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Development of a Multi-Family Water Conservation Project Tool

A Capstone Project Report

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by

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Abstract

In order for building operations to be successful long-term, the building must perform well and meet the needs of the occupants in a safe, cost effective manner. Utility costs, especially water costs, impact the performance of the building. Effective water conservation programs can significantly reduce operational costs. Designing and implementing an effective water conservation program for use in multi-family residences throughout a large portfolio poses a number of challenges that impact the success of the water conservation effort. Establishing a targeted program designed to deliver substantial savings requires a strong methodology. Without such methods, the program could be ineffective or fall short and therefore not be sustainable.

To encourage conservation, many federal and state agencies as well as local utilities are providing guidance and incentives for water conservation. The agencies push for conservation to reduce demand for potable water and the need for infrastructure expansions. For the end user, the need for conservation is driven by the cost impacts associated with usage and rates. Water conservation reduces these impacts.

The purpose of this project is to construct a program and tool to be utilized by the multi-family facility manager providing the framework and methodology for creating a sustainable water conservation program specific to her portfolio. The key deliverables are: a written guide explaining the components of a robust water conservation program, an Excel tool for use in estimating the project's return on investment (ROI) and a demonstration of the tool using data from a typical multi-family structure. This tool will be based on real world experience with implementing water conservation efforts across a national footprint of buildings and will be geared toward the typical industry demands of simple installations and measurable water reductions with a high rate of return in a short time-frame.

Introduction

In order for building operations to be successful long-term, the building must perform well and meet the needs of the occupants in a safe and cost-effective manner. A well-maintained building will be able to provide consistent performance and operate reliably within the design specifications. Costs for operating a building include preventative maintenance, repair and replacement of building equipment and utilities including electricity, natural gas and water. Management of these cost categories is required to deliver financially responsible building performance.

Most occupied buildings require water to some degree. Buildings, including multi-family housing, use water for drinking, food preparation, hygiene, cleaning/laundry, HVAC and irrigation. In addition to these intended uses, leaks account for approximately 12% of the water use in a residential building (EPA, n.d.). There have been water shortages in many regions of the country. Drought increases the use of irrigation while decreasing the rainwater available to refill reservoirs. Residential and commercial growth leads to increased local demand for water. Water and sewer rates vary greatly across the country but have risen over 50% on average since 2010 (Walton, 2017). Possible water shortages and volatile rates are potential risks to building performance. Water conservation reduces the amount of water used by a building. Reducing consumption will lower overall water costs especially if the utility charges are based on a tiered structure in which larger use customers pay higher rates. Also, water scarcity may have less impact on consumers that conserve water. For example, utilities often restrict irrigation during drought conditions. If the customer converted to drought tolerant landscaping in order to conserve water, the impact of the irrigation restriction to the customer would be reduced. Water conservation provides a great opportunity for the facility manger to contain cost and reduce risk.

Although the facility manager (FM) has no control over water and sewer rates, the FM can develop a water management plan and incorporate water conservation efforts in the operation of her building. Many water conservation projects, such as, installing low-flow toilets or low-flow sink aerators, have been available for years, but developing a cost-effective and long term sustainable program for a large portfolio of buildings can be challenging. The purpose of this project is to construct a water conservation program and tool for use in managing water use across large multi-family portfolios.

It is assumed that a facility manager, with little to no background in water management, can successfully use this tool to craft a successful and sustainable water conservation project for her building. In order for a project to be successful, it must meet the initial savings estimates, be cost effective to implement and provide long term savings.

Problem Statement

Designing and implementing effective water conservation programs for use in multi-family residences throughout a large portfolio pose a number of challenges that can impact the success of the program. Although water conservation projects have been around for decades, establishing a targeted program designed to meet the water saving target and the required return on investment (ROI) requires a strong methodology. Without addressing the special needs of large portfolios, the water conservation program could be ineffective and therefore not sustainable.

Significance

Effective water conservation programs impact four key components: resource utilization, risk management, cost reduction and sustainability. The amount of available water is essentially fixed while the demand for water is increasing. Per a 2014 report from the Government

Accountability Office, forty states expect to have a non-drought related water shortage within the next ten years (EPA, n.d.). Water conservation reduces the demands for water and reduces stress on the local water infrastructure. This is key to using the country's limited resources in a responsible manner.

Reducing risks are a large part of a facility manager's responsibilities. Potential for water shortages and potential for volatile water rates increase the risk to building performance. Water conservation is one means to reduce these risks. Reducing the need for water reduces the impact of both cost and supply. For example, Western states have seen unprecedented drought over the past few years. California's Governor Brown issued an Executive Order in 2015 requiring fifty million square feet of lawns be removed and replaced with drought tolerant landscapes (2015). In addition to providing immediate water and cost savings due to reduced irrigation, this reduced the risk of costly landscape losses due to lack of available irrigation. This is one example of water conservation reducing risk.

In addition, companies strive to improve their financial performance and robust management of utilities is one means of providing such opportunities. As noted earlier, water and sewer rates have increased over 50% since 2010 (Walton, 2017). These increases can have a substantial influence on a building's economic performance. Water conservation efforts can drive down water and sewer costs. For instance, WaterSense estimates that over 50% of irrigation is wasted (n.d.). Correcting irrigation issues could easily save 15% of the building's total water use. Conservation has a direct impact on building costs and therefore building performance.

Lastly, many companies now have published sustainability goals. Water conservation is one component of a vigorous sustainability plan and a visible sign of good corporate citizenship.

Companies with a primary dependence on water, like beer brewer MillerCoors, and companies that produce products that impact how others use water, like Microsoft, have made significant commitments to reducing water use at their facilities and promoting local and global water stewardship through action, research and product deployment (MillerCoors, 2017; Microsoft, 2018). MillerCoors and Microsoft are two examples of companies publically dedicated to reducing water use. All of these factors combined, resource utilization, risk management, cost reduction and sustainability, determine the success of a building and its impact on the portfolio's performance.

Literature Review

The need for water conservation has existed for many years in order to reduce the use of an essential finite resource, to improve financial performance and to minimize the stress on the water infrastructure. Many organizations, utilities and governmental agencies have published resources to guide owners and managers of multi-family and commercial properties on how to develop a water conservation program. The U.S. Environmental Protection Agency (EPA) and the Department of Housing and Urban Development, various states, such as North Carolina and Arizona, and cities, such as Portland, OR and New York, NY have published information and guides on conservation. In addition, the Pacific Institute completed an extensive study to determine if water conservation can meet the needs of growing water demand in California without increasing infrastructure. Water organizations including The Alliance for Water Efficiency and the American Water Works Association have studied and reported on the effectiveness of water conservation programs for the commercial, industrial and institutional markets. These organizations have developed a number of different approaches to water conservation.

The EPA created the WaterSense program. This is a voluntary program aimed at changing water products and practices in order to reduce water consumption. WaterSense published *WaterSense at Work*. This is a comprehensive 308-page guide to developing a water management program geared toward commercial and institutional facilities. It includes information on making a commitment to water reduction, determining the current use, communicating the goals, creating the action plan, implementing the plan, evaluating the results and celebrating the success of the program (EPA, 2012).

In 2002, the U.S. Department of Housing and Urban Development (HUD) issued *An Overview of Retrofit Strategies: A Guide for Apartment Owners and Managers* and a companion report entitled *Retrofitting Apartment Buildings to Conserve Water: A Guide for Managers, Engineers, and Contractors*. These guides outlined a six-step approach to achieve water savings including information gathering, water audits, savings assessment, strategy selection, implementation planning, and periodic monitoring. These documents also directed property managers to the currently available incentive programs offered through utility providers. The Guide for Managers provided specific information on self-performing the water audits and detailed information on water reduction calculations (Water Resources Engineering, 2002).

The State of North Carolina published a 150-page Water Efficiency Manual in 2009 in order to promote water conservation as part of the state's strategy to meet the increased water demand created by North Carolina's thirty-eight percent population growth from 1990 to 2007. This guide is intended for commercial, industrial and institutional organizations and outlines a six-step approach to water conservation including establishing goals, securing resources, conducting audits, identifying options, implementing projects and tracking results. The manual discusses common options for domestic water use, HVAC, kitchens, laundry, landscaping and

specific industrial applications. This report also provides a robust glossary for those new to water use terminology (NC Department of Environment and Natural Resources, 2009).

The State of Arizona through the AZ Department of Water Resources has made a commitment to "creating a culture of conservation." The state has tools for facility managers that outline a six-step approach for creating a water conservation plan. The steps focus on securing a commitment from top leadership, determining annual water use, completing a water audit, establishing a water budget, creating an awareness program and finally distributing the plan. The State also provides guidance on implementing these steps and provides examples of some rudimentary data collection sheets (ADWR, n.d.).

The City of New York, NY has taken a slightly different approach to encourage water conservation for multi-family housing. In exchange for installing water saving toilets, showerheads and faucet aerators, the building will be billed on a flat fee based on the number of dwelling units and not on metered usage. In addition, monitoring is required to ensure any future changes or repairs still use efficient devices. This is the first program reviewed that is based on replacing metered billings with a flat rate (New York City Water Board, 2015).

The Portland (OR) Water Bureau developed an extensive water conservation program for multiple business segments including commercial and multi-family housing. The commercial program starts with a free water audit performed by the Portland Water Bureau staff. A staff member reviews all available water data from billings to equipment specifications, conducts a site audit, prepares a water balance and determines the costs and savings with various conservation measures. In addition, there are direct incentives for installing low flow devices (City of Portland, 2018). The Bureau reports on the effectiveness of their programs in the *Water Efficiency Program Annual Report*. The goal of the water conservation program is to maintain a

per capita use of 66 gallons per day which has been consistently met (2016). This is a significant reduction from the national average of 81 gallons per capita per day (gpcd) as reported by the U.S. Geological Survey (Maupin, 2014).

In 2003, the Pacific Institute issued the results of a three-year study to determine if water conservation could provide enough water to meet the growing urban water demand in California without building dams or reservoirs. Through extensive analysis, the team determined that almost a third of the water supply could be cost-effectively saved using currently available equipment and technologies. The paper reviewed options for common residential and commercial applications, such as, toilets, showers, sinks, washing machines, dishwashers and leaks. In addition, the team reviewed the water pricing and regulation changes needed to drive conservation. Even as early as 2003, it was clearly determined that significant water conservation was technologically feasible, cost-effective and a sound alternative to searching for additional water sources to meet rising demand (Gleick, 2003).

The programs listed above discuss approaches to water conservation. Organizations dedicated to supporting water issues have studied and reported on the impact and effectiveness of these programs. The Alliance for Water Efficiency (AWE) published a positon paper on water efficiency as an infrastructure investment. They concluded that typical water conservation projects are dependable, scalable and readily deployable. In addition, conservation projects provide substantial economic and employment benefits to the country. Per billion dollars of direct investment, water conservation projects provide between $2.5 and $2.8 billion dollars of economic output, between $1.3 and $1.5 billion dollars of gross domestic product (GDP) and between 12,000 and 26,000 jobs (2017).

The American Water Works Association (AWWA) completed a comprehensive study of water conservation efforts at 383 utilities across the United States and Canada. Although they found water conservation has become an integral part of effective water management, only twenty percent or less of the utilities offered water conservation programs to the Commercial, Industrial, and Institutional (CII) markets. The research indicated there is significant potential in this market, however the complexity of the market and the lack of funding for staff and budgets is an impediment to expanding program offerings. AWWA has recommended further study to help develop streamlined programs and standard water savings estimates for typical equipment used in CII buildings (2015). The reports from these organizations confirm the need for effective and sustainable programs.

WaterSense, HUD, North Carolina and Arizona outlined conservation programs. Although the steps vary slightly, in general, the programs stressed the need to make a commitment to conservation, determine the current water use, audit the equipment and fixtures, create a conservation plan, implement the plan and monitor results. The literature also states that conservation is a key strategy for meeting increased demand. Organizations including the Pacific Institute and the Alliance for Water Efficiency quantified the resource and financial impact of conservation. Individual municipalities, such as, the City of Portland (OR), have reported on the effectiveness of their own conservation programs while the American Water Works Association has studied the effectiveness of utility programs across the country and identified the areas needing improvement and more study.

The density of data on water conservation opportunities for commercial and residential buildings and the extensive information provided by utilities, cities and states and the

preponderance of data indicating that water resource management is a strategic need, confirms that there is significant need for effective water conservation programs.

Purpose

The purpose of this project is to construct a program and tool to be utilized by the multi-family facility manager providing the framework and methodology for creating a sustainable water conservation program specific to her portfolio. This program would provide guidance on the items the FM would need to evaluate in order to establish a program to meet the needs of her buildings. The success of the program would be determined when outcomes are compared to expected performance.

Key Deliverables:

1. Written guide explaining the components of a robust water conservation program suitable and streamlined to the multi-family industry.
2. Excel tool for use in determining benchmarks for existing buildings and target reduction goals.
3. Demonstration of the tool based on data from a typical building.

Definitions and Abbreviations

CCF – Hundred Cubic Feet. Also referred to as HCF. 1 CCF = 748 gallons

CII – Commercial, Industrial and Institutional Market

CMMS – Computerized Maintenance Management System

Fixed charge – Amount charged by a utility for specific services but not impacted by the amount of commodity used.

FM – Facility Manager

GDP – Gross Domestic Product

Gpcd – Gallons per capita per day

KGal – 1,000 gallons

Potable water – Water safe enough for drinking or cooking

Unit Turn – Cleaning and refurbishing an apartment between renters

Volumetric charge – Amount charged by a utility that varies directly with the amount of commodity used.

Assumptions

This project will be constructed based on the following assumptions:

- The program will be developed for use by a facility manager with limited background in water conservation and little experience working with utility companies.
- The program will be designed to be simple to use and quick to implement. The goal of the tool is for significant but timely water conservation results.
- The program is not designed for complex water systems typical of larger facilities. These changes would require extensive engineering design.
- The tool will utilize Microsoft Excel and the user will need basic Excel skills.
- The suggested conservation measures will be limited in scope to items that could be completed by building personnel or contractors.
- It is assumed that there are personnel available at each building with basic maintenance skills.
- These are multi-family buildings with majority of square footage serving residential units, little common area and no commercial kitchens.

Scope / Delimitations

Development of the program and tool will be based on results from completed water conservation projects. The schedule of current water conservation projects is based on a number of company driven factors outside the control of this directed project. The use of the tool will be demonstrated with information typical of a multi-family building.

Methodology

This tool was based on real world experience of implementing water conservation efforts across a national footprint of buildings and was geared toward the typical industry demands of simple installations with quick paybacks. Development of the program and tool involved review of previous projects, for both success against metrics as well as lessons learned from implementation based on discussions with the site FM personnel and the implementation contractor. In addition, information identified through research of other available programs was incorporated as appropriate.

Results

Over the past two years, thirty-four multi-family buildings have received complete water audits to identify and implement water conservation measures. The work was performed by a knowledgeable contractor who specializes in water conservation. On average, the projects saved 16% of total water use after one full year of results primarily by retrofitting toilets, showerheads, and aerators.

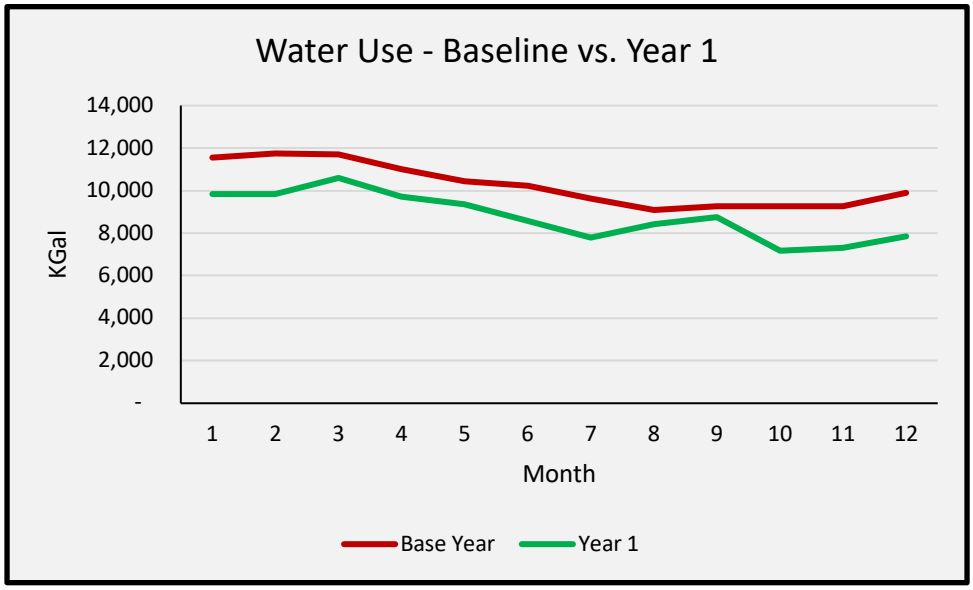

Figure 1: Conservation Project Results

These projects provided ROIs acceptable to the company. A contractor was hired to complete the audits, provide robust water balances for the buildings and implement the actual conservation measures. These projects were heavily monitored including follow up calls with local staff to ensure all new items were functioning as intended and provided acceptable performance for the residents. In addition, water bills were carefully monitored to determine if projects met reduction estimates and if costs and savings were acceptable to the company. Although these projects have been successful in supplying both water and cost savings as well as acceptable ROIs, the audit, review and implementation stages took significant time. The audits and the actual results have provided enough information and experience in order for the project manager to streamline the process and move the management of the program to the local FM.

In order for the FM at the building to manage a water conservation effort, she will need a concise written plan and a tool to assist with the surveys and savings and cost calculations. The Building Manager's Quick Guide to Water Savings for Multi-Family Buildings is shown in Appendix One. The Guide walks the FM through the five steps needed to develop and

implement a water conservation project. The five steps are: determine water and sewer costs, survey water using equipment and fixtures, identify savings options and costs, implement capital projects and best practices and monitor results. Basic information for each step is given in the guide with detailed information in the appendices. The Best Practices, which are crucial to long term water conservation, are identified in the Guide. There are links to resources for further information. This Guide will provide the information needed for the FM to review the facility and determine the best options for conservation in a timely manner. In addition, there is an Excel tool to help guide the FM through the survey and calculations needed to determine which are the best options for the specific building. The Excel tool can be found in file: Water Quick Savings Opportunity Check IUPUI Tool 2018 04 09.xlsx.

Since the time frame of the project did not allow the Guide and tool to be piloted in an actual building, information consistent with a typical building and using actual water and sewer rate schedules, has been used to demonstrate how an FM would proceed through the steps. Flow rates for the existing equipment are consistent with equipment available at the time of construction and for equipment that would have been replaced over the years. Building details are shown in Table One. Additional details, as well as the final results, are captured in the completed Excel file: Water Quick Savings Opportunity Check IUPUI Sample Building 2018 04 09.xlsx.

Building Location	Colorado Springs, CO
Year Built	1990
Age of Building	28 Years
Utility	Colorado Springs Utilities
Total Number of Apartments	100
Number of Studio Apartments	20
Number of 1 bed / 1 bath Apartments	60
Number of 2 bed / 2 bath Apartments	20
Irrigation System	Yes
Cooling Tower	No

Table One: Building Details

The FM would start with reviewing the Guide then work through the Excel tool. Information on a sampling of existing equipment is entered into the tool. Instructions for entering the data is included in the Guide and on the Excel worksheets themselves. The Estimated Savings tab provides the following estimates: annual cost savings, project cost, project ROI, annual water savings and overall percent water savings. This example requires $13,683 in project costs and provides annual savings of $12,061, project ROI of 1.1 years, annual water savings of 4,818 KGal which equates to a 15% overall usage reduction. These results would provide the FM all the information needed to determine if the savings and costs meet the company's metrics for projects. For example, the company may have an ROI requirement for funding approval. It also provides insight into costs required. Again, these projects can be completed all at once for the quickest savings or completed during unit turns. The information provided from the tool would give the FM the information needed to review in light of the building's current expense and capital budgets.

Conclusion

Large portfolios of buildings spread across a national footprint inherently create challenges for rolling out facility programs. There could literally be hundreds of facility managers involved in maintaining the buildings. Designing a water conservation program that can be implemented quickly and easily at the building level must keep in mind the complexities of large portfolios. Since water conservation may be a small part of the FMs' responsibilities, the information for such a program must be concise and easy to read, clearly define what needs to be done, provide the financial information required to scope the project and be straightforward to implement and maintain.

The Building Manager's Guide and the associated Excel tool meet these requirements. Since the information in the Guide is based on actual installations, the research and testing has already been done for the FM. The FM can confidently take the process from the Guide and use it to implement a water conservation program at the local level. The use of the Guide, the tool and the Best Practices will provide the information required for a facility manager to successfully implement and maintain water conservation at their facility.

Appendix One: Building Manager's Quick Guide to Water Savings for Multi-Family Buildings

1. **Introduction**
2. **Five Steps**
3. **Best Practices**
4. **Resources**
5. **Appendix – Additional Support Information**
    a. **Step 1 – Reviewing water and sewer bills**
    b. **Step 2 – Surveying existing equipment and fixtures**
    c. **Step 3 – Calculating savings and costs**
    d. **Step 4 – Implementation**
    e. **Step 5 – Monitoring progress**

Building Manager's Quick Guide to Water Savings for Multi-Family Buildings

The ability to provide safe and reliable water service in an effective and efficient manner is critical to the successful operation of a multi-family residence. Most indoor water is used by toilets, showers, faucets, clothes washing and leaks. Larger buildings may require water to support central HVAC equipment, such as, cooling towers. In addition, irrigation requirements can have a significant impact on overall water use depending on the region, size of the area to irrigate and the controls and condition of the irrigation system. Figure One shows the typical indoor water use in residential buildings in the United States (EPA, n.d.). Based on the pie chart, it is clear that upgrading and maintaining the bathroom fixtures (toilets, showers, sinks) can have a substantial effect on overall water use.

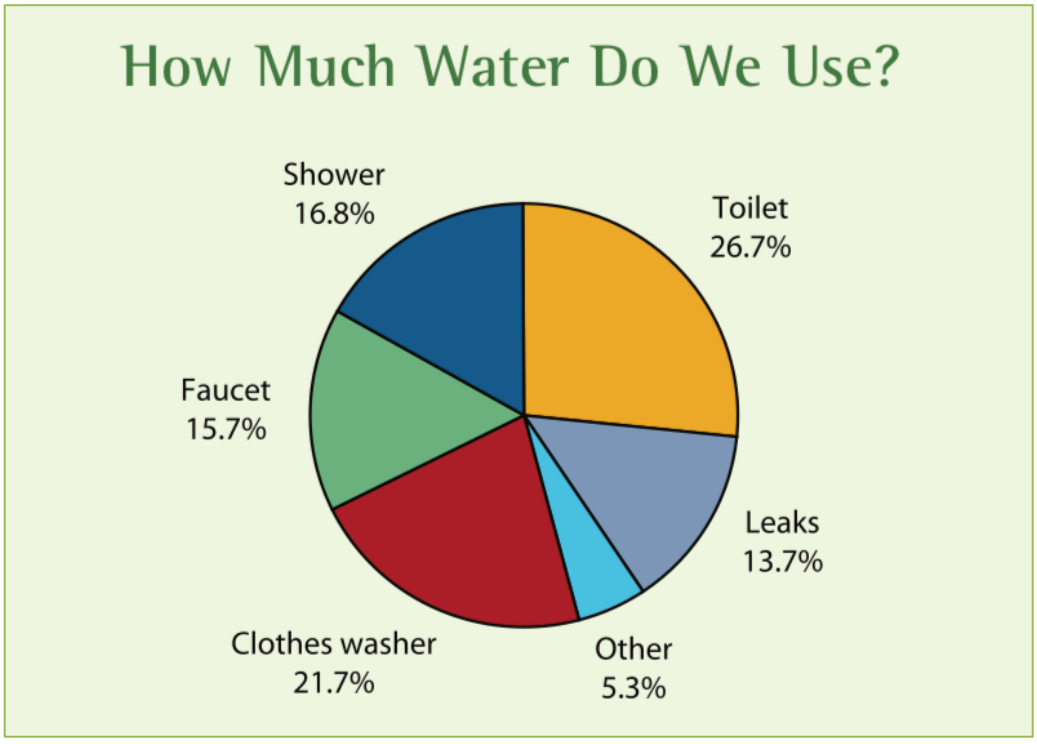

Figure 1: Typical Residential Indoor Water Use in the United States as retrieved from https://www.epa.gov/sites/production/files/2017-03/documents/ws-facthseet-indoor-water-use-in-the-us.pdf.

A water conservation program can significantly reduce water and sewer costs. In addition, a reduction in overall water use will reduce the impact of rising water and sewer rates and potential local shortages while saving a precious natural resource. Successful and cost-effective water reductions can be obtained from a mix of best practices and water conservation projects. This includes no and low-cost options as well as capital equipment upgrades. By working through the Five Steps shown below, the FM can identify and quantify water savings opportunities in the building. Additional information for each step is available in the Appendices. Record necessary information in the attached Excel tool. When the information is complete, the tool will estimate the project cost, water and cost savings and ROI.

The Five Steps

1. Understand annual and seasonal water use and determine the volumetric cost of water and sewer.
    a. Review 12 months of utility bills to understand typical and seasonal water use.
    b. Review the monthly bills to determine the volumetric water and sewer rates.
        i. Input information on the General Information tab of the tool.
2. Survey water using equipment and fixtures.
    a. Quantify the number and type of water fixtures in the building.
        i. Input the number of apartments on the Fixture Count tab of the tool.
        ii. Input the flow rates for the equipment surveyed in the Resident Room Survey tab of the tool.
    b. Identify any major pieces of water using equipment, such as, cooling towers.
        i. Cooling tower system checks are identified shown on the Cooling Tower Equipment Check tab of the tool.
    c. Inspect and repair or adjust irrigation system as needed.

        i. Irrigation checks are identified on the Irrigation Equipment Check tab of the tool.

3. Calculate costs and savings of the project.
    a. Identify which fixtures/equipment should be upgraded, maintained or are functioning as intended.
    b. Call the local water and natural gas utility to check for rebate programs. Many utilities offer free or low-cost toilets, showerheads and aerators. Natural gas suppliers may have programs for showerheads or aerators as reducing water use in these devices also reduces natural gas for hot water.
    c. Calculate costs and savings.
        i. Input the estimated cost to upgrade or replace fixtures on the Estimated Savings tab of the tool. The sheet will calculate the Return on Investment (ROI). This can help determine if the item should be upgraded or replaced.
    d. Based on company's funding and saving's goals, determine if equipment will be replaced at one-time to supply the quickest cost savings or during unit turns to spread out implementation costs.
4. Implement best practices and capital project selections.
    a. Implement Best Practices – See Best Practice Page
    b. Implement capital projects - Upgrade toilets, showerheads and aerators as identified.
5. Monitor the results.
    a. Continue to review the water and sewer bills for twelve months after the implementation is complete.

b. If results are not meeting expectations, review installations to determine if there are any issues with the changes. Adjust as needed. Note: The Estimated Savings tab of the tool estimates the water savings. Compare actual savings to estimated savings.

BEST PRACTICES

1. Encourage residents to report leaks promptly and develop a process to repair items quickly.
2. Train maintenance staff to routinely check for leaks during building walk-throughs.
3. Initiate a preventative maintenance task to check toilets for flapper leaks and proper valve function at least annually.
4. Initiate a preventative maintenance task to check entire irrigation system for leaks, broken heads and proper scheduling at least monthly during irrigation season.
5. Check water using devices during unit turns. Ensure there are no toilet leaks, showerhead is rated at 2.0 gpm or less, bathroom faucets have a 1.0 gpm or less aerator, and kitchen sinks have a 1.5 gpm or less aerator installed. Upgrade as appropriate.
6. Monitor water bills for unusual usage and investigate as needed.
7. If there is a fire service meter, check monthly bills to ensure there is no usage unless the system was discharged or emptied for repair. If there is unexpected usage, check for leaks.
8. For buildings with cooling towers, ensure proper operation. This can be managed in-house or through a contractor as appropriate for the building.
9. Implement a procurement strategy to purchase WaterSense labeled equipment or equivalent as devices are replaced.

Resources for the Facility Manager

The EPA's WaterSense website provides a wealth of information and tools to reduce water use in your facility. The links below provide succinct and straightforward information and guidance on the main water savings opportunities in multi-family including bathroom fixtures, kitchen and laundry, irrigation and HVAC.

WaterSense Website: Click here.

WaterSense Bathroom Resource Guide: Click here.

WaterSense Landscaping and Irrigation Guide: Click here.

WaterSense Residential Kitchen and Laundry Guide: Click here.

WaterSense Mechanical Systems Guide: Click here.

Appendix A: Step 1

Understanding the water and sewer bills.

Domestic water charges typically include four components: fixed water charges, volumetric water charges (charges based on the amount of water consumed), fixed sewer charges and volumetric sewer charges (sewer charges typically based on amount of water consumed). It is common for the water and sewer charges to be contained on the same bill. In some areas, water and sewer are billed separately. Dedicated irrigation meters will not have a sewer component as the water does not enter the sewer system.

Obtain copies of the water and sewer bills. Twelve months of bills is preferable to understand seasonal water use. Be sure to check the units of measure. If they are not identified on the bill, call the utility to confirm. Common consumption units are gallons, thousand gallons (KGal), cubic feet (CF) and hundred cubic feet (written as CCF or HCF). Note: 1 CCF = 748 gallons. From the bills, determine the volumetric rate for both the water and sewer usage in $/units. Fixed charges will not change and therefore will not be impacted by the conservation measures. Water and sewer rates vary significantly across the country and may make some conservations measures much more cost effective in one part of the country vs. another region. The relationship between water and sewer rates can also vary widely. Sewer rates can be substantially less the water rate, about equal to or substantially greater than the water rate. Understanding the actual volumetric rates will help determine the estimated financial impact of the changes.

Again, if it is difficult to determine the volumetric rates from the utility bill, contact the utility and have them explain the water and sewer rate schedule. Occasionally, sewer charges for multi-family residences are based on the number of apartments and are therefore are completely fixed charges that will not be impacted by conservation measure. If this is the case, ensure that the utility is billing on the proper number of apartments.

Understanding the impact of specialty meters

In addition to the domestic meters measuring the water supply to the building, the site may have fire service meters, irrigation meters, and/or cooling tower deduct meters. Some utilities will have a meter on the water used for fire suppression. It is good practice to confirm on the monthly bill that there is no usage on this meter unless the fire suppression system has been activated or emptied/refilled for service. If unexpected usage is shown, investigate for leaks.

Dedicated irrigation meters can provide significant cost savings and operational insight for a building. Since irrigation water soaks into the ground and does not enter the sewer system, the utility does not charge for sewer. In addition, irrigation meters provide insight into actual irrigation usage and can indicate when usage is outside of expected seasonal usage. If there are no irrigation meters installed, the FM can determine if having an irrigation meter installed is a cost-effective option.

Lastly, some utilities allow cooling tower deduct meters. These meters are typically on the make-up and blow-down on the cooling tower. These readings can be used to calculate the amount of water lost to evaporation and therefore not sent to sewer. Again, the utility can deduct this amount from the sewer charges. Not all utilities have a program for cooling tower evaporation credits, but it is worth investigating if the building has a cooling tower.

Appendix B: Step 2

Understanding Water Use Within the Building.

Survey the building to determine the major water use fixtures and equipment in the building. For multi-family, the major consumers are usually toilets, showers, sinks, irrigation, HVAC and leaks. Follow the spreadsheet to determine water use for major devices. Record typical water flow rates for toilets, showers and sinks. Tank toilets are typically stamped either on the neck of the toilet bowl or inside the tank with the flow rate. Although the stamped flow rates shown on toilets indicate design

flow, if the valve or flapper is worn or malfunctioning, flush rates can easily be double design. Sink aerators and showerheads may have flow rates stamped on the device. If not, a simple flow rate bag can be purchased for use in estimating flow rates. It is best to sample about 10% of the fixtures to get a good understanding of the fixtures throughout a building.

Note any large water using HVAC equipment like cooling towers. Ensure the cooling tower has regular maintenance as issues with the cooling tower can result in significant water loss. A vendor should check the cooling tower at least monthly to confirm it is performing properly.

In regard to irrigation, either personally or with the landscaper, check the irrigation system for leaks and broken heads and that the irrigation schedule is appropriate for the season. Repair or replace any damaged items quickly.

Appendix C: Step 3

Step 3: Calculate Cost and Savings of Opportunity.

At this time, the FM needs to review the existing equipment and determine if items should be replaced or maintained. Using the Excel tool, input information on the current and recommended fixtures. Include the installed cost of any new fixtures. The tool will calculate the return on investment for each item as well as for the project overall. Based on the company's requirements for payback, the FM can determine when it is best to replace an item and when it is best to retrofit the device (replace toilet valves and flappers, for example). The FM can also determine if it would be better to do all work at once which provides the quickest savings or complete during unit turns. Savings would then be determined by how many units are turned in a year.

Appendix D: Step 4

Step 4: Implement Best Practices and Capital Project Selections

Now, it is time to implement the Best Practices and capital improvements. Work can be completed in-house if staff has the time and skills to complete the work. Outside contractors can be useful if funding allows. They have the ability to come in and complete the work all at one time whereas in-house labor may have to complete the work around their daily activities. If there is a computerized maintenance management system (CMMS), preventative maintenance (PM) tasks should be entered to ensure equipment is checked at regular intervals. See Best Practice sheet for details. Work with purchasing to confirm that water using fixtures and equipment will be WaterSense certified.

Appendix E: Step 5

Step 5: Monitor Savings for next Twelve Months

Although these measures have been thoroughly tested, it is good practice to confirm performance and savings are as expected. Check in with residents to ensure new or retrofitted equipment is performing satisfactorily. Monitor the water use for the next twelve months. Compare each bill with the prior year's bill covering the same time-frame. When reviewing usage, be sure to note the days of service. These can vary significantly depending on the utility. The monthly bills can be compared by dividing usage by the days of service. This will provide the usage per day which can be compared directly between bills.

Total Billed Usage / Number of days of service = Usage / Day

If usage has not dropped as expected, check to ensure new equipment has remained in service, for example, confirm residents have not replaced showerheads or removed aerators. Confirm toilets are functioning as intended. If the incorrect valve or flapper was installed, actual water usage can increase.

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