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FACTORS INFLUENCING THE ESTABLISHMENT OF STORMWATER UTILITIES IN THE UNITED STATES

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Abstract: Communities throughout the U.S. struggle to provide basic public services to their residents, including stormwater management services and recent regulations have only added to this challenge. Increasingly, stormwater utilities are being established to fund stormwater management programs. As of 2018, there were an estimated 1,800 to 2,000 stormwater utilities in the U.S., however the establishment of these utilities has varied both temporally and spatially across the country. This research examines the factors at the national, state, and local levels that give rise to this variation. Overall, research findings indicate that a lack of clear legal authority, presence of stormwater regulations, and political and public opposition all influence the establishment of a stormwater utility, however the influence of these factors is more nuanced than shown by previous research. Moreover, this research identified several factors that influence the setup of utilities that had not been previously identified, including variations in state-level implementation and enforcement of stormwater regulations, general public attitudes, and the robustness of a community's baseline stormwater management program. These different factors come into play to varying degrees in individual communities and whether a community succeeds or fails in setting up a utility depends on the final balance of these factors.

Keywords: Stormwater utilities, management, services, fees, MS4 regulations, water quality, infrastructure, drainage.

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INTRODUCTION

Stormwater management systems are essential infrastructure for any urban area. These systems are used to reduce the risk of flooding when it rains by conveying stormwater runoff away from structures and transportation systems as quickly as possible (Bedient & Huber, 1988). The costs to construct and maintain these systems are significant and in recent years, communities in the U.S. have faced additional costs to mitigate the environmental impacts of stormwater discharges under the Clean Water Act (National Research Council, 2009). Many communities struggle to manage their stormwater to protect property, public health, and the environment due to insufficient funding (National Research Council, 2009).

Stormwater management programs have historically been funded with a mix of state and local funds, but these sources have numerous limitations (National Research Council, 2009; Debo & Reese, 2003). As an alternative, municipalities are establishing stormwater utilities with user fees to fund their stormwater management programs (Black & Veatch, 2016; Campbell *et al*., 2017). Stormwater user fees are preferred because they are a dedicated, stable, long-term funding stream and can be designed to equitably distribute the cost burden (NRDC, 2018). Moreover, stormwater fees can be structured to incentivize stormwater reduction.

As of 2018, there was an estimated 1,800 to 2,000 stormwater utilities in the U.S., a substantial increase from the approximately 60 utilities that existed in 1990s (NRDC, 2018; Campbell, 2007). However, the distribution of these utilities varies widely across the U.S. (Campbell *et al*., 2016), with distinct concentration and clustering in some states (see **Fig. 1**). Overall, a few states account for a majority of the utilities; six states have 100 or more stormwater utilities (Campbell *et al*., 2016). Given the potential for stormwater utilities to fund stormwater management, there is a need to better understand the factors contributing to the unequal distribution of stormwater utilities in the U.S.

Towards that end, this research seeks to identify the factors that influence the establishment of stormwater utilities in the U.S. and provides recommendations for policymakers and practitioners for overcoming possible barriers. The research paper is organized as follows. A literature review is provided first to set the context for the paper, followed by the research design that outlines the data sources and methods, then the analysis of the data is documented, and finally, a summary of the findings and implications for policymakers and practitioners are presented.

LITERATURE REVIEW

Conventional stormwater systems consist of gravity sewers or channels with inlets that capture stormwater runoff from roadways or other impervious surfaces and convey the runoff to a nearby waterbody or manmade structure for discharge, storage, or treatment. There are approximately 320 thousand kilometers of storm sewers in the U.S. and many communities lack adequate funding to maintain or replace this infrastructure (see e.g. Black & Veatch, 2016). Total funding needs for stormwater management in the U.S. are unknown, however various estimates provide an indication of their magnitude. According to USEPA (2016), around US$19 billion is needed to "plan and implement structural and nonstructural stormwater control measures" to address water quality impacts of stormwater alone for the period between 2012 and 2032, and this cost could be as high as US$47.9 billion. Another estimate indicates that the total funding needs for wastewater and stormwater infrastructure over the same 20 year period is US$271 billion (Building a 21st Century Infrastructure for America, 2016). Clearly, the potential costs are significant and beyond the capabilities of many municipalities.

Historically, funding for stormwater infrastructure has come from either state or local sources; the federal government has not provided financial assistance similar to what it provided for potable water and wastewater infrastructure (Pollock, n.d.; NRDC, 2018). However, state revenue sharing to support local services has decreased or been eliminated in recent decades (Bach-Huber, 2013), thus local governments currently provide the vast majority of funding for stormwater infrastructure and services.

Due to the longstanding association of stormwater infrastructure with transportation systems and the public good nature of drainage services, stormwater user fees have not typically been used to fund these services. Rather, local governments have relied on a variety of funding sources to finance stormwater management services, including general tax receipts, wastewater user fees, exactions and impact fees, and grants (Black & Veatch, 2016; Debo & Reese, 2003). However, these funding sources have limitations for stormwater management programs (NRDC, 1999), forcing many communities to look for alternative funding sources.

Funding Sources for Stormwater Infrastructure

General tax revenues, such as from property or sales tax, have been the principal source of funding for stormwater programs but taxes have limitations. Municipalities are often unable or unwilling to increase general taxes due to public and political opposition as the costs of stormwater management have increased (Schoettle & Richardson, 1993) or because of restrictions on raising taxes in some states (CBPP, 2018). Moreover, during a fiscal downturn, funding from taxes may be more easily reduced as local governments seek to cut costs (NEEFC, 2005).

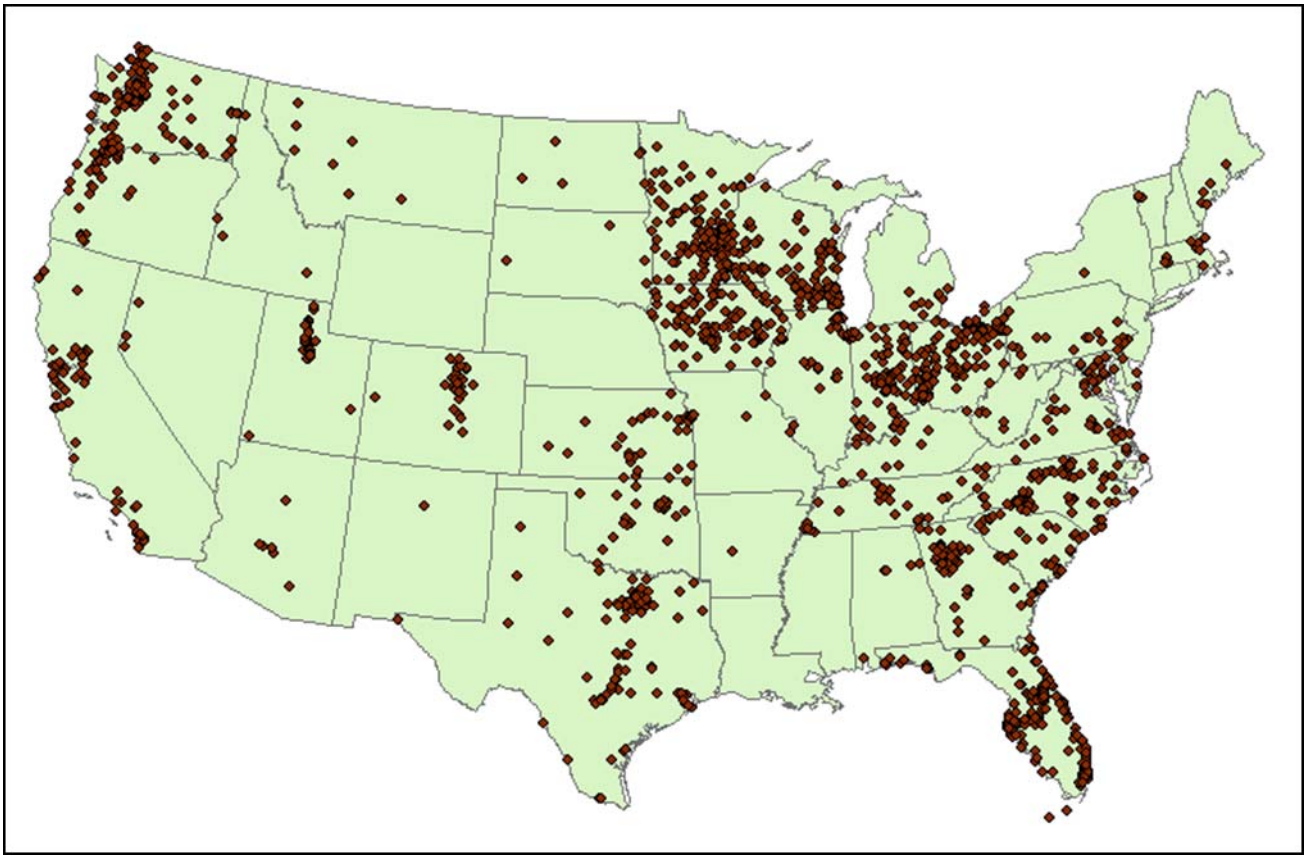

Fig. 1 Distribution of stormwater utilities in U.S. (n=1,681) (Campbell, 2018)

More importantly, general taxes are unrelated to the specific public service being provided; the taxes levied on taxpayers are not based on the level of services being used and thus result in an unequal distribution of costs and benefits across taxpayers (Schoettle & Richardson, 1993).

Other sources of financing, including exactions, impact fees, and special assessments, can provide some funding but are unlikely to be a stable funding source for the full breadth of stormwater funding requirements. For example, special assessments and impact fees, which are based on local government police powers, may be restricted to capital expenditures for stormwater systems (Schoettle & Richardson, 1993). Grant funds for stormwater management programs are preferred in principle but are not widely available in practice (NRDC, 1999). Soft loans from revolving funds "may not be attractive, especially for the non-capital elements of a stormwater pollution program" (NRDC, 1999) and there still needs to be a separate funding source to pay off the loan. User fees from a wastewater utility are a reliable funding source, but these fees are typically based on water usage or other metric unrelated to stormwater, and thus are not consider an equitable funding mechanism. Given the shortcomings of these funding sources, many local governments are increasingly relying on alternative funding strategies (NRDC, 1999) and "one of the most effective and equitable funding mechanisms … is the use of stormwater … utilities" (NRDC, 1999).

Background on Stormwater Utilities in the U.S.

A stormwater utility is a public funding mechanism established by a government body, typically a local government such as a city or county, to finance stormwater infrastructure and services, similar to utilities that have been widely used for other public services, such as for the provision of potable water and wastewater services (Schoettle & Richardson, 1993). The utility generates revenue from user fees that can only be used for the targeted infrastructure and services. In general, user fees must be "reasonable, fair and equitable, and must be uniform and without discrimination against any particular property owners" and must "be reasonably related to the burden placed on the system by the users and in proportion to the benefit to the user" (Schoettle & Richardson, 1993, p. 528).

There are "three major advantages of stormwater utilities over funds generated through property tax revenues: (1) increased stability and predictability, (2) greater equity, and (3) the opportunity for incorporating incentives for implementation of on-site stormwater management" (NRDC, 1999; see also

CMAP, 2013). Utility fees "provide a steady revenue stream that may be used for maintenance and operations costs as well as facilities construction. Also, utility charges are generally not subject to voter approval, as are many taxes" (Schoettle & Richardson, 1993, p. 524; see also Clarke *et al*., 1999). In addition, the local government's ability to bond to cover capital costs increases with the revenue stream of a utility (Schoettle & Richardson, 1993). Thus, stormwater utilities with user fees appear to be "the most dependable and equitable approaches available to local governments for financing stormwater management" (Schoettle & Richardson, 1993, p. 527; see also CMAP, 2013).

As of 2018, there were an estimated 1,800 to 2,000 stormwater utilities in the U.S. and these utilities served communities of widely varying size, from 88 residents to over 3 million residents (Campbell, 2018). The geographic distribution of utilities varies notably across the country (see **Table 1**, also **Fig. 1**). In addition to the geographic variation, there is also a temporal variation. In general, there has been a steady increase in the number of stormwater utilities since 1974, the date of the first known stormwater utility, through present (see **Fig. 2**).

Although there has been a steady increase in the establishment of the utilities over time, according to Kea *et al*. (2016), rates of establishment were generally higher for the years immediately before and after the Phase I and II regulations for municipal separate storm sewer systems (MS4s) came into effect (1990 and 1999, respectively), indicating that the regulations likely served as an impetus for the creation of many utilities (see also Chalfant, 2018). Nonetheless, municipalities have continued to establish stormwater utilities long after the regulations came into effect, indicating a continued demand for these funding mechanisms.

Some states have a longer history with establishment of stormwater utilities than other states and there is some relationship between the year of establishment of the first utility and total number of utilities in each state as of 2018 (see **Fig. 3**). States that have more recently established their first stormwater utility generally have fewer utilities, cet. par., however the existence of one or more utilities in a state does not necessarily lead to establishment of more utilities. Thus, establishment of a utility does not guarantee that additional utilities will continue to be established in a state over time.

Stormwater utilities can vary by their institutional design and approach to setting fees. Some stormwater utilities are stand-alone organizational entities while others are organizationally incorporated into existing local government agencies, such as departments of public works (Black & Veatch, 2016). A variety of fee structures are also used by the utilities, including fees based on a standardized impervious area, typically referred to as an equivalent residential unit or ERU, tiered fees, flat fees, dual fees, and residential equivalent factored fees (see **Table 2**) (Campbell, 2018; see also Kea *et al*., 2016; Black & Veatch, 2016). Although the specific institutional structure and fee structure for a utility may vary, they all share a common objective of serving as a stable, long-term funding mechanism for stormwater services.

Table 1. Stormwater utilities by state (adapted from Campbell, 2018)

State	No. of Utilities	State	No. of Utilities	State	No. of Utilities
Alabama	4	Louisiana	0	Ohio	109
Alaska	0	Maine	5	Oklahoma	22
Arizona	6	Maryland	18	Oregon	53
Arkansas	1	Massachusetts	9	Pennsylvania	19
California	56	Michigan	10	Rhode Island	0
Colorado	38	Minnesota	198	South Carolina	39
Connecticut	0	Mississippi	0	South Dakota	4
Delaware	3	Missouri	5	Tennessee	25
Florida	184	Montana	7	Texas	105
Georgia	66	Nebraska	0	Utah	36
Hawaii	0	Nevada	3	Vermont	3
Idaho	4	New Hampshire	0	Virginia	29
Illinois	28	New Jersey	0	Washington	117
Indiana	83	New Mexico	1	West Virginia	9
Iowa	106	New York	1	Wisconsin	126
Kansas	37	North Carolina	77	Wyoming	0
Kentucky	11	North Dakota	4		

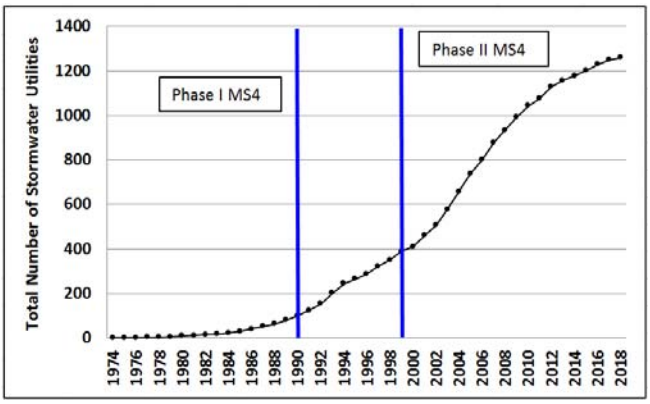

Fig. 2 Total number of stormwater utilities by year (n=1,260) (adapted from Western Kentucky University, n.d.)

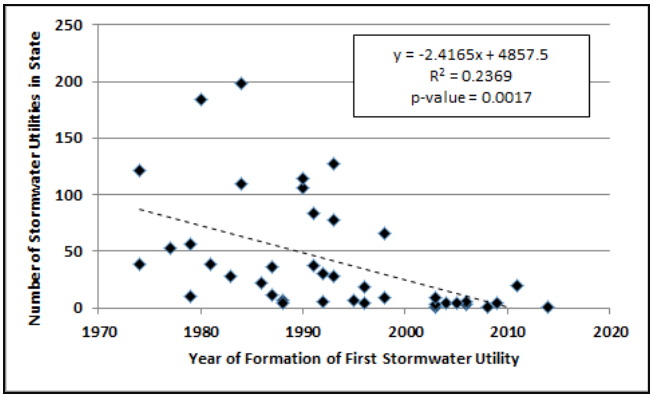

Fig. 3 Total utilities by state and year of first formation (n=1,260) (adapted from Western Kentucky University, n.d.)

Table 2. Stormwater utilities by fee type (Western Kentucky University, n.d.)

Fee types	No. of stormwater utilities
Equivalent Residential Units	787
Fixed Rate	236
Tier System	241
Residential Equivalence Factor (or similar)	140
Two Level System (Residential/Commercial)	108
No information	34
Fee per Parcel Acre	33
Water Meter	7
By Water usage	5
Existence of SWU/ Fee verified	87
Fee per Square Foot Impervious Area	3

Factors Influencing Establishment of Stormwater Utilities

Over the past few decades, municipalities have increasingly been creating stormwater utilities to finance their stormwater management programs but the highly variable distribution of these utilities across the U.S. (see **Fig. 1**) indicates that there are likely numerous factors influencing their establishment. A limited amount of research has focused on identifying these factors, and for purposes of discussion, the factors are categorized as either positive (contributing to or being correlated with the creation of a utility) or negative (hindering the creation of a utility), and as occurring at either the national, state, or local levels.

At the national level, the principal factor that has contributed to the establishment of stormwater utilities has been the MS4 regulations in the 1990s under the Clean Water Act for stormwater management; these regulations increased the need for stable funding for program implementation (see e.g. Kea, 2015; Black & Veatch, 2016; Chalfant, 2018). At the state level, the principal factor that has negatively influenced the establishment of a stormwater utility is the absence of clear legal authority (Schoettle & Richardson, 1993; Kumar *et al*., 2013; Chalfant, 2018). At the local level, where the stormwater management programs are funded and implemented, numerous factors have been identified that are positively and negatively correlated with establishment of stormwater utilities.

For example, Kea *et al*. (2016) identified geographic location while Chalfant (2018) identified the type of local government as positively correlated with establishment of utilities, but both of these findings may be a proxy for legal authority. Chalfant (2018) also identified policy diffusion as contributing to the establishment of utilities as well as the presence of various contextual features, such as percent of urbanized area and percent of owner-occupied high-value housing, that were positively correlated with establishment of a utility but the influence of these factors varied by state. Chalfant (2018) also identified factors that may negatively affect the establishment of a stormwater utility, in particular, the median age of the housing unit and land use diversity. Campbell (2013) posited that utilities formed along major highways, but this factor may be a proxy for urban areas. Other factors at the local level that may influence the establishment of a utility include political support or opposition (Water Words That

Work, 2014; Chandler, 2015) and high transaction costs, such as for coordination within institutionally fragmented metropolitan areas (Chalfant, 2018). The following discusses these factors in more detail.

National Level Factors

National-level stormwater regulations appear to be a major driver for the establishment of stormwater utilities. Under the 1972 federal Clean Water Act, the U.S. government did not initially regulate stormwater runoff, but its mandate was broadened under the 1987 amendments to the Clean Water Act to regulate discharges from MS4s as well as some industrial and construction sites (National Research Council, 2009). The regulations for stormwater discharges were developed in two phases: starting in 1990, Phase I regulations covered stormwater discharges from medium and large MS4s serving populations over 100,000 as well as some "high-risk" industrial facilities and construction sites while starting in 1999, Phase II regulations covered discharges from smaller MS4s as well as smaller construction sites (National Research Council, 2009).

As of 2012, the USEPA estimated that there were about 7,500 MS4s operated by municipalities or counties regulated under Phase I and II regulations along with about 100,000 industrial sites and 400,000 construction sites, counted on an annual basis (Copeland, 2012; USEPA, 2014). As with any new regulatory program, the implementation costs have been and remain an important concern for the owners and operators of MS4 systems. Municipalities of all sizes "have complained about the costs and difficulties of complying with EPA's regulations, especially because there is no specific CWA [Clean Water Act] grant or other type of assistance program to help pay for developing and implementing local stormwater programs" (Copeland, 2012, p. 5). As a result, owners and operators of MS4s may establish stormwater utilities to generate the needed funds to meet the requirements of the stormwater regulations.

State Level Factors

At the state level, the absence of clear legal authority is a critical factor in the establishment of a stormwater utility (see e.g. Chalfant, 2018). While the presence of clear legal authority is insufficient to ensure creation of a utility, the absence of a clear legal authority is very likely to prevent formation of a utility (see e.g. Roberts-Lahti, 2014; Feller, 2006; Horstmann & Bakare, 2017). In general, sources of legal authority may be home rule powers, statutory law, or case law (Schoettle & Richardson, 1993; NACWA, 2014). A brief survey of laws in all 50 states by NRDC (1999) found that that "in virtually all states, municipalities do have the legal authority to establish stormwater utilities. More than half the states have statutes that specifically delegate the power to municipalities to set up such utilities. In other states, the clearest statement of the authority to establish stormwater utilities comes from case law." However, where neither case law nor statutory law provides sufficient legal authority, home rule powers may allow for establishment of stormwater utilities (NRDC, 1999).

The presence of clear legal authority, however, does not necessarily mean that a local government will establish a stormwater utility. Local governments may be hesitant to do so because of potential legal challenges even if the authority exists (NRDC, 1999; Kumar *et al*., 2013; Chalfant, 2018; Cooperwasser, 2013). According to Chalfant (2018), there had been 61 legal challenges to established stormwater utilities as of 2013, of which 42 rulings were in favor the utility (69%), 17 rulings were against the utility (28%) and two cases were pending a final decision (3%) (see also NACWA, 2014, 2016). In general, the basis for the legal challenges falls into two categories: 1) the authority to enact, implement, and fund a stormwater management program; and 2) the legality of the financing mechanism and methodology used to design the fee structure (NACWA, 2014).

The legal challenges to governing authority often turn "upon the structure of the stormwater entity and the laws that enable and authorize its existence and operation", and "the basis for such challenges will vary by state and may even vary within a state" (NACWA, 2014, p. 4). The legality of the financing mechanism usually turns on "whether the stormwater charge is a user fee or a tax" (NACWA, 2014, p. 5). Most municipalities have "the legal authority to assess fees for public services, [but] a great many do not have the ability to assess taxes", and this issue is made more complex by the fact that "states often differ in how they distinguish between fees and taxes" (NRDC, 1999). Thus, "the legality and viability of any specific fee program will be based on a variety of factors including the specific structure of the fee and the specific law of the state in which the utility is located" (NACWA, 2014, p. 22).

Although not explicitly identified in the literature on stormwater utilities, another factor at the state level that may influence the establishment of a utility is the presence of a cap or restriction on general property taxes. At present, there are 44 states with some form of property tax restriction in place (CBPP, 2018). As a result, "[b]etween 1977 and 2015, property tax revenue nationally fell from 50 percent of local governments' own-source revenue to 39 percent", which also coincided with notable declines in state and federal aid to local governments (CBPP, 2018). A tax cap may reduce revenue for a wide variety of public services and programs, including stormwater programs which have been historically underfunded.

These caps limit the ability of local governments to raise taxes, thereby forcing them to defer maintenance and capital improvements, reduce levels of service, or alternatively to rely on non-tax sources of revenue to fund public services, such as a stormwater utility.

Local Level Factors

At the local level, there are a myriad of factors that may promote or hinder establishment of a stormwater utility and perhaps the most widely cited is political or public opposition which may hinder the establishment of a utility. In recent years, numerous local governments have tried and failed to establish stormwater utilities "due to controversy and poor political climate", including Manchester and Dover, New Hampshire, Berkeley County, South Carolina, and Huntsville, Alabama (Water Words that Work, 2014, p. 6). Additionally, in several states, communities have repealed already established stormwater utilities due to public opposition (Campbell, 2013; see also Chandler, 2015). Thus, the specter of public opposition or a political challenge may deter communities from establishing stormwater utilities even if they have the legal authority to do so.

High transaction costs may also negatively influence establishment of a stormwater utility. One source of high transaction costs is coordination between multiple jurisdictions within "hydrologically interconnected and politically fragmented metropolitan" areas (Chalfant, 2018, p. 170). Of the almost 1,600 stormwater utilities identified by Campbell (2018), the vast majority were single jurisdictions. A survey by Black and Veatch (2014, 2016) confirmed that stormwater utilities were more prevalent in cities than in multi-jurisdictional settings, such as counties or special districts; out of 74 survey participants, only 3% were regional authorities comprised of multiple municipalities and 8% were counties. Another source of high transaction cost is the administrative and technical burden to establish a utility, which may take several years and considerable costs for a community, especially to compile detailed information on characteristics of individuals parcels in order to design the user fee structure (see e.g. Chandler, 2015; Ali *et al.*, 2013).

Chalfant (2018, p. 50) identified the process of policy diffusion ("emulation of previous adoptions [of policies] by other governments") as a possible mechanism that contributed to establishment of a stormwater utility. Carter (2008) contends that some municipalities are more likely to establish a utility if neighboring communities have a utility, reflecting a diffusion of policies geographically. According to Campbell *et al*. (2013), "utilities ... seem to form in clusters suggesting that after one community forms a utility, it becomes easier for surrounding communities to form them" (p. 14; **Fig. 1** shows a distinct geographic clustering of utilities in some states) as communities talk to each other and obtain information on how to establish and operate a stormwater utility (see also Water Words That Work, 2014). According to Chalfant (2018), professional consultants and associations may serve as diffusion mechanisms by transferring knowledge about utilities from one client to another and otherwise publicizing the use and success of utilities to many local governments (see e.g. NACWA, 2014 white paper, Black & Veatch, 2016 survey).

Summary of Factors

Overall, based on existing research, there are numerous factors that influence establishment of a stormwater utility and these factors can be organized along two dimensions, the level of government where it most likely to act and whether its influence is likely to be positive or negative (see **Table 3**). Increased regulation at the national level appears to be the major driver for the establishment of stormwater utilities in the U.S, while at the state and local levels, the absence of clear legal authority and concern over potential legal challenges, as well as political and public opposition appear to be major barriers to their establishment. However, given that all but 10 states had established at least one stormwater utility as of 2018 and there are ample lessons learned at present to guide the design of a utility and user fee, it seems that the lack of legal authority and potential legal challenges should not be that significant. At the same time, the considerable variation and clustering of utilities across states seems to indicate that other factors may be limiting the establishment of these utilities. The research design drew upon past research but also employed an exploratory approach to identify and confirm the factors that influence the establishment of stormwater utilities.

RESEARCH DESIGN

A cross-sectional study of a subset of states and a random sample of municipalities within those states with and without stormwater utilities was conducted to identify the factors that influence the establishment of these utilities. The data sources included interviews (semi-structured) with professionals and government representatives, and secondary sources such as state laws, ordinances, and utility reports. Data on existing stormwater utilities in the U.S. were obtained from the Western Kentucky University Stormwater Utilities Survey Database (n.d.), which has compiled information on stormwater utilities since 2007 and the updated results are published annually.

Table 3. Factors that influence establishment of stormwater utilities

Level	Factor	Direction of influence
National	Presence of stormwater regulations	+
State	Lack of clear legal authority	-
	Presence of property tax restriction	+
Local	Political and public opposition	-
	Policy diffusion	+
	High transaction costs	-
	Contextual characteristics	+/-

Data from these sources were analyzed using content analysis, process tracing, and descriptive statistics. To keep the study manageable, eight states were examined in this research, selected based on criteria that sought to capture variability in the intensity and saturation of stormwater utilities across the states while taking into consideration other variables, as discussed further below (see **Table 4**; see also **Appendix A** for regulatory background on each state selected for the study).

Given the overall number of communities that could establish a stormwater utility and multitude of factors that might influence decision-making by these communities for or against setting up a utility, it is important to note upfront that this study is not the definitive research on stormwater utility formation. The study is exploratory in nature and seeks to identify possible factors, especially at the state and local level, that influence utility formation and their relative importance. The findings from this study can be used, in turn, to inform future research that has greater breadth and depth.

The sampling frame for selection of states included only states that had sufficient legal authority to establish a stormwater utility. As discussed under the Literature Review, the presence of clear legal authority is a key factor that influences the establishment of the stormwater utilities. Based on existing studies, it appears that the vast majority of states have clear legal authority (see e.g. NRDC, 1999; Campbell, 2018). To exclude states from the sampling frame that do not have clear legal authority, a limited review was completed for thirteen states that were deemed likely to lack clear authority. These states included 10 states without any existing stormwater utilities and three states with only one existing stormwater utility based on Campbell (2018). This review indicated that three states do not appear to have clear legal authority while legal authority in two states could not be confirmed (see **Table B1** in **Appendix B**), as such, these five states were excluded from the sampling frame.

The main variable used to select states for this study was absolute number of existing utilities per state. Campbell (2018) estimates that there are between 1,800 and 2,000 stormwater utilities in the U.S., with the absolute number of utilities per state ranging from zero to almost 200. Stormwater utilities are established primarily in urban areas, so it is reasonable to assume that the number of utilities will vary in each state by the number of urban areas.

According to Chalfant (2018), there are approximately 38,700 legally recognized, general-purpose county and sub-county governments in the U.S. (see **Table C1** in **Appendix C**). All else being equal, it would be reasonable to assume that the states with more county and sub-county governments are likely to have more stormwater utilities. Based on the number of local governments, all the states except for a few, such as Hawaii, Nevada, and Rhode Island, have the potential for a relatively large number of stormwater utilities. Therefore, with exception of a few states, there should be no bias in selecting states that have a range of absolute number of utilities, from zero to almost 200 utilities.

As a cross-check on whether the absolute number of utilities reflected a saturation of urban areas, two additional variables were evaluated and compared, the "intensity" of urbanization and "saturation" of utilities. Intensity, for purposes of this study, is defined as the percent of the population living in urban areas out of the total state population, while saturation is defined as the percent of the population served by stormwater utilities compared to the percent of total population. The intensity indicates the general level of urbanization within a state while the saturation indicates the extent to which urban areas within a state may have an existing a utility.

The intensity was calculated using the urban and total population of each state from US Census Bureau (2016). Intensities varied from around 57% for Arkansas to 91% for Utah. The saturation was calculated using the population served by the stormwater utilities in each state from Western Kentucky University (n.d), and total population of each state from the US Census Bureau (2016). The states selected for the study reflected a range of saturations, from 0% for New Hampshire to almost 63% for Ohio. There is variation between the intensity and saturation across the states selected for this study,

Table 4. States selected for study by selection criteria

State	NOAA climate region	No. of stormwater utilities	Date of first utility formation	% Total population with utilities	% Population in urban areas
Alabama	Southeast	4	2009	8.8	59
Arkansas	South	1	2008	1.2	56.6
Idaho	Northwest	4	2004	9.4	70.6
Kansas	South	37	1991	32.7	74.2
Minnesota	East North Central	198	1984	61.6	73.3
New Hampshire	Northeast	0	-	0	60.3
Ohio	Central	109	1984	62.5	77.9
Utah	Southwest	36	1987	42	90.6

with the differences ranging from approximately 12% to 60% (see **Table C2** in **Appendix C**). For example, approximately 59% the population in Alabama lives in urban areas, but only 9% of the population is served by stormwater utilities.

Another variable used to select states was the date of first utility formation. States with utilities that were formed decades ago may demonstrate some diffusion compared to states with utilities that were formed more recently. Selected states have dates of first utility formation ranging from 1984 to 2004 (see **Table C3** in **Appendix C**). A final variable used to select the states was the geographic location, intended to capture differences in climate and possibly ages of the stormwater system infrastructure. The nine climate regions defined by NOAA were used and states were selected from seven of the nine regions (with two states selected from south region with low and moderate numbers of utilities) (see **Fig. C1** in **Appendix C**). Ideally the study sample should include a state from each climate region, but as a practical matter, the sample size was limited to eight states to keep it manageable.

Municipalities selected for this study included ones with and without stormwater utilities. Municipalities with stormwater utilities were selected from Campbell (2018) or through interviews with state government representatives. A limited number of municipalities without stormwater utilities were selected from Internet searches and a snowball sampling technique. Interviewees consisted of representatives from state regulatory agencies and representatives from selected municipalities for the states selected for this study along with other professionals familiar with the establishment of utilities, such as consultants.

A total of 55 interviews with representatives from state and local governments, as well as other organizations familiar with stormwater utilities, were conducted from January through April 2019 (see **Table 5**). Data obtained from the interviews on factors influencing establishment of utilities are analyzed in the Data and Analysis section. Interviewees also provided background information on stormwater utilities and Phase I and Phase II MS4s in each state, implementation of MS4 regulations, and legal framework for establishing utilities, which is discussed in the Background on States section (see **Appendix A**). To maintain the confidentiality of the interviewees, only a general reference to them will be provided in the discussion of the results.

RESULTS

Data obtained from interviews with state and local governments officials and representatives from other organizations familiar with stormwater utilities (see **Table 5**), along with secondary sources of information, were analyzed to identify the factors that influence the establishment of stormwater utilities in the eight states covered in the study. Out of the 43 communities interviewed for this study, 23 communities (53%) had established a stormwater utility, while eight communities (19%) had either considered or tried to setup a utility but didn't succeed, three communities (7%) were in the process of setting up a utility, and nine communities (21%) had not considered setting up a utility (see **Fig. 4**). Following the same analytical framework as used in the Literature Review section, the analysis in this section is organized using the level of analysis approach with three levels: national, state, and local.

National Level Factors

At the national level, the primary factor influencing the establishment of stormwater utilities identified, consistent with past research, was regulatory pressure from stormwater regulations for MS4s under the Clean Water Act. Of the 34 local governments interviewed that had either an established utility or had tried to set one up, 19 interviewees (56%) indicated that the need for new funding to comply with MS4 regulations was a driver for setting up their stormwater utility. For these 19 interviewees, nine indicated that MS4 regulations were the sole driver

Table 5. Number of interviews by state and affiliation

State	No. of Stormwater Utilities	No. State Government Representatives	No. Local Government Representatives	No. Interviewees with Other Affiliations	Total No. Interviews
Alabama	4	1	6	1	8
Arkansas	1	1	6	-	7
Idaho	4	1	6	-	7
Kansas	37	1	4	-	5
Minnesota	198	1	6	1	8
New Hampshire	0	1	3	2	6
Ohio	109	1	7	-	8
Utah	36	1	5	-	6
Total No. Interviews	-	8	43	4	55

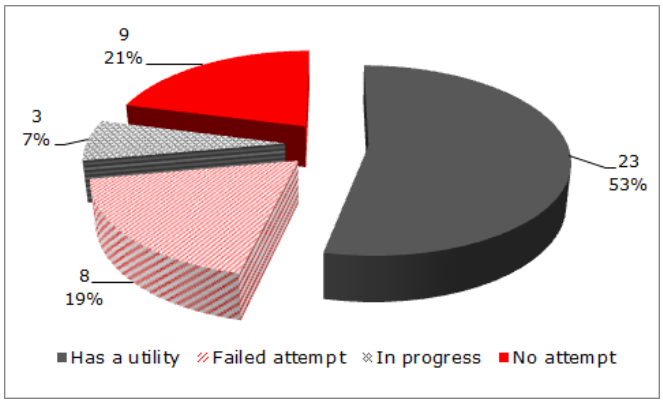

Fig. 4 Breakdown of communities by status of utility (n=43)

while ten indicated they were one of two drivers. Moreover, five out of the eight state representatives likewise felt that the MS4 regulations were likely a driver for communities to setup a utility.

Although the interviewees indicated that MS4 regulations were a driver for setting up stormwater utilities in general, the influence of the regulations varied notably at both the state and local levels. In other words, the regulatory pressure was not uniform at either of these levels. At the state level, the regulatory pressure appeared to vary depending on how extensively the MS4 regulations were being implemented and enforced by the state. At the local level, cet. par., the influence of the regulatory pressure varied depending on the baseline from which a community was starting, in particular, whether or not a community already had an adequately funded stormwater management program in place that could be used to address the new MS4 regulatory requirements. This variation in regulatory pressure is discussed in more detail below under the State and Local Level analyses.

State Level Factors

At the state level, previous research had indicated that the primary factor that influenced the establishment of stormwater utilities was the presence (or absence) of clear legal authority (either from statutory or case law). In general, the presence of clear legal authority would be considered a necessary but not sufficient condition for the establishment of a stormwater utility, and the interviews confirmed that was the case. The interviews, however, also revealed several other state-level factors that might influence the establishment of stormwater utilities. One factor, as mentioned in the preceding section, is the variation in implementation and enforcement of MS4 regulations across the states. Another factor is general public attitudes within a state towards protection of the environment and natural resources as well as general trust in government. A third additional factor, not previously identified by research but discussed in the literature review was restrictions on property taxes. All of these factors are discussed further below.

Clear Legal Authority

The presence of clear authority does not guarantee that stormwater utilities will be set up, but the lack of clear authority serves as a major barrier. The states covered in this research were selected based on a preliminary review that confirmed that clear *statutory* legal authority existed in each state. Two states covered in this study, Alabama and New Hampshire, had in fact amended their laws specifically to provide local governments with the requisite legal authority to setup a utility to comply with MS4 regulations. Despite the presence of clear legal *statutory* authority, however, some states had either no or very low numbers of utilities. New Hampshire stands out in this regard, as the law was amended shortly after the first MS4 permits were issued for the state and the state has been very supportive of stormwater utilities and financed feasibility studies for several communities to facilitate the setup of a utility. Nonetheless, no stormwater utilities have been established in the state to date.

Although all the states covered in the research had clear *statutory* legal authority, there had been at least eight legal challenges to stormwater utilities in five of the states covered in this study as of 2018 (Chalfant, 2018). Six stormwater utilities received favorable rulings, but, in the other two cases the utilities were not upheld. A detailed review of the case law associated with these legal challenges was beyond the scope of this study, but in general, it does not appear that the case law in the eight states covered by the study prohibits the establishment of stormwater utilities (Chalfant, 2018); rather the case law clarifies the criteria that should be used to design the utilities. For example, in Idaho, where the court ruled that the Lewiston stormwater utility fee was an unconstitutional tax, a utility can still be established by the community but it must conform to the criteria set forth in the ruling, which appeared to be consistent with case law from other states.

Therefore, if clear *statutory* authority exists in a state, communities must still ensure that a stormwater utility meets established case law (which may vary by state). Unfortunately, once there has been an unfavorable ruling in a particular state, communities may be reluctant to establish utilities for fear of a legal challenge, even if the possibility of a challenge or unfavorable ruling is remote (see e.g. Gabourey, 2010; Williams, 2009). One interviewee observed that past experience with legal challenges in a state may linger for years and hinder the establishment of stormwater utilities even where they are allowed. Under those circumstances, the lack of clear legal authority is not a barrier to setting up a utility per se, rather, it is only the fear that a utility could be designed to be inconsistent with that authority. Lastly, for states where clear *statutory* authority still does not exist, this factor will continue to serve as the major barrier for communities to setup a utility.

Regulatory Pressure

The MS4 regulations were categorized as a national-level factor because the regulations were developed at that level by the USEPA and as with any national-level regulation, there is an implicit assumption that their influence is uniform across the country. However, data gathered from the interviews and information on the state-level MS4 permitting programs indicates that the MS4 regulations exert varying levels of regulatory pressure at the state-level. There are several reasons why the regulatory pressure may vary across states.

First, the MS4 regulatory program differs from most other environmental regulatory programs because it does not include clearly defined numeric standards; rather it consists of a set of minimum control measures that must be implemented to reduce loadings of pollutants in stormwater runoff to the "maximum extent practical" (Dunn & Burchmore, 2007). As such, according to one interviewee, these regulations allow for more discretion, interpretation, and variability across states.

Second, it was generally envisioned that the MS4 permit requirements would be incrementally increased over time, later permits would have more stringent or comprehensive requirements than earlier permits. Thus, the regulatory pressure would depend on the pace that a state ratchets up these requirements (see e.g. Woodham & Gardiner, 2012; Kabler, 2007; Albright, 2012). Third, at the state-level, there is variation in the extent to which water quality requirements under a Total Maximum Daily Load (TMDL) for impaired waterbodies (under the Clean Water Act) are incorporated into the permits and these requirements tend to be more onerous (3 Interviewees). Thus, in states where TMDL water quality requirements are included in permits the regulatory pressure may be greater than in states where these requirements are not included, cet. par.

Lastly, states or the USEPA in states where they retain regulatory authority, have varying levels of staff and financial resources dedicated to implement the MS4 regulatory program and enforce the permits, which may result in varying levels of regulatory pressure across the states (3 Interviewees). In general, interviewees indicated that all the factors noted above existed to some degree in states covered in this study, but the incremental ratcheting of permit requirements and differing levels of resources for implementation and enforcement appeared to be the most significant.

With respect to the ratcheting up of permit requirements, some states appeared to have established fairly comprehensive requirements from the start in their initial MS4 permits and have not drastically changed the requirements. In these states, permits were only tweaked to clarify permit provisions during subsequent permit renewals (every 5 years) (7 Interviewees). However, other states changed the permit requirements notably over time, going from less to more stringent (6 Interviewees) or had requirements that were not that stringent and they have remained the same (1 Interviewee).

As an example, Minnesota appears to have a strong MS4 regulatory program (2 Interviewees) and has not significantly changed its permit requirements over time, rather it has worked closely with stakeholders and permittees to revise provisions to make them more effective (2 Interviewees). In contrast, subsequent renewals of the Phase II general permits in Alabama and New Hampshire have included notable changes (3 Interviewees; USEPA 03, n.d.). In Alabama, a revised Phase II permit included "significant changes", prompting the state to conduct numerous workshops for permittees to ensure they understood the changes

in the new permit prior to issuance (City of Auburn, 2010).

Another aspect of MS4 program implementation that might give rise to varying levels of regulatory pressure is the timing of permit issuance and renewals by states and the USEPA. In general, the issuance of the Phase I and Phase II MS4 permits varied somewhat for the eight states examined in this study (see **Table 6**). While some states were able to issue MS4 permits in a relatively short time period after the regulations went into effect at the national level, some states took a few additional years to get the permits issued. The USEPA also experienced delays in issuing permits in both Idaho and New Hampshire, due in large part to the extensive comments received, which necessitated multiple rewritings of the permits (see e.g. USEPA 03, n.d.).

As a case in point, the USEPA still had not issued a MS4 permit for Lewiston, Idaho as of the time of this study; the permit for this city was first drafted in 2003, then circulated for review and released for public comment twice, subsequently rewritten four times, and is out for public comment again as of early 2019 (USEPA 01, n.d.; 1 Interviewee). With respect to the USEPA implementation in New Hampshire and Idaho, a couple of interviewees indicated that permittees anticipated that there would be delays in MS4 program implementation by the USEPA in these states because "EPA moves a lot slower" and has a significant backlog (2 Interviewees). In fact, one interviewee felt that permittees preferred the USEPA retaining control of the MS4 program because it bought them three to five years in delays.

Enforcement levels appeared to vary as well between states, with some states and the USEPA exercising more limited monitoring and enforcement of community MS4 programs than other states, and these differences can give rise to varying levels of regulatory pressure. There are several ways that regulatory agencies can monitor a community's efforts to implement MS4 permits, including through the initial review of the Stormwater Management Plan (SWMP) that describes a community's programs to fulfill the MS4 permit requirement, review of the annual reports that communities submit describing their progress towards implementing the SWMP, and on-site audits of the community programs by the state regulatory agency or the USEPA. Interviews indicated that enforcement levels varied between states from weak (6 Interviewees) to "doing their job" to ensure communities are in compliance (3 Interviewees). However, enforcement levels may not remain static, rather they may change over time in a particular state. In Alabama, for example, enforcement of MS4 permits appeared to become more rigorous after the USEPA applied pressure around 2008 for the state to improve its audits of community MS4 programs (1 Interviewee). In the years that followed, the state conducted more in-depth audits, resulting in increased enforcement actions against communities with deficient MS4 programs, including assessing penalties and issuing consent decrees (3 Interviewees; City of Madison, 2015; ADEM, 2014). As the regulatory pressure and costs for compliance increased for these communities, local elected officials pressed the state legislature to amend the state law and allow for all MS4 communities in the state to establish a stormwater utility (1 Interviewee). State law was amended in 2014 (see Alabama Act No. 2014-439, 2014), and several communities established stormwater utilities shortly thereafter (see e.g. City of Madison, 2014). Interviewees also noted that efforts by regulators in other states to increase the auditing of MS4 programs also increased regulatory pressure on the communities (7 Interviewees).

The variations noted above in the content and ratcheting of permit requirements, timing of issuance of permits, and levels of enforcement of the permits may contribute to the variations in the regulatory pressure exerted by the MS4 regulatory program at the state-level. Past studies have indicated that stormwater utilities tend to be formed either immediately before or after the Phase I and II MS4 regulations went into effect (see e.g., Chalfant, 2018; Kea, *et al*., 2016).

Table 6. MS4 permits initial issuance dates by state

State	Phase I MS4 Permits (national regulations effective as of 1990)	Phase II MS4 Permits (national regulations effective as of 1999)	Timely 5-Year Renewals
Alabama	1995 – 1996	2003	No
Arkansas	1997	2004	Yes
Idaho (USEPA)	2000	2006 – 2009	No
Kansas	1997 – 2001	2004	Yes
Minnesota	2000	2002	No
New Hampshire (USEPA)	n/a	2008	No
Ohio	1997	2003	Yes
Utah	1992 – 1995	2002	Yes

However, while there may be some slight clustering around the years 1990 and 1999 (see **Fig. 2**), there has in fact been a steady growth of stormwater utilities over time. These data indicate that utilities are being formed many years after the MS4 regulations went into effect, which would suggest that the regulatory pressure has not been uniform over time. In addition, Chalfant (2018) identified an unknown "state effect" that influenced the likelihood that a local government will enact a stormwater fee in a particular state. The research findings from this study are consistent with this previous research and provide preliminary evidence that the state effect at play may be the varying levels of implementation and enforcement of MS4 regulations.

Public Attitudes

General public attitudes and sentiments within states were also identified as a factor that influences the establishment of stormwater utilities, although it is difficult to assess the magnitude and extent of their influence within the context of this study. Two interviewees noted that public attitudes towards protecting the environment vary across states and a states' natural resource endowment may influence these attitudes. Along similar lines, one interviewee felt that public trust in government and collective action to achieve specific public policy goals, such as protecting the environment, also varied across states. As a general rule, people do not like taxes or fees, but there are some states where those sentiments are held more strongly.

Two states covered in this study were characterized as being generally opposed to government, Idaho (with one stormwater utility) was described as being "very libertarian" with strong general opposition to government programs and taxes while New Hampshire (with no stormwater utilities) was described as the "live free or die" state, one of several northeast states that have the "old Yankee" mentality that is resistant to government programs and new taxes and fees (2 Interviewees). By contrast, Minnesota ("Land of 10000 Lakes", with almost 200 stormwater utilities) was characterized as having a strong tradition of valuing and taking great pride in its natural resources, in particular its water resources, and supporting "collective action" to protect them (2 Interviewees). In general, it is difficult to parse out the influence that these general public sentiments may have on the establishment of a utility within a state, but to the extent that they exist, they may have some influence on establishment of stormwater utilities.

Property Tax Restrictions

Six out of the eight states covered in the study had some form of restriction on property tax increases (see **Table 7**), however, the influence of tax restrictions on the establishment of stormwater utilities was difficult to discern from the interviews. Numerous interviewees characterized the MS4 regulations as an "unfunded mandate" imposed by the federal government and a couple of interviewees indicated that a stormwater utility was preferable to raising taxes. However, none of the interviewees explicitly indicated that restrictions on property taxes were a driver for utility formation.

Local Level Factors

At the local level, past research identified several factors that influenced establishment of stormwater utilities, including political and public support or opposition, policy diffusion, transaction costs, and contextual characteristics. The findings from this research found evidence of most of these factors, but not all, and the prevalence of these factors varied at the local level. In general, the interviews confirmed that public and political opposition plays an important role in influencing the establishment of stormwater utilities. There are various contextual characteristics that could influence the setup of a utility, but the influence of policy diffusion and transaction costs appeared to be weak. In addition to these previously identified factors, the interviews revealed one other

Table 7. Property tax increase restrictions by state (CBPP, 2018)

State	Rate limit	Levy limit	Assessment limit
Alabama	X		
Arkansas	X	X	X
Idaho	X	X	
Kansas		X	
Minnesota			
New Hampshire			
Ohio	X	X	
Utah	X	X	

factor at the local level that significantly influencedthe establishment of stormwater utilities: the baseline stormwater management programs. All these factors are discussed in more detail below.

Political and Public Support

General public and political support for stormwater utilities was identified in previous studies as the most important factor at the local level that influenced the establishment of stormwater utilities. This finding is not surprising given that the establishment of a utility requires a political decision and elected officials need to be responsive to the views and demands of their constituents. Data gathered from interviews were consistent with past research and in general, local public and political support was needed for creation of a utility, and a lack of local public or political support was the main reason a community's efforts to setup a utility had failed (11 Interviewees).

For most cases where a stormwater utility had failed to be established, however, interviewees indicated that it was often only a one or few members of the public, a single business, or one or a few elected officials that were opposed to the utility, even though there was broader public support. Thus, public or political opposition was not widespread, but it was enough to prevent formal consideration or approval of a utility. A lack of public or political support in one community, however, can have broader ramifications, as a failed attempt to setup a utility may deter other communities in the state from trying to setup their own utility (1 Interviewee), similar to a negative court ruling. For example, the failure of Dover, New Hampshire to enact its stormwater utility in 2011 "had a ripple effect, it created a negative vibe for the rest of the state, and the general consensus is that the next community that attempts to setup a stormwater utility needs to have its #!$% together" (1 Interviewee).

That said, the failure of a community to establish a stormwater utility due to public or political opposition may still result in some beneficial outcome. In numerous communities where efforts to setup a utility were unsuccessful, representatives felt that they had benefited from going through the process of evaluating and quantifying the costs for stormwater management because it served to raise awareness with elected officials about the need for more funding for managing stormwater. In a few of these communities, in fact, the elected officials subsequently increased the level of general funding for stormwater management (2 Interviewees).

Conversely, many of the interviewees from communities that had successfully established utilities indicated that a reasonable level of public outreach and stakeholder engagement was more than sufficient to ensure public and political support needed for utility creation. In general, they did not view obtaining the local public or political support as a major hurdle (12 Interviewees). In a few communities, elected officials lead the efforts to create a utility, usually in response to complaints from residents about flooding or drainage problems (3 Interviewees). In a couple of communities, elected officials recognized the need for additional funding for stormwater services and preferred creating a utility to raising property taxes (2 Interviewees).

Although gaining public and political support was not particularly problematic for many communities, one of the challenges they faced was explaining how the fees paid under a stormwater utility were associated with specific services, in other words, clearly explaining the need for a fee (3 Interviewees). User fees for wastewater and drinking water services are ubiquitous in the U.S. and widely accepted by the general public because these services are more tangible and visible. By contrast, stormwater services are not as visible. Stormwater services provide street drainage, and residents are not even aware the services are being provided if working properly, it is only when the drainage and flooding problems occur that the (lack of) services become more visible.

In addition, stormwater management has historically been included with and funded under streets or wastewater treatment programs, and its true costs are hidden from the public (1 Interviewee). The capital investments and operations and maintenance costs are not independently analyzed or funded, and efforts by communities to establish a stormwater utility are pushing up against this historical inertia (1 Interviewee). Thus, while the lack of public and political support is often cited as a major barrier to setting up a stormwater utility, the real challenge at the local level may be overcoming the long-standing approach to not treating stormwater management as a separate public service worthy of its own funding source (1 Interviewee). This challenge is compounded when the stormwater services are expanded to include addressing water quality issues under MS4 or TMDL regulations, which may be even more removed and intangible for the fee paying property owner.

Overall, gaining local public and political support is a hurdle that all communities need to overcome when they seek to setup a stormwater utility but communities may better able to gain this support by using well-established strategies for public outreach and engagement (1 Interviewee). However, the local context for each community is unique and even with these strategies, some communities may face intractable opposition that, when coupled with other factors, may be insurmountable. The strategy in those situations may be to wait until the context and the balance of competing factors changes.

Several communities that had failed to establish a utility indicated that they would consider or were considering another attempt to setup a utility (4 Interviewees). One community that was in the process of reconsidering setting up a utility noted that sufficient time had passed since the first attempt and it might now be feasible because some of the opposition had mellowed while others had experienced directly problems with flooding, so they might be more supportive of a new fee (1 Interviewee). Along similar lines, communities in New Hampshire were showing interest again in stormwater utilities because of the time elapsed since the attempt in Dover as well as new staff bringing different experiences to some of the communities (1 Interviewee). Thus, communities that failed to setup a utility may need to wait for a more amenable context to setup a utility.

Policy Diffusion

Policy diffusion is a process by which policies spread across different units of government, typically at the state and local levels (Shipan & Volden, 2008). As the policies are diffused from one government unit to another they may also be tailored to specific circumstances of the new policy context. One of the key mechanisms by which policies diffuse is through learning, which involves a "determination of whether a policy adopted elsewhere has been successful. If the policy is deemed to be successful, then a city is more likely to adopt it" (Shipan & Volden, 2008, p. 841-42). Prior research had indicated that policy diffusion might play a role in the establishment of stormwater utilities, but interviewees provided limited support for policy diffusion, either through peer-to-peer (community-to-community) or third-party to community learning, as a driver for utility formation.

Many of the interviewees with established stormwater utilities acknowledged that they had learned about other existing utilities either before or during the time they were setting up their own utility. In some cases, the communities learned directly from another community or through a third-party organization, such as consultants or stormwater umbrella groups (e.g. Minnesota Cities Stormwater Coalition), which facilitated the exchange of information on utilities (10 Interviewees). For some communities, the key information transmitted was that stormwater utilities were a standard approach or norm for funding. For other communities, the key information was more specific to the structure and functioning of the utilities.

Although communities were able to learn from each other, the fact that stormwater utilities had been adopted by other communities elsewhere did not appear to be a significant factor in their decision to adopt their own utility (8 Interviewees). However, some interviewees noted that being the first or early mover was probably more difficult than if there were numerous other existing utilities in the state (4 Interviewees). Nonetheless, interviewees noted that in the end, the decision taken by any community is based on the unique circumstances and the compelling case for that particular locale.

Transaction Costs

Transaction costs, such as coordination, search and information, and bargaining costs, were identified in past studies as a possible barrier to the establishment of stormwater utilities. When a community seeks to setup a utility, it needs to undertake various technical and financial studies, as well as engage in public and political outreach, all of which impose a cost. In some states, communities may need to also amend their charter before establishing a utility, which is a separate political process from approval of a stormwater utility. These types of transaction costs are multiplied when numerous communities need to work together to establish a regional stormwater utility, and in some cases, the costs may deter the community from setting up a utility at all.

In Alabama, for example, one community had considered establishing a stormwater utility as far back as the mid-1980s because of a well-documented need for funding for drainage infrastructure improvements. However, at that time the community would have needed to obtain direct state legislative approval and the local government officials were not willing to invest the effort to do so (1 Interviewee; see also USEPA, 2013, for Huntsville, Alabama). In Ohio, where the state tends to issue relatively more MS4 permits with co-permittees, the transaction costs may be higher than for a single municipality seeking to setup a utility. When the co-permittees have a history of not working well together, the transaction costs increase even more and may create an insurmountable a barrier to setting up a regional utility (1 Interviewee; see also Chalfant, 2018 for challenges of setting up regional utilities).

Lastly, some communities may not have the in-house expertise to complete the technical and financial studies for a utility and need to hire a consultant, which also imposes costs (1 Interviewee). In general, the establishment of a utility creates transaction costs for a community, but overall, the interviewees did not indicate the costs were a major barrier for their efforts to set up a utility (4 Interviewees).

Contextual Characteristics

Interviewees noted that there were a few contextual factors at the local level that may also influence the establishment of a stormwater utility, including the socio-economic conditions within community, form of

local government, and local environmental conditions, including the general topography, presence of surface waters, and proximity to waterbodies that may be impaired (3 Interviewees). In general, the contextual factors did not appear to be a major factor in the decision-making process to establish a stormwater utility, rather the other factors discussed herein appeared to be more influential.

Baseline (Non-Utility Funded) Stormwater Management Programs

One factor at the local level that appeared to have a major influence on the establishment of stormwater utilities but that had not been identified by prior research is the baseline (non-utility funded) stormwater management program that exists within a community and whether it is sufficient to meet ongoing or new demands for stormwater services. In general, interviewees indicated that the primary reason why communities established a stormwater utility was insufficient funding to either meet the regulatory requirement of MS4 permits or to maintain and improve the stormwater infrastructure to provide a satisfactory level of service. The degree to which these two drivers manifested themselves at the local level, however, was dependent on the baseline stormwater management program. In other words, a stormwater utility was created when the baseline management program did not provide sufficient funds to meet ongoing or new regulatory requirements or level of service stormwater management demands for the community.

Out of 34 communities interviewed in this study that had established, attempted to establish, or were in the process of establishing a stormwater utility, nine communities (26%) indicated that they did so solely to obtain new funding to comply with MS4 regulations while nine communities (26%) indicated they did so solely to obtain new funding to maintain or improve stormwater infrastructure, typically to address drainage or flooding problems or failing infrastructure (see **Fig. 5**). For the remaining 16 communities (47%), the stormwater utility was created to obtain new funding for both MS4 regulatory compliance and infrastructure maintenance and capital improvement, but in some communities, one driver may have been more important than the other.

In contrast, numerous communities that had not attempted to setup a stormwater utility indicated that their baseline stormwater program was sufficient to fund maintenance and capital improvements as well as meet MS4 regulatory requirements (4 Interviewees). For example, one community in Ohio determined that existing general funds were sufficient to cover their ongoing stormwater management activities as well as meet the new MS4 regulatory requirements and its city council did not feel it was appropriate to tax the community a second time. Similarly, a community in Idaho felt that it had sufficient existing general funds to comply with MS4 regulatory requirements and maintain its drainage infrastructure, thus it had not considered setting up a stormwater utility.

For the reasons discussed above, the MS4 regulations originated at the national level, but were not uniformly implemented or enforced at the state level, resulting in varying regulatory pressure across states. However, even within a particular state, the pressure from the MS4 regulations varied between communities depending on the robustness of their existing stormwater management program and level of effort required to meet the MS4 permit requirements.

In general, not all communities are starting from the same baseline in terms of managing their stormwater and pre-existing programs could be used to fulfill the MS4 permit requirements, thereby reducing the potential costs of compliance (1 Interviewee).

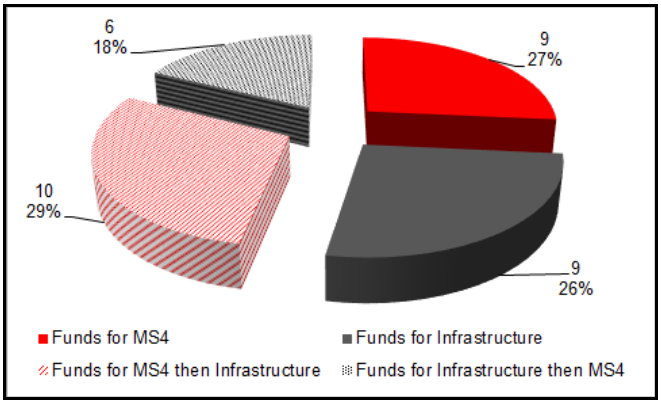

Fig. 5 Reason for establishing a stormwater utility (n=34)

As an example, one requirement of the MS4 regulatory program is for communities to establish a program to track down and eliminate illicit discharges to the storm sewer system, and as part of this requirement, communities need to develop a map of their sewer system. For some communities, developing this map was not a major undertaking because data on the sewer system were readily available while other communities might have to undertake a costlier sewer system inventory. One city in Arkansas estimated it would need about US$1 million to complete the sewer system mapping under its initial 2004 MS4 permit and it was still working on the mapping as of the time of this study. By contrast, other communities already had good data on their storm sewer infrastructure or could complete the mapping with minimal resources, and thus did not incur significant costs to comply with this MS4 permit requirement (3 Interviewees). Along similar lines, some communities may already have a well-established street sweeping program for litter, required under the good housekeeping of municipal operations while others may not, and the later communities would thus incur a new cost to comply with these MS4 permit requirements.

In addition, the nature and extent of a community's storm sewer system may vary widely, with some having more limited infrastructure systems to manage. For example, Boise, Idaho has limited responsibility for managing stormwater within its city boundaries because Ada County manages the majority of the storm drainage infrastructure under a regional roads' authority. Thus, while Boise is a Phase I MS4 community, it does not incur considerable costs to manage its storm sewer system and the existing general fund allocation is sufficient to meet MS4 permit requirements.

Thus, due to these variations at the local level, similarly situated communities in a particular state, with the same permit requirements and the same levels of enforcement, could still incur significantly different costs to comply with their MS4 permits due to different baselines stormwater management programs. As one interviewee observed, some communities may be able to comply with MS4 requirements without any additional funding while others would need substantial new funding, giving rise to the need to establish a stormwater utility.

In general, the data from this study indicate that the extent to which a baseline stormwater management program can fulfill MS4 permit requirements was a major factor in establishment of stormwater utilities. However, a utility was almost as likely to be setup if the baseline stormwater management program was insufficient to fund routine stormwater infrastructure maintenance and capital improvements. Around 44% of communities interviewed in this study established a stormwater utility to fund routine maintenance and capital improvements to stormwater infrastructure that were unrelated to MS4 permit requirements (see **Fig. 5**). In few of these communities, the MS4 regulations may have also been cited as a reason for setting up a utility, but the MS4 regulations were not sufficient by themselves to justify a utility. Instead, the regulations made it easier to justify setting up a utility if the infrastructure problems existed (4 Interviewees). As a couple of interviewees noted, the MS4 regulations shone a light on the need for more funding and helped the communities understand the true costs for the stormwater services.

All communities with stormwater infrastructure face the challenge of funding routine operations and maintenance as well as capital improvements; however, some communities may be better able to do so because they have allocated adequate financing in the past to address these needs while other communities may have deferred maintenance and capital improvements for years (1 Interviewee). As a result, these later communities more frequently must deal with long-standing drainage and flooding problems and infrastructure that has exceeded its useful life (9 Interviewees), sometimes on an emergency basis when infrastructure, such as culverts or bridges, fail. Eventually, local elected officials get tired of addressing drainage or failed infrastructure problems and the associated complaints from residents, and the community establishes a stormwater utility (1 Interviewee).

Numerous interviewees indicated that their communities had reached this tipping point where the deferred maintenance and a backlog of capital improvements were significant enough to justify establishment of a stormwater utility. A few communities may have had a pre-existing need for more funding for maintenance of stormwater infrastructure, and the MS4 regulatory requirements enabled the community to better quantify and separate the stormwater infrastructure from the streets infrastructure and justify a separate funding source (3 Interviewees). However, even with a new stable source of funding from a stormwater utility, numerous communities acknowledged that funding levels were still insufficient to fully address their needs (3 Interviewees, see also Black & Veatch, 2016). Total funding needs for one community in Kansas were estimated to be about US$17 million, while the utility provided only US$870 thousand per year while another community in Alabama identified a need for US$10 to 15 million per year for capital improvements but the utility only generated about US$2 million per year because of the cap imposed on user fees under the state law.

As the preceding discussion highlights, the baseline stormwater management program may be an important

factor in influencing a community's decision to setup a stormwater utility, but the lack of a robust baseline program may not always give rise to a stormwater utility, for various reasons. One community in Alabama noted that it had considered setting up a utility to fund capital improvements to its storm sewer system, but it did not formally pursue establishing a utility because state law restricts the use of utility revenue to only MS4 related activities, which was not their main funding need. This particular community had around US$70 million in capital improvement needs, which could not be funded with utility revenue. Similarly, a couple of communities had researched stormwater utilities but there was not high-level support for pursuing a utility and the idea did not gain traction.

Overall, numerous communities established stormwater utilities when funding from their baseline stormwater management program proved to be insufficient to address long-standing maintenance and capital improvement needs or to meet new regulatory requirements under their MS4 permits. In some cases, both of these needs converged at a particular point in time that allowed the community to more effectively justify establishment of a utility, but in other cases, the utility could be easily justified using either one of these rationales. Of course, the establishment of a utility is still influenced by the other factors that are discussed in the preceding sections, so the mere existence of increased funding needs is not sufficient to ensure a utility will be setup, as numerous communities also confirmed.

SUMMARY OF RESEARCH FINDINGS

Communities throughout the U.S. struggle to adequately to fund and provide basic public services to their residents, and this has particularly been the case for stormwater management services. Historically, most communities paid for their stormwater management programs using general tax funds but stormwater programs have been underfunded for many years, leading to a deterioration in levels of service. At the same time, new federal regulations to reduce water quality impacts of stormwater have only added to the challenge of properly managing stormwater in many communities.

Starting in the late 1980s, communities began to establish separate fees or utilities to fund their stormwater programs. At present, there are an estimated 1,800 to 2,000 utilities in the U.S. however the establishment of these utilities has varied both temporally and spatially across the states, with some states having a high prevalence of stormwater utilities dating back to the 1980s while other states have very few or no utilities. This research examined in detail the factors at the national, state, and local levels that influence utility establishment in the U.S. for eight states.

Overall, the research findings indicate that a lack of clear legal authority, presence of stormwater regulations, and political and public opposition influence the setup of a utility, however, the influence of these factors is more nuanced than revealed by previous research. In addition, there are several other factors not previously identified that have notable influence on establishment of a utility, in particular, variations in state-level implementation and enforcement of stormwater regulations and a community's baseline stormwater management program. Also influential are general public sentiments associated with particular regions of the U.S. (see **Table 8**).

In general, communities establish stormwater utilities to fund regulatory compliance, capital improvement, and/or operations and maintenance programs for their stormwater infrastructure if their existing funds are insufficient. The existence of other utilities in a state may lend some support in principle to their efforts to setup a utility. However, communities must also contend with local public or political opposition, fear of a potential legal challenge, and a potentially time-consuming and costly process to design a utility. At the same time, prevailing public attitudes and other contextual factors can either reinforce a community's efforts to setup a utility or work against its efforts. Whether or not a community establishes a utility depends on how these various factors balance out.

As an example, one interviewee characterized the failure to establish a stormwater utility in Dover, New Hampshire as the "perfect storm". There was a well-justified need for the utility to address failing drainage infrastructure, the community conducted an inclusive and open process to design an equitable fee structure and garner stakeholder support, and there was clear legal authority in the state to establish the utility. However, at the same time, there was a lack of a strong MS4 regulatory pressure, a vocal minority in opposition that didn't trust the government, a lack of other existing utilities in the state to serve as role models, and the national recession. These latter factors served to tip the balance away from the establishment of a utility in this community in 2011 and the community has not attempted again to set one up.

Overall, this research provides important insights into the factors that influence the establishment of stormwater utilities. While not every community may want to establish a utility, they should have the opportunity to do so if they desire because utilities are equitable and effective mechanisms for funding stormwater management services. Given the fiscal

challenges many communities face in providing public services, all options should be on the table. As such, there are actions that can be taken at the local, state, and national levels to support establishment of utilities, not only to improve stormwater management services but to link these services to broader community goals, such as quality of life and resiliency in the face of climate change.

IMPLICATIONS FOR POLICYMAKERS AND PRACTITIONERS

The increasing use of stormwater utilities in the U.S. indicates that they are a viable mechanism for funding stormwater management programs. Nonetheless, communities may be deterred or prohibited from establishing utilities for various reasons. In order to reduce potential barriers and level the playing field for all communities in the U.S., there are actions that can be undertaken by both policymakers and practitioners to create a context more supportive for establishing stormwater utilities. These potential actions are discussed further below using the same level of analysis framework employed elsewhere in the study with the three levels: national, state, and local.

Starting at the local level, communities can take several actions to be better positioned to establish a utility. Perhaps the most obvious is for communities to better quantify the costs of their stormwater management services, make the services as tangible as possible to the public, and better define the relationship between new funding from a utility and the improved level of services that will result from the utility revenue. Undertaking these actions will require adopting a mindset that stormwater management is a public service worthy of its own funding source. Towards that end, communities should take a more expansive view of stormwater services and link these services explicitly to broader community goals of public safety, economic development, environmental protection, community resilience, and quality of life.

The research findings indicated that communities often operate in a reactive mode when setting up a stormwater utility. Communities setup a utility when they need to fix drainage problems that have long been deferred or to meet MS4 regulatory requirements that could no longer be ignored. This reactive mode reflects a traditional view of stormwater management as merely a costly burden on a community. Rather than view stormwater management as a problem to be dealt with begrudgingly, communities need to recognize that effective "stormwater management is essential for healthy communities in the 21st century" (USEPA, 2018, p. 1). Stormwater management is an essential service that can be used to achieve broader community goals. As such, communities should link stormwater planning more clearly to other planning efforts, such as those related to hazard mitigation, community resilience, and safe growth. In doing so, they can recast investments in stormwater management as investments in community resiliency and health and make a more compelling case for a stormwater utility.

Communities also need to ensure that an inclusive and transparent process is used to develop an equitable and fair utility fee structure to minimize political and public opposition. Communities interviewed for this study indicated that there is always some level of resistance towards new fees. Without a doubt, no one likes to pay more money for public services, yet overall, garnering public or political support was not problematic for most communities. Even for those communities that failed to setup a utility, the public or political opposition was not widespread. Thus, communities should work proactively to minimize opposition and there is plenty of existing guidance on how to do so (see e.g. Reese, 2007; Smith, 2006; Carter, 2008; NACWA, 2016).

At the state level, some states still do not have clear legal authority for communities to establish stormwater utilities because of a lack of enabling laws or conflicting or non-supportive case law. For these states, there is a pressing need to provide legal clarity so that communities can pursue a utility at their discretion. Declining federal and state aid and restrictions on property taxes have limited funding for many public services. As such, communities should have the option to establish a utility if they chose to. Also, the establishment of collaborative mechanisms at the state level to exchange information on stormwater management can facilitate learning about stormwater utilities.

At the national level, the federal government should recognize that while stormwater utilities can provide much needed funding for stormwater management programs, there still remains a substantial gap in many communities. Thus, federal assistance along the lines considered by Congress in 2018 (Report 115-828, 2018) is needed to fill funding gaps and leverage utility revenue for stormwater infrastructure. Lastly, the federal government should scrutinize the implementation of the MS4 program to ensure that requirements are uniformly advanced and enforced throughout the U.S. This research reaffirmed that MS4 regulations are an important driver for communities to establish a utility, however, communities face an

Table 8. Factors that Influence Establishment of Stormwater Utilities

Level	Factor	Past research direction of influence	This study direction of influence
National	Presence of Stormwater Regulations	+	+
State	Lack of Clear Legal Authority	-	-
	Effective Implementation and Enforcement of Stormwater Regulations		+
	General Public Attitudes		+/-
	Presence of property tax restriction	+	+
Local	Political and Public Opposition	-	-
	Policy Diffusion	+	+
	High Transaction Costs	-	-
	Contextual Characteristics	+/-	+/-
	Weak Baseline Stormwater Management Program		+

uneven playing field when levels of implementation and enforcement vary across states.

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APPENDIX A – BACKGROUND ON STATES

Alabama

Prior to 1995, local governments did not have the authority to set up stormwater utilities in Alabama without legislative approval. In 1995, the state law was amended to authorize Class 1 municipalities, counties where Class 1 municipalities were located, and all other municipalities located in those counties with Class 1 municipalities, to set up a stormwater utility to comply with MS4 regulations (Alabama Act No. 95-775, 1995). At that time, Birmingham was the only Class 1 city in Alabama and it established a stormwater utility in 1996 (ADEM, n.d.). Shortly thereafter in 1997, Jefferson County, where Birmingham is located, along with 22 other municipalities in the County, established stormwater fees as well (SWMA, 2010). To obtain economies of scale, Jefferson County, the other 22 municipalities with stormwater fees, and Birmingham set up the Storm Water Management Authority, Inc. (SWMA), a regional stormwater utility, in 1998 to manage the MS4 stormwater management program (SWMA, 2010).

The SWMA was subject to some controversy in 2008, which lead Birmingham to withdraw from it that year and setup its own stormwater management program (Our View, 2010; 2 Interviewees; see also Spencer, 2010). Jefferson County followed suit, it withdrew and established its own stormwater program for the unincorporated areas of the county in 2009 (Wright, 2010; Restoration Recovery, n.d.; 1 Interviewee; Hansen, 2006). The remaining small municipalities in Jefferson County with stormwater fees continued to operate under the auspices of the SWMA, however several municipalities also withdrew from the Authority around 2009 (Whitmire, 2018; Hansen, 2006; National Research Council, 2009) while a few new municipalities subsequently joined the regional utility (Restoration Recovery, n.d.; 1 Interviewee).

In 2014, in response to more stringent enforcement of the MS4 permits, the state law was amended again to allow for any local government subject to MS4 regulations to establish a stormwater utility (Alabama Act No. 2014-439, 2014: Chalfant, 2018; 1 Interviewee). However, the law included a cap on the stormwater fees (e.g. $10 per residential property) that could be charged and restricted their use to only activities related to compliance with MS4 regulations (Alabama Act No. 2014-439, 2014). A portion of the fees is remitted to the state to fund administration of the MS4 program (1 Interviewee).

After these changes were made to the state law in 2014, a few other cities enacted stormwater fees (ADEM, n.d.; Alexander, 2018; City of Anniston, n.d.). The stormwater utilities for Jefferson County and Anniston were challenged in court in 2001 and 2016, respectively, but both were upheld and as a result, case law is considered to be supportive of utilities in this state (Chalfant, 2018; Densmore v. Jefferson County, 2001; McCreless, 2015). One community, Huntsville, tried to setup a utility but due to public opposition and legal uncertainty, it was not voted on (USEPA, 2013).

Alabama has delegated authority from the USEPA to implement the MS4 regulations, and as of 2018, there were 81 regulated MS4s in Alabama, including both traditional (e.g. cities, towns, counties) and non-traditional (e.g. DOT, military bases) (1 Interviewee; ADEM, n.d.). Of these 81 regulated MS4s, 27 were Phase I MS4s and 54 were Phase II MS4s (1 Interviewee). The initial permits for the Phase I communities were issued from 1995 to 1996 (SWMA, 2000; 1 Interviewee; Shelby County, n.d.; City of Huntsville, n.d.) while the first Phase II general permit was issued in 2003 (City of Auburn, 2010). Both permits were subsequently renewed but with some delays, in particular, when some of the Phase I permits with co-permittees were issued as individuals permits (see e.g. City of Madison, 2016). To facilitate the exchange of information on stormwater management in Alabama between municipalities, there are two umbrella groups, the Alabama Clean Water Partnership and Southeast Stormwater Association.

Arkansas

State law in Arkansas provides clear authority for local governments to establish stormwater utilities (1 Interviewee), however, as of 2018, there was only one known utility in the state (Campbell, 2018). Hot Springs established its utility in 2006 (1 Interviewee); the establishment of this utility was challenged in court in 2011 but upheld (Chalfant, 2018; 1 Interviewee). This research identified a utility in Bryant and two other communities were in the process of setting up a utility (Ryburn, 2019; City of Bryant, 2016; 1 Interviewee). Additionally, one community had attempted to setup a stormwater utility but it was not officially considered for approval (1 Interviewee).

Arkansas has delegated authority from the USEPA to implement the MS4 regulations, and as of 2018, there were a total of 53 regulated MS4s in the state, including both traditional and non-traditional permittees (ADEQ 1, n.d.). Only one of these permittees is a Phase I MS4 (Little Rock), the rest are Phase II MS4s (ADEQ 2, n.d.; ARDOT, n.d.). The initial MS4 Phase I permit for Little Rock was issued in 1997 and the Phase II general permit were issued in 2004 subsequently renewed in a timely manner (ADEQ 2, n.d.; ADEQ, 1996). Lastly, there is one forum to share information on MS4 and stormwater management issues, the MS4 Stormwater Compliance Group (NWA RPC, n.d.).

Idaho

Four stormwater utilities had been established in Idaho as of 2018, but only one of the utilities was still in effect (Campbell, 2018), the other three were repealed. The lawsuit challenging the Lewiston stormwater utility in 2009 ruled that the stormwater fee was an unconstitutional tax (upheld on appeal in 2011) and the City subsequently repealed the utility (Russell, 2011; Gabourey, 2010). In its ruling, the court set forth specific criteria that the stormwater utility fee needed to adhere to in order not to be considered a tax (e.g. “rational relationship to a regulatory purpose”) (Lewiston Independent School District v. City of Lewiston, 2011). According to one interviewee, the court ruling helped to better define how criteria for designing a utility. The court challenge of the stormwater utility in Nampa was rendered moot when the municipality repealed the utility fee before the court issued a ruling (Funk, 2012). A third stormwater utility in Pocatello, established in 2003, was also repealed after the residents passed a referendum for repeal in that same year (1 Interviewee; Idaho State Journal, 2003). The utility that remains in effect in Coeur D’Alene was established in 2004 and was not subject to any legal challenge; however, after the court ruling against Lewiston was upheld in 2011, Coeur D’Alene revised its ordinance in 2012 to be consistent with the court ruling, and it has still not been legally challenged to date (1 Interviewee; Ordinance No. 3455, 2012).

Up until July 2018, Idaho was one of only four states in the U.S. that did not have delegated authority from the USEPA to implement the MS4 regulations; thus, all existing MS4 were permits issued and enforced by the USEPA regional office based in the state of Washington. The USEPA formally approved delegation of all programs under the Clean Water Act to Idaho in

June 2018 and is in the process of transitioning oversight to the state (Ridler, 2018; 1 Interviewee). The MS4 program will be transitioned by July 2020 (1 Interviewee; IDEQ and USEPA, 2018). As of 2018, there were a total of 19 regulated MS4s in Idaho, both traditional and non-traditional (USEPA 04, n.d.). Of these permittees, there is one Phase I MS4 (Boise) and the rest are Phase II MS4 (1 Interviewee). The first Phase I MS4 permit for Boise was issued in 2000 by the USEPA, with a term of five years, but was administratively extended until 2012; the second permit was issued in 2012 but expired in early 2018 (1 Interviewee; USEPA 04, n.d.). The first Phase II MS4 permit was issued in 2006 for Pocatello, a second Phase II MS4 permit issued in 2007 for Idaho Falls, and the rest of the initial Phase II permits were issued in 2009 (USEPA 04, n.d.). All of the Phase II permits expired between 2011 and 2014 and have been administratively extended by the USEPA to present (USEPA 04, n.d.). One MS4 community has not yet received a Phase II permit as of 2018, Lewiston, which was first notified that it would need a MS4 permit in 2003 (1 Interviewee; USEPA 04, n.d.). Lastly, one forum that has been used to exchange information on stormwater management issues is the Association of Idaho Cities (1 Interviewee).

Kansas

As of 2018, there were 37 known stormwater utilities in Kansas, with the first utility established in 1991 (Campbell, 2018). Local governments can establish stormwater utilities under their home rule powers, however, they must obtain a designation from the Kansas Department of Health and Environment that the utility "is necessary in the interest of public health and welfare of the residents of the state" (1 Interviewee; Kansas Statutes Annotated, n.d.). There have been two legal challenges of stormwater utilities in the Kansas. Wichita's utility was challenged shortly after it was established in 1992, but the court ruled in its favor (City of Wichita v. Kansas Taxpayers Network, 1994; Chalfant, 2018). Topeka's utility, established in 1996, was challenged and the court ruled that the utility ordinance was invalid (Regency Park v. City of Topeka, 1999). The city revised its ordinance to address the shortcomings identified in court ruling and it has remained in effect to present (City of Topeka, n.d.).

Kansas has delegated authority from the USEPA to implement MS4 regulations, and as of 2018, there were 64 regulated MS4s in the state, both traditional and non-traditional, and of these permittees, three were Phase I MS4s and the rest were Phase II MS4s (KDHE, 2015). The three Phase I MS4 permits were first issued in 1997, 1998, and 2001, while the Phase II MS4 general permit was first issued in 2004 (KDHE, 2015). Both the Phase I and Phase II permits have been renewed in a timely manner. Lastly, MS4 communities in Kansas established a Stormwater Consortium, also known as the Clean 20 (the number of member communities) to exchange information on stormwater issues and approaches to complying with MS4 permit requirements (4 Interviewees).

Minnesota

Minnesota has the largest number of stormwater utilities in the U.S., with 198 known utilities as of 2018 (Campbell, 2018). Some of the utilities formed as early as the mid-1980s. The legal authority for establishing these utilities is clearly defined in the state statutes (Minnesota Statutes, 2018) and there have not been any legal challenges to existing utilities (Chalfant, 2018). However, there have been a few communities that have tried to set up a stormwater utility but were not successful (2 Interviewees). Minnesota has delegated authority from the USEPA to implement MS4 regulations, and as of 2018, there was a total of 250 regulated MS4s in the state (both traditional and non-traditional), of which two are Phase I MS4s and the rest are Phase II MS4s (1 Interviewee). The initial Phase I permits were issued in 2000, renewed in 2011, and then again in 2018 (City of Minneapolis, 2014, 2018; City of St. Paul, 2017; 1 Interviewee) while the initial Phase II permit was issued in 2002 (MN PCA, n.d.). However, the Phase II MS4 permit faced a legal challenge, which required the state to provide for public comments (Minnesota Center for Environmental Advocacy v. Minnesota Pollution Control Agency, 2003). The state complied with the court ruling and subsequently reissued the initial Phase II permit in 2006, which was renewed in 2013, and to be renewed again in 2019 (MN PCA, n.d.; National Municipal Stormwater Alliance, 2018). There is one forum in the state, the Minnesota Cities Stormwater Coalition, to help "cities in implementing various federal and state stormwater requirements" (League of Minnesota Cities, n.d.).

New Hampshire

New Hampshire did not have any stormwater utilities as of 2018 (Campbell, 2018). Prior to 2007, local governments did not have clear legal authority to establish a utility in the state (1 Interviewee). However, in 2006, Manchester pressed for changes in state law to allow it to create a stormwater utility and state law was amended in 2007 (2 Interviewees). In 2008, Manchester completed a feasibility study to establish a utility, but due to a change in the local political leadership, the utility never was formally presented for approval (1 Interviewee).

Around the same time in 2008, New Hampshire amended its state law again to allow for all local governments to setup a stormwater utility (Hoyle, Tanner & Associates/AMEC, 2008; New Hampshire Department of Environmental Services, n.d.; 1 Interviewee). After these changes, three other communities completed feasibility studies funded by the state in 2009 and 2010 to setup a utility (see e.g. AMEC, 2011; Comprehensive Environmental Inc., 2011), however none of the communities ultimately established a utility. Dover was the only community that sought approval by its city council, but it was not successful due to political opposition (1 Interviewee; City of Dover, 2011).

New Hampshire does not have delegated authority from the USEPA to implement the MS4 regulations. Thus, similar to Idaho, the MS4 permits are issued and enforced by the USEPA regional office based in Massachusetts. As of 2018, there were 42 regulated Phase II MS4s in New Hampshire (USEPA 02, n.d.). The initial Phase II MS4 general permit was issued in 2003 and expired in 2008, but was administratively extended until 2017 (USEPA 02, n.d.). A new Phase II general permit was drafted in 2008 and public comments on the permit were solicited three times over the course of seven years, and the permit was finally issued in 2017 (USEPA 02, n.d.). With respect to forums for exchanging information, some regulated communities have set up regional coalitions to share information on compliance with MS4 permit requirements (1 Interviewee).

Ohio

Ohio had 109 known utilities as of 2018 (Campbell, 2018), however some of these utilities are regional and cover multiple municipalities (2 Interviewees), so the total number of municipalities with stormwater fees would be higher than 109. The first utility was established in 1985 (Campbell, 2018). Three utilities have faced legal challenges, with two rulings in support of the utilities in 1990 and 2015, and one ruling with mixed support in 1998 (Chalfant, 2018). However, overall case law appears to be supportive of stormwater utilities in Ohio (Chalfant, 2018). Ohio has delegated authority from the USEPA to implement MS4 regulations, and as of 2018, there was a total of 623 regulated MS4s in the state, both traditional and non-traditional (OEPA 01, n.d.); four are Phase I MS4s, while the rest are Phase II MS4s, regulated under 296 separate permittees (with co-permittees) (OEPA 02, n.d.; Mathews & Fyffe, 2019; see also NMSA, 2018). The initial Phase I MS4 permits were issued in 1997, and Phase II MS4 general permits were issued in 2003 (OEPA 03, n.d.; 1 Interviewee). Lastly, the Ohio Stormwater Association is a statewide forum to exchange information on stormwater management issues (OSA, n.d.), while the Regional Stormwater Collaborative of Southwest Ohio and Northern Kentucky covers a portion of the state (Save Local Waters, n.d.).

Utah

Utah had 36 known utilities as of 2018 (Campbell, 2018). The first utility was established in Salt Lake City in 1991 (Campbell, 2018). There have not been any legal challenges to stormwater utilities in Utah up through 2018 (Chalfant, 2018). Utah has delegated authority from the USEPA to implement MS4 regulations, and as of 2018, there were 94 regulated MS4s in the state, of which three were Phase I MS4s and the rest were Phase II MS4s (1 Interviewee; UDEQ, n.d.). The initial Phase I MS4 permits were issued from 1992 to 1995, and the initial Phase II MS4 permits were issued in 2002 (Salt Lake City, 2016; Salt Lake County, 2008; UDEQ, n.d.). At the state-level, there is one group used to coordinate on stormwater management issues, the Utah Storm Water Advisory Committee (1 Interviewee), but counties with large numbers of small MS4s have established stormwater coalitions, such as Jordan County and Utah County (see e.g., Utah County Stormwater Coalition, n.d.).

APPENDIX B

Table B1. State legal authority to establish stormwater utilities

State	# of Utilities (Campbell, 2018)	Clear Legal Authority?	Discussion of Legal Authority to Establish Stormwater Utilities
Alaska	0	?	Did not confirm legal authority, but Anchorage has considered setting up a utility but may require direct voter approval (2 Interviewees).
Connecticut	0	No	State law does not explicitly authorize the creation of municipal stormwater districts, although in 2007, a law was enacted that allowed for grants to four communities to study stormwater utility districts and form such districts within their municipal boundaries if stormwater utility districts were desired upon completion of the grant studies (Fuss & O'Neill, 2010). In 2018, New London became the first community to establish a utility under the pilot program.
Hawaii	0	Yes	State law authorizes the counties to establish and charge user fees for stormwater management (House Bill No. 1325).
Louisiana	0	Yes	State law currently allows local governments to impose a stormwater fee but voters would need also to approve the fee, and home rule may allow for establishment of a stormwater fee if provided for in the home rule charter (Bureau of Governmental Research, 2017).
Mississippi	0	?	Could not confirm legal authority, state code indicates that municipalities can establish utilities (Mississippi Code, n.d.), but state official was not sure about establishment of stormwater utilities (1 Interviewee).
Nebraska	0	Yes	State law allows for establishment of stormwater utilities (1 Interviewee).
New Hampshire	0	Yes	State law allows for establishment of stormwater utilities (New Hampshire Revised Statute, 2016).
New Jersey	0	No	State law does not explicitly authorize local governments or utilities to create stormwater Utilities (Roberts-Lahti, 2014).
Rhode Island	0	Yes	State law allows individual towns and cities to create stormwater utilities to fund stormwater projects (Marsello, 2011).
Wyoming	0	Yes	State law allows for establishment of stormwater utilities by local governments but subject to approval by voters in a referendum (Rosenfield, 2017).
Arkansas	1	Yes	State law and case law allows for establishment of stormwater utilities (Chalfant, 2018; Arkansas Code, 2015).
New Mexico	1	Yes	State law allows for establishment of stormwater utilities (New Mexico Statutes, 2006).
New York	1	No	State law is ambiguous and provides very limited authority to establish stormwater utilities with user fees (Feller, 2007).

APPENDIX C

Table C1. Number of stormwater utilities and number of local governments by state (Campbell, 2018; Chalfant, 2018)

State	# of Utilities	# of Local Governments	State	# of Utilities	# of Local Governments	State	# of Utilities	# of Local Governments
Alabama	4	528	Louisiana	0	366	Ohio	109	2332
Alaska	0	170	Maine	5	505	Oklahoma	22	666
Arizona	6	577	Maryland	18	180	Oregon	53	277
Arkansas	1	106	Massachusetts	9	356	Pennsylvania	19	2627
California	56	539	Michigan	10	1856	Rhode Island	0	39
Colorado	38	333	Minnesota	198	2724	South Carolina	39	316
Connecticut	0	178	Mississippi	0	380	South Dakota	4	1285
Delaware	3	60	Missouri	5	1374	Tennessee	25	437
Florida	184	477	Montana	7	183	Texas	105	1469
Georgia	66	689	Nebraska	0	1042	Utah	36	273
Hawaii	0	5	Nevada	3	35	Vermont	3	294
Idaho	4	244	New Hampshire	0	244	Virginia	29	324
Illinois	28	2831	New Jersey	0	586	Washington	117	320
Indiana	83	1663	New Mexico	1	136	West Virginia	9	287
Iowa	106	1045	New York	1	1598	Wisconsin	126	1924
Kansas	37	2003	North Carolina	77	653	Wyoming	0	122
Kentucky	11	536	North Dakota	4	1724			

Table C2. Intensities and saturations based on percent of total population served by utilities and percent of urban population out of total population by state (Iowa State University, n.d.; Campbell, 2018; U.S. Census, 2016)

State	% Total Population with Utilities	% of Population in Urban Areas	State	% Total Population with Utilities	% of Population in Urban Areas	State	% Total Population with Utilities	% of Population in Urban Areas
Alabama	8.8	59.0	Louisiana	0	73.2	Ohio	62.5	77.9
Alaska	0	66.0	Maine	6.5	38.7	Oklahoma	43.3	66.2
Arizona	15.4	89.8	Maryland	79.8	87.2	Oregon	84.3	81.0
Arkansas	1.2	56.2	Massachusetts	6.1	92.0	Pennsylvania	15.5	78.7
California	36.7	95.0	Michigan	13.1	74.6	Rhode Island	0	90.7
Colorado	70.4	86.2	Minnesota	61.6	73.3	South Carolina	51.8	66.3
Connecticut	0.0	88.0	Mississippi	0	49.4	South Dakota	23.7	56.7
Delaware	11.2	83.3	Missouri	15.3	70.4	Tennessee	37.6	66.4
Florida	75.2	91.2	Montana	27.8	55.9	Texas	45.7	84.7
Georgia	35.9	75.1	Nebraska	0	73.1	Utah	42.0	90.6
Hawaii	10.1	91.9	Nevada	19.2	94.2	Vermont	12.8	38.9
Idaho	9.4	70.6	New Hampshire	0	60.3	Virginia	37.1	75.5
Illinois	52.8	88.5	New Jersey	0	94.7	Washington	109.8	84.1
Indiana	46.3	72.4	New Mexico	3.0	77.4	West Virginia	6.3	48.7
Iowa	48.2	64.0	New York	0.2	87.9	Wisconsin	52.8	70.2
Kansas	32.7	74.2	North Carolina	47.3	66.1	Wyoming	0	64.8
Kentucky	10.1	58.4	North Dakota	18.5	59.9			

Population data from the Stormwater Utilities Survey were not verified for accuracy. The intensity calculated for Washington state was over 100 percent, which indicates that the population values need to be validated. A difference of proportion test to compare the proportion of population served by utilities to the proportion of population residing in urban areas for each state was completed. All differences of proportions were statistically significant with $p<0.00001$, except for Oregon and Washington.

Table C3. Date of first utility formation by state (Campbell, 2018; Western Kentucky University, n.d.)

State	Date of First Utility Formation	State	Date of First Utility Formation	State	Date of First Utility Formation
Alabama	2009	Louisiana	-	Ohio	1984
Alaska	-	Maine	2006	Oklahoma	1986
Arizona	1995	Maryland	1996	Oregon	1977
Arkansas	2008	Massachusetts	1998	Pennsylvania	2011
California	1979	Michigan	1979	Rhode Island	-
Colorado	1974	Minnesota	1984	South Carolina	1981
Connecticut	-	Mississippi	-	South Dakota	1996
Delaware	2006	Missouri	1992	Tennessee	1993
Florida	1980	Montana	1988	Texas	1990
Georgia	1998	Nebraska	-	Utah	1987
Hawaii	-	Nevada	2003	Vermont	2005
Idaho	2004	New Hampshire	-	Virginia	1992
Illinois	1983	New Jersey	-	Washington	1974
Indiana	1991	New Mexico	2003	West Virginia	2003
Iowa	1990	New York	2014	Wisconsin	1993
Kansas	1991	North Carolina	1993	Wyoming	-
Kentucky	1987	North Dakota	1988		

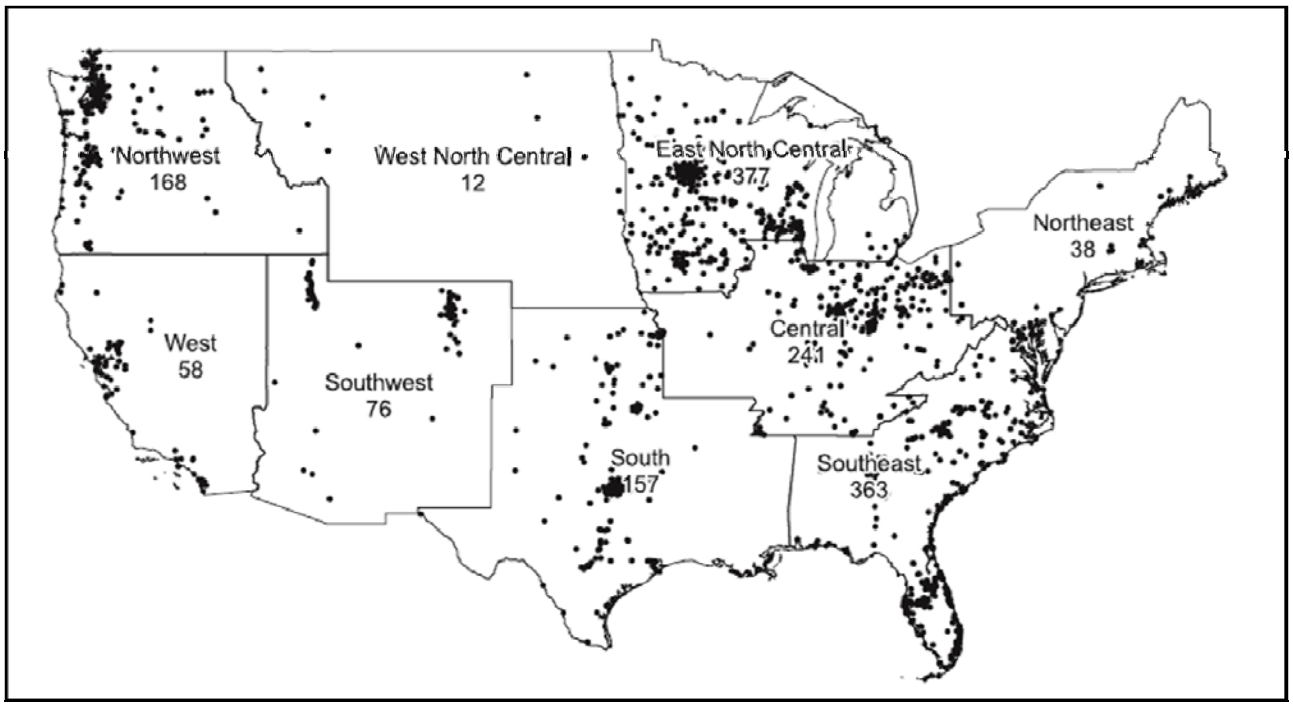

Fig. C1 Stormwater utilities by NOAA climate regions (Kea *et al*., 2017).