Environmental Quality Department
Massachusetts Water Resources Authority
01/09/2018

Contingency Plan Quarterly Report on Ambient Monitoring Results

Fourth Quarter 2017

MWRA gathers data near the outfall discharge location in Massachusetts Bay on various thresholds in the Contingency Plan related to its Deer Island Treatment Plant (DITP) NPDES discharge permit. This report includes ambient Contingency Plan threshold results for monitoring data that became available October through December 2017. These include results for nuisance algae, water column dissolved oxygen, water column chlorophyll, benthic infauna diversity, and sediment enrichment. There were no Contingency Plan threshold exceedances for any of these results.

Previous Contingency Plan reports are available at:
http://www.mwra.state.ma.us/harbor/html/archive.htm#cpq.

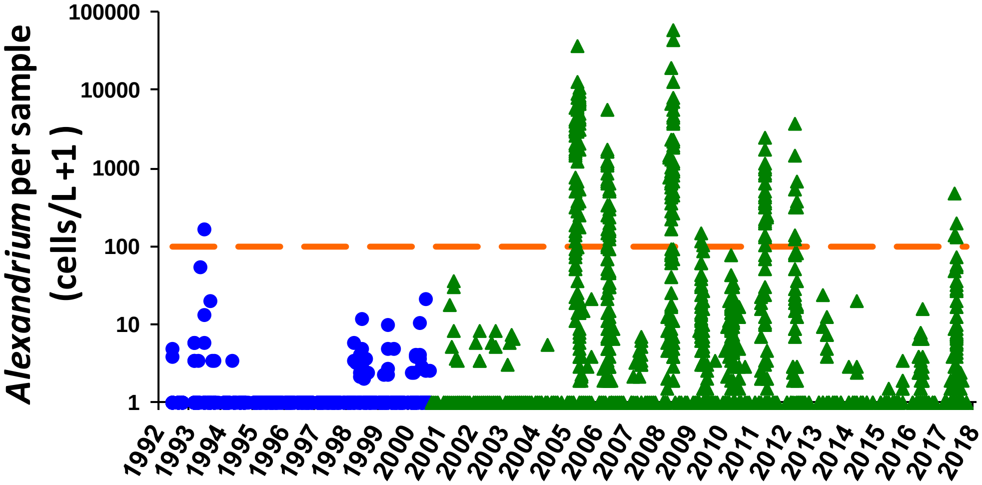
NUISANCE ALGAE –AUTUMN 2017

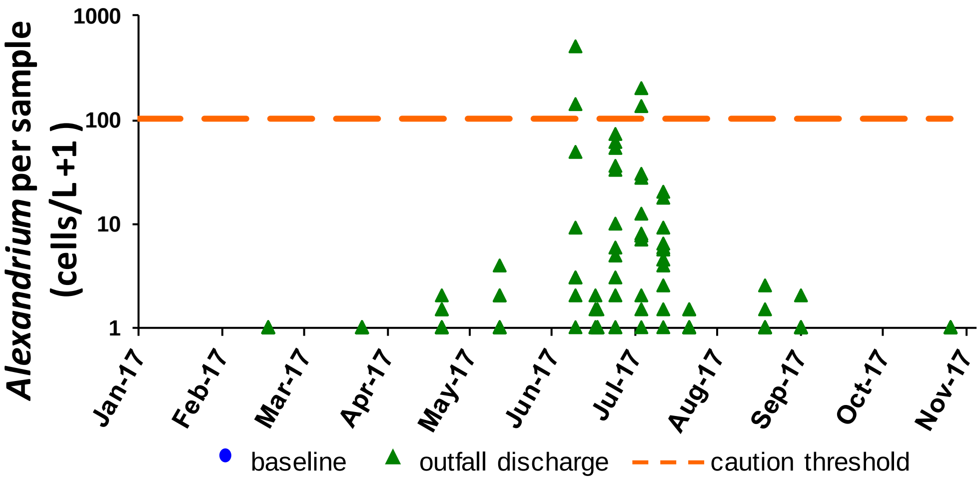
ALEXANDRIUM

The nuisance algae *Alexandrium* ("red tide") can cause paralytic shellfish poisoning (PSP) in Massachusetts Bay. MWRA measures *Alexandrium* abundance in its monitoring program and checks state fisheries agency observations of shellfish PSP toxicity to keep track of the course of Gulf of Maine *Alexandrium* blooms.

Final data for 2017 have been received for MWRA water column monitoring surveys in September through November 2017 (the September survey was delayed until October 3 and the late October survey delayed until November 1). There were no threshold exceedances in September through November.

In the figures below, we compare *Alexandrium* data to the threshold for each of 16 nearfield samples collected in September through November 2017. The first figure includes data since the start of the monitoring program in 1992. To better display recent values, the second figure shows data for 2017 only (Note logarithmic scale for each graph).





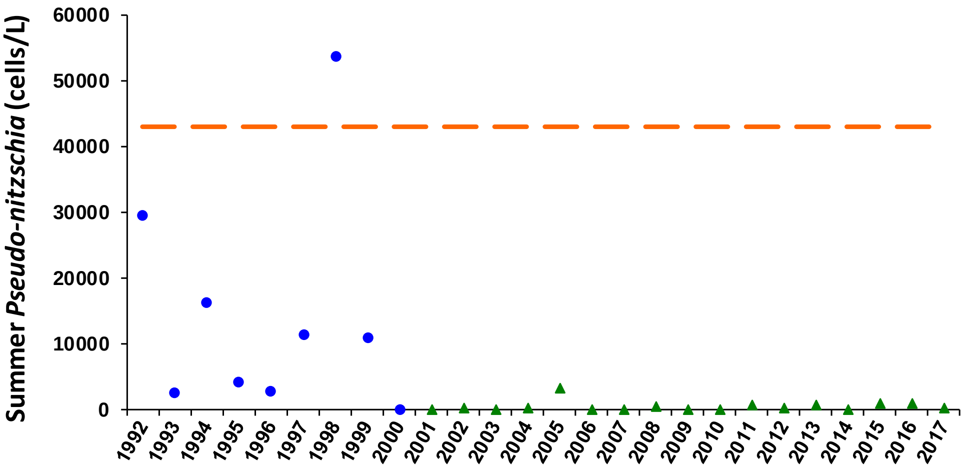
Alexandrium per-sample abundance (cells/liter).	
Caution threshold	100
September - November 2017	1*
* Maximum of all samples collected September through November 2017	

PSEUDO-NITZSCHIA - *Summer and Autumn 2017*

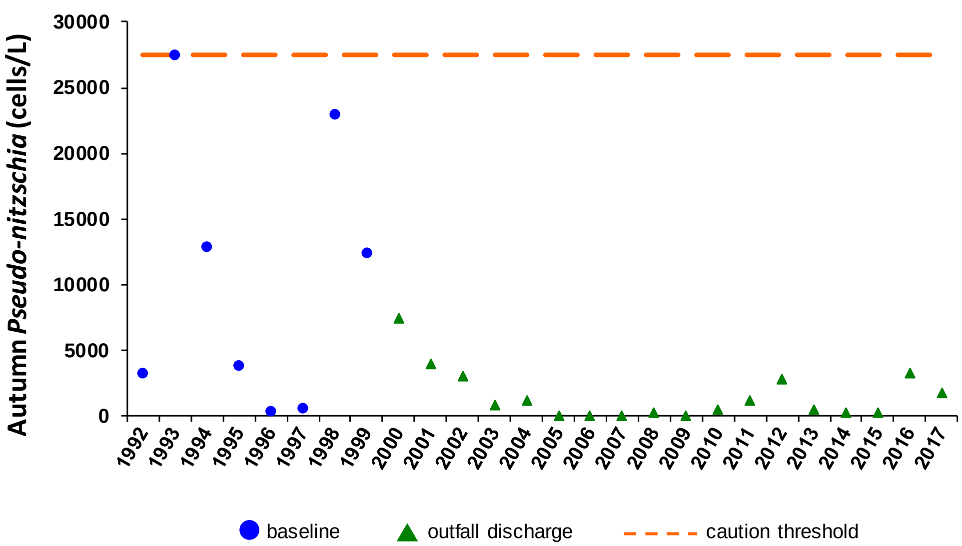
Seasonal abundances of *Pseudo-nitzschia* are compared against threshold values derived from the 95th percentile of seasonal baseline means. This report compares the summer seasonal means for surveys done in May, June, July, and August 2017, and the autumn seasonal means for surveys done in September-November, against threshold values.

In 2017, as in most other pre- and post-diversion years, the nuisance algae *Pseudo-nitzschia* did not exceed the threshold during either summer or autumn. Average nearfield abundance remained well below the threshold.

In the figures below, we compare *Pseudo-nitzschia* data to the nuisance algae thresholds for the summer and autumn seasonal thresholds. The graphs include data since the start of the monitoring program in 1992; however, the seasonal average values for 1992-2010 are calculated using a subset of all results reflecting the modified design that began in 2011, i.e. two autumn surveys. This enables us to better compare the threshold results across years.



Summer *Pseudo-nitzschia* mean abundance (cells/liter)	
Caution threshold	43,100
Summer 2017 seasonal mean	273



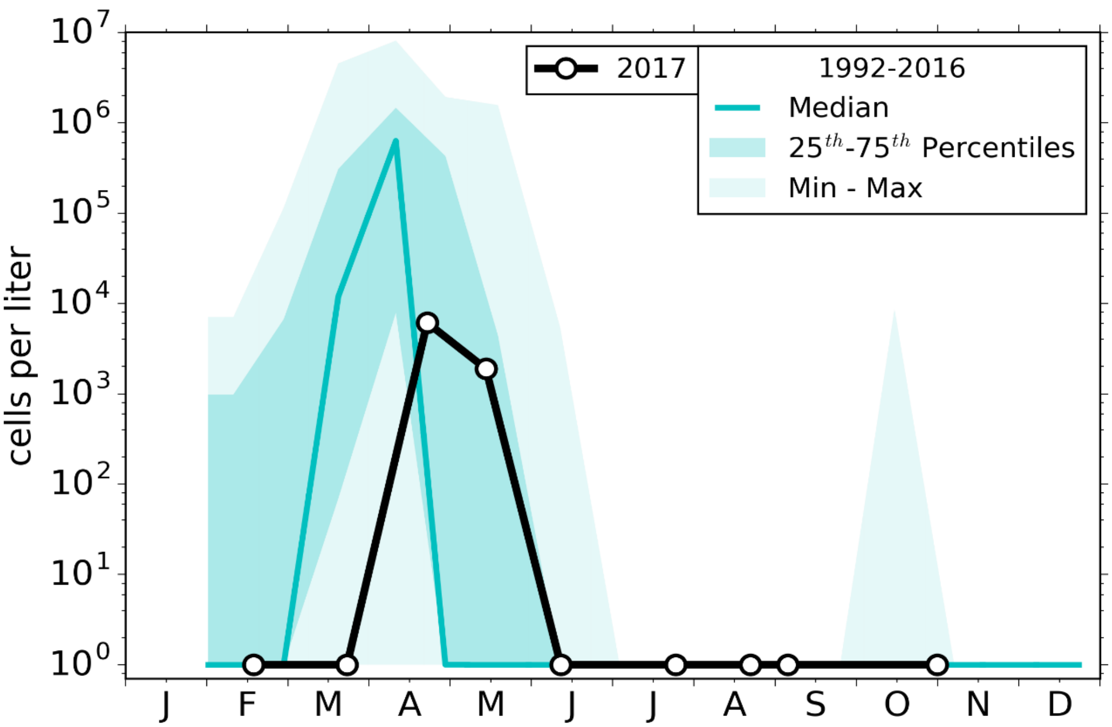
Autumn *Pseudo-nitzschia* mean abundance (cells/liter)	
Caution threshold	27,500
Autumn 2017 seasonal mean	1,780

PHAEOCYSTIS – *Summer and Autumn 2017*

In February 2017, EPA approved changes in the Contingency Plan to remove the threshold for the seasonal abundance of the nuisance alga *Phaeocystis pouchetii* in the nearfield water column. During bloom conditions, *Phaeocystis* can form large, gelatinous colonies, which may accumulate as foam as they disintegrate on beaches. Evaluations of prior threshold exceedances for this species have indicated that they had resulted from natural fluctuations in Massachusetts Bay, do not represent degradation, did not result from MWRA's discharge, and have not occurred in concentrations that would pose problems for recreation. MWRA agreed to continue to report each quarter on nearfield survey mean abundances of *Phaeocystis pouchetii* compared to its historical seasonal pattern. Results that became available this quarter were from July through November 2017 surveys.

The figure below shows the 2017 survey mean *Phaeocystis* results against the seasonal background for all prior years since 1992. Due to reductions in the number of surveys conducted each year, the historical seasonal pattern encompasses more time-points than shown for the current year.

No *Phaeocystis* were observed between July and the start of November 2017, which is typical of the historical seasonal pattern.



DISSOLVED OXYGEN (DO) – June through October 2017[1]

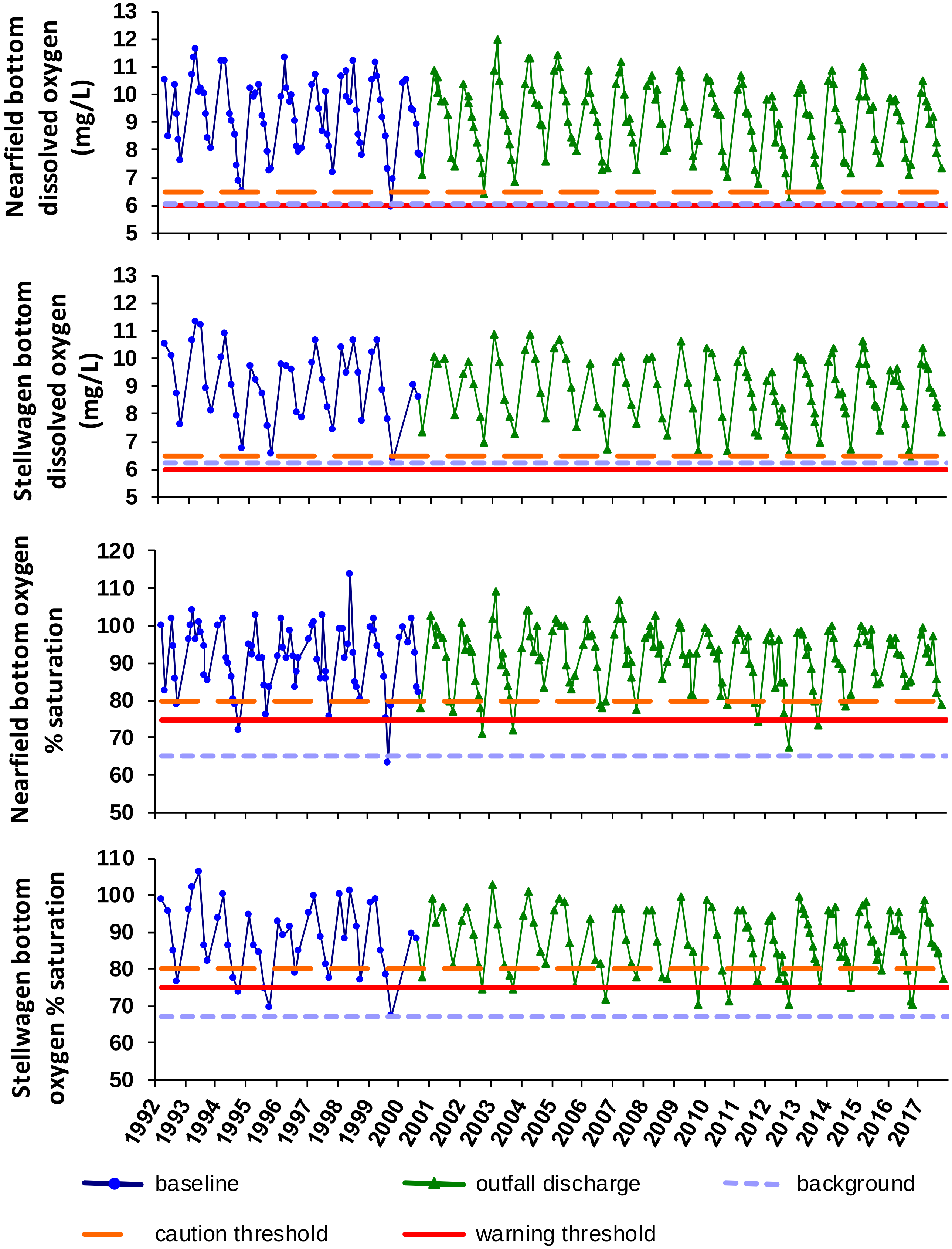
Dissolved oxygen (DO) thresholds are tested for nearfield bottom-water from June-October, when lower solubility due to warmer temperatures has the potential to reduce oxygen concentration and saturation. The seasonal rate of decline in bottom water oxygen concentrations is computed from June through October (this year through November 1), the months when the water column is stratified. DO concentration and saturation data from the survey scheduled for October 2017 became available this quarter. There were no threshold exceedances for these thresholds in summer 2017.

DISSOLVED OXYGEN CONCENTRATION AND SATURATION

The current reporting period for survey mean dissolved oxygen thresholds is October 2017. There was one regular water column survey during this period. The graphs below show the natural annual fluctuation of DO and percent saturation, which are typically lowest in early autumn. The 1992-2010 data shown are subsets of all data reflecting the modified design that began in 2011, *i.e.* nine surveys per year, and one station rather than four in Stellwagen Basin. This enables us to better compare the threshold results across years.

Nearfield and Stellwagen Basin bottom-water oxygen concentrations at the start of November 2017 were comparable to many baseline and post-discharge years and remained above the threshold caution levels. Oxygen percent saturation in bottom-water for Nearfield and Stellwagen Basin was below caution levels, but remained above background levels.

[1] Dissolved oxygen thresholds are usually calculated on data gathered in June through the end of October. Issues related to ship availability and weather conditions delayed the last survey of 2017 from its scheduled date of October 25 to November 1. A decision was made to include November 1st oxygen data in the threshold tests.


Nearfield bottom dissolved oxygen (mg/L)
Stellwagen bottom dissolved oxygen (mg/L)
Nearfield bottom oxygen % saturation
Stellwagen bottom oxygen % saturation
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
baseline
outfall discharge
background
caution threshold
warning threshold

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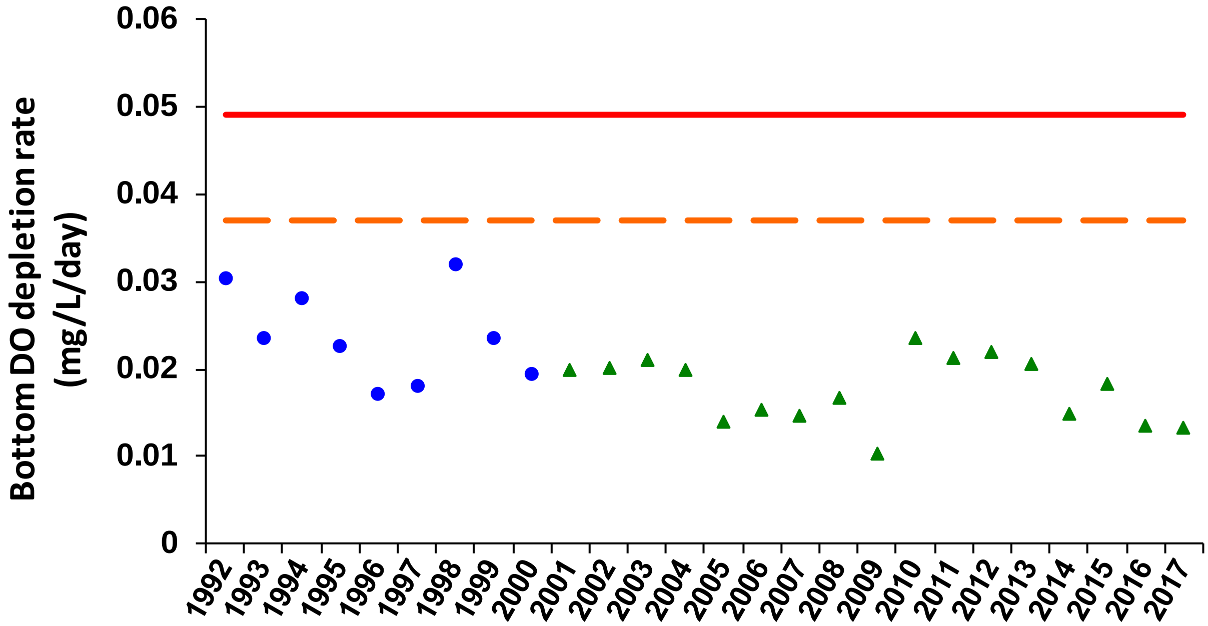
DISSOLVED OXYGEN DEPLETION RATE **– summer 2017**

An additional threshold measure of dissolved oxygen is the rate at which oxygen is depleted during the stratified summer period. Even if dissolved oxygen concentrations remain healthy, an excessively rapid rate of decrease could signal a future problem. A low rate indicates DO dropped only slowly. The threshold for DO depletion rate is based on a change from the baseline rate; the caution threshold is a rate faster than 1.5 times the baseline mean rate, while the warning threshold is twice the baseline mean rate.

The current reporting period for DO depletion rate is summer 2017, defined as June – October; in 2017 this includes a survey on November 1. The DO depletion rate for the summer of 2017 was similar to other post-discharge years and well below the threshold. The 2017 seasonal decline in nearfield, bottom water concentrations was the second lowest of pre and post-discharge years, and was well below the threshold value.



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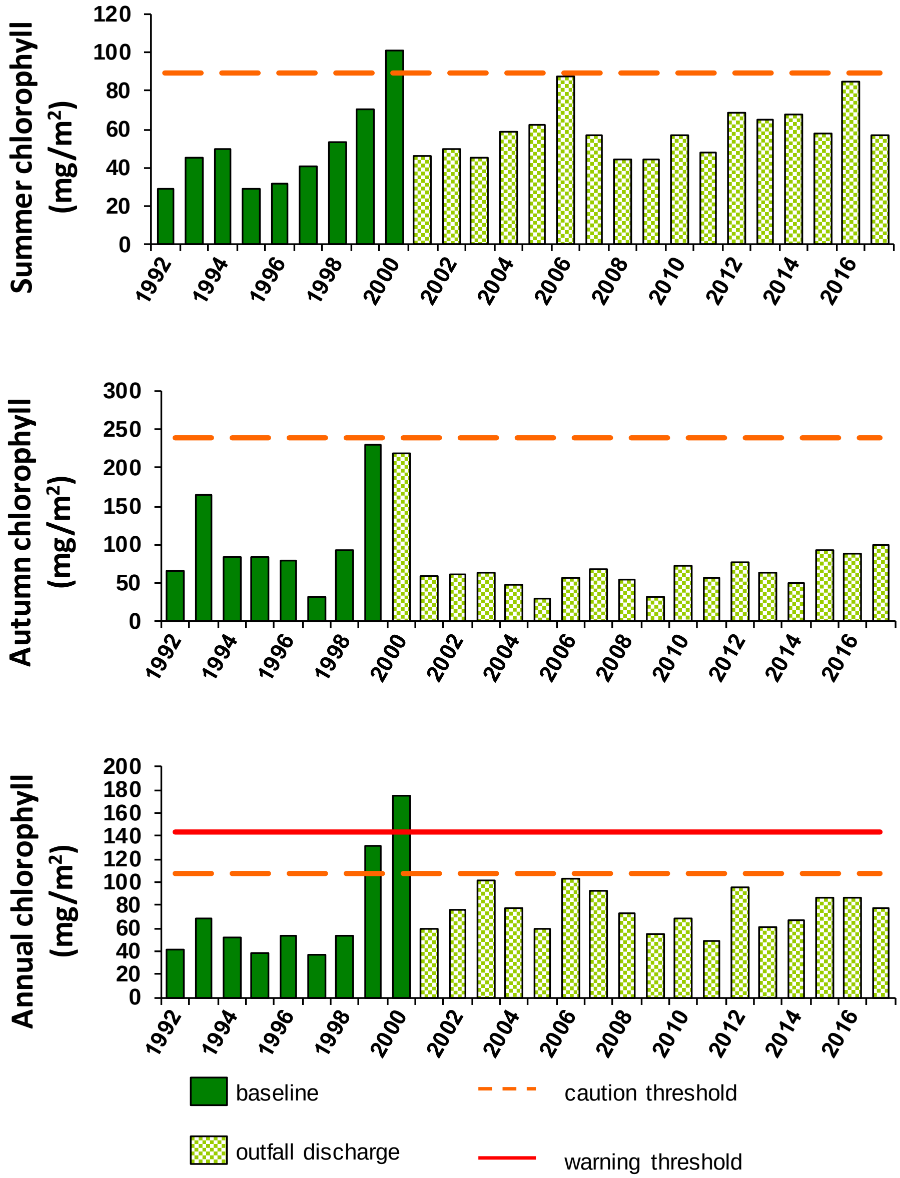
CHLOROPHYLL – May-August 2017, September-November 2017, and Annual 2017

There were no chlorophyll threshold exceedances for summer, autumn, nor for the entire year for 2017. The summer nearfield mean areal average chlorophyll was 57 mg/m^2, which is below the caution level threshold for summer of 89 mg/m^2. The autumn nearfield average areal chlorophyll was 100 mg/m^2, well below the caution level threshold for autumn of 239 mg/m^2 and in the range of other years in the pre-discharge period. The annual average was 77 mg/m^2, below the caution and warning thresholds for annual average chlorophyll of 108 and 144 mg/m^2, respectively. Summer, autumn, and annual results were similar to average years in the pre-diversion and post-diversion periods.

The figures below compare 2017 chlorophyll data for four summer (May-August), two autumn (September/October-November), and data for the entire year, to the corresponding thresholds. The graph includes data since the start of the monitoring program in 1992; however, the seasonal average values for 1992-2010 are calculated using a subset of all results reflecting the modified design that began in 2011, *i.e.* two autumn surveys. This enables us to better compare the threshold results across years.



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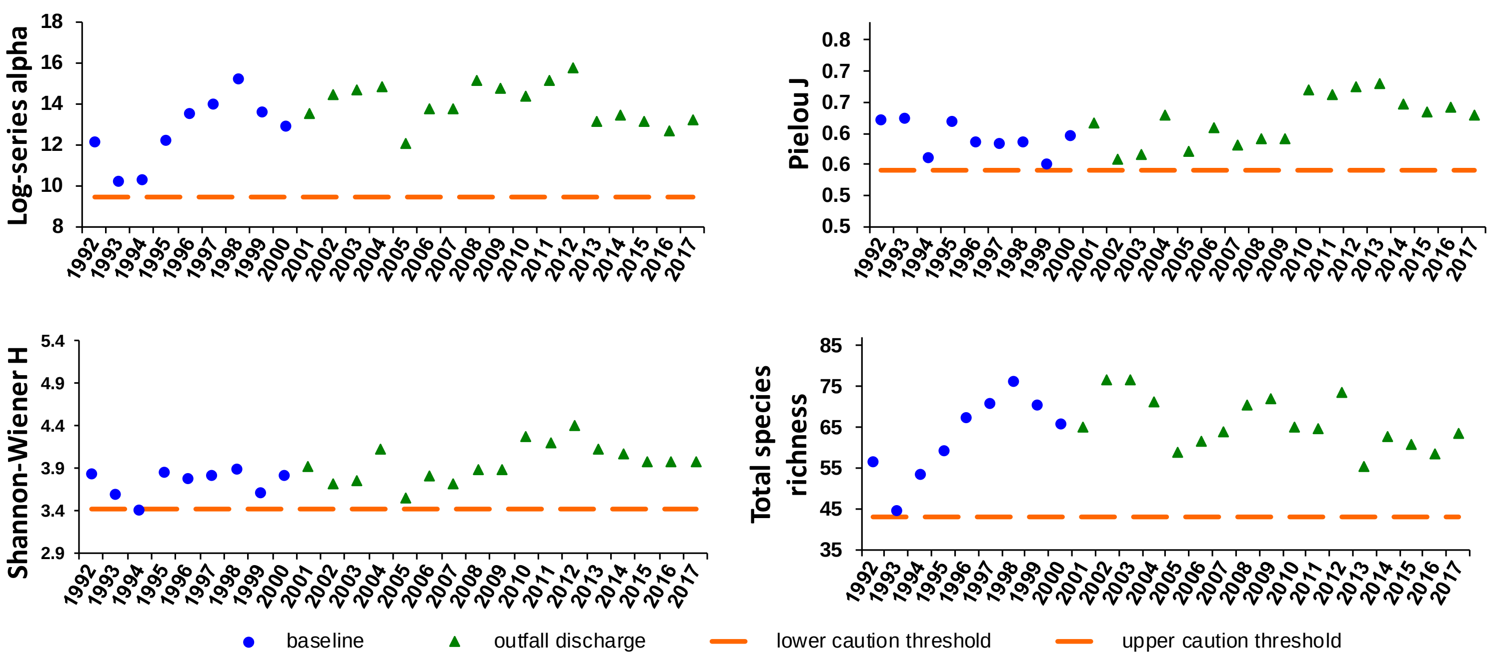
SEDIMENT BIODIVERSITY - 2017

MWRA samples the animals that live in the mud near the outfall every summer and measures the numbers and kinds of animals living there. These measurements are used in four indicators of biodiversity. In 2017, these indicate that, in vicinity of the outfall, the ability of the sediment and habitat to support diverse populations of infauna remains high and within the bounds of Contingency Plan thresholds. An additional indicator of habitat quality is the proportion of opportunistic animals, which predominate in degraded sediments. For 2017 this index remained low.

DIVERSITY

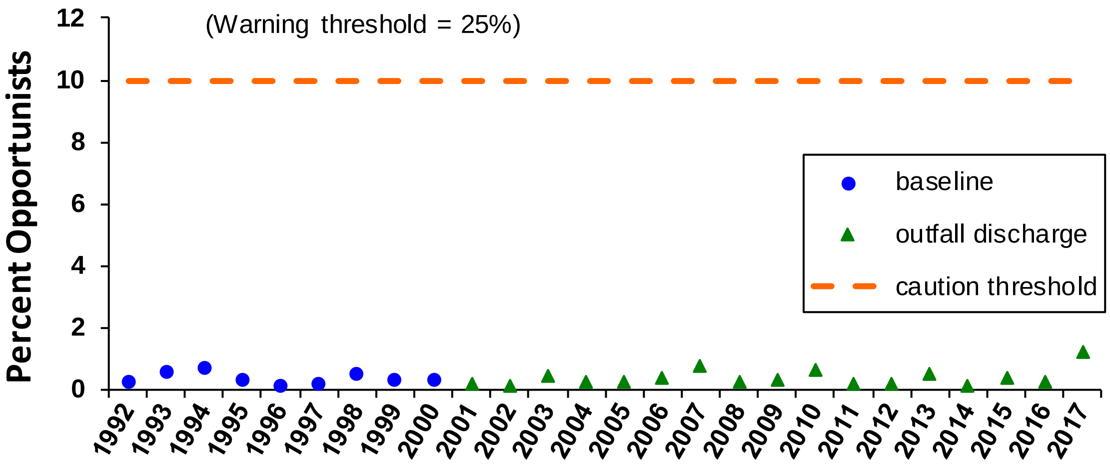
For each diversity measure, the graphs show the annual average for sediment samples collected within seven kilometers of the outfall discharge since 1992. The results shown for 1992-2003 and 2011-2017 are from the current eleven monitoring stations (which are a subset of the stations sampled 1992-2003), reflecting the modified design that began in 2011. Data from 2004 through 2010 are the averages for the odd- or even-year stations sampled then, as not all of the 11 nearfield stations currently sampled were sampled in those years. This enables us to better compare the threshold results across years to values corresponding to the 2.5th percentile of the baseline mean.

The threshold levels varied slightly through the monitoring period because of the differing station sets; for simplicity only the current thresholds are shown.



OPPORTUNISTS

The annual sampling in 2017 showed that the proportion of opportunistic benthic organisms (1.2 %) is slightly higher than previous years at the outfall site. This small increase was due to high abundance of one opportunistic worm in one of 11 samples and does not indicate degraded conditions overall in the vicinity of the outfall. The average percent opportunists remained far below the caution threshold of 10% of the total population.



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SEDIMENT ENRICHMENT - 2017

The depth of the oxygenated layer in marine sediment is a measure of ecosystem health. A diverse bottom-dwelling community includes organisms that mix water and oxygen down into the sediment. In an over-enriched environment, organic material deposited on the sediment surface can use up the available oxygen and smother the bottom-dwelling community. Such areas, including some areas of Boston Harbor, have a thin or nonexistent oxygenated layer. The thickness of the oxygenated layer is called the redox potential discontinuity (RPD) depth. In MWRA's monitoring program, the RPD depth is estimated from sediment-profile images, cross-sections of the upper several centimeters of the sediment taken with a special mud-penetrating prism and camera. The threshold for RPD is half the mean measured in the baseline period (that is, if the thickness of the oxygenated layer fell to less than half the thickness measured pre-discharge, a caution threshold would be exceeded). Sediment profile imaging for MWRA monitoring is done in August.

The 2017 annual sediment monitoring showed that the redox potential discontinuity (RPD) depth was the second deepest observed at the outfall site and did not exceed the threshold (did not fall below the minimum RPD threshold; see explanation below). Sediments in the nearfield continue to remain well oxygenated and are not experiencing habitat degradation due to organic matter enrichment.