OMSAP meeting

December 6, 2021

1 pm to 3:00 pm (to 3:30 pm for PIAC meeting)

Final agenda

1:00 pm	Welcome and intros (Judy Pederson, Julie Simpson, Matt Liebman)
1:15 pm	Monitoring results from 2020 and some 2021, Betsy Reilley, MWRA (includes discussion of annual nitrogen threshold and includes 10 minutes for Q and A)
1:45 pm	2021 Exceedances on low dissolved oxygen saturation in Stellwagen Basin and *Alexandrium*, Dave Wu, MWRA with contributions by Dan Codiga (includes 10 minutes for Q and A)

Two minute stretch break

2:10 pm	Bays Eutrophication Model (BEM) update, Dan Codiga, MWRA (includes 5 minutes for Q and A)
2:25 pm	Status of white papers; PPCP, PFAS, Microplastics, Judy Pederson MIT Sea Grant
2:30 pm	Overview from the Hypoxia in Cape Cod Bay forum on October 29, Pam DiBona (includes discussion of next steps)
3:00 pm	PIAC meeting all are welcome to join; Adjourn for everyone else

Welcome and intros

We asked people to put names in the chat so we can document who attended. Went over ground rules for meeting.

Julie Simpson of MIT Sea Grant hosting and Judy Pederson moderating.

Judy welcomed everyone and summarized the agenda.

Monitoring Results from 2020 and 2021

Betsy Reilley providing a brief update on 2020 results and where available, 2021 results. MWRA has finalized the annual report required by the permit by November 15, the Outfall Monitoring Overview. This is a high level overview, and Dave Wu will be going into the details of Contingency Plan exceedances in 2021.

We have completed all the 2020 monitoring and reporting. Covid impacted many elements of the monitoring including scheduling and collection of some parameters, but MWRA focused on monitoring parameters specific to the Contingency Plan thresholds.

The missing March survey did preclude calculation of some thresholds but there were sufficient data to report on all other thresholds. The Covid restrictions were relaxed for the June 2021 survey

Deer Island received the Platinum 14 award from NACWA; MWRA has met permit effluent limits with no violations for 14 consecutive years. Reminder about Contingency Plan (CP) thresholds; they are not necessarily based on a detrimental effect on the environmental; rather, they represent a change from baseline conditions. Given enough time, changes from baseline would not be unexpected.

2020 was a typical year, water quality remains good, no obvious adverse effects on Mass Bay. Here are some highlights from 2020.

Short bloom of *Alexandrium* triggered rapid response surveys, and no PSP toxicity observed. A larger bloom of *Karenia mikimotoi*, first seen in 2017, was observed and is now a regular part of the summer phytoplankton assemblage. Temperature is increasing and 2020 had some of the highest observed in the program.

For 2021, the monitoring season concluded in November 2021, and then final results will then be reported. There were some CP exceedances. There was an *Alexandrium* bloom that triggered rapid response surveys. *Alexandrium* bloom started in Mass Bay in 2021, which is a different pattern, but no PSP toxicity observed. There were two low dissolved oxygen (DO) percent saturation exceedances and one low DO concentration exceedance for Stellwagen Basin. There was a total nitrogen load exceedance in 2019, but not 2020, and one is not projected for 2021. Lobster, flounder, and mussels collected every three years, no issues reported.

Betsy summarized results from the Hypoxia in Cape Cod Bay forum held on October 29, 2021. Hypoxia appears to have been caused by a combination of factors, the bloom of *Karenia* provides organic matter in Cape Cod bay, which is decomposed and consumes oxygen, the winds promoted stratification, and increased temperatures promoted stratification also, and the fall mixing events were delayed.

In the Outfall Monitoring Overview, the MWRA has included a section that looks back at projections. Projections for effluent discharge of BOD, TSS, and metals were estimated to be higher 30 years ago in the Supplemental EIS than the actual results, which is good. Metals and other compounds are also much lower than estimates, and that is a testament to the MWRA TRAC pretreatment program.

Regarding monitoring of the SARS-COV2 virus (done by the MWRA contractor Biobot Analytics), you can see that there is a surge underway. MWRA's monitoring measures RNA for the virus and can't (currently) distinguish among variants. It is collected 3 to 7 times per week, and data shared with the governor and the state command center. (Update: Betsy contacted us on December 8 and provided a link to this news article that implies that the Biobot team is developing a method to detect the omicron variant in the effluent).

https://www.wcvb.com/article/this-mass-wastewater-treatment-plant-could-detect-spread-of-omicron/38444451

Discussion and questions:

Peter: How sure are we in the identification of *Karenia*? Betsy feels that Dave Borkman has a good handle on this and has a high level of confidence. Unfortunately, it is a new actor in the area.

Bruce: What would you find alarming regarding DO concentration and saturation? Betsy feels that the percent saturation isn't biologically significant, but more concerned about concentration. She is probably more concerned about levels at around 4.8 mg/l in marine waters.

Jeff Kennedy (in the chat) asks about whether this decline in DO has been observed previously. The notes seem to indicate that the answer in the chat was "no", but here is MWRA's clarification provided on December 21, 2021: Low DO % saturation below the warning threshold has been observed multiple times at this location in the past (pre and post outfall relocation). Low DO % saturation below the background has been observed twice; 1 time pre-outfall relocation, and this recent event.

Question from Ben Haskell, is station F22 really in Stellwagen Basin? Answer -- we will look into it, but it has always been assumed to be in Stellwagen Basin and is 80 meters depth. Here is MWRA's added clarification provided on December 21, 2021. Station F22 is one station in a group of stations denoted "Stellwagen Basin" because all the other stations are more unambiguously within the central part of the basin. After the monitoring program was scaled back, F22 is the only one in this group of stations still being sampled. This is why we still refer to it as the Stellwagen Basin station, and although it is at the far northern edge of the basin, we don't think this description is sufficiently inaccurate to be worth changing.

Bill Kiley asks whether *Karenia* was always here and MWRA could have missed counting it. Answer is that MWRA is confident that they would have counted it if it was present because all phytoplankton in the water samples are counted.

Betsy: We are seeing a confluence of different conditions that exacerbated the conditions for hypoxia and low DO. I like to be careful to say that an occurrence or two doesn't necessarily make a trend, but it is something certainly to be watching.

Jeff Kennedy confirmed in the chat that *Karenia* is new in the last 5 years.

Dave Wu, talking in more detail about the CP exceedances from 2021

First a reminder, the CP is part of Deer Island's NPDES discharge permit.

In 2021 there are four CP exceedances, for *Alexandrium* and DO. Dave summarized a little *Alexandrium* life history in Mass Bay, occurs in the late April to and peaks in May and June, it is variable year to year, the CP threshold is >100 cells per liter.

Exceedance led to rapid response monitoring. *Alexandrium* observed in all samples on June 23, seven stations were over the threshold, and levels peaked on the July 1 survey. Bloom disappeared by the end of July.

In the past, we think there was probably not an outfall influence because blooms were transported into Mass Bay from the Gulf of Maine from the north. But this year, the bloom appears to have been decoupled from Gulf of Maine. It is possible that some cysts beds have been established in Mass Bay, due to a bloom in 2019.

Regarding the DO exceedances on September 8 and November 2, the nearfield stations met all the thresholds on both dates. The thresholds are based on the stratification season, through October, but due to weather the October survey was moved to November 2. Still, the F22 (Stellwagen Basin) station

was not completely mixed to the bottom by November 2. The warning level for percent saturation at the Stellwagen Basin location was exceeded on both dates. For the DO concentration exceedance, the SB station exhibited a value of 5.89 mg/l on November 2, which is below the state standard and the warning level. But Dave stressed this is not considered hypoxic conditions which would be much lower (~2-3 mg/L).

Depletion of DO in Nearfield and SB is natural. However, the nearfield stayed above the thresholds, and SB (F22) did not. It is clear that seawater temperature in Mass Bay, including F22, is warming, at both the surface and bottom. Mixing didn't occur in the bottom waters of F22. The depleted oxygen levels are probably related to warming and could account for most of the decline. They will look at that in more detail. But, nutrient levels at F22 haven't changed over the years. And, there is an increase in temperature at F22 in both surface and bottom waters, and a decline in oxygen in both surface and bottom waters. These patterns are seen at stations across the bay.

Discussion and questions:

Regarding Alexandrium Todd asks: What does it mean for outfall influence?

Ken Keay said that they modelled *Alexandrium* around 2005 to look at the outfall influence.

Bruce Berman said that is not what happened this year, this year it is a change. And, so maybe there is a change in the way we should think about it.

Was there a bloom in the Gulf of Maine this year? Scott Libby said it was not a big bloom this year.

Discussion suggested that perhaps there is an outfall effect this year, in relation to the way the bloom appears to have occurred within Mass Bay without having been advected into the bay from offshore. However, this can happen-- cysts beds being established more permanently within the bay, making blooms possible there without coming in from offshore—even with no outfall effect. More investigation is needed.

Is the decline in DO concentration, but not DO percent saturation climate change related? Saturation is a function of temperature, so you would expect to see a decline as temperature increases. Overall, there is a long term trend in declining DO concentration and increasing temperature and that indicates a relationship to climate change because we know that warmer water holds less oxygen than colder water.

Dan Codiga, MWRA update on the Bays Eutrophication Model (BEM)

This is a requirement of the permit. It is a hindcast model, not a forecast model.

Its main goal is to model the potential for eutrophication in the outfall area, recently updated by Deltares.

Ad hoc Model Evaluation Group (MEG) evaluated the modeling report and said it is working as well as previous model. This was presented at the May 2021 OMSAP meeting. The ad hoc MEG said to look at the model performance at the diffuser looking at small scale variability in the plume.

There is a backlog because of the transition to a new modeler and model. Simulations are underway and reports are finishing up.

Exploratory investigations have been conducted in the past and will be performed using the new model. We are going to re-examine topics from the 1990s, e.g. looking at fraction of nitrogen contribution from MWRA effluent in Mass Bay and Cape Cod bay.

Also, people have asked if the model can be applied to hypoxia in Cape Cod Bay. This would be difficult because the model isn't calibrated for the shallow southwestern part of Cape Cod Bay where hypoxia occurred, individual species (such as Karenia) are not modeled (the model has four generic phytoplankton groups), and the thin near-bottom layers and short time scales involved are hard for any model to capture.

No questions on this topic.

Judy Pederson, status of White Papers on CECs

We have completed two of the three papers, the third one is on microplastics. MIT Sea Grant is going to going to publish them. Microplastics is dangling out there, and the OMSAP folks are looking at it, but we are also waiting on some peer reviewers that will be available later in December.

We know that some of the actions have already been taken, for example, PFAS is now included in drinking water standards, there are six PFAS monitoring requirements in NPDES permits, and new methodologies for monitoring have been standardized. Some of our general recommendations that haven't been accomplished yet include the need to develop water quality or tissue standards and monitoring protocols, to Identify sources presence, risk assessment and what is in the influent and effluent, conduct special studies to address gaps in understanding transport and fate of CECs in general.

No questions on this topic.

Pam DiBona, overview from the Hypoxia in Cape Cod Bay forum on October 29

Speakers included Judy Pederson, Tracy Pugh from MA DMF, Malcolm Scully from WHOI, Dan Codiga from MWRA, Jeff Barbaro from USGS, Dave Borkman from URI, Mark Tedesco from LISS plus a panel discussion. Observations started in 2019 of low DO in Cape Cod bay, DMF recruited fleet of fisherman to help monitoring, and also CCS, were able to track the low DO spatial extent. Observations and analyses seem to indicate that a bloom of *Karenia*, which produces a lot of organic matter, lives in low light conditions in the pycnocline, combined with changing wind conditions that pushed the cells to SE Cape Cod Bay and promoted stratification, rather than mixing. Some interesting issues include that the temperature was higher, which promoted reductions in DO; *Karenia* prefers ammonia as a nitrogen source and you can see that when nitrogen is depleted, there is more *Karenia*; *Karenia* is a recent inhabitant in the bays.

What are the next steps? People agree that *Karenia* appears to be a likely cause combined with climate factors.

Need funding for continued monitoring including the Cape Cod fleet is important, to fill in the gaps, and get granular monitoring. We need access to models.

Discussion and questions:

Looks like the nitrogen levels and types are critical. Looking at the nitrogen species, Amy Costa of CCS says that all the nitrogen species are collected, and *Karenia* is taking up the bottom nitrogen.

Betsy stressed the factors that favor a *Karenia* blooms were present; low light, ability to outcompete other species, preference for ammonia, and the physiology of *Karenia* is well suited to take advantage of the conditions in Cape Bod bay.

Jeff Rosen says we have a lot of hypotheses on the table, and we need to sit down and put down a design. And ask the question, does the outfall have a role in this?

Jeff says we need a clearly articulated question and sampling plan.

Judy says that we need an interim meeting to figure out the sampling to address these questions.

MWRA added this later, in an email on December 21, 2021: be sure to fully explore the existing observations before concluding that new sampling is necessary. MWRA is working on some follow-up investigations.

So, next steps are to schedule a meeting to make specific recommendations to the MWRA for addressing these questions regarding *Alexandrium* blooms and for potential contributions to low DO in Cape Cod bay, e.g. by stimulating a *Karenia* bloom.

Presentations have been posted here:

https://drive.google.com/drive/u/0/folders/12c9iJtcbjvES1x6sC6O5JouwFF5QMdRQ

We had 65 participants listed via the zoom record, which may be a record, and over 50 people stayed to the end, before the PIAC meeting. Regarding OMSAP members, Loretta Fernandez attended for the second half only. Ginny Edgcomb couldn't make it due to taking care of her mother. Mark Patterson and Bob Beardsley did not attend.

Here are the attendees based on zoom record and sign in via chat function.

Category	Name	Affiliation
OMSAP	Jeffrey Rosen	Corona Environmental Consulting
OMSAP	Judith Pederson	MIT Sea Grant
OMSAP	Juliet Simpson	MIT Sea Grant
OMSAP	Loretta Fernandez	Northeastern University
OMSAP	Peter Burn	Suffolk University
OMSAP	Robert Kenney	URI Oceanography
IAAC	Ben Haskell	Deputy Superintendent, Stellwagen Bank National Marine Sanctuary
IAAC	Matthew Liebman	EPA Region 1
IAAC	Todd Callaghan	MA CZM
IAAC	Jeff Kennedy	MA Division of Marine Fisheries
IAAC	Prassede Vella	MassBays and MA CZM
IAAC	Cathy Vakalopoulos	MassDEP
PIAC	Heather McElroy	Cape Cod Commission
PIAC	Amy Costa	Center for Coastal Studies
PIAC	Owen Nichols	Center for Coastal Studies
PIAC	Rich Delaney	Center for Coastal Studies
PIAC	Pam DiBona	MassBays and MA CZM
PIAC	Bruce Berman	Save the Harbor

PIAC	Chris Mancini	Save the Harbor
PIAC	Andreae Downs	Wastewater Advisory Committee
MWRA	Carolyn Fiore	MWRA
MWRA	Dan Codiga	MWRA
MWRA	David Wu	MWRA
MWRA	Douglas Hersh	MWRA
MWRA	Fang Yu	MWRA
MWRA	Jianjun Wang	MWRA
MWRA	Lucner Charlestra	MWRA
MWRA	Maret Smolow	MWRA
MWRA	Michael Altieri	MWRA Associate General Counsel
MWRA	Rebecca Weidman	MWRA
MWRA	Sally Carroll	MWRA
MWRA	Steve Rhode	MWRA
MWRA	Wendy Leo	MWRA
MWRA	Betsy Reilley	MWRA
MWRA	Denise Ellis-Hibbett	MWRA
MWRA	Eric Sanderson	MWRA
MWRA	Chris Goodwin	MWRA
MWRA	Karen Graham	MWRA Librarian
EPA	Betsy Davis	EPA Region 1
EPA	Ed Reiner	EPA Region 1
EPA	Michele Barden	EPA Region 1
EPA	Steve Wolf	EPA Region 1
	Ellen Baptiste Carpenter	Battelle
	Scott Libby	Battelle
	Bill Kiley	Boston Water and Sewer Commission
	Eileen Snedeker	Boston Water and Sewer Commission
	Brianne Shanks	MA Division of Marine Fisheries
	Chrissy Petitpas	MA Division of Marine Fisheries
	Devon Winkler	MA Division of Marine Fisheries
	Kaley Towns	MA Division of Marine Fisheries
	Tay Evans	MA Division of Marine Fisheries
	Jim Barsanti	MassDEP
	Carolina Bastidas	MIT Sea Grant
	Ken Keay	MWRA Retired
	Jake Kritzer	NERACOOS
	Meagan Riley	NOAA Fisheries
	Maureen Madray	Normandeau
	Barbara Warren	Salem Sound Coastwatch
	Qichun Xu	UMass Dartmouth
	Alexa Sterling	University of Rhode Island
	Barbara Moran	WBUR
	Carlton Hunt	

Christine Werme
Kelly Coughlin