



MASSACHUSETTS WATER RESOURCES AUTHORITY

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November 7, 2019

Karen McGuire, Director
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5 Post Office Square, Suite 100
Boston, MA 02109-3912

Kevin Brander
Northeast Regional Office
Massachusetts Department of
Environmental Protection
205B Lowell Street
Wilmington, MA 01887

RE: NPDES Permit Number MA0103284
O&M Annual Report/Status Sheets

Dear Ms. McGuire and Mr. Brander:

Enclosed please find the MWRA's annual status sheets on plant performance and maintenance for the period covering July 2018 – June 2019. This submittal fulfills the requirements of MWRA's NPDES Permit MA0103284 - Section 1.18.f and 1.18.g that states in part:

...The permittee shall report on the [operations and maintenance] plan's implementation and results to EPA and the MADEP on a yearly basis....An annual maintenance update shall be published in the MWRA's Annual Report. The MWRA shall submit an annual status sheet to EPA and the MADEP on plant performance, using key indicators for maintenance and providing detailed information on any necessary equipment replacement. The annual status sheet shall be placed on the MWRA web page for public information purposes.

Annual status sheets are posted at <http://www.mwra.com/harbor/html/archive.htm#maintenance>.

If you have questions or need additional information, please feel free to call Betsy Reilley at (617) 788-4940.

Sincerely,

David W. Coppes
Chief Operating Officer

Enclosures:

- Annual Report on Operations and Maintenance, FY2019
- Status Sheets with key indicators of maintenance, FY2019
 - Deer Island Treatment Plant
 - Wastewater Transport System
 - Fore River Pellet Plant

cc: T. Borci, US EPA
F. Laskey, MWRA

MWRA Annual Report on Operation & Maintenance

July 2018 - June 2019

This report fulfills the requirements of MWRA's NPDES Permit MA0103284, Section 1.18.f which states:

“Within ninety (90) days of the effective date of this permit, the permittee shall develop and implement a long-range operations and maintenance plan that will maximize the life of the treatment facility. The permittee shall report on the plan's implementation and results to EPA and the MADEP on a yearly basis.”

Also included with this submittal are the annual status sheets on plant performance and maintenance as required in section I.18.g.

1. SYSTEM OVERVIEW

MWRA's Metropolitan Boston wastewater system consists of the Deer Island Sewage Treatment Plant, the wastewater collection system, and the Pelletizing Plant, described below.

Deer Island Sewage Treatment Plant

The Deer Island Sewage Treatment Plant (DITP) is the centerpiece of MWRA's \$3.8 billion program to protect Boston Harbor against pollution from Metropolitan Boston's sewer systems. The DITP's purpose is to remove human, household, business, and industrial pollutants from the wastewater that is collected and transported through 5,400 miles of pipes, community owned sewer lines, and approximately 240 miles of Authority owned interceptors and tunnels.

DITP is a state-of-the-art wastewater treatment facility and one of the most automated in the country. The MWRA has made a considerable capital investment in the DITP and is fully committed to ensuring that this valuable public asset is maintained in the best possible manner. The MWRA's Board of Directors, Executive Director, management team, and staff are dedicated to providing the highest quality of asset management. The MWRA has assembled a highly skilled and qualified staff that will ensure that the treatment plant is operated and maintained to the satisfaction of the regulatory agencies and the public.

Wastewater Transport System

The Wastewater Operations Department operates and maintains MWRA's wastewater transport system, which transports wastewater from MWRA member communities to the Deer Island Treatment Plant. This system includes a network of 240 miles of interceptor sewer lines and related appurtenances, a screen house, 13 pumping stations, 4 remote headworks facilities, 3 combined sewer overflow (CSO) treatment facilities and 2 CSO storage facilities. The primary goal is to operate the system in a manner that will provide uninterrupted wastewater transport service in a safe, cost-effective, and environmentally sound manner.

Fore River Pelletizing Plant

The operation and output of the Fore River Pelletizing Plant are regulated by the terms of the federal NPDES permit, 40 CFR 503 regulations, and state sludge regulations in Massachusetts (310 CMR 32.00) and the states to which the pelletized product is shipped. Other important external factors that influence operation of the pellet plant include an extensive residuals management facilities plan developed as part of the permitting process as well as commitments to local communities.

Under the terms of the current operating agreement between New England Fertilizer Company (NEFCo) and MWRA, NEFCo budgets for and performs all necessary predictive, preventive and routine maintenance at the pellet plant. NEFCo's agreement contains a plan for the maintenance, repair and operation of the facility. At this time, NEFCo performance meets the necessary standard for proper operation and maintenance. Since the inception of the agreement in March of 2001, there has not been an incident requiring an interruption in service.

The operating agreement requires NEFCo to provide a letter of credit for \$1,000,000 (adjusted for inflation) that MWRA may draw on in the event that there is a material breach of the operating agreement, such as failing to adequately maintain the facility.

2. PERMIT VIOLATIONS

There were no violations at MWRA facilities due to inadequate maintenance efforts.

3. FACILITIES ASSET MANAGEMENT PROGRAM

The goals of the MWRA multi-year maintenance plan include coordinated, consistent asset inventory; condition assessment; maintenance scheduling and long-term replacement planning. The MWRA has developed and implemented the Facilities Asset Management Program (FAMP). This asset management program addresses the goal of becoming more efficient by developing consistent best practices and cost-effective operations and maintenance procedures.

MWRA had been conducting its maintenance on a calendar-based schedule in accordance with the original equipment manufacturers' (OEM) recommendations. This approach to maintenance was primarily driven by contractual obligations of the OEM warranties. MWRA's management team believed that it was important to modify its existing program with the goal of achieving a more rational approach to maintenance management. MWRA management acknowledges the importance of asset management and developed FAMP to meet the long-term demands of facility maintenance. The main objective of FAMP was to develop a sound maintenance strategy that would ultimately lead to better overall asset management, extended equipment life and increased reliability.

MWRA expanded its efforts in the areas of condition monitoring utilizing Reliability Centered Maintenance (RCM). This program focuses on asset replacement prioritization, capital improvements, and training of staff. MWRA is continuing to build the program with staff using Maximo 7.6, and continuing to use the methodology of RCM for preventive maintenance (PM)

optimization, expand condition monitoring oil analysis by using on site testing equipment, and review our metrics to ensure we are at or above industry benchmarks.

4. COMPUTERIZED MAINTENANCE MANAGEMENT SOFTWARE

Maximo is the Enterprise Asset Management (EAM) software program used by MWRA. The MWRA uses Maximo version 7.6.0.9 (7.6), which is supported by Maximo developer IBM. Maximo EAM includes job and safety plan modules allowing MWRA to document hazardous areas and materials at DITP. Maximo can develop Lock-Out Tag-Out (LOTO) tasks and generate associated work orders for field personnel. Maximo's document management function streamlines maintenance and regulatory functions and workflow capabilities for synchronizing operations. Maximo applications can be fine-tuned to suit specific work processes or interface with other software programs. MWRA also plans to implement Maximo's mobile application, Maximo Anywhere, which will allow field personnel to audit and gather asset information, check for spare parts in our warehouses and report labor and failure information in real-time, or upload entered data into Core Maximo when the device reconnects to MWRA's data management system.

Maximo gives operations and maintenance staff the ability to plan, prioritize and assign work, based on labor and required spare parts availability. Maximo's data analytic and reporting tools analyze failure trends in equipment, enabling staff to optimize preventive maintenance tasks and budget and plan asset replacement projects.

Maximo 7.6 added functionality to track labor, material, service, service contract, spare part costs and usage for over 130,000 assets.

Maximo 7.6 provides the MWRA with updated technology, increasing functionality for maintenance and improved reporting capabilities. The MWRA is now on one instance of Maximo with Deer Island, Field Operations, Information Technology (IT) (formerly Management Information Systems group), Laboratory asset tracking, and Vehicle Maintenance accessible in a single-organization, multi-site application. This increases productivity and limits the number of software systems to perform asset management functions. In addition, Maximo 7.6 add-ons include Maximo Calibration for instrumentation and SCADA assets and Maximo Spatial for buried assets and pipelines.

Clinton Advanced Wastewater Treatment Plant is now using Maximo 7.6. The Clinton Maximo site continues to be built out and PM schedules are in process, transitioning from a paper-based system to Maximo.

Operations and Maintenance continues to collaborate with IT enhancing Maximo's automation capabilities, data display and reporting efficiencies, and end-user usability, along with preparing to upgrade Maximo to version 7.6.1.

NEFCo has its own computerized maintenance management software, "E-maint." E-maint is used for work order management including preventive and corrective maintenance work.

5. SERVICE CONTRACTS

MWRA's maintenance program is supplemented by a series of service contracts. These contracts are intended to provide specialized services beyond the resources of the MWRA maintenance staff. Tables 1 and 2 below shows the service contracts currently used by MWRA.

TABLE 1
DEER ISLAND CURRENT SERVICE CONTRACTS
Laser alignment
Boiler maintenance
CCTV maintenance
Centrifuge maintenance
Combustion Turbine Generator maintenance
Continuous emissions monitoring
Catch Basin Contract
Copier/fax maintenance
Crane maintenance
Cryogenics facility maintenance
Digester Mixer overhauls
Electrical testing
Elevator maintenance
Facilities coatings
HVAC chemical treatment (Legion Ella testing)
Fire Sprinkler Repair Contract
Hydro turbine generator maintenance
Hydraulic maintenance
Janitorial services
Lab hood certification
Locksmith services
Lube oil analysis
Oil separator cleaning
Overhead door maintenance
Pest control
Plant and Public access landscape services
Plant instrumentation and control system (PICS) maintenance
Pratt Whitney Preferred service
Reactor Mixer gearbox rebuild
Recycle contract (Scrap/Paper)
Security
Steam turbine generator maintenance
Trash removal
Vibration analysis

TABLE 2 FIELD OPERATIONS CURRENT SERVICE CONTRACTS
Elevator Maintenance
Crane Maintenance
Hydraulic Equipment Maintenance
Instrumentation Maintenance
Fuel Storage Tanks
Fire Alarm and Sprinkler
Air Compressor Service
Boiler and Water Heater
Pest Control Services
Trash Removal
Electrical Testing
Grounds keeping
Lube Oil Analysis
Union Park Station Operation and Maintenance
Generator Maintenance
Overhead Door Maintenance
Vibration Monitoring

The attached pages constitute the annual status sheets on plant performance, using key indicators for maintenance. There are status sheets for Deer Island, Wastewater Transport (Field Operations), and the Fore River Pelletizing Plant.

Status Sheets
Deer Island Treatment Plant
July 2018 - June 2019

Deer Island Maintenance reporting on Key Performance Indicators for FY19.

- Preventive Maintenance - Maintenance is working to reach a work order completion rate goal of 100%. The average Preventive Maintenance (PM) percentage completion rate is 99.9%; 20,990 PM work orders were initiated this year. Incomplete PMs that are not completed in one month are rolled over into the workload of the following month, and given a high priority to complete first.
- Work Order Kitting - The first step to increase wrench time is to have all parts available for work orders. Kitting is a task where the maintenance planner identifies the specific parts required for a task on the work order and electronically sends the information to warehouse personnel to assemble the parts in one location (kit) for the technician to pick up and install. Deer Island was slightly under its new goal of 57%, with 55% in FY19.
- Predictive Maintenance - Extending the useful life of equipment, by monitoring and trending equipment characteristics, allows for better planning for equipment replacement. 6,421 work orders were completed for vibration, acoustic ultrasonic, ultrasonic thickness, and oil analysis. Deer Island reached its new goal of 25% in FY19 of all work orders being categorized as predictive maintenance.
- Maintenance Backlog in Hours - Backlog is determined by totaling the planned craft hours on open work orders and comparing them to craft resources, which are available. The average backlog in FY19 was 16,480 hours, equaling 5.7 weeks of work for the entire Maintenance workforce. This backlog falls within the industry standards of 8,730 hours to 17,460 hours or 4 to 6 weeks. DITP monitors these metrics very closely to ensure the backlog does not adversely affect equipment availability.
- Maintenance Overtime - The goal is to maintain maintenance overtime at or below 5% of total wages and salaries. DITP was below the benchmark at 3.6%.

Critical Equipment Availability: 12-Month Average — 99.8%

An equipment availability report is generated daily that details the critical equipment required to treat the maximum flow of approximately 1.3 billion gallons per day. Higher maintenance priority is given to equipment that drops below the number required. No operational impact has occurred in the past year from a 99.8% versus 100% availability because the plant normally operates at approximately one-third of the design flow capacity.

Average Craft Hours and Work Orders per Month:

Preventative Maintenance	2750 hours	24%	1628 work orders	60%
Predictive Maintenance	129 hours	1%	678 work orders	25%
Corrective Maintenance	7866 hours	68%	366 work orders	12%
Emergency Maintenance	9 hours	1%	1 work orders	1%
Project Work	77 hours	1%	2 work orders	1%
Other Work	589 hours	5%	32 work orders	1%
Total	11,420 hours	100%	2,714 work orders	100%

Total Work Orders:

36,250 work orders initiated in FY19

32,572 work orders completed/closed in FY19

Maintenance Projects and Equipment Replacement:

- Reactor Aerator/Mixer Gearbox Rebuilds: \$54,809
Secondary Reactor Batteries A, B, and C contain nine aerator trains; each train has (4) aerators and (4) mixers. In total, there are 72 gearboxes that drive 36 aerators and 36 mixers. Each aerator and mixer has a triple reduction gearbox and mixing blade. When condition monitoring techniques (oil analysis, vibration data and physical inspections) indicate a potential for failure, staff removes and ships out the gearbox to be refurbished back to original operational parameters. Two large gearboxes were refurbished in FY19 with new gears, seals, and bearings.
- Boiler, STG and Hydro Plant Maintenance: \$2,794,423
A maintenance contract was established for annual boiler preventive maintenance including necessary repairs. This contract was combined with similar contracts for the hydroelectric plant and steam turbine generator (STG). The intention of combining three contracts under one was to save money on like equipment and on mobilization costs. Maintenance spent additional money on repair work in Hydro. Rebuilt Hydro Unit #1, which included gearbox, blades and controls.
- Cryogenic Facility Repairs: \$529,997
The Cryogenic facility has an annual maintenance contract to handle preventive maintenance and some project maintenance work. The maintenance work includes two shut downs per year and scheduled projects. The scheduled projects completed include replacing eight modulating and block control valves and actuators located on the cold box units, mole sieves and oxygen vaporizers.
- Grinder Rebuilds: \$124,981
The Residuals Complex at Deer Island has small Muffin Monster grinders, installed "in-line" to provide continuous grinding of sludge into uniform, homogenized slurry. The sludge, which travels through these in-line grinders, is transported from Primary and Secondary treatment processes. The in-line grinders in Residuals are used after pre-treatment solids and rags are removed. In-line grinders are smaller than the larger channel grinders in size due to the composition of sludge entering them. Normal wear and tear to the grinders caused by constant operation wears the gears and seals requiring periodic

service to re-build the grinders or cutter blocks. Staff replaced thirteen in-line grinders this year.

- Roller Gates Rebuilds: \$167,627

The primary function of roller gates is to isolate channels or chambers. Isolation of flow is necessary for maintenance tasks to be performed. Stop logs are fabricated of structural steel and have specifically designed rubber fittings on the tops and bottoms that mate with the units above and below them to provide a watertight seal. As part of the overhaul, the stop logs were dismantled, removing all existing wheels, axles, bushings, retainers and seals. The stop logs were then cleaned, shop blasted, and repainted to the original specifications. All new wheels, bushings, retainers, and seals, per the original manufacturer's specifications were installed. Twelve (12) stop logs were refurbished in FY19.

- Electric Vehicles: \$140,175

Deer Island Treatment Plant staff perform multiple job-related activities and tasks all around the large expanse of the DITP and its numerous buildings and facilities on a daily basis. The expansive nature of DITP's terrain requires use of electric vehicles to ensure the most efficient transport of staff, tools, equipment, and supplies. Electric Vehicles save countless staff hours throughout the year. Utilizing these smaller electric vehicles is less costly than conventional vehicles, in addition to being significantly more environmentally friendly. Deer Island purchased fifteen new electric vehicles.

- Norwalk Compressor 101 Rebuild: \$31,268

DITP uses three Norwalk custom horizontal straight-line gas compressors to pressurize the digester gas prior to the boilers. Typically, two compressors are required to be on line and one is held in stand-by mode or out for maintenance work. After a detailed inspection of Compressor 101, which showed excessive wear internally and with valves, Maintenance performed a rebuild, which includes rebuilding suction valves, discharge valves, piston actuators and pressure rings. An assortment of gaskets and new packing was installed.

- HVAC Replacement: \$73,500

HVAC staff replaced four air handlers at Residuals complex. This was a direct replacement because existing units were problematic and exterior metals were showing signs of major corrosion. Cooling Tower #1 in the Administration/Laboratory building required a rebuild, which included the entire fan assembly, including a new shaft, new shaft bearings and fan blades. A crane was used to dismantle and reinstall the cooling tower fan assembly with the new replacement components. The replacement of the fan assembly will bring the existing cooling tower back to the original specifications, extending its operating life for several years.

- Emergency Lighting: \$124,243

There is an existing emergency lighting system currently throughout Deer Island. This lighting system was installed during the original plant construction and is approximately 23 years old. It utilizes obsolete high wattage, incandescent type lamps and battery technology. The lamps and batteries are increasingly difficult for staff to procure and, when available, the pricing has increased substantially. The proposed Dual-Lite, Dynamo DYN LED Series emergency light offers many benefits to the DITP staff in terms of value, maintenance and performance. The system is designed to provide a minimum of 90 minutes of illumination when the primary power is lost and is designed specifically for demanding

environments and high reliability operation in industrial settings such as wastewater treatment plants. The locations completed are North Main Pump Station, Central Blower facility, Primary Operation facility and Secondary Operations facility.

- Residuals Odor Control Fan: \$81,330
Two 52,000 cfm fan blowers are required to remove gases from the Gravity Thickener Complex to meet peak demand. The Blower Fans can be isolated or flow redirected using the dampeners located throughout the intake piping. A new Fan Blower was purchased for the Residuals Odor Control Facility. It was installed to replace fan #2 which was 23 years old and becoming difficult to maintain. These fans are considered critical pieces of odor control equipment. Maintenance collects vibration data and Condition Monitoring trends the results over time, checking for abnormal conditions, and recommends any corrective action. However, if a failure should occurred on either of these blower fans, Deer Island would be without redundancy. Deer Island is required by its air permit to have one fan operational at all times.
- Door and Hardware Replacement: \$663,792
The majority of the buildings on Deer Island Treatment Plant were constructed over 22 years ago. Due to inclement weather, daily usage and age, various exterior doors require replacement, repair, and/or maintenance. The Replacement of Exterior Doors Project work includes repairing nineteen doors, providing maintenance for 7 existing doors, and replacing hardware for forty-five other doors located throughout various buildings. In addition to the quantities described, extensive door replacement work will occur at the Administration Building's front entrance and at the Main Switchgear building.
- PICS Human Machine Interface (HMI) Upgrade: \$648,340
The current DITP PICS Human Machine Interface (HMI) system was installed in 2012. The HMI system is the computer-based portion of the plant's operating and control system that allows the plant operator to see information about the plant from a workstation and to make operational changes. A project to upgrade the HMI hardware and software began at the end of 2018 and the installation of the upgrade system was completed in 2019.

Capital Projects

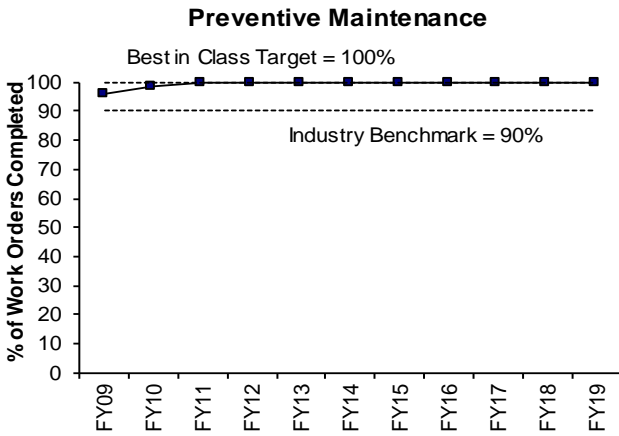
In addition to the maintenance projects listed above, the following Capital Improvement projects included work for Deer Island in FY19:

- Winthrop Terminal Facility Pump #6 VFD Replacement, Contract 7395 (\$4.9M)
- Gravity Thickener Rehabilitation, Contract 6875 (\$3M)
- HEEC Power Cable Installation, Contract EEA-15746 (MWRA Cost \$75M)

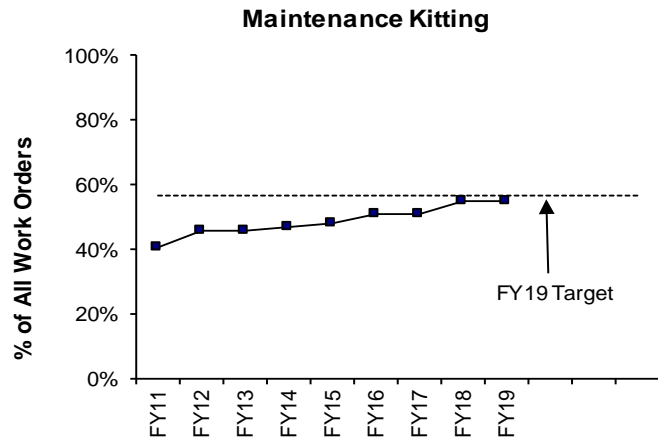
The following pages adapted from MWRA's quarterly performance report to the Board of Directors, the "Orange Notebook", summarize key indicators relating to Deer Island maintenance. The full Orange Notebook can be found at

<http://www.mwra.com/quarterly/orangenotebook/orangenotebook.htm>.

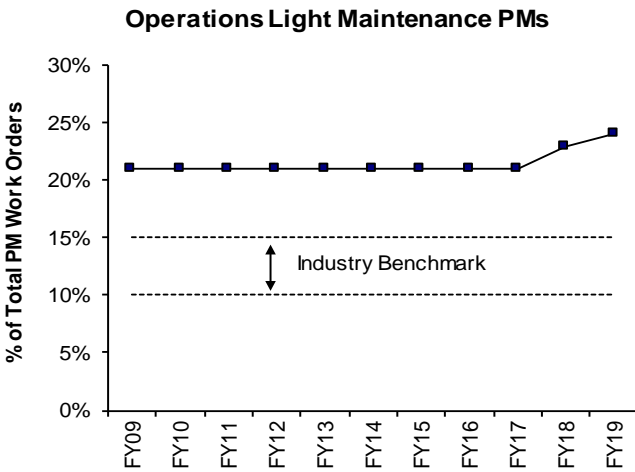
Deer Island Yearly Maintenance Metrics FY19 Proactive and Productivity Measures



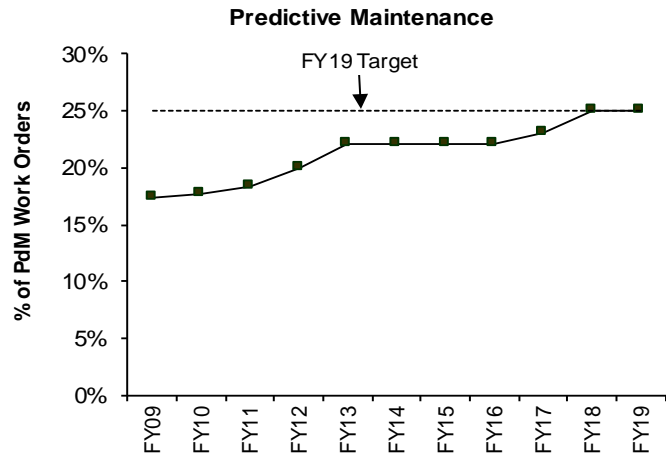
The industry benchmark is 90% for Preventive Maintenance (PM) completion. Upon reaching the 90% goal in FY05, the target goal was increased to the "Best in Class" Target of 100% PM completion. Since then, the percentage of PM work order completion has been at 99% or higher. Reliability-Centered Maintenance (RCM) and PM optimization efforts have continued since FY01. PM completion rate was at 99.9% in FY19.



Preventive Maintenance (PM) inventory items were loaded into Maximo to assign spare parts for equipment to PM work orders. DITP reached the PM kitting goal of 100% in FY10. In FY11 a new graph (above) was developed to track kitting of all maintenance work orders in an effort to increase wrench time. Staff continues to fine-tune the process to "kit" all maintenance work orders. Kitting is considered a best practice by maintenance and reliability professionals. It entails staging parts necessary to complete maintenance work. Kitting allows maintenance staff to spend more time "turning the wrench" and less time waiting for parts at the stockroom window. Kitting for FY19 was at 55%, just shy of DITP's new goal of 57%.



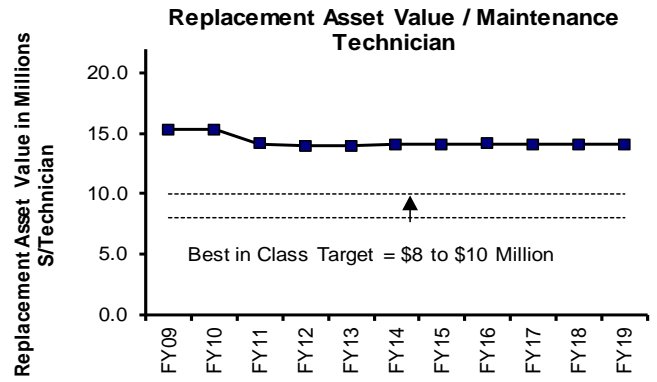
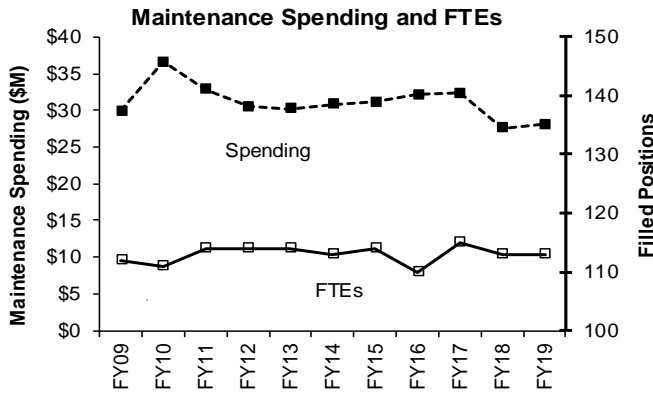
The percentage of preventive maintenance work order hours completed by Operations staff (not maintenance staff) increased from less than 1% in January 2002 to the current level of 24% in FY19. DITP reached the industry benchmark range of 10-15% in April 2003 and has exceeded the goal through FY19. Operations completes approximately 650 PM work orders per month.



Predictive maintenance has steadily increased from 2% in FY03 to 25% in FY19, reaching DITP's FY19 new goal of 25%. The increase in predictive maintenance was achieved through the expanded use of lubrication, vibration, thermography, and acoustic ultrasonic testing techniques. The Condition Monitoring Group continually reviews and investigates new opportunities and initiatives to expand condition monitoring testing and analysis.

Deer Island Yearly Maintenance Metrics FY19

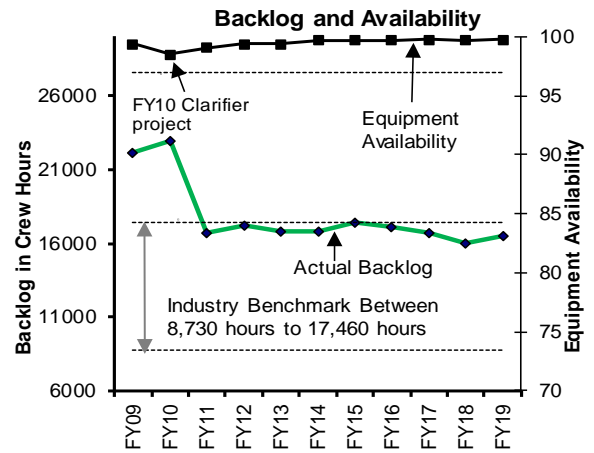
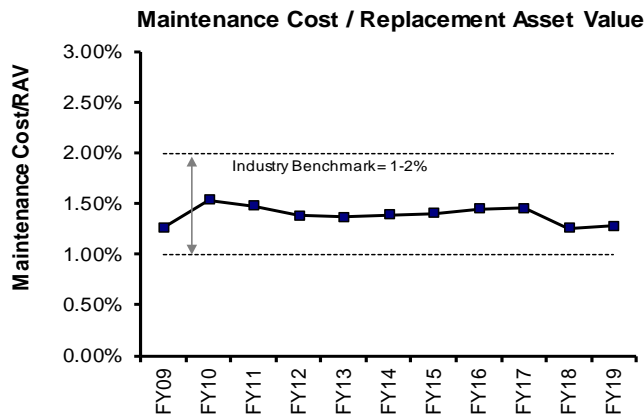
Overall Maintenance Program Measures



DITP's Maintenance staff is currently at 113 FTE's. Maintenance has been successful in meeting its goals through implementation of numerous maintenance efficiencies including: Operations staff performing light maintenance, cross-functional training and flexibility, and Reliability-Centered Maintenance.

DITP adopted a "best in class" target of \$8-\$10 Million/Technician for maintenance staffing. Even after a period of downward trending, DITP remains above this Best in Class target range. However, as the plant ages and additional equipment replacements are expected, DITP management will reassess staffing as needed.

The Maintenance Spending graph shows actual annual maintenance spending and large CIP asset replacements (equipment costs only). Maintenance budgeting continues to evaluate plant assets and requirements for replacement of obsolete equipment to ensure the plant operates at maximum efficiency. In FY19, overall spending increased slightly from FY18 due to some large Maintenance Projects; Wintthrop Terminal Facility VFD/Motor Replacements, Gravity Thickener #1 Rebuild, MCC Switchgear Replacements, Scum Hopper Rebuilds, Exterior Door Contract and PICS Upgrades.

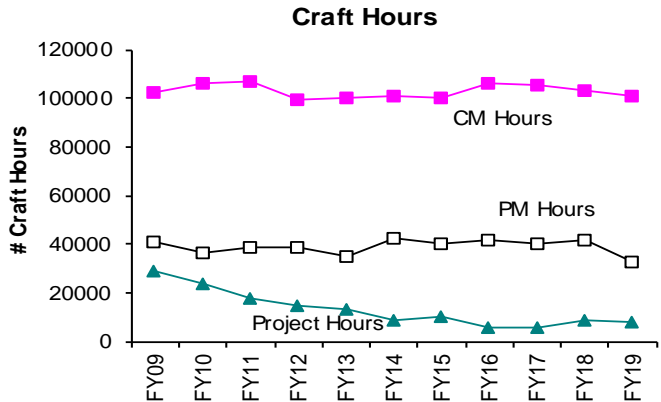
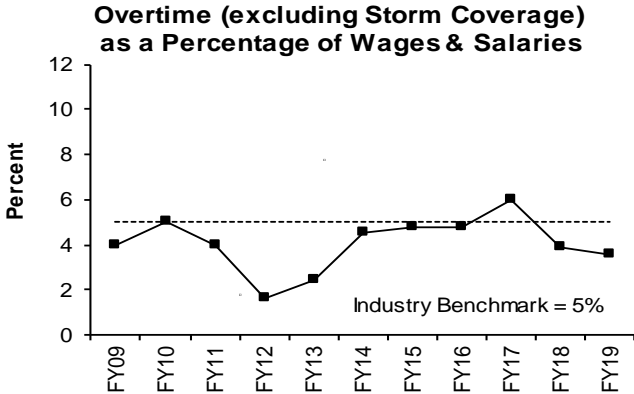


The industry benchmark for annual maintenance spending is between 1% to 2% of replacement asset value, currently DITP is at 1.28%. The plant's replacement asset value is calculated at approximately \$2.4 billion dollars. DITP's current maintenance spending is within the industry benchmark. As the plant ages and equipment replacement is required, spending is expected to increase. DITP Maintenance CEB spending is \$13.6 million coupled with CIP spending.

Industry benchmark for Equipment Availability is 97% and over the last ten years, equipment availability has consistently exceeded the benchmark. In FY19 the availability was 99.8%. The slight increase in Equipment Availability during FY19 was due to redundancy of equipment and effective/efficient maintenance practices. FY10's decrease was due to the Clarifier Rehabilitation Project.

Industry Benchmark for Backlog is between 8,730 to 17,460 hours for maintenance based on current staffing, the total average backlog for FY19 was 16,480 hours, which is below the industry benchmark. The slight increase in Backlog is due to difficulty hiring trade staff.

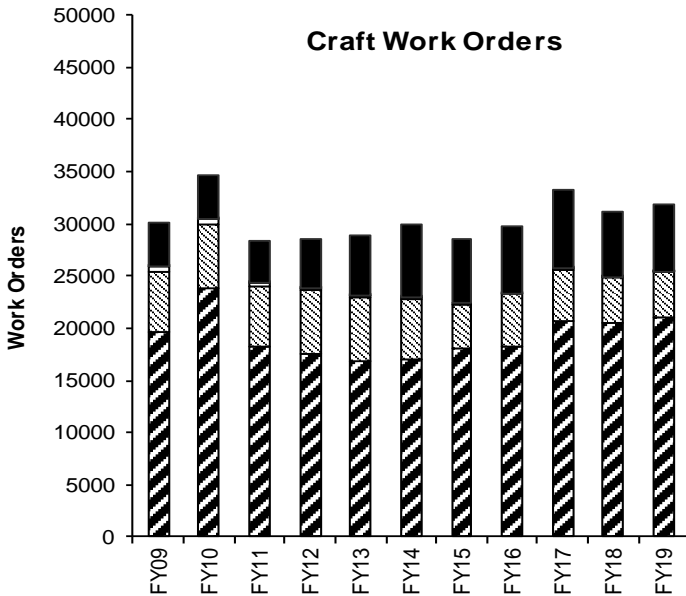
Deer Island Yearly Maintenance Metrics FY19 Overall Maintenance Program Measures (cont.)



Management continues its effort to keep overtime below the industry benchmark. DITP maintenance overtime was 3.6% for FY19. Management has taken steps to reduce overtime spending by limiting overtime to repair critical equipment and systems only. DITP has been on or under Industry Benchmark every year except FY17, due to the increase in overtime for the Eversource Cable Outage.

Continued optimization of the Preventive Maintenance (PM) program through the transfer of some light maintenance tasks from Maintenance to Operations staff (increased to 24% of PM work orders in FY19), elimination of duplicate work orders, combining some PMs, increasing PM frequency due to equipment history and performance has resulted in a decrease in PM hours in FY19.

Corrective Maintenance (CM) hours slightly decreased from last year. Project Maintenance hours slightly decreased due to a number of CIP projects being completed: Winthrop Terminal Facility VFD/Motor Rebuilds, Gravity Thickener #1 Rebuild, MCC Switchgear Replacements, Scum Hopper Rebuilds, and Exterior Door Contract.



During FY19, the number of work orders increased by 495 from the previous year. The increase in work orders was due to Planning Department entering new equipment (Operational Valves, Scum Hoppers, VFD Replacements, etc.) and setting up PM/PdM schedules, including increased visual inspections to identify issues at their onset. The number of Corrective Maintenance (CM) work orders increased slightly in FY19. Project (PROJ) work orders decreased for FY19 due to a number of CIP projects completed.

The Planning department is continuously modifying PM, PdM, and CM Job Plans to ensure maintenance is being performed efficiently and effectively, while ensuring reliability and availability of DITP's Assets.

- Predictive Maintenance
- Emergency Maintenance
- Project
- ▨ Corrective Maintenance
- ▨ Preventive Maintenance

Status Sheets
Wastewater Transport System
July 2018 - June 2019

1. Facilities Operational Statement

During FY19 Wastewater Transport facilities operated at full capacity throughout the year. All required equipment to maintain flow and processing of wastewater was available with the following exceptions: Chelsea Creek Headworks: Channel #1 was unavailable from July 1, 2018, to April 6, 2019, for channel rehabilitation; Channel #2 was unavailable from April 29, 2019, to June 30, 2019, for channel rehabilitation. DeLauri Pumping Station: screening channel #1 was unavailable from October 12, 2018, to December 19, 2018, for screen replacement; screening channel #2 was unavailable from January 3, 2019, to February 26, 2019, for screen replacement. There were no operational impacts as a result of this work and all required flows were processed through the Chelsea Creek Headworks and the DeLauri Pumping Station during the work associated with these capital improvement projects. The CSO facilities operated with sufficient chlorination and dechlorination, though some NPDES exceedances were reported. The required number of pumps in each gravity and pumping CSO was available throughout the year.

2. Equipment Availability

The average equipment availability for FY19 was 99.97%. An equipment availability report is generated daily that details the critical equipment required to collect and transport the wastewater flow at the facility design capacity. Higher maintenance priority is given to equipment that drops below the number required. Because of the high daily equipment availability, no operational impact has occurred in the past year.

3. SCADA Program

The MWRA Supervisory Control and Data Acquisition (SCADA) system provides a means of monitoring and controlling facilities and equipment from a remote centralized location, as well as providing a continuous record of facility operations. Although the system is continuously being upgraded through Capital Improvement Program projects and in-house efforts, the SCADA system for all field facilities has been in place since FY10.

MWRA SCADA staff perform the required maintenance and upgrades to the majority of the field instrumentation and control panel equipment to ensure accurate measurements and continued operation throughout MWRA's field facilities. During FY19, these efforts were supplemented by an Instrumentation Service Contractor who was primarily responsible for performing calibrations and corrective service to the gas monitoring systems within facilities and at H₂S monitoring sites within MWRA interceptors. SCADA staff also maintain, upgrade, program, and patch the computers and hardware used in collecting, controlling, transmitting and displaying facility data. During FY19, continued emphasis was placed on improving MWRA's cyber security posture. This included work on converting the SCADA communications network to "Domain" architecture,

where user accounts and policies are centrally managed via a “Domain Controller” and the expansion of the network monitoring system.

Equipment Replacement and Significant Maintenance Projects

Equipment replacement is part of the overall maintenance strategy that ensures compliance with permit requirements. Projects and initiatives are completed during each fiscal year to maintain redundancy and continued reliability. Many projects are extensive, requiring significant in-house resources and use of specialty/service contractors. Some examples of key improvements, equipment replacement, or significant repair work during the past fiscal year include in-house and outsourced projects.

Maintenance Projects and Equipment Replacement:

In-House Projects

Staff continued to work to replace equipment at the headworks to maintain equipment reliability on an as-needed basis. Each year, staff evaluate systems for upgrade. In all channels, dewatering pumps have been replaced or overhauled. Work continues to maintain reliability and availability of the headworks systems through Preventive and Predictive Maintenance Practices. The following is a detailed list of in-house work performed at all wastewater facilities in Metro East.

- Quincy Pump Station: HVAC Staff upgraded supply and exhaust fans.
- Squantum Pump Station: HVAC Staff upgraded supply and exhaust fans.
- DeLauri Pump Station: HVAC Staff upgraded supply and exhaust fans.
- Hayes Pump Station: Plumbing Staff replaced heating boiler.
- BOS 019 CSO: Electrical Staff installed Electric Vehicle Charging Stations.
- Chelsea Administration Building: Electrical Staff installed Electric Vehicle Charging Stations.
- Chelsea Creek, Columbus Park and Ward Street Headworks: Plumbing Staff performed Ultrasonic Thickness Testing on all Grit/Screen Pods, Grit Pipe and Grit Fittings.
- Infrared Thermography Inspections: Electrical Staff performed Infrared Thermography Inspections on electrical switchgear at seven Wastewater Pump Stations, one Water Pump Station, two CSO Facilities, and two Headworks Facilities.
- Vibration Monitoring: Mechanical Staff performed Vibration Monitoring at four Wastewater Pump Stations, four Water Pump Stations, two CSO Facilities, and four Headworks Facilities.
- Nut Island Headworks: Facility Staff removed and replaced Screen #2 head shaft and bearings.
- Nut Island Headworks: Mechanical Staff removed and replaced conveyor belting on Grit Conveyor # 3.
- Chelsea Tunnel Redundancy Department Office Space: Facility Staff built out new offices and Conference Room to support the new Tunnel Redundancy Department.

Outsourced Projects

- Prison Point Wash Down Piping Replacement: \$271,575.89 Tank wash down piping system needed upgrade to schedule 10 stainless steel pipe from schedule 80 PVC pipe to prevent piping and fitting failure. F.W. Webb and Met Pipe supplied the pipe and MWRA Plumbing Staff installed fittings and the piping.

Capital Projects

In addition to the maintenance projects listed above, the following Capital Improvement projects are underway or completed in FY19:

- Chelsea Creek Rehabilitation Contract 7161
- Alewife Brook Pump Station Rehabilitation Contract 6797
- DeLauri Pump Station Screen Replacement Contract 7361
- Reading Extension Sewer Rehabilitation Contract 7164
- Prison Point CSO Facility Improvements Contract 7462 (100% design)
- Nut Island Headworks Odor Control & HVAC Improvements Contract 7548 (100% design)

Wastewater Transport Pipelines

1. Manhole Inspection and Rehabilitation Program

The Technical Inspections Unit (TIU) of the Wastewater Operations Department conducts manhole inspections. These inspections facilitated the beginning of the manhole rehabilitation program. Specialized equipment and training are the essential elements of the program. Pipeline maintenance crews perform manhole renovations and repairs that result in reduced I/I. The manholes are coated using cementitious material applied with spinning equipment and then covered with special coatings to resist corrosion from hydrogen sulfide.

In FY19 TIU staff inspected a total of 665 manholes. Approximately 109 manholes were rehabilitated utilizing in-house staff. The rehabilitation work included frame and cover replacement, external repairs to raised manholes, internal repairs using the spin-cast application, and other miscellaneous repair work.

2. Pipeline Rehabilitation

Pipeline Rehabilitation projects are first identified by the TIU during routine television inspections of the pipelines and interceptors. MWRA engineers review these projects and perform or coordinate all necessary design and construction contracting. The following are the pipeline construction/rehabilitation projects under design & construction in FY19:

- Contract 7164 – Reading Extension Sewer Construction (project completed 12/18)
- Contract 7512 - Dorchester Interceptor Design (100% design)

- Contract 7643 – Charles River Valley Sewer Rehabilitation (In-house design at 90%)
- Contract 7540 – North Metropolitan Sewer Section 20 & 21 Rehabilitation (60% design)

3. Pipeline Inspection and Cleaning

The Technical Inspection and Wastewater Pipeline Maintenance groups were merged to more efficiently and consistently maintain the wastewater collection system. The work performed by the inspection staff is an important element to the planning and execution of pipeline maintenance work. The inspection tasks are shared by the entire staff and the maintenance workload is prioritized based on inspection data and information.

TIU conducts internal inspections of MWRA structures and pipelines to reveal potential problem areas and identify locations requiring maintenance. Pipeline inspections average about 70% of the workload followed by inspections of other structures and manholes. Approximately 35.04 miles of pipelines were TV inspected in FY19.

Pipeline maintenance crews perform a variety of maintenance activities for the MWRA's Wastewater Transport system. The Transport collection system includes 240 miles of interceptor sewer lines. Approximately 36.17 miles of pipeline and 123 siphons were cleaned in FY19.

In addition to general pipeline and manhole repair work performed under this program, the following are other activities pipeline crews perform during the year:

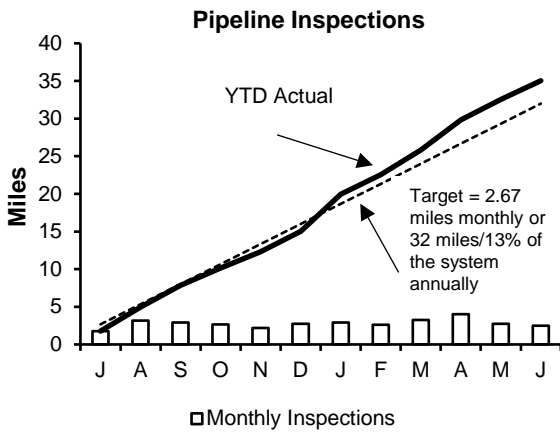
- Pipeline spot repair work in shallow excavations
- Clear obstructions and clean sections in community lines under the Community Assistance Program
- Snow plowing and removal during winter months
- NPDES inspections and best practice management activities
- Emergency pumping activities for communities during major wet weather events
- By-pass pumping for contracted pipeline rehabilitation or repairs
- Emergency response and overflow monitoring during wet weather events
- Response to odor complaints in the system

The “Maintenance Pipeline and Structure Inspections and Maintenance” page below provides a breakdown of the pipeline inspections and maintenance activities for FY19.

Wastewater Pipeline and Structure Inspections and Maintenance

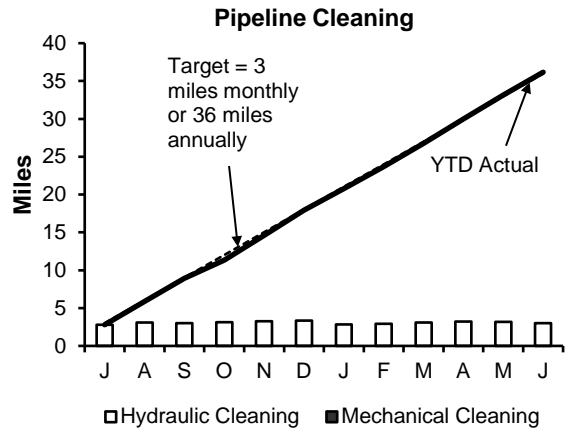
FY19

Inspections

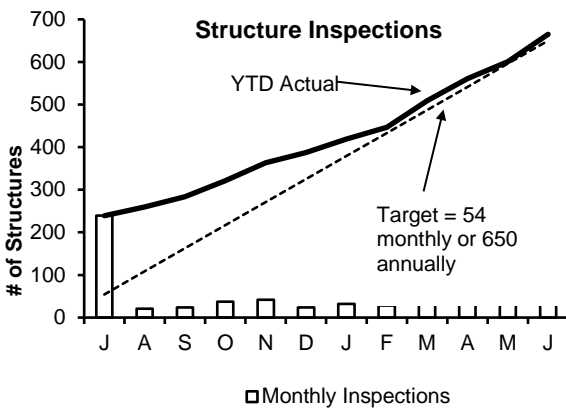


Staff internally inspected 35.04 miles of MWRA sewer pipeline during FY19.

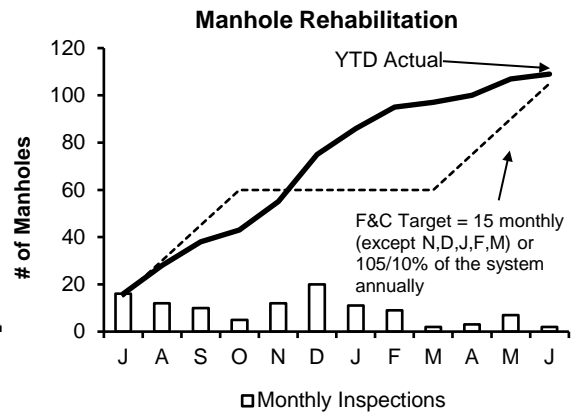
Maintenance



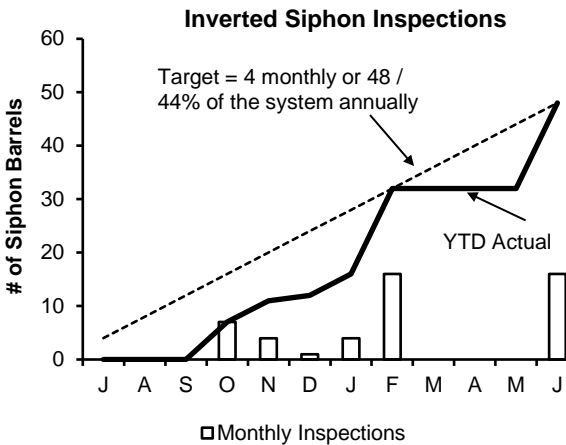
Staff cleaned 36.17 miles of MWRA's sewer system in FY19.



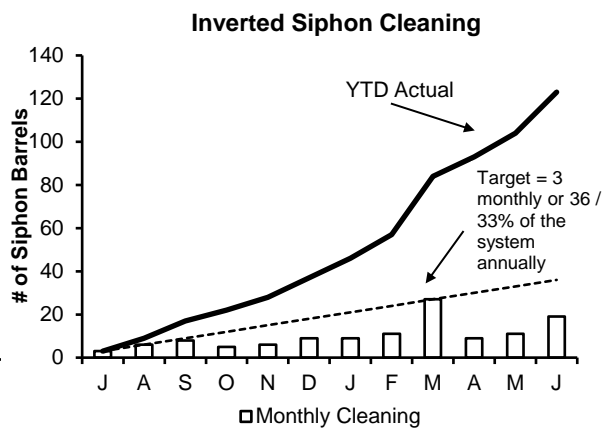
Staff performed 665 inspections of manholes and CSO structures in FY19.



Staff replaced 109 frames & covers during FY19.



In FY19, 48 siphon barrels were inspected.



Staff cleaned 123 siphon barrels during FY19.

Wastewater Transport Equipment Maintenance

The Field Operations Department Equipment Maintenance page for key indicators of performance for FY19 is on the next page. Monthly maintenance data is shown under six headings.

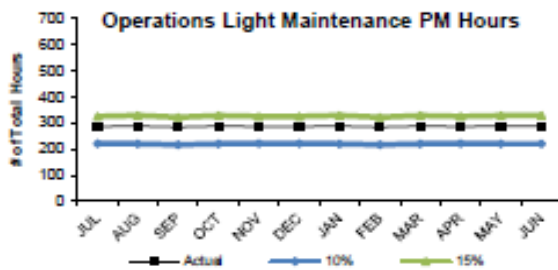
- Operations Light Maintenance Hours – In an effort to free up Maintenance staff to complete more detailed and complex maintenance, Operations staff have been committed to completing a number of the routine monthly preventative maintenance (PM) tasks. These tasks generally consist of observation and light maintenance tasks. The industry benchmark is 10% - 15% of the total preventative maintenance hours. In FY19, Operations staff completed an average of 286.6 hours per month which accounted for 13.75% of the total preventative maintenance hours.
- Overall Preventive Maintenance – The preventive maintenance work orders are completed by both operation and maintenance staff. The goal for FY19 was to complete 100% of all preventative maintenance work orders. The PM completion for FY19 was 100%.
- Items Kitted Utilizing Maximo – In an effort to more efficiently complete work, maintenance staff and work coordination center staff have utilized the Lawson/Maximo interface to better kit stock and non-stock material. The goal is to kit 30% of all work orders. The average for FY19 was 31% of all work orders.
- Operations Light Maintenance % PM Completion – In an effort to free up Maintenance staff to complete more detailed and complex maintenance, Operations staff have been committed to completing a number of the routine monthly preventative maintenance duties. The goal for Operations staff is to complete 100% of the preventative maintenance work orders. In FY19 Operations staff completed 100% of the work orders.
- Maintenance Backlog in Crew Hours - Backlog is determined by totaling the planned craft hours in open work orders and comparing them to craft resources available. The FY19 backlog average was 13,161 hours, which remains within the industry standard of 6,636 to 13,275 hours.
- Overtime Spending – Maintenance overtime spending was \$49,000 under budget for FY19. The overtime was used to support call-ins for emergency maintenance and planned overtime. It was also used for maintenance coverage related to weather events.

2. Critical Equipment Availability

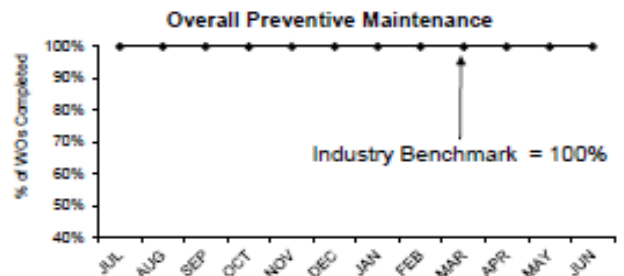
The average equipment availability for FY19 was 99.97 %. An equipment availability report generated daily, details the critical equipment required to collect and transport the wastewater flow at the facility design capacity. Higher maintenance priority is given to equipment that drops below the number required. Because of the high daily equipment availability, no operational impact has occurred in the past year.

Field Operations' Metropolitan Equipment & Facility Maintenance 4th Quarter - FY19

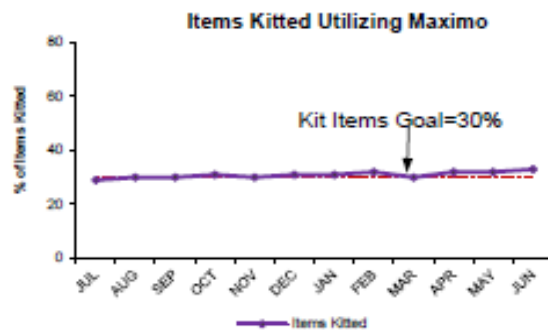
Several maintenance and productivity initiatives are in progress. The goal for the Overall PM completion and the Operator PM completion was raised to 100% for Fiscal Year 2010. The Operator PM and kitting initiatives frees up maintenance staff to perform corrective maintenance and project work, thus reducing maintenance spending. Backlog and overtime metrics monitor the success of these maintenance initiatives.



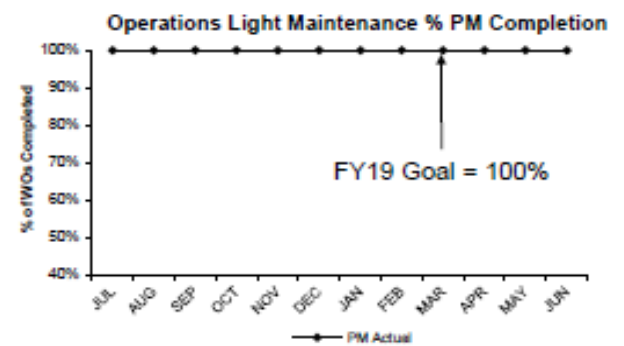
Operations staff averaged 287 hours of preventive maintenance during the 4th Quarter, an average of 13% of the total PM hours for the 4th Quarter, which is within the industry benchmark of 10% to 15%.



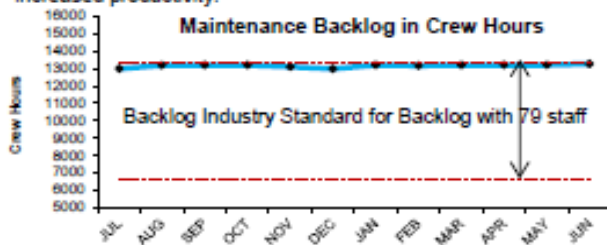
The Field Operations Department (FOD) preventive maintenance goal for FY19 is 100% of all PM work orders. Staff completed an average of 100% of all PM work orders in the 4th Quarter.



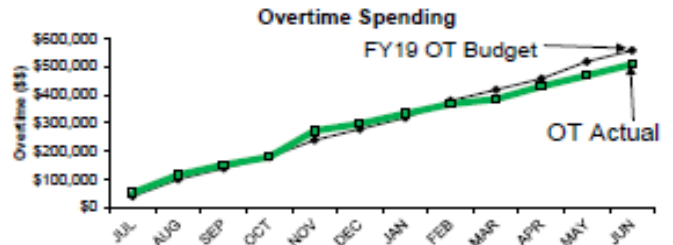
Operation's FY19 maintenance kitting goal has been set at 30% of all work orders to be kitted. Kitting is the staging of parts or material necessary to complete maintenance work. In the 4th Quarter, 32% of all applicable work orders were kitted. This resulted in more wrench time and increased productivity.



Wastewater Operators complete light maintenance PM's which frees up maintenance staff to perform corrective maintenance. Operations' FY19 PM goal is completion of 100% of all PM work orders assigned. Operations completed an average of 100% of PM work orders in the 4th Quarter.



The 4th Quarter backlog average is 13224 hours. Management's goal is to continue to control overtime and still stay within the industry benchmark of 6636 to 13275 hours.



Maintenance overtime was \$20k under budget for the 4th Quarter. Overtime was used for critical maintenance repairs and wet weather events. Overtime for FY19 was \$508k which was \$49k under budget for the fiscal year.

Status Sheets
Fore River Pelletizing Plant
July 2018 – June 2019

Critical Equipment Availability: 98.4%

Operating logs indicate that of the 1,825 machine days in the FY19, centrifuges were available for 1,795 days for an availability of 98.4%. The available machine days is lower in FY19 because train 4 was taken offline due to severe drum wear and was not run at all in FY19. This made the two rotating assemblies associated with train 4 to be utilized as needed elsewhere, driving up the total availability of the remaining 10 centrifuges. The centrifuges and ancillary equipment make up the critical components at the Pelletizing Plant because dewatered sludge can be processed through the dryers or it can be sent through a bypass system to trucks and taken to a landfill. The primary driver of downtime was disassembly and cleaning of the rotating assemblies. At the present time, 10 of 12 centrifuges are available giving the Plant more than enough capacity to process flows from Deer Island. The facility is currently operated on a 5-day workweek ceasing operations on most weekends.

Backlog:

The current maintenance monitoring software does not track craft hours, but at fiscal year-end, there were 21 outstanding work orders. Of the 21, nine are PM's and twelve are listed as corrective.

Maintenance Work Orders:

In FY2019, there were 662 work orders generated in the computerized maintenance management system (CMS). Of those 641 were completed during the fiscal year, equating to a 96.8% completion rate. The eMaint CMS system has allowed the plant to better track ongoing work orders and the benefits of the upgrade are clear. The Preventative Maintenance system is continuously being modified to include updates for equipment changes, new lubrication schedules and new equipment inspection and cleaning practices. In addition, the operations staff are utilizing the system to track non-routine cleaning tasks to better gauge necessary frequency and to allow these cleanings to be scheduled as preventative rather than corrective actions.

Maintenance:

More than \$1.40 million was spent on replacement parts and maintenance related items in FY2019, including:

- A new VFD was purchased and installed in RTO 2 after a power bump caused a failure in the original drive. Additionally, the 350 hp RTO fan motor was replaced.
- Replaced ceramic media in two of four RTO's
- Centrifuge repairs – two complete rotating assembly were sent back to the manufacturer and have been overhauled to OEM condition
- Conveyor Repairs – Several small to medium repairs were completed

- Major repairs were completed on the inlet and outlets of drum 6
- The outlet cone on drum 2 was replaced due to wear
- Silos 1-5 and the sludge tanks were water blasted, prepped and painted