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INDEPENDENT STATE AUDITOR'S REPORT ON CERTAIN ACTIVITIES OF MASSACHUSETTS WATER RESOURCES AUTHORITY'S EFFLUENT OUTFALL AMBIENT MONITORING PROGRAM 1988 THROUGH 2009

OFFICIAL AUDIT REPORT
OCTOBER 21, 2010

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The Massachusetts Water Resources Authority (MWRA) was established by Chapter 372 of the Acts of 1984 to assume the duties and responsibilities of the Metropolitan District Commission's Water and Sewer Division. These responsibilities include providing water and sewer services to 61 communities and approximately 2.5 million people in the Commonwealth.

On September 5, 1985, the Federal District Court in Massachusetts ruled that wastewater discharged into the Boston Harbor was in violation of the 1972 Federal Clean Water Act requirements, and the court ordered MWRA to develop and implement a program to provide treatment of its wastewater as required by that law. In accordance with the court-ordered schedule, MWRA undertook a program of improvements to the wastewater collection and treatment facilities serving the metropolitan Boston area. The major components of this multi-billion dollar capital program included new primary and secondary sewage treatment facilities on Deer Island; a new discharge point for treated sewage effluent, located 9.5 miles offshore in Massachusetts Bay; a sludge-to-fertilizer plant; and combined sewer overflow (CSO) control projects. Critical aspects of the operating program include an industrial pretreatment/pollution prevention program designed to remove toxic materials and other contaminants before they enter the sewer system; operator training; a process control and maintenance tracking system; and a water quality monitoring program at the treatment plant, in Boston Harbor, and in Massachusetts Bay.

The new treatment facilities, of which the 9.5-mile outfall tunnel is a part, are governed by both state and federal regulations and are required to comply with the Federal Clean Water Act and the State Clean Water Act. Discharge from the outfall is regulated by the conditions of a government discharge permit. The Deer Island National Pollutant Discharge Elimination System (NPDES) permit sets stringent limits on the type and amount of pollutants in the system's wastewater discharges and requires extensive monitoring requirements of the effluent discharge and the ambient (surrounding) receiving waters.

The Ambient Monitoring Plan for the MWRA Effluent Outfall was incorporated into the August 2000 NPDES permit and is the subject of this report. The Ambient Monitoring Plan was designed to address the environmental concerns for impacts that might reasonably be expected to be caused by effluent discharges. MWRA reports that the cost to administer the monitoring program has exceeded $70 million since its inception in 1988. The objective of this audit was to review the status of MWRA's effluent outfall monitoring efforts.

MWRA believes that its efforts to monitor water quality related to the effluent outfall have documented consistent performance results that justify a scale-back in program scope and cost. Accordingly, MWRA has submitted several proposals to governmental agencies and other interested parties for a revised ambient monitoring plan. Although progress has been made in achieving modifications to the existing plan, a few issues must be resolved before the Environmental Protection Agency (EPA) can give the proposed modification to the ambient monitoring plan final approval. MWRA should continue to encourage the parties to complete their reviews as expeditiously as possible, while fully addressing all environmental and safety concerns and potential cost benefits.

INTRODUCTION

Background

The Massachusetts Water Resources Authority (MWRA) was established by Chapter 372 of the Acts of 1984 to assume the duties and responsibilities of the Metropolitan District Commission's (MDC) Water and Sewer Division. These responsibilities include providing water and sewer services to 61 communities and approximately 2.5 million people in the Commonwealth.

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The Ambient Monitoring Plan for the MWRA effluent outfall was incorporated into the August 2000 NPDES permit and is the subject of this report. The Ambient Monitoring Plan was designed

to address the environmental concerns for impacts that might reasonably be expected to be caused by effluent discharges. The monitoring plan was designed to address four basic questions:

- Is it safe to eat fish and shellfish?
- Are natural/living resources protected?
- Is it safe to swim?
- Are aesthetics being maintained?

MWRA reports that the cost to administer the monitoring program has exceeded $70 million since its inception in 1988.

Legal and political issues have long been a part of Boston Harbor's history. The environmental conditions in the 1980s were highlighted in a legal suit filed in December 1982 by the city of Quincy against the MDC (the state agency then responsible for sewage treatment) and three other state agencies for discharging untreated or poorly treated sewage into the harbor.

Two subsequent actions were filed in Federal District Court in June 1983 and January 1985. The first action was brought by the Conservation Law Foundation against the MDC and the United States Environmental Protection Agency (EPA) for violations of the Clean Water Act. The second action was filed by the United States against the MDC, MWRA, the Commonwealth of Massachusetts, and the Boston Water and Sewer Commission seeking to mandate the clean-up of the Boston Harbor by court order.

In May 1985, the Federal District Court consolidated the two federal actions into one, taking jurisdiction over alleged Clean Water violations out of the state's jurisdiction. In July 1985, MWRA assumed the water and sewer responsibilities of the MDC, and in September 1985, MWRA was named as successor to the MDC.

In December 1985, the federal judge issued the initial schedule for MWRA's clean-up of Boston Harbor. The schedule required that MWRA submit a construction plan and schedule for a new sewage treatment system. This schedule included treatment system upgrades that would give the "citizens of the commonwealth a public assurance that Boston Harbor will be cleaned up within a defined period of time."

In 1986 MWRA embarked upon what has become known as the Boston Harbor Project to alleviate, without causing harm to the environment of Massachusetts and Cape Cod bays, the long-standing pollution associated with the discharge of inadequately treated sewage sludge and effluent into the shallow waters of Boston Harbor. Although the Clean Water Act of 1972 mandated secondary treatment of sewage, Boston Harbor continued to receive direct discharges of metropolitan Boston sewage sludge, primary-treated effluent, and raw sewage combined with storm water run-off from outfalls located at Deer Island in the northern part of the harbor and discharges from Nut Island in Quincy Bay, in the southern part of the harbor. By the early 1980s, bottom-dwelling animal communities had disappeared from many locations in the harbor, beaches were frequently closed to swimming, and fish were diseased.

One aspect of the Boston Harbor Project that created substantial controversy was the relocation of the sewage outfall from the mouth of Boston Harbor to a site in Massachusetts Bay 9.5 miles from the Deer Island Wastewater Treatment Plant in water at a depth of approximately 100 feet. Specifically, there was concern that the new outfall might adversely impact Massachusetts Bay and result into another Boston Harbor situation. According to MWRA, these concerns were recognized by the Authority and by the permit for the outfall issued jointly by EPA and the Massachusetts Department of Environmental Protection (DEP). This permit continues to be in effect in accordance with EPA's Administrative Continuation Policy, although it formally expired on August 9, 2005. The next NPDES permit is expected to be issued in draft by EPA and DEP.

When the regulatory agencies approved the plan to move the wastewater discharge from Boston Harbor into the deeper waters of Massachusetts Bay, they also required that MWRA monitor the effects of the new outfall. EPA and the Massachusetts Executive Office of Environmental Affairs (EOEA), in order to identify the potential outfall environmental concerns, created an Outfall Monitoring Task Force (OMTF), an advisory group of scientists, regulators, and environmental advocacy groups. Using the concerns identified in the National Research Council's (NRC)[1] model to guide the design and evaluation of marine monitoring programs (e.g., whether it would be safe to swim, safe to eat the fish, and whether there would be aesthetic problems or degradation of the

[1] The mission of the NRC, which was established in 1863 and is a part of the National Academy of Science, is to improve government decision making and public policy, increase public education and understanding, and promote the acquisition and dissemination of knowledge in matters involving science, engineering, technology, and health.

ecosystem), OMTF translated these concerns into monitoring questions that guided the design of the comprehensive monitoring program used at MWRA.

The rerouting of outfall discharges into Massachusetts Bay was planned for 1995 but was delayed until September 2000. This delay allowed collection of about nine years of baseline data, from February 1992 to August 2000.

According to MWRA, the Deer Island NPDES permit resulted from years of complex negotiations among MWRA and state and federal regulatory agencies, with active participation by public interest groups. The permit sets stringent limits on the type and amount of pollutants in the system's wastewater discharges and requires extensive monitoring requirements for the effluent and the ambient receiving waters. A Contingency Plan that is overseen by an independent Outfall Monitoring Science Advisory Panel (OMSAP), which replaced the OMTF, covers many of the monitoring requirements. The Contingency Plan prescribes actions to be taken by OMSAP, regulators, and MWRA in the event of certain unexpected or unfavorable monitoring results.

In addition to discharge limits, monitoring requirements, and the Contingency Plan, the permit also includes provisions for an industrial pretreatment program, pollution prevention requirements, best management practices, protections for endangered species and shellfish resources, CSO controls, and documentation and reporting requirements involving MWRA's wastewater system operations.

MWRA under its permit was originally required to conduct scientific studies in support of environmental monitoring of effluent, water, sediment, fish, and shellfish which were carried out by professional services contracts at an annual cost of $4 million. Starting in mid 2002, MWRA staff worked to reduce monitoring costs by using data collected to support the design of a more efficient monitoring program. Reductions were reviewed by OMSAP and approved by state and federal regulatory agencies. There is a provision within the permit for MWRA to propose changes to the monitoring, which become effective after public notification and regulatory approval. To date, MWRA reports that the cost to monitor the effects of the outfall tunnel discharge has totaled approximately $70 million.

Audit Scope, Objectives, and Methodology

The objective of this audit was to review the status of MWRA's effluent outfall monitoring efforts. We met with MWRA senior management and Environmental Quality Department officials and reviewed the operating permit, reporting requirements, and report results submitted to various regulatory agencies since the inception of the program in 1988.

We discussed MWRA's proposed changes to the ambient monitoring plan with representatives of EPA, DEP, the Massachusetts Office of Coastal Zone Management (CZM), and Save the Harbor/Save the Bay and received mainly positive responses to MWRA's efforts to reduce Ambient Monitoring Plan requirements under its current and future NPDES permit. We requested comments from the National Marine Fisheries Service (NMFS) with respect to their concerns, but have not received any as of the date of this report.

Our audit was conducted in accordance with applicable generally accepted government auditing standards and included such audit tests and procedures as we considered necessary under the circumstances. At the conclusion of our review, we provided MWRA with a draft report for comment, and considered its responses in the preparation of this final report.

AUDIT RESULTS

EFFLUENT OUTFALL WATER QUALITY MONITORING EFFORTS COULD LEAD TO A SCALE-BACK IN PROGRAM MONITORING SCOPE AND COST

The Massachusetts Water Resources Authority (MWRA) believes that its efforts to monitor water quality effluent outfall have documented consistent performance results that justify a scale-back in program scope and cost. Accordingly, MWRA has submitted several proposals to governmental agencies and other interested parties for a revised ambient monitoring plan. Although progress has been made in achieving modifications to the existing plan, a few issues must be resolved before the Environmental Protection Agency (EPA) can issue a new permit for MWRA's revised Ambient Monitoring Plan. MWRA should continue to encourage the parties to complete their reviews as expeditiously as possible, while fully addressing all environmental and safety concerns and potential cost benefits.

Existing Monitoring Program

Regular monitoring of the water quality environment around the Deer Island Treatment Plant's outfall is a requirement in MWRA's National Pollutant Discharge Elimination System (NPDES) permit issued by EPA and the Department of Environmental Protection (DEP). Key monitoring results are compared to 96 thresholds contained in MWRA's Contingency Plan (a component of the permit). The current permit requires MWRA to prepare and submit an annual report on the results of its monitoring efforts. In addition to the required monitoring of the Deer Island Treatment Plant's effluent quality for such things as bacteria, toxics, solids, nutrients, etc., MWRA conducts an ambient monitoring program in Massachusetts Bay that focuses on the health of fish and shellfish, sediments, and water columns. Other studies include water quality modeling, continuous monitoring of chlorophyll using moored instrumentation, and in-house studies of Boston Harbor and rivers affected by combined sewer overflows (CSOs).

MWRA has been monitoring Boston Harbor and the outfall area since 1992, gathering data to measure whether the outfall, which came on line in the fall of 2000, has had adverse environmental impacts. The current data are compared to the results collected before the outfall went on line (baseline). During the first three years of outfall discharge monitoring, the environmental changes detected were small and within the predictions of the Environmental Impact Statement for the outfall. Using these data (2000 to 2003), MWRA and its consultant

team worked with the Outfall Monitoring Science Advisory Panel (OMSAP) and regulatory agencies to redesign the monitoring program to refine and reduce the amount of monitoring required. Most of the reductions in the monitoring program were first implemented in 2004. These reductions saved MWRA approximately $900,000 annually.

MWRA submits a number of reports on an ongoing basis to federal, state, and local regulatory agencies and environmental groups. The yearly Outfall Monitoring Overview reports that discussed annual findings/violations have detected only a few insignificant deviations over the years. MWRA reported that, as in previous years, its calendar year 2008 monitoring efforts found that Deer Island effluent has had no adverse impacts on the ecology (e.g., plankton, flounder, water quality, bottom-dwelling animal communities) of the Massachusetts Bay, Cape Cod Bay, or the Stellwagen Bank National Marine Sanctuary. MWRA stated that approximately nine years of baseline monitoring and eight years of discharge monitoring have yielded an enormous amount of data that answered the questions related to potential outfall impacts that were posed when the program began. According to MWRA:

- The water column bottom-dissolved oxygen remains at healthy, normal levels; plankton communities remain diverse and normal; and naturally-occurring nuisance algal bloom events have not been aggravated by the discharge;
- Flounder liver disease remains low;
- The bottom-dwelling animal community is healthy and diverse; and
- Stellwagen Bank National Marine Sanctuary waters and sediments are unchanged.

Water Column

Monitoring in the water column focuses on the potential impact of nutrients discharged by the outfall. The monitoring was designed to address concerns about whether the nutrients could increase blooms of harmful algal species or change the types or amount of plankton, or whether excess algal growth could decrease the amount of oxygen in the water.

In 2008, plankton communities in the bays were normal and dissolved oxygen levels in the water were healthy. The major significant observations in 2008 were a large regional bloom of the alga

Phaeocystis[2] in the spring, and a large red tide event that originates off coastal Maine. Phaeocystis has been blooming throughout the Gulf of Maine in early spring in recent years, apparently linked to climatic factors. Boston Harbor was affected by red tide in 2008, but there was no evidence that the outfall had an adverse effect on the red tide event.

Sea Floor

Sea floor habitat (the benthos) is a major component of a healthy marine ecosystem and is of particular interest in studies of pollutant effects because contaminants ultimately end up on the sea bottom. MWRA's sea floor monitoring assesses animal communities, sediment contaminants, and metabolism of nutrients and oxygen. MWRA measures a number of chemical contaminants in the sediments every third year, including metals, polychlorinated biphenyls (PCBs), and synthetic pesticides such as dichlorodiphenyltrichloroethane (DDT). In 2008, levels of PCBs and DDT were significantly lower than the baseline means, likely reflecting a decline following their banning in the 1970s and 1980s. All other contaminants were well below the thresholds.

Studies of the animal communities living in mud found healthy, diverse groups of animals (e.g., worms, mollusks, crustaceans) normal to New England. Long-term, the abundance and diversity of animals near the outfall and at reference sites appear to follow a cyclical pattern that is likely to be driven by large-scale climatic factors and ecological interactions within the benthos.

Winter Flounder

Because flounder live in close contact with the bottom sediments, the health of winter flounder is thought to indicate the health of the bottom environment. Every year 50 winter flounder are taken from each of four locations: Boston Harbor at Deer Island Flats, Eastern Cape Cod Bay, Nantasket Beach, and at the outfall in Massachusetts Bay. The fish are examined for overall health and for liver disease. Liver disease continued to be low at all sites, including at the outfall site, and has decreased in Boston Harbor from the high levels seen in the 1980s.

[2] *Phaeocystis pouchetii* alga is not toxic, but it grows in very high abundances; individual cells can aggregate in gelatinous colonies that may be aesthetically displeasing.

Marine Mammal Observations

A certified marine mammal observer is required to be on board the outfall monitoring survey vessel. In 2008, 44 whales were sighted; the most seen since 2006. The Provincetown Center for Coastal Studies reported that in 2007 and 2008, twice the number of right whales visited the bays compared to 1998 to 2006.

Nutrient Flux

Scientists from the Marine Biological Laboratory in Woods Hole study sediment respiration and movement of nutrients in and out of the sediments in Boston Harbor and in Massachusetts Bay. No changes have been observed in Massachusetts Bay. In 2008, there was an increase in oxygen demand at some Boston Harbor locations due to increased colonization by amphipods (tiny shrimp-like crustaceans). However, this is not considered a decrease in environmental quality.

Proposed Reduced Monitoring Efforts

MWRA has reported that the environmental and treatment plant measures are all within the 96 thresholds identified in the NPDES permit except for red tide, which originates in the Gulf of Maine and is not attributed to the outfall discharges. According to MWRA, the monitoring performed during the past nine years has shown that the outfall discharges have not had an adverse impact on the bay environment and that harbor water, sediment quality, and fish health have greatly improved. Based on these results, MWRA has requested the regulatory agencies to reduce the monitoring efforts in the current and new NPDES permit, which is expected to be issued in draft by EPA and DEP for public comment during the summer/fall of 2010. According to MWRA, its proposed modifications to the current ambient monitoring plan will use fewer sample stations and surveys, and result in a better-integrated monitoring effort. MWRA has indicated that the complexity of the existing design, with the nearfield stations measured more frequently than the reference stations and different parameters measured at different locations, makes data interpretation difficult. MWRA believes that the proposed design will improve the ability to differentiate potential outfall-related events from region-wide events. Also, some data currently gathered by ship would be replaced by data from buoys.

OMSAP meetings were held in June, August, and October of 2009 to provide independent, expert technical review of the proposed changes. During this review process, MWRA revised its proposal based on comments received from EPA, the Massachusetts Office of Coastal Zone

Management (CZM), Stellwagen Bank National Marine Sanctuary, and the public. OMSAP has recommended that EPA approve MWRA's revised proposed changes. If approved, the changes could save MWRA up to $800,000 in monitoring costs annually in the future. We discussed MWRA's proposed changes to the ambient monitoring plan with the EPA, DEP, CZM, and Save the Harbor/Save the Bay and received mainly positive responses to MWRA's efforts to reduce Ambient Monitoring Plan requirements under its current and future NPDES permit. We requested comments from the National Marine Fisheries Service (NMFS) with respect to their concerns, but have not received any as of the date of this report. However, EPA has informed MWRA that the NMFS Division of Protected Resources (endangered species) has asked EPA to review the results of the monitoring recommendations from the Biological Assessment and Biological Opinion[3] studies issued in 1993. After that, EPA and NMFS will decide on what level of review is necessary for the endangered species issue.

Conclusion

MWRA believes that the scientific data, which have been reviewed by EPA's independent Outfall Monitoring Science Advisory Panel, support its proposed changes to the Ambient Monitoring Plan because all the original monitoring questions have been answered and the discharge is not causing adverse impacts to the marine environment. Also, the ecosystem of Boston Harbor has rebounded. According to MWRA, the proposed changes to the monitoring plan will be less expensive, provide a more integrated view of conditions in Massachusetts Bay and Cape Cod Bay, and enable a more straightforward interpretation of the data than is now possible. Moreover, MWRA has indicated that the proposed monitoring program eliminates unnecessary redundancy, increases the sampling in farfield areas, and will also end certain specialized studies that have answered their questions.

[3] Biological Assessment is a study for the purpose of identifying any endangered species or threatened species which is likely to be affected by an action (such as permitting the Deer Island Outfall). Regarding Biological Opinion, federal agencies such as EPA are required, in consultation with and with the assistance of NMFS, to "ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of designated critical habitat." Biological Opinions document NMFS's opinion as to whether a federal action is likely to jeopardize the continued existence of an Endangered Species Act (ESA)-listed species, or result in the destruction or adverse modification of species' critical habitat.

Recommendation

MWRA should continue to encourage the concerned parties to complete their evaluations as expeditiously as possible, while fully addressing all environmental and safety concerns and potential cost benefits.

Auditee's Response

MWRA's Executive Director provided us with the following response after reviewing a draft of this report:

> *The report accurately reflects the ambient monitoring activities related to the National Pollutant Discharge Elimination System permit for the discharge from the Deer Island treatment plant and MWRA's efforts to improve efficiency and save costs over time. In addition to changing the scope or the monitoring program, MWRA has saved costs by bringing many of the activities formerly carried out by consultant contract in-house. These activities include laboratory chemical analysis of environmental samples, data management, and data analysis.*