

Boston Harbor Cleanup: Use or Abuse of Regulatory Authority?

Does the current regulatory climate ensure that the plan proposed to clean the harbor represents the best solution environmental technology can offer?

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Boston Harbor is frequently described as the "dirtiest" in the country. During the presidential campaign the harbor was the subject of heated debate on whether its condition and the delay in cleaning it up was the fault of federal or state and local government. Regardless of who is at fault, a set of plans and priorities for the cleanup of Boston Harbor is finally in place. The present court-ordered schedule calls for the construction of a new primary treatment plant, interim sludge disposal facilities and a nine-mile ocean outfall by 1995. Additional treatment in a secondary stage, as well as facilities for the land disposal

of all sludge, is required by 1999. The estimated cost of all of these new facilities is \$6.1 billion. The bulk of these costs will be footed by the users of the system. In this way, Boston area residents will pay the highest water and sewer rates in the nation largely because the federal Environmental Protection Agency's (EPA) construction grant program, which previously would have paid 75 percent or more of the cost, has now been phased out of the federal budget.

Do the present court-ordered facilities and the schedule for the cleanup represent an environmentally sound solution for Boston Harbor? The answer is no. To understand the reasons why the current plan does not deliver its intended consequences, it is necessary to go back to the passage of the federal Clean Water Act of 1972, and beyond that to the evolution of the harbor pollution problem and plans by other governmental agencies to remedy it.

Clean Water Act of 1972

The Clean Water Act of 1972 required that all publicly-owned treatment plants, without regard to the nature or location of the water into which they discharge, achieve secondary treat-

ment by 1977. The EPA defined such treatment in terms of the amount by which two quantities — biochemical oxygen demand (BOD) and suspended solids — are reduced in the treatment plant effluent. BOD is of concern because it tends to reduce dissolved oxygen levels in the receiving water. The severity of the depletion depends on a replenishment process, known as reaeration, in which oxygen is transferred from the air through the water surface. If the treatment plant effluent is discharged to a fresh water stream, the dissolved oxygen may drop to a level that is harmful to aquatic life because reaeration is limited by small water surface areas. In such cases, high levels of BOD removal are desirable. In the ocean, water surface areas are large and oxygen is replenished readily; hence BOD removal is less critical. Suspended solids are of concern because their removal in the treatment process improves the clarity and reduces the formation of bottom deposits in the receiving water. In addition, hazardous and toxic substances tend to be adsorbed onto suspended solids.

A primary plant, which is the first stage of any treatment system, removes about 40 percent of the incoming BOD and 60 percent of the suspended solids in a series of sedimentation tanks. The secondary treatment stage is a biological process that provides additional treatment to the effluent of the primary plant. The result is that the overall removals of both BOD and the suspended solids are increased to about 85 percent. The additional removal of BOD in the secondary stage is accomplished by adding oxygen to the treatment tanks in order to speed the growth of bacteria that feed on, and thereby oxidize, dissolved organic oxygen-demanding material in the wastewater. The bacteria, which continually grow and die, and other suspended solids settle out in the secondary sedimentation tanks.

The sediment residue from the primary and secondary treatment stages is called sludge. The sludge contains everything that has been removed from the raw wastewater, as well as new biomass generated in secondary treatment. Consequently, the amount of sludge produced by the combined primary-secondary stages is about twice as much as is produced by the primary stage alone (p. 2-2).¹ Current

regulations prohibit the ocean disposal of sludge.

Soon after the 1972 act was passed, many municipalities argued to Congress and the EPA that secondary treatment was not universally necessary for the protection of the coastal marine environment. They contended that large reductions in BOD, while important for inland freshwater streams and lakes, were of little benefit to the coastal ocean where treatment plant effluents are mixed and dispersed by tidal currents and aerated by large water surface areas. They also pointed out that long outfall pipes could terminate in coastal areas at a significant depth in the water and that these areas exhibited substantial tidal flushing action. Furthermore, multi-port diffusers, thousands of meters in length, could be attached to the outfalls in order to reduce the concentration of treated effluents by more than a hundredfold through the process of jet mixing. A number of communities in the Los Angeles area that have been discharging primary effluent through ocean outfalls had accumulated evidence that demonstrated the scientific merit of their claims for exemption from the secondary treatment requirement. Congress was persuaded and in the Clean Water Act of 1977 (in particular, in Section 301(h)) directed the EPA to allow municipal marine dischargers to test their case in the administrative process.

Boston Harbor Pollution Background

Boston began discharging untreated waste into the harbor more than a hundred years ago. It was not until 1968 that all dry weather sewage began receiving primary treatment at Nut and Deer Islands. However, that treatment has been essentially negated by the fact that the primary effluent and the sludge is discharged, after some digestion and chlorination, through short pipes near the entrance to the harbor. Although the ill effects of this practice were sought to be ameliorated by discharging the sludge mainly during the outgoing tide in order to disperse it more adequately, much of Boston's present problem is due to this long-banned but continuing practice.

The first serious water quality study of Boston Harbor was completed in the late 1960s.^{2,3}

The findings of this study were that the primary treatment was satisfactory, but the disposal of sludge to the harbor should be stopped and that the major problem for the harbor was the combined sewer overflows (CSOs). These overflows derive from about 90 sources on the perimeter of the harbor and result from the collection of storm water and sewage in the same pipes throughout much of the older inner city area. Raw sewage is discharged from these sources during wet weather when the treatment plant capacity is exceeded. These discharges of raw sewage occur about 60 times a year. It is generally agreed that the combined sewer overflows are responsible for the frequent closing of the shellfishing and bathing areas within the harbor.

The only positive thing to be said about the water quality situation in Boston Harbor is that the depletion of dissolved oxygen has never been a problem, except near the shoreline. Therefore, it was natural that the Metropolitan District Commission (MDC), the state agency responsible for managing the treatment of wastewater in the Boston area, should apply for a waiver of the secondary treatment requirement so that it could focus clean-up efforts on stopping sludge discharges and the combined sewer overflows.

The Waiver Process

In response to the 1977 Congressional directive, the EPA published preliminary criteria and procedures in the spring of 1978 and final guidelines in the summer of 1979 by which municipalities could apply for waivers of the secondary treatment requirement for discharges into coastal waters.⁴ The EPA guidelines stated that applicants "will bear a particularly heavy burden in demonstrating to the EPA that such (less-than-secondary) treatment is sufficient to protect marine waters."¹ Despite the strong language against the waiver process, many communities applied. Boston's application was one of 70 filed prior to the 1980 deadline. Subsequently, the deadline was extended to the end of 1982 and 137 additional applications were filed. In addition, the EPA refused to allow applicants to compare the environmental impacts of less-than-secondary and secondary effluents through the same outfall, thus con-

tradicting an accepted principle of environmental impact analysis. That incremental benefits of secondary treatment might be negligible, or might be unjustifiably costly, was of no apparent interest to the EPA as reflected in the guidelines.

Boston's Waiver Plan

In 1975, well before the federal waiver amendment, the MDC had concluded that the benefits of secondary treatment were minimal and proposed a three-part plan:^{5,6}

- an ocean outfall seven miles offshore of Deer Island for the discharge of primary treatment effluent;
- the cessation of ocean sludge discharge; and
- combined sewer overflow controls.

In 1976, while in the process of setting priorities, the MDC determined that providing secondary treatment ranked 42nd in a list of 52 projects the agency was considering that would be required to improve Boston Harbor.⁷

These earlier studies became the basis for the waiver application to the EPA in the fall of 1979. The MDC proposed upgrading the existing primary treatment plants, which were severely deteriorated, and constructing a combined ocean outfall and multi-port diffuser that would have a total length of nine miles and that would terminate in water more than 100 feet in depth. Boston was required to demonstrate that their waiver plan would meet state water quality standards for marine waters. The major standard was that dissolved oxygen not fall below 6 parts per million (ppm), which is approximately 80 percent of its saturation value under summer temperature conditions.

The estimated cost of these proposed facilities, including sludge disposal on land, was \$480 million in 1979. The cost of the nine-mile ocean outfall and diffuser accounted for approximately half of the total costs for the project. At that time, the EPA was funding 75 percent of the capital costs for clean-up projects. The MDC settled back to await the EPA's verdict, having no inkling that a decision on the waiver would drag on for the next five-and-one-half years.

The EPA's Response

The EPA, overwhelmed by a mountain of waiver applications, hired a consulting firm to assist in the review process. In middle of 1981, the EPA requested additional information from the MDC. Among the data they requested was a sensitivity analysis of the water quality model, additional sampling, and assessments of sediment deposition and resuspension. The MDC responded in the fall of 1982 with new monitoring data and the analyses requested.

In the summer of 1983, the EPA issued a tentative denial of Boston's waiver application. The denial focused on potential violations of the state dissolved oxygen standard and excessive solids deposition. However, the EPA left the door open by stipulating that the MDC could submit a revised application by July 1984. There was a significant amount of interaction between the two agencies on the nature of new information to be submitted. The revised application was submitted and six months later the EPA's consultant issued its technical review.

One point of contention between the MDC and the EPA's consultant was the proper value of the background or ambient dissolved oxygen in the vicinity of the nine-mile outfall. The MDC asserted 7.4 ppm was reasonable for late summer conditions when dissolved oxygen was observed to be at its minimum (p. 151).⁸ The consultant recommended a more stringent value of 6.5 ppm, recalculated the dissolved oxygen impacts in four separate analyses that had been previously performed by the MDC and concluded that "the Massachusetts dissolved oxygen standard will be met" (p. 158).⁸ The MDC assumed that the major issue had been resolved and awaited its waiver. Its optimism was short-lived. In March 1985, the EPA regional administrator issued a "tentative decision" that the revised waiver application be denied.⁹

The EPA's denial was based on seven findings. Six of these findings were non-quantitative or procedural in nature and consisted of items such as deficiencies in the monitoring program to assess future impacts and future source control programs to reduce toxics. The single quantitative finding reversed the conclusion of the EPA's consultant in one of the

four impact analyses carried out to check the state's 6.0 ppm dissolved oxygen standard (p. 4).⁹ This analysis involved the calculation of a dissolved oxygen change due to the resuspension in a storm event of organic particles deposited on the bottom after 90 days of uninterrupted deposition. The EPA calculated a dissolved oxygen concentration of 5.5 ppm (a violation of 0.5 ppm) by means of two "adjustments." The first involved an arbitrary one-third increase in the rate of organic sediment accumulation in the vicinity of the outfall diffuser. The second and more serious adjustment reduced the ambient dissolved oxygen concentration for the resuspension event from 6.5 to 6.1 ppm (p. 17),⁹ a value only 0.1 ppm above the standard, which even the effluent from a secondary treatment plant would have violated. The EPA made no effort to defend these adjustments in this critical instance, yet the agency proceeded to rest its case for secondary treatment on them. There were grounds for challenging the EPA's tentative denial, but other events had by this time removed the MDC as the responsible state agency.

New Agency, New Plans

Early in 1983, the city of Quincy, on the southern portion of Boston Harbor, sued the MDC for polluting its beaches. The case was heard by State Supreme Court Judge Paul Garrity who appointed Professor Charles Haar of the Harvard Law School as special master. Haar's report adopted by the court in the fall of 1983 included:¹⁰

- a strict time-table for stipulated remediation measures which, incidentally, did not include secondary treatment; and
- recommended the creation of a new state agency with the power to issue bonds outside the control of the state legislature.

After a year of the MDC's failure to meet Haar's schedule, Judge Garrity threatened to stop sewer connections for new buildings in Boston. In the last hours of 1984, the legislature created the Massachusetts Water Resources Authority (MWRA) and gave it bonding authority. In January 1985, the EPA sued the MWRA in Federal District Court for polluting

the harbor. Under threat of a huge retroactive fine, the MWRA has been operating under a 1986 federal court-ordered planning and construction schedule that was designed to carry out the EPA's insistence on full secondary treatment by 1999. The MWRA made the judgement that any attempt to reopen the waiver issue was doomed to failure.

Determining the Best Course of Action

It is easy to look back over the past ten years and to say what should have been done to clean up Boston Harbor. The existing primary treatment plants are beyond rehabilitation and, in fact, never performed satisfactorily. Design and construction of new state-of-the-art primary plants and land-based facilities for the disposal of the primary sludge should have begun in 1979. No one ever questioned the need or priorities for these facilities regardless of the waiver decision. Work would have begun in 1979 but for the fact that the EPA would not approve an application for a federal grant while a ruling on the waiver application was pending.

In retrospect, the most serious flaw in the waiver process was the EPA's refusal to consider a comparison of the environmental impacts of primary treatment effluents and secondary treatment effluents through the same outfall. As a result, the incremental environmental benefits of secondary treatment for the harbor were never balanced against the negative environmental impacts of disposing of twice as much sludge on land or by incineration in the air. Through a fortuitous set of circumstances in the spring of 1988, the data necessary for such a comparison became available.

In March 1988, the MWRA published a comprehensive primary and secondary treatment facilities plan.¹¹ A few weeks later the EPA issued a draft Environmental Impact Statement (EIS) for Boston Harbor based on this plan.¹² The astonishing thing about the 1988 facilities plan is that the length of the outfall and diffuser, about nine miles, is the same as in the 1979 waiver plan. So it is now planned to discharge secondary effluent at essentially the same location as was originally suggested for the

primary effluent. If constructed, it would be the longest outfall and diffuser ever designed specifically for secondary treatment effluent.

According to the court-ordered schedule, the new primary plant and the outfall and diffuser are to be completed by 1995 and the secondary treatment stage by 1999. Because of the five-year construction lag, the MWRA and the EPA were required to predict water quality conditions for primary as well as primary plus secondary effluents. Separate consulting firms were employed to carry out the technical analyses for the two agencies.

The MWRA facilities report provides a detailed analysis of all state and federal water quality criteria for conventional as well as hazardous wastes.¹¹ The MWRA concluded that all of the standards, including dissolved oxygen, would be met by the primary effluent and that, in general, "secondary treatment discharge impacts are not expected to be significantly different from primary impacts" (p. 8-34).¹³ Despite these findings, the MWRA again made no effort to reopen the issue of the marginal benefit of secondary treatment. When this course of inaction was explicitly pointed out during the public comment period on the facilities plan, the MWRA response was that "it is not necessary to justify secondary treatment in the Facilities Plan as the MWRA is mandated by Federal law and court agreements to provide this level of treatment" (p. 7).¹⁴

The EPA performed separate impact analyses of the MWRA facilities plan for primary and secondary effluents through the proposed nine-mile outfall and diffuser. Non-compliance with standards was cited in three instances for primary effluent. The first was based on a predicted dissolved oxygen violation of 5.7 ppm during a 90-day sediment resuspension event. In contrast to the 1985 waiver denial based on a similar event, the EPA now assumed the ambient dissolved oxygen at 6.5 ppm, thereby backing away from its earlier ambient level of 6.1 ppm (p. 5-22).¹⁵ A search was made for reasons why the EPA predicted a dissolved oxygen violation while the MWRA's analysis of the same event did not. It was found that the EPA calculated a sixfold increase (compared to the MWRA) in the average rates of sediment deposition in the ocean area sur-

rounding the multi-port diffuser. The calculations were based on the EPA's determination that a small fraction of sediment in the primary effluent would be in the size range that has a fall velocity of 0.1 cm/sec (p. 5-5).¹⁵ On the other hand, the MWRA determined that the maximum fall velocity of sediment in the effluent would be 0.01 cm/sec (p. 3-63).¹³ A calculation of the sediment removal capability of the new primary treatment plant indicated that all particles having a fall velocity of 0.1 cm/sec would be removed in the primary treatment process even when the primary plant was operated at its maximum capacity of 1.2 billion gallons per day, which is two and a half times its average flow rate. The EPA's use of the larger size fraction in the effluent resulted in higher calculated rates of sediment deposition, and, consequently, an overestimation of the dissolved oxygen depression due to resuspension.

The second point in which the EPA indicated that primary effluent impacts were less satisfactory than secondary was in the areal extent of bottom sediment enrichment and toxicity. Again, this contention was the result of overestimating sediment deposition rates.

The third point — aquatic life criteria — is based on a screening of toxic effects of more than 50 non-conventional pollutants. Of these pollutants, the only violations indicated were for mercury and three compounds (two pesticides and PCB) not presently detected in the inflow to Boston's treatment plants (pp. A-41 & A-85).¹⁶

These issues were pointed out during the public comment period and the EPA's responses were given in the Final Environmental Impact Statement (FEIS) of July 1988 (p. 3-45).¹⁷ On the major non-compliance issue that revolved around the disagreement on sedimentation rates, the EPA acknowledged that the faster settling sizes would be removed in the primary treatment process. However, the EPA justified retaining the high settling rate in order to "account for potential aggregation of the effluent particles in the marine waters, which would cause the aggregate particles to fall faster" (p. 3-45).¹⁷ The suspended solids concentration in the primary effluent is only about 50 ppm before undergoing a hundred-fold reduction in concentration through the multi-

port diffuser. Even at the undiluted value, there is no scientific basis for assuming that aggregation is effective at such low particle concentrations. The only evidence for aggregation in marine waters is in the discharge of sludge from outfalls where particle concentrations are more than a thousand parts per million.

The EPA summed up the level of treatment issue in its FEIS:

"Some commentators questioned the need for secondary treatment, particularly for a discharge as far off-shore and as deep as the outfall location recommended. The suggestion was made that EPA was over-conservative in its analysis, and that money required to construct and operate the new secondary treatment facilities could better be used to address other pollution problems such as discharges of raw sewage from combined sewer overflows" (p. 3-52).¹⁷

The EPA continued by saying that because the waiver was denied and the MWRA is now committed to secondary treatment:

"[T]he need for secondary treatment of the MWRA wastewater was not a question addressed by this FEIS, and a comparison of the impacts of primary effluent versus secondary effluent is not required" (p. 3-52).¹⁷

The assumptions underlying such statements could be viewed as running counter to the spirit of environmentalism that led to the creation of the EPA and to the concept of environmental impact analysis. The EPA's "tentative" waiver denial of 1985 has become incontrovertible law. These actions reflect an abuse of regulatory authority through a process of circular reasoning. Because the waiver was denied, no further information can be considered that might indicate that the basis for its denial was flawed.

Priorities

A vitally important component has not been included in the present federal court construction schedule for the harbor cleanup — namely, the combined sewer overflow control facilities. Preliminary plans have indicated that

more than 20 miles of deep-rock tunnels, 25 feet in diameter will be needed to store wet weather sewer flows so they can be fed into the treatment system in subsequent dry periods. The cost, certain to be a billion dollars or more, will ultimately be added to the \$6.1 billion price tag for already-scheduled facilities. While the MWRA has accepted responsibility for the combined sewer overflow problem, its placement in the construction schedule will not be resolved until after final combined sewer overflow plans are submitted in mid 1990. It is very apparent that the MWRA's financial and management capabilities will be stretched to the limit to complete the secondary treatment facilities plan by 1999 and that combined sewer overflow construction will probably extend well into the next century. Without some means of handling the combined sewer overflows, the \$6 billion plan, when completed, will not make Boston harbor fishable or swimmable and will be a rude shock to ratepayers in the Boston area.

The cost of the secondary treatment and secondary sludge disposal facilities in the present schedule is about \$2.5 billion. This cost is a very high price to pay for the marginal environmental benefits of secondary treatment, especially when the negative environmental impacts of disposing of twice as much sludge that would result from such treatment have yet to be evaluated. The EPA's claimed benefits of secondary treatment relate to the removal of suspended solids rather than to the purpose for which it was designed — *i.e.*, the removal of soluble organic material (BOD).

An innovative treatment process capable of providing levels of suspended solids removal comparable to secondary treatment (but without high BOD removal and increased sludge production) has not been considered in any of the MWRA's post-waiver planning. This process, known as advanced primary treatment, consists of adding very small amounts of polymer chemicals to primary treatment tanks in order to cause the aggregation of particles and increased sedimentation. Los Angeles County, Orange County and the City of San Diego have successfully used advanced primary treatment for more than 10 years. Advanced primary treatment has achieved 80 percent suspended solids removal with only a 30

percent increase in sludge production over conventional primary treatment, as compared to a 100 percent increase in sludge production with secondary treatment. Orange County received a waiver of the full secondary treatment requirement from the EPA in 1985. Los Angeles County's waiver application is still pending. However, they are expecting a favorable decision that will allow them to continue this sensible practice. San Diego's waiver application has a checkered history. It was tentatively approved in 1981. However, in 1986 the EPA announced a reversal of its decision with an option for the city to submit a revised application. In 1987, in response to public pressure, San Diego decided not to resubmit.

A logical set of priorities for Boston Harbor would follow the current schedule through the completion by 1995 of the new primary treatment plant, its sludge disposal facility, and the nine-mile ocean outfall and diffuser. At that time, the cleanup effort should be directed away from secondary treatment in favor of facilities for the control of the combined sewer overflows. Upon completion of the new primary plant and the ocean outfall and combined sewer overflow remediation measures, an intensive monitoring program in Boston Harbor should indicate whether additional treatment is necessary. If so, the sensible step would be to implement advanced primary treatment.

Fortunately, during the next six years, there is time to bring scientific and political pressure to force the priority issue through the new EPA administration and Congress. When the EPA was footing three-quarters of the bill and threatening massive retroactive fines, there was little incentive to argue. Now there is every reason to insist that local funds be used to achieve an optimal environmental solution rather than one that adheres to a viewpoint more attuned to regulations than results.

NOTE — *Page notations are included in parentheses in the text for the reference cited.*

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