Stormwater Management Educational Materials for Central Massachusetts Municipalities

An Interactive Qualifying Project Final Report

In partial fulfillment of the requirements for the

Degree of Bachelor of Science

Submitted by:

Alex Legere
Anthony Perullo
Amy Toscano
Justin Waters

Submitted to:

Professor Corey Dehner
and
Professor Purvi Shah
Worcester Polytechnic Institute
Massachusetts Water Resource Outreach Center

Sponsoring Organizations:

Massachusetts Department of Environmental Protection (MassDEP)

Central Massachusetts Regional Stormwater Coalition (CMRSWC)

Sponsors:

Michael Knox, Cherry Valley Sewer District

Andrea Briggs, Massachusetts Department of Environmental Protection

Date: December 13th 2016

Abstract

Stormwater runoff is precipitation that runs along paved surfaces carrying pollutants, down storm drains and into bodies of water. The lack of treatment for stormwater runoff is a major cause of water pollution. The United States Environmental Protection Agency released a new Permit in April 2016, containing requirements for stormwater management that Massachusetts municipalities must meet. The goal of this project was to educate residents on the impacts of stormwater runoff by creating a branded promotional campaign, and educational materials in the form of two toolkits for local schools and events. We hope our toolkits will be used by the Massachusetts Department of Environmental Protection and the Central Massachusetts Regional Stormwater Coalition to educate their communities.

Acknowledgements

We would like to thank the following individuals and organizations for their support in the success of this project:

1. Our advisors Professor Corey Dehner and Professor Purvi Shah, for advising us during this project.

2. Our sponsors Michael Knox, Andrea Briggs, the *Massachusetts Department of Environmental Protection,* and the *Central Massachusetts Regional Stormwater Coalition* for facilitating our research and providing us with direction and various resources.

3. Frederick Civian for his constant guidance and support in helping us understand the 2016 Massachusetts MS4 permit.

4. James Monaco for providing us with technical assistance in making our project video.

5. Tina Boss and Ann Hyland for allowing us the opportunity to pilot our school toolkit at Leicester Memorial School.

6. Samantha Sorrentino for allowing us the opportunity to pilot our local event toolkit at stART at the Station.

7. Christina Andreoli, Chester Arnold, Cindy Brown, Deborah Cary, Christina Chappell, Peter Coffin, Stefanie Covino, David Dickson, Michael Dietz, Martha Gach, Ed Himlan, Anne Leiby, Beth MacBlane, Barbara McMillan, Jennifer Pederson and Heidi Ricci for sparing time for interviews that gave us important information on creating educational campaigns.

8. Robert Cox, Patty Gambarini, Adam Gaudette, Jeffrey Howland and Brad Stone for sparing time for interviews that gave us important information for our project.

9. Worcester Polytechnic Institute for providing us the opportunity to have a remarkable experience at the *Massachusetts Water Resource Outreach Center.*

Executive Summary

Stormwater starts as precipitation. Stormwater runoff is when water flows across impervious surfaces, such as streets and sidewalks, into storm drains or directly to bodies of water. A common misconception is that this water gets filtered in treatment plants, but that is not the case. Stormwater runoff flows directly to local waters, pollutants and all. These pollutants can include oil, road salt, fertilizer, and animal waste. These pollutants in local water bodies can cause death to aquatic life as well as unsafe areas for human use, such as for fishing and swimming.

In 2016, the United States Environmental Protection Agency (USEPA) released an updated version of their 2003 *Municipal Separate Storm Sewer System (MS4)* permit. The 2016 MS4 permit contains stringent stormwater management requirements that municipalities must meet. These requirements are contained within the permit's six minimum control measures. Our project focuses on three of the minimum control measures: 1. Public Education and Outreach; 2. Public Involvement; and 6. Good Housekeeping and Pollution Prevention (USEPA, 2016a).

The goal of our project was to assist 30 towns in Central Massachusetts in compliance with the 2016 MS4 permit while also educating residents on stormwater and its management. We worked in collaboration with the *Massachusetts Department of Environmental Protection (MassDEP)* and the *Central Massachusetts Regional Stormwater Coalition (CMRSWC)*.

In order to achieve our goal, we developed nine objectives. Objectives 1 and 2 were about researching what stormwater runoff is, its impacts, the MS4 permit, and the problems municipalities face in trying to comply. We accomplished this through online research and informative interviews. Objectives 3 and 4 looked at past educational campaigns. We analyzed

how and why other educational campaigns chose their target audiences as well as learning outcomes, later concluding how effective these choices were.

In objectives 5 and 6, we developed the campaign branding and educational materials. We created surveys to see what branding options would be best received. We developed two surveys, one for those involved in stormwater management and one for the general public. From these, we created recommendations on the branding of a stormwater education campaign. We also looked at other stormwater education resources that already exist and used them as models to develop educational activities and materials. Lastly, to complete objectives 7, 8, and 9 we tested, evaluated and revised the educational materials. We piloted the materials at the Boys and Girls Club in Worcester; Leicester Memorial School in Leicester; and at a holiday craft fair, stART at the Station, in Worcester. We looked at how the message was received, and used that to provide recommendations for revisions and future use of these materials.

Results

Through our research, we found that **there are many stormwater education resources already available, but it is hard to determine which are effective.** We came across dozens of materials created by various organizations and communities during our research. Even more materials were provided to us through our 15 interviewees related to educational campaigns. With so many available resources, why was the issue of stormwater runoff unknown to the general public? We came to the conclusion that finding good resources that fit an educator's needs can be difficult because there is no central location for such materials. Materials have to be visible or promoted to become used.

The best way to reach the target audience of residents is through their kids. We found that many past effective educational campaigns have had a portion that was aimed at children. One example is the Reduce, Reuse, and Recycle campaign, which created school materials such as backpack mail (USEPA, 2016d). Children would come home and then be able to influence their parents based on what they learned. In the same way, for the developed toolkit built for schools, we are hoping will achieve the same goal. According to Jeffrey Howland, Town Engineer for the town of Shrewsbury, MA, it can be difficult to change the habits of adults, but children are much easier to influence (J. Howland, Personal Communications, October 28, 2016). This idea was supported by Fred Civian, Stormwater Coordinator of MassDEP, Stefanie Covino, Project Coordinator at Mass Audubon, and Christina Chappell, Manager of Education at the Ecotarium (F. Civian, Personal Communications, October 27, 2016; S. Covino, Personal Communications, November 8, 2016; and C. Chappell, Personal Communications, November 8, 2016).

Figure 1: Soak Up the Rain logo. https://www.epa.gov/soakuptherain

Through our branding surveys, we learned that **the Soak Up the Rain logo (seen in Figure 1) is most preferred.** While Soak Up the Rain did win an average score for the survey sent to stormwater management experts, it was not as clear cut. Therefore, we conducted another survey with the public at the stART at the Station craft fair where we asked members of the public to rate five logos from most to least

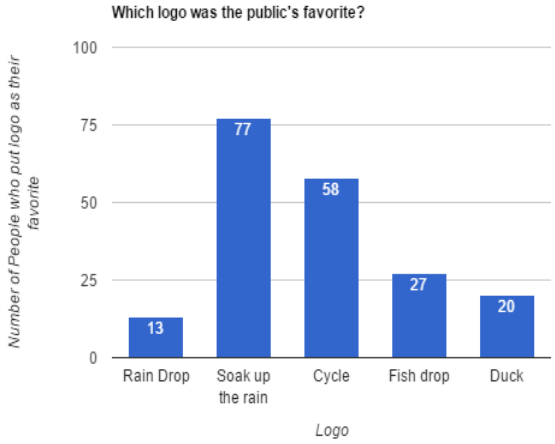


Figure 2: Graph depicting the public's favorite logo design.

favorite. Considering this data, the Soak Up the Rain logo was the favorite choice, holding 40% of votes **(seen in Figure 2)**.

With the amount of resources available, we recommend that the CMRSWC **share resources internally and externally while also bringing in new materials.** The most important part of making sure resource materials get used is connecting the information seeker with the correct material. The resources should be organized by who they are designed to target, and who they are designed to be used by. Categories or a searchable database of resources would allow the members of the CMRSWC to easily find resources they could deploy to raise awareness.

We also recommend the CMRSWC **create a statewide education campaign with the Massachusetts Statewide Stormwater Coalition.** Having many campaigns in Massachusetts creates duplicated work and does not foster familiarity for branding among residents. Having one unified campaign would allow easy sharing of relevant materials while also creating recognition for the brand.

At the moment, there are six stormwater coalitions in the state of Massachusetts. In order to maintain consistency and simplify where information can be found, **we recommend that a statewide campaign website be created.** This would allow all materials to be in a single location and allow people to access information in a straightforward fashion, assuming all coalitions are willing to do their part. If a statewide campaign website cannot be created, perhaps adding materials on the Worcester Polytechnic Institute's Water Resource Outreach Center (WROC) or CMRSWC website would allow more associates, such as watershed associations and educators, to use the materials as well.

We also recommend using the campaign title "Soak Up the Rain" with the Soak Up the Rain logo. The results of our two surveys revealed that the Soak Up the Rain brand holds the

most appeal both as a title and as a logo. Based on our data, we recommend that if the CMRSWC is looking to unify the stormwater educational campaigns with the statewide coalition, that it look towards working with the USEPA to support Soak Up the Rain as the official campaign of Massachusetts.

In addition to our findings and recommendations, we created **toolkits for use in schools and at local community events**. These toolkits began as a recommendation from our sponsors, but became a main deliverable for our project.

As a result of our two pilots with the school toolkit at the Boys and Girls Club of Worcester and Leicester Memorial School in Leicester, **we recommend that the school toolkit include: in-class and take-home activity books, backpack mail, pictures to show the students, stickers, and a copy of the video we developed to supplement in-class activities.**

As a result of piloting the local event toolkit at the stART at the Station event, **we recommend that the local event toolkit include: a banner, pamphlets, Enviroscape** (a scale demonstration of stormwater runoff in residential, industrial and rural areas) **or similar display, and giveaways.**

In conclusion, we believe that the materials we recommended in each of the toolkits should be utilized to educate children on stormwater, its impact on the environment, and what residents can do to mitigate the impact of stormwater runoff. We hope that our work will help prevent the stormwater pollution problems and protect surface water quality in Massachusetts.

Authorship

Chapter/Section	Primary Author	Primary Editor
Abstract	All	All
Executive Summary	All	All
Chapter 1: Introduction	All	All
Chapter 2: Background	Anthony Perullo	All
2.1 Stormwater	Anthony Perullo	Alex Legere
2.2 Stormwater runoff and causes	Anthony Perullo	Alex Legere
2.2.1 Pollutant	Alex Legere	Anthony Perullo
2.2.2 Impacts	Anthony Perullo	Alex Legere
2.3 Water Pollution Legislation	Justin Waters	Anthony Perullo
2.3.1 U.S. Clean Water Act	Justin Waters	Anthony Perullo
2.3.2 Phase I and Phase II MS4s	Justin Waters	Anthony Perullo
2.3.3 New General MS4 Permit	Justin Waters	Anthony Perullo
2.3.4 Anticipated Obstacles	Justin Waters	Anthony Perullo
2.4 Educating and Reaching out to the Community	Amy Toscano	Alex Legere
2.4.1 Developing a successful outreach campaign	Amy Toscano	All
2.4.2 Evaluating a successful outreach campaign	Amy Toscano	Anthony Perullo
2.4.3 Stormwater outreach program in NE Area	Amy Toscano	Anthony Perullo
Chapter 3: Methodology	Amy Toscano	All
3.0.1 Objective 1	Anthony Perullo	Alex Legere
3.0.2 Objective 2	Justin Waters	Anthony Perullo
3.0.3 Objective 3	Amy Toscano	Justin Waters
3.0.4 Objective 4	Amy Toscano	Justin Waters
3.0.5 Objective 5	Alex Legere	Amy Toscano

3.0.6 Objective 6	Justin Waters	Amy Toscano
3.0.7 Objective 7	Anthony Perullo	Alex Legere
3.0.8 Objective 8	Alex Legere	Anthony Perullo
3.0.9 Objective 9	All	All
3.1 Potential Obstacles	Alex Legere	All
3.2 Project Deliverables	Alex Legere	All
Chapter 4: Toolkits for Schools and Local Events	Alex Legere, Justin Waters	Anthony Perullo
4.1 School Toolkit	Justin Waters	Justin Waters
4.2 Local Event Toolkit	Justin Waters	Justin Waters
Chapter 5: Findings	Amy Toscano	Anthony Perullo
Finding 1: Municipal officials concerns about the 2016 MS4 permit change over time.	Amy Toscano	Anthony Perullo
Finding 2: There are many stormwater education resources already available that are well done, but are hard to track down.	Anthony Perullo	Amy Toscano
Finding 3: Different age ranges of residents require different methods of outreach.	Alex Legere	Amy Toscano
Finding 4: Best way to reach target audience of residents is through their kids.	Alex Legere	Justin Waters
Finding 5: The results of the branding research informs which logo to use.	Anthony Perullo	Anthony Perullo
Chapter 6: Recommendations and Conclusions	Justin Waters	Anthony Perullo
Recommendation 1: Share resources outside of coalition and bring in new materials.	Anthony Perullo	Amy Toscano
Recommendation 2: Create a statewide stormwater education campaign with other coalitions in the state.	Anthony Perullo, Amy Toscano	All
Recommendation 3: Unify the Statewide Stormwater Coalitions to create a united brand and website.	Amy Toscano	Anthony Perullo
Recommendation 4: Use various forms of advertising and outreach to gain traction in more than one demographic.	Alex Legere	Justin Waters

Recommendation 5: Use the campaign title Soak Up the Rain with the Soak Up the Rain logo.	Anthony Perullo	Anthony Perullo
Conclusion	Justin Waters	Amy Toscano
References	All	Amy Toscano
Appendix A: Interview Questions for Fred Civian and Ed Himlan	All	All
Appendix B: Interview Questions for Coalition Members	All	All
Appendix C: Interview Questions for Education Outreach Members	All	All
Appendix D: Survey of Branding for Educational Campaign	Amy Toscano	All
Appendix E: In-Class Activity Plans for Educators	Justin Waters, Alex Legere	All
Appendix F: Logo Survey for Local Event Attendees	Amy Toscano	Amy Toscano
Appendix G: Stormwater Chasers Activity Book	Justin Waters, Amy Toscano, Alex Legere	All
Appendix H: Backpack Mail for Parents	Justin Waters	Amy Toscano
Appendix I: Stormwater Chasers Sticker Template	Anthony Perullo	Anthony Perullo
Appendix J: Local Event Pamphlet	Justin Waters	Amy Toscano
Appendix K: Originally non-digitized materials	Anthony Perullo	Anthony Perullo

Table of Contents

List of Figures

List of Tables

List of Acronyms

CMRSWC	Central Massachusetts Regional Stormwater Coalition
CWA	United States Clean Water Act
MA	Massachusetts
MassDEP	Massachusetts Department of Environmental Protection
MS4	Municipal Separate Storm Sewer System
MWC	Massachusetts Watershed Coalition
NEMO	Nonpoint Education for Municipal Officials
NH	New Hampshire
NPDES	National Pollution Discharge Elimination System
USEPA	United States Environmental Protection Agency
WPI	Worcester Polytechnic Institute
WROC	Water Resource Outreach Center

1.0 Introduction

Have you ever swam in a lake, had a picnic by a river or even taken a stroll by a stream? Chances are many of these water sources are being polluted by stormwater runoff, an increasing problem as the world becomes more urbanized. Stormwater is water left over from weather events, such as snow or rain. When that water runs over pavement, asphalt, etc. it picks up any contaminants it comes across, and becomes stormwater runoff. Stormwater runoff is responsible for 60% of the nation's bodies of water not meeting environmental safety standards (Fitch, 2010).

Stormwater becomes polluted in a multitude of ways, including, but not limited to, litter, chemical pollution (detergents, fertilizers), natural pollution (leaves, animal droppings) and sediment pollution (building sites, unsealed roads) (NSW, 2013). We all are responsible for this

Figure 3: The Potomac River with and without pollution. (Left from https://commons.wikimedia.org/wiki/File:Potomac_green_water.JPG, right from https://www.flickr.com/photos/jweiss3/292379051).

pollution. Road salt used in winter, soap used to wash our cars, and fertilizers used on our lawns all get washed into stormwater drains. Many people believe that those stormwater drains lead to treatment plants that filter and clean out pollutants before the water is piped to a river. The truth is that most of those drains lead straight to river outflows. Reducing stormwater pollution can

only happen if communities work together to make a change. If a change is not made, valuable resources, such as our drinking water supply, may become inconsumable for generations to come. The disregard of bodies of water is not new and continues to result in streams and rivers like the Potomac, seen in **Figure 3**. Still, the general community knows little about where to start in addressing stormwater pollution.

There are many stormwater pollution problems in the Northeast, including the Charles River in Boston (**see Figure 4**). Chemicals such as phosphorus have entered the river stream via stormwater flows, originating from sources like city pavement or animal waste (USEPA, 2008a). These contaminants can also stimulate algae growth, which produces more toxins and allows bacteria to flourish (USEPA, 2016g).

The Massachusetts Department of Environment Protection (MassDEP) is working with the United States Environmental Protection Agency (USEPA) to address the stormwater pollution problem across the state. MassDEP, the agency responsible for overseeing the cleanliness of the state's water, is sponsoring us in our collaboration to educate Central Massachusetts residents on stormwater. (Commonwealth of Massachusetts, n.d.).

Since 1990, the USEPA has developed permits for Municipal Separate Storm Sewer Systems (MS4s), a system of pipes that are used to channel stormwater away from roads and into a local water body. The permits are designed to regulate what is discharged into surface water bodies through the storm sewer systems.

Figure 4: Charles River pollution warning sign.

On April 4th, 2016, the USEPA released a new permit meant specifically for small MS4s in Massachusetts. This new MS4 permit includes control measures that Massachusetts municipalities must abide by (USEPA, 2016a). MassDEP is finding that towns and municipalities in Central Massachusetts are concerned about their ability to comply with the new MS4 permit requirements. Bond, Racine, & Yang (2013), authors of an Interactive Qualifying Project assessing MS4 compliance in Massachusetts, cite quite a few obstacles municipalities face trying to meet the MS4 permit requirements, such as unclear wording in the permit, lack of funding, insufficient manpower, time constraints, and especially general misunderstanding of stormwater management.

In Central Massachusetts, others have completed research surrounding the aspects of the MS4 permit as well as the education of municipal officials on stormwater and its impacts (Bond, Racine & Yang, 2013; Correia, Giroux & Peterson, 2014; Deng, Houghton, Li & Weiler, 2014; Cabral, Luo, Rowles, 2016). However, there was no Massachusetts-specific research for how Massachusetts municipalities can educate its residents on stormwater and stormwater management, an important aspect of complying with the MS4 permit.

Consequently, our project goal was to help 30 town municipalities in Central Massachusetts comply with the educational requirements of the MS4 permit. We investigated various education campaigns and programs, such as Maine's ThinkBlue program, in order to address the lack of knowledge of Central Massachusetts residents pertaining to stormwater runoff and its environmental impact. By examining other resources, we developed toolkits with educational materials that towns can use to educate residents on what the problem is and what they can do to help.

In Chapter 2, we discuss stormwater runoff, its impacts, the MS4 permits, and the successes and limitations of previous educational campaigns and programs. In Chapter 3, we describe our methodology for the project, or what objectives we had to accomplish to complete the project. In Chapter 4, we introduce the contents of the toolkits we developed. In Chapter 5, we discuss our research findings. Lastly, in Chapter 6 we use the contents of all the previous chapters to provide recommendations on how to continue the work and conclude the report.

2.0 Background

Anyone who has lived in Central Massachusetts through all four seasons has experienced an East Coast storm. Most people's awareness about the water ends as soon as it goes down a storm drain. This is only the beginning of the journey for stormwater, and the rest of the story can be eye-opening. So where does that water go, and why should it matter? Stormwater is actually a bigger issue than many realize. In this chapter, we explain stormwater runoff and its causes. Then we explore stormwater runoff's impacts on the environment, and why residents should care. We look at past legislation addressing stormwater including the Clean Water Act, the 2003 MS4 permit, and finally the 2016 MS4 permit. Finally, we conclude with a look at various environmental campaigns that exist in the New England area.

2.1 Stormwater

Have you ever wondered where the water from storms goes? In the next section we describe stormwater and the consequences of stormwater runoff. Any water that originated from a weather event is classified as stormwater. "The primary source of stormwater is weather events like rain or snow. Any of that water can flow into storm drains, carrying any contaminants that it encountered along the way with it" (Cleveland, Ramsey, & Walters, 1970). This stormwater runoff enters storm drains and is led through a series of pipes into a nearby surface waterbody. Why are storm drains necessary though?

When water from rain or snow flows over grass, it can be absorbed, filtered by the soil and eventually ending up in the water table. This is the case in rural or suburban areas. However, urban areas contain mostly impervious surfaces (Novotny, 1995, Page 45). These are any

surfaces that cannot readily absorb water such as asphalt streets, cement sidewalks, parking lots, and driveways. As stormwater flows over impervious surfaces, it becomes stormwater runoff. The water still has to be removed to prevent flooding, and this is where storm drains come in. Storm drains, as seen in **Figure 5**, are the primary method in which stormwater is relieved from urban areas. What was once stormwater is becoming stormwater runoff before it enters these storm drains (USEPA, 2008b).

Figure 5: A storm drain with litter. http://bbp.ocean.edu/pages/157.asp

2.2 Stormwater runoff and causes

Stormwater runoff is defined as precipitation that moves across ground surfaces. As stormwater travels over impervious surfaces, it picks up pollutants (NPDES, 2016). These pollutants can be any number of things from dirt and sand to oil and fertilizer. The water picks up this waste and becomes dirty itself before reaching storm drains. An example of stormwater becoming polluted can be seen in **Figures 6A and 6B**.

Once contaminated water is in storm drains, it travels through a system of pipes to a nearby surface water body. Most of the time the pipes lead directly into rivers, no filtering or processing whatsoever (Botelho, Gorton, & Pai, 2013). Contaminants enter stormwater from a variety of sources in urban areas, so next we will learn more about the pollutants stormwater may acquire during its journey.

Figure 6A/B: A source of possible pollution, construction (left) and dirty water from the source entering a storm drain (right).

2.2.1 Pollutants

The pollutants that can be picked up by stormwater may vary geographically and seasonally. They can range from road salt in the winter to lawn care products in the summer and spring. For a summary of pollutants, sources and impacts, see **Table 1, below**.

In the winter and early spring, especially in northern regions such as New England, road salts used for deicing become a large source of stormwater pollution. When it snows in the winter, the roads get slippery. Plows have to spread salt to help melt the ice on the road as a safety measure. Stormwater can pick up this road salt as it sweeps over the top of impervious road surfaces. This salt can find its way into water bodies, raising the salinity and increasing the risk of dehydration for wildlife, as well as making respiration difficult for freshwater fish (Stranko, Bourquin, Zimmerman, Kashiwagi, McGinty, & Klauda, 2013).

Animal waste is another contributor to stormwater runoff pollution. Fecal matter in stormwater can come from all sorts of sources: humans, pets, livestock, wildlife, etc. This fecal matter can contaminate bodies of water with all sorts of fecal-borne illnesses, which become waterborne. Between bouts of precipitation, this fecal matter and the accompanying pathogens

(illness-causing microorganisms) can build up. When precipitation does occur, the accumulating waste gets swept up by stormwater runoff. After storms, levels of pathogens such as *E. Coli* rise as fecal matter enters into water sources, sometimes raising the levels of fecal-borne pathogens in these sources by over 1000 times. This in turn may cause outbreaks of waterborne diseases that can be found in fecal matter (Converse, Piehler, & Noble, 2011).

Lawn care products, such as herbicides and pesticides, can introduce a wide variety of dangerous chemicals, such as 2,4-dichlorophenoxyacetic acid (used for broadleaf weeds while leaving standard grasses untouched) to stormwater runoff and eventually, surface water bodies. These chemicals not only contaminate the water, but being herbicides, can also harm the flora and fauna surviving off it (Raina, Etter, Buehler, Starks, & Yowin, 2011).

Cars contribute several major pollutants that make their way into storm drains. Oil from the engine, paint chips, metal shavings, tire rubber, and impurities in exhaust (such as heavy metals) all can be washed off the roads and into storm drains. When metal from cars, whether from exhaust or wear on the parts, reaches the ground, it can become stormwater runoff pollution. Different pollutants can have different effects on water and wildlife. Heavy metals found in exhaust, such as cadmium and manganese, can poison surface water bodies (May, Sivakumar, 2009). Rubber, paint, and oil can get into the water and are toxic to fish and wildlife (McKenzie, Money, Green, & Young, 2009). **Figure 7** shows the "rainbow swirl" of oil being swept into a storm drain, an all-too-common occurrence in urban settings (Botelho, Gorton, & Pai, 2013).

Figure 7: Oil being swept up by stormwater runoff.

Pollutant	Source	Impact
Fertilizers	Lawns and farms	Nutrient spikes, resulting in algae bloom.
Road salt	Winter roads	Salinity increases, freshwater fish are unable to cope.
Pesticides, herbicides	Lawns and farms	Continue to kill pests and plants after being washed into natural bodies of water.
Motor oil, car paint, exhaust impurities	Cars and roads	Fish from water with these pollutants may not be sellable on the market.
Animal waste	Pets or wildlife	Fecal-borne diseases become waterborne diseases.

Table 1: Common Stormwater Pollutants, Sources, and Impacts

2.2.2 Impacts

If you have ever gone fishing in a local lake, visited a vacation spot like Cape Cod, or gone sailing on the Charles River then you have likely already seen the effects of polluted stormwater runoff. If you are not sure whether you have seen a polluted body, there are some obvious indicators that you might notice. Bodies of water all over the United States show the signs of stormwater pollution. The most obvious effect is visual; bodies of water turn algae green or a murky brown instead of a clear blue (see **Figure 8**). This discoloration can reduce tourism for a few good reasons, mostly from losses in fishing and recreational activities (USEPA, 2012). Out of the many effects stormwater runoff can have, discoloration is probably the least severe. Stormwater runoff pollutes communal waters like lakes and rivers. In the past, stormwater pollution has caused fishing suspension and limits on

Figure 8: Algae blooms in the Charles River. Julie Wood, Charles River Watershed Association.

recreation such as swimming, like at Silver Lake Beach in Wilmington, Massachusetts, which "was frequently closed due to high levels of Escherichia coli (E.coli) bacteria believed to be from polluted stormwater runoff" (MDCP, n.d., Page 8). In more extreme cases, entire bodies of water can be closed off from public use, such as when an algal bloom closed portions of the Charles River in Massachusetts. As local bodies of water become impaired, residents will see environmental, social, and economic consequences (USEPA, 2016a).

Even if residents are not drinking the contaminated water, they are very likely swimming or fishing in it. Swimmers can become ill from coming into contact with these pollutants, and fish caught from the lake may not be healthy enough to be put on the market (USEPA, 2008b).

> *"In 2006 there were over 15,000 beach closings or swimming advisories due to bacterial levels exceeding health and safety standards, with polluted runoff and stormwater cited as the cause of the impairment 40 percent of the time" (USEPA, 2008b, Page 21).*

Algal blooms can shut down entire bodies of water from public use and can even affect tourism in towns (USEPA, 2008b). Nitrogen and phosphorus are some of the main nutrients that enable algae growth. They mainly enter the water from stormwater runoff. This leads to accelerated algae growth which uses up oxygen in the water, suffocating aquatic life and producing toxins that can harm pets, and even people (USEPA, 2012). During the 1980s, because of numerous court cases against the United States Environmental Protection Agency, the USEPA began to regulate municipal separate storm sewers.

2.3 Water Pollution Legislation

The first significant U.S. law that addressed surface water pollution was the 1948 Federal Water Pollution Control Act (FWPCA) (USEPA, 2016b). Little was done for the next two decades and the 1948 Act was largely ineffective. Consequently, in 1972, Congress passed amendments to the 1948 Act and the FWPCA became known as the United States Clean Water Act.

2.3.1 U.S Clean Water Act

As a result of an increased concern over water pollution after the FWPCA, Congress passed amendments to the FWPCA in 1972 and the body of laws became known as the Clean Water Act (CWA). The Clean Water Act serves multiple purposes, including creating a system that would regulate the discharge of pollutants from a point source into United States' surface bodies of water and granted the USEPA the ability to build pollution control programs (USEPA, 2016b). The 1972 Amendments and future amendments established a solid groundwork, as conveyed by the USEPA: "Since passage of the Water Quality Act of 1948 and the Clean Water Act (CWA) of 1972, 1977, and 1987, water quality in the United States has measurably improved in the major streams and rivers and in the Great Lakes. However, substantial challenges and problems remain." (USEPA, 2008b).

There are 46 states that currently have the authority, or primacy, to administer the CWA within their state. However, Massachusetts does not have primacy authority to administer the CWA. Rather, the USEPA manages the CWA in Massachusetts and MassDEP acts more like an educational liaison to Massachusetts municipalities (USEPA, 2016c).

After the passage of the CWA, stormwater was viewed as a non-point source of pollution, since the pollutants do not come from a single point before entering the drains, but rather from

across the landscape. However, after multiple court rulings from 1976 into the 1980s, the USEPA began classifying stormwater that enters a Municipal Separate Storm Sewer System as a point source, as it pertains to the CWA (Franzetti, n.d.). As a result, the USEPA began regulating stormwater runoff that entered these sewer systems (USEPA, 2016f). One way the USEPA accomplished stormwater regulation was through the issuing of a Municipal Separate Storm Sewer System or MS4 permit.

2.3.2 Phase I and Phase II MS4s

A Municipal Separate Storm Sewer System is any system of sewers and pipes that is owned by a state, town, or city, that releases generally untreated runoff to a local body of water (USEPA, 2016e). The objective of the MS4 permit is to protect the safety of water bodies, so that clean water can be provided to residents, and so all local plants and animals can thrive. The permit defines standards for a separate storm sewer system like the one shown in **Figure 9**. In 1990, the USEPA issued its first MS4 permit, known as a Phase I regulation. This type of regulation requires cities with populations of 100,000 or more to obtain a type of National Pollutant Discharge Elimination System (NPDES) permit for stormwater discharges. A Phase I MS4 is typically designated with an individual permit. In 1999, the USEPA established the Phase II regulations, which covers smaller MS4s, particularly in urbanized areas. These regulations are appointed with general permits (USEPA, 2016e). On May 1, 2003, the USEPA put a new permit

into effect entitled *National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges From Small Municipal Separate Storm Sewer Systems*. This general permit primarily affected the Commonwealth of Massachusetts and the state of New Hampshire. Within the permit is a set of control measures that municipalities were to abide by (USEPA, 2003).

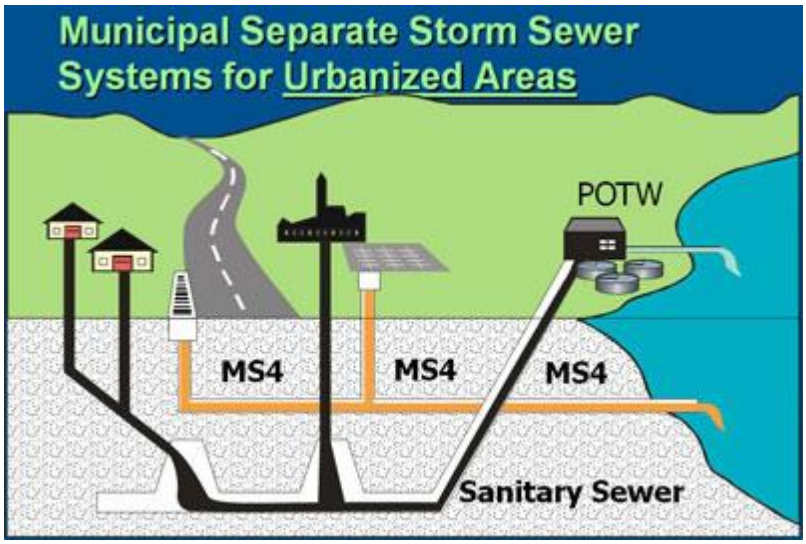


Figure 9: A diagram of an MS4 system.

2.3.3 New General MS4 Permit

On April 4, 2016, the USEPA established a new general MS4 permit. The 2016 permit, which goes into effect July 1, 2017 (USEPA, 2016a), is more rigorous in its requirements and is designed to limit the negative consequences of stormwater runoff. The permit applies to any municipality in Massachusetts that has a population of less than 100,000.

In order to more easily comply with this permit, some towns have begun working together to create coalitions, pooling their knowledge and resources. For example, 13 municipalities in the Central Massachusetts area created the Central Massachusetts Regional Stormwater Coalition (CMRSWC). The CMRSWC now has participants from over 30 municipalities (CMRSWC, 2016). There are six control measures within the permit that the municipalities are expected to abide by. These control measures are as follows:

1. *Public Education and Outreach*: Requiring all municipalities to develop an educational program intended to increase knowledge of stormwater runoff, and

facilitate behavioral changes to mitigate stormwater pollution. These efforts are to be applied to four audiences: residents, businesses or institutions, construction developers, and industrial facilities (USEPA, 2016a).

2. *Public Involvement and Participation*: Requiring that municipalities set up opportunities for municipal residents to become involved in the Stormwater Management Program (SWMP) (USEPA, 2016a).

3. *Illicit Discharge Detection and Elimination* (IDDE) program: Requiring municipalities establish a program to detect and remove any non-stormwater discharge into a storm drain (USEPA, 2016a).

4. *Construction Site Stormwater Runoff Control*: Requiring municipalities to limit effects of erosion and ensure that sediments at a work site do not exit said site as a part of stormwater (USEPA, 2016a).

5. *Post Construction Stormwater Management*: Requiring pollutants from construction sites that get caught in stormwater are treated or new construction is on redeveloped work sites (USEPA, 2016a).

6. *Good Housekeeping and Pollution Prevention*: Requiring municipalities to decrease pollutants entering bodies of water while also maintaining a high level of water quality. (USEPA, 2016a).

2.3.4 Anticipated obstacles

With this new permit applying to a number of smaller towns, many of which have limited financial resources, there are undoubtedly budget issues. Most municipalities lack the funding to properly address the content of the MS4 permit (Botelho, Gorton, & Pai, 2013). This can make it very difficult for some municipalities to comply with the MS4 permit. Municipalities have a multitude of tasks they have to accomplish using their budget, leaving very little room to take on new expenditures. There has been a history of budget shortfalls already with the 2003 MS4 permit. Around 2010, the USEPA issued a requirement to test water at stormwater outfalls. Spencer Town Administrator Adam Gaudette noted that "[f] itting new requirements in budgets has been difficult, if not impossible," (Spencer, 2012).

In response to the issuance of the 2016 MS4 permit, as well as the complexity of the permit requirements, CMRSWC member towns believe they need to educate the municipal employees and residents on the new MS4 permit. In reference to the 2003 MS4 permit, the town of Uxbridge, Massachusetts, for example, wanted to reach out and talk to the people before holding a town meeting to pass potential stormwater bylaws. Uxbridge Director of Public Works Ben S. Sherman said, "Personally, I just think people in the town need some education about it," (Spencer, 2012).

2.4 Educating and reaching out to the community

There are many educational outreach campaigns that have been used around the country to educate residents about the impacts of stormwater runoff, many of which are in the New England area. Before delving into these campaigns, we examine the creation of campaign brands, the creation of the campaign itself and the evaluation of campaign successes. We explore campaigns that experienced success including the Reduce, Reuse and Recycle national campaign and the Pay-As-You-Throw campaign in Massachusetts. Finally, we provide an interpretation of educational campaigns, in comparison to the steps in creating an educational outreach campaign as laid out by the USEPA, that exist in the New England area.

2.4.1 Developing an educational outreach campaign

While developing an educational outreach campaign may seem like a daunting task, the USEPA has created a guide to allow for any person in any position in a local municipalities water quality staff to have the building blocks to create an educational outreach campaign. As determined by the USEPA, the outreach development process contains six steps which are: 1) Define the driving forces, goals and objectives; 2) Identify and analyze the target audience; 3)

Create the message; 4) Package the message; 5) Distribute the message; and 6) Evaluate the outreach campaign (USEPA, 2010). We discuss each of these steps in more detail below.

Define the driving forces, goals and objectives

Creating an educational campaign begins with defining the driving forces which then allows goals and objectives to be shaped. The creation of an outreach campaign is due to a need for change of a concealed problem, in this case, water quality. Specifically, in Central Massachusetts, the driving force is mainly regulatory as the USEPA has issued an MS4 permit, due to environmental concerns about stormwater pollution that requires municipalities to conduct outreach to residents on the impacts of and methods to mitigate stormwater runoff.

After identifying the driving force, the development of goals and objectives takes place. The goal of the campaign connects back to the driving force. For example, if the driving force is the loss of aquatic life in local bodies of water, the goal of the campaign would be to educate and increase community involvement in protecting and restoring the water (USEPA, 2010).

The objectives support the goals. Objectives are the small steps that let the campaign fulfill the overall goal. According to the USEPA, objectives need to be specific and focused so they can be evaluated in a timely manner (USEPA, 2010). Objectives may, of course, change as campaign development moves forward. For example, if a campaign determines the awareness of their target audience increases, efforts will shift towards inspiring action.

While determining goals and objectives of an outreach campaign, one must also determine the social and environmental indicators to allow for evaluation throughout the development of the campaign. *Social indicators* measures groups of peoples in a broad sense in aspects such as housing, education and work (United Nations, 2012). For water quality, it becomes more specific to measuring awareness, beliefs and behaviors. *Environmental indicators*

can measure the climate, land and natural disasters, or make more specific measurements of things like water quality (United Nations, 2016). If the water quality improves, it may be a result of the target audience's changing behavior. Both indicators go hand in hand to not only allow a campaign to educate, but to facilitate change.

Identify and analyze the target audience

Organizations developing an educational outreach campaign need to be cognizant of the intended audience. Some topics, such as fertilizer overuse, warrant a very specific audience, for example, landscaping services. However, rarely does an educational outreach campaign have just one audience, especially on a topic as expansive as water. While many individuals use water, they may use it for different reasons, some as simple as for taking showers, others for fishing and swimming.

With a varied target audience, it needs to be determined how the majority will buy into what is being shared. According to the USEPA, by researching demographics and current practices in a given location, the preconceived notions of the target audience will be known already (USEPA, 2010). But how does the target audience receive new information? The target audience may listen to the radio, read the newspaper or use social media. The ever popular, "Got Milk?" campaign, does not just have a Facebook account but uses magazine advertisements to discuss the importance of drinking milk (USEPA, 2010). How did the campaign determine that those would be the most effective methods for circulating the campaign? Information on how target groups receive information can be found through databases, studies, reports and public agencies. However, if reaching out to the target audience oneself, distribution and collection of surveys via mail, phone, Internet or in person can determine methods of outreach (USEPA, 2010).

An organizer must also keep in mind that the target audience may simply not be aware their behavior has an impact. These barriers, however, according to Dr. Jennie Kronenfeld of Arizona State University, may prevent the target audience from making that change (Mathieson & Kronenfeld, 2003). The barriers may be physical, economic, psychological or simply knowledge based (USEPA, 2010). By understanding the barriers the target audience faces, one can better allow for the campaign's message to be presented in a more understandable way (USEPA, 2010).

Create the message

Once determining the target audience, one can start creating the message. The message of an educational campaign is designed to raise awareness, educate or motivate action (USEPA, 2010). According to research conducted on stormwater education campaigns from the American Rivers organization, you cannot provide a message of taking action to the target audience, if they are not first aware of the problem (American Rivers, n.d.). The message should create an accessible bridge between the goal of the campaign and what the target audience already knows (American Rivers, n.d.). This message can appeal to the target audience's sense of responsibility, personal benefits, hopes, and even fears (American Rivers, n.d.).

During this step, development of the campaign's brand begins. A brand is a "trademark, name, phrase, logo or design" used for an organization or campaign (McCullough, n.d.). Brands allow the ability to create consistent and memorable content for the target audience.

According to the USEPA, a brand is important for both consistency in material but also to have the hook to spark interest in the target audience. The USEPA has determined through surveys and focus groups that a general audience is intrigued by information linked to local water sources and the direct impacts of personal polluting (USEPA, 2010).

Another important aspect of creating the message of the campaign is the creation of a logo. The logo is one image that conveys the campaign's purpose (McCullough, n.d.). The logo would appear on all materials and provides an easy way to create consistent material to not confuse the target audience members (McCullough, n.d.). While a logo cannot convey all objectives of the campaign, an accompanying slogan can help. Creation of a clean, simple logo, according to the USEPA, will allow materials to be recognized based on logo alone (USEPA, 2010).

The message should also be a call to action as the goal of a campaign is to have the target audience respond in some way. For example, "save plastic grocery bags to use to scoop the poop from your pooch" is a phrase that is easy to remember and a simple solution for the target audience that costs little (USEPA, 2010). The USEPA also recommends the utilization of incentives to increase the chance of the target audience making a change (USEPA, 2010). Incentives could be discounts to local partnering businesses or rebates for using best management practices.

Package the message

Once creation of the message is completed, the campaign can move towards packaging and delivering the message to the target audience. To reach out to a large target audience effectively, take into account the audience's size, geographic distribution, level of awareness and preferred methods of outreach, such as via websites, newspapers or public events. Messages will likely be presented in different ways as, according to the USEPA, an increased frequency of viewing the message will make it easier and more likely to be remembered (USEPA, 2010).

Formats for reaching out to the target audience available include television news coverage, newspapers, websites and events. Each of these formats have specific pros and cons however (see **Table 2**). As a television advertisement can reach a large audience, it will be

difficult to evaluate its effectiveness (USEPA, 2010). These formats have different uses as well. For example, an event can be used for awareness and recognition for the target audience but a website can be used for more public education as more information can be presented (USEPA, 2010).

Format	Pros	Cons	Uses
Television Advertisements	Can reach a large audience, provide high impact and ability to demonstrate a behavior	Easy to tune out, stiff competition for airtime, difficult to evaluate effectiveness	Events, fundraisers, building awareness, promoting simple behavior change
Brochures	Can reach large audience, can be more technical, good to use as a follow-up	Printing can be costly, audience must have the interest in reading it	Events, workshops, public education, requesting feedback
Events	Good for persuasion, more personal, offer two-way communication	Difficult to reach entire audience, could be expensive, requires publicity	Awareness, recognition, one-on-one communication, modeling behavior change
Websites	May reach large audience, typically inexpensive, easily maintained, can be updated with new information	Challenge to market, may be difficult to evaluate effectiveness, requires staff to maintain	Public education, returning visitors for updated information

Table 2: Pros, Cons and Uses of Various Methods of Outreach

These formats have different costs associated with them as well. Formats such as local events can have giveaways, such as bumper stickers and water bottles that have costs dependent on amount purchased. Determining budgets beforehand allows for ample time to create budget allotments to outreach methods.

Distribute the message

Once having determined distribution methods, the release of the materials can begin via the chosen outreach methods. According to research done by the USEPA, face to face interaction allows for a more personal approach and therefore a higher chance of information sticking with the target audience. This distribution could be door to door or at a local community event. For example, a campaign called "Seeding Sustainable Communities" in England, went to 4,000 households providing each with a Sustainable Living Bag with various best management practices (USEPA, 2010). This personal approach of visiting each house and providing a giveaway with information had a 100% success rate in the residents adopting at least one of the sustainable behaviors (USEPA, 2010).

The Internet is a powerful source for communication, with in 2008, nearly 92% of Americans have Internet access (USEPA, 2010). However, reaching the audience solely through the Internet is impossible as they will not know the website exists. According to the USEPA, printed materials and events can draw the audience to the website (USEPA, 2010). The Internet also allows the ability to create Facebook and Twitter accounts to connect directly to the target audience. For example, the Huron River Watershed Council of Ann Arbor, Michigan has an active Facebook page with photos of events in the area, followed by over 2,300 people (USEPA, 2010). At this point, goals and objectives, target audience, materials and ways of distribution have been determined. Now one can begin evaluating the success of the campaign.

2.4.2 Evaluating a successful educational outreach campaign

According to the USEPA, after developing and distributing educational material, campaigns need to be constantly reevaluated. Evaluation should not only occur at the conclusion of the program but rather throughout the duration of the program so corrections can be made

(Harrison, Cohen, Hinchey, Moerke & von Dassow, 2009). According to the USEPA, three types of evaluations exist for educational outreach campaigns: process evaluation, impact evaluation and context evaluation (USEPA, 2010). *Process evaluation* involves looking at "indicators related to the execution of the outreach program". *Impact evaluation* involves the "indicators related to achievement of goals and objectives". *Context evaluation* involves the "indicators related to how the project functions in the community as a whole" as well as the economic ramifications. These types of evaluations look at all aspects of the campaign and create a more wholehearted look at where the campaign was successful and had potential downfalls.

One successful campaign used throughout the United States is the Reduce, Reuse and Recycle campaign, created by the USEPA in the 1970s (USEPA, 2016d). This program is still in use today. The program was successful due to its curbside approach, making it simple for residents to recycle without leaving their homes. More importantly, it also has its symbol; a triangle of green arrows, that children and adults alike can easily recall (**see Figure 10**). The majority of the outreach is still given through schools; children learn about the importance of recycling, then bring the information home to discuss with their parents (Smith, 2012). The USEPA successfully reached their goal of making recycling more common, with almost 60% of American households recycling in 2011, more than twice as many who recycled in the 1970s (Smith, 2012). The USEPA created simple steps residents in the United States could do to become part of the campaign and therefore created a program that was not only memorable, but also able to target

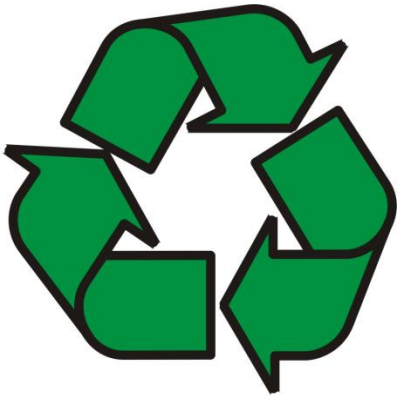


Figure 10: Symbol for the Reduce, Reuse, Recycle campaign from http://cliparts.co/recyle-symbol

its audience through numerous ways, such as information sent to children of residents and through the government itself (USEPA, 2016d).

While the Reduce, Reuse and Recycle campaign had success throughout the United States, Massachusetts municipalities took it a step further to make sure their residents increased the rate of recycling throughout the state. The main way the Commonwealth put recycling on residents' radars was through the Pay-As-You-Throw (PAYT) program, which charges residents per unit of trash disposed (Starr & Nicolson, 2015). Municipalities also offered a multitude of ways for residents to be able to recycle, such as dropping recyclables off to a facility or having them put it on their home's curb to be picked up while also allowing residents to put all recyclables into a single stream container (Starr & Nicolson, 2015). The success of this program shows as it is currently in use in 40% of the municipalities in the state (BWP, 2015). While the rate of recycling was dependent on socioeconomic, demographic as well as regional variables, the Massachusetts Department of Environmental Protection (MassDEP) recorded a 10% increase in the recycling rate from 2009 to 2012 (Starr & Nicolson, 2015). While this does involve residents having to pay a nominal fee, it was a step towards making recycling an important aspect of every resident's day, hand in hand with the Reduce, Reuse and Recycle campaign.

2.4.3 Stormwater education outreach programs in the New England area

The New England area has had its share of educational campaigns on clean water and stormwater as well. The *University of Connecticut NEMO* program, *SOAK Up The Rain New Hampshire* (NH), the Massachusetts Watershed Coalition (MWC) *Billion Gallons a Year* (BGY) and *ThinkBlue Maine* are four campaigns that our team investigated. In **Table 3** is a comparative analysis of these campaigns in respect to the steps the USEPA has determined for creating educational outreach campaigns, such as determining a project goal and methods of outreach.

The *University of Connecticut NEMO* program was created in 1991 to educate land use boards and commissions on how to protect natural resources while being able to see their municipality grow (Dietz, 2016). This program targets municipal officials and land use planners as the NEMO program believes land abuse is the primary cause of water pollution.

SOAK Up The Rain NH was designed by the New Hampshire Department of Environmental Services to tackle stormwater management. While they have a section dedicated to land use planners (landscapers), they are aimed towards educating residents (NHDES, 2016).

MWC BGY campaign was created by the Massachusetts Watershed Coalition, which was founded in 1991, to better educate residents, businesses and municipal boards on how to keep their water healthy (MWC, 2016). Their goal is to help residents and businesses alike cleanse 200-300 millions of gallons of water per year (MWC, 2016).

Lastly, *ThinkBlue Maine* is a program created by the Maine Department of Environmental Protection to provide insight on stormwater management to specifically homeowners. The program is used by 28 municipalities in Maine and provides ways for homeowners to learn and take action about stormwater runoff (MDEP, 2016).

Once completing this research, we were able to develop our own goals and objectives for our project, developing stormwater educational materials in Central Massachusetts.

Outreach Campaign	Creator of Campaign	Target Audience	Driving Forces, Goal	Modes of Distribution	Evaluation Tools
UConn NEMO	University of Connecticut Water Quality Educators	Municipal officials, land use developers	Natural resource protection.	Rain Garden app, website, Facebook, workshops	Downloads of app, analytics on website
SOAK Up The Rain NH	New Hampshire Department of Environmental Services	Landscapers	To protect and restore clean water in the state's lakes, streams, and coastal waters from the negative impacts of stormwater pollution.	Website, Facebook	Analytics on website
Billion Gallons A Year	Massachusetts Watershed Coalition	Businesses, municipalities, homeowners, communities	Healthy waters, reduce polluted runoff, cleanse one billion gallons of stormwater.	Website, Facebook, workshops, email list	Pre/post surveys of events
ThinkBlue Maine	Maine Department of Environmental Protection	Municipalities, educators, homeowners, kids	Meet permit requirements and make Maine a better place to live through mitigation of stormwater pollution.	Website, Facebook, television commercials	Report completed by USEPA

Table 3: Comparative Analysis of Stormwater Education Campaigns in New England

3.0 Methodology

The goal of our project was to assist 30 towns in Central Massachusetts in compliance with the 2016 *Municipal Separate Storm Sewer System (MS4)* permit while also educating residents on stormwater and its management. We worked in collaboration with the *Massachusetts Department of Environmental Protection (MassDEP)* and the *Central Massachusetts Regional Stormwater Coalition (CMRSWC)*. In order to achieve our goal we accomplished the following nine objectives:

- Objective 1: Understand stormwater runoff, as well as its causes and impacts in addition to the MS4 permit and its control measures.
- Objective 2: Identify potential difficulties municipalities face in complying with the MS4 permit.
- Objective 3: Identify the desired target audience and learning outcomes for a stormwater mitigation educational campaign for the Central Massachusetts area.
- Objective 4: Identify and examine the effectiveness of different methods used by various outreach and educational campaigns that could achieve the learning outcomes identified in objective three.
- Objective 5: Determine branding recommendations for a campaign for the Coalition with the guidance of the United States Environmental Protection Agency (USEPA), MassDEP and of the Coalition.
- Objective 6: Develop materials for an educational outreach campaign that achieves the findings from objectives one through four.
- Objective 7: Pilot these materials in a local school and public event.
- Objective 8: Assess the success of our materials in achieving the learning outcomes identified in objective three.
- Objective 9: Provide recommendations on future methods and materials for the educational outreach campaign to the Coalition.

Below, we elaborate on the objectives and the methods used to complete each of them.

Objective 1: Understand stormwater runoff, as well as its causes and impacts, in addition to the MS4 permit and its control measures.

Before we could create an educational campaign on stormwater runoff for Central Massachusetts, we needed an understanding of what stormwater runoff is, where it comes from, and why it is a problem. To find out more about stormwater runoff and its effects on the environment, economy, and potentially public health, we used several research methods. We analyzed the content of stormwater documents from the United States Environmental Protection Agency including: (1) "National Pollutant Discharge Elimination System" report (NPDES), 2016: discussed how stormwater runoff becomes stormwater pollution; (2) USEPA, 2008b: described the consequences of stormwater pollution; and (3) USEPA, 2012: gave examples of how the issue can directly affect people. We also analyzed independent studies about stormwater runoff and the pollutants that contribute to it, such as Gaffield, Goo, & Jackson (2003), Botelho, Gorton, & Pai (2013), and Novotny (1995). Finally, we conducted expert interviews with those involved in managing stormwater. The interviewees included Fred Civian, the Massachusetts Department of Environmental Protection's stormwater coordinator; and Ed Himlan, Executive Director of the Massachusetts Watershed Coalition (see Appendix A for Interview Questions for Fred Civian and Ed Himlan). We conducted 20 interviews in our project term, including with our project sponsors, Mike Knox, Superintendent of the Cherry Valley Sewer District and Andrea Briggs, Deputy Regional Director of the Massachusetts Department of Environmental Protection. By using the USEPA as a starting point for our research, we leveraged the research they have already done to establish clear definitions for our project. By looking at independent studies, we explored evidence about the effects of various pollutants.

Prior to beginning our research, we conducted an interview with Mike Knox, one of our project sponsors and Superintendent of the Cherry Valley Sewer District. This interview covered stormwater, the MS4 permit, compliance, and the ThinkBlue program. As a member of Cherry Valley Sewer District, Mr. Knox has had 40 years of experience dealing with many obstacles to water management. As a result, his opinions and guidance were a valuable resource for our research.

After understanding stormwater runoff, we created a table that summarized the most common stormwater pollutants, as well as the effects each can have when washed into bodies of water (see Chapter 2, Section 2.2.1, **Table 1**). The data we acquired from our various sources allowed us to populate the table. The table and our research into stormwater informed our decisions about what common pollutants to focus the educational campaign on.

Before developing the educational campaign, we had to be sure we understood the legislation surrounding stormwater, specifically the MS4 permit and its control measures. For the purposes of this project, we focused on control measures 1, 2, and 6. These control measures work well together as they all involve education. Specifically, the three control measures are: Public Education and Outreach, Public Involvement and Participation, and Good Housekeeping and Pollution Prevention (USEPA, 2016a). After we analyzed the content of the permit, we contacted Fred Civian for an interview during the first week of our project period. Mr. Civian works for MassDEP and is an expert on the MS4 permit. This expert interview provided us with a great opportunity to clarify anything we found unclear within the permit.

Objective 2: Identify potential difficulties municipalities face in complying with the MS4 permit.

Our group needed to understand the issues that municipalities could face when complying with the MS4 permit. Fortunately, on September 27th, 2016, our team had the opportunity to attend a Massachusetts Statewide Stormwater Coalition meeting in Worcester. This meeting included representatives from all stormwater coalitions in the state of Massachusetts, as well as Massachusetts Lieutenant Governor, Karyn Polito. The goals of the meeting included discussing two recent $50,000 grants, watching a video from Fuss & O'Neill about training municipal officials, and having each stormwater coalition provide updates. We sat in on this meeting and had an opportunity to introduce ourselves to the various coalition members. The meeting was particularly useful to us because it gave insight as to what the various coalition members discuss with each other about the MS4 permit.

We had a firmer understanding of potential difficulties after our interview with Fred Civian, which was discussed above in Objective 1. We asked Mr. Civian what he believes are the greatest challenges that municipalities face in complying with the MS4 permit (see Appendix A for Fred Civian Interview Questions). Once we had a firm grasp on the potential difficulties in complying with the permit, our group began researching past educational campaigns about the permit and stormwater management.

Objective 3: Identify the desired target audience and learning outcomes for a stormwater mitigation educational campaign for the Central Massachusetts area.

In order to determine what our collaborators, MassDEP and CMRSWC, wanted to emphasize in the educational outreach program, we conducted interviews with our sponsors, Andrea Briggs and Mike Knox. Following that, we conducted interviews with individuals spanning many jobs, such as marketing, permit legislation, stormwater management, and those

involved with educational campaigns. Through these interviews, we identified the most appropriate and primary target audience. Collaboratively with Mr. Knox and Ms. Briggs, we determined that residents should serve as the target audience, with elementary aged children being the immediate target and conduit to parents.

During the previously-mentioned Statewide Massachusetts Stormwater Coalition meeting, our team determined what would best help us in identifying the most appropriate areas of research. In addition, information we gathered through interviews with the Coalition members (see Appendix B for Interview Questions for Coalition Members) determined what aspects to include and avoid when creating the educational campaign for the CMRSWC and Central MA municipalities.

By examining general foci for our campaign research, such as specific aspects of stormwater runoff, we also determined appropriate learning outcomes for the desired target audience, meeting the needs of the Coalition and our sponsors. The learning outcomes are what the audience takes away from the program, whether it be small changes they can make or knowledge of stormwater runoff and its impacts. Once we achieved Objective 3, we began research on stormwater in Central MA and aspects of existing stormwater educational outreach campaigns.

Objective 4: Identify and examine the effectiveness of different methods used by various outreach and educational campaigns that could achieve the learning outcomes identified in objective three.

Next, we looked into already existing stormwater outreach campaigns, specifically ones in the New England area due to similar weather and geography. By investigating where these campaigns succeeded, our team picked the aspects to include in the educational campaign

materials for the Central MA area that would educate our target audience. Based on recommendations from our sponsors, project advisors and previous background research, we decided to focus our research on the five following campaigns: 1) SOAK Up The Rain New Hampshire (NH); 2) the University of Connecticut Nonpoint Education for Municipal Officials (NEMO); 3) Massachusetts Watershed Coalition's Billion Gallons A Year campaign; 4) the Mystic River Watershed Association's Clean Water Campaign; and 5) the Fishable/Swimmable Campaign from the Blackstone River Coalition. To determine the effectiveness of these outreach and educational campaigns, we sought interviews with those who were involved with these programs and conducted exploratory interviews with campaign directors, such as Ed Himlan from the Massachusetts Watershed Coalition with 25 years of experience and creators of campaigns, such as Michael Dietz, co-creator of UConn NEMO which began in 1991, among others. Our questions primarily concerned aspects of the programs such as the intended target audience, budgets and social media use (see Appendix C for Interview Questions for Education Outreach Members). We learned how the programs were created, how many people were reached, and what materials they used or provided. We then compared and contrasted the programs, picking and choosing the best aspects for use in an educational outreach campaign and its materials for the Central MA area.

In addition to these interviews, we utilized the USEPA's report entitled "Getting in Step: A Guide for Conducting Watershed Outreach Campaigns". This report provided us with the guidance of the steps that must take place in creating an educational outreach campaign, such as determining target audiences and outreach methods (USEPA, 2010).

Once we had a better grasp on existing stormwater educational campaigns in New England while also determining our overall target audience and learning objectives from

previous objectives, we began working towards a brand for an educational campaign for the CMRSWC.

Objective 5: Determine branding recommendations for a campaign for the Coalition with the guidance of the USEPA, MassDEP and of the Coalition.

Once we finished our more research-geared objectives, we looked into materials on branding for nonprofit educational campaigns. In order to make an effective campaign, we researched how to develop a brand that our target audience could see, such as a logo, and immediately think of our campaign. Much of our brand development research revolved around our interviews with approximately ten individuals, who are involved with the development of educational campaigns and marketing.

After talking with these educational campaign creators and marketers, we deliberated on possible campaign brand names, logos, and slogans for our campaign. We needed the brand to be relevant, simple, and engaging (USEPA, 2010). We created various examples of logos for the brand, potential slogans with alliteration and/or rhymes, and conceivable titles. We discussed which combinations of logos and campaign brand names might work best together. We then chose four combinations that worked well, put them into a survey (see Appendix D for Survey of Branding for Educational Campaign), and asked our respondents to rate each combination on a scale of one, their least favorite, to ten, their most favorite. The survey enquired which slogan would fit each with combination. Lastly, we asked if they had any tweaks they would like to see in the logo, and what they did or did not like about the combinations. This survey was created to take at most 10 minutes, with no questions being required. With the survey having checkboxes, there was no need for a respondent to do free response. Fred Civian and Andrea Briggs of MassDEP, distributed the survey electronically to employees of MassDEP as well as members of

the CMRSWC. Ed Himlan, Executive Director of the Massachusetts Watershed Coalition, allowed us to distribute the survey at a town stormwater meeting in Gardner, MA on November 18, 2016. This distribution helped us gain a wide array of responses from members of the CMRSWC to consultants for municipalities throughout Central MA. Using the feedback from 48 responses, we determined the most highly rated options from among the survey responses to recommend a brand the CMRSWC can use in the campaign.

We also conducted another survey; the Public Survey was conducted at a holiday craft fair, stART at the Station at Union Station in Worcester, MA. This survey asked the public to rank logos for a stormwater educational campaign from 1-5, one being their most favorite, and 5 being their least favorite; they were then asked to tell us why they chose their favorite and least favorite. We gave attendees a demonstration of how stormwater pollutes using an Enviroscape, and explained what a stormwater education campaign was. We then asked them to fill out our brief survey before they entered the fair. The information provided to them before the survey came from our local event toolkit which we tested concurrently.

Objective 6: Determine and develop materials for an educational outreach campaign that achieves the findings from objectives one through four.

Once we achieved objectives one through five, we used the findings to determine the best ways to reach out to the target audience. Our team brainstormed numerous materials for two toolkits for use at (1) local events and (2) elementary/middle schools. We later asked all of our interviewees about any potential materials that would be useful to either draw the attention or help educate our target audience. Interviews with members from Mass Audubon in Worcester, MA, and with a member of the Blackstone River Coalition informed our decision on what types of educational materials, fact sheets, and lesson plans to use for various age groups. We searched online and found a variety of activities, fact sheets, and lesson plans from other water-related

organizations and campaigns. From these, we picked activities and materials to use for the toolkit, since the materials were free for reuse and modification.

Objective 7: Pilot these materials in a local school and public event.

Once we developed a prototype of the toolkits we piloted them at the Boys and Girls Club of Worcester, MA, the stART at the Station crafts fair at Union Station in Worcester, MA and Leicester Memorial School in Leicester, MA.

To test the school toolkit, we reached out to several different elementary schools in the Coalition's towns in hope that we could arrange a time to go to a classroom to present the materials and evaluate educational activities. We first tested the school toolkit at the Worcester Boys and Girls Club on November 28, 2016. We ran it with a group of five, eight to eleven year old children. We ran through the curriculum which included an introduction about the uses of water, a pollution spot-the-difference activity, a paper watershed activity, a quiz, and a "make your own anti-pollution sign" activity (see Appendix E for In-Class Activity Plans for Educators).

On December 2, 2016, we went to Leicester Memorial School to test the toolkit. We tried out some of the activities, gave out stickers, and sent out backpack mail for parents, to ensure the information was going home to parents as well as their children.

To test out the local event toolkit, we attended and had a table at stART at the Station at Worcester's Union Station on December 4, 2016, where we handed out pamphlets and environmentally-friendly alternatives to common products to spread the message of what stormwater is, why stormwater runoff is important, and what people can do about it. After experiencing our booth, we asked attendees to fill out a short survey as well (see Appendix F for Logo Survey for Local Event Attendees).

Objective 8: Assess the success of our materials in achieving the learning outcomes identified in objective three.

After piloting the materials at local schools and events in the Central Massachusetts area, we determined the material's successes, shortcomings, and possible future applications. We determined the success of these campaigns by attending a meeting with the CMRSWC members to evaluate their approval.

For the aspects of the school toolkit geared towards elementary level students, we evaluated the success based on the amount of enjoyment and engagement the students had during the hour long lesson. When students remain interested in the specific activity that means they are engaged in the material, and therefore are more likely to talk about it at home with their parents (USEPA, 2016d).

Once we completed the analyses of surveys and engagement levels, we could provide recommendations to the CMRSWC on how to continue the educational outreach campaign.

Objective 9: Provide recommendations on future methods and materials for the educational outreach campaign to the Coalition.

Once all was completed, we compiled our findings and we discuss the results in the final chapters of this report. The report was provided to the CMRSWC and MassDEP for them to determine the next feasible and appropriate steps in the educational campaign process.

4.0 Toolkits for Schools and Local Events

For our project, we created toolkits for use in schools or at local community events. We began the toolkits as a recommendation from our sponsors, Mike Knox and Andrea Briggs, but confirmed them after interviews with Brad Stone and Jeff Howland, Shrewsbury town engineers; Fred Civian, MassDEP Stormwater Coordinator; and Peter Coffin, Coordinator of the Blackstone River Coalition.

As children are one of the most effective target audiences (see **finding 4**), we decided to create a toolkit for schools and through our interviews. As we learned, stormwater education for children is powerful because students will go home and share what they learned to their parents. In the United States Environmental Protection Agency (USEPA) watershed campaign guide, it describes tabling at local events, an easy way to reach out to residents with easy set up so we took that route as well. We developed our ideas for the materials contained in these toolkits through research and collaboration with our professors and sponsors in sponsor meetings. The research for the school toolkit was concentrated towards activities that our team felt children would understand and enjoy.

These toolkits are intended to be a starting point for the Central Massachusetts Regional Stormwater Coalition (CMRSWC) in educating residents in the Central Massachusetts (MA) area. Below we explain the contents of the toolkits, its future uses, and recommendations.

4.1 School Toolkit

Our team first piloted the school toolkit at the Boys and Girls Club in Worcester, MA, on November 28th, 2016. The contents of the kit are geared towards third to fifth graders and included a packet of activities (see Appendix E for In-Class Activity Plans for Educators) that

can be used by teachers and afterschool leaders. The activity packet includes some discussion pieces, such as what pollutants are on the ground, but mainly includes hands-on activities that will keep the students engaged, while allowing them to understand stormwater runoff. Stefanie Covino, Project Coordinator of Shaping the Future at Mass Audubon, explained that hands-on activities are very effective in helping children learn. Along with these activities, there are pictures of trash in a pond and a storm drain, which act as visuals that children can relate to. This was an idea that Mike Knox, one of our project sponsors, recommended. In addition, the toolkit contains an activity book students get to take home, with more independent activities such as a word search and information on what they can do at home to help mitigate stormwater runoff and pollution. The hope for this take-home activity book is that parents look at the materials with their child, become interested, and want to learn more (see Appendix E, G and H for the components of the school toolkit).

Once we piloted our materials at the Boys and Girls Club, we determined that the majority of the materials were very useful. The children (aged 8 to 11) were very engaged during the "Find all the Pollutants" activity and the "Water Shed" activity. However, the matching quiz that we gave the children was too difficult for them, mainly because it included terms such as fertilizer, pesticide, and hazardous waste, some of which they were not familiar with. The last activity, entitled "Stormwater Sign", we found that the kids enjoyed. As we asked each kid's favorite activity, "Stormwater Sign" was the most popular, and the crumpled watershed second most popular. **Figure 11** is an image at the end of our lesson at the Boys and Girls Club. When the lesson was completed, we passed out stickers and an activity

Figure 11: Our team with students at the Boys and Girls Club.

book that could be completed at home. While we could not determine the effectiveness of the Stormwater Activity Book, the children were excited when we mentioned the individual activities inside the book, such as the maze and word search. The children also enjoyed the Stormwater Chaser stickers (see Appendix I for Stormwater Chasers Sticker Template). Our group's biggest takeaway was that the quiz was not necessary because we could verbally question the kids' knowledge, which is more engaging than a quiz.

On December 2nd, 2016, we piloted the school toolkit for a second time, at Leicester Memorial School, an elementary school in Leicester, Massachusetts. Our team taught two different fourth grade classrooms of approximately 23 kids each. Each lesson plan was designed to last an hour. We followed the same format as at the Boys and Girls Club, except we did not include the matching quiz. Along with the Stormwater Chasers Activity Book, we gave each student backpack mail (see Appendix G for the Stormwater Chasers Activity Book and Appendix H for Backpack Mail for Parents). The backpack mail was created in order to have the information directly reach their parents, so that both the parents and children would learn about stormwater runoff and potential solutions that could be made near one's home.

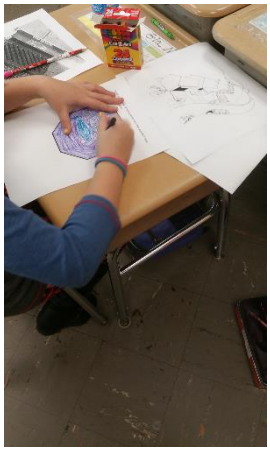


Figure 12: Student at Leicester Memorial School creating their stormwater sign.

Once we piloted the materials at Leicester Memorial School, we were confident that the materials were successful in educating 3rd and 4th graders about stormwater runoff and stormwater pollution. Like the children from the Boys and Girls Club, the students enjoyed the "Stormwater Sign" activity. **Figure 12** shows a student making a sign. When asking the class what they learned at the end of the hour, 100% of the approximately 46 students were able to

remember the most significant learning objectives, such as that dumping waste down storm drains is bad and that it can hurt the environment as well as wildlife.

4.2 Local Event Toolkit

We then piloted the local event toolkit at the stART at the Station crafts fair at Union Station in Worcester, MA on December 4th, 2016. This toolkit included Massachusetts Department of Environmental Protection and Worcester Polytechnic Institute banners for temporary use, pamphlets (see Appendix J for Local Event Pamphlet) with information on stormwater runoff mitigation, and free samples of biodegradable car wash soap from Green Earth Technologies. We also used an Enviroscape provided by Andrea Briggs of MassDEP to grab attention and demonstrate visually how stormwater runoff can lead to pollution. **Figure 13** shows our table at stART at the Station. For this event, we also used it as an opportunity to survey the public on logos for the statewide campaign.

Figure 13: Our team's booth at stART at the Station.

Once we piloted the materials at the stART at the Station event, we determined that the banner and the Enviroscape caught the eyes of adults and children alike. Additionally, the Enviroscape served as a good conversation starter and an apparent demonstration of stormwater pollution. **Figure 14** Enviroscape in use. The pamphlet was a well-received follow-up to the demonstration, allowing people to quickly become informed on the subject. Finally, the soap was

an action-oriented item that allowed individuals to immediately become engaged with stormwater pollution solutions. The one downside to the Enviroscape was that it was difficult to clean after each demonstration

Figure 14: Representation of the Enviroscape in use.

Even with all the tools and materials provided in the toolkit, there are more materials which can be added. Once the branding is established, a banner for the campaign can be designed to be hung at local events. From there, displays can also be designed with all sorts of information relevant to the campaign. At those local events, pamphlets can be printed and handed out. All sorts of handouts can be designed and purchased. To get people interested, the local event toolkit, or even the school toolkit, could include things like pens, bracelets, stickers, temporary tattoos, and decals to be given away. For possible price estimates, see **Table 4**.

Item	Seller	Quantity per order	Estimated Price
Banner, 8’ x 8’ with stand	Stickerbanners.net	1	$199
Banner, 2.5’ x 6’ for table	vistaprint.com	1	$42
Stickers	Avery.com	90	$16.49
Temporary tattoos	temporarytattoos.com	100	$52.42
Wristbands, printed, ½”	rapidwristbands.com	50	$55
Magnets	cmagnets.com	250	$95

Table 4: Cost Estimates of Giveaway Items for Local Events

Based on our findings, we have a list of what we recommend the CMRSWC put in each toolkit:

School toolkit:

- Stormwater Chasers stickers
- In-class activity book that includes activities:
    - Water Uses intro Activity
    - Find all the Pollutants
    - Water Shed
    - Stormwater Sign
- Relevant pictures (storm drain, trash in pond, etc)
- Backpack mail (or survey) to be given to parents
- Stormwater Activity book (take-home)
- Copy of Stormwater Chasers video (for use in the classroom to sum up stormwater information)

Local Event toolkit:

- Banner for table and/or behind table
- Pamphlets
- Enviroscape or similar display that can draw people's attention
- Biodegradable car wash soap samples, or other sample to give to attendee (**Table 4.1**)

It is worth noting that with all four members of our team helping move the lessons along and teaching important concepts, the lesson plans were completed in exactly one hour. So we recommend a single teacher may want to seek volunteers, or allocate more time to the activities. Next, we look what we can take away from our previous methods and from the pilot.

5.0 Findings

With the completion of our goals, objectives and piloting of educational materials, we were able to develop findings for the Massachusetts Department of Environmental Protection (MassDEP) and Central Massachusetts Regional Stormwater Coalition (CMRSWC). In this chapter, we discuss the results of our research for MassDEP and CMRSWC on creating a unifying stormwater education campaign for Central Massachusetts, and the outreach methods such a campaign may employ. Our research reveals several ways to begin complying with control measures 1, 2 and 6 of the MS4 permit. The research focused on educational materials for residents, and serves as a starting point for towns as they work to complete the requirements.

Finding 1: Municipal officials' concerns about the 2016 MS4 permit change over time.

Municipalities are apprehensive about the new 2016 MS4 permit. Speaking with municipal officials such as Adam Gaudette, Town Administrator for Spencer, MA; Brad Stone and Jeff Howland, engineers with Shrewsbury, MA; and Mike Knox, Superintendent of the Cherry Valley Sewer District in Leicester, MA brought this idea to our attention.

Mr. Stone and Mr. Howland said that, from the engineer's perspective, it's about getting the support at town hall meetings for a project that will inevitably cost money, meaning they have to show the future cost savings of completing the 2016 MS4 permit compared to the cost of not complying. While both Mr. Stone and Mr. Howland have won council support for a stormwater utility (a small fee imposed on members of the town towards stormwater management), their concern now is on how to implement it. Should the fee be based on land ownership, on income, or a flat fee? Should it be applied to residents, small businesses, land developers, or construction projects? Once the town has made the aforementioned decisions, the

challenge will be how to distribute the stormwater budget across the various requirements of the MS4 permit. They shared these insights into a few of the problems that they will have to overcome in the future, but added that no matter when you ask, the focus will always be on the problem immediately before the town, rather than looking forward. (J. Howland and B. Stone, Personal Communications, October 28, 2016)

Mr. Gaudette gave a different view, telling us that as an administrator of a small town, he already has a lot to juggle and the requirements of the permit, such as reports, are more things that can be easily forgotten or overlooked. Keeping up with the changing provisions will create additional challenges (A. Gaudette, Personal Communications, October 26, 2016).

According to Robert Cox, lawyer on the appeal process against the USEPA and 2016 MS4 permit, the permit is asking a lot of towns, especially ones lacking the necessary resources and staff (R. Cox, Personal Communications, October 27, 2016). Mike Knox informed us of the fines associated with failing to comply with the permit; sharing Leicester as an example, Mr. Knox explained that the town was fined $16,000 in 2012 for not completing an annual stormwater report (M. Knox, Personal Communications, September 16, 2016).

Fred Civian, Stormwater Coordinator for the MassDEP, added another layer of depth to the worries expressed above. The permit has stages that are to be completed in the six years after it goes into effect July 1st, 2017. Mr. Civian pointed out that while the concerns right now are almost strictly related to town budgets and lack of funding for compliance of the new permit, six months from the start of the permit, municipal officials will have to be concerned with getting the resources and staff together to fill out a form of intent to be sent to the U.S. EPA. Mr. Civian explained that a year from now, town concerns switch gears to the mapping and reporting of illicit discharges within the town. Five years from now, the concerns will be completely different

as the municipalities are checking the boxes of requirements of the permit. Yet at each stage, a given municipality is only looking at addressing the immediate concern; they may miss the opportunity to prepare for future concerns (F. Civian, Personal Communications, October 27, 2016).

Finding 2: There are many stormwater education resources already available, but it is hard to determine which are effective.

Many of our interviewees throughout the project were involved with stormwater education and outreach, such as Ed Himlan, Director of the Massachusetts Watershed Coalition; Patty Gambarini, Principal Environmental Planner at the Pioneer Valley Planning Commission; Beth MacBlane, Outreach and Communications Director of the Mystic River Watershed Association. All of these individuals, spanning every corner of New England, would recommend stormwater outreach campaigns to look into. (See **Table 5** for more interviewees and resources they pointed us towards).

Name	Position and Organization	What Resources They Recommended
Ed Himlan	Executive Director, Massachusetts Watershed Coalition	• UConn NEMO • USEPA Soak Up the Rain • Metropolitan Area Planning Council • Pioneer Valley Planning Commission

Patty Gambarini	Outreach and Communications Director of the Mystic River Watershed Association	• Connecticut River ThinkBlue • Connecticut River Stormwater Committee
Peter Coffin	Coordinator of the Blackstone River Coalition	• Massachusetts Watershed Coalition • Blackstone Headwaters Coalition • Mass Audubon science standard sheets for MA • A Raindrop's Journey by Suzanne Slade
Michael Dietz	Program Director of University of Connecticut NEMO	• UCONN NEMO's Rain Garden app • Charles River Watershed Association • Minnesota NEMO • ThinkBlue Maine • Rhode Island NEMO • USEPA Soak Up the Rain
Jennifer Pederson	Executive Director of MA Water Works Association	• MA Waterworks • Value of Water Campaign • Boston Water and Sewer Commission
Barbara McMillen	Watershed Outreach Coordinator, New Hampshire Department of Environmental Services	• USEPA • interactive tools
Christina Chappell	Manager of Education at the EcoTarium	• Ecophobia by David Sobel
Stefanie Covino	Project Coordinator, Shaping the Future at Mass Audubon	• Blackstone River Coalition • Mass Audubon • USEPA, *Catch It If You Can*
Beth MacBlane	Outreach and Communications Director, Mystic River Watershed Association	• ThinkBlue Maine • Soak Up the Rain New Hampshire

Table 5: Interviewees and Resources They Recommended

With so many campaigns to turn to, we started to wonder why there was a dearth in public knowledge towards stormwater runoff and its regulations. During our time at stART at the Station, the annual holiday craft fair held at Worcester's Union Station, we asked visitors questions like "What is stormwater runoff?", "Why is stormwater runoff a problem?", "Do you know where storm drains lead?" The, at most, four individuals able to answer correctly had either worked in a related field, or were science educators themselves.

We began to investigate the resources that these campaigns provided, because if there was not enough good materials to educate residents, the number of campaigns would not matter. We learned very early that there are already vast amounts of stormwater education resources available. An internet search reveals many websites, pamphlets, lesson plans, and templates already created and tested. Other materials were found on the USEPA website or through watershed organization websites. Additionally, our interviews uncovered even more well-made resources that are not digitized, like Peter Coffin's Common-Core compliant stormwater education materials (see Appendix K for originally non-digitized materials). The next mystery was "what could connect the lack of understanding to the abundance of materials?"

While there is an abundance of material available, according to our research, most municipal employees do not have the time to search the Internet to locate those which that are relevant and useful to them (A Gaudette, Personal Communications, October 26, 2016).

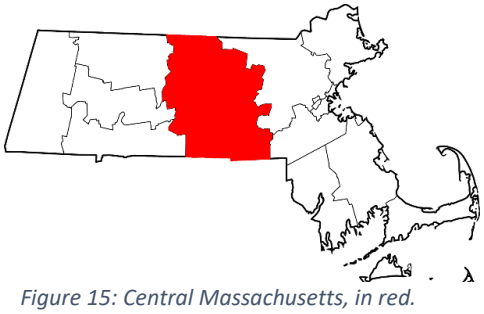


Figure 15: Central Massachusetts, in red. http://www.scan-ne.net/forums/forumdisplay.php?31-Central-Massachusetts

Finding 3: Different age ranges of residents require different methods of outreach.

The first, second, and sixth control measures of the 2016 MS4 permit are education-based. Specifically, these require public education and outreach, public

involvement, and good housekeeping and pollution prevention, respectively. An important aspect of these control measures is understanding the target audience of Central Massachusetts, or Worcester County. Below, in **Figure 15**, is a map showing the location of Worcester County in Massachusetts.

The age demographics in Worcester County are fairly spread out. According to the 2015 United States Census Bureau, more than a quarter of all 818,963 Worcester residents, 25.8% to be exact, are between the ages of 30 and 49, a common age range for parenthood. This is the largest age demographic in Worcester County. The next largest age group is ages 50 to 64, the late parenthood to early grand-parenthood ages. In Worcester County, this group makes up 21.7% of the population. The next group is minors, ages 18 and under. They make up 21.4% of the population. The second smallest group is young adults age 18 to 29. Much of this demographic likely includes college students, at 16.7% of the population. Lastly, the elderly, ages 65 and up, make up the smallest group. They make up the remaining 14.4% of the population (US Census Bureau, 2015). Above, in **Figure 16**, is a pie chart of the data.

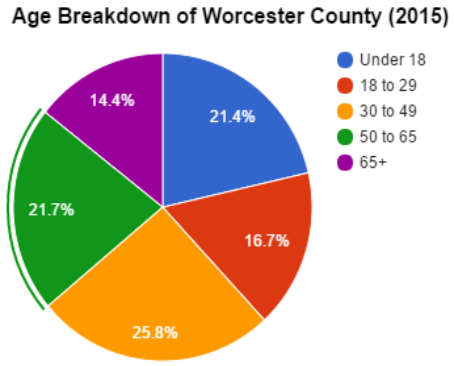


Figure 16: Pie graph depicting age breakdown of Worcester County in 2015.

The demographics may be varied, but geographically, the age groups often cluster in specific certain municipalities within Worcester County. According to Adam Gaudette, Town Administrator for the town of Spencer, MA, Spencer, has a lot of retirees and young parents. “It is not a town in which people stay.” This could be very different in other towns, such as Shrewsbury or Leicester, MA. Reaching out to all these demographics would be very difficult

using only one medium. Our interviews with Mr. Gaudette and Christina Andreoli, Vice President of the Worcester Regional Chamber of Commerce, helped us realize that we cannot just make a website or a Facebook page, expecting everyone in Central MA will see it. As Mr. Gaudette stated, much of Spencer is an older population, so much of the information they wish to spread to its residents are made available through the evening newspapers, cable access commercials, or mail (A. Gaudette, Personal Communications, October 26, 2016). However, Ms. Andreoli explains that as the President of the Discover Central Massachusetts tourist campaign, she mainly uses social media as they are targeting a broader audience of people that are 50+ miles outside of Worcester (C. Andreoli, Personal Communications, October 25, 2016).

Table 6 : News Medium Vs. Popularity Among Age Range

	Age				
Medium	18-29	30-49	50-64	65+	**Average**
TV	27%	45%	72%	85%	57%
Online	50%	49%	29%	20%	37%
Radio	14%	27%	29%	24%	24%
Newspaper	5%	10%	23%	48%	22%

(Mitchell et al, 2016)

Through our research, we have found that the best way to reach different audiences changes by age group. As seen in **Table 6**, the most common method for people up to age 49 to get news is through the internet, whether this be through social media, news sites, or other websites. In fact, nearly twice as many people get news through the internet than through print sources. The popularity of print sources decreased by 27% between 2013 and 2016. According to Mitchell et al, the only age group that still prefers print is the 65 and over group (Mitchell et al, 2016).

Despite the massive increase in people using the internet for news, television is still the main news source for most people. Ages 18 to 29 still prefer online sources, and television is tied with the internet for ages 30-49, but for both the 50 to 64 group and the 65 and over group, television is by far the most used news source. Overall, 57% of adults use television to get news. However, as people move through the age groups, the number of people using television or print will decline. The more tech-savvy generations will take their place, meaning television and paper media will become less prominent in the world of outreach (Mitchell et al, 2016).

Finding 4: Best way to reach target audience of residents is through their kids.

One of the requirements of the MS4 permit is public outreach and education. Through our research, we have determined that the best way to make people care is to make their children care. As a result, children are the target audience for part of the campaign. A large part of the Reduce, Reuse and Recycle campaign was teaching elementary school children about recycling in classrooms, which meant that the ideas about the importance of recycling went home with the kids to their parents. The ideas also grew up with the kids, so years later the kids-now-adults, had a more environmental mindset (J. Howland and B. Stone, Personal Communications, October 28, 2016).

In hopes of a similar result, we went to the Boys and Girls Club in Worcester and to two fourth-grade classrooms at Leicester Memorial School to try our toolkit. Not only were we able to keep the children engaged with the activities, but we were also able to teach them about stormwater and how it can contribute to water pollution. We made the students care about water quality. We showed them polluted water bodies and asked if they would want to fish and swim in those bodies. They answered with disgust and then were very eager to learn how it happens and

what they can do. After the classes in Leicester, we sent them home with an activity book and information for their parents, just as schools send home forms for parents. This is one of the best ways to be sure their parents, the residents and homeowners of Leicester, can see the information (USEPA, 2010).

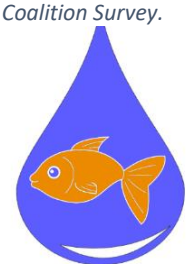
Finding 5: The results of the branding research informs which logo to use.

We examined various educational campaign resources, primarily looking at the USEPA's guide on creating an educational campaign. This served to inform our initial ideas on branding, which were further refined through interviews with Christina Andreoli from the Worcester Chamber of Commerce and Anne Leiby, and Cindy Brown of the USEPA. Ms. Andreoli informed us about reaching out to large groups, and also what moods messages can take (C. Andreoli, Personal Communications, October 25, 2016). Anne Leiby and Cindy Brown explained that creating a new brand may further disperse effort, and that the title of a campaign should convey action. We informed them of our ideas for a survey which we ran among Coalition members for recommending a title, logo, and motto. They advised that we conduct a survey, which includes the Soak Up the Rain logo as an option, since the Soak Up the Rain campaign was meant to be taken from the USEPA and adapted by towns (C. Brown, A. Leiby, Personal Communications, November 14, 2016). Consequently, we developed surveys to seek public and Coalition member opinions of various logos, including the Soak Up the Rain logo (right most logo in **Figure 17**). We ended up conducting two surveys (see Appendix D and F for both the Coalition Survey and Public Survey). The first survey was conducted among CMRSWC members (Coalition Survey). The second survey was conducted at a holiday craft fair, stART at the Station at Union Station in Worcester, MA (Public Survey).

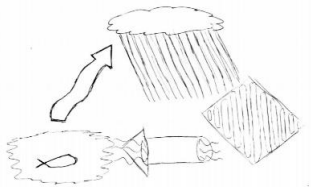
Figure 17: Logos for Coalition Survey.

Soak Up The Rain

ThinkBlue



Go With The Flow



Down The Storm Drain

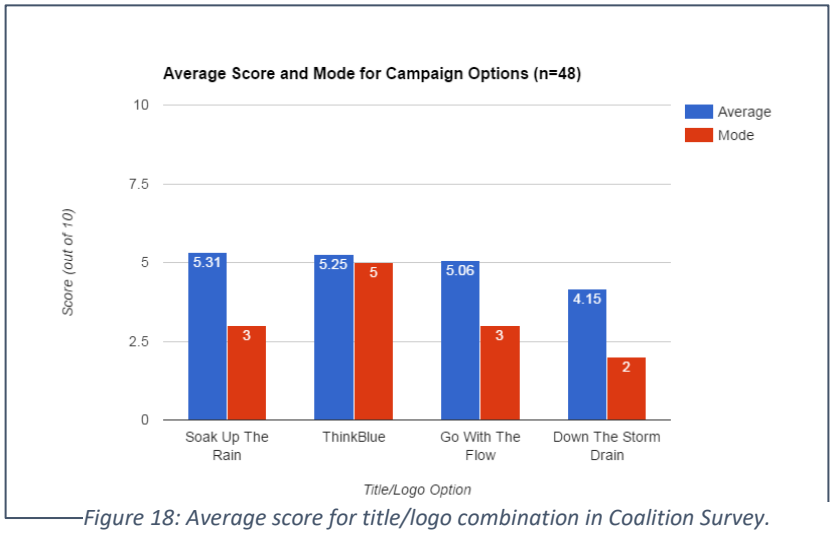
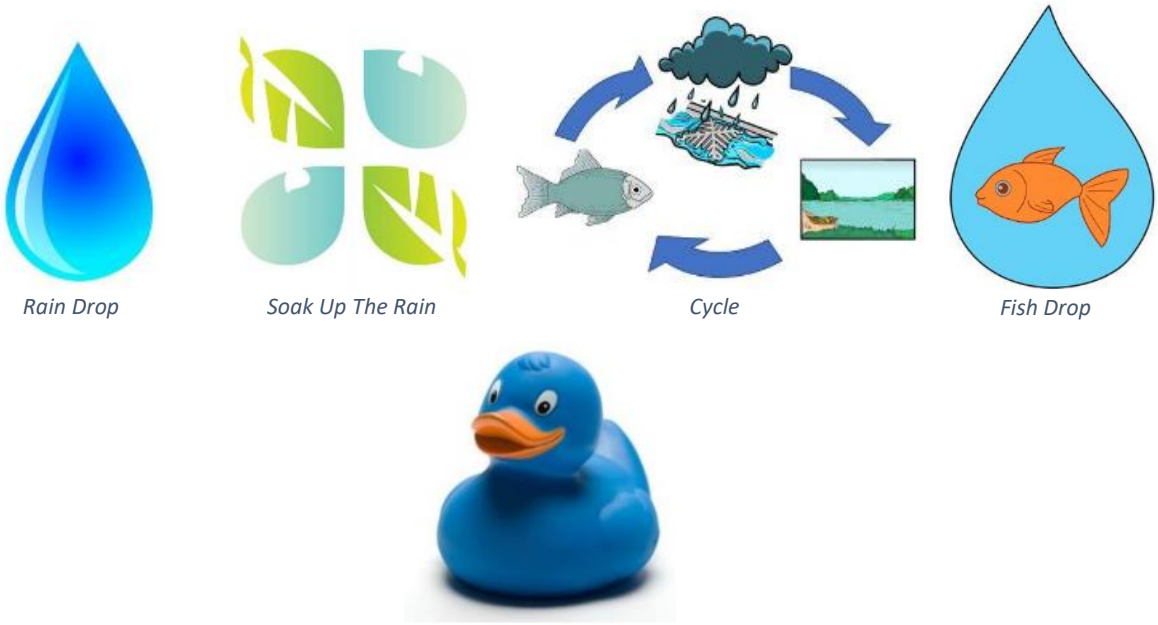


Figure 18: Average score for title/logo combination in Coalition Survey.

The Coalition Survey had 48 respondents, which included coalition members, municipal officials, and environmental consultants. In these graphs, the mean is the average score of the ratings, and the mode represents the mostly frequently picked rating. **Figure 17** shows the options; **Figure 18** shows the average score for each option out of 10 (since they were rating each 1-10), and the mode for each option. Soak Up the Rain, the USEPA's title and logo received the highest average score, but a mode score of 3. This can be interpreted as meaning the option was rather polarizing; option 1 received a few scores of 10, but many scores of 3. By contrast, option 2: ThinkBlue, received a mean and mode score of about 5. This means that the general attitude towards the option was lukewarm, since most people chose 5 as their rating, and the scores averaged to 5. Option 3: Go With the Flow was similar to option 1, in that it was polarizing with a mode score of 3, but its average rating was slightly lower. Finally option 4: Down the Drain,

was the lowest rated combination, both in mean and mode score. From this data we are not able to provide a recommendation for the best combination. The differences between the first and second best are too close, and with an average score hovering around 5 out of 10, both such options received a lukewarm response. We can conclude however that the Coalition members and municipal officials disliked option 4: Down the Storm Drain, and so we do not recommend using it. One shortcoming of this survey was that the Cycle logo was hand drawn, so responses included that it looked unfinished, which may have affected the responses.

Figure 19: Logo options for Public Survey.



Rain Drop *Soak Up The Rain* *Cycle* *Fish Drop*

Duck

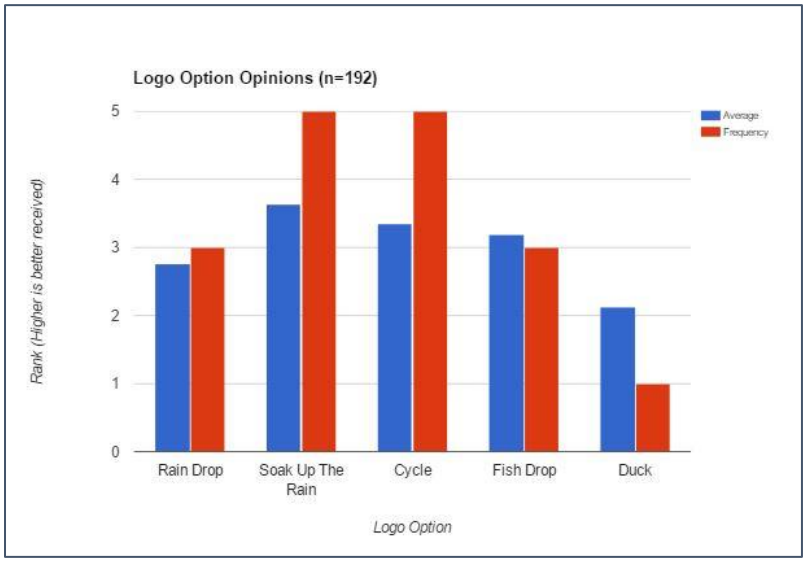


Figure 20: Logo Score for each option (inverted from data)

The Public Survey had 192 responses from shoppers at "stART at the Station". Among the respondents, we had 2 science teachers, a civil engineer, and a land developer who all knew about the problems caused by stormwater. The majority, however, had little to no knowledge about stormwater runoff pollution. We do not have exact numbers on how many we asked about their knowledge of stormwater, however it was likely at least half of all respondents as those questions were also openers to attract attention.

Each person who took the survey had to rank the five logos on the survey, 1 being their favorite, 5 being their least favorite. **Figure 19** shows the five logos that were used in the survey and **Figure 20** shows the data from the public survey. We inverted the data to put on the graph for the sake of readability. To invert the data, we simply took the rankings and subtracted them from six, so a one became a five, two became four, etc. This was done so the graph would follow the convention of higher being better that most graphs follow.

Option 1: the Rain Drop, ranked slightly below 3, with a mode of 3. From this we can conclude it was not a controversial logo, because the mode and median was very close. Option 2: Soak Up the Rain, had the highest average score at 2.5; however; its mode shows as being 5, meaning most respondents chose the option as their favorite choice. Option 3: Cycle, was similar in that a lot of people chose it as their favorite, but its average score was slightly lower. This makes both of these options rather polarizing. Option 4: Fish drop, had a middling average score, just above 3, and an uncontroversial mode of 3. Finally Option 5: The Duck, was controversial, as it had the lowest average score, and also the lowest mode score.

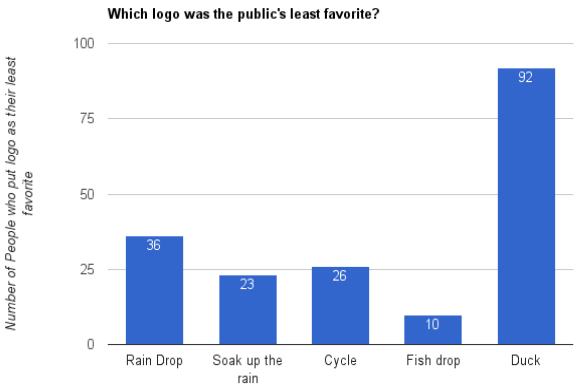


Figure 21: Number of favorites per logo.

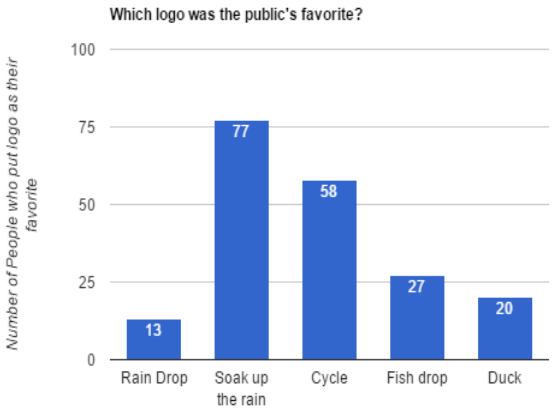


Figure 22: Number of least favorites per logo.

For making a recommendation, it may be more helpful to look at the most and least liked options. **Figure 21** shows how many times each logo was chosen as a respondent's favorite, therefore it shows the most popular logo among the sample. **Figure 22** shows how many times each logo was chosen as a respondent's least favorite, therefore it shows the least popular logo among the sample. These two graphs accentuate some of the trends noted in **Figure 20. Figure 21** widens the difference between the first and second most popular logos, with Option 2: Soak Up the Rain being the favorite logo of 40% of those surveyed, and option 3: Water Cycle being the favorite of 30% of respondents. **Figure 22** shows the least favorite. Option 5: the Duck was

the least liked, with 48% of those surveyed choosing it as their least favorite option. We therefore recommend **that a new stormwater campaign should use the Soak Up the Rain logo**, and should avoid using the duck logo. Having looked at all the findings, in the next section we will examine the recommendations in further depth and the conclusions we can draw.

6.0 Recommendations and Conclusion

Through our findings we were able to synthesize recommendations for the Central Massachusetts Regional Stormwater Coalition (CMRSWC) and Massachusetts Department of Environmental Protection (MassDEP). Below we list out and explain each recommendation, along with justification for each based on our findings.

Recommendation 1: Share resources outside of coalition and bring in new materials.

In **finding 2**, we found that the existence of well-made resources does not guarantee their use. The most important part of making sure resources and materials get noticed is connecting the information seeker with the correct material. This means centralizing it, and allowing searching or sorting by keyword, subject matter, or target audience. This also means digitizing resources that exist in paper form, such as Peter Coffin's Common Core compliant stormwater education materials. It also includes generalizing resources made for a specific area, like the Massachusetts Audubon's "When It Rains" pamphlets.

We recommend the CMRSWC prioritize the idea of sharing and collecting more resources. However, we recommend the Coalition only house resources of immediate utility to Coalition members. Each resource should be evaluated on its usefulness and whether another resource already covers the information. A central location should have the resources and where they can be found, along with a small blurb about what is contained within and who would find it useful. The "who" section would contain such information as target audience (kids, homeowners, construction, municipal officials) and venue (classroom, fair with booths, mailboxes, etc.), as well as information on which control measures the materials help address.

The CMRSWC already has the beginnings of an easy to search source of materials; its website contains sections along its navigation bar for educators and kids, with resources for each. This is a good start to organizing the information. In contrast, along the same bar is a section titled “Toolkit”, which contains more resources in its drop-down listed only by name such as “SWPPP Template”. Contrary to the first example, this drop-down provides no information on who may find those resources helpful. Reorganizing the toolkit drop-down into categories like municipalities, educators, homeowners, business owners, coalition members, etc. may help alleviate this problem. The CMRSWC has done well creating adaptable resources for municipalities, such as their Operation and Maintenance Plan template, which has easy step-by-step instructions which can be followed to complete the form. The template goes as far as to include areas for the town logo to be placed. Once the resources become easy to locate and adapt, then the success of several coalition towns will hopefully spur more to follow. For this reason, we recommend the CMRSWC to prioritize the idea of sharing their resources and centralizing them.

Recommendation 2: Utilize the “Getting in Step: A Guide for Conducting Watershed Outreach Campaigns”, created by the USEPA.

We synthesized much of the background section of our report with the help of a guide entitled, “Getting in Step: A Guide for Conducting Watershed Outreach Campaigns”, created by the USEPA. This document compiles previous reports, surveys and information to provide municipal employees with the tools to best create an educational outreach campaign.

This document was a useful tool for our team as we began creating materials for the school and local event toolkits, and creating a recommendation for the brand of the campaign. The guide provides sheets to fill out to make sure all is taken into account while creating an

educational campaign such as determining the overall goal and costs of items that may need to be purchased such as brochures, posters, and giveaways.

We recommend that the CMRSWC utilize the summary of the guide in chapter 2, background section of this report, but also utilize the guide itself when taking the additional steps in creating an educational campaign for the Central Massachusetts area.

Recommendation 3: Unify the Statewide Stormwater Coalitions to create a united brand and website.

As noted at the beginning of **finding 2**, a large number of stormwater education campaigns already exist in Massachusetts and throughout New England. Unless the campaign had a specific region that it wishes to target, such as a town or municipality, multiple campaigns targeting Massachusetts creates duplication of information across their materials. The Central Massachusetts Regional Stormwater Coalition is meant to represent and unite its member towns in stormwater compliance. We believe, however, that the CMRSWC has the ability to work together with the members of the Statewide Stormwater Coalition as well. We believe, a single brand will encompass the outreach done by the statewide members would be far more recognizable, hopefully reaching across the state, becoming a statewide campaign.

The campaign's materials should be freely reusable and alterable to allow the maximum amount of outreach to be done. This concept of modification and redistribution is the logical progression from **finding 1.** Once the CMRSWC has collected the resources and made them applicable to general audiences within the state, the resources must be available for modification. To see why, here is an example: a town official finds a presentation that they would like to use at a town meeting, they believe that it would make a larger impact better if the pictures of polluted water bodies were replaced by ones taken at local water bodies.

The CMRSWC has already shown modifiable templates to be effective on their own website, perhaps following on previous successes will create even more success. For these reasons, we recommend the creation of a statewide campaign website with other coalitions, and the alteration and redistribution of campaign materials.

Recommendation 4: Use various forms of advertising and outreach to gain traction in more than one demographic.

Once the CMRSWC establishes the campaign, a logical next step is to attract the media. This needs to wait until the campaign is developed because otherwise there will not be any message to spread. Once the campaign is developed and a message is established, however, the CMRSWC will need to keep up the outreach to spread the message and get the name, In order to be a success, the campaign needs to become a household name. **Finding 3** informs the target audience.

Spreading the word about the campaign cannot just be from word of mouth. In order to spread the word, the campaign must be advertised. This can be done through newspapers, local access TV channels, radio channels, and social media. To start, the CMRSWC can get short articles about the campaign and the message in local newspapers. The CMRSWC can also start a social media account for the campaign. This can begin with setting up either a Facebook page, a Twitter account, or both, for the campaign. It is important that someone maintains and updates these pages, otherwise they will fade into obscurity. Local access channels and local radio channels may also be easy routes, however, less used. Prepare a short public service announcement to share what people can do to help. If the campaign garners enough support, ask for news stations to run a short story about the campaign. Utilizing all of these outreach methods ensures the campaign can cover as many target audience bases as possible.

Recommendation 5: Use the campaign title Soak Up the Rain with the Soak Up the Rain logo.

The results of our surveys point us to the conclusion that Soak Up the Rain holds the most appeal both as a title and as a logo. The Coalition survey included the Soak Up the Rain title with the Soak Up the Rain logo. Responses from the Coalition survey showed Soak Up the Rain barely edging out the closest runner-up. This is possibly because those surveyed were more likely to be involved with stormwater management, and may have had preconceived opinions on the campaign or the USEPA as a whole. We would not have been able to recommend it as the brand purely off of results this close. Next we choose to highlight some comments from the coalition survey that were echoed multiple times in regard to the Soak Up the Rain branding, both positive and negative:

- "I like the variety. Connecting rainfall with nature. I imagine it to be green and blue."
- "May be too subtle for some folks."
- "Simple yet makes connection, clean water for greener world."
- "Should be about treating runoff, not just soaking up the rain."

Our second survey, the *public survey*, gave us clearer results. It showed us that the largest plurality (40% or 77 respondents) preferred the Soak Up the Rain logo to all of the other logos. It was the most favored of logos, gaining 10% on the runner-up. We received numerous comments from the *public survey* related to the Soak Up the Rain logo, both positive and negative:

- "It is a clean, recognizable design that will also not get confused with something else but is similar enough to other environmentally conscientious designs."
- "Didn't look like stormwater."
- "Looks the most professional."
- "Ambiguous and not fun."

Based on this data, we recommend that if the CMRSWC coalition is looking to unify the stormwater educational campaigns with the statewide coalition, **that it look towards working with the USEPA to port the Soak Up the Rain as the official campaign of Massachusetts.** This does not necessarily mean using only and all of the USEPA's materials related to stormwater education. Instead, using tested materials from the CMRSWC's collection, then adding USEPA materials, as well as some of the resources uncovered by our team would serve to bolster and unite the CMRSWC's efforts in establishing a single unified campaign as in **recommendation 3**. We also recommend that the CMRSWC avoid using the duck logo, as it was heavily disliked, accruing 47% or 92 of 192 votes for least favorite icon. We received numerous comments from the *public survey* related to the duck logo, common sentiments included not being visibly connected to stormwater, and seeming childish.

Conclusion

In collaboration with the Massachusetts Department of Environmental Protection (MassDEP) and Central Massachusetts Regional Stormwater Coalition (CMRSWC), our team was tasked with assisting Central Massachusetts municipalities in complying with the 2016 MS4 permit. After early research and collaboration with our sponsors, we chose to focus our efforts on the educational aspect of the permit. Collectively, we concluded that educating members of the community is a crucial first step to accomplishing other aspects of the permit. Our group sought the most effective ways to reach out to the public, using various means of outreach for different target audiences. Also, we sought the best audience to target for education on stormwater runoff and its impacts. Next, we designed and piloted two toolkits that could be utilized for elementary school teachers and local event workers, respectively. Lastly, we created and sent out surveys

with the main goal of obtaining CMRSWC member and public opinions about potential logos, slogans, brand names, etc. for an educational campaign.

As a result of our piloting and multiple interviews, we found that children from around 3rd grade to 5th grade are the best target audience because they are young enough to be taught about environment issues, but old enough to understand the lessons. After piloting elementary school and local event toolkits, we deemed them successful because people seemed engaged, and the children were enthusiastic about what we taught them. Lastly, our survey results showed us that the USEPA's Soak Up the Rain is the most well-received brand for the campaign.

In conclusion, we believe that the materials we recommended in each of the toolkits should be utilized to educate children on stormwater, its impact on the environment, and what residents can do to mitigate the impact of stormwater runoff. We hope that our work will help prevent the stormwater pollution problems and protect surface water quality in Massachusetts.

Bibliography

American Rivers (n.d.). *Messages for Change: Using Stormwater Communications Research to Inform Outreach Campaigns.* Retrieved December 6, 2016 from http://wren.palwv.org/documents/AmRiversPAStormwaterMessaging.pdf

Bond, H., Racine, M., & Yang, Y. (2013, December 15). Assessment of Municipal Compliance of Central Massachusetts Municipalities with the 2013 MS4 Draft Permit and Development of a Compliance Tool. Retrieved August 27, 2016, from http://www.wpi.edu/Pubs/E-project/Available/E-project-121813-121229/unrestriced/DEP1_Final_Report2.pfd

Botelho, A., Gorton, V., & Pai, V. (2013, December 15). Phase II MS4 Permit: Improving Central Massachusetts Stormwater Management. Retrieved September 8, 2016, from https://www.wpi.edu/Pubs/E-project/Available/E-project-121713-202825/unrestricted/DEP2IQPFinalReport.pdf

BWP. (2015, January). Pay-As-You-Throw Fast Facts. Retrieved September 18, 2016 from http://www.mass.gov/eea/docs/dep/recycle/reduce/paytfast.pdf

Cabral, G., Luo, Z., & Rowles, N. (2016, June 28). Stormwater Management Educational Materials for Central Massachusetts Municipalities. Retrieved September 15, 2016.

Cleveland, J., Ramsey, R., & Walters, P. (1970). Stormwater pollution from urban land activity, in Combined Sewer Overflow Abatement Technology, Water Pollution Control Research Series, Federal Water Quality Administration, U.S. Dep. Interior. Retrieved on September 9th, 2016 from The US Environmental Protection Agency website: https://www3.epa.gov/npdes/pubs/usw_b.pdf

CMRSWC. (2016). *About us.* Retrieved September 1, 2016 from http://centralmastormwater.org/pages/crsc_About/who

Commonwealth of Massachusetts. (n.d) *MassDEP: About us*. Retrieved August 31, 2016 from http://www.mass.gov/eea/agencies/massdep/about/

Converse, R. R., Piehler, M. F., & Noble, R. T. (2011). Contrasts in concentrations and loads of conventional and alternative indicators of fecal contamination in coastal stormwater. *Water Research, 45*(16), 5229-5240. http://www.sciencedirect.com/science/article/pii/S004313541100426X

Correia, E., Giroux, M., & Peterson, C. (2014, December 18). *Comprehensive Cost Analysis of the 2014 Massachusetts MS4 Permit.* Retrieved October 8, 2016 from http://wp.wpi.edu/wcpc/files/2015/02/DEP-Final-Paper-V9.pdf.

Deng, X., Houghton, N., Li, H., & Weiler, J. (2014, May 5). *Cost Analysis for the MS4 Permits.* Retrieved October 8, 2016 from https://web.wpi.edu/Pubs/E-project/Available/E-project-050614-115834/unrestricted/COST_ANALYSIS_FOR_THE_MS4_PERMITS_WPI_STUDENT_PROJECT.pdf.

Dennis, H.W. Salt Pollution of a Shallow Aquifer: Indianapolis, Indiana. Groundwater, Vol. 11, No. 4, 1973. http://info.ngwa.org/gwol/pdf/732000805.pdf

Dietz, Michael (2016). *CT NEMO Program.* Retrieved September 15, 2016 from program site: http://nemo.uconn.edu/index.htm

EPA (2016). *The Problem.* Retrieved August 30, 2016, from https://www.epa.gov/nutrientpollution/problem

Fitch, J. (2010). Think Blue Maine. *About Us.* Retrieved August 31, 2016, from http://thinkbluemaine.cumberlandswcd.org/about_us/index.htm

Franzetti, S. M. *Background and History of Stormwater Regulations*. Retrieved October 10, 2016.

Gaffield, S., Goo, R., Richards, L., & Jackson R. *Public Health Effects of Inadequately Managed Stormwater Runoff.* American Journal of Public Health: September 2003, Vol. 93, No. 9, pp. 1527-1533. Retrieved September 10th, 2016 from the American Public Health Association Website: http://ajph.aphapublications.org/doi/full/10.2105/AJPH.93.9.1527

Harrison, J. A., J. H. Cohen, E. Hinchey, A. Moerke, and P. von Dassow (2009), Developing and implementing an effective public outreach program, *Eos Trans. AGU, 90(38), 333–334.*

Hoppe, Kathy. (2005, February). *Assessment of Maine's Stormwater Phase II & NPS Outreach Campaign 2003/2004.* Retrieved September 17, 2016 from https://cfpub.epa.gov/npstbx/files/maine05report.pdf

Kylander, N., & Stone, C. (2012). The Role of Brand in the Nonprofit Sector. *Stanford Social Innovation Review.* Retrieved on November 6th, 2016.

Mathieson, K. M. & Kronenfeld, J. J. (2003). Barriers to Enrollment and Successful Outreach Strategies in CHIP: Reflections on the Arizona Experience. *Journal of Health Care for the Poor and Underserved* 14(4), 465-477. The Johns Hopkins University Press. Retrieved December 8, 2016, from Project MUSE database.

May, D. B., & Sivakumar, M. (2009). Prediction of heavy metal concentrations in urban stormwater. *Water and Environment Journal, 23*(4), 247-254. doi:10.1111/j.1747-6593.2008.00138.x

MDCP, Massachusetts Department of Conservation and Recreation. Three Low-Impact Development Case Studies. (No date) http://www.mass.gov/eea/docs/dcr/watersupply/ipswichriver/twg-lid.pdf

McCullough, Mark (n.d.). *Branding.* Retrieved November 18th 2016, from http://www.marketingdonut.co.uk/marketing/marketing-strategy/branding

McKenzie, E. R., Money, J. E., Green, P. G., & Young, T. M. (2009). Metals associated with stormwater-relevant brake and tire samples. *Science of the Total Environment, 407*(22), 5855-5860. doi:10.1016/j.scitotenv.2009.07.018 http://www.sciencedirect.com.ezproxy.wpi.edu/science/article/pii/S0048969709006755

MDEP (2016). *ThinkBlue Maine.* Retrieved September 15, 2016, from organization site: http://thinkbluemaine.cumberlandswcd.org/wordpress/

Mitchell, A., Gottfried, J., Barthel, M., & Shearer, E. (2016, July 7). The Modern News Consumer: News Attitudes and Practices in the Digital Era. Retrieved December 5, 2016, from http://www.journalism.org/files/2016/07/PJ_2016.07.07_Modern-News-Consumer_FINAL.pdf

MWC (2016). *Massachusetts Water Coalition.* Retrieved September 15, 2016, from organization site: http://www.commonwaters.org/index.php

NHDES (2016). *Soak Up The Rain NH.* Retrieved September 15, 2016, from program site: http://soaknh.org/

Novotny, Vladimir. (1995). *Non Point Pollution and Urban Stormwater Management, Volume 9.* Retrieved September 15, 2016 from https://books.google.com/books?hl=en&lr=&id=s5XFA55LvCQC&oi=fnd&pg=PR11&dq=stormwater+nonpoint&ots=x-I8rzL1G1&sig=gm2-pHqzbCsbCkAqvmH_0LNogFg#v=onepage&q=stormwater%20nonpoint&f=false

NPDES Stormwater Program. (2016, July 12). Retrieved September 10, 2016, from https://www.epa.gov/npdes/npdes-stormwater-program

NSW. (2013, December). *Stormwater Pollution.* Retrieved August 30, 2016, from Office of Environment and Heritage website: http://www.environment.nsw.gov.au/stormwater/whatcauses.htm

Raina, R., Etter, M. L., Buehler, K., Starks, K., & Yowin, Y. (2011). Phenoxyacid herbicides in stormwater retention ponds: Urban inputs. *American Journal of Analytical Chemistry*, *2*(8), 962-970. doi:10.4236/ajac.2011.28112 goo.gl/a9iabc

Ritchie, R., Swami S., & Weinberg C. (1999, February). A Brand New World for Nonprofits. *International Journal of Nonprofit and Voluntary Sector Marketing Volume 4, Number 1.* Retrieved on November 6th, 2016.

Smith, Carl (2012, May). *Recycling surveys offer some surprising results. Retrieved December 6, 2016 from* http://www.call2recycle.org/recycling-surveys-offer-some-surprising-results-waste-recycling-news/

Smith, T. (2009). The social media revolution. *International journal of market research*, *51*(4), 559-561. http://www.socialnety.pl/wpcontent/uploads/2015/01/The_social_media_revolution.pdf

Spencer, S. (2012, Jun 02). *Stormwater regulations are costly*, Telegram & Gazette. Retrieved from http://search.proquest.com.ezproxy.wpi.edu/docview/1018216767?accountid=29120Retrieved

Starr, Jared, Nicolson, Craig (2015, April 11). Patterns in trash: Factors driving municipal recycling in Massachusetts. *Resources, Conservation and Recycling, 99, 7-18.* Retrieved from: http://www.sciencedirect.com/science/article/pii/S0921344915000543

Stranko, S., Bourquin, R., Zimmerman, J., Kashiwagi, M., McGinty, M., & Klauda, R. (2013, April). *Maryland.gov* (Maryland, Department of Natural Resources, Monitoring and Non-Tidal Assessment Division). Retrieved October 9, 2016, from http://dnr2.maryland.gov/streams/Publications/RoadSalt2013.pdf

US Census Bureau (2015). *AGE AND SEX, 2015 American Community Survey 1-Year Estimates, Worcester County, Massachusetts.* Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_1YR_S0101&prodType=table

United Nations (2012). *Social Indicators.* Retrieved December 6, 2016 from http://unstats.un.org/unsd/demographic/products/socind/

United Nations (2016). *Environmental Indicators.* Retrieved December 6, 2016 from http://unstats.un.org/UNSD/ENVIRONMENT/indicators.htm

U.S. Environmental Protection Agency (2003). National Pollutant Discharge Elimination System (NPDES) General Permit For Stormwater Discharges From Small Municipal Separate Storm Sewer Systems. Retrieved on September 18, 2016, from https://www3.epa.gov/region1/npdes/permits/permit_final_ms4.pdf

U.S. Environmental Protection Agency (2008a). Environmental Challenges for the Charles River. Retrieved August 30, 2016, from https://www.epa.gov/charlesriver/environmental-challenges-charles-river

U.S. Environmental Protection Agency (2008b) Urban Stormwater Management in the United States. Retrieved September 15th, 2016 from https://www3.epa.gov/npdes/pubs/nrc_stormwaterreport.pdf

U.S. Environmental Protection Agency (2010, November). *Getting In Step: A Guide for Conducting Watershed Outreach Campaigns.* Retrieved November 14, 2016 from https://cfpub.epa.gov/npstbx/files/getnstepguide.pdf

U.S. Environmental Protection Agency (May, 2012). The Facts about Nutrient Pollution. Retrieved September 17th, 2016 from http://midwestadvocates.org/assets/resources/nutrient_pollution_factsheet.pdf

U.S. Environmental Protection Agency (2016a). *GENERAL PERMITS FOR STORMWATER DISCHARGES FROM SMALL MUNICIPAL SEPARATE STORM SEWER SYSTEMS IN MASSACHUSETTS.* Retrieved September 06, 2016, from https://www3.epa.gov/region1/npdes/stormwater/ma/2016fpd/final-2016-ma-sms4-gp.pdf

U.S. Environmental Protection Agency (2016b). History of the Clean Water Act. Retrieved September 17, 2016, from https://www.epa.gov/laws-regulations/history-clean-water-act

U.S. Environmental Protection Agency (2016c). NPDES State Program Information. Retrieved September 29, 2016, from https://www.epa.gov/npdes/npdes-state-program-information

U.S. Environmental Protection Agency (2016d). Reduce, Reuse, Recycle. Retrieved September 18, 2016, from https://www.epa.gov/recycle

U.S. Environmental Protection Agency (2016e). Stormwater Discharges from Municipal Sources. Retrieved September 17, 2016, from https://www.epa.gov/npdes/stormwater-discharges-municipal-sources#overview

U.S. Environmental Protection Agency (2016f). Summary of the Clean Water Act. Retrieved September 30, 2016, from https://www.epa.gov/laws-regulations/summary-clean-water-act

U.S. Environmental Protection Agency (2016g). *The Problem.* Retrieved August 30, 2016, from https://www.epa.gov/nutrientpollution/problem

Appendix A: Interview Questions for Fred Civian and Ed Himlan

Preamble:

We are a group of students from the Massachusetts Water Resource Outreach Center at Worcester Polytechnic Institute. We are conducting this interview as we believe it will help our research in mitigating the impact of stormwater runoff in Central Massachusetts as well as help municipalities comply with new stormwater regulations. Your participation in this interview is completely voluntary and you may withdraw at any time. Please remember that we are happy to keep your answers confidential if you so wish. This is a collaborative project between the Massachusetts Department of Environmental Protection (MassDEP), the Central Massachusetts Regional Storm Water Coalition (CMRSWC), and Worcester Polytechnic Institute (WPI), and your participation is greatly appreciated.

Fred Civian:

1. What is your specific role within MassDEP and with the MS4 permit?
2. In your opinion, what was the biggest change towns will have to face in switching to the new MS4 permit?
3. Can you explain to us the nuts and bolts of the public education control measure?
4. Can you explain to us the nuts and bolts of the public involvement control measure?
5. Can you explain to us the nuts and bolts of the good housekeeping and pollution prevention control measure?
6. What are municipalities most worried about with the MS4 permits?
7. Are there any education campaigns/videos that you believe described the old or new MS4 permit properly? What were they?
8. We looked at previous IQPs which did some cost analyses of complying with the MS4 permit, and we spoke to Adam Gaudette, town administrator of Spencer and co-founder of CMRSWC, who said he believes it may cost around $200k per town. What are your thoughts on the accuracy of this estimate?

Ed Himlan:

1. Can you please tell us a little bit about yourself and your involvement in the Massachusetts Watershed Coalition?
2. One of the goals of the Massachusetts Watershed Coalition, according to its website, is to strengthen the work and knowledge of community groups. How does the Coalition approach this goal?

3. What bodies of water in the Central Massachusetts region do you think have the biggest stormwater runoff issues?
4. Tell us about how the Billion Gallons a Year campaign started, and your involvement. What led to its creation?
5. What advertising techniques do you use to target your audiences (How was/is info about the campaign distributed)?
6. How have you evaluated the success of the Billion Gallons a Year campaign?
7. The approach to our campaign includes a website, social media, newspaper advertisements, and a toolbox to be used at various events, such as workshops. This toolbox would include pamphlets, a banner, a copy of our project video, and an Enviroscape when available. What are your thoughts on this approach, particularly with the toolbox?

Appendix B: Interview Questions for Coalition Members

Preamble:

We are a group of students from the Massachusetts Water Resource Outreach Center at Worcester Polytechnic Institute. We are conducting this interview as we believe it will help our research in mitigating the impact of stormwater runoff in Central Massachusetts as well as help municipalities comply with new stormwater regulations. Your participation in this interview is completely voluntary and you may withdraw at any time. Please remember that we are happy to keep your answers confidential if you so wish. This is a collaborative project between the Massachusetts Department of Environmental Protection (MassDEP), the Central Massachusetts Regional Storm Water Coalition (CMRSWC), and Worcester Polytechnic Institute (WPI), and your participation is greatly appreciated.

1. What is your specific role within your town?
2. Why did you join the coalition?
3. What is your familiarity with the topic of stormwater/stormwater runoff?
4. Who do you believe would be the target audience for an outreach campaign on stormwater?
5. How confident do you feel with your municipality's ability to comply with the new MS4 permit?
6. What challenges do expect your community to face in complying with the MS4 permit?
7. What type of budget is allocated for complying with the MS4 permit?

Appendix C: Interview Questions for Education Outreach Members

Preamble:

We are a group of students from the Massachusetts Water Resource Outreach Center at Worcester Polytechnic Institute. We are conducting this interview as we believe it will help our research in mitigating the impact of stormwater runoff in Central Massachusetts as well as help municipalities comply with new stormwater regulations. Your participation in this interview is completely voluntary and you may withdraw at any time. Please remember that we are happy to keep your answers confidential if you so wish. This is a collaborative project between the Massachusetts Department of Environmental Protection (MassDEP), the Central Massachusetts Regional Storm Water Coalition (CMRSWC), and Worcester Polytechnic Institute (WPI), and your participation is greatly appreciated.

1. How did the department determine that an educational outreach program should be created?
2. How was the educational outreach program advertised?
3. What aspects of your educational outreach program were the most successful?
4. How did you evaluate the success of your educational outreach program?
5. Do you have any recommendations on how to develop an outreach campaign based on stormwater?

Appendix D: Survey of Branding for Educational Campaign

Stormwater Educational Campaign for Massachusetts

Thank you for taking the time to complete our survey.

We are a group of students from the Massachusetts Water Resource Outreach Center at Worcester Polytechnic Institute. We are conducting research on development of an educational outreach campaign, including a campaign logo, to help mitigate the impact of stormwater runoff. Your participation in this survey is completely voluntary and you may withdraw at any time. Please remember that your answers will remain anonymous. No names or identifying information will appear on the questionnaires or in any of the project reports or publications. This is a collaborative project between the Massachusetts Department of Environmental Protection (MassDEP), the Central Massachusetts Regional Storm Water Coalition (CMRSWC), and Worcester Polytechnic Institute (WPI). If interested, a copy of our results can be provided at the conclusion of the study.

If you have any questions or comments, please feel free to email us at wroc2016@wpi.edu.

What is your affiliation? Choose all that apply.

- Local municipality
- Massachusetts Department of Environmental Protection
- U.S. EPA
- Central Massachusetts Regional Stormwater Coalition
- Massachusetts Department of Public Works
- Other: _____

Option 1: Soak Up The Rain Massachusetts

Logo:

Please rate the option below.

	1	2	3	4	5	6	7	8	9	10	
Hate it	○	○	○	○	○	○	○	○	○	○	Love it

Which of the following slogans do you feel would fit best with this campaign? Choose all that apply.

- Maintain the drain.
- Plan for a cleaner tomorrow.
- Do your part, one drop at a time.
- Drains to waterways.
- Only rain down the stormdrain.
- Be the solution to stormwater pollution.
- Other: _____

What do you like about Option 1?

What do you dislike about Option 1?

Option 2: ThinkBlue Massachusetts

Logo:

Please rate the option below:

	1	2	3	4	5	6	7	8	9	10	
Hate it	○	○	○	○	○	○	○	○	○	○	Love it

Which of the following slogans do you feel would fit best with this campaign? Choose all that apply.

- Maintain the drain.
- Plan for a cleaner tomorrow.
- Do your part, one drop at a time.

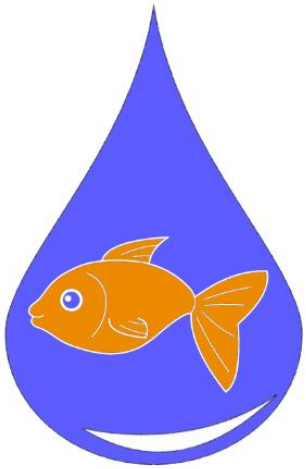
- Drains to waterways.
- Only rain down the stormdrain.
- Be the solution to stormwater pollution.
- Other: _____

What do you like about Option 2?

What do you dislike about Option 2?

Option 3: Go With The Flow Massachusetts

Logo:



Please rate the option below:

	1	2	3	4	5	6	7	8	9	10	
Hate it	○	○	○	○	○	○	○	○	○	○	Love it

Which of the following slogans do you feel would fit best with this campaign? Choose all that apply.

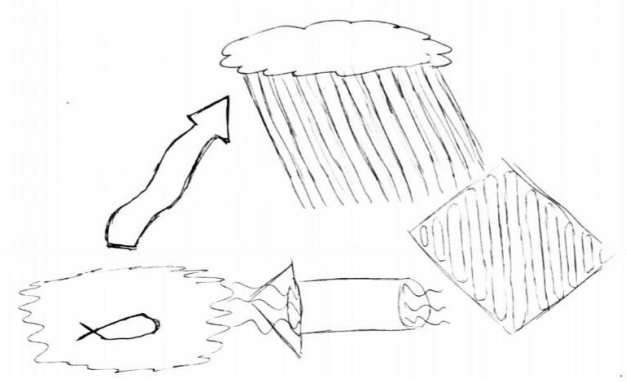
- Maintain the drain.
- Plan for a cleaner tomorrow.
- Do your part, one drop at a time.
- Drains to waterways.
- Only rain down the stormdrain.
- Be the solution to stormwater pollution.
- Other: _____

What do you like about Option 3?

What do you dislike about Option 3?

Option 4: Down The Storm Drain Massachusetts

Logo (sketch):



Please rate the option below:

	1	2	3	4	5	6	7	8	9	10	
Hate it	○	○	○	○	○	○	○	○	○	○	Love it

Which of the following slogans do you feel would fit best with this campaign? Choose all that apply.

- Maintain the drain.
- Plan for a cleaner tomorrow.
- Do your part, one drop at a time.
- Drains to waterways.
- Only rain down the stormdrain.
- Be the solution to stormwater pollution.
- Other: _____

What do you like about Option 4?

What do you dislike about Option 4?

Video Project

The final two sections will be about ideas for a video that we will be making. The first section will be about a theme entitled Stormwater Chasers and the second section will be about the tone of the video.
Stormwater Chasers will be a video parody of the television show Storm Chasers, with elements of other shows, such as: Mythbusters, The Crocodile Hunter, and Bill Nye the Science Guy. This is in order to make the video entertaining and engaging as well as educational. It follows a team, the Stormwater Chasers, as they educate the community about stormwater, mixing in some over-the-top comedy to keep the audience interested. After the video, we have stickers for kids to wear like badges to say that they are a Stormwater Chaser, too.

Title: Stormwater Chasers

Logo Design:

Please rate Stormwater Chasers.

	1	2	3	4	5	6	7	8	9	10	
Hate it	○	○	○	○	○	○	○	○	○	○	Love it

What do you like about Stormwater Chasers?

What do you dislike about Stormwater Chasers?

Appealing to the Audience

We are reaching out to kids as a primary audience for our materials.

Which approach do you believe would be best at engaging the audience? Choose all that apply (checking multiple choices would imply a combination of options).

- Humorous approach
- Factual approach (various statistics when appropriate)
- Fear approach about consequences
- Call to action approach (what you can do to help)
- Other: _____

Thank you very much for taking this survey, your assistance is greatly appreciated! If you would like a copy of our final report, please email us at wroc2016@wpi.edu

Appendix E: In-Class Activity Plans for Educators

Lesson 1: Water Uses Activity

Water Uses Activity - on a board activity

Duration of activity: 5 - 10 minutes
Materials: whiteboard/chalkboard, dry erase marker/chalk, students
Number of Students: 10-25
Recommended age: 2nd through 6th grade
Level of Difficulty: ★☆☆☆☆

On the board we will ask children to list out the uses for water (such as drinking, swimming, fishing, bathing, watering, brushing teeth, washing car, etc.)

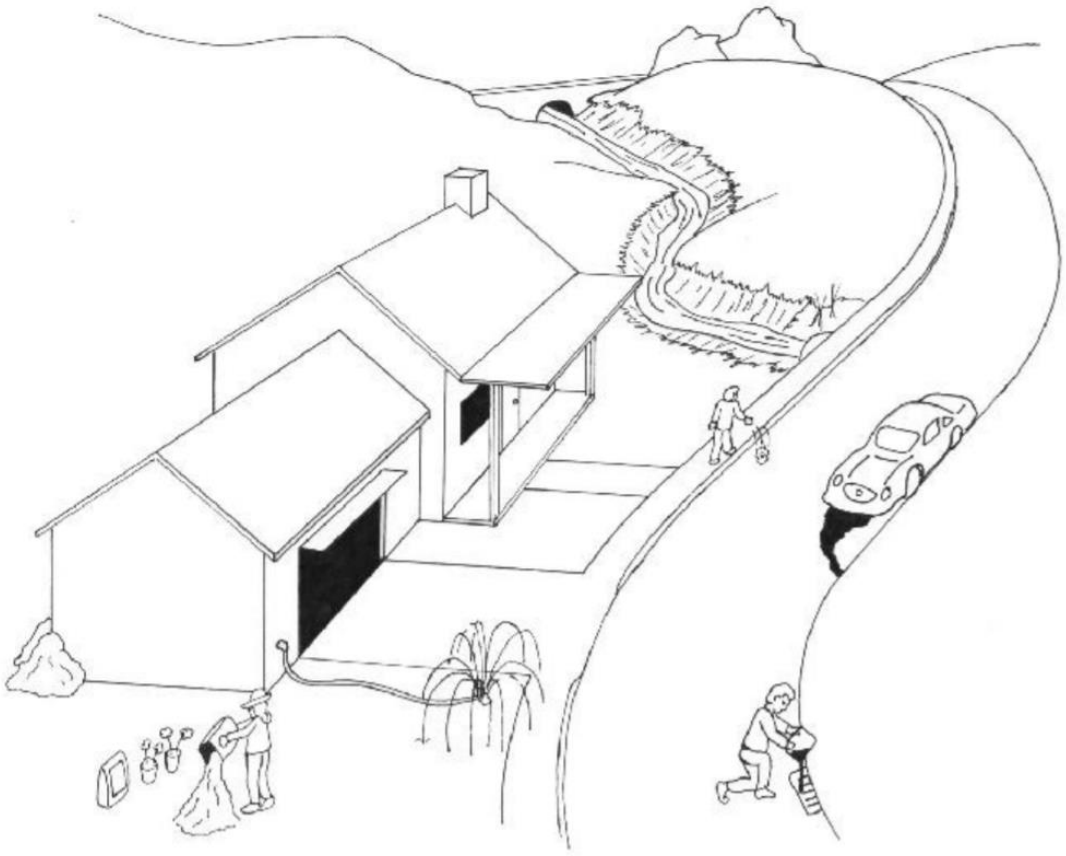
We'll ask them to raise their hand if they would want to swim in certain polluted bodies with pictures as examples.

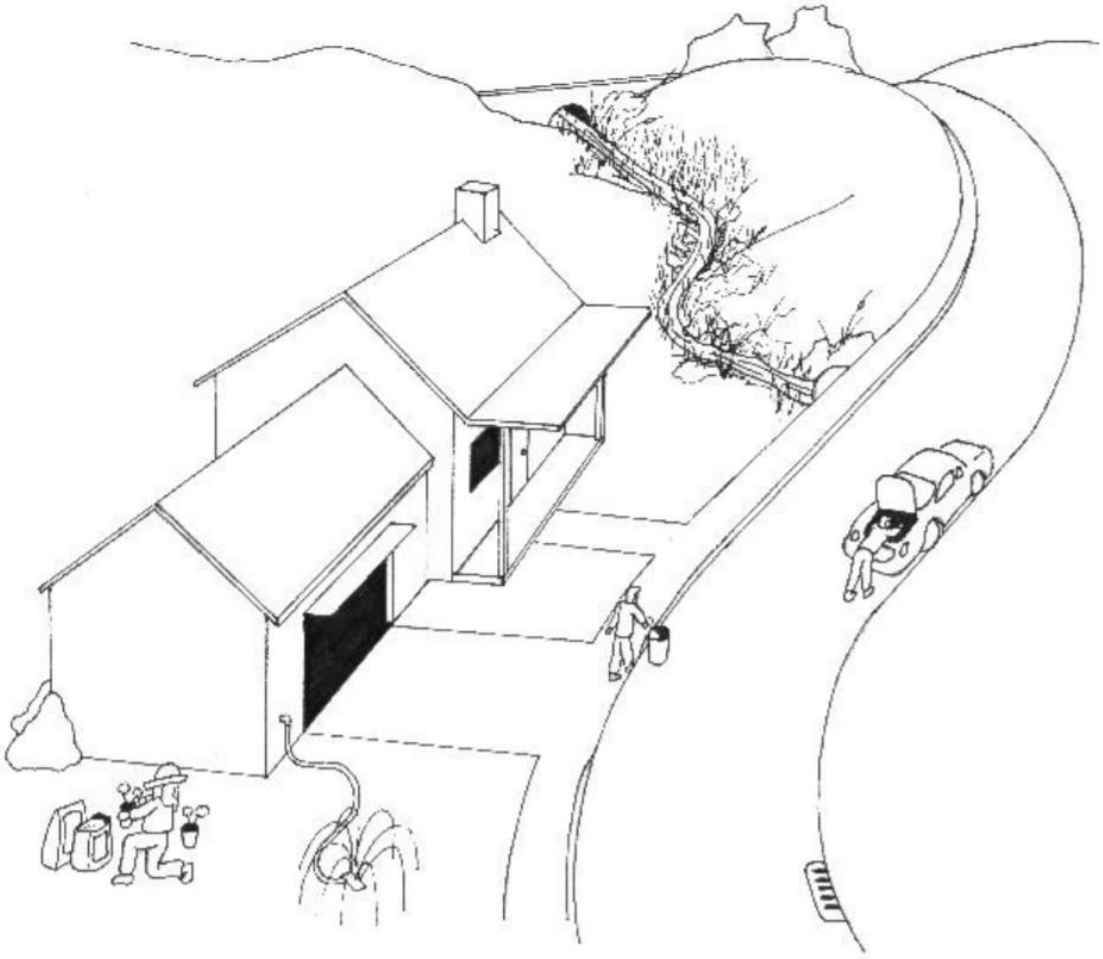
We'll then go into how water gets polluted and with what, those would be the next activities.

Lesson 2: Find All The Pollutants

Find all the pollutants (Spot the 6 differences)

Duration of activity: 5 - 10 minutes
Materials: coloring supplies
Number of Students: individual
Recommended age: 2nd through 5th grade
Level of Difficulty: ★☆☆☆☆





Have students, independently or in a group, seek out the differences in the above images.
Reconvene as a class and ask them about the differences they saw. This provides a basis of pollutants that can go down storm drains. Discuss the impacts (oil in ponds can kill aquatic life, etc).

Water Shed

Duration of activity: 10-20 minutes
Materials: Paper, washable markers, spray bottle, water
Number of Students: 1-2 per paper
Recommended age: 2nd through 6th grade
Level of Difficulty: ★★★☆☆

1. Take a sheet of paper and crumple it up in your hands.

2. Then open up the paper, but don't flatten it. You want it to have some-some high and low places. The high places are hills, the low spots are valleys, the wrinkles are streams and rivers.

3. Take one of the blue washable markers, and draw on the paper where you think the streams and rivers would be.

4. Use a brown marker and draw along the tops of the hills. With a green marker you can draw in trees, grass, crop or pasture land. Use a red marker to draw towns, houses or businesses.

5. Check to see if you are right. Place the paper on a tray or newspapers or towels. With the spray bottle, make it rain in the watershed. Squirt a fine mist over the paper, enough to make the marker run. It shows the water flow down the hills. Did you draw the streams and rivers in the right places? Do you have a lake? This is how watersheds function, the water is shed by the land into streams, rivers, and lakes.

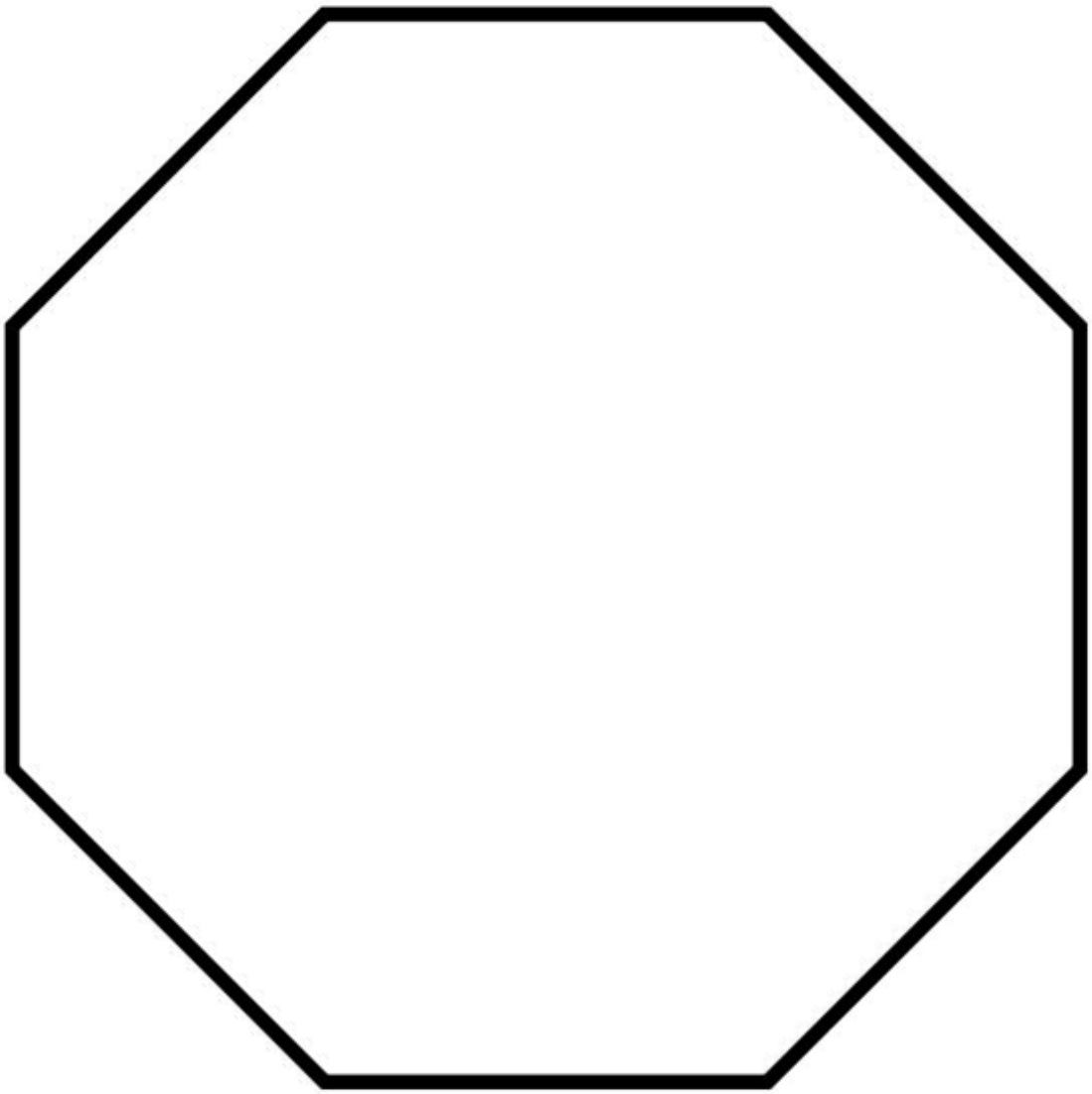
6. But you'll now see a lot of other stuff (colors) running into the streams along with the water. If this were a real watershed, the brown could be dirt from bare soil, the green could be grass clippings or leaves, and the red could be oil from leaky cars or fertilizer someone spilled on a driveway.

"That's what happens when things on the ground are picked up by stormwater runoff, they end up in streams and rivers and moving down the watershed. Can anyone tell me why this is bad?"

Stormwater Sign

Duration of activity: 10-20 minutes
Materials: coloring supplies
Level of Difficulty: ★★☆☆☆

Design your own sign to remind people why they shouldn't dump waste into storm drain.



Lesson 5: Stormwater Pollutant Quiz

Duration of activity: 5-10 minutes
Materials: writing utensil
Number of Students: individual
Recommended age: 2nd through 6th grade
Level of Difficulty: ★★★★☆

Stormwater Pollutant Quiz

Match the pollutant with the problem. If you need help, look back in the book.

1) Motor Oil	A. Used to kill garden pests, but can also kill animals living in the water.
2) Hazardous Waste	B. Animals sometimes confuse this with food and can die from eating it.
3) Fertilizers	C. This can cloud the water and make it hard for animals to see, and can even smother eggs.
4) Trash	D. Leftover poisonous chemicals that can pollute lakes and streams.
5) Dirt	E. Good for cars, bad for birds and fish.
6) Pesticides	F. Helps plants grow, but can pollute a stream and use up the oxygen.

Now match the pollutant with something you can do to help protect your water.

1) Motor Oil	A. Only use as much as you need to get rid of harmful pests.
2) Hazardous Waste	B. Don't litter, put this in its place. Better yet, recycle as much as you can!
3) Fertilizers	C. Cat litter can clean this up.
4) Trash	D. Look for disposal days in your community to get rid of this.
5) Dirt	E. Always use the right amount on your lawn to keep it green.
6) Pesticides	F. Plant trees and other plants near streams to help hold the soil in place.

Lesson 4/5: Stormwater Sign and Pollutant Quiz

Show the students a storm drain with a stencil on it:

Now allow them to create their own stencil/sign in the shape above that could be used at a storm drain near their house.

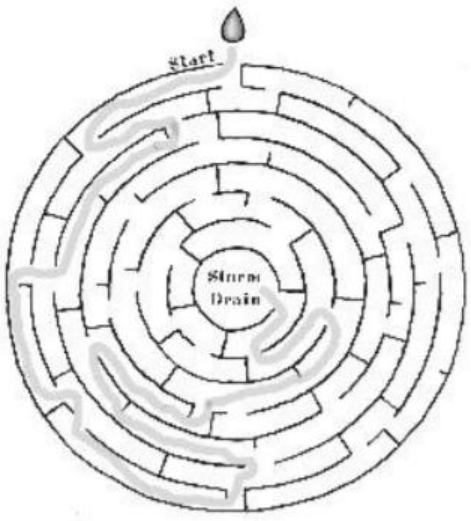
Once everyone is done, they can share their designs to the class.

At this point they have completed their in class activities and will receive their certified "Stormwater Chasers" sticker and "Stormwater Chasers" Activity Book.

Stormwater Chasers Activity Book Answer Key

This Page is to be Separate from In-Class Activities

Maze:



Word Search:

Hidden message:

Hidden message: Help keep sediment out of the stream!

Materials and illustrations originally created by Krista Kuester, Nancy Mesner, and Benjamin Kuhns of Utah State University

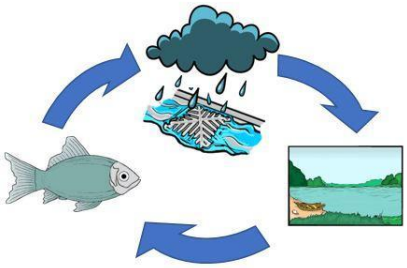
Appendix F: Logo Survey for Local Event Attendees

Logo for Central MA Stormwater Education Campaign

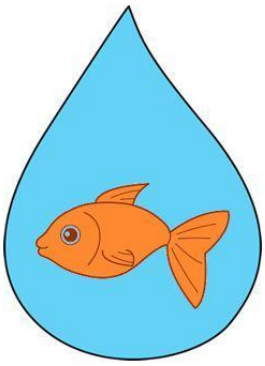
Please rank the following logos for a stormwater education campaign by writing the numbers on respective line below (1=most favorite, 5=least favorite).

_____

_____



_____



_____

_____

Why did you choose your most favorite option?

Why did you choose your least favorite option?

Appendix G: Stormwater Chasers Activity Book

STORMWATER CHASERS

Activity Book

What is stormwater and stormwater runoff?

- When it rains, water hits the grass, trees, roads and sidewalks.
- When it hits the grass, the rain goes into the ground.
- When it hits the sidewalks, roads and buildings, the rain runs into the street and becomes stormwater.
- Stormwater runs down the street and into storm drains which flows into the rivers, lakes and streams.
- Along the way it picks up pollutants.

What is a pollutant?

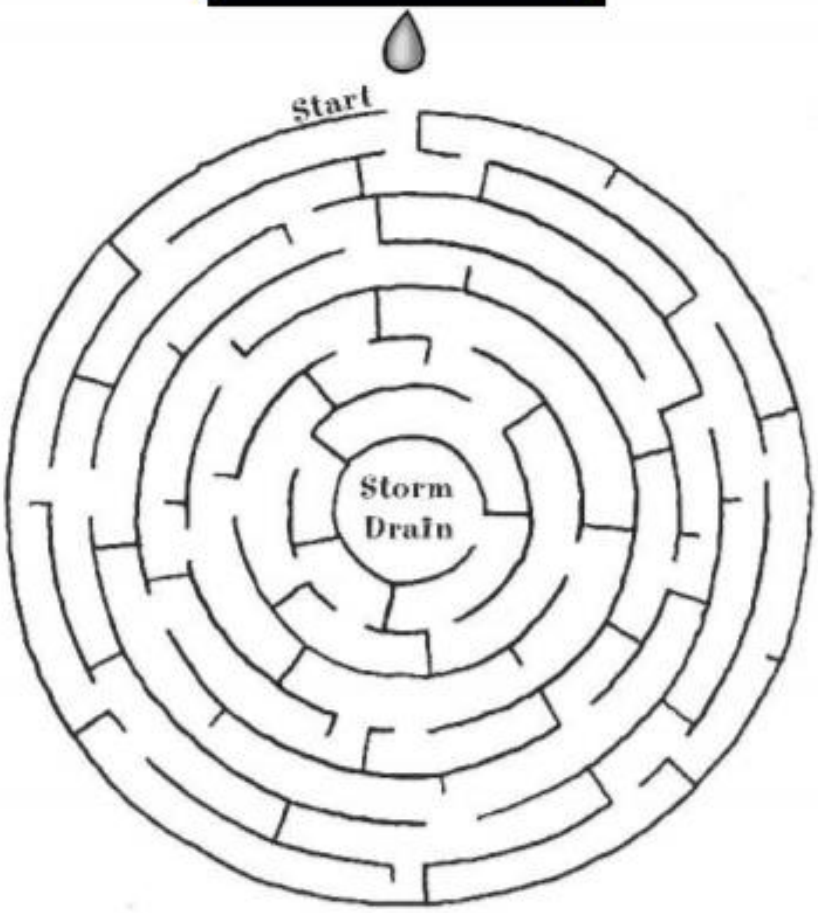
- Things that can make people, fish, or animals sick if it is in the water.
- Pollutants include trash, dog poop, chemicals used on our lawn and gardens, dirt, oils and greases from our cars.

Source: http://www.onlyraindownthedrain.com/kids

STORMWATER

Cities and towns have more stormwater runoff than areas in the country because they have more concrete so the water can't soak into the ground.

Lead the water droplet through the maze and into the storm drain.



Concrete
Drain
Driveway
Fertilizer
Lawn
Oil
Pesticides
Plants
Rain
Rooftops
Sediment
Stormwater
Stream

I	N	E	P	R	W	S	L	I	O	R	S	N	J	B
A	Z	W	A	E	T	I	F	O	P	Q	T	Y	Q	U
E	D	I	E	N	S	T	R	E	A	M	O	Q	S	Y
E	N	R	A	T	G	T	H	X	N	I	R	G	P	X
K	K	L	A	G	N	W	I	G	Z	R	M	T	O	X
M	P	X	Z	I	R	E	Y	C	O	B	W	L	T	N
K	K	G	W	T	N	I	T	N	I	D	A	A	F	H
F	E	R	T	I	L	I	Z	E	R	D	T	W	O	J
T	N	E	M	I	D	E	S	I	R	K	E	N	O	G
T	G	A	Q	A	H	P	V	C	H	C	R	S	R	A
G	W	Y	C	U	D	E	Z	X	Z	A	N	C	G	C
H	N	P	S	W	W	U	F	R	T	A	Y	O	I	L
F	X	D	E	A	W	Q	I	U	W	J	Z	M	C	U
Q	J	H	Y	C	B	G	F	V	O	W	F	O	N	V
Z	L	M	L	F	T	U	D	C	G	A	K	X	L	X

Draw a picture of a fish or some other cool animal that lives in water.

What can you do to help prevent stormwater pollution?

Solve the hidden message! Use the clues below!

♡ ☼ ✄ ✖ ✢ ☼☼ ✖ ✰ ☼ ♪✿ ● ☼■ ◆ ⌘ ⇨ ◆ ⌘ ♠ ◆ ♡ ☼ ✰ ◆ ✔ ☼ ✌ ● !

✌=A	✔= R	♪=D	☼=E
✖=P	●=M	✄=L	✢=K
♠=F	⇨=U	◆=T	✰=S
✿=I	■=N	♡=H	⌘=O

H _ _ _   _ _ _ _   _ _ _ _ _ _ _ _   _ _ _   _ _

_ _ _   _ _ _ _ _ _!

CERTIFICATE OF ACHIEVEMENT

This certificate is awarded to

_____

for becoming a Stormwater Chaser and preventing stormwater pollution in their community!

Put this on your fridge so your family knows what to do to become Stormwater Chasers too!

What can you do at home?

- Move sprinklers away from driveways and sidewalks
- Pick up after your pet using biodegradable bags
- Don't dump waste down storm drains

What can your family do at home?

- Use phosphate-free fertilizers
- Don't use more fertilizers than needed
- Wash cars over the lawn
- Use phosphorus-free car soap
- Put chemicals, oils, and paints away after every use
- Prevent oil leaks through regular car maintenance

Produced by:
Alex Legere
Anthony Perullo
Amy Toscano
Justin Waters
Worcester Polytechnic Institute
Water Resource Outreach Center

Most materials and illustrations originally created by Krista Kuester, Nancy Mesner, and Benjamin Kuhns of Utah State University

Appendix H: Backpack Mail for Parents

ASK YOUR CHILD WHAT THEY LEARNED TODAY...

WHAT IS STORMWATER RUNOFF?

Stormwater runoff is water that flows along the ground when it rains!

BUT WHERE DOES THIS WATER GO?

This water flows into storm drains but picks up pollutants first. Once in the storm drain, it releases at outfalls into local bodies of water.

BUT DOESN'T IT GET FILTERED?

Storm drains unlike sewers, **do not** get treated and filtered. **Everything** that goes into storm drains, come out at the outfalls.

WHAT TYPES OF POLLUTANTS ARE THERE?

Pollutants include: oil and other car fluids, soaps for washing cars, paint and other household chemicals, trash, pet waste, fertilizers, pesticides, etc.

WELL, WHY SHOULD I CARE?

In order to keep the environment healthy for future generations.

The U.S. EPA wants to hold a certain standard to water quality and towns need your help to make this possible.

WHAT CAN I DO TO HELP?

Take a look on the back page!

WHAT CAN I DO TO HELP?

- First, you can help clean the water by limiting how much you pollute
- For your car: keep up with proper maintenance to prevent leaks.
  Fun Fact: cat litter easily absorbs oil, making cleanup easier.
- Washing your car: wash over grass to help filter soapy water. Also use biodegradable soap.
- Pick up after your pets
  Fun Fact: Pet waste contains potentially hazardous bacteria.
- Do not use more fertilizers than necessary. Excess fertilizer can cause algae blooms.
- Do not leave paint or chemicals outside unattended. Dispose of them properly when you are done.

LASTLY, DON'T DUMP DOWN STORM DRAINS!

IMPORTANT: You have some say on how the town's budget is used. When voting, it is important to remember part of the budget can be used for stormwater runoff and environmental purposes.

Appendix I: Stormwater Chasers Sticker Template

Appendix J: Local Event Pamphlet

Where does rainwater go?

Important to note: Rain picks up pollutants, which goes unfiltered into bodies of water.
Pollutants include: oil and other car fluids, trash, pet waste, soaps for washing cars, fertilizers, etc.
Check to see how you can limit stormwater pollution!

Rain Garden:

Rain gardens, built in shallow depressions, capture runoff and the plants and soil filter the water, removing pollutants. The plants also provide habitat for birds, bees, and butterflies.
A rain garden will also reduce the volume of stormwater entering our streams.

For more info on rain gardens, download the "Rain Garden" app.

http://www.laurensgardenservice.com/rain-gardens-and-rain-barrels/

Learn more at:

- **centralmastormwater.org**
- **epa.gov/soakuptherain**
- **www.massaudubon.org**

What can you do to prevent stormwater pollution?

https://openclipart.org/detail/231395/storm-drain-grate

Easy solutions to stormwater pollution!

Rain Barrel:

You can take stormwater from a gutter's downspout and lead it into a rain barrel. This water can be saved to water a lawn or house plants instead of tap water. This can help especially during dry summer months.

http://savetherain.us/str_project/rain-barrel-program/

Car Care:

- If you notice vehicle fluids in your driveway, call your local repair shop and clean up any spills.
- When washing your car, use biodegradable soap. Also wash it on grass or gravel to help filter soapy water.

http://www.nccleanwater.org/involvement/house/vehicles.php

Poop Pickup:

When walking your dog, always bring a small trowel and a plastic bag. Flush the poop down the toilet or place the bag in your garbage can. Also make sure your dog does not pee directly on the pavement.

http://www.pet360.com/dog/lifestyle/how-to-start-a-dog-park/QNgX97i5YkqtFZMbD_hg6w

Appendix K: Originally Non-Digitized Materials

My School, My Neighborhood, My World

The Little School in the Woods takes a Raindrop Journey Along the Blackstone Watershed

Grade	Garden Connection	Trail Connection	Community Outreach / Trips	Science Standards
Pre K *Garden and Animal Connections* *Habitats*	• Local environments provide homes for different kinds of living things • Animals and plants are codependent	• Local resources meet human needs* • People's impact on the environment • Environment meets animals' needs	•	• **PreK-ESS2-1(MA).** Raise questions and engage in discussions about how different types of local environments (including water) provide homes for different kinds of living things. • **PreK-ESS2-3(MA).** Explore and describe different places water is found in the local environment. • **PreK-ESS3-1(MA).** Engage in discussion and raise questions using examples about local resources (including soil and water) humans use to meet their needs. • **PreK-ESS3-2(MA).** Observe and discuss the impact of people's activities on the local environment. • **PreK-LS2-1(MA).** Use evidence from animals and plants to define several characteristics of living things that distinguish them from non-living things. • **PreK-LS2-2(MA).** Using evidence from the local environment explain how familiar plants and animals meet their needs where they live.
Kindergarten *Garden and Animal Connections* Habitats	• Plant life • Animal + plants codependent	• Human /animal effect on environment • Pollution/reduce use of resources • Weather forecasting • recycling	•	• **K-ESS3-2.** Obtain information about the purpose of weather forecasting to prepare for, and respond to, different types of local weather. • **K-ESS3-3.** Communicate solutions to reduce the amount of natural resources an individual uses. • **K-LS1-1.** Observe and communicate that animals (including humans) and plants need food, water, and air to survive. Animals get food from plants or other animals. Plants make their own food and need light to live and grow. • **K-LS1-2(MA).** Recognize that all plants and animals have a life cycle: a. most plants begin as seeds, develop and grow, make more seeds, and die; and b. animals are born, develop and grow, produce young, and die.

1

Grade one *Seasonal Effects on the Environment*	• Seasonal patterns of change • Light, water affects on growning • Plants take in water/food through roots etc.....	• Seasonal patterns of change • Plants/animals	• Historical Museum •	• **1-ESS1-2.** Analyze provided data to identify relationships among seasonal patterns of change, including sunrise and sunset time changes, seasonal temperature and rainfall or snowfall patterns, and seasonal changes to the environment. • **1-LS1-1. b.** plants have roots, stems, leaves, flowers and fruits that are used to take in nutrients, water and air, produce food (sugar), and make new plants. • **1-LS3-1.** Use information from observations (first-hand and from media) to identify similarities and differences among individual plants or animals of the same kind.
Grade two *Ecosystems*	• Erosion • Plants depend on surroundings	• Mapping • Different kinds of living things in an environment	• Hike and observe • Create concentric maps of us, city, state, country, world • Tower HIll	• **2-ESS2-2.** Map the shapes and types of landforms and bodies of water in an area. • **2-LS2-3(MA).** Develop and use models to compare how plants and animals depend on their surroundings and other living things to meet their needs in the places they live. • **2-LS4-1.** Use texts and media to compare: a. different kinds of living things in an area, and b. differences in the kinds of living things living in different types of areas.
Grade Three *Life Cycles / Decomposing*	• Planting	• Worcester History • Map • Clean-up	• Preservation Worc. • Sturbridge Village	• **3-LS4-2.** Use evidence to construct an explanation for how the variations in characteristics among individuals within the same species may provide advantages to these individuals in their survival and reproduction. • **3-LS4-3.** Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive. • **3-LS4-3.** Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive. • **3-LS4-4.** Analyze and interpret data about changes in the environment in an area and describe how the changes may affect the ability of organisms that live in that area to survive and reproduce.

Lesson: Made to Sail
Posted on October 2nd, 2011 by ASEE
sailboat3In this lesson, students in grades 2 – 7 use simple materials to design and make model sailboats that must stay upright and sail straight in a testing tank. They will learn the basic components of a ship and how design represents a tradeoff between speed, stability, and ease of handling.

Possible Books

Project Wild: (Oh Deer!!!)
Field Guides
River Ran Wild
Keepers of the Earth
A Raindrops Journey

EIE book Saving turtles (India Girl – Jeff)

NSTA – BOOK RECOMMENDATIONS
National Science Teachers Association website: Notable books – back to 2010 - Jeff

About Habitats: Forests by Cathering Silli
In the Small, Small Pond
Next Time You See a Maple seed
Lady bugs – Gail Gibbons
Pond Circle Hardcover – June 9, 2009
Common Ground: The Water, Earth, and Air We Share
Rabbit's Good News
Secret Place Hardcover – August 16, 1996
by Eve Bunting
Sunflower House – April 19, 1999
Ferdinand Foxes first Summer
Flight of the Honeybee
Frog song
Hide and Seek Science – appropriate level?
Next Time You See a Firefly
Next time you see a Pill Bug (look at series)
What if you had Animal Teeth?
A Warmer World
Natures Patchwork Quilt
Open Wide – Animal Adaptations

Lesson Ideas per grade

Prek – K

http://growing-minds.org/lesson-plans/

- All About Worms (K-2)
  Teach students about life cycles by learning about worms and the ways they benefit the garden and farms. Through reading literature and completing hands-on activities, the class will conduct a worm investigation and observe that the organisms (and other animals) need food, air and space to grow.

  View details...
  Downloads
  All About Worms Lesson Set (quick view as .pdf)
  All About Worms Materials (.zip)

- Garden Friends (K-2)
  Introduce students to the insects and other creatures they will find in the garden and their characteristics.

  View details...
  Downloads
  Garden Friends Lesson Set (quick view as .pdf)
  Garden Friends Materials (.zip)

- Insects in the Garden – Preschool
  Introduce students to insects and other bugs they will find in the garden, their characteristics, and how they affect plants. Teach students to observe (rather than harm) living things in the garden and natural environment.
  View details...
  Downloads
  Garden Lesson 4: Insects in the Garden – Preschool (quick view as .pdf)

Grade Four *Environmental Concerns* *Pollution* *Erosion*	• Erosion • Rocks vs. soil etc..... • Problem solving	• The Blackstone's effect on Worc. History, immigration •	• Ranger Chuck • Art Museum	• **4-ESS1-1.** Construct a claim with evidence that changes to a landscape due to erosion and deposition over long periods of time result in rock layers and landforms that can be interpreted today. Use evidence from a given landscape that includes simple landforms and rock layers to support a claim about the role of erosion or deposition in the formation of the landscape. • **4-ESS2-1.** Make observations and collect data to provide evidence that rocks, soils, and sediments are broken into smaller pieces through mechanical weathering and moved around through erosion by water, ice, wind, and vegetation.
Grade Five *Environmental Concerns* *Pollution* *Erosion*	•	• Polluting in our community • Water as a resource • Caring for our environment • (work with K) • Clean-up trail	• Possible trip to water treatment and hike Blackstone	• 5-ESS2-1. Use a model to describe the cycling of water on Earth between the geosphere, biosphere, hydrosphere, and atmosphere through evaporation, precipitation, surface runoff, condensation, transpiration, and runoff. • 5-ESS3-1. Obtain and combine information about ways communities reduce the impact on the Earth's resources and environment by changing an agricultural, industrial, or community practice or process. • 5-ESS3-2(MA). Test a simple system designed to filter an impurity out of water and propose one change to the design to improve it.*
Grade Six *Engineering*	• Map out garden/trail scale	• Designing and Building Bridges • Designing and Building Boats	• Ecotarium • Broadmeadow Brook	• MS-ETS1-6(MA). Communicate a design solution to an intended user, including design features and limitations of the solution. • 2.1 Identify and explain the steps of the engineering design process, i.e., identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign. • 2.3 Describe and explain the purpose of a given prototype. • 2.5 Explain how such design features as size, shape, weight, function, and cost limitations would affect the construction of a given prototype.

Grade 1

- Stem Exploration (K-2)
  Continue teaching students about the parts of plants and their functions. Use the garden to teach a hands-on plant based activity.
  View details...
  Downloads
  Stem Exploration Lesson Set (quick view as .pdf)
  Stem Exploration Materials (quick view as .pdf)

- Watering the Garden
  Children will learn that plants need water just like people and animals need water. They will explore dry and wet soil and be able to describe the difference between them. Children will practice testing soil for dampness using their fingers. Children will be introduced to a rain gauge and its purpose.
  View details...
  Downloads
  Watering the Garden (quick view as .pdf)

- Seasons and Weather (K-2)
  Students will learn about seasonal weather patterns and their effects on local farms and gardens. Use qualitative and quantitative measurements to describe weather.
  View details...
  Downloads
  Seasons and Weather Lesson Set (quick view as .pdf)
  Seasons and Weather Materials (.zip)

- Soil Temperature
  Students will use thermometers to measure soil temperature and use the information to determine if the soil is warm enough to support plant growth.
  View details...
  Downloads
  Garden Temperature Chart (quick view as .pdf)
  Soil Temperature (quick view as .pdf)

- Changing Seasons and Changing Leaves (K-2)
  Teach students about changing seasons and the season of autumn. Students create a leaf spinner and record daily temperatures.
  View details...
  Downloads
  Changing Seasons and Changing Leaves Lesson Set (quick view as .pdf)
  Changing Seasons Changing Leaves Materials (.zip)

7

Grade 2

- Garden Planning (K-2)
  Through a hands-on activity, students learn about mapping and construct a "bird's-eye-view" picture of a garden bed. Students work together to make group decisions in planning a classroom garden.
  View details...

  Garden Planning Lesson Set – 1st Grade (quick view as .pdf)
  Garden Planning Lesson Set – 2nd Grade (quick view as .pdf)
  Garden Planning Lesson Set – Kindergarten (quick view as .pdf)
  Garden Planning Materials (all grades) (.zip)

- Measurement: Inch by Inch, Row by Row
  Students will determine the space needed to grow vegetables for a soup recipe.
  Zip file contains lesson plan and student worksheet.
  View details...
  Downloads
  Measurement: Inch by Inch, Row by Row (.zip)

- All About Worms (K-2)
  Teach students about life cycles by learning about worms and the ways they benefit the garden and farms. Through reading literature and completing hands-on activities, the class will conduct a worm investigation and observe that the organisms (and other animals) need food, air and space to grow.

  View details...
  Downloads
  All About Worms Lesson Set (quick view as .pdf)
  All About Worms Materials (.zip)

- Garden Friends (K-2)
  Introduce students to the insects and other creatures they will find in the garden and their characteristics.

  View details...
  Downloads
  Garden Friends Lesson Set (quick view as .pdf)
  Garden Friends Materials (.zip)

8

- **Soil Exploration**
  Through garden exploration, students will learn about the properties of soil and why soil is important to plants. They will closely observe soil and practice tallying and reporting results of soil experiments. Students love becoming soil scientists through this lesson and its activities!
  View details...
  Downloads
  Soil Exploration (quick view as .pdf)
  Soil Sorting Worksheet (quick view as .pdf)

Lesson Ideas per grade

Grade 3

Plant Life Cycles
(http://www.pbslearningmedia.org/resource/tdc02.sci.life.colt.lp_plantcycle/plant-life-cycles/)
In this lesson, students learn about the life cycle of plants by watching a time-lapse video. This activity provides students with further evidence that all living things grow and change as they progress through their life cycle. Two optional video segments show students how to set up a germination experiment and how to grow seeds they collect on their socks.
Objectives

- Understand that plants have a life cycle that includes sprouting; developing roots, stems, leaves, and flowers; reproducing; and eventually dying
- Observe the changes that occur during plant growth and development
- Understand that the life cycle of plants is different from the life cycle of animals
- Sequence the stages of plant life

Biology of plants
(http://www.mbgnet.net/bioplants/)
This resource is actually a unit focusing on the life cycle of plants, including sections on growth, plant parts, making food, pollination, seed dispersal, plant adaptations, and plants and life on Earth. It also has lesson plans, interactive games, and activities that are available for most of the concepts listed above. This resource provides a lot of content and background information for each topic and is presented in a clear and concise manner that would be appealing to both teachers and students.
Designing Investigations with Pill bugs
(http://outreach.mcb.harvard.edu/teachers/summer05/elizabethmick/pillbugbehavior.pdf)

Role of Pill bugs
Pill bugs play a role in decomposition. After feeding on decomposing plants, they return the organic material to the soil so it can be further digested into nutrients for growing plants.

9

Pill Bug Checkpoint Lab
(http://www.nsta.org/publications/press/extras/files/nexttime/PillBugCheckpointLab.pdf)
After completing this lab, a recommended book is The Next Time You See a Pill Bug.

Grade 4

Erosion
(http://science.nationalgeographic.com/science/photos/weathering-erosion-gallery/#/bernard-glacier_835_600x450.jpg)
Photographs of weathering and erosion to show students the effects of wind and water on landforms.
Weathering and Erosion
(http://www.uen.org/core/displayLessonPlans.do?courseNumber=3040&standardId=1210&objectiveId=1212)
How is the surface of the earth altered by weathering and erosion?
Wind, Water, Chemical Erosion
http://www.simplyscience.com/fourthgrade.html
Section 9 has a number of lessons on different types of erosion including a section on how engineering is connected.
The Changing Earth
(http://sbsciencematters.com/lesson-units/4th-grade/4earth-the-changing-earth/)
Lesson 2 (Rockin Rocks) and Lesson 3 (Slowly Reshaping Earth's Landforms) have great activities about both weathering and erosion.

Grade 5

Water Water Everywhere (From Boston Museum of Science Engineering is Elementary
Book: Saving Salila's Turtle
Zoom Water Filter
http://pbskids.org/zoom/activities/sci/waterfilter.html
Water Filtration
http://water.epa.gov/learn/kids/drinkingwater/upload/2005_03_10_kids_activity_grades_4-8_waterfiltration.pdf
An activity for water purification from the United States Environmental Protection Agency

Grade 6

Unit Overview
When it Rains, it Pours
When it rains, it pours—and when water can't soak through pavement, rain collects pollution that washes into rivers, lakes, and oceans. Use your environmental engineering skills to redesign a city and control storm water runoff.
http://www.eie.org/engineering-everywhere/curriculum-units/dont-runoff

Watercraft
Posted on May 25th, 2013 by Mary Lord
raft bugIn this activity, students in grades 6 to 8 learn about the engineering design process and the physical principles of buoyancy by working together to build a boat out of straws and plastic wrap that can hold 25 pennies for at least 10 seconds before sinking
http://teachers.egfi-k12.org/category/lessons/grades-6-8-lessons/page/2/

10