



MASSACHUSETTS WATER RESOURCES AUTHORITY

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October 27, 2016

Susan Studlien, Director
Office of Environmental Stewardship
U.S. EPA Region 1
5 Post Office Square, Suite 100
Boston, MA 02109-3912

David Ferris, Director
Division of Watershed Management
Department of Environmental Protection
1 Winter Street
Boston, MA 02108

RE: Massachusetts Water Resources Authority
Permit Number MA 0103284
O&M Annual Report

Dear Ms. Studlien and Mr. Ferris:

Attached please find the MWRA's annual status sheets on plant performance and maintenance for the period covering July 2015 – June 2016. This submittal fulfills the requirements of MWRA's NPDES Permit MA0103284 - Section I.18.f and I.18.g that states in part:

“The MWRA shall submit annual status sheets on plant performance, using key indicators for maintenance”.

The Status Sheets will be posted at www.mwra.com.

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

Sincerely,

Michael J. Hornbrook
Chief Operating Officer

cc: MA DEP, Wilmington
MA DEP, Worcester
B. Pitt, US EPA
T. Borci, US EPA
C. Vakalopoulos, MA DEP
F. Laskey, MWRA

MWRA Annual Report on Operation & Maintenance

July 2015 – June 2016

This report has been generated to fulfill the requirements of MWRA's NPDES Permit MA0103284 - Section I.18.f that 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

Deer Island Sewage Treatment Plant

The Deer Island Sewage Treatment Plant (DITP) is the centerpiece of MWRA's \$3.5 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 and community owned sewer lines and approximately 228 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 cared for 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 Field Operations Department (FOD) 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) facilities and 2 combined sewer overflow (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 (FRPP) is regulated, in part, 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 FRPP include an extensive residuals management facilities plan developed as part of the permitting process for the FRPP 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 FRPP. 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 in the amount of \$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 (FAMP)

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." This asset management program addresses the goal of becoming more efficient by developing consistent, compatible best practices, cost-effective operations and maintenance procedures.

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

MWRA has expanded its efforts in the areas of condition monitoring; Reliability Centered Maintenance (RCM); asset replacement prioritization and capital improvements; and training of staff. DITP is continuing to build the program, focusing on Maximo upgrade to version 7.6,

continuing using the methodology of RCM, consolidating the tool data-base in Maximo, expanding condition monitoring oil analyses by using on site testing equipment, and reviewing analytical software for better asset management decision making.

4. COMPUTERIZED MAINTENANCE MANAGEMENT SOFTWARE

The maintenance management software used by the Authority is MAXIMO version 5.2. The software includes safety plan and job plan features that allow users to document hazardous materials and areas around the plant. It has the ability to use lockout/tag-out tasks and generate associated work orders for the field. MAXIMO provides document management capabilities to streamline maintenance and regulatory functions, and workflow capabilities for synchronizing operations. Applications can be fine-tuned to suit specific work processes or integrate with other programs. The software also includes mobile applications for gathering and downloading data and an intuitive interface.

Maintenance staff can prioritize tasks, assign work based on the availability of necessary parts, labor, and analyze equipment failures in order to implement appropriate preventive maintenance measures.

The MAXIMO maintenance management tool is used to manage all MWRA assets. The software is used for work order management, planning and scheduling, asset management, resource management, recording of maintenance costs, and generation of reports and analyses. The software can store large amounts of data and is equipped with built-in failure analysis programs. In addition, MAXIMO contains the historical record for all maintenance activities, thus allowing staff to better address a problem with a facility, or a specific asset group.

MWRA contract 7287 was approved in FY15 to upgrade our computerized maintenance management software, Maximo from version 5.2 to version 7.6 (The latest version available). The project team is the consultant group of SHI International Corporation and Total Resource Management Inc. This project has started and will finish in FY17. Maximo version 5.2 is no longer supported by IBM Maximo. It tracks material cost, labor cost, actual work performed, spare parts, staff hours and service contract work. MWRA Maximo currently manages more than 120,000 assets.

This upgrade will provide updated technology, increase functionality for maintenance, improves reporting, allow MWRA to combine two separate Maximo instances which will result in an increase in productivity for the MIS department as part of this upgrade. Additional Maximo features will be added to increase efficiencies including Calibration for instruments, Help Desk to support MWRA computer network, Maximo anywhere using mobile devices, Spatial Asset Management for utilizing space, Linear Asset Manager for pipe sections, and Maximo scheduler to plan maintenance work.

NEFCo has computerized maintenance management software - Quickmaint. Quickmaint is used for work order management including preventive and corrective maintenance work.

5. SERVICE CONTRACTS

The 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. Table 1 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 (<i>Legionella</i> 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

Deer Island Treatment Plant

July 2015 - June 2016

Annual Report: Deer Island Maintenance reporting on Key Performance Indicators for FY16.

- Preventive Maintenance Work Orders Completed - Maintenance is working to reach the PM goal of 100%. The average PM % completion rate is 99.9%.
- 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 use. Deer Island exceeded its goal of 48% with 51% in FY16.
- Predictive Maintenance - Extending the useful life of equipment and allows for better planning for equipment replacements. 6,453 work orders were completed for vibration, acoustic ultrasonic, ultrasonic thickness, and oil analysis in the past year. Deer Island exceeded its FY16 goal of 20%, with 22% of all work orders being 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 for last year was 17,119 hours for day to day plant maintenance activities which is within the industry standard of 8,730 hours to 17,460 hours. DITP monitors all of our metrics very closely to ensure the backlog is not affecting our availability of equipment.
- Maintenance Overtime - The goal is to maintain maintenance overtime to 5% of total wages and salaries. DITP was below the benchmark with 4.8%. This doesn't include any wet weather event overtime requiring maintenance staff to be on site as a precautionary measure.

Critical Equipment Availability: 12-Month Average – 99.7%

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 99.7% versus 100% availability because the plant normally operates at approximately one-third the design flow capacity.

Day to Day Plant Maintenance Average Backlog: Backlog is determined by totaling the planned craft hours on open work orders and comparing them to craft resources which are available. Day to day plant maintenance backlog includes all PM, PdM, Project and CM backlog. A backlog of 17,119 hours constitutes 5.8 weeks of work for the entire maintenance workforce. This backlog is within the industry standards of 8,730 hours to 17,460 hours or 4 to 6 weeks. DITP monitors all of the metrics very closely to ensure the backlog is not affecting the availability of equipment.

Preventive Maintenance (PM):

99.9% of all PMs were completed and 18,164 PM work orders were initiated this year. Incomplete PM's that are not completed in one month are rolled over into the next month's workload and given a high priority to complete first.

Predictive Maintenance (PdM):

6453 predictive maintenance work orders were completed in the past year. Predictive maintenance work includes vibration, acoustic ultrasonic, ultrasonic thickness and oil analysis and is proactive maintenance work to extend equipment useful life by monitoring and trending equipment characteristics. It also provides early detection.

Average Craft Hours per Month:

Preventative Maintenance	3496 hours	25 %
Predictive Maintenance	144 hours	1 %
Corrective Maintenance	8794 hours	64 %
Emergency Maintenance	8 hours	<1 %
Project Work	489 hours	4 %
Other Work	819 hours	5 %
Total	13,750 hours	100.0 %

Total Work Orders:

37,225 work orders initiated this year

35,174 work orders completed/closed status

Maintenance Projects and Equipment Replacement:

- **Centrifuges Refurbishment \$162,232**

There are twelve waste sludge centrifuges which, due to high speed rotating assembly and critical nature of the process, require maintenance. Centrifuges require refurbishment at regular intervals based upon running hours for normal wear and tear. Due to the intricacy of the equipment all overhauls are sent back to Alfa Laval, the original equipment supplier. In the past year, two waste sludge centrifuge and gearbox was refurbished.

- **Reactor Aerator/Mixer Gearbox Rebuilds \$170,764**

The secondary reactor aerators and mixers have large gearboxes that have started to fail. Eight gearboxes were refurbished in FY16 with new gears, seals, and bearings.

- **Boiler, STG and Hydro Plant Maintenance \$1,145,506**

A maintenance contract was put in place to perform annual preventive maintenance and repairs as necessary. This contract was combined with Hydro plant and STG to save money with one contract on like equipment and save on mobilization cost.

- Cryogenic Facility Repairs \$608,464
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 project this year was coating piping and intercooler on compressor 1B to prevent corrosion.
- Uninterrupted Power Supply Replacements - \$147,521
The Uninterrupted Power Supplies on Deer Island are extremely important which requires constant maintenance and equipment replacements to ensure reliability. These steps are necessary throughout Deer Island to instantaneously continue operation in the case of a power loss. Uninterrupted Power Supply units (UPS) were installed in the Thermal Power Plant and Administration Building.
- Grinder Rebuilds \$45,140
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 rebuild the grinders or cutter blocks. Staff replaced six grinders this year.
- Roller Gates Rebuilds \$141,284
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 water-tight 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 be cleaned, shop blasted, and repainted to the original specifications. All new wheels, bushings, retainers, and seals, per the original manufacturer’s specifications were installed. Eight (8) stop logs were refurbished in Fy16.
- HVAC Equipment \$112,036
A key aspect of ensuring optimal operational performance of equipment on Deer Island is reducing occurrences of heat-related stresses. Excessive heat presents a constant challenge to HVAC staff as they work to maintain proper temperature and humidity levels within electrical buildings and facilities throughout the plant. DITP has purchased chillers, condensers, coils and associated equipment to ensure equipment reliability and take into account the environment at Deer Island. The replacement equipment includes updated environmentally beneficial of R-22 refrigerant and electro-fin™ coating to protect from exposure to the

corrosive nature of hydrogen sulfide. This coating will prolong the useful life of these HVAC units.

- Variable Frequency Drives and Motors \$1,700,000

Deer Island has been updating the Variable Frequency Drives and Motors throughout Deer Island to ensure proper operation of the Raw Wastewater Pumps. These existing Variable Frequency Drives and Motors were encountering an issue with the rotor bars creating unreliability as well as being obsolete. Four VFD's and motors were installed last year. All VFD drives and Motors are now complete in the North Main Pump Station.

- Lighting Energy Saving Project \$146,379

Deer Island has been updating all lighting throughout the Deer Island Treatment Plant with cost efficient replacements. This year's project included supplying and installing new LED explosion proof fixtures in on ceilings and wall mounted units in stairwell of all Digester Modules.

- RSL Equipment/Parts \$107,572

Return activated sludge (RSL) pumps move secondary sludge from the bottom of each stacked clarifier to the secondary reactor inlet and the residual facility for further processing. Each Secondary Battery has 27 RSL pumps and there are 81 RSL pumps across Secondary Batteries A, B & C. RSL pumps are horizontal-impeller, centrifugal pumps operating continuously removing secondary sludge powered by a Variable Frequency Drive (VFD) controlled motor. One RSL pump is needed for each secondary clarifier to operate. However, with plant built-in redundancy, every two secondary clarifiers there are three RSL pumps. MWRA staff performs routine maintenance and repairs on these pumps. As part of Deer Island's centrifugal pump maintenance protocols, staff perform inspections, preventive and predictive maintenance (vibration testing), on a quarterly, semi-annual, and annual basis. Staff also performs corrective maintenance tasks as required, including greasing, alignments and complete in-house overhauls when needed. When a RSL pump fails, repairs to the pump are made from stocked material from the DITP warehouse.

- Slide Gates \$35,091

There are forty-eight (48) primary clarifiers on Deer Island that remove floatable scum and settleable solids, or sludge. Each clarifier has a set of eight (8) 14-inch-diameter influent sluice gates that isolate the flow of raw wastewater from the primary influent channel into each clarifier and one (1) 18-inch dewatering sluice gate used to dewater the clarifier through the dewatering system to the Winthrop Terminal Facility. These sluice gates serve to both isolate and dewater the clarifiers for corrective or preventive maintenance is necessary. The gates operate on a continuous basis in submerged raw wastewater, which contains rags, grit, organic and inorganic solids, and high concentrations of corrosive compounds commonly found in raw wastewater. Over time, these solids and the corrosiveness of wastewater affect the ability of the gates to provide leak-free

isolation of the clarifier or a tight seal on the dewatering gates. Staff has replaced six sluice gates in Primaries.

- Insulation Repair \$89,534

Insulation covering is required because some Deer Island equipment is outside and requires insulation to prevent freezing. This insulation work installed 2” thick rigid insulation and thermal insulating blankets, which are a soft, flexible and a removable insulation system to facilitate maintenance on flame arresters, pumps and valves. The outside areas were located at the Thermal Plant and Residuals flares 1, 2 and 3.

- Lube Oil Skids 238,789

Each of the ten raw wastewater pumps in North Main Pump Station is equipped with three bearings (two radial bearings and one thrust bearing). These bearings are critical to the operation and life cycle of the pumps. In order to maintain the proper lubrication and temperature conditions for the bearing, there is a lube oil skid dedicated for each raw wastewater pump. The lube oil skids are self contained units that circulate lubricating oil from the oil reservoir to each of the bearings. The lube oil skids cool and filter the oil. The existing lube oil skids were provided by Fairbanks Morse Pumps as part of the original raw wastewater pump package under the Boston Harbor Project. In recent years, failures of the lube oil pumps and instruments on the skids have led to downtime for several of the raw wastewater pumps since the lube oil skids need to be functioning for the raw wastewater pumps to start. DITP has purchased five in Fy16.

- Electric Vehicles 145,000

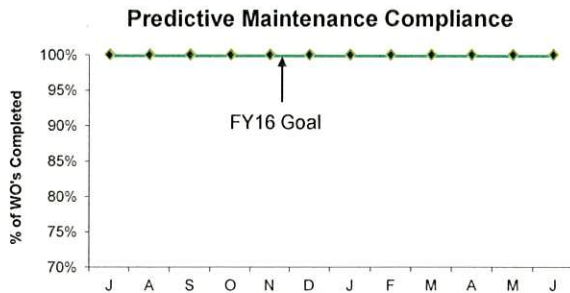
Deer Island Treatment Plant staff perform multiple job-related activities and tasks all around the large expanse of the DITP and its numerous buildings and facilities on a daily basis. The expansive nature of DITP’s terrain requires use of electric vehicles to ensure the most efficient transport of staff, 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.

Deer Island Maintenance

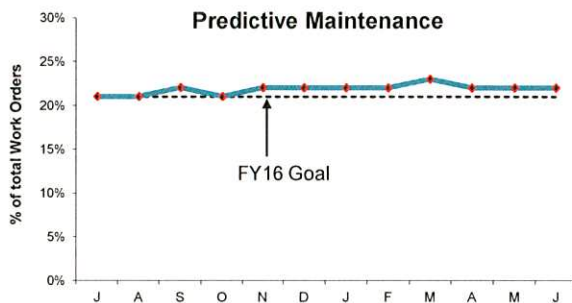
June 2016 - FY16

Productivity Initiatives

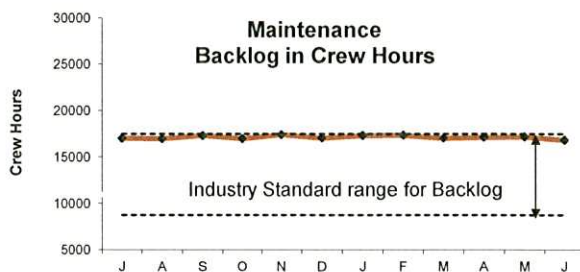
Productivity initiatives include increasing predictive maintenance compliance and increasing PdM work orders. Accomplishing these initiatives should result in a decrease in the overall maintenance backlog.



Deer Island's FY16 predictive maintenance goal is 100%. DITP completed 100% of all PdM work orders in June.



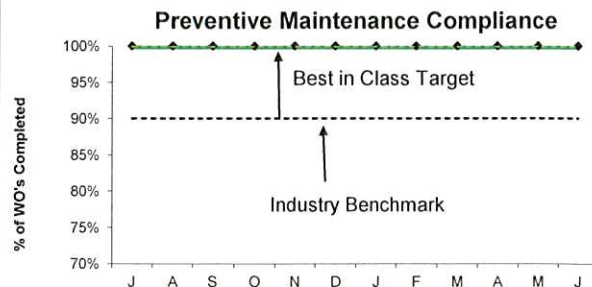
Deer Island's FY16 predictive maintenance goal has been increased to 21% of all work orders to be predictive maintenance. In June, 22% of all work orders were predictive maintenance.



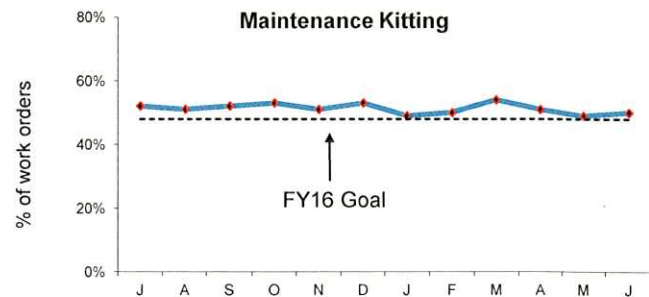
DITP's maintenance backlog at Deer Island is 16,814 hours. DITP is on the upper end the industry standard range. The industry standard for maintenance backlog with 97 staff (currently planned staffing levels) is between 8,730 hours and 17,460 hours. Backlog is affected by two vacancies; an Electrician and a HVAC Specialist. Management continues to monitor backlog and to ensure all critical systems and equipment are available.

Proactive Initiatives

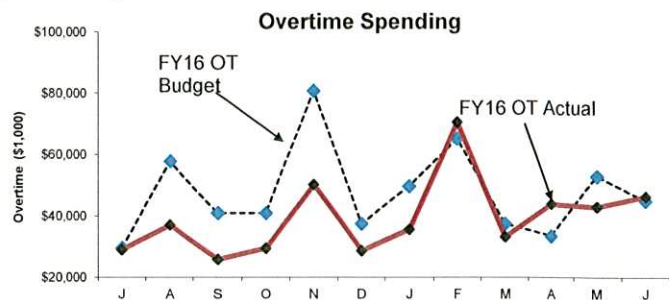
Proactive initiatives include completing 100% of all preventive maintenance tasks and increasing preventative maintenance kitting. These tasks should result in lower maintenance costs.



Deer Island's FY16 preventive maintenance goal is 100% completion of all PM work orders from Operations and Maintenance. DITP completed 100% of all PM work orders in June.



Deer Island's FY16 maintenance kitting goal has been increased to 48% of all work orders to be kitted. Kitting is staging of parts or material necessary to complete maintenance work. In June, 50% of all work orders were kitted. This has resulted in more wrench time and increased productivity.



Maintenance overtime was over budget by \$1k in June and is \$112k under for the FY16. Management continues to prioritize work and limit overtime to critical equipment or systems only. June's overtime was predominately used High Flow Coverage, Island Wide HVAC work, Influent Channel Gate Replacement, Power Conditioner Replacement in Electric Building #3, Assembling and Installation of Static Bearing Sprockets, and Conveyor Belt #6 Replacement.

Wastewater Transport System

July 2015 - June 2016

Wastewater Transport System Overview

The Field Operations Department (FOD) 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 headwork's facilities, 3 combined sewer overflow treatment (CSO) facilities and 2 combined sewer overflow (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.

Wastewater Transport Facilities

1. Facilities Operational Statement

During FY16 Wastewater Transport facilities operated at full capacity throughout the year. All required equipment to maintain flow and process of wastewater was available with the following exceptions: Prison Point engine/pump #3 was unavailable from October 1, 2015 to October 3, 2015 for water jacket pump replacement; Prison Point engine/pump #2 was unavailable from January 10, 2016 to March 14, 2016 for engine rehabilitation. 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. Chelsea Screen House screen #1 was unavailable from March 9, 2016 to May 13, 2016 for screen rehabilitation.

2. Equipment Availability

The average equipment availability for FY16 was 99.87 %. 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) systems provide 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 CIP projects and in-house efforts, the SCADA system for all FOD facilities has been in place since FY10.

MWRA SCADA staff performs 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 FOD facilities. During FY16, 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 maintains, upgrades, programs and patches the computers and hardware used in collecting, controlling, transmitting and displaying facility data. During FY16, continued emphasis was placed on improving MWRA's cyber security posture. This included installation of data diodes between the MIS and SCADA networks, enhancing the network monitoring systems, and making improvements to physical hardening.

4. 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 out-sourced projects:

In-house Projects

Headwork's Improvements: Staff continued to work to replace equipment at the headwork's to maintain equipment reliability on an as needed basis. Each year, staff evaluates systems for upgrade. All channels, all dewatering pumps have been replaced or overhauled. Work continues to maintain reliability and availability of the headwork's systems through Preventive Maintenance Practices. The following is a detailed list of work performed at all wastewater facilities in Metro East.

- Ward Street and Columbus Park Headwork's Air Conditioning Units: HVAC staff install new split AC in office area
- Columbus Park Headwork's Air Conditioning Units: HVAC staff install new split AC in office area
- Framingham Pump Station Air Conditioning Units: HVAC staff install new AC system in electric room.
- DeLauri Pump Station Air Conditioning Units: HVAC staff install new split AC in electric room
- DeLauri Pump Station: Electrical Staff worked with Water Pipeline and SCADA to install a new Wet Well sensing line

- Columbus Park Acid Wash Scrubbers: HVAC staff acid washed odor control scrubbers to clean media pipe lines and nozzles. Plumbing staff removed and replaced all polypropylene supply hoses and cleared nozzles.
- Nut Island Headwork's Odor Control Recovery:
 - Removed and replaced, aligned and balanced Odor Control Fan Assemblies
 - Overhauled odor Control fan motors 1, 2, 3 & 4 (see Outsourced Projects)
 - Overhauled ALP blower motors 1 & 2 (see Outsourced Projects)
 - Repaired Carbon Adsorbers
 - Repaired lighting in Odor Control Facility
 - Repaired and replaced Emergency lighting and exit signs
 - Installed new UPS in Odor Control for CP3&4
 - Removed for replacement Fire Pump # 3 (waiting for delivery)
 - Replaced Roots Blowers and motors 1-6
 - Painted main level and upper level walls
- Caruso Pump Station VFD Replacement: Electrical staff removed and replaced a VFD which had failed on raw wastewater pump 1-3 and 1-4 with a new Power Flex 700 which was retrofitted to replace obsolete VFD's.
- Prison Point Engine #3: Mechanical staff removed and replaced auxiliary water pump for engine #3 that failed.
- Hayes Pump Station Electrical staff removed and replaced Pump # 2 soft starter.
- Braintree Weymouth RPS Facility staff installed permanent Platform Odor Control room.
- Intermediate Pump Station Electrical staff removed and replaced UPS for control room.
- Chelsea Water & Wastewater Operation Control Center electrical staff removed and replaced outdated Uninterruptable Power Supply (UPS) This work was performed to improve the ability to monitor system conditions during a power outage. The existing systems had met the end of their useful life.

Outsourced Projects

- Prison Point Engine # 2 overheated requiring a top end overhaul Vendor rebuilt top end replace # 1 cylinder liner, piston and rings
- Framingham Pump Station vendor cleaned chemical storage tank
- Nut Island Odor Control fan motors 1, 2, 3 & 4 were removed by in-house mechanical staff, delivered to vendor to evaluate and overhaul motors. When overhaul was completed motors were delivered and installed by in-house mechanical staff.

- Nut Island ALP blower motors 1 & 2 were removed by in-house mechanical staff, delivered to vendor to evaluate and overhaul motors. When overhaul was completed motors were delivered and installed by in-house mechanical staff.
- North Dorchester Bay CSO Pump Station Pump # 3 internal seal failed, pump was removed and spare pump installed by in-house mechanical staff, failed pump delivered to vendor to evaluate and overhaul. When overhaul complete pump will be delivered and stored as a spare.

Wastewater Transport Pipelines

1. Manhole Inspection and Rehabilitation Program

The Technical Inspections Unit (TIU) of the FOD 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 FY16 TIU staff inspected a total of 818 manholes. Approximately 105 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 is a current pipeline construction/rehabilitation project included in the MWRA Capital Budget.

Phase 6 Sewer Manhole Rehabilitation Contract No. OP-291

Contract OP-291 was designed by MWRA staff. It is the sixth in a series of annual contracts to rehabilitate sewer manholes. The work under this contract consists of internal rehabilitation of 55 sewer manholes at various locations in Boston, Malden, Milton, Newton, Quincy, Somerville & Watertown. The interior surfaces of the manholes will be prepared by first cleaning and plugging active water infiltration. A fiber-reinforced, corrosion-resistant mortar will then be applied, which will improve the structural integrity of the manhole and also protect against future corrosion damage.

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 35.48 miles of pipelines were TV inspected in FY16.

Community Assistance was provided to member communities on an as needed basis. This assistance included:

- City of Waltham by-pass pumping. Waltham lost power to a wastewater pump station, MWRA personnel assisted by providing by-pass pumping with two 6" pumps.
- City of Somerville cleaning and inspection. Somerville experienced a sewer blockage and pipe collapse. MWRA cleaned and CCTV inspected 3,000 linear feet of 8" diameter and 24" diameter sewer pipes.

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 38.94 miles of pipeline and 72 siphons were cleaned in FY16.

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

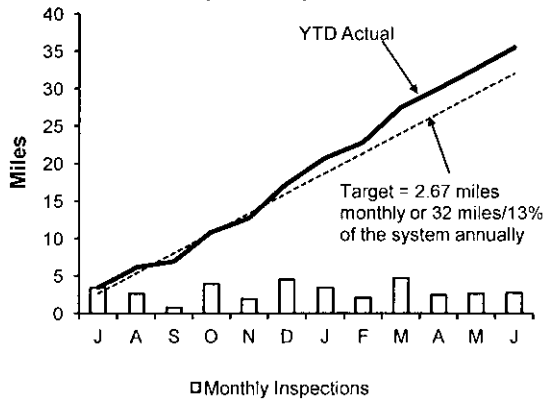
- pipeline spot repair work in shallow excavations
- clear obstructions and clean sections in community lines under the Community Assistance Program
- snow plowing and removal during winter months
- NPDES inspections and best practice management activities
- emergency pumping activities for communities 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

Wastewater Pipeline and Structure Inspections and Maintenance

June 2016 - FY 16

Inspections

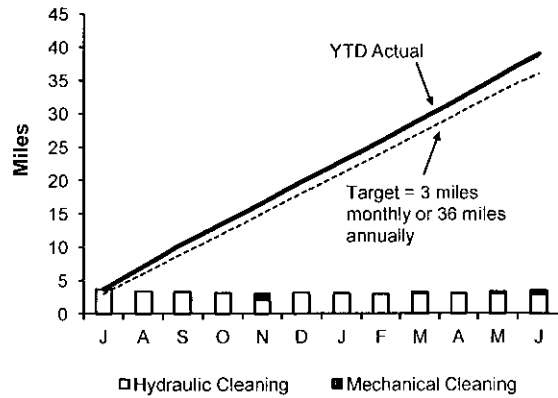
Pipeline Inspections



Staff internally inspected 2.80 miles of MWRA sewer pipeline during the month of June. The year to date total is 35.48 miles. No Community Assistance was provided this month.

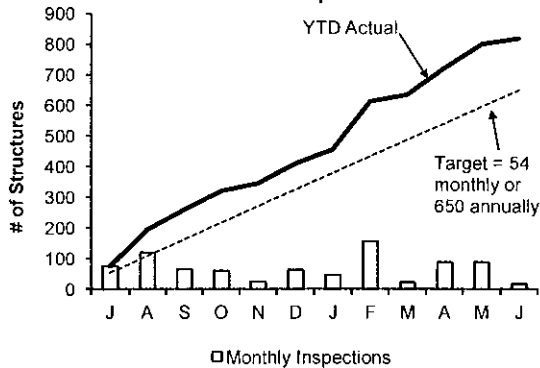
Maintenance

Pipeline Cleaning



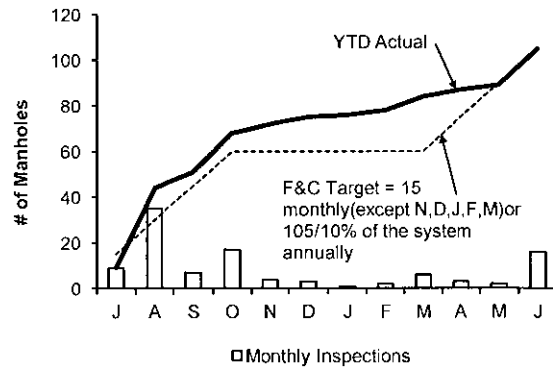
Staff cleaned 3.49 miles of MWRA's sewer system and removed 15 yards of grit and debris during the month of June. The year to date total is 38.94 miles. No Community Assistance was provided this month.

Structure Inspections



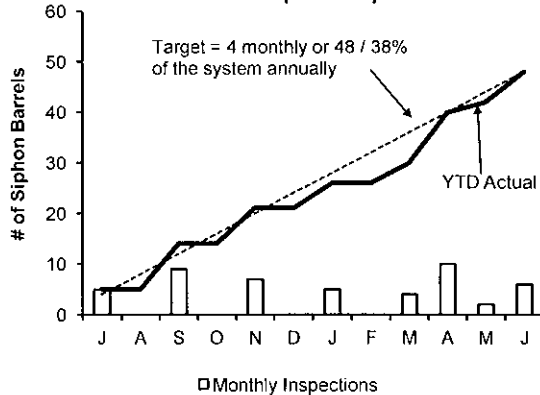
Staff inspected the 12 CSO structures and performed 6 additional manhole/structure inspections during the month of June. The year to date total is 818 inspections.

Manhole Rehabilitation



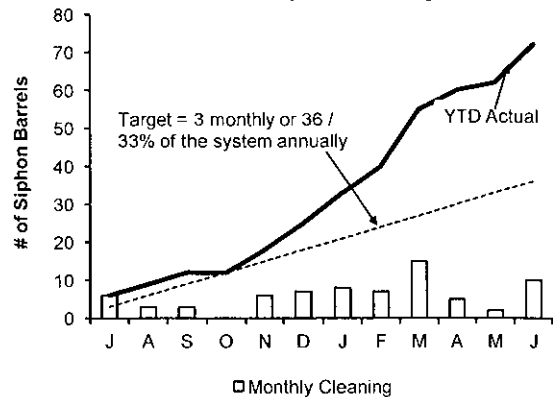
Staff replaced 16 frames & covers during the month of June. The year to date total is 105.

Inverted Siphon Inspections



Staff inspected 6 siphon barrels this month. Year to date total is 48 inspections.

Inverted Siphon Cleaning



Staff cleaned 10 siphon barrels during the month of June. The year to date total is 72 barrels.

FY16 Maintenance Program Costs, Staffing and Contracts

1. Budget

FOD has made a significant commitment to the maintenance of its wastewater system. Additional maintenance and improvement projects are included in the MWRA Capital Program and are identified on an annual basis. A Master Plan is ongoing within the Authority to prioritize projects and to determine required funding needs. The budget below includes only the Current Expense Budget (CEB). Maintenance includes protecting the many assets of the MWRA with individual programs that care for facility interior and exterior elements, maintain plant equipment, inspect and clean wastewater pipelines, and structures. Staff plan/schedule and track maintenance activities for each program, supervise staff, and provide adequate administrative support. The table below includes a summary of the approved budget in FY16 for programs within FOD for related maintenance activities.

FY16 APPROVED MAINTENANCE ANNUAL BUDGET

Budget Line Item	Total Funding
Wages and Salaries	\$10,620,474
Overtime	\$662,643
Maintenance (Parts & Supplies)	\$5,248,034
Professional Services	\$83,118
Other Materials	\$293,868
Other Services	\$329,356
Total	\$17,237,493

2. Staffing

A total of 131 employees are included in the chart below. They represent personnel responsible for the maintenance of wastewater transport facilities and pipelines. Unit Supervisors for each trade provide supervision and support in their respective areas: electrical, mechanical, machinists and welding, plumbing, HVAC, painting, and carpentry. Facility Maintenance and Equipment Maintenance are two consolidated programs made up of the mechanic specialists, machinists, metalworkers, welders, plumbers, HVAC specialists, electricians, building and grounds workers, and facility specialists (carpenters, painters, and masons). These groups perform maintenance activities at both wastewater and water facilities.

Work Coordination in FOD provides scheduling and job planning at all water and wastewater facilities, water and wastewater pipeline maintenance, and Western Operations. The Wastewater

Pipeline Maintenance and Technical Inspection programs maintain the collections system for the Transport system only. The staffing represents FY16 average levels for employees reporting to the Chelsea Facility. The table below indicates the amount of staffing available and dedicated to maintenance efforts.

MAINTENANCE STAFFING LEVELS

Staffing Categories	No. of Staff
Equipment Maintenance Program	
Maintenance Manager	1
Engineers	0
Program Manager/Area Manager	4
Administration	1
Maintenance Specialists	18
Electrical Specialists	12
Plumber/Pipefitters	9
HVAC Specialists	5
Machinists & Welders	4
	54
Work Coordination Group Program	
Work Coordination Group Program	9
Wastewater Pipeline Inspection and Maintenance Group	25
Building & Grounds Program	16
Facility Maintenance Program (Carpenters, Painters, Masons)	17
SCADA Engineers	2
SCADA Maintenance Technicians	8
Subtotal	77
Total	131

Staffing levels may vary as a result of vacancies, transfers, and other factors. This chart provides a number of available staff during the fiscal year for maintaining the collections system and wastewater facilities. Equipment Maintenance, Building & Grounds, and Facility Maintenance programs perform similar core business functions at Water Pumping Facilities and locations.

3. Service Contracts

The Maintenance Program is supplemented by a series of service contracts. These services are intended to provide resources beyond the in-house capabilities of the Maintenance staff. FOD currently utilizes the following service contracts and services, listed below, to supplement the existing workforce and assist with maintenance projects at water and wastewater facilities.

<u>CURRENT SERVICE CONTRACTS</u>
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

Wastewater Transport Equipment Maintenance

1. Annual Report

The Field Operations Department Equipment Maintenance page for key indicators of performance for FY16 is attached. Monthly maintenance data is shown under six headings.

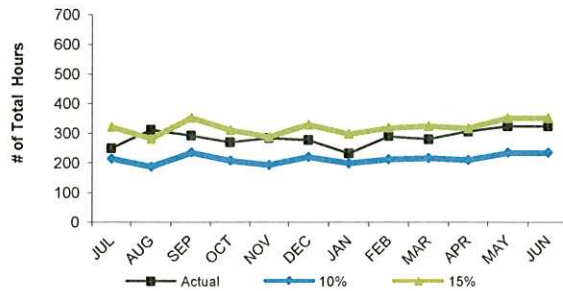
- Operations Light Maintenance (PM) Hours – In an effort to free up maintenance staff to complete more detailed and complex maintenance, operations staff have been committed to completing a number of the routine monthly preventative maintenance tasks. These tasks generally consist of observation and light maintenance tasks. The industry benchmark is 10% - 15% of the total preventative maintenance hours. In FY16 operations staff completed an average of 287 hours per month which accounted for 12% 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 FY16 was to complete 100% of all preventative maintenance work orders. The average PM completion for FY16 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 at least 50 items per month. The average for FY16 was 247 items per month.
- 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 FY16 operations staff completed an average of 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 FY16 backlog average was 12,766 hours which remains within the industry standard of 6,626 to 13,275 hours.
- Overtime Spending – Maintenance overtime spending was \$174,674 over budget for FY16. The overtime was used to support call ins for emergency maintenance, planned overtime and the Nut Island fire incident response. It was also used for emergency coverage and maintenance coverage related to weather events.

Field Operations' Metropolitan Equipment & Facility Maintenance

June 2016 - FY16

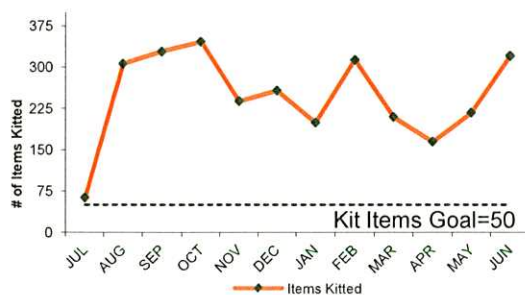
Several maintenance and productivity initiatives are in progress. The goal for the Overall PM completion and the Operator PM completion was raised to 100% in Fiscal Year 2010. The Operator PM and kitting initiatives frees up maintenance staff to perform corrective maintenance and project work, thus reducing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

Operations Light Maintenance PM Hours



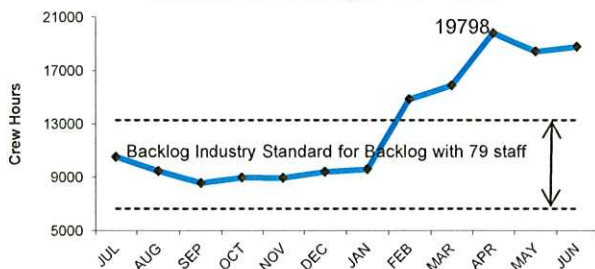
As part of efforts to improve efficiency, Operation staff completed 307 hours of preventive maintenance in June, about 14% of the total PM hours, which is within the Industry Benchmark of 10% to 15%. This frees up maintenance staff for heavier maintenance projects. Operators completed 100% of the Ops PMs scheduled.

Items Kitted Utilizing Maximo



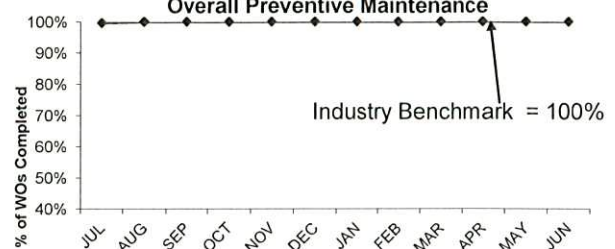
In an effort to more efficiently complete work, maintenance staff and work coordination staff have utilized the Lawson/Maximo interface to better kit stock and non stock material. The goal for FY16 is to "kit" 50 stock and non stock items total per month. 320 items were kitted during the month of June.

Maintenance Backlog in Crew Hours



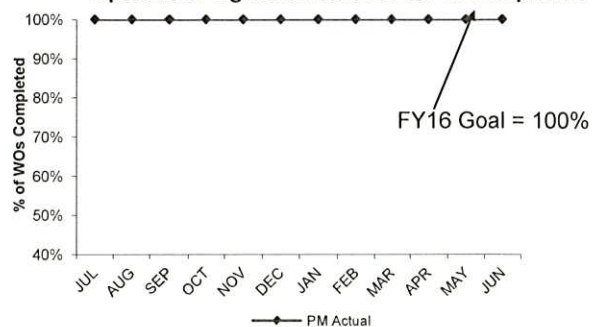
Current backlog is at 18783 hours while overtime spending was 17k over budget for June. The industry standard for maintenance backlog with 79 staff is between 6,636 and 13,275 hours. There are currently seven vacant positions, one Building and Grounds worker, two O and M Specialists, three HVAC technicians and one OMC Laborer. The backlog is also impacted by the Nut Island Incident Response.

Overall Preventive Maintenance



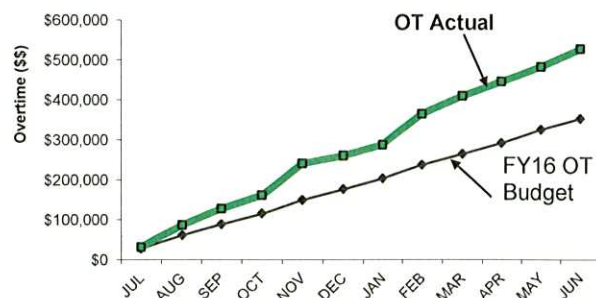
In June, Field Ops completed 100% of all PMs. Maintenance staff completed 100% of their assigned PMs and Operations staff completed 100% of their PMs.

Operations Light Maintenance % PM Completion



Operations' PM goal is the completion of 100% of all PMs each month; Operations completed 100% in June.

Overtime Spending



Maintenance overtime was \$18k over budget for June and is currently \$175k over budget for FY16. Overtime in June was used for staging for weather events, Nut Island Incident Response and critical maintenance repairs..

2. Critical Equipment Availability

The average equipment availability for FY16 was 99.87 %. 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.

Annual Status Sheets – Fore River Pelletizing Plant

July 2015 – June 2016

Critical Equipment Availability: 94.3%

Operating logs indicate that of the 2,190 machine days in the fiscal year 2016, centrifuges were available for 2,065 days for an availability of 94.3%. 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 the factory reconditioning of two complete rotating assemblies, which reduces capacity while those machines are off site. At the present time, all 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 it is estimated that the outstanding work orders could be completed in less than two weeks.

Maintenance Work Orders:

In FY2016, there were 1,062 work orders generated in the CMMS. Of those 1,056 were completed, equating to a 99.4% completion rate. The new 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 FY2016, including:

- A new VFD and control panel was installed on RTO 2.
- 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 include:
 - Replaced mixer B, screws and liners on Trains 2 and 4
 - Purchased three screws for the silo conveyors and replace units on silo 4 and 5