



# MASSACHUSETTS WATER RESOURCES AUTHORITY

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December 8, 2023

Todd Borci  
EPA Region 1  
5 Post Office Square, Suite 100  
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Boston MA, 02109-3912

Catherine Coniaris  
Department of Environmental Protection  
100 Cambridge St., 9<sup>th</sup> Floor  
Boston, MA 02114

RE: Massachusetts Water Resources Authority  
Permit Number MA 0103284  
Contingency Plan Threshold Exceedances: Summer nearfield chlorophyll

Dear Mr. Borci and Ms. Coniaris:

The Massachusetts Water Resources Authority (“MWRA”) monitors chlorophyll in the nearfield as part of its permit-attached Ambient Monitoring Plan<sup>1</sup> and Contingency Plan.<sup>2</sup> This letter is a regulatory and public notification that the results exceeded the Contingency Plan threshold for nearfield summer chlorophyll in accordance with Part I.8.b (Contingency Plan) of the Deer Island Treatment Plant NPDES permit.

The Contingency Plan caution threshold for summer chlorophyll is 89 mg/m<sup>2</sup>. There is no warning threshold for this parameter. The Contingency Plan defines summer as the May to August period. MWRA has received all the summer 2023 chlorophyll results and calculated that the nearfield average for the four summer surveys was 163 mg/m<sup>2</sup>, over the threshold of 89 mg/m<sup>2</sup>.

MWRA believes an extraordinary bloom of the dinoflagellate *Tripos muelleri* likely drove the high summer chlorophyll levels. The bloom of *T. muelleri* was not exclusive to the MWRA monitoring area; high abundances were seen throughout the Gulf of Maine and south to Martha’s Vineyard, MA.

## **Background**

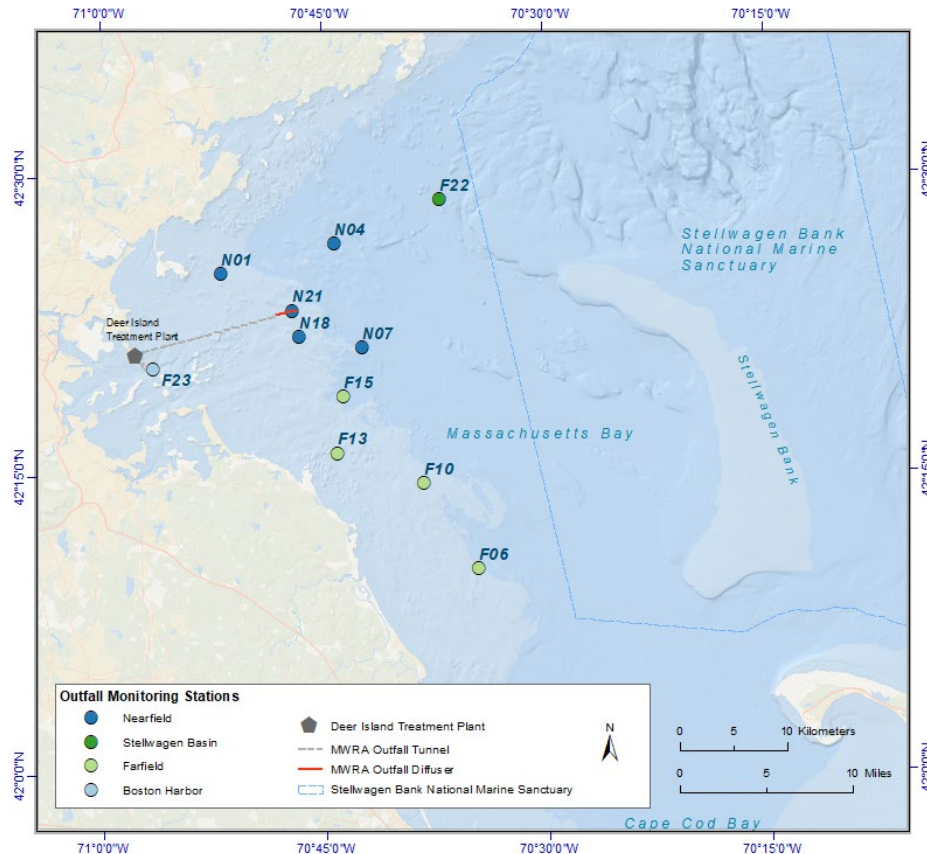
Figure 1 shows MWRA monitoring locations in Massachusetts Bay. The outfall nearfield is a group of five stations (N01, N04, N07, N18, and N21) covering a 6 by 7.5 mile (10 by 12 kilometer) area centered on the outfall diffuser.

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<sup>1</sup> *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>.

<sup>2</sup> *Massachusetts Water Resources Authority Contingency Plan Revision 1*. 2001. Report 2001-ms-071. <https://www.mwra.com/harbor/enquad/pdf/2001-ms-71.pdf>.

The farfield stations (F06, F10, F13, and F15) south of the nearfield and the Stellwagen Basin station (F22) are farther from the outfall and not part of Contingency Plan threshold. However, they often can provide useful context for nearfield conditions. Station F23 is at the mouth of Boston Harbor. While this station is physically quite different from the others, it can also give useful context.



**Figure 1.** Map of outfall, nearfield, Stellwagen Basin, farfield, and harbor monitoring stations.

### **Exceedance**

The nearfield summer chlorophyll average is calculated by first calculating a depth-averaged chlorophyll for each nearfield station visit using the calibrated fluorescence probe data measured every 0.5 m from the surface to the bottom and the depth at each station. Then, a survey average is calculated by averaging the depth-averaged chlorophyll values for each station. Finally, the four summer survey averages are used to calculate a seasonal average.

The threshold is based on a similar calculation done for surveys prior to the diversion of the wastewater discharge to Massachusetts Bay; the threshold is based on the 95<sup>th</sup> percentile of the pre-diversion summer averages.

Table 1 shows the “survey average” nearfield chlorophyll from each of the surveys in the summer season. Table 2 shows the overall nearfield summer chlorophyll average compared to the Contingency Plan threshold.

SURVEY ID	SURVEY DATE	AVERAGE NEARFIELD CHLOROPHYLL (MG/M <sup>2</sup> )	STANDARD DEVIATION	NUMBER OF NEARFIELD STATIONS IN AVERAGE
WN234	May 16, 2023	348.54	132.5	5
WN235	June 21, 2023	181.11	45.04	5
WN236	July 25, 2023	55.27	9.69	5
WN237	August 29, 2023	66.97	11.25	5

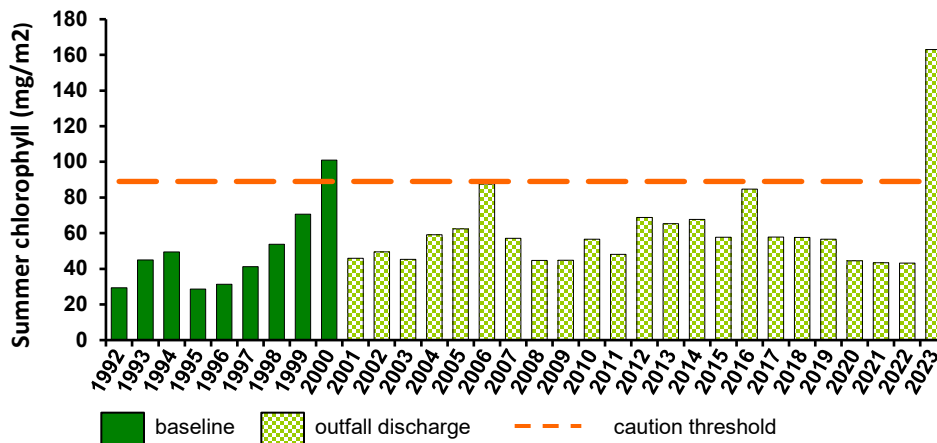
**Table 1.** Nearfield chlorophyll results, by survey date.

SEASON	SUMMER AVERAGE NEARFIELD CHLOROPHYLL (MG/M <sup>2</sup> )	STANDARD DEVIATION	THRESHOLD (MG/M <sup>2</sup> )	EXCEEDANCE (YES/NO)
Summer	163	136.1	89	Yes

**Table 2.** Nearfield summer chlorophyll results compared to the threshold.

### Discussion

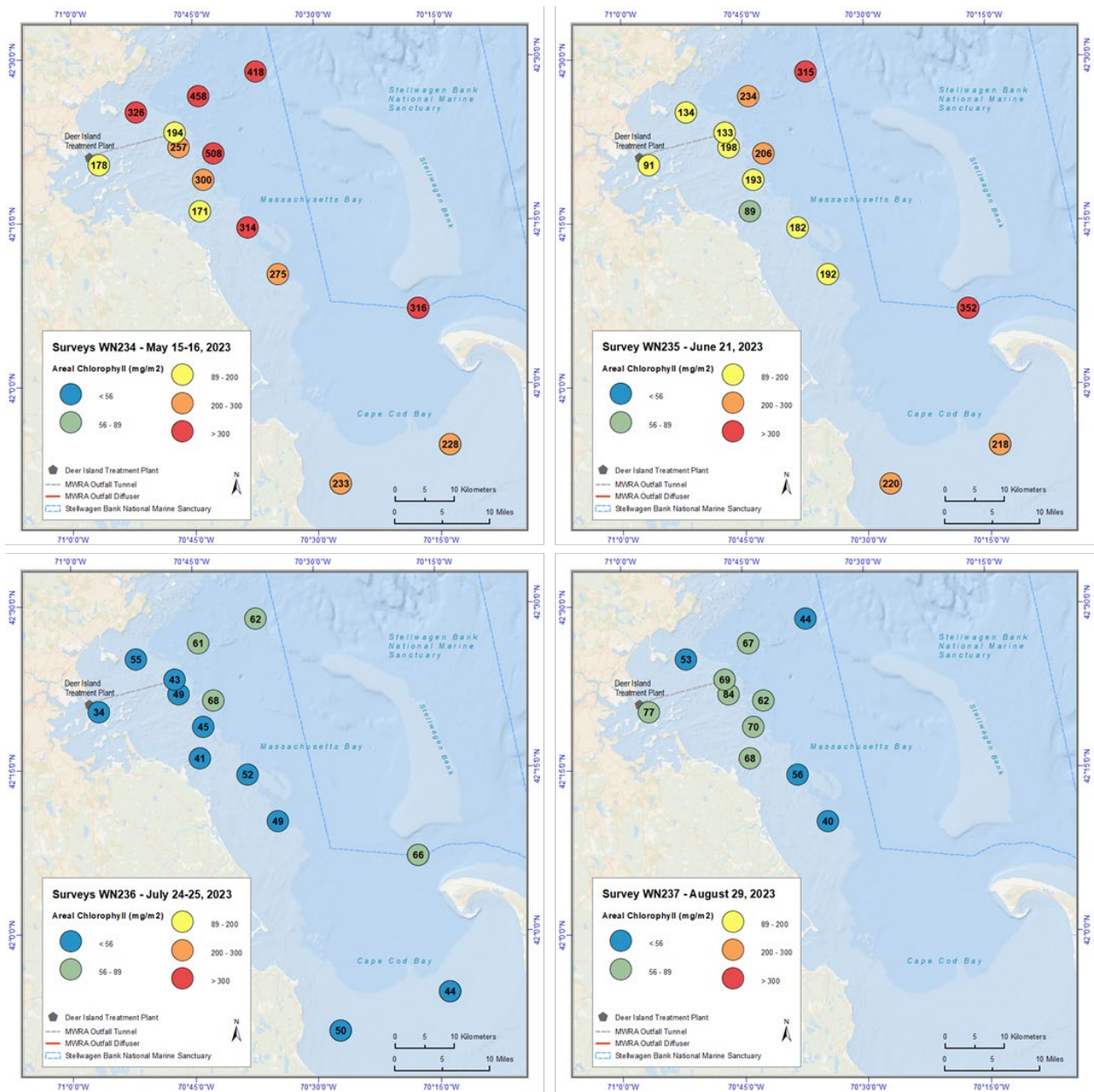
An unprecedented bloom of the dinoflagellate *Tripos muelleri* (previously known as *Ceratium tripos*) likely drove the high summer chlorophyll levels. *T. muelleri* is a dinoflagellate that is not considered a harmful or nuisance algae species. The most recent exceedance of the summer chlorophyll threshold was in 2006. That summer, chlorophyll levels were high due to a bloom of the chain-forming diatom *Dactyliosolen fragilissimus*.<sup>3</sup> Figure 2 shows the historical record of nearfield summer chlorophyll measurements from 1992 to 2023.



**Figure 2.** Nearfield summer chlorophyll, 1992-2023. The orange dashed line is the Contingency Plan threshold.

<sup>3</sup> October 25, 2006 letter to EPA and DEP. <https://www.mwra.com/harbor/pdf/20061025amx.pdf>

Figure 3 shows areal chlorophyll measurements at each individual station in the MWRA monitoring area from the four surveys in the summer period, as well as the three stations in Cape Cod Bay monitored by the Center of Coastal Studies (Provincetown, MA).



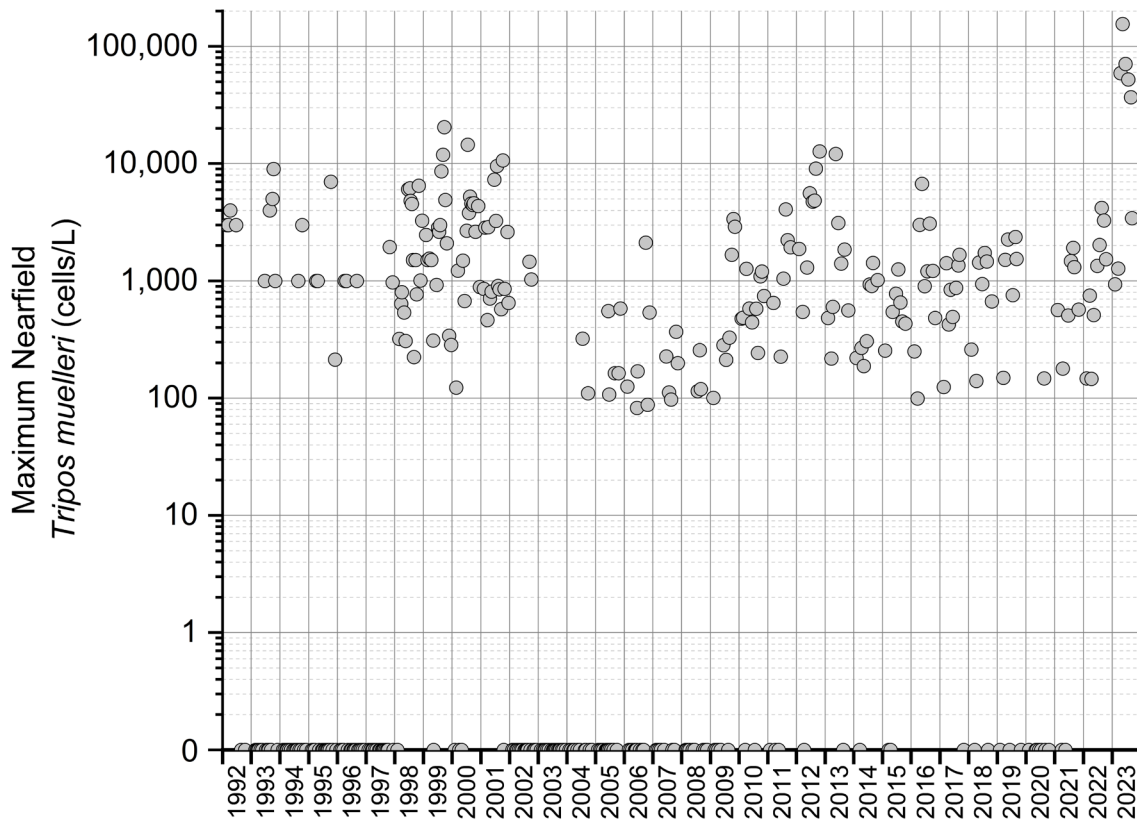
**Figure 3.** Station areal chlorophyll measurements ( $\text{mg}/\text{m}^2$ ) on each summer survey, May through August 2023. Data are not yet available for Cape Cod Bay stations surveyed August 28, 2023. Colors scaled by areal chlorophyll value, with blue and green below the Contingency Plan nearfield threshold of  $89 \text{ mg}/\text{m}^2$ .

Based on narrative MWRA survey reports, *T. muelleri* was one of the most abundant phytoplankton species seen in the March 21, 2023 survey. By the May 16, 2023 survey the



analyst, Dr. David Borkman,<sup>4</sup> described the qualitative rapid analysis sample from station N18 as being “dominated by an extraordinary bloom of *Ceratium tripos*.” *T. muelleri* also dominated the qualitative rapid analysis samples from June and July.

MWRA makes quantitative abundance counts of phytoplankton species at four of the nearfield stations (N04, N07, N18, and N01). While the magnitude of this bloom was unusual, MWRA’s monitoring program has observed *T. muelleri* throughout the 31 year span of the program. The fact that quantitative abundances measured in summer 2023 reached an order of magnitude higher than previous highs in 1999-2000, and 2012-2013 highlights the extraordinary nature of the 2023 bloom (Figure 4).



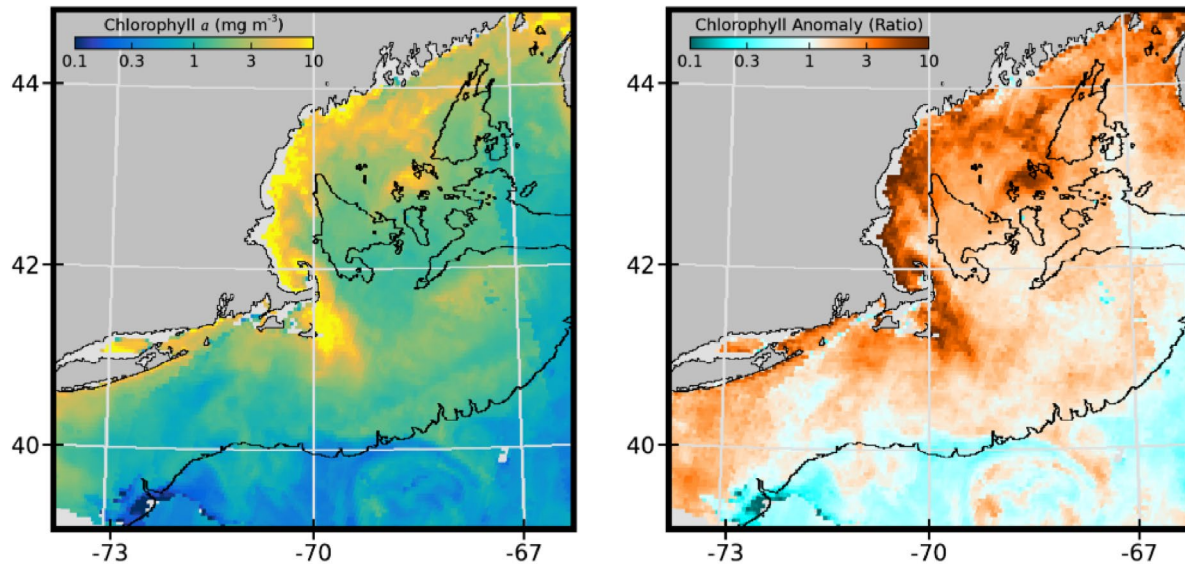
**Figure 4.** Maximum survey abundances of *Tripos muelleri* at nearfield stations since the beginning of the monitoring program in 1992. Results shown only for quantitative whole water phytoplankton count method.

The bloom of *T. muelleri* was not exclusive to the MWRA monitoring area. Multiple observers saw high abundances of *T. muelleri* throughout the Gulf of Maine, from Martha’s Vineyard, MA to Penobscot Bay, ME, so it was not exclusive to Massachusetts Bay.<sup>5</sup> Satellite imagery confirmed these observations (Figure 5).

<sup>4</sup> Dr. Borkman is Principal Environmental Scientist at the Rhode Island Department of Environmental Management, as well as the founder of Pausacaco Plankton, a firm specializing in phytoplankton enumeration and analysis.

<sup>5</sup> Cameron Thompson, Northeastern Regional Association of Coastal Ocean Observing Systems, personal communication. August 7, 2023.

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**Figure 5.** Preliminary satellite measurements of chlorophyll a (left panel) and anomalies from the long term mean (1997-2017; right panel) for the week of May 14, 2023 (corresponding with the MWRA and Center for Coastal Studies surveys on May 15-16). Note the large positive anomalies (i.e., chlorophyll above the long term average) represented by the orange and dark red areas throughout Massachusetts Bay and the larger Gulf of Maine. These are volumetric chlorophyll measurements ( $\text{mg}/\text{m}^3$ ) and so not directly comparable to the MWRA measurements of areal chlorophyll ( $\text{mg}/\text{m}^2$ ). Image courtesy of Kim Hyde/NOAA.

### Conclusion

The conclusion of our preliminary evaluation, based on the fact this bloom of *T. muelleri* was a region-wide event seen throughout the Gulf of Maine, is that the exceedance is not related to the outfall. Active research by a number of parties on the bloom's contributing factors is ongoing, including a meeting hosted by University of New Hampshire in January 2024.

MWRA will provide raw monitoring data upon request. If you have any questions regarding this matter, please email Dr. Betsy Reilley at [betsy.reilley@mwra.com](mailto:betsy.reilley@mwra.com).

Sincerely,

Rebecca Weidman  
Deputy Chief Operating Officer

**cc:**

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