which are then compared to time and motion estimates as a reality check. The resulting hours are increased by allocated costs to arrive at a fee. At less than 3% of total revenues (including front foot benefit and H/C assessments), collections appear low for such a large and diverse utility. There may be some weaknesses in the underlying data, but not the process.
- Many projects go through business case analyses using a triple bottom line (TBL) process.
- Budget to actual performance is reviewed monthly. Some financial controls are being updated.
- The financial plan is reviewed annually.
- AAA rating from all agencies.
- Achieves low cost of debt through combination of long-term bonds and its short-term financing program that uses Bond Anticipation Notes.
- WSSC is a recipient of GFOA's Distinguished Budget Presentation Award.

Risk Management Planning

Risk management identifies potential risks to the utility in terms of its strategic plan, its physical plant and human capital. It is meant to mitigate potential losses. Best practices include:

- Disaster readiness planning
- Security programs
- Health and safety programs
- Public liability exposure
- Emergency operation planning
- Hazmat contingency planning
- Insurance

Figure B.12 Risk Management Planning BP Index Score



Observations for Risk Management Planning include:

- A continuity of operations plan (COOP) is developed and in place.
- The vulnerability assessment (RAMCAP) has been updated.

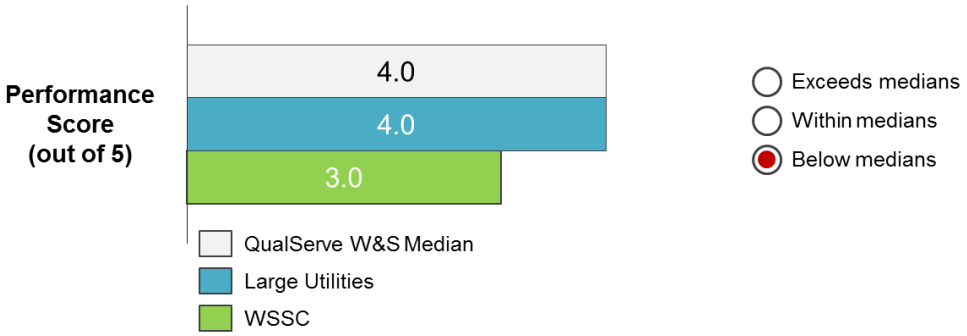
- Risk reduction measures are in place (new security controls, card readers, controlled entry at plant, etc.).
- Health and safety programs exist.
- There is a plan for supply risk of critical materials.
- WSSC is mostly self-insured with some asset insurance. Last insurance review was performed two years ago.
- No owner-controlled insurance program (OCIP) is in place.
- There is a plan for centralized coordination of emergency and risk planning.

Performance Measurement System

Performance measurement systems help a utility identify how well it is progressing to meeting its strategic goals and is an important part of the strategic plan's feedback loop through monitoring. Best practices include:

- Measures are multi-dimensional
- Established targets
- Focus on quality, efficiency and effectiveness
- Review of actual versus. target
- Failure analysis
- Lessons learned analysis
- Review and update measures

Figure B.13 Performance Measurement System BP Index Score



Observations for Performance Management include:

- WSSC has a large set of performance measures, but they are not fully aligned with a strategic plan and could be more comprehensive.
- Instead of annual reviews, the GM reports monthly and mostly reporting upward.
- Analysis of failures and identification of corrective actions occur in some departments but there is limited analysis of successes.
- Multiple performance management systems exist.
- There is a limited amount of management-to-performance measures.
- Line staff and managers are not clear on the purpose and use of metrics; therefore, metrics are not used to effectively manage daily operations.

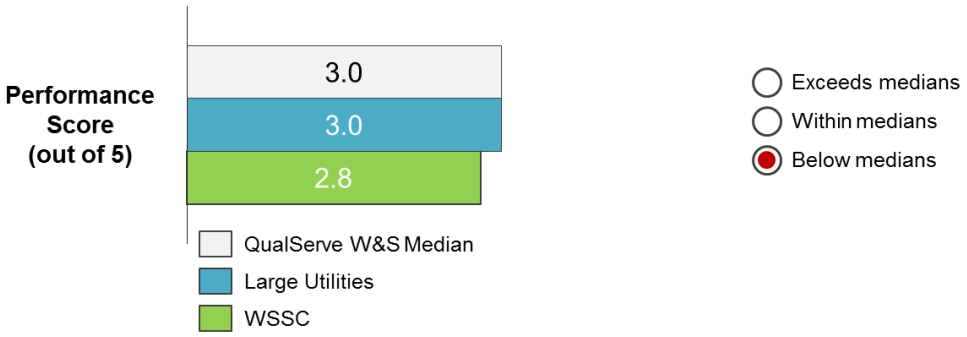
- A comprehensive enterprise statistics office has been created to centralize performance management.

Optimized Asset Management Program

An effective asset management program provides a balance between cost, risk and performance (service level). Best practices include:

- Complete asset inventory in GIS
- Regular condition assessments
- Identify asset replacement cycles
- Conduct repair versus replacement analysis
- Conduct life-cycle cost analysis
- Integrated use of data
- Communicate the asset management plan

Figure B.14 Optimized Asset Management Program BP Index Score



Observations for Optimized Asset Management include:

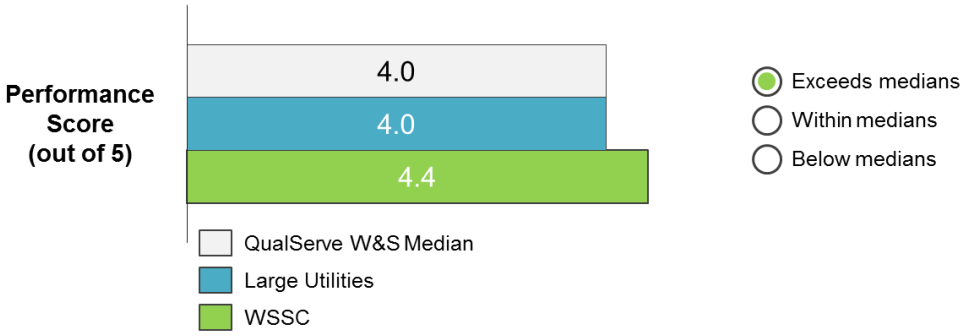
- 90+% of buried assets are in the GIS, but key asset information is not accurate in some cases.
- A condition assessment (3 level) of all buried assets and vertical assets has been performed, but field staff claim not to update the information regularly.
- Information on asset classes (replacement cycles, etc.) is in Riva Modeling® software.
    - Information in the Riva Modeling application is often not directly actionable – process not in place for frequent and extensive updating of actual asset condition in RIVA, actual condition deterioration not monitored and used extensively to adjust RIVA's theoretical decay curves, replacement values reported by operations/field staff as often inaccurate, etc. RIVA does however provide significant benefit through a portion of the information being directly actionable (following field verification of asset condition) as well as prioritization of in-depth condition assessments.
- Repair/replace decisions are made through business case analysis.
- Major asset decisions incorporate life-cycle costing and TBL – the process could be improved.
- Data from multiple sources supports capital decisions using spreadsheets – effective software is needed.

Governing Body

Proper governance provides a level of accountability and transparency to stakeholders and can include items such as sharing information about the organization and explaining actions to stakeholders. Best practices include:

- Provide relevant and accessible information
- Timely and accurate reporting
- Performance standards
- Investigation of poor performance
- Performance accountability through chief executive
- Addressing lagging performance
- Rewarding leading performance

Figure B.15 Governing Body BP Index Score



Observations for Governing Body include:

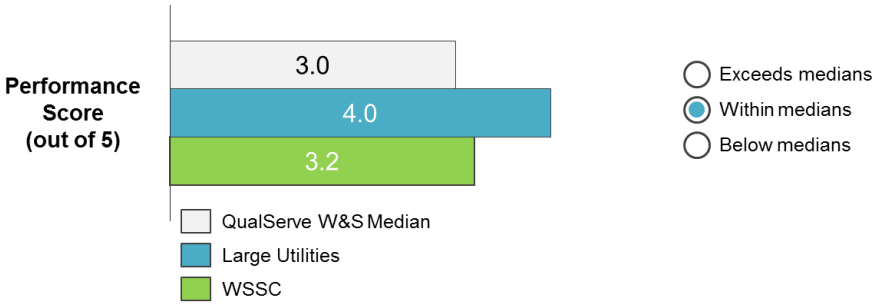
- WSSC conduct Board workshops in an effort to educate Board members on relevant issues.
- To ensure accuracy and relevancy of information, WSSC staff carefully manages the flow up to the General Manager, and subsequently to the Board.
- WSSC subscribes to the 10 principles of Carver's Policy Governance® model.
- The Board conducts self-assessments.

Customer Involvement

A formal customer involvement program involves better communication/education of issues with customers, allows them the opportunity to provide input, where helpful, and ensures their participation in the management process. Best practices include:

- Customer relations program
- Representatives have expertise to answer questions
- Conduct customer satisfaction surveys
- Solicit public input on capital projects
- Confirm customer priorities
- Resolution of customer complaints
- Conduct educational programs

Figure B.16 Customer Involvement BP Index Score



Observations in Customer Involvement include:

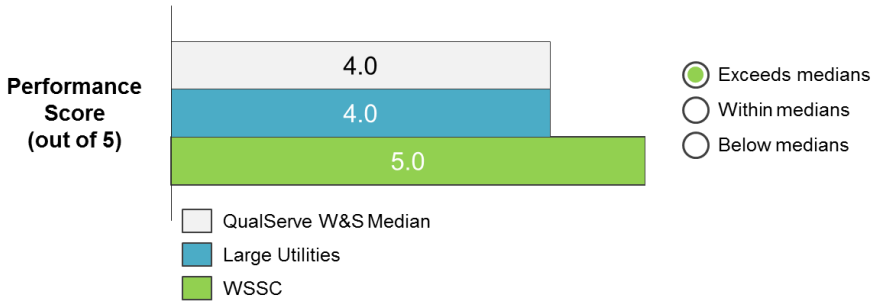
- Customer satisfaction surveys are scheduled to be performed every two years; the last two surveys were three years apart.
    - Many utilities perform annual surveys
    - Surveys performed by WSSC measure transactional satisfaction to a very limited extent
- WSSC solicits input on projects.
- WSSC identifies and seeks to resolve customer concerns.
- WSSC has a customer advisory board for environmental issues.
- WSSC has a customer app and some social media presence.
- Boards are used for dispute resolution and refund hearing to resolve billing issues
- Timely resolution of water quality issues (e.g. discolored water) could be improved.
- There is an extensive array of educational programs.

Drought Response

Utilities should have a water shortage contingency plan to help identify risks and mitigate system vulnerability. Best practices include:

- Drought response program
- Managed water supply
- Have a developed drought plan
- Implemented drought plan, if warranted

Figure B.17 Drought Response BP Index Score



Observations in Drought Response include:

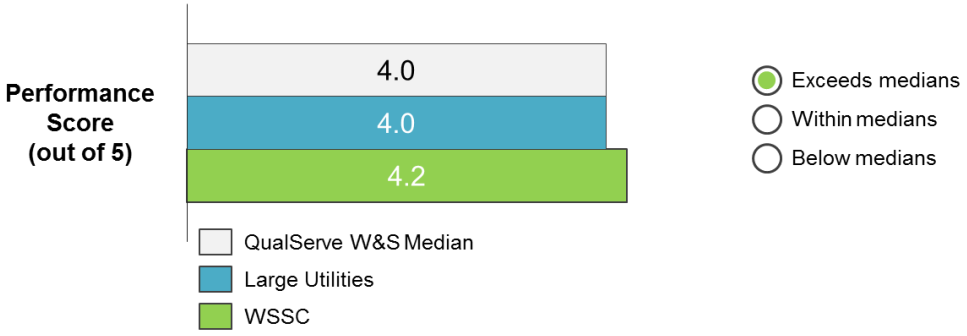
- Drought plans have been developed and are ready to implement, if needed.
- There has been little need for drought plans in the past 40 years.

Source Water Protection Plan

These are site-specific plans for each source of water, including dams, and incorporate stakeholder interests while maintaining a commitment to protecting the source water. Best practices include:

- Plans and processes to minimize pollution in source water
- Periodic review and update, as necessary

Figure B.18 Source Water Protection Plan BP Index Score



Observations in Source Water Protection Planning include:

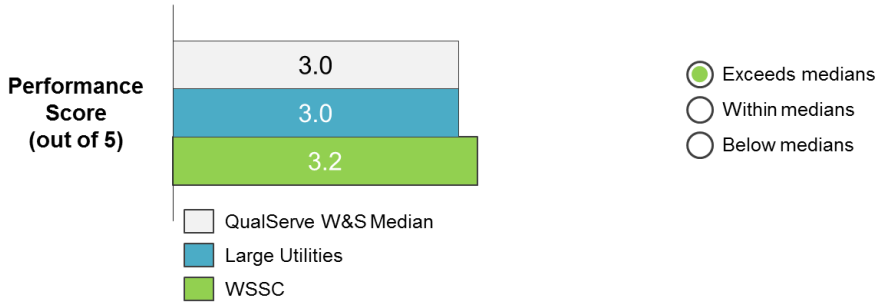
- There are prohibitions on recreational uses having the potential of adversely affecting source water.
- Selective land purchases in the watershed to act as a buffer.
- A water quality monitoring program exists.

Succession Planning

This is a process for identifying and developing suitable replacements for key managers and other critical positions. Best practices include:

- Have a documented strategic program
- Identify retirement risk
- Create three- to five-year succession plans
- Develop specific plans for senior team
- Use knowledge management programs
- Provide multiple career paths
- Craft retirement transition plans, when feasible

Figure B.19 Succession Planning BP Index Score



Observations in Succession Planning include:

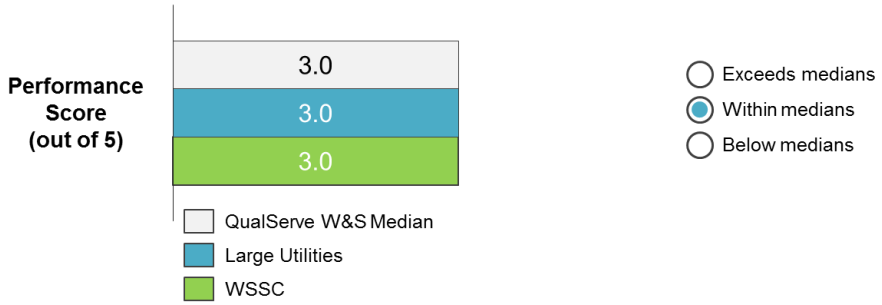
- Last comprehensive identification of retirement risk was five years ago.
- There is some knowledge of retirement risk at the team level.
- Replacements have been identified for key positions.
- Tacit knowledge has been documented using videotapes and some knowledge transfer programs.
- Career path/ladders exist mostly for field and plant personnel, not for professionals.
- There are some transition capabilities (overhires and shadowing)

Continuous Improvement Program

A continuous improvement program is useful in helping employees identify possible changes and improvements to their work practices for the purpose of improving the quality of service, efficiency and effectiveness of a process or program. Best practices include:

- Develop a continuous improvement program
- Pursue ISO 9000 or ISO 14001 certification
- Initiate work process documentation programs
- Conduct self-assessments and peer reviews
- Pursue awards from National Biosolids Partnership
- Pursue other industry water quality awards

Figure B.20 Continuous Improvement Program BP Index Score



Observations for Continuous Improvement Program include:

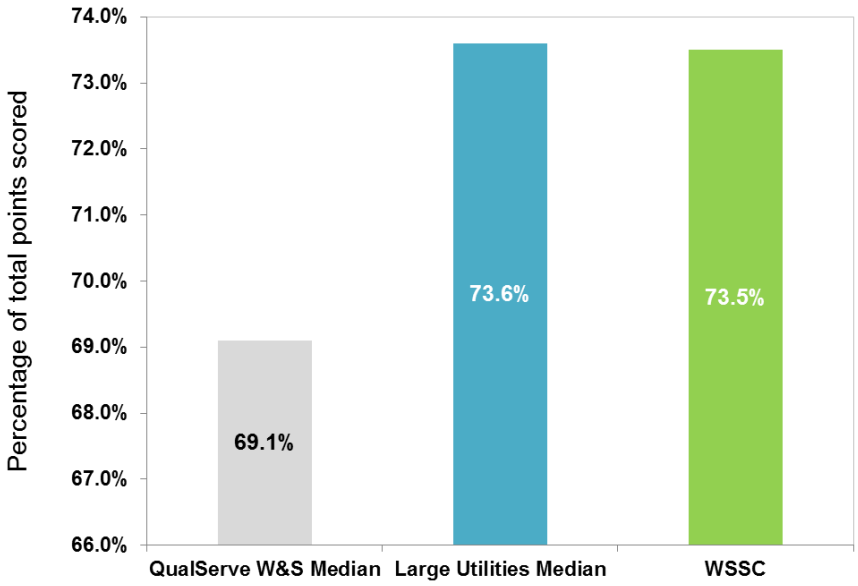
- Some ISO but not utility wide
- AWWA Partnership for Safe Water (Patuxent Plant)
- Some process mapping, but limited
- Tacit knowledge documentation
- Participating in QualServe, AWWA and NACWA (sporadic)
- 2015 awards include NACWA Peak Performance (WWTP compliance), Wendell R. LaDue (safety), and Partnership for Safe Water (high quality water treatment)

Overall Best Practices Index Assessment

Generally, the QualServe universe comprises better than average performers and some very high performers. The AWWA QualServe survey is time-consuming and not easy to complete. Some utilities have incorporated it into their performance compensation systems. WSSC did better than the combined utility median for seven out of the 11 best practice elements. Additionally, in two of WSSC's lowest score areas, the utility universe, as a whole, did poorly. This suggests that these areas are still industry-level challenges and not necessarily specific to WSSC.

After a utility assesses a best practice score for each area, the sum of the individual scores is divided by the maximum score possible, to determine the total percentage of points scored. Figure B.21 below shows how WSSC compares overall in implementing QualServe Best Practices.

Figure B.21 Overall QualServe Best Practice Index Scores



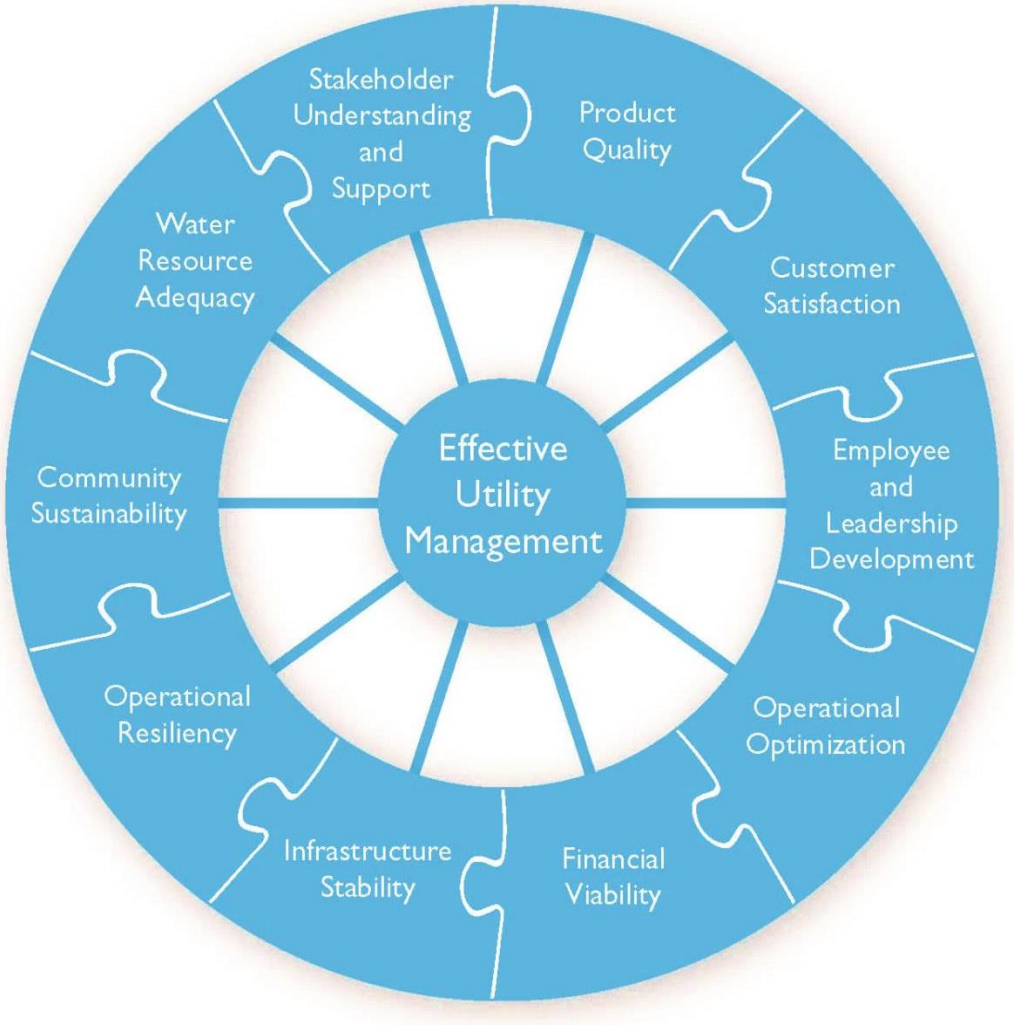
EUM Framework

In 2007, six associations representing the U.S. water and wastewater sector, including the American Public Works Association, the AWWA, the Association of Metropolitan Water Agencies, the NACWA, the NAWC, and the WEF, in collaboration with the U.S. EPA, signed a historic

agreement pledging to support effective utility management collectively and individually throughout the water sector and to develop a joint strategy to identify, encourage and recognize excellence in water and wastewater utility management. The organizations also announced the release of Findings and Recommendations for a Water Utility Sector Management Strategy. Designed to advance effective utility management practices, the report culminated a 12-month effort focused on excellence in water and wastewater utility management.

EUM includes the WRF's "Ten Attributes of Effective Utility Management". The project team met with WSSC to identify the metrics that are used to convey WSSC's performance on these attributes indicated in Figure B.22.

Figure B.22 EUM Attributes



Product Quality

This attribute requires a utility to produce potable water, treated effluent and process residuals in full compliance with regulatory and reliability requirements and consistent with customer, public health and ecological needs.

Table B.8: Product Quality Performance Measures

Measure	WSSC	Median	Performance
Drinking water compliance rate	100%	100%	
Wastewater treatment effectiveness rate	100%	100%	
Sanitary sewer overflow rate	2.98	2.5	

WSSC's SSO metrics are constantly improving and could be at median this year. WSSC's 2015 SSO performance was slightly better than the QualServe 2014 median, so if the QualServe 2015 median is unchanged from 2014, this metric would be green.

Customer Satisfaction

This attribute requires a utility to provide reliable, responsive and affordable services in line with explicit, customer-accepted service levels. It also involves receiving timely customer feedback to maintain responsiveness to customer needs and emergencies.

Table B.9 Customer Satisfaction Performance Measures

Measure	WSSC	Median	Performance
Billing accuracy rate	99.7%	99.9%	
Abandoned call rate	11.8%	10.2%	
Average wait time (minutes)	2.65	1.22	
Average talk time (minutes)	5.90	3.50	

Billing accuracy is close to median, but the call center metrics are clearly below. Many utilities include customer satisfaction and related metrics in their evaluation of this attribute.

Employee Leadership and Training

This applies to utilities that recruit and retain a workforce that is competent, motivated, adaptive and safe-working. They should establish a participatory, collaborative organization dedicated to continual learning and improvement, as well as ensure employee institutional knowledge is retained and improved upon over time. It also provides a focus on and emphasizes opportunities for professional and leadership development and strives to create an integrated and well-coordinated senior leadership team.

Table B.10 Employee Leadership and Training Performance Measures

Measure	WSSC	Median	Performance
Best Practice Index	39.2	38.0	
Employee turnover rate	6.6%	8.1%	
Retirement eligibility (in the next five years)	28.6%	17.3%	

Many utilities include training metrics (training hours/FTE) and training quality metrics in their evaluation of this attribute. WSSC has an above median retirement risk (hence the red rating), However it has and continues to develop programs to mitigate retirement risk.

Operational Optimization

Adhering to this attribute ensures ongoing, timely, cost-effective, reliable and sustainable performance improvements in all facets of the operations. It minimizes resource use, loss and impacts from day-to-day operations. It also includes maintaining awareness of information and operational technology developments to anticipate and support timely adoption of improvements.

Table B.11 Operational Optimization Performance Measures

Measure	WSSC	Median	Performance
Customer accounts per employee (combined)	301	476	
O&M Efficiency – Water (KBTU/yr/MG)	4,661	6,082	
O&M Efficiency – Wastewater (KBTU/yr/MG)	8,406	7,319	
MGD of Water Delivered per FTE	0.20	0.24	
MGD of Wastewater Processed per FTE	0.27	0.18	

Financial Viability

For this attribute, the utility management understands the full life-cycle cost of the utility and establishes and maintains an effective balance among long-term debt, asset values, O&M expenditures and operating revenues. It also establishes predictable rates – consistent with community expectations and acceptability – adequate to recover costs, provide for reserves, maintain support from bond rating agencies and plan and invest for future needs.

Table B.12 Financial Viability Performance Measures

Measure	WSSC	Median*	Performance
Bond rating	AAA	AA	
Debt ratio	34.2%	36.5%	
Return on assets	1.2%	1.5%	
Cash reserves adequacy (days)	276	259	

* For bond rating, the term in the median column is actually the mode of the measure.

Infrastructure Stability

The utility understands the condition of and costs associated with critical infrastructure assets. It maintains and enhances the condition of all assets over the long-term at the lowest possible life-cycle cost and acceptable risk consistent with customer, community and regulator-supported service levels, and consistent with anticipated growth and system reliability goals. This makes sure that asset repair, rehabilitation and replacement efforts are coordinated within the community to minimize disruptions and other negative consequences.

Table B.13 Infrastructure Stability Performance Measures

Measure	WSSC	Median	Performance
Water distribution integrity rate – leaks	1.9	15	
Water distribution integrity rate – breaks	31.0	13	
Wastewater collection system integrity rate	38.1	6.0	
System Inspection (%) – sewer	2.4%	9.6%	

Operational Resilience

This attribute ensures that utility leadership and staff work together to anticipate and avoid problems. Management identifies, assesses, establishes tolerance levels for and effectively manages a full range of business risks (including legal, regulatory, financial, environmental, safety, security and natural disaster-related) in a proactive way consistent with industry trends and system reliability goals.

WSSC did not have the information readily available at the time of the study to calculate measures related to this area. However, it is recommended that it do so on a continual basis.

Community Sustainability

Management is explicitly cognizant of and attentive to the impacts its decisions have on current and long-term future community and watershed health and welfare. It manages operations, infrastructure, and investments to protect, restore and enhance the natural environment; efficiently uses water and energy resources; promotes economic vitality; and engenders overall community improvement. It explicitly considers a variety of pollution prevention, watershed and source water protection approaches as part of an overall strategy to maintain and enhance ecological and community sustainability.

Table B.14 Community Sustainability Performance Measures

Measure	WSSC	Median*	Performance
Water loss	17%	14%	
Water service affordability	0.36%	0.64%	
Wastewater service affordability	0.50%	0.76%	
Low income assistance	Yes	-	
Triple Bottom Line index	75%	55%	

* For water loss, the term in the median column is actually the estimated mean of the measure.

Water Resource Adequacy

Proper execution of this attribute ensures water availability consistent with current and future customer needs through long-term resource supply and demand analysis, conservation and public education. It explicitly considers the utility's role in water availability and manages operations to provide for long-term aquifer and surface water sustainability and replenishment.

Table B.15 Water Resource Adequacy Performance Measures

Measure	WSSC	Median*	Performance
Current water demand	50.6%	44%	
Available future water supply	27.0	28.0	

Stakeholder Understanding and Support

This area engenders understanding and support from oversight bodies, community and watershed interests and regulatory bodies for service levels, rate structures, operating budgets, capital improvement programs and risk management decisions. It actively involves stakeholders in the decisions that will affect them.

Table B.16 Stakeholder Understanding and Support Performance Measures

Measure	WSSC	Median*	Performance
Stakeholder outreach index	66.7%	75.0%	
Average residential water bill amount for one month of service*	$21.78	$28.56	
Average residential sewer bill amount for one month of service*	$30.48	$32.02	

* Quarterly bill divided by three. Fixed charges were split evenly between water and sewer cost of service.

Overall Assessment

WSSC does well in more than half of the attributes in EUM, but it still has room for improvement in other areas. The water resource adequacy attribute is partially out of its control and WSSC expends a great deal of effort maintaining and supporting its water supply.

Table B.17 Overall EUM Assessment

Attribute	Overall Performance
Product Quality	
Customer Satisfaction	
Employee and Leadership Training	
Operational Optimization	
Financial Viability	
Infrastructure Stability	
Operational Resilience	N/A
Community Sustainability	
Water Resource Adequacy	
Stakeholder Understanding and Support	

Financial Management

For most utilities, there are two dimensions to the issue of financial management. The first has to do with the overall financial performance of the organization – the administration of financial resources. The second has to do with how its policies and practices affect its customers – the practical and creative recovery of the cost of service from various customers.

Financial Performance

WSSC is the eighth-largest utility in the U.S. and serves approximately 1.8 million people. Just as corporations become more complex as they get larger, so do utilities, which have to plan for the maintenance, repair and replacement of thousands of assets each and every year. They also procure complex and, sometimes, costly systems to help manage organizational resources, including financial resources.

Table B.18 Financial Performance Measures

Measure	WSSC	QualServe Median*	Large-Utility Median
Bond rating	AAA	AA	n/a
Debt ratio	34.2%	36.5%	53.0%
Return on assets	1.2%	1.5%	1.8%
Cash reserves adequacy (days)	276	259	195
Operating ratio	81.0%	61.4%	62.0%

* For bond rating, the term in the median column is actually the mode of the measure.

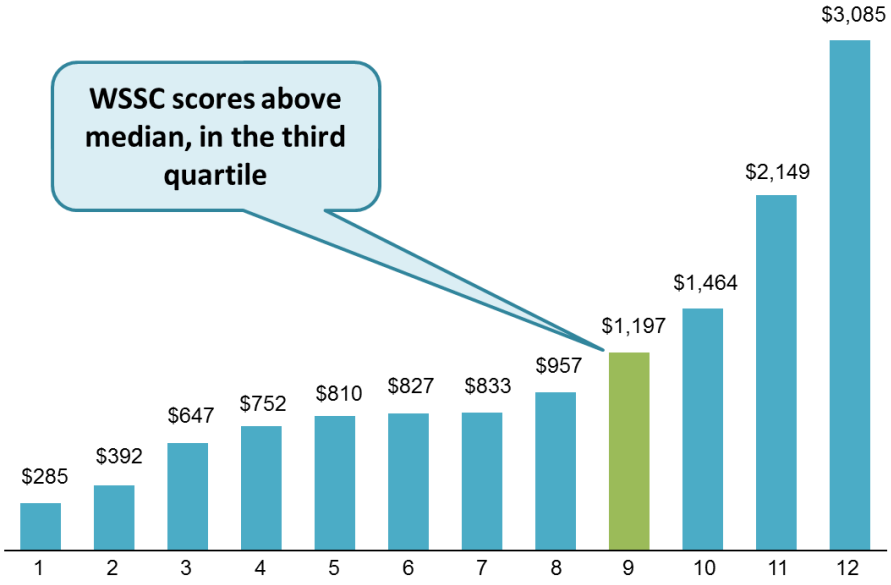
WSSC's financial performance was also compared to 10 other large utility peers (See Table B.19). Compared to its peers, WSSC is the only across the board AAA. WSSC also has the smallest percentage of revenue attributable to its 10 largest customers, which is an indicator of revenue stability.

Table B.19 Peer Utilities (Financials)

- Baltimore, MD
- Boston, MA
- Washington, DC
- Philadelphia, PA
- New York, NY
- Cleveland, OH
- NEORSD, OH
- Louisville & Jefferson County, KY
- Miami-Dade, FL
- San Antonio, TX

Figure B.23 shows that WSSC has an above median level of debt.

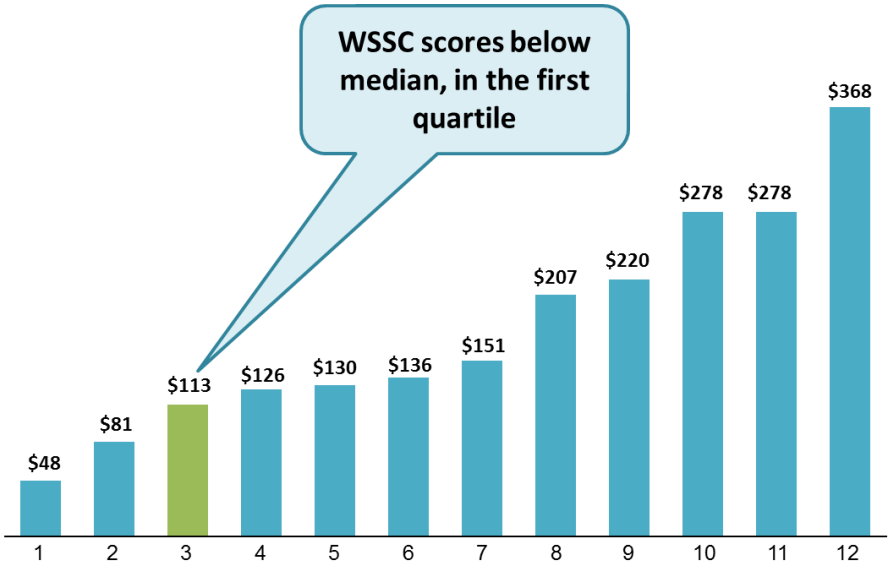
Figure B.23 Debt per Capita



In addition to high debt levels, WSSC also has an above average capital intensity (ratio of net asset value to revenues – or, put more simply, dollars in the ground needed to generate a dollar of revenue.

A promising sign is that the WSSC 5 year CIP (on a per capita basis) going forward is below its peers offering an opportunity to improve its relative debt levels:

Figure B.24 Annual Capital Expenditures per Capita



Rates and Affordability

For many customers, their primary interaction with WSSC is through their bills. WSSC bills each customer quarterly, which can lead to the false impression that WSSC's water and wastewater services

are somehow much more expensive than other large water utilities or when compared with other types of utility bills. In general, WSSC's overall cost of service is reasonable and not out of line with other large utilities, especially those with consent decrees. WSSC's average residential consumption is less than 5,000 gallons per month. However, it uses a maximum rate inverted conservation scale, where customers pay the highest rate for the average flow that ends up in that rate block. Figures B.25 through B.27 compare WSSC to other large utilities at three different levels of usage. The average residential bill is for less than 5,000 gallons per month, so bills are very affordable in comparison.

Figure B.25 Affordability Comparison for Low Water Consumption (3,740 gal/month) Users

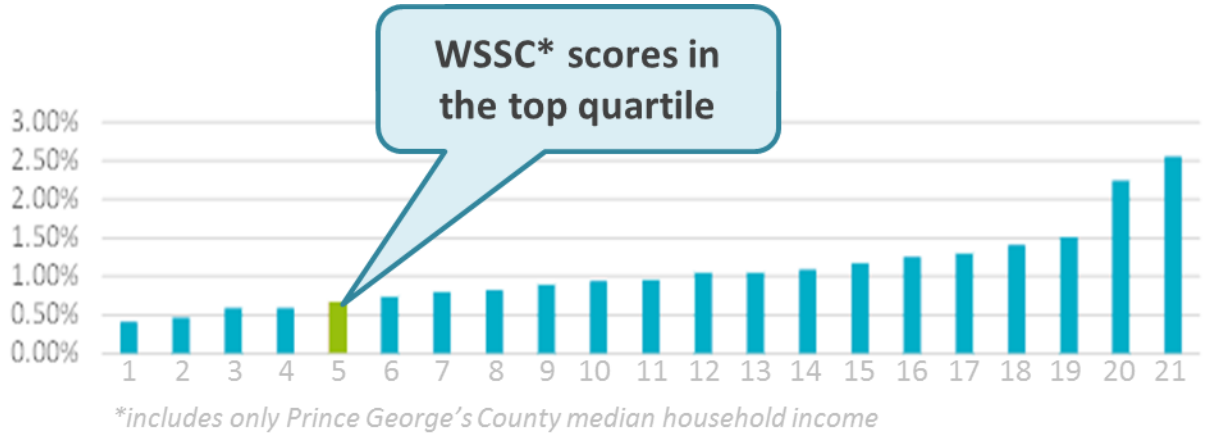


Figure B.26 Affordability Comparison for Moderate Water Consumption (7,840 gal/month) Users

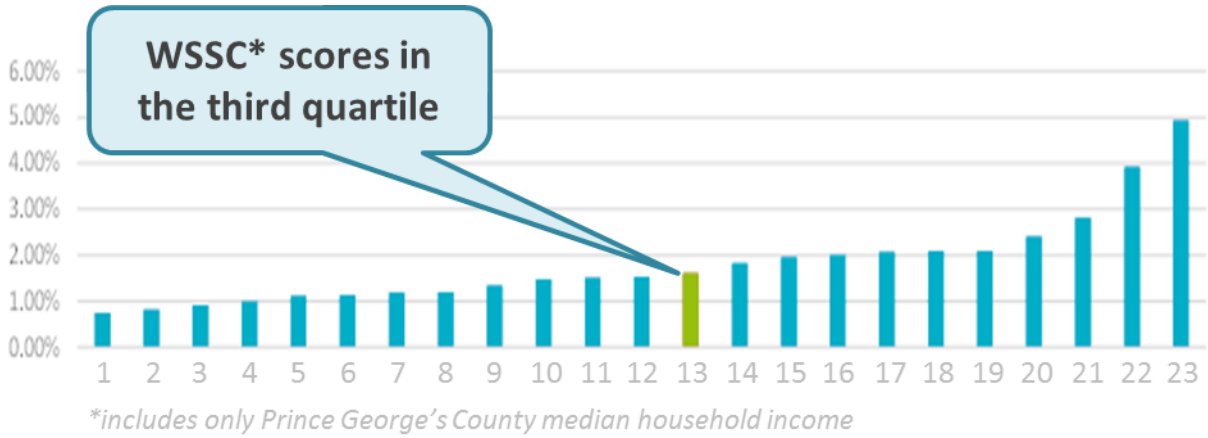
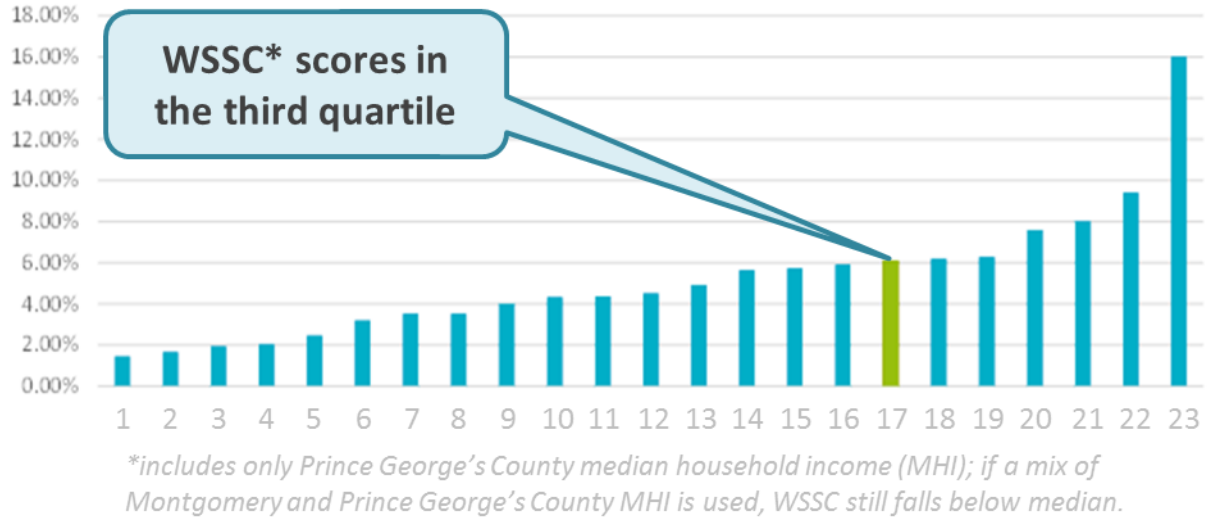
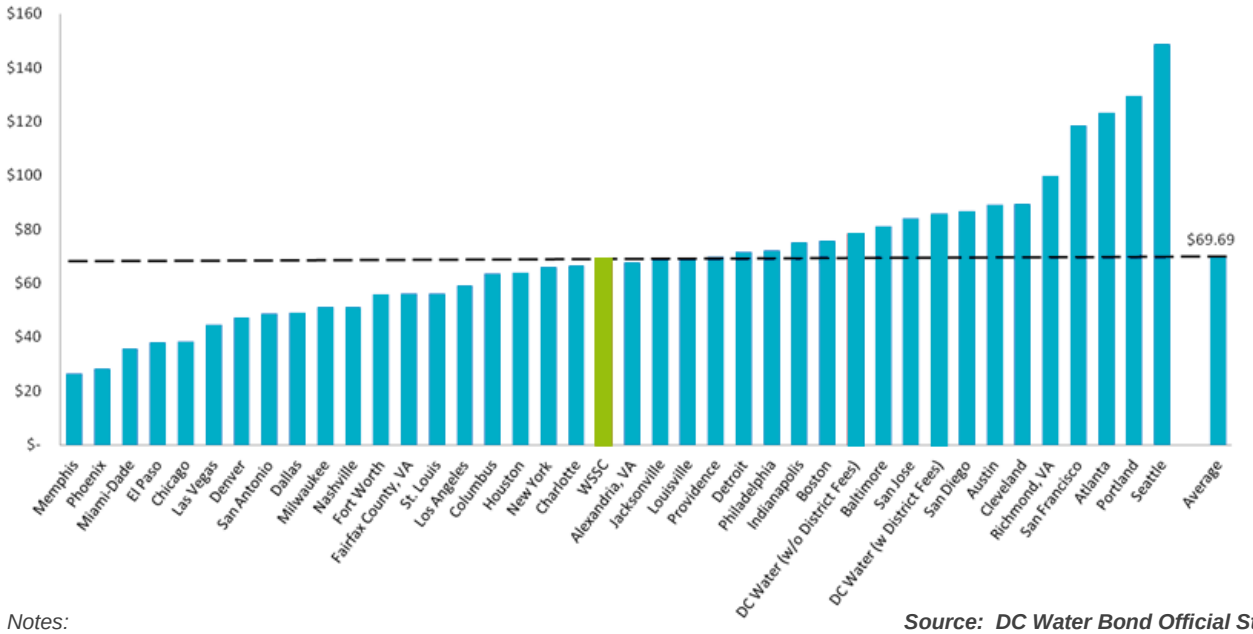


Figure B.27 Affordability Comparison for Large Water Consumption (22,400 gal/month) Users



One of the issues that WSSC has experienced over the years is declining per-capita usage. As the customer base has grown, the amount used, on average, by each customer has declined. Previous analyses on the rate structure of WSSC have consistently found that there is no statistically significant correlation between the decline and prices – a phenomena called price elasticity of demand (when prices go up, consumption goes down). Correlation measures the strength of the linear relationship between two variables. In WSSC's case, it has a nonlinear rate structure because the rate charged to the entire volume of flow is dependent on the average daily level of flow. The rate structure does incentivize conservation, but when a customer can reduce consumption to be charged a slightly lower rate on the entire volume, the revenue will decrease by more than the reduction in consumption. This makes revenue less stable than it could be.

Figure B.28 Single Family Residential Monthly Bill Comparison

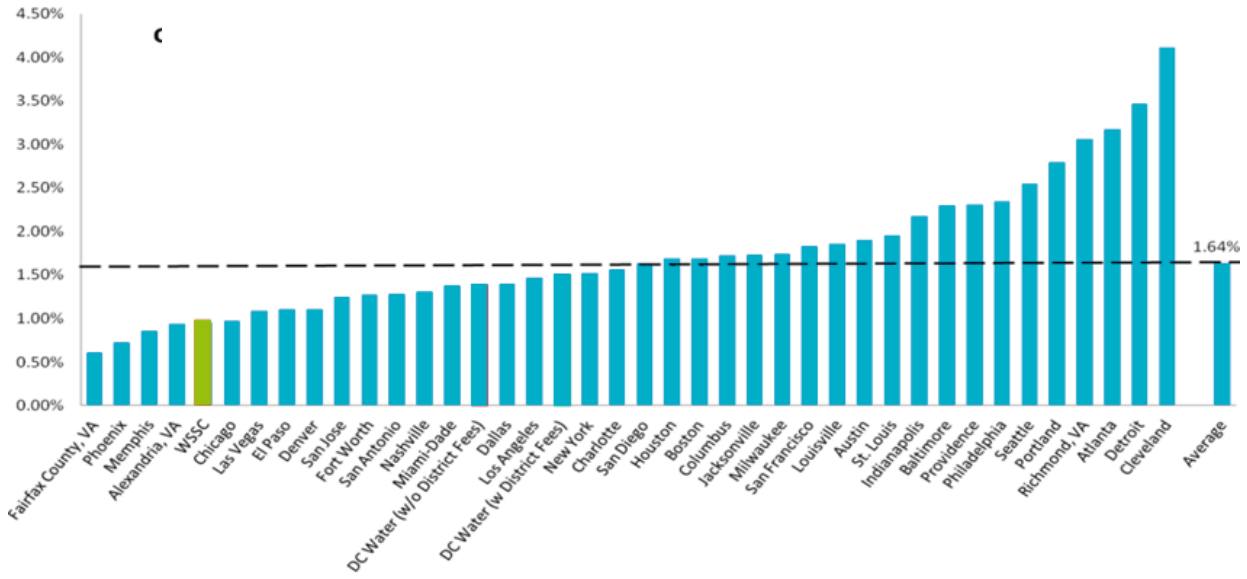


Notes:

Source: DC Water Bond Official Statement

1. *Assumes average residential consumption of 6.69 Ccf, or 5,004 gallons, per month. (Ccf = hundred cubic feet, or 748 gallons)*
2. *Reflects rates and fees in place as of July 1, 2015. The Authority's rate includes the PILOT/ROW fee totaling $0.63 per Ccf (effective October 1, 2014) and the DDOE residential stormwater rate of $2.67 per ERU per month.*

Figure B.29 Single Family Residential Monthly Bill Affordability Comparison



Notes: ***Source: DC Water Bond Official Statement***

1. *Assumes average residential consumption of 6.69 Ccf, or 5,004 gallons, per month. (Ccf = hundred cubic feet, or 748 gallons)*
2. *Reflects rates and fees in place as of July 1, 2015. The Authority's rate includes the PILOT/ROW fee totaling $0.63 per Ccf (effective October 1, 2014) and the DDOE residential stormwater rate of $2.67 per ERU per month.*

Human Resources

WSSC is one of the largest water utilities in the country and manages a large workforce to maintain the system and provide high-quality drinking and clean water. Additionally, WSSC is an independent authority and must provide all of its own administrative support, unlike many government-affiliated utilities that share support services. The scope of what the Human Resources (HR) department manages is broad and deep. In addition to the traditional responsibilities of hiring employees and managing their transition for the utility, it also manages a retirement plan for 1,600 retirees that is nearly fully funded and a medical plan for 5,000 employees and retirees. It also provides support for workers compensation. Comparison of WSSC performance versus QualServe median and Large Utility median is indicated in Table B.20 below.

Table B.20 Human Resources Performance Measures

Measure	WSSC	QualServe Median*	Large-Utility Median
Employee turnover rate	6.6%	8.1%	8.8%
Retirement eligibility (in the next five years)	28.6%	17.3%	14.1%

The HR department has worked to reduce the time it takes to find and hire quality employees, and it has enhanced existing programs or initiated new programs; however, one of its major challenges is dealing with the aging workforce. In the mid-1990s, WSSC went through a major project called the Competitive Action Plan that led to a significant workforce reduction, especially for longer-tenured employees. After

that, the age distribution of the workforce moderated. However, the challenge of an aging workforce is coming back. Figure B.30 below shows the age distribution of the U.S. labor force, WSSC's workforce age distribution in 2002, an age distribution from a 2012 survey of mostly large water utilities, and WSSC's current workforce distribution.

Figure B.30 Workforce Age Distribution Comparison

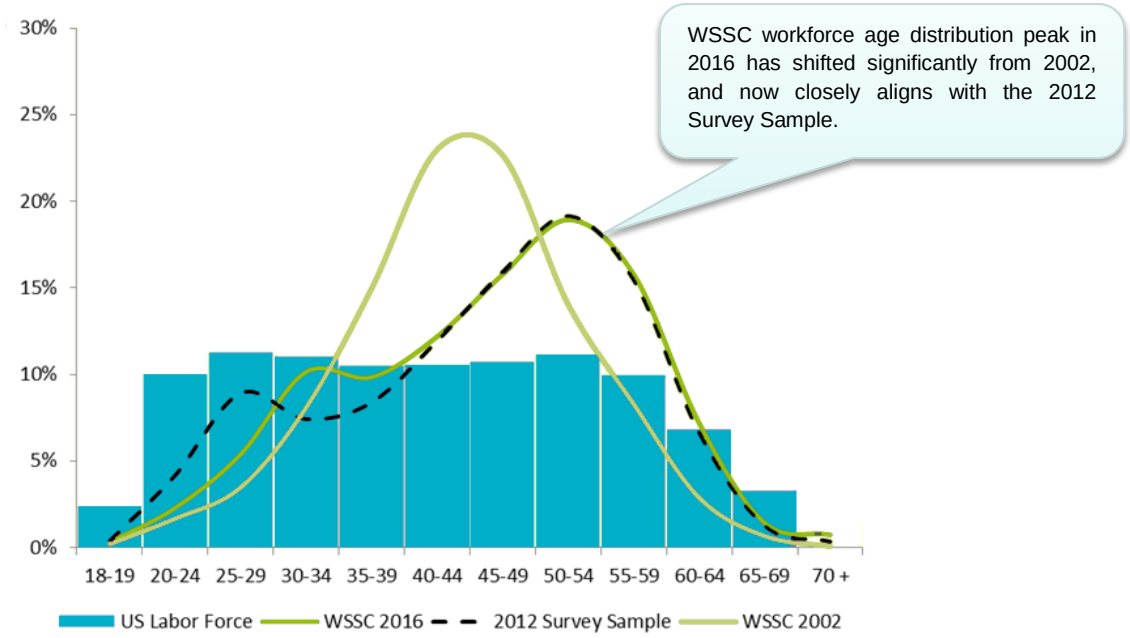
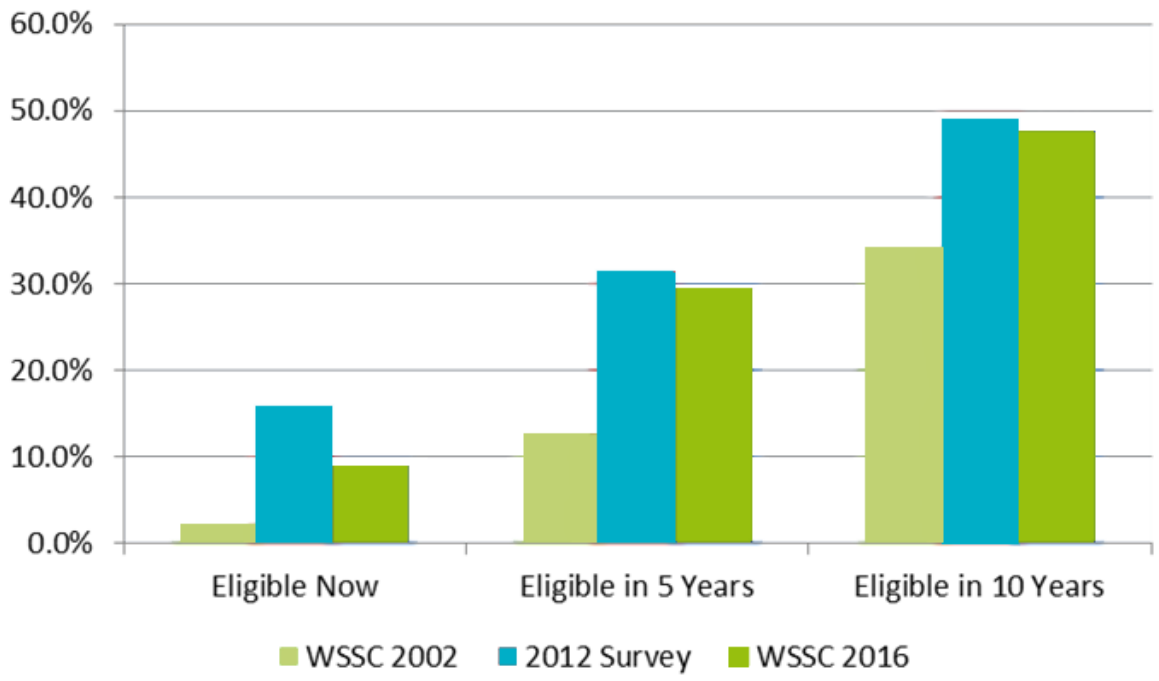


Figure B.30 shows how the age distribution of WSSC has shifted from an approximately normal distribution to one that is more heavily skewed in favor of older workers. This transition over 14 years is not necessarily a bad thing and reflects a workforce turnover that is much lower in the utility industry than for most other industries. This leads to higher average years of service. The average age of the U.S. workforce is approximately 42.34 years, while WSSC's is 46.68 years. There are a few differences between WSSC's workforce and the national workforce. First, the average age of the WSSC workforce is higher because a much greater percentage of its positions are skilled positions that require more years of experience, on average. Additionally, utility industries, including electric, have much lower turnover than other industries, which also contributes to an older workforce and longer average years of service.

WSSC does face a greater risk from retirements than many other utilities. Just as the age distribution has shifted higher, so has the portion of the workforce that is eligible or will become eligible in the future. Figure B.31 shows how the percentage of employees eligible to retire at different points has increased dramatically, but is not greater than other large utilities. A mitigating factor in retirement risk is that a significant portion of those who are eligible for retirement simply because they are able.

Figure B.31 Retirement Eligibility Comparison



To face these workforce challenges, the HR department is in the process of adopting or has already adopted many of the best practices suggested for succession planning:

- Implementing a retirement risk planning and tracking tool
- Developing a mentor program
- Sharing/transferring knowledge
- Using overhires for replacement transition
- Initiating defense training
- Launching a new general pay scale

Recommendations

After conducting many interviews and reviewing data provided by WSSC, recommendations that arose from the high-level benchmarking effort are being presented in this section.

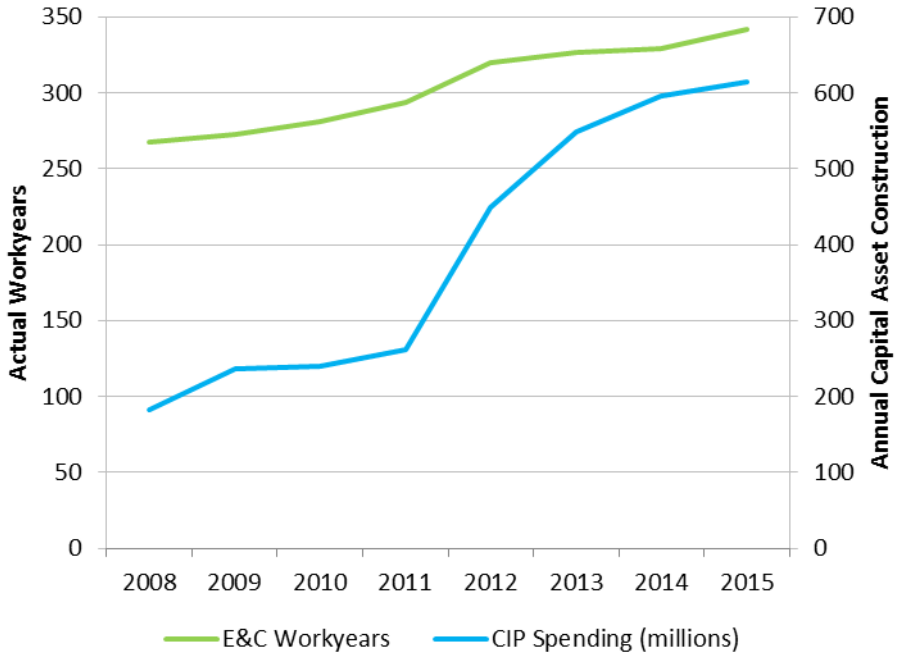
Staffing Levels

WSSC underwent a significant downsizing in the mid-1990s, the Competitive Action Program (CAP), which provided incentives to encourage mostly senior employees to voluntarily leave WSSC. While that program was successful in reducing the number of employees at WSSC, it also led to the degradation or effective elimination of many useful system maintenance programs. As a result of identifying the need to restart or enhance these programs, the number of FTEs at WSSC has slowly been rising again since the CAP. The initiation of the asset management program identified many of these needs and made plans that included work year increases. Among the programs that are now in place or being implemented from that and other department efforts are:

- Monitoring control corrosion and leak detection program for ductile iron pipe

- Hydrant inspection, flow measurement and maintenance program
- Acoustic fiber optic monitoring
- PCCP inspection program
- Valve exercising and inspection program
- Annual line flushing program
- Watermain reconstruction program
- WSSC's Engineering and Construction Team, which includes the planning function, is managing much greater capital spending than it has in the past, as it works it way through its consent decree and the implementation of its asset management program. As the consent decree projects wind down and the asset management program matures, a reevaluation of the department may be warranted. Currently, it is managing a much greater volume of capital spending, as shown in Figure B.32 below.

Figure B.32 Growth in E&C Workyears versus Growth in Capital Spending

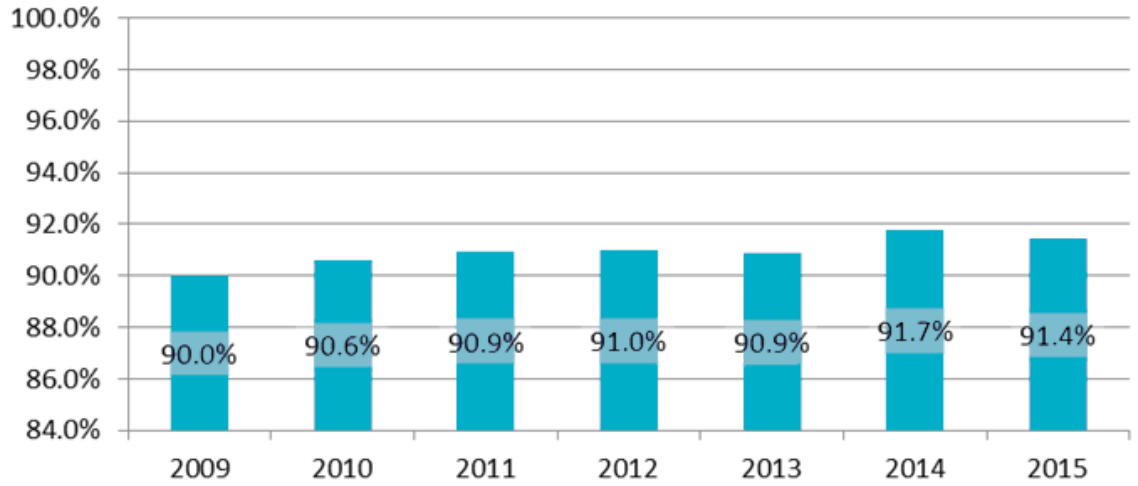


While vigilance should be maintained to ensure that new FTEs are needed and not being acquired at the expense of efficiency or productivity, they mostly seem to be warranted and it should be noted that WSSC conducts some activities that other utilities do not, such as the plumber and gas-fitters permitting and inspections, as well as backflow valve inspection. Additionally, many of these programs use contractors; in some cases, when there is a steady workload and productivity, it may be cheaper to do some things in-house, rather than hire contractors. As the performance management process improves, WSSC will be better able to show need for new FTEs or the need to launch another round of business process improvements.

Financial – Rate Structure

WSSC adopted its current rate structure around 1980. It was the first water utility to adopt an inclining block rate structure designed to achieve conservation and has been very successful at doing so. WSSC has one of the lowest per capita consumption levels among its peers. For some customers, the rate structure has become controversial, especially with respect to impacts on large families. The rate structure is not resilient, e.g. a 1% drop in consumption produces more than a 1% drop in revenues. Figure B.33 below shows the volumetric water and sewer charges as a percentage of total revenue. Utilities that have performed detailed cost studies report that their fixed costs (i.e., costs of operation that do not vary with the amount of water sold/wastewater treated) range from 65-80%.

Figure B.33 Volumetric Water and Sewer Charges as a Percentage of Total Revenue



Rate Structure Recommendation #1:

Consider implementing a more resilient, but still conservation-oriented, rate structure based on consumer budget, such as the CustomerSelect rate model. This is similar to what cell phone companies offer their customers in terms of their data usage. While this is a relatively new approach, it is worth WSSC's consideration:

- Although it is an innovative rate structure, WSSC has a history of being an innovator.

The likelihood of backtracking on existing levels of conservation is low due to demand hardening (much of the conservation that has been achieved is due to efficient fixtures and changes in consumer behavior). Also, this rate structure has conservation incentives so WSSC's commitment to conservation would not be reduced through implementation of a new rate structure.

- WSSC has a number of methods available to manage the impact of a transition to a new rate structure.

- WSSC could consider offering conservation programs (similar to those of other utilities) to assist large families in taking advantage of the conservation incentives in these rate structures.

CustomerSelect offers customers a choice by allowing them to select a target usage at an attractive rate, with higher rates for using more than the targeted amount. The risk in adopting a program like this is that

without knowing customers' response, WSSC may be taking on financial risk and therefore unintended consequence. Some transition alternatives:

- For a one- or two-year period, compute the rates under the new rate structure and show a comparison on the bill – "under a CustomerSelect rate structure your bill would have been $xxx". This has been done successfully in other utilities (and other industries) and would give WSSC information about possible financial impacts.
- Offer customers a choice of staying under the current rate structure or the new rate structure.
- Make the new rate structure available in portions of the system, increasing availability every year.

The capacity to implement this type of pricing structure may need to be taken into account when selecting a new Customer Service Information Data System (CSIS).

Rate Structure Recommendation #2:

If the first recommendation is not considered feasible to attempt at this point (it may be more manageable after the implementation of a new CSIS and further evaluation), then a more palatable compromise may be to run customer flows through each block, with a fewer number of volume blocks. This will greatly reduce the amount of revenue lost when customers reduce their consumption into the next lower rate block. This will allow WSSC to maintain a rate block structure meant to deter excessive water use. WWSC has recently awarded a contract for a comprehensive rate study that includes an extensive outreach effort.

Financial – Miscellaneous Fees and Charges

Miscellaneous revenues are computed annually. The computation begins with time charges for fee generating activities which are then compared to time and motion estimates as a reality check. The resulting hours are increased by allocated costs to arrive at a fee. At less than 3% of total revenues (including front foot benefit and H/C assessments), collections appear low for such a large and diverse utility.

Accurate computation of miscellaneous fees and charges requires accurate time and volume data in order to arrive at t costing. Finance performs a reality check on the time charge information it receives and appropriately computes hourly cost and burdens; however, as noted elsewhere in this document, there are weaknesses in the system that produces time charges.

While not as important as a review of the rate structure, a review of miscellaneous fees and charges should be performed. This could be done either through incorporation into the comprehensive study by a rate consultant or through an internal effort to perform a detailed analysis of labor classification, hours and transaction volumes.

Financial – System Development Charge

Historically, the System Development Charge (SDC) has provided a substantial amount of funds for growth-related construction. WSSC charges SDC on the basis of fixture units, one of a very small number of utilities that do so. The original study that resulted in the SDC did not contemplate the use of fixture units. The use of fixture units has resulted in procedures that are very complex and time-consuming. SDC procedures contribute to higher staffing levels in internal audit and Engineering and Construction. The annual SDC study performed by WSSC is focused on the proper use of SDC funds,

not on the amount of the charge. A recent study by an outside consultant contained an estimate that WSSC's SDC could be higher. Reportedly, WSSC elected not to increase the SDC for affordability reasons.

WSSC should consider performing an SDC review. Among the possible objectives for such a review:

- To determine if a change could be made to the more common basis for such charges – equivalent dwelling units (EDU) or equivalent residential units (ERU).
- If it is determined that it would be preferable to continue with fixture units as the basis for the SDC, examine whether any of the more streamlined procedures of the two neighboring jurisdictions which still use fixture units could be adopted (or adapted) to reduce the staffing burden.
- Perform a next unit of capacity computation to compare the current SDC level to the amount that could be charged. A regional benchmarking of these charges would also be useful to WSSC management

Strategic Planning

The current approach taken to strategic planning reflects management and/or Board preferences, reporting the broad strategic goals and objectives. An annual strategic performance report was developed to show how well WSSC was meeting key performance measures linked to the strategic objectives. However, WSSC has available far more performance measures that may inform the governance structure on how well it is progressing to or meeting those objectives.

It is recommended that he next round of strategic planning consider:

- More strategic factors, including the possible use of a goal-strategy-practices-performance-measure framework
- Increased line employee involvement, such as the use of goal teams
- Increased reporting of strategic performance to line employees

Performance Management

Current performance management efforts are fragmented. This fragmentation is reflected in multiple databases, a lack of consistent definitions for each performance measure, a lack of standardized processes for making sure any data or calculations are reported correctly, no establishment of performance targets and acceptable process control limits, no trend analysis of past performance, no robust discussions on current performance and general lack of accountability throughout the organization. Reliable performance reports are essential to adequate financial controls. Recently WSSC formed a stats office and has issued an RFP to develop a performance management system. Such a system should improve management and accountability

Futures Considerations

WSSC faces myriad existing and new issues it will have to manage. A recent review of EUM sponsored by US EPA and consisting of multiple panels of water industry personnel identified important future issues that utilities will need to be able to address. These are presented below.

Climate Variability and Extremes

Predicted climate variability and more extreme events affect utility operations in many ways – droughts, extreme rain events, rising river levels etc. Some utilities, especially those serving coastal communities and in low-lying areas, have already experienced these weather extremes and aftereffects. WSSC has the capacity to incorporate mitigation of these issues into its future planning process and can initiate changes, as required, in the design and construction of common and critical infrastructure.

The most recent asset management plan update outlines billions of dollars in spending to upgrade and replace infrastructure. With a significant focus on meeting the requirements of its consent decree, WSSC has taken a broad and deep look at its system, and this may be the best time to evaluate where it is economically and technologically feasible to mitigate the effects of extreme weather from rising river levels to higher peak winds to increased soil erosion. (A study conducted by WSSC staff found that a contributing factor to better-than-expected condition of some distribution system pipes was the quality of the fill dirt and the quality of the work in pipe placement).

WSSC is still not quite prepared to address these issues, but it making progress in that direction. WSSC may need to do more work to reduce wet weather SSOs. The collection system is susceptible to rain events. Climate change is likely to result in more frequent or longer-lasting extreme events or more intensive extreme events. This may require WSSC to periodically review and update its engineering design requirements for replacing assets susceptible to these changes, adopting more sustainable and resilient stormwater management practices. Additionally, a review of SSOs reported to the Maryland Department of the Environment show that some facilities next to a body of water contribute significantly to the volume of SSOs and may also need more protection against rising water levels and extreme weather flow impacts. It is clearly taking some mitigation steps through the consent decree, but it is primarily focused only on elimination overflows and not necessarily “hardening” assets to withstand other impacts from extreme weather. WSSC should lay the groundwork for adjusting their processes to address hardening assets against climate change while it contains a great deal of significant institutional knowledge about the system and changes to it over the last decade or two. Additional challenges remain in coordinating efforts with the governing counties, who independently manage stormwater in their respective jurisdictions.

Customer Expectations and Customer Awareness

Historically, water utilities have sought to maintain a low profile within their communities and tended to interact with customers and the media mostly in response to service failures, emergency events, and in other challenging contexts. In recent years, customer expectations and interest in information have increased, and the water sector has become more proactive in its customer and media relations, sharing information about utility programs, the value of water, and the utility operating context helpful to achieving utility and community goals. Many participants stressed that this area of management has taken on substantially more importance and criticality to successful operations of a utility. This includes:

- Prevalence of social media
- Real-time meter data available to customers
- Establishing proactive, positive relationships with customers and community members
- Proactive media management

- Broader watershed management and green infrastructure initiatives demanding coordination with "outside of the fence line" community interests and institutions
- Increased public expectations for transparency by utilities
- Foundational to world class utilities successfully managing change is to stay engaged with their customers and recognize that customers' expectations and perceptions are important performance measures.
- Developing, implementing and communicating best practice customer feedback, communication tools, and measures are essential to continuous improvement.

WSSC has made significant progress in this area with its award winning mobile, constantly updated web site, as well as use of Twitter and press releases to keep customers informed of what is going on at the utility. WSSC will be better able to meet future customer expectations when a new CSIS is implemented, plus the adoption of automated meter reading, and the potential for advanced metering infrastructure to provide customers with real-time data on their usage. One tool used by other types of utilities is a customer app that not only allows them to check their account, but also provides frequently updated outage information in the system based on the customers' home or business address.

Rate Structure

To a certain degree, no matter what WSSC does about its rate structure, a certain portion of the population served is going to complain because they just don't want to pay for the service. WSSC does have many excellent educational resources on its web site, but it doesn't seem to be effective in helping customers understand the agency's mission and the cost of its mission. Each year, customers believe that their bills are increasing at the same rate of the rate increases announced, which isn't necessarily true, but the current rate structure doesn't help to make the case or the rate policies of charging all of the volume at the highest rate based on the average daily consumption. Establishing a more understandable and simpler rate structure will make it easier for many customers to understand their bills. The current structure provides tremendous incentives for customers to reduce consumption which, in turn, drive higher rate increases to recover needed revenue.

WSSC is prepared and able to reach out to its customer base more through surveys, social media and events. It is also in the process of addressing its rate structure. Cost of service is driven by a technical process to allocate projected costs to different customer classes. How those costs (also called revenue requirements) are recovered through the rate structure, however, is a political decision and WSSC is first addressing this with a stakeholder outreach effort to determine priorities and obtain buy-in to any potential changes to the rate structure.

Employee Recruitment and Retention

In recent years, utilities have begun to experience a shift in workforce dynamics. In the past, workers tended to stay with organizations for the long-term, however, these employees have begun to reach retirement age, and the new generation of employees has tended to be more demanding of their workplace benefits and opportunities, and change jobs more frequently leading to higher rates of employee turnover than utilities have faced previously. Increasing turnover has necessitated the creation of more explicit programs for succession planning, workplace training, and leadership development.

The utility industry has much lower turnover than most other industries. WSSC's turnover rate is below the industry median and reflects employee longevity in the organization. WSSC will be choosing its next generation of employees from a pool of younger employees that tend to change jobs more frequently and demand a better work-life balance in some cases. As the utility industry becomes more sophisticated, it is competing against deep-pocketed for-profit companies for talent. To give it the best chance of maintaining a high-quality workforce, WSSC's Human Resources Department has already launched a number of initiatives, such as a flexible worker program, job shadowing for replacements, knowledge capture in a few instances, progressive retirement (where employees work a little longer to train their replacements) and writing succession plans for senior positions.

An important factor in WSSC being prepared to recruit and retain talent will be transferring critical, tacit knowledge from incumbent key employees to their successors. If the organization can continue to develop policies and codify SOPs critical processes and practices, it stands a good chance of remaining an employer of choice. An employer of choice is one that can attract and retain the workers from the top of the labor pool. Another challenge that WSSC will face to meet this future requirement is a periodic review of its compensation. It's not about whether compensation is good or not, it is about ensuring that it is offering competitive salaries for competitive positions. WSSC has a head start over many other public entities in this regard. It will be able to meet this future challenge if it does the following:

1) Emphasizes the natural utility advantage of being an organization that provides necessary public services.

2) Demonstrates corporate social responsibility through a combination of cause-based affiliations and volunteerism.

3) Emphasizes the benefits of the municipal sector: 74% of utilities have defined benefit retirement plans and the average retiree has more than 24 years of service.

4) Offers non-traditional benefits.

5) Engage in best practices as for HR. Talented employees want to work in an environment having growth opportunities (training, leadership succession) and where knowledge is valued (knowledge management).

WSSC is well-poised to meet this need as long as it continues to implement new programs to meet new challenges and is able to communicate that to talented people who may be unaware that this industry exists and that it is a good one to be in.

Resource Recovery

A substantial re-thinking of the water sector utility business model is underway, while innovations in technology are enabling substantial opportunities in the operation of and services provided by utilities. Leading utilities are repositioning themselves in their communities as resource recovery centers, establishing new sources of revenues, reducing environmental impacts and supporting and leading overall community sustainability and resiliency.

Renewable Energy

WSSC has started down this path by obtaining alternative, renewable energy sources for electricity consumption. The benchmarking revealed a well-above median level of energy consumption. WSSC isn't in the bottom quartile, but is it on the bubble for higher energy use for wastewater service. This area

will be more challenging for WSSC to address because it must manage the tradeoff in level of service over a large geographical area versus a more sustainable operation, or find a new way of conducting business to drive resource conservation, such as paper conservation through its e-bill service. Biosolids reuse as a product is still a challenge in regions where there is not a lot of farming or demand.

Energy Recovery and Conservation

The big picture is for WSSC to try to generate energy from wastewater processing. If its wastewater treatments plants aren't suited for it, then it could be determined whether its byproduct could be sent to the Blue Plains plant for energy conversion by the CAMBI® process. Other states have looked at wastewater energy recovery for use in heating and cooling applications at facilities to reduce external energy consumption. WSSC and its energy manger will have to determine the most economical and effective ways of approaching this issue within the context of WSSC's strategic planning and asset management processes.

Regulatory Requirements and Operating Conditions

More stringent regulatory requirements (e.g., nutrient limits, CSO and SSO control) and various shifts in operating conditions are increasing complexity, cos, and risks in the utility operating environment and placing substantial pressure on revenue needs and revenue generating capacity.

Future Regulatory Requirements

The biggest challenge will be meeting new regulations in a cost-effective manner. While the U.S. EPA conducts some baseline cost-benefit analyses, it usually errs on the side that the benefits outweigh the cost, with the cost being borne by WSSC customers in a political environment increasingly hostile to rate increases by both its customers and the elected officials in the jurisdictions it serves. WSSC will need better integrated IT systems if the entire enterprise is going to be used effectively in meeting the complex challenges described above. WSSC is prepared for near term changes, but there are some larger, potentially expensive regulations on the horizon dealing with pharmaceuticals and new contaminants in the water. Pilot studies are ongoing, evaluating the efficacy of removing some common pharmaceutical byproducts, such as antibiotics and anti-inflammatory substances that are toxic to algae or can promote resistance to currently working antibiotics for downstream populations. Additionally, the Chesapeake Bay Program is a long-term ongoing effort that impacts WSSC, especially through the collection of associated fees through its bills.

Operating Conditions

WSSC has started laying the groundwork for addressing this issue through the development of its asset management program and the introduction of triple bottom line analysis in its business cases as a requirement before many new projects can be added to the CIP. In the infrastructure area, WSSC is currently challenged to develop an effective means of systematically prioritizing its projected capital expenditures. However, it initiated the process of acquiring a high-end, customizable asset management application, Riva. The process of building the data necessary to allow systematic prioritization is behind and may take a few years longer. This will allow their work to be better aligned with the requirements or constraints placed on Finance. If WSSC can keep its debt ratio stable, it will eventually moderate long-term rate increases as costs increase. Financial resilience then becomes more important to stabilize revenues through the rate structure, and WSSC has to make sure that it is recovering the full cost of its services, including miscellaneous fees and charges.

Stormwater and Watershed Management

Meeting permit requirements and ensuring reliable and sustainable clean and safe water increasingly requires managing a watershed and the entire water cycle in an integrated and coordinated fashion. As stormwater management expectations have increased, an effective and affordable community response depends on explicit integration of water, stormwater and wastewater needs and priorities.

Stormwater Management

WSSC is not responsible for stormwater management in its jurisdiction, but this issue will provide WSSC with an opportunity to expand its regional cooperation with its governing counties, regarding the use and effectiveness of different stormwater best management practices (BMPs) and how they could affect its infrastructure to ensure that the counties have a robust system of mitigation to protect system infrastructure. Despite all of its current efforts, WSSC will still have to try to determine how to get to a "One Water" strategy, because the counties it serves handle many stormwater issues independently, especially policies that encourage stormwater Best Management Practices on private property.

Watershed Management

WSSC is prepared to meet this challenge in watershed management. It engages in extensive activity to maintain and safeguard its water supply and watershed. What WSSC does to operate its three dams involves the following:

- Annual Regional Drought Exercise (this includes planning to release from the Jennings Randolph Dam in Bloomington)
- Maintaining the Emergency Action Plans for each dam, Federal Energy Regulatory Commission (FERC) Functional Exercises, meeting with local officials and Maryland Emergency Management Administration
- Annual Regulatory Inspections by FERC and Maryland Department of the Environment Dam Safety Office
- Coordinating with the hydroelectric owner at Brighton Dam on releases, required shutdowns
- Storm preparations
- Maintaining the SCADA data for rain gauges and stream gauges and ensuring minimum stream flow-by
- Maintaining and updating Control Center operating software
- Verifying and approving electrical supply billing
- Maintaining electrical equipment and breakers and substations, including infrascanning
- Maintaining stream gauges, including the Parshall flume, and removing impacts of beaver activity
- Maintaining the grounds around the shoulders of all three dams and the downstream face of the earthen dam

- Routine inspection of the earthen dam at Little Seneca Dam
- Operating releases from Little Seneca Dam to maintain temperatures in the stream for trout fisheries with Maryland Department of Natural Resources (DNR)
- Working with Maryland Fisheries to optimize fish restocking efforts downstream by controlling the release of water
- Maintaining fish nursery pond to maintain fish stocking as required by Maryland DNR with the dam permits and working with fish nurseries to release fish stock into reservoirs
- Responding to fish kill events
- Removing heavy debris (floating trees) from reservoir upstream if dams
- Managing and directing gate operation with rain events to maintain normal reservoir levels during flooding events (requires two to four persons for 12 to 48 hours)
- Routine raw water sampling collected by the Environmental Group and the Patuxent Water Filtration Plant Personnel
- Monitoring and testing for cyanotoxin as part of harmful algae bloom management
- Maintaining fencing and security, including reservoir buoys
- Maximizing energy savings by converting to hydro power to operate raw water pumps at T. Howard Duckett Dam
- Coordinating hydro-electric operation/generation at Brighton Dam
- Silt removal when water reservoir levels permit – an intensive effort requiring two to three persons s for two to four months at a time
- Controlling and reducing the goose population, which helps to reduce the phosphorus loading
- Controlling the deer, pigeon and beaver population
- Monitoring the reforestation efforts on the WSSC-owned watershed property, monitoring forest health, providing watershed protection efforts with different entities to offset development and WSSC facility construction

Automated and "Smart" Systems and Data Integration

There has been a substantial increase in the availability and deployment of real-time, automated systems. Utilities are increasingly integrating data across all operational and business areas. As a result, information technology has taken on a substantially increased role in operating utility systems and is driving new skills, training and information management challenges.

Smart Technology

As WSSC implements and plans new systems, it must prepare for the myriad ways in which those technologies can be levered for its benefit. That includes field-based technologies that update real-time

to primary applications and can notify the right department when a new or emergency issue arises. Smart metering may allow WSSC to reduce its non-revenue water (water loss) and give customers a real-time view of their consumption patterns.

Smart Metering to Drive Customer Service

WSSC has concrete plans to address this issue, although some automated meter reading/automated meter infrastructure (AMR/AMI) technology issues may have to be addressed vis-à-vis its customer service information system. Additionally, the implementation of AMR/AMI with the eventual implementation of a new customer service information system (CSIS) provides the opportunity for WSSC to reduce the number of billing issues. It also provides the promise of allowing customers to better monitor and adjust their water consumption, as well as help them identify potential leakage problems before they get a big bill. If a customer can see how much water they are using before the bill comes, it can help them identify problems before they get out of control. It also has the potential of allowing customer to establish customized settings that alert them to varying levels of usage, similar to what banks do with their account balance or transaction alerts.

Data Integration and Maximizing Data Use

WSSC is not quite ready in this area. Other than rates, this will be one of the most complex issues for WSSC. While it is implementing a future CSIS, AMR and other system mapping/integration efforts, WSSC definitely has to find a way to manage all of these systems and leverage them to produce information that will help the utility run more effectively and/or more efficiently, as well as enhance the customer service experience. That requires a sustained effort over a long period, as well as the requirements of managing that change in terms of revising job classifications based on technology improvements, expanded deployment of connected or smart devices in the field, additional training needs and the cybersecurity risks associated with a high level of integration.

WSSC has many issues to address here, but on a more basic level, the agency will have to ensure that its systems support its performance management system to help drive improvements in the enterprise. This means that it needs better data definitions for the measures it tracks that all users can reference, identifying KPIs critical to each department or service, and measuring performance, as well as someone who helps manage and monitor the process for producing KPIs. This also includes identifying which data systems house which information for integrating the process.

BEST PRACTICES EVALUATION

Customer Service

CUSTOMER SERVICE

Background and Context

The Customer Service Group is the interface between the utility and its customers. Its primary responsibilities include the customer and emergency call centers as well as administering revenues through billing and collections.

Historic poor performance has plagued Customer Service and most recently resulted in implementation of a series of Strategic Initiatives outlined in the "Kramer Study" published in 2014. WSSC is now 19 months into implementation of these Strategic Initiatives and Customer Service management is well informed and generally pleased with progress made to date. The primary focus of this study is to evaluate how effectively various parts of the Customer Service Group are now operating against best practices in light of this progress, as well as to identify additional recommendations for improvement.

Best Practices Evaluation

Business practices currently implemented within the Customer Services Group were assessed through a series of document reviews, data evaluation and staff interviews conducted in January through March 2016. The evaluation that follows is based on seven Veolia Best Practice standards, each with specific subcategories to determine overall performance, and it uses a standardized scoring system from 1 (basic performance) to 5 (industry best). Criteria used in this scoring system, as well as the score assigned, are indicated below.

To assist in identifying which standards have the largest opportunity for improvement, a second score was identified as a near-term improvement goal. This score is determined to be where WSSC could be in less than 24 months with some additional focus and effort, given the current landscape. The difference between actual performance and the near-term performance goal forms the basis of a gap analysis that is then used to prioritize areas that have potential for additional improvement. Any arithmetic difference of 2.0 or greater between actual performance and the near-term performance goal was considered significant, and any difference in scores between 1.5 and 1.9 was considered potentially significant. Figure C.1 summarizes the evaluation and Table C.1 summarizes the results from the assessment analysis.

As a general guidance note, scores normally achieved for a large utility such as WSSC would range from 3 to 5.

Figure C.1 WSSC Best Practices Evaluation Summary

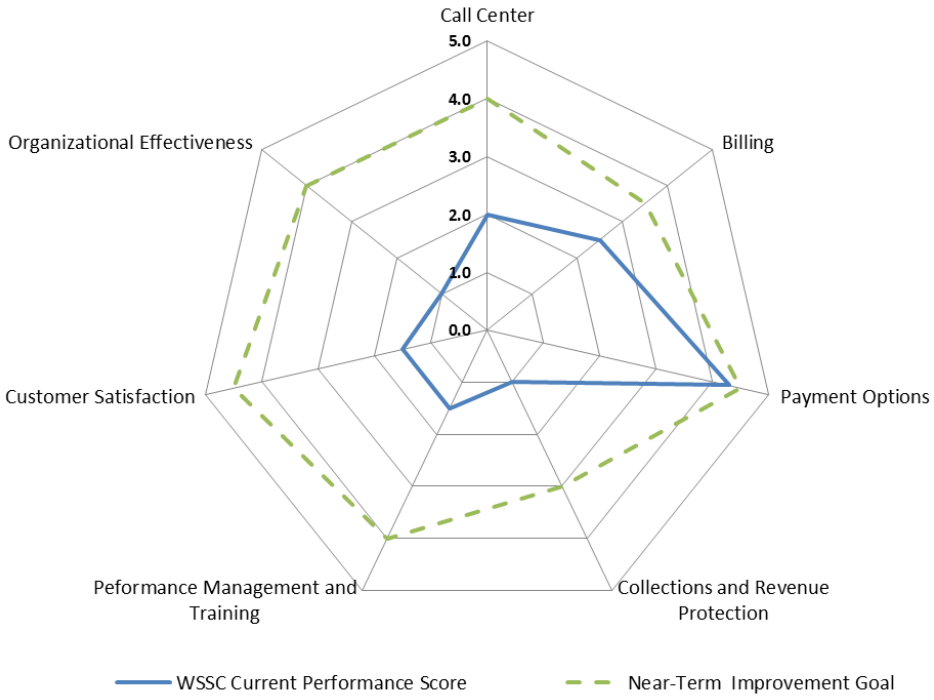


Table C.1. Assessment Analysis Summary

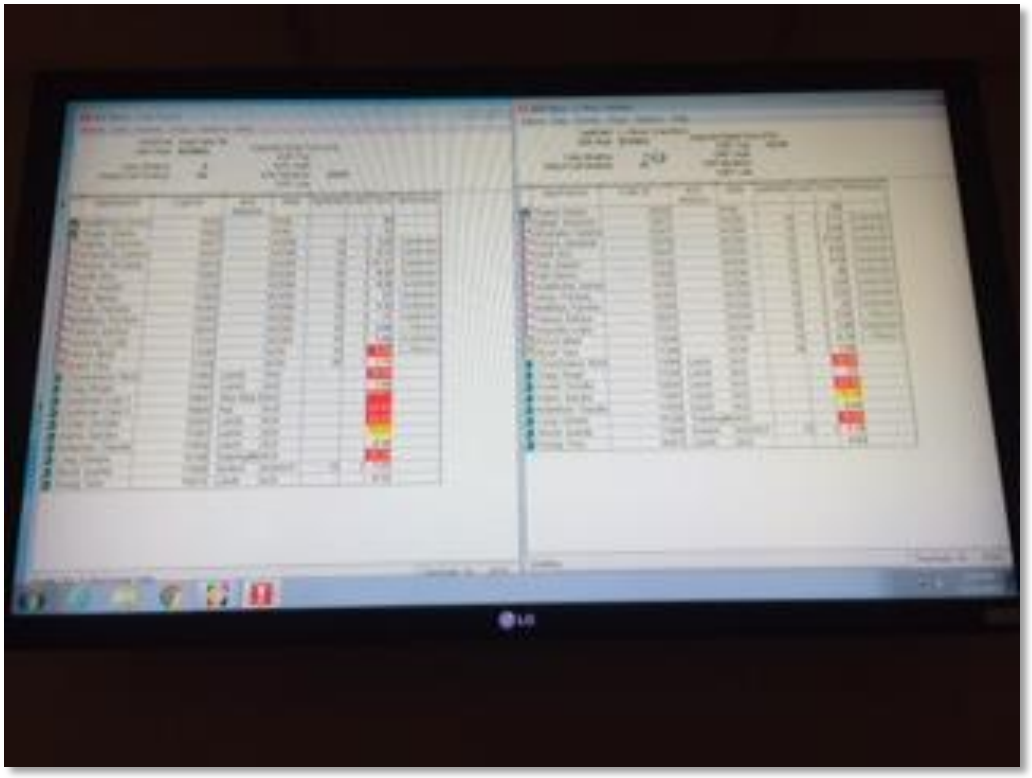
Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
Call Center	2.0	4.0	2.0	Yes
Billing	2.5	3.5	1.0	No
Payment Options	4.3	4.5	0.2	No
Collections and Revenue Protection	1.0	3.0	2.0	Yes
Peformance Management and Training	1.5	4.0	2.5	Yes
Customer Satisfaction	1.5	4.5	3.0	Yes
Organizational Effectiveness	1.0	4.0	3.0	Yes

Call Center

WSSC operates a call center for customer service with operating hours from 7:30 AM until 7:00 PM, Monday through Friday and is located at the WSSC headquarters building. The call center utilizes AVAYA telephony call management system (CMS), and has monitors posted prominently in multiple locations

throughout the call center displaying real-time information on the status of customer call queues, as is shown in Figure C.2 below.

Figure C.2 Real-Time Display of Customer Call Queues



The call center has a sophisticated voice recognition interactive voice response (IVR) system that offers a menu of customer options, including the ability to ask questions, access self-service or reach a customer service representative (CSR). Interestingly, the main menu does not offer the option to report an emergency as an explicit option. WSSC does publicize on bills and its website a separate phone number and email address for reporting an emergency. Test calls to the IVR indicated that the IVR had difficulty recognizing customer voice responses at times and may require additional IVR tuning. The result is more customers need to speak to a live agent than necessary, rather than availing themselves to self-serve options.

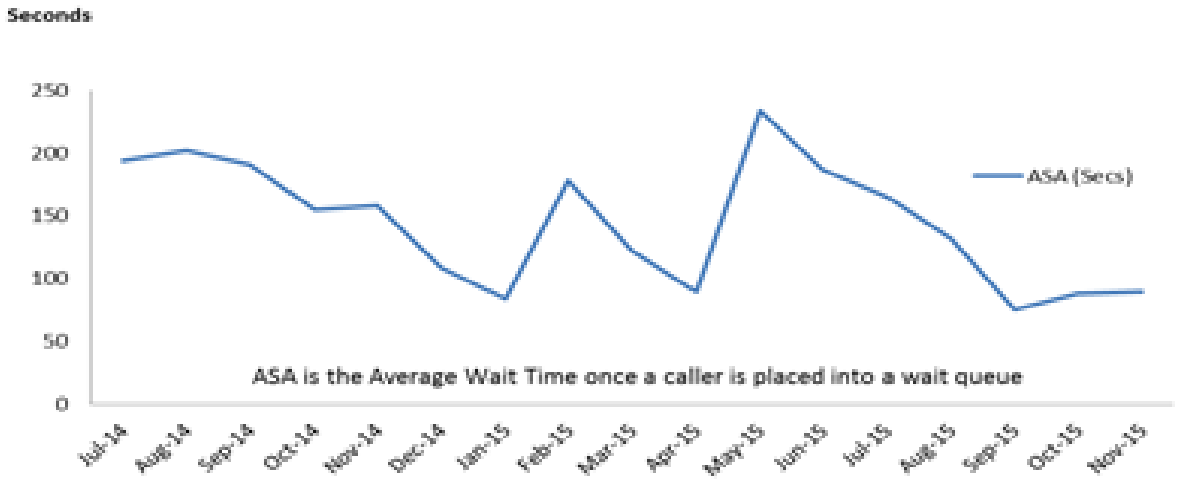
WSSC utilizes Avaya elite multichannel (EMC) to route customer emails to available agents between calls.

Contract Call Center

WSSC has struggled to achieve its targeted KPI of answering 95% of all calls. In 2014, as a result of the "Kramer Study", WSSC launched a strategic initiative called "call augmentation", which essentially added contractor CSRs from L J Ross Associates (LJ Ross), a Michigan vendor, to increase WSSC's call taking capacity. For FY2014, WSSC's answer rate was 84%. The additional call taking capacity from the contract CSRs had improved the WSSC answer rate, but the targeted levels had not yet been attained. In November 2014, WSSC expanded the scope of LJ Ross to add additional call-taking capacity and to have them handle additional types of customer calls. Currently, the call center switch is programmed to

send 50% of the calls to the contract call center. Average speed of answer has been erratic since July 2014, but recent trends indicate it is improving, as indicated in Figure C.3 below.

Figure C.3 Customer Wait Times



The LJ Ross contract states that vendor CSRs are to handle all call types except move-in or move-out calls since WSSC prefers to handle all transfer-of- service type calls themselves due to the complex nature of these calls. Calls received by contract CSRs determined to be too complex are transferred back to the WSSC call center with a priority status. WSSC generally staffs a special call queue for calls transferred back from LJ Ross. The number of calls transferred back to WSSC are tracked and deducted for payment calculation to the vendor per contract terms. The volume of transferred calls is significant, and even after recent improvements, 8% of non-emergency calls are being transferred back to WSSC for handling. See Figure C.4.

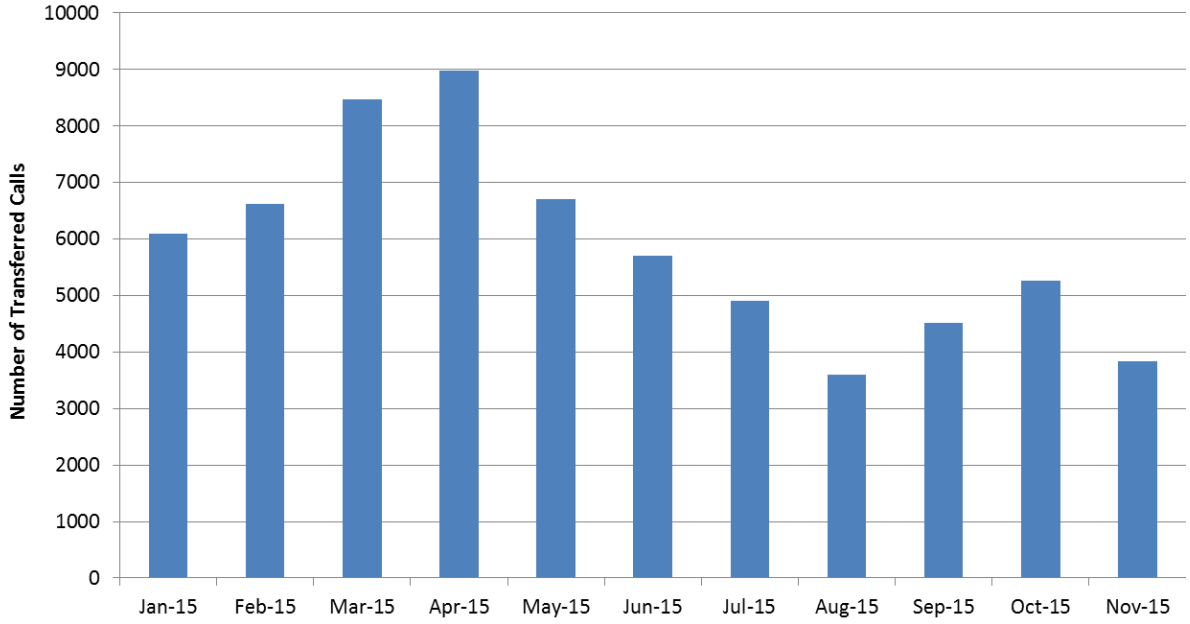
The contract generally calls for the contract call center to perform at the same KPI level as WSSC call centers. WSSC is responsible for training and monitoring the quality of the contract CSRs. WSSC conducts weekly conference calls with the LJ Ross call center management team. Based on November 2015 results, both the WSSC and contract call centers are answering about 94% of all calls offered.

Call Center Staffing Levels

As of December 2015, staffing levels were 33 WSSC CSRs (64.7%) and 18 LJ Ross CSRs (35.3%). It was indicated that the newest WSSC CSR has been on the job for about 3.5 years, indicating that any current attrition or turnover is managed by adding LJ Ross CSRs.

It is interesting to note that since January 2015, LJ Ross CSRs are, on average, handling 60.2% of the non-emergency calls even though they represent just 35% of the WSSC CSR capacity. Analysis of November 2015 data indicates that WSSC CSRs answer about 33 calls per day while LJ Ross CSRs handle about 89 calls per day. It should be noted, however, that this analysis does not account for the fact that some WSSC CSRs are out on FMLA as was reported by the management team or that WSSC CSRs are needed to staff the transfer queues from LJ Ross.

Figure C.4 Calls Transferred Back to WSSC (CY15)



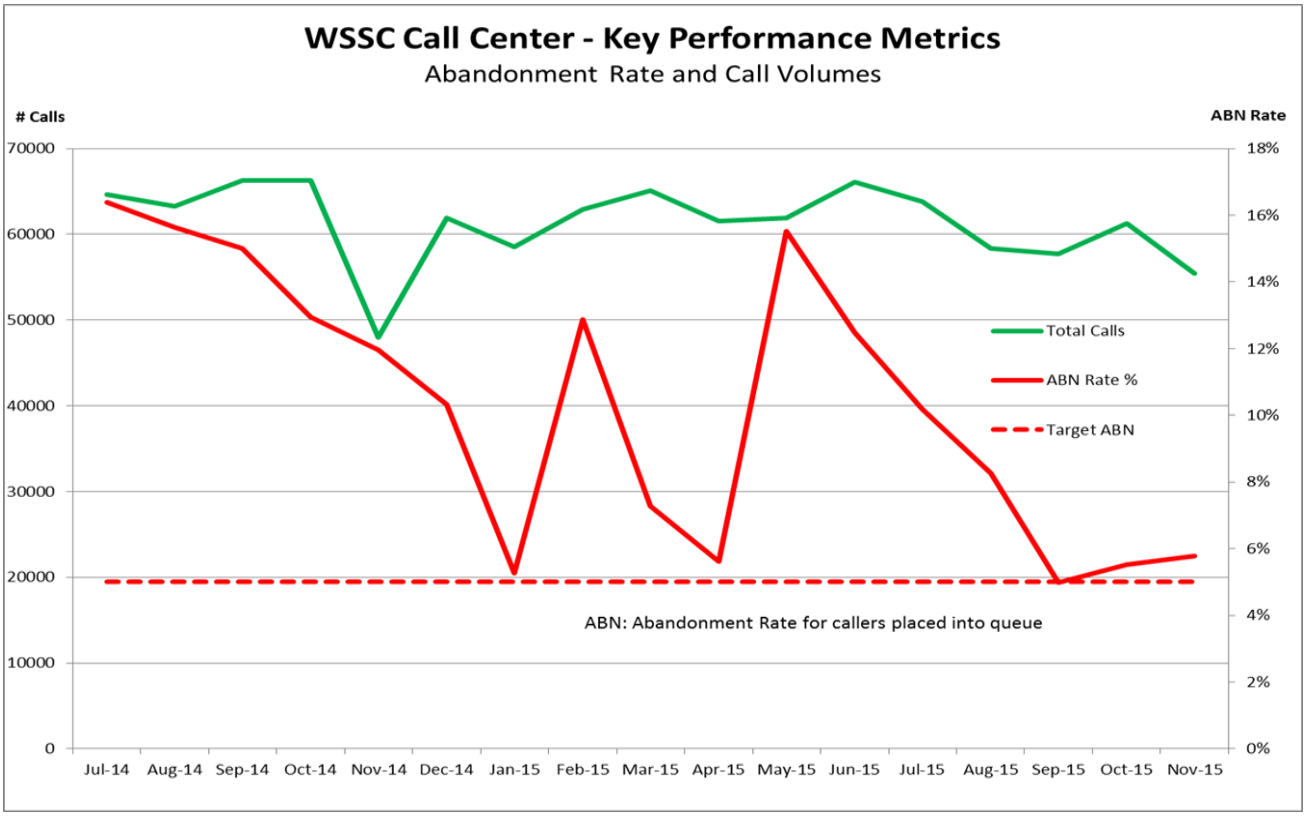
WSSC receives on average about 49,000 calls per month, as indicated in Figure C.5. This volume equates to about 1.3 calls per customer per year and is significantly higher than the water utility benchmark of 1.0 call per customer per year. Some of this disparity is due to repeat callers when abandonment rates were higher earlier in the year and prior to adding a second wave of LJ Ross CSRs. Attempts to analyze the call mix of reasons for customer calls were inconclusive based on insufficient data. Best practice utilities monitor this analysis monthly as it reveals a potential process breakdown or a business practice unique to the utility that warrants additional investigation.

It was reported by staff during interviews that WSSC CSRs are often pulled from their call taking responsibilities to handle “non-call center” tasks that are also the responsibility of the call center for completion. A list of these tasks was requested but the list was not provided and therefore not evaluated. During the interviews the only direct references to non-call center tasks mentioned were internal emails requesting additional information or investigation from CSRs, requests for CSRs to make outbound calls to customers, handling generic (not customer service related) correspondence and the need for CSRs to get off the phones to investigate progress on issue resolution from repeat callers.

Best practice would be to have specific small teams available to handle issue resolution and escalated calls which then allow CSRs to focus on inbound customer calls. Non-customer service related correspondence should be direct to the appropriate department during mail sorting before it gets to customer service.

This phenomenon generally occurs when there is an organizational gap or process breakdown elsewhere in the organization. Time did not permit an exhaustive investigation of this issue, but it is clear that this practice detracts from the ultimate call center goal of achieving their service level target.

Figure C.5 Customer Call Volume



Emergency Call Center (ECC)

WSSC has a separate ECC to handle emergency calls. Although this work team reports to the Chief of Customer Relations, the manager of the team is also responsible for handling claims filed against WSSC. It appears that this relationship evolved over time, not by deliberate decision since the two job functions are quite different, i.e., one focused on emergency response and the other focused on damage settlements with customers and other outside entities.

WSSC tracks ECC call-taking performance the same as its non-emergency call center and usually combines the ECC results into its overall performance reports. Viewing the ECC statistics individually reveals that over the past 18 months 14.2% of WSSC calls offered are emergency calls and WSSC averages 8,716 emergency calls per month. Even accounting for winter main breaks and recognizing that the ECC operates a 24/7/365 schedule, this amount of emergency calls represents over 20% of the WSSC customer base calculated over a year.

The abandoned call rate for emergency calls during the second half of 2015 averaged about 6%. Even with a reported average speed of answer (ASA) time of about 45 seconds, this rate indicates that over 6,000 emergency calls were not answered over the past year.

It should be noted that the ECC has a separate phone number from the main contact center and a separate IVR.

Strengths

Good telephony, call center management software and IVR technology deployed. Successfully integrated call augmentation strategy.

Areas of Potential Improvement

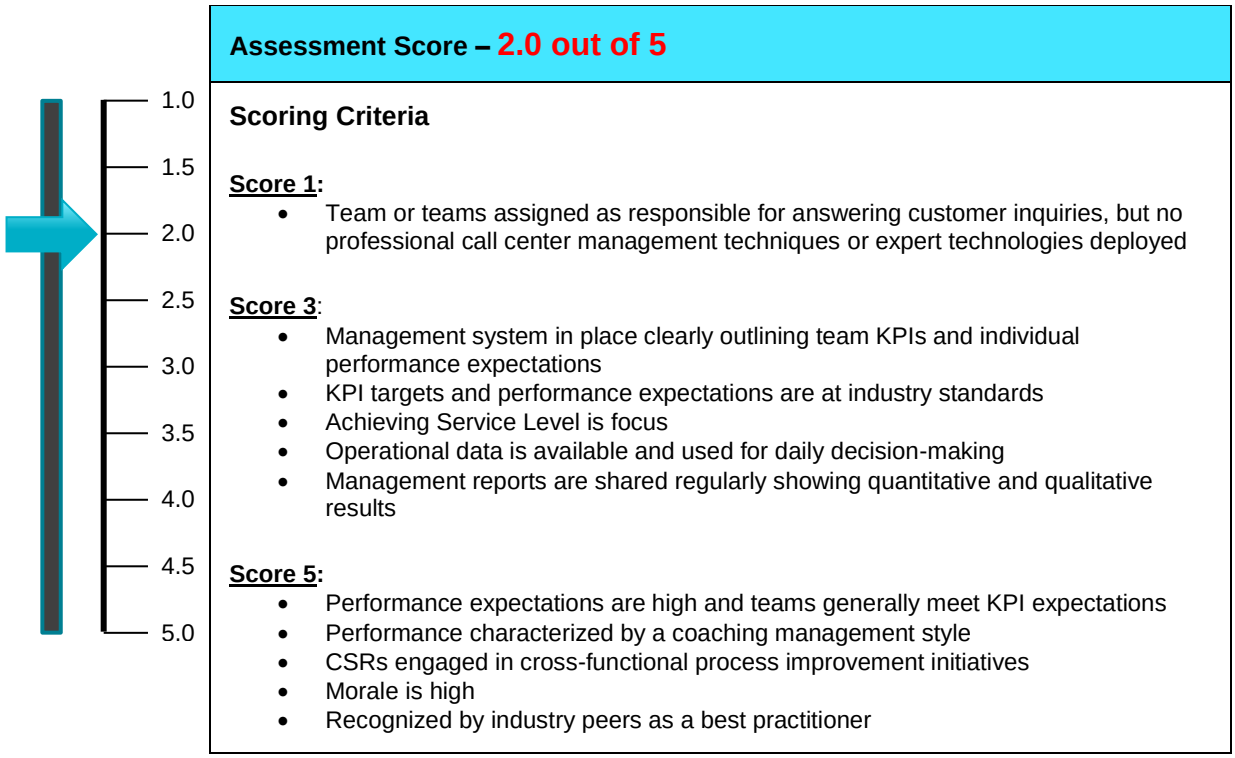
Not focused on a Service Level target. CSR resources are not optimized. Operational data is not optimized. High transfers of customer calls between call centers. Consider using ECC as overflow.

Recommendations

The following recommendations are offered to assist in improving the call center:

- Consider focusing call center management on Service Level as the primary KPI and rationalize the desired Service Level target for WSSC.
- Consider separate reporting of ECC performance metrics and explore whether additional KPIs are needed or whether more stringent targets are required for ECC.
- Consider cross-training all contract CSRs to allow them to handle all calls, including move-in/move-out calls to reduce customer call transfers and eliminate staffing of a special transfer queue. Once completed, consider changing the 50-50 call routing scheme to funnel calls to the next available agent.
- Consider removing claims from Customer Relations and rationalize the organizational alignment of the ECC.
- Consider modifying the call center IVR to include the option of reporting an emergency as a first option. Once completed, further consider using just one phone number for customers, as emergency calls will be routed to the ECC directly from the IVR.
- Consider another utterance tuning update for voice-recognition IVR.

Figure C.6 Call Center Best Practices Assessment Score



Billing

Understated but true, the single critical path process to ensure adequate cash flow for utility operations is customer billing. It was reported that the primary responsibility for WSSC customer billing rested with the IT department. It was explained that meter reading uploads meter reads and IT kicks off the billing process and ensures completion of nightly billing. There is a Customer Relations team called Special Billing that handles many, but not all, of the duties usually found in a utility billing group, but KPIs such as billing accuracy, timeliness and completeness do not exist at this level. This is a significant gap from best practices. Most utilities have a billing team in customer service (or finance) responsible for achieving KPI targets for timely, accurate and complete customer billing, with the support of IT resources as needed.

Special Billing Team

The Special Billing team manages billing exceptions that are identified through the use of predetermined edit checks, including high/low billing, no bills, zero consumption bills and credit bills. These exceptions are investigated as part of a pre-billing audit similar to most utilities. Commercial bills over $5,000 are also reviewed by Special Billing prior to releasing the bills to customers. Service orders are generated by Special Billing for any billing exception requiring field investigation. Without adequate billing data, WSSC will issue estimated bills. It was reported that Special Billing must spend time manually following up on service orders where they have not received a timely response from the field.

It was indicated that the estimated billing rate for WSSC billing was relatively low – around 1% – but there did not appear to be a high-level KPI target. Best practice is to have estimated billing rates below 2%. At most utilities of WSSC's size, a billing manager is ultimately responsible for timely and accurate billing.

The billing team kicks off the nightly billing batches with IT supporting if problems should develop. At WSSC, the special billing team is not involved until after billing has been completed by IT. At WSSC, it should also be noted that with quarterly billing, slower turnaround time from field service orders can be tolerated without adversely affecting the estimate rate. Moving to bi-monthly or monthly billing, these processes need to be tightened up or the estimate rate will go up if billing is to remain at timeliness targets.

WSSC has "around 20" customized billing arrangements for certain large commercial customers that are manually calculated and issued by the Special Billing team. These customer bills require specialized knowledge due to site-specific rates, meter and interconnect configurations and generally are for WSSC's largest customers. Many of the calculations are performed manually by using off-line spreadsheets and templates.

The Special Billing team is responsible for customer refunds, the process of which was reported to require up to about 20% of their time each week.

The Special Billing group is also responsible for processing adjustments and corrections to customer accounts. Some adjustments are generated internally, but many also come from the call center. Special Billing adjustments are generally for leaks, previously estimated bills or incorrect billing. Again, the dependence on timely field investigation results to complete this task should be noted.

WSSC has created a series of queries or CIS data requests that the Special Billing team runs on a routine basis to guide some of their daily activities. The management team indicated that some information is difficult to get if data is in disparate systems, such as service order status or meter exchange data, and they needed to engage in time-consuming workarounds to ensure issue resolution. Lack of good communication of meter exchange data was noted as a particular issue.

Lack of documentation of processes and procedures plus a reliance on institutional knowledge in a small, specialized Special Billing group creates some risk to WSSC due to possible attrition and staff turnover. It was indicated that the learning curve was steep for new members joining this team. It was evident that this team could benefit from additional automation and recruiting higher level technical skill sets. Billing issues for large commercial and industrial accounts are "normally routed" to the specific area managers for resolution.

Although there exists a lack of regular performance reporting, it appears that WSSC has no significant billing issues; however, WSSC and the Special Billing team would benefit greatly if they collected specific data needed to implement and monitor a system of KPIs and other billing performance metrics to provide focus for the staff and a system to identify problems quickly should they occur moving forward. Note that because this tracking data is not used now, there also is no evidence that there aren't current billing issues beneath the surface.

Bill Printing and Mailing

WSSC produces customer bills in-house and mails their bills from the company headquarters. Most utilities have moved away from operating a printing business, since it did not represent a core competency and vendor experts in this business line represented an opportunity for utilities to get a higher quality product with flexibility of design at a reduced cost.

The billing files are generated from WSSC's CSIS, with formatting of billing statements hard-coded internally. Any changes require additional coding from WSSC IT or their IT vendors. Utility bill print

vendors have resident specialists in utility billing design, and the competition for business has driven costs down. These specialized bill print vendors offer not only billing design services but customized contingent customer messaging capabilities to alert customers to high bills or for local company news at low cost. Best practice utilities switched to outsourcing customer bill print and mailing two decades ago.

For customers who continue to receive paper bills, these vendors ensure the lowest postage costs by efficient batching of outgoing mail. Noting the increased adoption of electronic bill presentment and payment (EBPP), many of these vendors offer EBPP services as well as traditional paper billing. As technology changes, the vendor assumes the risk of owning or contracting printing equipment and provides redundancy options as part of their service-level agreement with the utility.

One of the biggest benefits for utilities that use these specialized bill print vendors is the software they offer for the billing teams managing pre-bill audits and billing exceptions. Properly configured, the vendor software uses portals that offer electronic queueing of billing work, eliminating the need for staff to remember to run manual queries.

Customization of ad hoc bill messaging through bill print vendor portals is an additional benefit in that it is controlled by utility staff and quickly implemented.

Strengths

Good institutional knowledge.

Areas of Potential Improvement

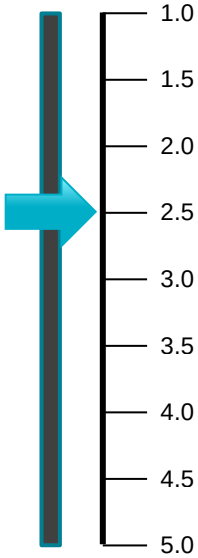
No KPI focus or accountability. Overly reliant on manual processes and manual control points. Processes and procedures are not documented. Outdated practice of printing bills internally.

Recommendations

The following recommendations are offered to assist in improving the billing:

- Consider instituting industry-standard billing KPIs.
- Consider further automation of action reports for identifying billing and meter reading anomalies.
- Consider using a professional utility bill print vendor service to gain operational efficiencies.
- Consider reengineering the customer refund process.

Figure C.7 Billing Benchmark Score



Assessment Score – 2.5 out of 5

Scoring Criteria

Score 1:

- Most customers are billed but no formal accountability or management system in place
- High level of customer billing complaints, which are resolved by settling in the customer's favor

Score 3:

- Formal accountability for customer billing exists with only a minimum number of manual processes or workarounds in use
- Formal KPIs exist for accuracy and timeliness and are targeted at industry standards
- Management accountability is clearly identified
- Daily work processes are monitored and performance metrics are reported to upper management
- Effective partnership exists with meter and field service staff
- Estimated customer bills are unusual
- Normal level of billing complaints

Score 5:

- Performance expectations are high and teams generally meet KPI expectations
- Estimated customer bills are rare
- Bill designs are easy to understand, use of dynamic customer messaging and promote branding strategy
- Robust e-billing with high adoption rates
- Shared performance metrics with meter and field management
- Electronic work queues in place
- Performance consistently meets or exceeds industry benchmarks
- Morale is high
- Recognized by industry peers as a best practitioner

Payment Options

WSSC offers multiple payment options for customers, including walk-in, mail, internet and phone options. WSSC has done a good job negotiating relatively low customer payment convenience fees with their vendors. Three payment options are offered where WSSC is ahead of most water utilities. First, the use of payment kiosks is only recently gaining the attention of water and wastewater utilities and WSSC is an early adopter, with kiosks already deployed as indicated in Figure C.8. Second, the app created at WSSC that allows mobile payments puts the utility ahead of most of its peers. Mobile payment options have been discussed by utilities for several years but it is already deployed successfully at WSSC. Third, WSSC also uses walk-in payment partners that have locations more convenient for customers than the WSSC headquarters building. The effort with walk-in payment partners should be expanded.

Figure C.8 Payment Kiosks Deployed

More strategic deployments have been implemented at cost-conscious utilities, such as using kiosks to reduce staff at walk-in locations and eliminating acceptance of cash to reduce additional cost, risk and accounting controls surrounding cash handling. Ranking payment options by cost to the utility shows that the least-cost option for the utility is a direct debit payment matched with an electronic bill. Many utilities develop processes to drive customers to this least-cost option. At WSSC, customers enrolling in EBPP are encouraged to discontinue their direct debit if they've previously chosen that option.

Electronic Bill Presentment and Payment (EBPP)

WSSC offers customers an option to receive and pay their utility bills electronically. The WSSC EBPP service offering combined with the WSSC app is professionally done and an upper-tier service compared with other utilities. EBPP offers utilities the opportunity to reduce billing costs (paper and postage) and to reduce their carbon footprint. It offers customers convenience.

WSSC reported that 24.4% of their customers have adopted EBPP. This too is upper-tier performance on adoption rate compared with other utilities. Research has shown that this service offering is favored by younger, more-educated and more-affluent consumers, so this relatively high rate of adoption at WSSC should not be surprising, based on WSSC service territory demographics. WSSC could increase the

adoption rate further with more aggressive marketing of this service and changing the marketing strategy away from a "green" focus that does not resonate with customers. Aside from recurring cost savings, WSSC could benefit from an image boost as a market leader and a responsible environmental steward.

Strengths

Complete array of modern customer payment options.

Areas of Potential Improvement

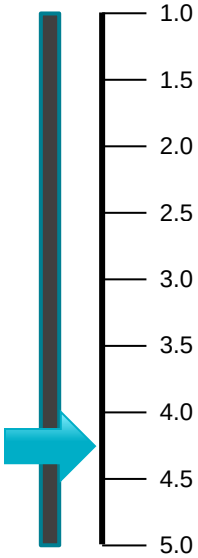
None

Recommendations

The following recommendations are offered to assist in improving payment options:

- Consider expansion of remote walk-in payment partners and payment kiosk strategy to reduce or eliminate the need to accept cash payments and related costs.
- Consider changing and expanding the marketing strategy for customer electronic billing and payment option.

Figure C.9 Payment Options Benchmark Score



Assessment Score – 4.3 out of 5

Scoring Criteria

Score 1:
- Requires customers to pay in-person or by mail

Score 3:
- Has made it easy for customers to pay by maintaining multiple payment options including choices for in-person, mail, pay-by-phone, direct-debit and e-payment
- Accepts credit/debit card payments
- Some utilization of remote-location payment partners

Score 5:
- Early adopter of innovative payment methods and cutting-edge technology
- Utilizes all e-payment channels
- High customer adoption rates of self-service payment options
- Routinely and deliberately steers customers to the most cost-effective payment channels
- Maximizes services of payment partners
- Recognized by industry peers as a best practitioner

Collections and Revenue Protection

Surprisingly, WSSC does not have a revenue protection unit in the Customer Relations department. Most commonly referred to as "credit and collections", a revenue protection unit controls management of

customer accounts receivable. It was indicated that this organizational gap was also raised in the 2014 "Kramer Study".

Utility collection units are charged with developing strategies to reduce delinquent accounts receivables and to reduce bad debt expense. While one area focuses on optimizing cash flow and the other on reducing expense, both areas are tracked as KPIs at best practice utilities within their customer service function.

Effective collection strategies start with the delinquency rules programmed into the utility CIS system. At WSSC it is clear that delinquency rules are in place in the CIS. These rules control conditions when late notices, late fees and service interruption service orders are sent to the field.

Currently at WSSC, based on interviews with the field service staff, collection service orders are "throttled" manually to the various County zones at a rate of 100 service orders per zone, or 200 per County each day, due to the volume exceeding "bodies" to work them. It was indicated that the collection service orders are viewed as "optional" or "filler" work for the WSSC field force. At times, WSSC will dedicate resources to collection service orders, but it is left to the discretion to the zone management. At the interview time, it was indicated that there was a backlog of 4,569 collection shut-off service orders.

Maintaining a consistent collection strategy has been demonstrated to be most effective at utilities to affect customer behavior patterns. Sending shut-off notices that the utility does not act on is perceived by customers as an idle threat and drives customers to wait until their service is shut-off before paying their bills.

The backlog numbers at WSSC represent about an 11-day backlog for collection service orders, assuming that the collection work assigned in the field is completed each day. More collection service orders are created daily, depending on the delinquency rules in the CIS. But by itself it is not indicative of a collection problem at WSSC.

The WSSC practice of "throttling" collection service orders is also not uncommon where the workload exceeds field capacity. What is uncommon is that the decision-making for field collection activity has been pushed to field service management staff who themselves have many other competing priorities and duties. Best practice utilities have a collections leader within customer service who can manage field capacity and balance it with increased call volume to the call center, mindful of the ultimate goal of reducing delinquent accounts receivables. Located within customer service, these managers are aware of the Service Level commitments of the call center staff responding to the majority of callers who are good-pay customers.

The revenue protection units at other utilities have other duties as well. They need to manage bankruptcy filings that require special treatment of customer accounts within the CIS. These groups are also focused on usage registered on inactive accounts, deposit policies and administration, collection of large commercial delinquent accounts, special rules and techniques for landlord-tenant delinquencies, lien placements if allowed, and managing adherence to payment arrangements promised by customers.

At WSSC these functions are spread out among various teams having other priorities and that lack the focus a revenue protection unit would bring.

Strengths

None

Areas of Potential Improvement

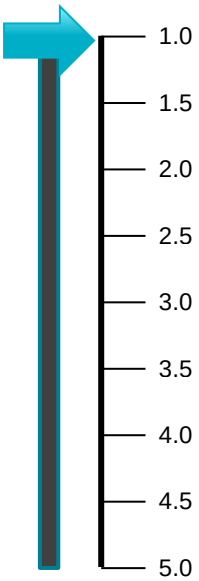
No formal accountability, KPIs or clear collection strategy. Policies and procedures are not strictly enforced. Non-Customer Service staff making field decisions for the field meter teams.

Recommendations

The following recommendations are offered to assist in improving collections and revenue protection:

- Consider instituting industry-standard KPIs.
- Consider a comprehensive review of credit and collection policies and procedures and benchmark to peer utilities.
- Consider having a dedicated field meter team that reports to Customer Service, rather than Field such as meter reading, shut-offs, turn-ons, collections, etc.

Figure C.10 Collections and Revenue Protection Benchmark Score



Assessment Score – 1.0 out of 5

Scoring Criteria

Score 1:
- Relies almost exclusively on delinquency rules programmed into the CIS
- Late notices are generated but not always followed up with service interruption for continued non-payment

Score 3:
- Formal KPIs exist for delinquency and bad debt expense and are targeted at industry standards
- Management accountability is clearly identified, collection policies are documented and call center staff is trained in enforcement
- Daily work processes are monitored and performance metrics are reported to upper management
- Collection service orders are generally completed on time with effective field staff partnerships

Score 5:
- Collection results routinely meet or exceed KPI expectations
- Large delinquencies are proactively managed
- Senior management is made aware of any large commercial customer or politically sensitive collection issues
- Close coordination and shared performance metrics with field service management
- Innovative collection vendor use for final bill collection or field collection support
- Normal collection-related call volume with lower level of complaints
- Performance consistently meets or exceeds industry benchmarks
- Recognized by industry peers as a best practitioner.

Performance Management and Training

Customer Service Representatives (CSRs) receive a monthly scorecard of their performance. CSRs receive feedback on their calls handled per hour and average handle times. In discussions with the management team, it is planned to add a quality score to the CSR scorecard. WSSC is creating a call-quality monitoring team as part of implementing a strategic initiative from the "Kramer Study". The call-quality monitoring team will also be tasked with training responsibilities for CSRs. This initiative is ongoing and is planned to be completed in the next six months. WSSC does have a professionally designed call-quality scorecard that is in use by CSR supervisors, but the volume of scored calls is lower than WSSC desires. The addition of the call-quality monitoring team should increase the number of scored calls to present a more statistically valid quality measure.

Analysis of productivity data for CSRs at WSSC, including vendor CSRs, indicates that CSRs answer about six calls an hour. Discussion with WSSC management indicates that this level of productivity is in line with their expected level; however, it is a much lower level of productivity than at other utilities where CSR are expected to answer 10-12 calls per hour. The average handle time (AHT) for customer calls at WSSC is about six minutes. At most utilities, AHT is about 4.5 minutes. The data suggests that CSR productivity at WSSC is very low, as demonstrated in Figures C.11 and C.12. This is likely due to multiple root causes including, but not limited to: call center strategy, organizational overlap, unrealistic management expectations, poor performance management, breakdowns in business processes, and inadequate training.

Figure C.11 Call Handling Performance versus Best Practice

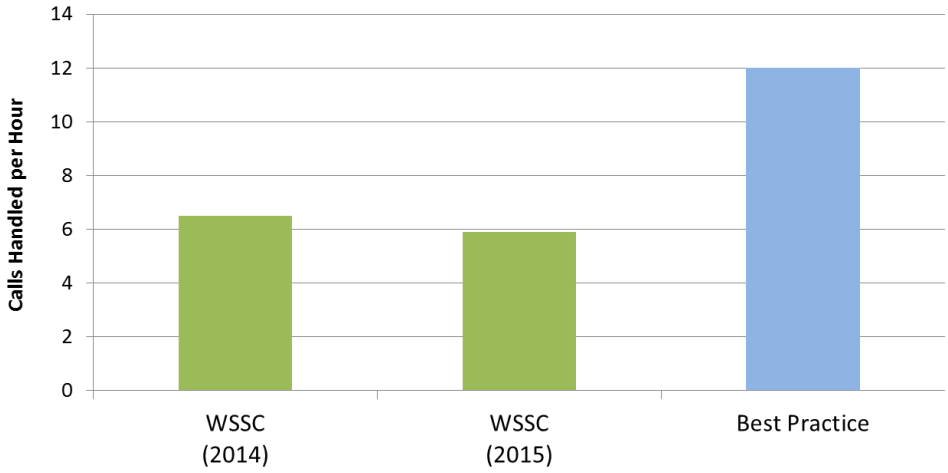


Figure C.12 Call Handling Time versus Best Practice

Strengths

None

Areas of Potential Improvement

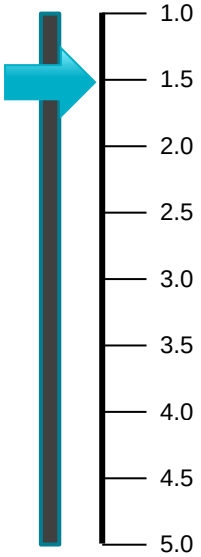
Performance expectations are low and CSR productivity is low as well. Performance management and coaching are not high priorities. There is too much upward delegation of work. Quality monitoring volume is too low to be effective.

Recommendations

The following recommendations are offered to assist in improving performance management and training:

- Consider raising call-per hour-performance expectations for all CSRs to increase productivity in call center.
- Consider investigating potential training or other options to reduce AHT of CSRs.
- Consider formalizing a monthly CSR performance management system and fairly, but strictly adhering to the performance expectations.
- Consider expanding the call-quality monitoring program to significantly increase the number of calls scored per CSR each month.
- Develop formal individual development plans that identify core competencies and the required training to achieve those core competencies.

Figure C.13 Performance Management & Training Benchmarking Score



Assessment Score – 1.5 out of 5

Scoring Criteria

Score 1:

- Performance evaluation is subjective and expectations are not clear
- Little formalized training and usually only for new hires

Score 3:

- Performance expectations are clear and aligned with industry standards
- Performance management is consistently applied and performed at regular intervals
- Performance evaluations are based on objective business metrics whenever possible
- Training is a mix of formal classroom and on-the-job training and tailored to job function
- Disciplinary action policy in place for consistently demonstrated poor performance

Score 5:

- Regular performance evaluation and coaching exists
- Positive reinforcement and praise/reward system is in place
- Performance appraisals include quantitative, qualitative and professional behavior elements, as well as formal individual development plans
- Characterized by no surprises, low turnover and high morale
- Team results are celebrated
- Training is formalized with new employee checklists and trainer sign-offs
- Recognized by peers as best in class
- Innovative use of technology is used to develop training modules; refresher training is scheduled and administered; information from quality monitoring, complaint analysis and employee feedback is looped back into future training materials

Customer Satisfaction

The customer satisfaction (CSAT) survey at WSSC has been traditionally conducted every two years and is a census survey. The design of the survey questionnaire represents a traditional utility survey focused on monitoring the utility's image and effectiveness of customer communications. It is not designed as a typical utility CSAT survey.

Many utilities perform multiple customer surveys tailored for specific reasons. A traditional customer satisfaction survey is administered quarterly, semi-annually or annually and specifically asks questions about product quality, reliability, value, and customer service. A census survey such as WSSC's by design interviews many customers who have had little to no interaction with the utility, so the results are usually based on image perception. A transactional survey only surveys customers who have had recent contact with the utility. At a utility such as WSSC, a transactional survey is more effective for tracking performance and effectiveness of change initiatives in the customer service arena.

Part of the strategic plan outlined and adopted by WSSC as a result of the "Kramer Study" included a post-call transactional survey. WSSC implemented a three question post-call survey in January 2016 that

requires customers to opt-in and answer high-level questions after their call to the call center is completed. It is a relatively inexpensive method and allows WSSC to collect some basic scores and answer affirmatively to whether they survey their customers. But this unsophisticated type of survey does not produce actionable intelligence.

Best practice utilities use quarterly, telephonic, transactional surveys administered by a third-party vendor. Although more expensive, these surveys drill down on call center, billing and field service activity while also measuring high- level utility attributes, such as overall satisfaction, price perception, product quality and value. The vendors will provide impact analysis, and results can be broken down by region if desired to compare customer perceptions in different locations. Management at best practice utilities reviews these survey results thoroughly to identify performance improvement opportunities.

Strengths

None

Areas of Potential Improvement

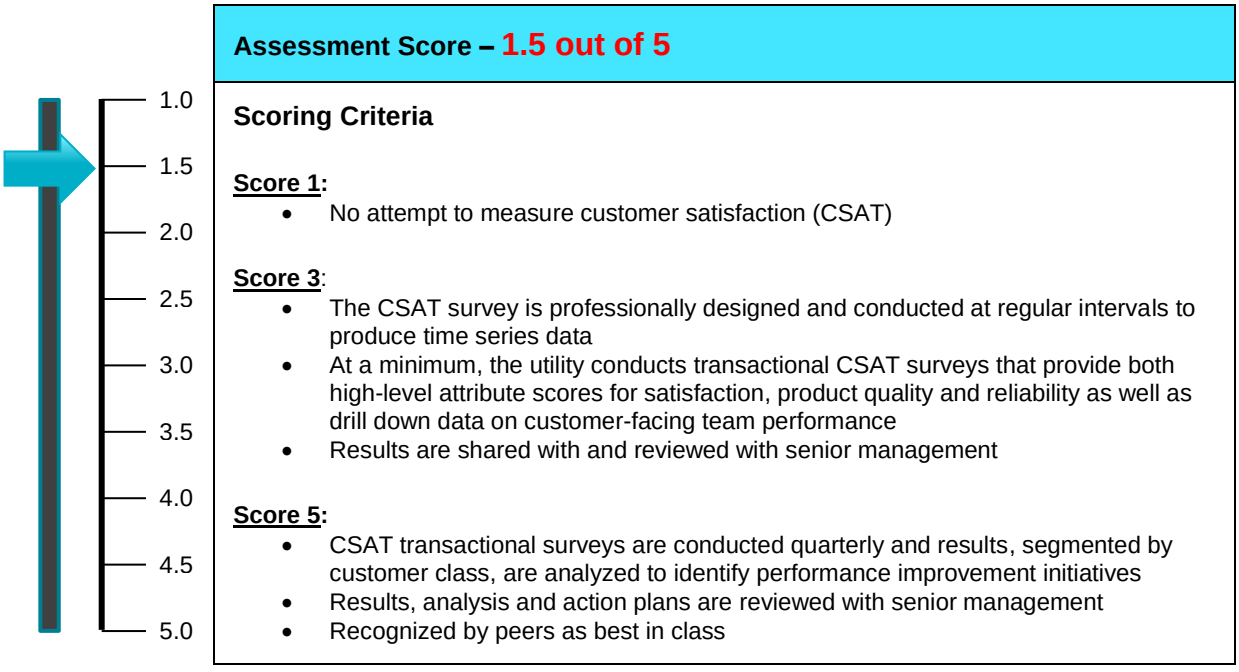
No reliable measure of CSAT. No actionable CSAT intelligence being gathered.

Recommendations

The following recommendations are offered to assist in improving customer satisfaction:

- Consider designing and implementing a quarterly, transactional, telephone-based customer satisfaction survey administered by a third-party market research firm to gain insight and analytics for analyzing and planning of customer service performance improvement initiatives.

Figure C.14 Customer Satisfaction Benchmarking Score



Organizational Effectiveness

WSSC has two KPIs for customer service that are regularly reported to the Board of Commissioners. The primary KPI is the Answered Call Rate and it was specifically requested to be reported to the Board. More recently, First Call Resolution (FCR) was also requested and has been included in the monthly reports. There is an additional monthly report called the "GM Report" that lists additional call center statistics that is sent to the General Manager. This report shows total call volume, abandonment rate and average speed to answer.

The GM Report also breaks down these call statistics to show performance of the WSSC call center, the WSSC emergency contact center and the LJ Ross contractor call center. FCR is reported in aggregate.

FCR is a relatively new KPI for WSSC. Although FCR is an important indicator of effectiveness used in many call centers, there are various ways to measure this KPI. The method currently employed at WSSC is a manual review of a small sample of calls by call center management who exercise judgment to determine whether a customer's issue was resolved on their first call.

WSSC is not focused on Service Level in their call center. Service Level is generally the primary KPI for call centers regardless of industry and generally is the primary KPI for utility customer service departments. Service Level is defined as the percentage of calls answered in a specified time frame. Best practice water and wastewater utilities strive to answer 80% of their customer calls in one minute or less. The Service Level target drives the staffing and resource allocation models for utility call centers.

Service Level was raised indirectly by the "Kramer Study" and data has been reported citing a Service Level definition within the WSSC systems as 80% of calls answered in 180 seconds or less. The WSSC strategic initiative around the call center also makes reference to an aspiration goal of achieving a Service Level target of answering 80% of calls within 60 seconds or less, but this KPI is not used as a regularly reported top-line indicator of performance, nor does it appear that there is an action plan in place to reach this aspiration goal other than the initiatives already implemented.

Generally, call center management focused on achieving the Service Level target as the primary KPI will make deliberate decisions about staffing, performance management, work distribution and process improvement mindful of the impact on their Service Level. WSSC does not focus on Service Level but it does focus on the call answer rate, which is good. Most call centers track their call abandon rate, which is one hundred minus the answer rate as another top level KPI.

KPIs and other performance measures for billing and collections at WSSC were not evident. Most utilities have a set of performance metrics in both of these areas, specific to each business focus.

Effective customer service organizations at utilities are dependent on other utility teams involved in the meter-to-cash cycle. Critical to success are meter reading, field services, IT and the other teams within customer service, such as billing. At WSSC, metrics measuring the effectiveness of these critical partners, specifically around timely completion of customer service-related service orders, is not tracked formally and monitored at a high level. It was indicated that some team members run ad hoc reports on occasion, but generally the various teams operate in functional silos. Best practice utilities track service order aging as a high-level shared KPI and have targeted turnaround times.

WSSC has a formal objective for the call centers to answer 95% of all telephone calls. The objective applies to all call centers, including the contractor call center and the emergency contact center. Results are combined when presented to the Board of Commissioners.

As previously mentioned, performance targets for billing and collections were not evident.

Strengths

High level of institutional knowledge and a management team knowledgeable in utility customer operations practices. Open to performance improvement and change initiatives.

Areas of Potential Improvement

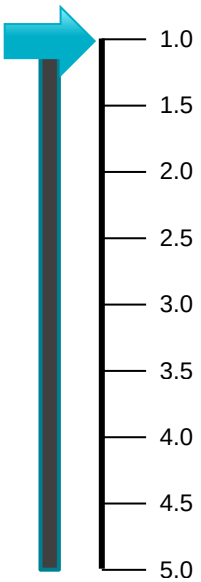
No comprehensive performance management system in place. Operational data is not always readily available for use by customer operations staff to aid in their day-to-day activities.

Recommendations

The following recommendations are offered to assist in improving organizational effectiveness:

- Consider implementing a customer service management system that is data driven complete with KPIs, performance metrics and targeted levels of operation for all customer service organizations, specifically adding billing and collections KPIs in addition to expanding call center metrics. This management system should include reports of operational metrics reviewed regularly by various levels of management, with high-level KPIs reported upward to the Board of Commissioners.
- Consider reorganizing Customer Relations to align resources and responsibilities toward achieving targeted levels of service. As part of this, identify responsible business leads for call center, billing and collections functions and specifically focus on removing non-call center work from the call centers.
- Consider documenting WSSC customer service policies, procedures and processes. Aside from general principle and advance preparation of the new CSIS implementation, this would reduce risk to WSSC of losing institutional knowledge and assist with new associate training programs.
- Consider implementing a method to identify reasons for customer calls.
- Consider automating, distributing and reporting aged service orders and identifying service order status.
- Consider formalizing a process for handling escalated customer complaints and include a monthly process of analyzing root causes of complaints and reporting results to management.

Figure C.15 Organizational Effectiveness Benchmark Score



Assessment Score – 1.0 out of 5

Scoring Criteria

Score 1:

- No management system in place
- No formal KPIs tailored to each functional area
- Resources balance issues
- Low productivity
- Operational data and reports difficult to obtain
- Sometimes characterized by low morale. Excessive "fire-fighting" saps productivity

Score 3:

- Management system in place with KPIs tailored to work teams
- Operational data available to all levels of management to assist with daily activities
- Resources aligned with KPIs and resource levels rationalized
- Team members know and understand KPIs and are focused to achieve targeted level of performance

Score 5:

- Proactive management teams armed with operational intelligence make intra-day adjustments as conditions change
- Performance targets are regularly met
- Unexpected emergent conditions are addressed without significantly disrupting other operations
- All teams included in resource, budget and strategy planning
- Cross-training is encouraged and relationships with other departments are good
- Performance consistently meets or exceeds industry benchmarks
- Morale is high
- Recognized by industry peers as a best practitioner

BEST PRACTICES EVALUATION

Procurement

PROCUREMENT

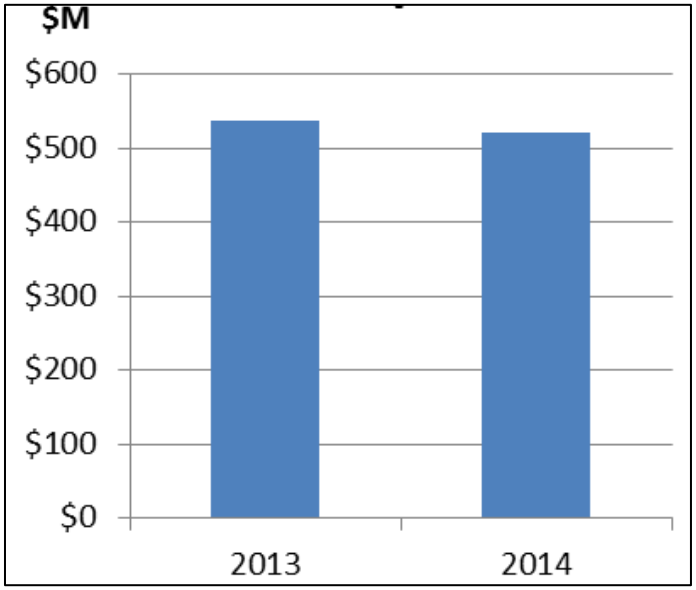
Background and Context

WSSC's average addressable annual spend is $530M/year as indicated in Figure P.1 below. This is the total spend through invoice payments only; the payments to DC Water or other utilities are not included. The main spend categories are as follows:

- 55% to 60% for construction
- 25% goods and supplies
- 15% to 20% professional services

About 25% of the total amount contracted out was for small-, local- and minority-owned business enterprises (SLMBE). This ratio is typical of some other public utilities that spend up to 30%-40% with SLMBE.

Figure P.1 Total Addressable Annual Spend



From 2013 to 2015, WSSC worked with a consultant to implement a Supply Chain Management Transformation. The objective was to review the main processes and define and implement improvements to help the procurement process to be more effective. Six Strategic Sourcing initiatives were developed and some key successes were achieved including, for example, savings in chemicals, ductile iron pipe, fleet and reduction of cycle time for pipe replacement. WSSC also went through an ambitious organizational redesign of the procurement team. While interviewing end-users in the Engineering and Construction and in the Production Groups, all still described the procurement process as lengthy and cumbersome.

End-users were sympathetic to the challenges and their main feedback included:

- The transformation is still very much a work in progress.
- Some ideas may stay at the top managers' level for the moment, with limited real impacts

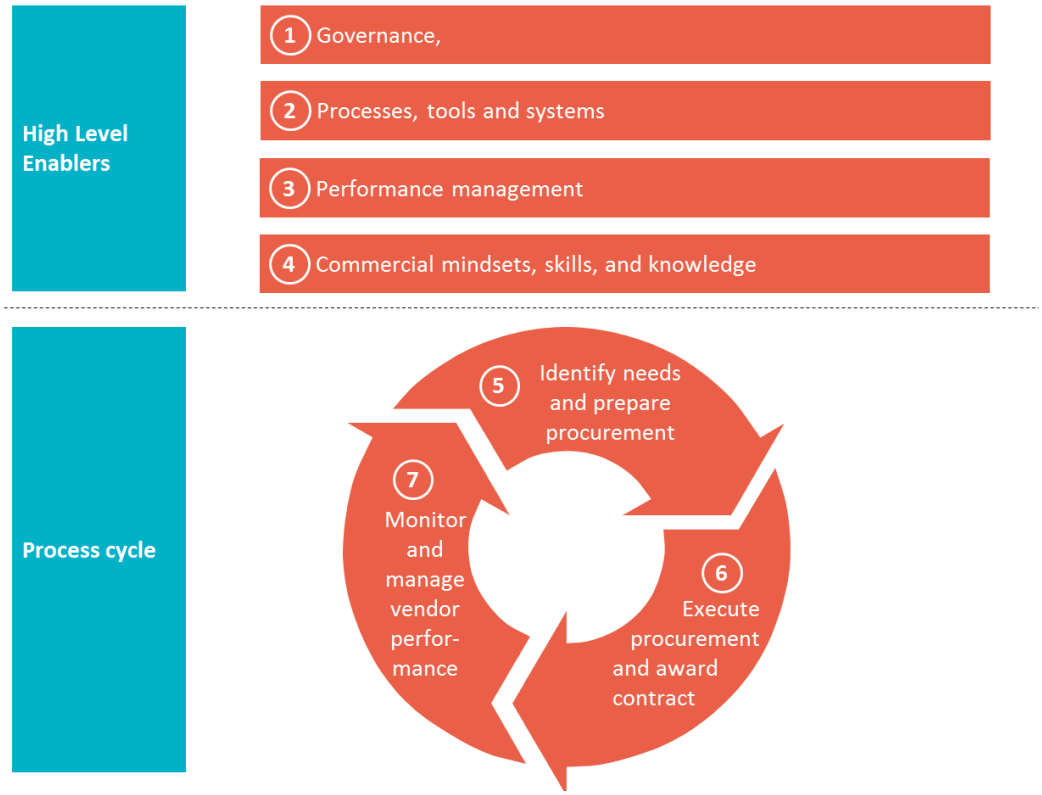
- Operations staff resorts to bypassing procurement frequently. (e.g., one interviewee mentioned that they do this "as much as they possibly can")

End users have noted some improvements and appreciate being more engaged in the process through the Strategic Sourcing Initiatives, but they pointed out that much improvement is still needed to reach a point of maturity, effectiveness and efficiency in procurement.

Best Practice Evaluation

Business practices currently implemented within the Procurement Group were assessed through a series of document reviews, data evaluation and staff interviews conducted in January through March 2016. The evaluation that follows is based on seven Veolia Best Practice standards, each with specific subcategories to determine overall performance, and it uses a standardized scoring system from 1 (basic performance) to 5 (industry best). Criteria used in this scoring system, as well as the score assigned, are indicated below. In the case of procurement, the best practice framework encompasses both the high level enablers and the full procurement process cycle, as indicated in Figure P.2.

Figure P.2 Best Practices Framework



To assist in identifying which standards have the largest opportunity for improvement, a second score was identified as a near-term improvement goal. This score is determined to be where WSSC could be in less than 24 months with some additional focus and effort, given the current landscape. The difference between actual performance and the near-term performance goal forms the basis of a gap analysis that is then used to prioritize areas that have potential for additional improvement. Any arithmetic difference of 2.0 or greater between actual performance and the near-term performance goal was considered significant, and any difference in scores between 1.5 and 1.9 was considered potentially significant.

Figure P.3 summarizes the evaluation and Table P.1 summarizes the results from the assessment analysis. As a general guidance note, scores normally achieved for a large utility such as WSSC would range from 3 to 5.

Figure P.3 WSSC Procurement Best Practices Evaluation Summary

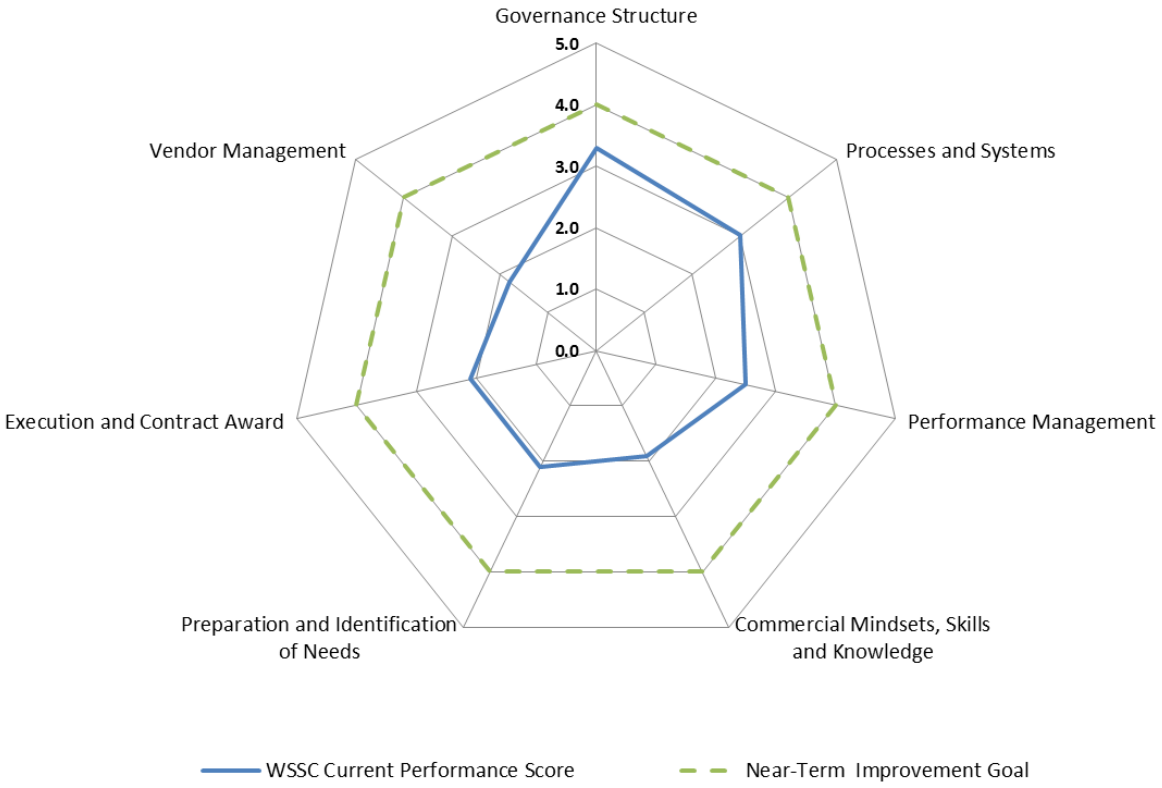


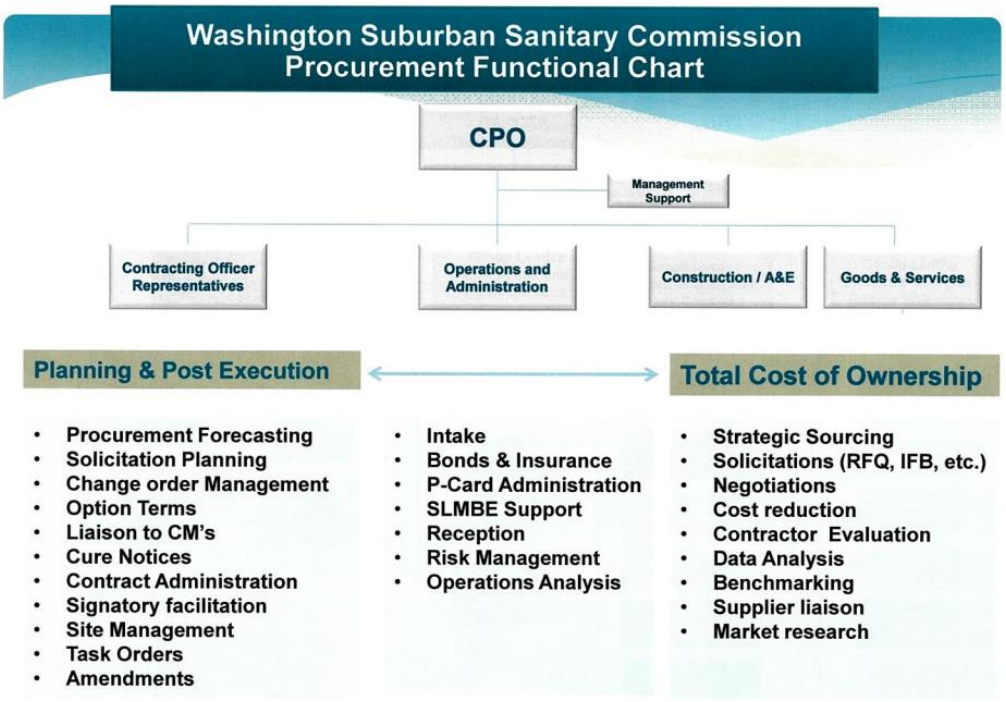
Table P.1 WSSC Procurement Best Practices Gap Analysis

Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
Governance Structure	3.3	4.0	0.7	No
Processes and Systems	3.0	4.0	1.0	No
Performance Management	2.5	4.0	1.5	Potentially
Commercial Mindsets, Skills and Knowledge	1.9	4.0	2.1	Yes
Preparation and Identification of Needs	2.1	4.0	1.9	Potentially
Execution and Contract Award	2.1	4.0	1.9	Potentially
Vendor Management	1.8	4.0	2.2	Yes

Governance Structure

The organizational redesign was a key recommendation of the previous consultants, Greybeard.
New positions were created, such as Strategic Sourcing Specialist, as well as new teams: "Contracting Office Representative" and "Operations and Administration", as indicated in Figure P.4 below.

Figure P.4 WSSC Procurement Organization Structure and Functional Groups



Strengths

The overall governance structure is very close to optimum and has enhanced the capacity of the procurement team to develop strategic sourcing, improve communication and collaboration with other teams, and better manage vendors. The Group Leaders and Buyers interviewed are engaged in the transformation process and committed to implementing ambitious improvements. The team is not afraid of change and has been keen to try new approaches to drive efficiency; the new Chief Procurement Officer also has ambitious goals to improve current performance.

Areas of Potential Improvement

Key positions such as Group Leader for the Contracting Office and two Strategic Sourcing Specialists are still vacant. WSSC needs to find new talent. Furthermore, roles and responsibilities of the Contracting Representatives and Operations & Administration Group are being defined.

- The Contracting Representatives will eventually help to better plan and anticipate the contracts renewals or termination, and better communicate and monitor the vendors once the contracts are awarded. Today, their role is still under construction and the leader position is vacant. Thus, the

collaboration with end-users is not yet fully efficient and the monitoring of vendors is in the early stages of development.

- The Operations & Administration Group needs to find the right way of supporting the procurement of contracts through facilitation of collaboration with the SLMBE office and administrative support of the other procurement groups. The SLMBE approval process was identified as a bottleneck in the procurement process. The team is defining its role and responsibilities with the new Chief Procurement Officer.

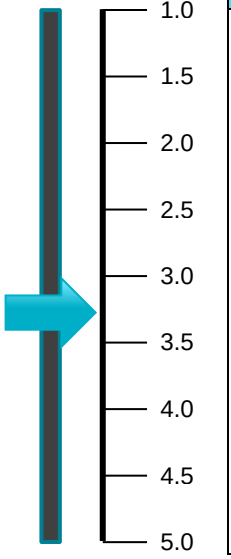
Finally, the procurement team has started to identify category buyers to improve efficiency and effectiveness, but this change has not yet been implemented. Having category buyers is a common best practice in the industry. There are 15 buyers and 668 contracts; hence, today each buyer manages 45 contracts on average.

Recommendations

The following recommendations are offered to assist in improving overall governance in Procurement:

- Fill the strategic vacant positions: Contracting Office Group Lead position, Strategic Sourcing Specialist positions.
- Clarify the roles and responsibilities of the Operations and Administration team.
- Develop and train key staff to be classified as category buyers to improve efficiency and effectiveness.

Figure P.5 Governance Structure Assessment Score and Scoring Criteria



Assessment Score – 3.3 out of 5

Scoring Criteria

Score 1:
- Individual awareness, but no organizational intention to act

Score 2:
- Organizational awareness and planning to implement

Score 3:
- Consistent approach used, but may or may not be documented or controlled

Score 4:
- Doing the right things, which are documented and have the right controls in place

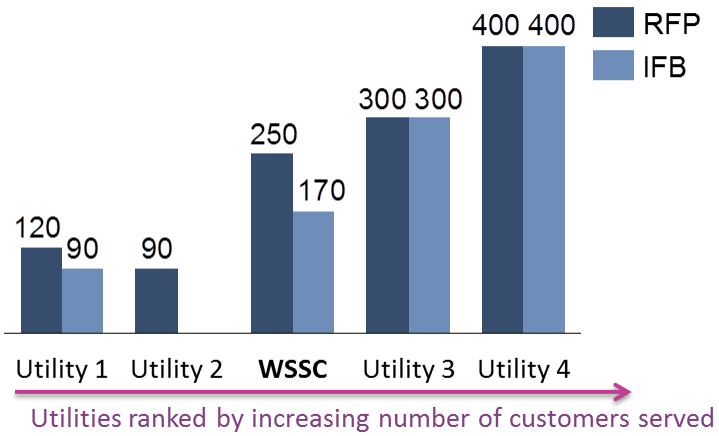
Score 5:
- Recognized by others in industry as the leader

Processes and Systems

During the Supply Chain Management Transformation, an effort was performed to document and streamline processes with a particular focus on the intake process, i.e., managing the requests coming from end-users and collaboration with the end-users throughout the procurement cycle to decide the best procurement strategy and evaluate the proposals.

The overall objective was to better monitor the total procurement cycle and drive some optimizations. Figure P.6 below indicates WSSC's current performance compared to selected utilities local utilities.

Figure P.6 WSSC Cycle Time Performance Compared to Local Utilities



Benchmarking data:

Procurement cycle times for IFBs and RFPs:

- Most efficient utilities: 90 days
- Typical large utilities: >180 days

Generally, the larger the utility, the longer the total procurement cycle time.

IFB: Invitation for Bid RFP: Request for Proposal

Strengths

The six Strategic Sourcing Initiatives brought some key successes that created a good momentum and increased motivation of the team. They also improved the communication and collaboration with the internal end-users.

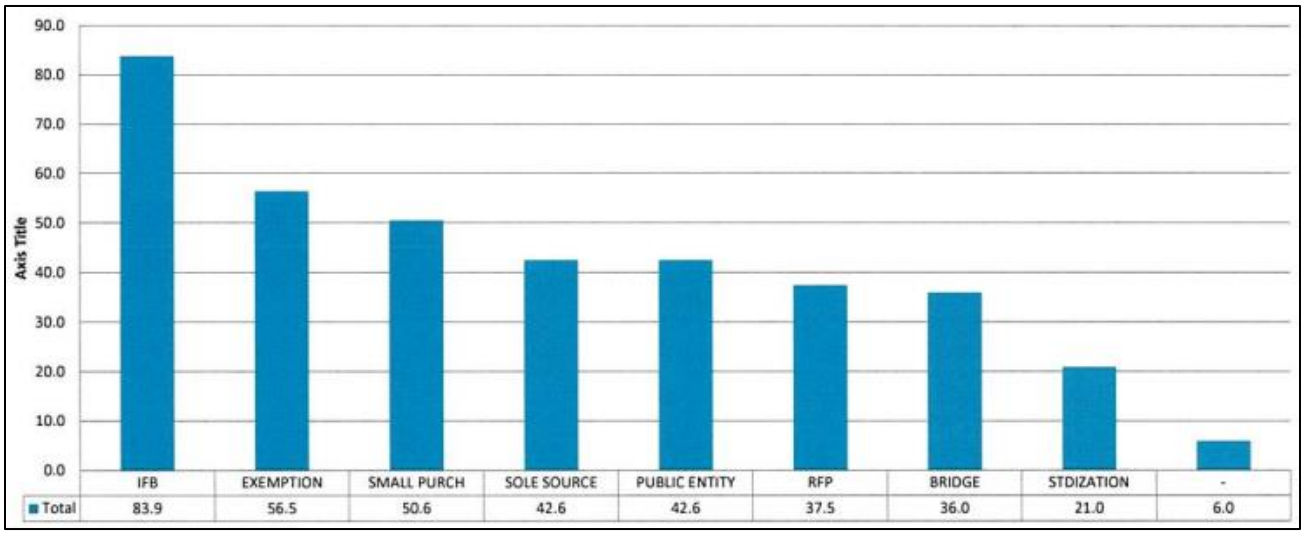
There is an annual internal audit that provides an independent assessment on risk management, control, or governance processes for the organization. Examples may include financial, performance, compliance, system security, and due diligence engagements. Assurance services add value by improving opportunities to achieve organizational objectives, identifying operational improvement, and/or reducing risk exposure.

Areas of Potential Improvement

The main improvement focus to date has been to reduce the total procurement cycle time. Despite this, WSSC operational staff still feels that the procurement process is too long. From December 2014 to November 2015, 1,502 requests were received and 1,204 Notices to Proceed were issued, resulting in about 300 requests in backlog. Currently, the waiting time for requests represents about 20% to 40% of the total procurement cycle time (+80 days for IFBs), due to incompletion or delays before a buyer starts working on them.

The procurement office has started to track the total opportunity time, i.e., the time before a buyer starts working on a request. A summary is indicated in Figure P.7 below.

Figure P.7 Number of Days in Planning or Pending, as of March 30, 2016



The approval process and approval time is currently not tightly controlled and can be a source of delays in the procurement cycle. The document management is still mostly paper based.

In addition, collaboration with the SLMBE office needs to be improved. Once the "Operations and Administration" team is fully mature and operational with clear roles and responsibilities, this will help make the SLMBE approval process less of a bottleneck.

WSSC Delegation of Authority (DOA) thresholds are at the lower range of the spectrum. Figure P.8 below compares these thresholds against other utilities.

Figure P.8 WSSC DOA Thresholds versus Other Utilities

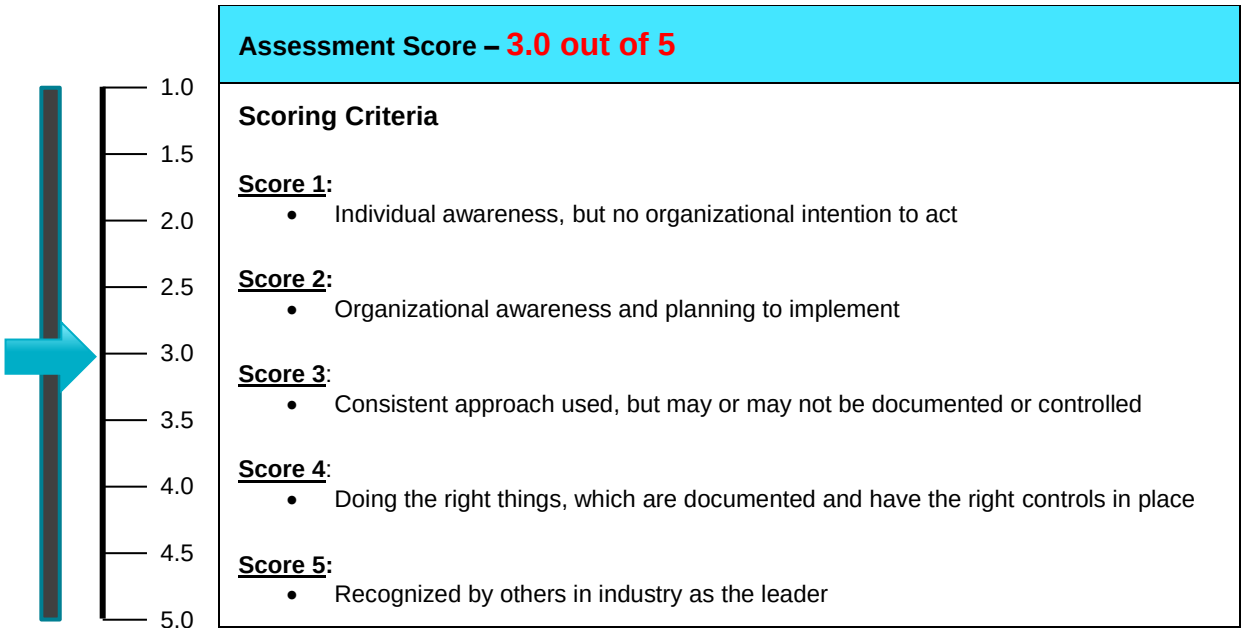
City/Utility	Level 1 (CEO, GM)	Level 2	Level 3 (Manager)
WSSC	**500,000**	**250,000?**	-
Utility 1 - in the region	1,000,000	500,000	100,000
Utility 2 - in the region	75,000	-	30,000
Utility 4 - Canada	10,000,000	5,000,000	100,000
Veolia	12,500,000	5,000,000	300,000

Recommendations

The following recommendations are offered to assist in improving overall Procurement processes and systems:

- Optimize preparation stages through enhanced collaboration with user's department and SLMBE to reduce planning and pending time.
- Develop and implement a more-detailed tracking system to assist in identifying reasons for delays.
- Develop and implement business practices that more-tightly control the approval process and approval timelines including an electronic document management system.
- Improve collaboration with the SLMBE office by developing clear roles and responsibilities within the Operations and Administration team.
- Take into consideration the existing DOA thresholds when setting targets of total procurement cycle time.

Figure P.9 Process and Systems Assessment Score and Scoring Criteria



Performance Management

Performance management is one of the most important factors in developing and maintaining a highly functioning organization. Reporting of metrics, although important, is not enough to effectively manage performance. These metrics must be meaningful, i.e., they must answer important management questions. Also, robust performance discussions must be held with personnel on a regular basis to discuss current performance, diagnose problems, and then develop and implement solutions.

Accountability and performance milestones should be assigned to specific individuals during this meeting, with current progress regularly discussed.

Strengths

WSSC has a sophisticated tracker showing performance with respect to speed of the procurement process as well as workload of buyers. This tracker is Excel-based, but eventually the procurement team would like to use an Oracle®-based data management system to track historical usages and prices. Oracle® will be used to track historical data (i.e., volumes, unit prices, total spend) in the future. That will help the procurement team to build more robust demand projections and cost estimates.

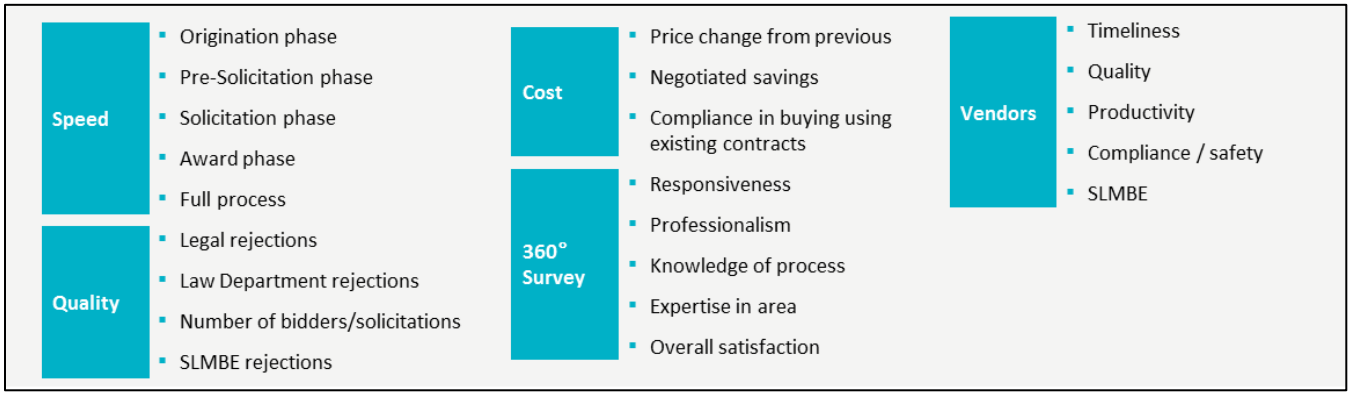
Areas of Potential Improvement

The WSSC Procurement team should develop, track and monitor more than the overall speed of procurement. Additional potential metrics and tools include:

- Average process times and volatility – break down by phases to better identify bottlenecks and opportunities of improvement
- Quality: Rejection level o of contracts (as a percentage of total), Number of compliant bids submitted for each solicitation (as a percentage of total), number of bidders per solicitation
- Cost: price changes and negotiated savings
- Survey of user's department
- Vendors' performance
- Indication of a target for each metric, with defined upper and lower control limits

Other core performance metrics are indicated in Figure P.10 below.

Figure P.10 Examples of Core Performance Metrics



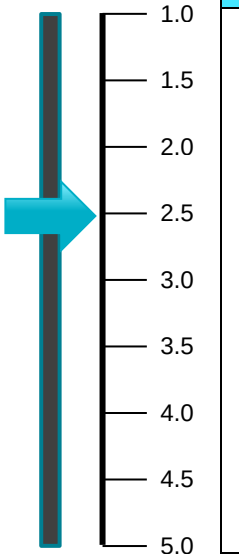
Some performance review meetings are held, but need to be generalized to bring a structured performance dialogue that helps buyers improve their work.

Recommendations

The following recommendations are offered to assist in improving overall Procurement performance management:

- Expand the metrics to be tracked to include quality, cost, end-user satisfaction, vendors' performance. Develop a contract evaluation process in collaboration with the end-users. The objective is to identify any issue in the vendor performance and plan corrective actions accordingly.
- For each relevant metric, establish a performance target.
- Develop and implement graphical charts showing performance using actual performance data. Plot data on a rolling one-year cycle to evaluate trends.
- Develop and implement robust weekly performance meetings for each group. Each meeting should be attended by key personnel and specific performance discussed using actual performance data. Focus discussion on performance gaps and understanding root causes.
- Develop action plans based on Specific, Measurable, Actionable, Relevant, and Time-Bound (SMART) principles, monitor progress at each weekly meeting and assign accountability to ensure plans are consistently carried through to completion.

Figure P.11 Performance Management Assessment Score and Scoring Criteria



Assessment Score – 2.5 out of 5

Scoring Criteria

Score 1:
- Individual awareness, but no organizational intention to act

Score 2:
- Organizational awareness and planning to implement

Score 3:
- Consistent approach used, but may or may not be documented or controlled

Score 4:
- Doing the right things, which are documented and have the right controls in place

Score 5:
- Recognized by others in industry as the leader

Commercial Mindsets, Skills and Knowledge

The commercial view of procurement is informed by a deep market knowledge and familiarity with the industry structure, including:

- Suppliers (who sells to the vendor?)
- Substitutes (what other products can serve the same function?)
- Customers (who else buys this product and for what?)
- Players (who manufactures/distributes this product?)
- Channels (how does the product enter the market?)
- Regulation (what laws/regulations apply to this product/industry?)

Areas of Potential Improvement

The commercial mindset is slowly being developed but is not mature yet at WSSC:

- **Deep market knowledge.** WSSC does not use any benchmarking tools to gain some knowledge on the market. For example, BidNet® or SmartProcure can be useful tools to understand the prices paid by other utilities.
- **Active management of vendor landscape.** When asked the question about number of vendors per solicitation, the Procurement group leaders say that there are globally not enough vendors for each solicitation. WSSC started to develop a vendor database, but there is a need to document the substitutes, players, etc. In the documented processes, there is no step relative to gaining market intelligence and vendor outreach in order to foster interest and competition. This is not done systematically and no person is in charge of vendor outreach.
- **Familiarity with advanced analytical methods.** The procurement team is working on data quality and data capture to enable the creation of spend analytics tools. They hope that the upcoming Oracle® project will bring everything together. But WSSC is missing in-house analytical skills to perform thorough total cost of ownership and cost modelling simulations.
- **Ability to prepare and conduct successful negotiations.** There is very little negotiation at the moment (allowed by contract specifications but not implemented). Some of the buyers may have developed a relationship with contractors and don't focus on negotiations. They are also missing the analytics to identify opportunities and their main focus has been on reducing the process cycle time.

Recommendations

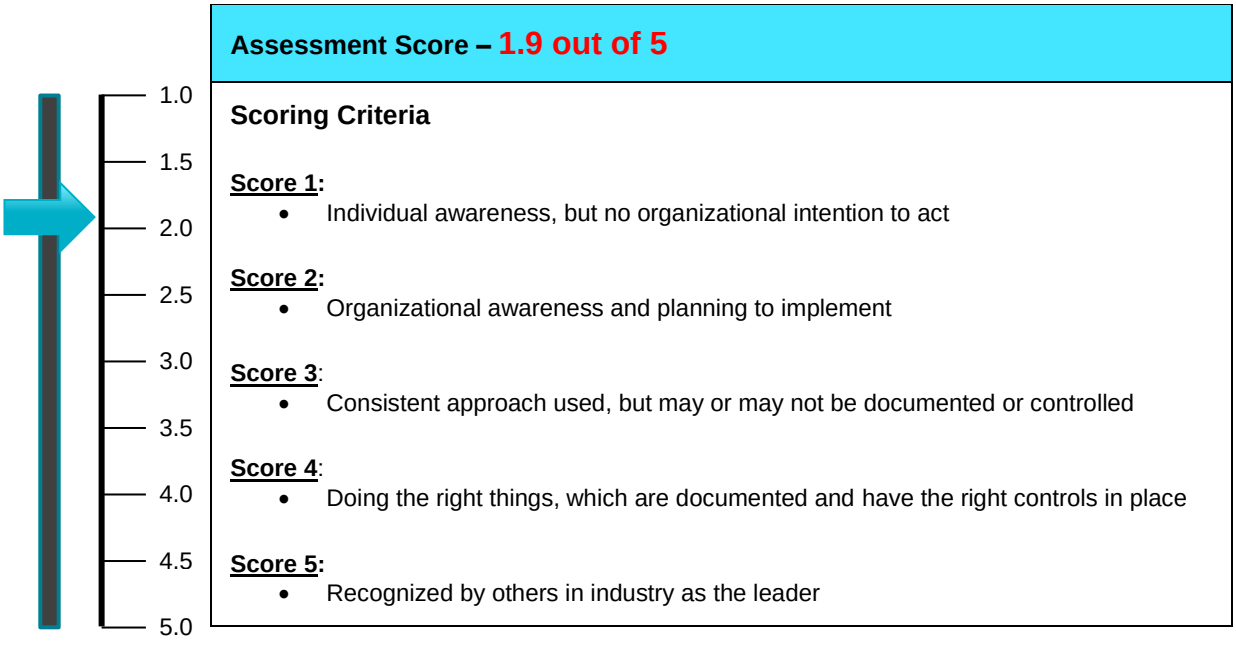
The following recommendations are offered to assist in improving overall commercial mindsets, skills and market knowledge in Procurement:

- Develop and implement business practices that include the use of industry-standard benchmarking tools such as BidNet or SmartProcure.
- Develop and implement a more-robust vendor database that includes substitutes and market intelligence.
- Develop and implement business practices that outline the process to perform vendor outreach in order to foster interest and competition. Assign responsibility for this effort to key staff.

- Develop and implement an individual development program that identifies core competencies for each classification within Procurement and the requisite training to achieve these core competencies. Include advanced analytical techniques, such as total cost of ownership, cost modeling simulation.

- Encourage negotiations of new contracts and track the savings that are achieved.

Figure P.12 Commercial Mindsets, Skills and Knowledge Assessment Score and Scoring Criteria



Preparation and Identification of Needs

The objective of this stage is to determine exactly what is needed by operations and how to best meet the need at a competitive price. The end products of this stage are the technical specifications, service level requirements, demand projections, procurement strategies and price estimates.

Strengths

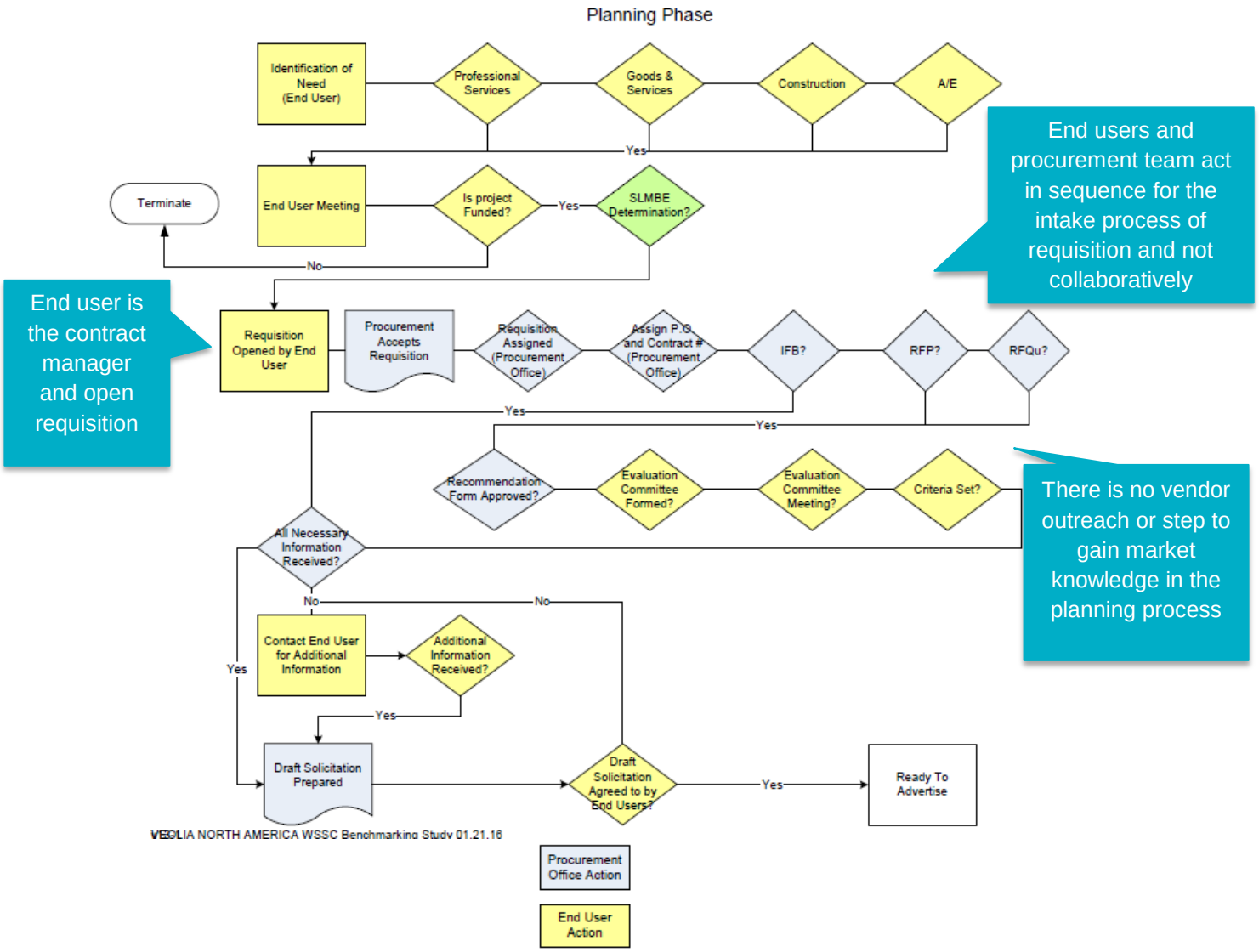
Collaboration between Procurement and Operations has improved with strategic sourcing initiatives.

The WSSC Procurement team has also been piloting some improvement initiatives regarding the procurement planning phase. An interesting recent success in January 2016 was the reduction of cycle time from 120 days to 35 days for a watermain replacement contract. It was achieved thanks to active outreach to vendors via an RFI (Request For Information), which increased competition and generated feedback.

Areas of Potential Improvement

Better planning is still a main focus of WSSC, as this can greatly improve the procurement cycle time. The current procurement workflow diagram is shown in Figure P.13 below.

Figure P.13 WSSC Procurement Workflow



Main observations are as follows:

- **Contract calendar.** The end-users are the contract managers and are, therefore, responsible for preparing a request for renewals and termination. Currently, there is no contract calendar that provides the procurement team a three-year look ahead.

- **Demand projections.** When interviewed, Operations indicated that they do buy outside of preferred-supplier contracts. The spend compliance is not tracked currently. There is no analysis of the market basket (spend versus forecast) to improve demand projections. Furthermore, there is no formal tracking of historical usages. This will be the responsibility of the COR team (Contraction Officer Representatives) in collaboration with end-users department.

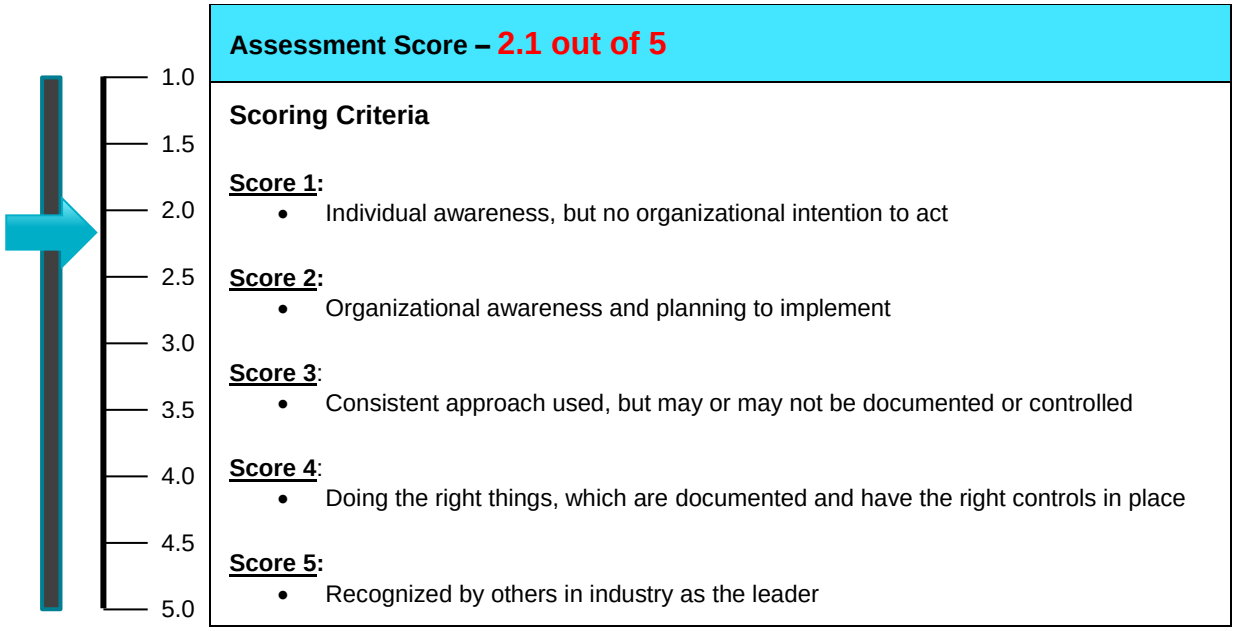
- **Robust cost estimation.** There is an opportunity to improve cost estimation and tracking previous costs and variations. WSSC recently hired estimators in the Engineering department to try to improve the accuracy of cost estimates as well as the structure of the cost lines. Veolia observed that historical vendors are able to game some price lines as they know that some work may not be implemented by WSSC, they charge a higher price than market on items they are sure to be paid on.

Recommendations

The following recommendations are offered to assist in improving overall preparation and identification of needs in Procurement:

- Develop a three-year look-ahead contract calendar that clearly identifies all of the current term and key action milestones for each contract.
- Develop and implement tools to track spend compliance.
- Develop and implement business practices that outline and assign responsibility to perform analysis of the market basket (spend versus forecast) to improve demand projections, and formally track historical usages.
- Improve the accuracy of cost estimates as well as structure of the cost lines on all construction contracts.

Figure P.14 Preparation and Identification of Needs Assessment Score and Scoring Criteria



Execution and Contract Award

The objective of this step is to move quickly through the procurement process (details are usually heavily dependent on local procurement regulations) and award a contract to a responsible and responsive vendor that provides best price or best value (depending on defined criteria). The end product of this step is to have a contract awarded.

Strengths

Execution of procurement and award of the contract are strengths of the WSSC procurement process. The main best practices are already implemented:

- Proposal review with all stakeholders. There is a proposal evaluation committee that includes the Procurement and Operations teams.
- Formal kick-off with new vendors and end-users. There is a pre-commencement meeting with the end-user documented in the WSSC “execution phase process”.
- Formal post mortem with unsuccessful vendors. There is usually a post-mortem with unsuccessful vendors.

In a continuous improvement mindset, the Procurement office wants also to apply a target of 48 hours to advertise and 72 hours to execute a contract, which will reduce the overall cycle time.

Areas of Potential Improvement

There is no consistent vendor outreach to start the dialogue with the vendors before advertising.

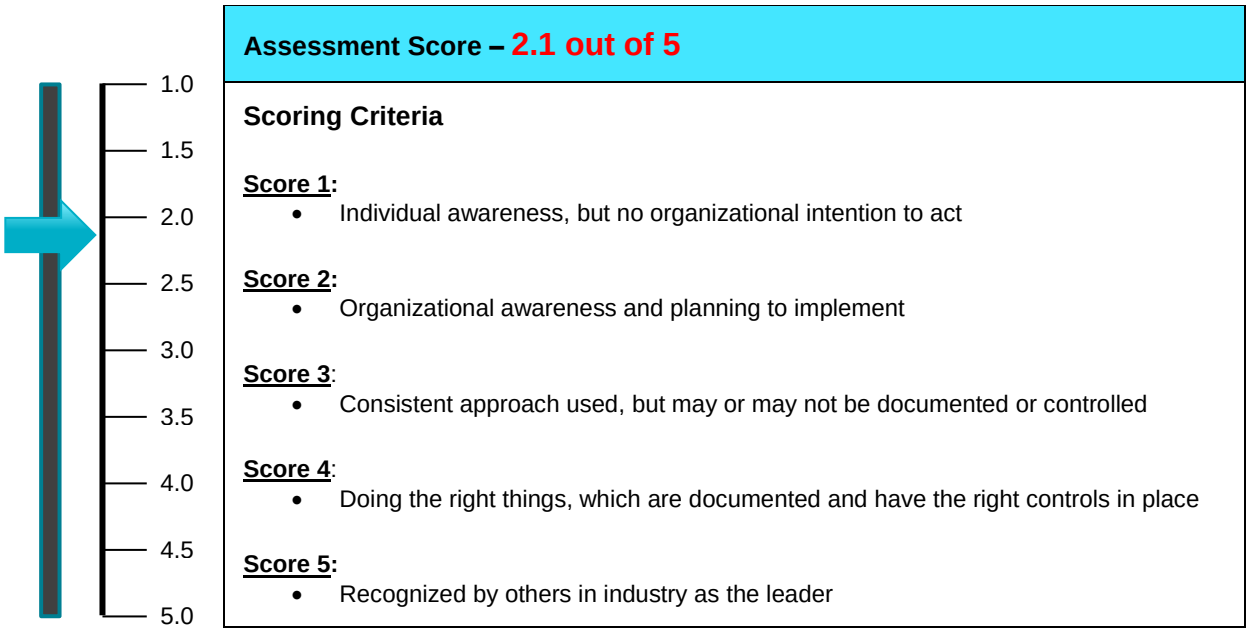
There is no consistent contact of suppliers/vendors that did not reply to understand the reasons and adjust future solicitations accordingly.

Recommendations

The following recommendations are offered to assist in improving overall Procurement execution and contract award:

- Develop and implement business practices that outline the process to perform vendor outreach in order to foster interest and competition. Assign responsibility for this effort to key staff.
- Consistently and regularly reach out to non-responsive bidders to generate additional bidders/competition in the future.

Figure P.15 Execution and Contract Award Assessment Score and Scoring Criteria



Vendor Management

The objective of this step is to monitor vendor and operational performance on an ongoing basis and to intervene with concrete actions, if necessary. The end products of this step are vendors and operations scorecards and performance improvement action plans.

Strengths

In November 2015 the WSSC Supplier Portal, a new procurement portal for vendors and suppliers, was launched. It replaces the Centralized Bidder Registration and enables WSSC vendors to manage their profiles, receive solicitations and communicate better with the organization.

Areas of Potential Improvement

WSSC has not closely monitored vendor performance, but the new COR team recently started to work with the end-users to develop a standardized approach of contract evaluation. The evaluation will include six parameters ranked from 1 to 5: Quality, Budget/Cost, Schedule/Timeliness, Compliance, SLMBE Compliance, and Regulatory Compliance/Safety.

- **Ongoing tracking of vendor performance.** There is no formalized vendor scorecard yet or means to provide feedback to vendors about performance. This is under development.
- **Regular formal vendor performance meetings.** The COR team will have to organize and manage these meetings.
- **Operational performance.** Delivery times, packaging and delivery options, vendor wait times when unloading product, and forecast versus usage are currently not tracked. The objective of tracking operational vendor performance is to avoid more-expensive packaging, promote delivery

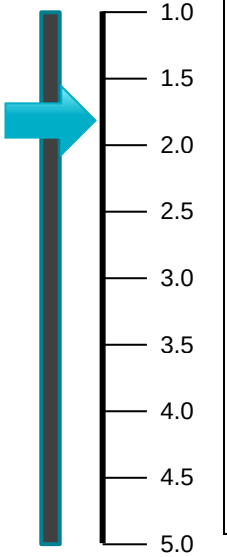
options and reduce unloading wait times. The Procurement team wants to start tracking complaints and internal response efforts.

Recommendations

The following recommendations are offered to assist in improving overall vendor management in Procurement:

- Develop and implement a formalized vendor scorecard and a means to provide feedback to vendors about performance.
- Hold regular formal vendor performance meetings.
- Develop and implement business practices that outline and assign responsibility to perform evaluation of vendor performance, such as tracking and analysis of delivery times, packaging and delivery options, as well as vendor wait times when unloading product, and forecast versus usage.

Figure P.16 Vendor Management Assessment Score and Scoring Criteria



Assessment Score – 1.8 out of 5

Scoring Criteria

Score 1:
- Individual awareness, but no organizational intention to act

Score 2:
- Organizational awareness and planning to implement

Score 3:
- Consistent approach used, but may or may not be documented or controlled

Score 4:
- Doing the right things, which are documented and have the right controls in place

Score 5:
- Recognized by others in industry as the leader

BEST PRACTICES EVALUATION

Fleet

FLEET

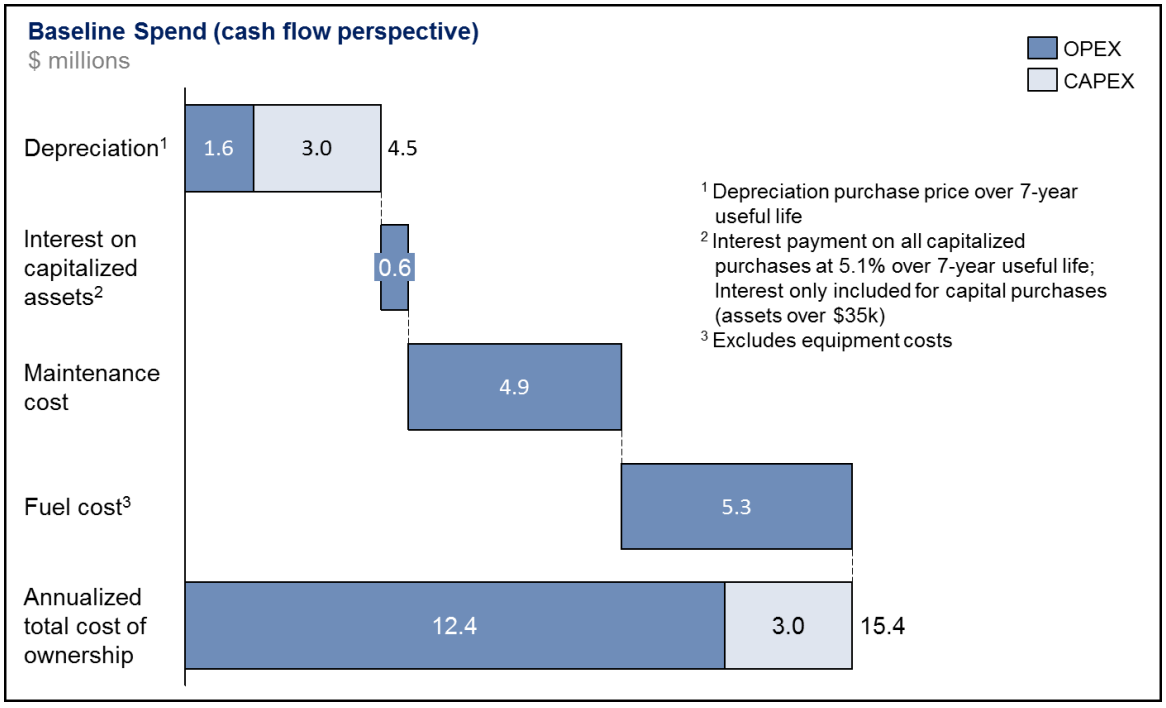
Background and Context

The Logistics Team Office is responsible for strategically planning, directing and coordinating the activities of a number of vital administrative, technical and support services at WSSC.

Logistics manages a fleet of 953 active vehicles and 798 pieces of equipment totaling 1,751 assets with a current book value of $38.7M. Fleet's annual cost of ownership for these assets is $15.4M, which includes fuel, maintenance, financing and depreciation. Approximately 75% of the costs are driven by vehicles (cars and light, medium and heavy trucks), as a result an emphasis will be placed on these assets.

From a cash flow perspective, Logistics' largest costs are maintenance and fuel, as demonstrated by Figure F.1.

Figure F.1 Baseline Spend



Logistics instituted an Oracle Utilities Work and Asset Management (WAM) based asset management system in 2011. Referred to as TEAMS, it is used to define preventive maintenance schedules, replacement schedules, costs and other pertinent asset information of active, inactive and relinquished vehicles.

Best Practice Evaluation

Business practices currently implemented within the Fleet Group were assessed through a series of document reviews, data evaluation and staff interviews conducted in January through March 2016. The evaluation that follows is based on seven Veolia Best Practice standards, each with specific

subcategories to determine overall performance, and it uses a standardized scoring system from 1 (basic performance) to 5 (industry best). Criteria used in this scoring system, as well as the score assigned, are indicated below.

To assist in identifying which standards have the largest opportunity for improvement, a second score was identified as a near-term improvement goal. This score is determined to be where WSSC could be in less than 24 months with some additional focus and effort, given the current landscape. The difference between actual performance and the near-term performance goal forms the basis of a gap analysis that is then used to prioritize areas that have potential for additional improvement. Any arithmetic difference of 2.0 or greater between actual performance and the near-term performance goal was considered significant, and any difference in scores between 1.5 and 1.9 was considered potentially significant. Figure F.2 summarizes the evaluation and Table F.1 summarizes the results from the assessment analysis.

As a general guidance note, scores normally achieved for a large utility such as WSSC would range from 3 to 5.

Figure F.2 Fleet Assessment Summary

Table F.1 Fleet Assessment Gap Analysis

Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
Policies and Procedures	2.5	3.5	1.0	No
Asset Knowledge	2.8	4.4	1.6	Potentially
Maintenance	3.0	4.0	1.0	No
Financial Accountability	2.9	4.3	1.4	No
Demand Management	1.8	4.0	2.2	Yes
Performance Management	1.5	3.5	2.0	Yes
Transparancy and Communication	1.5	4.0	2.5	Yes
Mindsets and Capabilities	1.8	4.0	2.2	Yes

Process and Procedures

Processes and procedures define the operations of Logistics and how other groups interact with Logistics. For instance, if a WSSC group requires a new vehicle, there is a defined method for how the group can request and acquire a new vehicle from Logistics. Processes and procedures are established and documented by Logistics.

Strengths

Logistics follows processes and procedures prudently and forms are used to document stages in each process, including: Vehicle Assignment Requests, Fleet Management Vehicle User Requests, New & Expanded Program Form, etc. In addition, there is an effort currently underway to develop flow diagrams for different processes and to update documents. Further, most of the documents that were reviewed had some form of version control.

Areas of Potential Improvement

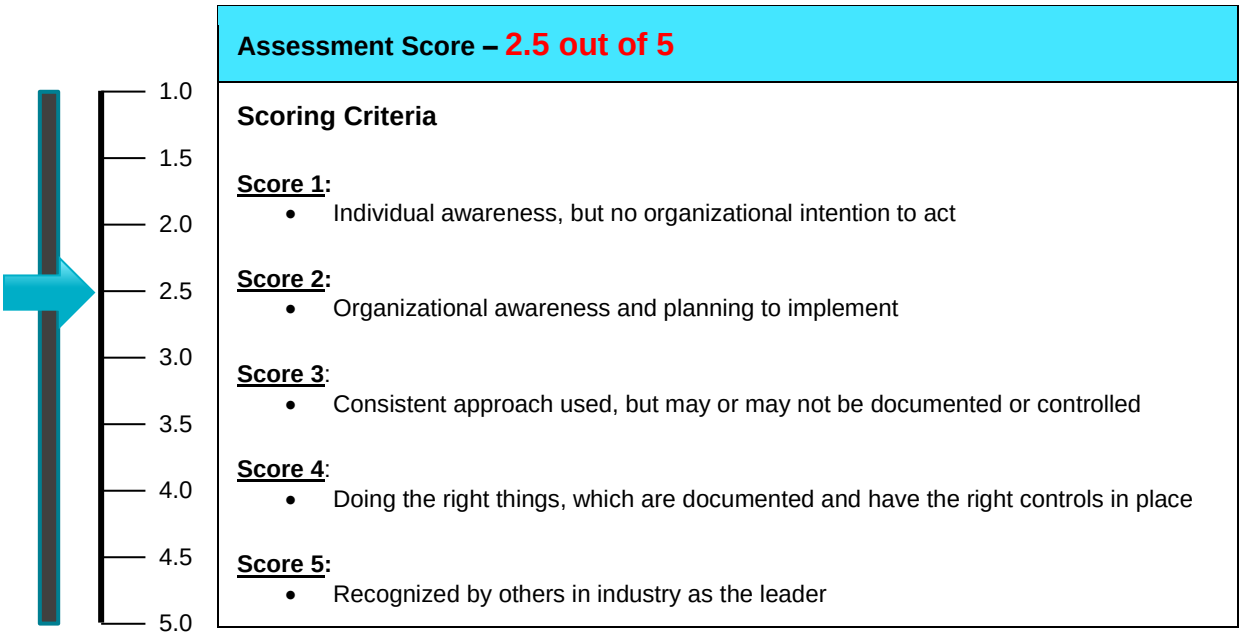
The critical processes and procedure document, Standard Procedures of the Washington Suburban Sanitary Commission, was implemented in 1994 but has not been updated since. WSSC staff interviewed felt the existing document does not assign accountability and nor define a vision by upper management. In addition, there have been changes since the document's inception that render some of its statements inaccurate and/or inapplicable. Once this document has been updated, other documents should be reviewed to ensure parallelism across all documents and that all documents are up to date.

Recommendations

The following recommendations are offered to assist in improving process and procedures:

- Establish a control team to manage documentation and assign accountability by reviewing all processes, procedures and documents with key stakeholders on an annual basis.

Figure F.3 Process and Procedures Best Practices Assessment Score



Asset Knowledge

Asset knowledge represents the systems and tools used to track asset information such as costs, condition, criticality, replacement schedule, etc. WSSC's TEAMS is used to develop asset knowledge. TEAMS is a robust system that can provide critical information to help manage assets effectively. However, there are some areas where improvements can be made.

Strengths

The new TEAMS asset management system will now track information on Fleet assets. The system is comprehensive and has the potential to provide key metrics and reports that can drive decisions.

Areas of Potential Improvement

Veolia review of existing data indicates that the database includes incorrect data. Anomalies should be reviewed on a regular basis and a root cause identified. Once a root cause is identified, a process change should be put in place to prevent future issues.

Data that is entered into TEAMS is mostly, but not completely standardized, nor is the database structured well to accept data and allow for proper data mining to develop meaningful management reports. With any data system, the first and most critical step is to first develop an efficient and robust back-end process. This means identifying the data that needs to be recorded and then standardizing that data. Once the back-end is developed, dashboards and metrics can be developed that users can easily execute to gain valuable information. Any dashboard or metric can be developed as long as the data exists. At WSSC, the data exists but the dashboards and metrics do not. Since most users are not comfortable with manipulating large data sets, the perception is that the system is insufficient, but once standard dashboards are created, the perception will likely change.

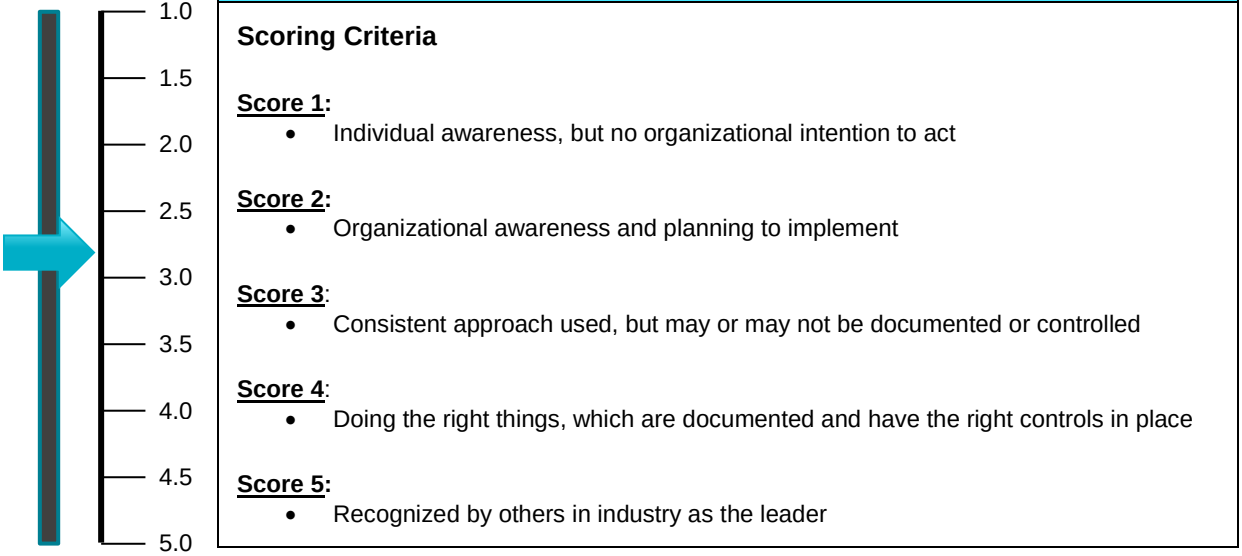
Under current conditions, it is not possible to quantify how many vehicles are used during any given day, making it difficult to develop a business case for downsizing the fleet. Incorporating an In-Vehicle Monitoring System (IVMS), which captures data that monitors the usage of individual vehicles into TEAMS, would provide daily use information such as how often an individual vehicle is used, the distance locations it traveled to, how long it was idle, and speed data. This information can provide WSSC the intelligence it needs to make pragmatic decisions on whether additional vehicles are warranted. By quantifying the usage rate of various vehicles in different groups, it becomes apparent where downsizing may be justified.

Recommendations

The following recommendations are offered to assist in improving asset knowledge:

- Program logic into the TEAMS software to identify and flag errors. For instance, if a user enters a downtime into the TEAMS system that is greater than a year, the system should display a warning.
- Assign someone from Logistics to be responsible for regular QA/QC of the data. Any errors that are identified should be noted and corrected. Errors that repeat frequently should generate an email that notifies users of the error and the issue should also be brought up during meetings.
- Review TEAMS system fields to identify those that can be standardized to improve simplicity and analysis. Standardize fields into drop-down menus or lists, instead of free-form text fields.
- Install IVMS on each vehicle, providing the ability to track vehicle usage.

Figure F.4 Asset Knowledge Best Practices Assessment Score



Maintenance

WSSC owns and operates seven maintenance facilities that are used for preventive and corrective maintenance. As Figures F.5 and F.6 indicate, maintenance costs and downtime have been increasing as vehicles get older.

Figure F.5 Average Maintenance Costs and Percentage of Asset Class Serviced

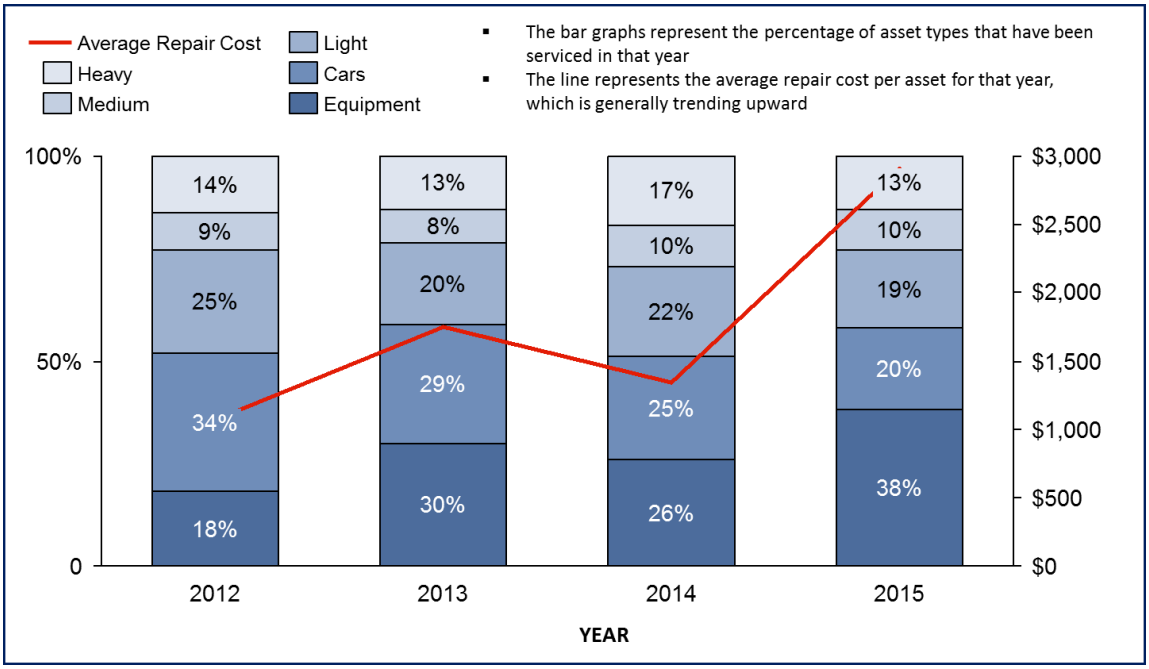
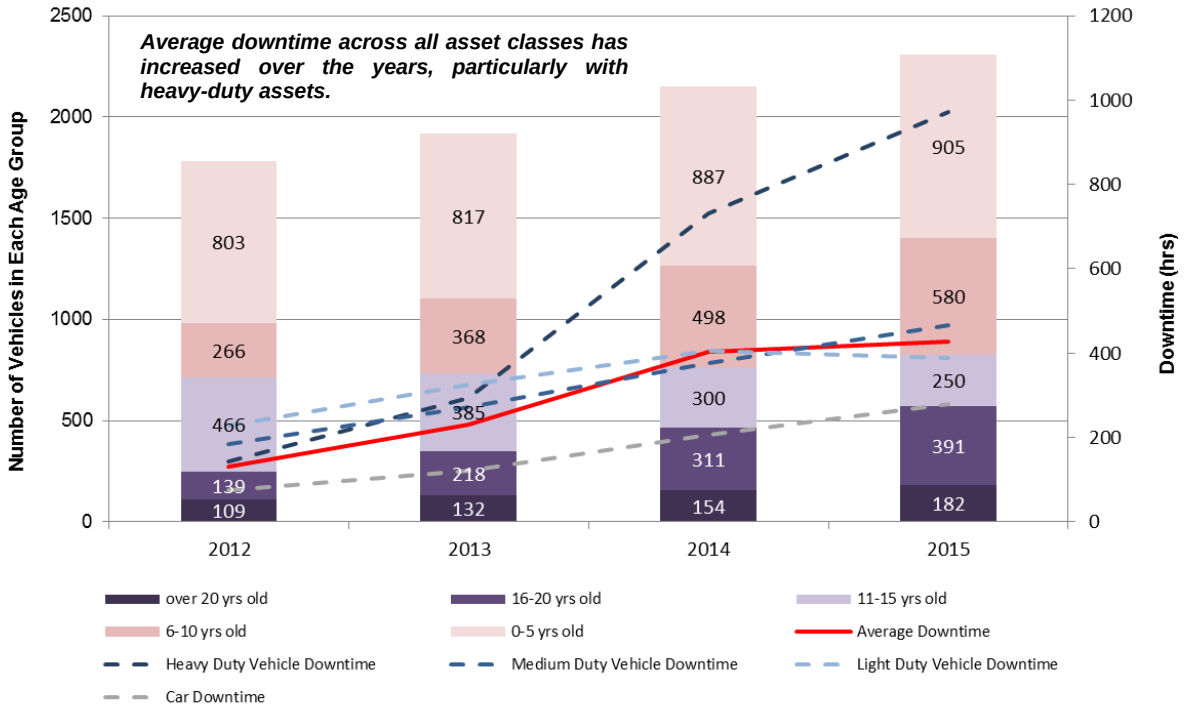


Figure F.6 Average Downtime per Asset, by Asset Class



Strengths

Even though downtime and costs are increasing, overall WSSC maintenance shops do a relatively good job putting vehicles back on the road, with an average downtime for heavy vehicles at 10% annually. In addition, Logistics does a relatively good job of maintaining assets by defining when an asset needs to be serviced using three criteria: mileage, time, and maintenance costs, based on the vehicle manufacturer's recommendations. These criteria are programmed into TEAMS which then highlights the assets that are due for maintenance. This triggers a process where someone from the Logistics team notifies the responsible party to bring the asset into the appropriate repair facility for servicing.

Areas of Potential Improvement

Repairing certain vehicles can be difficult at times due to limited availability of necessary repair equipment in certain shops, which leads to increased queues and downtime. Further examination on productivity and capacity in each shop may highlight areas for improvement. Additionally for certain vehicle classes, the same vehicle is scheduled for separate appointments for different work, rather than determining all work needed for that vehicle and scheduling it all for the same time.

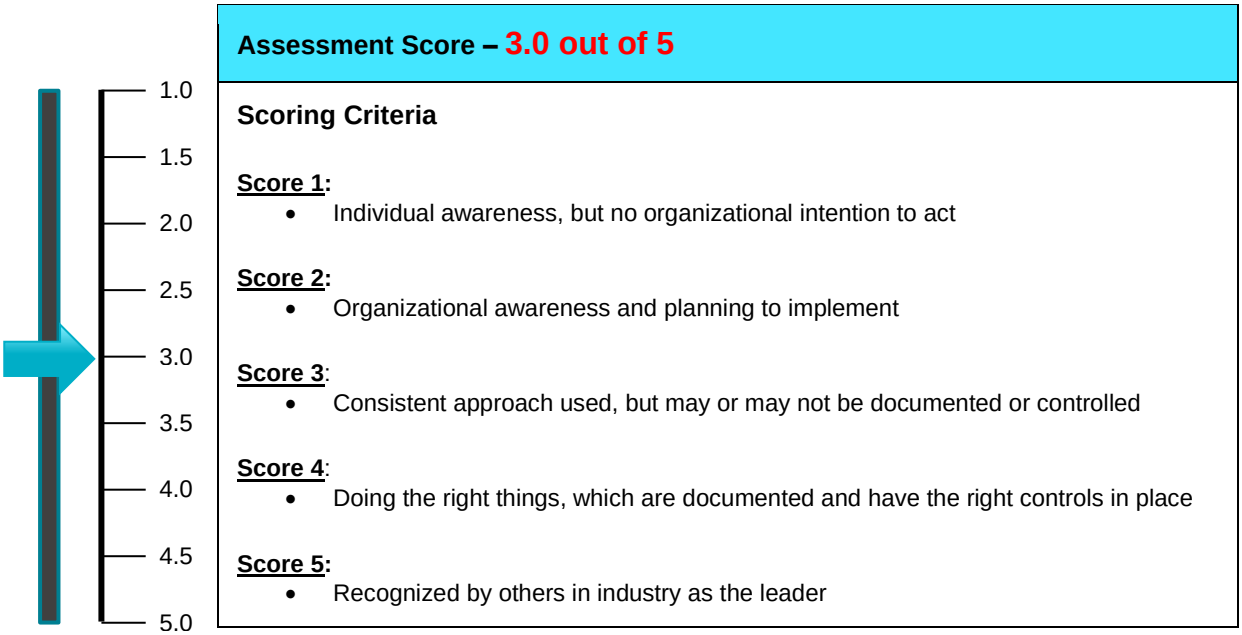
With this process, it takes an average of 9.7 days between the time the asset is flagged for maintenance and the time the asset is actually serviced. Best practice would range between two and three business days.

Recommendations

The following recommendations are offered to assist in improving maintenance:

- Examine the maintenance shops and the apportionment of work should be conducted to determine if there is a lack or shortage of equipment at certain facilities as indicated by Logistics personnel. Also, evaluate productivity and capacity in each shop.
- Schedule vehicles, especially those with specialty equipment, for all at the same time to prevent repeat trips.
- Identify opportunities to decrease time between maintenance notification and when the vehicle actually gets serviced.

Figure F.7 Maintenance Best Practices Assessment Score



Financial Accountability

Financial accountability examines Logistics' performance in regards to keeping costs down and in the use of tools and methods to identify cost saving opportunities.

Strengths

Logistics is actively examining ways to reduce costs and has developed good ideas, such as standardizing vehicles and downsizing where possible.

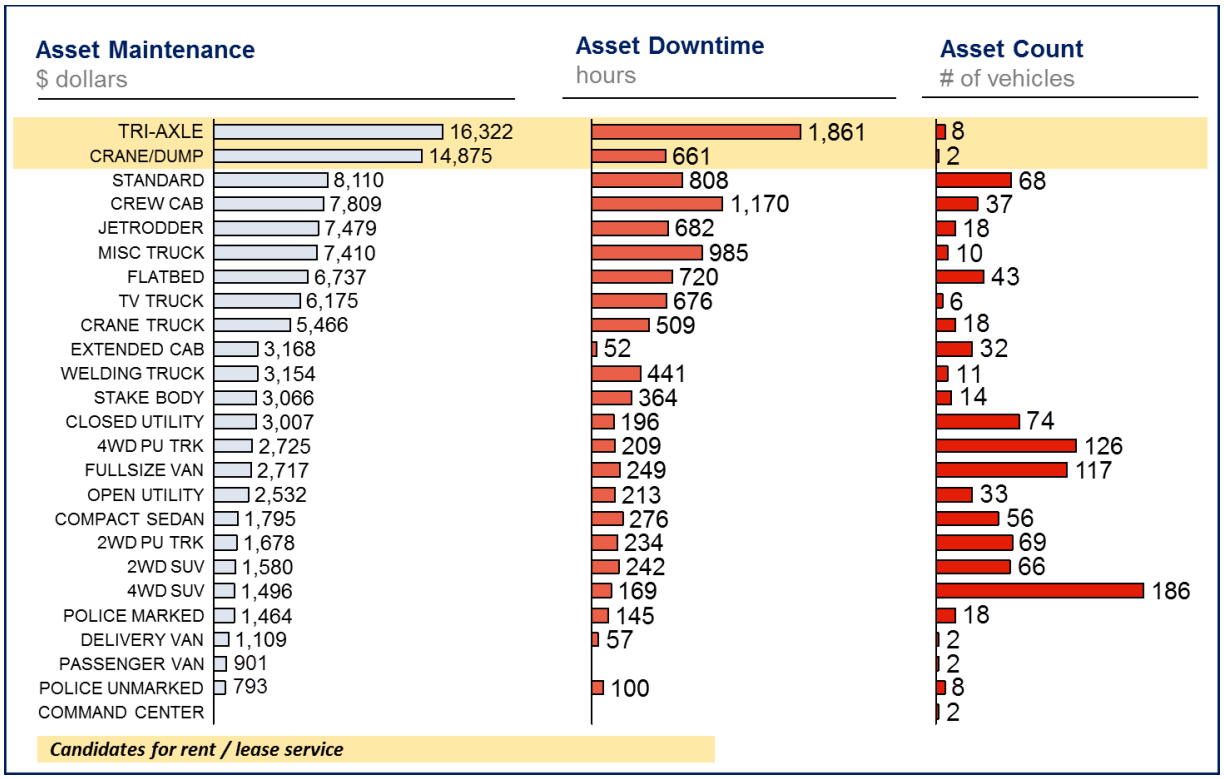
Areas of Potential Improvement

Approximately one-third of Logistics' operational expenditure is fuel. All vehicles are either diesel or gasoline and WSSC does not own any alternative fuel vehicles. A comprehensive evaluation of right-sizing the fleet should be performed to look for opportunities to reduce overall life cycle costs, including fuel, for vehicles in the fleet.

Certain vehicles are down for a considerable amount of time and are expensive to maintain. These vehicles may have potential to be rented or leased. Figure F.8 indicates the different vehicles currently owned by WSSC. The tri-axle truck and crane/dump truck have high maintenance costs and high downtime, but there are only a few of them. If these vehicles are only seldom used, then the possibility of renting them should be considered.

High-level budget, maintenance and cost information is captured. However, TEAMS data is not currently used to develop detailed cost analyses to help optimize expenditures and identify high-cost assets.

Figure F.8 Average Maintenance Costs, Downtime and County per Vehicle per Year

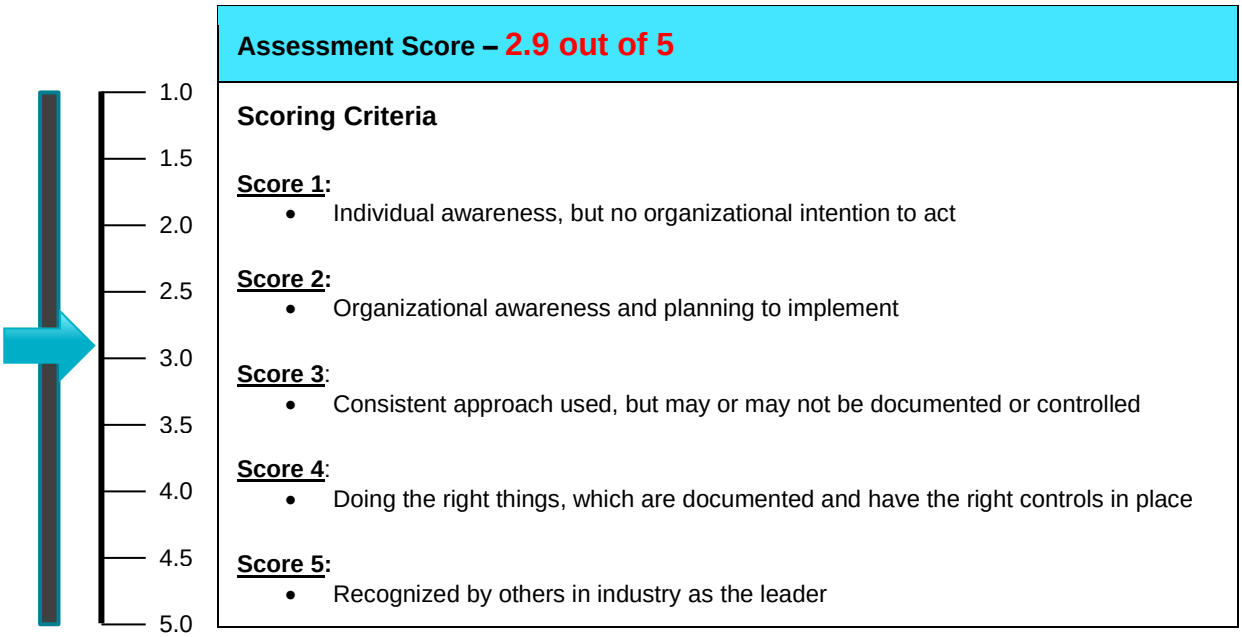


Recommendations

The following recommendations are offered to assist in improving financial accountability:

- Conduct a comprehensive evaluation of right-sizing the fleet should be performed to look for opportunities to reduce overall life cycle costs, including fuel, for vehicles in the fleet.
- Evaluate the potential to rent or lease specialty vehicles and equipment that are seldom used and historically carry significant repair costs.
- Using the TEAMS, develop metrics and dashboards that provide business cases for improvement in making vehicle and equipment purchasing decisions.

Figure F.9 Financial Accountability Best Practices Assessment Score



Demand Management

Demand management explores the responsibility of maximizing vehicle utilization while minimizing overall inventory. Logistics must work with each group to provide the appropriate vehicles and equipment needed.

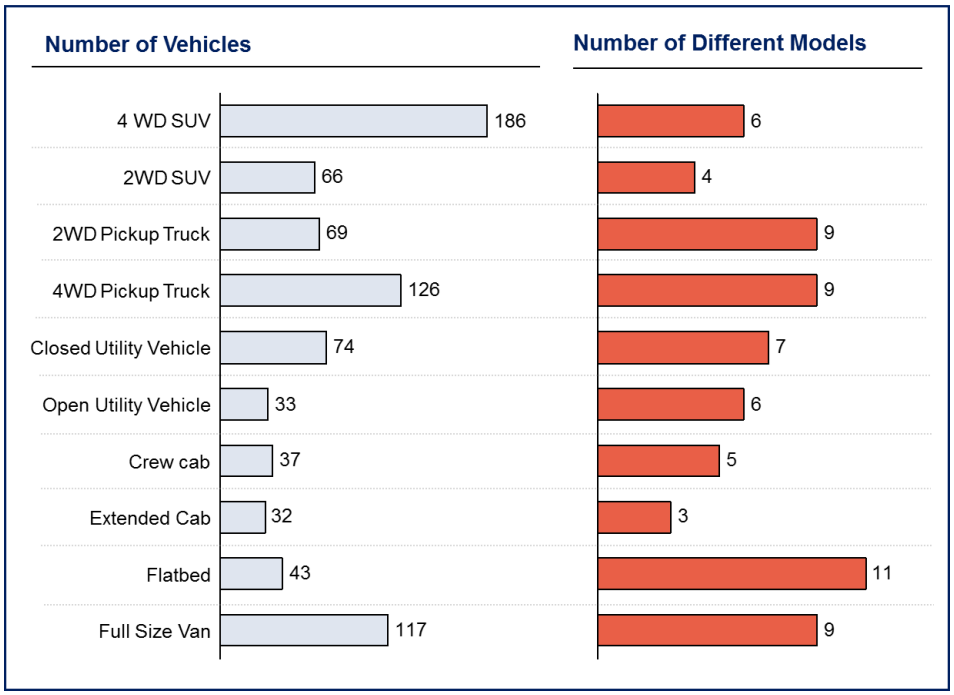
Strengths

Logistics does a relatively good job of maintaining vehicles as discussed earlier, ensuring that assets remain operational and available for use.

Areas of Potential Improvement

Consistent sentiment among staff interviewed indicated that there are vehicle types and models that can be consolidated. As Figure F.10 indicates, there are 783 vehicles that serve a similar purpose, but are broken down into 10 different types of vehicles accounting for 69 different models. This wide variety of types and models can increase procurement costs, since buying a smaller number of certain vehicles will reduce the opportunity for bulk buying discounts. Furthermore, maintaining 69 different models is typically more complex and expensive.

Figure F.10 Number of Active Vehicle Types versus Number of Models for Each Type



Currently, there is a lack transparency in utilization of pool vehicles. Anecdotally, staff tends to overbook vehicles to ensure access leading to underutilization of the pool fleet and causing the perception of insufficient fleet inventory.

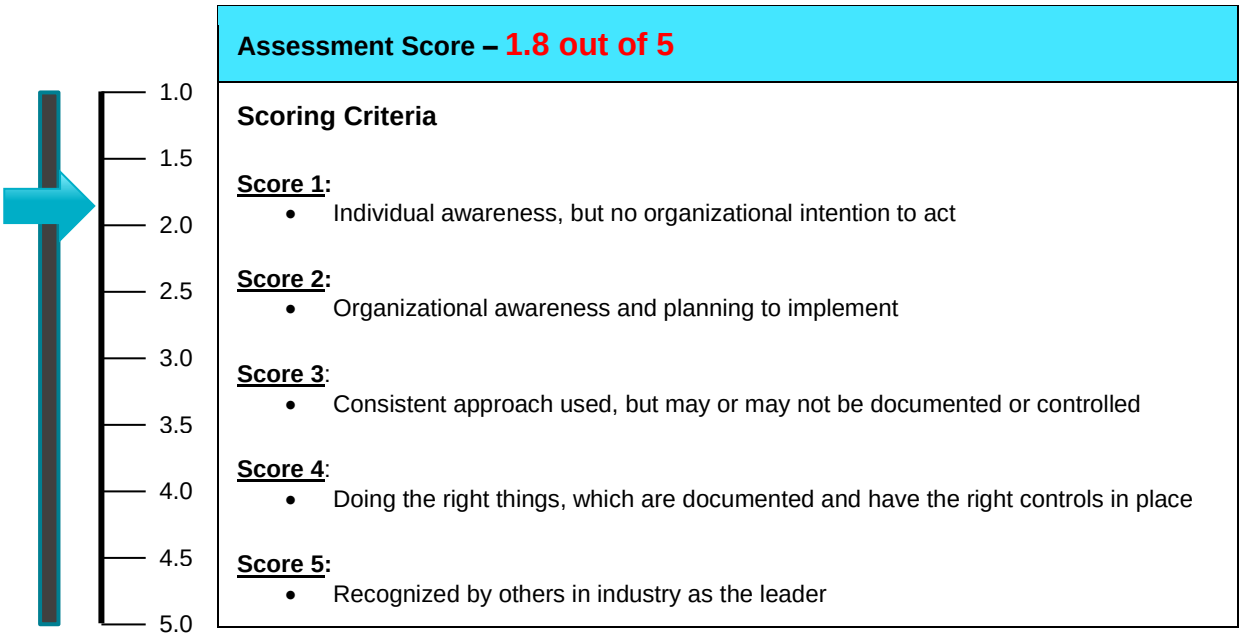
A common sentiment among all interviewees is that the procurement cycle can be long, sometimes lasting over a year, causing procurement cycles to misalign with budget cycles. This makes it difficult for Logistics to plan accordingly and provide vehicles when needed.

Recommendations

The following recommendations are offered to assist in improving demand management:

- Develop standard vehicle specifications to allow for bulk buying, better pricing and increased simplicity.
- To maximize pool vehicle utilization, evaluate the use of a reservation system such as the Zipcar® FastFleet tool for all pool vehicles.
- Align Logistics purchasing with Procurement schedules.

Figure F.11 Demand Management Best Practices Assessment Score



Performance Management

Performance management explores how Logistics tracks performance and how it manages operations based on that performance.

Strengths

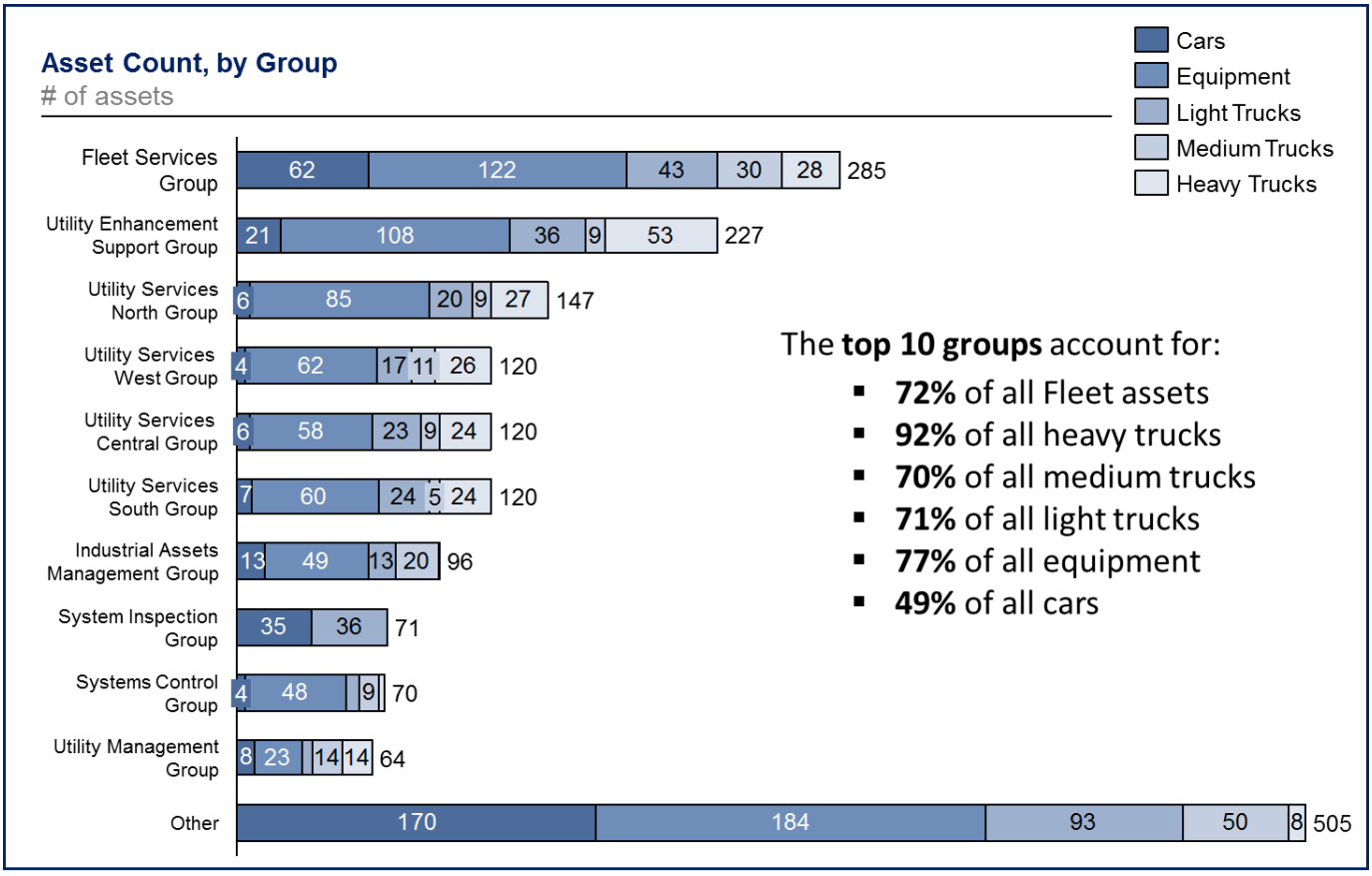
None

Areas of Potential Improvement

It is not clear how the metrics reported are used in actually managing Logistics. No targets or control bounds are set for each metric, and no clear, specific accountability is established for metric performance. Line level staff prepares the monthly metric reports, but find no meaning or value in doing so. Little to no regular formal performance discussions take place and problems are not systematically diagnosed using tools such as Root-Cause Analysis (RCA). There are 34 groups that interact with Logistics to replace and maintain vehicles, with the bulk of fleet assets assigned to the top 10 groups as indicated by Figure F.12.

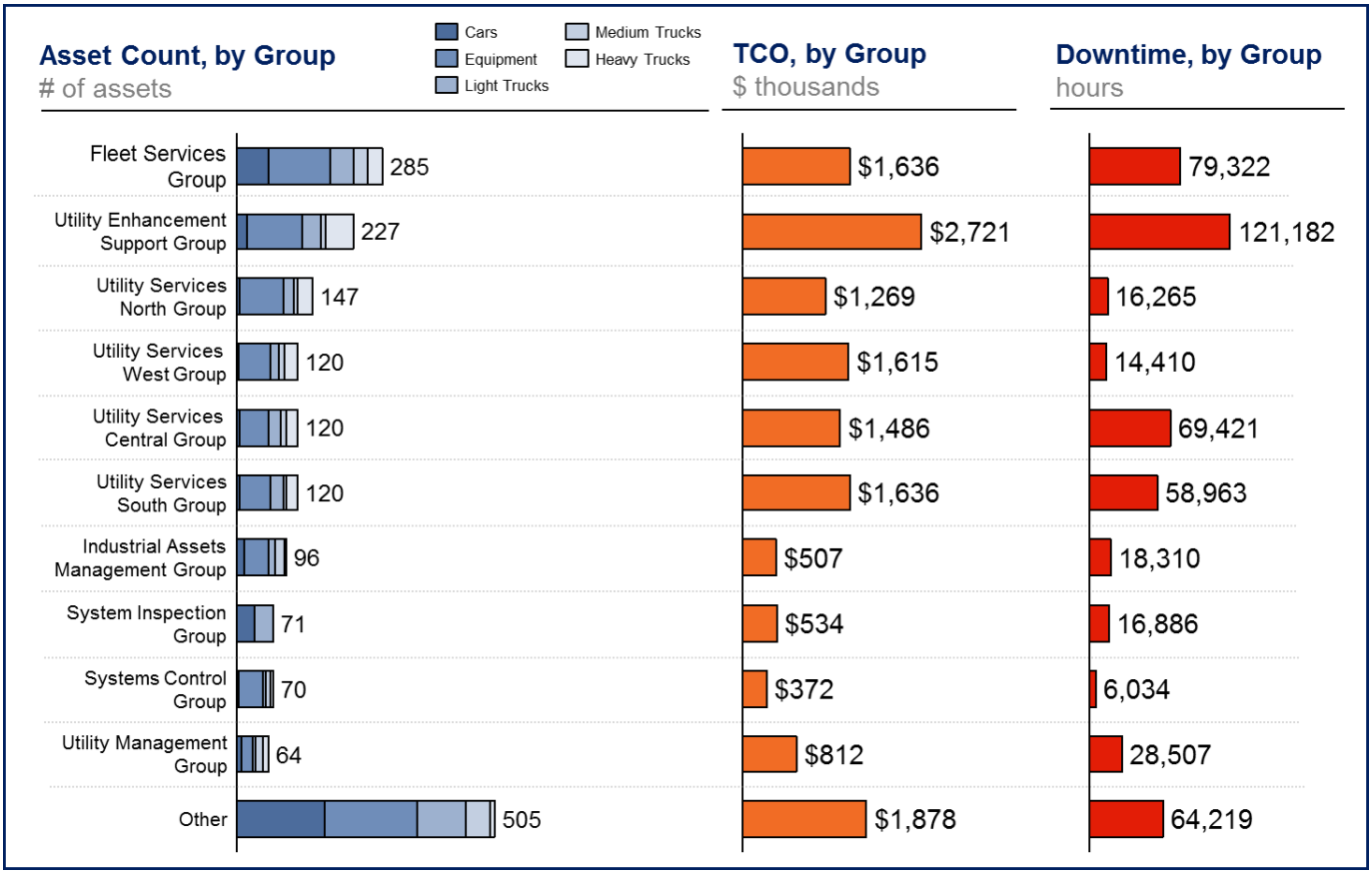
Currently, these groups all act independently rather than as a collective organization. This leads to fragmented and inconsistent processes, as well as a lack of information sharing that could improve operations and minimize costs. For instance, certain groups within Utility Services are proactive when it comes to requesting vehicles from another group. If an infrequent, temporary shortage of a particular type of vehicle exists, they will call another depot and request a short-term loan for that vehicle. Others do not take this approach and instead request additional vehicles from Logistics. If any group continually experiences a shortage of vehicles, then the request of additional vehicles may be warranted. However, if there are infrequent and temporary shortages, then communication should occur to allow vehicles to be temporarily loaned between groups when the need arises.

Figure F.12 Groups and their Asset Counts



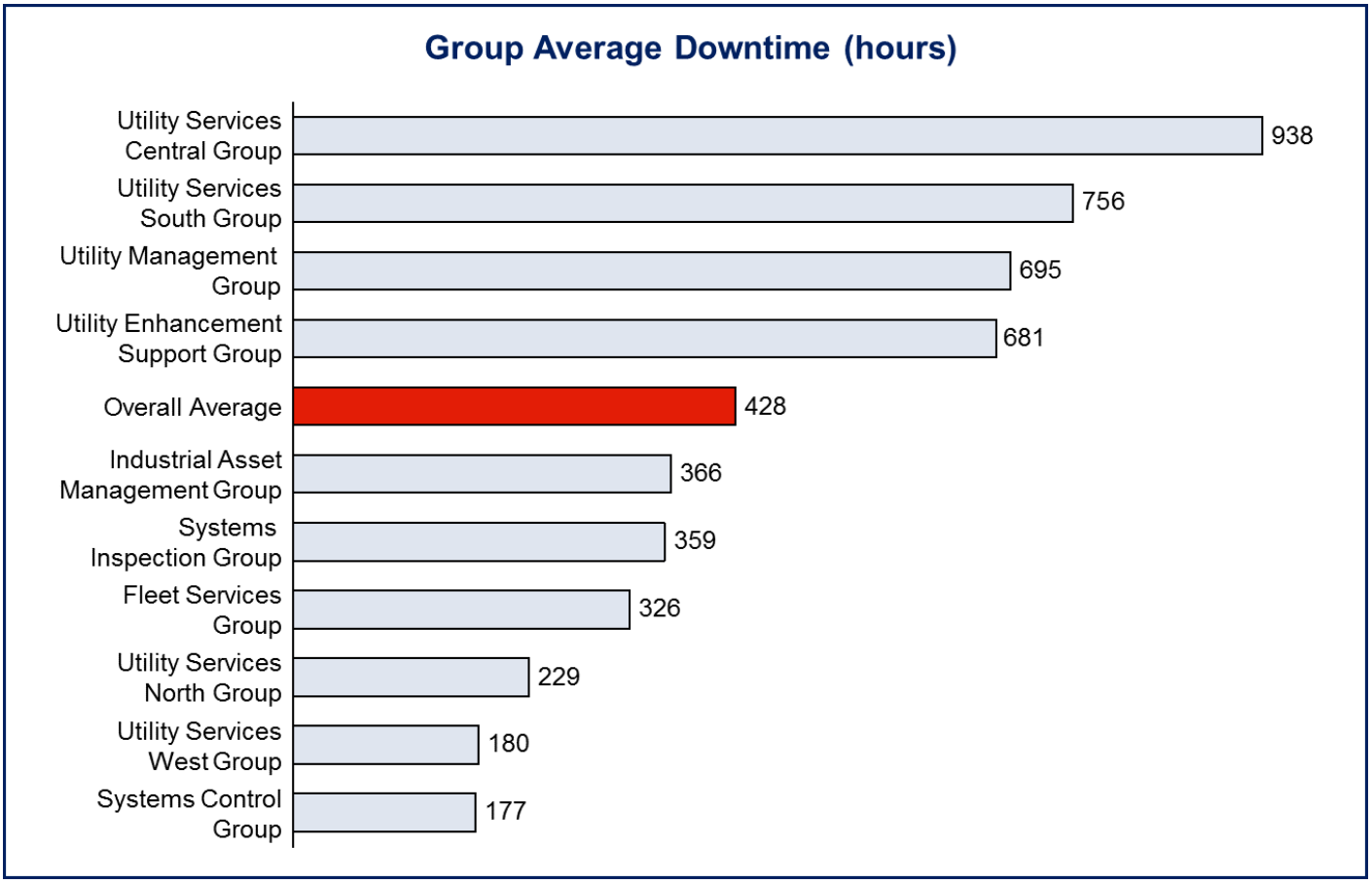
In addition, inconsistent processes have led to differences in terms of managing fleet. From Figure F.13, Fleet Services manages the most vehicles but has significantly better costs and downtime compared to the Utility Enhancement Support Group. Utility Enhancement Support's total cost of ownership is 66% higher and their downtime is 53% higher.

Figure F.13 Group Asset Count, Total Cost of Ownership (TCO), and Downtime



If the last column of Figure F.13 is broken down further to look at the average downtime per group per vehicle the differences become more apparent as shown in Figure F.14.

Figure F.14 Average Downtime per Vehicle

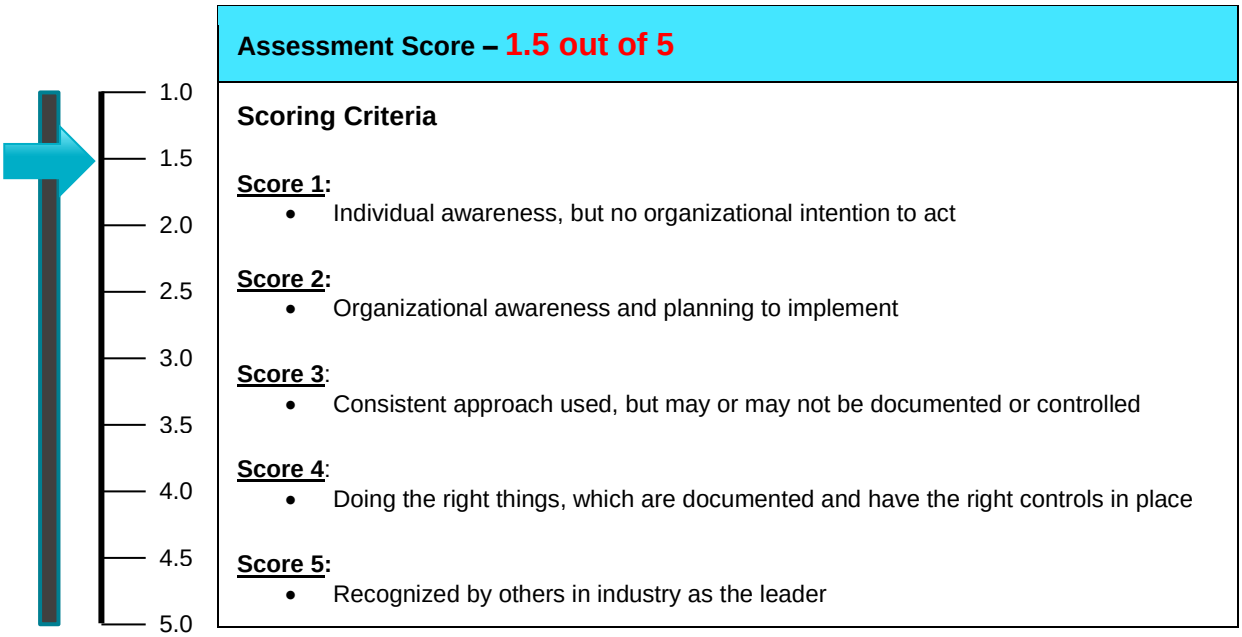


Recommendations

The following recommendations are offered to assist in improving performance management:

- Develop and implement a robust performance management system, including holding staff accountable for specified performance. Standardize metrics as much as possible across all workgroups.
- Logistics to play a more coordinating role in managing vehicles assigned to different work groups.
- Evaluate differences and perform root-cause analysis of vehicle downtime in all work groups.

Figure F.15 Performance Management Best Practices Assessment Score



Transparency and Communications

Transparency and Communications explores how effectively staff within Logistics communicates with each other and with other groups. Effective communication requires that Logistics be transparent, concise, complete, considerate, and provide mechanisms to not only disseminate information but to also have a mechanism to collect feedback and to have meaningful discussions.

Strengths

None

Areas of Potential Improvement

All staff interviewed felt that Logistics and end users are disconnected. Logistics currently does not have a consistent schedule for meeting with group leaders of different groups, and without an open forum where group leader and Logistics can discuss issues, needs, and ideas, the groups have "siloed" themselves. Logistics should take the a lead and setup a regularly scheduled meeting with the top 10 groups that use the most vehicles, to remove barriers and foster a more collaborative environment to improve the working culture.

Currently, there are no dashboards or standardized metrics in use that can easily and effectively convey the performance of a particular area within Logistics. Reports do exist but they are not intuitive and require technical knowledge to analyze. Without graphical dashboards and standardized metrics, the TEAMS tool will seem insufficient to most users.

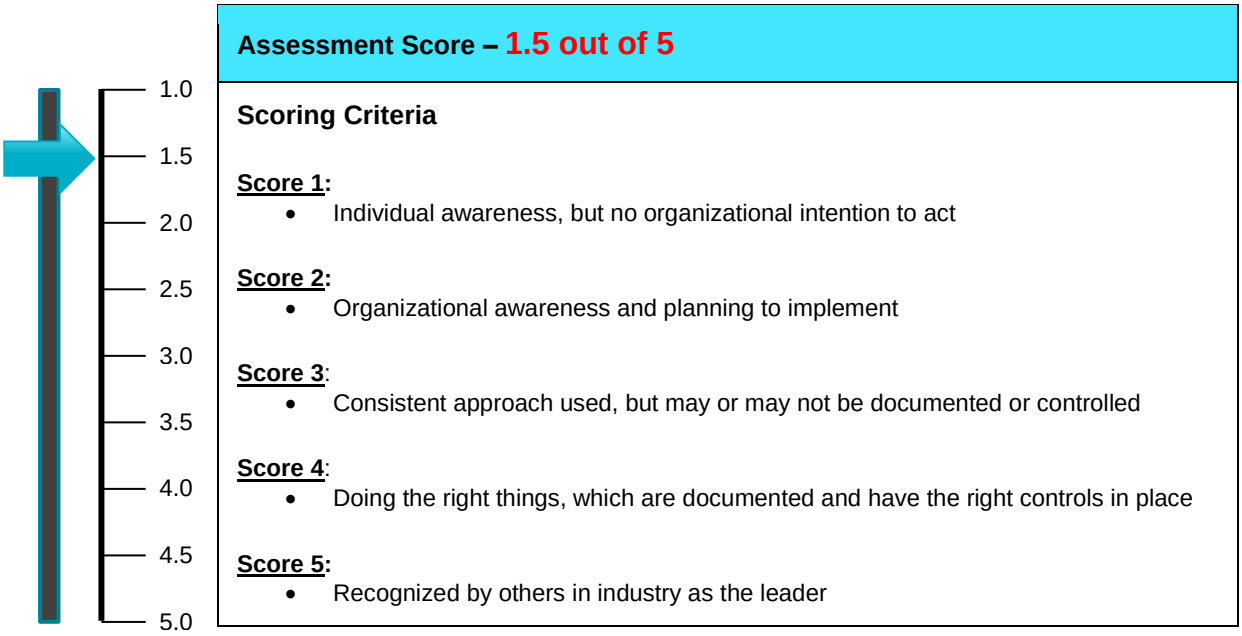
Recommendations

The following recommendations are offered to assist in improving transparency and communication:

- Establish clear communication channels, both internally among Logistics and with other WSSC groups, and define how information gets circulated as well as how Logistics can collect feedback on a monthly basis.

- Schedule regularly meetings with all groups and internal Logistics staff to share performance data, define action items, and assign accountability.

Figure F.16 Transparency/Communication Best Practices Assessment Score



Mindsets and Capabilities

Mindsets refer to the motivation staff has to perform the work and is normally reflected in overall morale, but also includes available performance incentives. Capabilities evaluate the level of competency and assign specific training to expand core skill sets.

Strengths

The Logistics staff is very knowledgeable in their area of expertise and is aware of changes that need to happen to improve day-to-day operations.

Areas of Potential Improvement

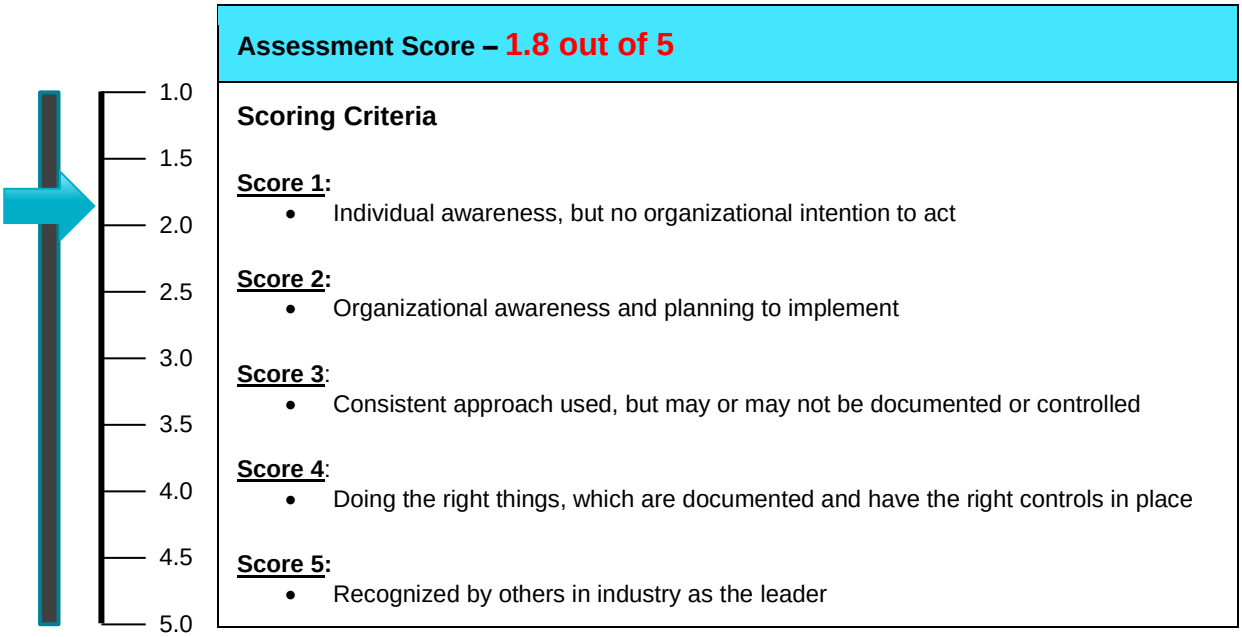
There is currently no data to quantify staff morale, and site visits indicate that current morale is mixed. Also strong individual development plans (IDPs) have not been developed that detail specific training required reaching a targeted level of competency. These are normally reviewed and assigned during annual appraisals with a supervisor.

Recommendations

The following recommendations are offered to assist in improving mindsets and capabilities:

- Develop and implement IDPs for each classification that detail personal objectives for the forthcoming year to be completed during their annual appraisal with their supervisor.
- Develop and implement regular climate and 360-surveys to gauge and track working attitudes and environment.

Figure F.17 Mindsets and Capabilities Best Practices Assessment Score



BEST PRACTICES EVALUATION

Utility Services

UTILITY SERVICES

Background and Context

The Utility Services Division is one of the largest within the WSSC organization, with 503 full-time staff. It provides field maintenance for the WSSC water distribution system, including water meters, and the sewerage collection system. The group consists of:

- Utility Services Depots (four groups) – Responsible for providing field maintenance in the water distribution and the sewerage collection systems within specified geographical boundaries. Responsibilities include infrastructure maintenance and repairs and both large- and small-meter testing and repairs. Each group consists of one meter unit and three maintenance units.
    - North Depot – Located in Gaithersburg, is responsible for field maintenance in northern Montgomery County
    - West Depot – Located in Lyttonsville, is responsible for field maintenance in southern Montgomery County
    - Central Depot – Located in Hyattsville, is responsible for field maintenance in northern Prince George's County
    - South Depot – Located in Temple Hills, is responsible for field maintenance in southern Prince George's County
- Utility Enhancement Support Group – Located in Hyattsville with satellite offices in various other depots, is responsible for water meter shop operations, meter reading and in-house water main replacement
- Utility Management Group – Located at WSSC headquarters in Laurel, is responsible for sewer inspection; pre-stressed concrete cylinder pipe (PCCP) inspection and monitoring; and large-valve inspection and replacement
- Utility Services Strategic Development Group – Located at WSSC headquarters in Laurel, is responsible for training and skills development, as well as performance measurement and monitoring

Work performed by the Utility Services Depots is mostly initiated by the emergency call center as a result of a customer issue and/or complaint. Per the approved FY16 Budget, WSSC's current level of service (LOS) is to have staff arrive at a customer's emergency maintenance situation within two hours of receiving the complaint and restoring service within 24 hours of a service interruption. This LOS drives the overall field operation and business practices set up to support it, including the 24/7 shift schedules implemented at all four depots.

Water Distribution System Maintenance

WSSC sends water from its two water treatment plants through 5,500 miles of water main. It faces the same problems as many of the Northeastern utilities in terms of the age of the system and the water main

breaks associated with the freeze/thaw cycle, as well as challenges with large-diameter PCCP (pre-stressed concrete cylinder pipe). Table U.1 compares high level benchmarks from WSSC to QualServe and the Large Utility Median.

Table U.1: Water Distribution System Maintenance Performance Measures

Measure	WSSC (FY13)	QualServe Median*	Large-Utility Median
Leaks/100 miles	1.9	15	15
Breaks/100 miles	31.0	13	15

Even though the number of water leaks WSSC reported is significantly less than either the QualServe or Large Utility median, the number of water main breaks WSSC experienced is more than double than the Large Utility median and almost three times the QualServe median. Construction methods; age, material, type and class of pipe; pressure surges; and surface loading should be evaluated and a root cause analysis performed to determine why and how so many breaks occur.

Wastewater Collection System Maintenance

Like many utilities, WSSC's unique history has contributed to the development of its wastewater system. Unlike many utilities, WSSC is operating under a consent decree to make massive upgrades to its collection system and treatment capacity to significantly reduce sanitary sewer overflows (SSOs). Table U.2 compares the number of SSOs from WSSC to QualServe and the Large Utility Median.

Table U.2 Wastewater Treatment and Collection Performance Measure

Measure	WSSC (FY13)	QualServe Median*	Large-Utility Median
SSO/100 miles	2.98	2.53	2.30

While SSOs are still above median, WSSC has been showing a downward trend over the past five years that is expected to continue into the future, as consent decree work in completed.

Best Practices Evaluation

Business practices currently implemented within the Utility Services Division were assessed through a series of document reviews, data evaluation from the WSSC's computerized maintenance management system (CMMS), and staff interviews conducted in January through March 2016. The evaluation that follows is based on 18 Veolia best practice standards, each with specific subcategories to determine overall performance. It uses a standardized scoring system from 1 (basic performance) to 5 (industry best). Criteria used in this scoring system, as well as the score assigned, are indicated below.

To assist in identifying which standards have the largest opportunity for improvement, a second score was identified as a near-term improvement goal. This score is determined to be where WSSC could be in less than 24 months with some additional focus and effort, given the current landscape. The difference between actual performance and the near-term performance goal forms the basis of a gap analysis that is then used to prioritize areas that have potential for improvement. Any arithmetic difference of 2.0 or

greater between actual performance and the near-term performance goal was considered significant, and any difference in scores between 1.5 and 1.9 was considered potentially significant. Figure U.1 summarizes the evaluation and Table U.3 summarizes the results from the assessment analysis.

As a general guidance note, scores normally achieved for a large utility such as WSSC would normally range from 3 to 5.

Figure U.1 WSSC Utility Services Best Practices Evaluation Summary

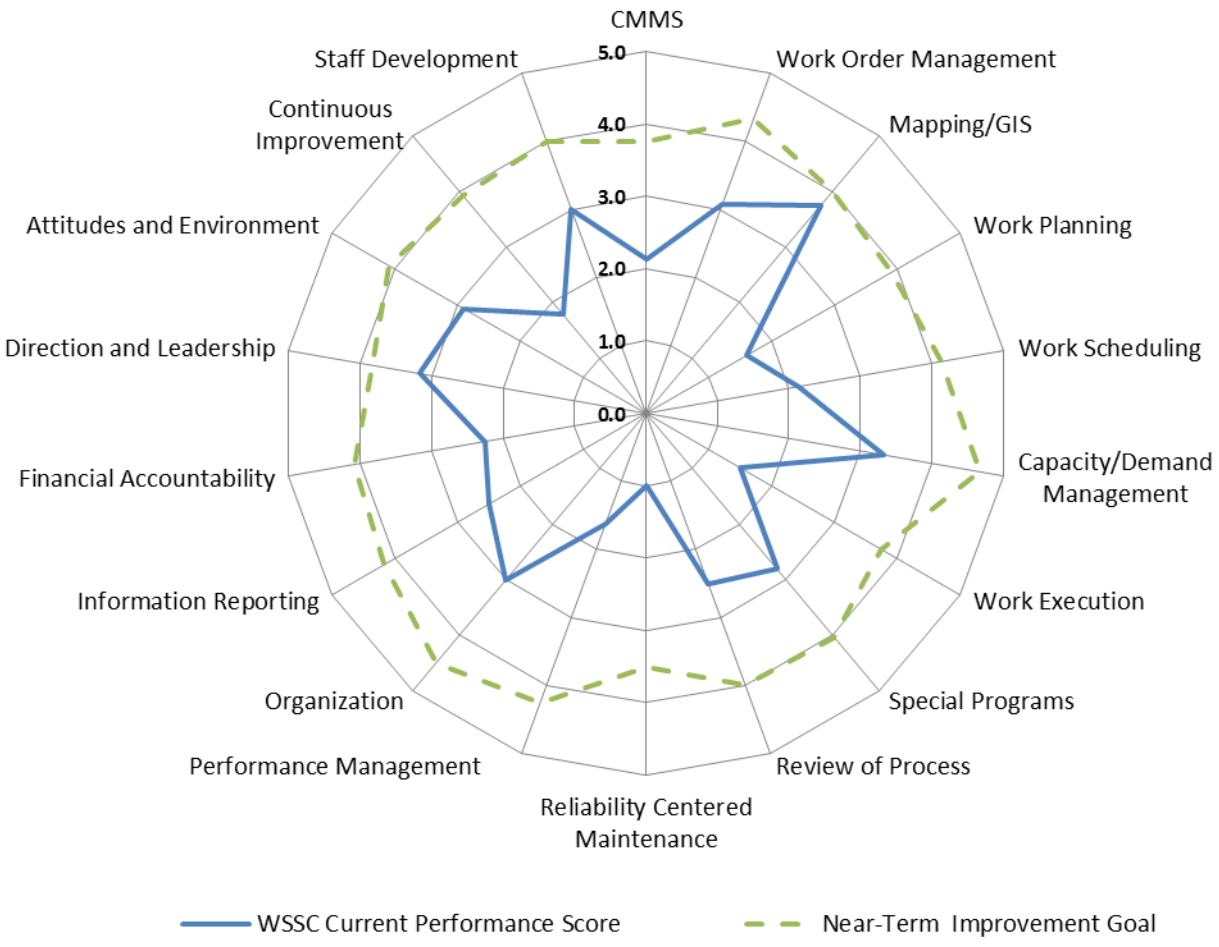


Table U.3 WSSC Utility Services Best Practices Gap Analysis

Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
CMMS	2.1	3.8	1.6	Potentially
Work Order Management	3.1	4.3	1.3	No
Mapping/GIS	3.8	4.0	0.3	No
Work Planning	1.6	3.9	2.3	Yes
Work Scheduling	2.1	4.1	2.0	Yes
Capacity/Demand Management	3.3	4.7	1.3	No
Work Execution	1.5	3.8	2.3	Yes
Special Programs	2.8	4.0	1.2	No
Review of Process	2.5	4.0	1.5	Potentially
Reliability Centered Maintenance	1.0	3.5	2.5	Yes
Performance Management	1.6	4.3	2.6	Yes
Organization	3.0	4.5	1.5	Potentially
Information Reporting	2.5	4.2	1.7	Potentially
Financial Accountability	2.3	4.1	1.8	Potentially
Direction and Leadership	3.2	3.8	0.7	No
Attitudes and Environment	2.9	4.1	1.2	No
Continuous Improvement	1.8	3.9	2.1	Yes
Staff Development	3.0	4.0	1.0	No

CMMS

WSSC currently utilizes a legacy in-house-developed mainframe CMMS system with plans to upgrade to an Oracle® Utilities Work and Asset Management (WAM) based product, which is referred to as “TEAMS”, within the next year.

Strengths

All staff currently uses the existing CMMS, and the new TEAMS system is starting to be field-piloted at the Customer Care Depots. The existing CMMS interface is relatively user-friendly and staff has mobile access to the system. Management indicated that some business practices are in place, but these were not provided for review. Most above-ground assets are included in the CMMS database, although asset condition assessments and full asset inventories do not regularly take place. Assets are structured into a logical hierarchy, each with unique identifiers, and most are correspondingly tagged in the field.

Areas of Potential Improvement

CMMS database is lacking key asset knowledge accuracy, including replacement value and anticipated asset life. Labor costs for each work order are not currently tracked in the CMMS, and based on data from calendar year 2015 (CY15), approximately only 3% of all work orders track actual material costs. The CMMS database is currently being used a clearinghouse for work orders and not as a planning tool in daily maintenance activities or as a true asset management tool.

After review of all work orders completed in CY15, it appears that there exist some data quality issues. For example, Figure U.2 indicates a Pareto analysis of the average time spent completing specified work order types. As can be seen below, approximately 34% of all time tracked in CMMS was for replacing water mains. Assuming this data is accurate, this task would have required approximately 285 FTE-shifts to complete, which equates to over 60% of the workforce in Utility Services. WSSC internally performs only about 10 miles per year of water main replacement and uses an outside contractor to perform the remaining goal of 50 miles per year of replacement. Discussing the data findings indicated in Figure U.2 below, Utility Services management believes that work orders are being generated to track contractor work in the CMMS. This practice is problematic as it inaccurately portrays actual performance by WSSC staff in the field.

Other issues with data quality are the indication of when the work order was created and which shift it was assigned to. There exists a time stamp that indicates a 12-hour time in the CMMS data, but there is no indicator of “AM” or “PM”. Also, as Figure U.3 below indicates, approximately one-third of all work orders do not specify during which shifts the work was performed. As such, it is impossible to evaluate the time and nature of work orders created after normal business hours to determine the appropriate staffing levels needed to accommodate the work. Implementation of the new WAM-based TEAMS tool should alleviate this issue.

Figure U.2 Pareto Analysis of Average Time Spent per Work Order Type, CY15

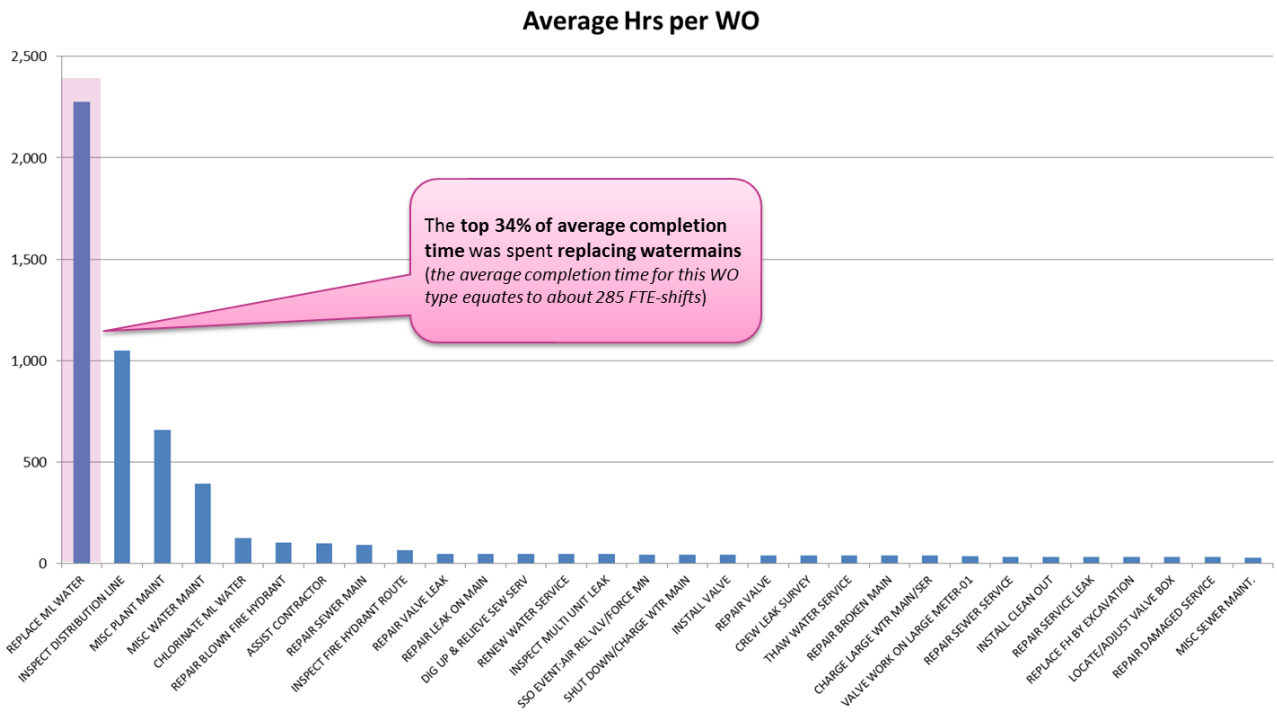
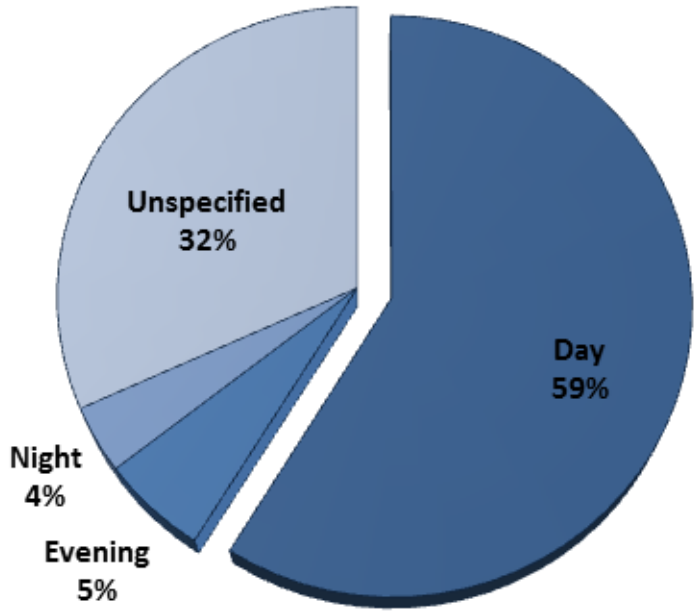


Figure U.3 Work Order Shift Assignment Distribution



Recommendations

The following recommendations are offered to assist in improving overall usage of the CMMS:

- Track only work performed by WSSC personnel in CMMS. Actual labor times and material costs should be also be tracked against each work order.
- Use the CMMS as an asset management tool:
    - Conduct regular, comprehensive inventories and condition assessments for all assets.
    - Conduct regular trend analyses on maintenance histories for critical assets.
- Develop and train staff on quality assurance/quality control (QA/QC) procedures to ensure the quality and nature of the data entered into the CMMS database.
- Include all below-ground assets in the TEAMS database, once implemented.

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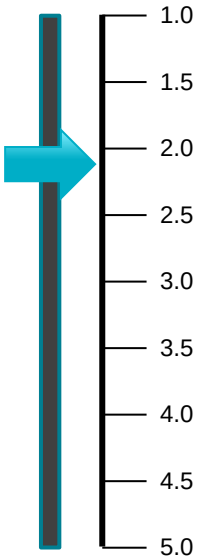
Figure U.4 CMMS Assessment Score and Scoring Criteria



Assessment Score – 2.1 out of 5

Scoring Criteria

Score 1:

- CMMS in use, but does not actually support field activities. Interface is cumbersome and there are little or no controls to ensure accuracy and consistency of data input.
- Formal asset inventory has never been performed - relying solely on historic/anecdotal information. Some new assets included when built. May include some above-ground assets, but no below-ground assets. No field assets are tagged with asset ID numbers.
- Asset condition assessments have never been performed. Too little relevant field data is input into CMMS database to track maintenance histories.
- No formal asset hierarchy exists; assets may have multiple asset ID numbers in database.

Score 3:

- CMMS used to track some items and data input is mostly accurate and complete. May or may not have mobile access to database. Sometimes used as a maintenance and/or asset management planning tool.
- Formal asset inventory performed periodically, and may include both above-ground and below-ground assets. Retired assets are not regularly reviewed and archived in CMMS database, and new assets are mostly added upon installation. Field assets are only partially tagged with corresponding asset ID number.
- Asset conditions are only performed when work is assigned against the asset and may or may not be recorded in CMMS database. Some field maintenance data is collected and entered into CMMS database, but full asset maintenance histories are incomplete.
- Asset hierarchy mostly exists, although it may be fixed and not easily adaptable to new facilities/asset families. Assets have a unique asset ID number in database but are difficult to find in database.

Score 5:

- CMMS is an integral tool in maintenance planning and asset management. Clear and simple user interface, with mobile access to all staff. Documented QA/QC controls of data input are followed.
- Formal asset inventory performed on a regular basis and includes both above-ground and below-ground assets. Retired assets are regularly reviewed and archived in CMMS database, and new assets are regularly input upon installation. All field assets are tagged with their corresponding asset ID number.
- Asset condition assessments are performed regularly in conjunction with formal asset inventories. Relevant maintenance field data is collected on every work order and immediately input into CMMS database to track asset maintenance histories.
- Fully modular asset hierarchy exists that clearly assigns a unique asset ID number within a formal structure of granularity.

Work Order Management

During interviews, staff indicated that approximately 90% of all work orders are generated through the emergency call center, as a response to customer issues and/or complaints. Based on the nature of the issue/complaint, customer service representatives create a work order using pre-determined work type codes and assign the work order to the appropriate depot based on geography. On daily basis at a minimum, Unit Coordinators for each depot access the new work orders assigned to their respective depots and dispatch the work to field crews as appropriate. Each work order type has a predetermined priority and anticipated work duration programmed against it to assist the Unit Coordinators in issuing the work.

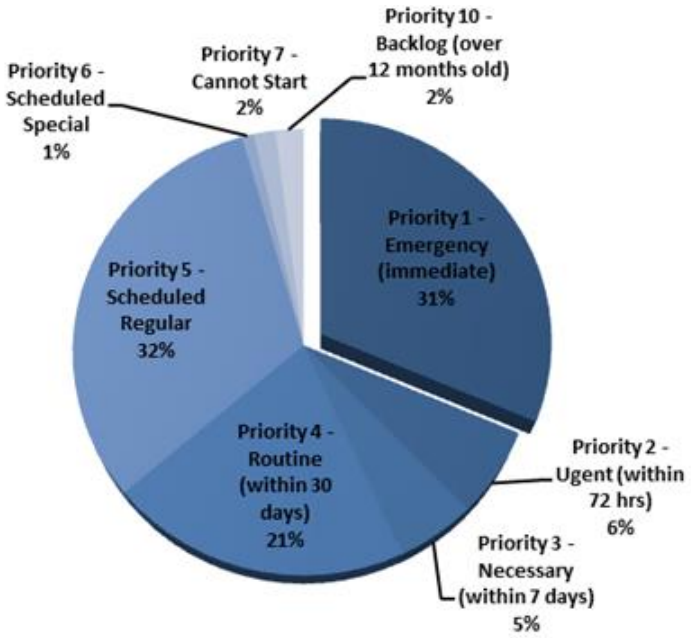
Strengths

There is a single, formal process in place to manage work orders that is tied directly to CMMS and staff regularly uses it. Emergency call center staff screen incoming work for duplicates, and field inspectors often perform site reconnaissance prior to issuance of a full crew to the worksite. Field staff do collect field activity data, although not material costs, and input it into CMMS against each work order for archival purposes.

Areas of Potential Improvement

In general, too much work is categorized as “emergency” work. This is largely indicative of a lack in appropriate work planning. Also, there exist too many priority codes that essentially dilute the effectiveness of the prioritization system. From Figure U.5, there are eight priority codes in use with the purpose of some, such as “Priority 5 - Schedule Regular” versus “Priority 6 – Scheduled Special”, being unclear. Also, work classified as “cannot start”, or is over 12 months old should still be prioritized, but not assigned a unique priority code.

Figure U.5 Distribution of Work Order Priorities



There also appears to be little cross-functional evaluation with respect to work orders at the depot level. Coordination does exist between the Utility Enhancement and Utility Management groups and the depots, but the depots do not coordinate well with each other.

Recommendations

The following recommendations are offered to assist in improving overall work order management:

- Provide one centralized management group that evaluates all incoming work generated from both the emergency call center and internally from the Utility Enhancement and Utility Management groups.
    - The centralized management group should be charged with evaluating the impacts of the work on the WSSC system as a whole and assigning work an appropriate priority level priority as well as evaluating what resources are available from all depots.
    - This group should also have primary responsibility for the QA/QC of all data input into the CMMS database, including capture of labor and material costs.
- Develop a new prioritization system consisting of four priority codes:
    - 1 – Emergency (to be done immediately)
    - 2 – High (targeted to be done with one week)
    - 3 – Normal (targeted to be done with two weeks)
    - 4 – Low (targeted to be done within four weeks)

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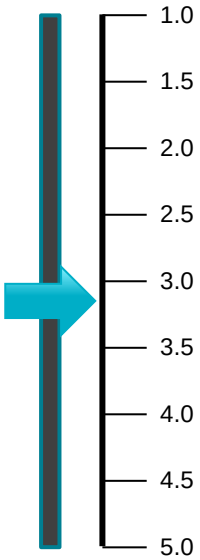
Figure U.6 Work Order Management Assessment Score and Scoring Criteria



Management Assessment Score – 3.1 out of 5

Scoring Criteria

Score 1:

- There is no single formal process by which work is requested. Work orders for field services are just passed on without further investigation or review.
- Informal and/or insufficient processes exist to prioritize work.
- Priority of a work order is decided with little or no consideration of other departments or within divisions.
- No formal rules/processes exist to determine what emergency work is; emergency work is dispatched without management and/or supervisor authorization.
- Little to no information regarding the work performed is captured on work order.

Score 3:

- There is an informal process in place to request work, but it is not fully documented. Staff may or may not always follow process, depending on situation. The process may or may not be tied back to CMMS.
- Unwritten and/or informal processes exist to evaluate work orders with some being completed without having to send field personnel.
- Work is prioritized, but is not consistently done. Too many or too few prioritization categories exist to effectively manage workload.
- Informal and/or insufficient processes exist for supervisors and management to jointly determine job validity and priority.
- Emergency work orders undergo a separate informal process to rapidly authorize work and dispatch field staff.
- Limited information regarding the work performed is captured in CMMS or on hard copies and stored in paper files.

Score 5:

- There is a standardized, documented process by which work is requested. Staff are trained on this process and the process is tied back to CMMS. There is a standardized process in place to investigate and evaluate work orders to minimize field visits.
- A specific, documented protocol describing work priority that accounts for overall system risk, customer importance and effects to revenue generation exists and staff uses it exclusively.
- Clearly articulated and sufficient processes exist for supervisors and managers to jointly determine job validity and priority.
- Clearly articulated and sufficient processes exist for management and/or supervisors to expedite the authorization of emergency work.
- All information regarding the work performed, failure types, actual labor costs, actual material costs and other relevant field information is captured by field personnel and input into CMMS before the work order is closed out.

Mapping/GIS

In general, there is a robust GIS system currently in place and will eventually be tied into the new TEAMS system when fully implemented.

Strengths

Interviews with staff indicated that the GIS comprehensively includes all above-ground and most underground assets in the WSSC system. Most asset information, such as asset sizes, material, date of installation, asset type, etc., is included. The GIS mapping is updated on a daily basis from construction as-built drawings and verified by field survey where needed. Staff also indicated that there exist hydraulic models for both the potable water distribution system and the sewerage collection system. Models are currently used to simulate flows under various demand and weather conditions.

Areas of Potential Improvement

The hydraulic models are only periodically calibrated and updated, using actual field data as well as work from the CIP and R&R programs.

Recommendations

The following recommendations are offered to assist in improving mapping and GIS:

- Calibrate and update the collection system model to account for County demographic information and development activity.

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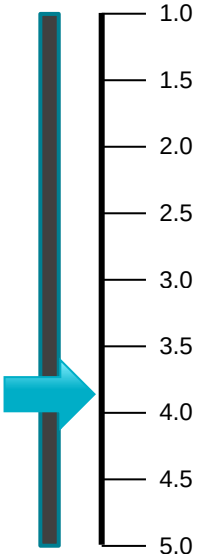
Figure U.7 Mapping/GIS Assessment Score and Scoring Criteria



Assessment Score – 3.8 out of 5

Scoring Criteria

Score 1:

- Only paper copies locating above-ground and underground assets (linear and discrete) and meters exist and may or may not be centralized in one location. Asset information is limited.
- No water distribution system model or sewerage system collection model exists.

Score 3:

- A fairly comprehensive GIS database locating above-ground and underground assets (linear and discrete) and meters exists. Limited asset information is included and the database is occasionally updated. There is no link between the GIS database and CMMS.
- Water distribution system model and/ or sewerage system collection models exists, but limited mostly to larger transmission lines. Water distribution model is used to simulate flows under various demand and/or shutdown conditions only. Sewer system collection/transmission model is only used to simulate flows under various seasonal, diurnal and weather scenarios.

Score 5:

- A fully comprehensive GIS database locating underground assets (linear and discrete) exists and includes all asset information, such as pipe size, pipe material, date of installation, valve type, valve size, valve actuator type, etc. GIS is tied directly back to CMMS and GIS database is updated regularly.
- Comprehensive water distribution system model exists and includes both larger transmission and smaller distribution lines; is used to simulate flows under various demand and/or shutdown conditions, determine and evaluate potential water hammer scenarios and evaluate chlorine decay within system; and is regularly calibrated with actual field testing and regularly updated with water main R&R work.
- Comprehensive sewer collection model exists and includes both larger and smaller collection lines; is used to simulate flows under various seasonal, diurnal and weather scenarios and evaluates potential for overflows as well as to manage FOG program; and is regularly calibrated with actual field testing and regularly updated with sewer inspection and R&R work.

Work Planning

With the exception of customer-scheduled meter work, work planning is generally limited to individual Unit Coordinators who provide daily review of new work orders issued by the Emergency Call Center and distribute the work directly to field staff. No specific data field indicates whether the work is preventive maintenance (PM) or corrective maintenance (CM), and as such, an evaluation of the two was not possible.

Strengths

Labor requirements and standard job time requirements have been predetermined and programmed into CMMS for each work type code, although these are not regularly reviewed, calibrated against actual work

performance and updated accordingly. None of the staff interviewed knew who originally performed this activity or when it was done.

Shutdown planning generally occurs through Engineering, and there are formal procedures to perform system shutdowns, as well as a formal sign-off process for all key personnel affected by the shutdown.

Areas of Potential Improvement

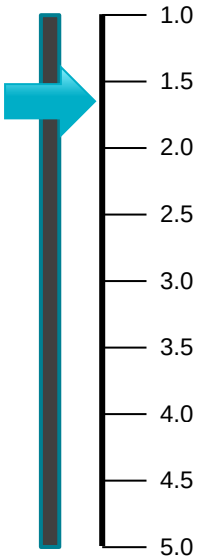
There is little to no pre-planning of work, outside of what has been preprogrammed in to CMMS, based on work type. Work planning horizon is one day or less, as Unit Coordinators essentially respond to "fires" as new work is assigned. There is inconsistency in this response between Unit Coordinators in the same depot, as well as across depots. Unit Coordinators generally have responsibility for the work of up to 30 field staff, which is much greater than optimal. Anticipated tool, equipment, parts and material requirements are not specified on each work order and rely on field staff to figure out when on-site. There exists no formal guidance and/or sequence of tasks identified on the work order to assist field staff in performing the work. No clearance and/or permit requirements to perform the work are specified on the work order, nor are there any specific safety requirements (e.g., confined space, fall hazards, hazardous materials, etc.) highlighted on the work order to assist staff in having the appropriate personal protective equipment and/or training/certification to perform the work.

Recommendations

The following recommendations are offered to assist in improving work planning:

- Establish a central planning section whose sole responsibility is to develop detailed job plans for every work order that identifies, at a minimum, the following:
    - Tools, parts, material and/or equipment required to complete the work.
    - Additional information to streamline or give guidance on the required repair.
    - Permits and/or clearances required to complete the work.
    - Special safety requirements for completing the work.
- Exclusively dedicate a planning group to developing job plans, evaluating and prioritizing work, as well as data mining the CMMS to provide useful information in making management decisions.
- Develop specific business practices to outline the new job planning workflow and describe in detail each step in the process, who is responsible for performing it, and how each step in the workflow influences the others.
- Regularly review labor requirements and standard job time requirements and calibrate them against actual work performance.
- Extend planning horizon to one week, at a minimum, and preferably two weeks.
- Assign specific shutdown coordinators to be held accountable for meeting all constraints during shutdowns assigned.

Figure U.8 Work Planning Assessment Score and Scoring Criteria



Assessment Score – 1.6 out of 5

Scoring Criteria

Score 1:

- No work is preplanned - work orders are issued as work requests are received. Labor requirements for each work order are determined daily, based on what staff is available that day, as work is issued directly to field staff. No standard job time requirements are indicated. No information is provided on work orders to give worker guidance as to:
- Tools, parts, material and/or equipment required to complete the work
- Additional information to streamline or give guidance on the required repair (e.g., only information is contained in title or an insufficient description)
- Permits and/or clearances required to complete the work
- Safety requirements to completing the work
- Shutdown planning is done locally without any type of formal documented process.

Score 3:

- Work is somewhat preplanned, but ad hoc and sporadic tasks done by field supervisors. Look-ahead windows generally run less than two weeks. A calendar of staff availability is used to track labor availability for whoever plans and schedules work. Standard job times are pre-programmed against each type of work order, but are never reviewed or calibrated against actual field work completion times. Work orders identify at least some of the following:
- Tools, parts, material and/or equipment required to complete the work.
- Additional information to streamline or give guidance on the required repair.
- Permits and/or clearances required to complete the work.
- Safety requirements to completing the work.
- Ad hoc shutdown planning is performed, although not consistently. Multiple departments/sections (e.g., plant operations, water quality, customer service, engineering, etc.) may be involved during the planning and approval process. A specific shutdown coordinator is generally not identified.

Score 5:

- All work is pre-planned and generally carries at least a two-week look-ahead window. Work planning is performed by an appropriately sized, dedicated staff. Supervisors complete weekly labor forecasts indicating who is available to work and how much labor time is available to the assignment of work and then submit forecasts to planning staff one week in advance. Every work order identifies all of the following:
- Tools, parts, material and/or equipment required to complete the work.
- Additional information to streamline or give guidance on the required repair.
- Permits and/or clearances required to complete the work.
- Safety requirements to completing the work.
- A formal, documented process is used to design shutdowns in order to minimize overall duration and customer impacts. Multiple departments/sections (e.g., plant operations, water quality, customer service, engineering, etc.) are involved during the planning and approval process. Specific shutdown coordinators are assigned and responsible for meeting constraints during shutdown.

Work Scheduling

In general, work scheduling is solely based on the discretion of the Unit Coordinator dispatching field crews. There is no formal business practice or procedure for how this is done, and some inconsistencies exist among Unit Coordinators as well as among Unit Coordinators in different depots.

Strengths

Generally, staff idle time is minimized and crews are assigned more than a full day's work. According to staff, travel time is accounted for in the standard job duration assigned to each work type. WSSC has standardized field staff into four multi-disciplined classifications to maximize flexibility with respect to resource allocation. Since Unit Coordinators are also supervisors, they maintain visibility of the location and general status of each job assigned to their respective crews.

Areas of Potential Improvement

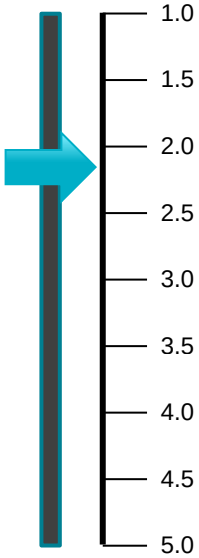
No formal look-ahead schedule exists as work is generally assigned within a day or two of being received, depending on priority. Even though travel time is reportedly included, very little attention is paid to sequence of visits.

Recommendations

The following recommendations are offered to assist in improving work scheduling:

- As part of a central planning section, establish scheduling responsibilities to dedicated personnel. Develop full, real-time visibility of resource location and job status to schedulers.
- Develop specific business practices to establish a two-week planning window that seamlessly corresponds with new job planning workflow.

Figure U.9 Work Scheduling Assessment Score and Scoring Criteria



Assessment Score – 2.1 out of 5

Scoring Criteria

Score 1:

- A full and fair day's work is not assigned to each individual (e.g., less than eight hours of work is assigned and/or the number of jobs is too few/too many).
- No attention is paid to sequence of visits or travel time.
- No formal scheduling exists; rather work is assigned as it is received.
- Scheduling is conducted with little or no consideration to skills, resources and central service/contractors.
- No dedicated schedulers exist, and whatever scheduling activities performed are done with no visibility into either location of field force or status of jobs.

Score 3:

- A full and fair day's work is assigned to each worker; however, a formal mechanism to ensure consistent application does not exist.
- Schedule is created to reduce travel time and may or may not be followed.
- At least a one-day look-ahead schedule exists, but it is continually adjusted due to add-in and/or carryover work.
- Scheduling is conducted with consideration to skills, resources and central service/contractors, but gaps remain.
- Dedicated schedulers have at least some visibility into either location of field force and/or status of jobs.

Score 5:

- A full and fair day's work is assigned to each worker and a formal mechanism exists to ensure consistent application. Time usage is tracked and reported to supervisors and management.
- Schedule is created to reduce travel time, and it is followed.
- Work schedules with at least a one week look-ahead exist and generally >90% of scheduled work is completed by week's end, with add-in work minimized.
- Skills, resources and central services/contractors are de-conflicted within each day and across the week.
- Dedicated schedulers have full, real-time visibility into location of field force and status of jobs.

Capacity and Demand Management

Capacity and demand management are generally well-managed in Utility Services.

Strengths

Again, staff idle time is generally kept to a minimum, as more than enough infill work is assigned to keep field crews busy. Since WSSC has standardized field staff into four multi-disciplined classifications, there are few, if any, issues with meeting work demand and preventing over- or under-supply.

Areas of Potential Improvement

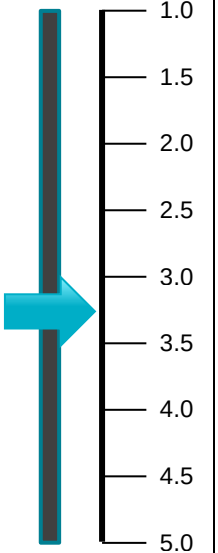
There is no labor forecasting taking place to assist Unit Coordinators in determining which staff are available to work. As such, visibility is limited to the day the work is assigned, which can result significant impact in how the daily schedule is developed and work issued.

Recommendations

The following recommendations are offered to assist in improving capacity and demand management:

- Develop specific business practices to provide for and implement weekly labor forecasting.

Figure U.10 Capacity and Demand Management Assessment Score and Scoring Criteria



Management Assessment Score – 3.3 out of 5

Scoring Criteria

Score 1:
- No labor forecast is made or forecast is routinely grossly inaccurate, no infill work is assigned, and no mechanism exists to flex field force labor.

Score 3:
- Forecasts of future labor resources are available but not always accurate and, therefore, unreliable.
- Labor forecasts may or may not be used in scheduling work.
- Infill work is provided, but is non-value adding. Some informal mechanisms exist to flex the supply of field force labor to meet demand and prevent over supply.

Score 5:
- Forecasts of future labor resources are available and highly accurate.
- Labor forecasts are always used to schedule enough work to match 100% of labor availability.
- Forecasts of future labor resources are regularly available, highly accurate and always used to schedule enough work to match 100% of labor availability.

Work Execution

Work execution at WSSC is limited to performing daily work as it is created, as almost one-third of the work is considered an emergency.

Strengths

Since priority codes are pre-programmed into CMMS for specific work types, there exists a formal process for determining emergency work.

Areas of Potential Improvement

Once a formal schedule is developed, adherence to that schedule should be monitored from a performance management perspective to identify what type of schedule breakage occurs, when it occurs,

and why. Work backlog monitoring, which is currently not quantified and regularly tracked with data, should also be developed and used to more effectively manage workflow.

Specific criterion for determining what constitutes an emergency on a case-by-case basis does not exist. For example, water main breaks, which are currently prioritized as emergency work, are not all created equal. A leaking joint from a 4-inch distribution line at a rate of less than 100 gallons per minute that is causing no visible damage does not require the same response as a break from a 36-inch transmission line leaking several thousand gallons per minute and causing significant property damage. Currently, both scenarios would be prioritized as an emergency and responded to in the same fashion.

CMMS data from CY15 indicates that timely work order closeout is problematic. Figure U.11 below indicates that of the over 206,000 work orders evaluated, the average field completion time per work order is approximately 1.8 hours, but work orders take about 17 days on average to close out. Ideally, work orders that require less than a day to perform should be closed out the day the work is performed.

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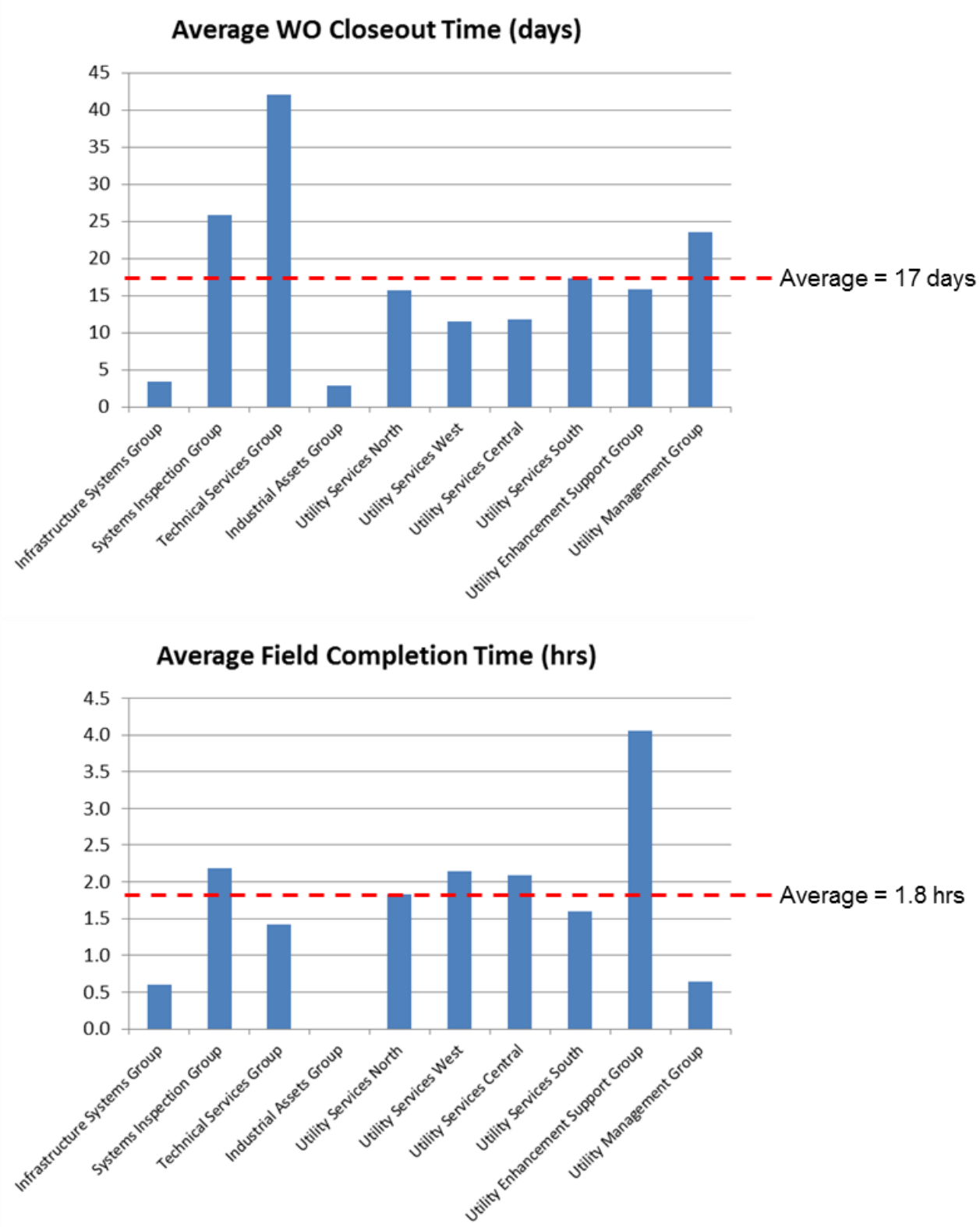
Figure U.11 CMMS Average Work Order Closeout Time and Average Field Completion Time

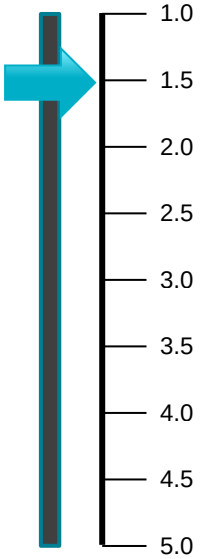


Recommendations

The following recommendations are offered to assist in improving work execution:

- Develop a tracking tool to monitor and report on schedule to identify what type of schedule breakage occurs, when it occurs and why.
- Develop a tracking tool to monitor and report on actual work backlog to more effectively manage workflow.
- Develop and implement a new business practice to evaluate emergency work on a case-by-case basis to minimize adverse effects to overall productivity, and assign a management-level "gatekeeper" to determine what actually constitutes an emergency and what does not.
- Develop and implement a new business practice to close out work orders in a more timely fashion.

Figure U.12 Work Execution Assessment Score and Scoring Criteria



Assessment Score – 1.5 out of 5

Scoring Criteria

Score 1:
- Schedule adherence is not followed or regularly monitored.
- Emergency schedule breakages are not accounted for according to pre-determined guidelines and often result in decreased productivity.
- Completed work orders are not closed out in a timely fashion, and with either insufficient and/or inaccurate field information.
- Work backlog exists, but is not measured or managed.

Score 3:
- Schedules are generally adhered to but only occasionally tracked and/or reported.
- Emergency schedule breakages are accounted for according to pre-determined guidelines but result in decreased productivity.
- Completed work orders are closed out properly within a week of work completion and contain at least some field notes that are input into CMMS.
- Work backlog is generally measured, but the only management focus is to reduce and/or eliminate it.

Score 5:
- Jobs are completed according to the schedule with little or no deviation. Schedule adherence is tracked and reported to management.
- Emergency schedule breakages are handled according to pre-determined guidelines/processes with little to no adverse effect to productivity.
- Completed work orders are properly closed out within 24 hours of work completion, with all applicable and appropriate field notes input into CMMS.
- Work backlog is actively measured and managed at levels to effectively feed appropriately prioritized work to field staff.

Special Programs

Special programs refer to proactive actions that are taken to maintain water quality in the distribution system (over and above regulatory requirements), perform preventive maintenance on key assets, monitor system-wide water losses and protect revenue through water meter testing and replacement.

Strengths

WSSC has a very robust valve exercising program for valves four inches and greater. Of these, all are exercised by contract on a four-year cycle, except "critical" valves, which are exercised annually. Sewer inspection and cleaning is currently performed by both WSSC staff and contracted resources on a daily basis. Smoke testing and flow isolation are performed seasonally with maintenance defects noted and required repairs issued to staff. Water main replacement is targeted at 60 miles per year, of which 10 miles are done with WSSC staff and 50 miles are done by contracted resources. Regular acoustic fiber monitoring and inspection are also performed for PCCP transmission lines. These programs are all well-coordinated with the CIP.

Areas of Potential Improvement

According to CMMS data from CY15, over 2,300 flushing work orders were issued; but according to staff, they are performed as short-term fixes to localized water quality issues rather than as a systematic approach to improve the overall health of the distribution system as a whole. Blowoff and flushing hydrants are identified in GIS, but no systematic flushing programs have been designed or implemented.

There is no surgical and targeted approach to water meter testing to maximize revenue. According to staff, a random 10% sample of each new meter shipment received is bench-tested to ensure compliance with WSSC specifications. Currently installed small meters (less than 1 inch) are not tested unless requested by the customer or in the event of a suspected malfunction. Currently installed large meters (1-1/2-inch and large) are randomly tested using only portable testers based on daily average consumption (DAC) according to the following schedules:

- DAC <20,000 units – performed at least once every 10 years
- DAC between 20,001 and 89,999 units – performed at least once every four years
- DAC > 90,000 units – performed at least once every six months

Staff has indicated that there is no system-wide pressure management program in place to provide protection against water hammer, nor is there a proactive leak control monitoring program. An annual accounting of water losses is determined against a system-wide water balance, but key losses such as those from flushing activities, construction activities, fires, etc., are not accounted for.

Recommendations

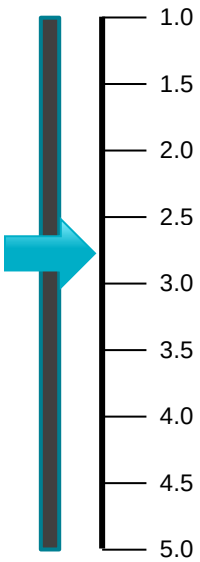
The following recommendations are offered to assist in improving special programs:

- Develop and implement a systematic dead-end and unidirectional flushing program.
- Develop and implement a more-technical approach to large-meter testing that focuses specifically on 20% of meters that correspond to the top 80% of revenue generation. Approach should look at factors such as statistically significant variance in usage rates, specific meter manufacturers

that have been prone to historically high failure rates, age of the meter, etc. Use of bench testing rather than portable testers should be employed for more accurate results.

- Develop and implement a system-wide pressure management system, based on hydraulic modeling results and calibrated by field data.
- Develop a more-robust water balance accounting, performed at least quarterly, in conjunction with a proactive leak detection program.

Figure U.13 Special Programs Assessment Score and Scoring Criteria



Assessment Score – 2.8 out of 5

Scoring Criteria

Score 1:
- Most special programs are ad-hoc with no formal documentation or management.

Score 3:
- A valve exercising program exists but is neither complete nor consistent.
- Customer water quality complaints are actively tracked and reported.
- An ad hoc dead-end flushing (water), unidirectional flushing (water), and/or inspection/cleaning (sewer) program exists but is neither complete nor consistent and is usually only implemented as a result customer complaints.
- Some proactive repair and replacement planning for water and sewer lines is in place. No risk assessment is made.
- Detailed system-wide water balance that may include estimation of metering inaccuracies, implementation of a documented water theft program and installation of dedicated meters for assessing unmetered usages (e.g., fire hydrants, roadway greening irrigation, etc.) exists.
- Use of efficient leak detection technologies by internal staff, or outsourced to contractors.
- Active acoustic and/or visual monitoring are periodically performed on PCCP to predictively determine potential for failure.
- Some proactive testing and replacement of meters is performed, but done so randomly without consideration of revenue generated.

Score 5:
- Valve exercising program has been well-designed, documented and executed to meet AWWA recommendations. Performance is regularly monitored and reported to management.
- Robust and documented program over and above regulatory requirements exists that evaluates and models water age, chlorine demand/decay, corrosivity, bacteriological testing results, free ammonia (if chloraminating), water temperature, etc. Extensively uses mixing techniques in treated water reservoirs, as well as aggressive system operational techniques to maintain water quality, especially in the extremes of the system. Robust cross-connection control and backflow prevention program implemented with active monitoring and reporting. Regular tracking and follow-up on customer water quality complaints.
- Both dead-end and unidirectional flushing programs have been well-designed, documented and executed, with performance being regularly monitored and reported to management. Engineering design efforts are actively implemented to reduce and/or eliminate dead-ends in distribution system.

Figure U.13 Special Programs Assessment Score and Scoring Criteria (cont.)

Assessment Score (cont.)

Scoring Criteria (cont.)

Score 5 (cont.):

- Sewer inspection/cleaning program has been well-designed, documented and executed with performance being regularly monitored and reported to management. Information from inspection program is fed into the sewer repair and replacement (R&R) program, and information from cleaning program is correlated with FOG reduction program.
- Water and sewer R&R program correlates maintenance histories from CMMS/GIS, information from sewer inspection/cleaning program, age of pipes, pipe material, information from cathodic protection program, etc., to evaluate overall risk and proactively plan and implement replacement into the capital improvement program
- Comprehensive system-wide soil corrosivity evaluation is done to determine need for cathodic protection. Passive protective measures, such as pipe wrap, are regularly utilized. Active protective measures, where employed, are regularly monitored and maintained. Frequent material sampling (more than one analysis per five miles of network) and/or frequent use of non-destructive inspection techniques are implemented.
- Detailed system-wide water balance exists that includes estimation of metering inaccuracies, implementation of a documented water theft program and installation of dedicated meters for assessing unmetered usages (e.g., fire hydrants, roadway greening irrigation, etc.). Water losses in water balance include reported leakages based on actual flows measured in the field as well as measured losses from tank overflows and flushing programs.
- Use of efficient leak detection technologies by internal staff, or outsourced to contractors. Prioritization of zones to target leak detection based on step tests, noise logger alerts, intervention history, lost volume cost and water marginal costs and prioritization of critical pipes. Assessment is performed of the economic level of leakage and adaptation of the leak detection and repair intensity. Time between leak detection and repair is optimized.
- Active pressure optimization is performed for the whole system, based on modeling results calibrated with actual system response data.
- PCCP replacement is programmed into the capital improvement program, prioritized based on risk assessment. Active acoustic and/or visual monitoring is regularly performed to determine potential for failure.
- Operation and daily monitoring of actual running point versus best efficiency point (verified with actual field testing) for all pump stations exists, optimization of the daily operation of the network system-wide (based on energy peak factors, variable energy rates, storage capacity, water quality and pressure management) exists, and opportunities for smart grid implementation are realized.
- Targeted, regular meter testing is performed and is prioritized by level of revenue generated, age of meter and meter type. Proactive replacement is programmed into capital improvement program to ensure minimal loss of revenue.

Review of Process

Review of process is simply how effectively QA/QC is performed on all business practices, including field work, and how effective the feedback loop is between field staff and their corresponding supervisors and managers.

Strengths

Some groups, for example the Utility Management Group, report weekly supervisor field visits, in addition to field reporting and analytical feedback to ensure the quality of work performed. However, this is not consistent across all groups within Utility Services.

Areas of Potential Improvement

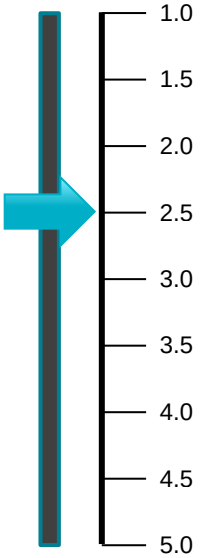
Based on staff interviews, quality discussions appear to be top-down with little coming from the bottom-up. There does not appear to be any formal and consistent process by which QA/QC is performed or measured, rather each supervisor employees various approaches as they see fit.

Recommendations

The following recommendations are offered to assist in improving review of process:

- Develop and implement a formal QA/QC review process for field work and CMMS data entry; include discussion from field staff.

Figure U.14 Review of Process Assessment Score and Scoring Criteria



Assessment Score – 2.5 out of 5

Scoring Criteria

Score 1:
- No feedback loop from maintenance techs to supervisors and/or managers exists so adequacy of work orders can be evaluated, and supervisors and/or managers do not provide any QA/QC of field work performed.

Score 3:
- Informal feedback loop from maintenance techs to supervisors and/or managers and supervisors and/or managers provide some, but inconsistent QA/QC of field work performed.

Score 5:
- Formalized feedback loop from maintenance techs to supervisors and/or managers exists so adequacy of work orders can be evaluated. Supervisors and/or managers provide regular and consistent QA/QC of field work performed.

Reliability Centered Maintenance

Reliability centered maintenance (RCM) is a corporate-level strategy to implement specific maintenance tactics for each critical asset within the system in an effort to reduce overall risk by increasing asset reliability/functionality and optimizing cost-effectiveness. There are four main steps in implementing an RCM program:

- Conduct a comprehensive criticality assessment of all system assets.
- Identify failure modes, causes, frequency and impacts to critical assets that can adversely affect the system function.
- Prioritize the failure modes.
- Determine and implement applicable and effective failure mitigation.

Areas of Potential Improvement

WSSC has not performed any type of comprehensive, holistic criticality assessment and, subsequently, does not perform any type of RCM.

Recommendations

At this time, it is not recommended that WSSC implement any RCM until TEAMS has been fully implemented and the data quality issues indicated herein are addressed.

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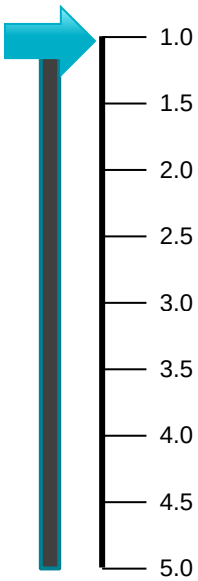
Figure U.15 Reliability Centered Maintenance Assessment Score and Scoring Criteria



Assessment Score – 1.0 out of 5

Scoring Criteria

Score 1:

- No criticality assessment has been performed, few, if any preventive maintenance work orders (PMs) are performed. No predictive maintenance work orders (PdMs) are performed.

Score 3:

- A basic criticality assessment was performed at least once to determine risk of asset failure, but assessment was never comprehensively reviewed or updated since.
- PMs, where they exist, are solely based on manufacturers' recommendations. Few, if any, PdMs are performed.
- Some spare parts have been procured and centrally managed for certain assets. Spare parts inventory may or may not correlate to asset criticality and may or may not be tracked in CMMS.

Score 5:

- Comprehensive criticality assessment is performed at least bi-annually. Assessment is performed by members from plant Operations, Engineering and Field Maintenance and is based on determining the overall risk (severity and likelihood of asset failure), then ranking assets by risk. Failure modes, consequence of failures and likelihood of failures are identified for all critical assets, and mitigation measures to minimize or eliminate failures for critical assets are identified and implemented.
- Based on criticality assessment, PMs from most critical assets are regularly reviewed by engineering and field maintenance staff using information from PdMs to determine applicability and appropriate recurrence intervals. Assets determined to be run-to-fail have PMs removed.
- Based on criticality assessment, spare parts are identified, procured and centrally managed for most critical assets. Inventory is tracked in CMMS and tied directly to warehouse/purchasing.

Performance Management

Performance management is one of the most important factors in developing and maintaining a highly functioning organization. Reporting of metrics, although important, is not enough to effective manage performance. These metrics must be meaningful, i.e., they must answer an important management questions. Also, robust performance discussions must be held on a regular basis to discuss current performance, diagnose problems, then develop and implement solutions. Accountability and performance milestones should be assigned to specific individuals during this meeting, with current progress regularly discussed.

Strengths

WSSC uses a number of high-level metrics, reported on a monthly basis, to evaluate performance; however, these metrics are not necessarily consistent across all workgroups within Utility Services.

Areas of Potential Improvement

It is not clear how the metrics reported are used in actually managing Utility Services. No targets or control bounds are set for each metric, and no clear, specific accountability is established for metric performance. Line-level staff prepares the monthly metric reports but find no meaning or value in doing so. Little to no regular formal performance discussions take place and problems are not systematically diagnosed using tools such as root-cause analysis (RCA). No wrench time analysis has been performed to quantify actual field productivity.

Recommendations

The following recommendations are offered to assist in improving performance management:

- Develop and implement a robust performance management system.
- Review the current list of reporting metrics for validity in management of Utility Services; eliminate those that provide no value and include additional metrics as necessary. Standardize metrics as much as possible across all workgroups.
- Conduct an initial wrench time analysis to baseline current field productivity, and then repeat annually to gauge changes in productivity as a result of implementing a performance management system.

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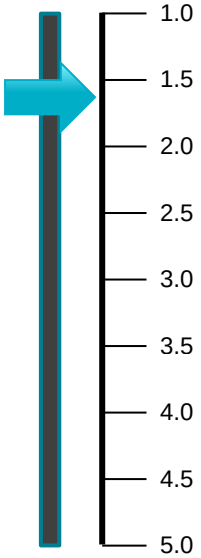
- **Figure U.16** Performance Management Assessment Score and Scoring Criteria



Assessment Score – 1.6 out of 5

Scoring Criteria

Score 1:

- No mechanism in place to track basic metrics (e.g., number of jobs assigned/completed, mean time between failure, etc.).
- No performance dialogue is conducted to review group performance.
- No RCA occurs to solve problems; rather focus is placed on finding blame rather than solutions.
- Staff field productivity is not well-defined or physically measured.

Score 3:

- Basic metrics are tracked but it occurs ineffectively and/or inconsistently.
- Group performance meetings are periodically held, but not well-attended. Performance discussion is limited to discrete data points rather than overall trends, and performance targets are not well-defined. Accountability for corrective measures may or may not be assigned.
- Some investigation and problem solving occurs, but no formal RCA performed.
- Staff productivity is anecdotally determined and may or may not be reported.

Score 5:

- Consistent and effective tools and mechanisms are in place to track and report meaningful performance metrics.
- Weekly group performance meetings are conducted by supervisor and attended by all subordinates. Current performance trends against well-defined targets are evaluated across a variety of appropriate metrics and accountability is assigned for corrective measures.
- RCA is used consistently to diagnose problems, evaluate risk and impact and mitigate problems. A failure mode analysis is also regularly performed to understand how the failure occurred and how to prevent it from recurring.
- Formal wrench-time analyses are performed regularly to objectively measure productivity. Discrete results, as well as productivity trends, are regularly reported to management.

Organization

A high-level organizational review was conducted to evaluate the overall organizational structure as well as span of control at all levels within Utility Services.

Strengths

The organizational structure as a whole is logical, with each group organized by both geography and function. Each field group consists of three emergency maintenance units and one meter unit, with the Utility Enhancement Group responsible for meter reading/testing and water main replacement and the Utility Management Group responsible for Consent Decree issues.

Areas of Potential Improvement

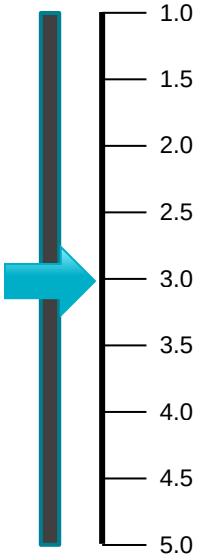
Span of control varies from 1:12 to 1:31, depending on the work group, which is generally too high to be effective. Staff interviews indicate that the Utility Enhancement and Utility Management Groups work well with the field depots, but the field depots themselves are compartmentalized and do not coordinate well with the other depots.

Recommendations

The following recommendations are offered to assist in improving organizational assessment:

- Evaluate span of control ratios across all groups, reorganize and appoint enough supervisory level staff to maintain ratios from 1:8 to 1:12.
- Promote cross-training across the depots to promote coordination among field depots.

Figure U.17 Organization Assessment Score and Scoring Criteria



Assessment Score – 3.0 out of 5

Scoring Criteria

Score 1:
- Organizational structure is fractionalized or “siloed”, with little interaction between sections/workgroups.
- Team sizes are consistently too large or too small to allow supervisors and/or managers to be effective.

Score 3:
- Clear organizational structure exists but may be either "top-heavy" or "bottom-heavy". Different sections/workgroups have good working relationships.
- Most teams are right-sized.

Score 5:
- Organizational structure is logical, based on geography, personnel type or other factors unique to organization. A clear hierarchy exists and appropriately sized with each level focusing on strategic, operational or tactical goals as appropriate.
- Team sizes are always appropriate to allow sufficient interaction between supervisor and/or manager and team members, i.e., 1:8 to 1:12.

Information Reporting

Information reporting focuses on how information is generated and reported. It looks at what types of reports are generated and evaluates if they are meaningful to the intended audience. It also looks at how easy it is to generate the information and how quickly the information can be reported.

Strengths

Information is available from the CMMS, and requested reports from IT are generally available within a couple of days.

Areas of Potential Improvement

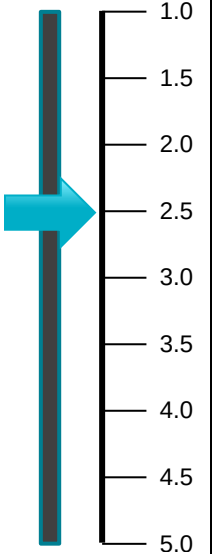
Staff interviewed indicated that some information reports are not readily accessible in CMMS and must be requested from IT, and these requests may or may not be run manually, depending on the information requested. This issue may be alleviated upon the transition to the WAM-based TEAMS system. Staff indicated that some reports generated have value, but they are not sure of the reason for or value in other reports.

Recommendations

The following recommendations are offered to assist in improving information reporting:

- Comprehensively review all reports currently generated and evaluate their respective usefulness as a management tool. Eliminate those of no value and develop additional reports as necessary.
- Once the TEAMS tool is fully implemented, then create standard reporting templates based on the revised list of reports determined above.
- Train all staff using the TEAM application on how to generate standard reports, as well as how to develop their own custom reporting templates.

Figure U.18 Information Reporting Assessment Score and Scoring Criteria



Assessment Score – 2.5 out of 5

Scoring Criteria

Score 1:
- Some reports are generated but have little to no value to the intended audience.
- Reports are created manually.
- Reports take longer than a week to become available.

Score 3:
- Reports are generated and have mixed value to the intended audience.
- Reports are produced automatically using systemized data. Responsibility for generation of reports may or may not be assigned.
- Reports are generally available within a week.

Score 5:
- Specific, clear and concise reports are regularly generated and tailored to the intended audience. Reports are action-oriented, relevant and time-bound.
- Real-time dashboards summarizing relevant information in key data reports are available to specified users. Responsibility for generation of reports is assigned to key personnel.
- Reports are available in real time or next day.

Financial Accountability

Financial accountability evaluates how well the various business practices of Utility Services are geared toward tracking and reducing actual costs.

Strengths

A strong, documented inventory management system exists that accounts for obsolete stock, appropriate stock and stock levels, efficient inventory assignment to staff and little to no delays in delivery of inventory to end users. Utility Services also effectively manages contracts to augment in-house capability.

Areas of Potential Improvement

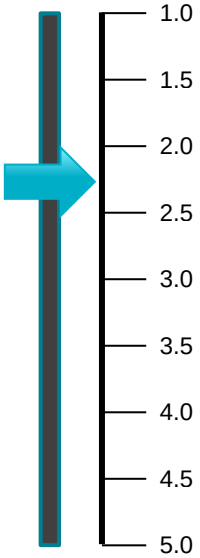
Each group has an annual operating budget that rolls up into the overall Utility Services budget, with each group responsible for managing that budget. Reconciliation occurs upon completion of the fiscal year. Although staff report that each group consistently meets its overall budget requirement, no control exists, other than a roll-up reconciliation, to control expenditures. Also, there is no real-time visibility where expenditures occur outside of general labor and materials expenses. Evaluating CY15 CMMS data indicated that no labor costs and only 3% of material costs were tracked by work order against specific assets and work types. It appears that annual operational budget forecasts are based solely on the previous fiscal year's expenditures plus additional costs associated with anticipated new expenditures for the next fiscal year.

Recommendations

The following recommendations are offered to assist in improving financial accountability:

- Once the TEAMS system is fully implemented, develop and implement a standard business practice to track actual labor and materials costs in the CMMS.
- Develop and implement standard reporting templates to evaluate cost expenditure trends for use in annual budgeting.
- Develop and implement cost control measures to minimize and/or eliminate operational cost overruns.

Figure U.19 Financial Accountability Assessment Score and Scoring Criteria



Assessment Score – 2.3 out of 5

Scoring Criteria

Score 1:

- Development of OPEX budget limited to slight increases in previous year's budget. Justification for increase may or may not be well-defined.
- Actual labor and material costs are not tracked against an asset/work order and/or are tracked in a separate system.

Score 3:

- Incremental operational increases based on assumptions are determined annually and programmed into OPEX budget requests. Accountability for budget may or may not be assigned, and controls to prevent over expenditures may or may not be used.
- Some actual labor and material costs are captured against each asset/work order and may or may not appear in CMMS.
- Inventory is ordered based on a one-month look-ahead of anticipated work.
- Management of contracts is centralized and may or may not be tracked against budget. No evaluation of insourcing vs. outsourcing work is regularly performed.

Score 5:

- Annual actual operational expenditure data is used to determine budget needs. Responsibility for budget is assigned to section head to whom accountability is assigned. Controls to prevent over-expenditures are actively in place and managed effectively. Costs consistently meet budgeted amounts at year's end.
- All actual labor and material costs against each work order are captured in CMMS and tied against a specific asset. Aggregate labor and materials costs are reported regularly and actively managed against OPEX budget.
- Inventory levels are based on historical usage and regularly reviewed to ensure applicability.
- Various contracts for outside services may or may not be used. For those that are, responsibility for management is centralized and regularly tracked against budget. Evaluation of insourcing vs. outsourcing work is regularly performed to ensure the most cost effective solution is used.

Direction and Leadership

Direction and leadership evaluates how well management is effective in leading Utility Services.

Strengths

Managers and supervisors are generally open to discuss issues with staff and, although a hierarchy exists for organizational purposes, line staff feels at least somewhat comfortable voicing issues and concerns. Personnel generally follow managers and supervisors because they feel they either should or they genuinely want to. Most decisions are made with at least some level of transparency.

Areas of Potential Improvement

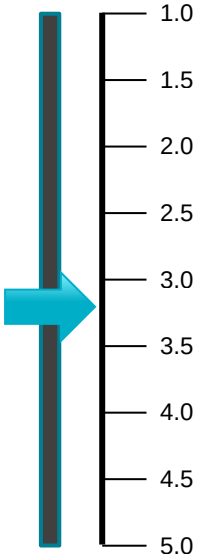
There appears to be little done with respect to coaching, either from supervisor to line staff or from manager to supervisor. There is a mix of attitudes with respect to how collaborative supervisors and managers are in hearing other viewpoints when considering decisions.

Recommendations

The following recommendations are offered to assist in improving direction and leadership:

- Develop and implement a coaching program to support line staff, supervisors and managers.

Figure U.20 Direction and Leadership Assessment Score and Scoring Criteria



Assessment Score – 3.2 out of 5

Scoring Criteria

Score 1:
- Managers and supervisors maintain a strict chain of command. Staff does not feel fairly treated and different rules apply to management and supervisors.
- Staff follows managers because they feel they have to

Score 3:
- Managers and supervisors are generally open to discussions with staff about issues but maintain a strict chain of command. The same rules may or may not apply to managers and supervisors as to line staff.
- Staff follows managers because they feel they should
- Supervisory and management decisions are sometimes made in a vacuum and may or may not be done with the solicitation of staff opinions.

Score 5:
- Staff feels fairly treated and they can talk directly to their supervisors about issues. Supervisors and managers role model behavior and the same rules apply to all staff. Managers and supervisors maintain a collaborative attitude.
- Staff follows managers and supervisors because they genuinely want to. Specific programs are implemented to encourage staff to care about what they do and regular coaching, as needed, are provided to improve staff performance.
- Supervisory and management decisions are with staff opinions encouraged and considered. Clear, logical reasoning is provided behind decisions that are made and staff feel that they are part of supervisory and management decisions.

Attitudes and Environment

Attitudes and environment evaluate what the current working climate is and how staff feels when at work. Over and above morale, it evaluates how well accountability is assigned and managed, what types of motivation are available to staff and how staff are either rewarded or disciplined.

Strengths

The Flexible Worker Program was designed and implemented to provide improve knowledge and skill sets as well as provide motivation to progress through higher pay scales. Each group within Utility Services has an employee award budget to provide monetary awards as incentives for outstanding performance, as well as a documented disciplinary process.

Areas of Potential Improvement

There is currently no data to quantify staff morale, and site visits indicate that current morale is mixed. Lack of crew leader positions has led to poor accountability with field crews.

Recommendations

The following recommendations are offered to assist in improving attitudes and environment:

- Develop and implement regular climate and 360-surveys to gauge and track working attitudes and environment.
- Assign a crew leader to each field crew greater than two persons, and hold crew leaders accountable for overall performance of their respective crew.

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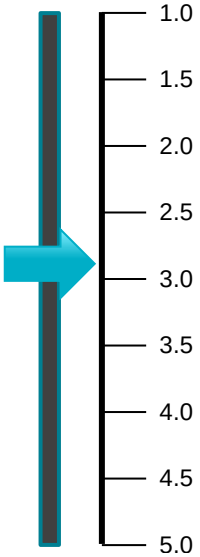
Figure U.21 Attitudes and Environment Assessment Score and Scoring Criteria



Assessment Score – 2.9 out of 5

Scoring Criteria

Score 1:

- Morale is generally low and is reflected in employee performance and staff is not held accountable.
- No explicit set of motivation levers are available to managers and there are no clear, appropriate incentive packages.
- No clear progression paths exist for high performers.

Score 3:

- Morale and motivation are mixed among staff.
- Staff is inconsistently held accountable for their work, and accountability is only present in parts of the organization.
- Specific motivation levers are defined (e.g., performance bonuses, training). Some reward packages are defined but rules to apply them are not always clear.
- There are development paths for high performers but criteria for promotion are not always clear.

Score 5:

- Morale is high; staff is generally motivated and works toward the betterment of the organization.
- Staff is held strictly accountable for their work and is very concerned by their individual performance. Accountability is present at all levels of the organization.
- All motivation levers are clearly defined and incentive packages are well-thought out and linked to operational targets to reward both team and individual performance.
- Reward management driven by process and not emotion, employees feel fairly treated and career development is linked to performance.

Continuous Improvement

Continuous improvement builds on the concepts covered in Performance Management by using those tools not just to track and report, but to learn and grow better.

Strengths

Data is contained in CMMS and reports are generated by IT as necessary.

Areas of Potential Improvement

Examples of all data reporting provided by staff have been discrete and tabular in format. There are no performance targets set for each metric nor are there any upper and lower control boundaries established that define optimal performance (the target) and acceptable performance variation (control bounds). No trend or statistical analysis is performed allowing managers and supervisors to quickly identify how actual performance measures against what is expected, as well as identify which direction performance measures are trending. Monthly meetings are held to discuss performance, but specific metrics, with trend and statistical analyses, are not presented nor is the discussion focused on identifying performance

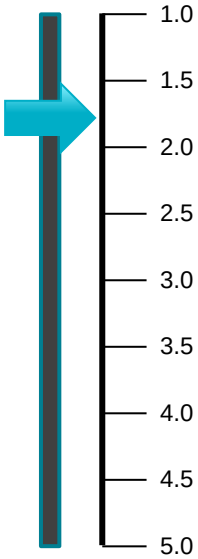
gaps and understanding root causes. Also, action plans are not based on specific, measurable, action-oriented, realistic and time-bound (SMART) principles; they are not regularly monitored nor consistently carried through completion.

Recommendations

The following recommendations are offered to assist in improving continuous improvement:

- For each relevant metric, establish a performance target as well as an upper and lower control limit.
- Develop and implement graphical charts showing performance using actual performance data. Plot data on a rolling one-year cycle to evaluate trends. Perform necessary statistical analysis to evaluate statistically significant departures from expectation.
- Develop and implement robust weekly performance meetings for each group. Each meeting should be attended by key personnel and specific performance is discussed using actual performance data. Focus discussion on performance gaps and understanding root causes.
- Develop action plans based on SMART principles, monitor progress at each weekly meeting and assign accountability to ensure plans are consistently carried through to completion.

Figure U.22 Continuous Improvement Assessment Score and Scoring Criteria



Assessment Score – 1.8 out of 5

Scoring Criteria

Score 1:

- Some basic operational KPIs are available at supervisor and staff level, but no explicit linkage between KPI and overall utility performance exists.
- Few formal data collection procedures exist, data and report storage is not well organized, and there is insufficient IT support on IT tool efficiency.
- No systems exist for managing problem resolution in the field.

Score 3:

- Some basic operational KPIs are available at the supervisor and staff level for each quality, delay and costs/revenues dimensions, but there is weak or poorly documented linkage between KPIs and overall utility performance.
- Some formal data collection procedures for selected KPIs exist and there is some structure to the data and report storage.
- Production/quality/timing indicators are tracked on the field but most people are not aware of performance against target, assuming targets exist.
- Meetings at each level (line and management) are scheduled at an appropriate frequency and generally happen.
- An ad-hoc problem resolution system exists in the field.
- Some improvement actions are defined but a business case is either not necessarily assessed or is quite weak and actions lack progress follow-up.

Score 5:

- There exists an explicit linkage between KPIs and overall company performance (e.g., performance metrics tree) with a clear cascade of top-level KPIs to supervisor and staff level. Clear accountability of KPIs (e.g., described in job description) is assigned.
- Clear and followed data collection procedures exist for all KPIs and there are clear, documented and followed procedures for data and report storage. Efficient IT tools and support are in place and used effectively.
- Highly visible systems are used for tracking production/quality/timing indicators against target, with deviation immediately visible. Processes are monitored using statistical techniques (e.g., control charts regression analysis) with clear and simple reporting formats at the right frequency that summarize KPIs on one page being used. Reports are highly actionable by managers.
- Clear targets exist against each KPI with a well-known timeline for achievement. All targets are defined according to the SMART (Specific, Measurable, Action-Oriented, Realistic, Time Bound) principles.
- A clear hierarchy and schedule of well-structured review meetings exist at all levels and each meeting has an agenda, specified timing, list of required attendees, attendee roles and meeting inputs and outputs. All meetings happen with maximum attendance and KPI owners demonstrate an understanding of root causes (e.g., special cause variation analysis).
- A problem resolution system in the field is fully used and updated regularly by the whole team. Well-structured and systematic problem solving processes are in place to identify root causes and managers at all levels demonstrate the ability to prioritize actions effectively.
- Clear and well-developed actions exist to deliver against targets, based on a sound business case. Each action has a clear owner and milestones, and progress is regularly monitored and reviewed.

Staff Development

Strengths

A very strong knowledge retention system is in place to document field practices using in-house subject matter experts. This information is stored and available online. Core skill sets and competencies are well defined and evaluated through knowledge exams and demonstrations to an appropriate subject matter expert. Training needs are regularly identified and provided through classroom settings and on the job. The Strategic Development group is working to develop, implement and track programmatic curriculums of training at each staff level.

Areas of Potential Improvement

It does not appear that strong individual development plans (IDPs) have been developed to detail personal objectives for the forthcoming year to be completed during an employee's annual appraisal with their supervisor.

Recommendations

The following recommendations are offered to assist in improving staff development:

- Develop and implement IDPs for each classification that detail personal objectives for the forthcoming year to be completed during each employee's annual appraisal with their supervisor.

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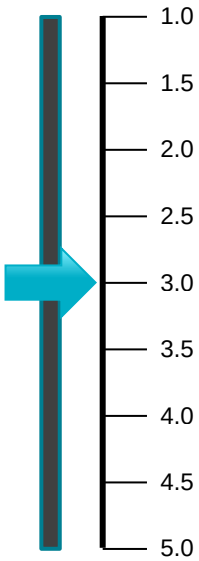
Figure U.23 Direction and Leadership Assessment Score and Scoring Criteria



Assessment Score – 3.0 out of 5

Scoring Criteria

Score 1:

- No programs exist to capture day-to-day operational knowledge from key staff. Some SOPs exist but are not centrally managed, regularly reviewed for applicability, trained to or necessarily followed in practice.
- Miscellaneous professional development training is either not identified or is randomly identified and only sometimes carried out.
- Very few training programs, if any, exist.
- Appraisals are often completed late or neglected altogether.

Score 3:

- Some day-to-day operational knowledge is passed down to new staff, but mostly through on-the-job training. There is no formal and comprehensive program to document this knowledge outside of a series of SOPs that may or may not be centrally managed.
- IDPs are created for each employee that detail personal objectives for the forthcoming year, and every employee completes an annual appraisal with their supervisor during which their skills are reviewed and the training programs corresponding to the skills to be developed are requested.
- Some training programs exist, mostly with in-house staff. Programs may or may not be consistent and are not comprehensive with respect to skill sets required for core competency levels.
- Appraisals generally happen on time but are not reflective of true performance and issues are rarely openly addressed.

Score 5:

- Core competencies have been identified for all classifications, along with specific training and knowledge required to maintain those core competencies. The program is documented, managed and regularly reviewed and updated at least annually to reflect the most current and applicable skill sets, procedures and practices utilized by staff. Competency levels for all staff are evaluated as part of the annual review with gaps and required training identified as an outcome.
- IDPs are meaningful, taken seriously by staff and executed as agreed by employee and supervisor.
- Comprehensive training programs are linked to specific skill sets as identified in the each of the core competencies for every classification of staff. Training program is centrally managed and is continuously reviewed to ensure applicability and quality. Training consists of both in-house staff as well as contracted services for specialty programs.
- Formal performance reviews are meaningful, accurate and completed on time with clear outcomes for the employee and the manager (especially when there are issues). Managers provide appropriate feedback and coaching in a constructive approach.

BEST PRACTICES EVALUATION

Asset Management
Capital Improvement
Program

ASSET MANAGEMENT AND CAPITAL IMPROVEMENT PROGRAM

Background and Context

Existing Asset Management and Capital Improvement Programs

WSSC provides water and sewer service to approximately 1.8 million customers in an area of nearly 1,000 square miles across Montgomery and Prince George's counties. Figure A.1 depicts WSSC's systems statistics as addressed in the FY2017 Enterprise Asset Management Plan.

Figure A.1 WSSC Systems Statistics FY17

ENTERPRISE	
Service Area (Square Miles)	1,000
Number of Customers Served	1,800,000
Total Asset Replacement Value (Billions)	$33.10
Total Asset Remaining Value (Billions)	$19.24
WATER NETWORK	
Total System (Miles)	5,655
Distribution Sub-system (Miles)	*4,822*
Transmission Sub-system (Miles)	*833*
PCCP (Miles)	*339*
PCCP Monitored (Miles)	*84*
Water Pipe Older than 50 Years (Miles)	*2,733*
Water Filtration Plants	2
Water Production Capacity (Million Gallons per Day)	*334*
Water Pumping Stations	14
Water Storage Tanks	47
Dams	3
Reservoirs	2
Reservoir Capacity (Billions of Gallons)	*14*
WASTEWATER NETWORK	
Wastewater Collection System (Miles)	5,687
Gravity Sewer (Miles)	*5,577*
Force Mains (Miles)	*51*
Low Pressure Sewer (Miles)	*59*
Wastewater Treatment Plants	6
Wastewater Treatment Capacity (Million Gallons per Day)	*89*
Wastewater Pumping Stations	52
Wastewater Storage	2
SUPPORT SERVICES NETWORK	
Buildings and Grounds	38

The objectives of, and connections between, WSSC's Asset Management Program (AMP) and Capital Improvement Program (CIP) according to the FY2015-2020 CIP are as follows:

The principal objective of the CIP is the six-year programming of planning, design, land acquisition and construction activities on a yearly basis for major water and sewerage facilities. These facilities may be

necessary for system improvements and/or service to existing customers, to comply with federal and/or state environmental mandates and to support new development in accordance with the counties' approved plans and policies for orderly growth and development. One of the WSSC's top priorities, in the core strategy of Infrastructure Asset Management, is to improve capital investment management. The objective of the AMP is to identify infrastructure needs and investment strategies for the next 30 years and develop and implement an asset management framework for optimal investment decision making. A key task is to identify the existing and future capacity, regulatory and rehabilitation/repair/replacement requirements for the next 30 years. The AMP provides input to the Commission's multi-year financial forecasting and develops and refines a 30-year capital investment projection based on the following requirements: regulatory, capacity, maintenance, rehabilitation/replacement, process control, energy conservation and reliability.

The AMP systematically identifies and validates water and wastewater needs and is the primary source of new CIP projects.

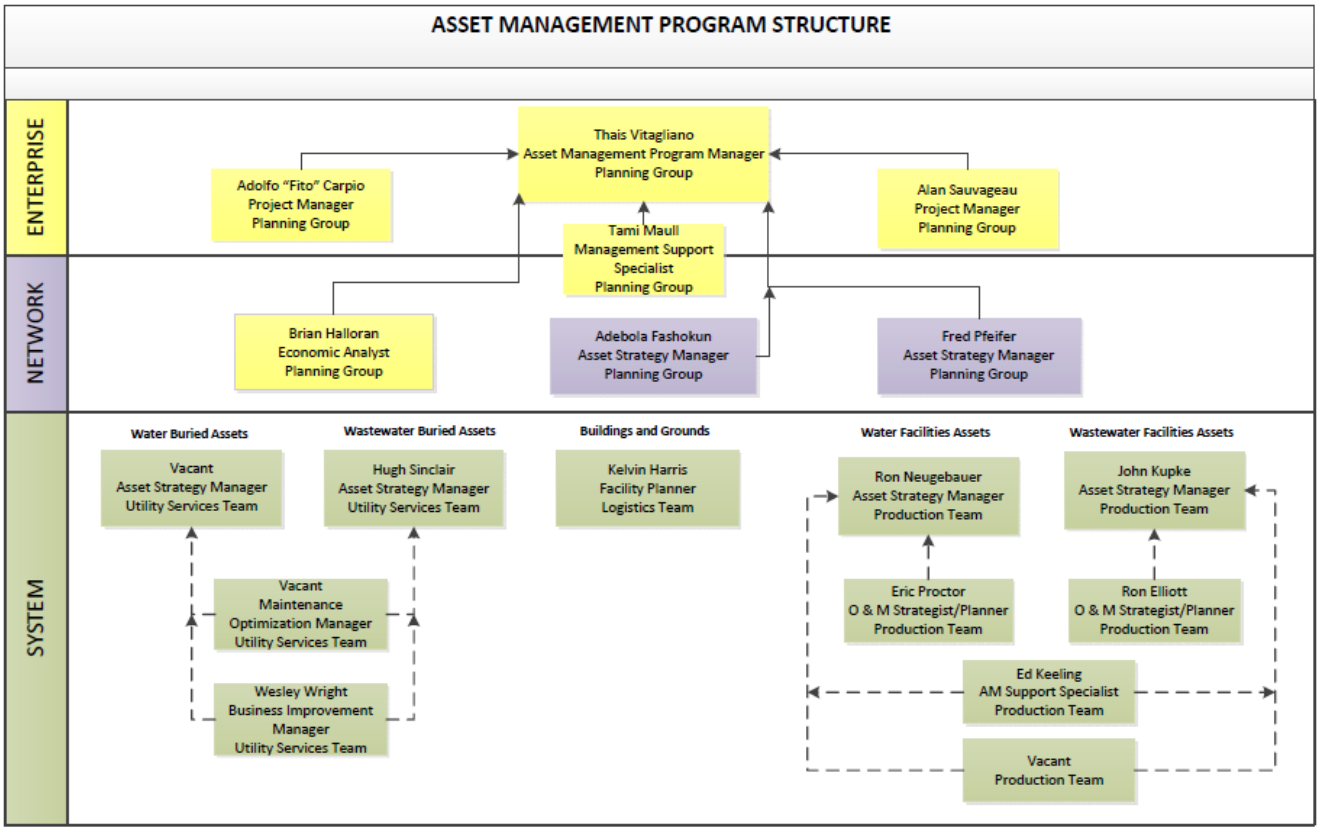
Asset Management and Capital Improvement Program Groups

The Engineering and Construction Team is, in addition to their other responsibilities, in charge of CIP preparation in liaison with WSSC's Finance Department and management of all associated projects from planning through to the design and construction phases. The Engineering and Construction Team is currently staffed by 378 positions (347 filled) across eight subordinate groups. Organizational changes from current arrangements are envisioned to ultimately incorporate an asset planning function within the Engineering and Construction Team.

As part of the AM Program, two organizational structures (immediate and long term) were developed in 2009 to ensure the successful implementation of the program within the organization. These organizational structures were decentralized by design. In 2010, the Corporate Asset Management Office (CAMO), and subsequently the AM Group, was established within the General Manager's Office. The CAMO was dissolved in 2011 and the AMP Group was transferred to the Planning Group within the Engineering and Construction Team as a unit, which is where the group is to date. This change has impacted the implementation of the program. The transition period has taken more than the 5 years initially anticipated and WSSC is still in the transition period. The plan is to move to a modified version of the long term structure in about 5 years. The modified version of the long term structure is presently being discussed, but it will expand the planning function within the E&C team. There is still a need for the AMP Unit to be at a level higher than a Unit within the Planning Group.

The Asset Management Program staff also currently resides within different Teams within the organization. The Asset Management Program staff currently includes a total of 18 positions (15 filled) and is organized as indicated in Figure A.2.

Figure A.2 Asset Management Program Group Organizational Structure*



***as of Jan 2016**

Asset Management Program

WSSC's AMP started in 2007 with the engagement of a specialist firm, GHD, which was tasked with developing the framework of WSSC's new AMP and supporting WSSC staff with its initial implementation. The Asset Management Unit was created within WSSC to manage and drive this new initiative and has subsequently achieved many major milestones, including the development of:

- A suite of Asset Management tools, policies and procedures to provide clear direction for WSSC's asset management goals and support towards reaching them.
- An Enterprise Asset Management Plan (EAMP) that was first published in 2011 and has since been cyclically improved annually and covers more than 93% of WSSC's estimated 1 million asset portfolio.

Currently, the Asset Management Unit's primary process of producing the EAMP involves stakeholders throughout the organization who collaborate through the production of individual AMPs by facility, service, etc., which are rolled up to the collective EAMP annually. Asset Strategy Managers are charged with managing the AMP development processes within their respective Teams/Office and fields of focus (water buried, wastewater buried, water facilities, etc.).

In terms of field level asset management processes, the Asset Management Unit does not have a significant amount of involvement in items such as maintenance organization, inventory management, document management, budgeting, etc.

Capital Improvement Program

The principal objective of the CIP is the six-year programming of planning, design, land acquisition and construction activities on a yearly basis for major water and sewerage facilities.

The CIP production cycle is carried out annually according to a series of well-defined steps. The process starts with the initiation of projects provided to WSSC's Finance Office (Budget Group) by organizational units throughout the commission tasked with this role. Initial proposals, expenditures and schedules included with project initiations are reviewed with the General Manager/CEO and senior staff. The output of this review is then assessed in work sessions between key stakeholders to solicit their input, and a draft document is ultimately presented to the WSSC's Board of Commissioners for their consideration. Draft CIP Public Hearing documents are published and distributed; and the Commissioners' public hearings are open to various invitees to attend, including all WSSC customers. After considering all relevant comments, the Commissioners approve the proposed CIP document for transmittal to both county governments. After the beginning of the following year, a series of finalization steps involving the Prince George's and Montgomery County's executives and their respective County Councils are performed and WSSC then adopts any changes and additions before the beginning of the new fiscal year.

Planning, design and construction follow the above project adoption process, with all of these stages of project advancement and delivery managed under the Engineering and Construction Group. The planning process includes business case studies to identify needs, develop and evaluate options and identify a preferred solution with the ultimate goal of producing a result that is acceptable to citizens, elected officials, regulatory agencies and the WSSC at a reasonable cost. Cost estimates for pipeline projects are developed in-house through the use of a detailed checklist of cost elements that are regularly reviewed and improved upon. Major facility projects (e.g., treatment plants and pumping stations) in the planning and design phases normally have their estimates developed by consulting engineers. Tendering and follow-on contractor engagement, construction, commissioning, etc., follows a well-defined scheduling and management framework that provides transparency of project status.

Best Practices Evaluation

Business practices currently implemented within the Asset Management and Capital Improvement Program Group were assessed through a series of document reviews, data evaluation and staff interviews conducted in January through March 2016. The evaluation that follows is based on ten Veolia Best Practice standards, each with specific subcategories to determine overall performance, and it uses a standardized scoring system from 1 (basic performance) to 5 (industry best). Criteria used in this scoring system, as well as the score assigned, are indicated below.

To assist in identifying which standards have the largest opportunity for improvement, a second score was identified as a near-term improvement goal. This score is determined to be where WSSC could be in less than 24 months with some additional focus and effort, given the current landscape. The difference between actual performance and the near-term performance goal forms the basis of a gap analysis that is then used to prioritize areas that have potential for additional improvement. Any arithmetic difference of 2.0 or greater between actual performance and the near-term performance goal was considered

significant, and any difference in scores between 1.5 and 1.9 was considered potentially significant. Figure A.3 summarizes the evaluation and Table A.1 summarizes the results from the assessment analysis.

As a general guidance note, scores normally achieved for a large utility such as WSSC would range from 3 to 5.

Figure A.3 WSSC Best Practices Evaluation Summary

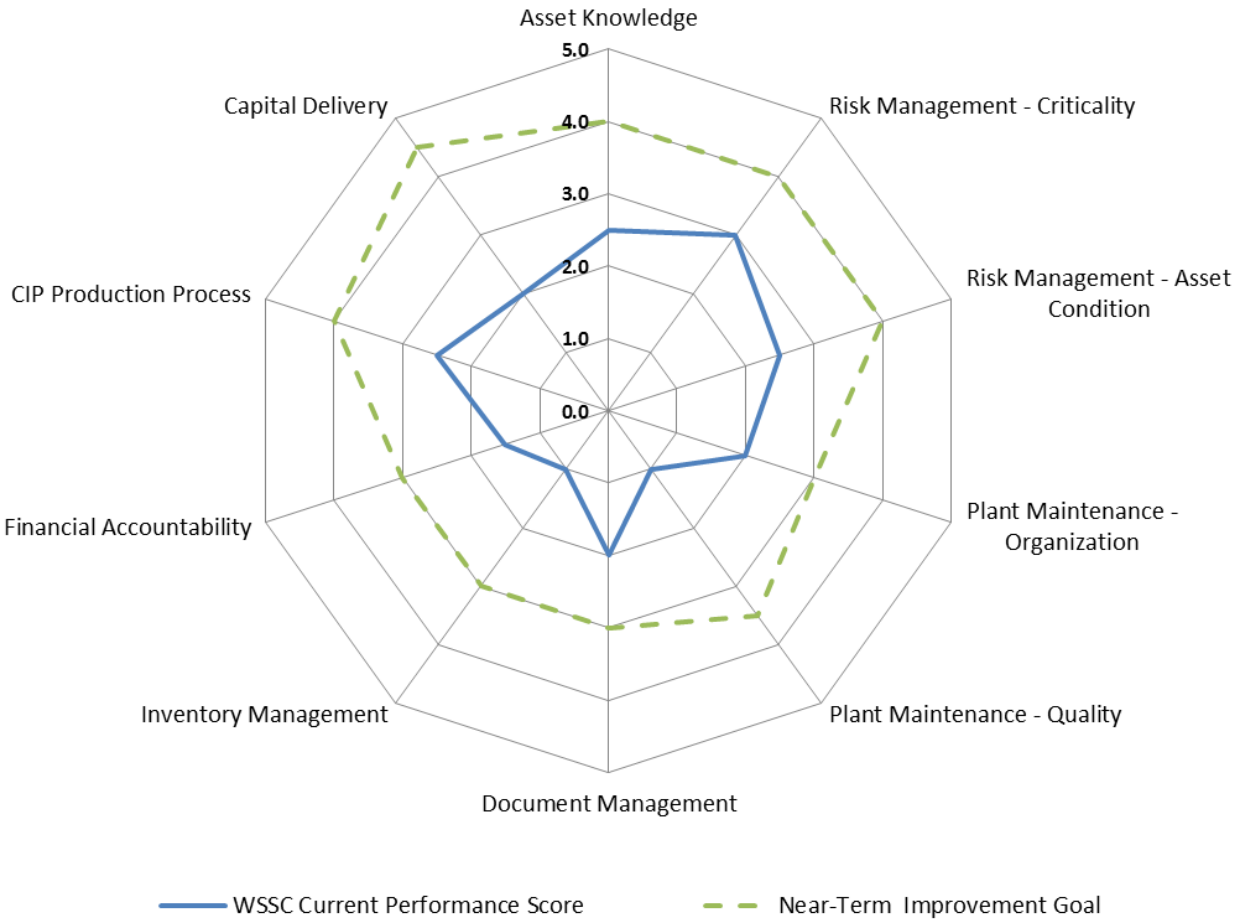


Table A.1 Assessment Analysis Summary

Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
Asset Knowledge	2.5	4.0	1.5	Potentially
Risk Management - Criticality	3.0	4.0	1.0	No
Risk Management - Asset Condition	2.5	4.0	1.5	Potentially
Plant Maintenance - Organization	2.0	3.0	1.0	No
Plant Maintenance - Quality	1.0	3.5	2.5	Yes
Document Management	2.0	3.0	1.0	No
Inventory Management	1.0	3.0	2.0	Yes
Financial Accountability	1.5	3.0	1.5	Potentially
CIP Production Process	2.5	4.0	1.5	Potentially
Capital Delivery	2.0	4.5	2.5	Yes

Asset Knowledge

WSSC has a range of asset knowledge management tools in place with sufficient capability to support advanced asset management practices. The current system of record for above-ground assets was implemented recently. It is an Oracle® Utilities Work and Asset Management (WAM) based product, referred to as "TEAMS" within WSSC. The system of record for underground assets is currently a combination of GIS and a legacy in-house developed mainframe CMMS system. These are in the process of being migrated to a WAM instance, with a significant amount of customization aimed at better supporting the management of underground assets than the standard WAM product. The Riva Modeling® application is an asset management support and decision-making tool also used by the WSSC asset management team and is linked to the aforementioned systems of record.

The corporate asset management team has provided direction for asset knowledge requirements through the development of standardized sets of data elements across varying asset classes and types.

When interviewed, field-level staff generally indicated that key asset knowledge elements are often inaccurate, missing, erroneous, etc., across the Production portion of WSSC's assets. Additionally, these members of WSSC staff indicated that the asset knowledge currently captured in WSSC's various management systems would not typically be trusted in performing any of their activities. Asset replacement values that were assigned primarily early in WSSC's asset management program development are also reportedly inaccurate in many cases. Asset knowledge associated with underground assets is reportedly significantly more comprehensive and accurate than with above-ground assets.

The ongoing verification, validation and updating of asset knowledge in Production appear as though they are not typically driven from Operations but are done ad-hoc using contractors. Utility Services reportedly manages these aspects of asset knowledge in a more mature manner.

Strengths

Structure defined for asset knowledge, supporting management tools in place and vast majority of assets already captured.

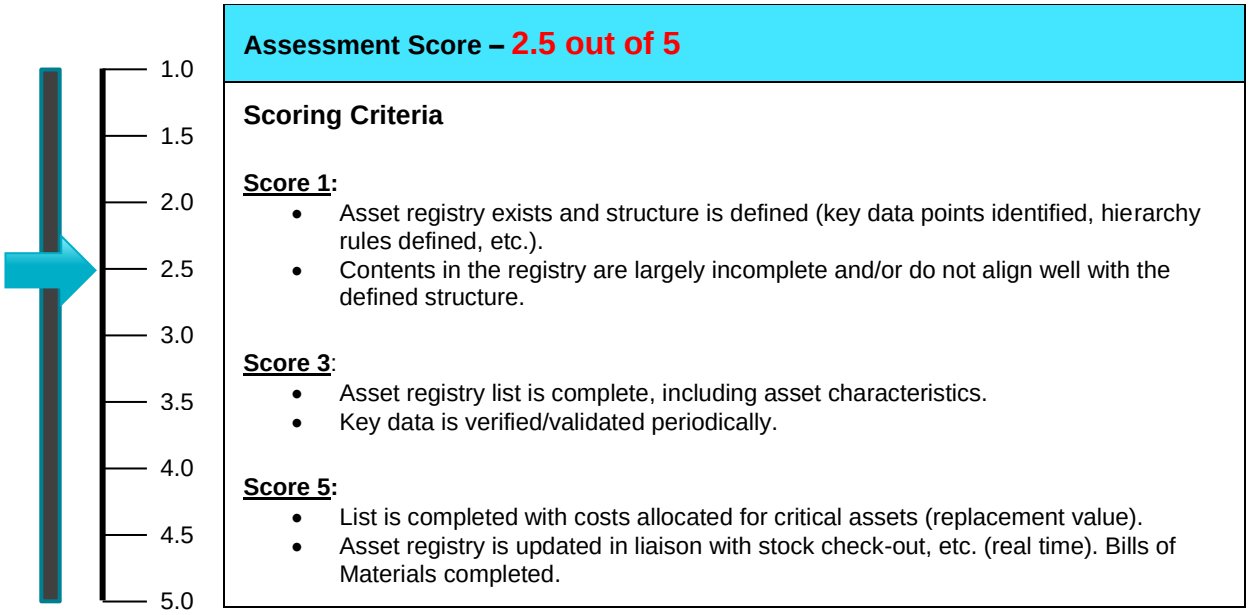
Potential Areas of Improvement

There is a low level of accuracy at the staff level with respect to asset knowledge (including replacement value and asset life), as well as little validation/updating of processes or actual use by field staff to aid in their daily activities.

Recommendations

WSSC's effort to capture asset knowledge across their million-asset portfolio is impressive. However, the management of this information, including its accuracy, completeness, ongoing validation/updating, and use throughout the organization likely justify improvement from the current situation. Incorporating a robust process of verifying, validating and updating key asset knowledge and improving the accuracy of replacement values would result in a higher level of maturity with respect to asset management practices.

Figure A.4 Asset Knowledge Best Practices Assessment Score



Risk Management - Criticality

The corporate asset management team has developed a comprehensive set of criteria, assessment processes, etc., for determining the business risk exposure (BRE) associated with assets in varying

contexts. Associated with this is measure of risk is the determination of a consequence of failure (CoF) rating at the asset level. Through these formalized indicators of risk, WSSC has available the equivalent of a typical criticality rating found throughout various industries.

When interviewed, field-level staff generally indicated that the values entered into the TEAMS system for BRE across the Production portion of WSSC's assets are neither well understood nor used by them in any formal way. Additionally, these staff indicated that the BRE values were often input at some point in the past and in some cases do not, in their opinion, reflect the current situation. BRE values that were assigned early in WSSC's asset management program development are reportedly inaccurate in many cases. BRE values associated with underground assets are reportedly significantly more accurate and integral to day-to-day activities and strategies than with above-ground assets.

The ongoing verification, validation and updating of BRE values in Production appear as though they are not typically driven from Operations but are done ad-hoc. Utility Services reportedly manages these aspects of asset knowledge in a more mature manner.

Strengths

Structure defined for BRE, supporting management tools in place and vast majority of assets already captured in a preliminary assessment campaign early in the development of WSSC's asset management program.

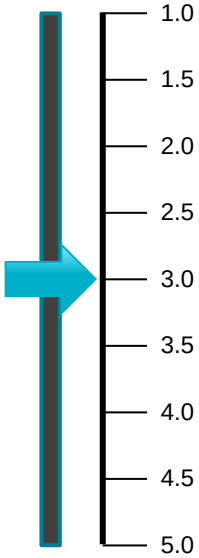
Potential Areas of Improvement

BRE accuracy, validation/updating process and actual use by field staff are not done to drive strategies.

Recommendations

WSSC's effort in capturing BRE and producing a monetary representation of risk across their million-asset portfolio represents a tremendous feat. However, the management of this information, including its accuracy, ongoing validation/updating, and use throughout the organization likely justify improvement from the current situation. Incorporating a robust process of verifying, validating and updating BRE and improving its use in driving operations' strategies would result in a higher level of maturity with respect to asset management practices.

Figure A.5 Risk Management - Criticality Best Practices Assessment Score



Assessment Score – 3 out of 5

Scoring Criteria

Score 1:
- Attempts made to define and use criticality, but no formal rules or assessment criteria in place.

Score 3:
- Rules and assessment process well-defined and progress being made but not yet fully complete.
- Criticality is well organized and initial evaluation done across all assets.

Score 5:
- Criticality update procedure in place for updating criticality as contextual changes occur (contractual, process, regulatory, legislation, etc.).
- Criticality is the basis of various other strategies (maintenance organization, inventory management, budgeting, etc.)
- Advanced FMEA studies performed on critical assets.

Risk Management – Asset Condition

The corporate asset management team has developed a comprehensive set of criteria, assessment processes, etc., for determining asset condition. Three distinct levels of condition assessment are formalized and rules are in place for the use of each, including a relatively confident level of assessment being required for the validation of CIP-related projects.

When interviewed, field-level staff generally indicated that the values entered into the TEAMS system for asset condition across the Production portion of WSSC's assets are neither well understood nor used by them in any formal way. Additionally, these staff indicated that the asset condition values were often input at some point in the past and in many cases do not, in their opinion, reflect the current condition of their assets. Asset condition values that were assigned early in WSSC's asset management program development are reportedly inaccurate in many cases. Condition values associated with underground assets are reportedly significantly more accurate than with above-ground assets.

The ongoing verification, validation and updating of asset condition values in Production appear as though they are not typically driven from Operations but are done ad-hoc, if at all. Utility Services reportedly manages these aspects of asset condition in a more mature manner, including regular updating of condition values in conjunction with maintenance activities.

Strengths

Structure defined for asset condition assessment, supporting management tools in place and vast majority of assets already captured in a preliminary assessment campaign early in the development of WSSC's asset management program.

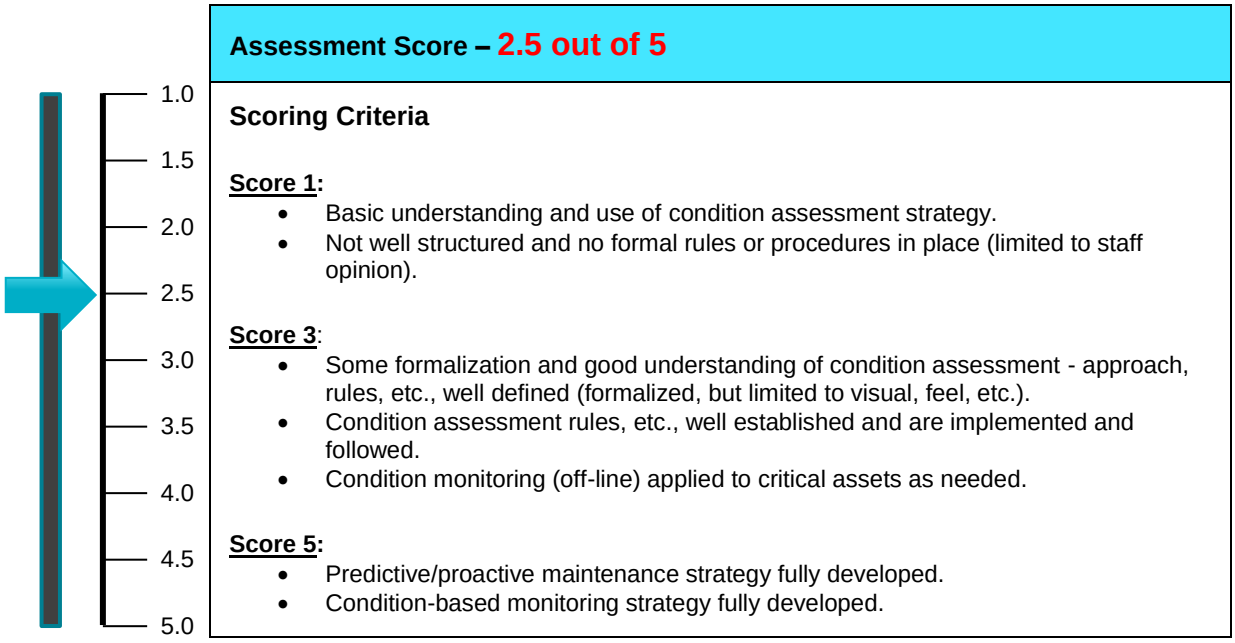
Potential Areas of Improvement

There exists no asset condition accuracy, validation/updating process and actual use by field staff to drive their strategies.

Recommendations

WSSC's effort in capturing asset condition across their million-asset portfolio is impressive. However, the management of this information, including its accuracy, ongoing validation/updating, and use throughout the organization likely justify improvement from the current situation. Incorporating a robust process of verifying, validating and updating asset condition, improving its use in driving operations' strategies and development of a condition-based monitoring strategy would result in a higher level of maturity with respect to asset management practices.

Figure A.6 Risk Management – Asset Condition Best Practices Assessment Score



Plant Maintenance - Organization

The corporate asset management team has reportedly not had a significant amount of direct influence in, or provided direction for, the maintenance organization, including staffing arrangements/competencies, maintenance strategy, data capture requirements, etc.

Maintenance planning and scheduling functions were in the process of being piloted in two Production facilities at the time of this assessment. Maturity and effectiveness of these pilots are reportedly both progressing, with a significant amount of improvement still to be made.

Maintenance backlog in Production is targeted at zero at the end of each month, reportedly from a carry-over performance measurement directive that was historically in force. Maintenance backlog is not formally managed according to risk exposure in any way.

No direct maintenance performance indicators exist that would allow for the ongoing management of performance. High-level indicators related to maintenance performance are captured in annual reporting that rolls into Level of Service indicators, though it is not clear if these are used in any way to effectively manage maintenance performance on a frequent and ongoing basis.

When interviewed, field-level staff generally indicated that maintenance across the Production portion of WSSC's assets is organized in a manner to provide a base preventive maintenance approach along with reactive maintenance as required. The preventive maintenance plans are reportedly based on OEM specifications and do not usually incorporate any additional consideration for factors, such as asset criticality, asset condition, ongoing optimization of the preventive maintenance plan, etc. Preventive maintenance plans associated with underground assets are reportedly significantly more advanced than above-ground assets with cyclic improvement reviews in place to optimize resource allocation. Predictive/proactive maintenance tasks were reportedly being considered in some facilities of Production, while an extensive set of such tasks are reportedly used by underground maintenance personnel in a formalized predictive maintenance strategy.

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Table A.2 Work Order Assessment on several Production facilities (Feb 2015 – Feb 2016 data)

	Plant			
	Piscataway	Western Branch	Potomac	Patuxent
Total WO count	1311	1196	2070	464
WO without labor hours	6%	18%	62%	14%
P type WO labor hours	55%	18%	19%	78%
R type WO labor hours	45%	82%	81%	22%
P type WO count	88%	76%	90%	99%
R type WO count	12%	24%	10%	1%
WO without any costs	5%	15%	61%	14%
WO without material costs	95%	77%	97%	100%
WO without other costs	94%	94%	97%	100%
Other notes	WO comments generally detailed and useful, though many noted as single-word entries (done, complete, fixed, etc.) No evidence of any predictive/proactive maintenance tasks	WO comments generally detailed and useful, though many noted as single-word entries (done, complete, fixed, etc.) No evidence of any predictive/proactive maintenance tasks	WO comments generally detailed and useful, many actually include a convention of adding a date/ chronology of the work, which is interesting. However, many noted as single-word entries (done, complete, fixed, etc.). No evidence of any predictive/proactive maintenance tasks	WO comments generally don't appear to be very detailed or useful; majority are single-word/simple entries (done, complete, fixed, etc.) No evidence of any predictive/proactive maintenance tasks

Notes:

1) Work Order labor hour capture varies greatly. None of the sample facilities currently captures all labor hours, though Piscataway is reasonable, with only 6% of work orders missing labor hours

2) Preventative-to-reactive maintenance work order counts and labor hours vary greatly across the sampled sites. This may indicate greatly varying definitions of preventive and reactive maintenance, maintenance organization, maintenance practices, etc., across these sites. Very low reactive work order counts may also indicate missing entries for reactive work performed (e.g., the Patuxent facility has only 1% of their work order count attributed to reactive maintenance).

3) Work order cost capture varies greatly across the sampled sites. It appears as though work order costs are primarily calculated directly in relation to entered labor hours, with very little capture of additional costs (materials, contractor-provided services, etc.).

Strengths

Strong base of preventive maintenance in place, supporting management tools in place and portions of assets covered by advanced asset management maintenance approaches (e.g., certain underground assets have predictive maintenance approaches in place).

Potential Areas of Improvement

Maintenance approaches that do not incorporate factors such as asset criticality, condition, etc. Poor data capture from maintenance activities in many areas. There exists a lack of direct maintenance performance measures to facilitate ongoing improvement.

Recommendations

WSSC's approach to maintenance organization appears to be somewhat fragmented across the commission. Certain aspects are reportedly highly mature and accommodate continual improvement through sound data capture and performance management. Conversely, in the Production environment, for example, maintenance is classically reactive, though a base preventive maintenance plan is often place. No additional key factors appear to be formalized, such as asset criticality, condition, etc., and no clear enablers appear to be present for managing performance and continual improvement. Recommend unifying maintenance organization through developing a clear set of organization-based guidelines and rules for field staff to use across the commission.

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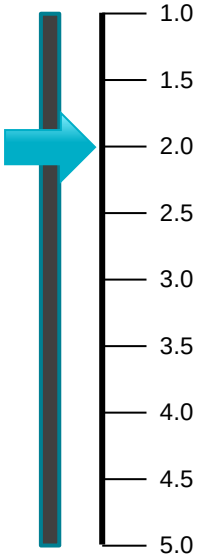
Figure A.7 Maintenance Organization Best Practices Assessment Score



Assessment Score – 2.0 out of 5

Scoring Criteria

Score 1:

- Asset management policy and maintenance procedures defined, but not necessarily well followed.
- Organizational strategy and structure are defined, as well as management responsibility structure.
- Safety procedures in place and followed.
- Maintenance staff competencies are verified to align with work performed and necessary certifications, etc. are maintained.
- Training policy in place.

Score 3:

- Preventive maintenance plan in place.
- Basic planning and scheduling in place but not optimized.
- Some or no costs captured.
- Maintenance staff competencies are periodically verified to align with work performed.
- Training policy in place and updated/verified periodically.
- Planning and scheduling functions well-defined and all internal and contracted work is recorded.
- Basic periodic reviews performed and basic cost controls in place.

Score 5:

- Monthly and yearly reports with performance indicators are produced and used to optimize plans with life-cycle focus.
- Failure analysis is performed for breakdowns on critical equipment and used to adjust the preventive maintenance (PM) plan and the renewal plan.
- Internalization versus subcontracting decisions assessed.
- The PM plan is analyzed and updated based on at least three years of data for optimization.
- Fully developed life-cycle maintenance plan.
- Full cost-benefit analysis performed.
- Advanced RCM, etc., techniques in place.

Plant Maintenance - Quality

The corporate asset management team has reportedly not had a significant amount of direct influence in, or provided direction for, maintenance quality management, including setting maintenance quality requirements and indicators, identifying training, tools, procedures, etc., to support the achievement of maintenance quality goals, etc.

No direct maintenance performance indicators exist that would allow for the ongoing management of performance. High-level indicators related to maintenance performance are captured in annual reporting that rolls into Level of Service indicators, though it is not clear if these are used in any way to effectively manage maintenance performance on an ongoing basis.

When interviewed, field level staff generally indicated that maintenance quality management across the Production portion of WSSC's assets is typically not formalized. No links have been developed to relate maintenance quality to related operational factors such as equipment reliability. No formal structure of incident escalation, analysis and reporting exists related to managing maintenance quality. Similar findings were common in other areas of the commission (underground assets, fleet, etc.).

Maintenance techniques / skill sets are well managed in terms of basic maintaining of certifications, providing refresher courses, etc. However, there is little, if any, formalization in relating the maintenance techniques and skill sets learned in these trainings to actual maintenance quality achieved in practice.

Strengths

Basic maintenance techniques and skill sets management is in place and well organized. It is likely that current maintenance staff competencies would generally support typical maintenance quality goals relatively easily if they were formalized, measured and managed on an ongoing basis.

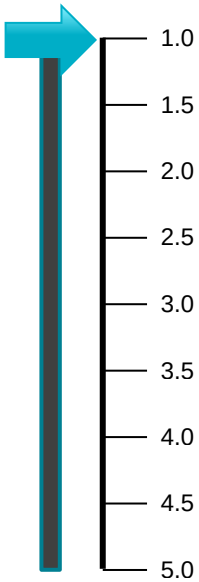
Potential Areas of Improvement

Maintenance approaches do not incorporate fundamental measurement and management of maintenance quality and poor data capture concerning maintenance quality exists. There also exists a lack of direct maintenance performance measures to facilitate ongoing improvement.

Recommendations

WSSC's approach to maintenance organization appears to be somewhat fragmented across the commission. No clear enablers appear to be present for managing performance and continual improvement. Recommend unifying maintenance organization through developing a clear set of organization-based guidelines and rules for field staff to use across the commission.

Figure A.8 Maintenance – Quality Best Practices Assessment Score



Assessment Score – 1 out of 5

Scoring Criteria

Score 1:

- Some maintenance quality indicators defined, but not well used and not well structured to address real Level of Service (LOS) based needs.

Score 3:

- Maintenance quality indicators well defined relating to LOS, but implementation and benefit not yet mature.
- Recording of staff hours is done as well as recording of spare part descriptions Indicators used regularly to control and manage maintenance quality.
- Links established between maintenance quality and equipment reliability that are in conformity to LOS requirements.
- A defined structure of incident escalation, analysis and reporting exists (example root cause analysis) that includes prioritization and responsibility for follow-up action.
- Maintenance techniques/skill sets are developed via an identification and formalization process.

Score 5:

- Benchmarked maintenance quality indicators.
- Quality indicators and policies are regularly reviewed and improved related to LOS
- Maintenance quality is fully optimized following numerous cycles of continuous improvement identifying and leveraging industry good practices.

Document Management

The focus of this assessment topic is primarily documentation related to operations. This includes, but is not limited to, construction documentation, as-builts, plans, operation and maintenance manuals, process and instrumentation drawings, standard operating procedures, policies, GIS location and attributes, etc.

The corporate asset management team has reportedly not had a significant amount of direct influence in, or provided direction for, document management within operations. Document management requirements aren't defined and document management tools, procedures, etc. don't appear to be harmonized to effectively manage documentation. The commission reportedly had a centralized team in the past which was specifically tasked with managing documentation throughout the commission, but this function and the capacity to manage documentation centrally ceased many years ago.

When interviewed, field level staff generally indicated that documentation management across the Production portion of WSSC's assets is limited to storing the majority of documentation in a dedicated store room / area. Formal validation and updating of documentation is not normally done and there is no check-in / check-out system or security in place for accessing stored documents. Updating of GIS type information does reportedly occur with underground assets following maintenance activities, but it is questionable how rigorously this is actually done in practice.

Strengths

Extensive documentation does exist throughout the commission, along with some validation and updates occurring in certain areas.

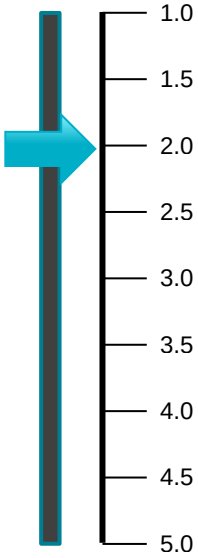
Potential Areas of Improvement

The current document management approach does not incorporate a formalized process for the ongoing validation and updating of documentation, and there is poor document check-in / check-out, security, etc. management in many areas. There exists little leveraging of the potential benefits to operations from highly accurate, complete and accessible documentation.

Recommendations

WSSC's approach to document management appears to be relatively weak across the commission. No clear enablers appear to be present for managing document accuracy, completeness and accessibility and benefitting from it. Recommend unifying document management approach through developing a clear set of organization based guidelines and rules for field staff to use across the commission.

Figure A.9 Document Management Best Practices Assessment Score



Assessment Score – 2.0 out of 5

Scoring Criteria

Score 1:
- Some Process & Instrumentation Diagrams (P&IDs), construction documents, etc., available, but possibly incomplete and/or not up to date.
- Technical equipment brochures with spare parts and procedures are available from suppliers.

Score 3:
- P&IDs, construction documents, etc., available and plan in place to update all documents.
- Preventive and mandatory inspection documentation available.
- Documents updated/verified.

Score 5:
- Process in place to update/verify periodically.
- Document management system in place and documents available electronically.
- Process in place to capture updates in real time or as they occur.

Inventory Management

Inventory at WSSC is managed by an enterprise team while local facilities, service areas, etc. also stock their own spares. The enterprise team manages acquisitions as generated by requests which are made from field level operations. Field staff reported that this process is cumbersome, inefficient and is often bypassed when possible. Additionally, field staff complained that WSSC's procurement processes are

currently also extremely cumbersome and slow. This indication of inefficiency and typical length of delay in procurement was shared throughout the commission.

When interviewed about inventory management practices, field level staff generally indicated that spares across the Production portion of WSSC's assets are kept for essentially any reason and are not in any way formally linked to asset criticality, asset condition, level of service, risk, etc. Numerous maintenance supervisors across Production indicated that their spare strategy is to have as many spares as possible for as many assets as possible, which clearly indicates a lack of financial and other pressures to optimize stock based on actual risk and other contextual factors. Inventory is reportedly managed in a more holistic and effective sense by underground maintenance personnel in their inventory management strategy.

Strengths

Enterprise inventory team exists and is working towards becoming more efficient and effective. Operations reported having specific, amply-sized locations dedicated to inventory storage. Tools are in place to enable effective inventory management.

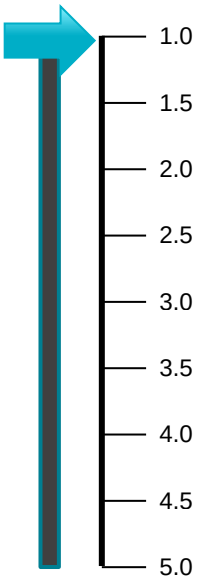
Potential Areas of Improvement

Inventory management approaches that do not incorporate factors such as asset criticality, condition, risk, etc. There are poor procurement processes that are held in negative regard across the commission, and a lack of direct inventory management performance measures to facilitate ongoing improvement.

Recommendations

WSSC's approach to inventory management appears to be somewhat fragmented across the commission. No key factors appear to be formalized for making sound decisions about inventory such as asset criticality, condition, risk, etc. and no clear enablers appear to be present for managing inventory in an effective and continually improving manner. Recommend unifying inventory management through developing a clear set of organization based guidelines and rules for field staff to use across the commission.

Figure A.10 Inventory Management Best Practices Assessment Score



Assessment Score – 1.0 out of 5

Scoring Criteria

Score 1:

- Basic understanding of the need for criticality awareness.
- Spares held, but no maturity related to management/prioritization of spares.
- No supply chains formalized – supply is ad-hoc.

Score 3:

- Criticality understood and links into critical spares identification.
- Spares are categorized and linked to equipment in the field.
- Dedicated stock warehouse in place.
- Supply chains understood and formalized.
- If a procurement strategy is in place higher than the plant level, some participation occurs but it is not optimized.
- Criticality completely linked to critical spare parts identification.
- Stock warehouse has check-in/check-out process formalized.
- Supply chains well defined.
- If procurement strategy is in place, mature participation occurs, which is optimized: use of framework agreements.

Score 5:

- Entity participates in inventory system standardized across defined sites organization.
- Common spares identified and available across the defined sites. Automated stock re-ordering in place based on simple thresholds.
- All wear parts are planned in.
- Intelligent automated stock re-ordering in place (not just static thresholds, but actually continually optimized/intelligence-based dynamic thresholds).
- Material requirements planning (MRP) process in place.

Financial Accountability

The focus of this assessment topic spans from day-to-day cost capture and budget management through to field level budgeting and roll up of projects as candidates for the CIP.

When interviewed, field level staff generally indicated that maintenance cost capture across the Production portion of WSSC's assets is not very well managed and rarely captures all costs. Additionally, maintenance budgeting is reportedly very limited in sophistication with the process being reportedly limited to taking last year's budget and incorporating only minor contextual changes to produce the next budget. Asset criticality, condition, level of service, risk, etc. do not appear to be formally considered during this process and there is no granularity as to what actual maintenance activities and associated costs are anticipated. No tools are in place to facilitate field level budget preparation and there aren't any performance management / indicators in place regarding maintenance costs and budget adherence.

In terms of the process of project identification for consideration in the CIP and existing supporting tools have the capability to facilitate this very well. RIVA is specifically designed as a decision support tool with detailed inputs such as asset condition, risk, replacement value, etc. and algorithmic capabilities to evaluate capital needs from a broad set of inputs and prioritization criteria. However, WSSC staff across varying organizational levels reported that this process is currently far from optimized, due primarily to factors such as actual asset condition often not being updated frequently enough or at all, replacement values being inaccurate in many cases, etc. There is however a strict policy of verifying asset condition prior to proceeding with all potential projects which are raised based on suspected poor condition, but ideally the process would be more robust to begin with (some staff members indicated that in many cases the majority of potential projects are dropped due to actual condition not being nearly as poor as RIVA's anticipated decay curve based condition).

Strengths

Supporting management tools in place for maintenance cost tracking, capital project identification, etc. Mature process for validating identified capital projects and associated downstream treatment within the CIP.

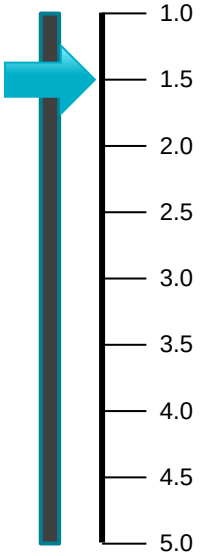
Potential Areas of Improvement

Maintenance cost capture is reportedly very poor. Maintenance budgeting process doesn't take into account such parameters as asset criticality, condition, level of service, risk, etc. There exists a lack of a performance management system with key performance indicators in regarding maintenance costs and budget adherence. Also, there is poor accuracy/maturity of RIVA process for capital project identification.

Recommendations

WSSC's approach to the financial considerations outlined of focus in this topic appears to be somewhat fragmented across the commission. Cost capture across the commission was generally found to be weak, which as a key input to financial matters (budgeting, capital planning, etc.), is a significant deficiency. Key factors to budget preparation appear as though they are not formalized, such as asset criticality, condition, risk, etc. and no clear enablers appear to be present for managing budget preparation in an effective and accurate way. Recommend unifying financial considerations associated with operations through developing a clear set of organization based guidelines and rules for field staff to use across the commission.

Figure A.11 Financial Accountability Best Practices Assessment Score



Assessment Score – 1.5 out of 5

Scoring Criteria

Score 1:
- Maintenance costs captured at site level.
- Basic budgeting in place and no or incomplete renewal cost capture and budgeting.

Score 3:
- Maintenance costs captured at process level but not well understood/performed.
- Basic financial KPIs in place with linear layout.
- Maintenance costs captured at system level and to asset level for critical assets.
- Budget has granularity to asset level for critical assets and planned and actual spend tracked and forecasted.
- Renewal costs and budgeting understood and done, but not optimized.

Score 5:
- Maintenance costs captured at asset level for all assets.
- Maintenance budget optimized with long-term visibility.
- Renewal costs and budgeting mature.
- Full budget granulation, activity-based costing, full life-cycle costing management.

CIP Production Process

The annual CIP production cycle follows a well-defined process. The process starts with the initiation of projects provided to WSSC's Finance Office (Budget Group) by organizational units throughout the commission tasked with this role. Initial proposals, expenditures and schedules included with project initiations are reviewed with the General Manager/CEO and senior staff. The output of this review is then assessed in work sessions between key stakeholders to solicit their input, and a draft document is ultimately presented to the WSSC's Commissioners for their consideration. Draft CIP Public Hearing documents are published and distributed and the Commissioners' public hearings, which are open to various invitees to attend, include all WSSC customers. After considering all relevant comments, the Commissioners approve the Proposed CIP document for transmittal to both county governments. After the beginning of the following year, a series of finalization steps involving the Prince George's and Montgomery counties' executives and their respective County Councils are performed and WSSC then adopts any changes and additions before the beginning of the new fiscal year.

Strengths

Good vision for project identification; regulatory requirements, AMPs with 100% asset coverage goal in the next few years (already at over 93%).

Well-defined project prioritization criteria; criteria developed for common comparison and assessment among all project types, triple-bottom line based.

CIP production process is well-structured and defined and numerous checks, reviews and opportunities for input, etc. exist. All stakeholders are involved and iterative improvement is maturing.

Potential Areas of Improvement

Immature AMPs used as primary source of projects; not all assets currently covered. RIVA-based needs identification not yet at its full potential. Certain AM processes and practices still immature.

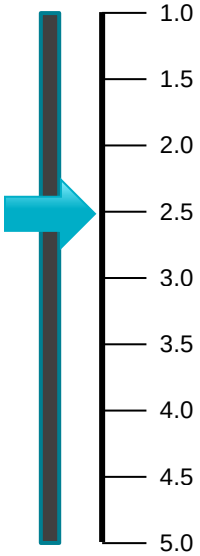
Project prioritization hasn't been truly tested; CIP budget has been historically underspent each year. Prioritization criteria well-defined but rarely used under budgetary constraint scenarios. CIP staff anxious about perceived budget shortfalls in the future and how effective prioritization will be.

Some shortfalls of the project development process; LOS currently not represented in a consistent and well-defined manner (staff working on developing a monetization representation for LOS, but this may take some time). Reportedly, other additional improvement opportunities exist that staff feel have some way to go before being optimized.

Recommendations

Further develop the existing AMP to cover all assets and use RIVA-based needs identification. Continually refine and fully implement project prioritization with the goal of meeting CIP budget expenditure targets. Develop, document and implement a new production processes that focuses on and represents LOS in a well-defined manner.

Figure A.12 CIP Production Process Best Practices Assessment Score



Assessment Score – 2.5 out of 5

Scoring Criteria

Score 1:
- Basic, but not well structured process in place to evaluate CIP projects with projects not prioritized.
- LOS not accounted for in project development.
- CIP budget significantly under or over spent every year.

Score 3:
- Structured process in place, with defined project prioritization criteria developed.
- Some projects are based on some criteria for LOS.
- CIP budget met in most years.

Score 5:
- Robust and structured process in place with continuous iterative improvement.
- Well defined project prioritization criteria developed for common comparison and assessment among all project types and triple bottom-line based.
- All projects are based on a consistent and well-defined LOS.
- CIP budget consistently met every year.

Capital Delivery

Planning, design and construction follow the above project adoption process with all of these stages of project advancement and delivery are managed under the Engineering and Construction Group. The planning process includes business case studies to identify needs, develop and evaluate options, and identify a preferred solution with the ultimate goal of producing a result that is acceptable to citizens, elected officials, regulatory agencies, and the WSSC at a reasonable cost. Cost estimates for pipeline projects are developed in-house through the use of a detailed checklist of cost elements which are regularly reviewed and improved upon. Major facility projects (e.g., treatment plants and pumping stations) in the planning and design phases normally have their estimates developed by consulting engineers. Tendering and follow on contractor engagement, construction, commissioning, etc. follows a well-defined scheduling and management framework which provides transparency of project status.

Strengths

Reportedly good accuracy in project cost estimating process. Reportedly good project budget adherence. Project design and delivery are transparent in terms of progress. Project pipeline also has good visibility (6 years). ID/IQ contracts becoming more and more commonplace, greatly improving contractor relations and project delivery. Assessment mentality and contractor selection process specifically avoids selecting the lowest bid during tendering phase, ensuring other factors are taken into account. Quality is formalized as the first priority of ultimate project delivery (behind schedule and cost).

Potential Areas of Improvement

Significant project duration overrun is commonly reported. Inefficient interfacing / interaction between Planning and Design; projects are not thoroughly planned before entering into the CIP. The design phase, by necessity, includes the planning of projects which often seriously delays project execution. Reportedly very little pressure on CIP management team to improve project duration overrun – staff acknowledges many deficiencies but also note that accountability and improvement incentives are lacking. WSSC Engineering and Construction Group staff elaborated and clarified this item by noting that there has been a history of projects taking more time to get through the process because of delays associated with a lack of thorough planning before design begins as well as permitting difficulties.

Performance management not formalized in many regards. Lack of metrics and improvement action for aspects such as:

- Project actual cost vs. estimate
- Change orders
- Claims
- Cost ratios of project phases (design, construction management, etc.)
- Number of bidders per type of project

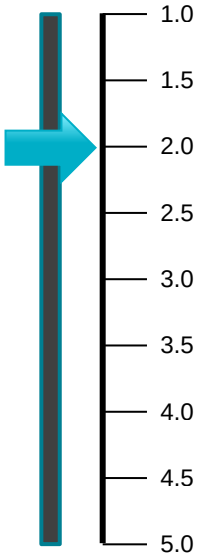
Immature process for reviewing aspects of tendering phase with key bidding contractors in aims to become a customer of choice (though some advancement paths have been identified to address this through Procurement). No Owner Controlled Insurance Plans (OCIPs) are in place.

Recommendations

Develop a forum to promote efficient interfacing and interaction between Planning and Design so projects are more thoroughly planned before entering into the CIP. Develop, document and implement a new performance management system with respect to project delivery using metrics such as, but not limited to:

- Project actual cost vs. estimate
- Change orders and requests for information
- Claims (contractor and customer)
- Cost ratios of project phases (design, construction management, etc.)
- Number of bidders per type of project
- Actual project duration vs. estimated project duration

Figure A.13 Capital Delivery Best Practices Assessment Score



Assessment Score – 2.0 out of 5

Scoring Criteria

Score 1:
- No performance management system is in place to track project delivery performance.
- Cost estimation is rarely accurate with respect to project bids, project budgets are not usually met, and project duration overruns occur often.
- Contracts awarded on lowest bid only.

Score 3:
- Informal performance management system in place and sometimes used to track project delivery performance.
- Cost estimation is relatively accurate with respect to project bids, project budgets are usually met, and some project duration overruns may occur.
- Project pipeline has visibility of at least 5 years.
- Contracts awarded on lowest bid only.

Score 5:
- Robust performance management system in place and utilized to track and report on key metrics of project delivery performance, as well as to set improvement goals.
- Cost estimation is consistently accurate with respect to project bids, project budgets are consistently met, and project duration overruns rarely, if ever, occur.
- Project pipeline has visibility of at least 10 years.
- ID/IQ contracts are commonplace to improve contractor relations and project delivery.
- Quality is formalized as the first priority of ultimate project delivery, and contract award is based on multiple criteria, not just lowest bid.

BEST PRACTICES EVALUATION

Water Treatment

WATER TREATMENT

Background and Context

In collaboration with WSSC, a review and assessment was conducted for the current water treatment facilities, existing treatment processes, operating records, water quality records and budgets for calendar years 2014 and 2015. The assessments included the Potomac Water Treatment Plant and the Patuxent Water Treatment Plant, and findings were measured against Veolia best practices.

In general, WSSC does an excellent job meeting the drinking water standards and supplying its customers with high-quality drinking water. Employees and managers appear to have great pride in their facilities and adequacy of their drinking water operations. AWWA's Partnership for Safe Water, a peer review program, has awarded both treatment plants recognitions of continuing treatment operations in accordance with the Partnership performance goals. The Potomac plant was presented the Director's Award (Phase III), and the Patuxent plant was presented the President's Award (Phase IV), based on previous operational performance. During Veolia's plant visits, the treatment facilities appeared to be well-operated and maintained. Both treatment plants have complete monitoring and control of unit processes and chemical feed rates using their respective SCADA systems. Based on assessments of the operating and monitoring records, both treatment plants are in compliance with drinking water quality requirements 100% of the time. Even though no regulatory requirements have driven the installation of ultraviolet (UV) disinfection, WSSC chose to install UV as part of its ongoing enhancements for water quality by implementing another barrier against disease-causing microorganisms. The Potomac plant has UV disinfection currently in operation, while the Patuxent plant will be installing UV disinfection in the near future.

A number of unit process assessments were completed as part of this evaluation, but they were limited to available water quality data, operational observations and available cost data only. Assessment of the existing equipment and process design characteristics were outside the current project scope.

Best Practices Evaluation

Business practices currently implemented within the Water Treatment Group were assessed through a series of document reviews, data evaluation and staff interviews conducted in January through March 2016. The evaluation that follows is based on seven Veolia Best Practice standards, each with specific subcategories to determine overall performance, and it uses a standardized scoring system from 1 (basic performance) to 5 (industry best). Criteria used in this scoring system, as well as the score assigned, are indicated below.

To assist in identifying which standards have the largest opportunity for improvement, a second score was identified as a near-term improvement goal. This score is determined to be where WSSC could be in less than 24 months with some additional focus and effort, given the current landscape. The difference between actual performance and the near-term performance goal forms the basis of a gap analysis that is then used to prioritize areas that have potential for additional improvement. Any arithmetic difference of 2.0 or greater between actual performance and the near-term performance goal was considered significant, and any difference in scores between 1.5 and 1.9 was considered potentially significant. Figure W.1 summarizes the evaluation and Table W.1 summarizes the results from the assessment analysis.

As a general guidance note, scores normally achieved for a large utility such as WSSC would range from 3 to 5.

Figure W.1 WSSC Water Treatment Best Practices Evaluation Summary

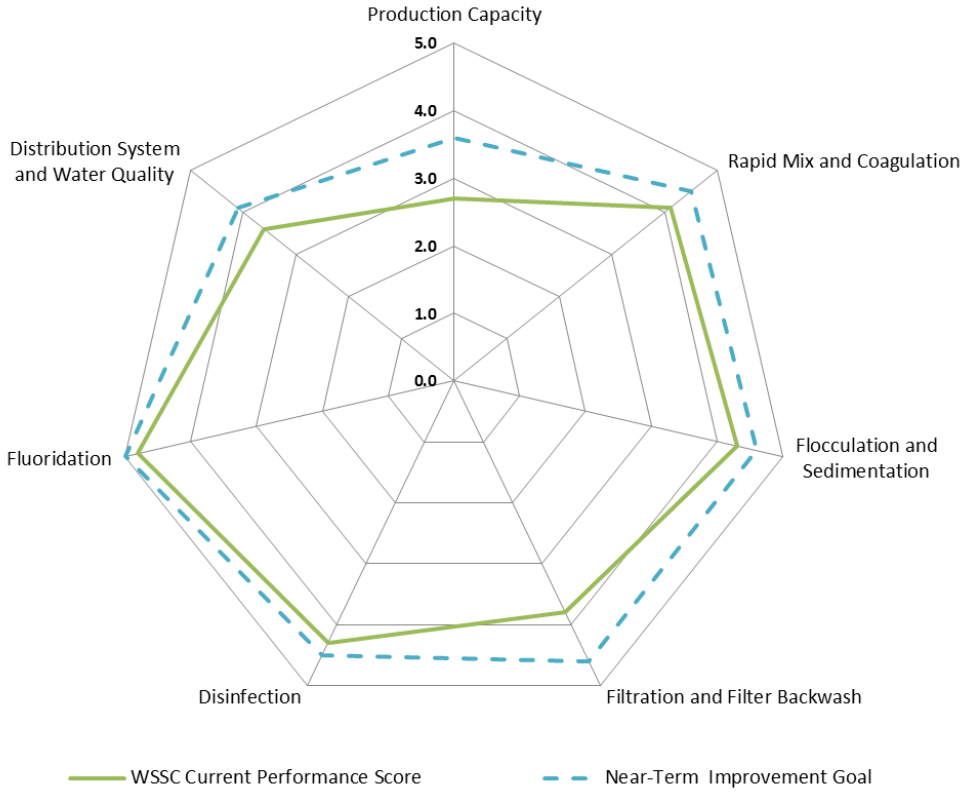


Table W.1 WSSC Water Treatment Best Practices Gap Analysis

Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
Production Capacity	2.7	3.6	0.9	No
Rapid Mix and Coagulation	4.1	4.5	0.4	No
Flocculation and Sedimentation	4.3	4.6	0.3	No
Filtration and Filter Backwash	3.8	4.6	0.8	No
Disinfection	4.3	4.5	0.2	No
Fluoridation	4.8	5.0	0.2	No
Distribution System and Water Quality	3.6	4.1	0.5	No

Production Capacity

National water demand figures and consumption per capita from AWWA are often used to compare water treatment plants across the U.S. Typically, large treatment plant capacities average about 139 gallons per capita per day (gpcd). The water demand to treatment capacity (D/C) ratio for treatment plants is also used as a comparison to evaluate excess capacity, according to the current water consumption in a utility. Traditionally, the D/C ratio should be greater than 70%, which allows for some treatment capacity for extreme demand periods, system growth and economic development needs. In 2013, the U.S. EPA reported that water pants operating at 50% of their rated capacity can experience up to a 250% increase in operating costs due to process inefficiencies. It also is well-documented that water treatment plants usually are more financially efficient when operating near their rated capacities.

The use of energy intensity and washwater metrics is a relatively simple method to compare water treatment plants. The energy intensity metric in kilowatt-hours per million gallons of water treated (KWH/MG) compares power usage based on treated water flow and establishes a baseline for utility operations regardless of power rate variations. Current energy intensity for large water treatment plants averages 1,754 KWH/MG. Washwater usage is another simple metric to help predict efficiency in filtration and backwash operations. Historically, water treatment plants use about 2% to 4% of the source water flow each month for washing filters. In well-optimized treatment plants, filter washwater accounts for less than 2% of the monthly raw water production flow and high washwater usage signals that more in-depth assessments of filtration and backwash practices are necessary. Table W.2 outlines the demand and consumption metrics for the WSSC water treatment plants.

Table W.2 Summary of Demand and Consumption Evaluation

	AWWA	Potomac	Patuxent	Combined
Capacity, gpcd	139	-	-	102
Demand/Capacity (D/C) ratio, %	64	45.8	70.7	50.9
Energy Intensity, KWH/MG	1,754	1,742	421	1,366
Washwater Usage, %	≤2	3.6	2.1	3.2

Strengths

Demand metrics appear to be slightly lower than the national average. The reason for the lower demand was not defined, but it is possible that water loss or flushing volumes used in WSSC's system are lower than other large treatment plant operations. Energy intensity appears to be lower than the average large water utility, although the Potomac plant has energy intensity very near the national average.

Areas of Potential Improvement

WSSC's water plants appear to have a lot of excess capacity based on current water demands. D/C ratios for the WSSC treatment plants were found to be lower than the national average of 64%. Washwater usage for both treatment plants averages about 3.2% of the monthly raw water production flow. This value is slightly greater than values for well-optimized treatment plants, but is commensurate with the national average for large plants. Some reduction in washwater usage might be possible based on other filtration and backwash metrics described later.

There exists no formal risk-based process control plan to drive overall operation at plant.

Recommendations

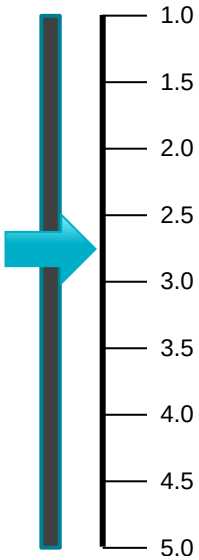
The following recommendations are offered to assist in improving overall management of production capacity:

- Develop and implement a risk-based process control plan. Develop a continuous improvement culture through workshops that engage all levels of the facility and organization Develop process control management plans that would proactively manage the treatment process, further developing key performance indicators. Implement regular process control meetings with documented meeting minutes. Develop a formal lessons learned process, based a root cause analysis. Create performance boards strategically placed at each facility to drive performance and accountability of staff. Implement formal audit program to ensure policy and procedures are being followed.

- Place excess capacity treatment trains in standby when water demand periods are low.

- Reduce washwater usage.

Figure W.2 Production Capacity Score and Scoring Criteria



Assessment Score – 2.7 out of 5

Scoring Criteria

Score 1:

- Little to no tracking of demand versus plant capacity.
- Operational paradigm to keep all treatment capacity online at all times.
- Significant and unmanaged energy usage.
- Frequent over-washing of filters, with no formal filter washing protocols.

Score 3:

- Periodic tracking of demand versus plant capacity.
- Operational paradigm to keep all treatment capacity online most times.
- Energy usage tracked, but not proactively managed.
- General filter washing protocols in place, but not well-followed, leading to periodic over-washing of filters.

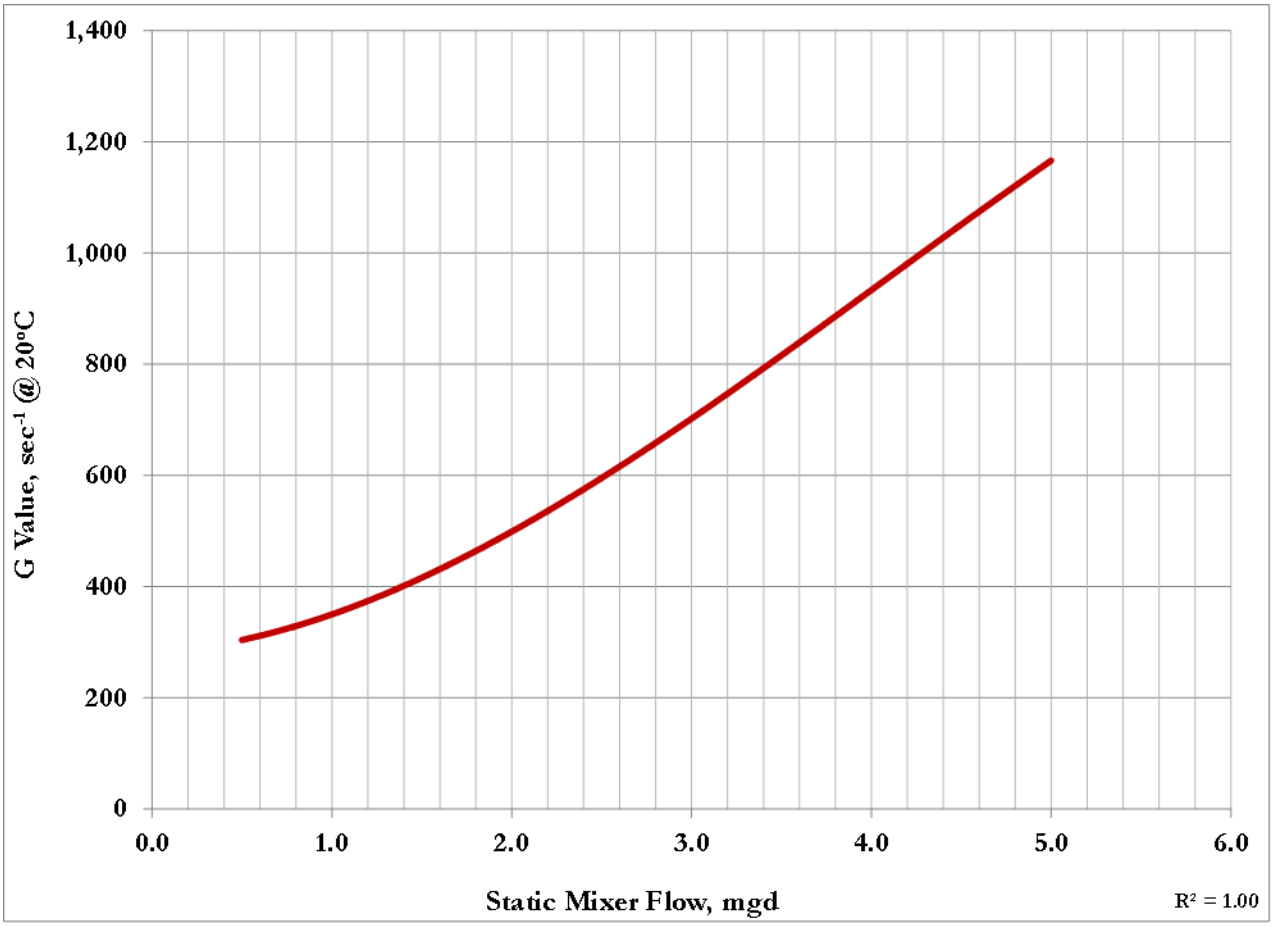
Score 5:

- Regular tracking and reporting of demand versus plant capacity.
- Operational paradigm to match treatment capacity with demand, but maintain sufficient reserve capacity to effectively manage short-term demand surges.
- Energy usage regularly tracked and reported with documented energy management program implemented.
- Documented filter washing protocol implemented that evaluates real-time turbidity monitoring to minimize over-washing.
- Formal and documented risk-based process control plan fully that is not only implemented, but also reviewed and updated regularly

Rapid Mix and Coagulation

The Potomac plant uses a conventional mechanical rapid mixer for the west side of the treatment plant and a static mixer for the east side of the treatment plant. The Patuxent plant uses static mixers for rapid mixing. Generally, coagulant is applied at the rapid mixer to disperse chemical into the water being treated and to initiate the coagulant reactions. Mechanical mixers operate to produce a desired mixing intensity (G value) based on the range of water temperatures experienced with the source water. Static mixers operate based on head loss across the mixing unit according to input flow rate – the higher the flow rate, the higher the head loss and proportional G values. Consequently, static mixers tend to provide less than optimum mixing if operating below design flow conditions. Figure W.3 illustrates the customary variations in static mixer G values according to flow changes in treatment, and has a design point of 4 MGD with a maximum G value of 932 sec^{-1}.

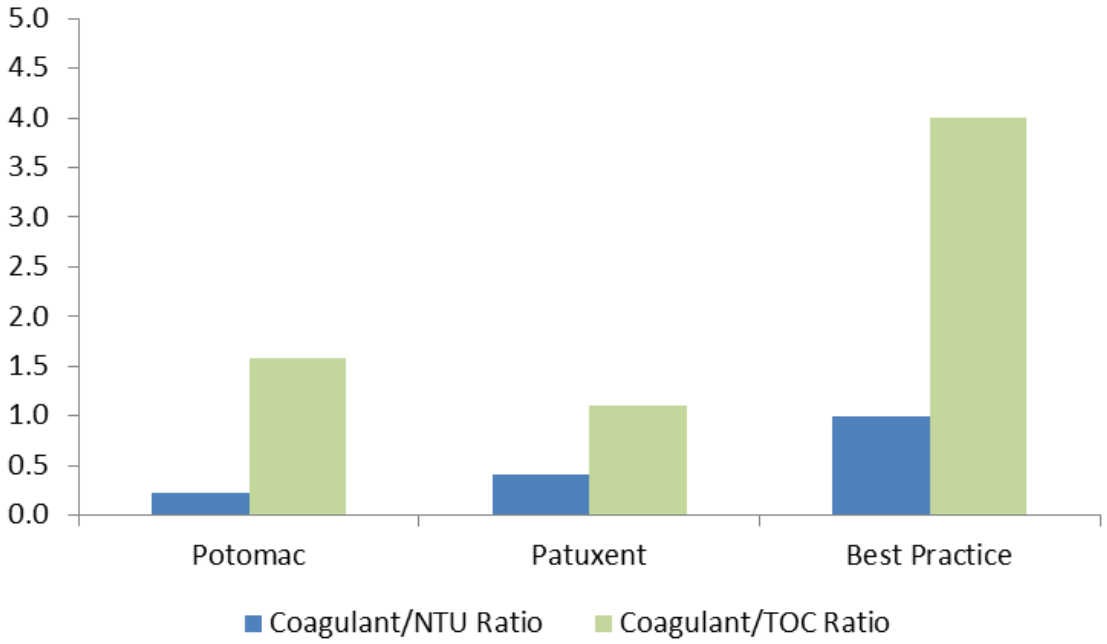
Figure W.3 Illustration of Static Mixer G Values



Coagulation has a two-fold purpose in water treatment. One purpose is to disperse chemicals quickly into the volume of water being treated. The second purpose is to foster coagulant reactions and initiate floc development. Both water treatment plants operated by WSSC are using sweep coagulation, where formation of hydroxide floc materials gathers turbidity, suspended solid, and total organic carbon (TOC) into the floc for subsequent removal. Generally, minimum G values necessary for sweep coagulation are 750 sec-1. Actual mixing intensities for the treatment plant rapid mixers were not evaluated but should be checked for optimum chemical dispersion and reaction initiation.

The evaluation of coagulation processes is limited to metrics related to coagulant dose versus turbidity and TOC and is used to gauge effectiveness of coagulant application and mixing operations. Settled-water turbidity also is evaluated to allow fine-tuning of coagulant dosages for operations. Figure W.4 below summarizes these results observed for WSSC's water treatment plants. Customary coagulant dosage to turbidity ratios average 1.0 or less for surface water plants, while the coagulant dosage to TOC ratios average 4.0 or less in utilities operating at best practice..

Figure W.4 Evaluation of Coagulation Parameters



Regulatory requirements for TOC removal are established in drinking water regulations based on source water quality. Table W.3 demonstrates the required TOC removal and the actual TOC reduction obtained from treatment. Generally, post-filtration TOC levels are targeted at less than 2 mg/L to minimize disinfection byproducts (DBPs) formation in finished water after disinfection. Average TOC levels during 2014 and 2015 in water produced by the Potomac plant were found to be 1.70 mg/L. Average TOC levels during 2014 and 2015 in the water produced by the Patuxent plant were found to be 1.42 mg/L. It is believed that both treatment plants would maintain compliance with the DBP regulatory limits based on the finished water TOC content.

Table W.3 WSSC TOC Removals

	Potomac	Potomac[(1)]	Patuxent
Required TOC Removal[(2)], %	25	25	35
Actual TOC Removal, %	41.5	45.2	44.2

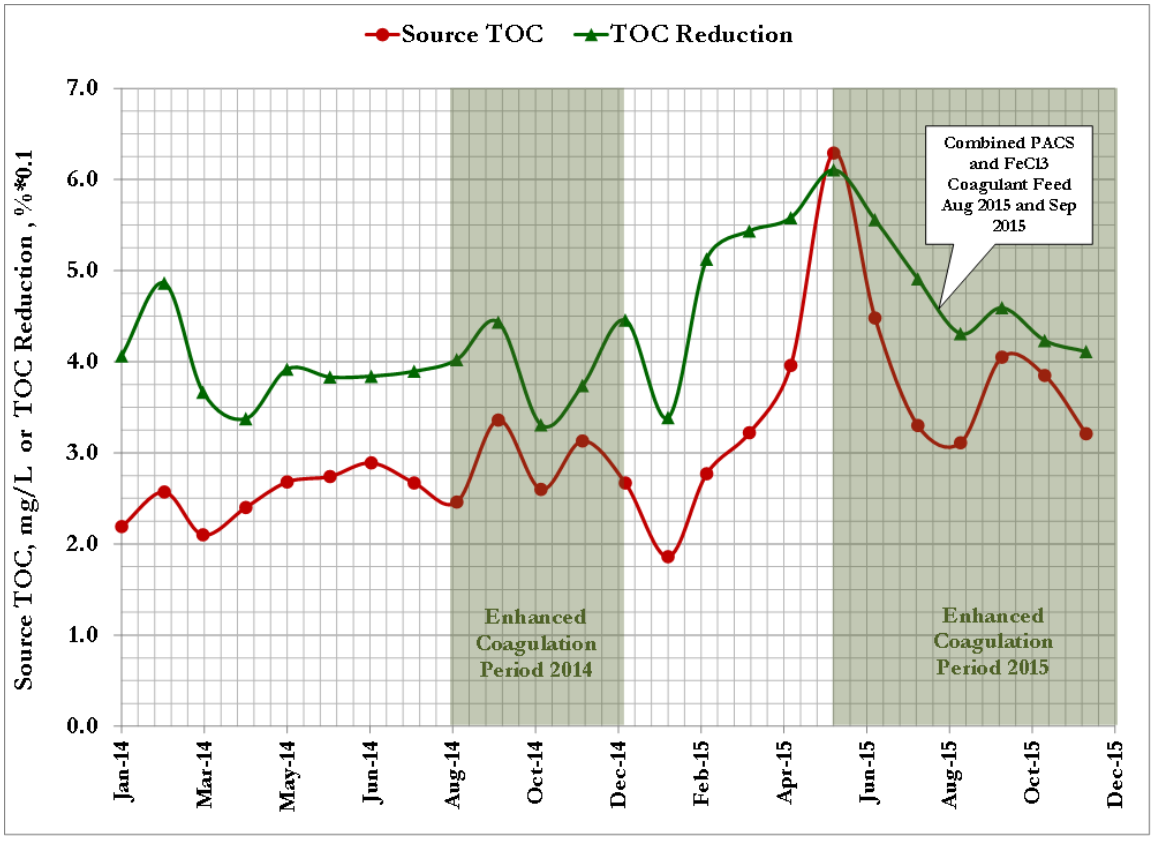
[(1)] *When enhanced coagulation practices are implemented*
[(2)] *Surface Water Treatment Rule TOC Removal Matrix*

Enhanced coagulation is a practice that uses sulfuric acid to depress pH levels for additional TOC reduction, and then follow-up pH adjustment is made for corrosion control using lime addition at the clearwells. The Potomac plant implements enhanced coagulation during the warm weather months for this reason. During these enhanced coagulation episodes, coagulant dosage is reduced slightly during the sulfuric acid application, but lime dosages tend to be more than three times higher than dosages

under conventional coagulation operations. Average lime dosages were found to be 4.4 mg/L, while enhanced coagulation lime dosages were found at 13.7 mg/L. Plant personnel stated that excess lime deposits are periodically removed from the clearwells to prevent high turbidity occurrences in the finished water. It appears that TOC removal under conventional coagulation averaged 41.5% from calendar years 2014 and 2015. TOC removal under the enhanced coagulation episodes for the same time period appeared to average 45.2%.

Evaluations of source water TOC levels and TOC removal percentages were made to assess the apparent treatability of the dissolved organic content. Figure W.5 below demonstrates the TOC removals obtained according to variations in source water TOC content. It appears that TOC removal at the Potomac plant is related more to source water organic character than to enhanced coagulation efforts. As the source water TOC level increases, TOC removal increases proportionally. As the source water TOC levels decreases, TOC removal decreases proportionally. This trend follows consistently with literature information and research data. Increasing TOC levels are often accompanied by an increase in Specific UV Absorbance (SUVA) levels as well. Increasing SUVA levels customarily indicate a change in organic character to a more treatable form resulting in increased TOC removal. The reverse is true if SUVA levels and TOC are decreasing. Data presented in Figure W.5 suggests that TOC removal is closely related to changes in SUVA levels in the source water and not to adjustments in coagulation treatment. The TOC trending presented appears to track very closely with the source water TOC content and character.

Figure W.5 Apparent TOC Removal According to Source Water TOC Content



Strengths

Although both water treatment plants coagulation ratios were found to be significantly lower than best practices in regard to customary coagulant dosing, it is likely that they are representative of the excellent source water quality and process management for turbidity control and TOC removal. Both treatment plants also produce settled water turbidity less than the 2 NTU benchmark used for turbidity control practices. Average settled water turbidity levels for the Potomac and Patuxent plants were found to be 0.51 NTU and 0.29 NTU, respectively.

Both treatment plants are providing more TOC removal than the regulatory requirements. Necessary TOC removals often are greater than the required TOC removal requirements to achieve compliance with the disinfection byproducts limits in the drinking water rules. Therefore, water treatment plants generally are operated to meet the regulatory limits for trihalomethanes (THM) and haloacetic acids (HAA5) and in doing so they meet the required TOC removals.

Areas of Potential Improvement

Under flow rate scenarios less than the design value, static mixers at both plants fail to produce the required coagulant mixing G values. The enhanced coagulation practice at the Potomac plant is yielding only a nominal increase in TOC removal for such a large increase in operating cost associated with the acid and lime addition, as well as the resulting lime deposits that require cleaning from the clearwells. There may be benefit in reducing coagulant dosing rates in view of the nominal benefit in TOC removal efficiency.

There exists no formal risk-based process control plan to drive overall operation at plant.

Recommendations

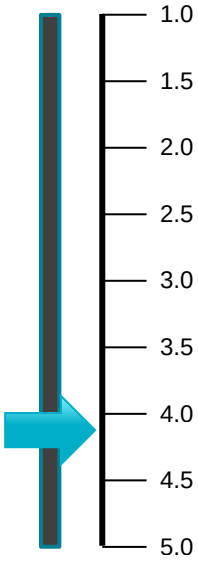
The following recommendations are offered to assist in improving overall performance of rapid mixing and coagulation:

- Develop and implement a risk-based process control plan. Develop a continuous improvement culture through workshops that engage all levels of the facility and organization Develop process control management plans that would proactively manage the treatment process, further developing key performance indicators. Implement regular process control meetings with documented meeting minutes. Develop a formal lessons learned process, based a root cause analysis. Create performance boards strategically placed at each facility to drive performance and accountability of staff. Implement formal audit program to ensure policy and procedures are being followed.

- Evaluate the use of mechanical mixers, in lieu of static mixers at both plants, to more effectively achieve required coagulant mixing G values under all flow scenarios.

- Reevaluate the need to implement enhanced coagulation at the Potomac plant.

Figure W.6 Rapid Mix and Coagulation Score and Scoring Criteria



Assessment Score – 4.1 out of 5

Scoring Criteria

Score 1:
- Little control of coagulant mixing values over all flow scenarios.
- Dosing of coagulant based on experience or historical usage.
- TOC removal based on regulated values only.

Score 3:
- Some control of coagulant mixing values over all flow scenarios, but normally set and left at a certain value regardless of flow.
- Dosing of coagulant based on jar testing only.
- Use of advanced techniques to increase TOC removal above regulated levels to control DBP formation.

Score 5:
- Full control of coagulant mixing values over all flow scenarios, with flow feedback loops to optimize operation of mixing equipment.
- Dosing of coagulant based multiple data points including jar testing as well as real-time analysis of source water SUVA, TOC and turbidity.
- Fully optimized use of advanced techniques to increase TOC removal above regulated levels to control DBP formation, while controlling operational costs
- Formal and documented risk-based process control plan fully that is not only implemented, but also reviewed and updated regularly

Flocculation and Sedimentation

Much of the suspended solids and dissolved organics removal occurs in the flocculation process. Coagulant addition simply initiates the chemical application for the removal of these contaminants and flocculation acts to force particle collisions and to agglomerate chemically treated water and contaminants into a settleable floc material. This floc must be sufficiently dense to overcome hydraulic flows within the flocculation basins as well as flow velocities within the outlet channels to the next stage of treatment. It is well-established that tapered flocculation produces the most effective floc formation in treatment. Tapered flocculation is controlled by successively reducing the mixing intensity in each stage of treatment so the final floc that is formed settles rapidly in the sedimentation process. Similar to rapid mixing, flocculation mixing intensity is produced by mechanical mixing equipment and is referred to as G value.

The Potomac plant uses two-stage flocculation with mechanical horizontal paddles to induce mixing. The Patuxent plant uses three-stage flocculation with mechanical horizontal paddles to induce mixing. Both treatment plants monitor operations routinely using settled water turbidity and operational jar testing to confirm chemical dosing and mixing meets the objectives established for the respective treatment plant.

G values were not determined as part of this assessment nor was floc density measured in the field. Flocculation operations were simply reviewed during the plant visits to observe floc development in-situ and to observe the apparent settling characteristics. Generally, the observed floc appeared to be about 2 millimeters (mm) in diameter and settled fairly rapidly once water was transferred to sedimentation.

Optimum floc size for surface water plants ranges from 0.5 mm to about 2 mm in diameter. Some customary floc carryover was observed from sedimentation to filtration in both plants. Settled water turbidity values are often used to assess flocculation operations. Average settled water turbidity was found to be 0.51 NTU and 0.29 NTU in the Potomac plant and in the Patuxent plant, respectively.

Sedimentation normally follows flocculation to allow floc to settle from the water in a quiescent area. Settled solids are periodically removed from the sedimentation process for separate handling and dewatering before disposal. Settled water is transferred to the next stage of treatment – usually filtration. The Potomac plant uses conventional sedimentation equipped with collectors to removed settled solids known as sludge. Sludge is transferred to solids handling operations and subsequent dewatering operations for disposal. The Patuxent plant uses high-rate sedimentation basins equipped with plate settlers. The plate settlers significantly increase available surface area and control exit velocities to maximize solids capture in treatment. Sludge is removed periodically and directed to the sanitary sewer for treatment at the wastewater plants.

No physical assessment of the process equipment was made during this evaluation. In-situ observations were made of settled water turbidity levels and coagulant feed ratios. The coagulant-to-NTU ratios and coagulant-to-TOC ratios were discussed previously. Settled water turbidity levels for each treatment plant also were discussed previously.

Dewatering operations at the Potomac plant were not evaluated due to incomplete data submitted on the current process operations and costs. Plant records for dewatering did not appear to be complete and polymer dosing could not be obtained from these reports.

Strengths

Plant personnel stated that tapered flocculation is practiced in operations, and field visits indicated that tapered flocculation was practiced in both plants, based on the physical character of floc development in the process. Floc sizing, based solely on field observation, appeared to be close to optimal and average settled water turbidities at both plants were well below 1 NTU.

Areas of Potential Improvement

There exists no formal risk-based process control plan to drive overall operation at plant.

Recommendations

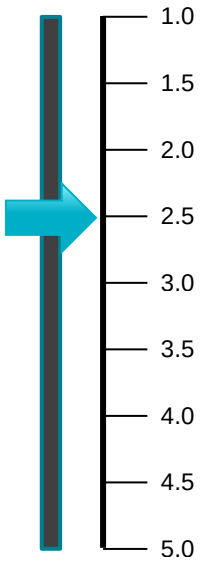
The following recommendations are offered to assist in improving flocculation and sedimentation:

- Develop and implement a risk-based process control plan. Develop a continuous improvement culture through workshops that engage all levels of the facility and organization Develop process control management plans that would proactively manage the treatment process, further developing key performance indicators. Implement regular process control meetings with documented meeting minutes. Develop a formal lessons learned process, based a root cause analysis. Create performance boards strategically placed at each facility to drive performance and accountability of staff. Implement formal audit program to ensure policy and procedures are being followed.

- Verify the optimum G values for flocculation and tapered mixing impacts for both plants – even though flocculation treatment appears to produce good-settling floc material, improvements might be achieved by optimizing the mixing and tapering of mixing intensities between stages.

- Proper evaluation of the solids handling processes should be conducted to define any potential improvement recommendations.

Figure W.7 Flocculation and Sedimentation Score and Scoring Criteria



Assessment Score – 4.3 out of 5

Scoring Criteria

Score 1:
- Little control of flocculator mixing values over all flow scenarios; may or may not use tapered flocculation.
- Dosing of coagulant based on experience or historical usage.
- Floc sizing routinely either too big or too small.
- Settled water turbidity routinely greater than 1 NTU, with significant carryover to filters.

Score 3:
- Some control of flocculator mixing values over all flow scenarios, but normally set and left at a certain value regardless of flow; use of tapered flocculation.
- Dosing of coagulant based on jar testing only.
- Floc sizing generally falls between 0.5 and 2.0 mm, but is usually unmeasured.
- Settled water turbidity normally less than 1 NTU, with only minor carryover to filters.

Score 5:
- Use of tapered flocculation with full control of each flocculator mixing values over all flow scenarios, and flow feedback loops to optimize operation of flocculators.
- Dosing of coagulant-based multiple data points, including jar testing as well as real-time analysis of source water SUVA, TOC and turbidity.
- Floc sizing fully optimized and regularly measured.
- Settled water turbidity routinely less than 1 NTU, with little carryover to filters.
- Formal and documented risk-based process control plan fully that is not only implemented, but also reviewed and updated regularly

Filtration and Filter Backwash

Significant optimization criteria are established for filtration and backwash operations that can be assessed from plant operating records to measure performance and process efficiencies. A complete description of these criteria is beyond the scope of this report, but the typical optimization techniques and procedures were evaluated for both water treatment plants as part of this analysis.

Filtration is used to capture and remove suspended solids from the settled water to meet regulatory limits for turbidity and to remove apparent color from the water. The primary efficiency measurement for filtration is filtered water turbidity. The AWWA Partnership for Safe Water filtered water turbidity goal is 0.1 NTU 95% of the time with no turbidity excursions above 0.3 NTU. Average filtered water turbidity for the Potomac plant was found to be 0.07 NTU with maximum turbidity levels at 0.13 NTU. Average filtered

water turbidity for the Patuxent plant was found to be 0.03 NTU with maximum turbidity levels at 0.16 NTU.

The Potomac plant has 32 dual-media filters consisting of 12 inches of filter sand and 25 inches of anthracite media. Filters are equipped with surface wash sweeps and backwash pumping for media cleaning. The design filtration rate was stated at 5.1 gpm per square foot of media area by the last sanitary survey report. Assuming one filter is out of service, the Potomac plant has an equivalent filtration capacity of 290 MGD, slightly exceeding the reported plant hydraulic capacity of 280 MGD. Each filter has individual turbidimeters to assess filter effluent quality. The Patuxent plant has 10 dual-media filters each equipped with air scour and backwash capabilities for media cleaning. One filter has 12 inches of filter sand and 60 inches of granular activated carbon (GAC) along with 6 inches of plastic pellets (determined ineffective for manganese removal). Three filters have 12 inches of filter sand with 60 inches of GAC media. Six filters have 12 inches of filter sand with 60 inches of anthracite media. The design filtration rate is 6 gpm per square foot, according to the last sanitary survey report. Assuming one filter is out of service, the Patuxent plant has an equivalent filtration capacity of 54 MGD, matching the existing plant hydraulic capacity. The Patuxent plant currently is under construction to increase plant capacity to 72 MGD and to install other necessary equipment improvements. Each filter has individual turbidimeters to assess filter effluent quality. No media specifications were provided for review and no critical bed depth determinations were made as part of this study. No determinations were made for predictions of backwash rates for effective media expansion.

Solids loadings, based on the settled water turbidity applied to filtration were found to be relatively low in each plant. The average solids loading for the Potomac plant was estimated at 0.007 pounds per cubic foot of filter media. The average solids loading for the Patuxent plant was estimated at 0.006 pounds per cubic foot of filter media. Maximum solids loadings for dual-media filters should not exceed 0.35 pounds per cubic foot. A good rule of thumb is to limit solids loadings to about 0.18 pounds per cubic foot of media.

Gross water production (GWP) is a filter performance metric to gauge run times, filtration rates and applied water quality simultaneously. GWP values for dual-media filters can approach 10,000 gallons per square foot per run and often are greater for well-optimized filtration systems. Average GWP for the Potomac plant was calculated to be 3,380 gallons per square foot per run. Average GWP for the Patuxent plant was calculated to be 8,794 gallons per square foot per run.

Typical backwash rates for dual-media filters range from 15 gpm per square foot to 20 gpm per square foot. The available backwash rates were found to be about 14.1 gpm per square foot and 20 gpm/sf at the Potomac and Patuxent plants, respectively. Although filter backwashes were observed at each plant, no determinations for media cleanliness were measured or estimated.

Typical backwash sequencing was reviewed from SCADA programming for each treatment plant. In general, the initial low-rate wash operates for 2 to 3 minutes, followed by the high -ate wash for 6 to 8 minutes. A final low-rate wash is then used to reclassify the media for the next run at about 2 to 3 minutes. The total wash period for each plant averages about 12 to 13 minutes. Generally, filter backwash should be completed within 6 to 8 minutes total duration providing the necessary media cleaning.

Table W.4 provides a summary of WSSC filtration performance compared to best practices.

Table W.4 WSSC Filtration Performance

	Best Practice	Potomac	Patuxent
Filter Effluent Turbidity, NTU	≤0.1	0.07	0.03
Filter Run Time, hrs	>48	22.6	29
Filtration Rate, gpm/sf	≥2	2.49	5.08
Solids Loading, lb/cf	<0.35	0.007	0.005
Gross Water Production, gal/sf/run	≥10,000	33,380	8,794
Filter Efficiency, %	>95	96.2	98.4
Backwash Rate, gpm/sf	15 to 20	14.1	20
Backwash Duration, min	≤8	12.5	12
Washwater Usage, gal/sf	100 to 150	129	131

Strengths

Both water treatment plans meet or exceed the regulatory limits and Partnership goals for filter effluent turbidity. Filter efficiency, which is used to assess the volumes of filtered water to backwash water consumed for media cleaning, ranged from 96.2% to 98.4% for Potomac and Patuxent, respectively, well above the typical filter efficiency of greater than 95%.

Areas of Potential Improvement

The filtration metrics above suggest that filter operations might be optimized, providing extended run times. Run times, solids loadings and GWP values are all below the customary filtration metrics. Filter coring exercises should be conducted on selected filters to assess filter behavior and to maximize run-time capabilities based on scientific principles. Filter coring also can be used to better define potential run times based solids capture during a typical run period. Any possible increase in run times would increase solids loadings during the run and GWP.

Backwash times at each plant average about 12 to 13 minutes, which is generally about 50% to 60% too long to provide the necessary media cleaning. Excess washwater usage fails to remove additional solids and simply wastes water. Washwater consumption was found to average 129 gal/sf and 131 gal/sf for the Potomac and Patuxent plants, respectively. Well-optimized filtration and backwash operations often result in washwater consumption of less than 100 gal/sf.

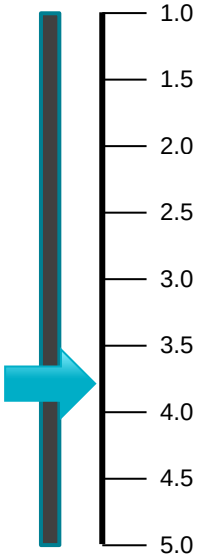
There exists no formal risk-based process control plan to drive overall operation at plant.

Recommendations

The following recommendations are offered to assist in improving filtration and filter backwash:

- Conduct routine annual filter assessments including, but not limited to, filter coring, bed expansion, backwash duration evaluations, and media examinations on representative filters to maximize filter performance.
- Develop and implement a risk-based process control plan.

Figure W.8 Filtration and Filter Backwash Score and Scoring Criteria



Assessment Score – 3.8 out of 5

Scoring Criteria

Score 1:
- Filter effluent turbidity does not exceed 0.3 NTU
- Filter run times consistently less than 48 hours.
- Filter ratings low enough that filtration capacity is significantly lower than hydraulic capacity of plant; typically no surface washing capability.
- Solids loading significantly high for filter media type.
- Consistently low gross water production.
- Inconsistent manual backwash sequence with consistently significant backwash times.
- No regular filter assessment conducted.

Score 3:
- Filter effluent turbidity is below 0.1 NTU 75% of the time, with no excursions above 0.3 NTU
- Filter run times occasionally greater than 48 hours.
- Filter ratings such that filtration capacity is about equivalent to hydraulic capacity of plant; surface washing capability exists, but may not be used effectively.
- Solids loading moderately high for filter media type.
- Gross water production sometimes approaches 10,000 gal/sf.
- Consistent backwash sequence with moderately high backwash times, may be manual or automated.
- Filter assessments occasionally conducted.

Score 5:
- Filter effluent turbidity below 0.1 NTU 95% of the time, with no excursions above 0.3 NTU
- Filter run times regularly greater than 48 hours.
- Filter's rating exceed hydraulic capacity of plant; surface washing capability exists and is used effectively.
- Solids loading only occasionally high for filter media type.
- Gross water production often exceeds 10,000 gal/sf.
- Consistent backwash sequence with relatively low backwash times and is fully automated.
- Full assessments on representative filters conducted annually.
- Formal and documented risk-based process control plan fully that is not only implemented, but also reviewed and updated regularly

Disinfection

Disinfection is required for all water treatment plants to inactivate microbial contamination and to produce a persistent disinfectant residual in the water. Breakpoint chlorination is practiced for WSSC, establishing free chlorine residual in the plant tap and in the distribution system. Both treatment plants use chlorine gas for primary disinfection. The Potomac plant also uses ultraviolet (UV) disinfection as a secondary barrier against water-borne disease-causing microorganisms. The Patuxent plant will be installing UV reactors for disinfection on each filter effluent in the near future. Although UV disinfection is not required by regulation, WSSC has elected to provide UV disinfection as an added microbial barrier for its customers.

Chlorine dosages are maintained at about 3.1 mg/L at the Potomac plant and at about 3.35 mg/L at the Patuxent plant. The estimated chlorine demand was found to range between 0.79 mg/L and 1.5 mg/L. Average chlorine demand in surface water plants around the U.S. are about 2.5 mg/L to 4 mg/L.

Required free chlorine residuals are established in both the plant tap and at all points in the distribution system at 0.2 mg/L. Plant tap residuals average 2.05 mg/L from the Potomac plant and 1.55 mg/L from the Patuxent plant, respectively. Both water treatment plants maintain free chlorine to total chlorine ratios greater than 0.84.

Contact time (CT) is a compliance technique to provide adequate disinfection and contact time for removal of certain microorganisms. Daily CT calculations must meet or exceed regulatory CT values for the required log inactivation of Giardia and viruses. The Potomac plant has four clearwells, each having a storage capacity of 5.5 MG, for a total storage capacity of 22 MG. The Patuxent plant has seven clearwells, each having storage capacities of 2.08 MG to 2.84 MG, for a total storage capacity of 19.1 MG. CT calculations are made each day to determine compliance with regulatory requirements. CT ratios, comparisons between the required CT values and the actual CT values, must be greater than 1.0. The Potomac plant appears to have CT ratios of about 12, while the Patuxent plant has CT ratios of about 4.45.

Strengths

The chlorine demand appears to be relatively low compared with other surface water plants, possibly due to the excellent source water quality. Free-to-total chlorine ratios are consistently greater than 0.80 to prevent water quality issues in the distribution system.

Areas of Potential Improvement

High CT ratios suggest there is an abundance of clearwell storage at the treatment plants that potentially leads to higher risk of DBP formation.

There exists no formal risk-based process control plan to drive overall operation at plant.

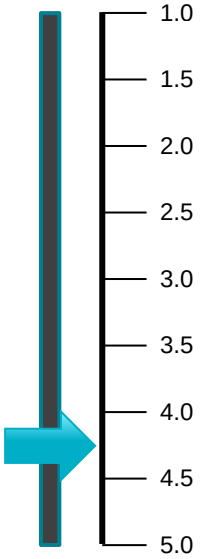
Recommendations

The following recommendations are offered to assist in improving disinfection:

- Conduct quarterly reviews of CT compliance to identify how much actual clearwell storage is necessary for CT and how much storage capacity could be taken offline to reduce DBP formation potential and onsite chlorine residual decay.

- Maintain ratio of CT actual to CT required between 2 and 3.
- Develop and implement a risk-based process control plan. Develop a continuous improvement culture through workshops that engage all levels of the facility and organization Develop process control management plans that would proactively manage the treatment process, further developing key performance indicators. Implement regular process control meetings with documented meeting minutes. Develop a formal lessons learned process, based a root cause analysis. Create performance boards strategically placed at each facility to drive performance and accountability of staff. Implement formal audit program to ensure policy and procedures are being followed.

Figure W.9 Disinfection Score and Scoring Criteria



Assessment Score – 4.3 out of 5

Scoring Criteria

Score 1:
- Use of one primary disinfectant.
- Chlorine demand not regularly monitored, fixed high chlorine dosage rate.
- Plant effluent free chlorine residuals generally less than 0.5 mg/L.
- Free-to-total chlorine ratios are consistently less than 0.80.
- Ratio of CT actual to CT required is actively monitored and is routinely greater than 10.0.

Score 3:
- Use of one primary disinfectant, but may have secondary disinfectant in place.
- Chlorine demand monitored occasionally with some chlorine dosage rate adjustments.
- Plant effluent free chlorine residuals generally around 1.0 mg/L.
- Free-to-total chlorine ratios are generally around 0.80.
- Ratio of CT actual to CT required is actively monitored and is routinely greater than 5.0.

Score 5:
- Use of dual disinfectants in place.
- Chlorine demand monitored frequently, with variable chlorine dosage rates to effectively handle demand.
- Plant effluent free chlorine residuals generally greater than 1.5 mg/L.
- Free-to-total chlorine ratios are regularly above 0.80.
- Ratio of CT actual to CT required is actively monitored and managed to a target between 2.0 and 3.0.
- Formal and documented risk-based process control plan fully that is not only implemented, but also reviewed and updated regularly

Fluoridation

Fluoride adjustment of drinking water is a long-established practice in the water industry. Generally, adjustment of fluoride to 1 mg/L has been used in the northern states for protection against tooth decay and other dental issues. In 2015, the U.S. Public Health Service (PHS) published new findings related to fluoride levels in drinking water and established that the optimum fluoride level is 0.7 mg/L. PHS

recommended that water systems reduce fluoride levels to prevent dental fluorosis that has been experienced at fluoride levels greater than 0.7 mg/L. Maryland does not regulate fluoride in drinking water; rather, fluoridation and its control are left to local governments. WSSC has elected to reduce the fluoride in the drinking water commensurate with the PHS recommended fluoride levels. The reduction from 1.0 mg/L to 0.7 mg/L was made prior to the assessments conducted. Current fluoride levels in the water produced by the treatment plants average about 0.68 mg/L.

Strengths

WSSC elected to reduce the fluoride in the drinking water commensurate with the PHS-recommended fluoride levels of 0.7 mg/L and implemented the change prior to the start of this evaluation.

Areas of Potential Improvement

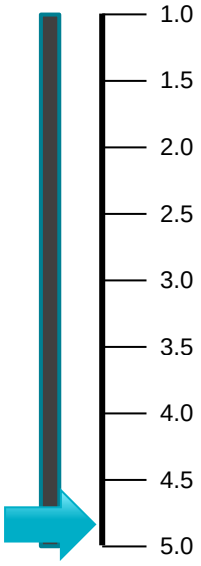
There exists no formal risk-based process control plan to drive overall operation at plant.

Recommendations

The following recommendations are offered to assist in improving fluoridation:

- Ensure fluoride dosing system is optimized, based on plant flow rate.
- Develop and implement a risk-based process control plan. Develop a continuous improvement culture through workshops that engage all levels of the facility and organization Develop process control management plans that would proactively manage the treatment process, further developing key performance indicators. Implement regular process control meetings with documented meeting minutes. Develop a formal lessons learned process, based a root cause analysis. Create performance boards strategically placed at each facility to drive performance and accountability of staff. Implement formal audit program to ensure policy and procedures are being followed.

Figure W.10 Fluoridation Score and Scoring Criteria



Assessment Score – 4.8 out of 5

Scoring Criteria

Score 1:
- Dosage rate set at constant level and not optimized

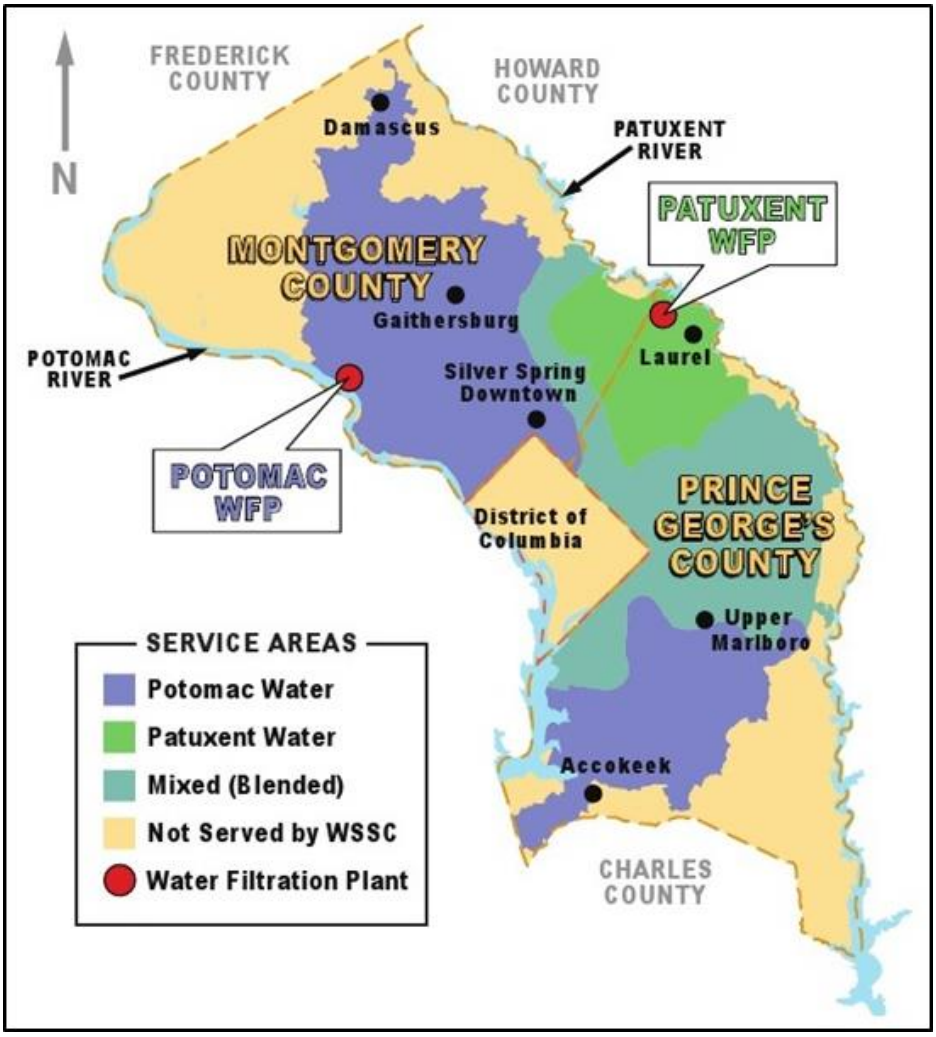
Score 3:
- Dosing fluoride at the traditional rate of 1.0 mg/L.
- Dosage rate based on average daily flows

Score 5:
- Reduce dosage rate to optimum fluoride level of 0.7 mg/L, consistent with the 2015 U.S. Public Health Service findings.
- Dosage rate based on feedback control loop and flow pacing
- Formal and documented risk-based process control plan fully that is not only implemented, but also reviewed and updated regularly

Distribution System and Water Quality

Water produced at the treatment plants is supplied through a very large distribution system to residents in Montgomery and Prince George's counties. The service area is illustrated in Figure W.11. Assessments were made relative only to water quality and storage volumes.

Figure W.11 WSSC Service Area



A number of elevated storage tanks, standpipes and ground storage tanks are present in the WSSC distribution system. Montgomery County reportedly has storage totaling 166 MG and Prince George's County reportedly has storage totaling 56.5 MG. Combining the system storage with the water treatment plants clearwell storage equals a finished water total storage volume of about 264 MG. The average daily water production from the WSSC treatment plants is 179 MGD, providing about 1.5 days of finished water storage. Generalized metrics for finished water storage are established at one day average demand, primarily for peak demand periods and fire flows.

Although a hydraulic model of the distribution system is believed to exist, no data or information related to water age or residence time was provided for these assessments. Based on experience with large systems and the reported finished water storage, it is possible that water age in the system averages about three days to six days. Some localized water age differences likely are present, depending on local water demands and stored water locations. Excessive water age tends to negatively impact system water quality.

Disinfection byproducts are regulated in drinking water. Surface water plants are required to comply with regulatory limits for THM and HAA5. Regulatory limits are established as a locational running annual average (LRRA) and distribution system monitoring is set based on the population served. THM limits are currently at 80 µg/L, while HAA5 limits are currently at 60 µg/L. Long-established practice is to strive for disinfection byproduct levels no more than 80 percent of the regulatory limits (64 µg/L THM , 48 µg/L HAA5). Based on the 2014 and 2015 DBP monitoring data, WSSC water contains THM concentrations that average 50.6 µg/L and HAA5 concentrations that average 36.2 µg/L. Maximum THM and HAA5 levels during the two-year period reviewed were found to be 57.3 µg/L and 45.6 µg/L, respectively.

Lead and copper concentrations are routinely monitored in the WSSC distribution system as regulated by regulation. The limits for lead are established at 15 µg/L (as a 90th percentile), while copper limits are established at 1.3 mg/L (as a 90th percentile). WSSC applies phosphoric acid for corrosion control and to minimize lead and copper concentrations in the water. Average phosphate dosages are 0.91 mg/L for the Potomac plant and 0.98 mg/L for the Patuxent plant. The most recent lead and copper monitoring results indicated lead levels were 1.17 µg/L and that copper levels were 0.087 mg/L.

Strengths

It appears that DBP control is well managed by WSSC to meet the compliance limits and is consistent with the relatively low finished water TOC levels observed.

Corrosion control practices are managed very well to minimize lead and copper in the drinking water. It appears, however, that WSSC maintains passivation dosages for corrosion control and has done so historically, rather than evaluating a lower maintenance dose.

Areas of Potential Improvement

Distribution system records showed some areas of the system experience periodic low free-chlorine residuals (below 0.2 mg/L). These low residual periods appear to coincide with the summer months when water temperature is greatest. Since the finished water is relatively low in organic content (TOC), it is believed that water age or residence time is causing much of the decay and loss of residuals in the system.

There exists no formal risk-based process control plan to drive overall operation at plant.

Recommendations

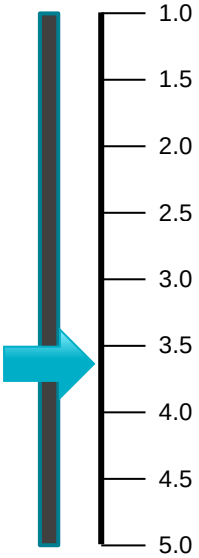
The following recommendations are offered to assist in improving distribution system and water quality:

- Conduct chlorine decay evaluations and compare to systems residuals to determine the impacts of pipeline storage and storage tanks on chlorine residual losses.
- In conjunction with chlorine decay evaluation, conduct quarterly reviews of system storage to identify how much actual storage is necessary to meet demand and how much storage capacity could be taken offline to reduce DBP formation potential and onsite chlorine residual decay.
- Develop and implement a risk-based process control plan. Develop a continuous improvement culture through workshops that engage all levels of the facility and organization Develop process control management plans that would proactively manage the treatment process, further developing key performance indicators. Implement regular process control meetings with

documented meeting minutes. Develop a formal lessons learned process, based a root cause analysis. Create performance boards strategically placed at each facility to drive performance and accountability of staff. Implement formal audit program to ensure policy and procedures are being followed.

- Conduct a thorough study, supplemented with field verification, to evaluate feeding a lower maintenance dosage of phosphates after successfully demonstrating passivation of the distribution system to continue to achieve compliance with lead and copper limits.

Figure W.12 Distribution System and Water Quality and Scoring Criteria



Assessment Score – 3.6 out of 5

Scoring Criteria

Score 1:

- Less than one day of distribution system storage is available, based on one-day average demand primarily for peak demand periods and fire flows.
- Hydraulic model may exist, but is rudimentary and rarely used.
- Water age in the extremities of the system is generally greater than two weeks old, with little turnover of finished water reservoirs.
- Lead and copper in the distribution system are regularly at and sometimes exceed regulatory levels when sampled discretely.

Score 3:

- Greater than one day of distribution system storage is available, based on one-day average demand primarily for peak demand periods and fire flows.
- Basic hydraulic model exists and is sometimes uses model demands that may affect production.
- Water age in the extremities of the system are generally less than two weeks old, with moderate turnover of finished water reservoirs.
- DBPs in the distribution system are regularly below and rarely exceed regulatory levels when sampled discretely.
- Lead and copper in the distribution system are regularly below and rarely exceed regulatory levels when sampled discretely; corrosion control techniques implemented to successfully passivate distribution system

Score 5:

- Greater than two days of distribution system storage is available, based on one-day average demand primarily for peak demand periods and fire flows.
- Advanced hydraulic model exists and is frequently calibrated against existing conditions using actual field data; hydraulic model is regularly used to model demands that may affect production.
- Water age in the extremities of the system is generally less than one week old, with regular turnover of finished water reservoirs.
- DBPs in the distribution system are significantly below and never exceed regulatory levels when sampled discretely.
- Lead and copper in the distribution system are significantly below and never exceed regulatory levels when sampled discretely; distribution system is fully passivated and corrosion control technique reduced to maintain passivation.
- Formal and documented risk-based process control plan fully that is not only implemented, but also reviewed and updated regularly

BEST PRACTICES EVALUATION

Wastewater Treatment

WASTEWATER TREATMENT

Background and Context

The mission of all the wastewater treatment plants (WWTPs) within WSSC is to return clean water to the environment all in an ethical, sustainable, and financially responsible manner. WSSC personnel are typically divided into the following four groups: Supervisory office, Operations, Electrical Mechanical and Plant Engineering. There are six WWTPs within WSSC with a total treatment capacity of approximately 71 MGD. Up to an additional 169 MGD of flow is pumped and treated at the Blue Plains Advanced Wastewater Treatment Plant, operated by DC Water, under a cost-sharing agreement. Normally, 65% of the total flow is pumped to and treated at the Blue Plains plant.

The Seneca/Damascus/Hyattstown group consists of 32 personnel that operates and maintains WSSC's wastewater treatment and pumping facilities in Montgomery County. These facilities include the Seneca plant, Damascus plant, and Hyattstown plant, as well as 20 separate remote wastewater pumping stations throughout the County. Average daily flows in FY14 and FY15 were 15 MGD, 0.9 MGD and <0.1 MGD, respectively.

The Piscataway group operates consists of 27 personnel that operates and maintains WSSC's wastewater treatment and pumping facilities in Prince George's County, as well as within the Bolling Air Force Base. The Piscataway plant, located in a rural section of southwestern Prince George's County, processed an average daily flow of 25 MGD in FY14 and FY15.

The Western Branch Group consists of approximately 32 personnel that operate and maintain the Western Branch plant in Prince George's County. The treatment plant also supports a 118-square mile collection system covering NASA Goddard Space Flight Center in Greenbelt, Andrews Air Force Base, Largo, Upper Marlboro, and Bowie, Maryland. In FY14 and FY15, this plant processed an average daily flow of 21 MGD.

The Parkway Group consists of 22 personnel that operate and maintain the Parkway WWTP. The Plant provides treatment for Prince George's County's portions of the City of Laurel, MD, and it also dewaters the residuals from WSSC's Patuxent WTP. Parkway staff provides operations and maintenance support for 20 remote wastewater pumping stations which pump to Parkway WWTP, Western Branch WWTP, and DC Water's Blue Plains WWTP. These stations include the Anacostia II pump station which pumps an average daily flow of 50-60 mgd, and storm related peak flows up to 200 mg; flows beyond 200 mgd are temporarily stored in an adjacent 6 MG storage facility to prevent SSOs. In FY14 and FY15 the Parkway WWTP process an average daily flow of 6.5 mgd

WSSC also pumps raw wastewater to the Blue Plains wastewater treatment plant in Washington, D.C. The Blue Plains plant has allocated 169 MGD of its 370 MGD treatment capacity dedicated to WSSC.

Best Practices Evaluation

Business practices currently implemented within the Wastewater Treatment Group were assessed through a series of document reviews, data evaluation and staff interviews conducted in January through March 2016. The evaluation that follows is based on seven Veolia Best Practice standards, each with specific subcategories to determine overall performance, and it uses a standardized scoring system from 1 (basic performance) to 5 (industry best). Criteria used in this scoring system, as well as the score assigned, are indicated below.

To assist in identifying which standards have the largest opportunity for improvement, a second score was identified as a near-term improvement goal. This score is determined to be where WSSC could be in less than 24 months with some additional focus and effort, given the current landscape. The difference between actual performance and the near-term performance goal forms the basis of a gap analysis that is then used to prioritize areas that have potential for additional improvement. Any arithmetic difference of 2.0 or greater between actual performance and the near-term performance goal was considered significant, and any difference in scores between 1.5 and 1.9 was considered potentially significant. Figure WW.1 summarizes the evaluation and Table WW.1 summarizes the results from the assessment analysis.

As a general guidance note, scores normally achieved for a large utility such as WSSC would range from 3 to 5.

Figure WW.1 WSSC Wastewater Treatment Best Practices Evaluation Summary

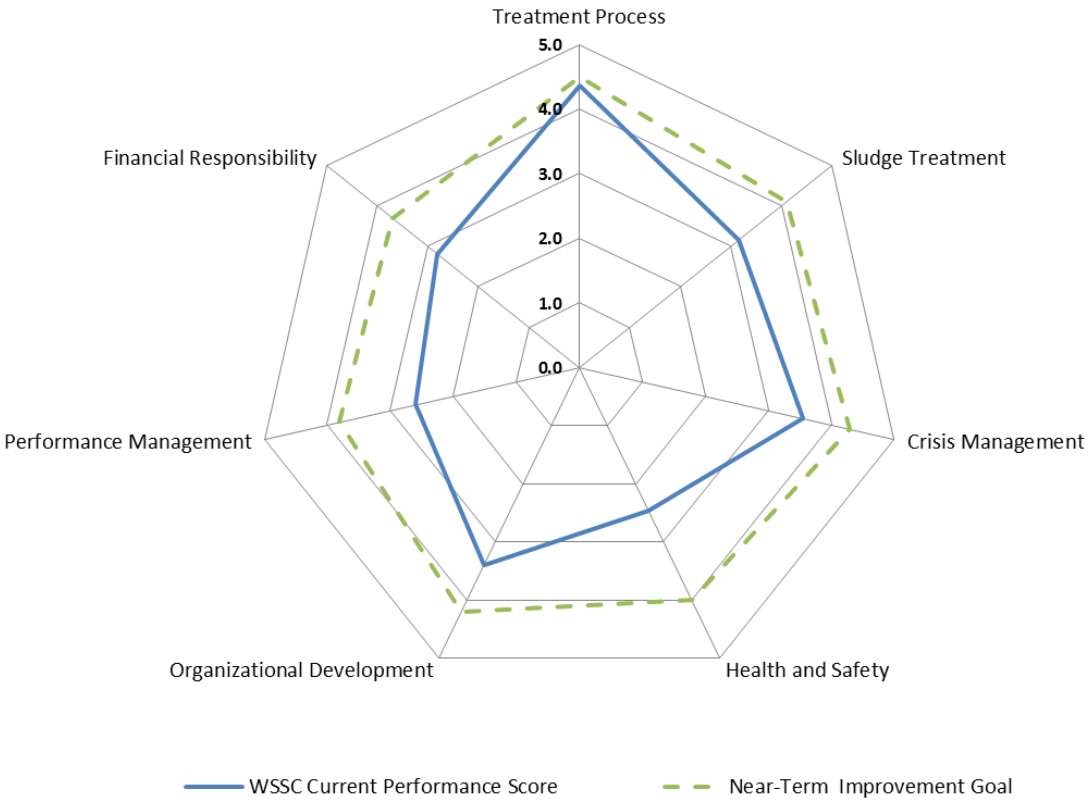


Table WW.1 WSSC Wastewater Treatment Best Practices Gap Analysis

Category	WSSC Current Performance Score	Near-Term Improvement Goal	Arithmetic Difference	Significant?
Treatment Process	4.4	4.5	0.1	No
Sludge Treatment	3.2	4.1	0.9	No
Crisis Management	3.5	4.3	0.8	No
Health and Safety	2.5	4.0	1.5	Potentially
Organizational Development	3.4	4.2	0.8	No
Performance Management	2.6	3.8	1.2	No
Financial Responsibility	2.8	3.7	0.9	No

Treatment Process

Most impressively, WSSC scored well above average in the functional area of treatment process, or how well each facility manages its wastewater treatment process to meet compliance targets. As mentioned previously, four facilities have been 100% compliant with their NPDES permit for five or more consecutive years. Many of the facilities target a reduced total nitrogen and phosphorous goal set forth by the Maryland Department of the Environment that would trigger performance payments. As shown in Table WW.2, only one facility reported a non-compliance event between FY14 and FY15.

Table WW.2 WSSC Compliance Reporting Summary

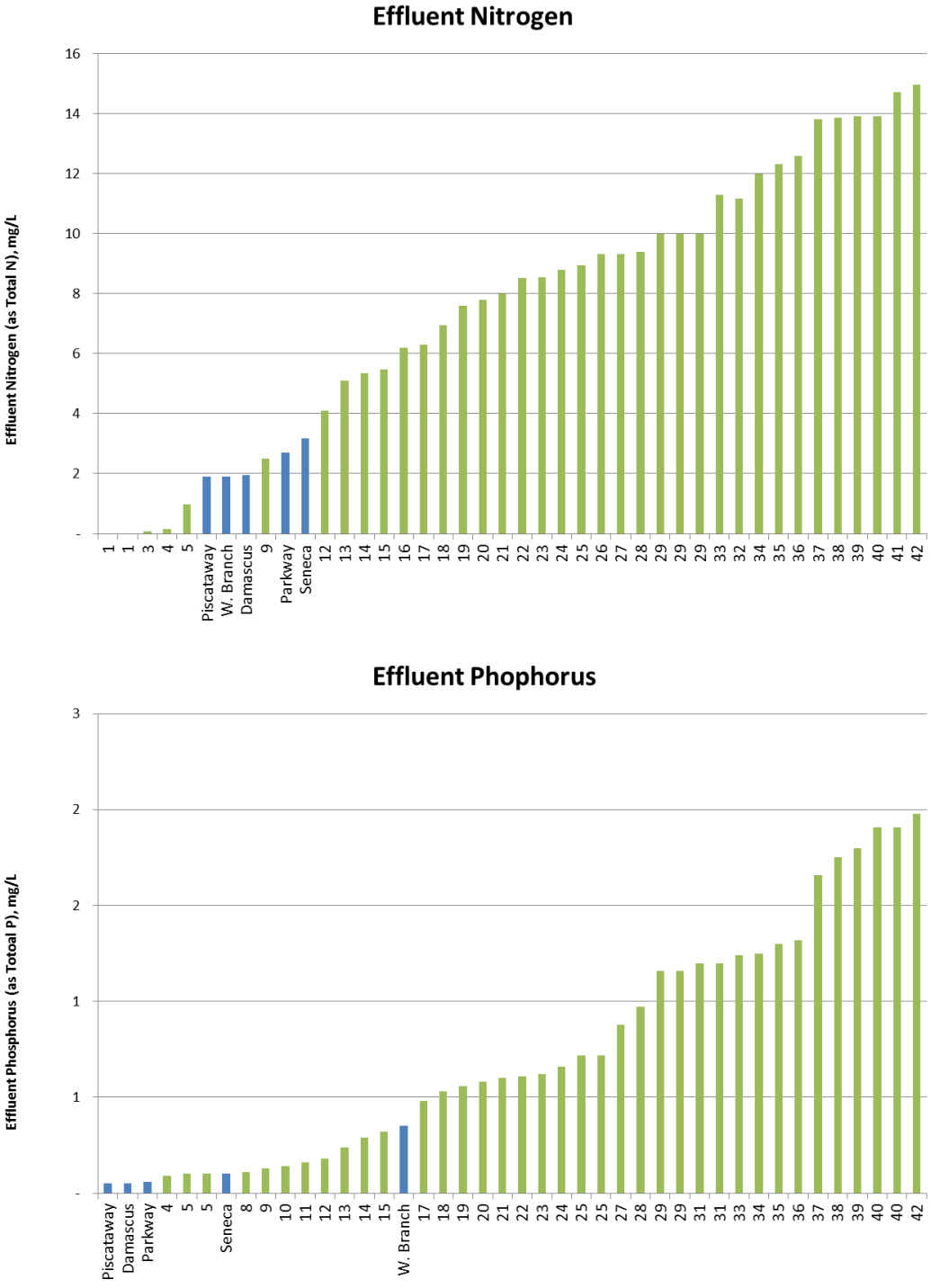
	Number of Non-Compliance Events	
Treatment Plant	FY14	FY15
Piscataway	0	0
Western Branch	**17**	0
Parkway	0	0
Seneca	0	0
Damascus	0	0

Strengths

WSSC has a Process Controls Group that is dedicated to maintaining and continuously improving automation at the plants. The facilities consistently perform at a high level and as a result of this, most key performance indicators (KPI) reviewed were tightly monitored and controlled within a narrow operating band. The control systems are reliable enough to enable five of the six facilities to be unmanned at night. Data management systems and proper sampling protocols are in place to run process control reports. Each facility consistently produces effluent water that is far below the permitted values.

When assessing nutrient removal of WSSC's treatment facilities against a peer group of Veolia facilities, WSSC ranked mostly in the first quartile, as indicated in Figure WW.3.

Figure WW.3 WSSC Effluent Water Quality Compared to Veolia North America[1]

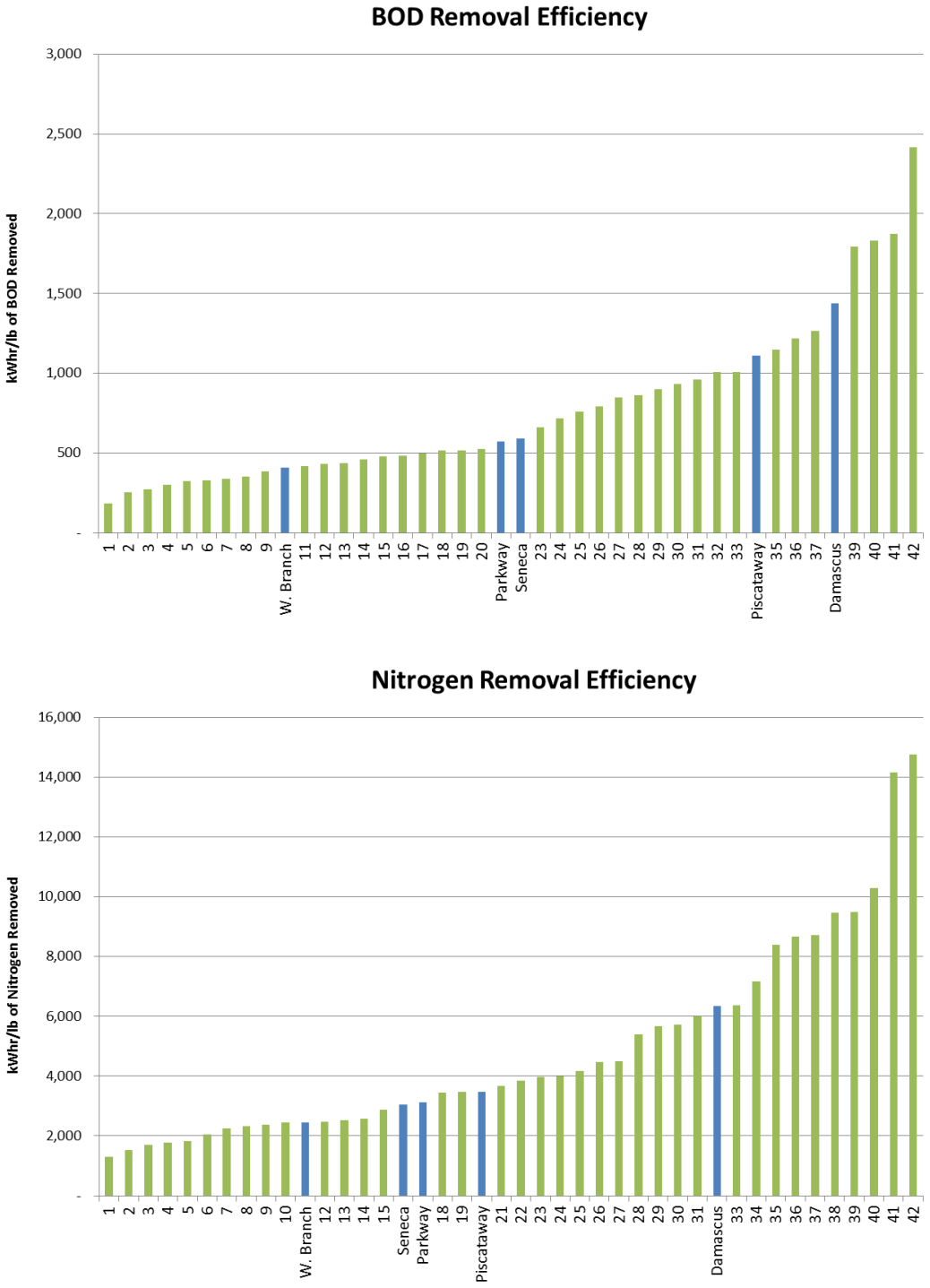


[1]*Peer group was selected from Veolia North America facilities having a treatment capacity greater than 0.7MGD, with effluent nutrient levels below 15mg/L of Total Nitrogen and 2mg/L of Total Phosphorous.*

Comparing WSSC against this same Veolia peer group for efficiency of nitrogen and BOD removals, different WSSC plants various quartiles, as indicated in Figure WW.4. With WSSC receiving ENR bonus

payments for achieving lower limits, the overall cost effectiveness of the nitrogen and BOD removals are not reflected.

Figure WW.4 WSSC BOD and Nitrogen Removal Efficiencies Compared to Veolia North America

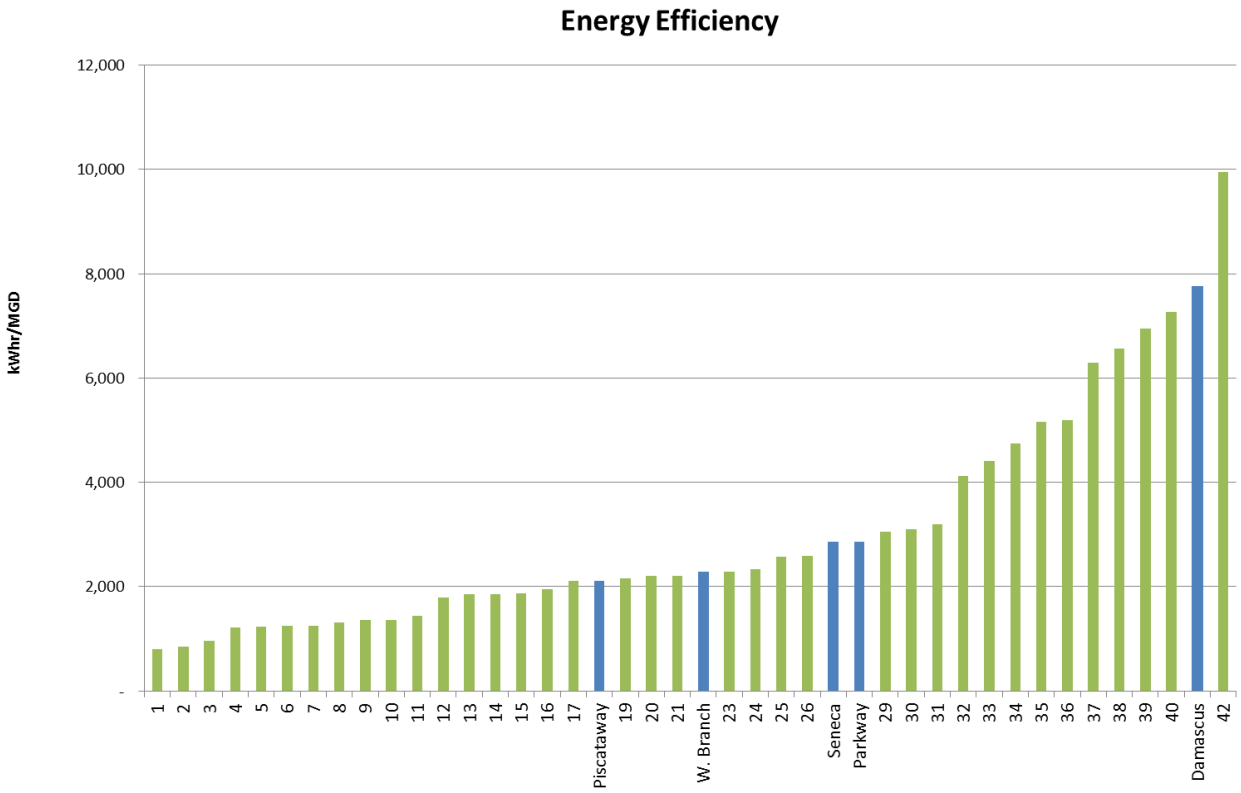


Potential Areas of Improvement

WSSC was observed to have a low degree of proactive management of all processes. Best practices would include a weekly process control meetings and continuous improvement workshops at all facilities with performance testing on key processes as part of the culture. The development and implementation of process control management plans would further reduce onsite risk and improve resiliency.

When looking at the energy efficiency of the treatment process, WSSC facilities ranked in mostly in the third and fourth quartiles against this same Veolia peer group, as indicated in Figure WW.5.

Figure WW.5 WSSC Energy Efficiencies Compared to Veolia North America



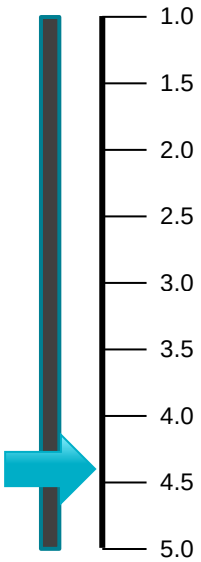
Recommendations

The following recommendations are offered to assist in improving overall management of treatment process:

- Development of process control management plans that would proactively manage the treatment process, further developing key performance indicators.
- Implementation of regular process control meetings with documented meeting minutes.
- Development of a continuous improvement culture through workshops that engage all levels of the facility and organization.
- Onsite management and accountability of energy usage for large pieces of equipment.

- A shift in mindset from a culture of “compliance at all costs” to “compliance at lowest cost”.
- Development of a mass balance of the entire plant process, and routine usage as an operational tool.

Figure WW.6 Treatment Process Score and Scoring Criteria



Assessment Score – 4.4 out of 5

Scoring Criteria

Score 1:

- Water treatment process performance is assessed regularly by simultaneous sampling at plant inlet and outlet, and treated water quality compliance is monitored according to the national standard(s) in force
- Laboratory measurements are at least COD_{cr}, BOD_5, SS, TN, TP, pH and any other legally required parameter achieved by using the standardized analysis protocols
- The whole is manually recorded and transmitted to the relevant water authority

Score 3:

- Composite 24 hours sampling (at least time based) at plant inlet and outlet
- Analysis performed at least twice a week of activated sludge basic parameters such as MLSS, MLVSS, DSVI
- The whole plant energy (electricity + other energy) consumption is manually recorded
- Weekly analysis of alkalinity for nitrification needs
- Computer based records include basic process calculations (inlet, outlet and removed loads, removal rates, sludge age, chemicals dosing rates, etc.) and detailed energy consumptions based on individual power meters for inlet pumps, blowers or surface aerator(s), recirculation pump(s)
- The aeration system (blowers and/or surface aerators) are 100% automatically controlled by PLC and 100% automatically adjusted based on DO, ORP or NH_4/NO_3 sensors

Score 5:

- Flow-based and Refrigerated Auto-sampler for routine sample collection
- Additional sampling (grab at least) at all intermediate treatment process stages (between primary settler and biological treatment, between biological treatment and tertiary treatment, etc.)
- Analysis of all Nitrogen and Phosphorus forms at plant inlet (except $N\text{-}NO_2/N\text{-}NO_3$) and outlet.
- All motors counting for more than 75% of the plant electricity consumption have their individual power meter with computer-based records
- Daily, Weekly and Monthly use of the process monitoring tools including a process Mass Balance of the whole plant for process management
- Continuous process management and performance improvement policy implemented with internal plant audits and improvement Action Plans formalized and enforced with measured and recorded results

Sludge Treatment

The overall handling and treatment of WSSC's sludge scored slightly above average. There is a large-scale project in the design phase for installation of digesters and a cogeneration facility at Piscataway. When completed, sludge treatment performance should improve. Currently, approximately70% of the sludge produced is disposed through a land application process.

Strengths

All facilities sample at key locations in the sludge process to monitor the chemical dosing required to thicken, dewater, and lime-stabilize their sludge. Out of almost 25,000 dry tons of sludge produced In FY14 and FY15, approximately 60% of the solids produced were lime-stabilized and hauled away with the intent of land application. The lime stabilized sludge had an average solids content of approximately 27%. The facilities that do land apply effectively test pH to ensure Class B requirements are met for land application.

Potential Areas of Improvement

No cost evaluation is currently being performed to evaluate financial impacts of operating the sludge processing system. To effectively do this, all facilities must adopt a process to continually track, monitor and manage the overall costs of the solids process.

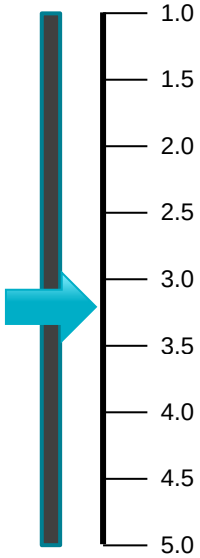
The process control parameters of the sludge handling system, i.e., feed rates, bowl speed, etc., were observed to be at a similar setting to that originally setup during testing and commissioning, with the performance maintaining consistent levels. Best practice would be to regularly test setpoints, feed rates, dosages and dosage locations. Doing so can significantly improve performance and reduce overall costs of the sludge handling system through energy, chemical and sludge hauling savings.

Recommendations

The following recommendations are offered to assist in improving overall management of sludge treatment:

- Development of a process control management plan for the solids handling process.
- Development of a continuous improvement culture through workshops that engage all levels of the facility and organization to reduce the cost of dewatering and disposal.
- Onsite management and ownership of energy usage for sludge handling equipment.
- Routine development and usage of a process mass balance of the entire plant process.

Figure WW.7 Sludge Treatment Score and Scoring Criteria



Assessment Score – 3.2 out of 5

Scoring Criteria

Score 1:

- Sludge treatment performance is assessed regularly by sampling of the final sludge produced at plant outlet
- Sludge quality compliance is monitored according to the national standard(s) in force
- The whole is manually recorded and transmitted to the relevant water authority

Score 3:

- Grab sampling is achieved daily at each inlet and outlet of the different sludge treatment processes in place
- Computer-based records include Dry Solids and Volatile Solids measured by standardized laboratory protocols
- Detailed energy consumptions read daily on individual power meters for centrifuge thickening and/or dewatering machine as well as the chemicals consumed
- Composite sampling representing the usual daily cycle are achieved at least twice a week

Score 5:

- Composite sampling is done daily and a computer- based recording is in place with the basic sludge process calculations
- All motors counting for more than 75% of the plant electricity consumption have their individual power meter with computer-based records
- Daily, Weekly and Monthly use of the process monitoring tools including a sludge Mass Balance of the whole plant for process management
- Continuous process management and performance improvement policy implemented with internal plant audits and improvement Action Plans formalized and enforced with measured and recorded results

Crisis Management

During this study, WSSC effectively managed a winter storm requiring activation of their Continuity of Operations Plan. There was no indication that dry runs or formalized lessons learned were part of the normal occurrence. The response to an actual event was a good indication into the effectiveness of their crisis management processes and procedures, leading to an above-average score.

Strengths

All of the plants have a formalized emergency response procedure, or Continuity of Operations Plan, with updates that occur as needed to ensure all proper contact numbers are listed. In general, this plan includes:

- A listing of the essential, emergency and critical functions with a priority scale, recovery time, responsible party and seasonality indicated for each, and
- A listing of succession and delegation of authority, and

- A listing of the vital reports (any databases, records or documents damaged or destroyed, would disrupt essential functions) with location, backup frequency, remote accessibility, and contact.

Potential Areas of Improvement

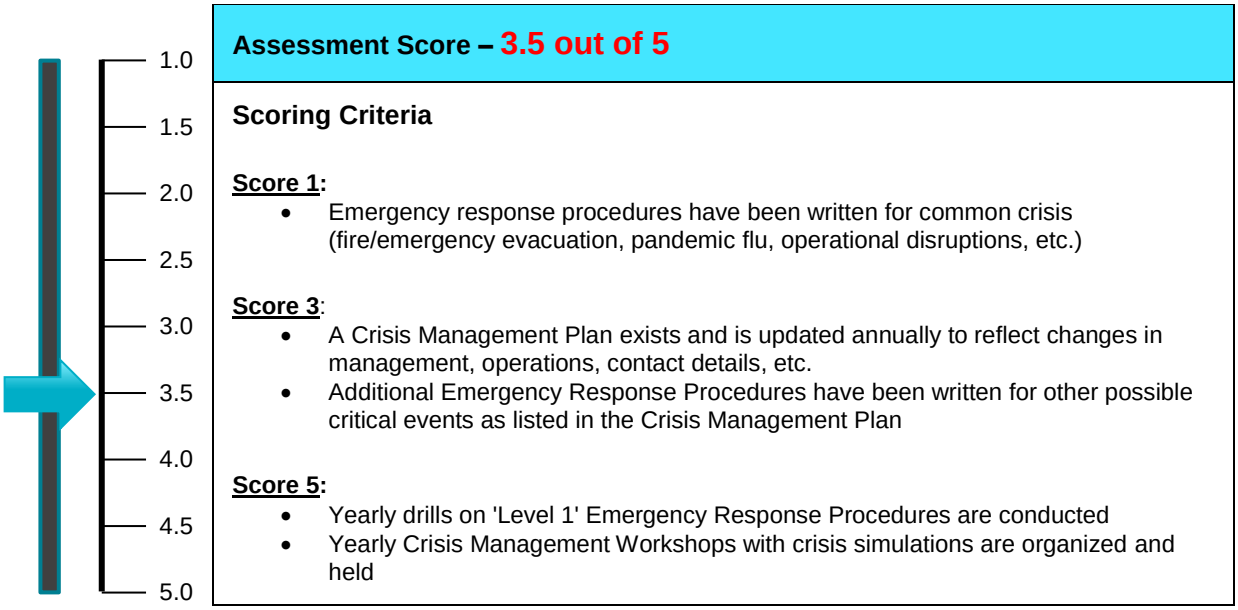
Development of a formalized lessons learned process, based on root cause analysis, and performance of dry run tests would continually improve WSSC's management of any future crisis. The transformation from a reactive to a proactive crisis plan would be a best practice. The utilization of dry runs would test and improve procedures. Also, during a site walkthrough, sleeping arrangements (sleeping bag and cot) were still observed a month after a snowstorm.

Recommendations

The following recommendations are offered to assist in improving overall crisis management:

- Conduct routine dry runs of Continuity of Operations Plan.
- Develop a formal lessons learned process, based a root cause analysis.

Figure WW.8 Crisis Management Score and Scoring Criteria



Health & Safety

During site walkthroughs, a safety near-miss tripping hazard was observed at Piscataway. A near miss by definition is an unplanned event that did not result in injury, illness, or damage – but had the potential to do so. Near misses can identify system weaknesses and exploit a managerial or procedural issue, both of which were observed at WSSC. From a procedural standpoint, WSSC was observed to be at or above average. As with the Energy Management group, all the metrics and procedures come from a centralized office; however, no metrics were witnessed onsite or provided for analysis. With procedural implementation lacking and the observations of unsafe conditions, WSSC scored below average.

Strengths

Each facility has a safety coordinator that rotates on a set frequency in an effort to continually develop staff know-how and responsibility for safety procedures. Safety refreshers are offered on an ongoing basis and pushed to site staff. Audits have been previously conducted at each facility, yet no formalized process or frequency was noted. Health and safety of all employees is continually a topic during weekly meetings with all onsite personnel. As seen in Figure WW.9, signage indicating the need for hearing protection is displayed and ear plugs are readily available at Parkway.

Figure WW.9 Proper Hearing Protection Was Available at Parkway

Potential Areas of Improvement

Proper personal protective equipment was observed to be loosely enforced compared to best in class. In addition, there seemed to be a lack of enforcement around some best-in-class procedures. For example, hazardous areas are not consistently and properly delineated. From Figure WW.10, a tripping hazard at Piscataway led to a near miss observed during a site visit.

Figure WW.10 Improper Delineation of a Tripping Hazard Shown at Piscataway

Safety metrics were requested, but not provided and no onsite safety metrics were observed. Whenever discussing safety metrics, onsite staff referenced a centralized safety group. The tracking and monitoring onsite of lagging safety metrics, such as near misses, OSHA recordable incidence rates, and lost-time incidence rates, in addition to leading safety metrics such as number of job hazard analyses completed, number of safety protocols reviewed and updated, number of safety tailgates performed, etc. would improve overall safety performance at WSSC.

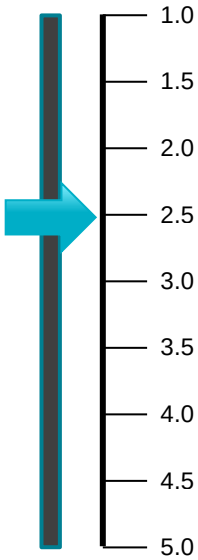
Recommendations

The following recommendations are offered to assist in improving overall management of health and safety:

- Development and implementation of protocols to hold onsite staff accountable for safety performance, including tracking and reporting leading and lagging safety metrics.

- Development and implementation of a formal audit program to ensure policy and procedures are being followed.
- Creation of performance boards strategically placed at each facility to drive performance and accountability of staff.

Figure WW.11 Health and Safety Score and Scoring Criteria



Assessment Score – 2.5 out of 5

Scoring Criteria

Score 1:

- H&S Policy has been defined, written, explained to all staff, and publicly available for review
- Due diligence review completed and report issued

Score 3:

- Appropriate PPE available for each employee including any specialist PPE available for high risk activities
- Department and Team managers have received suitable H&S training of the safety requirements of working in a wastewater treatment facility
- A suitably trained H&S representative is on site
- Employees have been suitably trained including any risks within the frame of their job scope.
- Risk assessment completed for all site activities and all effected personnel have been informed and understand the inherent risk with their operations and who could be affected by their activities
- H&S self-assessment completed and submitted to general management

Score 5:

- Management regularly monitors and enforces the minimum H&S requirements and regularly conducts safety audits
- Site safety committee is established and have regular safety meetings with actions raised recorded and tracked until closed
- Incident and Accident reporting to general management occurs on a monthly basis
- Gas detectors are installed, regularly calibrated and maintained in each area where it is necessary due to dangerous gas emission
- All H&S rules/regulations on-site are enforced for all employees as well as any sub-contractor with adequate training to both employee and subcontractors where necessary; a penalty system is in place for subcontractors who fail to comply with requirements
- A continuous H&S improvement has been achieved and has a higher than average compliance in the H&S assessment
- All employees have attended the appropriate regional H&S training for their disciplines
- Restricted access areas have been assessed and defined clearly on site together with appropriate signage and strict access management
- Suitable PPE and tools are used and provided
- An Explosion Prevention Document & Risk Action Plan has been completed
- Employees and subcontractors have received specialist training for accessing restricted areas
- Refresher training maintained for all employees
- Leading and lagging H&S KPIs set, tracked, and understood by all

Organizational Development

WSSC is in currently in the process of changing their organizational structure; therefore the assessment was based on WSSC's current organizational structure. WSSC's training program includes over 60 classes for operations staff to attend, leading to an above average assessment in organization development.

Strengths

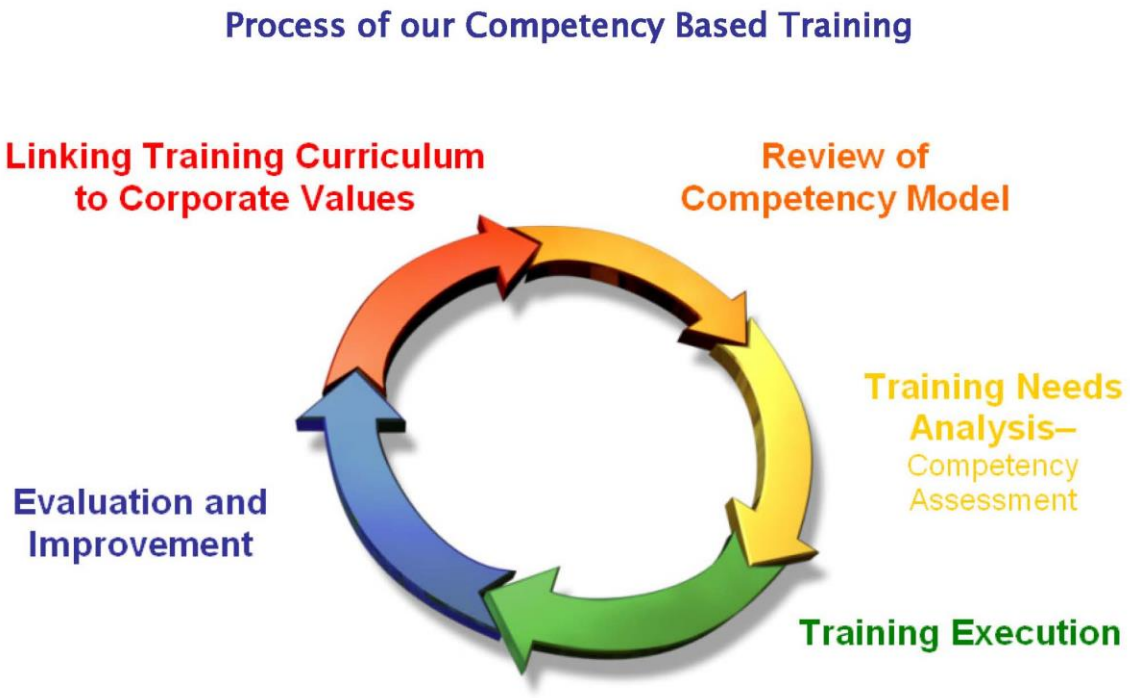
Staff comradery and onsite leadership observed were best practices. All staff members interviewed were very knowledgeable of the technical treatment processes and willing to work with Veolia for this assessment. The overall morale observed was high with lower level operators working well with plant management.

Yearly reviews were performed for all employees. Training classes were available for operations personnel, ranging from gears and gear boxes to four different levels of supervisory training. The number of units or are assigned to each course and the amount of credits each employees attends is tracked.

Potential Areas of Improvement

The current organization has a mix of old and new titles and job descriptions that should be solved by the new structure and Career Ladder. Implementation of a competency-based training approach that combines yearly reviews with training programs is the most effective way of continually developing an organization, see Figure WW.12.

Figure WW.12 Example of a Competency-Based Training Program Utilized within Veolia



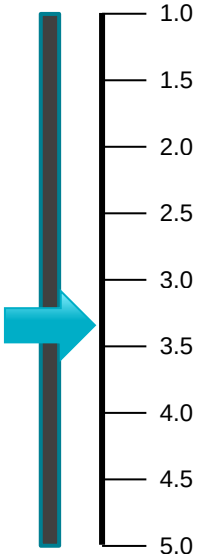
The best operating scenarios are developed by increasing the involvement and importance of the operator. Additionally, WSSC should reconsider phasing out the program to cross-train all staff in operations and light maintenance, which leads to a more multi-skilled workforce.

Recommendations

The following recommendations are offered to assist in improving overall management of organizational development:

- Development of a competency-based training program for all of WSSC staff.
- Cross-train all staff in plant operations and maintenance, leading to a more multi-skilled workforce.

Figure WW.13 Organizational Development Score and Scoring Criteria



Assessment Score – 3.4 out of 5

Scoring Criteria

Score 1:
- Operation and Maintenance team identified

Score 3:
- Organization chart describes who does what within each department; includes identified laboratory, process operations, electrical maintenance, mechanical maintenance, and instrumentation and control maintenance
- Each employee has a detailed job description including the required skills and experience

Score 5:
- Each employee performs an annual appraisal during which their skills are reviewed and training programs corresponding to the skills needed for development are assigned
- Each employee has new competencies assessed after training so that additional needs are identified for continuous improvement

Performance Management

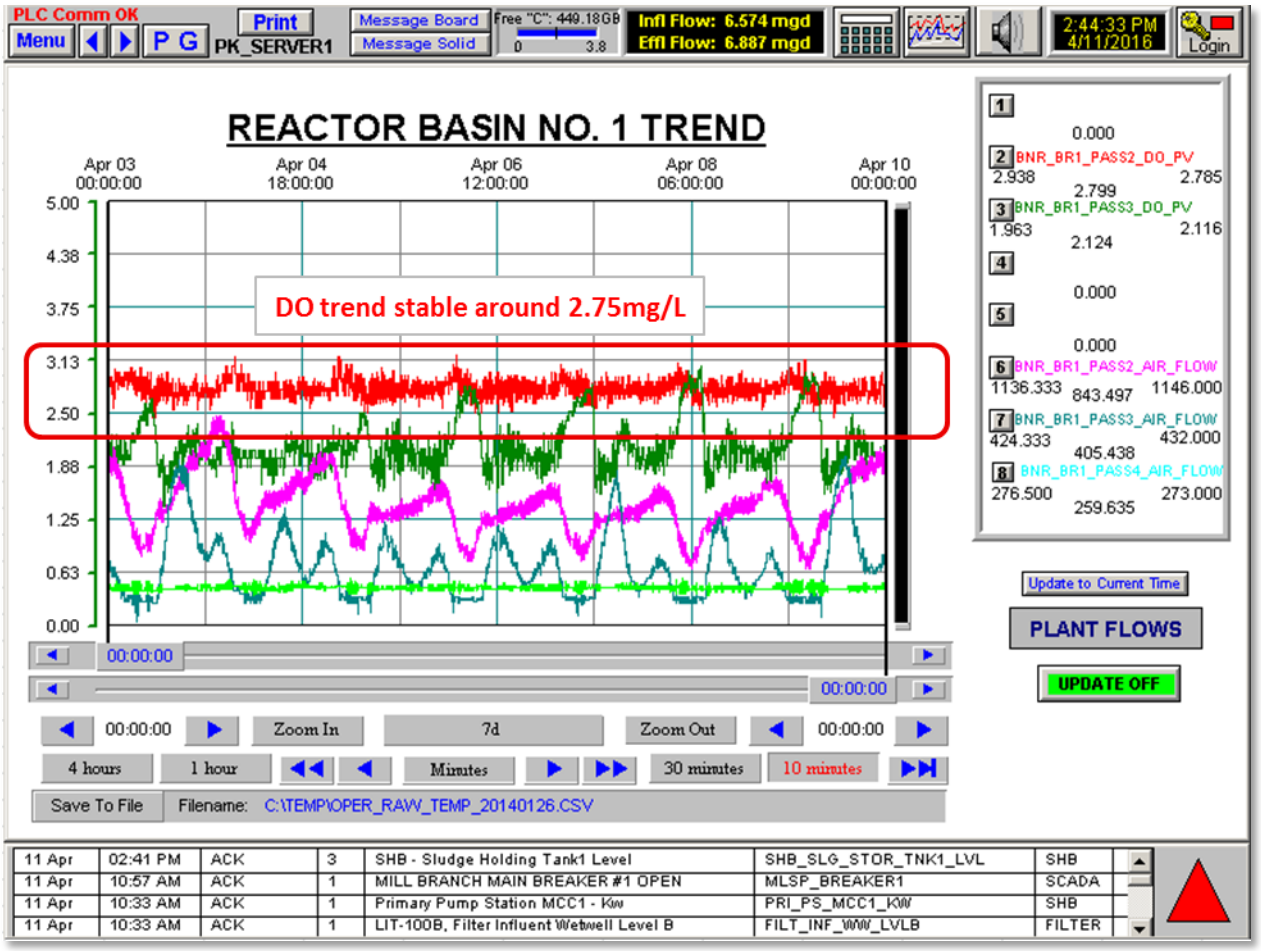
This category is an assessment of how well the treatment facilities document their processes and procedures while proactively tracking and monitoring the plants' performance metrics. Overall, WSSC scored below industry average.

Strengths

WSSC standard operating procedures (SOPs) were observed to generally align with Veolia best practices. Each SOP indicates an originator, approver, and effective date, while being shared in a centralized location for all plant staff. An effective data management system has been installed to run monthly and yearly reports. Onsite SCADA systems are functional with the capabilities to effectively performance manage the processes. Figure WW.14 illustrates how dissolved oxygen performance trends

can be tracked in SCADA.

Figure WW.14 Tracking Dissolved Oxygen through SCADA



Potential Areas of Improvement

Development of documented process control management plans is a Veolia best practice. These plans formalize what process data is collected to calculate specified performance metrics, process performance targets, acceptable control limits, and identify specific actions to be performed in the event that data indicates the process is trending out of control. The plans also assign accountability for the specified process performance. Use of these plans allows plant management to more efficiently and effectively manage the overall performance of the plants.

Robust performance meetings also do not regularly occur. A best practice would be to hold regular meetings attended by key operations staff that allows for and documents the following:

- Review of all current performance metrics, including an exceptions report
- Root cause analysis of any problems that arise
- Identification of specific action items required to address process issues, with time bounds for

completion

- Clear assignment of accountability of processes and action items

Longer-term metric tracking is currently being performed using monthly PDFs of 30 or more pages of data, as indicated in Figure WW.15. Effective management of KPIs must include exception reports along with weekly and monthly charts/trends that include upper and lower warning limits and targets that set on an ongoing basis.

Figure WW.15 Excerpt of WSSC's Existing Tracking of KPIs

Washington Suburban Sanitary Commission

Production Team

Western Branch Summary Report

July 2013 To June 2014

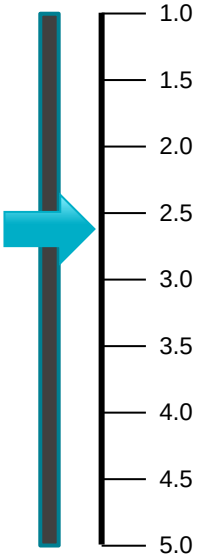
	Western Branch	Raw Influent + Recycle	Final Effluent	Final Effluent	Raw Influent	HRAS Effluent	Final Effluent
	Rainfall	Flow	Flow	Total Flow	Temperature	Alkalinity	Alkalinity
	inches	MGD	MGD	MG/mo	deg F	mg/L	mg/L
July - 2013							
AVG	0.14	26.907	19.301	598.346	72		103
MIN	0.00	24.759	17.369	598.346	42		97
MAX	2.40	32.818	23.944	598.346	82		108
SUM	4.10	834.126	598.346	598.346	2,155		2,569
CNT	30	31	31	1	30	0	25
GEO							
August - 2013							
AVG	0.05	27.280	19.214	595.645	59		99
MIN	0.00	25.064	17.786	595.645	50		95
MAX	0.60	28.712	20.366	595.645	68		107
SUM	1.70	845.685	595.645	595.645	1,830		2,278
CNT	31	31	31	1	31	0	23
GEO							
September - 2013							
AVG	0.07	25.909	18.142	544.272	57		104
MIN	0.00	23.726	16.462	544.272	25		98
MAX	2.00	27.894	21.366	544.272	82		113
SUM	2.21	777.281	544.272	544.272	1,705		2,495
CNT	30	30	30	1	30	0	24
GEO							

Recommendations

The following recommendations are offered to assist in improving overall management of documentation:

- Development and implementation of process control management plans.
- Development and implementation of robust performance dialogues.
- Improved continual improvement of SOP's through routine updating and increased visibility and awareness.

Figure WW.16 Performance Management Assessment Score and Scoring Criteria



Performance Management Assessment Score – 2.6 out of 5

Scoring Criteria

Score 1:

- No mechanism in place to track basic metrics (e.g., number of jobs assigned/completed, mean time between failure, etc.)
- No performance dialogue is conducted to review group performance
- No RCA occurs to solve problems; rather focus is placed on finding blame rather than solutions
- Staff field productivity is not well-defined or physically measured

Score 3:

- Basic metrics are tracked but it occurs ineffectively and/or inconsistently
- Group performance meetings are periodically held, but not well-attended; performance discussion is limited to discrete data points rather than overall trends, and performance targets are not well-defined
- Accountability for corrective measures may or may not be assigned
- Some investigation and problem solving occurs, but no formal RCA performed
- Staff productivity is anecdotally determined and may or may not be reported

Score 5:

- Consistent and effective tools and mechanisms are in place to track and report meaningful performance metrics
- Weekly group performance meetings are conducted by supervisor and attended by all subordinates; current performance trends against well-defined targets are evaluated across a variety of appropriate metrics and accountability is assigned for corrective measures
- RCA is used consistently to diagnose problems, evaluate risk and impact and mitigate problems; failure mode analysis is also regularly performed to understand how the failure occurred and how to prevent it from recurring
- Formal wrench-time analyses are performed regularly to objectively measure productivity; discrete results, as well as productivity trends, are regularly reported to management

Financial Responsibility

With typical budgetary procedures, WSSC scored slightly above-average. This assessment is based on how well the treatment facilities manage their budgets and the cost of doing business.

Strengths

All budgets are continually tracked on a year-to-date basis and future budgets are developed using the most recent available actual spend numbers. All costs are included into the budget, including energy, chemicals, sludge disposal, internal labor and subcontractors.

Potential Areas of Improvement

Currently, yearly budgets are developed utilizing prior year spend with a set yearly increase. Plant energy usage is not managed or monitored at the site level, but rather in a centralized energy office. The

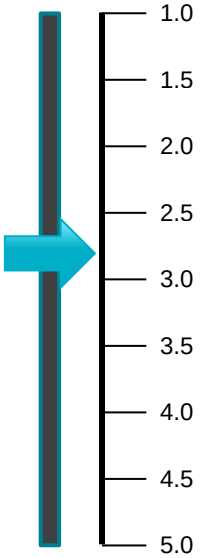
tracking systems for analyzing the yearly budget could be improved to dive deeper into specific spend categories.

Recommendations

The following recommendations are offered to assist in improving overall management of financial responsibility:

- Development of yearly budgets with a bottom up approach, pursuing operational efficiency gains in specific process areas.
- Tracking actual expenditures against targets.
- Holding plant managers accountable for plant energy expenditures.
- A shift in mindset from a culture of "compliance at all costs" to "compliance at lowest costs".

Figure WW.17 Financial Responsibility Score and Scoring Criteria



Assessment Score – 2.8 out of 5

Scoring Criteria

Score 1:
- The budget for Process Operation (energy, chemicals, sludge, etc.) is known

Score 3:
- All costs and expenses are recorded including energy, chemicals, internal labor, maintenance supplies and materials, and subcontractors

Score 5:
- Costs are analyzed in the yearly activity report with appropriate indicators
- CAPEX/OPEX optimization is performed yearly on plant treatment process, process cost efficiency, and equipment improvements/upgrades with the right KPIs and dedicated tool

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