Budget Considerations for Meeting MS4 Requirements in Massachusetts

An Interactive Qualifying Project
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Massachusetts Department of Environmental Protection

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Abstract:

The 2016 Massachusetts Small Municipal Separate Storm Sewer System (MS4) General Permit was established to reduce nonpoint source pollution of stormwater. Many communities have struggled to meet the fiscal demands of the regulation and need realistic budget expectations for future MS4 permit spending. Through regulation analysis and examination of spending practices, our research developed new MS4 budget predictions, suggested changes to MS4 permit spending for different regulatory aspects, and gave overall suggestions to improve permit spending for communities in Massachusetts.

Acknowledgments:

We would like to start by thanking our sponsor, the Central Massachusetts Regional Stormwater Coalition, for providing us with their time and resources. We would specifically like to thank Kerry Reed, Angela Panaccione, and Andrea Briggs, for taking time out of their weeks to discuss our project progress, and any concerns that we had at the given time. These meetings were of immense importance and they provided much information which was used in the report. They also gave us guidance on the direction of the project and helped to mold it to what best fit their needs. We are extremely grateful for all of the time and effort that they put into helping us.

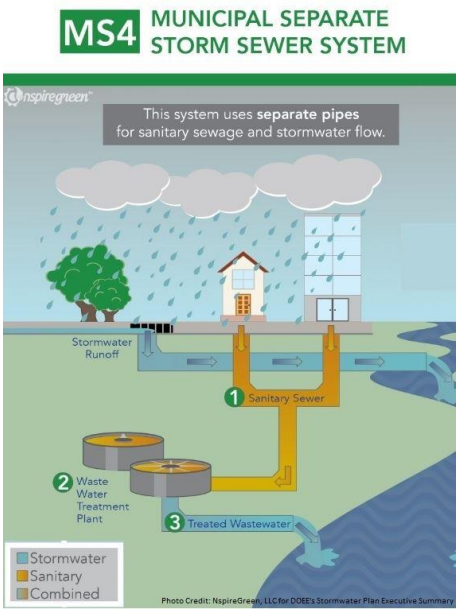
We would also like to thank Professor Mathisen for his help throughout the project, both this term and last term. The help he provided was crucial, and he made sure that we stayed on track and didn't fall behind where we needed to be. He also provided helpful insight on our draft sections of every part of our report. This was important for us in determining the format of the project, as well as the scope of much of our research. It required much of his time, but we are thankful that he helped us with so much of our project.

Additionally, we would like to thank those that provided us with the data that was required for our project. This came in several different forms throughout the project. First, we received data from the Massachusetts Budget Benchmark Survey. There were forty-two towns that filled it out, and this information was extremely helpful in analyzing the current spending data. Next, we would like to thank those that met with us for an interview. Thanks to Kerry Reed of Framingham, Angela Panaccione of Palmer, and Robert St. Germain of Ashland, we were able to gain more insight into the stormwater situation in each of their towns. They were also willing to send us spending data from their town to analyze further after the completion of the interview.

Executive Summary:

Introduction and Background

Stormwater is an important issue in many communities throughout the country. If unmanaged, stormwater can cause flooding in urban environments and can also allow a variety of pollutants to enter into local water bodies. Pollution caused by stormwater can have a number of negative impacts, so limiting water contamination is crucial. One of the ways that pollutants find their way into water systems is through MS4 drains, shorthand for Municipal Separate Storm Sewer Systems. These systems discharge stormwater runoff directly into water bodies in order to reduce flooding. Stormwater entering MS4 systems do not get treated before being discharged, meaning that MS4 runoff has the potential to carry a large volume of pollutants into local water bodies. This system is depicted in the margin (NspireGreen, 2018). Additional requirements for using MS4 drains have been mandated by the government to attempt to stop damage caused by polluted stormwater runoff, one of which being the requirement for towns to obtain permits to operate MS4s.



The Environmental Protection Agency (EPA) drafted the Massachusetts Small MS4 General permit in 2014 and finalized the permit in 2016. This permit came into effect on July 1, 2018, containing strict specifications regarding the use of MS4s. Many communities have since been unable to meet the cost demands of the new, expensive permit. Towns, who in the past were able to spend relatively little on costs associated with stormwater, now find themselves being overwhelmed with implementation costs. Many towns have been unable to meet the EPA's spending expectations and have fallen behind with the implementation schedule originally set with the 2016 permit. This has been further exacerbated because many municipal stormwater programs are a low priority within town budgets and do not receive enough funding to fully implement MS4 systems in accordance with the EPA's standards. Due to this, many towns will need to increase spending to retroactively complete past requirements and to meet future permit demands.

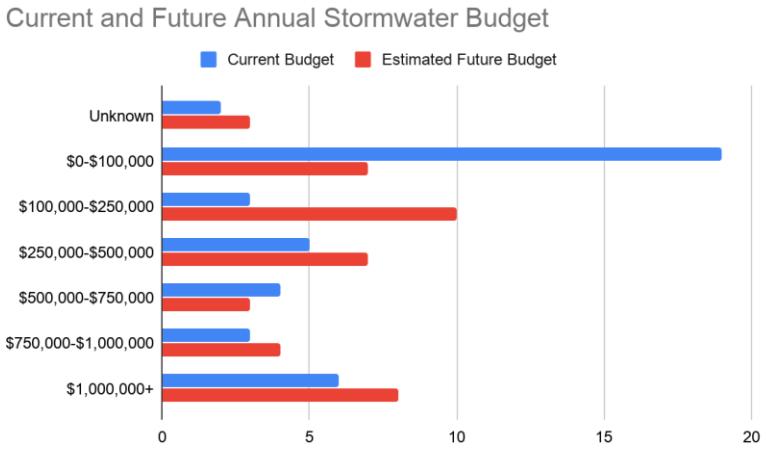
Communities have a need for updated cost estimates for MS4 permit expenses. The cost analysis supplied with the original permit by a 2014 Water Vision LLC report proved to not be realistic. Now, in 2020, communities have real data on MS4 spending, which can be compared to prior budget estimates for the same year. The goal of this project is to revise cost estimations for MS4 permit spending, which will give communities an accurate depiction of costs for stormwater management, and aid with their preparation to efficiently fulfill their implementation schedules.

Methodology

In order to create new cost estimates for the permit, we first had to understand the stormwater permit as it applied to our stakeholders. This was mainly through the use of the permit itself. Careful analysis of the permit allowed us to understand exactly what was being asked of the local communities. Naturally, there were some areas that were confusing and difficult to understand. These areas were explained to us further during several interviews with local experts on stormwater management. After understanding the permit, we analyzed the Stormwater Budget Benchmark Survey, which was provided to us by the Massachusetts Statewide Stormwater Coalition. This survey provided information on how each of the forty-two respondents were fairing up through the first year of the permits' implementation. It covered how far along they were in meeting the requirements, how much they were spending annually, what their major concerns were, as well as other relevant information for our project. This data was of critical importance to the project, and we have shown below one of the graphs we created from it. After studying the survey, we analyzed the actual implementation costs that communities have spent and compared these to the original costs estimates. In order to do this, we used the survey data and observation of three case study towns we selected: Framingham, Ashland, and Palmer. We interviewed representatives from each of these towns separately and used their town's data on stormwater spending to determine their current budget and provide a potential estimate for their likely future spending. Lastly, we created estimates for our stakeholders' future budgetary needs and provided recommendations. We were able to provide four key recommendations that should help aid towns with their current stormwater regulations concerns and provide them with more guidance on their future budget.

Findings

One of the major parts of adjusting future budgets was through the use of survey analysis. The graph below was created using survey data comparing a towns' current stormwater budget (in blue) with their anticipated future spending (in red). The size of the bar shows the number of towns in the labeled cost bracket. The data clearly shows that towns expect to see future increases in permit spending. Currently, many towns have a stormwater budget of less than $100,000, which is inadequate for nearly all towns. Future budget expectations reflect the demand towns see for increased stormwater spending.



One reason that towns expected a future cost increase is because new requirements of the permit go into effect each year, increasing the overall permit costs for towns. Below are our overall expected changes in current stormwater budget predictions for rural, suburban, and urban towns.

Rural Towns Projected Budget Change

Fiscal Year	FY19	FY20	FY21
Percent Change	78%	273%	261%

Suburban Towns Projected Budget Change

Fiscal Year	FY20	FY21	FY22
Percent Change	64%	3%	9%

Urban Towns Projected Budget Change

Fiscal Year	FY21	FY22	FY23	FY24
Percent Change	12%	-10%	13%	-2%

Our charts show the expected changes in current budgets for rural, suburban, and urban towns based on the U.S. Census designation. Rural towns are expected to see their budgets increase at the highest rate, which is likely due to the fact that many have been underspending and have failed to meet many of the scheduled implementation goals. Communities that have been underspending will need to significantly increase their budget in order to retroactively meet the EPA's deadlines.

Suburban and urban communities are expected to see an initial increase in budget before tapering off. Urban towns had the least predictable trend concerning MS4 spending, as there were wide differences between urban towns' budgets. Most urban and suburban towns had more established stormwater spending habits, which is why we expect to see slower increase than rural towns. These categories of towns needed fewer changes to their budgets, but changes were still needed nevertheless.

Costs analysis of all three types of towns were done, with the most detailed analysis coming from suburban towns. This is because our suburban town of study, Ashland, provided the most robust data of the three towns we analyzed. We incorporated town case study data with the overall survey data to produce budget changes for future MS4 permit spending.

Recommendations and Conclusions

After completing our research and cost analysis, we determined four main recommendations for the future.

Our first recommendation is that towns should plan to see budget increases. This is true for rural, suburban, and urban towns. Although this will take place at different rates for the communities, all three types should expect to see an increase, with the most rapid increase in rural town budgets, and the slowest increase in urban town budgets. The predicted cost increases are the result of some towns being behind schedule, forcing them to try to catch up over the next few years. Budgets will also likely increase due to new permit requirements coming into effect in the near future. Some of the main areas where towns should prepare for these increases include Municipal Good Housekeeping, IDDE, and TMDLs.

Our second recommendation is that towns should prepare for changes within their stormwater management programs. Towns should prepare to spend more on staffing dedicated to stormwater. Survey data has shown us that towns have much fewer staff than the EPA estimated would be necessary, and towns themselves have stated that they will likely need more personnel to properly comply with MS4

regulations in the future. Additionally, they may need to spend more in order to retroactively complete some of the permit requirements that have been missed. This includes disposal of street sweeping material and mapping of the MS4 system, which many towns have not yet completed. These are areas that will soon need to change, so towns should be prepared to make the necessary alterations within their stormwater management structure.

Our third recommendation is that towns should consider implementing a stormwater enterprise. This can be useful to them for several reasons. First, the enterprise guarantees the availability of funding dedicated to stormwater management. This solves the issue of stormwater programs being dependent on grants and town approval to enact MS4 regulations. There will be less of a focus on appealing to town appropriations committees attempting to get stormwater budgets approved. Stormwater enterprise funds have many different methods of charging fees to town citizens, so each community can tailor their billing strategy to best fit their town situation.

Our fourth recommendation is that towns should join a stormwater coalition if they have yet to do so. Coalitions prove to be helpful in many key ways. For example, they provide necessary resources and informative workshops on aspects of the permit. They host workshops to help member communities create proper technical documents, help coordinate public outreach events, and provide towns with expertise on MS4 regulation. Coalitions help towns better understand how to follow permit regulations and develop collaborative efforts between towns, which allow them to see which stormwater management practices work well, and which ones do not. Lastly, coalitions use collective bargaining to reach audiences with governmental and regulatory organizations. This allows a town to have more impactful inputs on stormwater regulation practices within the state.

Authorship

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1. Introduction

Stormwater pollution poses a significant threat to the safety and quality of Massachusetts' water bodies. Stormwater, which results from precipitation that runs off land areas, quickly collects contaminants such as trash and debris, salts, fertilizers, and organic waste. This is a significant concern in urban areas where stormwater drains prevent flooding by draining stormwater to localized bodies of water. If the runoff becomes polluted, waterways can become severely damaged, causing effects that lead to the destruction of aquatic ecosystems and compromising of public health and safety (DC.gov, 2020).

Due to these environmental threats, the Environmental Protection Agency (EPA) introduced regulations in 2016 regarding urban stormwater management, specifically around Municipal Separate Storm Sewer Systems (MS4s). MS4 sewers create a direct path for stormwater runoff to enter lakes and rivers, with any pollutants that enter the sewer system being discharged directly into water bodies. In order to prevent harmful pollutants from being washed or dumped into MS4s, municipalities are required to obtain permits to build and use these systems. Implementation and maintenance costs related to MS4 permits place a high fiscal burden on many communities (EPA, 2016).

Aside from the physical infrastructure of the storm drains themselves, the MS4 regulations also include several non-infrastructure related requirements that towns must abide by in order to keep their permits. The EPA has highlighted focus areas for towns to target in their stormwater management plans which include tasks such as public education, runoff management, housekeeping practices, and other requirements. These control measures prove to be an especially difficult task for communities to execute. Often, towns do not have enough funding to pay for stormwater management within their towns, and this is exacerbated by vague spending guidelines given out about stormwater budgets (EPA, 2016).

When the MS4 permit came into effect in 2018, Massachusetts' communities found that their budget estimates were inaccurate and inadequate for the demands of the regulations, so towns had poor fiscal expectations for the regulation's affordability and feasibility. For the communities tasked with implementing the regulations, creating accurate budgets and acquiring funding are the most challenging aspects of permit compliance. Fortunately, some communities have found ways to get help with abiding by the permit, one being the formation of stormwater coalitions. They act as central hubs of knowledge for stormwater regulations, providing towns with assistance about technical information, public education, and other aspects of stormwater regulations, including MS4 permits (Gregory, Reed, & Woodsmall, 2019). Even with their aid, communities are still struggling with meeting MS4 regulations.

At the completion of this report, two years have passed since the permit's initial implementation. Towns have gained more experience with the permit and many have obtained updated spending data for realistic expectations on permit compliance costs. Still, towns have a need for updated stormwater

budgets for future years of permit spending. To aid these communities, the Central Massachusetts Regional Stormwater Coalition (CMRSWC) would like to support the towns by improving the stormwater budget estimations. The goal of our project is to aid the communities of central Massachusetts by developing and revising MS4 budgets based on current spending data.

In order to accomplish this goal, we developed four main project objectives:

1. Understand the MS4 stormwater permit requirements as they apply to our stakeholders.
2. Analyze the MS4 Budget Benchmark Survey.
3. Analyze the regulation implementation costs and compare them to original cost expectations.
4. Estimate budgetary needs for future years of the permit.

To accomplish these objectives, we worked closely with representatives from the CMRSWC in order to gather data and receive guidance for our project. We analyzed MS4 survey data collected by the Statewide Stormwater Coalition from towns across the state in order to broaden our project's scope. We also performed case studies on the city of Framingham and the towns of Ashland, and Palmer to obtain detailed information on stormwater spending, cost predictions, and permit practices. Using data analysis, interviews, and reference of case studies/memorandums, we have updated the cost breakdowns of stormwater permit implementation. This information will be useful for our sponsors for distribution to their members, giving them a more concrete understanding of budgetary expectations for the future of MS4 regulations.

2. Background

Budget development for any type of program requires both a technical understanding of the requirements being pursued and a fiscal awareness for the costs of the demands. Likewise, to be able to create refined estimates for MS4 spending, we must first become educated on MS4 regulations. Because stormwater is such an important issue to the ecosystem of Massachusetts, it is critical that we understand its causes, effects, and the measures taken to lessen its impact on the environment. In this chapter, we analyze the development of stormwater regulations and observe their impact upon nature and on communities. We will review the principles of stormwater, its management, and accompanying regulations in order to build a baseline of knowledge needed for budgetary refinement.

2.1: Stormwater

Stormwater pollution is an important issue for many towns across the country. Stormwater is generated from rain and melted snow that flows over impervious surfaces. These surfaces are structures such as roads, rooftops, parking lots, and sidewalks that restrict water's ability to naturally soak into the ground (EPA, 2020). The water, unable to infiltrate into soil, pools ups and creates stormwater runoff. This runoff can become polluted with a variety of contaminants while it flows en route to storm sewer drains. Storm sewer systems dispose of stormwater by transporting it to the nearest water source (lakes, rivers, oceans) where the stormwater is then poured, usually without treatment. Stormwater pollution has a multitude of adverse effects on the environment. It can destroy aquatic ecosystems, impair water for recreational use, and threaten public health and safety (DC.gov, 2020). Further, stormwater pollution can contaminate sources of drinking water and can lead to flooding (Stormwater Equipment Manufacturers Association, 2015). This happens as a result of the debris and contaminants that pollute stormwater, such as road salt, fertilizers, automobile byproducts (gas, oil, tire debris, brake dust), rocks and sand, and other trash that infiltrate waterways. These pollutants cause harm in a variety of ways. Salts and oils can harm the wildlife that live in streams and ponds, while fertilizer runoff can lead to harmful algal blooms, which can decimate the ecosystems within waterways (Hans W. Paerl, Timothy G. Otten, & Raphael Kudela, 2018).

Figure 1: *Typical Stormwater Drain (WJLA-TV, 2016)*

2.2: Stormwater Regulations and the MS4 Permit

Several regulations have been put into place with the aim of reducing the prevalence of harmful effects from pollution. The effects of these regulations can lead to a decrease in negative impacts from stormwater. This is done by reducing the quantity of pollutants entering stormwater drainage systems, which can improve aquatic ecosystems by reducing the quantity and size of algal blooms as well as improved safety for wildlife (Mass.gov, 2020a). The regulations also help with other issues, such as flooding, blocked roadways, and damaged businesses and housing. Stormwater is the largest contributor of pollutants to impaired rivers, lakes, streams, ponds, and other waters in Massachusetts, and regulations represent an important step to reduce the impacts of stormwater on these water bodies (EPA, 2020). The largest and most important regulation is the MS4 permit, implemented by the EPA.

2.2.1: Municipal Separate Storm Sewer Systems (MS4s)

MS4s are storm sewers that dispose of collected stormwater directly into surrounding water bodies. MS4s drain stormwater runoff, and any pollutants which enter the system, straight into water bodies without treatment. This is done in order to allow fast transport of stormwater to reduce flooding in urban areas (Penn State Extension, 2018). This system is contrasted with Combined Sewer Systems (CSS), which blend stormwater runoff intake with regular sanitary sewage systems. CSSs have the benefit of treating all water before it is discharged into water bodies, cleaning both stormwater and sewage. However, CSS lacks the capacity to deal with heavy amounts of stormwater runoff, meaning that raw sewage overflows directly into water bodies. MS4s have distinct advantages over CSS in environments where large volumes of stormwater must be dealt with quickly and often. In New England, this is especially important because of the highly urbanized environment and the rainy climate, so MS4s are widespread across the region. The downside to MS4 use is the aforementioned side effects from pollution. The basics of these systems are shown in Figure 2.

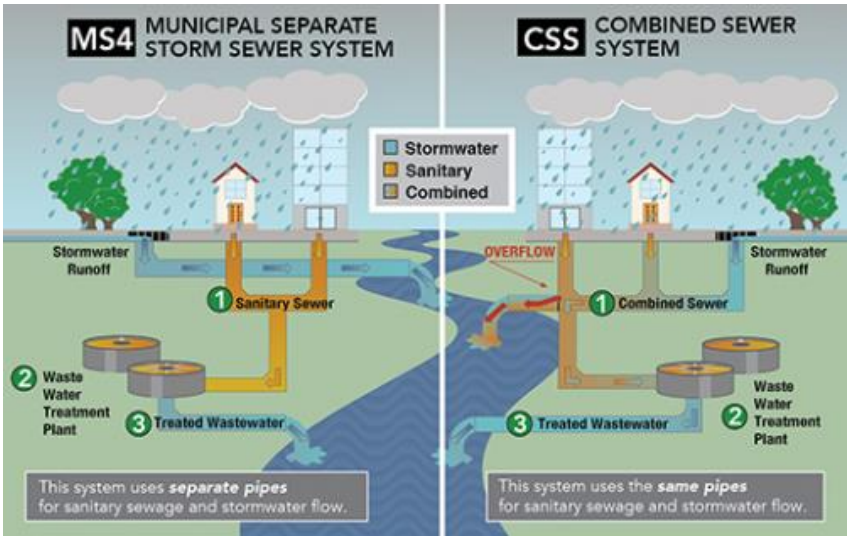


Figure 2: *MS4 vs Combined Sewer System (City of Somerville, 2020)*

In order to reduce the amount of pollutants entering MS4s, state and local governments must acquire permits to own and operate MS4s, which instate protective regulations towns must abide by for use. These MS4 permits are issued jointly by the state and federal government by the Department of Environmental Protection (DEP) and EPA (EPA, 2003). This regulation was completed in 2016, with implementation starting in 2018. Some general responsibilities demanded by the permit include maintenance and upkeep of stormwater drains, controlling runoff pollution, and implementing public education programs on stormwater runoff (EPA, 2016). The requirements, which are quite complex, aim to both cut back on pollution due to stormwater and to increase general stormwater awareness within the public.

2.2.2: Permit Struggles

Many communities are struggling to abide by the MS4 permit requirements. The financial burden of these regulations is placed onto the individual communities charged with implementing them. The MS4 permit mandate is unfunded, so communities have to develop funding for the permit on their own, often allocating capital from their own municipal budgets. Permit compliance costs can be quite expensive and challenging for towns, but they are still expected to meet the requirements, nevertheless. Additionally, while stormwater is an important issue, towns generally view it as of lesser importance than other costs within their budgets, such as public education and police departments (Reed, 2020).

On top of financing issues, communities have been given vague spending guidelines for the permit's implementation costs. This has led to towns not knowing the fiscal requirements of abiding by the permit. Estimates supplied by the EPA were the only references communities had access to when determining initial budgets for permit spending. A report by WaterVision L.L.C. was commissioned by

the EPA in 2016 and was supposed to give guidance to towns on their projected permit spending (WaterVision, 2016). It provided a wide range for the costs of the first handful of years of the permit. They estimated that for a suburban town, costs could vary between about $450,000 per year to just over $1.3 million (WaterVision, 2016). The wide variance from this cost prediction has led to many towns being unsure of how much they will need to spend on the permit (Gregory, Reed, & Woodsmall, 2019). With so much uncertainty as to how much the regulations will cost annually, many towns find these estimates to be too unpredictable and generally not applicable for budget development. This is because the cost determining circumstances vary greatly from town to town, so budget predictions need to be tailored for each community in order to be accurate. This key aspect makes the expenses so difficult to predict, as towns must figure out on their own the cost of MS4 permit implementation.

One important factor that determines MS4 implementation costs is what is known as an MS4 area, which is the region of a town that is subject to MS4 regulation (typically only areas designated as "urbanized" by the U.S. census) (EPA, 2012). MS4 areas play a large factor in cost prediction because even small towns can still have a large MS4 area due to "urbanized" designations, but the inverse can also be true. This makes knowledge of the total MS4 area in a community vital when trying to determine cost estimates. Another factor that makes budget estimation difficult is compliance with Total Maximum Daily Loads (TMDLs). These are restrictions placed on towns that inhibit the amount of certain types of pollution that are allowed through outfalls each day. These are emplaced based off town proximity to impaired watersheds, and TMDLs can be difficult for communities to abide by (Panaccione, 2020). Several aspects such as these add a lot of uncertainty towards budget estimation.

2.3: Permit Aspects

With the responsibility of realizing and enforcing these regulations, individual communities within Massachusetts look to guidelines set by the EPA for answers. The intricacy of these ordinances can be disorienting and frustrating to understand for the towns charged with implementing them. Thankfully, several organizations have helped to simplify and streamline the details of the MS4 regulations, including the MassDEP, National Association of Clean Water Agencies (NACWA), and EPA. Along with the towns putting these systems into action, our team has consulted these guides in order to understand and plan for this our project's budget development goal. Next, we will discuss the regulations in detail, their demands, and certain friction points that our sponsor organization has encountered trying to meet the MS4 Legislation.

2.3.1: Permit Relevance and Demands

The permit applies specifically to Phase II MS4s, also known as small MS4s, which consist of MS4s in U.S. Census Bureau defined urbanized areas that are not medium and large cities and to areas designated by permitting authorities (The National Association of Clean Water Agencies, 2018). Phase II MS4s are different from Phase I MS4s,which are also known as large MS4s. These apply to medium and large cities or certain counties with greater than 100,000 residents. "Small" and "Large" MS4s are distinct and are covered under separate permits (All further mentions of MS4s refer to small MS4s.) MS4s are regulated if they meet one of two thresholds; if an area is designated by the U.S. Census Bureau as "urbanized", then small MS4s in that area become regulated. If MS4s are operated within these urbanized portions, towns must apply for an MS4 permit (The National Association of Clean Water Agencies, 2018). Additionally, MS4s can become regulated if the EPA or State level National Pollutant Discharge Elimination System (NPDES) authority determines that certain MS4s not within an "urban" area still must follow the legislation (The National Association of Clean Water Agencies, 2018).

MS4 systems are dependent on the regulation definitions set by the EPA. Often, towns have many MS4s outside of areas which are regulated by the permit. Many towns, based on census data, are bisected by the definition of "urbanized" and "non urbanized" areas. The splitting of MS4 designated areas can disrupt the stormwater systems within a single town. The distinction between regulated and unregulated MS4s is important for towns to recognize because they only need to focus their MS4 permit budgets on the sections of stormwater sewers that lie within the "urbanized" portions of town. If they aren't informed of the difference, towns could waste valuable resources tending to unregulated MS4s. To exacerbate this issue further, the definition of urbanized areas changes for each new census, meaning that towns affected by the permit one decade may be able to ignore it the next decade (and vice versa). This can cause significant confusion for towns with much of their area on the "urbanized" border, specifically regarding their infrastructure. Towns need to be proactive with dealing with MS4 development, which needs to be reflected in their stormwater budgets. This confusion is alleviated with the help of stormwater coalitions and other similar organizations that provide education, assistance, and outreach to the impacted communities.

2.3.2: Minimum Control Measures

As mandated by the EPA, in order to obtain a permit to have a Small MS4s, towns must concurrently abide by six control measures that supplement the sewer system's ability to safely control stormwater (EPA, 2016). These are laid out below.

1. Public Education and Outreach: Towns are required to implement a public education and outreach program in communities with MS4s.

2. Public Involvement and Participation: Towns must provide opportunities for residents to participate in the stormwater management program, such as citizen advisory communities or through volunteer opportunities.
3. Illicit Discharge Detection and Elimination: Towns must create a program that detects illicit charges in the MS4 system. This must also be accompanied by an education program about the dangers of illegal discharges into stormwater systems.
4. Construction Site Runoff Control: Towns must instate a program to reduce pollutants associated with construction. This should focus on erosion control and inspection of sites.
5. Post Construction Site Runoff Control: Towns must create a program to combat stormwater runoff stemming from development properties after construction has occurred.
6. Pollution Prevention and Good Housekeeping: Programs must be put into place that addresses runoff from municipally-owned facilities and their related activities. This also is accompanied by an education program that trains employees of municipal sites on the importance of proper storage and labeling of organic materials, salts, and other typical MS4 runoff that causes harm.

The six minimum control measures inform the budgeting decisions of stormwater coordinators when creating stormwater budgets. These control measures take the highest amount of focus aside from the physical storm drain construction required by the permit. Some of the control measures have similar cost demands across town type, regardless of size and urbanization. On the other hand, some control measures have wide variances when differentiating between type and size of community. Towns face a lot of uncertainty when planning the cost of each control measure, so implementing regulations without proper planning and budget has proven to be quite difficult, particularly with the robust cost requirements of Illicit Discharge Detection and Elimination (IDDE) and Good Housekeeping.

2.3.3: Implementation Status

The MS4 permit was put into effect in 2018, however the working deadlines for the permit demands (as mentioned above) were not all required to be met immediately. The timeline for the permit was designed to be met by taking small steps towards implementation over an outlined timeline. This was done in order to pace out its implementation to make it more easily achievable. Certain requirements were given deadlines within 1 year of the permit's start date, others were scheduled for two years of the permit, and others within four years of the permit (EPA, 2016). One year after the permit, the towns must have completed their general implementation plan and an associated task organization in charge of meeting the EPA's minimum control measures. General information from the towns is scheduled to be implemented within two years after the permit went into effect. This involves stormwater management details such as maps and plans for how they would meet the permit requirements. Four years into the permit's enactment, the towns must have completed parts of the permit such as addressing impervious cover pollutants or

identifying properties for improvement and provide information on how they were able to meet the different permit criteria (EPA, 2016). An outline of this schedule can be seen in Appendix A.

While the EPA's initial timeline has outlined the expectation and deadlines for each permit mandate, the MS4 regulation plan has stagnated in practice. Many towns are failing to meet the permit requirements due to complications surrounding its implementation. They were slow to react to the permit, and securing the necessary funding takes time. The infrastructure, management, maintenance, and planning foundation had not developed quickly enough to meet the permit's expectation. The towns found that the regulations have proven to be difficult, time consuming, and expensive to meet(Central Massachusetts Regional Stormwater Coalition, 2019). In an effort to gain more time and aid in order to meet the permit, some towns have even sued the EPA. Coming from this, a settlement was recently reached near the end of 2019 to delay parts of the permit deadlines (EPA, 2019). The struggle between the local towns and the government is a deep point of friction. Communities are trying to meet the regulations, but at times are finding it impossible and are unsure what to do.

2.3.4: Current Cost Overview

Because funding is the critical issue holding back the regulation's status, it is vital to examine the regulatory spending regarding the MS4 regulation. Citing the technical memorandum reported by the EPA (WaterVision, 2016), we can outline certain cost saving areas for permit implementation. It identified the areas with the highest range in cost for implementation. In addition to the memorandum, individual town spending data will be important to understand actual permit expenditure. Data from initial cost estimates compared with real world spending data provide further insight on improving budget estimates.

In 2014, WaterVision published a cost memorandum on behalf of the EPA. This cost prediction broke the towns into three main groups: rural, suburban, and urban. This was supposed to make the prediction more accurate, as these groups should have similarities in their budgets. The estimates were broken down into sections,to show the approximate amount towns were expected to spend in each area. The total costs were expected to be $197,000 to $461,000 for rural towns, $454,000 to $1.06 million for suburban towns, and $1.08 million to $2.46 million (WaterVision, 2016). These price ranges were all extremely large, to help account for the diversity between towns; however, this makes them of little use to the communities. Additionally, this cost analysis fails to look at the different years within the permit. This cost estimate is an important place to start when analyzing the costs, but it will be important to investigate further to determine more accurate cost estimates.

2.4: Connection with 2014 IQP on Stormwater Costs

One similar study to our project is a 2014 IQP from WPI titled *Comprehensive Cost Analysis of the 2014 Massachusetts MS4 Permit.* It was based on the draft of the then upcoming Small MS4 Permit, as well as the details of the 2003 permit. The goal of this project was to assess the regulatory costs associated with the 2014 draft of the permit. Our project acts as a follow up to this report as our group assesses the actual costs of the finalized MS4 permit. The early cost estimates developed in the 2014 IQP will act as another resource in the process of correcting costs estimates for communities.

The paper concludes that in order to meet the requirements laid out in the permit, costs are going to be high and difficult for towns to implement. They provided several cost estimates for local towns, including Southbridge, Millbury, and Holden. Of interesting note is the wide variance of costs between the towns. While the expenses for Holden were predicted to be a little over $250,000 per year, the estimated cost for Millbury is about three times that (Cameron Peterson, Eric Correia, & Michael Giroux, 2014). This means that budgets aren't likely to be applicable between towns, so focusing on a small sample likely won't be enough to develop broadly accurate cost estimates. The paper has estimates for certain towns listed in the analysis, but these costs are non-consistent in comparison to other nearby locations (Cameron Peterson et al., 2014).

This project also breaks down the costs for different parts of the permit, which helps show the areas that are high in regulation costs. While several parts of the permit are cheap and easy to meet for all communities, there are several aspects that are not, such as the Good Housekeeping requirements. In addition, this case study also looked at the future costs that the towns will need to pay for further into the permit timeline. They provide what they thought the costs would be after initial implementation of the permit. Since we now have access to actual town expenditure, we will be able to contrast the cost estimates made by this project with the actual spending of their communities of study. By comparing the estimated costs from the project to the actual costs towns have faced within the first year of the permit, we can determine the accuracy of the predictions, and make changes as needed (Cameron Peterson et al., 2014).

2.5: Connection with Western Michigan University

Another related study was conducted at Western Michigan University (WMU) in Kalamazoo, Michigan in 2011 titled *Urban Stormwater Management* [sic] - *An MS4 Success Story for Eastern Michigan University*. Though it only focuses on MS4 implementation in one specific location, it still gives insight to the funding of these systems and types of collaborations that spread understanding of MS4 permit importance.

The paper explains that the university's concerns are with phosphorus total maximum daily load (TMDL) requirements. TMDLs are water quality standards set by the EPA for water bodies, putting a limit on how much of certain pollutants, in this case phosphorus, can enter into water bodies per day. The TMDL for the Kalamazoo River and Lake Allegan Watershed called for a 50% reduction of annual phosphorus loads from those set in 1998, a goal that was not met by any of the MS4s in the basin (K. Brian Boyer & Mark S. Keisser, 2012). Massachusetts towns have similarly struggled with complying with the new MS4 standard set in 2018.

WMU's collaborators include the City of Kalamazoo, Michigan Department of Transportation, Michigan Department of Environmental Quality, and the Kalamazoo River Watershed Council. These collaborators helped acquire state and general funds for renovations to the campus. The campus site also implemented Best Management Practices (BMPs) which are control measures for stormwater runoff pollutants. BMPs are relevant to our project as they form the foundation of how Massachusetts towns and businesses can comply with MS4 requirements (K. Brian Boyer & Mark S. Keisser, 2012).

To treat TMDLs, a number of BMPs were implemented, ultimately covering 53% of WMU's stormwater footprint, both on- and off-campus, as well as those not associated with MS4 permits at all. Since 1998 the university has spent over $4 million on urban stormwater management, a price which speaks to the high cost of implementing, retrofitting, and overseeing these systems (K. Brian Boyer & Mark S. Keisser, 2012).

This case study provides good insight about the specific BMPs that go into stormwater treatment, as well as the types of organizations that can assist with funding. Similar practices already exist in central Massachusetts, such as collaborations between stormwater coalitions and the MassDEP. However, this study shows the potential in increasing the effort behind stormwater in Massachusetts to better meet the MS4 standards.

2.6: Stakeholders

The heart of this project is dependent on helping communities in Massachusetts comply with MS4 regulations, hopefully, at a lower cost. Our primary stakeholder for this project is the Central Massachusetts Regional Stormwater Coalition (CMRSWC). The CMRSWC aids towns in central Massachusetts in abiding with stormwater regulations demanded by federal and state officials. Our stakeholders also extend to the citizens that make up CMRSWC towns, their wildlife, and the environment impacted by polluted stormwater runoff.

2.6.1: Central Massachusetts Regional Stormwater Coalition (CMRSWC)

The CMRSWC is an organization that represents thirty towns surrounding the Worcester area. It is a part of the Massachusetts Statewide Stormwater Coalition, an informal collection of seven regional

stormwater coalitions throughout the state (Central Massachusetts Regional Stormwater Coalition, 2019). The CMRSWC provides assistance to its member communities in a multitude of methods. These range from supplying detailed information on the MS4 permit, administering applications for grants, providing workshops to stormwater programs, and sharing resources between towns regarding stormwater regulation. The coalition aids local communities directly impacted by the regulations, aiding them with meeting all requirements.

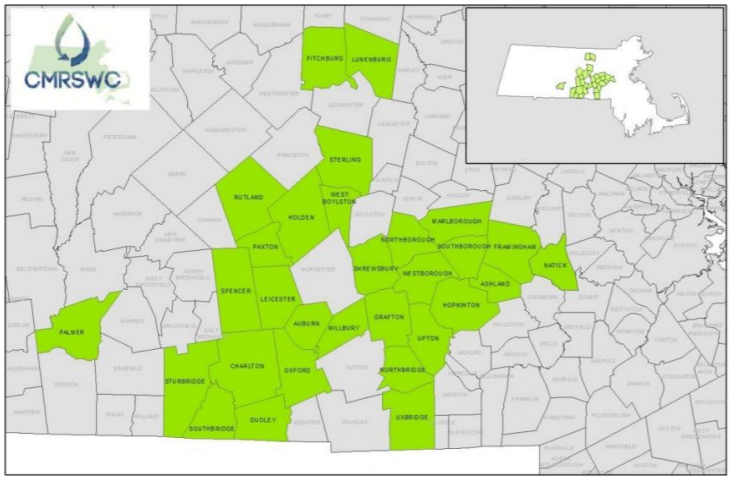


Figure 3: *Towns in the CMRSWC (Central Massachusetts Regional Stormwater Coalition, 2019)*

2.6.2: Individual Communities

Another important stakeholder are the individual towns of the CMRSWC. All towns in the coalition are required to meet the permits requirements, which can be a large burden on its taxpayers. Raising money to meet the permit and its related costs depends on the size of each town, but MS4 permit requirements generally lead communities to cut funding to other municipal areas in order to implement the EPA's mandates. To further exacerbate the funding problems, towns can be fined if they fail to meet permit expectations or inspections. The extent of the fine depends on the severity of the violation, though some fines can be greater than $250,000 (The National Association of Clean Water Agencies, 2018). Although the legislation is aimed at benefiting town environments and ecosystems, they also cause harm to the taxpayers and place a large burden onto the governments of the municipalities that are charged with meeting MS4 regulations. Towns are impacted by the regulations through the safety of their water bodies, but also face financial burdens from the regulations' high price tag.

2.6.2a: Our Focus Communities - Framingham, Palmer, and Ashland

To complete an in-depth examination of costs for our stakeholders, we will be focusing on three towns within the CMRSWC: Framingham, Palmer, and Ashland. These towns, all stakeholder

communities, were selected to be examined in detail for a variety of reasons. The first is the variation in size of the towns. Framingham represents urban towns, with nearly 70,000 citizens, Ashland represents suburban towns with almost 17,000 citizens, and Palmer represents a rural town with about 12,000 citizens (Massachusetts Demographics, 2020). The towns have a diversity in size, density, and geography, which we believe will provide a good sample of data that can apply to a wide variety of towns.

Another important area in which these towns differ is their means of funding stormwater regulations. Tax funds are used by all communities to pay for these regulations, however some towns acquire stormwater tax dollars exclusively from general funds, and some communities choose to charge taxes based off of stormwater utility enterprise funds. Stormwater utilities charge fees to residents based off of the stormwater containment costs that their property creates (Town of Milton, 2019). Similar to a gas or electric utility, residents are taxed appropriately to how much stormwater they "use".

These three towns all are in different stages of creating a utility enterprise fund. Ashland has an established and currently is utilizing a stormwater utility, while Framingham is currently developing an enterprise fund. At this time, Palmer has not yet implemented a stormwater enterprise (Mass.gov, 2020b). Viewing these towns through the lens of size, density, and funding ability will yield a diverse data set and will allow for the results of this research to be relevant to a wide amount of communities in New England. Further details on the specific findings from these towns are included in Section 4.2, 4.3, and 4.4.

2.7: Summary

Stormwater has been a struggle for many urban populations in the United States. The WEF Stormwater Institute suggests that by the year 2050, the number of urban populations will have increased by 70% (WEF Stormwater Institute, 2019). Along with the increase of urban populations, stormwater pollution into surrounding water bodies will also increase due to increasing urban development. In response to the growing issue of stormwater pollution, the MS4 General Permit was put into effect by the EPA.

MS4 Permit compliance is a complicated and often confusing process that individual towns of central Massachusetts are faced with implementing. Our goal is to aid the cities and towns of the CMRSWC, namely Framingham, Ashland, and Palmer, in developing a revised cost estimate for MS4 compliance in future years. Prior data and precedence have aided this project in observing previous cost estimates and finding areas to adjust cost savings to be more effective. Throughout this project, we will use this background data along with our own research to fill the gaps in our knowledge concerning the Massachusetts Small MS4 Permit. We will then create a cost estimate that will give cities and towns of central Mass a better understanding of what is needed for them to fulfill the requirements of the MS4 permit guidelines.

3. Methodology

The main goal tasked to us by the CMRSWC was to analyze and revise MS4 regulation budgets based on current spending data. In order to accomplish this goal, we developed four main project objectives:

1. Understand the MS4 stormwater permit requirements as they apply to our stakeholders
2. Analyze the MS4 Budget Benchmark Survey
3. Analyze the regulation implementation costs and compare them to original cost expectations
4. Estimate budgetary needs for future years of the permit

3.1: Objective One: MS4 Permit Analysis

In order to meet the project goal, it was important to understand the MS4 permit requirements as they applied to our stakeholders. Obtaining a concrete knowledge base of legal, regulatory, and practical situations of MS4 requirements was integral to our ability to make informed analysis to stormwater budgets. We developed our knowledge base by performing in-depth research into the final Massachusetts MS4 permit, published in 2016. Other literature referenced included supplementary information provided by the EPA, such as the Six Minimum Control Measures Overview and TMDL conditions. We also referenced all supporting regulations and addendums to the permit that have been added since the permit's release in 2016. This step gave our group the technical knowledge we would need for developing MS4 budgets and timelines.

Referencing the literature alone would not give our group a complete understanding of our stakeholders' MS4 needs. To address this, we conducted interviews that allowed us to conceptualize the permit's real-world impact upon our stakeholders. We interviewed key members of our sponsor organization, including Kerry Reed, Senior Stormwater Engineer of the town of Framingham, and Angela Panaccione, Stormwater Coordinator of the town of Palmer, to determine which aspects of the MS4 permit proved toughest for towns to meet. For example, the largest challenges listed in the FY19 MS4 Survey Results Report for several towns included lack of funding and financing, aging infrastructure, and an increase or expansion of regulations (WEF Stormwater Institute, 2019). Understanding the practical challenges of implementing MS4 regulations allowed us to gain insight on individual towns' MS4 budgets and allowed us to determine how to best revise future budgets for accuracy.

Finally, we examined past coalition projects in order to view cost estimates derived during the permit's drafting process. This analysis allowed us to see how the permit and its costs evolved from the initial drafting process all the way through the permit's adoption and the beginning of implementation. These methods allowed us to obtain a proficient understanding of how the MS4 permit applies to our stakeholders from a practical and fiscal viewpoint.

3.2: Objective Two: Budget Survey Analysis

After understanding the permit from the point of view of our stakeholders, we determined where to focus our efforts on aiding them with permit compliance. We utilized the results of a MS4 Budget Benchmark Survey from the Massachusetts Statewide Stormwater Coalition to analyze Massachusetts' stormwater spending data. The budget benchmark survey was sent out to coalition member towns (including those in the CMRSWC) regarding the first year of operation under the new MS4 regulations. This survey, filled out in March-April 2020, was critical to our goal of estimating and assessing compliance costs. It provided us with fiscal data regarding permit spending from towns across Massachusetts. The survey also reported the number of outfalls and catch basins in towns' stormwater systems, estimated percentages of completed mapping, estimated future budgets for stormwater capital, and cost and quantity of local stormwater permits. Some of this data can be found in Appendix E. All survey data was transferred onto charts and graphs, displaying the information in a centralized document using easily digestible visuals. From its analysis, we were able to visualize the concerns, costs, struggles, and the progress that towns are making while attempting to meet the permit's demands. Understanding the conditions of our stakeholder towns allowed our group to determine the most accurate budgetary changes needed for future stormwater spending estimates.

3.2.1: Supplement of Survey Information

Our group has conducted interviews with stormwater coordinators in chosen coalition towns to clear up questions from the survey. We have interviewed Kerry Reed, the Senior Stormwater Engineer of Framingham, Angela Panaccione, the Stormwater Coordinator and Conservation Agent of Palmer, and Robert St.Germain, the Chair of the Ashland Stormwater Advisory Committee. Because these officials have the most comprehensive understanding of their town's permit progress and their current needs, these interviews were a critical resource while determining our project's focus. Combining the expertise gained from these interviews with our project goal allowed our group to determine the course of action to take in developing our final project results.

3.3: Objective Three: Actual vs Expectation Cost Comparison

Developing new MS4 spending estimates was dependent on the comparison of old estimates with current spending data. The disparities shown in comparing actual costs with prior expectations have allowed us to understand which areas of the permit had budget estimates that were inflated, accurate, or inadequate. Using this comparison as a reference, and by integrating interviews, surveys, and other estimate guidelines, we have been able to develop revised budget estimates that are more realistic for the demands of the MS4 permit.

3.3.1: Choosing Three "Case Study Towns"

Detailed research of individual town spending was critical for our ability to observe fiscal behavior and to make changes to stormwater budgets. In addition to our analysis of the budget benchmark survey, our team chose to conduct in-depth research into three individual communities' stormwater programs. We selected three CMRSWC member towns to observe: Ashland, Framingham, and Palmer. We chose to study these towns specifically because of their diversity of population, MS4 area, budget, funding sources, and area of concern (ranking of concern from the Statewide Budget Benchmark Survey). In addition, these three case study towns fit into each of the three categories from the cost memorandum performed by WaterVision, which broke up towns into rural, suburban, and urban, helping to determine the accuracy of the memorandum.

To study them, we referenced MS4 spending data from each town, including spending estimates developed after the permit's release and first year permit spending data. We also conducted semi-structured interviews with key officials from each town of study to discuss specific problems they are facing with fiscal burdens, future plans for requirement compliance, and their relations with town governmental committees. The interview questions that were used are attached in Appendix B, C, and D. Through these interviews, we gained information on how towns are currently meeting standards and obtained an overview of where funding is being allocated on different aspects of the permit. Performing a case study on three towns gave us insight which allowed us to make detailed analysis of each town's budget. By studying a small yet diverse sample of towns, we determined that we would be able to make budgetary estimates that would be applicable to all of our stakeholder communities.

3.4 Objective Four: Future Budget Development

Following the completion of the first three objectives, we presented our stakeholders with budgetary updates for their permit-related expenses. To accomplish this objective, we undertook a budgetary analysis that began with compiling data from town budgets, regional survey results, and prior cost estimates or guidelines. This information was layered with the budget estimates of the first permit years and compared to actual expenditure. This method allowed us to view the broad budgetary practices of our stakeholder communities, which were then used to generate more accurate budget estimates for future permit years. As stated in the MS4 permit, the requirements come into effect on a scheduled timeline, beginning with the initial implementation in 2018. Each following year has a list of requirements, with new elements being added on a specified timeline, such as a two-year delay on limiting construction pollution, four years for addressing impervious covers, and four years to find five improvements to permittee property (EPA, 2016). By referencing the requirements by the years they

become mandatory and integrating them with our budgetary revisions, we were able to make our MS4 budget calculations applicable for several years beyond the end of this project.

3.4.1: Final Deliverables

Finally, to fulfill our sponsors' request for a final report and distributable product, we compiled our findings into a centralized deliverable that concisely presents all our relevant findings to our sponsors. This aided our sponsor towns to easily understand this project's findings and provided clear, upfront information to town stormwater coordinators. Our sponsors communicated that a large issue that town stormwater officials are facing is communicating the importance of MS4 spending with town government officials. Stormwater coordinators often struggle with obtaining funding from their local towns because the legislators who are tasked with apportioning the town's budget have limited knowledge about MS4s. This particularly applies when distinguishing between the different fiscal demands of the permit sections, as the elected officials are reluctant to grant substantial funding towards issues that they don't understand or see as important. To combat this, we developed a simple video information packet to explain a town's MS4 regulation requirements, cost, time, and labor demands, and their fiscal impact upon a community. It laid out the MS4 costs for each year of the permit, explained where the funding for each year is allocated, and explained the town MS4 program in layman's terms. Our sponsor towns can use this to explain their MS4 requirements to local officials in a simple, clear manner, as described in the next chapter. We also developed a brochure pertaining budget information on the three types of towns (rural, suburban, and urban) that could be distributed to the communities in order that they could compare themselves to similar communities. They can use this to help apply the information we analyzed and put it into relevant terms for their individual town.

4. Findings

Following the stated methodology, a number of findings were developed. This section consists of our judgements made from analyzing budgets and funding-related predictions. This section begins by analyzing several of the most important questions from the Budget Benchmark Survey and applying it to the difficult communities. We then examined each of the three case study towns, building off the survey results, and looking into their specific information, which was obtained through interviews and data we received directly from them. These case studies were then used to draw further conclusions on the community types (rural, suburban, and urban). The determinations found in this section were later used to create our conclusions and recommendations.

4.1: Survey Results

Using the MA State Stormwater Budget Survey, we obtained broad information on MS4 fiscal practices and spending predictions. The forty-two responses of the survey displayed a spectrum of town sizes and cost predictions, ranging from rural towns with just a few thousand citizens to urban towns with well over 100,000 residents, all with varying stormwater related spending.

The first step of our budget analysis was to separate the responses into different groups so the results could be analyzed according to a town's level of urbanization. Stormwater is generally impacted by the urbanization of a local community, which is reflected by MS4 regulations only being relevant in "urbanized" areas of a town (EPA, 2012). The larger a town's given MS4, the more impactful the regulations are on a community. This led to the determination that grouping communities as rural, suburban, or urban (based on U.S. Census designation, which used primarily the population density) would allow better analysis of MS4 spending trends as they relate to increased urbanization (MAPC.org, 2008). Of those surveyed, a total of eight towns were considered rural, twenty-three towns were considered suburban, and eleven towns were considered urban.

MS4 spending has been erratic. Within the three categories of urban, suburban, and rural, we have found that many communities have budgets well outside of the cost ranges given during initial permit approval. Additionally, the majority of towns surveyed predict to see an increase in MS4 spending in the future. Overall, future permit spending is due to increase.

4.1.1: Current and Future Annual Budget

As seen in Figure 4, the blue bars display the current stormwater budget for all forty-two of the towns surveyed. Contrasted to current spending, future expected spending is shown in red. Towns estimate increases in stormwater budgets for the foreseeable future. The data from the budget benchmark survey has shown that nearly all rural towns and about half of suburban towns had an annual budget for

their stormwater program totaling $100,000 or less. Urban towns currently use much more funding for their programs, generally around $750,000 to $1 million.

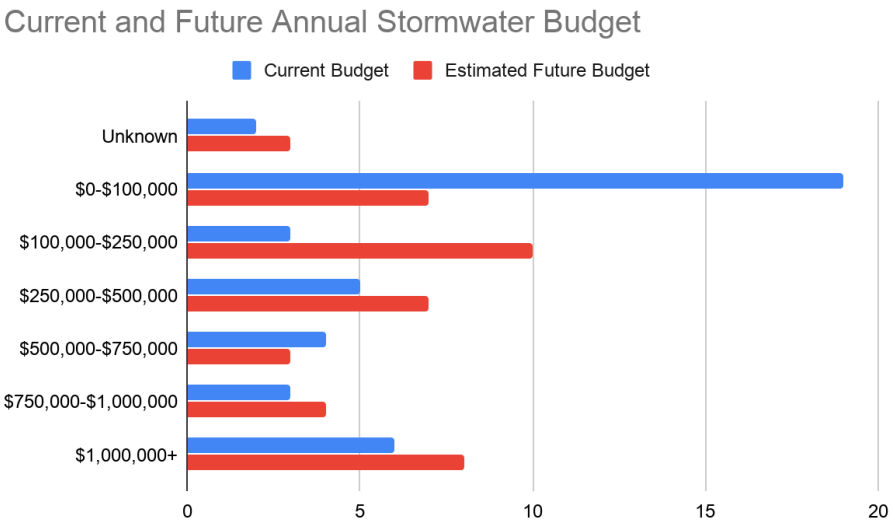


Figure 4: *Comparison of Current Annual Budget and Future Annual Estimates, All Towns*

Figure 5 shows current and estimated annual stormwater budgets for the eight rural towns. Of the eight towns that fell into the rural category, seven answered that current spending was less than $100,000 annually while one was unsure of their current spending. Future budget estimates for rural communities tend to move upward. Three communities are expecting to spend between $100,000 to $250,000 annually and two communities expecting a budget between $250,000 to $500,000. Further, towns that still are spending between $0 to $100,000 are likely seeing large increases, as one of our case study towns had a 200% difference in current and future budget, but still remained in the $0 to $100,000 category. Rural towns show a significant increase in budgets across the board.

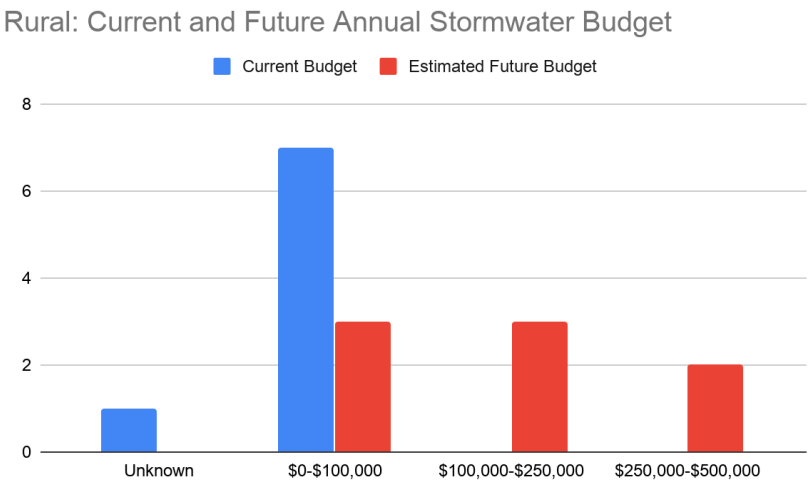


Figure 5: *Comparison of Current Annual Budget and Future Annual Estimates, Rural Towns*

Figure 6 shows current and estimated annual stormwater budgets for the twenty-three suburban towns. There was higher variation within this group, as there was a wide range in town size and other factors within the suburban designation which could lead to an increase in spending. Ten responses show that current spending was less than $100,000, similar to rural towns. Interestingly, the category with the second most responses was the $250,000 to $500,000 range with five towns spending this much currently. In the future, suburban towns expect to increase their budget according to estimates from the budget benchmark survey. Only four towns expect to still be spending $0 to $100,000 in future years, down from the current trend of only ten towns. Further, future budgets tend to be greater than what towns allocate in their current budgets. Overall, suburban towns show a wide range of predicted future spending, but budgets are still due to increase significantly from current budgets.

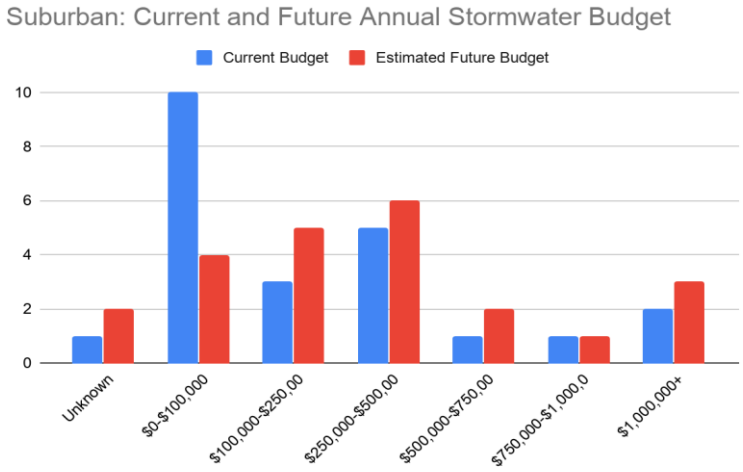


Figure 6: *Comparison of Current Annual Budget and Future Annual Estimates, Suburban Towns*

Figure 7 shows current and estimated annual stormwater budgets for the eleven urban towns. Four towns spent greater than $1 million annually, three spent between $500,000 to $750,000 annually, two spent between $ 750,000 and $1 million annually, two spent between $250,000 and $500,000, and two spent less than $100,000. This group had the greatest amount of variation.

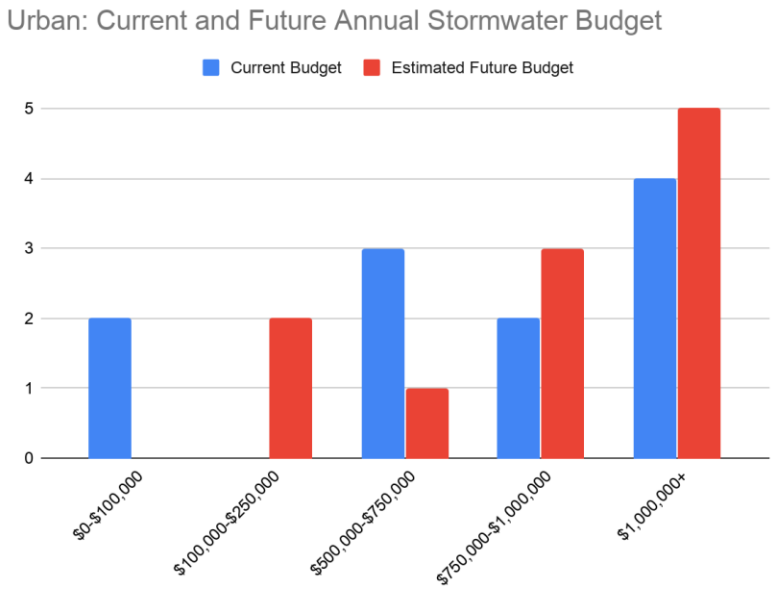


Figure 7: *Comparison of Current Annual Budget and Future Annual Estimates, Urban Towns*

By analyzing the spending based on the type of town, it shows that there are a lot of similarities in the expenses of each town based on population. Each group has a clear price range that was common for towns of similar size with a small number of outliers. This breakdown does not take into account the MS4 related circumstances of each town, which is predicted to be the cause of much of the variation. However, the data still provides useful information and can show the baseline for what towns of different sizes have been spending annually thus far.

Most of the towns expect to see a large increase in their budget in the coming years, likely due to aspects of the permit that have yet to come into effect. These aspects include the completion of outfall and interconnection inspections by the end of year three, BMP retrofit assessments by the end of year four. The bar graph in Figure 8 shows the relative increase that towns expect to spend on future permit years according to the budget benchmark survey. This chart has limitations, due to towns whose annual budget does not increase enough for it to cross over into a new budget category. Many towns likely follow this pattern, as we know that the town of Palmer does from our in-depth analysis of their budget. It is very likely that many towns that are currently showing a 0% change in their budgets are expecting to increase

their stormwater spending significantly, but because of the survey cost ranges, do not appear to show any change.

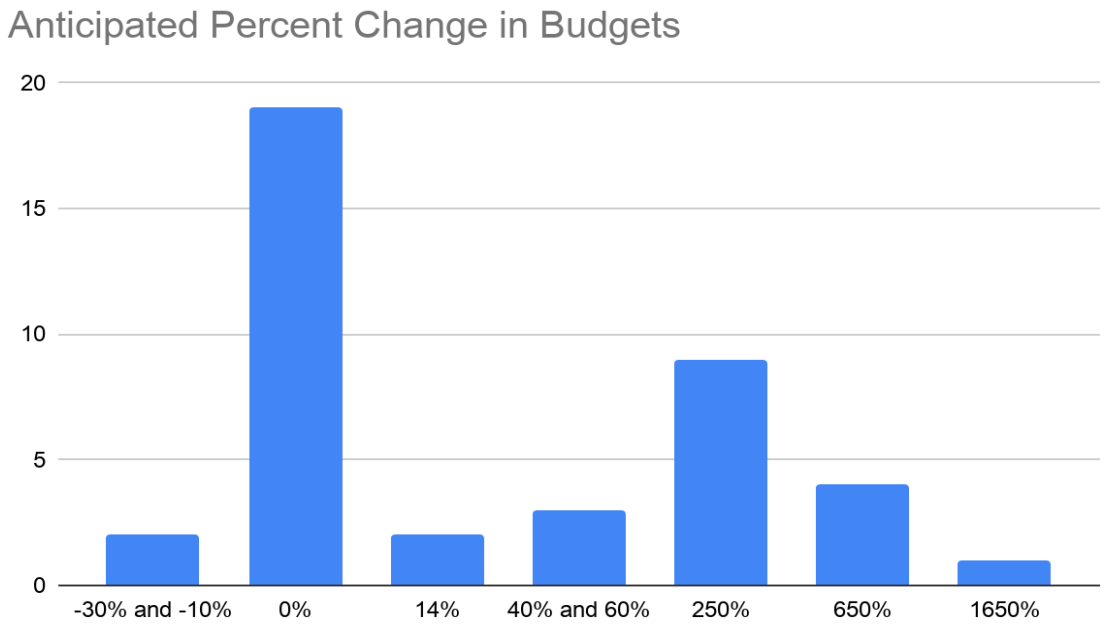


Figure 8: *Percentage Change in Stormwater Budget*

Due to an expected increase in requirements coming into effect years after initial implementation, it is not surprising that towns expect to see an increase in their necessary budget in the future. Our chart shows that most towns expect to see some increase in town budgets, with most towns of that subsection expecting a 22.5% increase in budget. We can reasonably assume that most towns showing a 0% increase are increasing in budget as well. Additionally, many towns are behind where they need to be on the current requirements of the permit, which means that they will be forced to spend more to make up for it in the years to come. This increase in anticipated spending was seen almost universally throughout the rural, suburban, and urban towns. Some towns spent less than they planned in their budget estimation, which resulted in a decrease in budget costs for future years. While the rural towns all spent less than $100,000 annually in the current years, only three expect to remain in this budget range in the future, while others expect to spend between $100,000 to $250,000. Additionally, there are two rural towns that anticipate spending between $250,000 and $500,000 annually. The changes in budgets can clearly be seen through the median, as it is expected to increase from $50,000 to $175,000 in the coming years..

These trends show that towns are expecting the costs associated with the permit to increase dramatically in the coming years. The same trends were also seen amongst the suburban sized towns. While the current budget of ten of the suburban towns is less than $100,000, only four expect to remain in

this price bracket. Most expect that they will be spending between $100,000 and $500,000 in the coming years. This is a large increase for many of the towns, and it will likely put a large strain on the budget in their community as the median is expected to increase from about $175,000 to $375,000.

The last group is the urban towns, and the results were similar with them as well, although not as clearly as the other groups. In the current spending, the most common budget was over $1 million, which was the highest price range listed. Since the prices of these budgets extend beyond the available price range, it is impossible to analyze how much towns expect costs to increase, although the graph shows that they expect higher costs in the future. While the current budgets for different sized towns are distinct, it is quite clear that they expect to see an increase to meet the needs of the permit in the coming years. This could not be seen in the urban towns, as the median remained $875,000. This is due to the fact that many fell into the greater than $1 million category, so they were unable to increase.

4.1.2 Main Revenue Source for Funding Stormwater Program

Towns often struggle with securing funding for stormwater, which tend to be of low priority for town budgets. We received data regarding funding from the budget benchmark survey, which showed where towns were acquiring stormwater funding from. As can be seen in Figure 9 below, the plurality of towns gets their main revenue from town general funds, while significant portions get funding primarily through stormwater utilities, grants, or from Chapter 90 reimbursements. Generally, towns have a variety of sources for their stormwater program budgets.

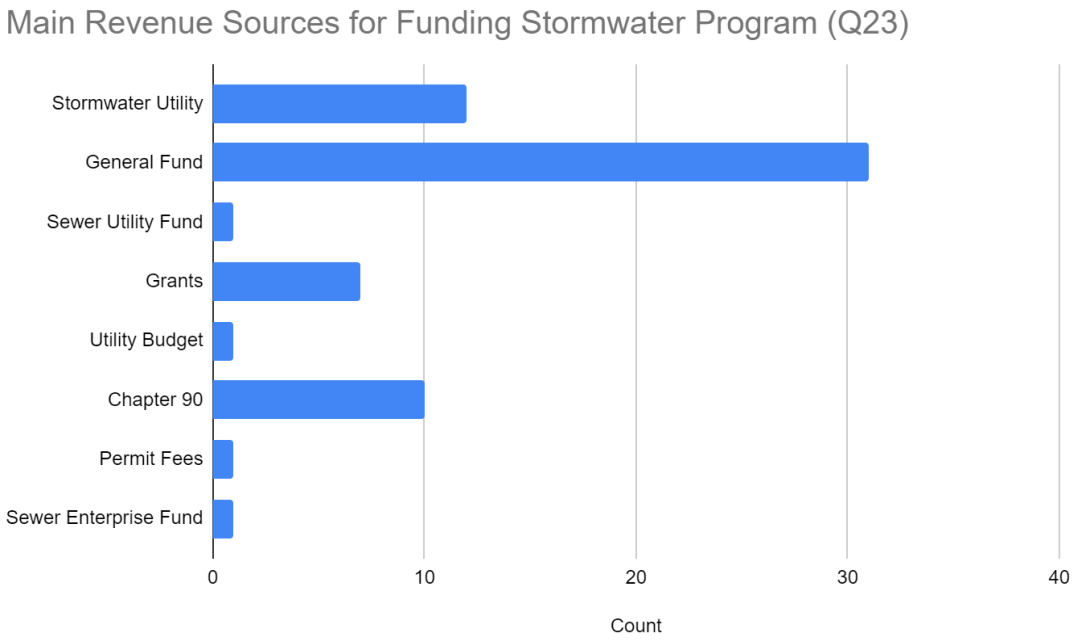


Figure 9: *Main Revenue Sources for Stormwater Program*

By far, the most funding for towns came from the General Fund, and the second most funding came from the Stormwater Utility. Chapter 90 came in third while grants came in fourth. A total of twelve towns total that got their funding from the Stormwater Utility, and eight of these towns obtained their funding solely from the Stormwater Utility. There were thirty-one towns total that received funding from the General Fund, and sixteen of those towns got funding solely from the General Fund. There were seven towns total that obtained funds from grants and other sources, and ten towns total that obtained funding from Chapter 90 and other sources. One town obtained their funding from both the Sewer Utility Fund and the Stormwater Utility Fund, and one town that got their funding solely from the utility budget. One town got their funding from permit fees, along with the General Fund and Chapter 90, while another town got their funding from the Sewer Enterprise Fund as their main source, while also receiving funds from the General Fund and Chapter 90.

Since many towns rely on the general fund for a majority of their stormwater budget, it has been difficult to receive the necessary funding. It is a difficult process, and stormwater is generally considered a low priority. This means that towns prioritize funding for other areas, like schools, instead of stormwater. Additionally going through the process to get funding is difficult. They must explain their need for funding and explain what the permit requires them to do. They need to convince the town committee that the funding is necessary. If the town committee feels otherwise, they will likely have to find ways to make do with the much smaller spending budget. This leads some to look for alternative ways to fund the stormwater programs within the town, which will be discussed next.

4.1.3: Has Town Considered Stormwater Utility and/or Passed Legislation

This question looks further into one of the possible ways to fund the stormwater program: a stormwater utility. Figures 10 and 11 show that while many towns have already considered a stormwater utility, very few have passed legislation to do so thus far.

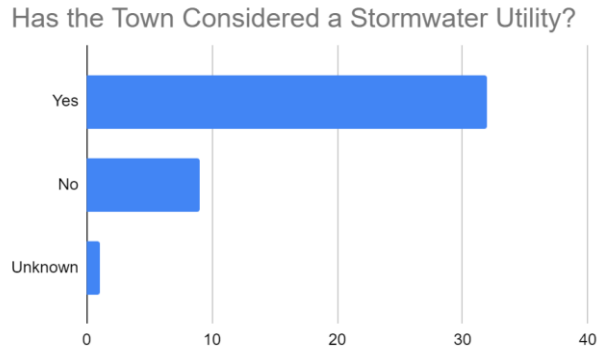


Figure 10:

Consideration of Acquiring a Stormwater Utility

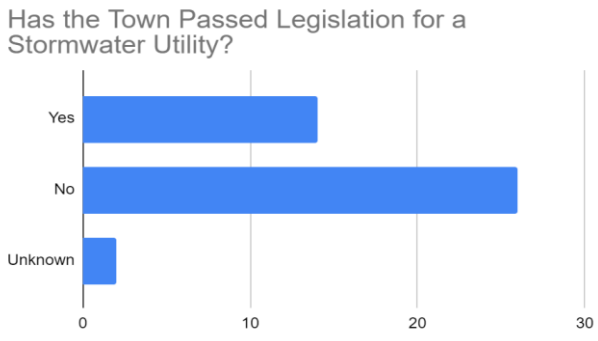


Figure 11:

Stormwater Utility Legislation Status

Thirty-one towns have considered implementing a Stormwater Utility, while nine towns did not consider it and two towns were unsure. Fourteen towns passed legislation to allow a Stormwater utility, twenty-six towns did not pass it, and two towns were unsure. From the data, most towns have pondered the implementation of a Stormwater Utility, but more than half of those towns failed to pass legislation to allow the fund.

Most of the towns that did not consider getting a Stormwater Utility had their main funding sourced from the General Fund. For example, the town of Tyngsborough considered the stormwater utility and didn't pass it into legislation. The town of Tyngsborough receives funding from the General Fund, Chapter 90, and permit fees. In contrast, Shrewsbury receives funding solely from the Stormwater Utility. A difference in these two towns is the amount of MS4 area each holds, with Shrewsbury holding several times more MS4 area than Tyngsborough.

Of the three case study towns we studied, only Ashland has implemented a Stormwater Utility Enterprise Fund, while Framingham and Palmer are in the early phases of starting a Utility fund. Framingham receives funding from the General Fund, Chapter 90, and grants, while Palmer receives funding from the General Fund and Chapter 90. Although Framingham has the largest MS4 area of the three case study towns, only Ashland passed the Stormwater Utility into legislation. However, Framingham receives funding from more sources than the two other towns. In terms of the amount of MS4 area, Ashland falls behind Framingham and Palmer.

4.1.4 Survey Conclusions

We were able to draw many conclusions from the data we received in the budget benchmark survey. We were able to see the current budgets for the rural, suburban, and urban towns, as well as how much they are expected to increase. We were also able to analyze various methods that towns used to fund municipal stormwater budgets. While many currently receive much of their funding from the general fund, many have also considered the use of a stormwater utility within their community.

4.2: Framingham Findings (Urban Town Case Study)

To further develop our findings, we completed case studies on a set of towns that serve as good examples to provide recommendations to the remainder of our stakeholder communities. Each one of the three case study towns were used to represent each of the different town types; rural, suburban, and urban. The towns included Framingham, Palmer, and Ashland. The results were determined through the use of survey data, as well as interviews with the specific case study towns. The results for these towns are summarized in the following sections.

4.2.1: Framingham Background

The first town to be analyzed was Framingham. Framingham is a large town mixed with both suburban and urban areas. It holds about 71,000 citizens, taking up approximately 17,000 acres, the largest of the three towns of study. Information about the town was collected through the budget benchmark survey, an interview with a town official, and supplementary budget information provided to the project(MA State Stormwater Coalition, 2020). Through this information, we were able to analyze their current costs and estimate the future expenses to prepare for.

4.2.2: Framingham Fiscal Data

	FY20	FY21	FY22
Catch Basin Cleaning/repair	$410,000	$430,500	$205,000
Street Sweeping	$110,250	$115,800	$121,600
Inspect/Maintain Open Conveyance	$12,600	$13,230	$13,900
Cleaning/inspect manhole covers/ storm drains	$158,400	$166,400	$174,800
Flood Control Structure Maintenance	$15,000	$15,000	$15,000
BMPs	$0	$0	$0
Staffing	$1,184,400	$1,385,800	$1,426,200
Permit Compliance Implementation	$375,000	$420,000	$325,000
Total	$2,265,650	$2,546,730	$2,281,500

Table 1: *Framingham's Budget Data for FY20-FY22*

We obtained fiscal data from Framingham officials and from the budget benchmark survey. The survey asked several questions pertaining to both the actual costs thus far, as well as the anticipated costs for the future years, though these estimates lacked specificity. The survey estimates that annual costs are currently greater than $1 million, and that they estimate that the future budget for the permit is also over $1 million in the next five years(MA State Stormwater Coalition, 2020). This is likely due to the fact that Framingham is a large town. They will have much higher costs than some of the smaller towns that were analyzed, such as Palmer. Although these estimates are helpful to understanding the large budget required in Framingham, it does little to actually determine the costs, as more exact data are required. Their main

methods of funding for the current town stormwater practices are through the use of the general fund, Chapter 90, and grants. These answers were all fairly common amongst the towns that responded to the survey.

4.2.3: Framingham Interview

After analyzing the data from the survey, we scheduled an interview with Kerry Reed, the Senior Stormwater Engineer in Framingham. She was extremely helpful in determining the effects of the permit, the largest concerns for the town, and how the town was attempting to pay for the necessary requirements.

Framingham had to make many changes to meet the permit. They hired two more employees last year due to increases in stormwater obligations and may need to add more in the future to meet the requirements as there are some areas where they are struggling. Little development of stormwater infrastructure has been constructed, and this is expected to be one of the costliest parts of the permit. This will be an area that they need to focus on in the coming years (Reed, 2020).

Next, we discussed the permit areas of Framingham's greatest concerns. This pertained to their specific answers from the survey. Framingham's largest concern is designing and building BMPs. They are expensive to build and can cost approximately $250,000 to construct. Many other urban towns are also struggling with this aspect, as they are so expensive to construct. Even implementing a few of them can take a large amount of the budget. Another high concern was about performing outfall inspections. Although Framingham had planned to perform about ⅓ of the outfall inspections each year, they have already fallen behind schedule. Since Framingham has about 500 outfalls, it is extremely time consuming to gather the wet and dry samples used in the inspections. This is a high concern for many other urban towns as well since they generally have more outfalls. With so many outfalls, they are both time consuming and costly. Fortunately, some of the urban towns have testing centers in their town so they do not need to transfer the sample elsewhere, but even without this added step it can be challenging (Reed, 2020).

After looking at the town and their concerns, it is important to look at how it will be funded. Most of the current funding comes through appealing to the local government. Since the permit is difficult to fully understand, they struggle with explaining it to the committee members. To further complicate the situation, there were recent elections which led to a good deal of turnover within the stormwater oversight committee. In order to fund the MS4 permit, the town is attempting to implement a stormwater utility. This would help fund the expenses, and at the same time not take away from other parts of the town budget. It would act similarly to other utilities. The town already had several plans drawn up to implement a stormwater utility through a study by Weston and Sampson (Weston and Sampson, 2020). However, they are concerned about larger bills for families and small businesses. Additionally, it may draw some pushback from larger businesses that do not want to have to pay the fees (Reed, 2020). This

will be an issue that they will have to look at further in the future and determine which method of funding will suit their community the best.

4.3: Ashland Findings (Suburban Town Case Study)

4.3.1: Ashland Background

Ashland was the third town that we interviewed, and in terms of size the town ranks second in between Framingham and Palmer. It is a suburb with approximately 17,000 citizens and with around 8,000 acres (MA State Stormwater Coalition, 2020). The data and information that we received for Ashland came from funding and cost estimates provided to us, our interview with the chair of Ashland's stormwater advisory committee, and survey results from the MS4 Stormwater Benchmark Survey. With this information, we are able to determine the stormwater regulations that Ashland struggles with, as well as gain a general idea of current costs and estimates for future years of the permit.

4.3.2: Ashland Fiscal Data

We were able to obtain substantial amounts of data about stormwater costs and funding for years one through five of the MS4 Permit. Stormwater representatives from Ashland gave us information regarding assumptions and guiding principles that affect funding and cost estimates. For example, we learned that all items of the MS4 requirements were taken into consideration for all estimates in order to create an accurate prediction of future MS4 costs and funds. Important to note is that the data generated for future budgets are based on Kleinfelder planning document, a budget forecast commissioned by Ashland’s stormwater officials. It consists of building cost estimates that consider the capabilities of Ashland stormwater staff and highlights areas of permit implementation where hiring contractors may be necessary. The budget is also proactive, in that it factored in maintenance of infrastructure as it wears down over time. This makes the budget less expensive in practice because preventive action would be cheaper than replacing failed infrastructure. Lastly, the budget includes a 20% contingency that allows flexibility for unpredictable costs such as aging infrastructure and pollution, providing a realistic outlook at stormwater management risks involved (Kleinfelder, 2018).

	FY19	FY20	FY21	FY22
SWMP	$0	$2,527	$2,424	$2,300
TMDL	$2,040	$26,640	$24,240	$46,850
Public Education/Outreach	$6,180	$4,740	$4,740	$ 4,740
IDDE	$25,785	$31,365	$47,745	$ 45,225
Construction	$7,720	$6,720	$6,720	$ 6,240
Green Infrastructure	$9,840	$7,680	$11,280	$ 13,440
Municipal Good housekeeping	$47,170	$100,394	$100,394	$ 100,394
Program Evaluation/ Reporting/Record Keeping	$31,200	$31,200	$31,220	$31,220
Coalition	$4,000	$4,000	$4,000	$4,000
Billing Software	$5,000	$5,000	$5,000	$5,000
Clerical Staff for billing	$6,250	$6,250	$6,250	$6,250

Table 2: *Ashland's Budget Data for FY19-FY22*

Among the several documents we received included revisions of the five-year budgets, cost projections, and revenue and funding estimations for the MS4 Permit. For example, we were given the NPDES MS4 compliance cost projections, which summarized total labor and expenses for FY19-FY23 of the permit, while including factors such as staff hours, labor cost, and non-labor expenses. Some other more specific factors include administration, regulation and enforcement, engineering and master planning, operations and maintenance, and monitoring. This summary for the general funding, as well as funding to be announced, went into detail for FY19-23. Factors considered included contract service,

town force, materials, and contingency. In calculating the total funding estimates to be announced for future years, inflation was not included. More data on this can be found in Appendix F.

One of Ashland's top concerns was performing outfall inspections, screening, and water quality sampling. From the survey results, we learned that Ashland has two to three hundred outfalls within their MS4 infrastructure. The main challenges with performing outfall inspections are wet weather inspections. There are two types of inspections that must be conducted: dry weather and wet weather (MA State Stormwater Coalition, 2020). When dry weather inspections are made, one must check for any flow. If found, then wet weather inspections must be made, which must be done during extreme weather conditions including rain or snow. In second place for highest concerns was mapping the storm sewer system. Mapping needs to include things such as outfalls, catch basins, structural BMPs, pipes, and saltwater in the town's stormwater system. This includes the two to three hundred outfalls, two to three thousand catch basins, and twenty-five to seventy-five BMPs currently in Ashland, which is a large amount of data to insert into a GIS system and keep organized. The people who operate and maintain Ashland's stormwater system mapping include municipal staff, PeopleGIS, and a consultant that costs $5,000 to $10,000. We also learned that only 50-75% of pipes have been mapped and inventoried in Ashland's MS4 system (MA State Stormwater Coalition, 2020).

Ashland currently has estimated the current annual budget for its stormwater program to be $250,000 to $500,000, and they estimated its future annual operating budget for its stormwater program to comply with MS4 permit requirements to be $250,000 to $500,000. The main source of funding that Ashland has implemented is the General Fund and the Stormwater Utility, from which they calculated the annual revenue generated to be $250,000 to $500,000. The conservation commission permits separate local stormwater permits for private development, which is usually zero to ten permits issued annually costing over $500, with under $5,000 collected annually. Street sweeping and disposal is done by the Highway, with associated costs ranging from $25,000 to $50,000, while catch basin cleaning and disposal is done by a public works contractor, with costs ranging from $25,000 to $50,000 (Kleinfelder, 2018). For the amount of costs associated with stormwater management and maintenance in Ashland's MS4 system, it appears that they can pay for most of their expenses through the Stormwater Utility and permit fees.

4.3.3: Ashland Interview

We were able to conduct an interview with Robert St. Germain, the chair of the Ashland Stormwater Advisory Committee. He informed us about the need to do more work with stormwater management in the town. For example, 100% of streets needed to be cleaned, sometimes more than once. There is now more documentation and updates that needs to be done. Usually 25% of catch basins were cleaned a year, but the requirements have now increased, and cleaning schedules have been accelerated. Additionally, Ashland still has yet to fill out the catch basin section of the National MS4 Benchmark

Survey. Nevertheless, they were able to complete all of these extra requirements with help from the enterprise fund. Mr. St. Germain mentioned the different taxes and fees involved with property containing impervious surfaces, including paved roads, parking lots, and rooftops. For example, $0.75 is charged for every hundred square feet of impervious area. Ashland doesn't have much industry, so the fees and taxes affect small businesses and homeowners the most (St. Germain, 2020).

He noted that outfall inspections have been completed already and that GIS mapping of storm sewer systems is in progress. He mentioned that the GIS system that Ashland used had jumbled information and data including outfalls, catch basins, structural BMPs, clean water, and saltwater, and that the data now must be consistently maintained. With the passing of the IDDE (Illicit Discharge Detection and Elimination) plan into law, Ashland's stormwater plan has been able to be maintained daily(St. Germain, 2020).

One of the major issues that Ashland faced included BMPs that were put in place for years, but currently have trees growing in them and a lack of staff to fix and maintain them. Mr. St. Germain also mentioned that they discovered bacteria from an unknown source has been flowing into the Sudbury River, and they are missing some records for the pipes in the infrastructure. There is also no enforcement over homeowner responsibilities concerning stormwater management, which is listed in Appendix E of the MS4 permit. He noted the different issues often arose during the annual outfall inspections (St. Germain, 2020).

However, Mr. St. Germain stressed the various help that the CMRSWC has provided to Ashland in order to combat stormwater pollution. For example, they were able to spread stormwater conservation awareness through the Think Blue Campaign, and through the many different training sessions and education material provided by the coalition. Ashland was able to receive $200,000 from the General Fund, and then $200,000 more from other funding sources. He stressed that despite the costs associated with stormwater permit regulations, adhering to them is still worth the money (St. Germain, 2020).

4.4: Palmer Findings (Small Town Case Study)

4.4.1: Palmer Background

The next town analyzed was Palmer. It is a suburban town that has the smallest population of the three towns with 12,000 citizens and an area of 20,480 acres, 9,600 of which is designated as an MS4 area (MA State Stormwater Coalition, 2020). We were able to obtain data and information about this town's stormwater management practices and budget through results from the MS4 Budget Benchmark Survey and an interview with the Stormwater Coordinator of Palmer.

4.4.2: Palmer Fiscal Data

We were able to obtain plenty of relevant data through the budget benchmark survey. The survey questions addressed many different areas of the stormwater permit and provided an overview of the current situation. Any areas that needed more clarification were discussed further in an interview with the Stormwater Coordinator, Angela Panaccione. The most important parts of the survey were those that pertain specifically to the MS4 permit. The survey lists that Palmer has one to two hundred outfalls, and the permit requires all of them to be tested (MA State Stormwater Coalition, 2020).

According to the interview, the current budget for stormwater in Palmer is $75,000, a large increase from the previous year's budget of $20,000 (Panaccione, 2020). The budget request for next year is over $270,000 and they estimate that between $750,000 and $1,000,000 is required over the next five years for capital improvements (Town of Palmer, 2020). Palmer's stormwater funding comes primarily from the General Fund and Chapter 90, as well as grants (MA State Stormwater Coalition, 2020).

4.4.3: Palmer Interview

Based on the survey, we hosted an interview with Angela Panaccione, the Stormwater Coordinator of Palmer. Like Framingham, Palmer is also hiring two more employees, both DPW/Stormwater Laborers. This new hiring increases the staff size from twelve to fourteen, with only several full-time workers, a quantity that is much less than Framingham's. Staff teams have roles covering from street sweeping to dry- and wet-weather testing, all increasing the amount of funding used for stormwater management (Panaccione, 2020).

The largest concerns for Palmer came from meeting Total Maximum Daily Load (TMDL) limits. As described in the interview, this is due to fertilizer runoff from non-MS4 towns upstream of four rivers that run through Palmer, the Chicopee River, the Quaboag River, the Swift River, and the Ware River. These rivers all are subject to TMDL limits, so Palmer has a substantial burden when trying to comply with TMDL limitations (Panaccione, 2020).

Palmer is also a part of the Connecticut River Stormwater Coalition (CTRSWC), which serves as an alternative source of assistance from the CMRSWC. The CTRSWC provides a different set of assistance other than the CMRSWC's technical support and is more focused on public education and outreach, due to how this can help with river pollution. This focus on education stems from the requirements of towns within the Connecticut River watershed to hold a minimum of five public outreach events per year, as opposed to most towns within the CMRSWC that are only required to host a minimum of two public events (Panaccione, 2020).

Performing outfall inspections was one of the highest concerns for Palmer. The process is timely, requiring samples to be transported within six hours of collection to a lab for analysis, reducing the speed at which inspections can occur. A high level of education and training is required for the process as well,

while a small minority of Palmer's staff is qualified to do it. This often forces Palmer to deal with contractors to meet this requirement, which takes large amounts of money from their stormwater budget, as consultant prices range from $150 per outfall to $8,000 per day (Panaccione, 2020).

4.5: Overall Findings

It is clear that there are some aspects of the permit that are universally difficult for all the towns to comply with, such as testing outfalls. This applies to nearly all the MS4 communities surveyed as both costly and time consuming. Also, there are other permit aspects that have a high variance of town compliance difficulty. For example, meeting TMDLs was ranked one of the highest concerns among many towns. While this issue is of the utmost concern for Palmer, it is of little importance for Framingham.

Funding proved to be a concern for almost all towns across the board. Because most towns obtain the majority of stormwater funds from town general funds, they only have a limited pool of money to spend in attempting to meet permit demands. We have reviewed several funding structures from different towns, many of which are contemplating the development of stormwater utility enterprise funds. This funding source has the potential to drastically increase the amount of stormwater funding that towns have available to use towards permit implementation.

5. Recommendations

In this section, we will discuss what recommendations we have for towns going forward with stormwater management. These recommendations apply to towns at various states of permit implementations, from those looking to see what they should expect from the future to those looking for examples of stormwater management to emulate.

5.1 Recommendation One: Increases to Stormwater Budget for Future Permit Years

Rural, urban, and suburban towns are to expect distinct increases in stormwater spending over the duration of the permit. MS4 area plays a significant role in determining the cost of a stormwater program, so these population density categories will be the basis for our cost recommendations. During the permit's original implementation, cost estimates were supplied by the EPA via a technical memorandum by WaterVision, LLC. These initial estimates were used by towns to develop their rudimentary stormwater budgets. Actual MS4 spending in some areas has exceeded the original costs that communities expected to spend on permit compliance. In response, we have developed a series of changes to town budgets. Budget changes are based on FY20 spending data, the WaterVision technical memorandum, interview data, and cost estimates given at the permit's approval in 2016.

5.1.1: Rural Towns

Communities designated as "rural" by the U.S. Census Bureau should expect to see the highest relative spending increase. Initial cost estimates had an extremely wide range of expected costs, ranging from about $200,000 to $460,000 (WaterVision, 2016). Many rural towns have found it difficult to manage stormwater requirements because of limited staffing and funding allocated to stormwater management. The original cost range makes a large difference for them, as the $260,000 difference in the range would be a substantial change in their budget. In addition to this, the initial budget for the rural towns may have been overestimated. It was predicted that rural towns would be spending a minimum of $80,000 prior to the permit, but many were spending significantly less (WaterVision, 2016). By using an inflated initial cost estimate, it makes the budget increase seem like they were less severe and makes the new estimates seem more reasonable. Table 3 lists the percent increases of stormwater management costs in rural towns for the FY 19-21. The case study example used in this table was the town of Palmer.

Fiscal Year	FY19	FY20	FY21
Percent Increase	78%	273%	261%

Table 3: *Estimated Percent Increase in Stormwater Budget for Rural Towns (Based on Palmer)*

5.1.2: Suburban Towns

Communities designated as "suburban" by the U.S. Census Bureau should expect to see high spending increases as well, although not as much as rural towns. Based on the initial cost estimates provided, suburban towns were expected to spend in the range of $450,000 to slightly over $1 million (WaterVision, 2016). Again, this wide range makes it difficult for the estimates to be incorrect but leaves actual costs ambiguous. Again, the original estimates for the town's spending prior to the permit was high. Table 6 details the cost estimates related to different areas of the EPA's minimum control measures for FY14 and FY19-23 (Kleinfelder, 2018).

Suburban	**FY14 Estimates**		**FY19 Actual**		**FY20 Prediction**		**FY21 Prediction**		**FY22 Prediction**		**FY23 Prediction**	
Minimum Control Measure	**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**	
	Low	*High*	*Low*	*High*	*Low*	*High*	*Low*	*High*	*Low*	*High*	*Low*	*High*
Public Education and Participation	$20.2k -64%	$90.8k +64%	$7.4k	$17.3k	$5.7k	$13.2k	$5.7k	$13.3k	$5.2k	$13.2k	$5.9k	$13.7k
Good Housekeeping	$278k -33%	$557k +33%	$59.0k	$138k	$164k	$383k	$150k	$349k	$176.8k	$378.6	$182.9k	$426.2k
NOI	$5.0k -38%	$11.2k +38%	$4.8k	$11.2k	$4.8k	$11.2k	$4.8k	$11.2k	$4.8k	$11.2k	$5.0k	$11.6k
SWMP	$12.8k -23%	$20.4k +23%	$0	$0	$3.0k	$7.0k	$2.9k	$6.8k	$2.8k	$6.4k	$2.9k	$6.7k
IDDE	$86.9k -51%	$267k +51%	$31k	$72k	$37.5k	$87.7k	$57.3k	$133.6k	$54.3k	$126.6k	$56.2k	$130.9k
Construction Site Control	$4.2k -67%	$21.6k +67%	$9.3k	$21.6k	$8.0k	$18.9k	$8.1k	$18.8k	$7.5k	$17.5k	$7.8k	$18.0k
Post Construction Site Control	$21.2k -29%	$38.4k +29%	$11.8k	$27.5k	$9.2k	$21.5k	$13.5k	$31.6k	$16.1k	$37.6k	$16.7k	$38.9k
Annual Report	$25.3k -34%	$51.6k +34%	$40.5k	$94.6k	$37.3k	$87.2k	$37.5k	$87.4k	$37.5k	$87.4k	$38.8k	$90.4k
MISC/Other	$0	$0	$14.6k	$34.1k	$13.5k	$31.4k	$13.5k	$31.5k	$13.5k	$31.5k	$14.0k	$32.6k
Total	$454k -40%	$1.06 M +40%	$174k	$406k	$283k	$661k	$293k	$264k	$318k	$743k	$330k	$769k
Avg	$757k		$290k		$472k		$488k		$530k		$549k	

Table 4: *Budget Predictions for Suburban Towns*

5.1.3: Urban Towns

Communities designated as "urban" by the U.S. Census Bureau should expect to see a steady change in spending. Using the cost estimates provided by the EPA, it was expected that urban towns would need to spend between $800,000 and about $2 million. As with the other estimates, this is an extremely wide margin, but there is also another problem with it: it seems to underestimate the actual costs. Framingham estimates to spend between $2.2 and $2.5 million in the coming years, all of which are greater than the estimates provided prior to the enactment of the permit. Table 5 presents the four cost change percentages present in the FY21-FY24 for urban towns, which was generated by using Framingham's cost estimates as an example (Schwartz & Gallucci, 2018).

Fiscal Year	FY21	FY22	FY23	FY24
Percent Change	12%	-10%	13%	-2%

Table 5: *Percent Change in Budgets for Urban Towns (Based on Framingham)*

5.1.4: Meeting Implementation Schedule

According to the budget benchmark survey, many towns have not met the implementation schedule laid out by the permit. For example, mapping of town stormwater systems was scheduled to be completed within two years of the effective date of the permit; however, this has not been completed by all towns. The budget benchmark survey shows that more than a quarter of towns have not fully mapped their stormwater system (MA State Stormwater Coalition, 2020). Towns will have to accelerate their permit adherence timeline in order to meet the implementation schedule. This will require additional work resulting in increased spending. Some requirements, such as outfall inspections, are not on track to be completed within the outlined implementation schedule either. In order to complete requirements such as outfall inspections, communities behind with the implementation schedule will need to accelerate their timeline and anticipate an increase in spending. An overview of the permit implementation schedule by control measure, sourced from the MS4 General Permit, is outlined in Appendix A.

5.1.5: Additional Staffing

Also according to survey data, towns are expecting to need more hires to comply with the future demands of the permit (MA State Stormwater Coalition, 2020). Our recommendation is that rural and suburban towns should expect to have two to four full-time equivalent employees, while urban towns should expect to have around four to eight. Hiring of employees is expensive and should be considered when towns are planning for their future stormwater budget. Another important reason to expect an

increase in the spending is because of changes in the permit. There are new, and often expensive, parts of the permit that will go into effect in the very near future. Hiring full time staff will help to lower some of the expensive contractor bills. If the towns plan to find ways to meet the permit, it will require a good deal of extra spending in this area. It is best for the towns to plan on increasing the budget now, so that they are aware of it. This will allow them to take this information into account when considering how much they will need to spend in other areas of the town.

5.1.6: Areas Where Costs Will Likely Increase

One specific area where towns are likely to need to increase their budget is IDDE. This was not one of the highest parts of the budget in FY19, but towns should anticipate a large increase over the next few years. Ashland, which spent about $25,000 on this in FY19, expects to see an increase of over 20% in FY20. However, this isn't even the biggest increase. The budget is expected to jump again between FY20 and FY21, from about $31,000 to almost $48,000, approximately a 50% increase (Kleinfelder, 2018). The 75% increases in IDDE costs are mainly due to the increase in dry weather screening. There are also increases in other areas, such as the mapping of systems, as well as the inspection of catchments that are having issues. There are things that are important for other towns to think about when they prepare their budget estimates for the future. They should not simply expect costs within areas to remain the same, but they should expect to see increases as some of the requirements become stricter throughout the years of the permit.

One of the important factors to stormwater funding is TMDLs. In FY19, the cost for maintenance of the TMDLs was $2,040 for Ashland. In FY20, the estimated costs rose to $26,640 and stabilized to $24,240 in FY21. And in FY22, the cost for TMDLs almost doubled to $46,850 (Kleinfelder, 2018). We recommend that the town of Ashland look over the budget estimations for FY20 to FY22. The estimated cost trend holds some inconsistencies that may need addressing. For example, the rise in cost from $2,040 to $26,640 from FY19 to FY20, as well as the rise in cost from $24,240 to $46,850 from FY21 to FY22, appears to be inconsistent with the year of stability in between FY20 to FY21 when TMDL costs dropped from $26,640 to $24,240. For future fiscal years of permit compliance and TMDL maintenance, it would be reasonable to expect more increases in TMDL costs from FY23 and beyond. However, the period of fiscal stability from FY20 to FY21 proves to be a point of interest, since it implicates that less money was required for TMDL maintenance during FY21. Either there were less TMDLs that needed maintenance during that time, or that the stormwater coalition in Ashland was able to obtain enough funding or revenue during FY20 to cover the TMDL costs that accrued during FY21.

5.1.7: Develop Realistic Contractor Costs

One of the other key areas to focus on is the costs associated with contractors. Ashland spent significantly more than expected on contractors in FY19 (Town of Ashland, 2020). They exceeded their estimate by nearly 20%. This is an important part of the budget to pay attention to. When more parts of the permit go into effect, contractor fees may increase if there are not additional staff hired. It is difficult to hire independent contractors, since all towns are trying to meet the same permit requirements. This leads to a large demand for the contractors from the towns that don't have enough of their own full-time staff. If the full-time staff are increased, towns will likely see a decrease in the amount they must spend on contractors; otherwise, they may see their contractor costs being greater than anticipated.

5.2: Recommendation Two: Upcoming Changes

Twenty towns anticipate needing to hire additional staff to comply with the permit (MA State Stormwater Coalition, 2020). The sample towns cited the need for additional street sweeping crews, as well as having difficulties with the amount of staff qualified to perform dry- and wet-weather outfall inspections. Testing needs to be specific, and the rate at which it can be accomplished is low due to needing to deliver wet samples to labs within six hours, labs which may not even be located near the town. Many towns are also behind schedule with testing, which is supposed to be completed by the end of year three of the permit. It is for these reasons that towns should be provided more funding for additional staff and staff education. Due to staffing issues, many towns find it impossible to meet these permit standards. In order to meet these standards, we expect towns will incur a cost of about $60,000 for full time employees in future years.

The costs of disposal of street sweeping material and catch basin materials are also a common issue seen by towns. Towns like Palmer face a minimum cost of $180,000 for the disposal of the materials, plus the extensive amount of time and money it can cost just to transport these materials. Additionally, many towns have kept the material within their town instead of disposing of it properly, so they will need to pay for its disposal as well (Panaccione, 2020). From the survey, fourteen towns faced costs of $25,000 or higher for this removal (MA State Stormwater Coalition, 2020). Palmer is pursuing a regional grant to reduce disposal costs from $160 per ton down to $75 per ton, cutting their costs by more than a half (Panaccione, 2020). Towns both in and out of the affected region should attempt to acquire grants to reduce the cost of material disposal. This is not just a localized problem, as all towns must afford to dispose of these materials, and adequate funding is still a requirement even at the reduced price.

5.3: Recommendation Three: Implement Stormwater Utility Enterprise Fund

We recommend local communities pursue the creation of a stormwater utility. This will help towns pay for the needs of the MS4 permit without relying on the tedious process of acquiring capital from the town General Funds. There are several reasons that this is helpful. First, stormwater utilities allocate separate funding which is independent of town budget, meaning that town stormwater programs are separate from the town's funding allocation decisions. Stormwater enterprises also typically allow stormwater programs to allocate much more funding than from what would be acquired from a General Fund. The higher budget allows stormwater coordinators to abide by MS4 requirements more effectively and comprehensively. Another positive aspect of a utility is that stormwater budgets will not need to be approved by town appropriations committees, which is currently an issue that holds back towns from acquiring the funding needed to correctly implement MS4 regulations. With stormwater utility funds, stormwater officials will not need to rely on the tedious process of appealing to local government for funding. Often, stormwater management programs do not get the amount of funding necessary to comply with MS4 regulations when appealing for General Fund budget requests. Under a utility fund, towns will instead receive the bulk of their funding from their stormwater utility and will not rely so heavily on town budget approval for stormwater projects. Although having a utility may not solely guarantee sufficient funding for the permit, it will go a great length in providing for the budget. This may be unpopular amongst large towns with large areas of industry, because most of the businesses' land area consists of impervious surfaces, such as pavement and concrete. This may result in fees per impervious area, which will result in greater costs for large businesses than for small businesses and individual homeowners.

Implementing a stormwater utility has been considered by many towns; however, relatively few have actually passed legislation to date. While thirty-two towns who filled out the survey have considered the utility, only fourteen have actually passed legislation (MA State Stormwater Coalition, 2020). This is significantly more than the state as a whole, as only about 1% of towns actually have implemented a stormwater utility (Reed, 2020). Developing a stormwater utility can be difficult. Even after deciding to create one, challenges arise while trying to determine the best method for applying the fee to the town members and will require full time staff to run. New staff would likely need to be hired to fulfill these responsibilities, and many communities do not have the capacity to create a stormwater utility enterprise fund with their current staff. Reasons that some may not have adopted the fund may be due to associated startup costs and additional staffing issues. Thankfully, it is possible to receive grants toward creating the stormwater utility through the EPA, which should help to potentially make the decision easier and more appealing to some of the towns questioning its implementation. Our recommendation is that all the towns investigate the feasibility of such a utility in their community, and if possible begin moving forward in the implementation process.

5.4: Recommendation Four: Consider joining a Stormwater Coalition

Lastly, we recommend that towns within Massachusetts consider joining a stormwater coalition, if they have not already. As has been demonstrated by the CMRSWC, stormwater coalitions aided by the EPA provide a valuable resource to towns by aiding with stormwater policy. They give participating towns access to resources shared by other towns in the coalition, acting in their interests in a court of law. For example, the EPA introduced stakeholder assessments in Ashland, where the EPA asks about concerns within the town and addresses them. The EPA had provided a standardized format for towns to follow and present their plans. The CMRSWC provides technical support and workshops for official documentation, leading to a negligible cost to maintain a work plan, as is the case for Palmer. Coalitions can aid with educational outreach, as well as training for stormwater officials. The EPA has helped towns within stormwater coalitions to market with the "Think Blue" Campaign, which spread awareness about stormwater issues amongst the many towns of Massachusetts (St. Germain, 2020). Within a coalition, towns can share information and techniques amongst themselves, thus helping to collectively improve the stormwater management practices of towns within the coalition quickly and efficiently. If towns face challenging stormwater situations, they may consider joining multiple coalitions that specialize in these issues. All three of the case study towns praised the coalition's involvement, including Palmer's praise of the CTRSWC (Panaccione, 2020).

6. Conclusions

We determined four major recommendations for towns of Massachusetts concerning stormwater budgets. From the budget data provided, we can infer that costs for TMDLs, IDDE, and hiring stormwater personnel will increase in future fiscal years through FY23. By providing them with percentage increases for future budget estimates, towns can utilize their resources and meet specific needs in their MS4 area. However, the amount these vary depends on the type of town and its current situation. Towns can look at the three case study towns and compare areas where they would expect to see similarities with these communities, and areas that will likely be different. Secondly, we urge towns to prepare for changes to their stormwater management timelines. Many towns are falling behind in terms of adhering to the MS4 Permit requirements. In order to catch up, they will need to speed up by making changes to their current schedule and management practices. For example, we informed towns about where funding should specifically be allocated in order to meet the permit deadlines quickly. There will likely be a need for an increase in the current number of staff. Many communities are lacking the work hours necessary, and it will be cheaper to hire full time employees instead of individual contractors.

Third, we recommend that towns pass a stormwater utility enterprise fund into legislation. This will not only provide them with enough funding to fulfill permit requirements, but will give them the flexibility to allocate funding into different areas of their budget that are the most challenging to meet. Lastly, we strongly recommend the towns within Massachusetts to join a stormwater coalition. The benefits of this decision are vast, including receiving aid from participating towns, the utilization of resources provided by the coalition and EPA, and the ability to maintain a work plan for future years. Additionally, they have been extremely helpful in areas such as public education and have replaced much of the costs that would ordinarily be associated with this task. We strongly believe these recommendations will provide a fresh perspective to stormwater communities' budget estimations for future years. These recommendations will also highlight key issues within various towns' stormwater management practices, while providing them with feasible solutions that will expedite progress in meeting the vast amount of MS4 Permit requirements.

Appendix A: Permit Implementation Schedule by MCM

MCM 1:

The permittee shall continue to implement the public education program required by the MS4- 2003 permit by distributing educational material to the MS4 community (EPA, 2016).

1. Additionally, the educational program shall include education and outreach efforts for the following four audiences:
    a. Residents
    b. Businesses institutions (churches, hospitals), and commercial facilities
    c. Developers (construction)
    d. Industrial facilities

    The Permittee must include two educational messages over the permit term to each audience identified above. The distribution of materials to each audience shall be spaced at least a year apart.
2. The permittee shall identify methods that it will use to evaluate the effectiveness of the educational messages and the overall education program. Any methods used to evaluate the effectiveness of the program shall be tied to the defined goals of the program and the overall objective of changes in behavior and knowledge.

    The permittee must include the evaluation of effectiveness in the annual report.

MCM 2:

Annually, beginning year two, the permittee shall annually provide the public an opportunity to participate in the review and implementation of the SWMP. The permittee shall report on the activities undertaken to provide public participation opportunities. These may include, but are not limited to: websites, hotlines, clean-up teams, monitoring teams, or an advisory committee.

MCM 3:

The permittee shall implement an IDDE program to systematically find and eliminate sources of non-stormwater discharges to its municipal separate storm sewer system and implement procedures to prevent such discharges.

1. The permittee shall identify all known locations where Sanitary Sewer Overflows (SSO)s have discharged to the MS4 within the previous five years. This shall include SSOs resulting, during dry or wet weather, from inadequate conveyance capacities, or where interconnectivity of storm and sanitary sewer infrastructure allows for communication of flow between the systems. Within one year of the effective date of the permit, the permittee shall develop an inventory of all identified SSOs.
2. The system map shall be updated within two years of the permit effective date to include the

following information:

a. Outfalls and receiving waters (required by MS4-2003 permit)

b. Open channel conveyances (swales, ditches, etc.)

c. Interconnections with other MS4s and other storm sewer systems

d. Municipally-owned stormwater treatment structures (e.g., detention and retention basins, infiltration systems, bioretention areas, water quality swales, gross particle separators, oil/water separators, or other proprietary systems)

e. Water bodies identified by name and indication of all use impairments as identified on the most recent EPA approved Massachusetts Integrated List of waters report

f. Initial catchment delineations

The system map shall be updated within two years of the permit date with initial required information.

3. The system map shall be updated annually as the following information becomes available during implementation of catchment investigation procedures. This information must be included in the map for all outfalls within ten years of the permit effective date:

    a. Outfall spatial location (latitude and longitude with a minimum accuracy of +/-30 feet)

    b. Pipes

    c. Manholes

    d. Catch basins

    e. Refined catchment delineations. Catchment delineations shall be updated to reflect information collected during catchment investigations

    f. Municipal sanitary sewer system (if available)

    g. Municipal combined sewer system (if applicable).

    The system map shall be updated within ten years for additional requirements, and annually as information becomes available.

4. The IDDE program shall be recorded in a written (hardcopy or electronic) document. At a minimum this shall include the written procedures for dry weather outfall screening and sampling and for catchment investigations. The permittee shall implement the IDDE program in accordance with the goals and milestones contained in this part.

    A written IDDE program shall be completed within one year of the effective date of the permit and updated in accordance with the milestones of this part.

5. The permittee shall assess and priority rank the outfalls in terms of their potential to have illicit discharges and SSOs and the related public health significance. This ranking will determine the priority order for MA MS4 General Permit 34 screening of outfalls and interconnections.

An initial outfall and interconnection inventory and priority ranking to assess illicit discharge potential based on existing information shall be completed within one year from the effective date of the permit; an updated inventory and ranking will be provided in each annual report thereafter.

6. All outfalls/interconnections (excluding Problem and excluded Outfalls) shall be inspected for the presence of dry weather flow.

   All outfalls and interconnections excluding problem and excluded outfalls shall be inspected for the presence of dry weather flow within three years of the permit effective date. Training shall take place at a minimum annually.

7. The permittee shall, at a minimum, annually provide training to employees involved in IDDE program about the program, including how to recognize illicit discharges and SSOs. The permittee shall report on the frequency and type of employee training in the annual report. Training shall take place at a minimum annually.

MCM 4:

The permittee shall develop and implement a construction site runoff control program that includes the following elements:

1. An ordinance or regulatory mechanism that requires the use of sediment and erosion control practices at construction sites. In addition to addressing sediment and erosion control, the ordinance must include controls for other wastes on construction sites such as demolition debris, litter and sanitary wastes.

   Development of an ordinance or other regulatory mechanism was a requirement of the MS4-2003 permit. The ordinance or other regulatory mechanism required by the MS4-2003 permit shall have been effective by May 1, 2008.

2. Written (hardcopy or electronic) procedures for site inspections and enforcement of sediment and erosion control measures.

   If not already existing, these procedures shall be completed within one year from the effective date of the permit.

3. Requirements for construction site operators performing land disturbance activities within the MS4 jurisdiction that result in stormwater discharges to the MS4 to implement a sediment and erosion control program that includes BMPs appropriate for the conditions at the construction site.

   This procedure is ongoing.

4. Requirements for construction site operators within the MS4 jurisdiction to control wastes, including but not limited to, discarded building materials, concrete truck wash out, chemicals, litter, and sanitary wastes. These wastes may not be discharged to the MS4.

This procedure is ongoing.

5. Written procedures for site plan review and inspection and enforcement.
   If not already existing, the procedures for site plan review and inspection and enforcement shall be completed within one year from the effective date of the permit.

MCM 5:

Permittees shall develop, implement, and enforce a program to address post-construction stormwater runoff from all new development and redevelopment sites that disturb one or more acres and discharge into the permittees MS4 at a minimum. Permittees authorized under the MS4-2003 permit shall continue to implement and enforce their program and modify as necessary to meet the requirements of this part.

1. The permittee's new development/ redevelopment program shall include sites less than one acre if the site is part of a larger common plan of development or redevelopment which disturbs one or more acre.
   This procedure is ongoing.
2. The permittee shall develop or modify, as appropriate, an ordinance or other regulatory mechanism to contain provisions that are as least as stringent as those outlined in 2.3.6.a.ii.4 of the MS4 Permit.
   The permittee's development or modification of regulatory mechanism must occur within two years of the effective date of the permit.
3. The permittee shall require, at a minimum, the submission of as-built drawings. The as-built drawings must depict all on site controls, both structural and non-structural, designed to manage the stormwater associated with the completed site (post construction stormwater management). The as-built drawing must be submitted no later than two years after completion of construction projects.
4. The permittee shall develop a report assessing current street design and parking lot guidelines and other local requirements that affect the creation of impervious cover.
   The assessment of current street design and parking lots must occur within four years of the effective date of this permit.
5. The permittee shall develop a report assessing existing local regulations to determine the feasibility of making, at a minimum, the following practices allowable when appropriate site conditions exist:
   a. Green Roofs
   b. Infiltration Practices
   c. Water Harvesting devices

   The report assessing existing local regulations to determine the feasibility of implementing the

BMPS stated above shall be implemented within four (4) years from the effective date.

6. The permittee shall identify a minimum of 5 permittee-owned properties that could potentially be modified or retrofitted with BMPs designed to reduce the frequency, volume, and pollutant loads of stormwater discharges to and from its MS4 through the reduction of impervious area.
   The identification of 5 properties appropriate for BMP retrofits must be submitted within four years from the effective date of this permit.

MCM 6:

The permittee shall implement an operations and maintenance program for permittee-owned operations that has a goal of preventing or reducing pollutant runoff and protecting water quality from all permittee owned operations.

1. The permittee shall develop, if not already developed, written (hardcopy or electronic) operations and maintenance procedures for the municipal activities listed below. These written procedures shall be included as part of the SWMP.
   The written operations and maintenance procedures for municipal activities must be developed within two years of the effective date of this permit
2. The permittee shall develop an inventory of all permittee owned facilities within the categories listed below. The permittee shall review this inventory annually and update as necessary.
   a. Parks and Open Space
   b. Buildings and facilities where pollutants are exposed to stormwater runoff
   c. Vehicles and Equipment

   The inventory of all permittee owned facilities must be developed within two years of the effective date of this permit.
3. The permittee shall establish a written (hardcopy or electronic) program detailing the activities and procedures the permittee will implement so that the MS4 infrastructure is maintained in a timely manner to reduce the discharge of pollutants from the MS4. The written operations and maintenance procedures for MS4 infrastructure must be developed within two years of the effective date of this permit.
4. The permittee shall optimize routine inspections, cleaning and maintenance of catch basins such that the following conditions are met:
   a. Prioritize inspection and maintenance for catch basins located near construction activities (roadway construction, residential, commercial, or industrial development or redevelopment). Clean catch basins in such areas more frequently if inspection and maintenance activities indicate excessive sediment or debris loadings.

b. Establish a schedule with a goal that the frequency of routine cleaning will ensure that no catch basin at any time will be more than 50 percent full.
c. If a catch basin sump is more than 50 percent full during two consecutive routine inspections/cleaning events, the permittee shall document that finding, investigate the contributing drainage area for sources of excessive sediment loading, and to the extent practicable, abate contributing sources. The permittee shall describe any actions taken in its annual report.
d. For the purposes of this part, an excessive sediment or debris loading is a catch basin sump more than 50 percent full. A catch basin sump is more than 50 percent full if the contents within the sump exceed one half the distance between the bottom interior of the catch basin to the invert of the deepest outlet of the catch basin.
e. The permittee shall document in the SWMP and in the first annual report its plan for optimizing catch basin cleaning, inspection plans, or its schedule for gathering information to develop the optimization plan. Documentation shall include metrics and other information used to reach the determination that the established plan for cleaning and maintenance is optimal for the MS4. The permittee shall keep a log of catch basins cleaned or inspected.
f. The permittee shall report in each annual report the total number of catch basins, number inspected, number cleaned, and the total volume or mass of material removed from all catch basins.

   This is required annually.

5. The permittee shall establish and implement procedures for sweeping and/or cleaning streets, and permittee-owned parking lots. All streets apart from rural uncurbed roads with no catch basins or high-speed limited access highways shall be swept and/or cleaned a minimum of once per year in the spring (following winter activities such as sanding).

   This is required annually.
6. The permittee shall ensure proper storage of catch basin cleanings and street sweepings prior to disposal or reuse such that they do not discharge to receiving MA MS4 General Permit 50 waters.

   This is required annually.
7. The permittee shall establish and implement procedures for winter road maintenance including the use and storage of salt and sand; minimize the use of sodium chloride and other salts, and evaluate opportunities for use of alternative materials; and ensure that snow disposal activities do not result in disposal of snow into waters of the United States. For purposes of this MS4 Permit,

salt shall mean any chloride-containing material used to treat paved surfaces for deicing, including sodium chloride, calcium chloride, magnesium chloride, and brine solutions.

8. The permittee shall establish and implement inspection and maintenance frequencies and procedures for all stormwater treatment structures such as water quality swales, retention/detention basins, infiltration structures, proprietary treatment devices or other similar structures. All permittee-owned stormwater treatment structures (excluding catch basins) shall be inspected annually at a minimum.

   This procedure is ongoing.

Appendix B: Framingham Interview Questions

1. How has the implementation of MS4 regulations impacted stormwater management in your town? In terms of budget? Workers? Infrastructure?
2. Have your stormwater officials struggled with communicating stormwater issues & funding structure to your town's local government?
    a. For stormwater enterprise funds, did your town committees have trouble understanding MS4 permit info? Did this impact their decision to adopt an enterprise?
3. How do you enforce the six minimum control measures?
    a. Which of the six minimum control measures do you need help with the most?
    b. What is the cost breakdown for the control measures?
4. Has your town instated any stormwater fees or taxes?
    a. Does the stormwater program have any other forms of funding?
    b. Have you had to cut spending in any other areas?
5. Why was designing and constructing new BMPs and BMP retrofits for municipal projects/properties of high concern for your community?
6. Why was meeting TMDL limits of low concern for your community?
7. Which aspects of the permit would you want to see delayed or repealed?
8. Do you feel the CMRSWC is effective in providing assistance with stormwater issues?
    a. What more could the coalition do to benefit you?
    b. Is there anything the coalition currently does that isn't helpful?
9. What difficulties have you faced with performing outfall inspections, the concern we found ranked highest overall on the MS4 Budget Benchmark Survey?

Appendix C: Ashland Interview Questions

1. How has the implementation of MS4 regulations impacted stormwater management in your town? In terms of budget? Workers? Infrastructure?
2. Have your stormwater officials struggled with communicating stormwater issues & funding structure to your town's local government?
    a. For stormwater enterprise funds, did your town committees have trouble understanding MS4 permit info? Did this impact their decision to adopt an enterprise?
3. How do you enforce the six minimum control measures?
    a. Which of the six minimum control measures do you need help with the most?
    b. What is the cost breakdown for the control measures?
4. Has your town instated any stormwater fees or taxes?
    a. Does the stormwater program have any other forms of funding?
    b. Have you had to cut spending in any other areas?
5. Why was meeting performing outfall inspections of high concern for your community?
6. Why was maintaining and updating your community's Stormwater Management Plan yearly of low concern for your community?
7. Which aspects of the permit would you want to see delayed or repealed?
8. Do you feel the CMRSWC is effective in providing assistance with stormwater issues?
    a. What more could the coalition do to benefit you?
    b. Is there anything the coalition currently does that isn't helpful?
9. What difficulties have you faced with performing outfall inspections, the concern we found ranked highest overall on the MS4 Budget Benchmark Survey?

Appendix D: Palmer Interview Questions

1. How has the implementation of MS4 regulations impacted stormwater management in your town? In terms of budget? Workers? Infrastructure?
2. Have your stormwater officials struggled with communicating stormwater issues & funding structure to your town's local government?
    a. For stormwater enterprise funds, did your town committees have trouble understanding MS4 permit info? Did this impact their decision to adopt an enterprise?
3. How do you enforce the six minimum control measures?
    a. Which of the six minimum control measures do you need help with the most?
    b. What is the cost breakdown for the control measures?
4. Has your town instated any stormwater fees or taxes?
    a. Does the stormwater program have any other forms of funding?
    b. Have you had to cut spending in any other areas?
5. Why was meeting TMDL limits of high concern for your community?
6. Why was maintaining and updating your community's Stormwater Management Plan yearly of low concern for your community?
7. Which aspects of the permit would you want to see delayed or repealed?
8. Do you feel the CMRSWC is effective in providing assistance with stormwater issues?
    a. What more could the coalition do to benefit you?
    b. Is there anything the coalition currently does that isn't helpful?
9. What difficulties have you faced with performing outfall inspections, the concern we found ranked highest overall on the MS4 Budget Benchmark Survey?

Appendix E: Survey and the Data Obtained from It

Link to survey used: **https://www.surveymonkey.com/r/J3H8Y7V**

Data Tables:

	Outfalls	Catch basins	Manholes	Pipes
Unknown	2	2	2	2
0-25%	2	3	4	7
25-50%	0	0	0	1
50-75%	4	3	4	6
75-100%	32	32	30	24

	Culverts	MS4-owned Stormwater BMPs	Privately-owned Stormwater BMPs	Catchment areas
Unknown	4	6	10	4
0-25%	5	8	18	13
25-50%	2	8	5	3
50-75%	4	3	2	3
75-100%	25	15	5	7

Table 6: *Data on Completion of Parts of Permit*

According to tables above, the majority of towns that filled out the survey have most of their outfalls, catch basins, manholes, pipes, culverts, and MS4-owned stormwater BMPs close to completely mapped. However, there are several towns that are behind on mapping privately-owned stormwater BMPs and catchment areas. Specifically, Ashland and Framingham had most of their infrastructure mapped and inventoried, while Palmer fell behind in many areas. All three towns struggled with the completion of mapping either their privately owned or MS4 owned BMPs. Nevertheless, funding sources including the Stormwater Utility, grants, and the general fund are utilized by towns within the statewide coalition to mitigate the harmful effects of stormwater.

Appendix F: Ashland Spending Data: FY19

	Expected Costs FY19	Actual Costs FY19
Permanent Possessions	$95,050	$79,543
Longevity and fringes	$500	$0
Uniform expenses	$500	$360
Contracted Services	$43,000	$51,576
Supplies	$3,250	$6,180
Postage/stamps	$2,500	$2,500
Tools/hardware	$1,000	$2,243
Concrete	$500	$772
Asphalt/ hot-top	$1,500	$0
Gravel/loam/mulch	$200	$0
Training/Conferences/Courses	$2,000	$1,856

Table 7: *Ashland's Expected and Actual Costs Comparison for FY19*

Appendix G: Brochure for Local Communities

CMRSWC

The Central Massachusetts Regional Stormwater Coalition is just one of the 6 municipal stormwater coalitions in the state

Recommendations:

1. **Increases to Stormwater Budget for future years of permit**
2. **Plan on upcoming changes in budget**
3. **Towns should consider implementing a Stormwater Utility if feasible**
4. **Towns should consider joining a local stormwater coalition, or multiple, if they have not already**

Who We Are

We are a group of students from WPI. Our project was sponsored by the Central Massachusetts Regional Stormwater Coalition, who tasked us with analyzing the current costs associated with stormwater and estimating the future costs.

Methods of Research

This research was completed using the Massachusetts Stormwater Budget Benchmark Survey, interviews with the towns of Framingham, Ashland, and Palmer, and analysis of spending data that we were provided

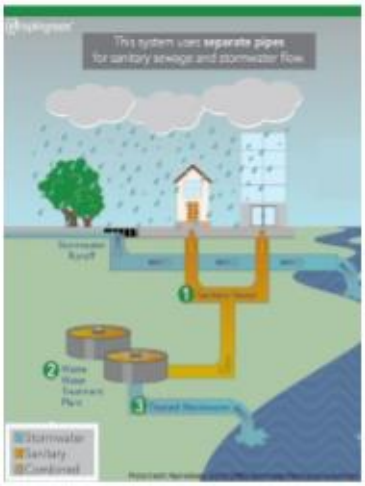
Contact Us

Email: gr-wroc_swcosts@wpi.edu

WPI

ANALYSIS OF MS4 PERMIT COSTS
Worcester MA, 01609

MS4 MUNICIPAL SEPARATE STORM SEWER SYSTEM



ANALYSIS OF MS4 PERMIT COSTS

Evan Mackie, Joe Tzanetos, Noah Bradlee, Jeremy Branch

Rural Towns in MA

Large percent increase expected in budgets

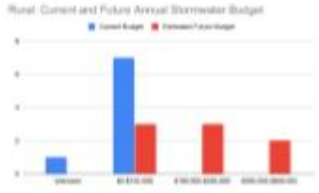
Fiscal Year	Budget Increase from expectations
FY19	78%
FY20	273%
FY21	261%

Percent Change in Budget (Based on Palmer)

Median expected budget for future years: **$175,000**

Major Areas of Cost:

- TMDLs
- IDDE



Suburban Tows in MA

Large percent increase in beginning, then slow increase

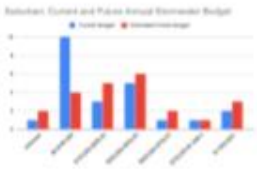
Fiscal Year	Percent Change from expectations
FY20	64%
FY21	3%
FY22	9%

Percent Change in Budget (Based on Ashland)

Median expected budget for future years: **$375,000**

Major Areas of Costs

- IDDE
- Good Housekeeping



Urban Towns in MA

Less budget change expected than smaller towns

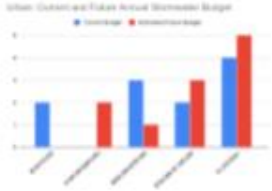
Fiscal Year	Percent Change from expectations
FY21	12%
FY22	-10%
FY23	13%
FY24	-2%

Percent Change in Budget (Based on Framingham)

Median expected budget for future years: **$875,000**

Major Areas of Cost

- Designing/building BMPs
- Inspections of outfalls/ culverts



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