



MASSACHUSETTS WATER RESOURCES AUTHORITY

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November 4, 2015

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 Mr. Perkins and Mr. Ferris:

Attached please find the MWRA's annual status sheets on plant performance and maintenance for the period covering July 2014 – June 2015. 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,

A handwritten signature in blue ink, appearing to read "Michael J. Hornbrook".

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 2014 -- June 2015

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) rollout; asset replacement prioritization and capital improvements; and training of staff. DITP is continuing to build the program, focusing on Maximo upgrade to

version 7.5, continuing rollout 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 procedures or 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 and 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 started in FY16 and will finish in FY17. Maximo version 5.2 is no longer supported by IBM Maximo. It tracks cost, spare parts, consumables, staff hours and service contract dollars. 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 users, 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 (Legion Ella testing)
Hydro turbine generator maintenance
Hydraulic maintenance
Janitorial services
Lab hood certification
Plant and Public access landscape services
Locksmith services
Lube oil analysis
Oil separator cleaning
Overhead door maintenance
Pest control
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 2014 - June 2015

Annual Report: Deer Island Maintenance page of the MWRA Report on Key Indicators of Performance for FY15. Monthly maintenance data is shown under six headings.

- Preventive Maintenance Work Orders Completed - Maintenance is working to reach the PM goal of 100%. The average PM % completion rate is 99.9% over the past nine years.
- 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 reached their goal of 48% in FY15.
- Predictive Maintenance - Extending the useful life of equipment and allows for better planning for equipment replacements. 6,154 work orders were completed for vibration, acoustic ultrasonic, ultrasonic thickness, and oil analysis in the past year. Deer Island exceeded its FY15 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 17,454 hours for day to day plant maintenance activities which is under 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 4.6%. This doesn't include any wet weather event overtime requiring maintenance staff to be onsite 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 17,454 hours constitutes 5.9 weeks of work for the entire maintenance workforce. This backlog is slightly below 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 17,926 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):

6154 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	3372 hours	25 %
Predictive Maintenance	163 hours	1 %
Corrective Maintenance	8876 hours	64 %
Emergency Maintenance	4 hours	<1 %
Project Work	469 hours	4 %
Other Work	614 hours	5 %
Total	13,494 hours	100.0 %

Total Work Orders:

35,583 work orders initiated this year
32,563 work orders completed/closed

Equipment Replacement:

Major replacements, in the past year, include the following:

- Centrifuges Refurbishment \$78,789
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, one waste sludge centrifuge and gearbox was refurbished.
- Reactor Aerator/Mixer Gearbox Rebuilds \$283,391
The secondary reactor aerators and mixers have large gearboxes that have started to fail. Eight gearboxes were refurbished in FY15 with new gears, seals, and bearings.
- Boiler, STG and Hydro Plant Maintenance \$1,257,483
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. In FY15, additional maintenance was required on the Steam Turbine.

- Cryogenic Facility Repairs \$383,691

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 replacing the honeycomb fills, support brackets and isolation valves for the cooling towers.

- Elevator Controllers Replacements \$71,263

One existing elevator controllers in North Main Pump Station freight elevator was replaced with a new Galaxy controller. The Galaxy controller's variable-frequency closed loop controller with phase 1-2 fire service and code compliant features is a state of the art system. The existing controller was obsolete.

- Uninterrupted Power Supply Replacements - \$235,000

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 North Main Pump Station, Winthrop Terminal Facility and the Maintenance Warehouse Building.

- Grinder Rebuilds \$98,131

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 eight grinders this year and had four rebuild to be used as spare to avoid any operational impact.

- Roller Gates Rebuilds \$282,635

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. Fifteen (15) stop logs were refurbished.

- HVAC Equipment \$194,554

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 \$2,500,000

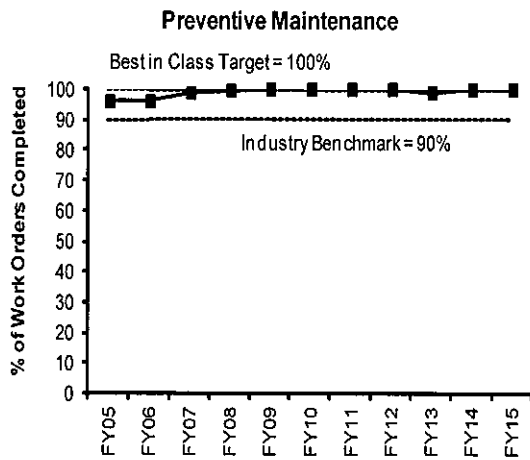
Deer Island has been updating the Variable Frequency Drives and Motors throughout Deer Island to ensure proper operation of the Raw Wastewater Pumps. These VFD's are directly linked to the Primary Operations building via the PICS system. The existing Variable Frequency Drives and Motors were encountering an issue with the rotor bars creating unreliability as well as being obsolete. Six VFD's and motors were installed last year. They were Pump 1, 2, 3, 4, 5, and 8.
- Lighting Energy Saving Project \$128,282

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 upper and lower sections of Digester MOD 3, replacing eight high pressure sodium shoebox fixtures on the pier and retrofitting sixty-nine high mast flood light fixtures on twelve poles with LED fixtures.

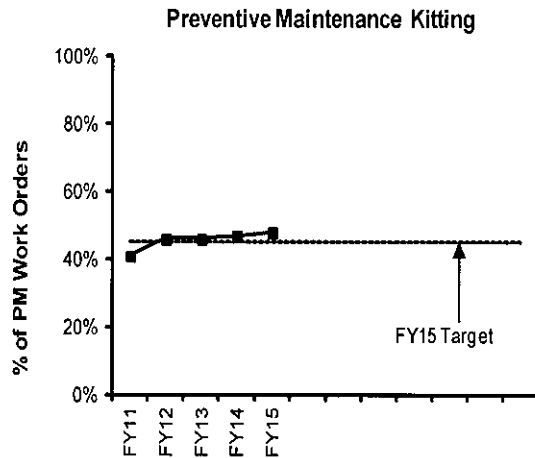
Deer Island Yearly Maintenance Metrics

FY15

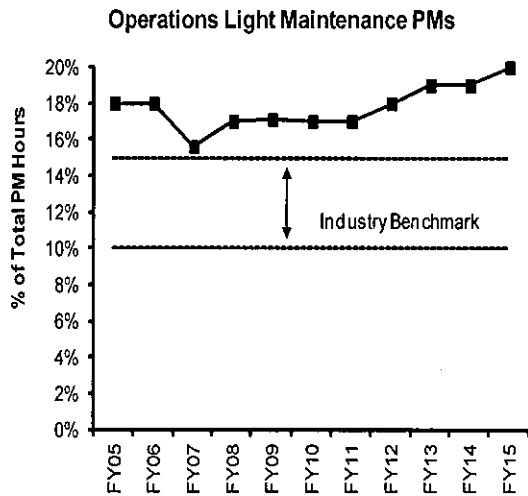
Proactive and Productivity Measures



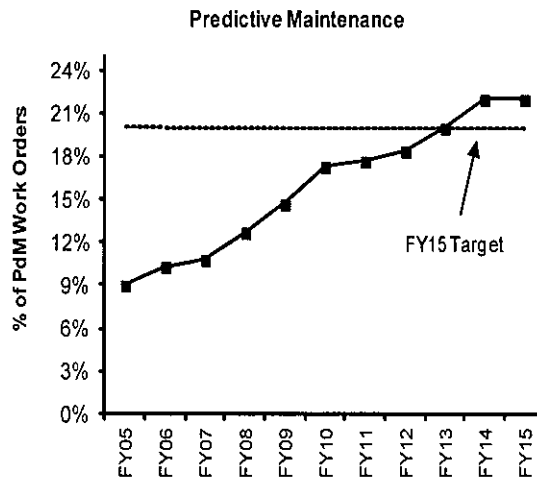
The industry benchmark is 90% for Preventive Maintenance (PM) completion. Upon reaching the 90% goal in FY05, the target goal was increased to the "Best in Class" Target of 100% PM completion. Since then, the percentage of PM work order completion has been at 99% or higher. Reliability-Centered Maintenance (RCM) and PM optimization efforts have continued since FY01. PM completion rate was 99.9% in FY15.



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 FY15 was 48%.



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 20% in FY15. DITP reached the industry benchmark range of 10-15% in April 2003 and has exceeded the goal through FY15. Operations completes approximately 600 PM work orders per month.

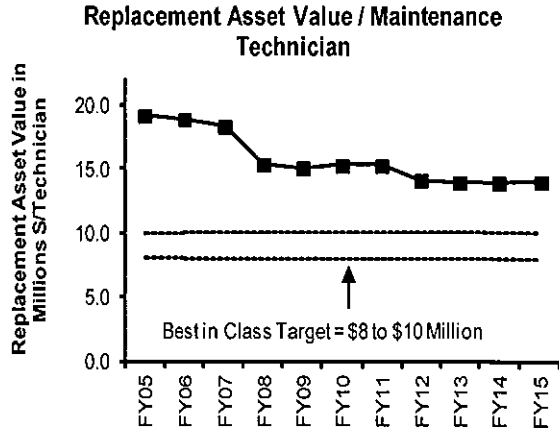
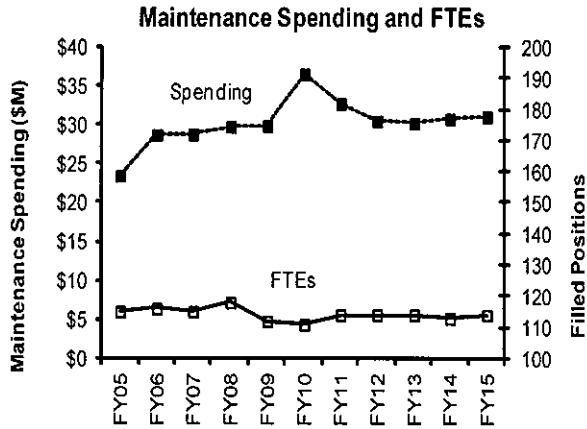


Predictive maintenance has steadily increased from 2% in FY03 to 22% in FY15, surpassing DITP's FY15 goal of 20%. The increase in predictive maintenance was achieved through the expanded use of lubrication, vibration, thermography, and acoustic ultrasonic testing techniques. The Condition Monitoring Group continually reviews and investigates new opportunities and initiatives to expand condition monitoring testing and analysis.

Deer Island Yearly Maintenance Metrics

FY15

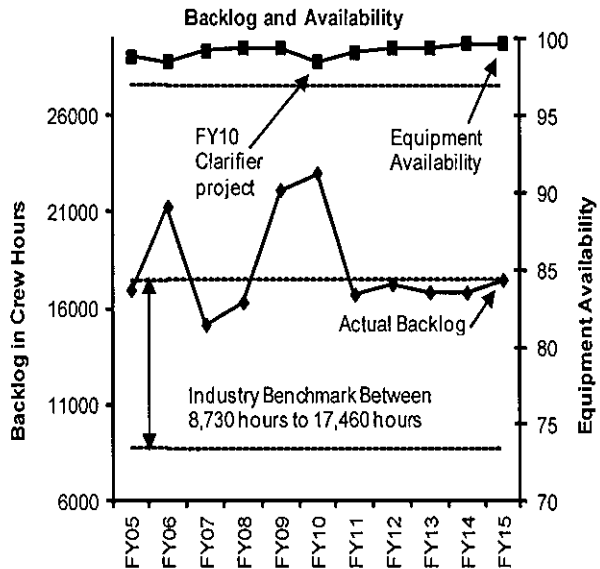
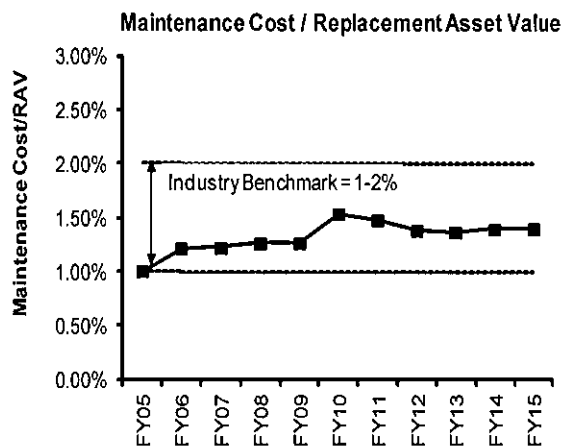
Overall Maintenance Program Measures



DITP's Maintenance staff is currently at 114 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 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 FY15, overall spending increased slightly from FY14. CIP projects during FY15 included: Electrical equipment upgrades, North Main Pump Station VFD replacement, and the Primary/Secondary Scum Tip-Tube replacement project. The large spike in FY10 and FY11 is attributed to the Clarifier Rehabilitation project (\$58M), which was on-going during that period.



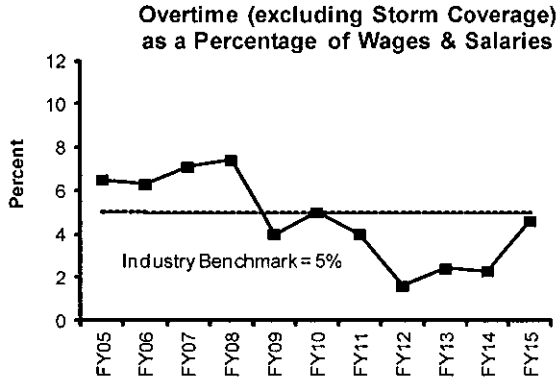
The industry benchmark for annual maintenance spending is between 1% to 2% of replacement asset value. The plant's replacement asset value is calculated at approximately \$2.4 billion dollars. DITP's current maintenance spending is within the industry benchmark. As the plant ages and equipment replacement is required, additional spending is expected to increase. DITP Maintenance CEB spending is \$12.4 million coupled with CIP spending which funded Electrical Equipment upgrades, North Main Pump Station VFD replacement, and Primary/Secondary Scum Tip-Tube replacement projects.

Industry benchmarks for equipment availability is 97% and the maintenance backlog, based on current staffing levels is between 8,730 to 17,460 hours, respectively.

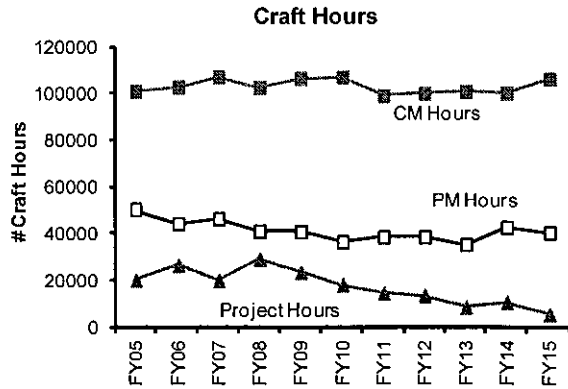
Over the last ten years, equipment availability exceeded this benchmark. In FY15 the availability was 99.7%, the highest availability attained to date.

Total average backlog for FY15 was 17,454 hours, which is at the top of the industry benchmark. The increase in backlog is attributed to additional HVAC equipment replacements and maintenance work delayed due to staff dealing with extreme winter weather. Management continues to prioritize work and closely monitor DITP's backlog.

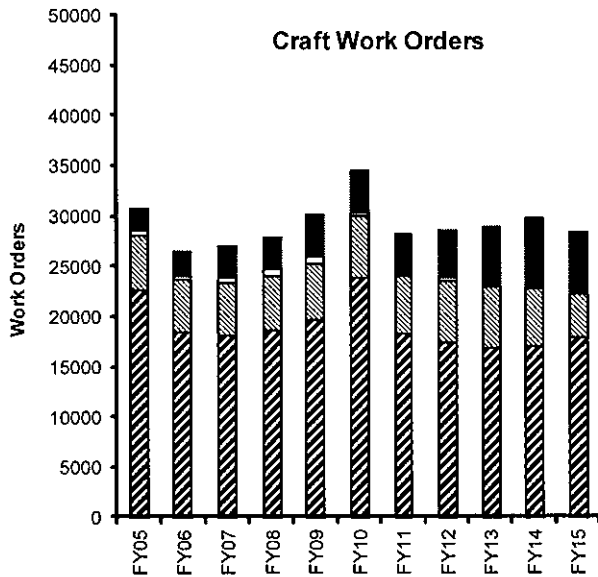
Deer Island Yearly Maintenance Metrics 4th Quarter - FY15 Overall Maintenance Program Measures (cont.)



Management continues its effort to keep overtime within the industry benchmark. DITP maintenance overtime was 4.5% for FY15. Management has taken steps to reduce overtime spending by limiting overtime to repair critical equipment and systems only. DITP has been on or under budget from FY09 through FY15. The increase in overtime over the last year was due to plant shutdowns, HVAC equipment replacements, and added maintenance due to extreme winter weather.



Continued optimization of the Preventive Maintenance (PM) program through the transfer of some light maintenance tasks from Maintenance to Operations staff (20% of PM hours at the end of FY15), elimination of duplicate work orders, increasing PM frequency due to equipment history and performance, completion of PM Optimization efforts, and Reliability-Centered Maintenance (RCM) recommendations resulted in a significant decrease of 4,658 hours in maintenance staff PM hours from FY05 to FY15. Corrective Maintenance (CM) hours increased from last year due to additional HVAC work. Project Maintenance hours decrease due to a number of CIP projects on-going during FY15.



During FY15, the number of work orders decreased by 1,474 from the previous year due to the decrease in Condition Based Maintenance (CBM), Project work orders, and Corrective Maintenance (CM). The Planning department is streamlining work orders while ensuring all work by various trades are captured on one work order ensuring all costs are available for reporting and/or reimbursement if needed.

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

Wastewater Transport System July 2014 - June 2015

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 FY15 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 #4 was unavailable during July 1st to July 3rd for engine silencer replacement, Prison Point engine/pump #2 was unavailable during July 7th to July 18th for engine silencer replacement, Prison Point engine/pump #1 was unavailable during July 25th to August 1st for engine silencer replacement, Prison Point engine/pump #3 was unavailable during August 4th to August 10th for engine silencer replacement, Prison Point engine/pump #1 was unavailable during November 18th to February 6th for storm water pump and right angle drive rehabilitation, Prison Point engine/pump #4 was unavailable during February 17th to March 9th for storm water pump and right angle drive rehabilitation, Prison Point engine/pump #3 was unavailable during March 16th to April 10th for storm water pump and right angle drive rehabilitation, Prison Point engine/pump #2 was unavailable during April 16th to May 11th for storm water pump and right angle drive rehabilitation, Cottage Farm engine #2 July 1st to July 11th for engine rehabilitation and Cottage Farm engine #3 during August 4th to August 14th for engine rehabilitation. 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 critical equipment evaluated includes pumps and screens in the pump stations, CSOs, the screen house, and headwork's. Operational staff track and report the availability of critical equipment on a daily basis and report on a weekly basis. The critical equipment availability for FY15 for FOD facilities was 99.98%. Higher maintenance priority is given to equipment that drops below the number required.

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 FY15, 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 FY15, continued emphasis was placed on improving MWRA's cyber security posture. This included the performance of a "Design Architecture Review" by the Department of Homeland Security in partnership with Idaho National Laboratory of both the FOD SCADA system and Deer Island PICS system. This review was a four day, tabletop exercise in which the DHS/INL team reviewed the design & configuration of the systems in detail. The report generated by this review described some of the strengths of the cyber security posture of the SCADA and PICS systems. The report also presented some security opportunities to be evaluated which would "bolster the MWRA's cyber security posture". These opportunities are being reviewed and acted upon based on risk assessments associated with each opportunity.

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 water and wastewater facilities in Metro East.

- Ward Street and Columbus Park Headwork's Grit Pit Rewiring: Electrical staff removed and replaced all wire, conduit and fixtures in grit pit areas.
- Ward Street Headwork's Channel Dewatering Pit Rewiring: Electrical staff installed all new explosion proof conduit and lighting in dewatering sump pit areas.
- Ward Street, Columbus Park, Chelsea Creek and Nut Island Headwork's Odor Control Scrubber Acid Wash: HVAC staff acid washed all odor control scrubbers' to clean media pipe lines and nozzles. Plumbing staff removed and replaced all polypropylene supply hoses.
- Nut Island Headwork's Chemical Pump Replacement: Plumbing staff changed out two small SPX 10 hose pumps with two new SPX 20 hose pumps to increase efficiency of the odor control system. SCADA, Process Control and Operations staff reprogrammed and tested logic to ensure feed rates controlled pH and ORP levels within required control bands.
- Nut Island Headwork's Roadway Light Fixture Replacement: Electrical staff replaced all roadway light fixtures from sodium vapor lamps to new LED lamps to improve energy conservation.
- Caruso Pump Station VFD Replacement: Electrical staff removed and replaced a VFD which had failed on raw wastewater pump 2-3 with a new Power Flex 700 which was retrofitted to replace an obsolete VFD.
- Caruso Pump Station Screen Belt Replacement: Mechanical staff removed and replaced screen belt #1 due to the belt reaching its useful life.
- Squantum Pump Station VFD Replacement: Electrical staff removed and replaced a VFD which had failed on raw wastewater pump # 3 with a new which was retrofitted to replace an failed and obsolete VFD.
- Framingham Pump Station Generator Radiator Replacement: Plumbing and Welding staff installed a new radiator, and ancillary piping for the facility emergency generator. The new radiator was relocated from the facility rooftop to the ground level next to the generator room. This work was completed to increase efficiency of the generator cooling and also to prevent premature failure of the generator cooling hoses.
- Framingham Pump Station Gas Monitoring Controller: SCADA staff replaced the gas monitoring controller used to receive facility gas measurements and initiate local strobe and horn alarms. This work was performed given the inability to get replacement parts for the obsolete controller.
- Intermediate Pump Station High Voltage Transformer Replacement: Electrical staff removed and replaced the facility high voltage transformer that had exceeded its useful life and was causing intermittent power outages. The work consisted of The Utility Company National Grid isolating their power from the transformer, running the facility

on the one megawatt facility generator, having a portable one megawatt generator on site as back-up power.

- Intermediate Pump Station Screen Belt Replacement: Mechanical staff removed and replaced the screen conveyor belt. 350' of belt, 136 rollers, 272 idler bearings were removed and replaced. The upper level tray was removed, redesigned and installed to eliminate water and grit from cascading toward the back of the belt, discharging instead to a wash-press at the discharge shute of the screen conveyor.
- Intermediate Pump Station Filtrate Line Discharge Relocation: Plumbing and Machinist staff relocated the discharge point for the filtrate line from the Pelletizing Plant. The filtrate discharge line was relocated from the facility influent channel to the grit classifier influent channel. By performing this relocation wear and tear on the three screens and the screen conveyor was reduced, eliminating grit build up on rotating parts caused by polymer introduced at the Pelletizing Plant.
- Prison Point CSO Influent Sample Pump Replacement: Plumbing staff removed and replaced three submersible sample pumps in the influent channel. As part of the pump replacement clear PVC pipe was installed on the pump discharge line to show flow from the pumps. The pumps were replaced with pumps that had a flanged connection on the suction side. The flanged connection allowed for the addition of a suction pipe that has been installed into the influent flow. The samples drawn from the influent channels of the CSO facility will be composite samples allowing for better determination of Sodium Hypochlorite injection into the waste stream for better sampling results.
- Cottage Farm Detention Tank # 6 Wash Down Piping Replacement: Plumbing staff replaced failed piping with 180' of schedule 10 stainless steel pipe. This type of pipe was used due to its durability and light weight. There are 6 detention tanks in the Cottage Farm CSO, 5 more tanks will be completed in FY16. This system is used to spray water into the detention tanks to remove wastewater and reduce odors. The piping was severely corroded, hard to access and had multiple leaks.
- BOS019 Level Sensors: SCADA staff installed new redundant level sensors and transmitters upstream of the facility used in controlling the facility influent gate and dewatering pumps. This existing level measuring devices were producing erroneous measurements.
- BOS 019 Dewatering Pump Replacement: Mechanical staff replaced both raw wastewater dewatering pumps. The pump impellers deteriorated due to excess grit build up within the CSO chambers. (Wastewater Pipeline removed the grit build up with a Vactor truck.) Work Coordination Group has created a Monthly PM for Wastewater Pipeline to clean the chambers.
- South Boston CSO Pump Motor # 2 Repair: The motor for raw wastewater pump #2 failed. Electrical staff with the assistance of an outside vendor analyzed the motor. The problem was a faulty terminal strip in the connecting head of the motor. The terminal strip was repaired under existing warranty.

- **Outsourced Projects**

Squantum Pump Station Pump Rebuild: Pumps 3 & 4 were removed by in-house mechanical staff, delivered to vendor to rebuild pump. When rebuild was completed pump was delivered and installed by in-house mechanical staff.

Squantum Pump Station Pump # 3 VFD Programming: Pump # 3 VFD was removed and replaced by in-house electrical staff. A VFD vendor was out sourced to program the VFD.

Somerville Marginal CSO Flow Meter Replacement: SCADA staff coordinated the service for the replacement of sensors and cable use by an ADS multipath flow meter. The meter is used for pacing chemical and recording facility discharge volumes. This work was performed to improve metering performance and reliability. Further work is expected to replace the ADS flow meter in the coming year.

Prison Point Pump, Gear Box and Engine Upgrade Contract #7452: All four pumps, gear boxes, and associated shafting have been overhauled and/or replaced. This project was implemented to improve the pumping capacity of the facility, improve the reliability of the pumping components and minimize the impact of a potential pump failure.

Intermediate Pump Station Raw Wastewater Pump # 1 Motor Repair: Mechanical and Electrical staff removed, shipped and reinstalled RWW pump # 1 after rebuild by outsourced vendor.

Hayes PS, Hingham PS, Prison Point CSO, and Cottage Farm CSO: New Uninterrupted Power Supply (UPS) systems were purchased and installed by SCADA staff. 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.

FY15 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 FY15 for programs within FOD for related maintenance activities.

FY15 APPROVED MAINTENANCE ANNUAL BUDGET

Budget Line Item	Total Funding
Wages and Salaries	\$14,312,919
Overtime	\$452,000
Maintenance (Parts & Supplies)	6,547,590
Professional Services	\$175,000
Other Materials	\$284,370
Other Services	\$167,000
Total	\$21,938,879

2. Staffing

A total of 109 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 & 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 FY15 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	6
Administration	1
Maintenance Specialists	18
Electrical Specialists	12
Plumber/Pipefitters	8
HVAC Specialists	5
Machinists & Welders	4
	53
Work Coordination Group Program	11
Collection System Technical Inspections Program	9
Wastewater Pipeline Maintenance Group	12
Building & Grounds Program	13
Facility Maintenance Program (Carpenters, Painters, Masons)	11
SCADA Engineers	2
SCADA Maintenance Technicians	8
Subtotal	56
Total	109

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 FY15 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 FY15 operations staff completed an average of 300 hours per month which accounted for 13.8% 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 FY15 was to complete 100% of all preventative maintenance work orders. The average PM completion for FY15 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 FY15 was 59 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 FY15 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 FY15 backlog average was 10,920 hours which remains within the industry standard of 6,130 to 12,260 hours.
- Overtime Spending – Maintenance overtime spending was \$153,785 over budget for FY15. The overtime was used to support call ins for emergency maintenance and planned overtime. It was also used for emergency coverage and maintenance coverage related to weather events, including the heavy snowfall of January and February 2015.

In addition to these monthly performance indicators Field Operation's staff also tracks the following:

2. Critical Equipment Availability

The average equipment availability for FY15 was 99.99 %. 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 2014 – June 2015

Critical Equipment Availability: 93.01%

Operating logs indicate that of the 2,190 machine days in the fiscal year 2015, centrifuges were available for 2,037 days for an availability of 93.01%. 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 FY2015, a transition was made from the MX4 software to the eMaint software. During the transition, open work orders were transferred from the old to the new system. During this process, some work orders were duplicated so the total number of work orders for the year is artificially high. During the FY15, 3,172 work orders were opened (many duplicates) and 3,166 were completed. This equates to a near 100%% completion rate. The new eMaint 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.

Maintenance:

More than \$1.47 million was spent on replacement parts and maintenance related items in FY2015, including:

- A new VFD and control panel was installed on RTO 1.
- All of the elbows on the pneumatic transport system were replaced along with all of the horizontal piping between the plant and the silos.
- Centrifuge repairs – two complete rotating assembly were sent back to the manufacturer and have been overhauled to OEM condition
- Process hot water tanks were replaced with stainless steel tanks and then reinsulated.
- 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 unit on silo 3, others to be done in FY16