Evaluating CSO and SSO Notifications to the General Public and Board of Health in Massachusetts

An Interactive Qualifying Project Report
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Abstract

MassDEP is interested in better engaging with city and town Boards of Health (BOHs) departments and community Environmental Justice Organizations' to better understand the new sewer overflow notification system. We conducted surveys with 87 Boards of Health. We also conducted a short survey of 20 of Environmental Justice/Watershed Advocacy Groups to gauge the effectiveness of the new notifications system. We found training along with having an overflow event increased understanding of the new regulations drastically. Our recommendations based on these findings are to hold future training with scenario-based training alongside supplementary material that summarizes the requirements for BOHs and further research into the underlying problems of the communication system.

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Executive Summary

Combined sewer overflows (CSO) and sanitary sewer overflows (SSO) systems are important for helping mitigate flooding. Moreover, the pipe system, connected to municipal stormwater and sewage water systems, is already in place across the United States. CSO and SSO, however, can lead to a number of public health issues when raw sewage flows into bodies of water without being treated. The end result is a contaminated body of water. In the Northeast and some communities in the Midwest, drainage for stormwater and sewage use the same pipe systems due to old infrastructure (Rhea, 2021). Due to the cost and inconvenience to the general public, replacing all the combined sewage and stormwater pipes is not practical for many areas throughout the commonwealth making public notifications of CSOs important. Contact with contaminated water has previously caused gastrointestinal related illness to members of the public.

In January 2021, Governor Baker signed 314 CMR 16.00 into law requiring notifications of a Combined Sewer Overflow. This law did not get fully implemented until July 6th, 2022. This law consists of five subsections, but for the purposes of this research, we focused on the public health warming requirements. Per the law, public health warnings are supposed to originate from the Boards of Health (BOH) or Health Departments (HD) and require temporary signage. In some locations, permanent signage by public access points close to the water, such as a public beach, is required.

CSOs and SSOs are not only an issue in Massachusetts but are also an issue across the country. Some states have legislation about CSO and SSO notifications, which Massachusetts has based their regulations off of. The two main States that we focused on are New York and

Michigan. New York passed a bill in 2012 called the "Sewage Pollution Right to Know Act, a bill mandating public notices be issued within four hours of when raw or partially treated sewage is discharged into New York waters" (Callegari, 2012). In Michigan 72 million dollars to improve the sewer infrastructure due to the Clean Water Act making it unlawful to discharge any pollutant from a point source into navigable waters (Mount Clemens-Clinton-Harrison Journal (Michigan), 2022). Massachusetts was able to mimic the legislation of New York and Michigan to create an effective notification plan.

With the new legislation in place, notifying community members is the main focus to prevent contact with the contaminated water. In Massachusetts CSO permittees are required to notify the BOH of a CSO event with the following information, location, date, duration, and volume of discharge. After the BOHs are aware of the situation, they are required to notify the public in addition to local News stations in the area to avoid contact with the contaminated water. BOHs are also required to put up temporary signs near public access points with infographics, and a translation of the warning if there is a minority population that represents 25 percent or more in the area near the outfall that does not l. In addition to notify the public, the overflow needs to be recorded in the public database found on the Mass.gov website, which allows anyone to look up incident dates and filter through it to get valuable information of CSO events that required notifications. Participant observation was the best way we learned about it, and it allowed us to be able to compile data where the CSO events were happening across Massachusetts.

The database was helpful in finding the outfalls across Massachusetts, and frequency of discharges. We were able to access data which told us the duration of the discharge. The volume

was not something the CSO permittee were initially able to input, but now they are able to input the volume.

We conducted a survey with BOHs across Massachusetts to better understand their comprehension of the new regulations. The questions consisted of multiple choice, selected all that apply, and short answers. We sent out the survey to 241 BOH and HD, but only received 87 responses. The first multiple choice question asked if the BOH had attended training hosted by MassDEP. 55.6% of BOH answered that they had attended training, while 48.3% of the BOH did not attend the training. BOH that attended training and did not have a CSO event had a confidence level of 28% pertaining to their understanding of the new regulations. Whereas similar BOHs that didn't attend a training, but a CSO event happened, their confidence level increased to 66%. However, BOH that attended training and no CSO event occurred, their base confidence level of the new regulations was much higher at 51%. BOH that had attended training and had a CSO event occurred had a confidence level of 77%. Another one of the multiple choice questions asked about the communication between BOH and CSO permittees. 80.5% of the BOH in Massachusetts stated that CSO permittees in their region had not contacted them in any form.

Our short answer questions were meant to help us better understand where these new regulations could be clearer to better support cities and towns. BOH were very expressive about their confusion from the new regulation in its entirety, ranging from the notification process to the signage. We would recommend MassDEP support training or summarized directions of what is required from them during a CSO event.

The training by MassDEP and/or a CSO event occurring in their jurisdiction increases their confidence level in responding to an event. The communication between permittees and

BOHs seems to be very minimal, but it is crucial in the notification process. There is also confusion between signage, and the notification process which is a critical issue because the BOHs are unable to notify the public if they cannot fully understand what is required on the signage or in the notification.

Our recommendation for MassDEP was that they should hold more training events for BOH and HDs focusing on the required signage and the notification process. More training events are helpful because BOH/HD that had attended training were more likely to understand CSO event requirements.

Another recommendation we have for MassDEP is that they make it clear when translations are needed for Environmental Justice Populations and help the BOH/HD with correct translations for their signage and public health warnings. In addition to MassDEP helping with translations and identifying the Environmental Justice populations, we believe that MassDEP should continue to reach out to community organizations so that the organizations can be as informed as possible.

In addition to more training, we found that changing the method of training might be beneficial. For example, we believe that a more hands on learning approach would help the BOH/HD understand the regulations better. The hands-on learning could be a factious scenario during a training seminar which would allow for the BOH/HD to practice how they would respond to an actual scenario. Another form of training we would also recommend online modules which would allow BOHs and HDs to learn at their own pace. This online training could also have a summarized list of what to do when a CSO event occurs.

Our recommendations about how training is delivered, and the frequency of it will lead to BOHs across Massachusetts being able to notify the public with the correct information in a

timely manner. The surveys we conducted not only benefit MassDEP to understand where more training is needed, but it also benefits the general public because the BOH will be able to respond to a CSO event faster due to their better understanding of the new regulations which will prevent the public from coming in contact with the contaminated water.

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Definitions

BOH - Boards of Health
CSO - Combined Sewer Overflow
HD - Health Department
IQP- Interactive Qualifying Project
MassDEP - Massachusetts Department of Environmental Protection
POTW - Publicly Operated Treatment Works
SSO - Sanitary Sewer Overflow

Chapter 1: Introduction

Sewage waste is a global problem and can have many different causes like overflows and lack of infrastructure. In Massachusetts, a frequent health concern is the overflow of sewage systems considering there have already been over 500 overflows so far this year (CSO Data Portal, 2022). MassDEP has been working with cities and towns to implement a new notification and signage system to warn people of public health risks. A combined sewer overflow (CSO) describes untreated stormwater and wastewater being released into nearby bodies of water when the volume of wastewater exceeds the capacity of the Combined Sewer System (CSS) and, in some cases, exceeds the sewer treatment plant. A sanitary sewer overflow (SSO) is an event that can happen in both a CSS and sanitary sewer system which unlike a CSS just deals with sewer water and not stormwater. An SSO occurs when wastewater from a sanitary sewer system reaches surface water somewhere like a lake, pond, or river. This can happen in various ways, such as maintenance in a POTW or a problem with a pump in the sewer system. An SSO overflow can contain hazardous chemicals and bacteria that can cause harm to health (Jagai et al., 2017) interaction with contaminated water by fishing, or swimming is not recommended for 48 hours after an overflow stops.

Sanitary Sewer Overflows pose a danger to the general public and while random parts of the sewer system breaking are not predictable, CSOs, on the other hand, can be predicted to a certain degree using the weather in the area. Preventing all CSO and SSO events from happening would be very difficult due to the old age of storm and wastewater infrastructure and the expense

of replacing all the combined sewer pipes, but notifying the public promptly is a possibility. This is why Massachusetts passed regulation 314 CMR 16.00, “Notification Requirements to Promote Public Awareness of Sewage Pollution”. Another aspect that makes notifying necessary is the frequency of the sewer overflow events. In a little over two months since notification requirements went into effect and a public database of the events was made public, there have been over 500 occurrences (reported from the CSO Data Portal, on 9/11/2022) of CSOs and SSOs. That is roughly seven and a half sewer overflow events a day on average in Massachusetts, which again, is just another example of why these notifications are so important. However, it should be noted that the overflow event will vary in size which is information that is described in the notifications.

A group of WPI students dealt with this issue in 2021. They suggested more signage around the outfall locations. An outfall is an “outlet designed for the purpose of allowing a discharge that is part of, or connected to, a combined sewer system, sanitary sewer system, or treatment works” ("314 CMR: DIVISION OF WATER POLLUTION CONTROL", 2022, pg. 3). They also suggested a new notification system that would be an opt-in subscription rather than an opt-out, and the notifications would be sent by text, email, or reverse 911 depending on what the subscriber would prefer (Williamson et al., 2021).

MassDEP has had continued contact with permittees, which are sewer authorities across the state with permits to discharge in specific locations. There has been less effective communication, however with cities and towns' BOHs and HDs about effective regulations. Specifically, Boards of Health in Massachusetts have an important part in sewage awareness when an overflow event happens. To help the BOH and HD understand the regulations better, we gathered data on what they do know.

By collecting this data, we were able to provide analysis and recommendations to MassDEP regarding education on the requirements of the new regulation. We hope by achieving this goal we can better serve the people in Massachusetts by helping improve the system that notifies them.

We also investigated community outreach about these events through watershed, community, and environmental organizations. We looked at the CSO permittees that have CSO-related events and the frequency of these events, and the watershed locations for these events. The watershed location is the actual waterway where the overflow was deposited. Both helped provide the information needed for investigating how the notification process is reaching the general public. Using the information we identified watershed, community, and environmental organizations close to these events and investigated how and if these organizations were promoting notifications about overflows. By doing this we again hope to better serve the people in Massachusetts by increasing awareness about sewer overflow notifications.

Chapter 2: Background

2.1 Combined Sewer Overflows

Combined sewage overflows (CSO) collect rainwater, sewage, and wastewater all into one pipe. The wastewater is normally transported to a treatment plant so that it can be treated and then discharged into the water. In some cases, the treatment system overflows due to heavy rainfall or snow melting and flooding the pipes. When the treatment plants overflow, it is designed so the untreated water flows directly into the nearby bodies of water. CSOs contain a mixture of stormwater, partially treated sewage and debris. 860 municipalities across the U.S. have CSOs (Rhea, 2021).

2.2 Sanitary Sewer Overflows

Sanitary Sewer Overflows (SSO) happen when untreated sewage water is discharged into nearby water areas before reaching a treatment facility. SSOs can have a variety of severe impacts. A sanitary sewer system differs from a combined sewer system in that a sanitary sewer system has different pipe networks for stormwater and sewer water. Similar to a CSO, an SSO occurs when the flow in the sewer system exceeds the system's capacity. An SSO can occur in both dry and wet weather but is more common in wet weather and is vulnerable to events with increased precipitation. SSOs happen in dry weather for various reasons including having an older sewer system. These older sewer systems have less capacity and an increase in flow overwhelms the system causing an overflow or sewer breakage.

A pipe breaking in a sewer system can also cause an SSO event. This is more of a risk where infrastructure is on the older side, which in Massachusetts is a common occurrence (Golden, 1995).

In the U.S. "SSO reporting requirements vary from state to state. Several states, including California, Texas, and Massachusetts, have passed laws mandating the reporting of SSOs, Massachusetts"(Jagai et al., 2017). Even still, the current status of knowledge is not very high. This is due to the type of reporting to the public when events like this happen. If the event is big enough, then it is likely to make the news, but smaller instances like part of a pipe breaking may not.

2.3 Impacts and Effects of Sewage Overflows

Both CSOs and SSOs are known to be a public health risk and are part of the reason for the new notification regulations in Massachusetts. This is due to sewage overflows impacting

water sources, which can cause an ecological impact by pouring sewage waste into these waterways, causing water pollution.

Sewage waste being discharged into water by an overflow can cause serious health impacts. When an overflow occurs, it might contaminate water areas with "pathogenic microorganisms associated with untreated sewage, including protozoa (e.g., Cryptosporidium sp.), viruses (e.g., norovirus, adenovirus), and bacteria (e.g., Salmonella sp.) (Jagai et al., 2017). These pathogens can cause infections with diarrhea, nausea, vomiting, and upper respiratory issues. In addition, a study was done in 2006-2007 on SSO events and ER (Emergency Room) visits where 270 SSO events were found to cause 66,640 visits to the ER involving gastrointestinal illness (Jagai et al., 2017).

Another interesting study about health and overflows concluded that "heavy precipitation in combination with high percentages of imperviousness is associated with a higher incidence rate of COVID-19 cases in counties with a Combined Sewer System (CSS) compared to in counties without a CSS. The results suggest implications for COVID-19 in relation to CSOs "(Chan et al., 2022).

Overflows can also have economic impacts. In the city of New Bedford, Massachusetts, there were various occurrences when an overflow event closed public beaches and fishing areas (Beard, 2022). These closures can negatively impact any businesses that rely on visitors to beaches and fishing areas.

2.4 The United States Sewer Pollution Regulation

2.41 New York

New York passed a bill in 2012 called the "Sewage Pollution Right to Know Act, a bill mandating public notices be issued within four hours of when raw or partially treated sewage is discharged into New York waters" (Callegari, 2012). This is very similar to Massachusetts's new CSO notification regulations. This bill does not cover CSOs, however, they have also implemented a database system with "sewage discharge reports"(Vedachalam et al., 2016). New York's reasoning for enacting this bill is the same reason why Massachusetts is implementing a notification policy. Both states are notifying the public to prevent people from coming into contact with sewage-contaminated water (Callegari, 2012). This implementation by New York follows other states including Connecticut (Callegari, 2012).

2.42 Michigan

Michigan is well aware of the failings of its water and sewer systems and so "The Clean Water Act was passed by a large bipartisan coalition in Congress and took effect on October 18, 1972. It was passed in response to growing concerns about water pollution in our rivers and lakes (Advocates and Lawmakers Celebrate 45th Anniversary of Clean Water Act, 2017). In Michigan, "Combined sewer overflows and failing septic systems alone account for an average of 15.1 billion gallons of raw sewage entering Michigan's lakes and rivers annually" (Advocates and Lawmakers Celebrate 45th Anniversary of Clean Water Act, 2017). This has brought up the need for rebuilding sewage infrastructure in recent years, with Macomb County planning to spend millions on infrastructure with "$72 million the county has been promised will help rehabilitate infrastructure, prevent combined sewer overflows and protect residents from basement flooding" (Kristyne E. Demske, March 31, 2022). The infrastructure spending plan brings millions to Macomb County. (Mount Clemens-Clinton-Harrison Journal (Michigan), 2022). In addition to the sewage infrastructure being rebuilt, Michigan has a law stating that the

person responsible for the sewer system is required to notify their department and local Health Departments by telephone or in another manner. The person responsible for the sewer system also has to report the duration, quality, and reason for the overflow shortly after the conclusion of the discharge. (*Michigan Legislature - Section 324.3112a*. (2004))

2.5 Massachusetts

2.51 MassDEP

MassDEP is a constituent department of the Executive Office of Environmental Affairs, established by the Massachusetts Legislature in 1975. MassDEP is a government organization at the state level in Massachusetts. The governor of Massachusetts appoints the commissioner of MassDEP. MassDEP strives to enhance Massachusetts's resources when it comes to air, water, and land. Often, a state organization's work spans the local, state, and federal levels of government. Any partnerships, whether with their cities, towns, legislators, or other government agencies, would be done through the Office of Municipal Partnerships and Governmental Affairs. For example, MassDEP sometimes communicates with the United States Environmental Protection Agency (EPA). (Brief History of EEA | Mass.Gov, n.d.) (MassDEP, 2022)

2.52 314 CMR 16.00

314 CMR is the Division of Water Pollution Control in Massachusetts, and 314 CMR 16.00 is Notification Requirements to Promote Public Awareness of Sewage Pollution. 314 CMR 16.00 are the actual regulations requiring notification for sewer overflows in Massachusetts, so it is important to understand what information is in these regulations. The regulations have 10 sections which are labeled as the following:

16.01: Purpose, Authority and Applicability

16.02: Definitions

16.03: Events Requiring Notification

16.04: Requirements for Public Advisory Notifications

16.05: CSO Permittee Website and Signage Requirements

16.06: Public Notification Plans

16.07: Permittee Reporting Requirements

16.08: Waivers

16.09: Public Health Warnings

16.10: Enforcement, Violations, and Right of Entry ("314 CMR: DIVISION OF WATER POLLUTION CONTROL", 2022)

2.53 Permittees

In Massachusetts, there are currently 19 CSO permit holders that operate in various parts of Massachusetts. The permittees are Boston Water and Sewer Commission/ MWRA, Cambridge, Chelsea, Chicopee, Fall River, Fitchburg, Gloucester, Greater Lawrence Sewer District, Haverhill, Holyoke, Lowell, Lynn, Montague, Massachusetts Water Resources Authority (MWRA), New Bedford, Somerville, Springfield, Taunton, and Worcester. These permittees are granted a permit to operate and maintain a particular outlet for the discharge of pollutants into the waters of the commonwealth (Session Law - Acts of 2020 Chapter 322, 2020). In addition, there are 222 non-CSO permittees across Massachusetts. These permit holders have a National Pollutant Discharge Elimination System (NPDES) permit, which allows them to discharge from a point source into waterways or areas. The NPDES permit program is administered solely by the US Environmental Protection Agency. It is important to understand

that permittees need the NPDES permits to be able to discharge wastewater in an overflow event. (Sanitary Sewer Systems & Combined Sewer Overflows | Mass.Gov, n.d.)

CSO permit holders are in various locations across the state. However, they include most of the older urbanized communities in Massachusetts. Whereas Non-CSO permittee holders are spread across the state and not just in high-population areas.

A big part of the regulation that is going into effect now is strengthened notification requirements about overflow occurrences in Massachusetts. When public notification is required due to an overflow, it will be because of the following events:

> Any Combined Sewer Overflow; (b) Any discharge of partially treated wastewater, including blended wastewater; (c) Any Sanitary Sewer Overflow (SSO) that discharges through a wastewater outfall, either directly or indirectly, into a surface water of the Commonwealth; (d) Any SSO that flows into a surface water of the Commonwealth and is the result of the sanitary sewer system surcharging under high flow conditions when peak flows cannot be conveyed to a POTW due to capacity constraints; and (e) Any SSO that flows into a surface water of the Commonwealth and is the result of a failure of a wastewater pump station or associated force main designed to convey peak flows of 1 million gallons per day or greater. ("314 CMR: DIVISION OF WATER POLLUTION CONTROL", 2022, pg. 4)

Within the actual notification, a description of the discharge, date and time, the estimated volume of the discharge, and the identity of the permittee are all required. In-depth information about the approximate time and date that the discharge or overflow ended, the waters and land areas affected or potentially affected by the discharge or overflow, and precautionary measures to be taken by the public are also required in the notification. Finally, additional information,

such as a link to the permittee's website for additional information on discharges and overflows, and a statement that the discharge may consist of untreated or partially treated sewage and waste, is again required on the notifications. ("314 CMR: DIVISION OF WATER POLLUTION CONTROL", 2022, pg. 5-7)

In addition, CSO permittees have a signage responsibility for when overflow occurrences happen. In MassDEP's combined sewer overflow preliminary public notification plan it describes what the permittees should do for signage, The description is as follows and examples of signage can be seen in figures 1 and 3:

> Each permittee shall install and maintain a warning sign at each of its CSO outfalls in accordance with requirements of its NPDES and surface water discharge permits. Each permittee shall install and maintain signage at public access points to waters affected by a potential discharge from a permittee’s outfall. The locations for the signage shall be based on consultation with Boards of Health or Health Departments in the municipalities directly impacted by the discharge. Each sign shall identify: (a) The existence of the outfall; (b) The permittee; (c) Information about weather events that may cause a discharge; (d) A warning of the potential threat to public health by recreating in, or using waters and shores affected by a discharge; and (e) Information for the public to subscribe to notifications about discharges in local area waters. For discharges directly affecting neighborhoods identified as environmental justice populations due to lacking English language proficiency, signage shall provide access to translations in the language(s) most appropriate for those neighborhoods and shall utilize universal symbols.

Figure 1 *Boston Water and Sewer Commission Outfall Sign, Boston* (own photo)

Each CSO permittee has anywhere from one to thirty outfalls they are responsible for. An "Outfall" is an outlet designed to allow a discharge that is part of or connected to, a combined sewer system, sanitary sewer system, or treatment works, including a connection to any such system or facility intended to allow wastewater to divert or bypass treatment by a facility. (Session Law - Acts of 2020 Chapter 322, 2020) The number of outfalls varies from permittee to permittee, with the most being 30 outfalls for a single permittee and the least being 1 for a single permittee. In total, there are 199 different CSO outfalls for the 19 different CSO permit holders in Massachusetts. A map of the outfall locations can be seen in Figure 2. Non-CSO permittees also have outfalls.

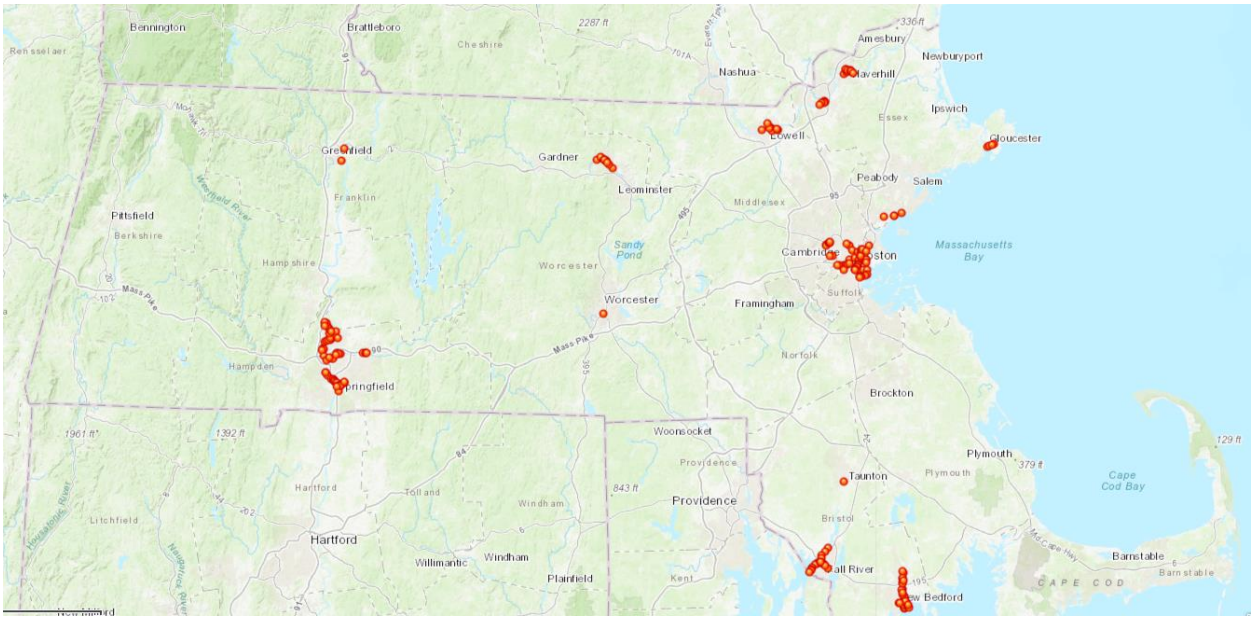

Figure 2 *Map of CSO outfall locations in Massachusetts* (EEA, MassDEP, 2022)

In addition, it should be noted that there does not seem to be any major significance between the number of outfalls and overflow occurrence as discussed more in our results section.

Another important part of these new regulations is sanitary sewer overflows (SSO). This is because, in the event of an SSO, a notification is required, similar to a CSO occurring. As mentioned a bit earlier some of the SSO events requiring notification are “Any Sanitary Sewer Overflow (SSO) that discharges through a wastewater outfall, either directly or indirectly, into a surface water of the Commonwealth; (d) Any SSO that flows into a surface water of the Commonwealth and is the result of the sanitary sewer system surcharging under high flow conditions when peak flows cannot be conveyed to a Publicly Operated Treatment Works (POTW) due to capacity constraints; and (e) Any SSO that flows into a surface water of the Commonwealth and is the result of a failure of a wastewater pump station or associated force main designed to convey peak flows of 1 million gallons per day or greater("314 CMR: DIVISION OF WATER POLLUTION CONTROL", 2022 , pg. 4, pg. 11)”. It is important to

understand that SSOs can apply to both CSO and Non-CSO permittees. Another important piece of information is the SSOs that do not require notification. According to the regulations, “A permittee is not required to issue a public advisory notification for SSOs that are regulated under 314 CMR 12.00: Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Dischargers, except for the SSO events specified in 314 CMR 16.03(1)(c) through (e)”(Combined Sewer Overflow Preliminary Public Notification Plan Instructions, 2022, pg. 3).

2.54 Definition in the Regulations

The regulations include definitions for the regulations. These are important to understand what the regulations are asking for. Definitions can be found in Appendix A.

The way that discharge volume is measured is different from outflow to outflow. Therefore, MassDEP is considering meters to be any sensors that can be used to calculate volume (MassDEP, 2022). During the first training session, it was stated that anything other than metering to discover overflows would need to be approved by MassDEP and accurate (MassDEP, 2022). One way to calculate the volume of overflows that was given as an example was through computer modeling (MassDEP, 2022). This is an accurate method as long as the metadata coming from sensors is accurate (Brzezińska et al., 2016).

Permittees that have CSO outfalls that discharge are required to maintain signage at public access points that are affected. Regulations also require municipal Boards of Health or Health Departments in the area to issue health warnings and they are required to post signage under certain circumstances. This happens when Boards of Health or Health Departments in areas directly impacted by the following event “ (a) For CSO, partially treated, and blended

wastewater discharges, if the discharge has a duration longer than two hours; (b) For CSO, partially treated, and blended wastewater discharges, if the board of health or health department determines that a public health warning is necessary to protect public health, regardless of the duration of the discharge; or (c) For any SSO that requires notification pursuant to 314 CMR 16.03(1)(c) through (e)". When a board of health or health department experiences one of these events then they must issue a "public health warning using existing emergency notification systems, including if available, a reverse 911 emergency call system." The public health warning that the board of health or Health Department sends out must, at a minimum, have the following information:

> warning shall identify receiving waters affected and shall include: (a) The location, date, and time of the discharge or overflow; (b) A recommendation that the public avoid contact with affected water bodies for at least 48 hours after a sewage discharge or overflow, and during rainstorms and for 48 hours after rainstorms end, due to increased health risks from bacteria or other pollutants associated with urban stormwater runoff and discharges of untreated or partially treated wastewater; (c) Information on where to find the closure or advisory status of shellfish growing areas, beaches, or other water resource areas potentially affected by the discharge or overflow; and (d) Access to translations of the warning, as appropriate for neighborhoods identified as environmental justice populations due to lacking English language proficiency, in the language(s) most appropriate for those neighborhoods.

If a Board of Health or Health Department issues a public health warning, then they must also post a temporary sign or use a permanent sign in a visible area where the discharge took place. "Permanent signs installed and maintained by permittees in accordance with 314 CMR

16.05(3) may be used for this purpose", however, if a temporary sign is used there is required information. Information including a warning message, infographic warnings, translations if needed, information about closures regarding "shellfish growing areas, beaches, or other water resource areas potentially affected by the discharge or overflow", and finally contact info for the board of health. (New Regulations Requiring Public Notification of Sewage Discharges Into Waterbodies – East Boston Times-Free Press, 2022). An example of what is required on the signage is shown in Figure 3.

Figure 3. *Public access point sign template* This was given to CSO permittees in Massachusetts from a MassDEP email (MassDEP, 2022).

2.55 Training

MassDEP's job is to make sure that the CSO permittees in Massachusetts are ready for the new notification regulation. MassDEP has been holding training sessions for all of the 19 CSO permittees in Massachusetts on the requirements in 314 CMR 16.00. In addition, there was also training available on similar topics to non-CSO permittees, Boards of Health, and Health Departments.

The first two training sessions MassDEP held were on January 14, 2020, and January 20, 2020. These meetings were to help permittees understand the new overflow notification requirements to give them a good foundation for understanding how to create a CSO notification plan. MassDEP gave them the Permittees documents and templates laying out the steps of what their plan should look like and how to properly create one. Each meeting was about 2 hours long with no breaks and allowed for questions from those attending. The topics covered were what the permittee was expected to do for each section in 314 CMR 16.00 (CSO preliminary notification plan discussion for CSO, 2022).

The meeting for the Boards of Health (BOH) was not mandatory and out of the 351 BOH, only 64 people from the BOHs from across the state attended the first online meeting. Some of the people on the list were from the same town. While there are 351 BOHs only about 241 (Langley, 2022) are required to put up signage and issue public health warnings required by

the regulations. There was a total of three training meetings for the BOH to initiate communication and discussion.

2.56 Current Implementation

Over the summer of 2022, this new notification system has been implemented and used during combined sewer overflow (CSO) and sanitary sewer overflow (SSO) events. The data from the overflows can all be accessed via the database that includes the data collected from each event including the duration of the event, the location, and the number of overflows by location and in total (CSO Data Portal, 2022). The way they are collected varies and was approved by MassDEP in their proposal. The data portal has various fields available with various identifying information. There was identifying information about the permittee, identifying information about when and where the overflow took place and identifying information about the characteristics of the event.

For identifying information about the permittee, the following fields were available. Report number, which is an official number assigned to the report. There was also Permittee Name, which gives us the name of the permittee involved with the event. Next, there was Permittee ID, part of the identification for the permits each permittee has that allows them to discharge wastewater into surface waters. There was a Permittee Class, which gave information about the type of permittee doing the reporting. The type was either a CSO permittee or a non-CSO permittee. Also, there was Municipality, which gives us the town or city where the permittee is located which is useful since in some cases the permittee name does not match up since some permittees are a sewer authority and not a municipality. Finally, there was Outfall ID, which is an identifier.

For identifying information about when and where the overflow took place, the following fields were available. Incident date, Incident time, and an AM or PM category, all of which give precise information about when the overflow occurred. There was also a Water Body, which gave the surface water that was affected by the overflow. In addition, there was a road or pump station near where the overflow occurred. There is also longitude and latitude which give the precise outfall location of where the overflow occurred.

For identifying information about the characteristics of the event, the following fields were available. Reporting type, which gave information about what the event was when the reporting happened. For this category there seemed to be two main options, initial ceased and initial ongoing. Initial Ceased means the initial overflow has ceased when the notification was made and Initial Ongoing being that the initial overflow was still ongoing when the notification was made. There was also a reporting class, which had two main options, Public Notification Report and Verified Data Report. There was also an Event Type field that gave the specific event that required the reporting. This information was the same as the events listed in CMR 16.00 except with an additional separation of CSO-event which was CSO-untreated and CSO-treated. Also, a waterbody description field was available. In addition, Volume and Rainfall Data fields were available. Volume gave the estimated volume of the discharge in gallons and Rainfall Data gave the amount of rain in inches. Finally, there were Hours and Minutes fields which gave the time of the overflow.

An overflow event was prevented due to timely notifications in Provincetown. When an overflow event was on the verge of happening in mid-August 2022, Provincetown MA was able to send out an emergency notification alert to the residents and multiple news organizations before any serious problems occurred. Even though this notification was not part of or required

in the new regulation because an overflow did not occur, it goes to show the power that notifications regarding sewer incidents can have in Massachusetts. The alert seemed to have worked and an overflow was prevented, but many businesses and residents were unhappy due to the loss of revenue and comfort in their own homes. (Vacation Hotspot Provincetown, Mass., Declares Sewer Emergency: 'Only Flush When Absolutely Necessary'-People, 2022)

2.6 Project Impact

Due to the impacts that can be seen in section 2.3, the general public in Massachusetts needs to be notified of sewer events. The new regulations as seen in section 2.52 help notify the public with signage, and public health warnings in addition to notifications from permittees hopefully in the coming years more people are aware of the impacts of sewage overflows. With the assistance of our project, we can offer help to this process.

2.61 Affected Communities

Due to the causes of SSOs and CSOs, affected communities can be any place where part of a sanitary sewer system or combined sewer system is located. This is because an SSO can occur for many reasons. For example, parts of the sewer system breaking.

Another important aspect of the affected communities is the Environmental Justice population. An important part of the new notification is attending to the environmental justice (EJ) populations in Massachusetts. The CSO permittees have to make sure to identify EJ populations that have at least 25 percent of households that lack English language proficiency. Of the CSO permittee locations, the ones that have an EJ population with a lack of English language proficiency are Boston, Cambridge, Chealse, Fall River, Holyoke, Lawrence, Lowell,

Lynn, New Bedford, Sommerville, Springfield, and Worcester (Combined Sewer Overflow Preliminary Public Notification Plan Instructions, 2022, pg. 3) (2020 Environmental Justice Populations, 2020).

The term “Environmental Justice population” was used in two different ways by MassDEP, one where it was used to mean advocacy groups and another where it meant communities where the environmental justice policies apply. This means “a neighborhood whose annual median household income is equal to or less than 65 percent of the statewide median or whose population is made up 25 percent Minority, Foreign Born, or Lacking English Language Proficiency” (*Cities and Towns That Include Environmental Justice Communities*, n.d.).

Chapter 3: Methodology

The goal of this project was to assess the public notification of Combined Sewer Overflows (CSOs) and Sanitary Sewer Overflows (SSOs), identify potential system improvements, and give recommendations to better inform the public. We surveyed with multiple choice questions and short answer questions to better understand the communication between Boards of Health (BOH) and Health Departments (HD) with the permittees and to gauge their understanding of the new overflow notification regulations. We also sent out a survey to the environmental justice and watershed advocacy groups to see where the new notifications fall on their priority list. This is a continuation of previous WPI IQPs (Interactive Qualifying Projects) where the last IQP project worked on the implementation of new notification regulation and this work assesses the implementation. To achieve this goal, we developed the following objectives:

1. Understand the notification system surrounding CSO and SSO reporting and observe and collect overflow data
2. Understand how the Boards of Health and Health Departments interpret notification requirements and identify any issues they have had while carrying out the requirements
3. Investigate how the notification process is reaching the general public
4. Identify any recommendations for system improvements and education about sewer overflows

In the following subsections, we will go into more detail about each objective. Among the things discussed will be the methods we will implement to accomplish this objective and the justification behind those methods.

3.1 Participant Observation of the MassDEP sewage notification data system

By better understanding the reporting systems surrounding CSOs and SSOs in Massachusetts and interacting with the public data portal, which can be seen in figure 4, which has information about past overflows, we can learn more about when CSO and SSO occurrences happen in Massachusetts which helps us better understand the other three objectives of our project by targeting places with overflow occurrences.

MassDEP has developed a sewage overflow notification data system for Massachusetts as of July 6, 2022 (CSO Data Portal, 2022).

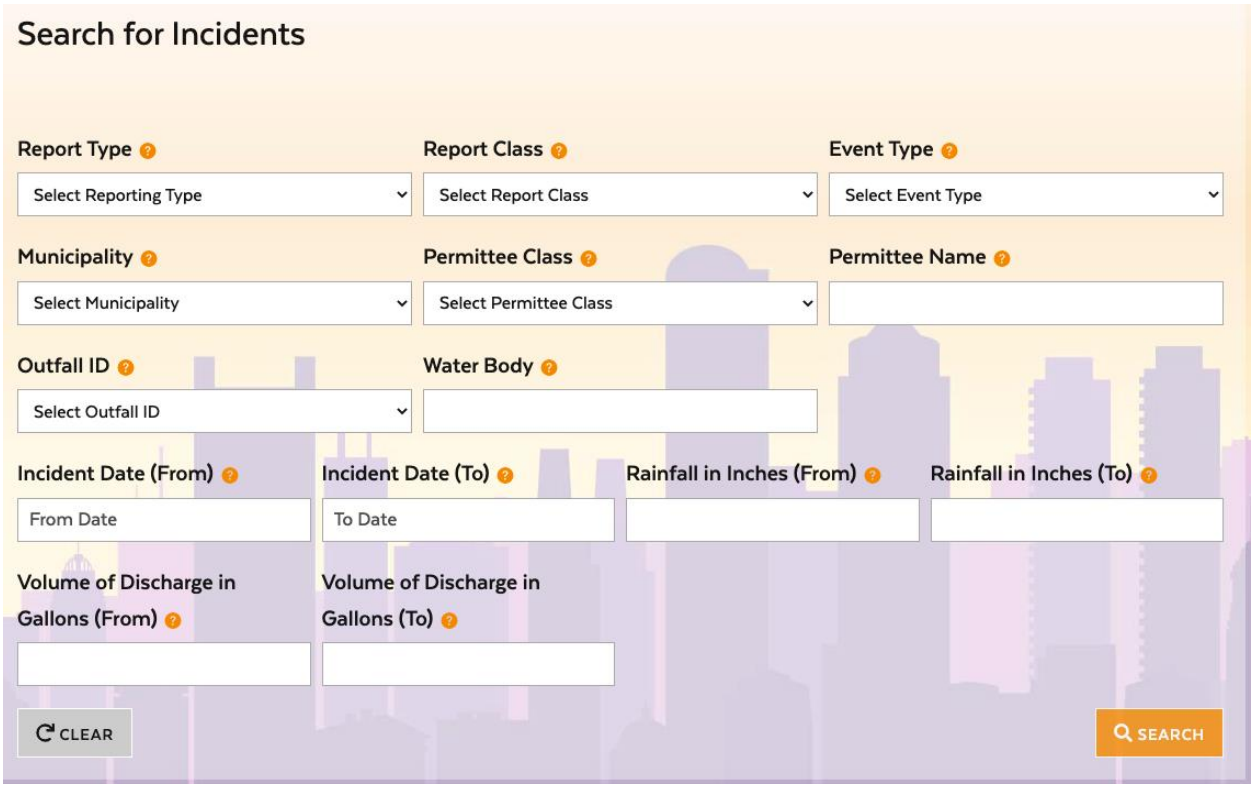

Figure 4 *Database for overflow events in Massachusetts starting from July 6th, 2022*

This is a public database as stated earlier and we used the "Incident Date" filter to get the information that we need.

We contacted our sponsor early in the first week and in the process of scheduling meetings, they provided a link to the publicly available database. This database helped us better understand where and when sewage discharges occurred in communities around Massachusetts. We looked at the frequency of overflows at different locations and targeted our surveys to environmental justice and watershed advocacy organizations within the vicinity of these CSOs.

We stored the data we collected for this system on a shared spreadsheet (Appendix D). We analyzed the data in two main ways. First, we looked at the CSO permittees that have CSO-related events and the frequency of these events, and the watershed locations for these events. The watershed location is the actual waterway where the overflow was deposited. Both helped

provide the information needed for investigating how the notification process is reaching the general public.

3.2 Participant Observation of MassDEP and Permittee Websites

In addition to observing the public data portal, we also observed both MassDEP's website on the new CSO and SSO notification system as well as the CSO permittees' websites. When we looked at the permittees' websites, we wanted to gauge how easy it was to subscribe to the notifications. We looked at MWRA, New Bedford, and Fitchburg permittees and tried to find the least number of clicks to the subscribe page.

When we were finding information about the new notifications, we started by trying to find information on MassDEP's website. They have a page on the new notifications called "Sanitary Sewer Systems & Combined Sewer Overflows" and we browsed through as someone would do if they were in the general public (Sanitary Sewer Systems & Combined Sewer Overflows | Mass.Gov, n.d.). We also looked for information specific to the BOH as this is a likely place they would start looking for information if they do have an event and need more information.

3.3 Understand the Boards of Health/Health Departments' Interpretation of 314 CMR 16.00

Considering that sanitary sewer overflows (SSOs) can happen just about anywhere in the state, it is important that the BOHs across the state understand these new requirements. A part of MassDEP's goal for our project was to determine how well the BOH and HDs in Massachusetts understand the new notification requirements. Another reason for this goal is that MassDEP does

not have as much direct contact in general with the BOH as they do with the CSO permittees. However, it should be noted that some BOH and HD have reached out to MassDEP with frequent questions.

Determining how well the Boards of Health and Health Departments in Massachusetts understand the new notification requirements

We used an anonymous ethnographic survey to help collect data from 87 BOHs from around Massachusetts. MassDEP emailed a google forms survey to 241 BOHs throughout Massachusetts (Appendix B).

An anonymous survey seemed the most appropriate way to gain data and encourage participants to be open and honest when answering the question without worrying about being liable. We wanted an anonymous survey to improve participation from BOH and HDs who may otherwise avoid responding due to concerns about DEP taking compliance or enforcement action against them. In addition, given that there are 241 (Langley, 2022) BOH and HDs in Massachusetts that have to follow the new regulations, it made sense to do a quick and simple survey made up of mostly multiple choice and yes or no questions with few short answer questions to make the survey efficient and succinct for the busy Boards of Health. We did not consider doing interviews before creating our survey. This will make it more likely for the BOHs and Health Departments to respond and complete the survey and let us get more data.

In order to effectively achieve figuring out what BOH and HD need to work on, the types of questions on this survey revolved around how the BOHs were affected by the new notification requirements. (Appendix B).

After the initial small sample size survey of five Boards of Health, all of whom attended a MassDEP training meeting, and were more likely to respond, we used the data collected to add, change, or delete questions. We used our results to better understand potential misunderstandings with our questions. In the final version of the survey (Appendix B), we expanded on the majority of our original questions to increase specificity and gain more important data. We emailed our survey questions to our sponsor for feedback. During the process of reworking our survey, we had problems understanding what regulation 314 CMR 16.00 was expecting from the BOHs. To clarify, we asked our sponsor during one of our meetings and even they had to look up the information as these regulations are so new. In addition to clarifying who was sending out the notifications, MassDEP suggested the style of some questions. We switched the questions from being all, “yes” or “no” answers to questions that said, “select all that apply”. This new question strategy allowed us to collect more data on what the BOHs understood about the new regulations. There were no wrong answers which were important because we were trying to comprehend what the BOHs knew, not quiz them. The new style of question that allows multiple selections is shown in Figure 5.

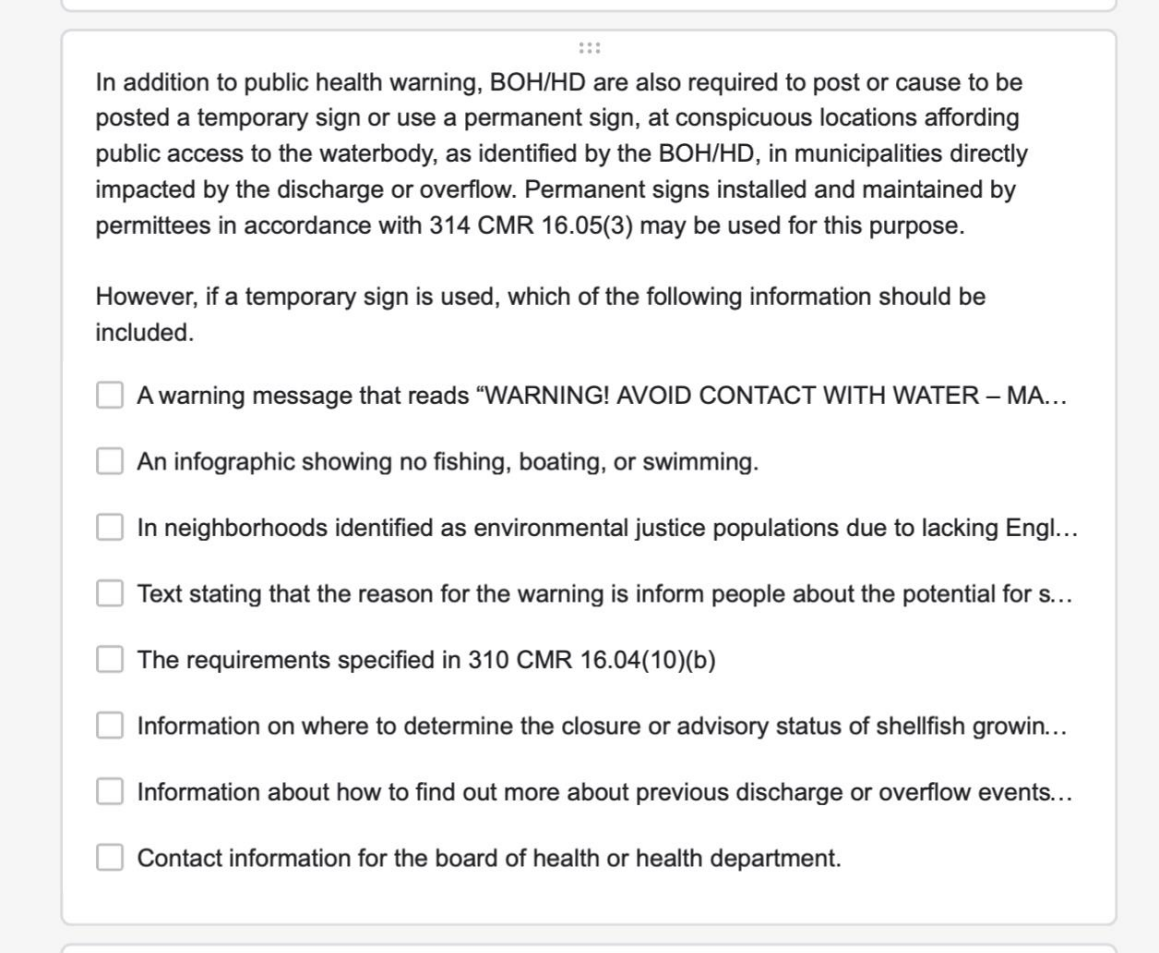

Figure 5 *Survey Question Understanding Regulations Pertaining to Signage*

In addition to the questions that were required, and multiple selections were allowed, we added some short answer questions. The short answer questions were not mandatory for the Boards of Health to complete. Short answer questions were important because it allows us to understand what the BOHs are actively doing to comprehend the new regulations and what MassDEP could do better in training, which would be difficult to analyze from a standard multiple-choice question. The style of the question is shown in figure 6.

Figure 6 *Open ended style question pertaining to communication between BOH/HD and permittee*

We reached out to our sponsor to send it out in hopes of getting a better response from the BOHs relying on the department's credibility.

3.4 Surveying Environmental Justice and Watershed Organizations

To investigate how the notification process is reaching the general public, we sent a survey to environmental justice groups, community, and watershed advocacy organizations within close proximity to CSO events to assess the effectiveness of the community outreach. The questions we sent can be found in Appendix C.

To identify groups that have had contact with the regulations already our sponsor looked through their information and sent us a list of groups known to care about CSO notification. We sent the initial set of survey questions to the sponsor to look at before sending them out. We took what we learned about writing survey questions from the previous surveys to the BOHs and used that information to edit the initial questions we had to make them more understandable and specific.

3.5 Develop recommendations for system improvements

This objective, tied into our deliverables for our project, is what we wanted to do with the information gathered in our first three objectives. During this project, we assessed how well the notifications are reaching the intended audience and collected information about the BOH in terms of their notification comprehension. We used data from our survey as well as the information we gathered from the public data portal and websites to identify areas that need improvement. We looked at specific problems brought up in the survey answers to help identify problems and develop potential solutions to mitigate each of these findings.

Deliverables

- New knowledge of the public concerning CSO and SSO notifications
- Determining whether or not the BOHs need more training
- Provide specific areas where BOHs can improve
- Help develop more effective methods of training the BOHs
- Developing resources for BOH and the public on notifications

Chapter 4: Results and Findings

4.1 MassDEP Public Data Portal

For this section, most of the results we obtained were about the overflows reported from July 6th to September 11, 2022. First, we got the data from MassDEP's public data portal (CSO Data Portal, 2022), and exported it to excel (Appendix D).

Using the twenty-three total data fields in this dataset (Appendix D). We were able to take what we knew about the categories and look into the questions important to us being where the overflow events are happening and into what waterways.

As expected, we were able to confirm that the majority of overflow events are CSOs compared to SSOs. As seen in Table 1:

Permittee	**Number of Overflow Events**
SPRINGFIELD WATER & SEWER COMMISSION	148
CITY OF CHICOPEE	83
CITY OF FALL RIVER	71
CITY OF NEW BEDFORD	60
LOWELL REGIONAL WASTEWATER UTILITY	49
CITY OF FITCHBURG	30
CITY OF HAVERHILL	28
CITY OF HOLYOKE	6
CITY OF WORCESTER	4
LYNN WATER & SEWER COMMISSION	3
BOSTON WATER & SEWER COMMISSION	3
GREATER LAWRENCE SANITARY DISTRICT	2
CITY OF CAMBRIDGE	1
MASSACHUSETTS WATER RESOURCES AUTHORITY	1

Table 1 *Frequency of CSO events in the first two months of reporting*

Out of the 19 CSO permittees, only 14 of them had overflow events in the period we looked at. Springfield had by far the most incidents. Chicopee, Fall River, New Bedford, Lowell, Fitchburg, and Haverhill also have a high number of incidents. This means awareness of possible events is much more critical in those areas.

It was also important to note that number of outfalls did not necessarily mean that a CSO permittee had more occurrences as shown in Figure 7:

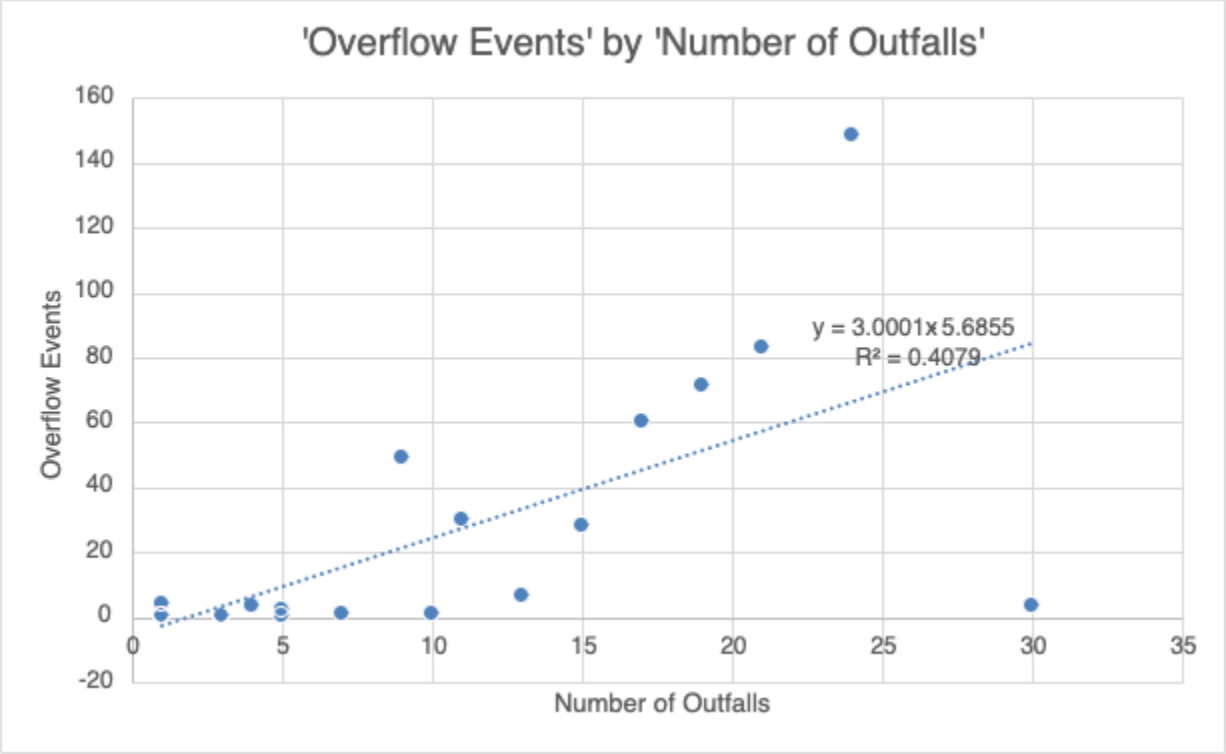

Figure 7 *Correlation between Overflow Events and Number of Outfalls*

With an R-squared score of 0.40, there is not much of a correlation between the number of overflow events and the number of outfalls.

In non-CSO permittee municipalities, a total of 6 events occurred, all being SSO, in the five municipalities of Quincy, Oak Bluffs, Watertown, Hull, and Agawam. These events happen far less frequently.

The specific type of events can be seen in Table 2.

Type of SSO Event	**Frequency**
SSO – Discharge Through Wastewater Outfall	2
SSO – Failure of Pump Station or Associated Force Main	2

SSO – System Surcharging Under High Flow Conditions	2

Table 2 *Frequency of SSO event is first two months of reporting*

Only 6 out of the 498 overflows reported were SSO related which comes out to about 1.2% of the reported overflows.

The characteristics of the events are important since it allows us to see the importance of the issue. For characteristics, we mainly looked at mean, median, max, and min for time, volume, and rainfall data for the overflows.

We also looked at some of the means and medians etc. for the Volume, Rainfall, and Time fields using the available data.

	Mean	Median	Maximum	Minimum
Volume (Gallons)	720,544	136,616	8,222,979	0
Rainfall (Inches)	0.62	0.56	1.35	0
Time	1 hour and 13 minutes	41 minutes	12 hours and 33 minutes	5 minutes

Table 3 *Statistics about overflow events in the first two months of reporting*

Looking at the volume the average was about, 720,000 gallons, which is an important metric as it shows us the severity of this issue.

Using the information from the database we have gathered so far, we reached out to places where there have been frequent events which would be locations with CSOs. As mentioned in the methods we got the information about the water bodies affected by CSO permittee overflows and used that to identify possible watershed, community, and environmental justice organizations in the area close by (Table 4).

CSO Permittee	Waterway Affected	Possible Watershed, Community, EJ organizations
Boston Water and Sewer Commission	● Boston Inner Harbor ● Fort Point Channel	● Conservation Law Foundation ● Boston Climate Action Network ● Boston Harbor Now
City of Chicopee	● Chicopee River ● Connecticut River ● Willimansett Brook	● Chicopee River Watershed Council ● Connecticut River Conservancy Organization
City of Fall River	● Mount Hope Bay ● Quequechan River ● Taunton River	● Taunton Rivershed Alliance ● https://www.fallriverma.org/ ● SNEP network ● United Neighbors of Fall River
City of Fitchburg	● Nashua River ● Punch Brook Culvery @ Boulder Drive via Putnam St. ● Punch Brook Culvert @ Main St.	● Nashua River Watershed Association
City of Haverhill	● Little River ● Merrimack River	● Merrimack River Watershed Council
City of Holyoke	● Connecticut River ● Dingle Bk to Connecticut River	● Connecticut River Conservancy Organization
City of New Bedford	● Acushnet River ● Clark Cove	● Buzzards bay Coalition ● Greater New Bedford Youth Alliance
City of Worcester	● Mill Brook to Blackstone River	● Blackstone River Watershed Association ● https://environment.worcesterdiocese.org/environmental-advocacy-

		organizations
Greater Lawrence Sanitary District	• Merrimack River	• Groundwork Lawrence • Merrimack River Watershed Council
Lowell Regional Wastewater Utility	• Beaver Brook • Concord River • Merrimack River	• Merrimack River Watershed Council • OARS • Mass Rivers Alliance • https://westfordconservationtrust.org/tws_holding/beaver-brook/
Lynn Water and Sewer Commission	• Lynn Harbor • Saugus River	• Saugus River Watershed Council
Springfield	• Chicopee River • Connecticut River • Mill River	• Connecticut River Conservancy Organization
Massachusetts Water Resources Authority	• Mystic River	• Mystic River Watershed Organization
City of Cambridge	• Alewife Brook	• Save the Alewife Brook

Table 4 *Waterways the CSO permittees have had overflow events and possible corresponding community, watershed, and environmental justice organizations*

4.2 Website Observations

From our website observations, MWRA has a decent website and took about 2 to 4 clicks from a quick Google search (MWRA - Sign Up to Receive Notifications from MWRA, Powered by Everbridge, n.d.). When we tried to find New Bedford's website to subscribe it showed the website as being "WEBSITE UNDER CONSTRUCTION PLEASE CHECK BACK SOON."(Combined Sewer Overflows - Public Infrastructure - City of New Bedford Official Website, 2022) Fitchburg doesn't have a separate notification system for sewer overflow

notifications, however, they do have a spot for their cities alerts ranging from CSO notifications to road blockages. (Alert Center • Fitchburg, MA • CivicEngage, 2022)

We discovered that the MassDEP website does not have links to the permittees or links to subscribe which makes it difficult for people to subscribe to the notifications. It should be noted that legislation does not require this and doing this would not be feasible for MassDEP's resources. They do have some of their training materials linked, however the table of contents at the top of the page does not indicate that there are training materials available to view (Sanitary Sewer Systems & Combined Sewer Overflows | Mass.Gov, n.d.).

4.3 Initial Boards of Health Survey

For our initial survey with a small population size of 5, you could already see that there was some confusion regarding the regulations. This can be seen in the following questions that we asked:

- "Are you aware of what needs to be on signage for public health warnings"
- "Are you aware of the environmental justice population requirements?"
- "Overall, how would you define your understanding of the new requirements?"
- "Has your BOH/Health Department had any difficulties they have encountered in carrying out the new requirements? If so, please explain those difficulties."

The corresponding graphs that describe responses for each question can be seen below in figures 8 through 10:

Has your BOH/Health Department had any difficulties they have encountered in carrying out the new requirements? If so, please explain those difficulties.

One comment we received for this question that possibly indicates that more training might be helpful in the future is "One CSO occurred on a Friday evening after the office closed; we saw the notification the following Monday morning, well beyond even the 48 warning period." An example like this is a good reason why training in the future is a good idea, as more BOH and HD experience overflow events, more scenarios like this one might arise and future training might be able to direct boards of health on what the correct course of action should be.

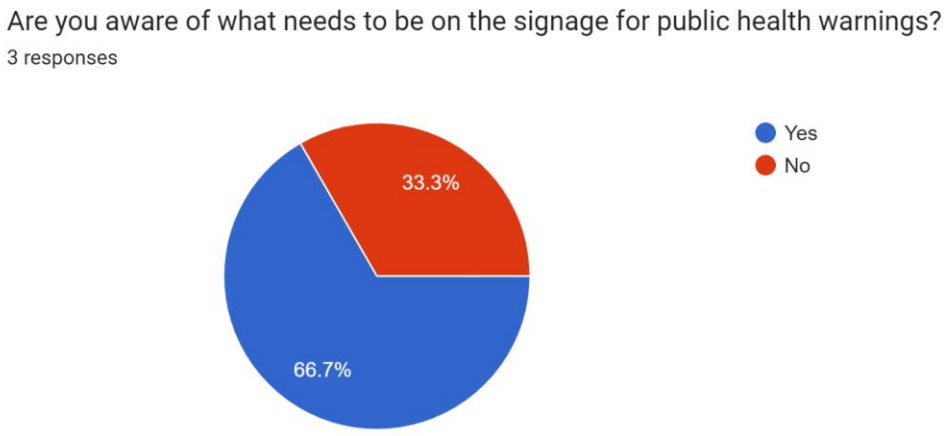

Figure 8 *Survey question regarding signage for public health warnings*

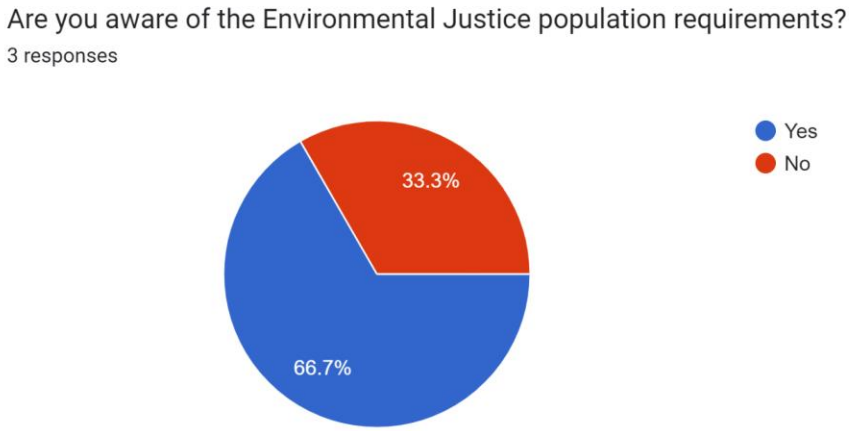

Figure 9 Survey *question regarding environmental justice population requirements*

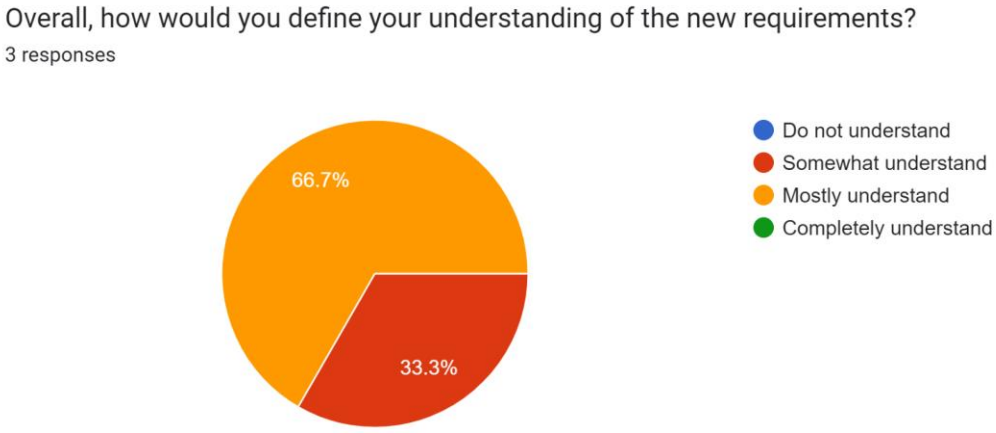

Figure 10 *Survey question regarding understanding of BOH/HD requirements*

From the initial results, we found that there was confusion about our questions with conflicting answers. We were also unable to fully understand what was happening to cause issues within the Boards of Health (BOHs) due to our vague questions. We revised and made more specific questions for our larger sample size survey that was sent out to 241 BOHs. An example of conflicting responses can be seen in Figures 11 to 12. In Figure 11 there was only one person who answered that they had an event. However, based on the second question in Figure 12, there were two who answered as if they had an event.

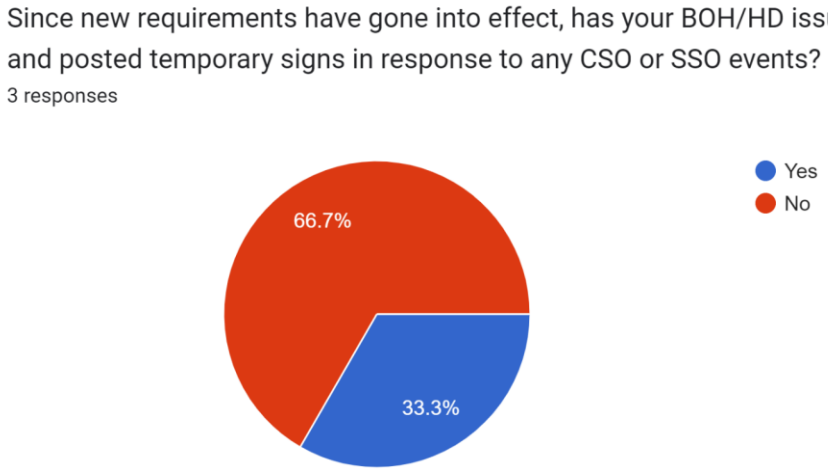

Figure 11 *Survey question regarding the usage of signage and public health warnings*

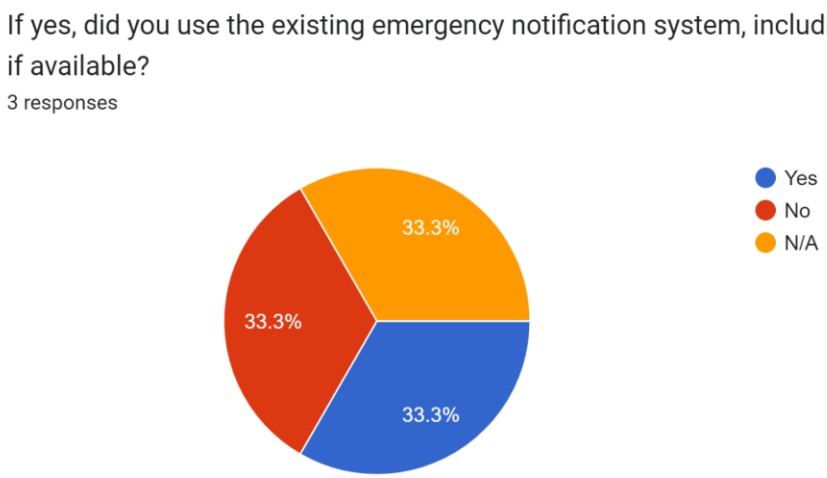

Figure 12 *Survey question regarding the usage of an emergency notification system*

4.4 Final Boards of Health Survey

In our main survey, we had 87 responses out of about 241 which is around a 36% response rate. Out of those responses, it was important for us to see how many attended MassDEP training in the past since this allows us to evaluate the effectiveness of the training by

looking at the awareness from people who went to training versus people who did not go to training.

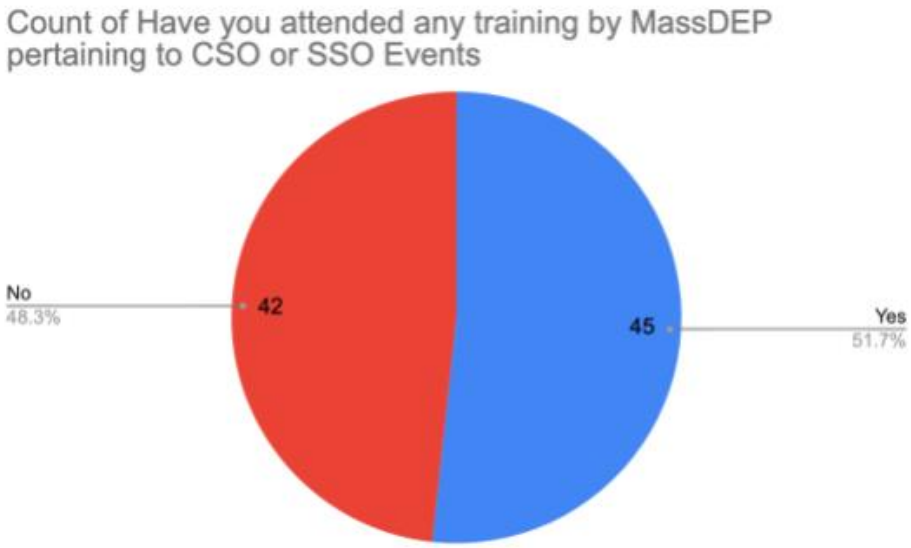

Figure 13 *Information about training participation from BOH/HD Survey*

Out of those 87 responses, about half went to training and half did not go to training. We were able to use these two groups as a comparison with questions later on in our survey.

Similarly, we also believe that it was important to see what Boards of Health and Health Departments that have already had overflow events. Out of 87 respondents, 12 of them have experienced an overflow event and we were then able to also look at this group separately for questions later on. This would allow us to determine that groups are aware of the regulations which is important because awareness is the most important for those who have or are experiencing overflows. For example, here we were able to ask if they used an existing emergency notification System including a reverse 911 system if available.

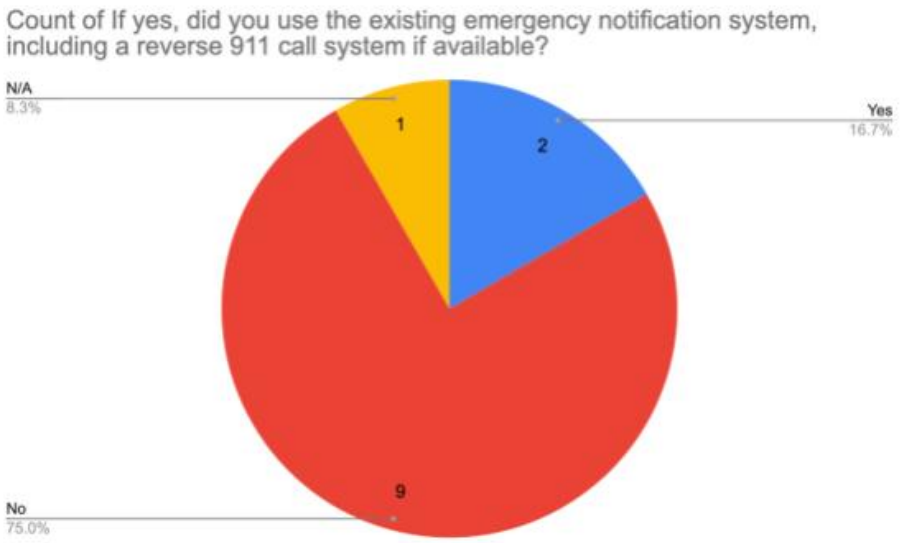

Figure 14 *Graph about the use of an emergency notification system for those who had an event*

Out of the 12 Boards of Health/Health Departments that had events only 2 used an existing emergency notification system to give a public health warning. Just as a note, the use of an existing emergency notification system is a requirement of the statute and regulations. Next, we looked at the awareness of the Boards of Health and Health Departments about the events that require a public health warning. In figure 15, the awareness was much higher for those who went to training than those who did not go to training.

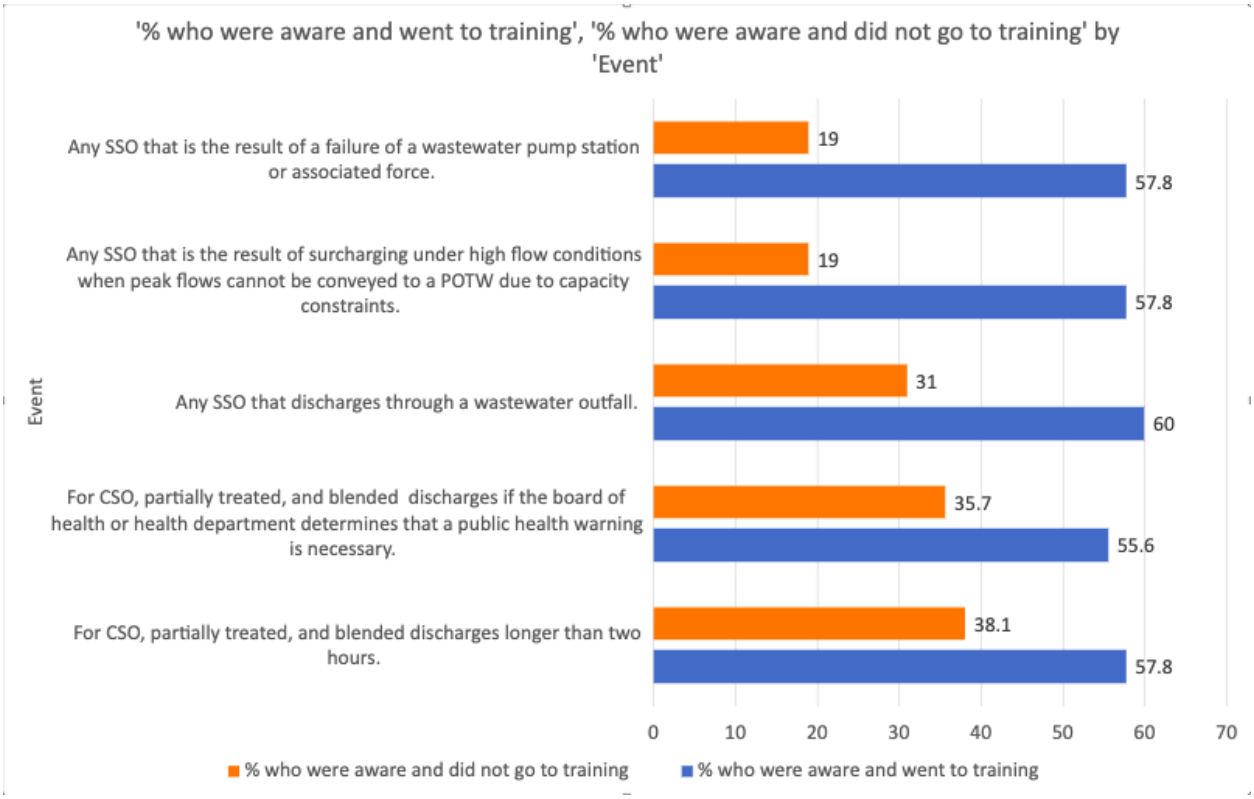

Figure 15 *BOH/HD awareness of events requiring notification*

In table 5, the groups who had the highest awareness of events requiring Public Health Warnings were the groups who had to deal with a sewer overflow event and/or training. This corroborates findings from the previous graph as well since like the previous class graph this table also shows that people without training have lower awareness and understanding of events requiring notification. Another piece of information we can see in terms of awareness is the events that had at least an amount of awareness was SSO that is the result of surcharging under high flow conditions when peak flows cannot be conveyed to a POTW due to capacity constraints. Along with any SSO that is the result of a failure of a wastewater pump station or associated force main.

Event 1: For CSO, partially treated, and blended discharges longer than two hours.
Event 2: For CSO, partially treated, and blended discharges if the board of health or health department determines that a public health warning is necessary.
Event 3: Any SSO that discharges through a wastewater outfall.
Event 4: Any SSO that is the result of surcharging under high flow conditions when peak flows cannot be conveyed to a POTW due to capacity constraints.
Event 5: Any SSO that is the result of a failure of a wastewater pump station or associated force.

	Training?	NO	NO	YES	YES
	Had Event	NO	YES	NO	YES
% Who Were Aware of Event 1		29.7	100	52.6	85.7
% Who Were Aware of Event 2		32.4	60	50	85.7
% Who Were Aware of Event 3		24.3	80	60.5	57.1
% Who Were Aware of Event 4		13.5	60	60.5	42.9
% Who Were Aware of Event 5		13.5	60	57.9	57.1

Table 5 *Awareness of overflow events requiring a public health warning by training and having event experience*

We also looked into the awareness of required information in a public health warning regarding a sewer overflow. Similar to the last question, we broke this question down into two groups: those who attended MassDEP training and those who did not attend MassDEP training.

Once again as you can see in figure 16 below, those who went to training had a higher amount of awareness about the information required. We also had another observation, the pieces of information that have the least amount of awareness were, access to translations if necessary, and information on where to find closure or advisories status of selfish growing areas beaches, or other water resource areas.

Figure 16 *BOH/HD awareness of information required in public health warning*

Similar to the previous table, the best groups in terms of awareness of the information required in public health warnings regarding sewage overflow are the groups who either had an overflow before and/or had training from MassDEP. People who had no training or no event had significantly less awareness of the required information needed for a public health warning. Information that seemed to be lacking awareness was information on closures or advisory status of selfish growing areas beaches or other water resource areas and access to translations if needed.

Info 1: The public health warning shall identify receiving water affected
Info 2: The location, date, and time ofthe discharge or overflow
Info 3:A recommendation that the public avoids contact with affected water bodies.
Info 4: Information on where to find the closure or advisory status of shellfish growing areas, beaches, or other water resource areas.
Info 5: Access to translations of the warning, as appropriate for neighborhoods identified as environmental justice populations.

		Training?	NO	NO	YES	YES
		Had Event	NO	YES	NO	YES
% Who Were Aware of Info 1			37.8	80	78.9	100
% Who Were Aware of Info 2			48.6	100	78.9	85.7
% Who Were Aware of Info 3			29.7	100	73.7	57.1
% Who Were Aware of Info 4			24.3	60	57.9	71.4
% Who Were Aware of Info 5			18.9	60	55.3	57.1

Table 6 *Awareness of information required in a public health warning by training and having event experience*

In addition, we also looked at the awareness of the required information in temporary signage. In figure 17, similar to the previous two graphs we separated the data into two groups: the people who went to MassDEP training and the people who did not go to MassDEP training. Once again, those who went to training seem to have a higher awareness of the required information. The two pieces of information that seem to have the lowest amount of awareness were again translations if needed, and a message in text stating that the reason for the warning is to inform people about the potential for sewage in the surface water.

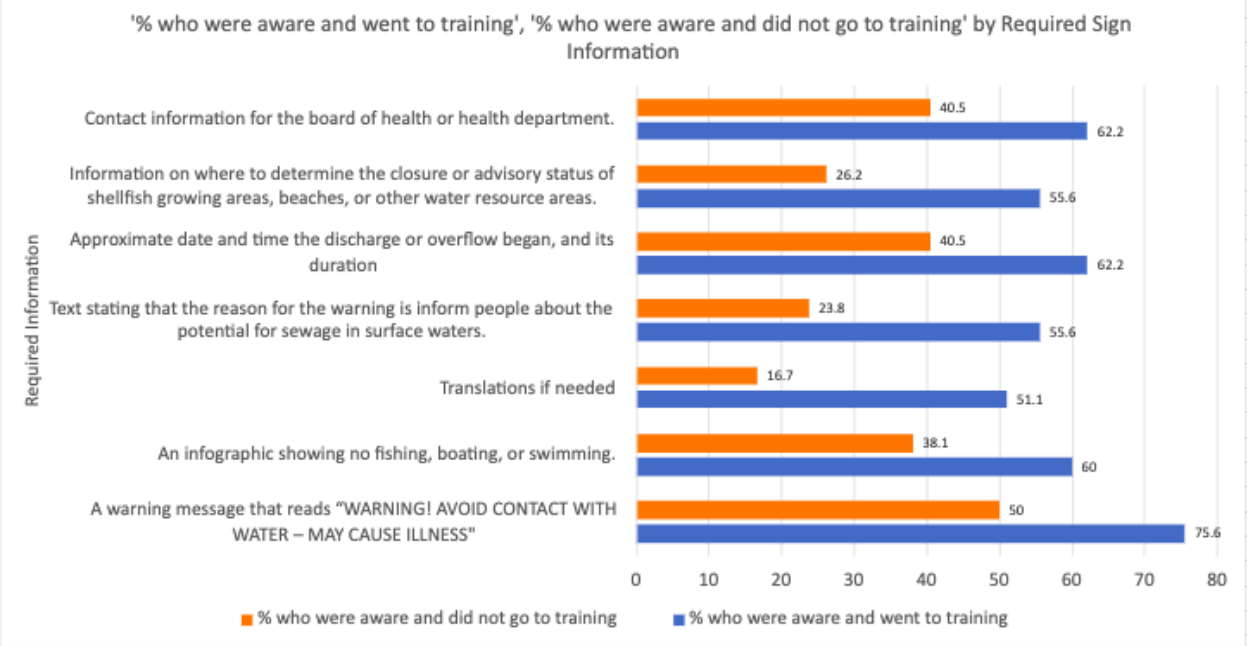

Figure 17 *BOH/HD awareness of information required in temporary signage*

In table 7, again we see the best awareness for signage information for those who had an event or went to MassDEP training. The Boards of Health/health departments with no event or no training have very little awareness.

Info 1: A warning message that reads "WARNING! AVOID CONTACT WITH WATER – MAY CAUSE ILLNESS"
Info 2: An infographic showing no fishing, boating, or swimming.
Info 3: Translations if needed
Info 4: Text stating that the reason for the warning is inform people about the potential for sewage in surface waters.
Info 5: Approximate date and time the discharge or overflow began, and its duration
Info 6: Information on where to determine the closure or advisory status of shellfish growing areas, beaches, or other water resource areas.
Info 7: Contact information for the board of health or health department.

	Training?	NO	NO	YES	YES
	Had Event	NO	YES	NO	YES
% Who Were Aware of Info 1		45.9	80	76.3	71.4
% Who Were Aware of Info 2		32.4	80	60.5	57.1
% Who Were Aware of Info 3		16.2	20	50	57.1
% Who Were Aware of Info 4		21.6	40	57.9	42.9
% Who Were Aware of Info 5		35.1	80	57.9	85.7
% Who Were Aware of Info 6		21.6	60	52.6	71.4
% Who Were Aware of Info 7		37.8	60	68.4	28.6

Table 7 *Awareness of information required in temporary signage by training and having event experience*

To summarize the awareness the Boards of Health/Health Departments had in terms of awareness, we looked at the bottom 5 requirements in terms of awareness:

In total the bottom 5 for awareness for all survey takers were:
Translation if needed (signage)
Any SSO that is the result of surcharging under high flow conditions when peak flows cannot be conveyed to a POTW due to capacity constraints.
Any SSO that is the result of a failure of a wastewater pump station or associated force main.
Translation if needed (public health warning)
Text stating that the reason for the warning is to inform people about the potential for sewage in surface waters.

Table 8 *List of requirements for boards of health with least amount of awareness*

In total the bottom 5 for awareness for those who had events were:
Translations if needed (signage and public health warning)
Text stating that the reason for the warning is to inform people about the potential for sewage in surface waters.
Contact information for the board of health or health department.
Any SSO that is the result of surcharging under high flow conditions when peak flows cannot be conveyed to a POTW due to capacity constraints.
Any SSO that is the result of a failure of a wastewater pump station or associated force main.

Table 9 *List of requirements with least amount of awareness for boards of health that went to training*

As you can see just from the previous three graphs, training has had an improvement on awareness. We also looked at the percentage of people who had no awareness of each of the topics discussed. In figure 18 you can see for each of the topics, there was a higher number of individuals with no understanding and did not go to training than those that did. The topic that had the most people with no awareness and did not go to training was events requiring notification. The topic the most amount of people with no awareness and did go to training was the information required on temporary signage.

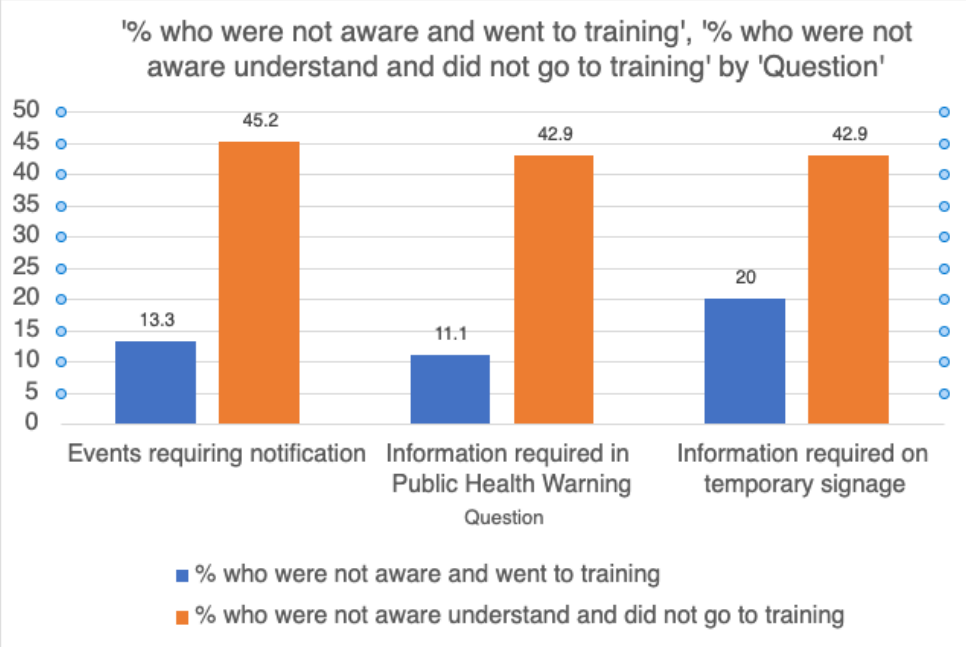

Figure 18 *BOH/HD percentage with no awareness of main requirements*

We also had a question that asked the survey taker to gauge their awareness of their requirements in the regulations as a whole. As you will see in Table 10, those who went to training with MassDEP said they had a higher understanding.

Ratings by group:	
Didn't attend training, and an overflow event did not occur	3.1/10
Didn't attend training, and an overflow event occurred	6.6/10
Attended training, and an overflow event did not occur	5.44/10
Attended training, and an overflow event occurred	8/10

Table 10 *Boards of Health Understanding of CSO Notification Requirements*

Part of the awareness of the requirements is due to a Boards of Health's communication with their respective sewer authorities/permittees. The survey results indicated there are areas where communication could be improved.

One aspect of communication between Boards of Health and Sewer authorities/permittees is the placement of signage. As you can see by the graph only about 19.5% of our 87 respondents had any contact from their sewer authority/permittee in regard to the placement of permanent signs at public access points. However, an important note, looking at the same question, those who had an event had an increased outreach about signage at 66%.

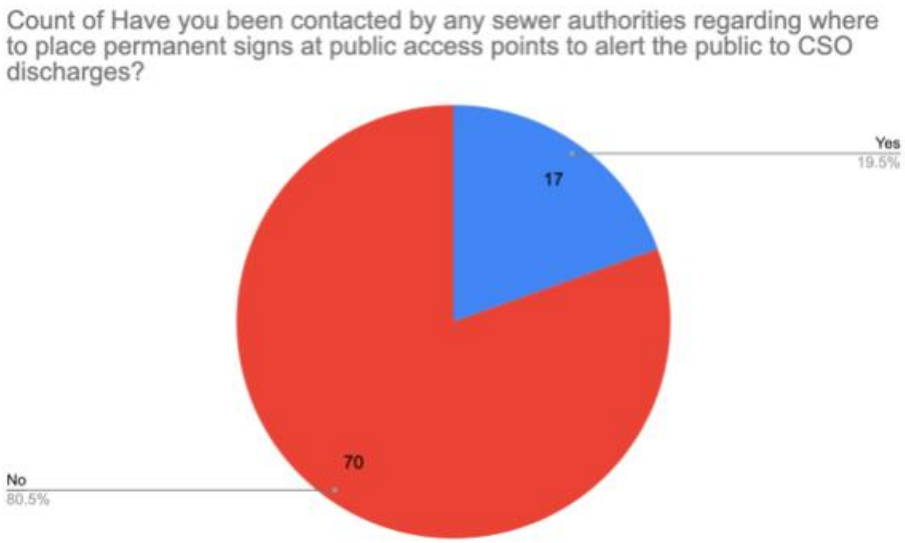

Figure 19 *Graph about communication between BOH/HD and permittee regarding signage*

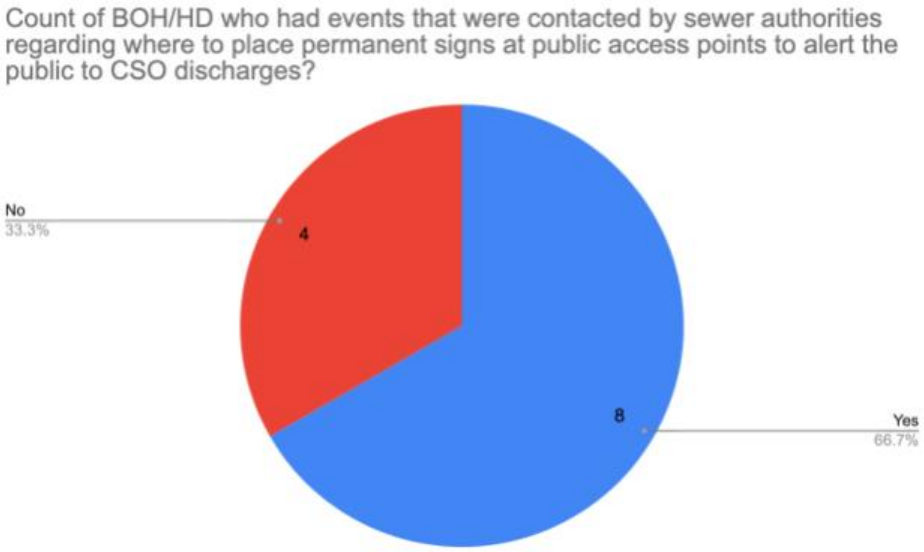

Figure 20 *Graph about communication between BOH/HD who had an event and permittee regarding signage*

Another aspect of communication between Boards of Health and Sewer authorities/permittees is about notification of overflow events. We asked survey takers to describe what steps they have taken in this area:

Most Common Responses to “What steps have you taken to create effective communications between your BOH/HD and permittee?”

- Communication through Town/City DPW
- None
- Either Unaware of the issue or claim to not have CSOs/SSOs
- Tried to set up communication
- Used website or signed up for notifications
- Did not Answer (37)

With 37 people not answering and one of the most common responses being “None” there seems to be a lack of communication in this area.

We also asked those who had an event if sewer authorities/permittees had reached out to see if public health warnings were being sent out.

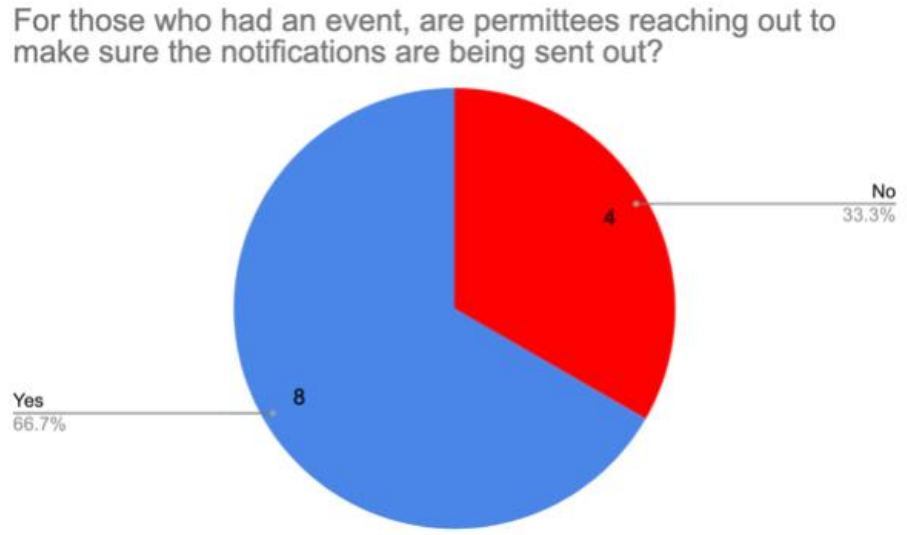

Figure 21 *Graph about communication between BOH/HD who had an event and permittee regarding if notifications are being sent out*

In addition, we asked the same group how they were being contacted the three main ways were: Email with DPW/Permittee, Notification, and phone call with DPW/Permittee. Since these are places that have had events, it would have been good to see all 12 having communication about the health warnings.

We had a couple of open-ended questions, and we got some good information back about what is not understood in the regulations. The following were the most common topics:

- Signage
- Who needs to be warned and when
- Questions about whether permittees/sewer departments are required to make contact
- Summarized information about the regulations and requirements that are easily available
- Questions about signage. Examples … who is required to fund it … what if there are no points of access
- Who is enforcing communication between BOH and the permittee, what are the permittee's obligations to the BOH, and how do their requirements differ.

There were also plenty of comments about wanting more training and resources regarding the regulations.

In addition, some general concerns about the regulations arose:

- Concerns about whether it is required year-round or concerns about reverse 911 misuse
- What BOH/HD gave input on this regulation
- Who needs to be warned and when

- MassDEP should facilitate meetings between permittees sewer departments and BOH
- What if we don't have CSOs

We reached out to some community organizations to see what kind of community awareness was going on for CSOs which are the most frequent and predictable events. We got 9 out of 20 responses back which is a 45% response rate. Out of those 9, only 5 were aware they could receive notifications, did receive notifications and promoted notifications to the public. The information can be seen in the following graphs.

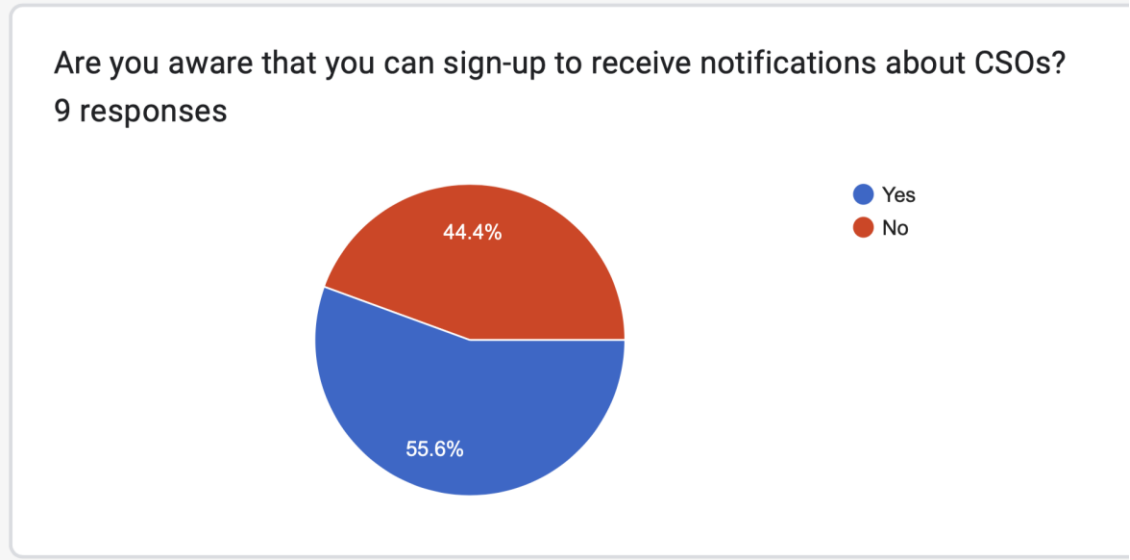

Figure 22 *Graph about if organizations we reached out to knew about signing up for CSO notifications*

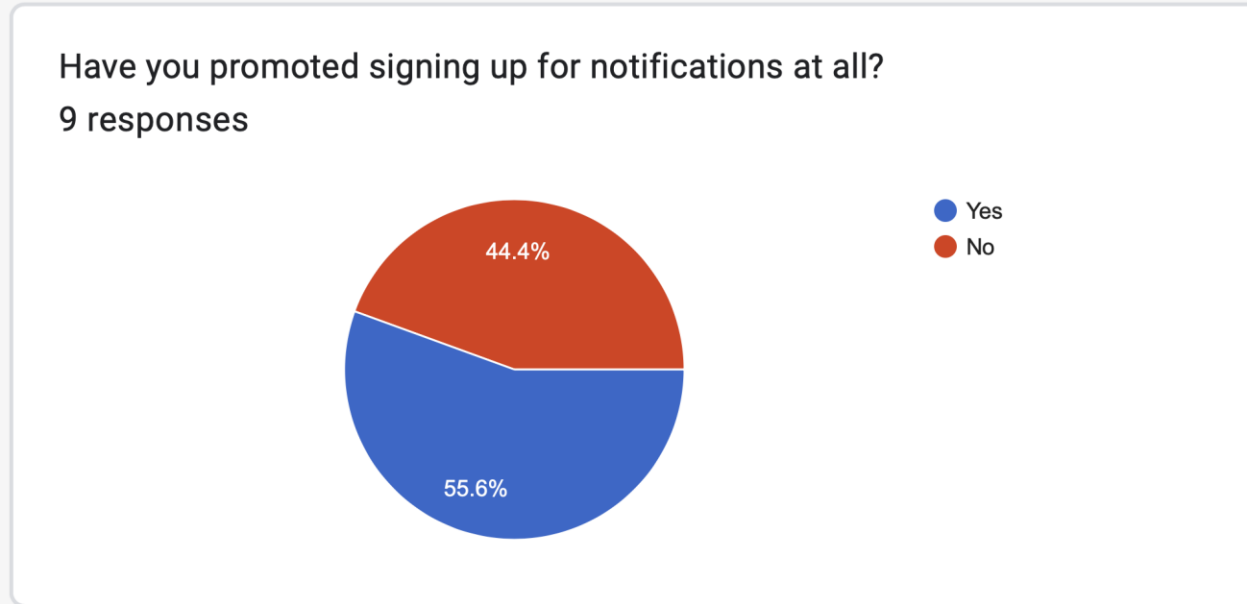

Figure 23 *Graph about if organizations we reached out to promoted signing up for CSO notifications*

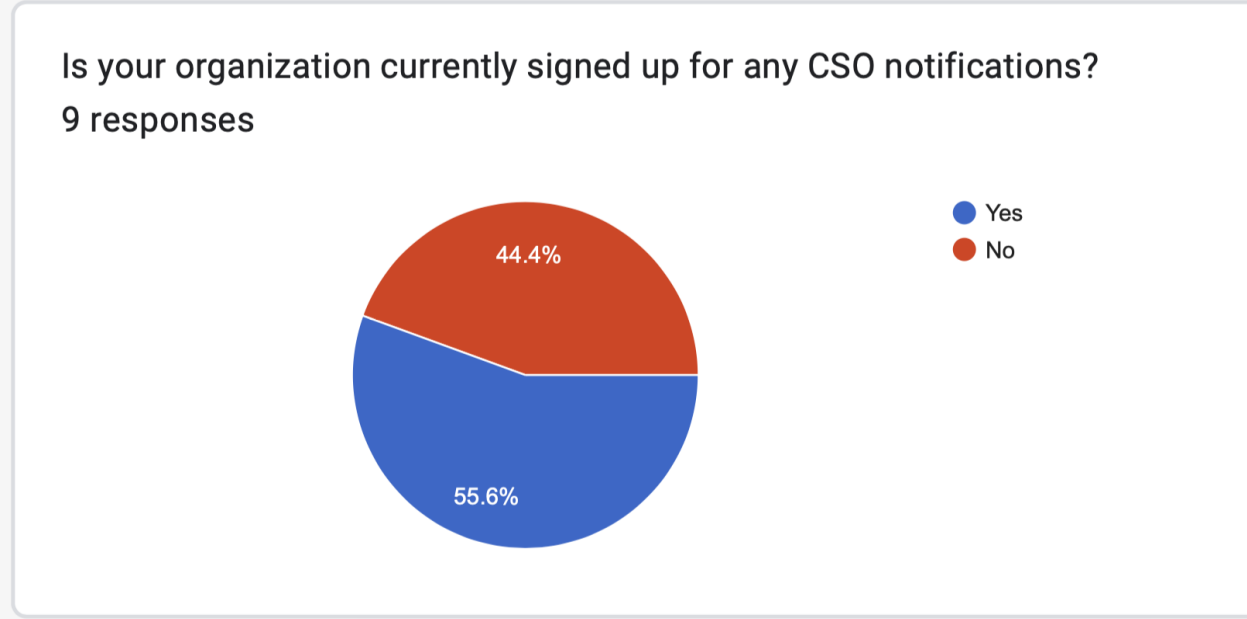

Figure 24 *Graph about if organizations we reached out to are signed up for CSO notifications*

For the organizations that did sign up, they seem to be heavily invested in the issue with two of those organizations advocating for the regulations before they were passed. Out of the four who were not signed up, two of them indicated that they were going to now, while one said they would like to but could not figure out how to, and the last one said signing up for notifications and promoting notifications is not something they can do. In addition, one of the four indicated that once they signed up, they would help promote awareness of this issue.

It seems that community outreach was done in various successful ways.

Such as

- Sharing information via a Flagging Program, CRWA's own live-water quality alerts program that updates river users on E. coli concentrations, CSOs, and cyanobacteria blooms, threats to public health.
- By posting links for the public to sign up and holding info sessions on CSOs. Also, we collect CSO notifications, "translate them" into understandable language and post them on our website.
- Website, Facebook page
- Social media, newsletter

4.5 Limitations

There were some limitations to what the data could provide us after further review. This was due to missing data. For the category “permittee name”, 495 out of 498 rows had a permittee name which is 99.39%. For permittee ID, 491 out of 498 rows in the data set had a permittee ID which is 98.59% percent of all the rows. The missing permittee IDs were later found to be due to towns/cities with sewer systems that do not have a treatment plant and were not assigned a

permit ID. For Outfall ID, 486 out of the 498 rows had an Outfall ID which comes out to 97.59% of the rows. The municipality field had 490 out of 498 or 98.39% of the rows filled. Location also had a high amount of rows with data at 98.59% of the rows or 491 out of the 498 rows. The Waterbody field also had 491 out of 498/ 98.59% of the rows with data.

The Reporting Type field was the first field we looked at and noticed had a significant amount of missing information. Only 335 out of 498 of the rows had a value for Reporting type which comes out to 67.36%. Latitude and Longitude also had a significant amount of data missing with only 4.81% or 24 out of the 498 available rows having data for longitude and latitude. Waterbody description only had 1% or 5 of the available rows with data. Volume, Rainfall, Hours, and Minutes information all had data in 32.73% or 163 of the available rows.

In the survey to the boards of health and health departments there we were limited by some of the short answer questions since they were not required and the response rate for those questions was not as high as the required questions. This means conclusions drawn from those questions are not as strong.

In the survey sent to environmental justice, watershed, and community organizations, we were limited by small sample size. With only 9 responses we had to be careful with any claims we made.

Chapter 5: Recommendations and Conclusions

We were able to create many recommendations based on our survey responses from the BOH and EJ groups. In addition to surveys, we also accessed the public data portal and CSO

permittees' websites to observe the difficulty in subscribing to notifications. Our recommendations were formulated from the concerns shown in our findings.

Our findings indicated that Boards of Health (BOH) and Health Departments (HD) that went to training delivered by MassDEP were more aware and had a higher understanding of their responsibilities regarding the new regulations (see Table 10 and Figure 18). In addition, there were multiple occurrences of BOH and HDs that indicated that they would like additional or future training sessions. When we looked into subscribing to the permittees' websites, they were difficult to navigate and reach the link needed to subscribe. For example, New Bedford's website page for CSOs is still currently under construction. Therefore, we recommend that MassDEP hold more training events in the future. We believe that this will greatly benefit the BOH/HD who have not yet had any training but who want training. Along with any BOH and HD that want a review of the regulations or still have questions regarding the regulations. With increased training, we expect there to be more awareness and understanding surrounding the regulations for CSO and SSO occurrences across Massachusetts.

The results indicated that there were multiple BOH/HD that were looking for more clear examples and run-throughs of what their requirements might look like if an event were to occur in their municipality. Due to this reason, we suggest that MassDEP have a video or document running through an example of a specific municipality and what their responsibilities and requirements might look like. This would break down each step the BOH/HD would have to do chronologically, along with a description of why they are taking each step.

Another way that the BOH/HD could receive additional and more effective training is to get more involved in the training. Most of MassDEP's previous training meetings were seminar-based, where the BOH/HD in attendance could ask questions. Given some of the responses in

our survey that indicated that the training did not stick, it seems that some BOH/HD would benefit more in a training session if they were more involved than just listening and asking questions. One possible way MassDEP might be able to achieve this is to allow an effective way for BOH/HD to get feedback on their understanding of the requirements if they want it. For example, if a BOH/HD was to make a simulated public health warning and temporary signage for their specific municipality based on their understanding they should be able to get feedback for that from MassDEP to know if they are doing it right.

We also recommend that there be a self-paced training document available to the BOH/HD. This would include any information a BOH/HD might need in an all-in-one document in order to carry out their requirements regarding sewer overflows. We believe this would allow the BOH/HD still interested in learning about their requirements which would boost awareness and understanding. Our findings also indicated that some BOH/HD would like summarized information in one place where they can go and look at it when needed. We believe that this might help.

In addition, our findings indicated that a concerning amount of BOH/HD struggled with knowing if they needed to follow the translation requirements and there also seemed to be a lack of awareness about translation requirements and identifying environmental justice populations. To help this we recommend that MassDEP provide a clearer translation help to BOH/HD. One concern that was brought up in our survey results was BOH/HD didn't know where to go if they were to need a translation. We recommend that MassDEP try to help provide resources that can help translate for the Boards of Health if they need a translation. In addition, the MassDEP web page on sanitary sewer overflows and combined sewer overflows does not have a clear link to a resource that goes over environmental justice population requirements for BOH/HD if they may

need it. To find the requirements, one has to click on either the sanitary sewer overflow public notification plan instructions or the instructions for the combined sewer overflow public notification plan. We would recommend providing a clear link that anyone can go to in order to look at the requirements for environmental justice populations directly.

Our findings also indicated there seems to be an interest in community outreach from community and watershed organizations near where CSO events are occurring. Therefore, we recommend that MassDEP try and continue to reach out to community and watershed organizations near where CSO events are happening. This is because in our survey it seemed like some organizations that did not know you could sign up for notification seemed interested in signing up and promoting it to their followers. We even got some to comment that they plan on doing so. If MassDEP could get more community and watershed organizations to be aware of the issue and possibly promote the issue in their communities, it would greatly benefit the communities where CSOs occur frequently.

All of our previous recommendations would benefit if MassDEP were to collect more information on what they could do to better help BOH/HD understand their requirements. This is why we recommend that MassDEP continue to reach out to Boards of Health and Health Departments to better understand what additional information they might need, and a focus group might be able to achieve this.

By regulating sewer overflows, we can mitigate the impact on communities that are affected by overflow occurrences. Without regulation, the consequences of CSOs and SSOs would be far worse than what they are now. We believe that these recommendations will continue to help mitigate the impact sewer overflows have on communities by making sure Boards of Health are better prepared for when an overflow occurs.

Overall, what was most concerning is the lack of communication between permittees/sewer authorities and the BOH/HD, along with how little information some Boards of Health understood. A lack of communication can be a problem for two reasons, firstly it means the Boards of Health not being communicated with have less awareness, and secondly, permittees are supposed to contact their local BOH/HD for their final notification plan that is due in January 2023. This only gives the permittees a few months to address this in their notification plans. The other concerning piece of information is how little of an understanding a BOH/HD with no training from MassDEP has. This does not even include all the BOH/HDs who did not complete the survey, so it is likely there are even more BOH/HDs that have little understanding. Of the 42 who did respond and did not attend a MassDEP training, a vast majority showed a lack of understanding as seen in table 10. This finding is concerning because if an overflow occurs in one of those areas, then the community impacted might have a higher chance of coming in contact with water contaminated by overflow. This would be due to the BOH/HD not being able to properly warn people due to the BOH/HD's lack of knowledge. This is why we recommended that MassDEP continue to offer training and improve resources.

Another concern brought from our findings is that some Boards of Health seemed to not care about the issue enough or would wait until an event occurred in their area to further look at what they are required to do. This is problematic, again since if an event did occur in their area members of their community might suffer from the BOH's lack of awareness and preparation. So hopefully, if MassDEP continues to offer training then some of these Boards of Health may have an increase of awareness on these events, and what they are responsible for doing.

There also seemed to be some pushback from some BOH/HDs regarding the regulations. These mainly had to do with the use of preexisting emergency systems to distribute public health

warnings and signage. The main concern with signage was that the BOH/HDs were not sure if any funding would be available for temporary signage. For the use of emergency systems, some feared that alerting of an overflow event using something like reverse 911 would be a misuse of the technology.

In addition, training had a positive impact on the BOH/HDs' awareness of the regulations. This is great as their communities will be better served for any possible overflow events in the future. If MassDEP continues to offer training, it will have a good chance of benefiting more communities.

Having overflow events also drastically increased the understanding of requirements among BOH/HDs. This is why we recommended example-based training in hopes to simulate an event that could impact a municipality. If a Board of Health can see an example of what they are supposed to do this can help them by explaining their responsibilities differently and prepare them for future overflow events in their municipality.

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Appendix A

Definition in the Regulations

The definitions given by the regulations are important to understand what the new regulations are referring to. The regulations define basic regulatory terms like "Agencies" and Person" which are not relevant to looking into notification regulations (Galvil W.F.,2016, pg.19). However, this leads to how the statutes are written up with their own definitions. The statute states that a combined sewer system is "a sewer system designed to collect and convey stormwater runoff and sewage in shared piping" (Session Law-Acts of 2020 Chapter 322, 2020). "Department" is referring to the Department of Environmental Protection (Session Law - Acts of 2020 Chapter 322, 2020). A discharge or discharging is "a release or diversion of sewage, industrial waste or other effluent, which is untreated or partially treated, including from a combined sewer system overflow, that is emitted from an outfall directly or indirectly into waters of the commonwealth" (Session Law - Acts of 2020 Chapter 322, 2020). The "outlet designed for the purpose of allowing a discharge that is part of, or connected to, a combined sewer system, sanitary sewer system or treatment works, including a connection to any such system or facility intended to allow wastewater to divert or bypass treatment by a facility" (Session Law - Acts of 2020 Chapter 322, 2020) is considered and outfall according to the statute. A permittee is "a person granted a permit under section 43 to operate and maintain a particular outlet for the discharge of pollutants into waters of the commonwealth or a person discharging pollutants from an outlet without a required permit or in violation of the conditions of a valid permit" (Session Law - Acts of 2020 Chapter 322, 2020).

Appendix B

Boards of Health Survey Questions:

1. Have you attended any training by MassDEP pertaining to CSO or SSO Events
   - Yes
   - No

2. Since new Requirements have gone into effect, has your BOH/HD issued Public Health Warnings and posted temporary signs in response to any CSO or SSO events?
   - Yes
   - No

3. If yes, did you use the existing emergency notification system, including a reverse 911 call system if available?
   - Yes
   - No
   - N/A

4. How were you notified that there was a CSO/SSO occurrence?
   Short answer text

5. BOH/HD in municipalities directly impacted by a discharge or overflow are required to issue a public health warning to impacted residents of the municipality upon receipt of a public advisory notification in which of the following circumstances.

Please select all that you were aware of and understood before taking this survey.

- For CSO, partially treated, and blended wastewater discharges, if the discharge has a duration longer than two hours.
- For CSO, partially treated, and blended wastewater discharges, if the board of health or health department determines that a public health warning is necessary to protect public health, regardless of the duration of the discharge.
- Any SSO that discharges through a wastewater outfall, either directly or indirectly, to a surface water of the Commonwealth.

- Any SSO that flows into a surface water of the Commonwealth and is the result of the sanitary sewer system surcharging under high flow conditions when peak flows cannot be conveyed to a POTW due to capacity constraints conveyed to a POTW due to capacity constraints.
- Any SSO that flows into a surface water of the Commonwealth and is the result of a failure of a wastewater pump station or associated force main designed to convey peak flows of one million gallons per day or greater.
- Please only select this option if you were not aware of any of these scenarios.

6. In regards to the public health warning, there is minimum required information that should be included with the warning.

Please select all that you were aware of and understood before taking this survey.

- The public health warning shall identified receiving water affected
- The location, date, and time of the discharge or overflow.
- A recommendation that the public avoid contact with affected water bodies for at least 48 hours after a sewage discharge or overflow, and during rainstorms and for 48 hours after rainstorms end, due to increased health risks from bacteria or other pollutants associated with urban stormwater runoff and discharges of untreated or partially treated wastewater.
- Information on where to find the closure or advisory status of shellfish growing areas, beaches, or other water resource areas potentially affected by the discharge or overflow.
- Access to translations of the warning, as appropriate for neighborhoods identified as environmental justice populations due to lacking English language proficiency, in the language(s) most appropriate for those neighborhoods.
- Please only select this option if you were not aware of any of the required information.

7.In addition to public health warning, BOH/HD are also required to post or cause to be posted a temporary sign or use a permanent sign, at conspicuous locations affording public access to the waterbody, as identified by the BOH/HD, in municipalities directly impacted by the discharge or overflow. Permanent signs installed and maintained by permittees in accordance with 314 CMR 16.05(3) may be used for this purpose.

However, if a temporary sign is used, the following information should be included.

Please select all that you were aware of and understood before taking this survey.

- A warning message that reads “WARNING! AVOID CONTACT WITH WATER – MAY CAUSE ILLNESS"
- An infographic showing no fishing, boating, or swimming.

- In neighborhoods identified as environmental justice populations due to lacking English language proficiency, the sign shall include translation of the text above and provide access to translations of the following information in the language(s) most appropriate for those neighborhoods.
- Text stating that the reason for the warning is inform people about the potential for sewage in surface waters.
- The requirements specified in 310 CMR 16.04(10)(b)
- Information on where to determine the closure or advisory status of shellfish growing areas, beaches, or other water resource areas potentially affected by the discharge or overflow.
- Contact information for the board of health or health department.
- Please only select this option if you were not aware of any of the required information.

8. Have you been contacted by any sewer authorities regarding where to place permanent signs at public access points to alert the public to CSO discharges?

- Yes
- No

9. What steps have you taken to create effective communications between your BOH/HD and permittee, and are permittees reaching out to make sure the notifications are being sent out?

Short answer text

10. In previous questions, environmental justice population requirements were mentioned. If you have any question or concerns about these requirements please feel free to share.

Short answer text

11. On a scale of 1 to 10, how would you define your understanding of the new requirements?

Do not understand 1 2 3 4 5 6 7 8 9 10 Completely Understand

12. Is there anything you would like more information on regarding the new regulations?

Short answer text

13. What part/parts of the regulation do you not understand?

Short answer text

Appendix C

Environmental Justice and Watershed Organizations Survey Questions:

- Are you aware that you can sign-up to receive notifications about CSOs? (yes/no)
- Is your organization currently signed up for any CSO notifications? (yes/no)
- If your organization is subscribed, how exactly did you figure out how to sign-up for the notifications? (short answer)
- If your organization is not subscribed do you plan on subscribing now, why or why not? (long answer)
- Have you promoted signing up for notifications at all? (yes/no)
- If yes, how are you informing people about the new notification? (short answer)

Appendix D

See Overflow Incidents July 6 - September 11 2022 excel