Integrated Water Resources Management in North Carolina

by

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INTRODUCTION
Although North Carolina has historically enjoyed the privilege of abundant fresh water resources, the state water supply is currently facing the combined threats of rapid population growth, expanding development, and agricultural pollution. From 2000 to 2010, the North Carolina population has grown at a rate approximately two times the national average (U.S. Census Bureau 2012). As development rates and electricity demands parallel population growth, water use has escalated and water quality has deteriorated. The population of North Carolina is predicted to reach approximately 12.5 million by 2030 (North Carolina State Demographics 2011), which will further exacerbate water quality and quantity issues. Global climate change will also likely impact natural water flows and the availability of water resources through a greater frequency of extreme weather events, which contribute to flooding and drought. While global climate change will undoubtedly affect water quantity and quality in the near future, the nature of these effects is uncertain and presents an additional challenge to water resources planning.

Local water managers of North Carolina are grappling with how to protect local water supplies in the context of population and development growth, climate change, and limited economic resources. Innovative management strategies are needed in order to ensure adequate water quality and quantity to sustain North Carolina’s natural ecosystems, economy, and human health and prosperity. Integrated water resources management (IWRM) is one such strategy that has been gaining momentum among water resources experts. Essentially, IWRM aims to improve the efficiency and sustainability of water resource management through a more holistic approach that engages various stakeholders. The principle underpinning the IWRM concept is that water is a finite resource that holds economic value and that must be managed in a way that does not undermine the needs and well-being of current and future populations.

IWRM may be implemented at various levels of government, and integration may be applied to a variety of concepts, such as stormwater and groundwater, freshwater and coastal water, multijurisdictional watersheds, or land and water management. This study focuses on the potential for integration between stormwater, wastewater, and drinking water at the local-government level in the state of North Carolina. IWRM might be useful in this context because it encourages the sharing of resources and expertise from different water departments in addressing water quality and quantity issues. Not only would this approach potentially reduce the duplication of efforts and improve the cost-effectiveness of water management, but it could also facilitate innovative and collaborative solutions to water management issues if stormwater, drinking water, and wastewater were conceptualized and managed as one single resource and regulatory objectives were synthesized.

The United States Environmental Protection Agency (EPA) highlighted the advantages of IWRM in a recent memorandum issued on October 27, 2011. The memorandum states that integrated planning will enable municipalities to achieve Clean Water Act (CWA) objectives more efficiently by identifying some of the overlapping and competing requirements of separate stormwater and wastewater programs. The memorandum touts integrated planning as a means of achieving sustainable and comprehensive solutions at the nexus of stormwater, drinking water, and wastewater management, such as green infrastructure. In addition, the memorandum states that existing federal regulations and policies allow for adequate compliance schedules and encourage innovative solutions that synthesize wastewater and stormwater management activities in a way that optimizes environmental quality. EPA’s viewpoint that IWRM implementation is not only feasible under existing regulations, but also engenders innovative solutions, should encourage local water managers to evaluate local potential for IWRM by genuinely exploring ways that the regulatory, policy, and societal goals of the different water programs intersect.

Given the recognition of the IWRM approach in the national water policy discourse, this study seeks to explore the lack of IWRM among North Carolina localities and determine possible barriers and drivers to IWRM implementation. In an effort to assist policy makers and local water professionals who are considering the IWRM approach, recommendations are made for overcoming barriers to IWRM implementation. In order to harmonize organizational culture and strengthen interdepartmental relationships among water programs, these recommendations emphasize the need to change perceptions of stormwater, identify regulatory constraints and opportunities for collaboration, and address the role personality plays in organizational transitions.
METHODOLOGY AND DATA ANALYSIS

The principal sources of data for this analysis were semistructured phone interviews with 14 local water professionals in 11 North Carolina localities: Asheville, Burlington, Cary, Chapel Hill, Charlotte, Durham, Fayetteville, Greensboro, Raleigh, Wilmington, and Winston-Salem. The majority of interviews were conducted with stormwater managers, but a water resources manager, a wastewater manager, and a reuse water manager were also interviewed to allow for a better understanding of the integration of stormwater programs in those localities. Localities were selected for the study in an effort to capture variation within the state, based on the existing knowledge of the study advisors. A qualitative data analysis software program, NVIVO9, was used to code and analyze interview data and relevant government documents.

For the purposes of this study, successful IWRM is defined as a conceptual and organizational integration of stormwater, drinking water, and wastewater programs, in which regulatory objectives are coordinated, the water management mission is unified, and communication and collaboration between water programs occurs regularly and effectively. Based on this definition of successful IWRM, certain criteria were used to assess the level of integration among varying organizational approaches and to understand barriers and drivers to IWRM implementation.

- Physical consolidation: the consolidation of stormwater, drinking water and wastewater programs under the management of one water resources department.
- Strong interdepartmental relationships: the interaction between stormwater professionals and the staff of other local departments, including frequency and formality of communication, and resource sharing.
- Unified program culture: a sense of shared program goals, vision, and priorities within an organization.

RESULTS

The results of this study are based on the perspectives of local water managers, as relayed through semistructured interviews. The following themes are discussed: how stormwater programs have evolved organizationally and conceptually over time, the current organizational structures of stormwater programs within local governments, the current interdepartmental collaboration dynamics in relation to organizational structure, and barriers and drivers to IWRM. Budget management and the potential for development of local stormwater capture and reuse systems are specifically addressed in regards to collaboration dynamics and perceptions of integration.

The Evolution of Stormwater Programs

In contrast to drinking water and wastewater, the majority of stormwater programs emerged in only the past 15 to 20 years in response to federal regulations (NPDES Phase 1, 1990 and Phase 2, 1999; 40CFR Parts 9, 122, 123, 124). Stormwater is also distinct from the other water programs in regards to the degree of organizational variation that exists between local stormwater programs. For example, stormwater programs can be managed within a water resources department, or as a division of a public works department, or within a division, such as the engineering or streets division. As a first step to understanding the potential for integration among local North Carolina water programs, this study explores how stormwater programs have evolved conceptually over time and how conceptual changes are related to organizational transitions.

When asked about the evolution of their programs from conception to current status, the majority of stormwater managers responded that their programs had evolved considerably in response to changes in regulatory emphases. For instance, the emergence of Total Maximum Daily Load regulations in the 1990s (40 CFR, Part 130) was said to have steered stormwater programs away from an infrastructure focus, toward an emphasis on water quality. One stormwater manager explained that in the past stormwater programs had been perceived as a secondary responsibility of the Flooding and Erosion Division, but in recent years the water quality aspect of stormwater programs was being considered more seriously, as demonstrated by greater allocations of budget and staff resources. Similarly, another interviewee explained that the stormwater program now had adequate funding for water quality improvement projects that cost as much as $8 million, whereas projects of such great expense never would have been funded 10 years ago. The need to modify staff expertise in response to changing regulatory demands was also mentioned. Specifically, one stormwater manager explained that his program used to employ general engineering technicians for infrastructure operations, but now he is hiring engineers with training
particular to stormwater. These trends of increased emphasis on water quality, greater funding, and a need for specific stormwater expertise often paralleled a growing sense of autonomy among stormwater programs.

Based on the finding that 9 of the 11 localities interviewed for this study had experienced an organizational stormwater transition, the changes in the focus, funding, and independence of stormwater programs seems to have inspired widespread organizational transition. The outcome of these transitions, however, has taken two separate forms. Seven stormwater programs interviewed for this study had moved from an Engineering or Streets division to become an independent division within a Public Works department. The remaining two localities that had undergone a transition had combined stormwater with drinking water and wastewater utilities to form a Water Resources department, which meets the previously defined IWRM criterion of physical consolidation.

Different motivations were given for the aforementioned transitions. The transition that formed standalone stormwater divisions within Public Works was generally attributed to the development of stormwater utilities and the increased attention stormwater received from upper management. In the first example of consolidation, the transition occurred because of the need for collaboration between stormwater, drinking water, and wastewater in order to obtain the technical expertise required to comply with new regulations, such as nonpoint source pollution standards. Stormwater objectives and priorities were believed to be more closely aligned with the other water programs, than with the infrastructure-oriented department under which they were previously managed. In the second example of consolidation, the transition was said to have resulted from an organic process of personnel turnover and managerial changes, without much regard for programmatic implications. The first example of consolidation seems to be tied to a change in the perception of stormwater from an infrastructure issue to a water resource, whereas the second example does not suggest a conceptual change.

**Collaboration Dynamics within Different Organizational Structures**

Based on the assumption that strong interdepartmental relationships are necessary to achieve IWRM, interviewees were asked about how they collaborate and communicate with other local divisions and departments, with a particular emphasis on water programs. This information helped to illuminate the dynamic of interdepartmental relationships, and how those dynamics might differ depending on the local organizational structure. Managers of stormwater programs housed within Public Works emphasized the importance of collaboration with other divisions of Public Works and reportedly interacted with the other water programs infrequently. The emphasis on collaboration within Public Works as opposed to between water programs stemmed from the notion that the priorities, objectives, and functions of stormwater programs, as dictated by regulatory requirements, are more compatible with other divisions of Public Works than with the other water programs. In fact, one interviewee suggested that stormwater goals conflicted with the other water programs to the extent that consolidation would compromise the stormwater program’s ability to meet regulatory objectives. He stated, “It wouldn’t be as effective if the fox was guarding the hen house. We can effect change there. We aren’t controlled by them and absorbed by their agenda. We can fully implement the aspects of our permit.”

Interviewees also emphasized the importance of collaboration within Public Works, as opposed to with other water programs, in regards to resource sharing. According to interviewees, stormwater revenues can be allocated outside of the stormwater division for “indirect stormwater costs” up to a limited amount. Indirect stormwater costs are related to stormwater activities, but are not necessarily carried out by stormwater program staff. These activities might include street sweeping, drainage maintenance, billing services, or use of other departments’ staff, such as attorneys or GIS personnel. Given that stormwater funds can be used for indirect stormwater costs related to infrastructure, local governments might be incentivized to manage stormwater programs under Public Works in order to facilitate management and transfer of funds.

While budget management has strengthened the tie between stormwater and Public Works in some instances, it is possible the resource sharing between stormwater and the other water programs will become more practical as stormwater programs continue to grow and place more emphasis on water quality, and possibly water quantity, improvements. The majority of stormwater managers predicted that stormwater rates would increase over the next 5 to 10 years. They attributed rate increase projections to the need to improve institutional capacity in response to expected additional regulatory requirements, the need to complete retrofit projects that reduce nutrient loads from existing developments, the need for drainage improvement projects, and dam replacement. In light of changing
stormwater program functions and increased demands, new strategies for resource sharing between water programs may be advantageous in reducing costs.

Similar to the stormwater programs of Public Works departments, stormwater programs of consolidated Water Resources departments also experienced limited collaboration between water programs. One interviewee explained that the stormwater office of a consolidated Water Resources department only communicated with drinking water and wastewater offices through an occasional phone call or e-mail. The three water programs were located in different buildings and did not collaborate frequently or very effectively. The lack of collaboration was attributed to conflicting program objectives, which resulted from different regulatory emphases on surface water as opposed to the water intake environment, or point sources instead of nonpoint sources. While physical consolidation had occurred, the integration appeared to lack strong interdepartmental relationships and a unified culture, as evidenced by the infrequent communication between water programs and the perception of incompatible program objectives.

Collaboration dynamics between water programs was also captured through interviewee perceptions of the potential for the development of stormwater capture and reuse systems within their respective localities. The development of such a system would likely require collaboration between water programs. For example, the stormwater program would have to coordinate with the wastewater utility on wastewater metering and integrating the plumbing and reuse systems. Interviewee perspectives on stormwater capture and reuse systems also may reflect the local perception of stormwater as either an unexploited resource that can be used for nonpotable purposes, or as a waste.

In response to this interview question, most stormwater managers reported that their programs advocate for the use of rain barrels, cisterns, or bioretention cells for stormwater capture and reuse for nonpotable purposes. One local program had implemented a pilot rain barrel project in a public space, while others participated in capture and reuse outreach activities. Such outreach activities included the promotion of rain barrel usage among residents by arranging for rain barrel vendors to attend public fairs or events. Although most stormwater managers had not explored the potential for stormwater capture and reuse systems in their locality, most stated that developing a stormwater capture and reuse system would be possible in the future and that they would likely support such efforts.

A few water managers opposed the development of stormwater capture and reuse systems. Two managers mentioned the challenges of complying with state plumbing codes in implementing capture and reuse systems. The negative public perception of reused water, even for nonpotable purposes, was also mentioned as a barrier. One water manager argued that implementing conservation-based rates is a more economical way to increase water supply and reduce irrigation demand than developing capture and reuse systems. He explained that the conservation-based-rates strategy eliminates the redistribution costs associated with reused water and incentivizes reduced water usage, without increasing costs for water providers. In contrast to a stormwater capture and reuse system, however, the conservation-based-rates approach does not address the water quality issues associated with stormwater mismanagement, nor does it take advantage of the potential for improving water quantity through stormwater management.

Overall, local involvement in the development of stormwater capture and reuse systems was limited to non-incentive-based consumer education, and in some cases local managers were outwardly opposed to the development of such systems. Apparently, steps have not been taken toward developing actual stormwater capture and reuse systems that would significantly impact water quantity and quality. While other reasons exist as to why stormwater capture and reuse systems have not been implemented, this trend demonstrates another area where coordination between stormwater and other water programs appears to be absent and where stormwater is not perceived as a joint solution to water quality and quantity issues.

The majority of stormwater programs evaluated in this study, of both physically consolidated and unconsolidated organizational structures, collaborate more regularly and effectively with Public Works divisions than with wastewater and drinking water utilities. Furthermore, interviewees justified this collaboration dynamic based on alignment of regulatory objectives and the need to share resources between stormwater and Public Works divisions. This perspective demonstrates a perception of stormwater as an infrastructure function as opposed to a
water resource, despite the frequent mention of an increased focus on water quality within stormwater programs. It is likely that stormwater is typically still not perceived as a water resource because of the absence of water quantity objectives from stormwater program goals. If water quantity regulations were coupled with the water quality regulations that are currently driving stormwater management, then stormwater programs would likely be more incentivized to collaborate with wastewater and drinking water utilities.

**Barriers and Drivers to Integration**

Current collaboration dynamics have illustrated that the perception of stormwater as an infrastructure function instead of as a water resource can hinder the development of strong *interdepartmental relationships* and a *unified culture*, even in instances where *physical consolidation* of water programs has occurred. As long as barriers prevent the development of these two IWRM criteria, water programs will not collaborate effectively or synthesize regulatory objectives, and successful IWRM will not be achieved. If these barriers are addressed, however, they may actually serve as drivers for integration in the future.

One factor that was frequently mentioned as both a barrier and a driver for successful IWRM was the role of individual personalities within organizations. According to interviewees, personalities influence the strength of *interdepartmental relationships* and the ability to *unify program cultures*, and can facilitate or obstruct *physical consolidation* transitions. One manager emphasized the role personality plays in effective interdepartmental collaboration. He said, “Folks in that job have to have the right personality and want to work together.” Similarly, another manager stated, “People are an asset, especially in a small town. Having strong contacts makes it manageable.” In contrast, interviewees stated that joint management, spatial proximity, or routine face-to-face meetings have less of an effect on fostering interdepartmental relationships and collaboration.

“Personalities” or “champions” were also often cited as the reason for successful integration transitions. For example, one manager of an integrated system said, “This transition took time before it became palatable. People and personalities usually play a role in the resistance to transition. There must be a champion that sees a value in this integration.” It appears as though successful integration occurs when it begins organically from within an organization and is heartily supported by leaders on both sides of the integration. Furthermore, the value of integration must be articulated throughout the organization and must become an inherent aspect of the organization’s culture and sense of identity.

On the other hand, failed collaboration was also attributed to organizational resistance or conflicting personalities. For example, one water manager said, “The original vision of the organization was to have a totally integrated program with stormwater regularly interacting and coordinating with other water program areas. This idealized vision has not proven to be feasible in reality, largely because of conflicting personalities and people being territorial and not wanting to collaborate with others from different programs.” This statement further supports the notion that true IWRM depends on the attitudes and beliefs of people affected by the integration.

**RECOMMENDATIONS**

As stormwater programs have evolved over the past two decades, they have developed various levels of integration with other local government programs. The majority of stormwater programs have grown, gained some autonomy, and become standalone divisions within Public Works. Some stormwater programs have united with other water programs to form Water Resources departments. It has become clear through interviewee responses that the *physical consolidation* of water programs does not necessarily lead to successful IWRM. Meanwhile, the other two criteria of a *unified culture* and *strong interdepartmental relationships* have proven necessary for achievement of IWRM. These two criteria depend upon a changed perception of stormwater as a water resource, the coordination and synthesis of regulatory objects, and the willingness of individuals to work together and embrace change at various levels of organizations.

The local government’s perception of stormwater refers to how stormwater’s role is viewed in regulatory, policy, and societal realms. This perception influences the objectives and priorities of stormwater programs, and whether efforts are made to align objectives with wastewater and drinking water utilities. In order to achieve integration, the perception of stormwater as a water resource as opposed to an infrastructure function must be promoted throughout organizations. Additionally, the mutually beneficial potential for stormwater to interact with drinking
water and wastewater in addressing water quality and quantity issues would have to be ingrained in the organizational culture.

Changing perceptions of stormwater and building a unified water program culture depends upon personalities within the local government. Interviewees mentioned that internal champions of integrated water management were needed in order to make integration successful. Organizational leaders play a vital role in mustering support for integration, uprooting entrenched resistance to change, and ensuring that changes in program perceptions, objectives, and culture translate throughout the organization and resonate with all employees. In addition to identifying key leaders as champions for IWRM, efforts also must be made to strengthen interdepartmental relationships at the staff level. Interviewees often mentioned that their success in collaborating with other programs depended on the personal ties they had with the staff of other departments. Working to foster interdepartmental relationships by promoting regular communication, collaboration on projects, and a shared sense of vision, values, and objectives would be a vital first step toward IWRM.

Moving forward, local water managers who recognize the advantages of IWRM and choose to pursue this approach may want to consider the experiences and perspectives of other North Carolina managers expressed in this study. First, physical consolidation does not necessarily predict improved collaboration between water programs. Second, the successful coordination of true integration greatly depends on interdepartmental relationships and supportive leaders. Third, perceptions of stormwater must be changed and translated throughout organizations to reflect the value of stormwater as a water resource. Finally, regulatory objectives of different programs must be evaluated in order to develop a unified organizational vision and innovative strategies for collaboration within integrated entities. While the history, organizational structure, and personal perspectives of each local stormwater program may differ, these considerations should be useful across the board in understanding how IWRM may be implemented in an effort to increase cost effectiveness and sustainability of local water management in North Carolina.
APPENDIX A: NORTH CAROLINA LOCAL WATER MANAGEMENT PROFILES

The profile descriptions below highlight when stormwater programs or utilities were established and how organizational structures have evolved over time for each locality analyzed in this study. Public Works departments typically include engineering and transportation functions, whereas Public Utilities departments typically include drinking water and wastewater utilities. In some instances the term Water Resources Department is synonymous with Public Utilities, and in other instances the Water Resources Department manages drinking water, wastewater, and stormwater.

- **Asheville:** The stormwater utility was established in 2007 within the Transportation and Engineering Department. In 2009, the Stormwater Services Division moved to the Public Works Department. The Water Resources Department provides drinking water and wastewater services.
- **Burlington:** The stormwater program was established in 2005 as part of the Public Works Department. In 2009, the stormwater program joined the water and sewer utilities to form the Water Resources Department.
- **Cary:** The stormwater program was established in the 1980s as part of flood plain management activities. The stormwater program now resides within the Engineering Department. There is no stormwater utility. The Department of Public Works and Utilities provides drinking water and wastewater services.
- **Chapel Hill:** The stormwater utility was established in 2004 under the Engineering Department. In 2007, Engineering and Stormwater both became separate divisions under the Public Works Department. A regional utility, Orange Water & Sewer Authority (OWASA), provides drinking water and wastewater services.
- **Charlotte-Mecklenburg Stormwater Services:** The city Stormwater Services Division was established in 1993, and the county stormwater program was established in 1994. Because the county and city were operating in one geographic region, they were only allowed to operate one stormwater utility. Through an interlocal agreement, responsibilities were divided between the city and county, based on the size of regulated channels. City and county fees are combined and charged to residents within the city of Charlotte. The city of Charlotte’s Engineering and Property Management Department and Mecklenburg County’s Land Use and Environmental Services Agency dually manage Stormwater Services. The Engineering and Property Management Department is one of the key city business units, which reports directly to the Charlotte city manager. Charlotte-Mecklenburg Utilities (CMU) provides drinking water and wastewater services. Mecklenburg County is one of the few counties that operates a stormwater utility.
- **Durham:** The city stormwater program was established in 1994 and was housed in the Public Works Department, where it resides today. Durham County also has a stormwater program that provides sediment control services, but does not have a stormwater permit. The Department of Water Management provides drinking water and wastewater services.
- **Fayetteville:** The stormwater program was initially housed in the Planning and Development Department, but moved to the Engineering and Infrastructure Department in 1995, where it remains today. The Fayetteville Public Works Commission (PWC) provides drinking water, wastewater and electric services.
- **Greensboro:** The stormwater program was established in 1994 as part of the Environmental Services Division. In 1999, the stormwater program was moved to the Water Resources Division, where it is managed in conjunction with the water and sewer utilities.
- **Raleigh:** The stormwater program was established in 1989, and the stormwater utility was formed in 2004. Stormwater was originally housed in the Engineering Department, which later combined with the Transportation Department to become the Public Works Department. The Public Utilities Department provides drinking water and wastewater services.
- **Wilmington:** The stormwater program was initially part of two separate departments. The Engineering Department managed the administrative tasks, while the Public Services Department managed maintenance operations. Within two years these two separate functions were combined and Stormwater became its own division of the Public Services Department. The Stormwater Services Division Utility was established in 1998. The city-county Cape Fear Public Utility Authority provides drinking water and wastewater services.
Winston-Salem: The Stormwater program was established in 1997 under the Streets Division of the Public Works Department. Approximately five or six years ago (2005), the stormwater program became its own division within the Public Works Department, while the Streets Division was moved to the Transportation Department. The City/County Utilities Commission provides drinking water, wastewater, and solid waste services.
### APPENDIX B: NORTH CAROLINA LOCAL WATER MANAGEMENT PROFILE TABLE

<table>
<thead>
<tr>
<th>Locality</th>
<th>Year SW Program Established</th>
<th>Original Stormwater Management Regime</th>
<th>Current Stormwater Management Regime (&amp; year of transition)</th>
<th>Wastewater and Drinking Water Management</th>
<th>Integrated Water Management</th>
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<tbody>
<tr>
<td>Asheville</td>
<td>2007</td>
<td>Transportation &amp; Engineering Department</td>
<td>Public Works Department (2009)</td>
<td>Water Resources Department</td>
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<tr>
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<td>1980s</td>
<td>Flood Plain Management</td>
<td>Engineering Department</td>
<td>Department of Public Works and Utilities</td>
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<tr>
<td>Chapel Hill</td>
<td>2004</td>
<td>Engineering Department</td>
<td>Public Works Department (2007)</td>
<td>Orange Water &amp; Sewer Authority (OWASA)</td>
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<tr>
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<td>Engineering and Property Management Department</td>
<td>Charlotte-Mecklenburg Utilities (CMU)</td>
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<tr>
<td>Durham</td>
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<td>Public Works Department</td>
<td>The Department of Water Management</td>
<td>N</td>
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<tr>
<td>Fayetteville</td>
<td>1995</td>
<td>Planning and Development Department</td>
<td>Engineering and Infrastructure (1995)</td>
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<td>N</td>
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<tr>
<td>Wilmington</td>
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<td>Cape Fear Public Utility Authority</td>
<td>N</td>
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<tr>
<td>Winston-Salem</td>
<td>1997</td>
<td>Streets Division of Public Works Department</td>
<td>Public Works Division (2005)</td>
<td>City-County Utilities Commission</td>
<td>N</td>
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REFERENCES


