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November 13, 2026

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Whitney Fenwick
NPDES Section Chief
Department of Environmental Protection
1 Winter Street
Boston, MA 02108

RE: Massachusetts Water Resources Authority
Permit Number MA 0103284
Contingency Plan Threshold Exceedances: Stellwagen Basin DO Concentration and Percent Saturation

Dear Mr. Borci and Ms. Fenwick:

The Massachusetts Water Resources Authority ("MWRA") monitors bottom water dissolved oxygen ("DO") concentration and percent saturation in the Stellwagen Basin[1] as part of its permit-attached Ambient Monitoring Plan[2] and Contingency Plan.[3] The Contingency Plan states that the bottom water DO concentration, during any survey while the water column is stratified (June through October), is expected to be at least 6.5 mg/L (caution level threshold) or at least 6.0 mg/L (warning level threshold), unless background conditions are lower. Background conditions are computed from monitoring during the baseline period 1992-2000, prior to when operation of the outfall in Massachusetts Bay began. When testing against the caution and warning level thresholds, if background conditions are lower than the thresholds, the measured values must be above the background conditions.

On October 26, MWRA conducted a routine water column monitoring survey. After routine data quality checks, the results were compared to thresholds on November 9. **The threshold checks for bottom water DO concentration and percent saturation revealed that there were warning level exceedances for the Stellwagen Basin station.** For concentration, the measured value of 5.89 mg/L is below the 6.0 mg/L warning threshold and the 6.23 mg/L background value. For percent saturation, the measured value of 64% is below the 75% warning threshold and the 67.17% background value. As with DO exceedances reported in 2021 through 2023,

[1] For an explanation of the DO measurements, see https://www.mwra.com/harbor/html/thresholds.htm#do.
[2] *Ambient Monitoring Plan for the Massachusetts Water Resources Authority Effluent Outfall (Revision 2.1, August 2021)*. Report 2021-08. https://www.mwra.com/harbor/enquad/pdf/2021-08.pdf.
[3] *Massachusetts Water Resources Authority Contingency Plan Revision 1*. 2001. Report 2001-ms-071. https://www.mwra.com/harbor/enquad/pdf/2001-ms-71.pdf. For sections in the Contingency Plan specifically relevant to DO, see pages 23-24 and 26.

MWRA believes that these exceedances are due to region-wide processes not related to the outfall. There were no exceedances of DO thresholds for the outfall nearfield stations (Figure 1).

These exceedances require regulatory and public notification, provided by this letter, in accordance with Part I.8.b (Contingency Plan) of the Deer Island Treatment Plant NPDES permit.

Background

Figure 1 shows MWRA monitoring locations in Massachusetts Bay. The outfall nearfield is a group of five stations (N01, N04, N07, N18, and N21) covering a 10 by 12 kilometer (km; 6 by 7.5 mile) area centered on the outfall diffuser. The stations are located at distances between 60 meters (m; 197 ft; N21) and 7.1 km (4.4 miles; N04) from the 30 m (100 ft) deep outfall diffuser. Station depths range from 26.6 m (87.3 ft; N18) to 50.2 m (164.7 ft; N07). For the calculation of the nearfield DO values to compare to the Contingency Plan thresholds, the deepest measurements from each of the five stations are averaged together. Stellwagen Basin is sampled at Station F22, in water 81 m (266 ft) deep, located 17.5 km (10.9 miles) away from the easternmost riser of the 30 m (100 ft) deep outfall diffuser.

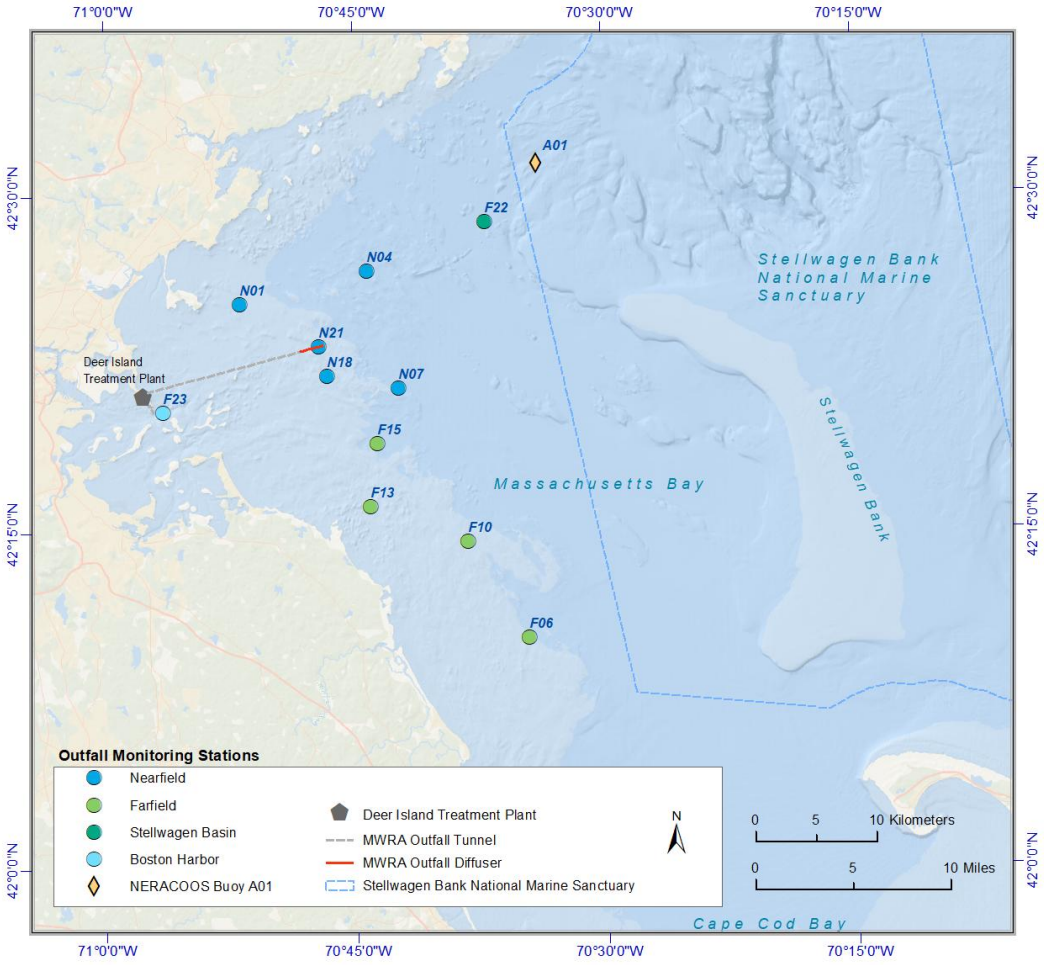


Figure 1. Map showing MWRA's Massachusetts Bay monitoring stations grouped by region of interest and NERACOOS Buoy A01, just northeast of station F22.

Past MWRA studies have identified regional factors as having a larger influence on DO levels in Massachusetts Bay than the outfall (emphasis added below):

> On a regional scale, circulation in the bays is often affected by the larger pattern of water flow in the Gulf of Maine. The western Maine coastal current usually flows southwestward along the coast of Maine and New Hampshire and depending on prevailing oceanographic and meteorological conditions may enter Massachusetts Bay south of Cape Ann (Geyer et al. 1992). Optimal conditions for inflow usually occur during the spring when winds out of the northeast bring significant freshwater inflow from the gulf into the bays and transport generally follows a counterclockwise path along the coast to Cape Cod Bay. Inflow from the gulf is the major source of nutrients to the bay. ***The inflow also helps to flush the bay, and gives the bay its water quality characteristics including dissolved oxygen levels*** and plankton communities (including nuisance blooms such as *Alexandrium*)…
>
> Furthermore, modeling and statistical analyses indicate that bottom water DO levels in Massachusetts Bay are highly correlated with conditions along the bay/Gulf of Maine boundary and that ***regional processes and advection are the primary factors governing bottom water DO concentrations in the bay*** (HydroQual 2001, Geyer et al. 2002, Jiang et al. 2007).[4]

Exceedances

Table 1 shows bottom water DO data from the October 26 survey and the Contingency Plan thresholds (caution, warning, and background). Results are shown for both the nearfield and Stellwagen Basin. There were no threshold exceedances for the nearfield stations. At the Stellwagen Basin station (F22), there was an exceedance of the warning level threshold for DO concentration and an exceedance of the warning level threshold for DO percent saturation.

LOCATION	PARAMETER	TEST LEVEL	THRESHOLD VALUE	BACKGROUND VALUE	UNIT	TEST RESULT	EXCEEDANCE Y/N
Nearfield	bottom dissolved oxygen	CAUTION WARNING	6.5 6	6.05	mg/L	**6.85**	N
Nearfield	bottom DO % saturation	CAUTION WARNING	80 75	65.28	%	78.7	N
Stellwagen Basin	bottom dissolved oxygen	CAUTION WARNING	6.5 6	6.23	mg/L	**5.89**	**Y Warning**
Stellwagen Basin	bottom DO % saturation	CAUTION WARNING	80 75	67.17	%	64	**Y Warning**

Table 1. Bottom water DO results and their Contingency Plan thresholds from the October 26 survey.

[4] *Ambient Monitoring Plan for the Massachusetts Water Resources Authority Effluent Outfall (Revision 2.1, August 2021).* Report 2021-08. https://www.mwra.com/harbor/enquad/pdf/2021-08.pdf. See pages 24 and 40-41 for specific information on DO monitoring.

Figure 2 shows the vertical profiles for DO concentration, DO percent saturation, and temperature results at Stellwagen Basin station F22 on the October 26 survey. The results from the downcast (as the instrument travels down through the water column) are in green, and the upcast results (as the instrument returns to the surface) are the yellow circles. The dark blue line is the mean of the results from the previous three years during the same time of year as the current results. The shaded blue and gray areas are, respectively: (a) the interquartile range of the results from 2000-2025 and (b) the minimum and maximum results from 2000-2025, respectively – both from the same time of the year as the survey results.

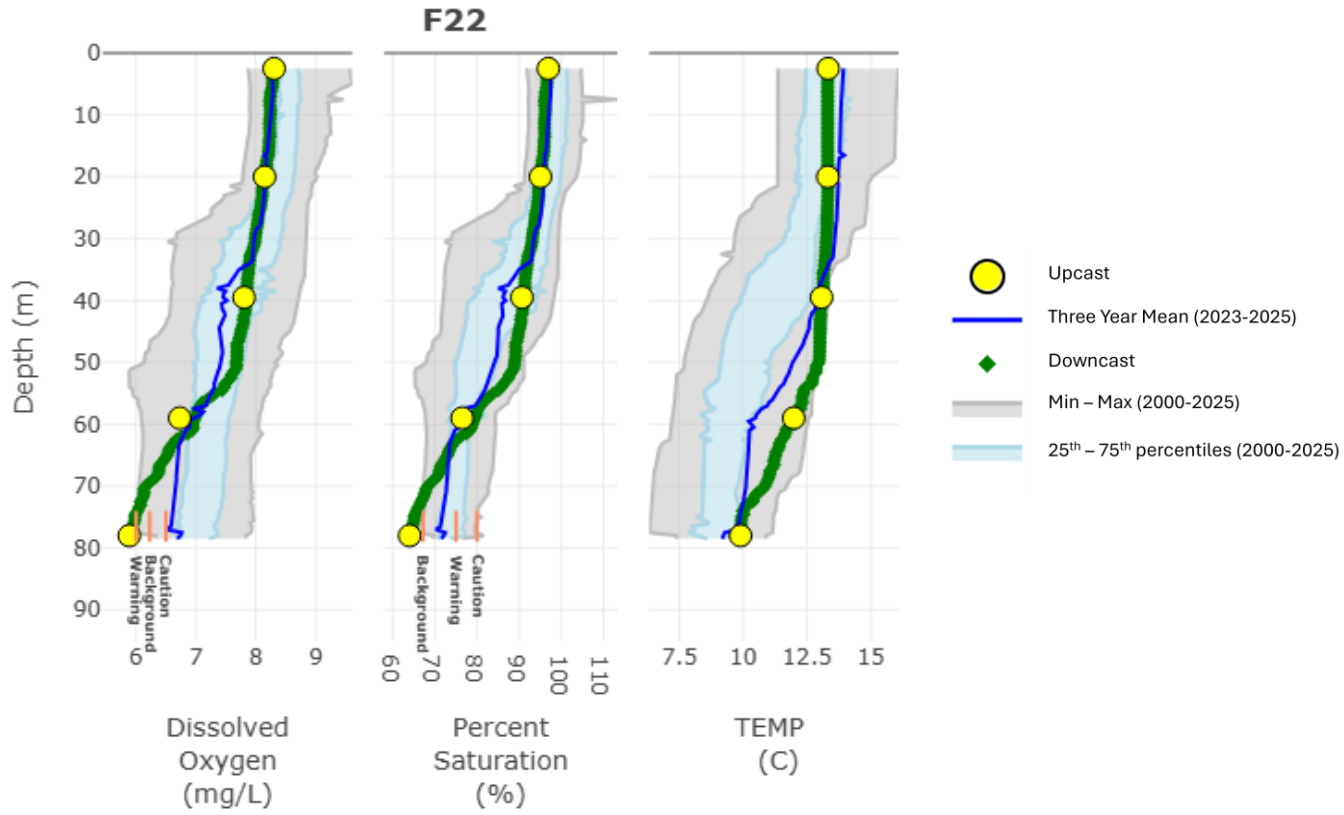


Figure 2. Vertical profiles of DO concentration (left), percent saturation (middle), and temperature (right) measurements from the Stellwagen Basin station (F22) on the October 26 survey. Relevant thresholds are noted at the bottom of their respective plots, as given in Table 1.

Figure 3 shows the bottom water DO results from 2026 water column surveys alongside corresponding historic ranges of observations from 1992-2025. Both the nearfield average and Stellwagen Basin station F22 DO measurements tracked historical averages throughout most of 2026, before an increased rate of depletion between the September and October surveys. Still, the rate of oxygen depletion at nearfield stations from June to October did not exceed the nearfield oxygen depletion Contingency Plan threshold for 2026.

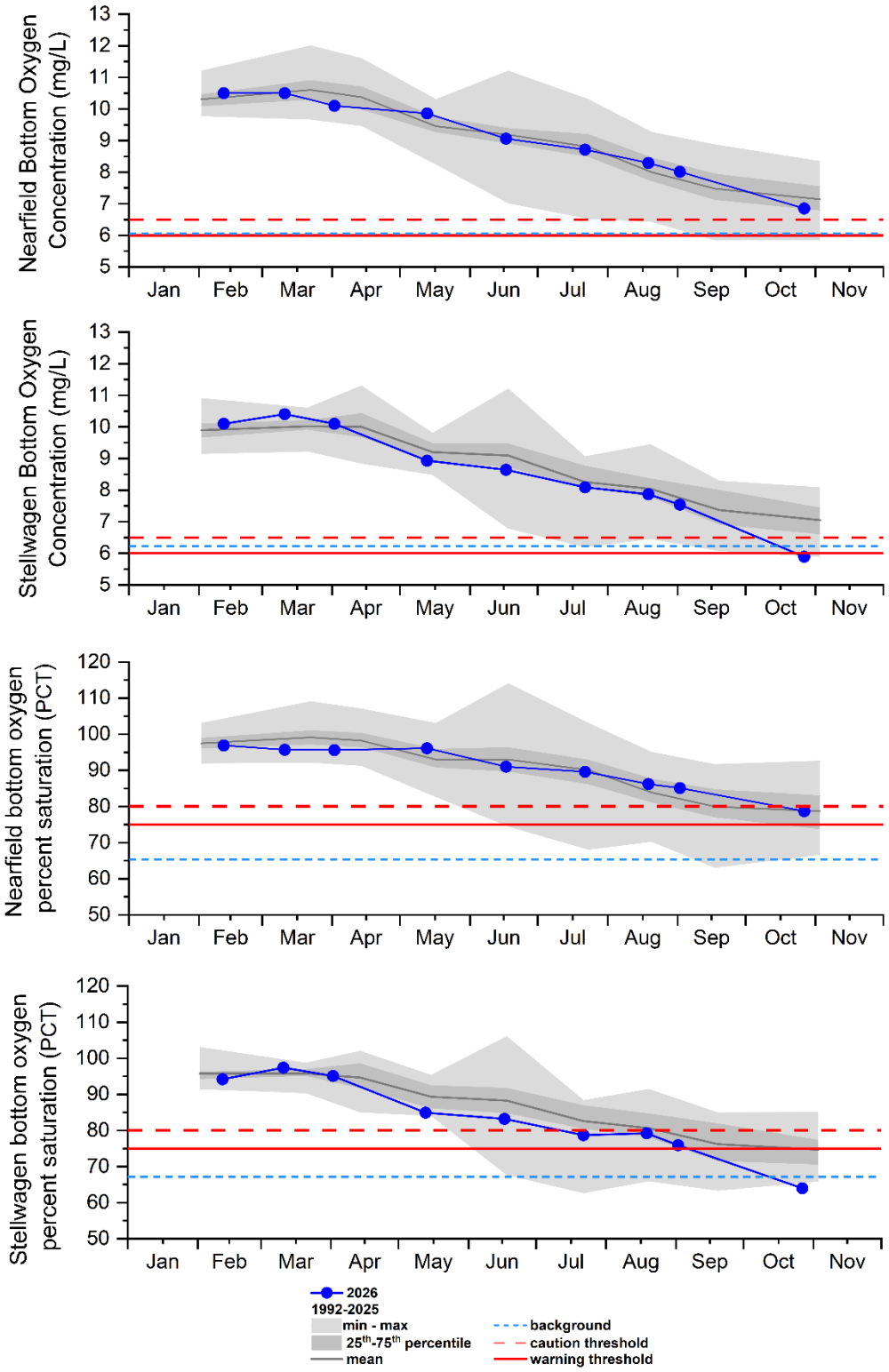


Figure 3. 2026 DO concentration and percent saturation seasonal progression results compared to 1992-2025 historical results in the nearfield and Stellwagen Basin station F22. Contingency Plan thresholds and background levels used to determine exceedances are shown as red and blue horizontal reference lines.

Discussion

This is the first Contingency Plan exceedance for dissolved oxygen thresholds since 2023.[5] In 2026, DO concentrations were near historical averages through the September survey (Figure 3). A bloom of the dinoflagellate *Karenia mikimotoi* was documented throughout the southern Gulf of Maine, peaking in late-September or early-October.[6] The bloom was evident in the raw *in situ* fluorescence data collected on the September survey, though cell count data are not yet available at the time of this notification.

Between the September and October surveys, MWRA expects that the senescing *Karenia* bloom resulted in an increased rate of dissolved oxygen consumption in deeper waters, particularly locations deeper than 30 meters (~100 feet).

As with the previous DO threshold exceedances, MWRA believes this set of exceedances may be due to region-wide processes in the Gulf of Maine, and are not related to the outfall.
It should be noted that under stratified water column conditions – as existed for this survey – it is normal for DO concentrations and percent saturation to decrease in bottom waters over time (see historical data in Figure 3). As a result of the stratification, in the absence of strong storms, there is no physical mechanism for the water below the thermocline to be reaerated through exchange with the atmosphere, and natural biological consumption processes cause DO in the bottom water to decline. Stratification naturally breaks down with the onset of stormier weather in the fall. Mixing during strong storms in August and September alleviated some of the seasonal depletion, as evident in preliminary sensor data at the 51 meter depth on the NERACOOS A01 buoy northeast of station F22 (Figure 4). The sensor data show a high rate of depletion in late-September to early-October as the widely reported *Karenia* bloom was waning. The current buoy deployment began on October 4, 2026, but data are not available at the time of this notification due to equipment failures that occurred shortly after deployment.

[5] Contingency Plan Threshold Exceedances Webpage. https://www.mwra.com/our-environment/water-quality-reports/regulatory-reports-0
[6] Maine Department of Marine Resources. Accessed November 10, 2026. https://www.maine.gov/dmr/news/wed-09232026-1200-dmr-updates-karenia-mikimotoi-bloom

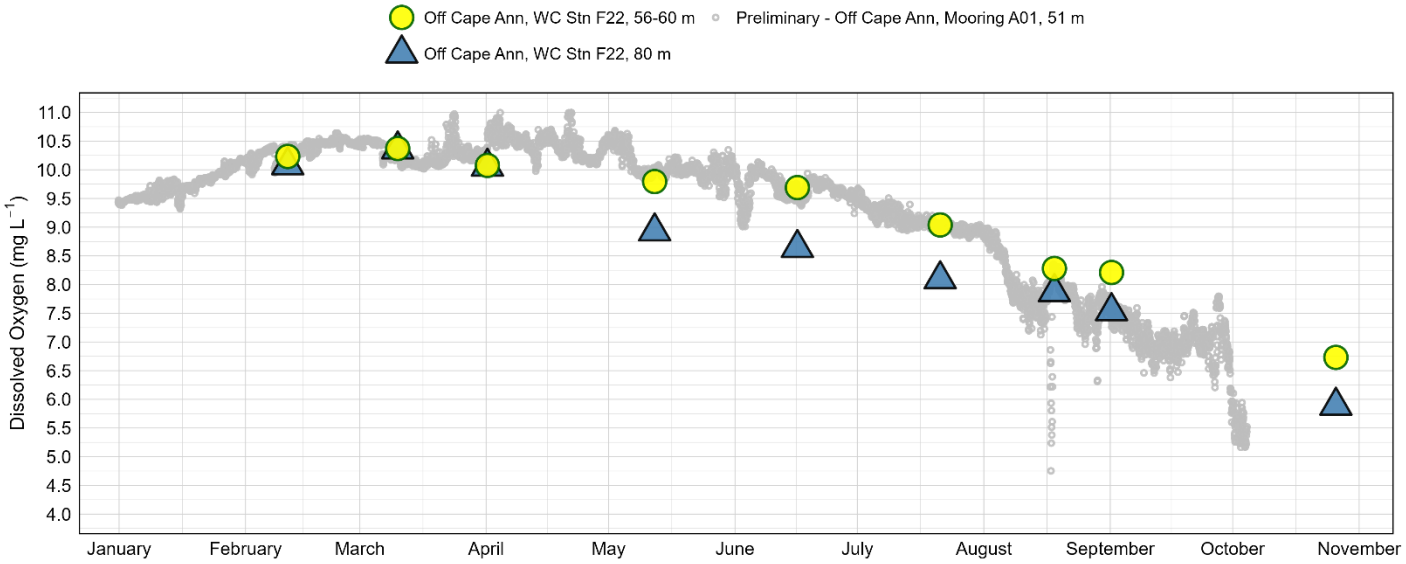


Figure 4. 2026 preliminary dissolved oxygen concentrations at NERACOOS A01 Buoy, 51m depth, compared with MWRA station F22 upcast data (~60m and ~80m depths). No data are available at this time for the current deployment, which began October 4, 2026.

Deer Island Treatment Plant Effluent Results

There is also no evidence these exceedances are related to the Deer Island Treatment Plant outfall discharge. The NPDES permit specifies two limits for effluent carbonaceous biochemical oxygen demand (cBOD), a measure of the effluent's oxygen depletion potential: a monthly average of 25 mg/L and a weekly average of 40 mg/L. cBOD limits are met consistently at DITP. During the period between the October 26 survey and the previous survey on September 1, the average of the effluent cBOD samples was 5.9 mg/L, well below the monthly permit limit. The average effluent cBOD the week preceding the October 26 survey (October 19-26) was 5.0 mg/L, also well below the weekly permit limit. No Deer Island Treatment Plant operational issues have been reported in 2026.

Long-Term Trends in Dissolved Oxygen

As with previous DO threshold exceedances, MWRA believes these exceedances may in part be due to long-term, region-wide changes not related to the outfall. Utilizing data from the MWRA monitoring program collected from 1992-2022, Codiga *et al*. documented temperature and salinity increases that can explain more than half of the observed decreasing dissolved oxygen trend.[7]

Relationship to Water Quality Standards

Although bottom water DO concentrations at Stellwagen Basin were threshold exceedances per the Contingency Plan (CP), aquatic life was not necessarily endangered. CP thresholds were intended to enable detection of changed conditions compared to the 1990s baseline period, not

[7] Codiga, D. L., Keay, K. E., & Libby, P. S. (2025). Thirty-one years of warming and oxygen decline in Massachusetts Bay, a well-flushed non-eutrophic temperate coastal waterbody. *Journal of Geophysical Research: Oceans*, 130, e2024JC021589. https://doi.org/10.1029/2024JC021589

necessarily to indicate harmful or degraded conditions. Marine DO concentration standards in other New England states and New York range from 4.8-5 mg/L, in contrast to that of Massachusetts.[8]

The origin of the lower DO standard used in other northeastern states can be found in EPA's January 2000 document, *Draft Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras*. That document stated that "If the DO exceeds the chronic protective value for growth (4.8 mg/L), the site meets objectives for protection." This same phrase appeared in the final version of the criteria issued in November 2000.[9] In fact, as early as December 1997, the Outfall Monitoring Task Force (the predecessor to the Outfall Monitoring Science Advisory Panel) had already noted that "the DO thresholds appear to be overly sensitive." In February 2000, after the publication of the draft criteria, MWRA proposed changing the warning level threshold from 6.0 mg/L to 4.8 mg/L. OMSAP agreed to review the issue once the final criteria were issued.[10] However, while the DO thresholds in the Contingency Plan were modified to add the "unless background conditions are lower" clause, the 6.0 mg/L warning level threshold remained.

On March 27, 2023, Dr. Judith Pederson, Chair of OMSAP, sent a memo[11] to EPA and MA DEP recommending that the DO caution and warning level thresholds be set to 6.0 mg/L and 5.0 mg/L, respectively. The rationale for this change was based on the 2000 EPA report cited above, as well as research done at Dalhousie University (Halifax, Nova Scotia) on DO tolerances of important species in the Gulf of St. Lawrence and Scotian Shelf region.[12]

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[8] New England Interstate Water Pollution Control Commission matrix of state water quality standards. Available at: https://neiwpcc.org/our-programs/pollution-control/water-quality-standards/wqs-matrix/

[9] https://www.epa.gov/sites/default/files/2018-10/documents/ambient-al-wqc-dissolved-oxygen-cape-code.pdf

[10] Attachment C of the November 10, 2000 letter to DEP and EPA regarding Contingency Plan exceedances of DO. https://www.mwra.com/media/file/ax111000.pdf

[11] Dr. Judith Pederson, email to Alexa Sterling (EPA) and Cathy Conairis (MA DEP), "DO Recommendations for the MWRA contingency plan." March 31, 2023.

[12] Brennan CE, Blanchard H, Fennel K. 2016. Putting Temperature and Oxygen Thresholds of Marine Animals in Context of Environmental Change: A Regional Perspective for the Scotian Shelf and Gulf of St. Lawrence. *PLoS ONE* 11(12): e0167411. doi:10.1371/journal.pone.0167411.

Conclusion

The conclusion of our initial evaluation, based on the information presented here, is that the exceedance is not related to the outfall. It may be related to widely recognized regional long-term trends of warming temperatures and declining oxygen concentrations, which are clear from analysis of many independent datasets including MWRA monitoring data. Additionally, the waning bloom of the dinoflagellate *Karenia mikimotoi*, which was reported in high abundances throughout the region in August through September, may have also contributed to low DO levels. The October survey was the final survey in 2026. These exceedances of dissolved oxygen will continue to be investigated as all data are reviewed and synthesized.

MWRA will provide raw monitoring data upon request. If you have any questions regarding this matter, please email David Wu at David.Wu@mwra.com.

Sincerely,

Rebecca Weidman
Deputy Chief Operating Officer

cc:

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