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WHY AND HOW TO BETTER UNDERSTAND NON-RESIDENTIAL WATER
CUSTOMERS

By

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Abstract

Non-residential customers contribute significantly to water utilities' financial resources and water resource demand profile, yet they are not studied or benchmarked nearly as often as residential customers. Conducting business intelligence on a utility's largest customers can change the way it does business – for the better. The finance director can better project revenue, the billing staff can correct erroneous (and potentially costly) mis-categorizations, customer service representatives can build relationships, and water resource planners can better understand how different non-residential customers respond to price and non-price signals. This report highlights the significance of non-residential customers for four urban water utilities in North Carolina. It proposes a method of analysis that can be used to understand and project non-residential customer water use, including key accounts, water use plateaus, and meter right-sizing. The analysis is founded in customer-level billing analysis and in-depth staff consultation with each of the utilities.

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1. Introduction

What happens if your largest water customer moves out of town? What if you suddenly need to reduce usage drastically in your service area due to an emergency - which of your customers should you call first? How has water use changed over time for your ten largest customers, and what does that mean for your bottom line? What other changes have happened with your commercial customers, and are those changes systemic or temporary? Understanding how a utility's non-residential customers use water can help answer these questions and can provide critical information to utility managers in assessing their water resources and financial stability into the future.

In 2010, non-residential customers used nearly 43% of public water supplied in the United States (Maupin et al, 2014). In fact, across the country, the portion of public water demanded by commercial, industrial, and institutional water customers has increased over the past twenty years as water efficiency in the residential sector has improved. Studying customer behavior has become an essential strategy for most businesses. Yet non-residential customers are largely understudied and compared by utilities, in large part because it is an extremely diverse customer classification (Morales & Heaney, 2014).

Although few studies have been conducted on the elasticity of non-residential water demand, it is generally understood to be much more elastic than residential water demand (Worthington, 2010). This suggests that non-residential customers (as more economically-rational entities) are more responsive to changes in pricing. Their water demand is likely to fluctuate greater with changes in water prices and economic and weather conditions. Given that there is so much water demand and revenue at stake with this group of customers, this responsiveness alone makes them worthy of tracking.

The purpose of this report is to illustrate how tracking non-residential customers' water use individually over time and using a few metrics can contribute significantly towards water resource management and financial planning, and how to sub-classify non-residential customers to target outreach and planning efforts.

For the purposes of this paper, a non-residential customer is any water customer that is not an individual household (i.e. single family dwelling unit) and not a wholesale water purchaser (i.e. an interconnected water system). Typically, non-residential customers include commercial customers (like strip malls and car washes), institutional customers (like schools and prisons), and industrial customers (like manufacturers). For the purposes of this study, non-residential customers also include master-metered multifamily customers, treating these customers more as businesses where people live, rather than residential. And while past studies have shown that even single-family residential customers are a diverse group of customers (Boyle et al, 2011), they are a much more generalizable group than non-residential customers. Non-residential customers include everything from an insurance agent's office with a toilet and sink to a beverage bottling plant that uses millions of gallons every day.

There are many utilities that sub-classify their non-residential customers, including the four utilities included in this study. But surprisingly, there is typically little to no difference in the

rates charged to non-residential customers regardless of their sub-classification. Multi-family customers (and wholesale purchasers) may have a unique rate, but otherwise, unlike the myriad of rates offered by energy utilities, there is typically only one rate structure option for non-residential customers, if at all.

Using the findings from an in-depth analysis of the non-residential customers of four North Carolina urban water utilities, this paper explores why it is important for water utilities to monitor, track and study their non-residential customers in more detail than simply analyzing them as a single ambiguous class of customers. In addition, we demonstrate how utilities can monitor and study their non-residential customers through the use of metrics that can be computed from basic data found in billing records.

2. Methods

This research is founded in a collaborative process between the Environmental Finance Center at the University of North Carolina, Chapel Hill, Valor Water Analytics, and each of the four utilities in North Carolina: the Orange Water and Sewer Authority (OWASA), Fayetteville Public Works Commission (PWC), the Town of Cary (Cary), and the City of Greensboro (Greensboro). The research team met with members of each utility at the beginning of the project to discuss the scope of analysis, data availability, and data nuances. The utility staff members represented the perspectives of customer service, finance, water resource management, administration, and billing.

Each utility provided billing records for all water and/or wastewater customers of the utility for every month from July 2009 through June 2013. The billing records included data on each customer's water use in each month, their billed charges, meter size(s), and billing code or customer classification. In addition to billing records, the utilities also provided a rate and billing code glossary and rate schedule for all years of data.

The billing data were extensively cleaned for each utility and standardized to allow cross-utility comparisons. Anomalies in water use were scrutinized and either kept, modified, or deleted based on the nature of the anomaly. For example, anomalies that were assumed to be leaks or a result of inaccurate meter reading were discarded from analysis in order to analyze only billing records reflective of true demands of the customers. In many cases separate billing data was combined or merged to produce a single record per customer per month, indicating the water use, charges, and customer characteristics that applied in that month.

Customer billing data were analyzed longitudinally. That is, each customer's water use was tracked from month to month, and analyses were conducted on that customer's water use patterns over time. These analyses revealed the water use behaviors of the customer: their average use, the baseline and peak use, variable peaking demands across time (seasonal or not), whether the average use declined or increased over time, etc. The analyses were then replicated for all customers, identifying groups of customers with similar water use behavior patterns. The methodology used to conduct these analyses (for residential customers) is described in detail in a 2011 Journal AWWA article (Boyle et al., 2011).

Non-residential customers were analyzed using two different units of analysis.

Premise-level – Premise was used to analyze total water use and billed charges in a fixed location. Although multiple customers may rotate through the premise within a year, the characteristics of the premise (e.g. size, number and age of plumbing fixtures, outdoor acreage, geographic location, etc.) strongly influence water use and therefore allow us to assume that water use at the premise will be relatively consistent despite possible occupancy changes at the premise. The key to the premise-level analysis, however, is to aggregate all water use through all meters that supply the premise. For example, a business office compound with five meters serving multiple buildings belonging to one company might be recorded as a single premise, and water use through all five meters will be aggregated and attributed to the premise.

Meter-level – The second unit of analysis is the meter level. As many non-residential premises have multiple meters of multiple sizes, dissecting water use by meter allows the utility to examine capacity, cost of service, inefficiencies, and other critical issues at the sub-premise level.

After conducting the longitudinal analyses at the premise-level and meter-level, the resulting data were uploaded into a Microsoft Excel®-based *Water Sales Profile* individualized for each utility. The *Water Sales Profile* provided further analysis of individual customers. The purpose of the profile is to partially disaggregate the non-residential customer class and increase understanding of water use and revenue trends in this diverse sector. The profiles used Microsoft Excel's® Pivot Slicer to allow utility staff to filter and organize data by year, meter type, customer type, and water use type. Each utility was also provided with a dashboard of their Top Ten Customers identified by water use in the most recent fiscal year of analysis.

After a preliminary *Water Sales Profile* was created, the research team met with each utility to review the analysis before the profiles were finalized and delivered to each of the utilities. This report summarizes some of the major cross-utility comparison findings, but by no means reports all of the analysis included in each *Water Sales Profile*. A screenshot of a generic *Water Sales Profile* is provided below.

Figure 1 Snapshot of one screen of Water Sales Profile



Description of Utilities Included in Study

OWASA

The Orange Water and Sewer Authority (OWASA) is a public, non-profit regional utility that provides water, sewer, and reclaimed water services to the Carrboro-Chapel Hill community, including The University of North Carolina at Chapel Hill. The University is the utility's largest customer and, previously owned much of the utility infrastructure until the late 1970s before OWASA was created. There is little manufacturing in the Chapel Hill-Carrboro area. The economic composition of Orange County is primarily education, health, and social services (39%) and professional, scientific, management, administrative, and waste management services (14%) (Orange County Economic Development, 2015). OWASA currently serves 21,000 customer accounts.

PWC

The Fayetteville Public Works Commission provides water services to nearly 70,000 customer accounts inside and outside the City of Fayetteville, including residents of the nearby Town of Hope Mills. With the U.S. Army Base Fort Bragg nearby, the primary industries in the area are defense support, manufacturing, food processing, logistics, and business and financial services (Economic Development Alliance, 2015).

Cary

The Town of Cary Water Resources Department serves about 60,000 customer accounts in Wake County. Cary is adjacent to the state's Research Triangle Park. The primary industry in Cary is technologies, such as IBM, Lucent Technologies, and Siemens. Cary's largest employer is the SAS Institute Inc., the biggest privately held software company in the world.

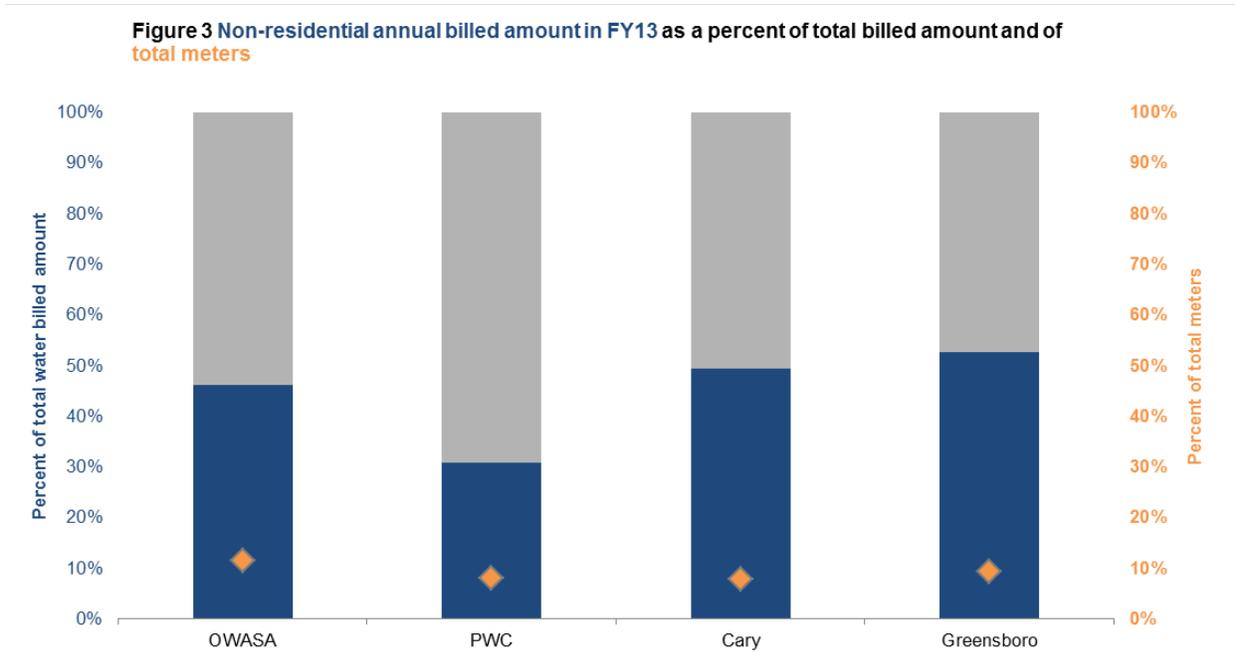
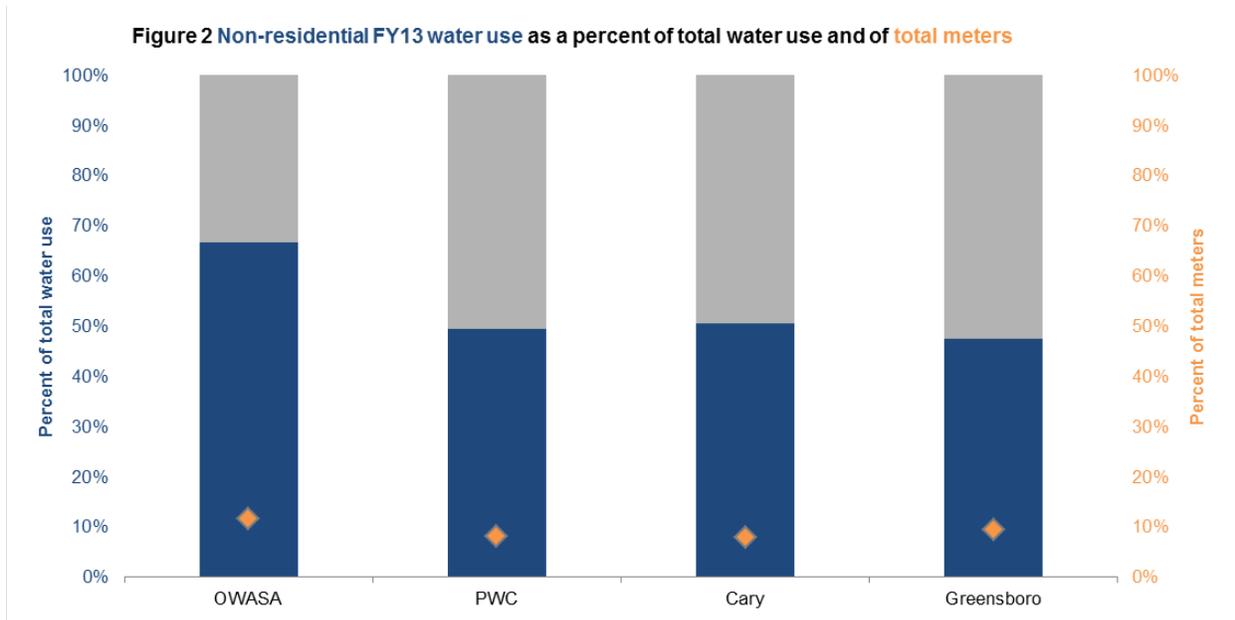
Greensboro

The City of Greensboro's Water Resource Department serves over 100,000 customer accounts in the state's third largest city. There is a wide variety of industry in Greensboro, including manufacturing, aviation services, specialized business services, research life sciences, and supply chain and logistics support (Greensboro Partnership, 2015).

3. Findings (Results/Discussion/Summary)

Why it is important for utilities to conduct business intelligence on their non-residential customer class?

Although in most cases non-residential water customers make up a small portion of number of utility customer accounts, their demand on water resources is significant. Between July 2012 and June 2013, non-residential customers accounted for between 48-67% of each utility's total retail sales. During the same time, non-residential customers only comprised between 8-12% of total water meters in the service areas (Figure 2).



Likewise, non-residential customers contribute significantly to a utility’s bottom line. During the same time period (July 2012 through June 2013), non-residential customers accounted for between 30-53% of total retail sales revenue (Figure 3). Non-residential customers are not contributing to a utility’s revenue at a level proportional to their water use. There are a few reasons for this. First, there are significantly fewer non-residential customers than residential, which means that there are fewer base charges (even if base charges increase with meter size). Additionally, the four utilities charged different rates for non-residential customers than residential. PWC and Greensboro charge non-residential customers uniform rates at a level close

to the second tier of their increasing block rate structures for residential customers. OWASA charges a seasonal uniform rate structure for non-residential customers while residential customers are charged a year-round increasing block rate structure. In their off-peak months, the non-residential uniform rate is close to the second tier of the residential increasing block rates. In on-peak months, the non-residential uniform rate is slightly more than the third tier of the residential increasing block rates. Cary has a budget-based rate structure for its non-residential customers. Budgets are set for individual customers by the utility. Below their budget, non-residential customers are charged a uniform rate equal to the second tier of the residential increasing block rates. Above their budget, non-residential customers are charged a rate greater than the fourth (and highest) residential tier.

What sub-categories of non-residential customers can be identified from billing records?

There are two general methods of determining how a utility characterizes a non-residential customer: by knowledge of the actual customer/property attributes, and/or by observations of their water use behaviors.

Availability of Customer Attribute Data

Some utilities identify the class of each customer in their billing systems or other databases. This involves manually keying in a code to identify what type of customer it is. Sometimes this is linked to the types of rates charged to the customer. The fact that each of the four utilities studied has separate rate structures for non-residential customers is relatively uncommon. Many utilities, especially smaller utilities, do not differentiate rates for customers based on customer classification. In a 2015 survey of rates and rate structures in 496 utilities across North Carolina, only 27% of the water rate structures surveyed had explicitly listed different rates for non-residential customers than for residential customers (EFC and NCLM, 2015). All four of the utilities studied in this paper are among the minority 27% in the state.

Charging separate rates for non-residential customers requires the utility to maintain records of the type of customer over time within the billing system in order to charge appropriately. If utility records were kept only for billing purposes, these four utilities would not need to classify customers beyond “residential” and “non-residential,” since there are only two types of rates charged by each utility. However, for water resource management and planning purposes, the four utilities in this study further sub-classified non-residential customers. However, no two utilities used the same sub-classifications or level of detail. OWASA has 14 sub-categories for non-residential customers programmed into their billing system. Cary has 22 sub-categories. Fayetteville has incorporated North American Industry Classification System (NAICS) codes into their billing database. Greensboro, on the other hand, simply sub-classifies non-residential customers into three groups: multi-family, commercial, and industrial.

A few of the utilities use a separate classification to specifically call out a single customer in their billing codes.¹ For OWASA, this single customer is the University of North Carolina, which is far and above their largest single customer. The Fayetteville Public Works Commission

¹ In many cases, these would include bulk or wholesale customers. Wholesale customers were excluded from our analysis of non-residential customers.

uses a specific classification for water used by their own operations and water used by the City of Fayetteville.

In the individual analysis conducted for each of the utilities, sub-classifications unique to each utility were maintained. The purpose of this report, however, is to introduce generalizable metrics that can be applied to any and all non-residential customers and used to inform utility planning and decision-making.

Observations of Water Use Behaviors

As an entire customer class, non-residential customers are a worthwhile group to monitor and track. There is a great deal of opportunity in using water use patterns to sub-classify customers based on their observed water use patterns. By tracking each customer's water use over time, the analysis used the following metrics to identify and target smaller groups of non-residential customers for the purposes of financial management, resource planning, and customer service. These metrics can be applied to any and all non-residential customers and used to inform utility planning and decision-making.

1) Key Accounts

A single large water customer can be a financial boon for a water utility, but it also makes the utility's revenue vulnerable to the operational and business fluctuations of that individual customer. It is important for a water utility to be aware of its biggest water customers in resource and financial planning and be able to quantify what is at risk if those customers make a change in its operations or business practices that would alter its demand for water. This is why many local government utilities identify the top ten water customers in the statistical section of their Comprehensive Annual Financial Report.

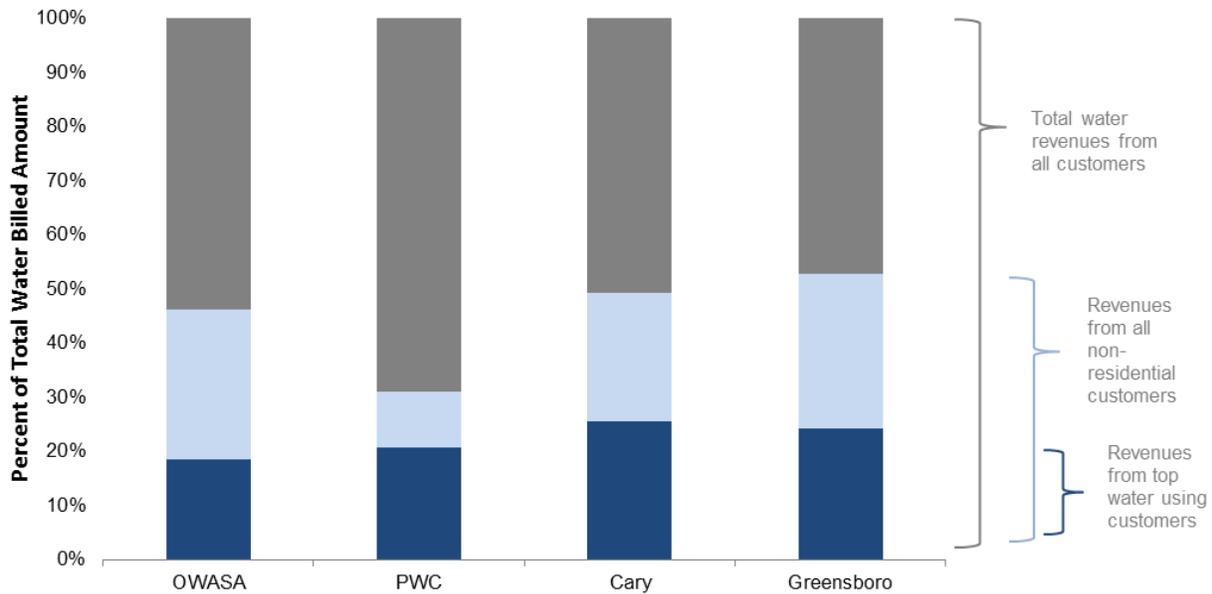
This is similar to the concept of "key accounts" that the public power industry has promoted in response to the deregulation of the electricity market, which has allowed many electricity consumers to purchase the generation portion of their electricity from a supplier other than their utility. By establishing Key Account programs, power utilities were able to at least plan for the potential consequences of their largest customers switching their power generation purchases to other suppliers. Even if the power utility is not in a deregulated market, Key Account programs have been valuable to energy utilities as supply costs increase by initiating insightful relationships that benefit the utility and the customer. From water utilities' perspective, identifying, tracking and working with the largest individual customers can facilitate the same level of financial and resource planning.

Using the billing data of the largest customers provides a starting point for this understanding. Each customer's total annual water use is determined and ranked from highest to lowest. A small number of customers that have the highest water use are then included in the "Key Accounts" category.

Results from the four utilities show the extent of the revenue reliance on just a few large customers in Fiscal Year 2013 (Figure 4). Figure 4 was created by separating out the revenue from the customers whose use fell beyond the 95th percentile of non-residential average water use. Despite the differences in customer bases, each utility collected between 18-26% of their

retail revenue from just a few hundred customers numbering less than 1% of their total actual customer accounts.

Figure 4 Utilities collected between 18-30% of their total retail revenue from less than 1% of their customers (FY2013)

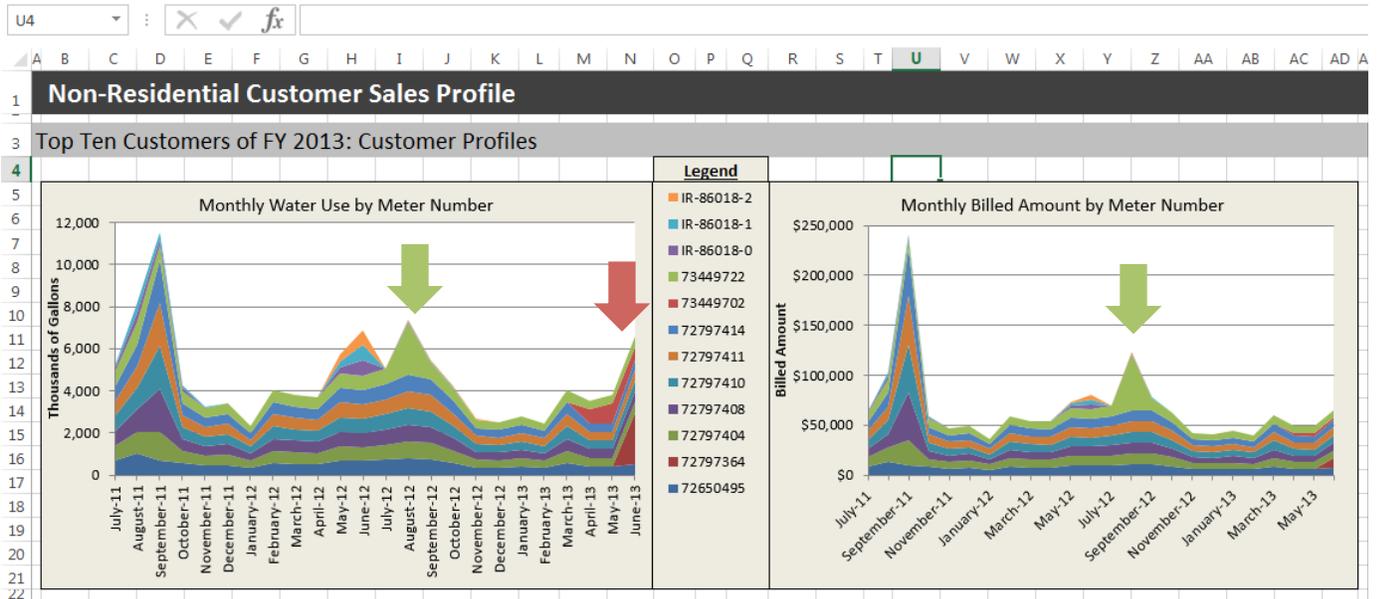


On one hand this means that the utility’s revenues are significantly tied up in and are vulnerable to the success of a few hundred customers. But on the positive side, it also means that utility staff can target their analysis of and efforts to communicate with just a few customers to have a significant understanding of and potentially impact on a lot of their resources.

These customers, or even a small sub-set of these customers, are worth tracking at the meter level. Figure 5 is a snapshot of a dashboard of “Top Ten” non-residential customers created for one of the utilities, with data for one particular customer displayed. This particular customer has twelve meters, and the dashboard tracks the monthly usage and billed amount for each meter over the past two years. It also sums the total revenue from base and volumetric charges and displays the maximum and average monthly usage for each meter. Even without knowing the business of this particular non-residential customer, much can be learned by looking at the dashboard. It seems that there was some significant peak shaving between the summer of 2011 and 2012. A utility could use an analysis like this to follow-up with this customer. Was the summertime peak shaving in response to weather conditions, or has the customer invested in efficient technology or changed its business operations in a way that will likely affect future peak demands? Additionally, meter #73449722 (green) saw an abnormal one-time increase in water use in August 2012. If a utility tracks this information on a regular basis, it could help this customer determine if there was a leak. For example, if this dashboard was tracked on a monthly basis, the utility might also see that meter #72797364 (red) experienced an abnormal peak in June 2013. It would be worth following up to find out if this is a sustained change or will only be temporary. If temporary, was it purposeful, and for how long does the customer expect that

higher demand to continue? Equally interesting would be significant drop-offs in one or more meters.

Figure 5 Screenshot of a “Top Ten” dashboard



2) Plateauing Customers

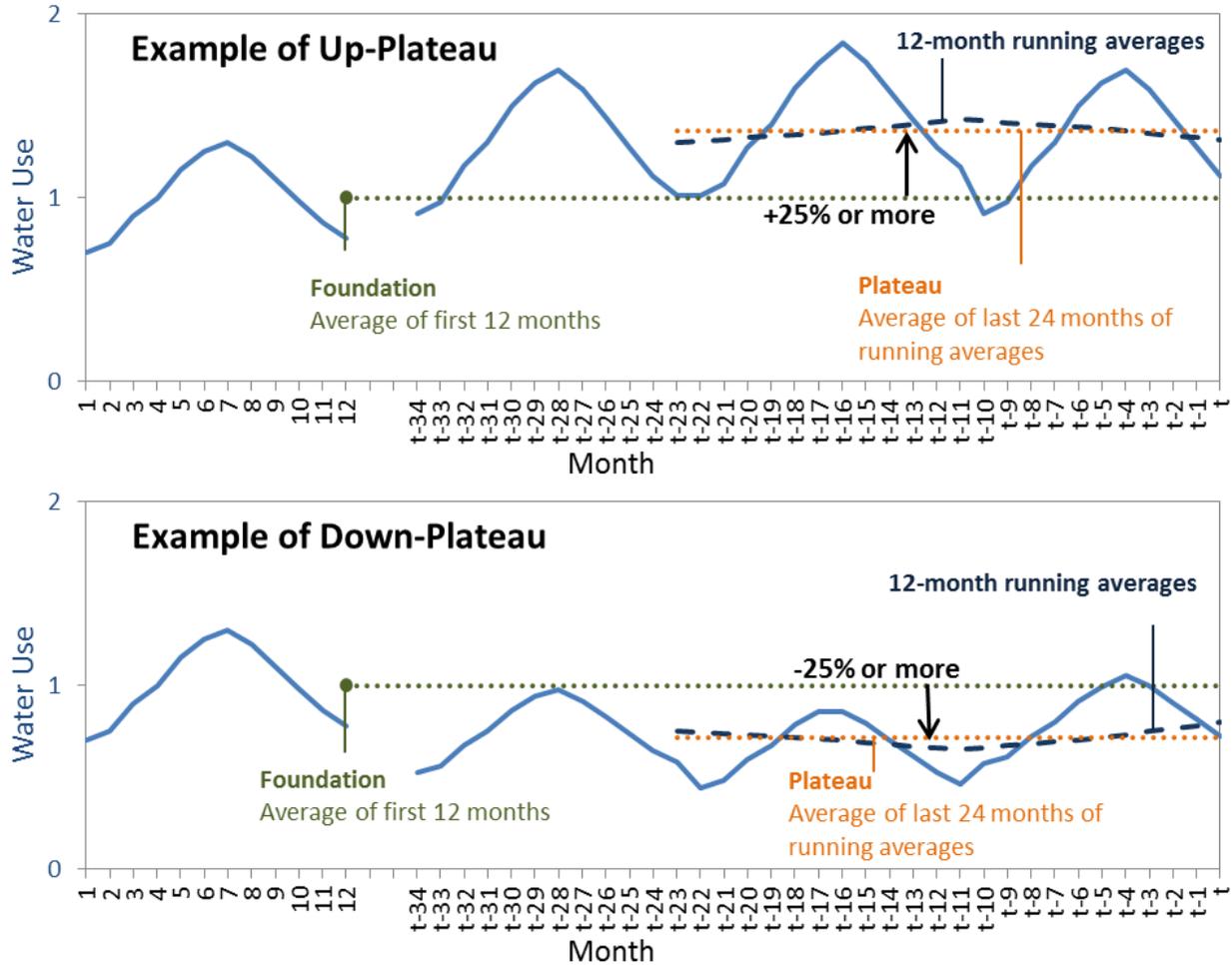
Of course, one month anomalies are not necessarily real and sustained change, the kind of change that will either significantly increase or decrease the amount of water the utility sells. The research team analyzed the billing records to identify non-residential customers that had significant and sustained change in total water use between 2009 and 2013 (a time period that falls immediately after a major drought in North Carolina). These customers stabilized their water use at the new level for many months, demonstrating a “new plateau” of water use.

To conduct this analysis, we developed an algorithm to detect significant and sustained changes in the 12-month running averages of water use for each customer, as shown in Figure 5. A “foundation” was calculated for each premise as the running average of their first 12 months of water use, marking the level of use in the “before” period. The final 36 months of water use were then used to calculate 24 twelve-month running averages. Each premise’s “plateau” was then calculated as the average of those final 24 running averages, marking a sustained level of use in the “after” period. Plateaus were calculated only if the final 24 running averages were relatively steady.

Non-residential customers were identified as “up-plateau” customers if they increased their average water use by at least 25% between 2009 and 2013 and sustained their new average for at least 36 months at the end. In other words, the “plateau” for the customers was at least 25% greater than the “foundation”, as displayed in Figure 6. This increase may be due to an increase in production or a change in ownership. Conversely, non-residential customers were identified as

“down-plateau” customers if they decreased their average water use by at least 25% and maintained that new plateau at the end. The sustained drop in use could perhaps be due to a decrease in production or an investment in water efficiency.

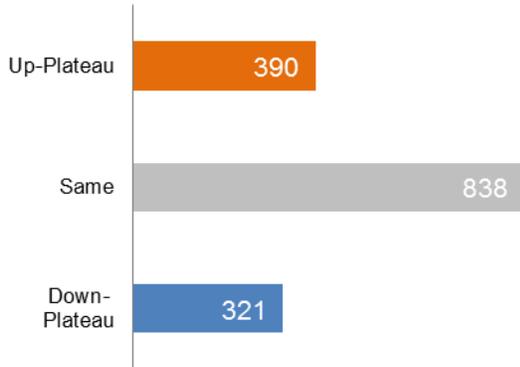
Figure 6 Determining “Plateauing” Customers from Water Use Records



This analysis can be helpful in detecting real and sustained change in a customer’s water use. With non-residential customers, the change is most likely due to a structural change (e.g. new tenant, operational changes, renovation, new equipment, etc.), rather than behavioral change. These changes can impact future water use and revenue projections. In the case of OWASA, this methodology was used to specifically identify more than 700 “plateauing” commercial customers. These customers were nearly equally split between up-plateau and down-plateau customers, as shown in Figure 7.

Figure 7: Number of non-residential customers with significant & sustained changes in use between '09 and '13

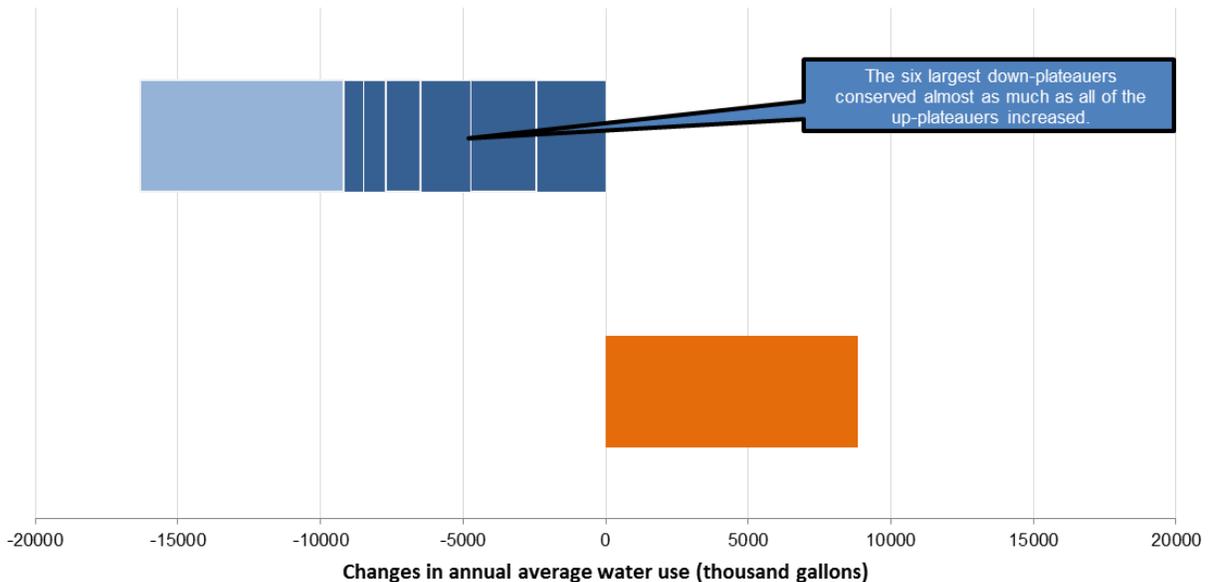
More non-res customers **increased** water use than **decreased**



Ultimately, the impact of an up-plateau or down-plateau customer on the utility’s water resources and revenues depends on the starting and ending points of that customer’s water use. OWASA’s 321 “down-plateau” customers had nearly twice the impact on declining demand than the 390 “up-plateau” customers had on increasing demand. In other words, although there were 69 fewer “down-plateauers” than “up-plateauers,” their total sustained decreases in water use were nearly twice the total sustained increases in water use of their counterparts. In fact, the 6 “largest down-plateauers” at OWASA conserved almost as much as all of the 390 “up-plateauers” increased their water use, as shown in Figure 8. In total, the “up-plateau” customers are using 7.5 million gallons less per year than the “down-plateau” customers, resulting in a significant net decline in water use (and, therefore, revenues) among OWASA’s non-residential customers.

Figure 8: Cumulative water use changes of plateauing customers

Customers that **down-plateaued** did so to a much greater degree than those that **up-plateaued**



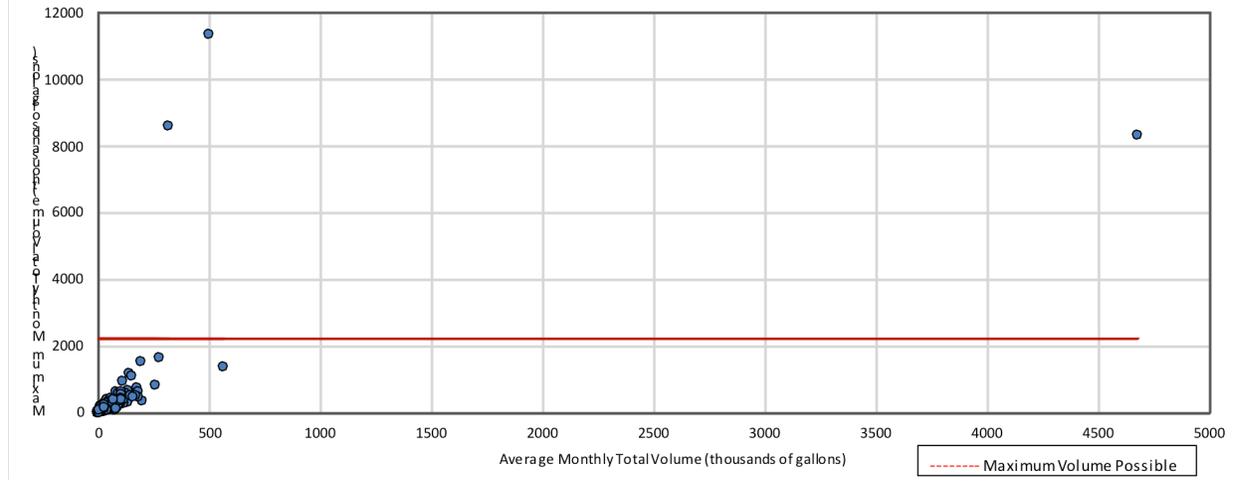
Taken across a utility, these trends are important and could represent a large-scale response to a utility policy or price. It would be useful for a utility to reach out to the biggest “new-plateauers” to understand the reasons behind the changing demands and determine whether a change in price or policy is warranted. Even without directly contacting a representative of these non-residential customers, a utility could use readily available secondary data to understand the types of customers that are “plateauing”. For example, a utility can profile those customers by incorporating tax parcel data to identify the age, size, ownership changes, and other defining characteristics of the “plateauing” non-residential customers.

How can mining water use data from billing records ensure meter right-sizing for non-residential customers?

Billing records can also be used to make sure that customers are being billed appropriately, particularly if rates vary by meter size. Because the meter size of non-residential customers varies so much, an annual review of non-residential customers’ billing records can be used to track the average and maximum water use of each meter against its potential. Each meter size is rated to have a maximum flow rate. For example, AWWA’s M6 manual on Water Meters displays that a 1” meter is rated for a maximum flow of 50 gallons per minute, while a 2” meter’s maximum flow rate is 160 gallons per minute.

Utilities can compare the flow rate through non-residential meters by plotting all of their meters of a particular size on a graph displaying each meter’s average monthly use and maximum monthly use throughout a year. This graph would then identify outliers in terms of meters that have abnormally high flow rates in comparison to other meters of the same size. For example, in Figure 9 which displays the average and maximum monthly water use in all 1” meters at one utility, three meters stand out as having much higher water use (thus flow rate) than the other 1” meters. Having identified these individual meters, the utility could then check to see if the meters were sized inappropriately for the demand levels of those customers, or if the meter sizes were recorded inaccurately in the billing software. Both problems present different challenges and potential lost revenues for the utility. Undersized water meters are likely to wear out more quickly due to the increased flow rate, and they may not be recording water flows accurately over time. Inaccurate records in the billing software may result in lost revenues if the utility is undercharging the customer by erroneously charging rates for smaller meter sizes than what the customer is actually using.

Figure 9: Average use versus maximum use by meter number to aid in meter right-sizing



Although they are difficult to see in the graph, oversized meters are an issue too. After excluding zero-consumption meters, we identified 38 meters at this utility that may be oversized. Each of these 38 meters used between 1 and 100 gallons each month throughout the year. In a single year, this could likely mean that a business sat empty or a process unused. However, extending the analysis to multiple years can identify chronically underutilized meters. In this particular utility, there were four meters that appeared to be underutilized for three years in a row. Oversized meters may not be registering all of the water that flows through them.

4. Conclusions

This report is not meant to recount every metric that can be tracked and used on non-residential customers. Previous reports (Boyle et al. 2011; Vickers, Tiger, and Eskaf, 2013) have introduced metrics such as peaking ratios and percent base charge revenue that are just as insightful to track for non-residential customers as for residential customers. Further, this report is not meant to benchmark water use and revenue of the studied utilities. The purpose of this report is to illustrate how tracking non-residential customers’ water use individually over time and using a few metrics can contribute significantly towards water resource management and financial planning, and how to sub-classify non-residential customers to target outreach and planning efforts. Finance directors and water resource planners can use this type of analysis to understand trends in customer water use and response to price and non-price conservation signals. This understanding can assist in forecasting revenue and resources.

Furthermore, the analysis could actually be a service that the utility provides to its “key accounts.” By detecting anomalies or just giving month-by-month comparisons for their meters, a utility’s non-residential customers will better understand their own water use. They may see the utility as more of a partner with whom they can work on their water demands, rather than a monopoly water provider that simply charges them for a resource that is vital for their business success. Customer service representatives can form relationships with the utility’s largest accounts and work alongside them as they are planning to make significant changes in operations that will impact their water use.

Additionally, this analysis is useful for utilities in managing their billing database. Running business intelligence on billing records can help make sure that non-residential customers are being billed accurately. These metrics and method of analysis can also be useful for utilities in improving data accuracy and categorization.

The “non-residential” customer class is a broad and variable one. There is a great deal of information that can be learned and compared about this group of customers from billing records alone. Further research is needed to propose best practices in billing database management and intelligence to better standardize the practice across the industry.

5. Recommendations

Although it is challenging to generalize non-residential customers, this report shows that there is value in tracking the water use and revenue trends of non-residential customers. Understanding their water use patterns is the first step in anticipating their changes in water demand and responses to prices. Furthermore, a utility could use this type of analysis to develop pricing schemes and business practices that better align with water use trends and utility objectives for financial stability and customer service.

References (in alphabetical order)

Boyle, C.; Eskaf, S.; Tiger, M.W.; & Hughes, J.A., 2011. "Mining Water Billing Data to Inform Policy and Communication Strategies." *Journal AWWA*, 103:11, 45-58.

Economic Development Alliance of Fayetteville and Cumberland County, North Carolina. *Industry Summary*. Accessed online at: <http://www.thencalliance.com/industries/>.

Environmental Finance Center at the University of North Carolina and the North Carolina League of Municipalities, 2015. *Water & Wastewater Rates and Rate Structures in North Carolina*. Raleigh, NC: NCLM. Accessed online at: <http://www.efc.sog.unc.edu/reslib/item/annual-report-water-and-wastewater-rates-and-rate-structures-north-carolina-january-2015>

Greensboro Partnership. 2015. *Community Profile*. Accessed online at: <http://greensboropartnership.com/economic-development/data-center/>

Maupin, M, J.; Kenny, S.; Hutson, J.; Lovelace, N.; Barber; & Linsey K., 2014. "Estimated Use of Water in the United States in 2010." U.S. Geological Survey Circular 1405. Washington, DC: US Department of the Interior.

Morales, M. & Heaney, J., 2014. "Classification, benchmarking, and hydroeconomic modeling of nonresidential water users." *Journal AWWA*, 106:12, E550-E560.

Orange County Economic Development, 2015. *Orange County Community Profile*. Accessed online at: http://growinorangenc.com/wp-content/uploads/2011/10/Community-profile.web_4.pdf.

Vickers, Tiger, and Eskaf, 2013. *A Guide to Customer Water-Use Indicators for Conservation and Financial Planning*. Denver, CO: American Water Works Association. Accessed online at: <http://www.awwa.org/Portals/0/files/resources/resource%20dev%20groups/tech%20and%20educ%20program/documents/Water%20Use%20Indicators%20for%20Conservation%20and%20Financial%20Planning.pdf>

Worthington, Andrew, 2010. "Commercial and Industrial Water Demand Estimation: Theoretical and methodical guidelines for applied economics research." *Griffith Business School Discussion Papers*. Accessed online at: http://www.griffith.edu.au/_data/assets/pdf_file/0019/261154/2010-11-commercial-and-industrial-water-demand-estimation-theoretical-and-methodological-guidelines-for-applied-economics-research.pdf

Appendix 1: Alphabetical list of abbreviations and symbols, with definitions
AWWA: American Water Works Association

Appendix 2: Lists of the following items resulting from the project:

- Presentations and publications, including theses or dissertations
 - Water Use Profiles and Top Ten Dashboards for each utility
 - Presentation given at 2015 WRRI Annual Conference (Attached)
- Patents, data sets, or web sites ---
 - Data set of customers' water use, aggregated within the Water Use Profiles
- Efforts at technology transfer or communication of results to end users, policy makers, or others
 - Kick-off meeting with each utility to discuss analysis
 - Mid-term meeting with each utility to show preliminary results and demo of interactive profile
 - Delivery of final analysis (Delivery memos for each utility attached)

Subject: Expanding and Enhancing Customer-Level Billing Analysis: Delivery of Non-Residential Customer Sales Profile, Top Ten Dashboard, and Plateau Analysis

To: Ed Kerwin, Stephen Winters, Ruth Rouse, and Pat Davis at the Orange Water and Sewer Authority

From: Mary Tiger at the Environmental Finance Center

CC: Nicole Wilkinson, North Carolina Water Resources Research Institute
Christine Boyle, Valor Analytics
Jeff Hughes, Environmental Finance Center at the University

Date: January 15, 2015

Attachments: Folder on ftp site containing the following files:

- DO NOT OPEN NonResData.xlsx
- OWASA_Dashboard_Final.xlsx
- PlateuaAnalysisOWASA.docx
- PlateauResultsOWASA.xlsx
- TopTen.xlsx

Non-residential water customers use nearly 43% of public water supplied in the United States¹. In fact, their portion of public water demand has increased over the past twenty years as water efficiency in the residential sector has improved. Studying customer behavior has become an essential strategy for most businesses. Yet this group is largely understudied and compared by utilities – in large part because it is an extremely diverse customer classification².

Funded by the North Carolina Urban Water Consortium (UWC), the Environmental Finance Center and Valor Analytics have been cleaning, compiling, and profiling OWASA's non-residential customers over the last year, along with those of three other UWC members (Fayetteville PWC, Town of Cary, and Greensboro Water). We have individually met with each utility to review the accuracy and usefulness of the analysis and have taken those discussions into consideration in developing the final individual deliverables for each of the participating utilities. These deliverables specific to OWASA are described below and accompany the delivery of this memo.

In the coming months, the EFC will be developing a final report for the Urban Water Consortium (and the greater water industry) that discusses the opportunities and challenges of analyzing non-residential billing data. The report will compare the similarities and differences between the four utilities in classification, water use, and revenue contributions of non-residential customers. Additionally, the report will introduce meaningful metrics and discuss their potential for understanding and projecting

¹ Maupin, M, J. Kenny, S. Hutson, J. Lovelace, N. Barber, and K. Linsey. 2014. Estimated Use of Water in the United States in 2010. U.S. Geological Survey Circular 1405. US Department of the Interior, Washington.

² Morales, M. and J. Heaney. 2014. Classification, benchmarking, and hydroeconomic modeling of nonresidential water users. Journal AWWA Peer-Reviewed Article. December 2014; 106:12.

non-residential water use and revenue. We look forward to your feedback on this report and thank you very much for your involvement and assistance with this research so far.

- **Non-Residential Dynamic Dashboard Tool (OWASA_Dashboard_Final.xlsx)**

The dashboard tool allows you to explore the water use and revenue trends of OWASA non-residential customers from July 2009 through June 2013. Each tab presents a different way of analyzing the data, allowing you track and compare the trends of OWASA's non-residential customer class. For most analyses, you are able to filter your analysis of water use and revenue by customer type, fiscal year, meter size, and, on some dashboards, water use type (e.g. irrigation, reclaim, and water). Based on the organization of your billing data, we identified five types of non-residential customers served by OWASA: commercial, governmental, institutional, multifamily, and UNC. The tab "TypeTable" identifies how non-residential customers were organized into these types.

This type of customer intelligence is useful in understanding how different types of customers have changed their water use and revenue generation for the utility over time. Through this understanding, the utility can better project future trends in water use and revenue and better anticipate the needs of its customer base.

- **Top 10 Customer Analysis Dashboard (TopTen.xlsx)**

The Top 10 Customer Analysis looks in-depth at OWASA's ten highest water-using (and revenue-contributing) customers in the non-residential sector for Fiscal Year 2013. The purpose of this analysis is to examine water use and revenue trends for each customer at the meter level to help understand the relationship between use and revenues, as well as, inter-monthly variation for each of the top ten customers. A unique profile is created for each customer.

- **Plateau Analysis (PlateauAnalysisOWASA.docx and PlateauResults.xlsx)**

This analysis identifies the non-residential customers that made sustained changes in demand between 2009 and 2013. The customers identified as "up-plateau" customers are those that significantly increased water use by at least 25% - perhaps due to an increase in production or a change in ownership. The customers identified as "down-plateau" customers are those that significantly decreased water use by at least 25% - perhaps due to an investment in efficiency, changes in ownership or processes. The Word document titled "PlateauAnalysisOWASA" summarizes the number, extent, and impact of these changes. It also explains the methodology for identifying these customers. Additionally, you will likely be interested in the specific customers that both significantly and sustainably increased and decreased water use. The list of the location ID's of these customers, as well as a summary of their changes in water use, are listed in the first two worksheets of the Excel document titled "PlateauResultsOWASA."

Thank you once again for your participation in this study. Please don't hesitate to contact us with any questions or comments!

Subject: Expanding and Enhancing Customer-Level Billing Analysis: Delivery of Non-Residential Customer Sales Profile, Top Ten Dashboard, and Plateau Analysis

To: Dwight Miller, Rhonda Haskins, and Carla Supples at Fayetteville Public Works Commission

From: Mary Tiger at the Environmental Finance Center

CC: Nicole Wilkinson, North Carolina Water Resources Research Institute
Christine Boyle, Valor Analytics
Jeff Hughes, Environmental Finance Center at the University

Date: January 15, 2015

Attachments: Folder on ftp site containing the following files:

- NonResData.xlsx (DO NOT OPEN THIS FILE. It “feeds” the dashboard.)
- NonResData – full - DONOTUSE.xlsx (DO NOT OPEN THIS FILE. It also “feeds” the dashboard.)
- PWC_Dashboard_Final.xlsx
- PlateuaAnalysisPWC.docx
- PlateauResultsPWC.docx
- TopTenPWC.xlsx

Non-residential water customers use nearly 43% of public water supplied in the United States¹. In fact, their portion of public water demand has increased over the past twenty years as water efficiency in the residential sector has improved. Studying customer behavior has become an essential management strategy for most businesses. Yet this group is largely understudied and compared by utilities, in large part because it is an extremely diverse customer classification².

Funded by the North Carolina Urban Water Consortium (UWC), the Environmental Finance Center and Valor Analytics have been cleaning, compiling, and profiling PWC’s non-residential customers over the last year, along with those of three other UWC members (OWASA, Town of Cary, and Greensboro Water). We have individually met with each utility to review the accuracy and usefulness of the analysis and have taken those discussions into consideration in developing the final individual deliverables for each of the participating utilities. These deliverables specific to PWC are described below and accompany the delivery of this memo.

In the coming months, the EFC will be developing a final report for the Urban Water Consortium (and the greater water industry) that discusses the opportunities and challenges of analyzing non-residential billing data. The report will compare the similarities and differences between the four utilities in classification, water use, and revenue contributions of non-residential customers. Additionally, the report will introduce meaningful metrics and discuss their potential for understanding and projecting

¹ Maupin, M, J. Kenny, S. Hutson, J. Lovelace, N. Barber, and K. Linsey. 2014. Estimated Use of Water in the United States in 2010. U.S. Geological Survey Circular 1405. US Department of the Interior, Washington.

² Morales, M. and J. Heaney. 2014. Classification, benchmarking, and hydroeconomic modeling of nonresidential water users. Journal AWWA Peer-Reviewed Article. December 2014; 106:12.

non-residential water use and revenue. We look forward to your feedback on this report and thank you very much for your involvement and assistance with this research so far.

- **Non-Residential Dynamic Dashboard Tool (PWC_Dashboard_Final.xlsx)**

The dashboard tool allows you to explore the water use and revenue trends of PWC non-residential customers from July 2009 through June 2013. Each tab presents a different way of analyzing the data, allowing you track and compare the trends of PWC's non-residential customer class. For most analyses, you are able to filter your analysis of water use and revenue by customer type, fiscal year, meter size, and, on some dashboards, water use type (e.g. irrigation and water). Based on the organization of your billing data, we identified six types of non-residential customers served by PWC: commercial, industrial, City of Fayetteville, Multifamily (identified by NAICS code), PWC, and Wholesale. The tab "Rate Codes" identifies how non-residential customers were organized into these types using rate and NAISC codes.

This type of customer intelligence is useful in understanding how different types of customers have changed their water use and revenue generation for the utility over time. Through this understanding, the utility can better project future trends in water use and revenue and better anticipate the needs of its customer base.

- **Top 10 Customer Analysis Dashboard (TopTenPWC.xlsx)**

The Top 10 Customer Analysis looks in-depth at PWC's ten highest water-using (and revenue-contributing) customers in the non-residential sector identified for FY2013 through a separate data set provide by PWC. The purpose of this analysis is to examine water use and revenue trends for each customer at the meter level to help understand the relationship between use and revenues, as well as, inter-monthly variation for each of the top ten customers. A unique profile is created for each customer.

- **Plateau Analysis (PleatueAnalysisPWC.docx and PlateauResultsPWC.xlsx)**

This analysis identifies the non-residential customers that made sustained changes in demand between 2009 and 2013. The customers identified as "up-plateau" customers are those that significantly increased water use by at least 25% - perhaps due to an increase in production or a change in ownership. The customers identified as "down-plateau" customers are those that significantly decreased water use by at least 25% - perhaps due to an investment in efficiency, changes in ownership or processes. The Word document titled "PlateauAnalysisPWC" summarizes the number, extent, and impact of these changes. It also explains the methodology for identifying these customers. Additionally, you will likely be interested in the specific customers that both significantly and sustainable increased and decreased water use. The list of the location ID's of these customers, as well as a summary of their changes in water use, are listed in the first two worksheets of the Excel document titled "PlateaResultsPWC."

Thank you once again for your participation in this study. Please don't hesitate to contact us with any questions or comments!

Subject: Expanding and Enhancing Customer-Level Billing Analysis: Delivery of Non-Residential Customer Sales Profile and Top Ten Dashboard

To: Steven Brown, Karen Mills, Leila Goodwin, Sydney Miller, and Maria Cefalo at Cary Water Department

From: Mary Tiger at the Environmental Finance Center at UNC-Chapel Hill

CC: Nicole Wilkinson, North Carolina Water Resources Research Institute
Christine Boyle, Valor Analytics
Jeff Hughes, Environmental Finance Center at the University

Date: January 21, 2015

Attachments: Folder on ftp site containing the following files:

- NonResData.xlsx (DO NOT OPEN THIS FILE. It “feeds” the dashboard.)
- Cary_DASHBOARD_FINAL.xlsx
- TopTenPWC.xlsx

Non-residential water customers use nearly 43% of public water supplied in the United States¹. In fact, their portion of public water demand has increased over the past twenty years as water efficiency in the residential sector has improved. Studying customer behavior has become an essential management strategy for most businesses. Yet this group is largely understudied and compared by utilities, in large part because it is an extremely diverse customer classification².

Funded by the North Carolina Urban Water Consortium (UWC), the Environmental Finance Center and Valor Analytics have been cleaning, compiling, and profiling Cary’s non-residential customers over the last year, along with those of three other UWC members (OWASA, Fayetteville PWC, and Greensboro Water). We have individually met with each utility to review the accuracy and usefulness of the analysis and have taken those discussions into consideration in developing the final individual deliverables for each of the participating utilities. These deliverables specific to Cary are described below and accompany the delivery of this memo.

In the coming months, the EFC will be developing a final report for the Urban Water Consortium (and the greater water industry) that discusses the opportunities and challenges of analyzing non-residential billing data. The report will compare the similarities and differences between the four utilities in classification, water use, and revenue contributions of non-residential customers. Additionally, the report will introduce meaningful metrics and discuss their potential for understanding and projecting non-residential water use and revenue. We look forward to your feedback on this report and thank you very much for your involvement and assistance with this research so far.

¹ Maupin, M, J. Kenny, S. Hutson, J. Lovelace, N. Barber, and K. Linsey. 2014. Estimated Use of Water in the United States in 2010. U.S. Geological Survey Circular 1405. US Department of the Interior, Washington.

² Morales, M. and J. Heaney. 2014. Classification, benchmarking, and hydroeconomic modeling of nonresidential water users. Journal AWWA Peer-Reviewed Article. December 2014; 106:12.

- **Non-Residential Dynamic Dashboard Tool (Cary_DASHBOARD_FINAL.xlsx)**

The dashboard tool allows you to explore the water use and revenue trends of Cary's non-residential customers from July 2011 through June 2013. Each tab presents a different way of analyzing the data, allowing you track and compare the trends of Cary's non-residential customer class. For most analyses, you are able to filter your analysis of water use and revenue by customer type, fiscal year, meter size, and, on some dashboards, water use type (e.g. irrigation and water). Based on the CT codes in your billing data, we identified nine types of non-residential customers served by Cary:

- Residential Multifamily
- Commercial – Irrigation
- Commercial – HOA
- Commercial – Restaurants
- Commercial – Laundermats
- Commercial – Motel/Hotel
- Commercial – Other
- Industrial
- Institutional

The tab "Codes" identifies how non-residential customers were organized into these types using rate and NAISC codes.

This type of customer intelligence is useful in understanding how different types of customers have changed their water use and revenue generation for the utility over time. Through this understanding, the utility can better project future trends in water use and revenue and better anticipate the needs of its customer base.

- **Top 10 Customer Analysis Dashboard (TopTenCary_FINAL.xlsx)**

The Top 10 Customer Analysis looks in-depth at Cary's ten highest water-using (and revenue-contributing) customers in the non-residential sector for Fiscal Year 2013. The purpose of this analysis is to examine water use and revenue trends for each customer at the meter level to help understand the relationship between use and revenues, as well as, inter-monthly variation for each of the top ten customers. A unique profile is created for each customer.

Thank you once again for your participation in this study. Please don't hesitate to contact us with any questions or comments!

Subject: Expanding and Enhancing Customer-Level Billing Analysis: Delivery of Non-Residential Customer Sales Profile, Top Ten Dashboard, and Plateau Analysis

To: Stephen Drew, Kristine Williams, Jeff Kimel, Kenney McDowell, and Terrell Brown at Greensboro Water Department

From: Mary Tiger at the Environmental Finance Center

CC: Nicole Wilkinson, North Carolina Water Resources Research Institute
Christine Boyle, Valor Analytics
Jeff Hughes, Environmental Finance Center at the University

Date: January 15, 2015

Attachments: Folder on ftp site containing the following files:

- DO NOT OPEN NonResData.xlsx
- GB_DASHBOARD.xlsx
- PlateuaAnalysisGB.docx
- PlateauResultsGB.xlsx
- TopTenGB.xlsx

Non-residential water customers use nearly 43% of public water supplied in the United States¹. In fact, their portion of public water demand has increased over the past twenty years as water efficiency in the residential sector has improved. Studying customer behavior has become an essential strategy for most businesses. Yet this group is largely understudied and compared by utilities – in large part because it is an extremely diverse customer classification².

Funded by the North Carolina Urban Water Consortium (UWC), the Environmental Finance Center and Valor Analytics have been cleaning, compiling, and profiling Greensboro Water's non-residential customers over the last year, along with those of three other UWC members (OWASA, Fayetteville PWC, and Town of Cary). We have individually met with each utility to review the accuracy and usefulness of the analysis and have taken those discussions into consideration in developing the final individual deliverables for each of the participating utilities. These deliverables specific to Greensboro are described below and accompany the delivery of this memo.

In the coming months, the EFC will be developing a final report for the Urban Water Consortium (and the greater water industry) that discusses the opportunities and challenges of analyzing non-residential billing data. The report will compare the similarities and differences between the four utilities in classification, water use, and revenue contributions of non-residential customers. Additionally, the report will introduce meaningful metrics and discuss their potential for understanding and projecting

¹ Maupin, M, J. Kenny, S. Hutson, J. Lovelace, N. Barber, and K. Linsey. 2014. Estimated Use of Water in the United States in 2010. U.S. Geological Survey Circular 1405. US Department of the Interior, Washington.

² Morales, M. and J. Heaney. 2014. Classification, benchmarking, and hydroeconomic modeling of nonresidential water users. Journal AWWA Peer-Reviewed Article. December 2014; 106:12.

non-residential water use and revenue. We look forward to your feedback on this report and thank you very much for your involvement and assistance with this research so far.

- **Non-Residential Dynamic Dashboard Tool (GB_DASHBOARD.xlsx)**

The dashboard tool allows you to explore the water use and revenue trends of Greensboro's non-residential customers from July 2009 through June 2013. Each tab presents a different way of analyzing the data, allowing you track and compare the trends of Greensboro's non-residential customer class. For most analyses, you are able to filter your analysis of water use and revenue by customer type, fiscal year, meter size, and, on some dashboards, water use type (e.g. irrigation, reclaim, and water). Based on the supplementary file provided, we identified three types of non-residential customers served by Greensboro: commercial, multi-family, and industrial. The tab "Codes" identifies how non-residential customers were organized into these types.

This type of customer intelligence is useful in understanding how different types of customers have changed their water use and revenue generation for the utility over time. Through this understanding, the utility can better project future trends in water use and revenue and better anticipate the needs of its customer base.

- **Top 10 Customer Analysis Dashboard (TopTenGB.xlsx)**

The Top 10 Customer Analysis looks in-depth at Greensboro Water's ten highest water-using (and revenue-contributing) customers in the non-residential sector for Fiscal Year 2013. The purpose of this analysis is to examine water use and revenue trends for each customer at the meter level to help understand the relationship between use and revenues, as well as, inter-monthly variation for each of the top ten customers. A unique profile is created for each customer.

- **Plateau Analysis (PlateauAnalysisGB.docx and PlateauResultsGB.xlsx)**

This analysis identifies the non-residential customers that made sustained changes in demand between 2009 and 2013. The customers identified as "up-plateau" customers are those that significantly increased water use by at least 25% - perhaps due to an increase in production or a change in ownership. The customers identified as "down-plateau" customers are those that significantly decreased water use by at least 25% - perhaps due to an investment in efficiency, changes in ownership or processes. The Word document titled "PlateauAnalysisGB" summarizes the number, extent, and impact of these changes. It also explains the methodology for identifying these customers. Additionally, you will likely be interested in the specific customers that both significantly and sustainably increased and decreased water use. The list of the location ID's of these customers, as well as a summary of their changes in water use, are listed in the first two worksheets of the Excel document titled "PlateauResultsGB."

Thank you once again for your participation in this study. Please don't hesitate to contact us with any questions or comments!

Why and How to Better Understand Non-Residential Water Customers

Mary Tiger

Environmental Finance Center at the University of North Carolina

WRII 2015 Annual Conference

March 18, 2015

McKimmon Center



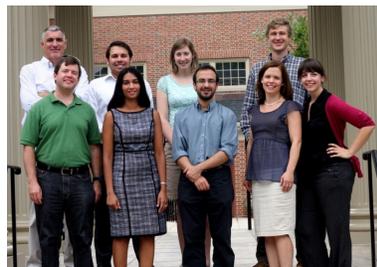
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Non-Residential Customers



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Urban Water Consortium Study

Orange Water and Sewer Authority



Fayetteville Public Works Commission



Greensboro Water Department



Cary Water Resources



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Study Objective

- Quantify the water use and financial impact of non-residential customers
- Advance understanding and exploration of non-residential customers
- Propose meaningful metrics for monitoring their demand

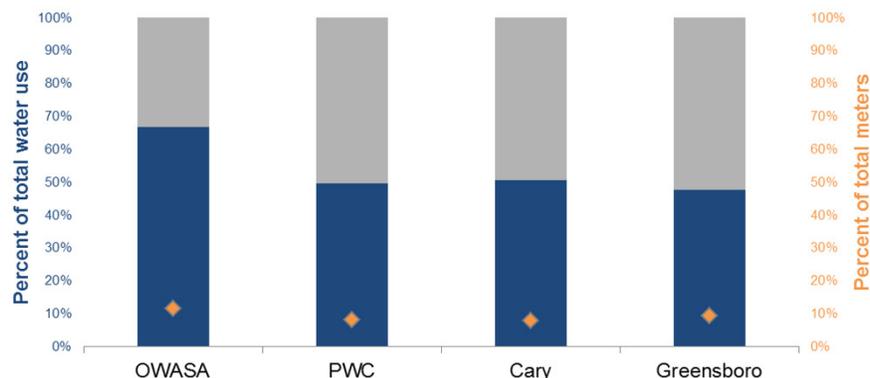


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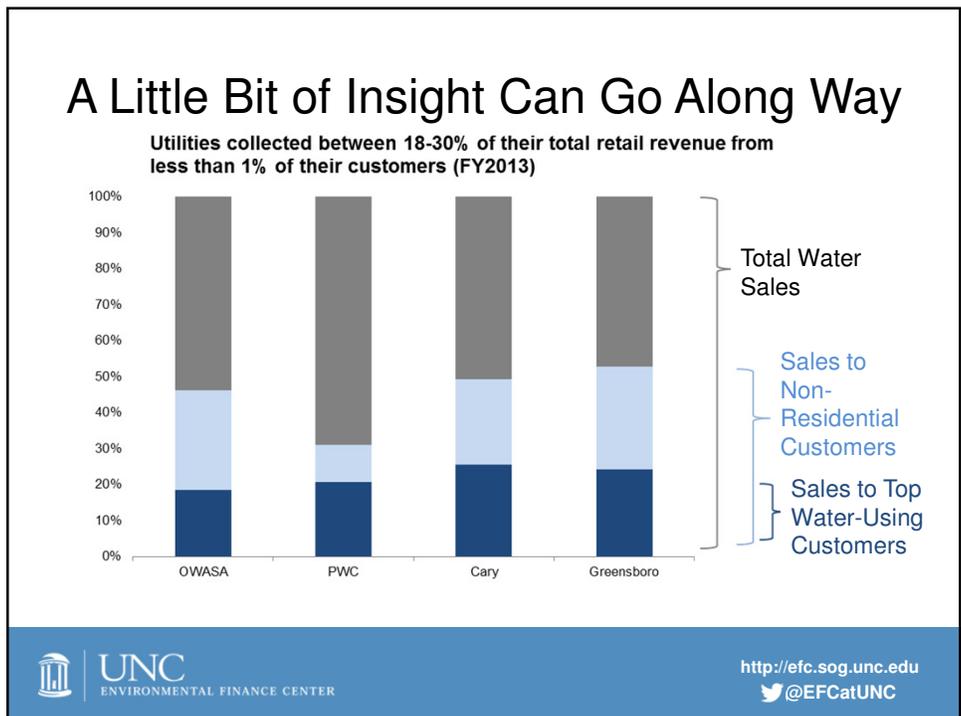
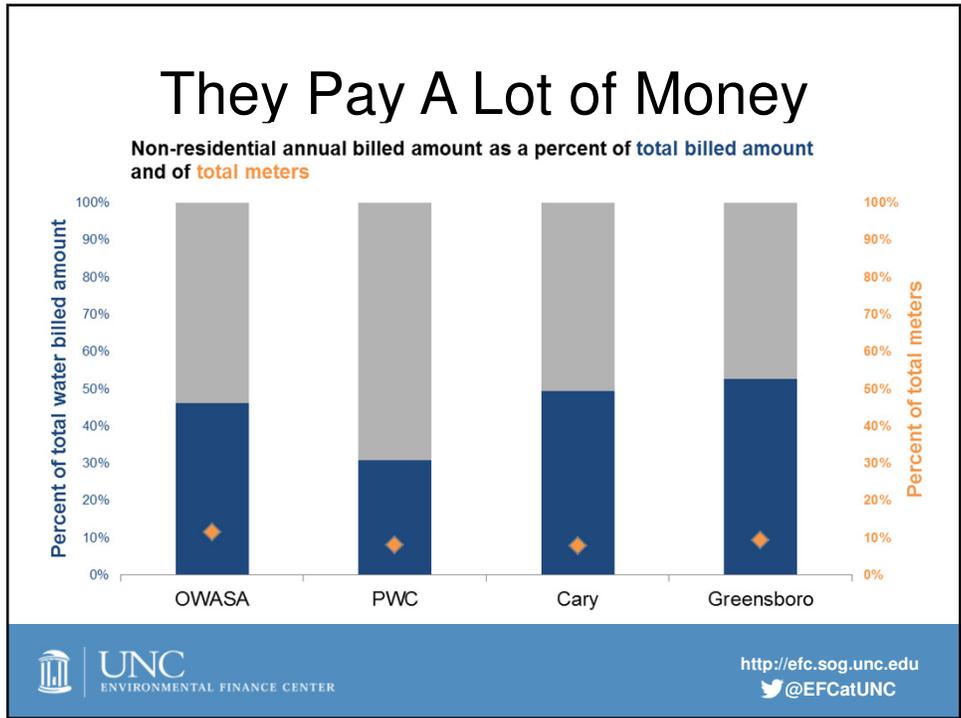
Non-Residential Customers Use A Lot of Water

Non-residential FY13 water use as a percent of total water use and of total meters



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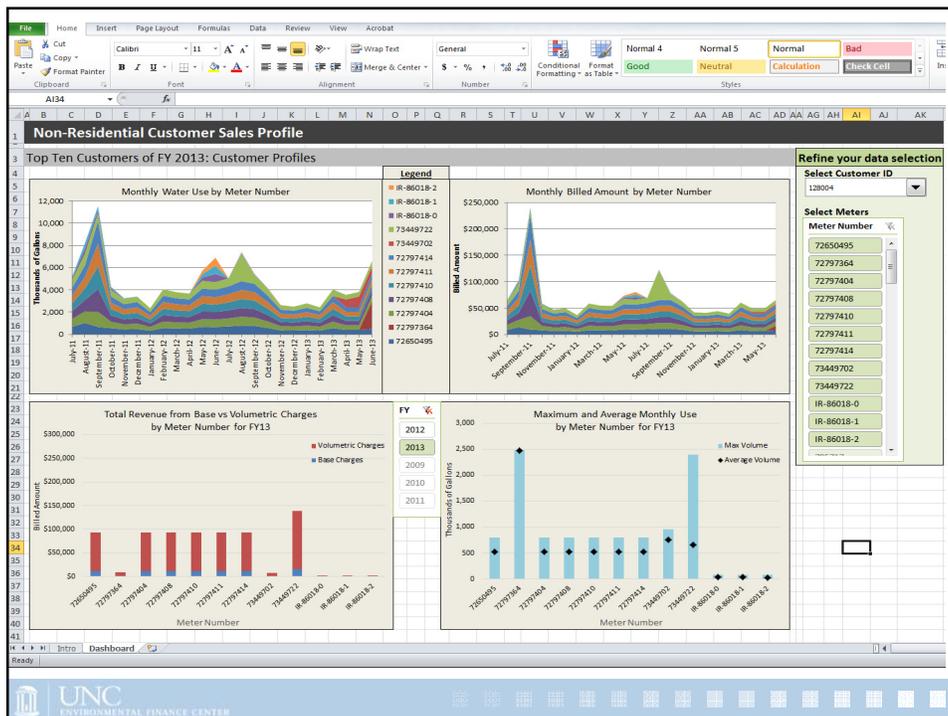
Big Data Can Minimize Efforts in Resource and Financial Planning and Customer Service

- Top Ten Dashboard
- Plateau Analysis
- Meter Right-Sizing



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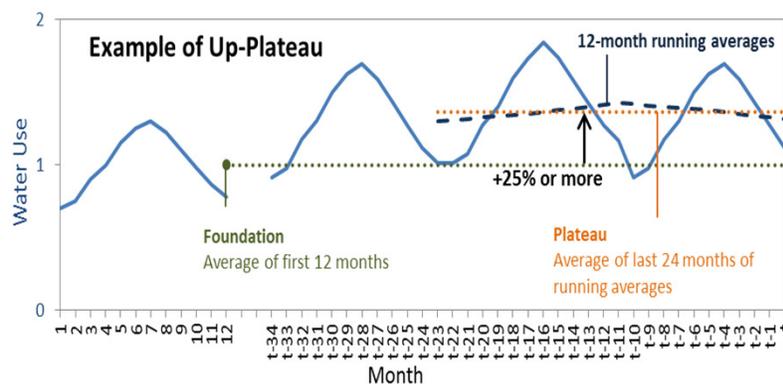
They Can Make Real and Sustained Changes



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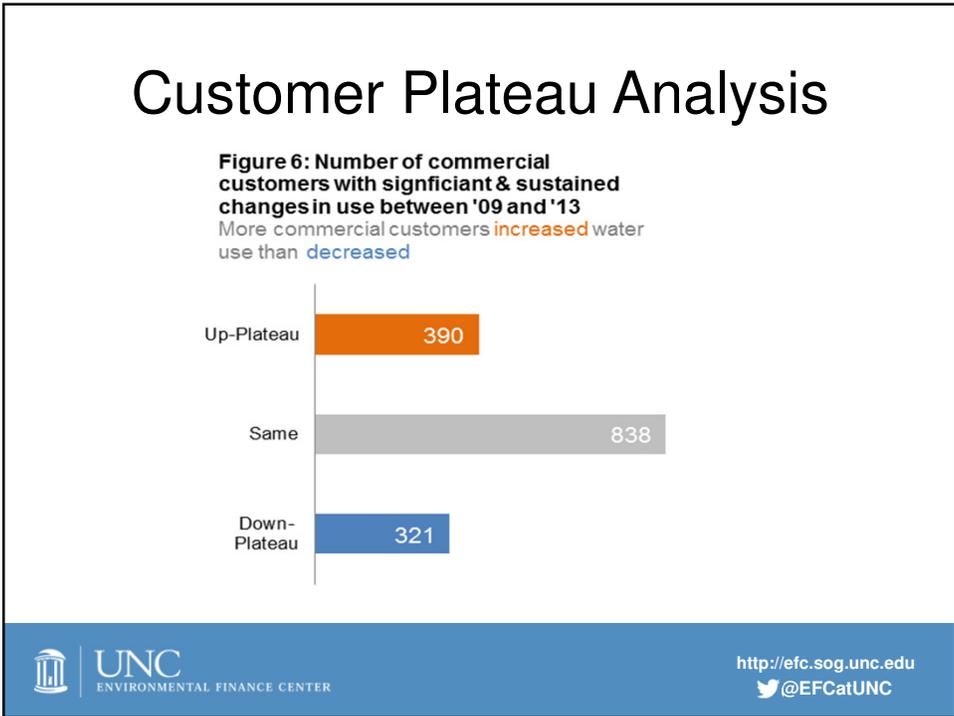
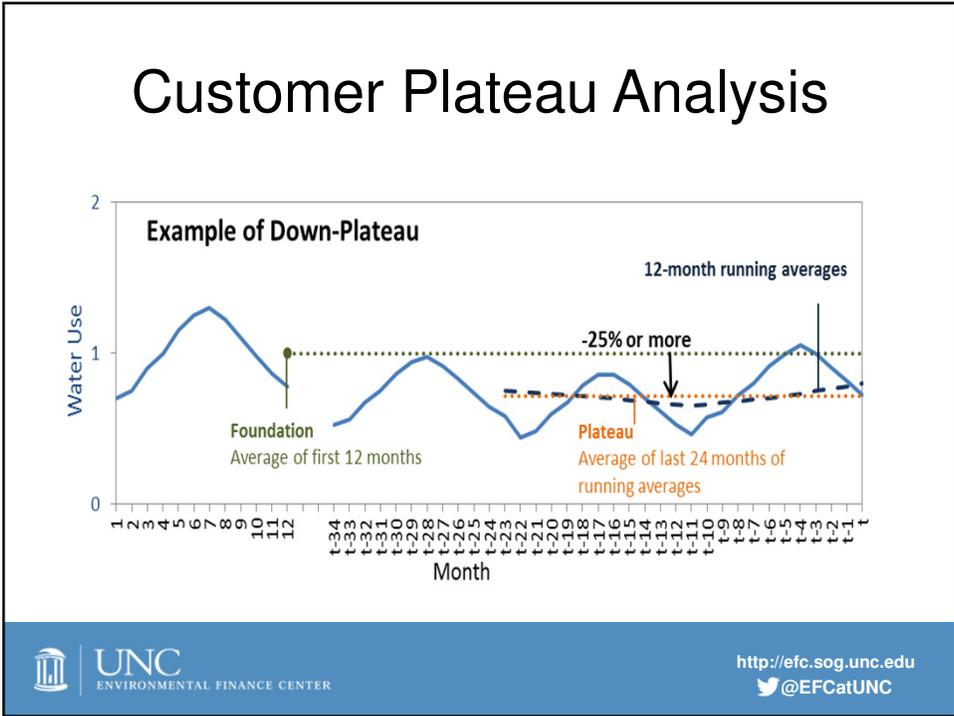
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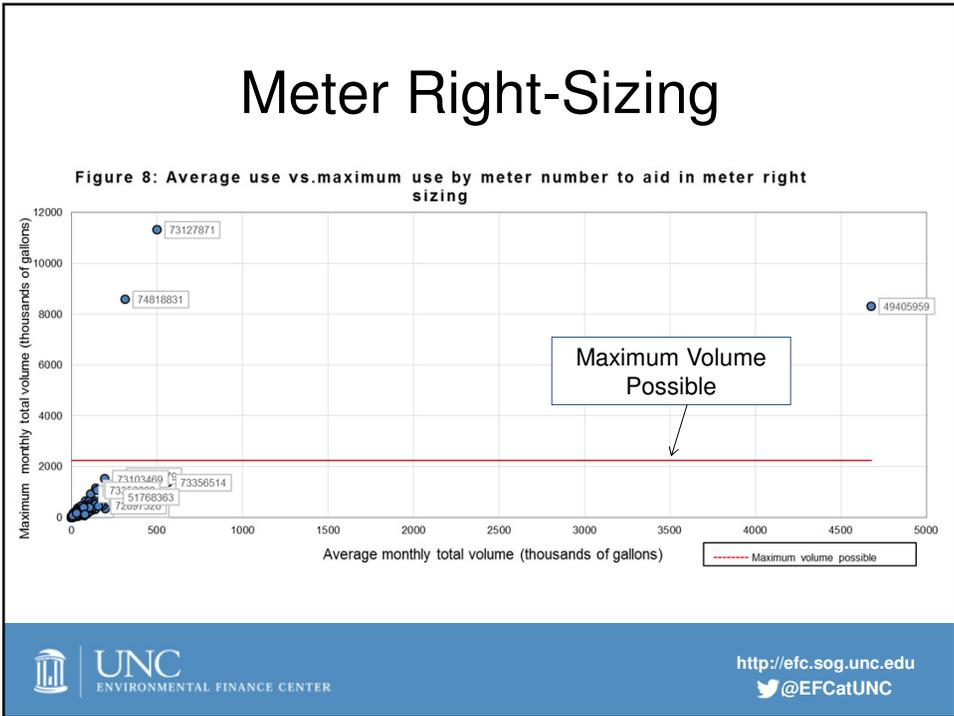
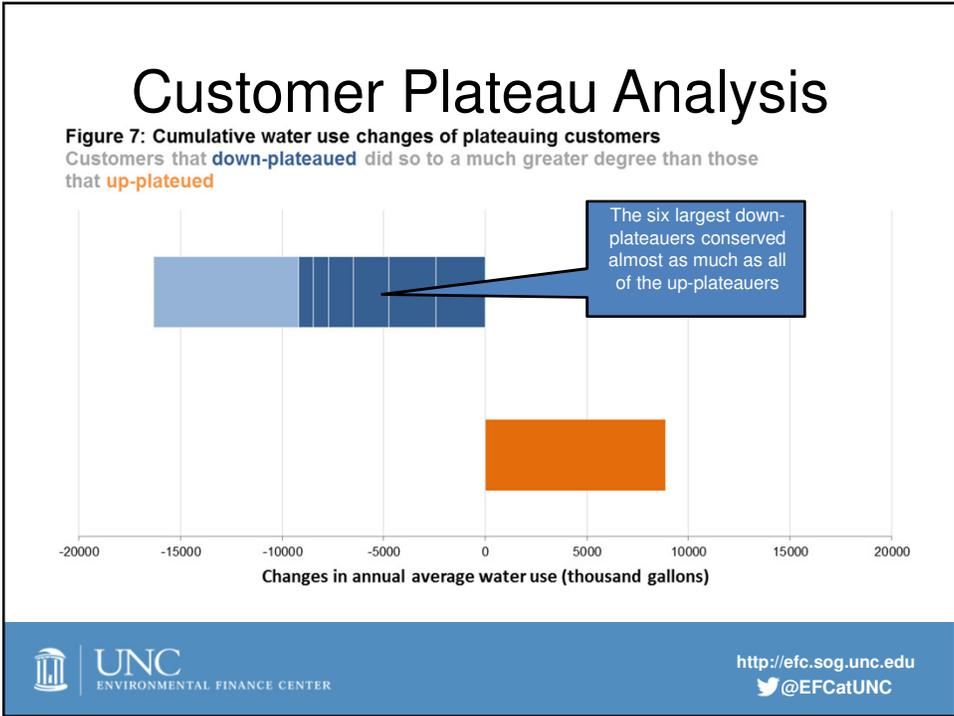
Customer Plateau Analysis



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Acknowledgements



**North Carolina
Urban Water Consortium**

EFC Team: Mary Tiger, Yijing Cheng,
Shadi Eskaf, Jeff Hughes



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When Big Customers Make Big Changes

Print PDF

Non-residential water customers use nearly 43% of public water supplied in the United States[1]. In fact, their portion of public water demand has increased over the past twenty years as water efficiency in the residential sector has improved. Studying customer behavior has become an essential management strategy for most businesses. Yet this group of water customers is largely understudied by utilities, in large part because it is an extremely diverse customer classification[2]. There are many ways to slice-and-dice the data. This blog post describes one way of identifying the big changes that big customers make.

The study: Over the past year, the Environmental Finance Center has worked with the [North Carolina Urban Water Consortium](#) and [Valor Analytics](#) to develop meaningful and feasible metrics to track non-residential water customers' behavior. Utilities can incorporate these metrics into their practices to better understand and anticipate non-residential water customer

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