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Julia Kasukusa Date

# Grant Proposal for a socio-ecological approach, using community-based engagement principles and green infrastructure, to reduce magnitude and improve quality of storm water runoff entering storm drains in the Sandtown-Winchester/Harlem Park neighborhood, Baltimore City, Maryland

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An abstract of

A thesis submitted to the Faculty of the Rollins School of Public Health of Emory University in partial fulfillment of the requirements for the degree of Master of Public Health in Prevention Science

2017

## Abstract

Grant Proposal for a socio-ecological approach, using community-based engagement principles and green infrastructure, to reduce magnitude and improve quality of storm water runoff entering storm drains in the Sandtown-Winchester/Harlem Park neighborhood, Baltimore City, Maryland.

By Julia Kasukusa

Urban neighborhoods have the potential to help reach the targeted outcomes of the 2014 Chesapeake Bay Watershed agreement goals: targeting climate resiliency, stewardship, and water quality. High density populations, urban heat island effects (where temperatures are higher due to human activity), high levels of impervious surfaces (through which water cannot penetrate), and areas available for repurpose are all reasons to target the urban environment for storm water management. SW/HP is one of 55 neighborhoods that make up the port city of Baltimore. This urban landscape plays a substantial role in the water quality of the Inner Harbor, a key economic and environmental landmark for Baltimore and Maryland, and the storm water that runs into it.

The grant proposal seeks funds from the Chesapeake Bay Stewardship Fund to reduce storm water runoff and reduce the pollutants available to enter the local watershed through storm water runoff within the Sandtown-Winchester/Harlem Park neighborhood. With community-determined needs, this project will provide knowledge building, via trainings, a social marketing campaign, workshops, and community fairs. Partner organizations will help residents install Green Infrastructure (GI) elements that can reduce storm water volume. Focusing on the quality of the built environment in the community serves two functions: improving the local environment and watersheds, as well as impacting the health of the community. Storm water management betterment can result in healthier watersheds, and a healthy harbor, bay and community.

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# Chapter I: Introduction

## Problem Statement

The Chesapeake Bay Watershed is the largest watershed on the east coast with an estimated population of 18.1 million residing within the watershed. Currently, the water quality of the Bay is considered poor, with only 37% of the Bay and its tributaries meeting current Environmental Protection Agency (EPA) water quality standards for chemical and microbial contaminants (Chesapeake Bay Program, 2012c). The health of the Bay is monitored by examining habitats, fish and shellfish, and microbial water quality and measuring levels of pollutants such as toxic contaminants, nitrogen, phosphorous, and sediment. The watershed, which consists of six states and the District of Columbia has 70% of the population residing in just two of those states, Maryland and Virginia (Chesapeake Bay Program, 2012a). The fastest growing source of pollution for the Bay is storm water runoff. Addressing storm water runoff within the Chesapeake Bay watershed is needed in order to restore the quality of the Bay and promote healthy habitats for those that reside in and around the Bay (Chesapeake Bay Program, 2012b).

Storm water runoff is highly impacted by urbanization. Urbanization is the migration of populations to city areas that are highly developed areas with limited open areas and little undeveloped land. Urbanization is also the emerging of urban centers from areas that were once more open such as small towns and increasing development of cities (Chesapeake Bay Program, 2012a). Urbanization leads to increased pollutants, contaminants, and sediments entering the water stream, which affects the delicate balance of the ecosystem and public health.

Urbanization activities that can impact water quality include but are not limited to construction of buildings and roads, wastewater plant discharge, increased pet waste, use of motor vehicles, and increasing impervious surfaces (surfaces that water cannot pass through). These activities result in a variety of pollutants, including trash, sediments, oils, animal waste, and other pollutants that can be carried into waterways. Historically, urban areas have been designed with surfaces that allow water to run, unfiltered, through pipes and storm drains or through water treatment plants – into waterways carrying pollutants and sediments (Cann, Thomas, Salmon, Wyn-Jones, & Kay, 2013). This design focused on mitigating flooding and directing water away from residents but does not focus on environmental contamination by direct discharge into natural waterways (Maryland Department of the Environment, 2014).

Improper or antiquated sewers and storm water pipe systems can result in fecal contamination of water by bacteria and other microorganisms, as well as increases in other chronic and acute illnesses from chemical pollutants, with the potential for increases in waterborne disease. Due to age, lack of maintenance, and changing climate, these systems are unable to accommodate more dramatic weather events, such as heavy precipitation. When heavy precipitation occurs, the infrastructure is compromised, stormwater enters the sewer lines, and water travels over surfaces that often have trash, heavy metals, and other contaminants and pollutants, all of which get carried along. Sewer pipes overflow, water treatment plants become overwhelmed, and sewage and trash contaminate area watersheds including drinking and recreational water sources (Cann et al., 2013). Populations are most often at risk for disease through recreation in polluted water, and the risk increases just after a storm event. Hence, urban stormwater

quality management is a priority for public health (Gaffield, Goo, Richards, & Jackson, 2003).

As part of the Chesapeake Bay Watershed, Baltimore City is located along the Patapsco River, a river that is essential to the health, social welfare, and economy of the people and the city. Baltimore City is a prime example of an urban center with an antiquated sewer system, built over 100 years ago, that continues to contribute to pollution problems. Heavy storms often result in sewer lines overflowing, due to the magnitude of the storm water volume and the deterioration of the pipes, cracks in the lines allow the sudden increases in volume of stormwater to enter and overflow the system (Clean Water Baltimore, 2015). The overflow results in both stormwater pollutants and fecal contamination entering the waterways, decreasing the quality of the local water. In 2002, the EPA and Maryland Department of the Environment sued the city for the lack of compliance with the Clean Water Act (CWA). The CWA was implemented to control water pollution, to curb pollutants from damaging the waterways in the United States, and to restore the waterways to a natural state. The CWA set standards for pollutants and regulations for discharge, pollution control standards, and recognizes that nonpoint source pollution is an issue that has significance as well (EPA, 2017a). The settlement resulted in a consent decree that requires adjustments to capacity loads, eliminating physical overflow structures and updating the sewer system over a 14 year period (EPA, 2016a). The consent decree has since been reviewed and revised. The timeline has been extended and revised into a phase one and phase two plan with phase two scheduled to be completed by 2030 to be in full compliance with the CWA (EPA, 2016c).

Baltimore's waterways, in particular the Harbor, have been improving but still do not meet standards for swimming and fishing. Sewage, trash, and stormwater are recognized as the main sources of pollution in the Harbor. In 2015, the first Total Maximum Daily Load (TMDL) for trash in the Baltimore Harbor was developed. The TMDL not to be exceeded is listed as trash in pounds removed, based on removal of 100% of the baseline average: 8.4 lbs./day of trash to be removed from non-point sources and 128.4 lbs./day to be removed from point sources (MDE, 2014). The water quality of the harbor is measured against standards set by the EPA and the state of Maryland. For example, the EPA's qualifications for safe swimming are measurements of less than 126/100mL for *E. coli* and 35/100mL in marine water for *Enterococci* spp., and the Inner Harbor basin only met those standards 20% of the 15 water samples tested in 2016 (Waterfront Partnership of Baltimore, 2017). In 2011, the Waterfront Partnership of Baltimore, a nonprofit organization focused on the waterfront of the Inner Harbor, released a ten year strategy plan focused on reducing fecal bacteria, trash and litter, as well as polluted storm water runoff in an effort to improve water quality (Waterfront Partnership of Baltimore, 2011). While a significant amount of progress has recently been made, there is still much more that needs to be done to address storm water management, in order to ensure improved water quality for the residents and visitors of Baltimore City.

A significant intervention that can be implemented at the community and individual level is the use of green infrastructure (GI). GI and its management is the use of technology and techniques based on the natural water cycle that allows water to be absorbed and filtered at the point of impact, reducing the amount of runoff. Examples of means that can be used to reduce excess storm water and increase absorption at point of

precipitation contact are increasing pervious (water penetrable) surfaces, rain gardens, rain barrels, green roofs, bio swales, and increasing tree canopy (United States Environmental Protection Agency, 2016). Rain gardens use the natural slope of the land to direct excess water to an area designed specifically to filter water slowly through gravel and soil and uses plants to help absorb the water. Rain barrels collect rain primarily from rooftops by linking to the gutter system to store for repurposing at a later date. Bio swales are similar to rain gardens but are generally constructed in a much narrow landscaped area such as alongside a road (United States Environmental Protection Agency, 2016).

**Purpose Statement**

This grant proposal aims to accelerate adoption of green infrastructure through development of a social marketing campaign and reduce non-point sources of storm water pollution through community behavior change by members of the Sandtown-Winchester/Harlem Park neighborhood of Baltimore City, Maryland. Completion of this campaign and program will change behavior to sustain improved water quality for the Chesapeake Bay watershed.

**Objectives to be Answered by the Proposal**

There are two main objectives to be answered by the grant proposal. Both are equal in importance and can be targeted in conjunction to improve water quality. The first is to reduce the amount of stormwater runoff by using local partnerships to educate community members on storm water stewardship and to implement green infrastructure projects. The second is to reduce the amount of pollutants in stormwater runoff that enter the local watershed through increased GI adoption and increased community stewardship.

These objectives are focused on improving the health and wellbeing of the community as well as the Chesapeake Bay.

**Significance Statement**

Stormwater management starts with small actions, proper disposal of waste, and implementation of GI that can have significant impacts on water quality. Individual and community stewardship can have a lasting effect on water quality, the health of the neighborhood, and the health of the bay. Stewardship skills are also passed down generationally, which helps to create a sustainable path for the future. Improving water quality can increase safe recreation and safe sources of food, which can improve health and increase pride in the community and the city. Engagement by individuals in a community provides hands on approach that provides benefits at the social and ecological level that may be difficult to replicate at a higher level (Krasny, Russ, Tidball, & Elmqvist, 2014).

This proposal focuses on cost effective methods for reducing pollutants from entering local watersheds, demonstrating how communities can be stewards for the environment and their own health. The process for this community to develop storm water stewards through social marketing, outreach, education, and GI implementation can serve as a model to be replicated in other communities and to be used to increase awareness of stormwater management. It can also demonstrate how small actions can have significant positive impacts on the community ecosystem and health. Emphasizing and demonstrating the connection between public health, our structural environment, and the natural environment within the community provides a new perspective in viewing daily activities. The end result of this proposal will ultimately aid in the protection of the

Chesapeake Bay, an important water source, and the health of the city, with implications for sustained replication in other cites as well.

**Definition of Terms**

*Green Infrastructure*: An approach to excess precipitation that uses simple methods to reduce and treat at the point of impact. The methods and structures are designed to mimic natural and semi-natural areas that can collect, absorb and filter the water, a manner of water purification and climate mitigation.

*Storm water*: The rainwater or melted snow that runs off streets, lawns and other surfaces. Amounts can vary based on the intensity of the storm.

*Storm water Management:* The control of the precipitation from rain or snow, traditionally a network of pipes to direct the precipitation to its final location away from built environments.

*Watershed:* The area that drains into a larger body of water such as a river or a lake.

# Chapter II: Literature Review

## Introduction

This chapter is a review of the literature that pertains to urban storm water management, pollution and the use of green infrastructure, and the known relationships to health of communities. This review will focus on Baltimore City as an urban environment. Urban areas have significantly altered the natural water landscape due to increased populations and size and number of urban and semi-urban areas.

Human health relies on clean water for eating, drinking, hygiene, and sustaining the planet that humans inhabit. Even in the United States where it is often assumed that access to clean water is available, it is not guaranteed. Since development of regulations and guidelines is relatively new storm water management can be viewed as a relatively new practice and field of research.

## Literature Review

Storm water management in an urban setting is the management practices of excess precipitation that result from rain and snow that cannot be absorbed by the environment. The management of that excess utilizes tools and practices to control how the water moves and where it ultimately ends up. Urban areas have a higher percentage of built surfaces, surfaces that are impervious and cannot absorb water, than surfaces that can absorb and filter the excess precipitation. Along with increased impervious surface area, climate change has amplified the excess precipitation from rain and snow and created an increased focus on stormwater management. Pollutants on the ground are picked up by the excess water as it runs over the surfaces and enters the waterway without filtration. Without storm water management, this excess precipitation can cause

flooding, erosion, habitat destruction, infrastructure damage, contamination of drinking water, increased pollutants including sewage in watersheds and disease breakouts (Center for Watershed Protection, 2016).

Climate change impacts continue to compromise current storm water systems as storms have increased in frequency and intensity in the Northeast United States in the last thirty to fifty years (US Global Change and Research Program, 2014). Vulnerable communities, individuals living in urban areas, areas with open water sources, and those who are immuno-compromised are at higher risk of infection from bacteria, viruses, parasites, and chemicals in the water (Centers for Disease Control and Prevention, 2015). A study done in the United States found that just over half of waterborne disease outbreaks occurred after heavy rainfall events and outbreaks due to surface-water contamination were associated with excessive extended rainfall (Auld, MacIver, & Klaassen, 2004). Intense storm events create high volumes of water, which create a faster, more direct way for pollutants to enter the waterways. High volumes of water also add to an already antiquated sewer system resulting in sewage and stormwater entering surface water through overflow. Combined sewer outflows (CSOs) are often a planning feature in many older urban areas, which allow stormwater and sewage to allow overflow to spill directly into surface water (Baltimore City Department of Planning, 2006). The direct spillage of sewage into the waterways means fecal bacteria levels are higher, which are often indicated by increased levels of *E. coli*. Increased levels of *E. coli* is also another result of climate change, seasonal changes, as well as changes in landscape as levels are often higher during the first rains after a dry period (Chen & Chang, 2014).

Stormwater management can play a significant role in reducing volume and pollutants and thus decreasing the number of outbreaks.

Urban landscapes can provide more sources for pollutants and contamination (Chen & Chang, 2014). Human activity is the cause of litter and improper disposal of garbage, heaped in alleys or piled on streets. Garbage and litter are not only an eyesore, but are also sources for pollution via storm water runoff, as they attract rats and other animals that can increase animal waste that contaminates water via storm water, and create an unhealthy environment, as well as decrease property value (Mmari et al., 2014). Dense population areas, food deserts, cultural barriers, as well as attitudes resulting from knowledge gaps in downstream effects, contribute to the amount of packaging and other litter that can be found on city streets. An individual or community's perception of the environment influences their health. Often a negative perception of the environment, such as high crime rates, trash and pollution, and safety will influence health-seeking behaviors such as limiting physical activity as well as behaviors such as increased smoking (Gary et al., 2008). Behaviors such as smoking also contribute to increased litter. Litter and trash in the neighborhoods contributes to stress that can be linked to health problems such as cardiovascular disease and depression (Latkin & Curry, 2003). Simple acts of littering and trash pollution that are controllable and preventable that can impact the health of the community.

An increased side effect from urban activity that also contributes to storm water pollution is motor vehicle use. Motor vehicle use is increased in urban area, many people commute into urban areas for work, and there is an increased density of filling stations and parking locations (Chesapeake Bay Program, 2012a). Motor vehicles often leak oil,

gas, or other fluids that sit on pavement until they are washed away in storm water. Fuel storage and transfer releases liquid and unburned fuel vapor that contaminates the air and ground and the cumulative effects in an urban area create greater health issues and contribute more to storm water contamination (Hilpert, Mora, Ni, Rule, & Nachman, 2015).

With an abundant amount of sources for pollutants, urban settings create an easy pathway for those pollutants to contaminate water. Urban settings have high rates of darkly-colored, impervious surfaces that can cause changes in temperature to the runoff, which then affects the temperature of the waterway the storm water drains into (Hathaway, Winston, Brown, Hunt, & McCarthy, 2016). Increased temperatures can create an imbalanced ecosystem and can increase the solubility of pollutants in the surface water creating a hazard to human health when contacted or ingested. Pollutants in the urban setting that end up being transported via stormwater can include motor vehicles wastes, pesticides, trash and litter, sediments, spilled oils and chemicals, and pet and animal waste. Pet and animal waste is a common occurrence and often not disposed of properly leading to fecal contamination within the watershed. Measurement of fecal contamination in the water often includes levels of *E. coli* and/or *Enterococci* spp. Concentrations of these organisms increase in association with precipitation events, indicating the importance of storm water management and importance to public health (Chen & Chang, 2014).

Baltimore, established in the 1700s, is an old city with a significant history. In the early 1800s, Baltimore's original water system piping was installed and again expanded in the mid and late 1800s (Baltimore City Department of Planning, 2006). During that

time, a number of creeks and streams were buried or partially covered and became the storm drain infrastructure that exists currently. Baltimore City's storm drain infrastructure consists of 1,146 miles of storm drain pipes, 52,438 storm drain inlets, 27,561 manholes, and 1,709 outfalls (Baltimore City Department of Public Works).

Antiquated piping has been a contributor to the significant struggles with storm water management that have faced Baltimore City. In not being able to keep up with maintenance as well as other socio and political reasons, Baltimore City has been out of compliance with EPA CWA regulations for the last fifteen years. The city is required to implement a plan to become compliant within the next fifteen years (EPA News Releases, 2016). Water quality in Baltimore is a significant issue as levels of pollutants do not meet the requirements of the EPA nor for that of healthy watershed, ecosystem, and communities.

Although there are federal and state regulations and guidelines, these were not developed until 1985 or later. Urban areas, such as Baltimore City, are much older than that and thus were not built with these regulations in mind or with concern for environmental pollutants. In 1990, the National Pollutant Discharge Elimination System (NPDES) was outlined. The NPDES focuses primarily on point sources such as construction, municipal sewage, and industrial storm water. It recognizes that it is difficult to regulate non point sources of storm water pollution and that storm water management can result in protection of ecosystems, improved water quality, conservation of resources, flood control, and protection of human health (EPA, 2016b).

Along with federal regulations focused on storm water there are also state regulations. In 2007, Maryland published its Stormwater Management Act, which took

effect in October of that year. The Stormwater Management Act outlines best management practices and techniques that should be utilized to protect public health (Maryland Department of the Environment, 2007).

GI uses natural methods in order to reduce, cleanse, and capture runoff. Urban best management practices that utilize GI, outlined in Maryland's Storm Water Management Act, include ponds, wetlands, infiltration practices, filtering systems and open channels (Maryland Department of the Environment, 2007). Trees, rain gardens, and rain barrels work at a smaller scale and are frequently used in residential or smaller landscape areas. Water harvesting via rain gardens and rain barrels can redirect the excess precipitation from entering storm drains. Replacing impervious surfaces with soft surfaces such as grass and soil or pervious pavers allows the water to filter naturally. Rain gardens and filtration planters create a space for this natural filtration and allow a certain amount of water to collect before being filtered or displaced as runoff. Low Impact Development (LID) utilizes landscaping techniques to maintain natural drainage and landscape is also considered a GI technique. Environmental Site Design and Better Site Design are design practices that look to mimic natural techniques and features for storm water management (Center for Watershed Protection, 2016). Maryland requires that Environmental Site Design be implemented to the maximum ability and utilize best management practices outlined in the Storm Water Management Act {Maryland Department of the Environment, 2007 #91}.

GI use has been around in some form for many years but studies on the benefits to water quality and technological advancements in methods are relatively new (Pennino, McDonald, & Jaffe, 2016). Research has been done with GI to show the impact on

variability in water flow and changes in volume, intensity, and peak frequency. GI can help mitigate the impacts of increasingly frequent and severe hydrological events. Greater numbers of GI are linked to reduced magnitude of runoff and less peaks of runoff during storm events. Implementation of GI also helps to maintain and reduce increases in variability when compared to water ways without GI. Water ways without GI are more likely to have an increase in variability of flow due to environmental effects such as erosion and climate change and unregulated storm water runoff (Pennino et al., 2016). GI may also reduce nitrogen from being exported downstream (Reisinger, Groffman, & Rosi-Marshall, 2016). These are promising trends on reduction of outflow but there is a need for continuing research on the benefits of implementation over time (Pennino et al., 2016).

Rain water harvesting aids in reduction of storm water runoff volume and was initially developed with a focus on water conservation efforts. Rain water harvesting has continually evolved over the last 20 years and systems technology has rapidly grown in the most recent years (Campisano et al., 2017). Rainwater storage, such as the use of rain barrels, is beneficial but requires continuous use to be effective and to maximize the benefit. Rainwater can be used for multiple purposes such as car-washing, laundry, toilet flushing, and garden irrigation. Rain water harvesting with the use of rain barrels is not a new practice but one that has not been researched extensively (Campisano et al., 2017). There have been some studies in Australia as the water crisis in that region has created momentum towards water conservation (Dean, Fielding, & Newton, 2016; Hathaway et al., 2016). Globally, in areas that have water shortages, community rainwater harvesting has been found to be instrumental in sustaining communities. Nationally, rainwater

harvesting benefits and uses are highlighted in drought areas in the United States. Texas, in fact, has more usage of techniques than other states and the state encourages conservation with incentives, which is uncommon for a state (Campisano et al., 2017). More data focused on the barriers for adoption of water policies that could promote water conservation and water quality at the state and local level is needed. There is also a lack of data linking rainwater harvesting, water quality, and stormwater management at the regional scale (Campisano et al., 2017).

Community members can also play a role in storm water management, as they are the ones that often have the most impact (Jerome, Mell, & Shaw, 2017). Individual actions multiplied by large populations can have detrimental effects and thus the importance of the individual in regulating whether or not pollutants enter the water ways. Garbage management, pet waste management, household activities, and household water usage all play a role in stormwater management. Proper storage and disposal of waste can aid in reducing possible pollutants, garbage heaps or improperly stored garbage bags attracts animals and creates a trash source for storm water. Trash, sediments, oil, and chemicals from motor vehicle maintenance often contain heavy metals and are carried into our waterways via in storm water. It's essential that communities and citizens are aware of the consequences of actions such as improper disposal of garbage and are able to engage in best management practices. Increased knowledge is associated with increased pollution reduction behaviors including support for GI (Dean et al., 2016).

In order for citizens to be engaged they need access to knowledge. Areas of focus when looking to engage communities are cognitive engagement, emotional engagement, and behavioral engagement. These methods of engagement involve examining

determinants to acceptance of pro-environmental ideas. Part of the process to examine determinants involves assessing communities' strengths and weaknesses, acknowledging current skills and attitudes, and developing ways to align with communities pre-existing knowledge. To fully engage within a community, a deeper understanding must be undertaken (Dean et al., 2016). Overall, there is a need for more information on social and cultural barriers to adoption of rainwater harvesting and GI (Chaffin et al., 2016). Some issues may arise due to community perceptions and engagement, which may be limited by understanding and approach by implementers (Church, 2015). Understanding the community is essential to creating community engagement. Engagement requires building social capital among all partners and stakeholders, investing and supporting community groups, and utilizing and building on community networks for sustainability and success (Chaffin et al., 2016).

Current storm water research has primarily focused on 'end of pipe' outflows and effects on waterways. GI is continuing to be studied and is becoming more common in planning and implementation practices. However there are areas for more research and data to be developed as pertains to storm water management and GI. GI implementation and reduction of pollutants and volume has limited research thus far. Qualitative data has been more abundant than quantitative data. Storm water management is multi-faceted and leads to difficulty in quantifying and providing statistically significant data. Storm water pathways are also unique to the geographic location and the built environment (Goonetilleke, Thomas, Ginn, & Gilbert, 2005).

**Summary of Current Problem and Proposal Relevance**

This grant proposal project targets community and individual aspects of improving the upstream quality of water as well as reducing the volume of runoff that enters the waterway, as they go hand in hand to improving the quality of water through storm water management.

# Chapter III: Methodology

## Introduction

Chapter III includes a review of funding agencies that typically address stormwater management especially in relation to the water quality of the Chesapeake Bay Watershed. It also includes a summary of the grant announcement for this proposal, the grant review process, and a description of the grant proposal reviewers and their expertise.

## A Review of Funding Agencies

An interdisciplinary field, environmental health has not just one definition but many interpretive definitions that focus on the relationship between people and the environment, or specific factors in the environment such as air, water, chemical or biological hazards, as well as social, or physical environment attributes (*Environmental Health: From Global to Local*, 2010). A broad view of environmental health means that there are a variety of sources for funding for environmental health proposals ranging from examining specific chemicals to the communities that live in specific social and built environments. This proposal focuses on water quality as affected by storm water runoff. Organizations and foundations that typically fund this type of proposal include globally, the Bill and Melinda Gates Foundation, domestically within the United States; the Clean Water Fund, and governmental organizations such as the EPA and USDA. Grant funding for the local Chesapeake Bay watershed is typically available through the Chesapeake Bay Program, the Chesapeake Bay Trust, and the EPA CWSRF, that encompass the Chesapeake Bay watershed. Much of these funds are allocated through the congressional budget.

## Funding Agencies

### Water Environment & Reuse Foundation

The Water Environment & Reuse Foundation is a nonprofit 501(c)3 founded in July 2016 when the Water Environment Research Foundation and the WateReuse Research Foundation merged. The foundation's mission is to use water research to advance science in technology with the goal to influence policy and regulations to protect and conserve natural resources and public health. The foundation works to fund research that can provide data to influence policymakers as well as to inform the public on information from research on the following:

- Applied research on water and the environment
- Accelerating innovation and adaption of technology
- Transferring knowledge and
- Setting an industry research agenda (Water Environment & Reuse Foundation).

One example, is a recently funded project that looks at standardizing, analyzing and compiling data on 'Community-Enabled Lifecycle Analysis of Stormwater Infrastructure Costs' and to provide tools and resources to communities in storm water management planning (Water Environment & Reuse Foundation).

### Chesapeake Bay Program

The Chesapeake Bay Program was founded in 1983 in order to reduce pollution and restore the ecosystem of the Chesapeake Bay based on the motto: science, restoration, partnership. The program is a unique set of partnerships all working together to contribute to the common goal of conserving and protecting the Bay. The Program

consists of groups of committees, goal implementation teams, workgroups, and action teams. The main goal is to aid in directing policy while additionally holding partners accountable for reaching specified targets and goals. The management team at the Chesapeake Bay Program works directly with the Chesapeake Executive Council, consisting of the 6 governors of the watershed states, the mayor of the District of Columbia, chair of the Chesapeake bay commission, and administrator of the EPA (Chesapeake Bay Program, 2017b). The Chesapeake Bay Program was instrumental in developing, creating guidelines, setting goals, and managing progress of the 2014 Chesapeake Bay Watershed Agreement. Multiple grant opportunities are available throughout the year through the Chesapeake Bay Program and partner organizations (Chesapeake Bay Program, 2017a).

**Chesapeake Bay Trust**

The Chesapeake Bay Trust is a non-profit organization begun in 1985 that has been awarding grants since 2009. The Trust provides grant funding to projects that focus on one or more of three core objectives. The objectives are environmental education, demonstration-based restoration, and community engagement. These three objectives support the mission of the organization to promote public awareness and participation in restoration of the Chesapeake Bay region. Multiple grant opportunities are available through the Trust. The opportunities are split into four types; Restoration, Retrofits, and Science; Environmental Education; Outreach; and Grants by County or City. Each specific grant differs in funding amounts, partnerships, and funding sources. In 2016, 27,669 volunteers were engaged in cleaning up neighborhoods, the Bay, and local

watersheds through grant funding by the Chesapeake Bay Trust (Chesapeake Bay Trust, 2017).

**Clean Water State Revolving Fund (CWSRF)**

The EPA CWSRF was established in 1987 as an amendment to the Clean Water Act (CWA) and a partnership between the EPA and the states to provide financial assistance to water infrastructure projects. It is a loan assistance program that was started with $41 billion in federal funds that through 2016 has given out $118 billion to communities. Throughout 2016 more than 38,450 low interest rate loans have been given out. In order to be eligible recipients must be involved in one of 11 project types: Construction of Publicly Owned treatment works, Nonpoint source, National Estuary Program projects, decentralized wastewater treatment systems, storm water, water conservation, efficiency, and reuse, watershed pilot projects, energy efficiency, water reuse, security measures at publically owned treatment works, and technical assistance (EPA).

**The Chesapeake Bay Stewardship Fund, National Fish and Wildlife Foundation (NFWF)**

The Chesapeake Bay Stewardship Fund is a partnership between the Bay Program and the NFWF, which has awarded over 950 grants since 1999. The funding comes from a mix of partnerships including the U.S. Environmental Protection Agency, Altria Group, the USDA's Natural Resources Conservation Service and Forest Service, CSX, National Oceanic and Atmospheric Administration, and U.S. Fish and Wildlife Service (NFWF, 2017). Each year the Chesapeake Bay Stewardship Fund request for proposals consists of a small watershed grant and an innovative nutrient and sediment reduction grant. The

small watershed grant aims to promote community-based efforts to protect and restore local watersheds within the larger Chesapeake Bay watershed, creating healthier environments by and for the people who live in them. The small watershed grant highlights the need for building capacity and for behavior change for green infrastructure adoption in urban communities.

**A Summary of the Grant Announcement**

Since 2007 the National Fish and Wildlife Foundation in conjunction with the Chesapeake Bay Stewardship Fund has put out a Small Watershed Grant and Innovative Nutrient and Sediment Reduction Grant requests for proposal every year typically occurring at the end of February or beginning of March. The Chesapeake Bay Small Watershed grants are awarded in the amount of $20,000 to $200,000. The request for proposal is advertised on the Chesapeake Bay Program, the Chesapeake Bay Trust, and the Chesapeake Bay Stewardship Fund websites.

The Chesapeake Bay Stewardship Fund's conservation efforts focus on three main goals: restore and protect vital habitats, improve conservation on private lands, and improve urban stormwater management. The proposals for funding must align with at least one of the main goals as well as relevant outcomes and priorities from the 2014 signed Chesapeake Bay Watershed Agreement. Successful proposals are described as meeting one of the following three priorities: targeted river and watershed restoration, green infrastructure in urban landscapes, and innovation on cross cutting issues.

Green infrastructure in urban landscapes, was this proposals primary focus, this priority requires emphasis on advancing GI strategies, integrating green infrastructure into existing local government and watershed partner programming, and/or accelerating

adoption of green infrastructure practices on public and private lands. This proposal focuses on two strategies within the priority: implementing GI in small, high-growth, and unregulated communities and behavior change for GI adoption.

The submission process is completed online via easygrants.nfwf.org. The applicants first must complete an eligibility quiz once logging onto the website. Once eligibility is confirmed the full application can then be filled out, the narrative summary template can be downloaded, forms are uploaded, and the fully complete application is submitted. Both the Innovative Nutrient Grant and Small Watershed Grant follow the same application process. Basic project information such as title, start and end date, description, abstract, project location, and project location description is entered into the respective fields following the required character count. There is also a mapping feature that allows the project location to be selected using a mapping interface. A number of required files are uploaded in order to complete the application; the full proposal narrative, which must follow the template and stay within a ten page limit, Field Doc Project Summary, Statement of Litigation, Board of Trustees or Directors, GAAP audited Financial statements, IRS form 990, and an A-133 audit. Additional files that may be uploaded but are not required include project maps and diagrams, letters of support, conceptual or engineered plans, photos, and other document (ten page limit). A metrics section, budget section, and as needed permit section follow. The deadline for submission of a fully completed application for 2017 is May 9$^{th}$. The grant application is then reviewed against several criteria: relevance, accuracy, completeness, and compliance with NFWF funding source policies. After that the application is reviewed against the following criteria: Environmental Results, Program Priorities and Goals, Partnership and

Community Engagement, Transferability and Dissemination Plans, and Technical Merit, Work Plan, and Budget. The review period runs from submission in May through June and an anticipated announcement of awards occurs in August.

For the purpose of completing a thesis for the Emory EMPH program the student was only required to write the narrative part of the proposal and did not need to complete pieces that included budget, or any financial and tax information.. The proposal requires a narrative of no more than ten pages, prepared in a semi outline format following the instructions for the full-proposal project narrative obtained from the NFWF by the student.

**The Grant Review Process**

Besides the review criteria, the actual review process for the submission of the proposal for NFWF is unknown. This section describes the grant review process followed by the student for purposes of this thesis.

The five grant reviewers for the small watershed grant narrative proposal received the proposal via email on August 8th. Along with the proposal the reviewers were given the proposal review criteria for Environmental Results, Program Priorities and Goals, Partnership and Community Engagement, and Transferability and Dissemination Plan described in the following section directly from the request for proposal. Each reviewer was given three weeks to review, comment, and provide feedback based on the criteria and a short questionnaire of mixed multiple choice and open ended questions. Once responses were received, comments and feedback were then noted, reviewed, accepted or rejected, and incorporated into the final grant proposal. Any confusion or questions on comments and feedback were clarified by a follow-up email. A thank you note was also

emailed once responses were received. One final review of the proposal was conducted and the final version of the proposal is found in Chapter Five.

Questionnaire

1. Please state your level of agreement/disagreement with the following statement: The submission is responsive to the proposal criteria.

A. Strongly Agree

B. Agree

C. Neither Agree nor Disagree

D. Disagree

E. Strongly Disagree

2. How could the submission have been more responsive to the proposal criteria?

3. Please state your level of agreement/disagreement with the following statement: The proposal is well thought out and theoretically sound.

A. Strongly Agree

B. Agree

C. Neither Agree nor Disagree

D. Disagree

E. Strongly Disagree

4. What improvements could be made to the theory and structure of the proposal?

5. Please state your level of agreement/disagreement with the following statement: The Principle Investigator (PI) makes a compelling case that the proposed research/project/program is necessary.

A. Strongly Agree

B. Agree

C. Neither Agree nor Disagree

D. Disagree

E. Strongly Disagree

6. What would have improved the argument that the proposed activities are necessary?

7. What additional comments and suggestions do you have for the PI?

**Proposal Criteria**

The proposal criteria is listed and briefly addressed on how the proposal meets the criteria from the NFWF request for proposals. The criteria were sent along with the previous questionnaire to assist the reviewers in evaluation.

***Environmental Results*** *– Project provides quantifiable improvements in water quality, habitat, and/or other conservation priorities for the Chesapeake Bay and its tributaries, and contributes toward meeting water quality targets expressed in Chesapeake Bay TMDL Watershed Implementation Plans (WIPs) and broader conservation goals and outcomes outlined in the 2014 Chesapeake Bay Watershed Agreement (CBWA). Proposal references existing water quality, habitat, and species monitoring data and programs in the project area and utilizes associated data to validate estimated environmental results with real-world monitoring information (NFWF, 2017).*

Storm drain monitoring within SW/HP will be implemented for the duration of the program to measure nitrogen, phosphorous, sediment, fecal bacteria, and trash and debris. Along with data from the storm drain monitoring, existing monitoring data from the Maryland's Department of Environment accessed via the Water Quality Portal and

Blue Water Baltimore's ambient water quality monitoring program will be used to validate environmental results.

The CBWA outlines several goals and outcomes that the partnership strives for and aims to work on collectively. Improving water quality, reducing toxic contaminants, sustaining a healthy watershed, building stewardship, and improving climate resiliency are the goals targeted by this proposal (Chesapeake Bay Program, 2014). Through the use of social marketing to influence behavior change of the residents of SW/HP water quality will be improved and toxic contaminants through reduction of trash and debris, animal waste, and household and auto maintenance. The program will create invested watershed stewards that can assist in sustaining a healthy watershed and pass on the knowledge, techniques, and tools needed to maintain the behavior that will meet the targeted five goals. Sustained stewardship measured by a minimum of 30 pledges to commit to stormwater stewardship. Implementation of a minimum of fifteen rain gardens and/or rain barrels and ten infiltration planters will improve climate resiliency by reducing the volume of stormwater from the neighborhood.

***Program Priorities and Goals*** *– Project contributes to the Chesapeake Bay Stewardship Fund Conservation Outcomes, has specific, quantifiable performance metrics to evaluate project success, and addresses one or more of the program priorities outlined in the Request for Proposals (NFWF, 2017).*

The Chesapeake Bay Stewardship Fund has nine listed conservation outcomes. This proposal addresses two specific outcomes: Reduce nutrient and sediment pollution and stormwater runoff from residential and commercial properties; and store, treat and infiltrate stormwater runoff through management practices such as GI. Community

mobilization of green infrastructure in the urban neighborhood of SW/HP speaks directly to these two conservation outcomes. Reduction of nutrient and sediment pollution as well as reduction of stormwater runoff will be completed by reducing behaviors that allow pollutants to enter stormwater. Changes are measured via storm drain monitoring and water quality data from area water source. Storage and treatment of stormwater management include a minimum of 25 green infrastructure installations, community members trained, and minimum of 30 community members with written commitments to improving and reducing stormwater runoff.

***Partnership and Community Engagement*** *– Project engages diverse local community members, leaders, community-based organizations, and other relevant partners to ensure the long-term sustainability of the project, integration into local programs and policies, and community acceptance of proposed restoration actions. Non-traditional partners or communities are enlisted to broaden the sustained impact from the project. Projects successfully demonstrate how prior efforts in the project area or region have informed and shaped proposed approach (NFWF, 2017).*

This proposal is built on existing partnerships and future partnerships within the SW/HP community. The social marketing campaign targets residents and diverse community block leaders, non-traditional partners such as faith leaders, school, and business residents and leaders. Community stakeholders who implement GI are invested in the projects and leaders in the community to aid in community acceptance and integration of GI into the community. Partners that have worked on similar projects, and have established trust and community acceptance include Parks and People Foundation and Blue Water Baltimore, who both have extensive knowledge and experience in

working on education and implementation of green infrastructure. Working together with Department of Public Works, Public Safety, and officials from the City of Baltimore will aid in sustainability and aid in building a level of trust with the city for further dissemination. Utilizing organizations from public and private backgrounds as well as establishing a baseline assessment to fully understand the barriers and avenues for adoption, implementation, and sustainability of GI utilizes a socio-ecological approach that creates a sustainable environment.

***Transferability and Dissemination Plans*** *– Project includes clear plans to actively transfer and disseminate project-related information to appropriate audiences and relevant stakeholders within the Chesapeake Bay watershed through multiple communications mechanisms, with the goal of expanding adoption of successful approaches and integration into government programs and policies (NFWF, 2017).*

Dissemination of project progress and results, including success and pain points, will be shared within six months of project completion. Information will be shared with residents via social media, focus groups, and community meetings. Partner organizations including government entities will receive information throughout via meetings in person or via phone with contributing key stakeholders as well as to share findings of project completion and evaluation.

Utilizing a formative evaluation plan, residents and key stakeholders will provide input at multiple stages of the project. This formative evaluation plan allows the project to evolve and adapt as new challenges and opportunities arise to continue to meet the proposal objectives. This project is replicable in any neighborhood in Baltimore City, the distinctive blend of community stakeholders and social marketing implementation that

requires a baseline assessment to fully understand the communities being addressed means the each neighborhood's needs and challenges are incorporated and addressed in the plan. This program provides an outline for implementation that can be utilized in any area of the city and create a sustainable path to utilize available resources in order to meet the Chesapeake Bay Watershed Agreement and Chesapeake Bay Stewardship Fund targeted goals and outcomes.

**Description of Grant Reviewers**

The grant reviewers consisted of the EMPH Committee Chair and Field Advisor for the student thesis, as well as three additional outside reviewers. The reviewers were chosen based on their expertise and experience with environmental health, storm water management, Baltimore City, grant writing or program development.

W. Michael Caudle, PhD – Committee Chair

Assistant Professor in the Department of Environmental Health at Emory University for the past seven years as well as a member of the Graduate Division of Biomedical and Biological Sciences (Neuroscience Program), The Center for Neurodegenerative Disease, and the Neuroscience and Behavioral Biology Program. His focus includes the relationship of environmental toxins with neurological diseases.

David M. Berendes, PhD, MSPH – Field Advisor

David is an epidemiologist interested in public health solutions to water, sanitation, and hygiene related diseases. He is a postdoctoral fellow in the Brown Water Group at the Georgia Institute of Technology.

Jill Schmid, Program/Management Analyst, Office of Federal Assistance Management

Mrs. Schmid has worked for the federal government for 30 years in multiple roles. Her past roles include Accounting Technician, Budget Analyst, Public Health Analyst, and her current role is Program/Management Analyst for the Office of Federal Assistance Management within the Health Resources and Services Administration (HRSA). This office reviews grant proposals, creates and releases all the grants that are funded through HRSAs programs. In her role she analyzes data statistics of all grants for all of HRSA.

Jamie Cascio

Ms. Cascio a native of Baltimore City has a B.A. in English from McDaniel College and a M.Ed. in International Educational Development from Boston University. During the last decade, she has been an educator. During that time she worked at The Newman School in Boston, MA where she taught English as a Second Language before developing and leading the international student services program. Jamie is currently a resident artist at Brickbottom Studios in Somerville, MA.

Kerry Bonhag, Management Analyst, Division of Grants Management Operations

Mrs. Bonhag started her federal career as a summer student in HRSA's Office of Women's Health and the Maternal and Child Health Bureau (MCHB), than as a student intern in the Office of Federal Assistance Management (OFAM); and in 2014, was converted to a full-time federal employee. For the past seven years she has worked as a

Management Analyst for the Health Resources and Services Administration (HRSA), in the Division of Grants Management Operations (DGMO) within OFAM. As a Management Analyst on DGMO's Data Analytics and Compliance Team, she is responsible for providing technical assistance to both grant recipients and DGMO's Grants Management Specialists (GMS); specifically, in areas such as closeout, financial reporting, the Payment Management System (PMS), and other post-award operations. She is also tasked with closing out grants once they are at the end of their project periods; generating data reports for internal and external customers; maintaining various projects/assignments aimed at ensuring the compliance of our grant recipients; and leading the monitoring and tracking effort of post-period drawdown requests from the Division of Payment Management (DPM).

**Protection of Human Subjects**

The Belmont report identifies basic ethical principles and guidelines that should be followed for all research involving human subjects. The basic principles include respect for persons, beneficence, and justice. According to 45 CFR 164.501, research is defined as "a systematic investigation, including research development, testing, and evaluation, designed to develop or contribute to generalizable knowledge."

This grant proposal involves interaction with human subjects during educational seminars, GI installations, focus groups, community meetings, surveys, and behavior observation. The proposal implements a social marketing plan targeted at community members ages 12-50 in the community of Sandtown-Winchester/Harlem Park. Data will be collected in initial and post surveys, focus groups, and behavior observation. All

subject matters discussed involve non-sensitive topics, specifically storm water and urban activity best practices, that pose no risk to the human subjects involved.

## Chapter IV: Incorporation of Reviewers Comments

This chapter discuses and addresses the reviewers comments and explains changes and how the comments were incorporated into the final proposal.

I want to thank the reviewers for their time, honesty, and support in reviewing the proposal. Their expertise and different perspectives allowed me to create a strong proposal that I can be proud of. Each reviewer provided invaluable feedback and provided insight that I could not have gotten without their experiences. My thesis committee members have continuously reviewed the proposal and given content and grammatical support that have added incredible value to the proposal. I also really appreciate the many grammatical edits that were provided by all of the reviewers which helped to create a polished final project. Each reviewer was integral in molding the final proposal.

### Reviewer 1 Comments: W. Michael Caudle

Comment 1: The PI has done an excellent job of addressing the proposal criteria and has highlighted her alignment with these criteria in various places throughout the document.

Response to comment 1: No response needed.

Comment 2: The PI has worked closely with her committee to make and incorporate any revisions and improve the presentation of her proposal. She has worked diligently to address concerns and has been proactive in seeking feedback.

Response to comment 2: No response needed.

Comment 3: The PI is very familiar with the community and the environmental issues that are of concern. She has effectively translated this understanding into a compelling argument that is succinct and clear.

Response to comment 3: No response needed.

**Reviewer 2 Comments: David M. Berendes**

Comment 1: The content was good, clearer language would make the submission more responsive to the proposal criteria.

Response to comment 1: The second to last sentence on Page 12 was simplified and restructured to be clearer; this was also noted by reviewer 5 with comment 3. An additional proofreader was asked to read through the proposal to check for grammatical issues as well as clarity.

Comment 2: Improvements to theory and structure of the proposal could include improved specificity of language and specific monitoring and evaluation targets, and improved alignment of activities and outcomes of the proposal.

Response to comment 2: The monitoring and evaluation section, section F on page 11, was rewritten to be clearer and to include areas of measurement for monitoring of storm

water including litter, sediment, nutrients, oxygen demand, oil and grease, heavy metals, toxic chemicals and bacteria. Addressing the specific monitoring measurements for quality and volume then improves alignment of the activities and outcomes.

Comment 3: To support the argument that the proposed activities are necessary include improved specifics on the gaps present in the current infrastructure, with specific links to targeted health outcomes, which then are linked to health outcomes addressed by the proposal.

Response to comment 3: Additional maps and data was added in Appendix A and C, to describe more specific gaps such as clogged storm drains and dirty streets, which leads to dirty storm drains. A map of average healthy food availability was also added to link to current health disparities. This info was addressed on page 6 in the paragraph that describes disparities faced by the SW/HP community. Reducing the volume of storm water through green infrastructure and littering in the community would also reduce the number of clogged storm drains

Comment 4: All of the pieces seem to be in place in this proposal, but it could do with improved specificity of language and clearer links between the gaps and health issues and how those issues are specifically addressed. The PI should make it clearer how activities directly lead to outputs and outcomes downstream that immediately address the health issues stated in the problem statements.

Response to comment 4: An additional column was added to the activity chart found in Appendix D to highlight the outcomes from the activities in an effort to more clearly show the links between activities and outcomes of the proposal.

**Reviewer 3 Comments: Jill Schmid**

Comment 1: The submission was responsive to the criteria. It could possibly include expected results in 1 year, 3 years, or 5 years based on projects similar to this one.

Response to comment 1: On page 4, objective number 6 was edited to include minimum gallons of storm water reduced per year with installation of rain barrels. A sentence was added to monitoring and evaluation on page 11 to address expected results "With continued program implementation throughout Baltimore, improvements would be expected to appear in the Healthy Harbors Report Card over the next five years."

Comment 2: The theory and structure of this proposal was well thought out and presented logically.

Response to comment 2: No response needed.

Comment 3: I believe that the proposal was described effectively and showed that this project is needed.

Response to comment 3: No response needed.

Comment 4: Including an estimated budget for the cost of personnel, supplies, any travel associated with this project, and training and workshop materials would give the reader an idea of where the funding would go.

Response to comment 4: While I am in total agreement with the statement that an estimated budget for the project would provide insight into use of funds, for the purpose of this thesis it is not required. I purposely did not include any financial or budgetary information for simplicity and consistency of this thesis project.

Comment 5: A list of personnel, salaries, and their experience could assist the grantor of the possible success of the project based on their knowledge and experience.

Response to comment 5: An additional Appendix E has been added to the proposal to describe the qualifications and experience of the key personnel involved.

**Reviewer 4 Comments: Jamie Cascio**

Comment 1: In general, the submission addressed each criteria and does provide a comprehensive, realistic plan to meet project goals. More detailed background information on the community, the state of poverty there in relation to health, and the direct impact water quality has on these issues would make the proposal more compelling to the reader. Data is mentioned but visual aids including maps of the neighborhood and the Inner Harbor, charts, etc. would be helpful.

Response to comment 1: Visual aids have been added to the proposal. Appendix A has several geographical maps to show the specific area being targeted and to give a visual of the location within the Chesapeake Bay watershed and within Baltimore City. Appendix C includes visuals from the Baltimore Neighborhood Indicators Alliance data that shows 311 rates of calls for dirty streets and alleys and clogged storm drains from 2013. The appendix supports the measures of success mentioned on page 11 as well as to highlight the importance of storm water management.

Comment 2: The purpose, solution, and plan of action are explored and detailed in a clear, concise, organized manner. The need for this project is clear as are the techniques for the solution.

Response to comment 2: No response needed.

Comment 3: As mentioned previously, more details of the specific community as well as data on impact of water pollution/quality on poor communities is needed. Are there other projects like this tried in other cities? If yes, has it been successful? How will this program build on those results?

Response to comment 3: On page 7 of the proposal two other city programs were mentioned that are examples of positive green infrastructure projects. The two programs are Philadelphia's Water Department Green City, Clean City plan and California's Erase

the Waste educational campaign and toolbox. Specific details were not provided in the proposal due to space constraints of the ten page narrative.

Comment 4: The significant need for a solution to this problem is evident in this proposal. The solutions offered are realistic and scientifically sound. The writer has answered all criteria. With minor additions in data and further ideas on motivation, this proposal will be very strong.

Response to comment 4: The suggestions given by the reviewer were considered very seriously and added as possible within the constraints of the proposal requirements. The visuals suggested in the previous comments add striking substance to the narrative and are ones that I had not previously considered.

**Reviewer 5 Comments: Kerry Bonhag**

Comment 1: Provide quantitative data (i.e., statistics/numbers); the only reference I see to water quality is on page 5 when you state that the "2016 report card for the Harbor" was a D-. What levels (specific #s) make the water quality a D-? The goal of your project is to improve the water quality, but to what extent (to a B-; or increase the quality by 45%)? Elaborate more on Evaluation Criteria #1: Environmental Results.

Response to comment 1: Objective 2 was expanded to address the quantitative goals; "Educate on waste management-related behaviors such as littering, pet waste, trash management, including dumping and household maintenance, and recycling to *reduce the*

*amount of wastes that enter the water stream by half*." To expand on the improved water quality goals, a timeline goal was added to see improved results within five years on the Harbor report card under section F- Monitoring and Evaluation. A sentence was added on page 5 to address the parameters for the Harbor report card "In grading, the report card considers fecal bacteria, chlorophyll a, dissolved oxygen, nitrogen, phosphorous, and water clarity and if the levels exceed Maryland's predetermined thresholds for human and ecological health."

Comment 2: More detail/examples in how the current state of the water impacts the economy (#s).

Response to comment 2: A sentence was added to the paragraph on the importance of a healthy harbor including benefits to the economy that describes the losses that can occur due to poor water quality on page 5. One specific number added to create emphasis and show the impact water quality can have on the economy is the loss in revenue of $640 million due to the decline of blue crabs.

Comment 3: Consistency throughout the proposal with word usage (i.e., storm water as two words), sentence structure, percentages, and fonts. Each appendix should start on its own page, as well as your references.

Response to comment 3: Font from the reference citation manager was adjusted and the proposal was checked to ensure consistency as well as word usage of storm water.

Stormwater was changed to storm water at 5 instances on pages 1, 3, 4, 8, and 9. The spacing of the appendix and references has been adjusted to each start on individual pages. And the second to last sentence on page 12, described as hard to follow, was simplified and rewritten to read: “The City of Baltimore and partner organizations will receive data and evaluation results in the form of a final report and debriefing meetings.” to provide clarity on dissemination of results and findings.

Questionnaire multiple choice responses:

| Comment | Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| The submission is responsive to the proposal criteria. | |||| | | | |
| The proposal is well thought out and theoretically sound. | ||| | || | | |
| The Principle Investigator (PI) makes a compelling case that the proposed project is necessary. | ||| | || | | |

# Chapter 5: Final Version of Grant Proposal

## Project Title

A socio-ecological approach, using community-based engagement principles and green infrastructure, to reduce magnitude and improve quality of storm water runoff entering storm drains in the Sandtown-Winchester/Harlem Park neighborhood, Baltimore City, Maryland.

## Description

This proposal will work with community members to facilitate the adoption of green infrastructure, using community participatory engagement, in order to reduce non-point sources of storm water pollution in the Sandtown-Winchester/Harlem Park (SW/HP) neighborhood of Baltimore City, Maryland. The approach used in this proposal will 1) reduce the volume of storm water runoff and 2) the amount of non-point source pollutants that contaminate storm water runoff, in order to create a healthier built environment for the community, improve the water quality at the local watershed level, as well as protect and restore the water quality of the Chesapeake Bay.

## Abstract

Urban neighborhoods have the potential to help reach the targeted outcomes of the 2014 Chesapeake Bay Watershed agreement goals: targeting climate resiliency, stewardship, and water quality. High density populations, urban heat island effects (where temperatures are higher due to human activity), high levels of impervious surfaces (through which water cannot penetrate), and areas available for repurpose are all reasons to target the urban environment for storm water management. SW/HP is one of 55

neighborhoods that make up the port city of Baltimore. This urban landscape plays a substantial role in the water quality of the Inner Harbor, a key economic and environmental landmark for Baltimore and Maryland, and the storm water that runs into it.

The proposal objectives are to reduce storm water runoff and reduce the pollutants available to enter the local watershed through storm water runoff. With community-determined needs, this project will provide knowledge building, via trainings, a social marketing campaign, workshops, and community fairs. Partner organizations will help residents install Green Infrastructure (GI) elements that can reduce storm water volume. Focusing on the quality of the built environment in the community serves two functions: improving the local environment and watersheds, as well as impacting the health of the community. Storm water management betterment can result in healthier watersheds, and a healthy harbor, bay and community.

**Project Location**

The Chesapeake Bay Watershed, Maryland, Maryland's 7th Congressional District, and Maryland's 3rd Congressional District (see Appendix A)

**Project Location Description**

The community of SW/HP is located within the heart of Baltimore City, an area of just over 325 acres and 18.4% green space, defined as tree canopy, vegetation, and parkland (BCHD, 2017a). The built environment found in SW/HP has been linked to community health indicators of low rates of physical activity, poor diet, and low energy.

**Full Proposal Narrative**

**A. Objectives**

The objectives of this proposal are to reduce storm water runoff and reduce the amount of pollutants that ultimately enter the Chesapeake Bay watershed. Working closely with key community members to address their needs, educational resources will be provided on waste management through knowledge building trainings, workshops, and community fairs led by community-based partner organizations. A social marketing campaign "Stormwater, Clean Water, Clean Harbor" will be developed and implemented to reinforce the educational resources. Along with the outreach campaign, partner organizations will also assist community members in installation of Green Infrastructure (GI) elements as listed below and found in Appendix B.

Specific activities, to be conducted in conjunction with partner organizations:

1. Design and implement a social marketing plan, using community-based participatory engagement, focused on residential waste management behavior in SW/HP that can reduce the amount of storm water and improve the runoff quality.
2. Educate on waste management-related behaviors such as littering, pet waste, trash management, including dumping and household maintenance, and recycling to reduce the amount of wastes that enter the water stream by half.
3. Utilize the social marketing plan to engage a minimum of 30 community members to commit to best management practices for household maintenance and waste management through written commitments (i.e. pledges).
4. Empower community members, through support of Peer-to-peer collaboration and community support, to sustain best waste management practices.

5. Collaborate with local health department, city officials, and local organizations to support community members implement and maintain best practices for GI.
6. Install 15-20 rain gardens and rain barrels, and 10-15 infiltration or flow-through planters at residents' homes with their participation reducing storm water volume by over 1,000 gallons per year. Engage those implementers and others to commit to a maintenance and sustainability plan with written agreements designed with the residents input to attract more accountability.

**B. Project Priority**

Storm water runoff, sometimes referred to as "storm-induced pollution", is excess precipitation that runs over surfaces, picking up trash and pollutants, as it makes its way into local waterways. The abundance of water often overloads antiquated pipe systems and water and sewage treatment facilities, resulting in overflow sewage and storm water entering directly into waterways leading to high levels of contamination (Center for Watershed Protection, 2016). Those contaminants can cause an imbalanced ecosystem in the waterways, and public health concern for water-borne disease outbreaks and threats to drinking water (Cann et al., 2013). Storm water management is important from both a public health perspective and a conservation perspective.

SW/HP plays an important role in impacting the health of the local watersheds of Baltimore City. It lies at the head of Baltimore's Watershed 263 (so named due to the outflow pipe number that empties into the mouth of the Gwynns Falls River) (*Watershed 263 Project: Baltimore, Maryland*). Parts of the neighborhood lie within the Gwynns Falls, Jones Falls, and Baltimore Harbor watershed (Blue Water Baltimore, 2017). The goal of this project is to work within the community to reduce barriers to stewardship and

GI use, and to instill ownership and accountability for local watersheds, the Inner Harbor and the Chesapeake Bay.

A healthy harbor is important for many reasons, including downstream effects such as deteriorating water quality, and decreased habitats, which effects public health and the economy throughout the Chesapeake Bay watershed. The Chesapeake Bay is dependent on the health of the tributaries to aid in improved water quality. The flux of pollutants entering the bay can have hazardous effects on the supply of many of the regions sources of food and economy, fish, oysters, crabs, as well as the health of the communities that depend on the Bay for recreation and sustenance. Between 1998 and 2006, Maryland and Virginia lost $640 million in revenue from declining crab populations due to poor water quality in the Chesapeake Bay (Pimental, 2010). A healthy harbor also provides healthy means of recreation, boosts the economy, and improves food security for the city (Waterfront Partnership of Baltimore, 2011).

The Inner Harbor of Baltimore is a historic seaport and current tourist attraction, which is annually analyzed and graded for water quality by the Waterfront Partnership of Baltimore in conjunction with Blue Water Baltimore (BWB). In grading, the report card considers fecal bacteria, chlorophyll a, dissolved oxygen, nitrogen, phosphorous, and water clarity and if the levels exceed Maryland's predetermined thresholds for human and ecological health (B. H. W. Blue Water Baltimore, 2017). The 2016 report card for the Harbor rated the tidal waters as a failing grade and streams, D-, listing storm-induced pollution as a major cause of these poor grades (Waterfront Partnership of Baltimore, 2017). Poor water quality results in lost economic benefits from tourism, increased costs

for managing drinking water, commercial fishing and shell fishing losses, and property value (EPA, 2017b).

Improving those grades requires working upstream within the neighborhoods of SW/HP, an urban underserved community that faces many challenges, but is also extremely resilient. The socioeconomic situation within the neighborhood, along with the urban landscape, leads to many health disparities, such as low rates of physical activity, poor diet, and low overall energy of the residents. In SW/HP, 22% of total deaths are due to heart disease; and the neighborhood ranks 6th of all 55 Baltimore neighborhoods with diabetes as a cause of death (BCHD, 2017a). In Baltimore City, 32% of respondents to the 2014 health survey reported being obese, with a higher percentage of obesity affecting those that identified as black than white (BCHD, 2015). Additionally, higher rates of asthma are found in the city than in the state or at the national level (BCHD, 2017b). SW/HP is comprised of a population of 15,518 people, of which 96.7% are African American (BCHD, 2017a). The median household income is $24,374; just over half of the overall median income for Baltimore City ($42,241) and 50% of the families, defined as having a child under the age of 18, live below the poverty line of $24,250 for a family of 4 (US Census Bureau). The neighborhood has a history of high rates of clogged storm drains and visibly dirty streets and alleyways. (See Appendix C) The statistics outline a picture of disparity where environmental health may not be seen as a priority, but the potential for storm water management provides a focus that can ultimately lead to improved quality of life by creating an area more conducive to exercise and recreation, decreasing stress and violence, and improving community attitude and pride. Decreasing litter on the streets also reduces the precedent for others to continue to litter.

Not only will this project have short-term results of improved waste management practices, but also long-term effects on water quality and health. Empowering the community members to take a role in protecting themselves, their community, and creating a healthier environment will have positive benefits (Dean et al., 2016).

**C. Associated Plans and Initiatives**

Targeting the implementation of green storm water infrastructure at the individual level, works in conjunction with the targeted goals of Maryland's Phase I and Phase II Watershed Implementation Plan. Those goals include increasing pervious surfaces and reducing storm water runoff in order to reduce the Total Maximum Daily Load (TMDL) of nitrogen, phosphorus, and sediment that enters the Bay watershed, per the EPA and Maryland-specific levels (MDE, 2012). Maryland also has additional TMDLs for trash and debris, fecal bacteria, and chlordane within Baltimore City (MDE). This project also aligns with five of the ten goals and outcomes outlined in the Chesapeake Bay Watershed Agreement, specifically Clean Water: Water Quality, Toxic Contaminants, and Healthy Watershed Goals; Climate Resiliency Goal; and Engaged Communities: Stewardship Goal (Chesapeake Bay Program, 2014). Examples for models in other cities include Philadelphia's Water Department Green City, Clean City plan and California's Erase the Waste educational campaign and toolbox (California Environmental Protection Agency, 2013; Philadelphia Water Department, 2017).

This project is grounded in the Social Ecological Model (SEM), which focuses on people's behavior and health within a social, institutional, and cultural context at the individual, interpersonal, community, and organizational level (DiClemente, 2013). The

SEM is used to maximize and sustain health promotion of the waterways and the community.

**D. Overall Context**

Baltimore City has many resources and organizations that are invested in improving the health of the city and its residents. Many organizations, both governmental and non-governmental, partnered together in the Watershed 263 project. The Watershed 263 project focused on improving water quality and environmental conditions by increasing green space and tree cover through a number of different projects in 2004 and 2005 that spanned 12 neighborhoods in the city (*Watershed 263 Project: Baltimore, Maryland*). In order to increase the sustainability of the outcomes, those organizations that worked on the Watershed 263 project, and others that have been well established in Baltimore, will be utilized. These organizations include Parks and People Foundation, Baltimore City Department of Public Works, Baltimore Ecosystem Study, BWB, and Waterfront Partnership of Baltimore. The listed stakeholders are well-versed in aspects of GI and the SW/HP neighborhood. Utilizing input from the residents of SW/HP, will focus efforts on individual investments at residential homes within the community.

The social marketing design process will take into account existing threats and opportunities, while also being ready to adapt to new and unexpected challenges. Some threats that need to be addressed include the social and economic situation of the SW/HP community, especially with the recent turmoil that the community has experienced. Establishing trust and credibility within the community will need to be prioritized. Materials and presentations will need to be mindful of education level and experience of the audience. Perceived barriers as well as actual barriers will be investigated and

addressed in order to instill and encourage adoption of storm water green infrastructure. Established best management practices will be utilized to increase adoption of green infrastructure use and environmental education.

Data from the Maryland Department of Natural Resources via the Water Quality Portal and BWB will be used to monitor fecal bacteria, conductivity, dissolved oxygen, total nitrogen, and total phosphorous. In addition, twenty monitoring stations will be set up at select storm drains in the neighborhood and monitored by BWB. Parks and People Foundation will lead trainings and workshops on sanitation, green infrastructure, and improving the quality of storm water runoff. These will be supplemented with local speakers, including other GI users. BWB will be the lead in Rain Garden and Barrel installations. Both organizations will be instrumental in planter installation, along with the Department of Public Works (DPW). The DPW will also engage with community members as a representative of the city and provide practical and social support for sustainable waste management practices.

**E. Work Plan/Activities**

This project will rely heavily on social marketing to increase participation and investment, along with the SEM focus and multi-level approach to prevention (CDC, 2015). An evaluation plan for the program will be prepared within the first three months and implemented throughout to ensure accountability and transparency.

**Activities: see Appendix D**

1. Baseline community assessment: The first step in the project will be to conduct an assessment of community needs and engagement with storm water management and GI. A community-based engagement/participatory approach

will be used to conduct the baseline community assessment. Community meetings and focus groups will determine baseline knowledge and attitudes. Key stakeholders will be involved in conducting surveys. Ten community members will be selected from local faith leaders, neighborhood block leaders, business leaders, and school community leaders to administer the surveys. The knowledge of storm water impact, pollution, and reduction methods, gleaned from the surveys and qualitative data, will be used to tailor both the social marketing campaign, as well as the educational trainings.

2. Community Engagement

A. Social Marketing Campaign: Developed from, and based on, results from the community assessment to ensure a community-driven campaign. Current knowledge and attitudes will be used to evaluate specifics to target that are geared towards homeowners and waste management best practices.

B. Educational workshops and community fair: The workshops and fair will include demonstrating specific household impacts on pollutants in the water ways, as well as benefits of green infrastructure. Throughout the project, education and outreach will be conducted in the neighborhood, based on the information gaps determined by the continuous assessments. Community meetings and workshops will focus on the waste management pieces that individuals can do to reduce contaminants entering the storm water. Events will emphasize the importance of removing trash, litter, and pet waste from streets and yards, and how the proper disposal of household trash and automobile maintenance impacts the watershed. Community fairs will bring the partners and

residents together to better understand their needs, the resources available, and who to contact about specific issues. These events will utilize the Baltimore City DPW, Public Safety, local government representatives, and the Baltimore City Clean Guide. The publication outlines specific actions, resources, and consequences for maintaining a clean neighborhood and city (Baltimore City, 2016). The outreach events will focus on what residents can do to reduce pollutants in their storm water. The impact of these minor changes and increased awareness can make significant changes to the future of the neighborhood. Community members will be encouraged to pledge to become “captains for change" in their neighborhood and promote the best practices discussed.

3. Rain Garden and Rain Barrel installations: During the initial assessment, participants will be identified as potential candidates and invited to participate in the installs. From those invited participants, 15 to 20 people, with community interest, community investment, and influence, will participate in building and installing rain gardens, rain barrels, and planters at their residence. BWB will lead the installation.
4. Planter installation: These will occur at residential or community locations, such as churches, businesses, and/or recreation centers. Those that are interested in installing infiltration or flow-thru planters will be instructed and aided by BWB to complete a soil assessment to determine the proper use. BWB and the community will also work in conjunction with DPW to install GI planters at ideal locations. These community members will be provided with resources on how to maintain the infrastructure, and will be able to contact BWB with further questions. They

will also sign a written commitment pledge to continue maintenance and ensure sustainability. The final number of participants selected will ensure the possibility of a support system being established to improve the sustainability of the GI elements, account for potential dropout from participation, and make supplies cost-effective to implement.

**F. Monitoring and Evaluation**

Water quality and volume of storm water will be tested monthly at twenty neighborhood storm water drain sites. Storm water will be tested for litter, sediment, nutrients, oxygen demand, oil and grease, heavy metals, toxic chemicals and bacteria. Monitoring sites already in place including along the Gwyn Falls and Jones Falls will continue to monitor watershed water quality. Water volume and flow will also be measured at the storm drain sites as well as at the newly installed rain gardens. Testing and measuring will occur at a minimum of quarterly for three years.

Data may also be influenced by outside factors, particularly at the watershed level, such as pollutants from outside of the SW/HP neighborhood, and other water quality improvement projects conducted around the city and state of Maryland. The results from this project are just one small step in restoring the Chesapeake Bay; continued work will be needed to influence upstream pollutants, effects of neighboring communities, and other sources of pollutants. Long-term goals of the project would involve improved water quality results at local monitoring sites. With continued program implementation throughout Baltimore, improvements would be expected to appear in the Healthy Harbors Report Card over the next five years.

The majority of monitoring of community engagement will be evaluated by qualitative means. Community engagement behaviors will demonstrate an understanding and use of the trainings and workshops. Behaviors specifically targeted are household maintenance, animal waste responsibility, as well as trash and recycling habits. Interviews, focus groups, and surveys will be conducted to look at acceptance and sense of change within the community. The number of written commitments for both GI infrastructure and Community Captains will be measured to indicate community investment and buy-in. Success will also be measured by a decrease in the number of calls to the City 311 service; for rat inspection service and other related public health issues such as those shown in Appendix C.

The program evaluation plan developed during the assessment period will ensure that the program stays on track and will also remain adaptable to ensure efficiency, accountability, and transparency in meeting the proposal objectives.

**G. Partner Justification**

This project will work with key city organizations including BWB and Parks and People Foundation to provide guidance to community members. Both organizations have over 20 years of experience working within the field. The City of Baltimore, specifically the Department of Public Health and DPW, has developed plans and goals to improve greening of neighborhoods based on the policies and strategies of the past city mayors. The community trust that comes with utilizing established partners within the community is essential in targeting key stakeholders and acceptance. Appendix E lists the key personnel involved.

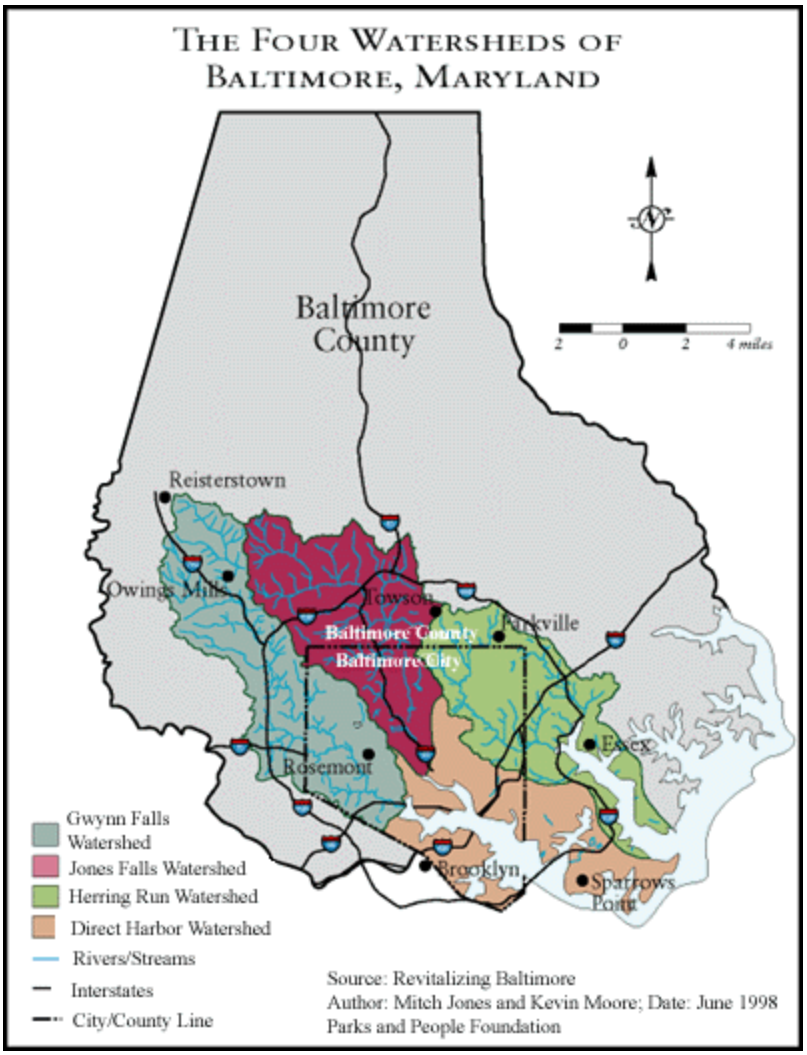
**H. Dissemination and Transferability of Results**

This project will provide a template that can be used to engage other communities and neighborhoods in storm water management. The DPW and Public Safety of Baltimore City can use the information in broader campaigns to engage city residents and improve water quality. Storm water management is a priority for Baltimore City and government officials will be able to utilize the strategies, partnerships, and techniques honed through this program to expand into other neighborhoods within the city and, eventually, to other cities. Program and evaluation results will be shared and utilized to target urban environments or for use in future urban planning. Results including success and lessons learned will be shared within six months of project completion. The City of Baltimore and partner organizations will receive data and evaluation results in the form of a final report and debriefing meetings. Residents will continually be updated, and findings shared via social media, focus groups, and community meetings.

## Appendix A: Maps

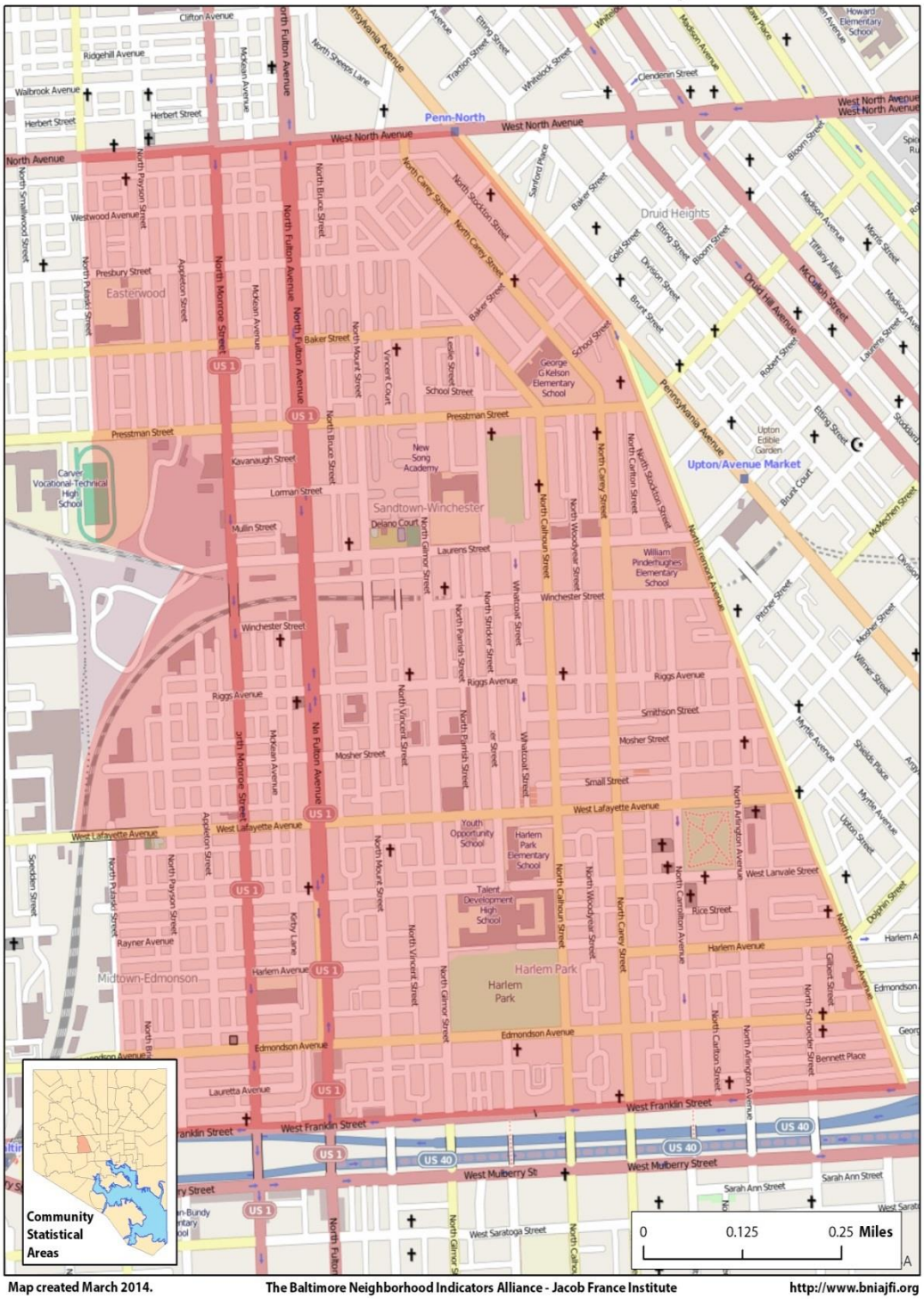
### Chesapeake Bay Watershed


Retrieved from https://www.epa.gov/chesapeake-bay-tmdl




Retrieved from http://ww2.mdsg.umd.edu/marinenotes/Sep-Dec99/index.html

## Sandtown-Winchester/Harlem Park Community Statistical Area




**Retrieved from http://bniajfi.org/mapgallery/gallery-csa-reference-maps/**

## Appendix B: Green Infrastructure

**Rain barrel examples- Diverts rain from downspout that can be utilized for other purposes.**

Images from https://www.flickr.com/photos/aquamech-utah/24445198643 and https://www.flickr.com/photos/akeg/2519688503

**Rain Garden**

Image retrieved from https://commons.wikimedia.org/wiki/File:7sigma_RainGarden_66.JPG

**Rain Garden Illustration**

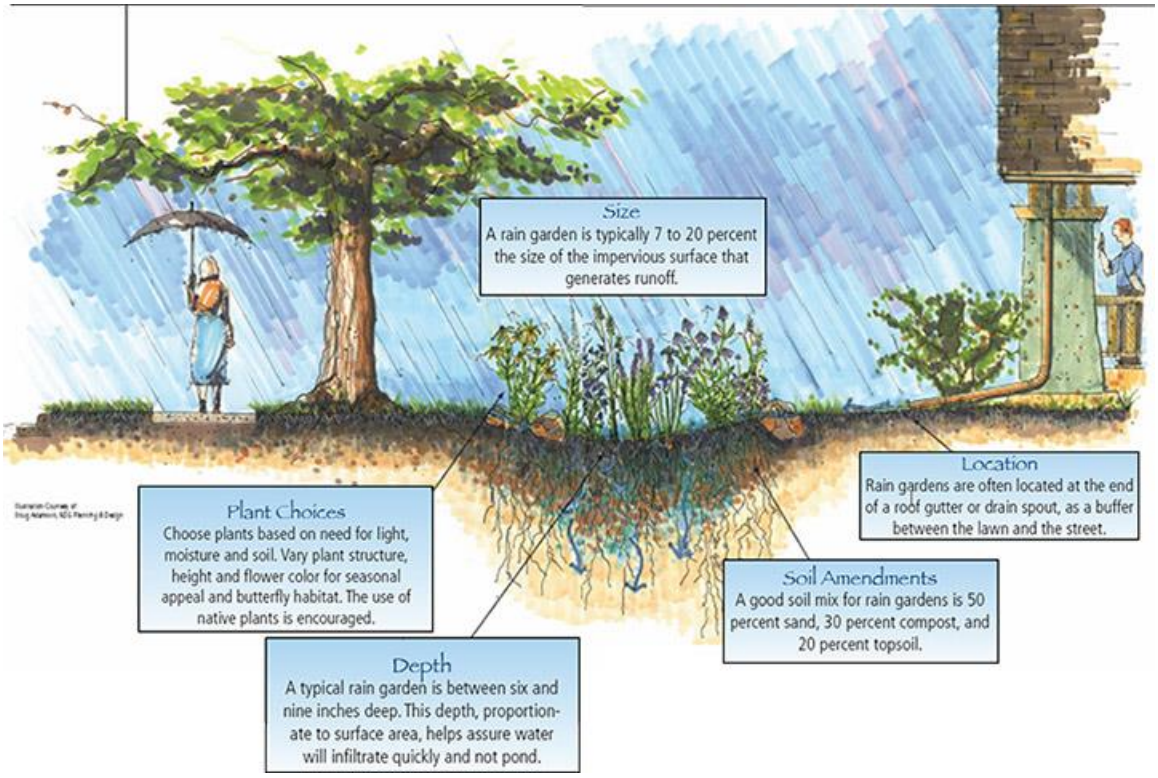
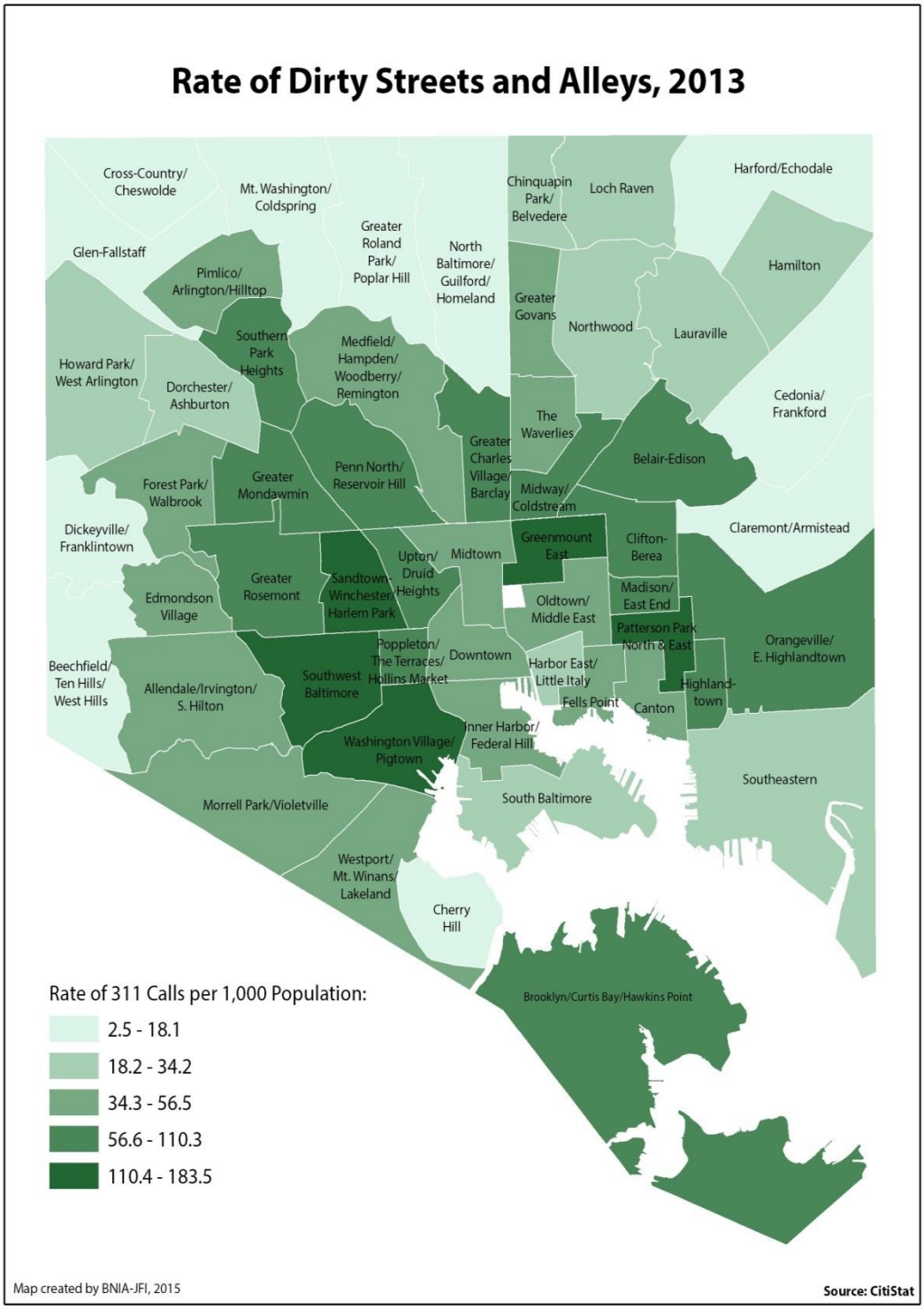
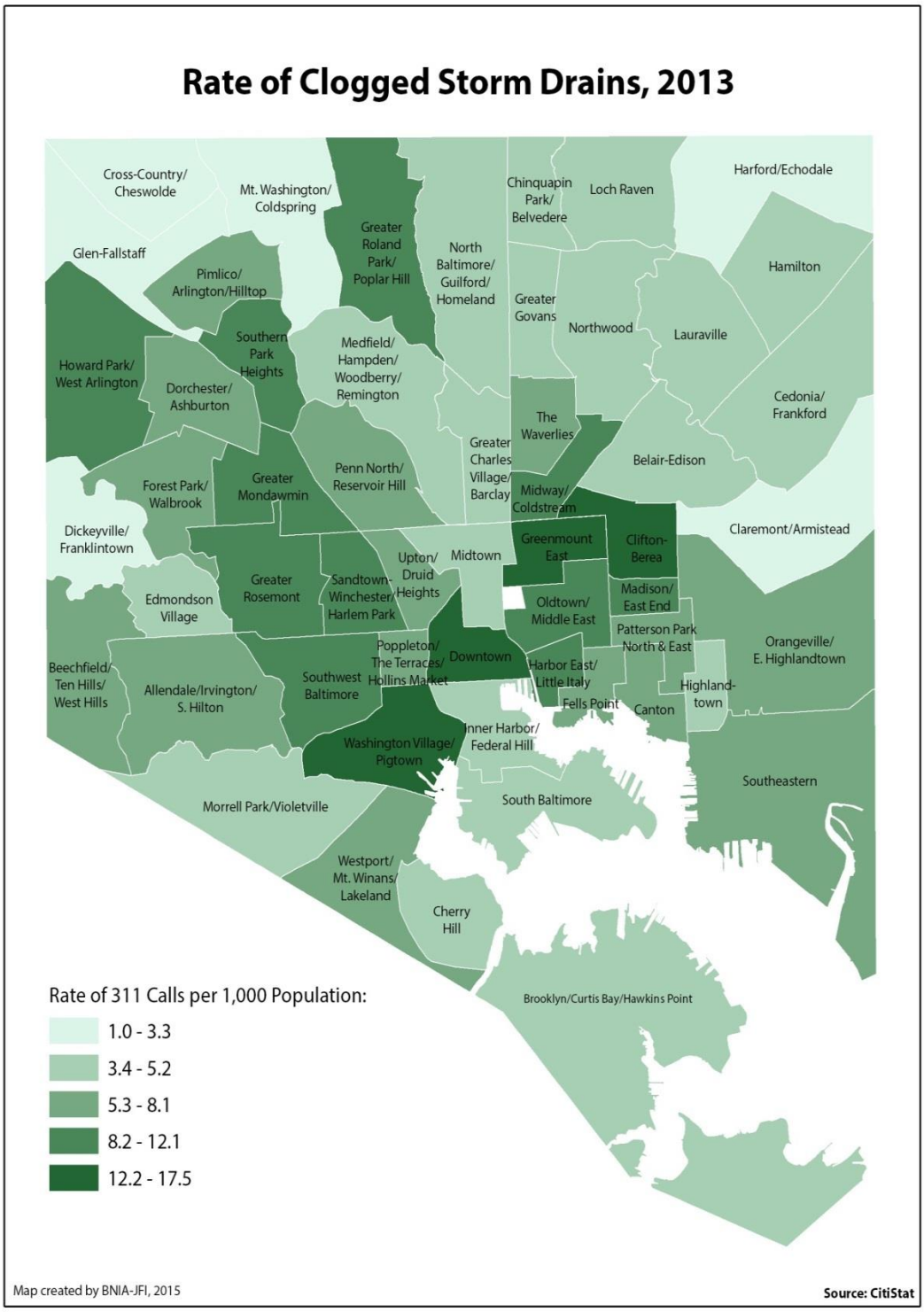
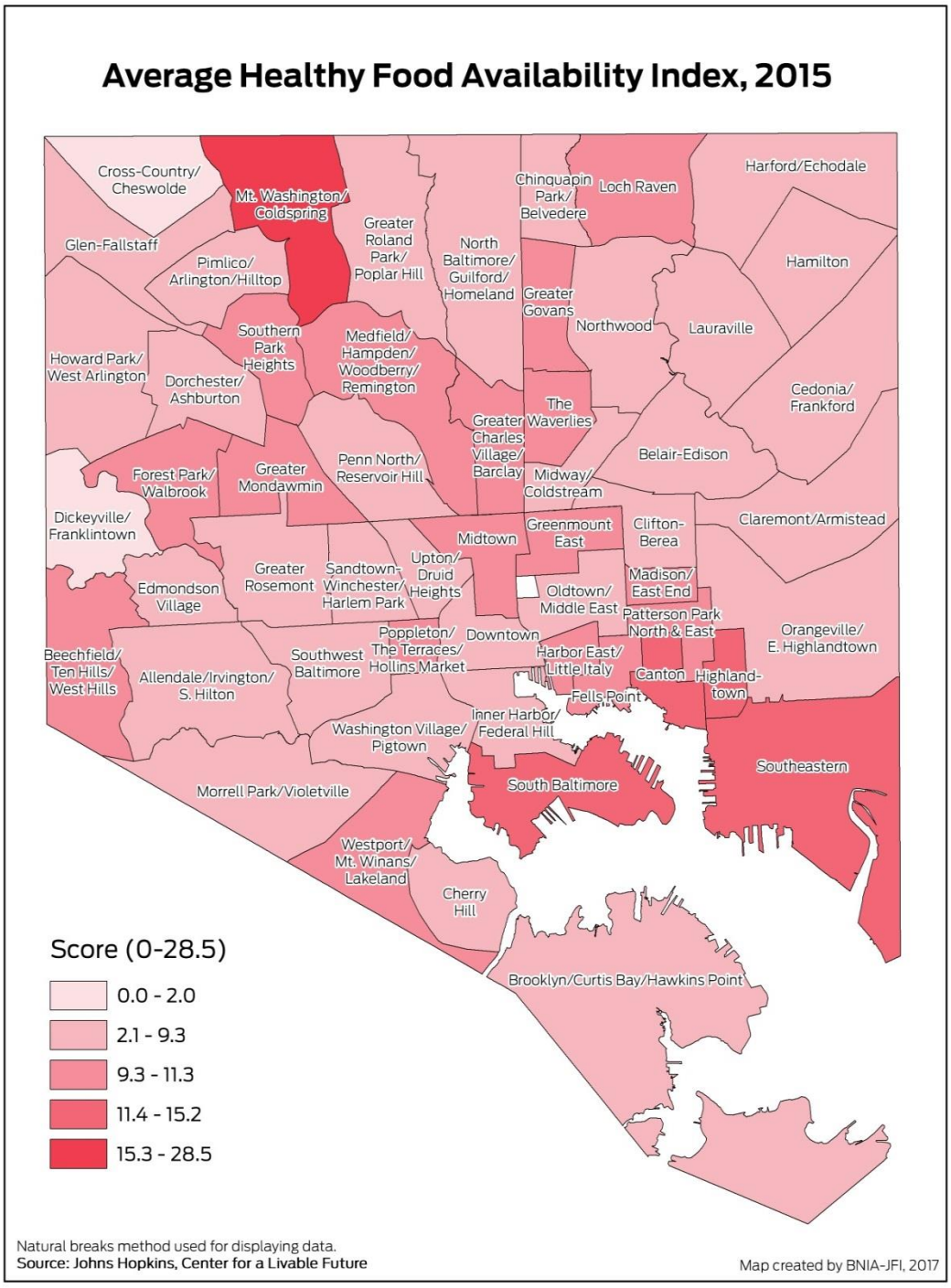



Illustration by Doug Adamson, RDG Planning & Design, provided by USDA-NRCS in Des Moines, Iowa. Retrieved from https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ia/newsroom/factsheets/?cid=nrcs142p2_008527

## Appendix C: Neighborhood Statistics




Rate of Clogged Storm Drains, 2013
Cross-Country/ Cheswolde
Mt. Washington/ Coldspring
Greater Roland Park/ Poplar Hill
Chinquapin Park/ Belvedere
Loch Raven
Harford/Echodale
Glen-Fallstaff
Pimlico/ Arlington/Hilltop
North Baltimore/ Guilford/ Homeland
Hamilton
Greater Govans
Northwood
Lauraville
Howard Park/ West Arlington
Southern Park Heights
Medfield/ Hampden/ Woodberry/ Remington
Dorchester/ Ashburton
Cedonia/ Frankford
The Waverlies
Greater Charles Village/ Barclay
Belair-Edison
Penn North/ Reservoir Hill
Forest Park/ Walbrook
Greater Mondawmin
Midway/ Coldstream
Claremont/Armistead
Dickeyville/ Franklintown
Greenmount East
Clifton-Berea
Upton/ Druid Heights
Midtown
Greater Rosemont
Sandtown-Winchester/ Harlem Park
Madison/ East End
Edmondson Village
Oldtown/ Middle East
Patterson Park North & East
Orangeville/ E. Highlandtown
Poppleton/ The Terraces/ Hollins Market
Downtown
Harbor East/ Little Italy
Beechfield/ Ten Hills/ West Hills
Allendale/Irvington/ S. Hilton
Southwest Baltimore
Fells Point
Canton
Highland-town
Inner Harbor/ Federal Hill
Washington Village/ Pigtown
Southeastern
South Baltimore
Morrell Park/Violetville
Westport/ Mt. Winans/ Lakeland
Cherry Hill
Brooklyn/Curtis Bay/Hawkins Point
Rate of 311 Calls per 1,000 Population:
1.0 - 3.3
3.4 - 5.2
5.3 - 8.1
8.2 - 12.1
12.2 - 17.5
Map created by BNIA-JFI, 2015
Source: CitiStat




Retrieved from http://bniajfi.org/mapgallery/

**Appendix D: Work Plan Chart**

| Approach | Activity | Stakeholders | To be completed by: | Outputs and Outcomes |
|---|---|---|---|---|
| Socio-ecological | Community evaluation via focus groups/surveys/community meetings | Principle Investigator(PI), Community Members, Neighborhood Alliance, Parks and People | 3 months from start of project | • Social marketing plan<br>• Increased investment of community members<br>• Baseline knowledge level |
| Formative Evaluation | Evaluation Plan<br><br>Evaluation of Program | PI, Community Members, Stakeholders, Participating organizations and governmental entities | 3 months from start of project<br><br>Continuous, 3, and 6 months post program implementation | • Improved engagement with community<br>• Improved storm water management implementation |
| Community Engagement and Awareness through Social Marketing | Community meetings, Events, Workshops, Assessments, Fairs | Parks and People, Blue Water Baltimore, Department of Public Works, Neighborhood Alliance | Continuously for 12 months from project start. | • Increased awareness of storm water management best practices<br>• Increase in trash management best practices<br>• Increased capacity of community members to utilize and spread best management practices |
| Pilot households | Rain Gardens & Rain Barrel Installation | Blue Water Baltimore with Influential Community | 6 months from start of project | • Increased use of GI |

| | | | | |
|---|---|---|---|---|
| | | Members | | • Decreased amount of stormwater runoff<br>• Decreased amount of pollutants in stormwater<br>• Improved watershed quality |
| Pilot households and businesses | Infiltration or Flow through planters | Blue Water Baltimore, Department of Public Works, Parks and People, Influential community members | 8 months from start of project | |

**Appendix E: Personnel**

| Personnel | Organization | Qualifications |
|---|---|---|
| Sharon Light Program Manager | Baltimore Department of Public Health | Has 7 years' experience with Parks and People Foundation before being hired with the City of Baltimore. She has been with the Department of Public Health for 10 years working on cross cutting projects with the Department of Public Works, Department of Education, Office of Sustainability, Parks and People Foundation, Blue Water Baltimore, and the Center for a Livable Future. |
| Sandy Wright Technical Specialist | Blue Water Baltimore | Sandy has 12 years' experience monitoring water quality. She has been instrumental in the last 3 years analyzing data for the Healthy Harbor Report Card. |
| Sam Thompson Program Coordinator | Parks and People Foundation | Sam has 10 years' experience with Parks and People as an educator and has spent the last 5 years as the coordinator for their urban greening projects within the City of Baltimore. |
| Anthony King Program Evaluator | Baltimore City | Anthony has worked in the Baltimore area for the last 25 years. He's worked for the City to conduct evaluations on several projects over the last 6 years. |
| Bella Frank Education Specialist | Blue Water Baltimore | Bella has 2 years' experience working with BWB as an education and outreach specialist. |

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