The Effectiveness of Stormwater Utilities in Mitigating Stormwater Runoff in the United States

By
Laura Anne Mulcahy
B.A, Lehigh University, 2006

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Curriculum Vita

Laura Anne Mulcahy, both November 19, 1983 in Philadelphia, PA. Graduate of New Hope-Solebury High School, New Hope, PA, Class of 2002.

Undergraduate Education: Lehigh University, B.A, May 2006, Earth and Environmental Science and B.A. Political Science, May 2006

Graduate Education: Brown University, Master of Arts in Environmental Studies, Fall 2006-Present. Concentrating in environmental policy.

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List of Abbreviations and Acronyms

APWA: American Public Works Association

BMP: Best Management Practices (see *Appendix A: Definitions*)

CIP: Capital Improvement Project

CWA: Clean Water Act (1972)

DPW: Department of Public Works

ERU: Equivalent Residential Unit

ESU: Equivalent Stormwater Unit

LID: Low Impact Development

MEP: Maximum Extent Practicable (see *Appendix A: Definitions*)

MS4: Municipal Separate Storm Sewer System (see *Appendix A: Definitions*)

NAFSMA: National Association of Flood and Stormwater Management Agencies (see *Appendix A: Definitions*)

NPDES: National Pollution Discharge Elimination System

O&M: Operations and Maintenance

RI DEM or DEM: Rhode Island Department of Environmental Management

RIPDES: Rhode Island Pollution Discharge Elimination System

SRF: State Revolving fund

TMDL: Total Maximum Daily Load

U.S. EPA or EPA: United States Environmental Protection Agency

Abstract

Stormwater runoff has been a major water pollution issue facing the United States for decades. Hundreds of municipalities across the country rely on stormwater utilities to help implement and comply with current state and federal stormwater requirements. New England has been facing difficulties in complying with stormwater requirements, however many New England states have yet to explore stormwater utilities as an efficient option. This thesis will examine problems associated with stormwater, the options to mitigate these problems, and the potential role of a utility as a solution. Two major research questions are explored: what is the overall efficacy of stormwater utilities in mitigating stormwater runoff in the United States, and: can a municipality use existing stormwater utilities as examples to aid in utility development and implementation? Two case studies were conducted: one focusing on an evaluation of stormwater utilities in the nation, and one on the potential implementation of a local stormwater utility.

A nation-wide, detailed analysis of 25 utilities suggests many trends and examples of beneficial aspects a stormwater utility. Each utility is evaluated for efficiency, equity, effectiveness, and incentives to reduce or improve stormwater. Based on the analysis, the author concludes that stormwater utilities are a viable way to manage stormwater in many communities, if developed and implemented properly. Trends of the highest scoring utilities are analyzed as well. The information from this analysis was applied to the local case study. Some of the main themes of effective existing utilities include public education programs, equitable utility fee structures, and comprehensive user fee credit systems.

Narragansett, RI was chosen as a case study community to examine the feasibility of establishing the first stormwater utility in Rhode Island. After an extensive evaluation of the community, its existing stormwater issues and infrastructure, and its interest in improvement, Narragansett would be a good candidate for a stormwater utility. The analysis includes structure recommendation for Narragansett that would create an effective, efficient, and equitable stormwater utility, as well as recommendations for next steps for the municipality. While these recommendations were formulated especially for Narragansett, the results of the national stormwater utility analysis were used in order to follow common trends of the highest scoring utilities. Overall, stormwater utilities can be a viable tool to gain the resources needed by municipalities to maintain efficient stormwater management programs.

Chapter 1: Introduction

Nonpoint source water pollution has been a growing concern in the United States since the 1970s. Currently, this source of water pollution is a major issue facing all U.S. waterways, and an issue of increasing concern for law-makers. According to the U.S. Environmental Protection Agency (U.S. EPA), 40% of surveyed impaired water bodies are impaired due to polluted stormwater runoff. (U.S. EPA, 2007a)Stormwater runoff, defined as "precipitation from rain or snowmelt flows over the ground", is the main contributor to nonpoint source water pollution in the U.S. (U.S. EPA, 2003)Runoff flows along roofs, streets, and other impervious surfaces to reach storm drains, or other stormwater infrastructure, where it is eventually discharged, often untreated, into receiving waterbodies downstream.

Table 1. 1 Contaminants in Stormwater Runoff and their Environmental Effects

Bacteria and Pathogens	Human health hazards in swimming areas.
Sediments	Inhibit or prevent aquatic plant growth by clouding waterways, destroy aquatic habitats.
Household and Roadway Wastes	Poisons aquatic life which can them harm wildlife and humans that consume poisoned fish or shellfish.
Floatables	Harms aquatic life and aesthetic value of waterways.
Excess Nutrients	Algal booms that can lower dissolved oxygen levels in waterways and harm aquatic life.

All contaminants and pollutants such as pet wastes and other bacteria sources, dirt, discarded trash, nutrient-rich fertilizers, grass clippings, insecticides, motor oils, brake dust, tire fragments, and toxic chemicals from the road that accumulate along this journey are eventually deposited into receiving water bodies. Table 1.1 provides a summary of possible stormwater runoff pollutants and their negative environmental effects. (U.S. EPA, 2003a)

Each year, polluted stormwater runoff has negative effects on drinking water, recreational areas, fisheries, and wildlife. Federal and state governments recognize stormwater runoff as being a major concern and have issued regulations to improve the situation by reducing stormwater quantity and improving stormwater quality. Meeting these measures is an essential step in providing clean drinking water, unpolluted recreational areas, and clean habitats for wildlife and aquatic life. Many municipalities across the country, however, have inadequate resources to comply with the regulations. Although stormwater runoff is recognized as a national problem that transcends political boundaries, the U.S. approach under the Clean Water Act has been to mandate state implementation of federal laws. Most states have delegated this responsibility to municipalities and allowed them to implement stormwater controls consistent with state and federal laws.

1.1 Why Should We Be Concerned?

Stormwater management is a growing concern for many American cities. Not only can outdated or non-existent infrastructure lead to flooding, soil erosion, and changes in natural hydrology, but also many towns are currently required by the National Pollution Discharge Elimination System permitting program to implement Phase II regulations for stormwater management. Meeting Phase II measures requires many different "best management" abatement practices (BMPs) including public education, illicit discharge elimination, and more responsible development practices. While BMPs have been developed and used successfully in many municipalities, municipalities face the problem of lack of funding for routine operations and maintenance, administrations, and capital improvement projects (CIPs).

The solution to this problem is not as simple as finding a one-time funding source to implement technologies and methods to comply with the regulations. Not only do stormwater management systems require routine maintenance to function properly, even with constant upkeep stormwater infrastructure only has a limited lifespan which necessitates additional capital funding. Also, it is important to have an organizational structure in place that allows for responsible and efficient stormwater management at the municipal level. Developing a method to not only fund the immediate infrastructure solutions but to also create a program that provides infrastructure funding for years to come may seem difficult, but the solution can be found in the form of a stormwater utility.

Over 400 municipalities in the United States have stormwater utilities in place. The money raised from utility user fees is a dedicated funding source for stormwater management in these municipalities. Some of the existing utilities use the revenue generated to fund the entire stormwater program, including routine operations and maintenance, personnel costs, and capital improvement projects. Other utilities use the user fee to supplement another funding source, or to only cover one aspect of stormwater management, for instance to finance capital improvement projects. Municipalities that do not have a stormwater utility generally use the town general fund to provide resources for stormwater management. Since stormwater is just one of many competing priorities for funding from this source, funding is not always adequate to comply with federal stormwater requirements or to meet municipal stormwater needs.

Creating a stormwater utility is a possible solution to the often faced problem of underfunding stormwater management. While many existing stormwater utilities acquire funding solely through a fee system, others also use grants, bonds, and other methods in addition to the user fee in order to obtain funding for capital improvement projects. There are also utilities that obtain funding through user fees in addition to the municipal general fund.

To date there are few stormwater utilities in New England. While there are over 400 stormwater utilities in the United States, there are only six in New England: South Burlington, VT, Reading, MA, Newton, MA, Augusta, ME, Lewiston, ME, and Chicopee, MA. (See Section *2.4.2 Implementing a Stormwater Utility)* Most of these utilities have only been in existence for few years and are still in the start-up phases. There is also some debate over whether the dedicated fund in Chicopee, MA should be categorized as a stormwater utility. There are many communities in New England that are in different phases of considering a stormwater utility as of Spring 2008 to help manage their stormwater management programs, including Milton, MA, Franklin, MA, East Providence, RI, and Narragansett, RI. Many approaches are possible to these communities, and it is presently unknown which each will choose, if any. (Charles River Watershed Association, 2007)

Municipalities that lack a dedicated stormwater funding source are therefore often underfunded and struggling to find the resources to meet the requirements of federal and state stormwater legislation. While a stormwater utility seems like a viable solution to this problem, many towns have not adopted them. This in part could be due to the lack of compelling proof of a stormwater utilities efficacy. Key concepts involved in analyzing the efficacy of stormwater utilities are effectiveness, efficiency, incentives, and equity. In many instances there is also a perceived lack of knowledge about the implementation process and how to obtain funding for it. A national consensus on the potential value that stormwater utilities may add and the best practices for implementation of a utility is required.

There are two specific research questions. The first is, are stormwater utilities a viable to way mitigate stormwater runoff in the United States? The case study devoted to exploring this question is a national utility analysis. The second research questions is, can municipalities use the information gathered from the national stormwater utility analysis in order to implement a successful utility of their own? This question is explored through a second case study that revolves around a stormwater utility feasibility study for a local Rhode Island community.

This thesis works through these issues in a comprehensive and methodical way. Chapter 2 is devoted to outlining the background information concerning stormwater management in the U.S. Background information is provided on federal and state stormwater regulations, options for stormwater management, funding sources, and stormwater utilities.

Chapter 3 includes description and analysis of the two case studies used in this thesis. The first, a national stormwater utility analysis shows trends throughout stormwater utilities in the United States and provides an evaluation of each utility included on its overall effectiveness. The second case study applies the information gathered by the national stormwater analysis to a local municipality, Narragansett, RI. This case study involves conducting a stormwater utility feasibility study for the municipality and using the results from the National Stormwater analysis to provide Narragansett specific recommendations.

Chapter 4 provides a summary of major findings from both case studies, as well as conclusions. Detailed recommendations are offered for existing stormwater utilities, municipalities developing stormwater utilities, and state environmental departments. This chapter also provides a further research section that would enrich the two case studies.

Chapter 2: Background

2.1 Regulatory History

The management of stormwater has been regulated in the United States since the 1970's. Prior to this, stormwater management was addressed as a local issue as a way to facilitate stormwater conveyance away from properties. With increased understanding of issues such as water quality, quantity, and watershed health, stormwater was recognized by federal and state governments as being a concern that required regulatory legislation. Table 2.1 below is a timeline of major federal stormwater legislation, and the following section provides an overview of the major federal stormwater regulations and state stormwater responsibilities.

Table 2. 2: National Stormwater Legislation Timeline

Prior to 1970	Prior to 1972 no state or federal stormwater legislation existed, stormwater was a State and local issue
1972	The Clean Water Act (CWA) is passed and is the first national effort to address improving water quality through regulation of point sources of water pollution. However, stormwater was not thought of as a point source of pollution at this time except through combined sewer overflow.
Early 1980s	Stormwater is defined as being a potential point source of water pollution and becomes regulated in part by the National Pollution Discharge Elimination System (NPDES) permit program and Total Maximum Daily Load (TMDL) requirements.
1987	Section 402 (P) of the Clean Water Act is amended to include all stormwater, both point and non-point sources. Non-point sources are required to be reduced locally to the "maximum extent possible".
1990	Phase I of the National Pollution Discharge Elimination System permitting program takes effect for communities with a population of over 100,000.
1999	Phase II of the National Pollution Discharge Elimination System permitting program takes effect for all municipalities.

2.1.1 Federal Stormwater Regulations

The U.S. Environmental Protection Agency is largely responsible for regulating stormwater in the United States. While many federal organization have a vested interested in stormwater management, U.S. EPA is the authorizing agency behind all major federal stormwater regulation. Figure 2.2 illustrates many of the federal agencies and departments that have an interest and activities in stormwater management. For a diagram including state and local level organizations with an interest in stormwater management, see section 3.2.1 with an example from Narragansett, RI.

Table 2. 3: National Agencies Involved in Stormwater Management

US EPA→ State Environmental Departments→ Municipalities

- Clean Water Act
  - Total Maximum Daily Load- Requirements for polluted waterbodies.
  - National Discharge Elimination: regulates stormwater quality management in all municipalities. Penalties exist for non-compliance

Army Corps of Engineers

- Stormwater management in wetlands
  - Installing best management practices in order to maintain flow

Department of Commerce → National Atmospheric and Oceanic Administration

- Stormwater quality and quantity ocean discharge monitoring

Department of Homeland Security→ Federal Emergency Management Agency

- Flood Control and Management Assistance

The most influential piece of legislation that affects stormwater policy is the Clean Water Act (CWA). This act is instrumental because it authorizes the National Pollution Discharge Elimination System (NPDES) and Total Maximum Daily Load (TMDL) programs. Both the NPDES and TMDL programs strongly influence stormwater management by setting standards and minimum control measures that must be met by municipalities and states. While most state governments have accepted responsibility for implementing these programs, U.S. EPA ensures that standards are being met nationwide.

Clean Water Act (CWA)

The Clean Water Act, passed in 1972 was a major piece of environmental legislation that developed ambient water quality standards and point source controls for water pollution. The CWA was expanded with the adoption of the Water Quality Act of 1987 to include nonpoint sources of water pollution. The CWA addresses stormwater pollution by defining deadlines for U.S. EPA to develop and implement a program that regulate stormwater from municipal and industrial discharges through a permit system in order to protect water quality. The program had to establish priorities, requirements, and expeditious deadlines for state stormwater management programs. The resulting program was the National Pollution Discharge Elimination System.

The National Pollutant Discharge Elimination System (NPDES)

The CWA of 1972 states that stormwater permits "shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and systems, and design and engineering methods." EPA developed the National Pollution Discharge Elimination System to meet the expectations of the CWA. Originally stormwater was not regulated under the NPDES permitting program because it was not classified as a point source of pollution. In the early 1980s the definition of point source water pollution was expanded to include certain stormwater discharges, enabling them to be regulated under the CWA. In 1987 the Clean Water Act was amended to include all stormwater sources, point and non-point. The implementation of the NPDES permitting system for all forms of stormwater was separated into two phases. Phase I took effect in 1990 and requires communities with a population of over 100,000 that maintained a municipal separate storm sewer system (MS4) to file a permit for their discharges. (See *Appendix A: Definitions*) Phase I also requires permits to be filed from industrial sites and construction sites that affect more than 5 acres of land. In 1999 Phase II of the program was implemented and included all MS4 communities regardless of size, and expanded construction permits to include those that disturbed an area between 1 and 5 acres. The NPDES regulations are intended to be a cost effective way to reduce previously unregulated stormwater runoff by requiring municipalities to adopt six minimum measures intended to lessen pollution. (U.S. EPA, 2008c)

The six minimum measures are:

1. Public education and outreach on stormwater impacts
2. Public involvement/participation
3. Illicit discharge detection and elimination
4. Construction site stormwater runoff control
5. Post-construction stormwater management in new development and redevelopment
6. Pollution prevention / good housekeeping for municipal operations

Both federal and state governments have roles in implementing the Phase II NPDES stormwater regulations. The role of the federal government in the NPDES is to develop an overall framework for the program (which it has already completed), encourage consideration of smart growth approaches (see Section *2.2 Options for Stormwater Management*), provide financial assistance (see Section *2.3 Funding Options for Stormwater Management*), oversee state and tribal programs, and implement the program in jurisdictions not authorized to administer the NPDES program. (NPDES, 2002)While most states have the authority to develop, implement, and enforce a specialized NPDES program, some states have chosen not to take on this responsibility and in those cases U.S. EPA has taken on the roles of the state government. The state's role in the NPDES programs is to develop the program, comply with applicable federal requirements as a discharger, and communicate with U.S. EPA about the status of the State's waters. Each state's program may differ slightly because of the ability to tailor the program to meet the state's unique needs. (NPDES, 2002)

The statutory standard for the NPDES program is the same as is described in the CWA, the "maximum extent practicable." Permit holders are also required to provide a notice of intent including what Best Management Practices (BMPs) they intend to use to meet the minimum measures and what sort of approach is expected. (NPDES, 2002)

Total Maximum Daily Load (TMDL)

The Total Maximum Daily Load (TMDL) program was also authorized by the Clean Water Act. (TMDL, 2002)This program is intended to inventory and address contamination issues for waterbodies across the nation. Section 303(d) of the CWA requires states to inventory their waterbodies and to identify those that are impaired. Each waterbody has a specified use that could include drinking, swimming, and fishing. Each use has specific requirements that it must meet under the CWA, with drinking water having the most stringent requirements. Impaired waterbodies, by definition, do not fit the criteria for their specified use and are placed on the impaired record, called the 303(d) list. If technical solutions applied to the point sources of pollution for impaired water do not alleviate the problem, a TMDL program is developed for the waterbody by the state environmental department. Waterbodies on the 303(d) list have a TMDL created for them if they still do not meet their criteria for use after technical fixes are applied to point sources of pollution. 40% of the nation's waterbodies are currently on the 303(d) list, and as mentioned previously 40% of those on the list are impaired due to stormwater runoff. (U.S. EPA, 2008a)

The TMDL program applies to stormwater management systems because towns with a TMDL regulated waterbody must meet TMDL standards for point and nonpoint source pollution, including stormwater. Often capital improvement projects are needed in order to improve the quality of stormwater that is discharged into TMDL regulated waterbodies.

2.1.2 State Stormwater Regulations

As explained in the previous sections on federal stormwater legislation, delegated states have the responsibility to address stormwater rules mandated by the federal government, for example NPDES and TMDL programs. All states implement program they have tailored to their specific needs with federal requirements as a guideline. Each state's environmental department administers the NPDES permit system and ensures municipal compliance with meeting the six minimum measures. Using Rhode Island as an example, the authorized body to implement NPDES (i.e. RIPDES in RI), is the Rhode Island Department of Environmental Management (RIDEM). Permits are received by the RIDEM from municipalities across the state and are then reviewed by engineers before they are approved.

As explained in the previous sections, states are also responsible for implementing the TMDL program, and many state environmental departments have infrastructure set up to administer this program. Nationwide there are currently 6,185 TMDLs approved for 2008. (U.S. EPA, 2008b)

2.2 Stormwater Management Approaches

There are two main areas of concern for stormwater management. One is the reduction in stormwater quantity, and the other is the improvement of stormwater quality. Most state and federal regulations work to improve both of these measures in a variety of different ways. Source reduction is achieved by lessening impervious surfaces such as sidewalks, driveways, and rooftops, allowing the rain to naturally infiltrate into the earth after it falls. Installing and maintaining stormwater management structures such as vegetated swales also increase pervious surfaces and promote natural absorption. Stormwater quality is improved by capturing runoff and treating it before it is integrated back into the water cycle. There are many different methods of capture and treatment of stormwater runoff and the most effective choice for a particular situation will depend on the town and the pollutants that are a concern.

Basic policy strategies to address stormwater runoff include command and control measures, technological approaches, and market based approaches. A variety of these choices are currently being used in stormwater management across the country. Command and control is exhibited through the CWA, through which the federal government sets standards that must be met by State and local governments. Technological solutions are important because they are used to improve the quality of contaminated stormwater through treatment and impervious surface reduction. Market based approaches are currently used least often in stormwater management, but are increasing in use through credit systems implemented in most stormwater utilities. (See Section *2.2.1 Components of Stormwater Utilities*)

The U.S. EPA has published manuals to aid state usage of stormwater BMPs that must be met under the NPDES Phase II regulations. In addition to the BMPs listed under the Phase II rule, there are structural BMPs that can be used to stop flooding, or reduce pollution of municipal stormwater; many of which are technological fixes. Many structural BMPs use infiltration to reduce the volume of stormwater. Some examples of infiltration structures include dry wells, rain gardens, and vegetated swales. BMPs used to improve stormwater quality include constructed wetlands, sand filters, and retention basins. (See *Appendix A: Definitions*) (U.S. EPA, 2006) Individual states also have the authority to create and enforce guidance documents for stormwater management that require mandatory action by municipalities. In Rhode Island, for example, the Department of Environmental Management has produced numerous stormwater guidance documents including the Urban Environmental Design Manual, published in 2005, that provides guidance for municipalities to develop stormwater and other urban best management practices. (RI DEM, 2005)

Many municipalities face the problem of having to manage an aging stormwater system and to develop and fund BMPs that address issues in new stormwater areas. Many new or expanding communities are being urged to adopt Low Impact Development (LID) as a BMP to address stormwater issues before they occur. (U.S. EPA, 2007)LID includes adopting porous sidewalks and driveways, vegetated roofs, and strategic planning to develop land in stormwater-friendly locations that take into account the natural water cycle. Many examples demonstrate that a well planned LID solution is often more effective and less expensive than traditional development. (U.S. EPA, 2007b)The EPA has recently started a campaign to promote the use of 'Green Infrastructure' in the management of stormwater. (U.S. EPA et al, 2007) Green infrastructure is defined by the EPA as "approaches and technologies [that] infiltrate, evapotranspire, capture and reuse stormwater to maintain or restore natural hydrologies." Many LID strategies are similar to low impact development, for instance implementing rain barrels, porous pavements, and green roofs, however in the long-term the goal of green infrastructure is to preserve and restore natural landscape features. (U.S. EPA, 2007b)

2.3 Stormwater Funding Options

The EPA published a Stormwater NPDES Phase II Compliance Assistance Guide in 2000 to assist Phase II communities to meet new the Phase II measures. It states that funding may be one of the biggest challenges in trying to comply with the new stormwater regulations, and that other funding sources in addition to municipal general funds will likely be required. The American Public Works Association (APWA) has conducted a number of workshops on different potential funding mechanisms for municipalities and this useful information is included in the U.S. EPA Compliance Guide. Potential sources of funding for stormwater management were: debt financing, grants, loans, users/utility fees, special assessments, local improvement, general fund, inspection fees, developer fees, alternative fees, and connection fees. (U.S. EPA, 2000)In 2006 the National Association of Flood and Stormwater Management Agencies (NAFSMA) wrote a report titled Guidance for Municipal Stormwater Funding, which outlined many similar financing options while also providing the negative and positive aspects of each. (NAFSMA, 2006)

The most commonly used funding sources for stormwater management, including general fund/property tax, user/utility fee, state revolving fund, bonds, grants, and special assessments are summarized below.

2.3.1 Property Tax/General Fund

Many communities use property taxes paid through the town general fund to implement a stormwater management program. Most communities use the general fund to supply resources for many different programs, such as education and public safety. This can lead to competition between programs for funding. Competition for general fund resources and underfunding of stormwater management is not the only problem with this funding source. Property taxes, for example, do not reflect the contribution of each property to stormwater runoff. Property taxes are collected based on the value of a property, and stormwater runoff is influenced by the impervious area of the property.

2.3.2 User Fee

User fees, implemented through a stormwater utility, are more equitable than property taxes for funding stormwater management. User fees, sometimes called service fees, charge each property owner based on stormwater contribution. Since the user fee is calculated based on stormwater contribution, each stormwater utility customer will pay a proportionate amount towards stormwater management.

A stormwater user fee is highly flexible and can be easily tailored to individual situations and coordinated with other funding methods. (NAFSMA, 2006) Some communities decide to partially fund their stormwater management program through user fees, while others use it to support the entire program. Diverse rate structures are made possible by the many factors that can be used as a base for user fee calculations. Most municipalities use square feet of impervious surface to calculate rate structures, however other options include percent of impervious surface, or gross parcel area.

2.3.3 State Revolving Fund

The State Revolving Fund (SRF) Water Pollution Control Program provides long-term low-interest loans for capital improvement projects intended to abate point and non-point sources of water pollutions. The 1987 Clean Water Amendments established this fund, which is intended to be a permanent financing source for water quality projects. The SRF program is administered and operated by states using federal grant money and loan repayments to fund eligible projects.

While an SRF is a viable funding source for many stormwater capital improvement projects, these loans are only available for projects that offer a solution for stormwater quality issues. Many municipalities also have important capital improvement projects that are intended to improve drainage and flooding issues.

2.3.4 Bonds

Bonds had been a popular method of funding stormwater management capital improvement in the past because they spread the cost of a program over a number of years. While bonds enable large expenditures that would not be possible by revenue alone, they involve borrowing money and accruing debt and are not a stable source of funding for an entire stormwater program.

There are two types of bonds, revenue and general obligation. A revenue bond is supported by a specific source of revenue, for example a user fee or special assessment. Many existing stormwater utilities are currently using this type of bond to fund capital improvement projects. Bonds can be used to cover any capital improvement project, including stormwater quality and quantity improvement, unlike a State Revolving Fund loan. A General obligation bond is supported by more than one revenue source, and can include a variety of taxes.

2.3.5 Grants

Grants may be used for capital improvement project (CIP) expenses but are not available for general stormwater management because a grant is not a dedicated or stable funding source. One grant that states can apply for is a "319 grant" which is funded through the U.S. EPA and is intended to provide supplemental funding for meeting the provisions of section 319 of the CWA. Grants may be used to cover the development costs of a stormwater utility and are often used for CIP projects even if the rest of the stormwater management system is funded through another source.

2.3.6 Special Assessments

Special assessments have been used to fund stormwater capital improvement projects in various areas of the country. They are intended to be an equitable way to fund projects that benefit a limited portion of the jurisdiction. Only those who directly receive the benefit will pay the special assessment fee. Usually there is some measure to ensure that each person is paying to the extent that they will see the benefits. One problem with special assessment fees is that it is sometimes hard to accurately predict the benefits and to assign a cost to them.

2.4 Stormwater Utilities

Many municipalities are finding it difficult to meet current regulatory guidelines even with stormwater management programs in place. Deficiency of dedicated resources for stormwater management can lead to inconsistent execution of existing programs, shortages in personnel, and an inability to initiate capital improvement projects. Many of the funding sources described in the following section are not adequate or stable, even when a municipality utilized a variety of sources. Stormwater utilities have been implemented in many municipalities as a way to avoid these common problems by providing a dedicated revenue source for stormwater management programs. Funding under a stormwater utility for stormwater management is commonly provided through a user fee to utility customers. Every land owner in the municipality is considered a utility customer because each inhabitant benefits from stormwater utility programs. The revenue generated is used for stormwater control measures, increasing personnel and implementing and maintaining support structures. A dedicated funding source allows the municipality to establish a comprehensive and ongoing stormwater management program that includes long-term goals.

There are many benefits to states promoting the implementation of stormwater utilities in those municipalities that have found it difficult to comply with federal and state stormwater regulations. The implementation and development of a stormwater utility requires many considerations that may be intimidating to municipalities, but with state endorsement and assistance, municipalities could have the potential to comply with regulations and improve stormwater management. Many states, such as Florida, with numerous stormwater utilities already in place often have guidance documents to provide assistance during implementation. Lack of a consistent definition of a stormwater utility leads national estimates to range from 300 to 500 utilities in operation currently. It is estimated that over 100 current utilities exist in Florida. Since this paper accepts a broader definition of stormwater utilities an estimate closer to 500 is accepted. (See the following section and *Appendix A: Definitions)* The first stormwater utility was created in Washington state in the 1970's, soon after the passage of the Clean Water Act. Since then stormwater utilities have been gaining popularity as a way to create available resources that are needed to promote healthy waterways. (Florida Stormwater Association, 2003)

2.4.1 Components of Stormwater Utilities

As previously mentioned, stormwater utilities are very varied and often tailored specifically to individual communities. It would be very unlikely to find two utilities that are exactly alike, just as it would be very unlikely to find two communities that are exactly alike. A stormwater utility is defined as "providing a vehicle for consolidating or coordinating responsibilities previously dispersed among several departments; generating funding that is adequate, stable, equitable and dedicated solely to the stormwater function; and developing programs that are comprehensive, cohesive and consistent year-to-year" by the National Association of Flood and Stormwater Management Agencies. (NAFSMA, 2006)Resources for stormwater management are provided by the utility depending on what resources the community needs. Monetary support is given through funds collected via user fees, personnel support is supplied through either shared staff or exclusive stormwater staff, and an organized stormwater program is provided through resource management. The following sections are intended to provide summaries and descriptions of some of the different components that must be decided on and incorporated into stormwater utilities.

User Fees

The user fee is the one aspect that all utilities have in common, however the user fee can be calculated through many different means. A popular and equitable way to assign user fees is charge a rate that is proportional to the impervious surface if each parcel. An impervious surface is a non-porous surface that does not allow water or other liquids to permeate into the soil, therefore resulting in runoff. There are many methods of using impervious surface to calculate a user fee, which will be explained below; however each method is based around the concept that the measurement of impervious surface is one of the best ways to calculate user fees because stormwater runoff is in direct correlation to impervious surface area. (NAFSMA, 2006)

Impervious Surface

A 2007 survey of 71 utilities nationwide conducted by Black & Veatch found that 65% of stormwater utilities used impervious surface area as the basis for their user fee. (Enterprise Management Solutions, 2007) This survey does not specify whether each parcel was analyzed individually, or if an "estimated residential unit" (ERU) was used in the calculation; however it does show that impervious surface area is a popular method to determine user fee. In the NPDES legislation it is stated that: "studies reveal that the level of imperviousness in an area strongly correlates with the quality of the nearby receiving waters." Not only has research proved impervious area to be an effective measure of stormwater runoff, many "users" can easily understand the causal relationship that exists between the two, making it a widely accepted basis for utility user fees. (NAFSMA, 2006) Other popular parameters for user fees include gross area, percentage of imperviousness, and land use. Often a community will try to balance equity of the available rate structure base with efficient use of existing municipal infrastructure. If the stormwater utility is being implemented in a small town with limited staff and is billed through an existing wastewater bill, it is possible that a flat rate may be the best option for this community.

Most municipalities use an ERU as the basis for the stormwater utility user fee. An ERU is determined by calculating impervious surface areas for a representative sample of single-family residential parcels in the utility area. The impervious area is commonly calculated through tax assessor database information, aerial photos, Geographic Information System (GIS) technology, or field measurements. The ERU also has many other names, including the "Equivalent Runoff Unit", and "Equivalent Square Feet of Impervious Area". Calculating an ERU is beneficial not only because it is a standard unit for utility user fees, but also because it is a statistically viable way to charge customers in proportion to their input to stormwater runoff if a municipality chooses not to calculate impervious areas for each parcel.

Using an ERU as the basis for user fees has been upheld as equitable by a variety of court cases. (See Section *2.5 Legal Review*) The concept of paying for the amount that a property owner contributes to the problem is essential for developing an equitable fee and distinguishing it from a tax. The enabling legislation for many states includes mention of the equity issue, while some legislation directly mentions the need for a representative fee. In Rhode Island, for example, the legislation enabling the formation of stormwater utilities states that, "each contributor of runoff to the system shall pay to the extent to which runoff is contributed." (Rhode Island Stormwater Management and Utility Disctict Act of 2002, 2002)(See *Appendix B: RI Enabling Legislation*)

Some states are bound by statutes that are specific in wording and nature and clearly state what the duties of a stormwater utility can be, while the enabling legislation in other states is more open to interpretation. This is chiefly due to the difference between states with and without home rule authority. (See *Appendix A: Definitions*) The specific attributes of utilities vary greatly and can be influenced by the state, yet the overall manner in which many utilities function is generally the same. The general characteristics that exist in most utilities are usually not impeded by the legislation of the state.

An illustration of how a state can shape or limit utility characteristics can been seen in Rhode Island's stormwater utility enabling legislation, passed in 2002. This legislation asserts that "the state shall be exempt from the fee system." This provision prevents municipalities from obtaining revenue from any state structure within the utility service area, including buildings and state roads, regardless of now much they contribute to stormwater runoff. While this puts considerable restrictions on the municipality, the Rhode Island enabling legislation also asserts that "the state Department of Transportation shall cooperate with the municipalities in the planning and implementation of wastewater management ordinances, including the providing of funds, if available, to match the fees collected by the municipalities annually." (See *Appendix B: RI Enabling Legislation*)

While impervious surface and ERU have been shown to have a strong correlation to stormwater runoff, there are utilities that do not use these measures as the basis for their user fee calculation. The reasons behind this choice vary, including concepts of equity and availability of data. Other ways to calculate rates include gross parcel size and complex runoff coefficients that are specialized for each town and include factors such as elevation, slope, and proximity to waterbodies. There are an almost unlimited number of potential user fees because of the many different factors and decisions that can influence rate structures.

Considerations for Rate Structure

Deciding on a stormwater utility user fee rate structure is one of the most complex decisions during a stormwater utility development phase. There are several considerations that need to be resolved when determining a rate structure including legality, equity, rate coverage area, and data requirements. Descriptions of these issues as well as reasons and methods for addressing each are provided in the following sections.

Legality

The legality of a stormwater utility fee structure is an important issue because a user fee can easily turn into a tax if not formulated in the correct way. There are a few key differences between a user fee and a tax (see Section *2.3 Funding Options for Stormwater Management*) and while most stormwater utilities do not face legal challenges, the majority of challenges are over the validity of the user fee. (Enterprise Management Solutions, 2007)Charging comparable user fees to similar properties can be accomplished by developing a rate structure that matches the community profile, and can be an effective argument against legal challenges. (See Section *2.5 Legal Review*, and Section *4.1.1 Recommendations for Communities*)

Equity

For a rate structure to be equitable there must be a strong, credible link between the amount of stormwater runoff that a utility customer generates and the amount of money that customers pay as a user fee. There are many different ways of calculating a user fee, and not every method works well for every community. It is important to examine the positive and negative traits of each fee calculation method as they apply to the target community. A rate structure that is very equitable for one community may be extremely inequitable for another. Ensuring that no one entity or type of customer bares a disproportionate weight for stormwater management may help reduce future challenges. (See Section *3.1.3 Criteria for Evaluation*)

Simplicity

Simplicity is an important consideration when deciding on a rate structure. While some of the most equitable user fee structures (for instance calculating impervious area for each parcel) are very complex, the basis for the fees may be difficult for the public to understand. It is important to create the right balance of equitability and simplicity in order to ensure customer understanding and acceptance.

Data Collection

While the choice of user fee structure shouldn't be made solely based on what information is available for each parcel in the municipality, it is important to know what information is currently available before deciding on a rate structure. Some rate structures require more data than others and gathering new data requires resources that may not be available. Having current GIS parcel information (sometimes available from the tax assessor's office, or another utilities database) is essential in most cases for calculating a rate structure. Aerial photographs can also be used to calculate impervious area. Site visits might be required in order to get information for parcels that have been developed or altered after the most recent GIS information. Creation of a new database to allow calculation of fees can be prohibitively expensive – consideration of every available database must be an early priority in developing a stormwater utility.

Exemptions/Credits

A credit system is necessary to have for a user fee to be distinguished from a tax. Because, by definition, user fees are voluntary, there needs to be a system in place for utility customers to reduce their fee. Stormwater credit manuals are often developed by the utility to describe the different sorts of credits that are available, what requirements must be met, how much credit will apply, and how to obtain a credit.

Credits can be available for stormwater quality improvement, stormwater quantity reduction, or both. Stormwater quality credits are usually offered for non-residential parcels that offer credits for off-site stormwater structures that are maintained by the parcel owner. Residential credits can exist for installing rain barrels, rain gardens, or reducing existing impervious area.

An education credit has also been adopted by some stormwater utilities. An education credit is applied to schools that offer stormwater education programs to their students. Schools often have a large area of impervious surface and providing this credit can alleviate a certain percentage of the school's yearly user fee, with the added bonus of also providing the important service of education in the hopes that one day it will change behavior that will positively influence stormwater runoff. Towns are required to meet certain minimum measures for public education under NDPES and some of these education programs are already in place.

It should be noted that many communities in the implementation phase of a stormwater utility currently do not have a credit system in place, but intend to adopt one in the future. The start up resources and time that is required to implement a stormwater utility is significant, and some of these communities have decided to wait until funding for a dedicated stormwater manager or other full time staff is available to develop a proper stormwater utility credit manual.

One way to set-up a user fee is to adopt a small flat fee that every customer pays in addition to a fee based on the stormwater contribution of each parcel. An example is a utility that operates on a flat ERU based fee for residential properties at $3/month with each customer also paying a $0.75/month base fee for a total of $3.75/month for residential customers. The $0.75 flat fee can be added to each customer's bill regardless of what their parcel size or impervious surface area because it is a fee issued for use of municipal maintained roads, parking lots, and impervious structures. Use of municipal areas creates pollution (for instance from cars) that is then swept into water ways by stormwater when it reaches these areas. With a system such as this it might be possible for a customer to reduce some, if not all of the fee that is added on top of the flat rate, but the flat rate would always remain to off-set the cost of managing stormwater from municipal road ways.

Exemptions are similar to credits in the sense that if the property-owner is contributing so much to the utility based on other aspects of the fee structure that they do not have to pay the flat fee for stormwater management. Exemptions aren't always provided in utilities, and the municipalities that do provide them create the exemption for specified reasons. For example, the state enabling legislation in Rhode Island claims that the state must be exempt from these user fees, and that the Department of Transportation must work towards helping the utility in any way that is possible, even if through other resources besides funding. (See *Appendix B: RI Enabling Legislation*)

Single-Family vs. Multi-Family Approach

Utilities can either decide to charge all residential parcels the same rate, or to break them up into different categories with different rates. Often multi-family residential parcels are charged a different fee than single-family residential because of their proportionately higher impact on stormwater runoff (due to increased impervious surface). There are many potential ways to charge multi-family parcels. One is to charge each residential unit the same fee as a single-family parcel. Another way is to treat multi-family residents as non-residential parcels. A combination of these two approaches may also be used, with duplexes being charged like single-family homes, while apartment complexes are charged as non-residential.

Staffing and Organization

Many municipalities express a need for more resources in order to meet the NPDES minimum measures, and while funding is the most common limitation, other resources are needed as well, such as personnel. Personnel are needed for organization and implementation of the improvements that a stormwater utility funds. Staffing has been handled in many different ways and depends on the existing staff and needs of the municipality. Stormwater utilities can be a component of another existing utility, such as water or wastewater utilities. Stormwater utilities can also be implemented as part of another municipal department, such as the Department of Public works.

One of the most popular linkages is between the Department of Public Works (DPW) and stormwater utilities. The DPW is responsible for routine operations and maintenance (O&M) in most communities. Another popular linkage is between the municipal Engineering Department and a stormwater utility since Engineering Departments often play a large role in developing stormwater management plans and maintaining NPDES permits. Some stormwater utilities, especially those who maintain stormwater for a large area, are established as stand-alone entities.

One foreseeable benefit of developing utilities within another department is the potential for a fluid exchange of staffing time if staff is being shared. Some utilities do not add additional staff after the creation of the utility, maintaining the current staff and allocating revenue from the utility to pay employees for time spent on stormwater related issues. This structure is more likely to be adopted in a community where lack of dedicated resource only extends to funding for stormwater projects and not personnel. However, most municipalities would benefit greatly from hiring at least one dedicated staff member under a new stormwater utility. A dedicated employee can create an efficient system through exclusive management and oversight of stormwater programs and projects.

2.4.2 Implementing a Stormwater Utility

While many stormwater utilities have been successfully implemented across the country, there is no standardized implementation method and the implementation processes can be challenging. Municipalities are faced with the task of developing a utility that meets their specific needs, commonly resulting in each reaching the implementation stage through differing methods. While there is no consistent way to develop and implement a stormwater utility, there are some elements that must be decided on before a utility can be established. Collaboration between the stormwater utilities and outside entities has also brought about elements common to many utility. These elements are considered to be important and at times essential to implementation. Even if there are many people who are enthusiastic about a adopting a stormwater utility, many communities enlist the help of consulting firms during the development and implementation phases of a stormwater utility. The decision to work on implementation steps entirely in-house, or with a consulting firm, or a combination of the two is a decision to be made by the town, and is dependant on many factors. Consulting firms, while experts at the information that is usually needed to successfully implement, are often expensive and can draw out a process that could have been completed more inexpensively and efficiently in-house. It is important to know what information and commitments, financial and otherwise, are required for implementation before making the decision whether or not to use in-house resources. Many stormwater programs are already underfunded, understaffed, and misunderstood by the public, so this decision may be a hard one to make.

The implementation process can be long and costly. While a consulting firm is one of the largest possible expenditures during implementation, collecting the data necessary to make these decisions in-house can still require a significant amount of resources. Many states support municipal actions towards meeting stormwater regulations. One way to obtain the funding for the implementation process is to apply for federal or state grants. Another way is to implement the utility before all aspects are fully developed, in order to start generating revenue. After revenue flow begins, it can immediately be used to hire personnel or to buy the resources necessary to fully develop the utility. Many of the alternate or supplemental funding options for stormwater management could be utilized to acquire the funding necessary to implement a stormwater utility. (See Section *2.3 Funding for Stormwater Management*)

Initial development of a user fee and implementation of a stormwater utility can be broken down into different aspects for individual consideration. A method used to describe the main elements organizes them into the following areas of focus, or 'tracks':

political, financial, legal, information, and technical. (NAFSMA, 2006) Each track has many considerations and decisions should reflect the municipality. Before any of these elements can begin development, the municipality must initially determine if a stormwater utility is feasible for the community. Prior to conducting a formal feasibility study (see following section), it is important to understand if the political body of the town is receptive to passing a stormwater utility ordinance, if the utility is formulated correctly. Dialogue between a consulting firm or in-house implementation committee and the municipal stormwater staff to establish whether a utility should be investigated further is an important step. If the staff deems the formation of a stormwater utility worth investigating, the next step is to conduct a feasibility study either using in-house or consultant resources.

A number of important decisions need to be made in order to move forward with implementation of a stormwater utility. The many different options available at each of these many steps are one of the factors that make each stormwater utility unique. Deciding on the user fee structure, staffing, and organization are important aspects but even more considerations exist, including start-up strategy, development period, bill distribution and collection, and determination of expenses covered by the user fee. Conducting a feasibility study can give insight into what options are best for the municipalities and the recommendations from the feasibility study can be used to make the decision making process easier by already eliminating options that did not seem viable.

Feasibility Study

A feasibility study is a way to determine if a utility is worth developing for a community. The implementation process is very costly, and a feasibility study is a straightforward and cost-effective method that can determine if it is viable to continue the development process. A feasibility study outlines the current stormwater management program and provides a detailed description of the current activities, including costs and funding sources for each. Information concerning current stormwater activity and costs is often obtained through a series of interviews with key members of stormwater management for the municipality. Additionally, reviewing recent budgets and the current NPDES permit application can provide necessary information.

A feasibility study also inventories necessary future stormwater management activities. This information can be found through examining CIP plans, interviewing town staff, and analyzing the community's success in meeting all of NPDES Phase I or II minimum requirements. Any minimum requirements that are not currently being met are added to the list of required future stormwater management activities. The costs of each activity or program could be difficult to quantify. Using estimates from similar projects and programs is a way to incorporate these future costs into the feasibility study.

Examining the difference between the current cost of stormwater management and the cost after adding all desired or required activities allows a municipality to see how much additional revenue must be generated in order to implement a fully comprehensive stormwater management plan. Additionally, because stormwater utilities generally collect money into an enterprise fund, the cost of all necessary stormwater management activities is important to calculate in order to ensure that the actual revenue collected does not exceed the costs of the plan.

Since a feasibility study is intended to explore potential options for stormwater management, a list of potential funding sources (including a fees collected by a stormwater utility) is often included. It is important to present this information with specifics on how the funding sources would be collected and utilized. The decision on what expenses to cover with the user fee can only be made if other funding options have been inventoried explored and considered.

A rate structure analysis is also included in most feasibility studies in order to distinguish which structures to explore further if it is decided to implement a stormwater utility. A primary step of the rate structure analysis is to outline the kind of data that is already available to the municipality. Data that is potentially helpful to organize if available include aerial photos, GIS parcel information, and tax assessor's data.

Utility Start-up Strategy

There are two main options for a start-up strategy: to delay implementation of the utility until each consideration is fully developed, or to push forward with implementation when only a subset of the considerations have been established. Municipalities that lack the necessary implementation resources may implement the utility and user fees with a simplified rate structure. An example of a simplified rate structure would be one that lacks certain important but not immediately necessary aspects, such as a credit manual. (See Section *2.4.1 Components of Stormwater Utilities*) The simplified user fee would start generating revenue and these initial funds could be used to create more complex aspects of the utility. If a simplified start-up strategy is implemented, it is important to have a good understanding of the elements that will be developed in the future and how long it will take to implement changes.

Development Period

The development period and start-up strategy decisions are closely linked. The overall goals of stormwater utilities should be to achieve high efficiency, maximum effectiveness, reasonable equity, and appropriate incentives. If issues in meeting these goals arise, revisions should be made to the utility structure. Utilities often revise their user fee after a certain period of time and make necessary changes based on stormwater management needs. Stormwater utility development periods can be as short as one year, with the development of some utilities taking up to 10 years. Utilities that adopt a simplified start-up strategy may opt for a longer development period depending on their goals and timelines.

Billing Issues

Billing considerations can be the most complicated aspects of implementing a new stormwater utility. While some utilities decide to create an entirely new billing process, this option is often expensive. Many municipalities have existing billing structures for other utilities and it is common for the stormwater utility user fee to be distributed through an existing billing structure, commonly the water utility bill. This eliminates the cost of setting up a new billing structure, especially if the utilities share the same customers. Using another utility's bill for distribution of user fees can be used as a temporary method as part of a simplified start-up strategy. Revenue from the user fee can then be used to adopt a new billing structure for implementation at a later date.

Expenses Covered

Deciding what expenses the stormwater utility user fee should cover is another important consideration. Some towns decide to apply the user fee funding to cover all

O&M, capital improvement, and personnel costs. Other towns have chosen to use the user fee to fund only one or two of these expenses. It is also possible to use funding in different ways at different times. An example of a more flexible user fee coverage system is to dedicate most of the revenue to fund operations and maintenance then during years of low maintenance costs, the decision could be made to allocate more money to capital improvement projects.

If only a subset of the expenses will be covered by the user fee, it is important to identify all of the funding sources used to fully implement all aspects of a stormwater management plan before deciding on what expenses the user fees should cover. Often grants and bonds can be used for large capital improvement projects when necessary. (See Section *2.3 Stormwater Funding* Options)

Evaluation Measures

Developing an ongoing water quality and water quantity evaluation program is essential to ensure efficiency and effectiveness of stormwater management plans. Distributing the results of the evaluation measures to utility customers is also beneficial in educating the public about the effectiveness of the stormwater utility. Only through constant evaluation can efficiency and effectiveness of the stormwater utility be assured.

The desired outcome of any stormwater program is usually to reduce flooding and to improve water quality. The traditional way to evaluate water quantity improvement is to look for a reduction in the number of flooding events. The traditional way to evaluate water quality improvement is through dry weather which is required by the Phase II permitting program. While these evaluation measures are effective, they often consume numerous resources and the results are not always easily understood by the public.

There are other innovative and simple measures that can be developed to evaluate stormwater quality and quantity improvements. These can be cost effective and more simply understood by the public. For example, an innovative method would be to monitor the number of drainage complaints each year. Utility customers will easily be able to understand the benefit of a reduction in this category. Another example of an innovative evaluation method would be to analyze an existing list of capital improvement projects that are in development and calculate the percent reduction in stormwater quality or the percent improvement in stormwater quality resulting from these projects in the future A combination of traditional and innovative evaluation methods can be used to ensure efficiency and effectiveness of a stormwater utility. Innovative methods can also be developed to meet the specific needs and special circumstances of individual municipalities.

2.5 Legal Review

Stormwater utilities can provide essential revenue for stormwater management; however a new utility is not always readily accepted by the utility customers. While one of the key differences between a user fee and a tax is the customers ability to “opt-out” or obtain credits towards reducing their stormwater user fee, there have been challenges over the legality of the user fee. While some of these cases resulted in the user fee being upheld, others resulted in the user fee being determined as a tax, and therefore unacceptable in its current form. By reviewing a sample of these cases important generalizations can be drawn for constructing and implementing an effective and legal stormwater user fee and utility.

In the 2007 Black and Veatch Stormwater Utility Survey 24% of the 71 utilities stated that they had faced a legal challenge. Of these challenges, 15% of these ended in user fees being sustained, 7% are still pending, 1% reached settlement, and 1% of challenges were sustained. (Enterprise Management Solutions, 2007)Major themes in stormwater utility legal cases involve the distinction between a user fee and a tax, which properties are benefited, and cost of service. Examples of cases for each of these issues were examined in order to further understand what characteristics create successful utilities. A summary of the US Supreme Court Case Dolan vs. City of Tigard and how it relates to stormwater utilities is also included.

2.5.1 User fee vs. tax

In Church of Peace v. City of Rock Island (2005) the definition of a user fee was upheld by the Illinois Court of Appeals. The Church of Peace argued that the user fee was actually a tax, however it was decided that the fee fit the description of a user fee. The fee was based on an ERU and the court found that since there is a proportional relationship between impervious area and stormwater runoff contribution, the fee was legal. Also, Rock Island has a credit system, and the court ruled that the credit's existence is enough to consider the fee voluntary, regardless of the customer's willingness to apply for a credit.

2.5.2 Cost of Services

Stormwater utility customers often disagree about the amount of the user fee, arguing that the fee provides more revenue than the cost of the services provided. The City of Hampton, VA sued the owners of several residential properties due to their failure to pay the stormwater utility user fee. The utility operates under a user fee based on a flat residential rate, and the customers felt that a flat rate meant that they did not pay into the cost of services proportionately. In Twietmeyer v. City of Hampton (1998), the Supreme Court of Virginia ruled that the flat rate residential fee was proportionate because non-residential properties paid a much higher rate than the residential flat fee.

2.5.3 Properties Benefited

Tax exempt properties are still liable to pay stormwater utility user fees because a user fee is paid by every property owner that benefits from the utility. The Sarasota Church of Christ legally challenged their stormwater utility fee payment, stating that they did not see any specific benefit to their property. In Sarasota County v. Sarasota Church of Christ (1995), the Florida Supreme Court found that the church did have to pay the user fee. The basis for this decision was that all properties with impervious surface contribute to stormwater runoff, therefore they benefit from the stormwater management the utility provides.

2.5.4 Dolan vs. City of Tigard

While the previous cases are important to illustrate some of the legal challenges that might arise with the implementation of a stormwater utility, many regions of the United States, including New England, do not have legal precedents set for stormwater utilities. In these regions, Dolan vs. City of Tigard is a US Supreme Court decision that can be used in relation to stormwater utilities.

In this supreme court case, petitioner Dolan of Tigard, OR filed a case against the City of Tigard when they stipulated that she could only expand her store and parking lot if she also constructed a public greenway along an adjacent stream to offset the increased impervious surface area, and a pedestrian/bicycle pathway in order to alleviate added traffic congestion. The petitioner did not agree with these stipulations and felt that they constituted uncompensated takings under the Fifth Amendment. The decision by the Oregon Supreme Court was that the green way and pedestrian path showed a clear relationship to increased impervious surface and traffic due to the proposed development. This decision was reversed by the US Supreme Court, because while there was a clear relationship between the public harm of the proposed development and the stipulations placed upon the petitioner, the City had failed to provide evidence that the stipulations were properly related to the impact.

This decision is important for the legality of stormwater utilities and stormwater management in general because it shows that a municipality has the right to mandate certain actions if it will alleviate public harm, if there is a justifiable relationship between the actions and the harm. For stormwater specifically, this case is also important because it established an upheld connection between stormwater runoff and impervious surface, and to LID development through a greenway.

Chapter 3: Case Studies and Application

3.1 National Stormwater Utility Analysis

A principal focus of this thesis is to analyze and evaluate a representative sample of stormwater utilities in the United States. This analysis allows identification of alternatives and success factors for municipalities that are considering a stormwater utility. The selected utilities were "scored" based on an estimation of their efficiency, effectiveness, incentives to reduce, and equity.

The stormwater utilities included in this analysis were chosen to represent the many different structures and approaches to stormwater utilities. Of the over 400 national stormwater utilities in the US, 25 utilities were chosen as a representative sample that reflects the differences that can be expected in utilities throughout the US. The utilities in the representative sample were chosen based on their geographic location, as well as their unique features. While there are areas in the nation that have many stormwater utilities (for example Florida), the sample set of 25 was carefully chosen to represent diverse geographic regions in the United States. The stormwater utility representative sample included in this analysis offer an illustration of the overall composition of national stormwater utilities. The sample group exhibits the following attributes:

- Every region of the United States is represented by at least one utility.
- Size of utility service areas range from small villages to large metropolitan areas.
- NPDES Phase I and Phase II municipalities are included
- New utilities as well as the oldest in the country are analyzed
- Identified goals of the utilities include both improving stormwater quality and reducing stormwater quantity.
- A variety of rate structures are characterized, including Equivalent Residential Units (ERUs) and non-ERU based.
- Utility organization ranges from simply funding mechanisms to vastly staffed free-standing departments.

It should be noted that utilities were selected from two sources. Internet searches for stormwater utilities resulted in the discovery of many websites devoted to the stormwater utilities of individual municipalities. While not every stormwater utility maintains a comprehensive website, the web-based searches provided essential information and were the primary source of utility details. The secondary source for identifying utility candidates was the two most current Black & Veatch stormwater utility surveys. Survey questions typically did not include specific utilities; however a list of many of the utilities involved and their ERU rate structure was included. (Enterprise Management Solutions, 2006) (Enterprise Management Solutions, 2007)

It should also be noted that the 25 utilities included in this analysis may not provide a perfect representation of the entire body of stormwater utilities nation wide for a number of reasons- a very important one being the level of public education and outreach provided by the utilities evaluated. Utilities that maintain websites containing public educational content were the easiest to access through an internet search. Public education is an important part of stormwater management, is included as one of the minimum NPDES measures, and is an important factor leading to the success of a stormwater utility. The utilities included in this analysis may have had a high rate of success in implementation possibly due to their readiness to provide public educational materials about the utility. Information on their public education campaigns was included in the raw data but not factored into the analysis because of the unknown influence of public education as a factor of success. Other issues that may limit the ability to generalize the results from this analysis include selection bias and limitations on geographic representation. A selection bias exists because only those utilities that provided sufficient information on their website were included. It was also not possible to ensure geographical representation because only approximately 6% of national utilities were sampled, however all of the current New England stormwater utilities were included in this study

The author carefully evaluated the 2006 and 2007 Black &Veatch stormwater utility surveys, which, while being extensive and important tools for identifying existing utilities, did not provide sufficient details on each utility to allow the analysis intended for this thesis. From the information presented in the Black & Veatch surveys, it is impossible to conclude where each utility fell in the range of responses for each survey question. The surveys did, however, identify national trends they provide a list of utilities considered for inclusion in the web-based search for information by the author. Utilities with updated information online were the easiest to identify and to gather all of the information necessary to include them in the detailed analysis. Table 3.1 shows the stormwater utilities included in the analysis. For a map of the locations of analyzed utilities, see *Appendix C: Map of Stormwater Utilities Used in Analysis*.

Table 3.1 Stormwater Utilities Included in the National Stormwater Utility Analysis				
Municipality	**Population**	**Size (sq. mi.)**	**Median Household Income**	**Annual Average Rainfall (in)**
Griffin, GA	*23,451*	15.5	$30,088	50
Valparaiso, IN	27,428	10.1	$45,799	40
Union, OH	5,574	0.9	$51,500	39
Sarasota County, FL	325,957	725	$41,957	54
Fort Collins, CO	118,652	47.1	$44,459	14.5
Olympia, WA	42,514	18.5	$40,846	50.5
South Burlington, VT	15,814	16.6	$51,566	36
Chapel Hill, NC	48,715	19.8	$39,140	47.5
Reading, MA	23,708	9.9	$77,059	48
Newton, MA	83,839	18	$86,052	51
Tampa, FL	303,447	107.6	$34,415	44
Lewiston, ME	35,690	35.2	$29,191	45
Chicopee, MA	54,653	23.9	$35,672	45.5
Orlando, FL	185951	101	$42,036	48
Mason, OH	22016	17.7	$76,806	44.7
Moline, IL	43,768	15.8	$39,363	50.2
Lakeland, FL	78,452	51.45	$43,980	49
Bloomington, IL	64,808	22.5	$68,683	37.5
Redmond, WA	45,256	16.6	$79,557	35.9
Kissimmee, FL	47,814	17.32	$39,816	48
El Paso, TX	563,662	250.5	$38,921	9.4
Columbia, MO	84,531	60.4	$55,834	40.3
County of Sacramento, CA	1,223,499	995	$46,982	19.8
Rock Island, IL	39,684	17	$34,729	39
Wichita, KS	344,284	138.9	$53,494	30.4

The Black & Veatch 2006 and 2007 stormwater utility surveys provide helpful summary information on many national stormwater utilities, however the author's analysis is more comprehensive because it provides comprehensive analytical information and is useful in identifying more than just baseline trends. While it is important to recognize trends in demographic and profile details, the more insightful analysis involves evaluation of these differences in terms of four important utility criteria that are indicators of the success of a utility. Utility effectiveness, efficiency, equity, and incentives to reduce are the important evaluation criteria that are addressed by this analysis.

3.1.1 Overview

A profile of the 25 stormwater utilities follows:

- Communities ranged in population from 5,574 (Union, OH) to 1,223,499 (County of Sacramento, CA)
- The ERU used for single-residential parcels ranged from 2,000 ft^2 (Orlando FL) to 3,310 ft^2 (Tampa, FL).
- There are 7 NPDES Phase I and 18 Phase II communities.
- 60% of utilities had been in existence for less than 10 years.
- 40% of utilities have been in existence for less than 5 years.
- The oldest utility has been in existence for 27 years.
- The youngest utility analyzed send out its first bill in March of 2008.
- 2 utilities service an area wider than their municipality (both are county-wide).

3.1.2 Criteria for Evaluation

A unique scoring system was developed by the author to allow comparison across the selected utilities. Information collected for each utility was grouped into four different main categories in order to facilitate evaluation for each of these issues: efficiency, effectiveness, incentives to reduce, and equity. Each of the four categories has a potential total high score of 1 as defined below.

Effectiveness

For the purpose of this research, an effective stormwater utility was defined as a utility that has funding adequate to meet all of its individualized needs, and to meet the goals set for the utility. The needs of a utility must be considered separately and include all of the responsibilities and activities that the individual utility was implemented to manage. The primary goals of each utility differed slightly due to individualized needs; therefore the standardized goals of reducing stormwater quantity and improving stormwater quality were used as evaluators in the analysis. Itemization of the effectiveness criteria is shown in the table below, as well as possible point values available to each utility.

Table 3. 2: Effectiveness Criteria*

Effectiveness Criteria	Evaluator	Score
Adequacy of Funding (0-.3 points)	Funding Meets All Needs	0.3
	Funding Meets Most Needs	0.2
	Funding Meets Some Needs	0.1
	Funding Meets Few or No Needs	0
Quality improvement or Quantity Reduction (0-.7 points)	Quality Reduced and Quantity Improved	0.7
	Quantity Reduced	0.3
	Quality Improved	0.3
	No Measures in Place for Evaluation	0.1
	No Improvement	0
Total Point Value Available for Effectiveness		1

*L. Mulcahy, Master's Thesis. Center for Environmental Studies. Brown University (2008)

The utilities included in the analysis had costs associated with personnel, infrastructure, O&M, and CIPs. Since some utilities were created to only address certain stormwater issues, these utilities could still receive full scores as long as they had funding for all their designated utility needs.

A utility that met the "Meets All Needs" criteria had enough funding to pursue all desired activities and pay for all operational costs and received a score of 0.3 points. A utility that met the "Meets Most Needs" criteria had funding for all primary activities but lacked funding for all secondary goals. For example a utility that had funding to actively pursue CIP projects, but not all proposed or necessary CIP projects received this score. A utility meeting the "Some Needs" criteria had funding for only some desired activities. A utility in this category may have sufficient funding to cover O&M costs, for example, when the intention was to also fund CIPs. . A utility in the "Few or No Needs" category has inadequate funding in all areas.

The second criteria for stormwater utility effectiveness as used in this paper, was each utility's ability to meet the primary goals of stormwater management: quality improvement and quantity reduction. Evidence of meeting these goals included water quality data or water flow data. A utility that had evidence of both quality being improved and quantity being reduced received a scored of 0.7 points. A utility that could only prove one of these goals scored 0.3 points. Any utility without proof of meeting either of these goals was given a score of 0.1 point if they provided a list of completed activities towards stormwater management was provided, assumption that these activities improved stormwater quality. No points were awarded for utilities that did not provide evidence of meeting goals or supply a list of stormwater activities.

Efficiency

In order to assess the efficiency of a utility, it is necessary to know the specific purpose and responsibilities of the individual utility. The main efficiency categories considered during this research were allocation of funds towards meeting all needs, the use of existing municipal or stormwater infrastructure, and the existence of a stormwater utility evaluation system. The importance of sufficient funding and careful allocation of funds is pivotal for overall success. Integrating or sharing aspects of existing municipal departments enables saved funding that can be used for other activities. Finally, evaluation measures must be in place in order to ensure efficiency and future utility success. An itemization of the efficiency criteria is shown in the table below, as well as possible point values available to each utility.

Table 3. 3 Efficiency Criteria*

Efficiency Criteria	Evaluator	Score
Is Money Being Used for Purpose? (0-0.2)	All Purpose	0.2
	Some Purposes Met	0.1
	No Purposes Met	0
Is there efficient use of existing stormwater Infrastructure? (0-0.6)	Utility within Existing Municipal Department	0.4
	Utility Shares Staff	0.1
	Uses the same Billing System	0.1
	No sharing of Infrastructure	0
Are there Evaluation Measures in Place? (0-0.2)	Quality	0.1
	Quantity	0.1
	None	0
Total Point Value Available for Efficiency		1

*L. Mulcahy, Master's Thesis. Center for Environmental Studies. Brown University (2008)

Sampled utilities that used funding towards meeting all purposes received a score of 0.2 points. If only some purposes were met, for instance if the purpose of the utility was to fund both O&M and CIP activities yet only O&M was funded, the utility received a score of 0.1 point. If none of the stated purposes of the utility were funded, 0 points were awarded.

Depending on the level of integration with previously existing municipal infrastructure, utilities were awarded 0-0.6 points. A utility that exists within, shares staff, and uses the same billing system as an existing municipal department or utility received a score of 0.6 points. A utility that exists within an existing department but does not share staff or billing systems received a score of 0.4 points. If a utility is a separate entity but shares staff and a billing system it received a score of 0.2 points, if only one of these applied, the utility received a score of 0.1 point. Utilities operating as separate entities with no shared municipal infrastructure received 0 points. The evaluation criterion was assessed by awarding 0.1 point for utilities that had quality evaluation measures and 0.1 point for utilities that had quantity evaluation measures.

Incentives to Reduce

Providing incentives to reduce stormwater on a parcel of land is usually accomplished through a credit program. For the purpose of this research, utilities were evaluated on their incentives for two criteria: the existence of a credit system, and the different categories of utility customers that could apply for a credit. The amount of credit available for both residential and non-residential customers was also included as a criterion for evaluation. A breakdown of the incentive to reduce criteria is shown in the table below, as well as possible point values available to each utility.

Table 3. 4 Incentives Criteria*

Incentive to Reduce Criteria	Evaluator	Score
Credit system in place? (0-0.2)	Yes	0.2
	No	0
Credits for residential parcels? (0-0.4)	Yes	0.4
	No	0
Percent Credit Available? (0-0.4)	75-100%	0.4
	50-75%	0.3
	25-50%	0.2
	1-25%	0.1
Total Point Value Available for Incentives to Reduce		1

*L. Mulcahy, Master's Thesis. Center for Environmental Studies. Brown University (2008)

Utilities with credit systems in place (non-residential, residential, or both) received a score of 0.2 points. Because of the importance of offering credit systems to residential customers, utilities that offered residential credits received an additional 0.4 points. Utilities that did not offer any sort of credit system received a score of 0 points. The maximum amount of credit available was also analyzed. A maximum credit between

75 and 100% scored 0.4 points, 50 to 75% scored 0.3 points, 25 to 50% scored 0.2 points, and 1 to 25% scored 0.1 points.

Equity

The issue of equity is very important to address when tackling the implementation and development of a stormwater utility. Many communities have made their fees equitable by imposing a fee system that uses impervious surface to calculate the fee. Equity in a stormwater utility deals in large part with the rate structure that is used. For the purposes of this research, the fairness of the rate structure and the level of stormwater quality improved or quantity reduced were used as evaluators of equity. An itemization of equity criteria is shown in the table below, as well as possible point values available to each utility.

Table 3. 5 Equity Criteria*

Equity Criteria	Evaluator	Score
Equitability of Rate Structure (0.1-0.6)	High	0.6
	Medium	0.3
	Low	0.1
Level of Quality improvement or Quantity Reduction (0-0.4 points)	Quantity Reduced	0.4
	Quality Improved	0
Total Point Value Available for Equity		1

*L. Mulcahy, Master's Thesis. Center for Environmental Studies. Brown University (2008)

The first criterion for equitability was that of the rate structure used. The rate structure criterion was broken down into three different levels of impartiality, high, medium and low. A utility with a highly equitable rate structure used some form of ERU to calculate fee structures. Utilities using ERU or another impervious area unit are highly objective because of the very strong link that exists between the amount of impervious surface and the amount of stormwater runoff that is generated from a given property. Utilities were also deemed highly fair if they offer a variety of tiers or classes represented in their rate structure. An example of this would be different rate structures assigned for residential versus non-residential parcels, even if they are based on the same ERU rate. Municipalities that include a separate rate structure for multiple housing units were rated as more equitable than one that charges rates similar to a single housing unit or to a non-residential unit. Utilities that exhibited these characteristics received a score of 0.6 points.

A rate structure that is moderately equitable lacks some of the characteristics considered highly equitable. For instance a user fee that is based on ERU but doesn't charge different rates for residential versus non-residential properties is moderately equitable. Another example of a moderately equitable rate structure would be use of a method other than impervious area to calculate user fees. Utilities that use water bill rates to calculate rate structure also display a medium amount of equitability. Low equitability was defined as communities that split the cost of stormwater management between all of the properties in the town with a single flat rate regardless of stormwater runoff generation.

The second criterion used for determining equity is the ability for the utility to justify the rate structure. Justification is provided by the ability to show how the user fee was created and by what means the user fee is linked to stormwater runoff. Utility utilization of aerial photos, field surveys, GIS data, and runoff coefficients to assign user fees are examples of highly justifiable rate structures and in the authors analysis they received a full score of 0.4 for this category. A rate structure that is somewhat justifiable uses a commonly accepted method to calculate rate structure, however only a sampling of parcels would be included in the fee calculation. An example of this would be a utility that used GIS data to calculate an ERU, however only a very small number of parcels were used in the calculation (for example only using information from 20 parcels out of 10,000). Moderately justifiable rate structures received 0.2 points. Utilities with rate structures that could not be justified used unrelated methods to calculate user fees, such as drinking water use, and received a score of 0 points.

3.1.3 Results of the National Analysis Case Study

The following results were obtained following application of the author's scoring system described above on the 25 selected utilities:

- 40% (10) of utilities were also included in the Black & Veatch 2007 Stormwater Utility Survey.
- 76% (19) of utilities offered a credit system.
- 28% have residential credit systems.
- 24% (6) have evaluation measures for either stormwater quality improvement or stormwater quantity reduction.
- 15% (4) have evaluation measures for both stormwater quality and stormwater quantity.
- 36% (9) have funding that is adequate to meet all stormwater management needs.
- 84% (21) are organized as part of another utility or municipal department.
- 32% (8) have highly equitable rate structure.
- 56% (14) have highly justifiable rate structures.
- 64% (16) use an ERU (or equivalent unit) to calculate at least part of their rate structure.

(*See Appendices D and E* for final utility scores and graphs)

While the figures above show the results of the study, there are a number of specific similarities and differences between the 25 utilities. For instance, when looking at residential rate structure only, a number of different methods were used by utilities. Flat rates, variable rates, and tiered rates were all used, however the most commonly used rate structure for residential rate structure was a flat rate. Most utilities used a variable rate for non-residential parcels, however tiered and flat rates were also used. There were a number of different combinations for overall rate structure, but the most popular was a flat rate for residential parcels and a variable rate for non-residential parcels.

Credit incentives available to residential and non-residential also varied greatly among the 25 utilities analyzed. Potential credits were offered for: peak flow reduction, education, on-site stormwater management, stormwater BMPs, rain barrels, rain gardens, reduction in impervious surface, direct discharge, and temporary storage. Some utilities had credits available for only one of these options, while some included two or three in their credit systems. Most utilities with credit systems offer total credits of between 25% and 50% of the total utility charge.

Highest Scoring Utilities

The three utilities with the highest overall scores were analyzed individually to identify unique features that contributed to their high scores. The highest scoring utilities were Griffin, GA, Sarasota County, FL, and Tampa, FL. In addition, the 5 New England utilities that were analyzed are presented below as a group.

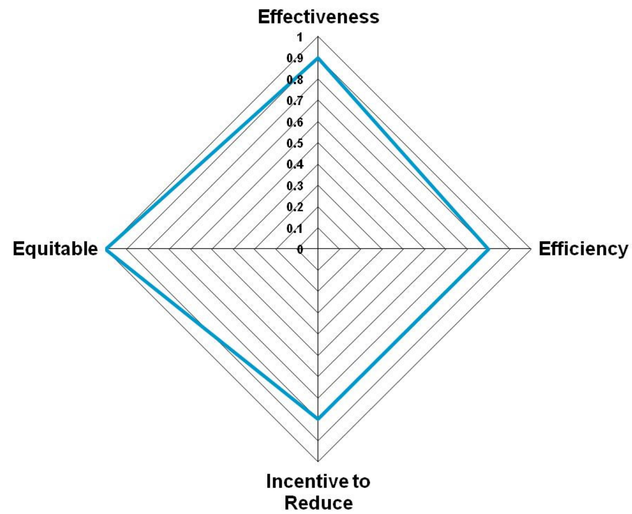
Highest Scoring Overall

Griffin, GA

Griffin, GA was one of the top three highest rated utilities for each of the four categories, and the highest scoring utility overall with a total of 3.5/4 points. (See *Appendix D: National Stormwater Analysis Scores*) Griffin is a community of 25,000 that implemented the first stormwater utility in Georgia in 1997. While exhibiting many of the traits that other high scoring utilities have for the four analyzed categories, Griffin has four additional unique features that increase the efficiency of their stormwater utility:

a stormwater utility "champion", a long development period, stormwater quality evaluation, and a comprehensive public education program. (Keller, 1999)

Figure 3. 1Griffin, GA Overall Score



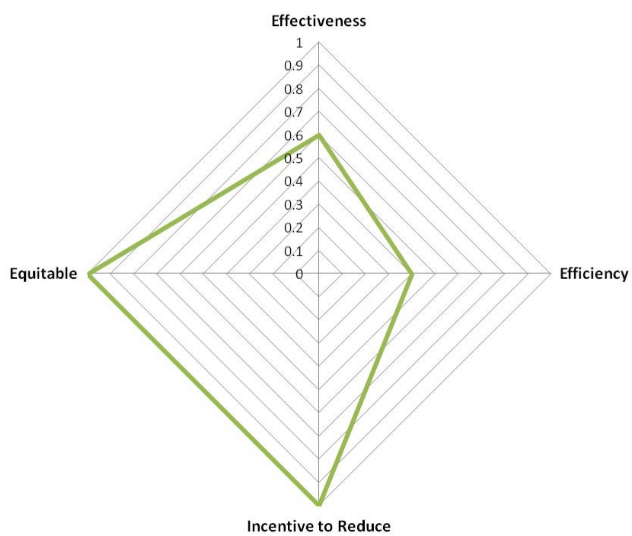
The self-proclaimed stormwater utility "champion" in Griffin is the Director of the Department of Public Works. A champion or group of champions promotes a stormwater utility all throughout the implementation process. Since the implementation process can last a number of years (four years for Griffin), having a champion can help ensure that all essential decisions are made with the community in mind, and help ensure that the utility stays on the forefront of the town's priorities. Griffin cites having a champion as one of the main reasons for the successful implementation of their stormwater utility. (Keller, 1999)

Griffin's four year development period was due to a desire to have the utility well developed and accepted by town government before pushing forward with implementation. While most utilities have shorter development periods that also result in successful implementation, in this case careful planning lead to an efficient, effective utility structure. Griffin also implemented a comprehensive public education program a year and a half before implementation to educate the public about the need for a stormwater utility. The public outreach contributed to there being little opposition when the first user fee bill was distributed. The ongoing success of Griffin's utility is evaluated through a pollutant monitoring program. The successful work of the Griffin Utility was featured as a Section 319 Success Story by the USEPA. (U.S. EPA, 2002)

Sarasota County, FL

Sarasota County, FL is the stormwater utility with the second highest overall score- 3 of 4 points. Sarasota County is an example of how a utility can be effective operating outside of municipal boundaries, in this case encompassing the entire county since 1991. The age of this stormwater utility alone sets it apart from other utilities in terms of effectiveness and success, however some other unique attributes of the utility that aided its success are also noteworthy. Sarasota County's unique comprehensive rate structure and ongoing public involvement in utility management were unique in the utilities evaluated.

Figure 3. 2**:** Sarasota County, FL Overall Score



Sarasota's rate structure is based on an Equivalent Stormwater Unit (ESU), which is similar to an ERU but takes into account pervious as well as impervious surface, and also intensity of development. The ESU is then applied to 12 different residential and non-residential categories. The fee itself is broken into multiple sections. The first portion, the customer service fee, is a flat rate that is charged to everyone in the utility and does not allow for credits. Other parts of the user fee include planning are planning assessment and maintenance charges. These fees are calculated differently for each customer and are based on the ESU. There is a fourth factor to the user fee that is sometimes used. A capital improvements assessment is sent out to specific customers if a CIP needs funding that will affect certain parcels more than others. Many credit opportunities are in place for both residential and non-residential customers, but they only apply to the supplemental fees.

Sarasota County is also unique because of an ongoing public outreach and education program. The most unique aspects of these programs are the frequent public meetings that are held to ensure that customers understand the user fees and also to ensure that customers have an opportunity to provide input into planning. Meetings are held to get customer input on what issues need to be addressed. After plans are developed more meetings are convened to explain the problems and solutions. CIP meetings are also arranged for all customers that will pay for a proposed CIP. During these meetings the project is outlined, and customers have the opportunity to provide their thoughts and concerns. Customers also have the opportunity to reject the current CIP plan and request that another be formulated.

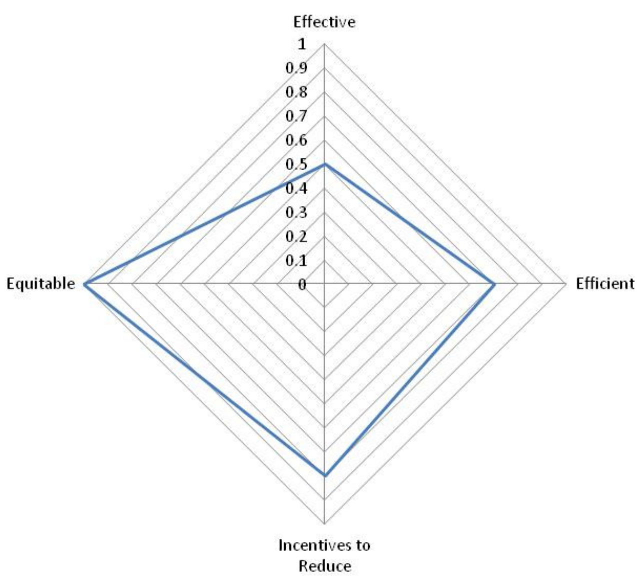
Tampa, FL

Tampa, FL also scored 3 of 4 total points in the analysis. Tampa has one of the largest populations (303,447) of all of the utilities analyzed, and its large population classifies it as a NPDES permitting system Phase I community. Tampa maintains one of the largest stormwater management systems of the municipalities included in the analysis, with 613 miles of stormwater lines, 259 miles of ditches and culverts, and 105 retention ponds. Tampa is also the youngest of the there highest scoring utilities, it was implemented in 2003, ten years after Sarasota County and six years after Griffin. Although Sarasota County and Tampa received the same overall score of 3 of 4 points, Tampa scored higher than Sarasota County on efficiency, but lower on incentives to reduce. Tampa stormwater utility is unique due to the extensive public education and outreach plan, the intensive use of GIS in rate structure formulation, and its wide public acceptance due to flooding issues.

Like Griffin and Sarasota County, Tampa also provided a vast number of public education and outreach materials at the onset of the implementation of their stormwater utility. The education materials, which are still available through their website, highlight the city's need for increased stormwater management and the steps that the city was going to take to improve the problem. Also included in the public education materials was a detailed explanation of the stormwater utility.

Tampa had a number of flooding concerns that eventually lead to the implementation of a stormwater utility. While Tampa is a Phase I community and has been regulated under the NPDES permitting system Phase I best management practices since 1999, continued flooding issues and difficulties meeting BMPs lead to the utility's implementation. The flooding issues that the city faced were so apparent to many of the citizens were very accepting of a implementing a utility to alleviate the problem. This increased public awareness coupled with the additional public education program lead to little opposition of the stormwater utility.

Figure 3. 3 Tampa, FL Overall Score



Tampa used GIS extensively in order to calculate their user fee. Tampa has a tiered rate for non-residential parcels and a variable rate for non-residential parcels. The residential parcels have four tiers, which is more than the usual three seen in tiered structures. GIS and aerial photos were used to provide very accurate separations between the four tiers. Variable rates for non-residential parcels were also calculated through GIS and aerial photos.

New England Utility Analysis

Each of the five utilities currently operating in New England as of Spring 2008 are included in the national stormwater analysis. The five utilities are: Reading, MA, Newton, MA, Chicopee, MA, South Burlington, VT, and Lewiston, ME. Almost all of these utilities have been implemented within the last two years. Table 3.6 and Figure 3.5 shows that New England utilities received lower scores overall compared to the other 20 utilities in the analysis. The highest scoring New England utility was Reading, MA, with a score of 2.5/4 (compared with a score of 3.5/4 for the top-scoring utility in Griffin, GA).

Table 3. 6 New England Utility Scores

	Effective	Efficient	Incentives to Reduce	Equitable	Total
Reading, MA	0.3	0.7	0.5	1	2.5
South Burlington, VT	0.2	0.7	0.4	1	2.3
Lewiston, ME	0.3	0.5	0.4	1	2.2
Newton, MA	0.3	0.7	0	0.7	1.7
Chicopee, MA	0.3	0.4	0	0.1	0.8

Figure 3. 4 New England Overall Scores

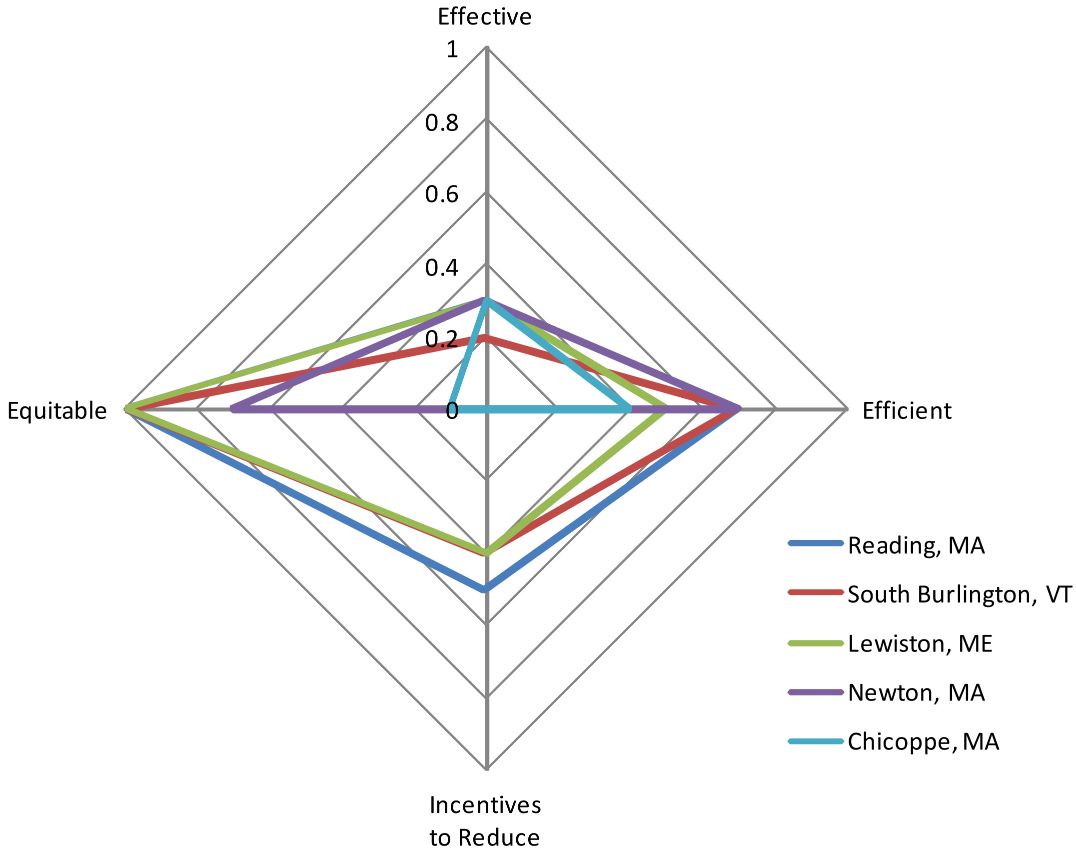


Table 3.6 and Figure 3.5 show that in New England, most stormwater utilities scored higher on equitability, average on efficiency and incentives to reduce, and scored very low on effectiveness. One of the main reasons for this trend was a lack of reporting by New England utilities on the existence and results of evaluation measures. The low scores of these utilities can be attributed at least in part due to the young age of the utilities. Two of the five utilities have chosen to adopt a simplified fee structure method in order to implement quickly, and their full systems have not yet been developed. The New England utilities represented some of the youngest in the 25 utility sample set.

There are some features that are unique to some of the New England stormwater utilities. One unique feature is the rate at which Newton, MA was able to develop and implement its utility, 5 months, which is the shortest period observed for any of the utilities analyzed. Reading, MA and South Burlington, VT, for example, had development and implementation periods of over 3 years. South Burlington is unique in that it successfully implemented under a simplified start-up strategy and has already had a change in rate structure within its 3 year history. After two years of operation the rate structure of the South Burlington utility was changed to be more comprehensive and equitable. Lewiston, ME offers a stormwater utility fee calculator on it's website that enables both residential and non-residential customers to calculate their expected stormwater utility fee. This feature allows for an individualized form of public education at very little expense or time to the utility.

The New England stormwater utilities are similar in many ways. They all used some form of an ERU to calculate their fee structures and all have flat rate fees for residential parcels. Four have variable rates for non-residential parcels, and one (South Burlington, VT) has a three tiered non-residential rate structure. All five New England utilities are also organized in some way under the municipal Department of Public Works or Department of Public Services. Three utilities have credit systems currently operating, and Newton intends to adopt a credit system in the new future. Of the three with credit systems, credits are only offered to non-residential customers.

3.2 Stormwater Utility Feasibility Study: Narragansett, RI

New England is an interesting area for stormwater management research because stormwater utilities only recently become prominent topics for discussion. While there are many successful stormwater utilities nation-wide, including some that have been in existence for decades, there are only six stormwater utilities in New England, most of which have only recently been implemented within the last three years.

New England's stormwater management has gained notoriety recently because numerous New England towns have been fined for not providing NPDES permits for their stormwater discharges. (Environmental News Service, 2008)Although many of these towns have subsequently provided the proper documentation, the inability of communities to complete permits may reflect the lack of stormwater management resources that New England towns face.

The national stormwater utility analysis described above provides valuable insights into the success factors for stormwater utility planning, implementation, and ongoing evaluation. Due to the recent implementations of the New England stormwater utilities, it is difficult to analyze their overall effectiveness; however valuable lessons can be learned through the study of their implementation processes. The national utility analysis, with special emphasis placed on existing New England utilities, can be a tool for formulating an implementation and development plan for other newly implemented or proposed New England utilities. While it is critically important to customize the utility to the municipality, the issues of efficiency, effectiveness, equity, and incentives must still be factored in to the overall planning and implementation process. Incorporating the information collected from the national utility analysis into the planning and discussion for few stormwater utilities is an informed way to develop and integrate information learned from previous experiences, while tailoring planning to the specific situation of the new utility location.

The Town of Narragansett, RI is located at the west end of the mouth of Narragansett Bay. Its population and demographics make it a typical Rhode Island and New England town and this is a primary reason it was chosen by the author to be the focus of the feasibility study completed as a local case study for this thesis. (See Table *3.7: Narragansett Demographics*)

3.2.1 Narragansett Demographics

The Town of Narragansett, Rhode Island (to be known as the town, or Narragansett) has 9,056 acres of land with 16,361 residents, based on 2000 census data. Narragansett currently owns and maintains approximately 130 miles of municipal streets containing 54 stormwater outfalls into the Narrow River and Pettaquamscutt Cove, Narragansett Bay, Point Judith Pond, and the Atlantic Ocean. While Narragansett has been working to meet the deadlines for their NPDES Phase II stormwater plan, there are areas of stormwater management that the town is interested in improving or adding to their existing activities. Unfortunately, Narragansett lacks the resources needed to meet these additional goals.

Of special interest in stormwater management is the Narrow River, which has a TMDL for bacteria which enters the river in part through stormwater runoff. Because Narragansett contains most of the residential and commercial development within the Narrow River watershed, it is especially important for the health of the Narrow River to be taken into account when managing stormwater. (RI DEM, 2001)The inability to meet the Narrow River TMDL bacteria requirements is an example of why Narragansett might particularly benefit from improving its current stormwater management program. Also, resident complaints of flooding from stormwater due to faulty or non-existent stormwater structures illustrates that a more comprehensive, long-term stormwater program must be developed to meet federal requirements in the future.

Table 3. 7: Narragansett Demographics*	
Land Area	$14mi^2$ ($394,479,360ft^2$)
Population	16,361
Median Household Income	$50,363
Number of Households	6,846
Miles of Municipal Streets	130
Number of Stormwater Outfalls	54
Average Annual Rainfall	42 inches

* From 2000 Census

3.2.2 Current and Future Stormwater Activities

Current stormwater operations and maintenance costs are financed by the town General Fund which is supplied mainly through property taxes. Narragansett has also been awarded state and federal grant money to fund certain stormwater capital improvement projects. Narragansett has federal grant approval to fund a CIP project aimed towards meeting the Narrow River TMDL; however until the town is able to provide matching funds, the grant money is inaccessible.

The Narragansett Department of Public Works (DPW) maintains all municipal streets and stormwater structures while the Engineering Department oversees construction, handles stormwater mapping, and provides plans for stormwater projects. The Engineering Department is also responsible for subcontracting NPDES permit work to the Southern Rhode Island Conservation District which is responsible for completing the permits to be submitted to the Rhode Island Department of Environmental Management. Smaller stormwater projects are handled in house by the DPW while larger CIP projects are contracted to private enterprises.

The Director of Public Works maintains a list of stormwater projects that are prioritized in order of importance of completion. At the current time there are approximately 35 projects on the list ranging from the cleaning of outfalls and swales outside of the usual scheduled time to major BMP construction projects like the Narrow River CIP. The stormwater CIP list is growing much faster then the town can complete pending projects. Lack of funding is the main problem, but there is also a lack of dedicated personnel to formulate a comprehensive stormwater management plan. Table 3.8 shows Narragansett's total stormwater budget for 2008. Narragansett's total stormwater expenditures for 2008 are $414,358.00.

Table 3. 8 Narragansett Total Stormwater Budget FY 2008

Department	Activity	Amount
DPW	Operations and Maintenance	$177,600.00
DPW	Personnel	$80,000.00
DPW	CIP	$78,000.00
Engineering	Phase II Implementation	$30,000.00
Engineering	Personnel	$48,758.00
	Total Stormwater Costs	$414,358.00

3.2.3 The Future of Stormwater Management in Narragansett

Narragansett's main stormwater management issues are similar to those faced by many municipalities across the nation. A lack of funding for desired projects is at the forefront of the issue, with many projects, even extensively planned projects, having to be postponed until the proper funding has been obtained. The shortage of resource requirements for stormwater management in Narragansett, however, goes beyond funding. There is also a lack of staff dedicated solely to stormwater management. Staff that works on stormwater management also works in other departments and on other projects. By increasing the funding towards stormwater management, more projects be completed, and a full or at least part-time stormwater coordinator could also be hired whose main priority would be managing stormwater for the town. A main duty of the stormwater coordinator would be to act as an envoy and coordinator between the several of town departments working on stormwater management.

3.2.4 Proposed Benefits of a Stormwater Utility in Narragansett

Many municipalities with stormwater problems similar to Narragansett's have implemented stormwater utilities with great success. Looking once again at the definition of a stormwater utility offered by the National Association of Flood and Stormwater Management Agencies, a stormwater utility is intended to be a vehicle for:

- consolidating or coordinating responsibilities previously dispersed among several departments;
- generating funding that is adequate, stable, equitable and dedicated solely to the stormwater function; and
- developing programs that are comprehensive, cohesive, and consistent year-to-year. (NAFSMA, 2006)

Under this definition it appears that a stormwater utility would solve most if not all of Narragansett's stormwater management issues including lack of funding, dedicate staff, and ability to develop a comprehensive long-term stormwater management plan

To investigate this proposition, a comprehensive stormwater utility feasibility study was conducted by the author in conjunction with the RI DEM and Narragansett to outline what a potential viable stormwater utility might look like in Narragansett.

3.2.5 Methodology for Conducting the Feasibility Study

The feasibility study was conducted with funding provided in part by the RI DEM, and in part by the Narragansett Department of Public Works. Research started in

June of 2007 and the final recommendations by the author are currently available in draft form. Information regarding how to conduct a feasibility study was obtained before hand from the NAFSMA's Guidance for Municipal Stormwater Funding, which gives directives on conducting a thorough stormwater utility feasibility study. Previously conducted feasibility studies completed for other municipalities provided real-world examples including the AMEC conducted study for Chapel Hill, NC (AMEC, 2002), the Strand Associates conducted feasibility for Lancaster, WI, (Strand Associates , 2007)and the Fuss and O'Neil conducted feasibility study for East Providence, RI. (Fuss & O'Neill, 2006)

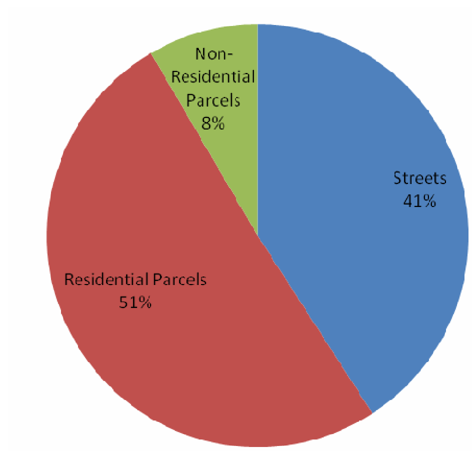
Information necessary for current and future stormwater activities was obtained through a number of interviews with the Director of the Department of Public Works (DPW), a staff engineer, and the Narragansett Town Planner in June and July of 2007. Data on funding and budgetary items was obtained through interviews, the town budget, and data from stormwater program reports. Information was also gathered from the towns most current NPDES permit application, and the application for state and federal grants for the Narrow River BMP projects.

The author's national stormwater utility analysis confirmed the data provided by the Black & Veatch 2007 survey stating that most stormwater utilities use some form of standardized impervious surface area unit to calculate at least some part of their user fee system. It was determined through examining Narragansett's community profile that developing an ERU for the town would be beneficial to rate structure development. To calculate an estimated residential unit (ERU) the existing parcel information and GIS layers for Narragansett were used. The most current data available to the author was from 2005, so new development or changes in impervious area since that time were not included in this evaluation. After calculating the ERU, potential rate structures were examined for feasibility for the proposed Narragansett stormwater utility. A paper produced in 2005 from the New England Environmental Finance Center entitled Stormwater Utility Fees offered insight into potential positive and negative aspects of each of the many options for user fee structure. (New England Environmental Finance Center, 2005) Their analysis method was adapted for a comparison of the two different user fees asexplained below.

3.2.6 Results of the Feasibility Study

A random sampling of 70 single family residential parcels was used to calculate an estimated ERU rate for Narragansett. The parcels were chosen by having a computer randomize a list of the total number of residential parcels and picking out each hundredth parcel on the list to be included in the sample set. The range of the impervious surfaces for the sample set was from 811ft^2 to 7,203 ft^2 with a standard deviation of 1,234. See *Appendix F: Narragansett ERU Analysis* for histograms depicting the sample set standard deviation from the mean, and the overall parcel size distribution. The ERU analysis resulted in an ERU of 2,650ft^2 for Narragansett. This ERU is intended to be used as a tool to calculate what the potential revenue of the proposed Narragansett stormwater utility. Because more recent data

Figure 3. 5: Narragansett Impervious Surface Percentages by Parcel Type



should be available by the time the ERU is re-calculated, it is unlikely the ERU giving in this paper will be the same. The actual ERU will be calculated using a representative sample of residential properties in the town, and with updated information on parcels.

An analysis of the impervious surface breakdown by parcel type in Narragansett can be seen in Figure 3.6. The impervious areas of residential parcels and non-residential parcels were calculated using GIS layers, while information on impervious area of the streets was calculated by taking the total miles of streets in Narragansett and finding a surface area using the average width of the streets. The total impervious Narragansett area calculated using the method above is 39,111,713. This figure represents approximately 10% of Narragansett's total land area and is equivalent to approximately 680 professional football fields. Close estimates of Narragansett's impervious surface have been calculated in other research papers. (Zhou, 2007) Table 3.9 illustrates impervious surfaces areas for different parcel types and the corresponding number of football fields each number represents. Considering Narragansett's land use (mainly residential), two rate structures, both using impervious surface a Narragansett specific ERU as the basis for the fee appear feasible for the proposed Narragansett stormwater utility.

Table 3. 9 Impervious Surface Area Breakdown by Parcel Type

Parcel Type	**Total Impervious Surface**	**Percent of Total Impervious**	**Equivalent Number of Professional Football Fields**
Residential	19,946,973ft^2	51%	54
Non-residential	3,128,937 ft^2	8%	346
Streets	12,035,802 ft^2	41%	278
Total	39,111,713 ft^2	100%	680

Option 1: Flat Rate Residential, Variable Rate Non-Residential

Adopting a flat rate residential, variable rate non-residential stormwater utility rate structure would mean that each residential parcel would be charged monthly as having one ERU of impervious surface. Because of the small number of non-residential parcels in Narragansett (139), each would have an individual fee calculated that reflected the number of ERUs on their property.

In the national stormwater analysis in the previous section, 13 of the 25 utilities analyzed operate under a flat rate residential rate structure. These results show that charging a flat fee rate structure for residential parcels is an effective financing mechanism for many existing stormwater utilities. The overall results show a tendency towards a flat rate, however, of the four analyzed utilities that most closely resemble Narragansett in terms of population, size, median household income, and annual rainfall (Griffin, GA, Union, OH, Redmond, WA, and Moline, IL), half use a flat rate, to calculate residential fees (the other half use tiered rates).

A flat residential fee would be beneficial for Narragansett because residential parcels are similar in size, making a flat rate for all residential properties an equitable choice. Also, this rate structure is easy for customers to understand, and easy to implement. The amounts of bookkeeping and initial calculations are far less than if a variable or tiered residential rate was applied. This type of rate structure could also be more stable and therefore less expensive over time- given the limited opportunity for new development, the need for frequently updated data to re-calculate the ERU may be reduced. Estimated ERUs for Option 1 can be seen in Table 3.10. Potential yearly revenue estimates and rates are shown on Table 3.11 in the following section.

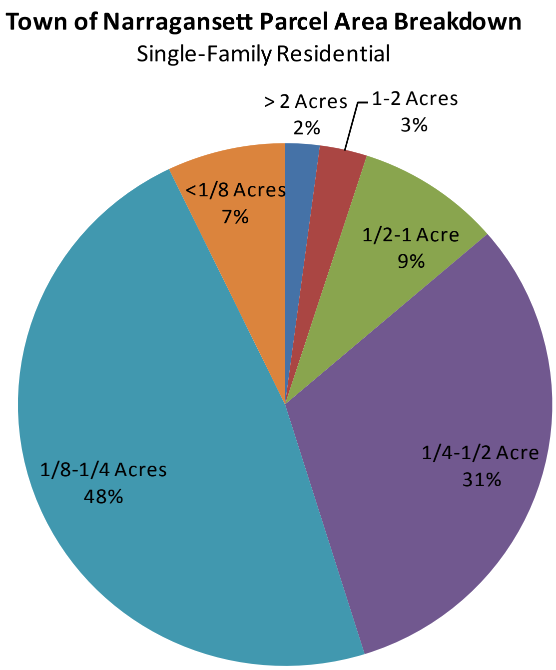
Table 3. 10: Estimated ERUs for Option 1				
Land Use Class	**Number of Parcels**	**Parcel Area (acres)**	**Non-Residential Impervious Area (ft^2)**	**Estimated ERUs***
Residential	7,075	2,687		7075
Commercial	105	404	2,314,693	873.5
Industrial	21	25	507,271	191
Tax Exempt	13	78	307,973	116
Total	7,214	3,194	3,129,937	8,256

* 1 ERU= 2,650 ft^2

Options 2: Tiered Rate Residential, Variable Rate Non-Residential

Another option for Narragansett's user fee structure could be to formulate a tiered rate structure for single-family residential parcels of land while still keeping a variable rate for non-residential parcels. Tiered rates to calculate residential parcel fees are used in seven of the 25 utilities analyzed in the previous section. Half of the four utilities that most closely resemble Narragansett have tiered rate structures. The breakdown of parcel sizes for single-family residential parcels in Narragansett can be seen in Figure 3.7. This rate structure would still be based on impervious area and an estimated ERU, but would also include parcel size in the determination of a parcel's user fee. Results of the national stormwater utility analysis demonstrates that many of the utilities having tiered rates structures for residential properties adopt three different tiers, usually small, average, and large differentiations for

Figure 3. 6: Residential Parcel Size



parcel size. While the specifications for what quantifies each parcel size for Narragansett would have to be determined after an actual ERU was calculated, two hypothetical rate structures for the breakdown of the tiers as shown below

- Small Parcel: 0- ¼ Acre
- Average Parcel: >¼-1 Acre
- Large Parcel: Over 1 Acre

- Small Parcel: 0- 1/8 acre
- Average Parcel: >1/8- ¼ acre
- Large Parcel: Over ¼ acre

Using these categories, all parcels that are considered average size would pay the ERU rate, while small parcels would pay only a fraction of the ERU rate, and large parcels would pay more than one ERU rate.

Potential Revenue for Rate Structure Options

Information collected through the author's national utility analysis, and also from other national stormwater utility surveys, indicates that most stormwater utilities adopt rates between $2 and $4 a month per ERU. Potential revenue for both fee options for Narragansett was calculated for this study using monthly fees ranging from $2 to $5 per month per ERU at $.50 increments.

Revenue Estimate for Funding Option 1

Table 3.11 illustrates the potential revenue estimates of a user fee structure with a flat rate for residential parcels and a variable rate for non-residential. Revenue estimates were calculated by first taking the total amount of residential parcels used in the analysis (7,075) and multiplying this by the monthly ERU rate. Using this option each residential parcel would be assumed to have one ERU of impervious surface so each residential parcel would pay the flat ERU rate per month.

Table 3. 11: Potential Yearly Revenue for Option 1

Monthly ERU Rate	Estimated Yearly Revenue
$2	$198,137.54
$2.5	$247,671.93
$3	$297,206.31
$3.5	$346,740.70
$4	$396,275.09
$4.5	$445,809.47
$5	$495,343.86

Table 3. 12: Estimated Non-residential Monthly Fee

Monthly ERU Rate	Estimated Monthly Fee for a 8.5 ERU non-residential parcel
$2	$17
$2.5	$21.25
$3	$25.50
$3.5	$29.75
$4	$34
$4.5	$38.25
$5	$42.50

The total square footage of non-residential impervious surface was divided by 2,065 (the ERU) then multiplied by each monthly rate to get an estimate for non-residential parcels. By dividing the total number of non-residential ERUs (1,180) in Narragansett by the number of non-residential parcels (139) it can be concluded that an average non-residential parcel in Narragansett has an impervious area that represents 8.5 ERUs. (See *Table 3.7*)Monthly user fee estimates for an 8.5 ERU non-residential parcel are shown in Table 3.12. and range from $17/month ($204/year) at a $2/ERU/month rate to $42.50/month ($510/year) at a rate of $5/ERU/month.

Yearly revenue estimates range from $200,000 at a $2.00/ERU/month rate to almost $500,000 at a $5/ERU/month. To fund the current level of stormwater management in Narragansett (approximately $414,400/year, see *Table 3.8*), a user fee/ERU between $4 and $4.5 would be required using this rate structure model.

Revenue Estimate for Funding Option 2

Many assumptions are required in order to calculate a rough revenue estimate for user fee Option 2. While the variable rates for non-residential remain the same as in Option 1, calculating the annual revenue for a tiered residential rate requires numerous decisions that will likely be different at the time of implementation. The broad nature of a good feasibility study allows for generalizations to be made while still providing information that is essential in the decision making process. Two important decisions include the definition of the different parcel size designations and what proportion of the monthly ERU should be used for each size category.

The rough estimates provided for the tiered rate residential and variable rate non-residential option were calculated using Scenarios A and B listed below. The percentages represent the percentage of parcels in the sample set that are represented by each size:

- Scenario A:
  - Small Parcel: 0- ¼ acre → ½ ERU/month (61%)
  - Average Parcel: >¼- 1 acre →1 ERU/month (33%)
  - Large Parcel: Over 1 acre →2 ERU/month (6%)

- Scenario B:
  - Small Parcel: 0- 1/8 acre →1/2 ERU/month (13%)
  - Average Parcel: >1/8- ¼ acre→ 1 ERU/month (50%)
  - Large Parcel: Over ¼ acre →1.5 ERU/month (37%)

There are numerous other scenarios based on different initial decisions that could be used to calculate this rate structure, however to get a general idea of the income range, each of these rate structures has a estimated yearly revenue based on a $2, $3, $4, and $5/ERU/month user fee as shown in Table 3.11. The range of possible revenues increases greatly when the rate structure is changed, and decisions about final rate structure would be made by the town council based on recommendations from town departments. To fund existing stormwater management expenditures ($414,400/year, see *Table 3.8*), a user fee/ERU of over $would be required for Scenario A while a user fee/ERU of between $3 and $4 would be required for Scenario B.

Table 3. 13: Potential Yearly Revenue for Option 2

Monthly ERU Rate	Scenario A	Scenario B
$2	$157,512	$230,316
$3	$236,270	$345,474
$4	$315,024	$460,632
$5	$393,780	$575,790

Comparison of Rate Structure Options

Because Narragansett has over 7,000 single-family residential parcels and only 139 non-residential parcels, it is recommended that one of two feasible rate options be chosen for a proposed Narragansett stormwater utility. Option 1 is a flat rate for all residential parcels and a variable rate for all non-residential parcels, while Option 2 is a three tiered rate for residential and a variable rate for non-residential parcels. While both of these options would be a viable way to set up an equitable and sufficient fee structure for Narragansett, there are slight differences in how each option impacts the issues of equity, simplicity, data collection needs, cost/ease of administration, and legal defensibility. Table 3.14 provides scores on the following issues on a scale of 1-10 with 10 being the highest possible score.

Table 3. 14: Rate Structure Option Comparison						
Rate Structure Option	Equity	Simplicity	Data Collection Needs	Cost/Ease of Admin.	Legal Defensibility	Total Score
Option 1 Flat Residential Variable Non-Residential	5	8	7	9	7	36
Option 2 Tiered Residential Variable Non-Residential	8	6	5	5	8	32
Adapted from: Stormwater Utility Fees: Considerations and Options for Interlocal Stormwater Working Groups, New England Environmental Finance Center						

Utility Recommendations for Narragansett

The following recommendations for developing and implementing a Narragansett stormwater utility have been formulated specifically for the unique needs of the town. for different aspects of stormwater utility structure were investigated first during the national stormwater utility analysis section of this paper, and specific options are now offered for consideration for the proposed Narragansett stormwater utility with the belief that each option would work well with the Narragansett town structure and stormwater management needs. For most options two of the most potentially equitable, efficient, and effective methods are offered, however the choices in Option A represent the decision that would create the most efficient, effective, equitable utility that provides the most incentives to improve stormwater runoff . If Narragansett adopts all Option A choices their stormwater utility would theoretically score a perfect 4 using the scoring mechanism developed for the national stormwater utility analysis in the previous chapter. The town could adopt any combination of these options in order to formulate their stormwater utility, and components of Option A and B for any one consideration can be combined.

Table 3.15 shows the options that are recommended, in some instances, two options are offered for consideration. An explanation for each recommendation follows.

Table 3. 15: Stormwater Utility Options for Narragansett		
Consideration	**Option A**	**Option B**
Start-up Strategy	Start with a simplified fee structure. Refine later.	
Fee Structure	Flat rate for residential. Variable rate for non-residential.	Tiered rate for residential. Variable rate for non-residential.
Multi-Family Approach	Treat multi-family units as non-residential units and calculate a variable rate for each.	Treat multi-family units as multiple single-family units.
Fee Basis and Data Collection	Estimated impervious surface using the ERU.	Parcel size in conjunction with the ERU.
Administration	Hire a full-time stormwater coordinator.	Use only existing staff.
Organizational Structure	Within an existing utility or municipal department, sharing some staff and billing structure.	Organized as an enterprise fund for financing purposes. Rely on existing entities and resources with no additional staffing.
Fee Collection	Local collection through existing utility bill.	
Implementation	Local implementation to start with, potential to expand in the future.	
Expenses Covered	All stormwater management.	All new expenses.
Geographic Coverage	Entire town.	
Exemptions	State owned property and roads, undeveloped or agricultural lands.	Only state-owned property as required by RI enabling legislation
Credits	Stormwater quantity reduction, stormwater quality improvement, and education credits for residential and non-residential customers.	Stormwater quantity and quality credits for residential and non-residential parcels.
Evaluation Measures	Establish both on-going stormwater quality and stormwater quantity evaluation measures.	

Start-up Strategy

While it would be potentially feasible for Narragansett to adopt a more complicated user fee structure, a more simplified rate structure is recommended initially. This simplified rate structure would lack a credit manual outlining all of the credits available to customers and including applications and instructions to obtain the credits. This strategy is recommended for Narragansett because of the time and resources needed in order to adopt a truly effective stormwater credit manual. This strategy has worked for many municipalities in the past (including recently in nearby Newton, MA) in order to start collecting revenue and build up resources for stormwater management. Using a simplified start-up strategy is recommended as long as there is a strict deadline for development of the credit manual; the author suggests that the credit manual be completed by the beginning of the next fiscal year after utility implementation.

Fee Structure

For detailed information about the fee structure recommendations see section 3.2.6: ERU Analysis.

Multi-Family Approach

There are many different ways to handle multi-family residents and many of the utilities analyzed in the previous chapter had developed their own unique way of approaching this issue. Some approaches separate multi-family residence into more categories (two family, 4 family, apartment, etc) and handle them separately. For instance a two-family home is treated like two single-family homes, but an apartment complex is treated like a non-residential parcel. This feasibility study did not identify any one way that would be most beneficial for Narragansett to handle multi-families. If

Narragansett decides to adopt a simplified fee structure to start-up it might be possible to treat each household as one ERU for the first year or two and then to develop a more complex multi-family approach at a later date.

Fee Basis and Data Collection

As discussed in section 3.2.6: ERU Analysis, the basis for fee collection should be impervious surface, since impervious surface has been shown to be the best indicator of stormwater runoff contribution. Out of the 25 utilities analyzed and presented in the previous chapter, over half used some form of ERU as the basis of their rate structure. Also, of the 4 utilities analyzed that most closely resemble Narragansett in terms of population, size, median household income, and annual rainfall (Griffin, GA, Union, OH, Redmond, WA, and Moline, IL) the trend was for half of the utilities to use some form of ERU in their rate structure analysis.

There were two options presented for Narragansett, one using a flat rate for all residential parcels based on a town specific ERU and incorporating the ERU and parcel size to create a tiered residential user fee. The data collection method that is recommended for calculating the user fee is similar to the methodology used in the feasibility study to obtain the ERU. The most current GIS layers should be used for analysis with the most current aerial photographs. The data should be updated using the tax assessor's database if the information is older than one year.

Fee Collection

Due to the high cost of implementing a new billing system, it is recommended that Narragansett send out bills for the stormwater utility through an existing utility bill. Using 2005 homeowner information it was concluded, as part of the feasibility, that most parcel owners are existing customers of the water utility, so attaching the stormwater utility to that billing system may prove to be the most efficient. When the actual Narragansett stormwater utility is being planned, billing structures for the different towns will have to be examined so a final billing decision can be made.

Exemptions

Narragansett is required to exempt the state from the fee system due to a provision in the Rhode Island enabling legislation for the creation of stormwater utilities. (See *Appendix B: RI Enabling Legislation)* One potential recommendation would be for Narragansett to have the state as the only exempt entity. Another option for Narragansett would be to allow other exemptions, for instance undeveloped or agricultural lands. Undeveloped and agricultural lands have little impervious surface, and although many pollutants come from agriculture, 2 of the 25 utilities in the national stormwater analysis have exempted these parcels from paying into the user fee.

Credits

If Narragansett decides to adopt a simplified start-up strategy the formation of a credit manual may be temporarily delayed, however it is strongly recommended that Narragansett implement a credit system by the beginning of the fiscal year following utility implementation. A credit system is one of the main aspects that differentiate a user fee from a tax, and it is important for maintaining equity that a well developed credit system is in place. A credit system is a key way to provide incentives for reducing stormwater quantity and improving stormwater quality.

One option is for Narragansett to only offer off-site stormwater quantity reduction credits to non-residential parcels; however it is strongly recommended that Narragansett also develop a residential credit system based on not only stormwater quantity but quality as well. Some form of credit system is used in 19 of the utilities in the national stormwater analysis. Of these 19 utilities, seven utilities provide credits for residential parcels as well as non-residential while 12 have non-residential credits only. Of the four utilities most similar to Narragansett in terms of population, size, median household income, and annual rainfall (Griffin, GA, Union, OH, Redmond, WA, and Moline, IL), Griffin has residential and non-residential credits that can total up to 50% of the bill, Moline has residential and non-residential credits that can total up to 100% of the bill, Redmond only has a credit system for non-residential parcels, and Union has no credit system in place at this time.

Non-residential quantity credits could be used by Narragansett by calculating the reduction in the amount of stormwater and reducing the bill by that percentage. Residential properties could receive a credit through reducing impervious surface area of their parcel, installing a rain barrel, or planting a rain garden. Some existing utilities, for example Griffin, GA, have developed a credit system for education. Because public education is an important BMP for improving stormwater quality, schools that provide stormwater education receive a substantial reduction in their utility fee. Narragansett could greatly benefit from incorporating a similar program into their credit system.

Many of the activities available to residential parcels usually take a considerable amount of resources to set up. Rain barrels for example, can cost up $120 or more and many lower income families, who may be in most need of a credit, might find it difficult to meet the requirements of getting one. (Urban Garden Center, 2008)To address this important issue of equity in a credit system, it is recommended that Narragansett look into providing a subsidy for lower income families in order to help alleviate the costs of installing the BMP to receive a credit. One way for Narragansett to do this would be to purchase rain barrels at a bulk discount and then offer them to customers that meet the income requirements at a discounted price.

It is recommended that Narragansett adhere to the idea that no credit should be worth 100%. While 3 of the 25 utilities in the national analysis offered 100% credit, the second highest scoring utility, Sarasota County, FL, has flat fees in addition to other variable fees that prevent providing a 100% credit. There should be a base fee for stormwater management regardless of the runoff that originates from any one property because of the maintenance that Narragansett provides to the roads and stormwater structures. However, while the state is exempt under the stormwater utility because of Rhode Island's enabling legislation, the enabling legislation also states that RIDOT should provide services when possible to help the municipal stormwater utility. The services that the state provides towards stormwater management in Narragansett are substantial and it could therefore be viewed as the state having the only 100% credit for Narragansett's stormwater utility user fee.

While developing a credit manual takes a resources and time, a comprehensive credit manual is important to provide a way for utility customers to apply for a credit. There are many credit manuals in existence that could provide a guide for the development of the Narragansett credit manual.

Organizational Structure

Two options for the organizational structure of a stormwater utility for Narragansett were recommended in the feasibility study. The strongly recommended option would be to create a stormwater utility within an existing utility or municipal department. Twenty of the 25 utilities analyzed in the previous section are organized as part of another municipal department. Twelve utilities are set up within the municipal Department of Public Works. All four of the utilities most closely resembling Narragansett are organized under the Municipal Department of Public Works in some way and share staffing. Since the Narragansett Department of Public Works and the Engineering Department are currently responsible for a majority of stormwater management activities in Narragansett, either department would be efficient and viable choices for integration of a stormwater utility. Also, the water and wastewater utilities are currently set up within the town Engineering Department. Both of these utilities are funded through user fees and are set up for financial purposes as enterprise funds. (See *Appendix A: Definitions*) This must be a consideration when deciding where and how to lace a stormwater utility in the town infrastructure.

It is feasible that the proposed Narragansett stormwater utility could operate similar to the current water and wastewater utility structures as an enterprise fund that works as a financial tool to provide resources towards stormwater activities in other departments. While this setup would be feasible for Narragansett, utilizing an enterprise fund would make the stormwater utility reliant on existing entities and resources. It is therefore highly recommended that Narragansett set up a utility as an entity in addition to the enterprise fund to allow for full time staffing and an infrastructure that is utilized exclusively by the stormwater utility.

Administration

Two options for administration were recommended in the author's Narragansett feasibility study, both and are closely linked with the recommendations offered for organizational structure above. While it is strongly recommended that Narragansett hire a dedicated stormwater manager to oversee resources, customer inquiry, capital improvement planning, stormwater education, and other stormwater management activities, this administrative system would only be possible if the utility was created as an entity in addition to an enterprise fund.

Narragansett could implement the utility solely as an enterprise fund within another town department, like the water and wastewater utilities that are currently operating in Narragansett. However, if this is decided it is advisable to hire an additional part or full-time employee in one of these departments that spend a majority of their time managing the stormwater utility.

Geographic Coverage

There are existing stormwater utilities in the U.S. that currently operate within a larger boundary than a municipality (including two of the utilities analyzed in the previous chapter). Some utilities encompass more than one city or town, while others service counties. While this is viewed as an efficient way to set up some utilities because of watershed boundaries, it is recommended that Narragansett take the simplest approach by implementing a stormwater utility within the municipality. If the opportunity arises for the utility to grow it is recommended that Narragansett consider this option if sufficient revenue can be generated since stormwater runoff is not governed by municipal boundaries.

Expenses Covered

Since it would be beneficial for Narragansett to implement the user fee slowly and refine the rate structure during the first few years of utility existence, it is likely that during this time Narragansett will require supplemental subsidies from the General Fund. After the refined rate structure is in place it should be expected that all of the objectives of the utility can be met through the user fees. One option for covering expenses would be for the user fee to fund all stormwater management activities in Narragansett, with some additional assistance from grants, bonds, or the general fund for large capital improvement projects. Another alternative for Narragansett would be to use the user fee only to fund new stormwater activities. There are a number of stormwater management activities, mainly CIP, that Narragansett could complete if all new revenue was used for them alone. This option may improve some aspects of stormwater management, however it would not provide stable or dedicated funding for O&M and personnel costs which is not ideal. Channeling user fees revenue through O&M and personnel costs first, with the excess used for CIP projects that are supplemented through other funding sources appears to be the more effective program at this time.

Efficiency Measures

In the national stormwater analysis, most utilities did not have evaluation measures in place for either stormwater quality or quantity. This is a serious issue for existing utilities, because while their actions show that some improvement in stormwater is being made, it is not being monitored and evaluated. Narragansett could be a forerunner in adopting a combination of traditional and innovating evaluation methods in order to ensure efficiency and effectiveness for both stormwater quality and quantity. (See Section 2.4.1: Components of Stormwater Utilities)

Chapter 4: Conclusions and Recommendations

4.1 Key Findings

Stormwater runoff has been a major issue facing the United States for decades. While stormwater runoff has regulated through the Clean Water Act (CWA) since the 1970's, stormwater quality and quantity issues still remain. Rhode Island has obligation to manage stormwater runoff through the National Pollution Discharge Elimination System (NPDES) and Total Maximum Daily Load (TMDL) programs authorized by the CWA. Rhode Island has developed numerous TMDL programs, promotes low impact development, and assists municipalities in adopting best management practices in order to meet the NPDES Phase I and II minimum requirements. Even with these efforts, there are still Rhode Island communities that face difficulties implementing their stormwater management programs.

There are approximately 400 stormwater utilities nationwide. Municipalities, regions, or counties have used stormwater utilities since the 1970s as a way to provide dedicated, stable, and equitable funding for stormwater management. Stormwater utilities also allow for coordination between municipal departments and long-term stormwater plan development. While many regions of the US have stormwater utilities, over 100 exist in Florida. One region lacking in stormwater utilities is New England. There are only five stormwater utilities currently implemented in New England, with none implemented in the state of Rhode Island.

Stormwater utilities have many components and decisions that are necessary before implementation can begin. Major components include rate structure, staffing, and organization. Rate structure can vary greatly depending on a number of considerations.

Rate structure considerations include decisions on equivalent residential unit, legal and equity issues, simplicity, and data collection needs. Implementation of a stormwater utility also has many considerations, decisions, and phases. The first step for most communities contemplating a stormwater utility is to conduct a feasibility study. Feasibility studies aid in making decisions on utility start-up strategy, billing issues, expenses covered, and evaluation measures.

The national stormwater utility analysis took 25 utilities nationwide and evaluated them on effectiveness, efficiency, equity, and providing incentives. Utilities representing each region of the country were analyzed, and many utilities had unique features. Most communities analyzed used an ERU as the basis for their rate structure. Most utilities were organized as part of the municipal Department of Public Works. A comprehensive public education program was seen across most of the highest scoring utilities. A variety of rate structures were utilized by the 25 utilities, including flat rates, tiered rates, and variable rates. Incentives provided through credit programs included rain barrels, rain gardens, education credits, BMP credits, and on-site stormwater control credits.

Narragansett, RI faces the common problem of inability to obtain adequate funding for all municipal stormwater management needs. Narragansett is interested in pursuing a stormwater utility in order to obtain funding for additional staff and capital projects, and to develop a comprehensive, long-term management plan. The feasibility study results show that a stormwater utility would be a beneficial option for Narragansett. By incorporating key findings from the national stormwater analysis into decisions on stormwater utility considerations, all of the components for a successful and effective stormwater utility can be addressed by Narragansett.

4.2 Conclusions

The purpose of this thesis was to explore the efficacy of stormwater utilities in mitigating stormwater runoff in the United States. Two specific research questions and the key findings that answer them are as follows:

1. Is a stormwater utility a viable way to mitigate stormwater runoff in the United States?

The national stormwater analysis presented in this thesis demonstrates that stormwater utilities can be effective and successful tools for stormwater management if they are equitable, efficient, effective, and provide incentives to reduce or improve stormwater. The most successful utilities were formulated to be sensitive and responsive to the community profile and to leverage existing infrastructure. While following the guidelines given in this thesis do not guarantee successful implementation, research shows that combining the consideration of unique community attributes with the four core concepts can lead to utility adoption.

2. Can municipalities use the information gathered from the National Stormwater Utility Analysis in order to implement a successful utility of their own?

The Narragansett stormwater utility feasibility study was completed utilizing findings from the author's national stormwater utility analysis in order to help assure success for the proposed Narragansett utility. The same goals of equity, efficiency, effectiveness, and incentive plan in addition to consideration of the unique situation, stormwater management requirements, and current town infrastructure were considered when developing the feasibility study recommendations. Because of the emphasis placed on these measures of success, it is likely that the proposed Narragansett stormwater utility, if adopted, will be a successful endeavor both with sufficient funding and infrastructure mechanism for stormwater management.

4.3 Recommendations

The following recommendations are directed towards four specific audiences: municipalities with existing stormwater utilities or municipalities that are developing utilities, State agencies promoting stormwater utilities in their state, and Narragansett, RI. These recommendations are based on the results from the national stormwater utility analysis presented in this thesis, and the Narragansett feasibility study prepared by the author and summarized in this thesis. There are also recommendations formulated specifically based on the results of the Narragansett Stormwater Utility Feasibility Study.

4.3.1 Overall Recommendations for Narragansett

If Narragansett's unique town structure and stormwater needs are considered at every stage of implementation, it is highly likely that Narragansett will be able to implement a successful and efficient stormwater utility in the near future. The national stormwater analysis shows that many municipalities similar to Narragansett have set up successful stormwater utilities. The development and implementation procedures for these successful utilities are similar to the recommendations made for the proposed Narragansett stormwater utility in the previous sections. A utility created using all or most of the "Option A" recommendations from Table 3.15 will most likely result in a perfect score of 4 for Narragansett, under the guidelines used in the national stormwater utility analysis earlier in this chapter.

It is recommended that the first action that Narragansett takes towards stormwater utility implementation would be to develop a public education and outreach program to educate the public on the needs of stormwater management to help ensure a smooth implementation process.

4.3.2 Recommendations for Municipalities with Existing Stormwater Utilities

The recommendations that follow are specifically for existing stormwater utilities that are interested in increasing their overall effectiveness by adopting the results of the national stormwater analysis. Recommendations are mainly focused on areas that were identified as overall lacking with stormwater utilities in general by the national stormwater utility analysis, mainly the lack of evaluations measures and credit systems. These are two important issues that are main components of effective stormwater utilities nationwide.

- Program evaluation is an essential tool for ensuring continuous efficiency. All stormwater utilities should conduct program evaluations for improving stormwater quality and reducing stormwater quantity periodically and make revisions to their user fee, rate structure, and utility organization when necessary. A helpful document entitled <u>Evaluating the Effectiveness of Municipal Stormwater Programs</u> can be found in the EPA website. (Region 3 EPA, 2008)

- There are many ways to evaluate existing stormwater programs. Examples of both traditional and innovative ways to evaluate stormwater utilities can be found in Section 2.4.2.

- All stormwater utilities should develop credit systems, if not already employed, in order to distinguish existing user fees from taxes. Credit systems should encompass both residential and non-residential parcels for a variety of different activities that improve stormwater runoff.

4.3.4 Recommendations for Municipalities Developing Stormwater Utilities

The following recommendations are offered to municipalities that are considering developing and implementing a stormwater utility in order to improve stormwater management. Recommendations have been formulated using the results of the national stormwater utility analysis, and each recommendation was considered and adopted using the Narragansett Stormwater Utility Feasibility Study.

It is essential to develop a stormwater utility that provides efficiency, equity, effectiveness, and incentives in mind by thinking through the following considerations in detail with specific important put on individual municipal needs:

- Identify municipal specific stormwater needs and establish detailed stormwater utility goals to ensure that user fees are being used for the intended purpose.
- Develop ongoing evaluation measures starting with baseline data before the utility is implemented. Results should be periodically reported to the public in order to illustrate the effects of the stormwater utility. While most of the utilities included in the national analysis did not have these measures in place, many of the highest scoring utilities did have measures in place.
- Create effective relationships between the stormwater utility and existing municipal infrastructure. A majority of utilities in the national analysis has links to another municipal department, mainly the municipal Department of Public Works.
- Develop a credit system for both residential and non-residential parcels that enables customers to "opt out" of at least a portion of the user fee, therefore distinguishing the user fee from a tax.
- Having a dedicated stormwater "champion" or group of champions can aid in utility implementation by ensuring that the process follows all the necessary steps and gathers public support, as can be seen with the highest scoring utility in the national analysis, Griffin, GA.

- There are many avenues for obtaining the initial funding, including grants from state and federal agencies, and a certain percentage of the initial work may not have to be funded directly by the town. Some utilities have chosen to adopt simplified start-up strategies in order to produce funding for more specific development through user fees.

- It is important to know what sorts of information are needed to develop and implement a stormwater utility and how much it will cost to obtain information before development.

- Many legal challenges can be avoided by implementing an equitable rate structure that includes a credit system for both residential and non-residential parcels. Equitable rate structures are community specific, but entail that the utility customers who contribute more to stormwater problems have the highest user fees. Credit systems are varied and can include a number of different incentives, from education credits, to rain barrels, to on-site BMPs. A complete list of the incentives used by the utilities included in the national analysis can be found in Section 3.1.3.

4.3.5 Recommendations for State Agencies Promoting Stormwater Utilities

The following recommendations are provided for state environmental agencies that are considering promoting stormwater utilities as a viable and effective way for municipalities to comply with state and federal stormwater regulations. Developing and implementing a stormwater utility is a detailed process, and assistance provided by state environmental agencies has the potential to greatly assist struggling municipalities. These recommendations were in large part formulated through experiences and research conducted while formulating the Narragansett stormwater utility feasibility study and experiencing the difficulties that face many municipalities.

- States should offer incentives for municipalities to conduct stormwater utility feasibility studies as a first step towards working towards a stormwater management solution. Incentives could include assistance with funding for the feasibility study, or providing guidance documents and assistance on how to conduct a feasibility study with in-house resources.

- Detailed information about state stormwater utility enabling legislation should be provided, and discussed with municipalities in order to provide a detailed understanding of what provisions needs to be incorporated into a potential implementation.

- State environmental departments should work together regionally and nationally to share resources on utility development. While many states (for instance Florida) already have a number of stormwater utilities in place and resources and guidance documents to support them, other states have yet to have any developed. States new to stormwater utilities could benefit greatly from advice given by other state environmental departments.

4.4 Further Research

After completing the research and analysis outlined and discussed in this paper, the following further research is suggested and recommended by the author. Adding public education to the national stormwater analysis would provide a better understanding of how outreach influences success. The analysis examines 25 utilities, which is about 6% of the total number of utilities in the U.S. Analysis of a larger sample size would strengthen the results. Selection of additional utilities using a scientifically robust method (e.g., randomized selection) would also increase the ability to generalize the results.

It would be informative as well as beneficial to the town of Narragansett, RI to follow the stormwater utility process past the feasibility study outlined in this research. Identifying issues that may arise with implementation and adoption of the stormwater utility would offer important information about ways to ensure success for the Narragansett stormwater utility and also insight into what aspects are preventing New England from implementing stormwater utilities at the same rate as the rest of the nation.

Two subsequent studies involving community education and outreach are suggested by the research completed for this paper. Fist, continued research is needed to measure the importance of education the public about stormwater management and stormwater utilities before and during the implementation process. This research is necessary to measure how this education influences the ease of utility fee acceptance by the population and if public education as part of the development or implementation phases of a stormwater utility effects overall success. Secondly, for initial stormwater utility development as well as for existing utility evaluation, additional research is needed on what activities or programs offer the most incentives for changing use patterns of utility customers. In the national stormwater analysis all forms of credits were treated equally and only the percent maximum credit offered was included. It may not be true that all credits provide the same incentives. A study of this kind might show what credit activities or percentage reductions offer the most incentive for increasing stormwater quality or reducing stormwater quantity.

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Appendix A: Definitions

Stormwater Utility- For the purposes of this paper, the term stormwater utility to describe any organized effort to acquire resources for stormwater management (either capital improvement projects, repairs of existing infrastructure, or a combination of the two) through the use of a user fee. Stormwater utilities area also called other things, for instance a stormwater district, or a stormwater management district.

Stormwater Runoff- The water runoff from rain water events that travels through a town, often picking up pollutants, before being discharged into a water body

Impervious Surface- Surfaces that water can not be absorbed into, so it will travel across or down. Common impervious surfaces include rooftops, driveways, parking lots, and side walks.

Pervious Surface- a pervious surface is one that allows water to soak into it, for instance undeveloped land, or a gravel driveway. Pervious surfaces do not interrupt natural water movements.

Maximum Extent Practicable- the statutory standard that establishes the level of pollutant reductions that operators of regulated MS4s "shall require controls to reduce the discharge of pollutants to the maximum extent practically, including management practices, control techniques and system, design and engineering methods." CWA Section 202 (p)(3)(B)(iii) *From the Federal Register for NPDES, pg, 68754*

Municipal Separate Storm Sewer System (MS4) - a conveyance or system of conveyances (including roads with drainage systems and municipal streets) that is "owned or operated by a State, city or town borough, county, parish, district, association, or other public body" designed or used for collecting or conveying stormwater with is not a combined sewer and which is not part of a Publically Owned Treatment Works. *From the Federal Register for NPDES, pg 68748*

Total Maximum Daily Load (TMDL)- a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources.

Appendix B: RI Enabling Legislation

Rhode Island General Law

TITLE 45

Towns and cities

CHAPTER 45-61

Stormwater Management Districts

45-61-1. Short title. -- This chapter shall be known and may be cited as the "Rhode Island Stormwater Management and Utility District Act of 2002."

45-61-2. Legislative findings. -- The general assembly hereby recognizes and declares that:

The general assembly finds that stormwater, when not properly controlled and treated, causes pollution of the waters of the state, threatens public health, and damages property. Stormwater carries pollutants and other material from the land - such as human and animal waste, oil, gasoline, grease, fertilizers, nutrients, and sediments - into rivers, streams, ponds, coves, drinking water aquifers, and Narragansett Bay. Stormwater reaches the state's waters by streets, roads, lawns, and other means. As a result, public use of the natural resources of state for drinking water, swimming, fishing, shellfishing, and other forms of recreation is limited and in some cases prohibited.

The general assembly further finds that inattention to stormwater management results in erosion of soils and destruction of both public and private property, thereby putting public safety at risk and harming property values and uses, including agriculture and industry. Therefore, to help alleviate existing and future degradation of the state's waters and the associated risks to public health and safety, and to comply with state and federal stormwater management requirements, stormwater conveyance systems must be maintained and improved. The state of Rhode Island is delegated by the United States Environmental Protection Agency to implement "Phase II" stormwater management regulations, which require municipalities and other persons to increase their capacity to control stormwater. The Department of Environmental Management's Pollution Discharge Elimination System program has promulgated these regulations.

45-61-3. Declaration of purpose. -- The purpose of this chapter is to authorize the cities and towns of the state to adopt ordinances creating stormwater management districts (SMD), the boundaries of which may include all or part of a city or town, as specified by such ordinance. Such ordinances shall be designated to eliminate and prevent the contamination of the state's waters and to operate and maintain existing stormwater conveyance systems.

45-61-4. Powers of councils. -- The city or town council of any city or town in the state, by itself or with other cities and towns, pursuant to chapter 45-43, and in accordance with the purposes of this chapter, are hereby authorized to adopt ordinances creating stormwater management districts, which will be empowered, pursuant to such ordinance, to:

(1) establish a fee system and raise funds for administration and operation of the district. The fee system shall be reasonable and equitable so that each contributor of runoff to the system shall pay to the extent to which runoff is contributed; and the state shall be exempted from the fee system. However, the state Department of Transportation shall cooperate with the municipalities in the planning and implementation of wastewater management ordinances, including the providing of funds, if available, to match the fees collected by the municipalities annually.

(2) prepare long range stormwater management master plans;

(3) implement a stormwater management district in accordance with regulations and model ordinances promulgated under this chapter;

(4) retrofit existing structures to improve water quality or alleviate downstream flooding or erosion;

(5) properly maintain existing structures within the district;

(6) borrow for capital improvement projects by issuing bonds or notes of the city or town;

(7) hire personnel to carry out the functions of the districts;

(8) receive grants, loans or funding from state and federal water quality programs;

(9) grant credits to property owners who maintain retention and detention basins or other filtration structures on their property;

(10) make grants for implementation of stormwater management district plans;

(11) purchase, acquire, sell, transfer, or lease real or personal property;

(12) impose liens;

(13) levy fines and sanctions for noncompliance;

(14) provide for an appeals process;

(15) contract for services in order to carry out the function of the district.

SECTION 2. This act shall take effect upon passage.

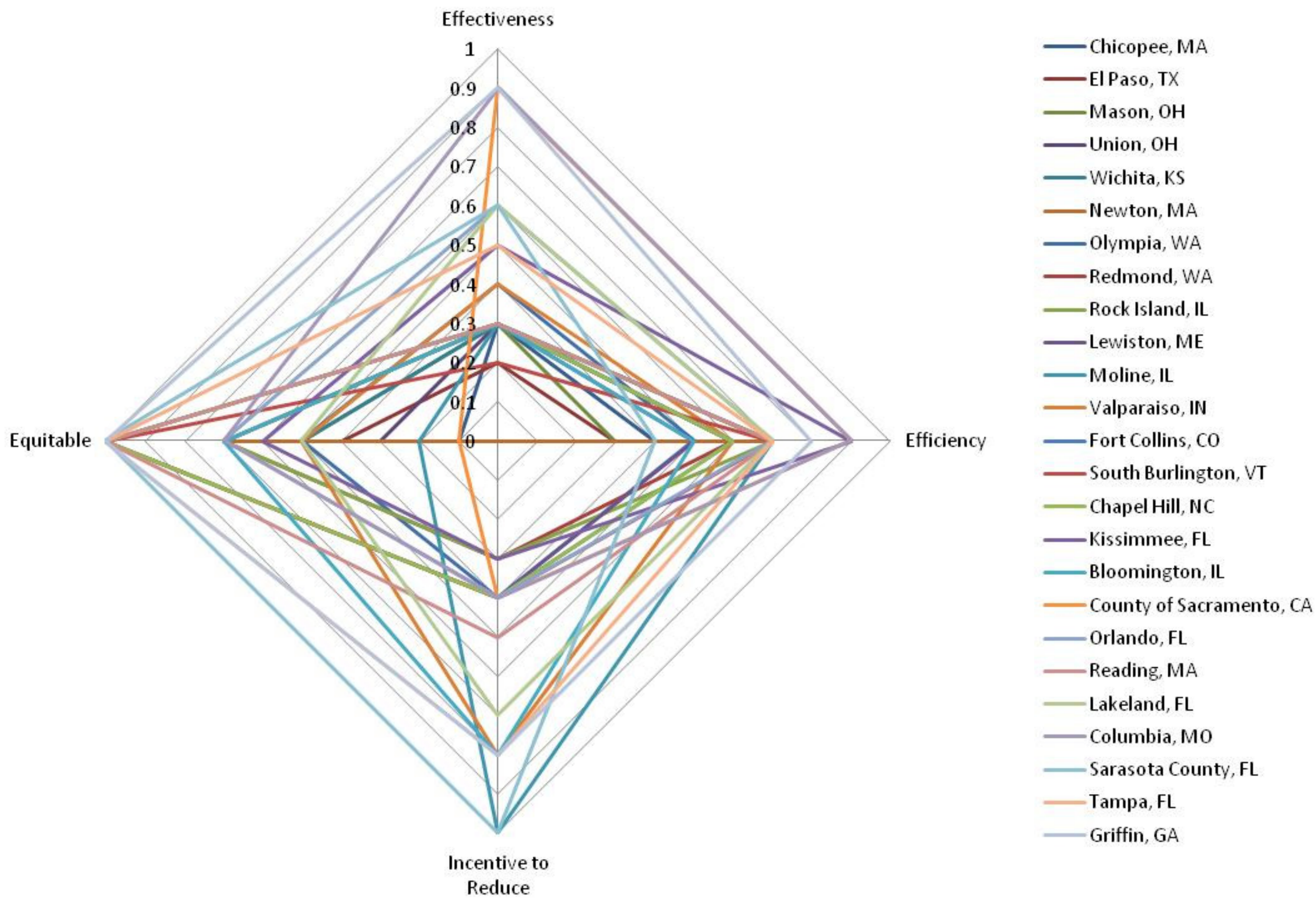
Source: http://www.rilin.state.ri.us/PublicLaws/law02/law02329.htm

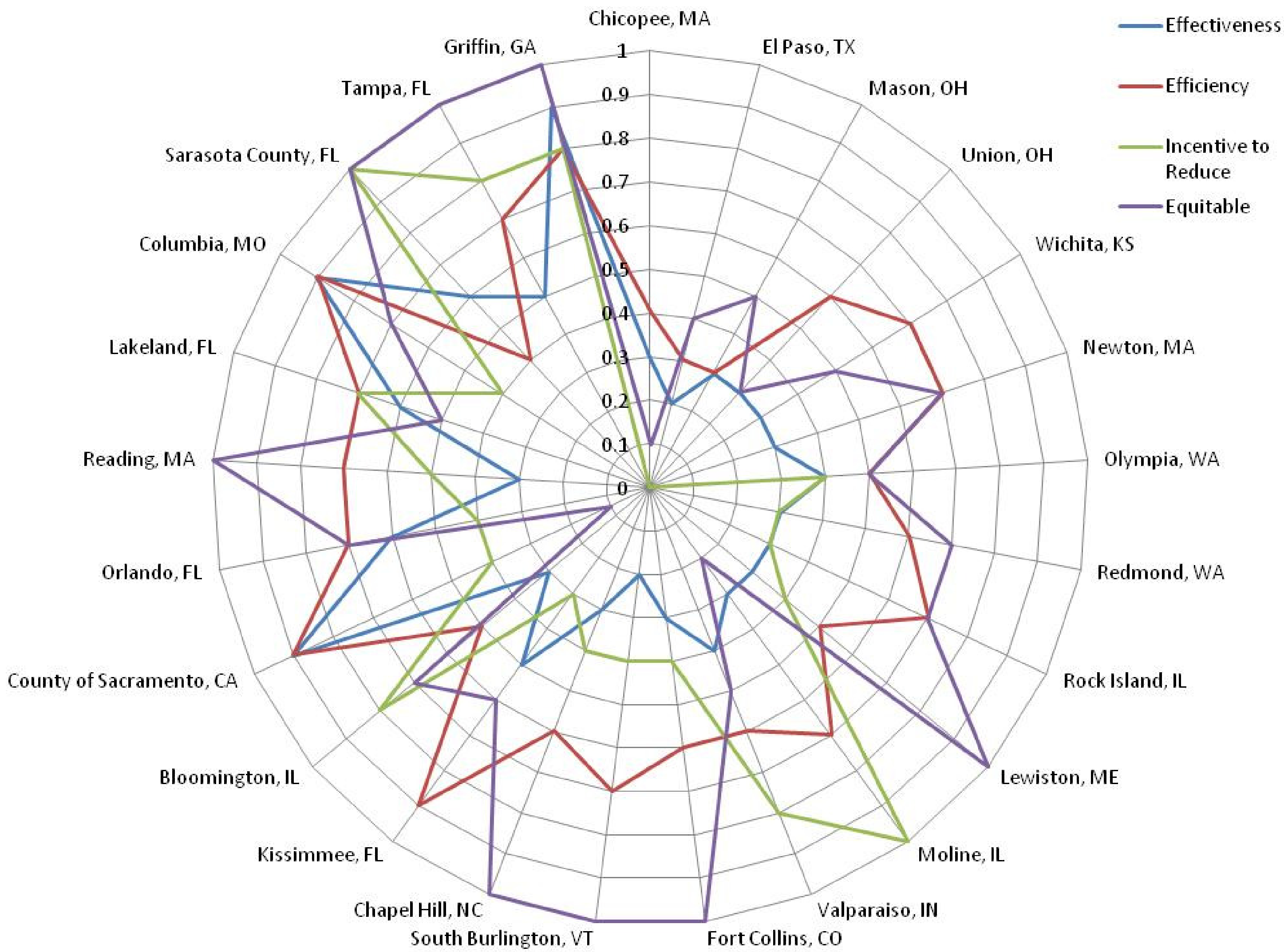
Appendix C: Map of Stormwater Utilities Used in Analysis

Appendix D: National Stormwater Analysis Scores

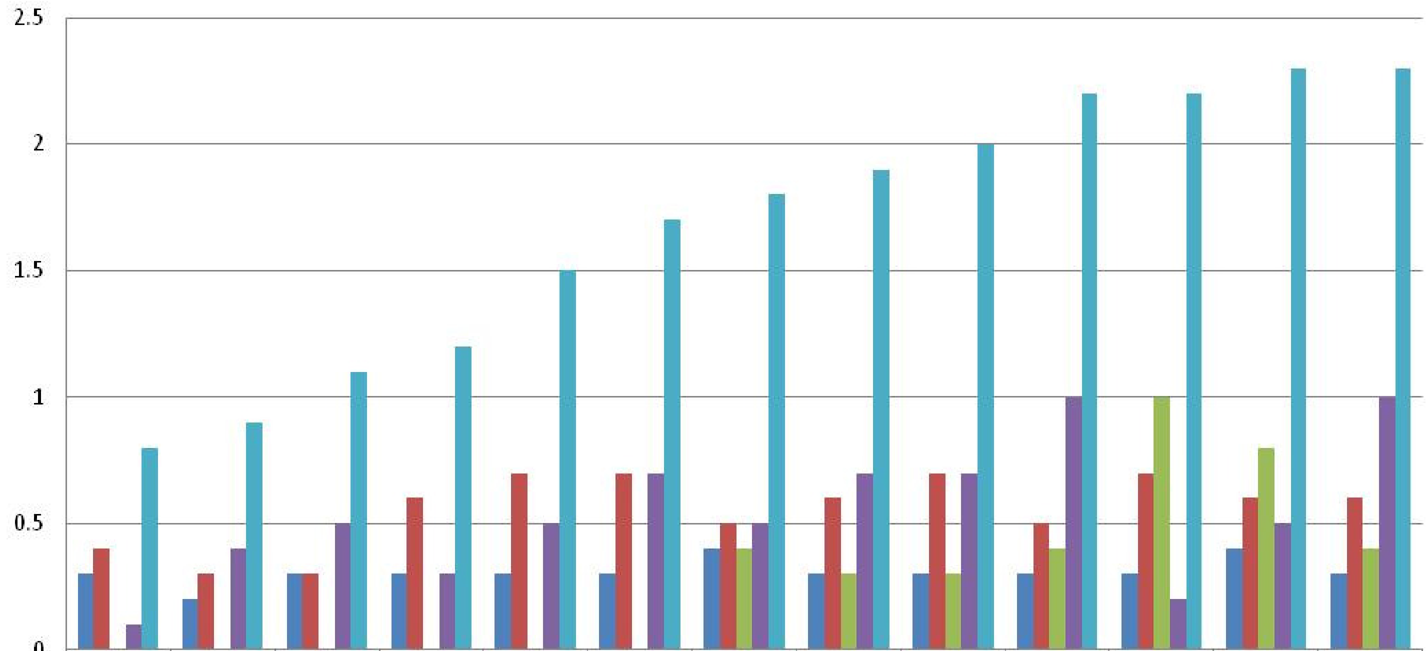
	Effective	Efficient	Incentives to Reduce	Equitable
Griffin, GA	0.9	0.8	0.8	1
Valparaiso, IN	0.4	0.6	0.8	0.5
Union, OH	0.3	0.6	0	0.3
Sarasota County, FL	0.6	0.4	1	1
Fort Collins, CO	0.3	0.6	0.4	1
Olympia, WA	0.4	0.5	0.4	0.5
South Burlington, VT	0.2	0.7	0.4	1
Chapel Hill, NC	0.3	0.6	0.4	1
Reading, MA	0.3	0.7	0.5	1
Newton, MA	0.3	0.7	0	0.7
Tampa, FL	0.5	0.7	0.8	1
Lewiston, ME	0.3	0.5	0.4	1
Chicopee, MA	0.3	0.4	0	0.1
Orlando, FL	0.6	0.7	0.4	0.7
Kissimmee, FL	0.5	0.9	0.3	0.6
Mason, OH	0.3	0.3	0	0.5
Moline, IL	0.3	0.7	1	0.2
Lakeland, FL	0.6	0.7	0.7	0.5
Bloomington, IL	0.3	0.5	0.8	0.7
Redmond, WA	0.3	0.6	0.3	0.7
El Paso, TX	0.2	0.3	0	0.4
Columbia, MO	0.9	0.9	0.4	0.7
County of Sacramento, CA	0.9	0.9	0.4	0.1
Rock Island, IL	0.3	0.7	0.3	0.7
Wichita, KS	0.3	0.7	0	0.5

Appendix E: Stormwater Utility Analysis

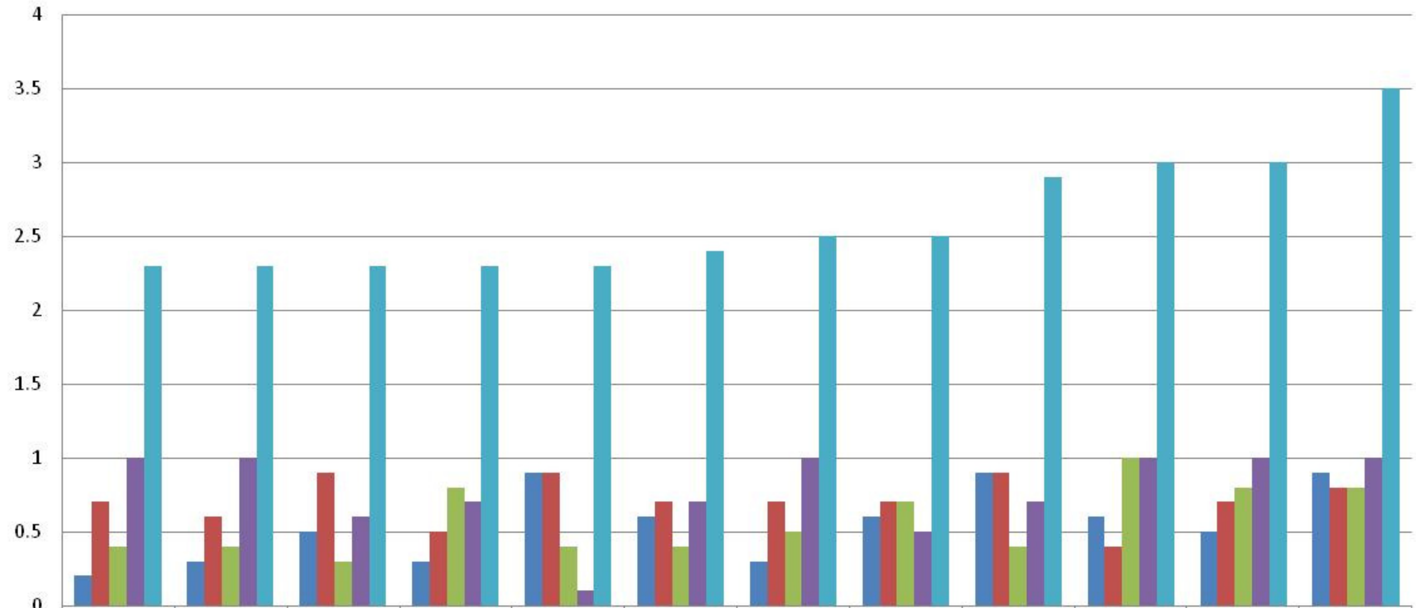




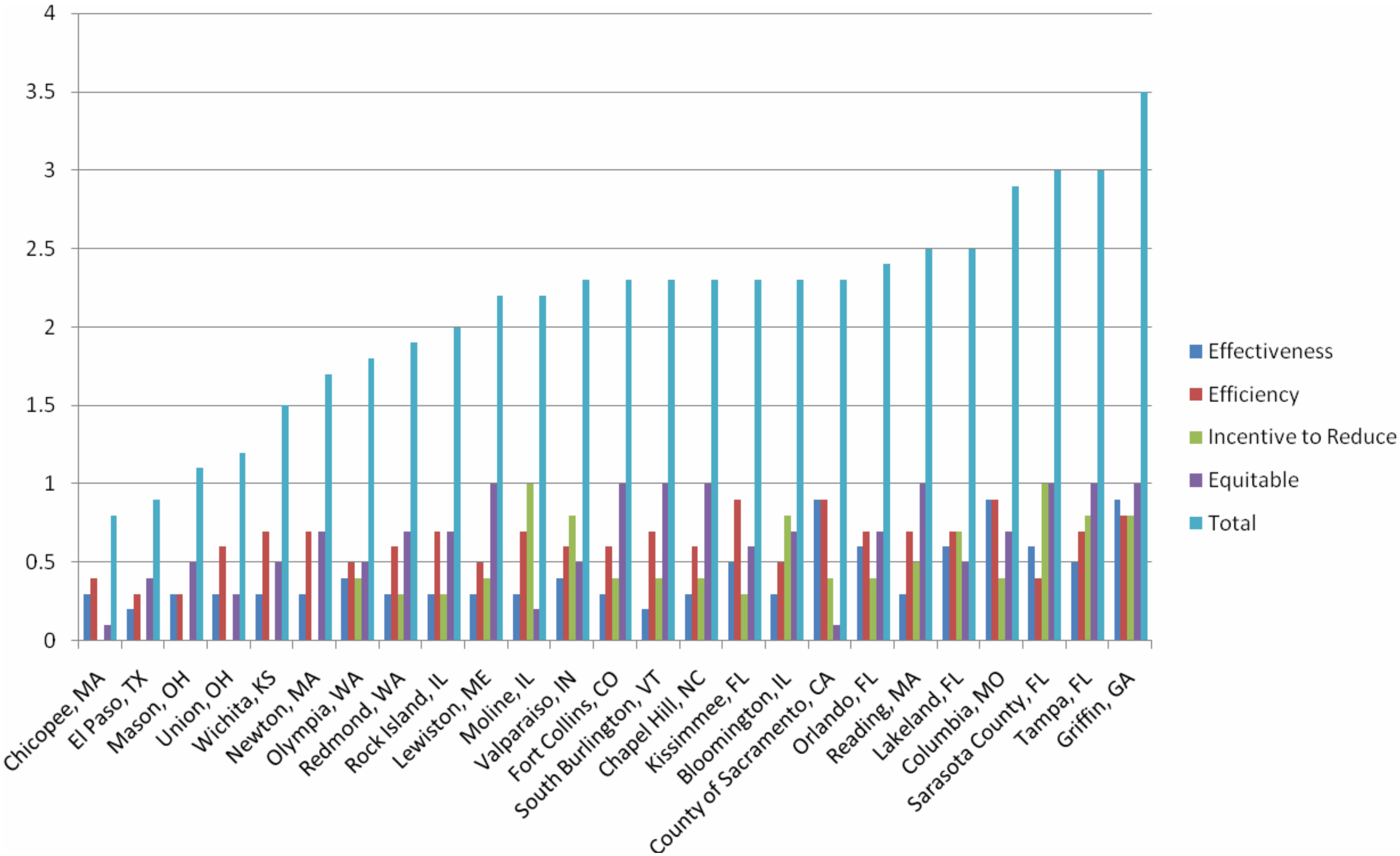
Chicopee, MA
El Paso, TX
Mason, OH
Union, OH
Wichita, KS
Newton, MA
Olympia, WA
Redmond, WA
Rock Island, IL
Lewiston, ME
Moline, IL
Valparaiso, IN
Fort Collins, CO
South Burlington, VT
Chapel Hill, NC
Kissimmee, FL
Bloomington, IL
County of Sacramento, CA
Orlando, FL
Reading, MA
Lakeland, FL
Columbia, MO
Sarasota County, FL
Tampa, FL
Griffin, GA
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Effectiveness
Efficiency
Incentive to Reduce
Equitable



	Chicopee, MA	El Paso, TX	Mason, OH	Union, OH	Wichita, KS	Newton, MA	Olympia, WA	Redmond, WA	Rock Island, IL	Lewiston, ME	Moline, IL	Valparaiso, IN	Fort Collins, CO
Effectiveness	0.3	0.2	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.4	0.3
Efficiency	0.4	0.3	0.3	0.6	0.7	0.7	0.5	0.6	0.7	0.5	0.7	0.6	0.6
Incentive to Reduce	0	0	0	0	0	0	0.4	0.3	0.3	0.4	1	0.8	0.4
Equitable	0.1	0.4	0.5	0.3	0.5	0.7	0.5	0.7	0.7	1	0.2	0.5	1
Total	0.8	0.9	1.1	1.2	1.5	1.7	1.8	1.9	2	2.2	2.2	2.3	2.3

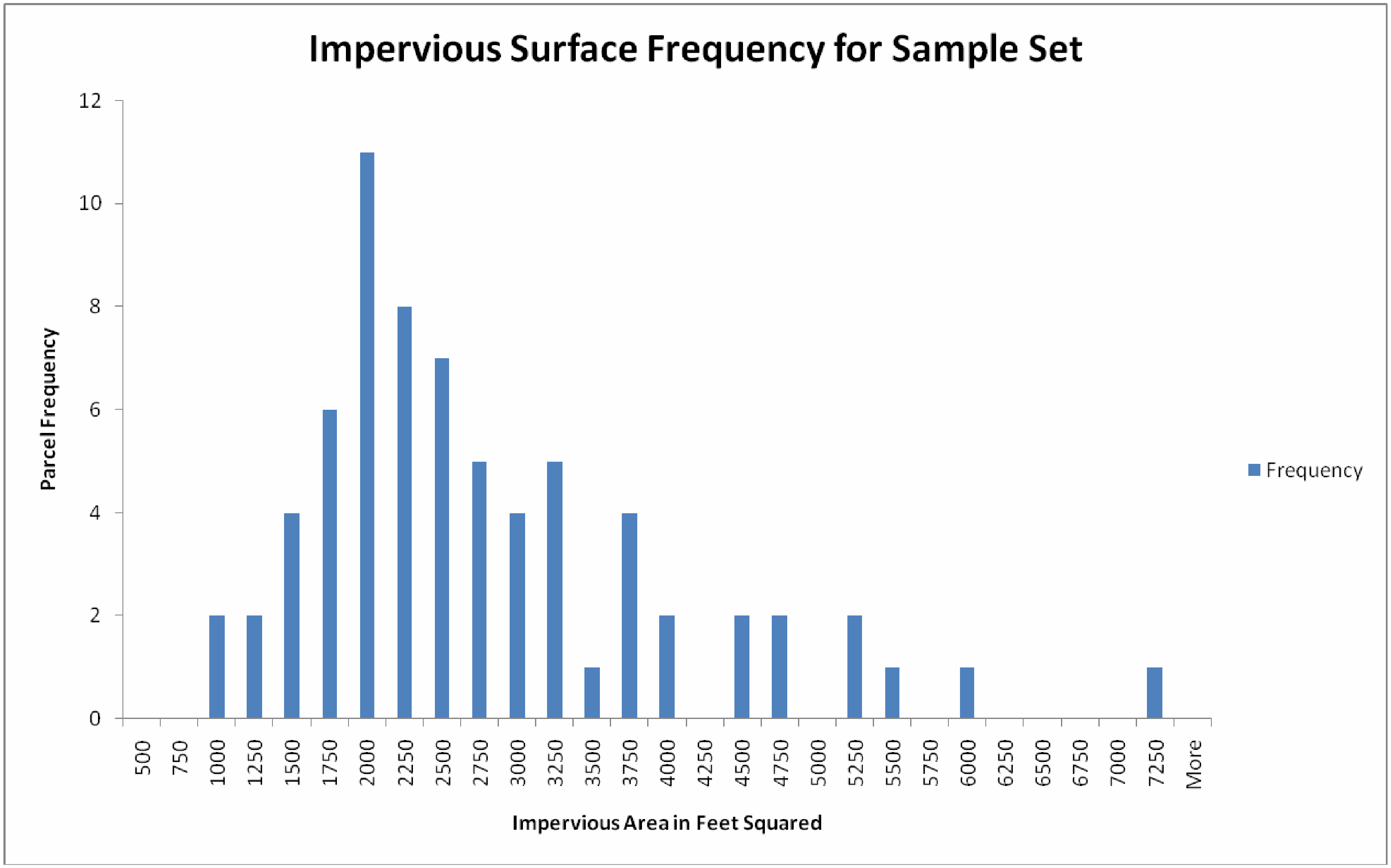


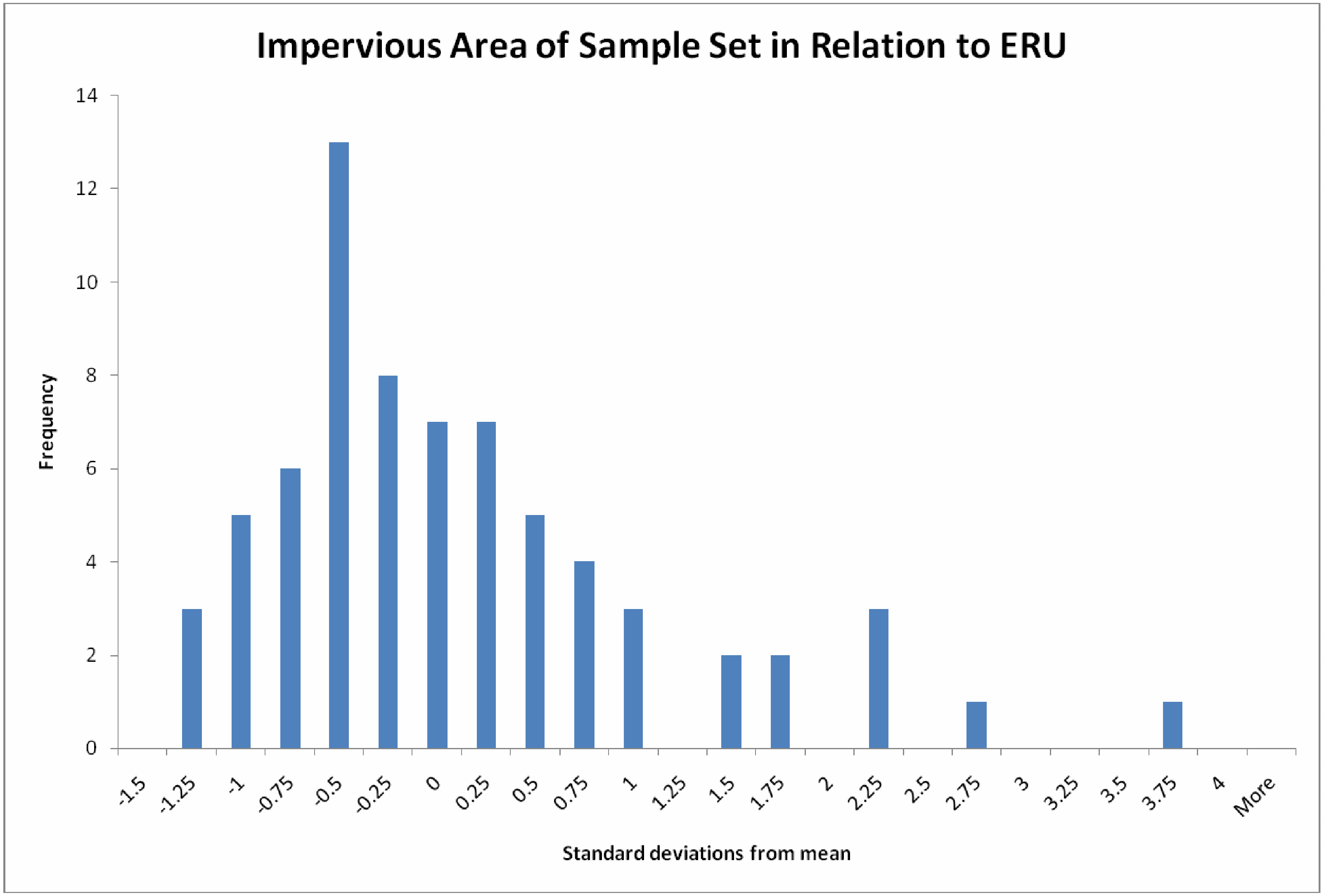
	South Burlington, VT	Chapel Hill, NC	Kissimmee, FL	Bloomington, IL	County of Sacramento, CA	Orlando, FL	Reading, MA	Lakeland, FL	Columbia, MO	Sarasota County, FL	Tampa, FL	Griffin, GA
Effectiveness	0.2	0.3	0.5	0.3	0.9	0.6	0.3	0.6	0.9	0.6	0.5	0.9
Efficiency	0.7	0.6	0.9	0.5	0.9	0.7	0.7	0.7	0.9	0.4	0.7	0.8
Incentive to Reduce	0.4	0.4	0.3	0.8	0.4	0.4	0.5	0.7	0.4	1	0.8	0.8
Equitable	1	1	0.6	0.7	0.1	0.7	1	0.5	0.7	1	1	1
Total	2.3	2.3	2.3	2.3	2.3	2.4	2.5	2.5	2.9	3	3	3.5



4
3.5
3
2.5
2
1.5
1
0.5
0
Chicopee, MA
El Paso, TX
Mason, OH
Union, OH
Wichita, KS
Newton, MA
Olympia, WA
Redmond, WA
Rock Island, IL
Lewiston, ME
Moline, IL
Valparaiso, IN
Fort Collins, CO
South Burlington, VT
Chapel Hill, NC
Kissimmee, FL
Bloomington, IL
County of Sacramento, CA
Orlando, FL
Reading, MA
Lakeland, FL
Columbia, MO
Sarasota County, FL
Tampa, FL
Griffin, GA
Effectiveness
Efficiency
Incentive to Reduce
Equitable
Total

Appendix F: Narragansett ERU Analysis




Impervious Area of Sample Set in Relation to ERU
Frequency
0
2
4
6
8
10
12
14
-1.5
-1.25
-1
-0.75
-0.5
-0.25
0
0.25
0.5
0.75
1
1.25
1.5
1.75
2
2.25
2.5
2.75
3
3.25
3.5
3.75
4
More
Standard deviations from mean