Water Conservation Best Management Practices

Best Management Practices for Municipal Water Users

Texas Water Development Board

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Content List

1.0 Introduction

Water consumption by water utilities serving municipal water customers is driven by a wide variety of domestic, commercial, industrial and institutional needs. BMPs have been developed for utilities to both improve water use efficiency of their own operations and for programs to improve the efficiency of their customers.

It is important that water utilities focus on the efficiency of their supply operations while promoting water efficiency to their customers. A utility can reduce water loss through careful and regular monitoring of its water delivery systems through the System Water Audit and Water Loss BMP. In addition, the Water Conservation Pricing BMP can provide an effective method of encouraging water efficiency by the customer through feedback from the cost of the water to the user. The Prohibition on Water Wasting BMP can help send a message to users about the value of water as well as educate the general populace about simple steps to save water.

Despite the variety of water uses and numbers of water users, many patterns of water use, especially in domestic water use are common. As a result a number of conservation measures have been developed in municipal settings over the past several decades to reduce the total gallons consumed for daily activities without reducing the benefit of the water used. The Showerheads, Faucet Aerators and Toilet Flapper Retrofit BMP and the Residential Toilet Replacement Programs BMP focus on indoor water use. The Residential Clothes Washer Incentive Program BMP encourages the installation of water efficient clothes washers.

The School Education BMP affects water consumption through changes in behavior as students learn about water resources and the wise use of water. The Water Survey for Single-Family and Multi-Family Customers BMP educates customers about specific water saving opportunities as well as water wasting practices which may be present in their home or business.

Outdoor water uses driven by climatic differences, and water needs of different plants, and used for diverse purposes result in BMPs which are focused on good landscape management principles. The Landscape Irrigation Conservation and Incentives BMP focuses on water savings that can be obtained through efficient operation of automatic irrigation systems, while the Water Wise Landscape Design and Conversion Programs BMP focuses on landscape materials.

A utility can reduce water loss through careful and regular metering of water delivered to billed as well as unbilled water uses and through proper maintenance of meters as through the Metering of All New Connections and Retrofit of Existing Connections BMP. For agencies or utilities offering water to wholesale customers who in turn serve retail customers, the Wholesale Agency Assistance Programs BMP offers methods for promoting water conservation among the retail water utilities. In addition, the Conservation Coordinator BMP can provide an effective method of ensuring that the utility's conservation programs are well administered and

effective. The Reuse BMP outlines how utilities can make more efficient reuse of their existing supplies.

The Public Information BMP can affect water consumption through changes in behavior as customers learn about water resources, the wise use of water and the utility's conservation program. The Rainwater Harvesting/Condensate Reuse BMP focuses on water savings that can be obtained through capturing rainwater or the condensate from large cooling systems while the New Construction Graywater BMP focuses on reuse of water which has been used in washing clothes.

Commercial water uses also have a variety of practices and equipment that can benefit from efficiency measures. The Municipal BMPs also include those focused on good water use practices for Park Conservation and for Conservation Programs for Industrial, Commercial, and Institutional Accounts.

Best-management practices contained in the BMP Guide are voluntary efficiency measures that save a quantifiable amount of water, either directly or indirectly, and can be implemented within a specified timeframe. The BMPs are not exclusive of other meaningful conservation techniques that an entity might use in formulating a state-required water conservation plan. At the discretion of each user, BMPs may be implemented individually, in whole or in part, or be combined with other BMPs or other water conservation techniques to form a comprehensive water conservation program. The adoption of any BMP is entirely voluntary, although it is recognized that once adopted, certain BMPs may have some regulatory aspects to them (e.g. implementation of a local city ordinance).

2.1 Conservation Coordinator

Applicability

The designation of a conservation coordinator is required by House Bill 1648, effective September 1, 2017, for all retail public water utilities with 3,300 service connections or more. This best management practice (BMP) outlines suggested duties and details for utilities regarding conservation coordinators.

Smaller utilities with less than 3,300 service connections may choose to share costs with other similar-sized utilities by jointly contracting with a conservation coordinator. Wholesale water suppliers may hire or contract with a conservation coordinator to serve their customer retail water utilities if these retailers fall below the service connection threshold that triggers the utility-specific requirement.

Why this is a Strategic BMP

The Texas Water Code §11.002 states that BMPs are voluntary efficiency measures that save "a quantifiable amount of water, either directly or indirectly...". BMPs that are useful in implementing other measures but for which quantifiable savings cannot be identified are described as Strategic BMPs.

Description

The conservation coordinator coordinates water utility staff, data from various departments, and other resources as necessary for the purpose of developing, implementing, and evaluating the effectiveness of the utility's water conservation plan. The designated conservation coordinator may have other duties and/or titles within the utility regardless of size. Other duties may include responsibility for drought contingency plans or preparation and submittal of annual conservation status reports to utility management and the Texas Water Development Board. Additionally, the conservation coordinator will prepare the annual conservation budget and promote the value of water conservation programs both within the utility and throughout the utility's service area. The conservation coordinator often becomes the utility spokesperson on conservation-related issues and, therefore, might be assigned to participate in regional water planning conservation and drought-period initiatives. When appropriate, the conservation coordinator will manage other conservation-related staff, consultants, and contractors.

Implementation

Implementation should consist of designating a conservation coordinator and support staff (when needed), whose duties can include the following:

1) Select and manage the implementation of conservation BMPs as part of the utility's conservation program;

2) Document water conservation BMP and program implementation status in relation to state requirements;
3) Communicate and promote water conservation to utility management;
4) Coordinate conservation BMPs with utility operations and planning staff;
5) Prepare annual conservation program budget;
6) Manage consultants and contractors assisting in various aspects of the water conservation program;
7) Develop public outreach and marketing strategies for water conservation support and uptake;
8) Participate in regional water conservation planning and drought planning initiatives; and
9) Conduct regular conservation BMP and program evaluations to determine water savings, benefits of savings as compared to program implementation costs, etc. and need for adjustments.

Scope and Schedule

For water utilities with 3,300 service connections or more, the name of the conservation coordinator shall be reported, in writing, to the Executive Administrator of the Texas Water Development Board to maintain compliance with HB 1648. Reporting can be accomplished online when the utility submits its Water Conservation Plan or Conservation Annual Report.

Measuring Implementation and Determining Water Savings

To track this BMP and compliance with HB 1648, the utility should gather the following documentation:

1) Description of the conservation coordinator position,
2) The date the conservation coordinator was appointed or hired, and
3) The utility water conservation plan, for submission to the Executive Administrator of the TWDB at required frequencies.

Water savings are not quantified for having a conservation coordinator. The conservation coordinator, required of utilities with 3,300 service connections or more, is considered an essential or foundational BMP for smaller utilities that will benefit from having the coordinator in place to manage the utility's conservation program. The coordinator leads and/or assists in the implementation of other water conservation BMPs, and this additional effort can be as essential to water savings accrued by the implementation of the BMPs that are offered by the utility.

Cost-Effectiveness Considerations

As noted above, it will be difficult to do a true cost-effectiveness analysis for assigning the role of conservation coordinator. The coordinator, however, is essential to the successful implementation of other BMPs that the utility chooses to undertake. There will be nonfinancial benefits as a result of having a conservation coordinator, such as an enhanced public image

developed through increased outreach and visibility when emphasizing the entire conservation program. The salary and overhead expenses associated with the coordinator could be the primary costs that would be incurred by implementing the Conservation Coordinator BMP unless an existing staff person with other responsibilities assumes this new role. Other costs incurred that are associated with developing, implementing, and evaluating individual conservation BMPs can be compared to the value assigned to water savings in the short term and other factors related to long-term savings (e.g., delaying or downsizing future capital projects that expand system capacity as a result of successful demand management). Depending on the size and scope of the water conservation program, the coordinator position can be full-time, part-time, shared with others, or contracted out.

References for Additional Information

Alliance for Water Efficiency, Water Conservation Tracking Tool[1].
http://www.allianceforwaterefficiency.org/Tracking-Tool.aspx

Alliance for Water Efficiency, AWE Resource Library, Water Conservation Programs.
http://www.allianceforwaterefficiency.org/Water_Conservation_Programs_Library_Content_Listing.aspx

Handbook of Water Use and Conservation by Amy Vickers, 2001. Amherst, MA: WaterPlow Press. ISBN1-931579-07-5

American Water Works Association (2006). Manual of Water Supply Practices M-52: Water Conservation Programs – A Planning Manual.

Memorandum of Understanding Regarding Urban Water Conservation in California. Council, 1999 (last amended in 2014).
http://www.cuwcc.org/Portals/0/Document%20Library/About%20Us/MOU/MOU_09-17-14.pdf

Groundwater Conservation Plan, Edwards Aquifer Authority (as adopted in 2014).
http://www.edwardsaquifer.org/permits/groundwater-conservation-plan

Texas Water Development, Water Conservation Resources & Planning Tool.
http://www.twdb.texas.gov/conservation/municipal/plans/index.asp

[1] The tool can help the conservation coordinator plan for implementing the most appropriate conservation programs for their utility.

APPENDIX A:
SAMPLE JOB DESCRIPTIONS

Sample Job Description #1:

Water Conservation Coordinator - Senior

General Overview
At a senior level, provides expert counsel and information regarding water conservation. Develops and implements water conservation programs. Fosters water conservation awareness among relevant stakeholders and the general public. Acts as water conservation advocate at regulatory meetings and functions. Represents the organization at public speaking engagements and through written outreach. Collaborates with other organizations and entities on water conservation programs. Provides input on policies, rules, and strategic planning related to conservation. Utilizes in-depth knowledge of best practices and experience in discipline to provide and improve services. Takes a new perspective to solve complex problems. Works independently under minimal guidance. Acts as a resource for colleagues with less experience. May direct the work of other staff members.

- Reviews and provides technical assistance to raw water customers with planning and implementation of their water conservation and drought contingency plans.
- Develops, designs, and implements water conservation programs.
- Provides conservation presentations to homeowners and the public. Writes articles related to landscapes and landscape irrigation. Develops and delivers presentations on various water conservation topics to internal and external stakeholders.
- Researches and provides input into organizational policy, rules, and strategic planning related to long range water conservation and reuse.
- Serves as a representative of the organization promoting water conservation to communities, neighborhoods, educational institutions, and public entities. Participates in outreach events in the community, including staffing booths and giving presentations on water conservation topics. Travels independently or with other staff to various locations as necessary.
- Applies state and local government laws and abides by regulatory and legislative practice.

This general overview only includes essential functions of the job and does not imply that these are the only duties to be performed by the employee occupying this position. Employees will be required to follow any other job-related instruction and to perform any other job-related duties requested by supervisor or management.

Minimum Qualifications
A degree(s) in business, planning, social science, environmental management, or relevant field may be substituted per organizational guidelines for years of experience.

Sample Job Description #2:

Director - Conservation

JOB SUMMARY

The Director - Conservation is a senior management-level professional responsible for strategic policy and program initiatives that achieve short- and long-term water conservation goals. S/he leads all aspects of conservation planning and project development from initial planning and conceptual development through project implementation. In addition, s/he leads the system in all aspects of drought management and enforcement and serves as the principal spokesperson for the system on conservation and drought-related issues. The Director-Conservation reports to the Vice President-Strategic Resources & Business Planning.

ESSENTIAL FUNCTIONS

- Develops and recommends policies and programs to meet conservation goals and obtain the best value for conservation funds.
- Develops, recommends, and implements departmental policies and procedures to maximize use of physical, fiscal, and personnel resources.
- Supervises, selects, develops, trains, determines compensation, and evaluates personnel.
- Prepares and makes presentations to the Board of Trustees, Executive Management, elected officials, and to the public via newspaper, radio, and television.
- Develops and evaluates various water conservation policies and technologies.
- Develops and maintains diverse stakeholder partnerships with community groups, industry and government, and the system's principal public advisory group on conservation, the Community Conservation Committee.
- Obtains and interprets public input to evaluate conservation programs through a variety of mechanisms to include survey, evaluation of conservation events and programs, and public presentations.
- Demonstrates continuous improvement of conservation through analysis conservation of current demand and program impact utilizing accounting, statistical, and cost benefit analysis.
- Develops, negotiates, and monitors contracts.
- Develops and participates in conceptual long-term planning to meet goals in water supply plan.
- Forecasts, allocates, and monitors the human, physical, and financial resources for the assigned area as well as manages the use of conservation revenue.
- Coordinates and communicates department activities with other internal departments and groups.
- Keeps abreast of scientific, political, and legal issues relating to implementation of conservation programs, drought management, and new technology.

DECISION MAKING

- The Director – Conservation works under limited supervision.
- Supervises: 20 - 25 employees.

MINIMUM REQUIREMENTS

- Bachelor's Degree in Urban Planning, Public Administration, Engineering, Environmental Science, Business Administration, Geology, or other related field from an institution accredited by a nationally recognized accrediting agency.
- Eight years progressive experience in budgeting, management, supervision, design, operations, and construction of water infrastructure-type projects including five years of supervising personnel, project development, budgeting, and strategic planning.
- Able to use word processing, spreadsheet, database, and presentation software.
- Valid Class "C" Texas Driver's License consistent with the organization's driving policy.

PREFERRED QUALIFICATIONS

- Master's Degree in appropriate field.
- Experience working with a variety of media to include radio, television, and print.

JOB DIMENSIONS

- Contact with internal and external customers, media, consultants, stakeholders, and elected officials.
- Communicates effectively, verbally and in writing.

PHYSICAL DEMANDS AND WORKING CONDITIONS

Working conditions are primarily in an office environment.

May be required to work hours other than regular schedule including nights and weekends with occasional travel.

Sample Job Description #3:

Conservation Program Coordinator

Purpose:

Works under minimal direction, responsible for coordinating energy, water, or natural resource conservation programs, projects, and plans

Duties, Functions, and Responsibilities:

Essential duties and functions, pursuant to the Americans with Disabilities Act, may include the below. Other related duties may be assigned.

1. Designs, develops, implements, and evaluates educational or outreach programs that promote energy, water, or natural resource conservation awareness and initiatives.
2. Coordinates and manages educational or outreach events, small projects, contracts, marketing, and on-line literature content to promote energy, water, or natural resource conservation awareness and initiatives.
3. Analyzes energy, water, or natural resource conservation-related research findings to inform or make recommendations on program structure or program delivery to city leadership and other stakeholders.
4. Develops, establishes, and manages service agreements with other programs, departments, and agencies.
5. Researches energy, water, or natural resource conservation policies, best practices, and legislation to recommend changes to conservation initiatives.
6. Prepares studies, reports, memoranda, briefs, or other written materials on energy, water, or natural resource conservation to inform customers, city leadership, and other stakeholders.
7. Provides analytical support for policy briefs and program development related to energy, water, or natural resource conservation.
8. Prepares grant applications to obtain funding for programs related to energy, water, or natural resource conservation.
9. Reviews permit or plan revisions with project engineers and contractors.
10. Reviews, evaluates, and recommends changes to technical reports, studies, and other departmental written materials. Provides technical advice to conservation program personnel.

Responsibilities - Supervisor and/or Leadership Exercised:

May provide leadership; lead cross-functional and departmental conservation project teams; work assignments; evaluation; training; and guidance to others.

Knowledge, Skills, and Abilities:

Must possess required knowledge, skills, abilities, and experience and be able to explain and demonstrate, with or without reasonable accommodations, that the essential functions of the job can be performed.
Knowledge of energy or water efficiency technologies, practices, programs and rebate requirements.
Knowledge of applicable building codes, and of energy or water retrofit requirements and specifications.
Knowledge of safety practices and procedures.
Knowledge of department energy or water resource initiatives and targets.
Knowledge of construction materials, practices, and procedures.
Knowledge of federal, state and local laws.
Knowledge of city practices, policies, and procedures.
Skill in oral and written communication.
Skill in using computers and related software.
Skill in handling multiple tasks and prioritizing.
Skill in data analysis and problem solving.
Skill in planning and organizing.
Ability to negotiate.
Ability to determine quality of materials, workmanship, and compliance with specifications.
Ability to handle conflict and uncertain situations.
Ability to lead cross-functional and departmental project teams.
Ability to operate and maintain testing and diagnostic equipment.
Ability to use graphic instructions, such as blue prints, schematic drawings, plans, maps, or other visual aids.
Ability to work with frequent interruptions and changes in priorities.
Ability to establish and maintain good working relationships with city employees and the public.

Minimum Qualifications:

Graduation with a Bachelor's degree from an accredited college or university with major coursework in Architecture, Business, Environmental Studies, Natural Science, Planning, and Resource Management or in a field related to the job, plus five (5) years of related experience.
Masters Degree may substitute for experience up to two (2) years.
Experience may substitute for education up to the maximum of four (4) years.

Licenses and Certifications Required:

None.

This description is intended to indicate the kinds of tasks and levels of work difficulty required of the position given this title and shall not be construed as declaring what the specific duties and responsibilities of any particular position shall be. It is not intended to limit or in any way modify the right of management to assign, direct, and control the work of employees under supervision. The listing of duties and responsibilities shall not be held to exclude other duties not mentioned that are of similar kind or level of difficulty.

Sample Job Description #4:

Environmental Conservation Program Manager

Purpose:

Under minimal supervision, plan and direct environmental and/or conservation program strategies to ensure compliance with federal, state, and local regulations. Develop and implement program policies, procedures, and systems to maintain and enhance the organization's adherence and responsiveness to environmental and conservation issues.

Duties, Functions and Responsibilities:

Essential duties and functions, pursuant to the Americans with Disabilities Act, may include those described below. Other related duties may be assigned.

1. Negotiate regulatory compliance issues with state and federal environmental agencies
2. Manage and review programs/projects
3. Administer programs
4. Market programs
5. Develop, monitor, and evaluate program and resource budgets
6. Develop, manage, and administer contracts
7. Develop training for internal and external customers
8. Develop and maintain program policies and standard operating procedures
9. Develop, review, interpret, and rewrite ordinances, codes, and regulations
10. Perform public relations functions
11. Participate in short and long-range planning activities
12. Develop and manage quality control initiatives
13. Develop and conduct audits
14. Assist with evaluating bid proposals
15. Perform supervisory duties i.e., hiring, promoting, disciplinary actions, performance evaluations, etc.

Responsibilities - Supervisor and/or Leadership Exercised:

May be responsible for full range of supervisory activities including section training, evaluation, counseling, and recommendation for dismissal.

Knowledge, Skills, and Abilities:

Must possess required knowledge, skills, abilities and experience and be able to explain and demonstrate, with or without reasonable accommodations, that the essential functions of the job can be performed.

- Knowledge of supervisory and managerial techniques and principles.
- Knowledge of applicable processes, techniques, and methods.
- Knowledge of city practices, policies, and procedures.

- Knowledge of supervisory and managerial techniques and principles.
- Skill in handling conflict and uncertain situations.
- Skill in handling multiple tasks and prioritizing.
- Skill in using computers and related software applications.
- Skill in data analysis and problem solving.
- Ability to establish and maintain effective communication and working relationships with city employees and the public.
- Ability to work with frequent interruptions and changes in priorities.
- Ability to train others.

Minimum Qualifications:

- Graduation with a Bachelor's degree from an accredited college or university with major course work in a field related to Environmental Science, Life Science, Biology, Chemistry, Engineering, Landscape Architecture, Public Administration, Business Administration, Planning, plus six (6) years of experience in a related field, three (3) years of which was in a lead or supervisory capacity.
- Master's degree may substitute for experience up to two (2) years.

Licenses and Certifications Required:

- As required in a related area.

This description is intended to indicate the kinds of tasks and levels of work difficulty required of the position given this title and shall not be construed as declaring what the specific duties and responsibilities of any particular position shall be. It is not intended to limit or in any way modify the right of management to assign, direct and control the work of employees under supervision. The listing of duties and responsibilities shall not be held to exclude other duties not mentioned that are of similar kind or level of difficulty.

2.2 Cost-Effectiveness Analysis

Discussion

The decision whether to implement a water conservation program should be based on some type of benefit-cost or cost-effectiveness analysis. The underlying concept is a comparison of the inputs of any action with the outcomes, usually expressed in dollars. In evaluating water conservation efforts, the decisions center around comparison of the costs of implementing a program against the "costs of conserved water" or the "avoided costs" of acquiring new sources of water. In the strictest sense, if the analysis shows that the water user will gain positive value (benefit-cost) or that the costs of one option are less than the costs of another (cost effectiveness), then the conservation program should be implemented. In reality, there are external factors that are also considered such as public perception, long term environmental considerations, or political factors that may affect the decision.

A variety of analytical processes are used in making these types of decisions. One of the most common is use of present value techniques to evaluate expenditures or income incurred at different times. Present value takes into account the time value of money. Basic principles that are part of making valid present value analyses include:

- Selection of the appropriate discount rate.
- Consistency in the consideration of inflation.
- Matching the time period for the analysis.
- Ensuring that all appropriate cost and benefits are considered.

There are many studies, models and worksheets that have been developed to guide the decisions for implementing water conservation programs using present value analysis. For these decision models to be more accurate and consistent, they may be quite detailed in the assumptions made, statistical smoothing of data, and consideration of influencing parameters such as weather or natural replacements.

The challenge is to make an analysis that reflects real life situations and is complete, but still comprehensible and usable. It is important that in an analysis that consistently compares the costs of implementing a conservation program to the costs of water saved or deferred, that the costs themselves be consistently developed.

Program Costs

To determine the program costs of a BMP it is important to include those costs associated with both administration and implementation. They can be categorized generally along the lines of:

- Capital expenditures for equipment or conservation devices.
- Operating expenses for staff or contractors to plan, design, or implement the program.
- Costs to the customers.

Program costs should be measured in reference to the opportunity costs of a program – that is, what must be foregone in order to provide the service. The costs should be realistic costs, both direct and indirect, that would be incurred above and beyond those the entity would normally incur if the program were not implemented. The timing of the costs is extremely important, whether up front, one time only, intermittently recurring, or ongoing on a periodic basis. The analysis should use all of the costs incurred over the life of the program. Specific program considerations for the different BMPs will be developed.

Each BMP has one or more of the costs and benefits categorized below. Cost considerations specific for BMPs are summarized in Section H under the individual BMPs.

- Start up: Any equipment necessary to initiate a BMP such as a computer for database tracking, software, specialized equipment, etc.
- Staff and administrative costs: Water conservation staff or contractor costs for implementing the BMP on an ongoing basis.
- Marketing and promotion: Costs for bill stuffers, media advertising, direct mail, etc., to let customers know about the BMP program. In many cases, marketing and outreach costs and expenses can be reduced or spread out when multiple BMPs are implemented by an entity.
- Materials: Costs for education and other materials provided to customers such as student workbooks and plant guides, etc.
- Incentive: Cost of incentives or rebates and/or any free equipment provided to customers.

Costs of Saved Water

If a conservation program will result in less water used (saved water) from existing supplies or less water needed from a wholesale supplier, then the benefits to the user are developed along the lines of:

- Direct avoided costs of treatment and delivery of water, including labor, energy, and chemicals.
- Costs of water not purchased from a wholesale supplier.
- Other expenses associated with the cost of providing water.

These costs are sometimes known as marginal operating costs. In the case of saved water, the costs that are to be compared to the costs of implementing the program are those directly saved by the provider, and not always the same as the lost revenues at the retail rate that would have been charged to the consumer.

Other benefits that may be considered include:

- Direct benefits: reductions in hot water use, energy use, and landscape labor costs when the frequency of watering and fertilizing is reduced.

- Indirect benefits: better air quality when energy use is decreased; and improved runoff water quality when fertilizer and herbicide use is reduced in landscape related BMPs.
- Environmental: One example would be reduced water withdrawals from rivers due to implementation of BMPs, resulting in more inflows to bays and estuaries.

Avoided Costs of Supply

Avoided water supply costs are those total costs, both capital and operational associated with new water supply that is deferred, downsized, or eliminated because of the conservation effort. These include:

- Capital costs of construction of production, treatment, transportation, storage, and related facilities.
- Costs of obtaining water rights and permits.
- These costs may also include avoided costs of additional wastewater treatment facilities if significant.
- Directs avoided costs of treatment and delivery of water, including labor, energy, and chemicals.

The Texas Water Development Board has very detailed cost guidelines for determining the values of the water management strategies in Section 4.2.9 of its Guidelines for Regional Water Plan Development. In making the comparisons it is very important that costs for water supply facilities still needed, but deferred until some point in the future, are discounted properly in the present value analysis.

Determination of Water Savings

Besides development of the costs themselves, the next most important number in a cost effectiveness analysis is the actual volume of water saved associated with a particular conservation BMP. Careful efforts should be made to ensure that the volumes of water savings are associated with the costs incurred. In some BMPs, the water savings associated with a conservation measure may be continual or permanent, where in other cases they can be determined over a defined life.

In some cases there can be an easy correlation. For example, each toilet retrofit measure is estimated to save 10.5 gallons per day per person. The total amount of water saved by the measure can then be estimated from the number of measures to be implemented. A toilet has an average life of 25 years so the savings due to the program would be estimated over the total life, even though the period of program implementation may be less than that.

In other cases, due to the nature of the BMP, there really are not easy ways to predict water savings. In reality, when BMPs such as these are included along with other water conservation activities, there will be a complementary or synergistic effect that should enhance the overall success of the initiatives.

Cost-Effectiveness Considerations

To make valid cost effectiveness decisions, costs must be presented on a comparable basis. In comparing the costs of conservation programs, the costs of saved water, or avoided costs of water, the costs are usually condensed down to terms of dollars per acre ft ($/ac ft) or dollars per measure ($/unit).

Two levels of comparison costs can be developed from the analyses. At the first level, for general comparison purposes, costs are given as an annualized or amortized value, which is the equivalent to an equal payment per time period over the life of the program for a one-time cost or stream of costs. The second level of costs for specific measures is the present value of all costs for a specific scenario, usually calculated and expressed in $/ac ft.

Example Cost Effectiveness Models

Two models have been developed to provide examples of how the cost effectiveness of conservation programs can analyzed. The example BMP Cost Analysis Spreadsheet is designed for use to evaluate the costs of implementing a BMP. The example Supply Analysis Spreadsheet allows future expenditures to obtain water supply over a period of time to be valued in the present. Then these expenditures can be compared with the present day costs of implementing conservation programs.

Cost of BMP versus New Water Supply: The cost per acre-foot of new water supply and treatment capacity can be compared to the cost per acre-foot achieved by implementing the BMP. The Municipal Supply Analysis Table provides an example of the water supply cost savings that can be achieved by implementing one or more BMPs.

Notes on Present Value and Discount Rate

In order to compute net present value, it is necessary to discount future benefits and costs. This discounting reflects the time value of money. Present value analysis allows a comparison of alternative series of estimated future cash flows – either costs or income. To do a present value analysis we use a “discount rate” which by general definition reflects the minimum acceptable rate of return for investments of equivalent risk and duration.

Benefits and costs are worth more if they are experienced sooner. The higher the discount rate, the lower is the present value of future cash flows. For typical investments, with costs concentrated in early periods and benefits following in later periods, raising the discount rate tends to reduce the net present value.

What discount rate should be used? In constant dollar analyses the real discount rates used reflect the treatment of inflation and the adjustment of future costs for real price escalation. In the private sector, discount rates can vary significantly from investor to investor. We are using the TWDB recommended discount rate of 6 percent that is in line with current economic expectations and those frequently seen used in energy and water conservation projects.

By comparison, the Office of Management and Budget in its Circular A-94 Update (2004) recommends a base rate for Federal project evaluations to be determined using a nominal discount rate of 5.5 percent for 30 year projects. This rate is supposed to approximate the marginal pretax rate of return on an average investment in the private sector in recent years. The Federal Energy Management Program uses life cycle costing for project decision making for potential energy and water conservation projects and has established a nominal rate (includes a general price inflation factor) of 4.8 percent for 2004. The TWDB Planning group periodically uses an EPA recommended 6.38 percent in water infrastructure cost effective analyses.

Example Spreadsheet for BMP Cost Effectiveness Analysis

Municipal conservation programs typically involve the implementation of a combination of several BMPs. In this spreadsheet example are models based upon existing state plumbing code which will account for expected changes in demand due to natural replacement of less efficient plumbing fixtures over the next several decades. These anticipated changes are accounted for in the Cost Savings Analysis and Program Planning sheets that the conservation analyst will use to determine cost-effectiveness. This model can be expanded to include additional BMPs in a scenario-building model that can be used in conjunction with the Supply Analysis Needs worksheet.

Utility baseline information is required to be put in, as well as confirmation of assumptions for program implementation. Information required to be input for these BMPs includes:

	Example
2000 SF Population	752,791
2000 MF Population	248,658
Institutional Population	0
2000 SF Units	270,788
2000 MF Units	207,215
1995 SF Units	63,294
1995 MF Units	203,574
SF Growth Rate (Calc Ann Avg)	0.6%
MF Growth Rate (Calc Ann Avg)	0.4%
No. of ICI Customers	20,000
SF Household Size	2.78
MF Household Size	2.44
No. of Bathrooms per SF House	2.0
No. of Bathrooms per MF Unit	1.2

The following data is used by default, unless the user has more accurate data.

Category:	**Default**
No. of Bathrooms per SF House	2.0

No. of Bathrooms per MF Unit	1.2
No of Irrigation Months	6
% of High Use SF customers	10%
No. of MF Units per Washer	18
No. of MF Units per Complex	50
Additional Data:	
Toilet Natural Replacement Rate	2.0%
Showerhead Natural Replacement Rate	6.7%
Annual SF Program Goal (Housing Turnover Rate)	6.7%
Annual MF Program Goal (MF Housing Turnover Rate)	10%
Percent of SF Units with CWs	95%
Discount Rate	6.0%
Projected Inflation Rate	2.0%

These models also use net free ridership assumptions, a very real consideration in plumbing fixture program analysis. This considers the number of measures receiving an incentive that would have done the program anyway less the number of measures that were done because of the publicity about the conservation program without any incentives (free drivers).

The resulting information can be used in decisions to select cost effective BMPs to meet the water saving goals of the utility.

TABLE 1 EXAMPLE BMP COST SAVINGS MODEL

	Selected Length of Program (years)	Life of Measure (years)	Savings per Residential Capita (gpd)	Savings per Living Unit (gpd)
Residential	1	2	3	4
SF Toilet (ULFT) Retrofit BMP	10	25.0	10.5	29.2
SF Showerheads and Aerators BMP	10	15.0	5.5	15.3
MF Toilet (ULFT) Retrofit BMP	10	25.0	10.5	25.6
MF Showerheads and Aerators BMP	10	15.0	5.5	13.4
SF Irrigation Survey	10	10.0	18.0	50.0
ICI Irrigation Survey	10	10.0	NA	NA

	No. of Measures / Living Unit	Savings per Measure (gpd)	Natural Penetration Rate	Program Penetration Goal
Residential	5	6	7	8
SF Toilet (ULFT) Retrofit BMP	2.0	14.6	18%	80%
SF Showerheads and Aerators BMP	2.0	7.6	53%	80%
MF Toilet (ULFT) Retrofit BMP	1.2	21.4	20%	80%
MF Showerheads and Aerators BMP	1.2	11.2	53%	80%
SF Irrigation Survey	1.0	50.0	0%	50%
ICI Irrigation Survey	NA	470.0	0%	25%

	Number of Measures at Penetration Rate	Estimated Annual Savings (at Penetration Rate) (gpd)	Estimated Annual Savings (at Penetration Rate) (acre-ft/yr)	Number of Years to Reach Penetration Goal
Residential	9	10	11	12
SF Toilet (ULFT) Retrofit BMP	275,761	4,024,725	4,508	22
SF Showerheads and Aerators BMP	110,990	848,518	950	11
MF Toilet (ULFT) Retrofit BMP	138,200	2,950,563	3,305	15
MF Showerheads and Aerators BMP	64,077	716,600	803	8
SF Irrigation Survey	13,539	676,970	758	10
ICI Irrigation Survey	5,000	2,350,000	2,632	10

TABLE 1 cont.

	Penetration Estimated at 10 Yr	Program Costs per Measure	Estimated Net Free Ridership	Net Program Costs per Measure
Residential	**13**	**14**	**15**	**16**
SF Toilet (ULFT) Retrofit BMP	61%	$ 85	10%	$ 94
SF Showerheads and Aerators BMP	79%	$ 7	50%	$ 14
MF Toilet (ULFT) Retrofit BMP	70%	$ 75	10%	$ 83
MF Showerheads and Aerators BMP	82%	$ 4	50%	$ 8
SF Irrigation Survey	NA	$ 50	1%	$ 51
ICI Irrigation Survey	NA	$ 200	1%	$ 202

	Cost per AF of Water Saved (Amortized)	Total Program Costs (at Penetration Rate)	Present Value of Program Costs (year 1 = 2005)	Estimated Water Saved over Life of Measure (acre ft)
Residential	**17**	**18**	**19**	**20**
SF Toilet (ULFT) Retrofit BMP	$ 452	$ 26,044,051	$ 19,112,751	101,436
SF Showerheads and Aerators BMP	$ 168	$ 1,553,858	$ 634,306	7,128
MF Toilet (ULFT) Retrofit BMP	$ 273	$ 11,516,638	$ 9,117,548	74,364
MF Showerheads and Aerators BMP	$ 66	$ 512,620	$ 371,221	6,020
SF Irrigation Survey	$ 123	$ 683,808	$ 540,425	7,583
ICI Irrigation Survey	$ 52	$ 1,010,101	$ 980,392	26,323

	Present Value Per Acre Foot Saved	Standard Delivery Description	Other Delivery Options
Residential	**21**	**22**	**23**
SF Toilet (ULFT) Retrofit BMP	$ 188	free or rebate	direct install
SF Showerheads and Aerators BMP	$ 89	kits picked up by customer	door to door dist or direct
MF Toilet (ULFT) Retrofit BMP	$ 123	free or rebate	direct install
MF Showerheads and Aerators BMP	$ 62	kits picked up, installed by apt.mgmt	
SF Irrigation Survey	$ 71	audits performed by utility staff	contractor performs audits
ICI Irrigation Survey	$ 37	audits performed by utility staff	contractor performs audits

TABLE 1 cont.

Notes to Municipal cost Savings Model

SF=single-family, MF=multi-family *Population figures are from 2000 Census

Column 1 - user selects the length of time the program will be implemented for.

Column 2- assumed useful life of the measure

Column 3 - savings per person in gallons per day

Column 4 - savings per housing unit in gallons per day (Col 3 x No.of persons per living unit, input page)

Column 5 - the number of measures needed for each living unit

Column 6 - gallons saved per day for each measure

Column 7- estimated percentage penetration of efficient measures already accomplished: either defined or calculated from models

Column 8 - the potential number of customers who could be expected to implement the program with substantial marketing and outreach- includes natural replacements and retrofits

Column 9 - estimated number of measures ultimately accomplished by program (no. of MF or SF units x no. of measures per unit)

Column 10- potential savings in gallons per day (column 10 x column 7)

Column 11- potential savings for the region in acre-feet [(column 11 x 365) / 325,851]

Column 12- years to reach penetration goal selected in Column 9

Column 13- actual penetration achieved during life of program (Column 1) and desired retrofit goal per year (turnover rate, input page)

Column 14- program costs including rebates, staff time and marketing

Column 15- percentage of free ridership, or those that would participate even without incentive

Column 16- net program costs after adjusting for net free ridership

Column 17 - amortized cost per acre foot of water saved each year [(column 17 x 325,851 gallons/AF) / (column 6 x 365 days)]) amortized at discount rate over the life of the measure

Column 18 - total program cost (column 7 x column 10)

Column 19 - net present value of costs of program incurred each year

Column 20 - total acre feet of water expected to be saved over expected life of measure (col 7 x col 10 x col 2)

Column 21 - net present value of program per acre ft saved (col 20 divided by col 21)

Column 22 - delivery option(s) for which costs are estimated

Column 23 - other possible delivery options

Municipal Cost Effectiveness Example

This example shows a straight forward example of a midsize utility that is growing and that anticipates that it will have to purchase water rights or develop additional water supply. The utility would prefer to delay purchasing these additional rights if one of more BMPs would achieve the required savings to delay the purchase. This analysis does not take into account the reduced operating cost benefit to the utility of implementing the conservation measures.

A simple Example Municipal Supply Analysis spreadsheet has been set up for use by the utility to *Find the Benefit to the Utility of a Delay in Purchasing Water Supply*. The utility enters:

- increase in annual water demand (AF),
- number of AF to be purchased,
- number of years until the purchase will be made,
- cost for the additional water rights,
- years of the new supply contract,
- number of years of delay desired, and
- discount rate.

The Example Municipal Supply Analysis spreadsheet set up for this example contains the following assumptions (region-specific data from the State Water Plan or utility generated data should be used when performing this analysis for a particular conservation program):

- The utility water demand is increasing by 1000 AF per year.
- In 10 years, the utility anticipates being at 90 percent of its existing water supply and plans to purchase an additional 25,000 AF of water.
- The new water supply will cost $400 per AF and will be a 50-year contract.
- Water costs are anticipated to rise 2 percent per year.
- The utility hopes to delay the purchase by 3 years.
- The assumed discount rate is 6 percent.

Based on these assumptions, the utility would have to conserve 3000 AF of water. The Municipal Supply Analysis spreadsheet shows the present value of water saved ($/AF). To get to this number the spreadsheet includes several calculations. First the value of a 50-year water contract starting in 2015 is determined. It has been calculated using Microsoft Excel's NPV function. In this case, the NPV function is used to calculate the total amount that a series of future payments is worth in 2015.

- The syntax of the Microsoft NPV function is NPV(rate,nper,pmt1,pmt2, pmt3,…);
- Rate is the interest rate per period. For simplicity this is presented as 6 percent per annum;
- Pmt1, Pmt2, Pmt3, …, are the annual payments for the time period selected. For this example the contract is 50 years, starting at $400 per AF in year 1 and increasing by 2 percent per year.

- Next the NPV function is used to calculate the value of the 50-year water contract if it started after a 3-year delay, which would be 2018.

  To determine the present value of the water saved, the difference in the present value in 2005 for the 2015 NPV value and the 2018 NPV value is determined. This is done using the appropriate discount factor. The difference between the 2015 and the 2018 PV values in 2005 dollars is the value of the conserved water.

  Energy and chemical deferred cost savings are calculated in a separate tab and entered in this tab.

  The present value of the delay and deferred chemical and water savings is $930 per AF that could be compared to the cost of implementing the water saving BMPs.

TABLE 2 EXAMPLE MUNICIPAL SUPPLY ANALYSIS WORKSHEET

Utility Entered Variables

1	Cost per AF	$	400	
2	No. of AF Purchase		25,000	
3	No.of Years until Purchase: No Conservation		10	
4	Annual Increase in Water Demand (AF)		1,000	
5	No of Years of Contract		50	
6	Delay Projected Due to Conservation		3	
7	Discount Rate		6.0%	
8	Increase in Water Costs per Year		2.0%	
9	Annual Cost per AF for Energy and Chemicals	$	65.00	
10	Estimated Annual Inflation in Energy and Chemical Costs		2.0%	
11	Water Savings Required (AF)			**3,000**
12				

13	Present Value of Contract if Purchased in 2015		Present Value of Contract if Purchase Delayed Until 2018	PV Value of Conservation per AF
14			642.36	
15		$8,538.78	$9,061.42	
16		0.538615114	0.447365096	
17		$4,599.12	$4,053.76	**$545.35**
18				**$384.91**
19				**$930.26**

Notes

1 Negotiated or anticipate cost per AF
2 Amount of water to be purchased in AF
3 Anticipated date when water will be purchased without conservation
4 Projected annual increase in water demand without conservation
5 Length of supply agreement
6 Desired delay due to conservation
7 Rate that will be used to discount future cost back to present value in todays' dollars
8 Projected annual increase in user rates during the period of delay
9 Actual costs for Energy and Chemicals for water treatment per AF
11 This is the total water savings needed based on the annual growth in water demand and the length of delay selected
15 Cost per AF: This amount is the value for the 50 years of payment for 1 AF in 2015 and 2018.
16 Discount to Present: The calculated discount amount from 2015 to 2005; and 2018 to 2005
17 Present Value of Delay: The difference in the discounted value from 2015 to 2005; and 2018 to 2005
18 PV of Energy and Chemical Savings: From Energy and Chemicals tab
19 Total Present Value of Delay

References for Additional Information

1) *Waste Not, Want Not: The Potential for Urban Water Conservation in California,* Pacific Institute, November 2003.
2) *BMP Costs and Savings Study,* prepared for The California Urban Water Conservation Council, by A & N Technical Services, July 2000.
3) *Cost-Effective Cost Effectiveness: Quantifying Conservation on the Cheap,* David L. Pekelney, Thomas W. Chesnutt, and David L. Mitchell, Abstract of Paper presented at AWWA National Conference June 26, 1996.
4) Office of Management and Budget Circular No. A-94 Revised, October 29, 1992.
5) OMB Circular No. A-95, Appendix C (revised February 2004).
6) *Life-Cycle Costing Manual for the Federal Energy Management Program,* prepared for the U.S. Department of Energy, Sieglinde K. Fuller and Stephen R. Petersen, February 1996.
7) *Energy Price Indeces and Discount Factors for Life-Cycle cost Analysis – April 2004*, prepared for U.S. D.O.E, by U.S. Department of Commerce.

2.3 Water Survey for Single-Family and Multi-Family Customers

Applicability

This BMP is intended for a Municipal Water User Group ("utility") that has 20 percent of homes and apartments constructed before 1995 and/or more than 10 percent of landscapes with automatic irrigation systems. If the utility is unaware of the number or percentage of customers using automated irrigation systems, a drive-by survey can be conducted of a sample of customers to develop an estimate of how many have automatic systems. Once a utility decides to adopt this BMP, the utility should follow the BMP closely in order to achieve the maximum water efficiency benefit from this BMP.

Description

A Water Survey Program can be an effective method of reducing both indoor and outdoor water usage. Under this BMP, the utility conducts a survey of single-family and multi-family customers to provide information to them about methods to reduce indoor water use through replacement of inefficient showerheads, toilets, aerators, clothes washers, and dishwashers. If the customer has an automatic irrigation system, the survey includes an evaluation of the schedule currently used and recommends any equipment repairs or changes to increase the efficiency of the irrigation system.

Surveys should be offered based on water use starting with the highest single-family and multi-family accounts, respectively. Multi-family accounts should be analyzed based on gallons per unit, although almost all multi-family customers would benefit by this survey if they have not already retrofitted plumbing fixtures. The irrigation component of the single-family survey should target single-family customers using more than a certain amount of water per billing period that could be considered excessive for the particular geographic area and other characteristics of the service area. Typically, this is around 20,000 gallons per month in summer since that could represent an outdoor use of more than 12,000 gallons per month. Surveying outdoor water use in homes with water use below 20,000 gallons per month does not usually provide as significant an opportunity for water reductions. Customer water use records can give the utility a snapshot of which neighborhoods have higher than average water use. The drive by survey should note which lawns have monoculture of a turfgrass species and/or visible irrigation heads indicating an automated sprinkler system.

Once the scope of services is determined, there are three options for conducting the survey: train utility staff to conduct an onsite survey; hire an outside contractor to conduct the onsite surveys; or provide a printed or online survey for customers to complete on their own. When conducting an onsite survey for a customer with an automatic irrigation system that is managed by an irrigation or maintenance contractor, it is beneficial to have the contractor present for the irrigation system survey.

For the indoor water use survey, a form can be used to provide the information on water reductions that would be achieved with each type of equipment change and the length of the payback period, taking into account any utility incentives that may be available. If it is an onsite survey, showerhead and faucet aerators can be changed during the survey.

A leak check should be conducted to determine if there are any toilet leaks occurring and any dripping faucets. If 1.6 gallons per flush toilets have already been installed, the flush volume should be checked and, if needed, the water level in the tank should be adjusted to restore the flush volume to 1.6 gpf. If after the water level in the tank is adjusted, the flush volume is still well above 1.6 gpf, it is likely that the toilet originally had an early closure flapper. Using the model number on the inside of the tank and the Flapper Table (see References for Additional Information), the flapper required to restore the flush volume to 1.6 gpf can usually be determined. If the flapper is one of several early models of closure flappers, the flapper should be replaced during the survey and the information on the correct replacement flapper should be provided to the customer.

Information on water use habit changes such as shorter showers, for example, should also be provided at the time of the survey. The customer should be provided information on climate-appropriate landscaping and about any programs the utility has for incentives to replace inefficient landscaping.

The survey of automatic irrigation systems should include a check of the entire system for broken, misdirected or misting heads and pipe or valve leaks. The customer's service line and meter box should also be checked for leaks. The system should be run to determine precipitation rates for typical zones. Each zone should be checked to be sure that rotors and spray heads are not on the same zone since they have greatly different precipitation rates. Head spacing should be checked to determine if proper heads are installed. The schedule on the irrigation controller should be checked and the customer queried about how the schedule is adjusted during the year. A schedule should be provided based on evapotranspiration ("ETo")-based water-use budgets equal to no more than 80 percent of reference ETo per square foot of irrigated landscape. The statewide Texas Evapotranspiration Network (http://texaset.tamu.edu/) should be consulted for historical evapotranspiration data and methodology for calculating reference evapotranspiration and allowable stress. More aggressive landscape conservation programs can utilize stress coefficients lower than 80 percent (*See* website). For larger water users, a uniformity analysis can be conducted. The customer should be provided a written report on the system repairs and equipment changes needed and the appropriate efficient irrigation schedule by month. The controller should be reset with the efficient schedule. If the system does not have a rain sensor, it should be installed as part of the survey if feasible or provided to the customer to be installed by a contractor. Information should be provided on the installation of dedicated landscape meters for multi-family customers if offered by the utility.

Implementation

The utility should develop and implement a plan to market these surveys to both single-family and multi-family customers. Marketing should be done by ranking single-family customers according to water use on a monthly average and offer the program starting with those with the highest water use as a means of increasing cost effectiveness and water savings rapidly. Multi-family customers should be ranked by water use per unit. The survey can be offered by mail, telephone calls, email or through utility bill stuffers or other appropriate methods of communication. The Showerhead, Aerator, and Toilet Flapper Retrofit BMP outlines a method for determining the number of homes and apartments constructed before 1995.

The customer incentive to participate can be reduced utility costs and also recognition as a water efficient customer. If the utility has incentive programs for 1.6 gpf toilets, efficient clothes washers, irrigation systems upgrades, or water efficient landscape, the survey should include this information in the report to the customer.

Once a customer agrees to participate, the utility should collect the following information in the survey:

1) Calculation of the ratio of summer to winter use based on a review of the customer water bills;
2) Pressure on the customer's side of the meter;
3) Number and flush volume for each toilet;
4) If any 1.6 gpf toilets are flushing at greater than 1.6 gpf due to replacement of early closure flapper with standard flapper;
5) If any toilets are leaking around the flapper or over the overflow tube;
6) Showerhead and aerator flow rates in gallons per minute ("gpm") when valve is fully open;
7) Estimated capacity of current clothes washer. If it is a top loading inefficient model, use 41 gallons per load as an estimate;
8) If customer has a swimming pool, the frequency and duration of backflow. Check fill valve and float to determine if working properly. Turn fill valve off at the start of survey to see if any drop in water level is noticed. Ask customer if they have noticed any leakage from pool;
9) Irrigation schedule as indicated on the controller. Ask customer who is responsible for changing the schedule and how often that occurs, if the system is turned off in winter months and if turfgrass areas are over seeded in winter.

The changes that can be made immediately at the time of the survey include:

1) If needed, installation of showerheads using 2.0 gpm or less; kitchen faucet aerators using 2.2 gpm or less and bathroom faucet aerators using 1.5 gpm or less;

2) Resetting the toilet tank water levels to the correct level. Replacement of leaking flappers or flappers that cause the toilet to flush above the design flush volume.
3) Determination of irrigation system precipitation rate for representative zones or all zones if needed;
4) Resetting controller with efficient schedule based on ET and measured precipitation rates;
5) Providing the customer a copy of the twelve months irrigation schedule and attach a copy near the controller;
6) Showing the customer how to use the controller so they can adjust controller throughout the year;
7) Installing a rain sensor on the irrigation system if needed and feasible;
8) Explaining to customer any incentives that the utility offers and how to take advantage of these incentives; and
9) Providing customers a brief report on estimated savings for each item listed in the report and the estimated payback for each item.

The changes that may need to be done after the survey by either a contractor for the utility or by the customer include:

1) Replacing inefficient toilets with 1.6 gpf models;
2) Restoring correct flush volume of existing 1.6 gpf toilets by installation of early closure flapper correctly matched to the model of toilet;
3) Fixing faucet leaks;
4) Replacing the inefficient clothes washer with a new efficient model;
5) If needed, repairing the fill valve on the swimming pool;
6) Replacing damaged portions of the irrigation system;
7) Installing a new controller if warranted such as an ET based irrigation controller;
8) Installing a rain sensor; and
9) Installing a pressure reduction valve if needed.

To assure that the water savings measures recommended during and after the survey are achieved, the utility should follow up with the customer to determine which were actually implemented. The utility should begin a notification program to remind customers of the need for maintenance and adjustments in irrigation schedules as the seasons change and to check toilets and faucets for leaks.

Schedule

1) The scope of this BMP should be realized within five years of the date implementation commences.
2) Develop and implement a plan to target and market water-use surveys to all residential customers using more than 20,000 gallons per month in summer

months and all multi-family customers in the six months of the first year after implementing this BMP.

3) Repeat marketing efforts until the goals are reached.

Scope

To accomplish this BMP, the utility should:

1) In the first year, implement the program and complete a survey of at least 1 percent of eligible single-family customers and 1 percent of multi-family customers;
2) In years two through five, complete a survey of at least 5 percent of eligible single-family customers and at least 5 percent of multi-family customers;
3) Within 5 years, complete water-use surveys for at least 25 percent of eligible single-family customers and 25 percent of multi-family customers; and
4) Follow up on each survey completed within three months of completion and then annually thereafter to encourage implementation of survey recommendations.

Documentation

To track this BMP, the utility should gather the following documentation:

1) Number of residential customers,
2) Number of single family customers using more than 20,000 gallons per month in summer months;
3) Number of multi-family customers;
4) Number of surveys offered and number of surveys completed by customer type; and
5) Measures installed during the customer surveys or completed after the survey and verified through a follow-up phone call.

Determination of Water Savings

Saving should be based on measures implemented by each customer. Savings are calculated by multiplying the number of each type of measure implemented by the savings for that measure as listed below.

1) Single-Family Home
   - Irrigation Audit: Actual utility survey results or 26 gallons per day ("gpd")[1] per house.
   - Showerhead and aerator replacements: 5.5 gpd per person
2) Multi-Family Community

- Irrigation Audit: Actual utility survey results or 15 percent[2] of outdoor water use or 208 gpd[1]
- Showerhead and aerators: 5.5 gpd per person

Savings for resetting toilet tank levels, toilet leak repair, flapper replacement and installation of rain shut-offs should be estimated during the water survey. The rain shut-off savings depend both on the ET of the customer as well as the setting on the rain shut-off switch which can be set to shut off after rainfall of ¼ to 1 inch. If the survey results in toilet and clothes washer replacements, these savings can be included in either this BMP or the Toilet Retrofit or Efficient Clothes Washer BMP if the utility has adopted those BMPs.

Cost-Effectiveness Considerations

Surveys can be performed by utility staff or by contractors. The labor costs range from $50 to $150 for a SF survey and start at $100 for a MF survey and go up from there depending on the efficiency in scheduling and the scope of the survey.

If water efficient plumbing fixtures are distributed during the survey, the costs of that equipment should be considered. High quality showerheads purchased in bulk are available starting at less than $2 each with aerators costing less than $1 each. Flappers range in cost from $3 to $10.

There may be other one-time costs such as purchase of leak detection equipment and meters. Marketing and outreach costs range from $5 to $15 per survey. Administrative and overhead costs range from 10 to 20 percent of labor costs.

References for Additional Information

1) *Project Review of the Irvine ET Controller Residential Reduction Study*, Irvine Ranch Water District, November 2003. http://www.irwd.com/Conservation/R3ProjectReview.pdf
2) *CUWCC BMP No. 5: Large Landscape Program and Incentives*. http://www.cuwcc.org/m_bmp5.lasso
3) *WaterWise Council of Texas.* http://www.waterwisetexas.org/
4) *Austin Green Gardening Program.* http://www.ci.austin.tx.us/greengarden/
5) *Texas Cooperative Extension for El Paso County.* http://elpasotaex.tamu.edu/horticulture/xeriscape.html
6) *San Antonio Water System Conservation Program.* http://www.saws.org/conservation/
7) *City of Corpus Christi Xeriscape Landscaping.* http://www.cctexas.com/?fuseaction=main.view&page=1047
8) *EWEB Home Water Survey Database: PowerPoint Presentation,* Jill Hoyenga, Eugene Water and Electric Board, Water Sources Conference Proceeding, 2004.

9) *CUWCC Cost Effectiveness Models, BMP 1 Water Surveys*. http://www.cuwcc.org/ce_spreadsheets.lasso
10) *Toilet Flappers: A Weak Link in Conservation in Water Conservation,* John Koeller, http://www.cuwcc.org/Uploads/product/Flappers_Weak_Link.pdf
11) *Tampa Bay Water List of Toilets and Replacement Flappers,* Dave Bracciano, Tampa Bay Water, Tampa, Florida
12) *CUWCC BMP No. 5: Large Landscape Program and Incentives.* http://www.cuwcc.org/m_bmp5.lasso
13) *Turf and Landscape Irrigation Best Management Practices*, Water Management Committee of the Irrigation Association, February 2004. http://www.irrigation.org/gov/pdf/IA_BMP_FEB_2004.pdf
14) *Waste Not, Want Not: The Potential for Urban Water Conservation in California,* Pacific Institute, November 2003. http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf

2.4 Customer Characterization: Analysis to Prioritize BMP Selection

Applicability

This best management practice (BMP) is intended for all utilities. The effectiveness of municipal water conservation planning relies on the completion of a customer characterization analysis prior to the implementation of any water conservation BMPs. The practice of completing a customer characterization enables utility staff to learn how water is used within the service area, to recognize "normal" usage trends within each customer category, and to familiarize high consumptive users with more efficient practices for water use.

Failure to complete this analysis could result in spending resources on conservation practices with little impact for a utility. For example, if a utility has mostly new housing stock, it would be a poor use of resources to manage a large high efficiency toilet retrofit program for single family customers. If a utility has a strong summer peaking challenge, they may be best served by looking at BMP options that help address outdoor landscape issues.

The goal of the customer characterization process is to stimulate discussions and creative thinking that will benefit the water utility and its customers by targeting specific water conservation BMPs, that will allow the water utility the opportunity to leverage available resources to implement the most cost-effective water saving activities. Therefore, it is important that a customer characterization is performed, though the way it is carried out may vary by utility and customer base.

Why this is a Strategic BMP

The Texas Water Code §11.002 states that BMPs are voluntary efficiency measures that save "a quantifiable amount of water, either directly or indirectly," BMPs that are useful in implementing other measures but for whom quantifiable savings cannot be identified are described as Strategic BMPs.

Customer characterization is intended to act as a tool for municipal water conservation planning. The best way to ensure that chosen conservation BMPs are successful in reducing consumption and continue to target the correct audience is to conduct BMP evaluations before and after implementation, in addition to an annual customer characterization. Consistent program evaluations will indicate when a BMP is no longer producing a significant volume of water savings and will give the utility an opportunity to make adjustments.

Description

Customer characterization is an analysis to understand who your customers are and how they use water. Such understanding is an important step in ensuring that utility conservation goals are met in an effective and efficient manner. To keep the customer characterization process simple to understand and perform, recommended steps are outlined below. It is important to remember that this step-by-step process suggests a single method, not the only method, to complete a

customer characterization. Actual methods used will vary among utilities based on available information, time, staffing resources, and expertise.

Residential customers

1) Gather Data
   Data used in this example include billed consumption by account (available within the utility) and individual property information (available from local appraisal districts). It is also possible to utilize census demographics and any spatial data available from the city or appraisal district.

   Although multi-family properties like apartments and duplexes sometimes contain one billed water meter (and account) for multiple residences, they are considered residential for water use accounting purposes. Because of ownership and marketing needs, the utility may choose to look at these properties separately from their single-family properties for programming.

2) Prepare Data
   Preparing existing data for analysis includes removing nonessential accounts, separating accounts by customer category, and integrating property data into the consumption data set. Thorough preparation of the data will support easier identification of account characteristics across a wide range of consumption levels in the next phase.

   To accurately compare and sort data, the complete data set must be separated into similar customer use categories. A residential customer should not be compared to a non-residential customer on any scale, as the characteristics of these customer categories and the nature of their consumption are inherently different.

3) Analyze Data
   The initial analysis of residential customer data consists of yearly and aggregate consumption distributions by ranges of property build-dates and assessed home values compared to annual consumption. These distributions serve to identify the characteristics of high consumption accounts. It is appropriate to compare water use on a per capita (per person) basis when comparing single-family residential accounts because the nature of consumption is the same for most single-family residential customers.

Non-residential customers

Non-residential customers use water in different ways, even when compared to each other, so methods of normalization are necessary. Normalization is as simple as comparing water consumption per output. Car washes evaluate their efficiency in terms of gallons per car. Institutional, commercial, and industrial (ICI) or non-residential customers can be analyzed based on water consumption per dollar of revenue. The idea is to use terms that are comparable to each other without having to further sub-categorize customers.

1) Gather Data

Non-residential customers are made up of industrial, commercial, and institutional (ICI) customers. This customer group is more difficult to categorize since it consists of many different uses of water, but doing so will allow for an accurate comparison between users of the same type.

2) Prepare Data

The most complete list of categories can be found in the North American Industry Classification System (NAICS) which consists of two to six-digit coded categories that describe the type of use for each customer account. As utilities update their billing systems or customer relation management (CRM) platforms, they should consider starting a practice of adding a NAICS code to each non-residential account. The benefits of the practice are significant as they allow the utility to analyze use patterns by specific industrial or commercial categories. This analysis identifies high usage outliers to work with and may help with future rate setting practices.

3) Analyze Data

It can be helpful to sort users from highest to lowest annual consumption and isolate a specified number of non-residential users with the highest annual consumption. The process of categorization can be applied to only those customer accounts that may allow the utility to realize the largest amount of savings instead of the entire data set.

Implementation

Strategic decisions about which BMP strategies to adopt and which customers to target should be derived from an analysis of water use patterns. If the strategic need of a utility is to delay a sewage treatment plant upgrade, then targeting older homes with higher indoor (winter) water usage rates would be logical. If, in contrast, the strategic need is to better manage peak demands during hot, dry summers, then targeting customers with the highest summer consumption is important. It has been common for utilities to adopt toilet replacement programs early in the planning process because high efficiency toilets save a considerable amount of water if they replace older high-flow toilets. However, the Energy Policy Act of 1992 passed national efficiency standards stating that toilets were not allowed to be installed in new development if they did not meet a 1.6 gallon per flush or less requirement. As a result, manufacturers no longer produce toilets with flow rates higher than 1.6 gallons per flush, and all development is currently required to meet this standard. In addition, manufacturers are moving to the updated EPA WaterSense Standard; and much of new fixture installation is meeting this target. Having data suggesting the market penetration of high efficiency fixtures versus older high flow ones is important before deciding that a retrofit program would be cost-effective. If a retrofit program is desired in a community of mixed age development, then the program requirements could be designed to expend funds only on older housing stock retrofits.

Scope & Schedule

Scope

The process of customer characterization is considered complete when groups of similar water users are identified, and their use has been evaluated for trends. There is no individual indicator that the process is complete across all utilities or water providers. Data may be analyzed in a very fine or coarse capacity, as deemed necessary by the utility, until enough information is presented to make informed choices for water conservation BMPs that best suit the service area. Utilities concerned with peak usage should complete analyses showing which customers contribute most to peak. Utilities concerned with overall growth in total annual demand may instead focus on which customers generate the largest annual usage increase.

Schedule

It is important for the process of utility customer characterization to occur prior to any water conservation BMP planning, as well as on a regular basis. Annual customer characterizations within the water utility will produce more accurate and informative trend data on water consumption within different customer categories. Managers will become familiar with normal usage trends and be able to better recognize anomalous and consistent high consumption levels. An annual process will also help managers target BMPs and be able to recognize, when accompanied with program evaluations, the point at which specific BMPs are no longer needed among different groups.

Cost-Effectiveness Considerations

There are no capital costs involved in performing a customer characterization, but it is a process requiring significant staff time or the services of a qualified contractor. It is important to note that the investment of time to complete this analysis will help ensure proper utilization of utility resources in the future.

It is expected that staffing costs incurred will be reduced over time as the process of customer characterization becomes more familiar and streamlined to fit the needs of the utility or water provider.

Determination of the Impact on Other Resources

Conservation programs are funded through municipal government utilities and water providers. Therefore, efficient time utilization through efficient water conservation planning saves tax-payer money as well.

References for Additional Information

Mayer, P. W., DeOreo, W. B., Opitz, E. M., Kiefer, J.C., Davis, W. Y., Dziegielewski, B., & Nelson, J. O. (1999). *Residential End Uses of Water.* Denver: AWWA Research Foundation and American Water Works Association.

U.S. Census Bureau. (2015, August 4). *North American Industry Classification System.* Retrieved December 2015, from United States Census Bureau: http://www.census.gov/eos/www/naics/

Vickers, A., Tiger, M. W., & Eskaf, S. (2013, October). *A Guide to Customer Water-Use Indicators for Conservation and Financial Planning.* American Water Works Association.

Wolff, A., Boellstorff, D., Berthold, T.A. (2015). *Residential Customer Characterization Guide for Urban Water Conservation Planning.* Texas A&M AgriLife Extension Service, Texas A&M University.

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3.1 Water Conservation Pricing

Applicability

This BMP is intended for all Municipal Water User Groups ("utility") wishing to send price signals to customers to encourage water conservation. A utility may have already accomplished this BMP if it currently has a conservation price structure.

Description

Water Conservation Pricing is the use of rate structures that discourage the inefficient use or waste of water. Conservation pricing structures include increasing unit prices with increased consumption such as inverted block rates, base rates and excess use rates such as water budget rates, and seasonal rates. Seasonal rate structures may include additional charges for upper block (outdoor) usage or excess-use surcharges for commercial customers to reduce demand during summer months. The goal of conservation pricing is to develop long run consumption patterns consistent with cost. Under this BMP, utilities should consider establishing rates based upon long-run marginal costs, or the cost of adding the next unit of capacity to the system. An established cost of service methodology should be followed whenever rates are developed or proposed for change.

This BMP addresses conservation pricing structures for retail customers. For utilities supplying both water and sewer service, this BMP applies to pricing of both water and sewer service. Utilities that supply water but not sewer service should make good faith efforts to work with sewer agencies so that those sewer agencies do not provide sewer services for a declining block rate.

For conservation pricing structures to be effective, customers should be educated on the type of rate structure that the utility uses and be provided monthly feedback through the water bill on their monthly water use. Most customers do not track water use during the month because of the difficulty and inconvenience of reading the meter. When customers read their bill, they most often just look at the total amount billed. Conservation pricing has the advantage of providing stronger feedback to the customers who will see a larger percent increase in their water bill than the increase in water use. Utilities should move toward adopting billing software that allows customers to compare water use on their bill with average water use for their customer class as well as their individual water use for the last 12 months. The rate structure should be clearly indicated on the water bill.

It is not recommended that a minimum monthly water allotment be included in the minimum bill. The AWWA notes that minimum charges are often considered to work counter to conservation goals and are unfair to those who use less than the monthly minimum. A customer who does not use the entire amount included in the minimum during the billing period will be charged for the water allotment regardless, and thus may feel he should find a way to use the additional water. A customer in a house with all efficient fixtures and appliances

can use 1000 gallons or less per month and may be inclined to increase their water use if a minimum bill includes more than 1000 gallons[1]. In the Residential End Use Study[2], approximately 6 percent of homes had a per capita use of less than 1000 gallons per month.

Implementation

Successful adoption of a new rate structure may necessitate developing and implementing a public involvement process in order to educate the community about the new rate structure. The new rate structure should adhere to all applicable regulatory procedures and constraints. If the conservation pricing structure to be implemented is substantially different from current practices, then a phase-in approach may be appropriate.

Public involvement in the development and implementation of conservation rates can help assure that the goals of the conservation pricing initiatives will be met and accepted by local constituents. Public meetings, advisory groups, and public announcements are among ways to generate public involvement.

Development of conservation-based rate structures is more than just selection of arbitrary usage breaks. The process requires consideration of the effect on water demand and water utility finances.

1) Basic rate structure considerations should include rates designed to recover the cost of providing service and billing for water and sewer service based on actual metered water use. Conservation pricing should provide incentives to customers to reduce average or peak use, or both. The conservation rate structure can be designed to bring in the same amount of revenue, often termed revenue neutral, as the previous rate structure.
2) Only one type of conservation pricing is required for this BMP. Conservation pricing is characterized by one or more of the following components:
    a. Seasonal rates to reduce peak demands during summer months. There are a variety of approaches including having increasing block rates only during the summer months or having a year round block rate structure with higher block rates during the summer months.
    b. Rates in which the unit rate increases as the quantity used increases (increasing block rates). For block rate structures, the rate blocks should be set so that they impact discretionary use. A utility should analyze historical records for consumption patterns of its customers. The first block should typically cover the amount of water for normal household health and sanitary needs. To increase the effectiveness of this rate structure type, the additional revenue from the higher blocks should be associated with discretionary and seasonal outdoor water use.
        - Rates for single family residential and other customer classes may be set differently to reflect the different demand patterns of the classes.

- The price difference between blocks is very important in influencing the customer's usage behavior. Price increases between blocks should be no less than 25 percent of the previous block. For maximum effectiveness, the price difference going from one block to the next highest block is recommended to be at least 50 percent of the lower block. For example if the third block of a four-block rate structure is $4.00 per 1000 gallons, the fourth and final block should have a rate of at least $6.00 (50 percent higher) per 1000 gallons. Any surcharge based on water usage should be included when calculating these percentages.

c. Rates based on individual customer water budgets in which the unit cost increases above the water budget. Water budget rate structures are based on the philosophy that a certain amount of water is adequate for all normal necessary uses, and uses above that amount are considered excessive and charged as excessive. For example, Irvine Ranch Water District in California[3] sets the excess use charges at 200 percent of the base rate. Typically there should be an indoor and an outdoor component to a water budget.
   - For residential rates, the indoor component should be based upon estimates of average family use. The outdoor component is based upon landscape area. For business customers, water budgets will often be based upon historical average for indoor water use, and outdoor component based upon landscape area.
   - To qualify as a conservation rate, utilities that implement water budget based rate structures typically begin excess rate charges for landscaped areas at no more than 80 percent of average annual reference evapotranspiration replacement rates.

d. Rates based upon the long-run marginal cost or the cost of adding the next unit of capacity to the system.

3) Conservation pricing should use a consumption charge based upon actual gallons metered. The minimum bill for service should be based on fixed costs of providing that service which generally includes service and meter charges. Including an allotment for water consumption in the minimum bill does not promote conservation and it is recommended that if a minimum is included, it not exceed 2000 gallons per month. Utilities including a water allotment in the minimum bill should consider eliminating that allotment within five years of implementing this BMP.

4) Adoption of lifeline rates neither qualifies nor disqualifies a rate structure as meeting the requirements of this BMP except that the minimum bill guidelines should be followed. Lifeline rates are intended to make a minimum level of water service affordable to all customers.

5) The utility should educate customers about the rate structure and use billing software that allows the customer to compare water use on their bill with average water use for their customer class as well as their individual water use

for the last 12 months. The rate structure should be clearly indicated on the water bill. The utility may want to consider implementing the Public Information BMP in conjunction with this BMP in order to provide customers information on how to reduce their water bill under a conservation rate structure.

6) In order to be able to set up an effective irrigation rate, the utility should consider adopting rules or ordinances requiring new commercial and industrial customers to install separate irrigation meters and consider retrofitting current commercial and industrial customers with irrigation meters. It is important for commercial and industrial customers to have a separate irrigation meter so they can better understand how much water they are using for irrigation. This provision is optional for this BMP.

Schedule

Utilities pursuing this BMP should begin implementing this BMP according to the following schedule:

1) The utility should follow applicable regulatory procedures and adopt a conservation oriented rate structure within the first twelve months. The conservation rate structure should be designed to promote the efficient use of water by customer classes as outlined in this BMP.
2) At least annually, a utility should review the consumption patterns (including seasonal use) and its income and expense levels to determine if the conservation rates are effective and make appropriate, regular rate structure adjustments as needed.
3) At least annually, the utility should provide information to each customer on the conservation rate structure.
4) If not already in place, within five years or when the utility changes billing software, whichever is sooner, the utility bill should provide customers with their historical water use for the last 12 months and a comparison of water use with the other customers in their customer class. The rate structure should be clearly indicated on the water bill.
5) While not required to be implemented as part of this BMP, within one year the utility should consider adopting service rules or an ordinance requiring all new commercial and industrial customers to install separate irrigation meters and the feasibility of retrofitting commercial and industrial current customers with irrigation meters.

Scope

To accomplish this BMP, the utility should implement a conservation-oriented rate structure and maintain its rate structure consistently with this BMPs definition of conservation pricing and implement the other items listed in D above.

Documentation

To track this BMP, the utility should maintain the following documentation:

1) A copy of its legally adopted rate ordinance or rate tariff that follows the guidelines of this BMP;
2) Billing and customer records which include annual revenues by customer class and revenue derived from commodity charges by customer class for the reporting period;
3) Customer numbers and water consumption by customer class at the beginning and end of the reporting period;
4) If a water allotment is included in the minimum bill, a cumulative bill usage analysis similar to Figure C-3 in the AWWA M1 Manual;
5) A copy of the education materials on the conservation rate sent to customers for each calendar year this BMP is in effect;
6) A utility bill meeting the parameters and schedule in Section D;
7) Optional provisions:
    a. A copy of the rule or ordinance requiring all new commercial and industrial customers to install separate irrigation meters; and
    b. Implementation and schedule for an irrigation meter retrofit program for current commercial and industrial customers or a feasibility analysis of an irrigation meter retrofit program for current commercial and industrial customers.

Determination of Water Savings

The effect of conservation pricing implementation is very specific to each utility. Elasticity studies have shown an average reduction in water use of 1 to 3 percent for every 10 percent increase in the average monthly water bill.[1] When implementing a conservation pricing structure, consideration should be given to the factors that influence whether the new structure results in a reduction in water use. The *Water Price Elasticities for Single-Family Homes in Texas* (*See* Section I. References for Additional Information, 1) study included several significant findings that water savings can be expected:

1) Average price is better than marginal price in explaining the quantity of water demanded by customers.
2) Customers have a general lack of awareness of their block rates.
3) The water savings that accompanies a switch to a block rate may be lost in subsequent years if water rates do not keep up with inflation.
4) Customers do not understand the link between water use and sewer billing and therefore do not tend to factor sewer prices into their water use decisions.

5) The study did find price elasticities of approximately -0.20, which translates into a reduction of 2 percent in water use for a 10 percent increase in price.

The utility should focus on a rate design that sends the appropriate price signal to customers to reduce discretionary water use. To remain effective, the rates need to be adjusted periodically to take into account inflation as well as other factors.

Cost Effectiveness Considerations

A cost effectiveness analysis can be done by comparing the cost of implementing this BMP to the anticipated water savings from adopting the conservation rate structure. The costs for implementing a rate structure change are associated with managing a stakeholder involvement process and costs for consultant services, if needed, and there may be one time only costs associated with developing and adopting ordinances and enforcement procedures. There may be significant costs associated with reprogramming the billing system if this step isnecessary.

References for Additional Information

1) *Principles of Water Rates, Fees, and Charges (M1 Manual)*, AWWA, 2000.
2) *Residential End Uses of Water,* AWWA Research Foundation, 1999
3) *Irvine Ranch Excess Use Residential Water Rate*
4) http://www.irwd.com/FinancialInfo/ResRates.html
5) *Water Price Elasticities for Single-Family Homes in Texas*, Texas Water Development Board, August 1999.
6) *Designing, Evaluating, and Implementing Conservation Rate Structures*, California Urban Water Conservation Council, July 1997.
7) *Effectiveness of Residential Water Price and Nonprice Programs*, AWWARF, 1998.
8) *San Antonio Sample Water Bill*
http://www.saws.org/service/ebill/saws%20ebill%20sample.htm
9) *Example Rate Structures*
   - *City of Austin Water Rates*
   http://www.ci.austin.tx.us/water/rateswr03.htm
   - *Dallas Water Utilities*
   http://www.dallascityhall.com/dallas/eng/pdf/dwu/conservation_rate_100101.pdf

3.2 Wholesale Agency Assistance Programs

Applicability

This BMP is intended for Wholesale Municipal Water User Groups ("agency") supplying potable water. The specific measures listed as part of this BMP can be implemented individually or as a group. Upon review, an agency may find that it is already implementing one or more of these elements and may want to adopt additional elements outlined below.

Once an agency decides to adopt this BMP, the agency should follow the BMP closely in order to achieve the maximum benefit from this BMP.

Description

Wholesale agency assistance program measures are designed to deliver assistance to its wholesale utility customers who purchase water and provide retail water service to customers. Under this BMP, the wholesale agency will provide financial and/or technical support to wholesale purchasers to advance water conservation efforts both for the wholesale customer and its retail water customers. Financial support should consist of incentives or equivalent resources as appropriate and beneficial. All BMP programs that target retail water customers should be supported when they can be shown to be cost-effective in terms of avoided cost of water from the wholesaler's perspective.

Financing for water conservation programs can be built into the rate structure as a dedicated fund available to wholesale customers who are retail purveyors. The wholesale agency can offer its BMP programs either to the wholesale customer or directly to its retail customers and should provide technical assistance to implement them. When mutually agreeable and beneficial, the wholesale agency may operate all or any part of the conservation-related activities for one or more of its retail customers.

Wholesale agencies should work in cooperation with their wholesale customers to identify and remove potential disincentives to conservation that are created by water management policies including, to the extent possible, when considering the nature of wholesale water service, its water rate structure. Wholesale rate structures should be designed upon the basic principal of increased cost for increased usage. Incentives to conserve can be built into the base rate/volumetric rate ratio with greater emphasis on volumetric rates or with a seasonal increment.

Implementation

Agencies are encouraged to consider stakeholder group information meetings, especially for those affected by this BMP. Working with stakeholder groups will be important to achieving

"buy in" from the stakeholders. Implementation of this BMP will exceed the requirements of §TAC 288.5, Water Conservation Plans for Wholesale Water Suppliers. To implement this BMP, the following elements and strategies should be included:

1) Wholesale agency baseline profile: A description of the wholesaler's service area, including population and customer data, water use data, water supply system data, and wastewater data;
2) Wholesale agency goals: Specification of quantified five- and ten-year targets for water savings including, where appropriate, target goals for municipal use in gallons per capita per day (Total "GPCD") for the wholesaler's service area, maximum acceptable water loss and the basis for the development of these goals;
3) Wholesale water system accounting and measurement:
    a. A description as to which practice(s) and/or device(s) will be utilized to measure and account for the amount of water diverted from the source(s) of supply;
    b. A monitoring and record management program for determining water deliveries, sales, and losses;
    c. A program of metering and leak detection and repair for the wholesaler's water storage, delivery, and distribution system;
4) A requirement in every wholesale water supply contract that each successive wholesale customer develops and implements a water conservation plan that meets TAC 288 rule requirements for public water suppliers. Because no state mechanisms are in place to enforce implementation of these plans, the wholesale agency should consider developing and adopting penalties for non-compliance of this requirement.
5) Conservation-oriented water rates. During the process of contracting for water service, either new or renewed, the wholesale agency should implement wholesale water rate structures that provide incentives to conserve.
6) Wholesale customer assistance. A program to assist customers, which could include, but not be limited to, the following:
    a. Technical assistance with the development of plans and program implementation;
    b. Development of consistent methodologies for accounting and tracking water loss and gallons per capita per day;
    c. Development of procedures for calculating program savings, costs and benefits;
    d. Coordination of conservation incentive activities. Examples of pooling funds and providing grants; offering bulk purchase of equipment such as ULF toilets;
    e. Implementation of wholesale service area-wide education and outreach programs, such as school education programs, public information programs, etc. (*See* BMP for school education and public information);

f. Cost-sharing, including joint management of retrofit and education programs and partial funding of rebates for specific conservation measures.

7) A program for reuse and/or recycling of wastewater and/or gray water and
8) Any other water conservation practice, method, or technique which the wholesaler shows to be appropriate for achieving the stated goal or goals of the water conservation plan.
9) A means for implementing this BMP, which will be evidenced by official adoption of the wholesale agency's BMP initiatives by the wholesale customers.

Schedule

Program participants should begin implementing this BMP within twelve (12) months of official adoption.

Scope

To accomplish this BMP, the agency should adopt wholesale agency assistance policies, programs or rates consistent with the provisions for this BMP as specified in Section C.

Documentation

To track the progress of this BMP, the agency should gather the following documentation:

1) Copy of wholesale agency assistance BMP enacted in the service area;
2) Copy of Conservation Plan pursuant to §TAC 288.5;
3) Annual report of measures accomplished; and
4) Copies of progress reports of BMPs implemented by wholesale customers that are done in conjunction with the wholesaler or which are cost-shared through this BMP.

Determination of Water Savings

Using historical records as appropriate, calculate water savings due to implemented BMPs, such as water loss programs or programs delivered to retail customers. Calculated savings should be based upon equipment changes, quantified efficiency measures, or alternative water sources as appropriate.

Cost-effectiveness Considerations

The labor costs for technical services to retail customers are dependent upon the type of conservation BMPs which the wholesale agency decides to implement. Wholesale providers should evaluate each of the BMPs to determine the appropriate costs associated with technical

assistance. Cost-share costs also depend upon the cost of the BMP and the percentage of BMP implementation the wholesaler determines is appropriate. It is recommended that the wholesaler determine the NPV of avoided costs for new supply projects to determine the appropriate level of financial support to offer retailers for cost-share programs.

References for Additional Information

1) *A Water Conservation Guide for Public Utilities,* New Mexico Office of the State Engineer, March 2001.

2) *Pulling Utilities Together: Water-Energy Partnerships*, Home Energy Magazine Online July/August 1993. http://hem.dis.anl.gov/eehem/93/930709.html

3) *Memorandum of Understanding,* California Urban Water Conservation Council, 1999.

4.1 Metering of All New Connections and Retrofit of Existing Connections

Applicability

This BMP is intended for all Municipal Water User Groups ("utility") that do not have 100 percent metering of all customer connections. Improved accuracy of meters resulting from increased maintenance efforts should result in increased revenue and reduced "water loss." Metering of all new customer connections and retrofit of existing connections are effective methods of accounting for all water usage by a utility within its service area.

Description

Proper installation of meters by size and type is essential for good utility management. Using and maintaining the most accurate meter for each type of connection will generate adequate revenues to cover the expenses to the utility, equity among customers, reduce water waste and reduce flows to wastewater facilities. The American Water Works Association (AWWA) provides a number of resources listed in the reference section of this BMP. The purpose of this BMP is to ensure that all aspects of meter installation, replacement testing and repair are managed optimally for water use efficiency.

For a utility's meter program to qualify as a BMP it should have several elements:

1) Required metering of all new connections and existing connections.
2) A policy for installation of adequate, proper-sized meters as determined by a customer's current water use patterns. The use of compound meters for multi-family ("MF") residential connections or other industrial and commercial accounts is recommended.
3) Direct utility metering of each duplex, triplex, and fourplex unit whether each is on its own separate lot or whether there are multiple buildings on a single commercial lot.
4) Metering of all utility and publicly owned facilities, as well as customers.
5) Use of construction meters and access keys to account for water used in new construction.
6) Required separate irrigation meters for all new commercial buildings with a site plan area of more than 10,000 square feet and for all duplexes, triplexes and fourplexes.
7) Implementation of the State requirements in HB 2404, passed by the 77th Legislature Regular Session and implemented through Texas Water Code 13.502, that requires all new apartments to be either directly metered by the utility or submetered by the owner.

8) Review of capital recovery fees to determine whether the fees provide any disincentive to developers to use utility metering of apartment units.
9) Annual testing and maintenance of all meters that are larger than two inches since a meter may underregister water use as the meter ages.
10) Regular testing and evaluation of 5/8 and ¾ inch meters which are 8 to 10 years in service to determine meter accuracy or a periodic, consistent replacement program based on the age of the meter or cumulative water volume through the meter. This program should be based on testing of meters at each utility to determine the optimal replacement/repair period since it depends both on the quality of water and the average flow rate through the meter versus the capacity of the meter.
11) An effective monthly meter-reading program where readings are not estimated except due to inoperable meters or extenuating circumstances. Broken meters should be fixed within 7 days or a reasonable time frame.
12) An accounting of water savings and revenue gains through the implementation of the Meter Repair and Replacement Program.

Implementation

To accomplish this BMP, the utility should do the following:

1) Conduct a Meter Repair and Replacement Program following the methodology and frequency currently recommended in industry practices and specified by the AWWA.
2) Develop and perform a proactive meter-testing program and repair identified meters.
3) Notify customers when it appears that leaks exist on the customer's side of the meter. An option would be to repair leaks on the customer's side of the meter.

Schedule

To accomplish this BMP, the utility should do the following:

1) The utility should develop procedures for implementation of this BMP within the first twelve months.
2) The procedures should include annual or more frequent benchmarks for measuring implementation.
3) The program participant should develop procedures for and maintain a proactive Leak Detection and Repair Program (*See*, Water Loss BMP) within the first twelve months.

Scope

To accomplish this BMP, the utility should do the following:

1) Develop and implement a metering program based on current AWWA practices and standards.
2) Produce a regular schedule for the utility meter repair and replacement program based upon total water use and the consumption rates of utility accounts.
3) Effectively reduce real water losses though implementation of the meter replacement and repair programs.

Documentation

To track the progress of this BMP, the utility should gather the following documentation:

1) Copy of meter installation guidelines based upon customer usage levels.
2) Copy of meter repair and replacement policy.
3) Records of number and size of meters repaired annually.
4) Report on the method used to determine meter replacement and testing intervals for each meter size.
5) Estimate of water savings achieved through meter replacement and repair program.

Determination of Water Savings

Every year the utility should estimate its annual water saving from the BMP. Savings can be estimated based upon a statistical sample analyzed as part of the meter-testing program. Project potential savings into future years and include in utility water savings targets and goals.

Cost-Effectiveness Considerations

Capital costs to the utility in implementing this BMP may include the costs of installing new meters and retrofitting older ones, as well as one-time or periodic costs such as purchase of meter testing and calibration equipment. A replacement meter can run from as little as $50 for a residential meter to several thousand for larger compound meters. Meter testing and repair can be done by utility staff or by outside contractors. Smaller utilities could consider sharing testing facilities. A typical residential meter test can be done from $15 to $50. There also may be administrative costs for additional tracking and monitoring of meter replacements.

References for Additional Information

1) *Water Loss Control Manual,* Julian Thornton, McGraw-Hill, 2002.
2) *M6 Water Meters – Selection, Installation, Testing and Maintenance,* AWWA 4th Edition, 1999.

3) *Applying Worldwide BMPs in Water Loss Control,* AWWA Water Loss Control Committee, Journal AWWA, August 2003.
4) *HB 2404 2001 Session.* http://www.capitol.state.tx.us/cgi-bin/tlo/textframe.cmd?LEG=77&SESS=R&CHAMBER=H&BILLTYPE=B&BILLSUFFIX=02404&VERSION=5&TYPE=B
5) *Texas Water Code, Submetering Rules for Apartments, Subchapter M, Section 13.502.* http://www.capitol.state.tx.us/statutes/docs/WA/content/htm/wa.002.00.000013.00.htm#13.502.00

4.2 Utility Water Audit & Water Loss

Applicability

This Best Management Practice (BMP) is intended for all utilities. This practice should be considered by a utility that

1. would like to analyze the benefits of reducing its water loss, unbilled authorized consumption, and other nonrevenue water,
2. does not conduct a water loss audit on an annual basis,
3. wants to determine if under-registering meters are impacting its revenues, or
4. wants to reduce main breaks and leaks.

To maximize the benefits of this BMP, a utility should use the information from its water loss audit to revise meter testing and repair practices, reduce unauthorized water use, improve accounting for unbilled water, and implement effective water loss management strategies.

Texas Water Code Section 16.0121(b) requires retail public water utilities to conduct a water loss audit every five years, unless they have an active financial obligation with the Texas Water Development Board or have more than 3,300 connections, in which case they must conduct a water loss audit annually. By adopting this practice, a utility may be conducting a more frequent water loss audit than required.

Description

Water loss audits and water loss programs are effective methods of accounting for all water usage by a utility. Performing a reliable water loss audit is the foundation of production-side water resource management and loss control in public drinking water systems. The structured approach of a water loss audit allows a utility to reliably track water uses and provides the information needed to address unnecessary water and revenue losses. The information resulting from a water loss audit is valuable in setting performance indicators and in setting goals and priorities to cost-effectively reduce water losses.

Compiling a water loss audit is a two-step process involving a top-down audit followed by a bottom-up audit. The first step, phase 1 of a total water loss control program and known as the top-down audit, is a desktop audit using existing records and some estimation to provide an overall picture of water losses. Records needed include but are not limited to: quantity of water entering the system, customer billing summaries, leak repair summaries, average pressures, production and customer meter accuracy percentages, permitted fire hydrant use, and other records that may be kept on water theft and unmetered uses such as street cleaning.

The second step of the audit, phase 2 of a total water loss control program, is a bottom-up audit. This process involves a detailed investigation into actual policies and practices of the utility and can be phased in over several years. Several areas should be addressed, including development of better estimates of water use by the fire department, water used in line flushing

and street cleaning, metering of all authorized uses, and improved measurement of meter accuracies. Other tools to identify and isolate water loss include conducting a system-wide leak detection program, using night flow and zonal analysis to better estimate leakage, analyzing pressure throughout the system, and analyzing leakage repair records for length of time from reporting to repair of the leak. A utility may wish to adopt a water loss or nonrevenue water policy such as the one endorsed by the American Water Works Association.

The third step of the audit, phase 3 of the total water loss control program, is applying a reliable validation program including recordkeeping and best management practices.

Several indicators from the analyses in a water loss audit should be considered by utilities in order to improve water loss control procedures. These include:

(1) Real Loss

Real loss is water lost due to leakage and excess system pressure. With these losses, the water is not beneficially used by any party. Real losses can be reduced through more efficient leakage management; improved response time to repair leaks; improved pressure management and level control; improved system maintenance, replacement, and rehabilitation; and avoiding second- and third-party excavation damage. The cost of real losses is typically, but not always, estimated using variable production costs, such as the costs of energy and chemicals needed to treat and deliver the water (see Cost-Effectiveness Considerations section).

Real loss performance can be tracked using one of three technical performance indicators for real loss depending on the size of the utility. Infrastructure Leakage Index (see (4)) should be used by utilities with 3,000 or more connections and a connection density of 16 or more connections per mile. Utilities with a connection density of more than 32 connections per mile should use real loss per connection per day as a performance indicator, while utilities with a connection density of 32 or fewer connections per mile should use real loss per mile per day.

(2) Apparent Loss

Apparent loss includes losses due to retail customer meter accuracy error, data transfer errors between retail customer meters and archives, data analysis errors between archived data and data used for billing/water balance, and unauthorized consumption including theft. These losses are experienced by the utility as forgone revenues, even though the water is still being beneficially used. The cost of apparent losses is estimated using the retail price of water and the variable rate the customer pays for water use. Apparent loss performance is tracked using the same technical performance indicator for all utilities: apparent loss per connection per day.

(3) Unavoidable Annual Real Loss

Unavoidable Annual Real Loss (UARL) represents the lowest theoretical level of annual real losses in millions of gallons per day that could exist in a system if all possible leakage control efforts are exerted to reduce losses, without regard to cost effectiveness. UARL is based on data obtained from systems where effective leakage management was implemented. The calculation

of the UARL is based on the length of water mains in miles, the number of service connections, and the average annual water pressure. The UARL is only applicable to utilities with 3,000 or more connections and a connection density of 16 or more connections per mile.

(4) Infrastructure Leakage Index

The Infrastructure Leakage Index (ILI) is the ratio of annual real losses divided by UARL. The ILI provides a ratio of current leakage relative to the lowest level obtainable using current best management practices for leakage. A ratio of 1.0 indicates that the utility has reduced losses to the lowest level theoretically possible, given its annual average water pressure.

(5) Economic Level of Leakage

This is a calculation based on the cost of reducing leakage. It is the theoretical level at which the cost of leakage reduction meets the cost of the water saved through leakage reduction. These costs include not only the cost of producing water, but also the avoided cost of replacing the water. Further details on this measure can be found in the Water Research Foundation report 4372 Water Audits and Real Loss Component Analysis.

In order to reduce water losses due to leakage, a utility should maintain a proactive water loss program. A structured approach to leakage management has proven to be successful in limiting losses.

Potential elements of an active water loss program include

- reducing repair time on leaks (long-running, small-to-medium-size leaks can be the greatest volume of annual leakage);
- conducting regular inspections and soundings of all water main fittings and connections;
- installing temporary or permanent leak noise detectors and loggers;
- conducting a large transmission main leak detection program;
- metering individual pressure zones;
- establishing district metering areas and measuring daily, weekly, or monthly flows with portable or permanently installed metering equipment;
- continuous or intermittent night-flow measurement;
- installing temporary or permanent pressure gauges throughout the distribution system to identify high- and low-pressure areas and pressure transients;
- controlling pressure just above the utility's standard-of-service level, taking into account fire requirements, outdoor seasonal demand, and requisite tank filling;
- operating pressure zones based on topography;
- limiting surges in pressure;
- reducing pressure seasonally and/or where feasible to reduce losses from background leaks;
- implementing a program to facilitate the location and marking of system distribution lines for contractors in the utility service area to reduce damage to system infrastructure during excavation and construction activities.

Detection and marking of system distribution lines can be accomplished through a focused utility program such as an on-line location request tool with GIS capability. Participating in an existing location request program such as the 811 "Call before you dig" or "One Call" utility notification center is another option. Either option will require utility follow-up to field locate utility lines for contractors.

If a utility has not had regular leak surveys performed, it will probably need at least three leak surveys performed in consecutive years or every other year because

1. the first survey will uncover long-term leaks,
2. the second survey will uncover additional long-running leaks whose sounds were masked by larger nearby leaks,
3. by the third survey, the level of new leaks should start to approximate the level of new reported leaks.

The utility should make every effort to inform customers when leaks exist on the customer side of the meter. If customer service line leaks are significant, a utility might consider the option of making the repairs itself. Lost revenue can be made worse by the length of time and the number of occurrences of a customer service line leak.

The utility should also reduce apparent losses since reducing these losses will increase utility revenue. Some of the areas that should be examined are

- customer meter inaccuracy due to meter wear, malfunction, or inappropriate size or type of meter;
- data transfer error when transferring customer metered consumption data into the billing system;
- data analysis errors, including poor estimates of unmetered or unread accounts;
- inaccurate accounting resulting in some accounts not being billed for water use;
- all forms of unauthorized consumption, including meter or meter reading tampering, fire hydrant theft by contractors and others, unauthorized taps, and unauthorized restoration of water service cutoffs.

Implementation

The Texas Water Development Board's Water Loss Audit Manual for Texas Utilities is a comprehensive guide to performing a water loss audit. It provides a framework for gathering data, calculating performance measures, assessing data validity, and reporting requirements under Texas Water Code Section 16.0121(b). Utilities implementing this BMP should use the methodology from the Texas Water Development Board manual. The American Water Works Association also offers products that can assist with performing a water loss audit. They have published the M36 Manual, which provides additional guidance on implementing this Best Management Practice, and they offer free water loss audit software that allows utilities to quickly compile a preliminary water loss audit.

Gathering Data for the Audit

Utilities implementing this BMP should start by forming a working group from the following work areas: management, distribution, operations, production, customer service, finance, and conservation. Each of these work areas has an essential role to play in implementing this BMP. Smaller utilities may have the same person performing several of these functions; in these cases, the working group may just be one or two individuals. The utility should also consider a public involvement process to solicit outside input as well as to enhance public relations.

Initially the working group should focus on gathering relevant data and identifying current practices that form the basis for the top-down audit. Some of the questions that should be addressed during the top-down audit are

1. How often do we test production meters? Are they tested or just calibrated?
2. How often do we test commercial meters over 1 inch? Over 2 inches?
3. How often do we replace or repair $^{5}/_{8}$ - and $^{3}/_{4}$ - inch meters?
4. How accurate are the $^{5}/_{8}$ - and $^{3}/_{4}$ - inch meters on average when they are replaced?
5. Do we estimate total leakage from each leak based on the leakage flow rate and length of leakage from time reported when we fix leaks?
6. How long does it take to repair leaks, itemized by size of leak?
7. Are customers encouraged to report leaks?
8. Do we have a system for tracking location of leaks and a method to calculate when it is cost-effective to replace mains and service lines?
9. Are meter readers trained to look for and report leaks?
10. Do we adjust consumption records when billing records are adjusted?
11. How effective is our theft reduction program?
12. How do we track water used for flushing both new and existing lines?
13. Are excavation activities causing damage to pipes? Who is causing the damage, and how often? Are most excavation damage activities from a failure to communicate with the utility or from a failure to follow excavation guidelines provided?

Completing the Audit

Based on the data and information collected from the questions above, the utility should have enough information to complete a top-down audit. The water loss audit can be completed using the Texas Water Development Board's Water Loss, Use, and Conservation application. Completing the audit through the online application allows for the connection of data between the Water Use Survey and the Water Loss Audit reports submitted to the Texas Water Development Board and provides an easier approach for providing the data requested in the audit.

The data requested for completing the audit includes

- number of connections served,
- miles of main line length,

- average annual operating pressure,
- treated production volume and meter accuracy from the utility's own sources,
- treated purchased volume and meter accuracy from the utility's provider,
- treated volume of water sold to other water systems and the accuracy of these meters,
- the volume of authorized consumption,
- the average customer meter accuracy,
- the volume of systematic data handling discrepancy and unauthorized consumption,
- the volume of reported breaks and leaks,
- the retail price of water,
- the variable production cost of water,
- the annual operating cost.

The utility must then assess the validity of the data provided on the water loss audit. Data validity is critical for developing an accurate water loss picture. The Water Loss Manual for Texas Utilities provides an assessment scale for the data used in the water loss audit, allowing the utility to score 20 audit components on a scale from 0.5 to 5, with a maximum of 100. The assessment scale score represents the conditions present at the utility during the collection of the data used to complete each audit component. The Texas Water Development Board's Water Loss Audit Resources webpage provides a guidance document to assist the utility in completing its validity assessment.

Data Validation

Assessing the validity of the audit data components requires the utility to dive into its policies, procedures, and practices, as well as their effectiveness in the collection of accurate data. This detailed analysis requires the utility to take a hard look at itself. Completing the validity assessment is not intended to judge the utility but rather to provide an accurate assessment of the quality of its water loss audit data. The Water Research Foundation report 4639a Level 1 Water Audit Validation: Guidance Manual provides details to assist utilities in conducting an accurate assessment of the quality of water loss audit data.

The Water Research Foundation report 4639b Utility Water Audit Validation: Principles and Programs provides details on water loss audit data validation.

There are three levels of water loss audit data validation:

- Level 1 validation ensures the utility accurately applied the correct assessment scale scores
- Level 2 validation investigates and ensures the accuracy of some key data
- Level 3 validation confirms data through field verification

It is important to note that validation occurs as a separate process from the completion of the audit. A self-reported water loss audit, and the result of completing the audit, does not provide validation of the data.

Many utilities have found a benefit to the operations and management of their systems after undertaking a water loss audit validation process. Data validation can be performed by a third-party or another individual trained in this method. Preferably, the individual performing the data validation is different from the individual or group that completed the audit, thus providing an independent perspective on the quality of the data. Data validation may or may not improve the assessment score, and in many cases, it may lower the score. Validation provides an understanding of how effective the utility's data collection and management activities are.

The assessment scale also provides guidance on improving the assessment score. Efforts to improve data validity include metering all water accounts and connections, including municipal connections; annually testing or calibrating all production meters; implementing district metering areas and automatic meter reading; tracking all unmetered water use, such as fire suppression and line flushing; conducting a theft identification and reduction program; tracking and quantifying all repaired leaks; and conducting a leak detection program. A utility should ensure the validity of its water loss audit data prior to using the audit to set targets and plan water loss control projects and programs.

Using the Audit to Set Targets and Plan the Total Water Loss Control Program

Ensuring the validity of the water loss audit data helps the utility identify cost-effective steps in controlling water loss. The Water Loss Control Planning Guide (adapted from the American Water Works Association) can help a utility identify steps to take in setting targets and controlling water loss. The guide uses the total assessment score, which represents the utility's confidence in the overall water loss audit data, to guide the utility in identifying potential areas of planning and control.

Utilities with low confidence in their data should view the overall water loss audit data as preliminary. Utilities with a score below 25 should not use the audit data to design targets, long-term loss programs, or benchmarks with other utilities due to the unreliability of the data. Processes to improve data quality provided in the assessment scale should be implemented. Utilities with scores between 26 and 50 should feel comfortable beginning investigations of portions of their system and assessing long-term needs but should not use the audit to set targets or benchmark with other utilities. Improvements to data quality should be implemented first.

Utilities with greater confidence in their data should view the overall water loss audit data as a tool to inform more detailed water loss mitigation strategies. Utilities with scores between 51 and 70 should feel comfortable establishing or revising policies, procedures, and practices, and beginning to establish long-range targets. Utilities with scores between 71 and 90 have many water loss tracking measures in place and can place greater faith in their data. They can use their data to guide their water loss control mitigation programs, set mid-range targets, and track and benchmark the data with utilities with similar scores. Utilities with scores of 90 or more have taken steps to maximize their validity scores through implementation of mature water loss control and data collection efforts. They have greater confidence in the reliability of their water loss audit results and should continue to

perform and confirm these efforts.

A utility with high confidence in its water loss audit data should set a water loss mitigation goal using industry performance indicators. Utilities with an Infrastructure Leakage Index can set a goal based on their available and potential water supplies, excess treatment capacity, projected growth, and economic considerations. A guide for setting Infrastructure Leakage Index target ranges is available in the Texas Water Development Board's Water Loss Audit Manual for Texas Utilities. Utilities can also set a goal using other technical performance indicators listed in the Description section above.

Controlling Water Losses

In conducting a bottom-up audit, the utility addresses the relevant issues identified during the top-down audit and further investigates any areas where the data may be lacking or incomplete. The utility uses the results of the audit to focus on the best approaches to reduce both real and apparent losses. Whether the technical performance indicators for water loss are relatively high or low determines the number of years it may take to reduce the indices.

Each subsequent year, as the utility completes another audit, the utility should be able to gradually reduce its technical performance indicators for water loss. If the utility has performed bottom-up auditing to improve data collection, it may find that its technical performance indicators for water loss increase due to better data.

Scope and Schedule

To accomplish this BMP, the utility should undertake the steps listed below.

1. Conduct a water loss audit annually following the methodology contained in the Texas Water Development Board's Water Loss Manual for Texas Utilities, yielding technical performance indicators and a total assessment score.
2. Develop and implement a proactive distribution system water loss program and repair identified leaks.
3. Implement a program to reduce apparent losses.
4. Advise customers when it appears that leaks exist on the customer's side of the meter and evaluate a program to repair leaks on the customer's service line.
5. If the utility's real loss volume is high
    a. Implement a program to reduce real losses, including a leak detection and repair program,
    b. Implement a pressure reduction strategy if warranted, and
    c. Take steps to account for and minimize all unmetered water.
6. If the audit data validity assessment score is below 90, implement a plan to identify areas where data collection can be improved, using the assessment scale table on the Texas Water Development Board's Water Loss Webpage.

Measuring Implementation and Determining Water Savings

To track the progress of this BMP, the utility should gather and have available the following documentation

1. a copy of each annual water loss audit, the technical performance indicators for water loss for each year, the audit data validity assessment score for each field and the total for the year, and a list of actions taken in response to audit recommendations;
2. annual leak detection and repair survey, including number and sizes of leaks repaired;
3. number of customer service line leaks identified, actions taken to repair these leaks, and the average time to make repairs, if repaired by the utility or through a program;
4. pressure reduction actions taken, if any; and
5. annual revenue lost to real and apparent losses.

Potential water savings are an integral part of the water loss audit process and can be tracked by comparing trends from annual water loss audits. Based on the results of the audit, the utility should set goals for reducing its losses.

Cost-Effectiveness Considerations

Direct costs that should be considered in implementing this BMP include the initial and ongoing costs of performing and updating the water loss audits and capital costs for items such as leak detection equipment and billing system upgrades. Utilities may wish to do the work in-house with technical staff or by using outside consultants and contractors.

A recommended method to make cost-effectiveness decisions is based on the economic value of real losses and apparent losses. Real losses are losses due to leaks and are valued at actual costs to produce and deliver the water. According to the M36 Manual, however, leakage should be valued at retail cost if the utility operates in a context of water resource limitations and is implementing water conservation measures in response. Apparent losses, sometimes called paper losses, are those attributable to meter and billing inaccuracies and are valued at the retail rates charged by the utility. The amount of lost revenue due to real losses, based on the utility's variable production or retail cost, and apparent losses, valued at the retail rate charged to customers, can be compared to the costs of reducing the sources of loss.

Determination of the Impact on Other Resources

Reduction of real water loss increases the available water supply in addition to the traditional conservation benefits of reducing water demand, electricity and chemicals used in treatment and pumping, and water procurement costs. These benefits can be achieved without reducing utility revenues. Reducing apparent losses by improving data management and meter accuracy can even increase utility revenues.

Reducing water loss can require a range of resources which vary depending on the age of the utility's distribution system, pipe materials, soil types, and system design. A responsive leak repair program is essential to reducing water loss. Leak detection and meter testing can be done by the utility or contracted out. Timely repairs and an ongoing preventative maintenance and

replacement program will allow the utility to operate efficiently, minimizing operational losses.

References for Additional Information

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5.1 Athletic Field Conservation

Applicability

This BMP is intended for all Municipal Water User Groups ("utility") which manage irrigated athletic field(s) and/or serve a customer with irrigated athletic field(s). Athletic fields often involve a visible use of water during the day, which comes under scrutiny by the public and water resource managers both because of large water demand to maintain an athletic field, and because of the perception that the water use may be excessive. The specific measures listed as part of this BMP can be implemented individually or as a group. Utilities may already be implementing one or more these elements and they may want to adopt additional elements outlined in this document.

Once a utility decides to adopt this BMP, the utility should follow the BMP closely in order to achieve the maximum water efficiency benefit from this BMP.

Description

Athletic field conservation is an effective method of reducing system water demands. The athletic field manager implements a watering regimen that uses only the amount of water necessary to maintain the viability of the turf and maintain the turf adequately to maintain the health of users. Water is only applied to areas that are essential to the use of the field.

The utility provides the customer, by staff or a third party, a large landscape water-use survey and develops reference evapotranspiration ("ETo")-based water-use budgets equal to no more than 100 percent ETo per square foot of landscape area. The survey includes the following elements: measurement of landscape area; measurement of total irrigable area; irrigation system checks and distribution uniformity analysis; and review or development of monthly irrigation schedules. If landscape use is determined to exceed 20 percent of total water use by the customer, the athletic facility should install a dedicated landscape meter. Alternatively the utility may allow customers to perform their own survey by properly trained staff and provide documentation of the survey to the utility. Proper athletic field management emphasizes precise nutrient management, soil preparation techniques, and regular watering as compared to simply using more water to ensure a dense turf.[1,2,3]

At a minimum, the athletic field BMP should require the replacement of all manual controlled or quick couple irrigation systems with automatic irrigation systems and controllers. The automatic controllers should be able to shut off flow when a sudden pressure loss occurs from a broken system. It is important that access to such controllers be limited to the authorized landscape manager or be designed to shut off flow automatically if the irrigation system is activated manually. The authorized landscape manager should be trained in good soil management and cultural practices such as proper aeration, nutrient management, mowing and soil testing as well as in irrigation management. The utility implementing this BMP should consider offering training for athletic field managers or co-sponsoring training with qualified

agronomy program(s). Documentation of cultural practices and soil management measures should be included in a successful program. Although expensive, replacement of natural turf grasses with artificial turf is becoming more popular in some areas of Texas.

When cost-effective, the athletic field user should be required to provide methods for achieving enhanced water conservation through computer controlled irrigation systems ("CCIS") or similar technology. In order to achieve maximum efficiency a CCIS should include at least the following components: computer controller ("digital operating system"), software, interface modules, satellite field controller, soil moisture sensors, and weather station. A CCIS should be designed so as to prevent overwatering, flooding, pooling, evaporation, and run-off of water, and should prevent sprinkler heads from applying water at a rate exceeding the soil holding capacity. School districts or park systems with a number of remotely located athletic fields should consider a CCIS with satellite systems. Subsurface irrigation systems are also becoming more reliable and are an option. The utility may choose to offer incentives for athletic field management in direct relation to the size and sophistication of the system.

It is recommended and encouraged to use reclaimed, reused, and/or recycled water by athletic fields, however, such use must meet TCEQ water quality standards for treated effluent and human contact. When utilizing reclaimed water or water with high levels of total dissolved solids ("TDS") or hardness, the water budget will need to be adjusted to permit leaching of salts below the root zone of the turfgrass. Consultation with local extension agents can assist athletic field managers in properly managing the use of lower quality water for irrigation.

Soil improvement is an effective method for reducing irrigation water usage while maintaining healthy soils. Soil improvement programs on high visibility areas such as athletic fields can demonstrate to the public the effectiveness of this method. For athletic fields, compost applications of 1/4 to 1/2 inch annually are recommended. Compost is most beneficial when applied in the fall.

Implementation

The utility should consider stakeholder information meetings. Working with stakeholder groups is important to achieving "buy in" from the athletic field managers. Also a number of voluntary environmental management programs exist in which athletic fields may already be participating. There are two approaches to be considered: an incentive or voluntary approach and an ordinance or other enforceable requirement approach.

Incentive or Voluntary Compliance Approach

The utility may provide staff or contract with a third party to provide a water audit of the athletic field. The water-use surveys, at a minimum, include measurement of the irrigated turf areas; determination if hydrozones within the irrigation system are proper for the type of turf present; irrigation system checks and distribution uniformity analysis; review of irrigation schedules or development of schedules as appropriate; and provision of a customer survey report and information packet.

If indicated by survey results and if cost-effective, the utility may offer incentives to the athletic field user for upgrading of irrigation systems, installing or upgrading controllers, changing hydrozones to eliminate irrigation of areas that do not receive high foot traffic, or reducing the amounts of potable water used on the athletic fields. For athletic field managers that agree to manage water efficiently, variance procedures may assist them with watering schedules on large systems with many hydrozones. Utilities may consider assisting athletic field managers in developing an individualized conservation plan, which accounts for turf type, soils, and irrigation system constraints.

When cost-effective, the utility should offer workshops by trained professionals on pesticide and soil and nutrient management for optimal water use efficiency. To ensure that water savings goals are met, the utility should be explicit about the efficiency expectations of voluntary programs.

Ordinance or Enforceable Requirements Approach

1. For utilities with ordinance-making powers, in the first twelve (12) months plan develop, and pass an ordinance, including stakeholder meetings as needed. Develop a plan for educating customers, especially those directly affected by the requirements of the ordinance. Plan customer follow-up compliance and education after ordinance passage. Implement ordinance and tracking plan for violations, compliance notifications, and enforcement.

   After ordinance passage (in the 2nd year and on), continue implementation and outreach program for customers. Continue compliance education and initiate enforcement programs. Enforcement can include citations with fines for repeat offenders. Or,

2. For utilities that lack ordinance-making powers, in the first twelve (12) months plan a program including stakeholder meetings as needed. Develop a plan for educating customers, especially those directly affected, about the requirements of an athletic field conservation program. Plan follow-up compliance and education program. Implement water conservation program and tracking plan for violations and compliance notifications. Consider passing excess-use rates as a disincentive to athletic fields that do not stay within a budgeted amount of water (*See* Conservation Pricing BMP).

Schedule

1. The utility should adopt an incentive program, an ordinance or rules within twelve (12) months of commencing this BMP.
2. The utility should implement the incentive plan or commence enforcement upon adoption of the ordinance or rule.

Scope

To accomplish this BMP, the utility should adopt athletic field conservation policies, programs or ordinances consistent with the provisions for this BMP specified in Section C.

Documentation

To track the progress of this BMP, the utility should gather and have available the following documentation:

1) Copy of incentive plan or athletic field conservation ordinances or rules enacted in the service area;
2) Copy of compliance or enforcement procedures implemented by utility, if applicable;
3) Records of enforcement actions including public complaints of violations, and utility responses, if applicable;
4) Number of customers completing the incentive plan;
5) Tracking mechanism developed to determine customer water use before and after implementation of BMP;
6) Water savings attributable to changes implemented; and
7) Costs of incentive plan(s) or ordinance if applicable.

Determination of Water Savings

Estimating total water savings for this BMP may be difficult, however, water savings can be estimated from each water-wasting measure eliminated through the actions taken under this BMP. For the replacement of inefficient equipment, the water savings are the difference in use between the new or upgraded equipment and inefficient equipment. For landscape water waste, the savings can be calculated based on estimated savings from each water waste incident. For an irrigation survey, water savings can be expected in the range of 15 percent to 25 percent for athletic fields that do not have a CCIS and where the efficiency measures recommended by the results of the survey are implemented. Switching to artificial turf, reuse or other nonpotable alternatives can save up to 100 percent of the potable water supply used in irrigation. These savings should be determined by measuring water use before and after the conversion to the new water supply.

Cost-Effectiveness Considerations

The labor costs for irrigation survey of an athletic field range from $250 to more than $1000 for an irrigation survey depending on the efficiency in scheduling the surveys, the size of the facility, and the scope of the survey. Surveys can be performed by utility staff or by contractors.

Marketing and outreach costs range from $5 to $15 per survey. Administrative and overhead costs are in the range of 10 to 20 percent of labor costs. Costs for upgrades to irrigation systems and controllers can be much more extensive depending upon the scale of changes needed. Costs for incentive programs for system upgrades will need to be evaluated on a case-by-case basis.

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5.2 Golf Course Conservation

Applicability

This BMP is intended for all Municipal Water User Groups ("utility") that serve a golf course customer. Golf courses often involve a visible use of water, which comes under scrutiny by the public and water resource managers both because of large water demand to maintain the course, and because of the perception that the water use may be excessive. Golf courses are often good candidates for reuse water or other alternative sources of water. The specific measures listed as part of this BMP can be implemented individually or as a group. Utilities may already be implementing one or more of the elements of this BMP and they may want to adopt additional elements outlined below.

Once a utility decides to adopt this BMP, the utility should follow the BMP closely in order to achieve the maximum water efficiency benefit from this BMP.

Description

Golf course conservation is an effective method of reducing water demands. Under this BMP, the utility requires each golf course to develop a conservation plan that includes the elements described in this section. The golf course manager conducts a landscape and irrigation survey to determine water needed to efficiently irrigate the course. A water budget should be developed using reference evapotranspiration ("ETo"). The manager implements a watering regimen that uses only the amount of water necessary to maintain the viability of the course. In addition to commercially available information from irrigation controller equipment companies, the Texas Evapotranspiration Network (http://texaset.tamu.edu/) has information to assist golf course managers and utility planners with proper management of large turf areas. Golf course managers should be encouraged to limit their water use to areas essential to the use of the golf course. An example of a use that has been eliminated on some golf courses is irrigation of the roughs.

The golf course plan utilizes methods of achieving enhanced water conservation such as a Computer Controlled Irrigation Systems ("CCIS") or similar technology. In order to achieve maximum efficiency a CCIS should include at least the following components: computer controller ("digital operating system"), software, interface modules, satellite field controller, soil sensors, and weather station. A CCIS should be designed so as to prevent overwatering, flooding, pooling, evaporation, and run-off of water and should prevent sprinkler heads from applying water at an intake rate exceeding the soil holding capacity. The golf course plan provides an analysis of the cost-effectiveness of utilizing a CCIS.

If potable water is used and if non-potable water is available, the golf course converts to use of non-potable water as soon as is practicable. The golf course plan should include projected implementation dates to convert to alternative water supplies. Use of reclaimed, reused,

and/or recycled water by golf courses must meet TCEQ water quality standards for treated effluent and human contact.

Soil improvement is an effective method for reducing irrigation water usage while maintaining healthy soils. Soil improvement programs on high visibility areas such as golf courses can demonstrate to the public the effectiveness of this method. For golf courses compost applications of 1/4 to 1/2 inch annually on turf areas and one inch annually on flower beds are recommended. Compost is most beneficial when applied in the fall.

Implementation

The utility should consider stakeholder information meetings. Working with stakeholder groups will be important to achieving "buy in" from golf course businesses. Also a number of voluntary environmental management programs exist in which golf courses may already be participating. There are two approaches to be considered to implement the golf course conservation plan described in Section B: an incentive or voluntary approach and an ordinance or other enforceable requirement approach.

1) Incentive or Voluntary Compliance Approach

The utility may provide staff or contract with a third party to provide a water audit of the golf course. The water-use surveys should, at a minimum, include measurement of the irrigated turf areas; measurement of the greens, tee boxes and fairways; determination whether hydrozones within the irrigation system are proper for the type of turf present; irrigation system checks and distribution uniformity analysis; review or development of irrigation schedules; and provision of a customer survey report and information packet.

If indicated by survey results and if cost-effective, the utility may offer incentives to the golf course user for upgrading irrigation systems, installing or upgrading controllers, changing hydrozones to eliminate irrigation of rough, or reducing the amount of fairway watering.

When cost-effective, the utility should offer golf course management and staff workshops by trained professionals on pesticide and nutrient management for optimal water-use efficiency. An advantage to working with programs like the Audubon Cooperative Sanctuary Program ("ACSP") for Golf program is that the third party can assist in implementation at no cost to the utility. To ensure that water-savings goals are met, the utility should be explicit about the efficiency expectations of voluntary programs.

2) Ordinance or Enforceable Requirements Approach

a. For utilities with ordinance-making powers, in the first twelve (12) months plan, develop, and pass an ordinance that requires development and implementation of the golf course conservation plan, including stakeholder meetings as needed. Develop a plan for educating

customers, especially those directly affected by the requirements of the ordinance. Plan customer follow-up compliance and education after ordinance passage. Implement ordinance and tracking plan for violations, compliance notifications, and enforcement.

In the second year and on (after ordinance passage): Continue implementation and outreach programs for customers. Continue compliance education and initiate enforcement programs. Enforcement can include citations with fines and service interruption for repeat offenders.

b. For utilities that lack ordinance-making powers, in the first twelve (12) months plan a program including stakeholder meetings as needed. Develop a plan for educating customers, especially those directly affected, about the requirements of a golf course conservation plan. Develop follow-up compliance and education program. Implement water conservation program and tracking plan for violations and compliance notifications. Consider passing excess-use rates as a disincentive to golf courses that do not stay within a budgeted amount of water (*See* Conservation Pricing BMP).

Schedule

1) The utility should adopt an incentive program or an ordinance or rules within twelve (12) months of commencing this BMP.
2) The utility implements the incentive plan or commences enforcement upon adoption of the ordinance or rule**.**

Scope

To accomplish this BMP, the utility adopts golf course conservation policies, programs or ordinances consistent with the provisions for this BMP specified in Section C.

Documentation

To track the progress of this BMP, the utility should gather and have available the following documentation:

1) Copy of incentive plan or golf course conservation ordinances or rules enacted in the service area;
2) Copy of compliance or enforcement procedures implemented by utility, if applicable;
3) Records of enforcement actions including public complaints of violations and utility responses, if applicable;
4) Water savings from implemented changes; and
5) Number of customers completing the incentive plan.

Determination of Water Savings

Estimating total water savings for this BMP may be difficult, however, water savings can be estimated from each water-wasting measure eliminated through the actions taken under this BMP. For an irrigation survey, water savings can be expected in the range of 15 percent to 25 percent for courses without a CCIS that choose to implement the efficiency measures recommended by the results of the survey. There will be additional savings from the education of customers about golf course watering efficiency, which will be difficult to calculate but will encourage public goodwill toward the golf course water user and the utility. Switching to reuse or other non-potable alternatives can save up to 100 percent of the potable water supply used in irrigation. These savings are determined by measuring water use before and after the conversion to the new water supply.

Cost-Effectiveness Considerations

The one-time labor costs for producing golf course conservation plan guidelines and meeting with golf course stakeholders are dependent upon the level of staffing, the number of meetings, and time allotted to the planning process. Costs for annual review of golf course water use and conservation plan updates should be less than $100 per plan.

Marketing and outreach costs range from $5 to $15 per plan. Administrative and overhead costs are approximately 10 to 25 percent of labor costs. The costs to the golf course facility for an irrigation system survey and CCIS or other systems upgrades or switching to reuse water are highly variable. Costs are dependent upon the efficiency in scheduling the surveys, the size of the course, and the scope of the survey. Surveys can be performed by golf course staff or by contractors.

References for Additional Information

1) *Audubon Cooperative Sanctuary Program (ACSP) for Golf*. http://www.audubonintl.org/programs/acss/golf.htm
2) *Environmental Principles for Golf Courses in the United States*, United States Golf Association, 1996. http://www.usga.org/green/download/current_issues/print/environmental-principles.html
3) *Golf Course Irrigation: Environmental Design and Management Practices*, James Barrett, et al., Wiley & Sons Publishers, 2003.
4) *Irrigation Information Packet*, Golf Course Superintendents Association of America. http://www.gcsaa.org/resource/infopacks/pdfs/irrigation.pdf
5) *Turf Management for Golf Courses, 2nd Edition*, James B. Beard, United States Golf Association, 2002.

6) *U.S. Air Force Golf Course Environmental Management Program*, Air Force Center for Environmental Excellence, San Antonio, Texas. http://www.afcee.brooks.af.mil/ec/golf/default.asp

7) *Wastewater Reuse for Golf Course Irrigation*, edited by James T. Snow, United States Golf Association, 1994.

5.3 Landscape Irrigation Conservation and Incentives

Applicability

This BMP is intended for use by a municipal water user group ("utility") with a substantial percentage of customers using automated landscape irrigation systems and is targeted to customers who have automated irrigation systems. If data on the number of customers with irrigation systems are lacking or absent, the summer peak/winter average ratio can be used as an evaluation tool to determine whether to proceed with this BMP. A ratio of 1.6 or greater indicates the potential for substantial water savings with implementation of this BMP. For maximum water-use efficiency benefit, the utility should adhere closely to the measures described below.

Description

Landscape irrigation conservation practices are an effective method of accounting for and reducing outdoor water usage while maintaining healthy landscapes and avoiding run-off. Using this BMP, the utility provides non-residential and residential customers with customer support, education, incentives, and assistance in improving their landscape water-use efficiency. Incentives include rebates for purchase and installation of water-efficient equipment. Four approaches are outlined below. Successful implementation of this BMP will be accomplished by performing one or a combination of the approaches listed.

1) ETo-Based Water Budgets

If the utility chooses the water budget approach, the utility also develops reference evapotranspiration ("ETo")-based water-use budgets equal to no more than 80 percent of ETo per square foot of irrigated landscape area for customers participating in its Landscape Irrigation Conservation Program. More aggressive landscape conservation programs can utilize stress coefficients lower than 80 percent.

Evapotranspiration is the combined amount of the water transpired by plants and the water evaporated from the soil. ETo is defined as the estimate of evapotranspiration that occurs from a standardized reference crop of well-watered, clipped, cool-season grass. The amount of supplemental irrigation water needed is the shortfall between plant water need (which is a fraction of ETo) and precipitation.

The statewide Texas Evapotranspiration Network (http://texaset.tamu.edu/) should be consulted for historical evapotranspiration data, historical precipitation, and methodology for calculating reference evapotranspiration and allowable stress. (Communities located in the North Plains areas may find local historical data on potential evapotranspiration at: http://amarillo2.tamu.edu/nppet/whatpet.htm.

2) Water-Use Surveys, Metering, and Budgeted Water Use

If the utility chooses the survey approach, the utility develops and implements a plan to promote landscape water-use surveys to industrial/commercial/institutional ("ICI") and residential accounts with mixed-use meters. The water-use surveys, at a minimum, include: measurement of the landscape area; measurement of the total irrigable area; irrigation system checks and distribution uniformity analysis; review of irrigation schedules or development of schedules as appropriate; and provision of a customer survey report and information packet. When cost-effective, the utility should offer the following: landscape water-use analyses and surveys; voluntary water-use budgets; installation of dedicated landscape meters; acceptance of site conservation plans; and follow-up to water-use analyses and surveys.

At the start and end of the irrigation season, irrigation systems should be checked, and repairs and adjustments made as necessary. Notices should be included in bills to remind customers of seasonal maintenance needs. For accounts with water-use budgets, the utility should provide notices with each billing cycle showing the relationship between budgeted water usage and actual consumption. When soil conditions allow, and landscape managers are familiar with the use and maintenance of soil moisture sensors, water budgets can be allocated based upon soil moisture status, thereby providing a closer estimate of actual evapotranspiration.[3]

Many utilities require dedicated irrigation meters for all commercial and/or industrial accounts with automatic irrigation systems or if the lot is above a minimum size. For municipalities with ordinance-making powers, this can be accomplished by ordinance. Otherwise, dedicated meters may be implemented as a new customer policy.

3) Landscape Design

If the utility chooses the landscape design approach, the utility provides information on climate-appropriate landscape design and efficient irrigation equipment and management for new customers and change-of-service customer accounts (*See* the Landscape Design and Conversion Programs BMP for more detail). To serve as a model, the utility should install climate-appropriate, water-efficient landscaping at water agency facilities and landscape meters where appropriate. Municipalities with ordinance-making powers should consider adopting ordinances that require all new apartment complexes and commercial buildings to install a water conserving landscape. This can often be accomplished by amending an existing commercial landscape ordinance.

4) Minimum Standards and Upgrades

If the utility chooses the landscape standards approach, the utility should require new commercial and industrial customers to install separate irrigation meters and consider retrofitting current commercial and industrial customers with irrigation meters. The utility should consider this requirement for new residential customers installing automatic irrigation systems. For municipalities with ordinance-making powers, this can be accomplished by ordinance. Otherwise, this may be implemented as a new customer policy.

Irrigation system design and maintenance components and landscape design may be systematically upgraded through use of municipal ordinance-making powers where possible. Minimum water efficient design features can be mandated for new construction, while existing systems or landscapes are offered incentives to upgrade. Rainwater sensors, soil moisture sensors, irrigation controllers, pipe specifications, and hydrozone specifications are all potential elements of an irrigation systems ordinance. Total turf grass areas, buffer zone plant material, and hydrozones are all potential elements of landscape design ordinances. Buffer or median areas represent additional savings when all landscaped areas less than five feet in any dimension are restricted to drip or other surface or subsurface (non-spray) irrigation system or no irrigation system.

Implementation

The utility should consider offering the Landscape Irrigation Program to customers with large landscapes first as a means of rapidly increasing cost-effectiveness and water savings. Marketing the Program to the customer via bill inserts will allow the utility to target the largest summer peak users first. The utility should consider also approaching local weather announcers, radio gardening show hosts, and newspaper columnists for assistance in notifying the public about the program. Public/private partnerships with non-profits such as gardening clubs, Cooperative Extension offices and/or with green industry businesses such as landscape and irrigation maintenance companies are potential avenues to market the program and leverage resources.

Incentives can include rebates for irrigation audits and systems upgrades, recognition for water-efficient landscapes through signage and award programs, and certification of trained landscape company employees and volunteer representatives who can promote the Program. Utility staff can also be trained to provide irrigation audits which can include resetting irrigation controllers with an efficient schedule.

Approximately one year after conducting an irrigation audit, the utility should consider conducting a customer-satisfaction survey. The objective of the customer-satisfaction survey is to determine the implementation rate of recommended modifications and to gauge customer satisfaction with the program.

The initial step in assisting customers with landscape irrigation systems is a thorough evaluation of the existing landscape area and irrigation systems. This includes:

1) A list of landscape areas, measurements, plant types, irrigation system hydrozones, and controller(s);
2) A list of existing irrigation policies or procedures including maintenance and irrigation schedules;
3) A distribution uniformity analysis on irrigated turf areas;
4) A review of water bills with attention to the ratio of summer to winter use; and
5) An initial report summarizing the results of the evaluation.

The water customer who participates in this program needs to maintain and operate its irrigation systems in a water-efficient manner. Maintenance programs include pre-irrigation system checks, adjustment of irrigation timers when necessary, installation of rain sensors, and regular review of irrigation schedules and visual inspection of the irrigation system. When landscape management companies are utilized, contracts should include a required report showing regularly scheduled maintenance and seasonal adjustments to irrigation systems controllers. A more advanced form of contracting would be to build into the contract a dollar amount based on 80 percent of ET and require the contractor to pay for any water use above that amount. The utility should consider implementing a notification program to remind customers of the need for maintenance and adjustments in irrigation schedules as the seasons change.

When appropriate, the utility should consider offering the following services:

1) Training in efficiency-focused landscape maintenance and irrigation system design;
2) Financial incentives (such as loans, rebates, and grants) to improve irrigation system efficiency and to purchase and/or install water efficient irrigation systems;
3) Financial incentives to replace high-water use plants with lopw water use ones;
4) Rebates and incentives to purchase rain sensors or soil-moisture sensors; and
5) Notices at the start and end of the irrigation season alerting customers to check irrigation systems and to make repairs and adjustments as necessary.

The utility should need to ensure that landscape irrigation system specifications are coordinated with local building codes.

Evaluations and/or rebate processing could be done by the utility staff or be outsourced. If a utility chooses to perform the evaluations using in-house staff, they may take advantage of irrigation evaluation training programs provided by the Texas A&M School of Irrigation or the Irrigation Association.

An outsourcing option for the non-residential sector is to use or recommend a water-based performance contractor. Performance contracting is a financing technique that uses cost savings from reduced utility (water and sewer) consumption to repay the cost of installing

water conservation measures. This technique allows for the development of a water-savings program without significant up-front capital expenses on the part of the customer. Instead, the costs of water-efficiency improvements are borne by either the contractor or a third party lender who recoups cost and shares water savings profits with the user.

Schedule

1) Realize the Scope of this BMP within ten years of the date implementation commences.
2) Develop ETo-based water-use budgets for all accounts with dedicated irrigation meters by the end of the second year from the date implementation commences.
3) Develop and implement a plan to target and market landscape water use surveys to ICI accounts with mixed-use meters by the end of the first year from the date implementation commences.
4) Develop and implement a customer incentive program by the end of the first year from the date implementation commences.
5) Follow up with the participating customer approximately one year after a water use survey has been conducted and/or a rebate processed.

Scope

To accomplish the goals for this BMP, the utility should do the following:

1) <u>Landscape Irrigation System Management Programs</u>
   a. Within one year of implementation date, develop and implement a plan to market water-use surveys to ICI accounts with mixed-use meters;
   b. Within one year of implementation date, develop and implement a customer incentive program;
   c. Within two years of implementation date, develop ETo-based water-use budgets for 90 percent of ICI accounts with dedicated irrigation meters;
   d. Within ten years contact and offer landscape water-use surveys to 100 percent of ICI accounts with mixed-use meters;
   e. Within ten years complete landscape water-use surveys for at least 15 percent of ICI accounts with mixed-use meters.
   f. Within ten years contact and offer landscape water-use surveys to 100 percent of residential accounts with summertime monthly use of greater than four times annual average; and
   g. Within ten years complete landscape water-use surveys for at least 15 percent of residential accounts with summer monthly use of greater than four times annual average.

2) <u>Ordinance Approach</u>
   In the first twelve (12) months: Plan a program, including stakeholder meetings as needed. Consider offering rebates for all or a portion of the time this program

is in place. For example, offer rebates for only the first five years to encourage customers to take advantage of rebates and retrofit early in the program. Develop a plan for educating real estate agents, landscape companies, and irrigation installers about this requirement. Plan a follow-up inspection program after retrofit. Develop and pass ordinance. Implement ordinance and tracking plan for number of units retrofitted.

In the 2nd year and all subsequent years: Continue implementation; continue outreach program for real estate agents, landscape companies, and irrigation system installers; and continue verification inspections.

Documentation

To track this BMP, the utility should gather the following documentation:

1) Number of dedicated irrigation meter accounts;
2) Number of dedicated irrigation meter accounts for which water budgets have been developed;
3) Aggregate water use for dedicated landscape accounts with budgets;
4) Aggregate budgeted water use for dedicated landscape accounts with budgets;
5) Number of mixed-use accounts;
6) Number of surveys offered and number of surveys accepted and completed;
7) Number, type, and dollar value of incentives, rebates, and loans offered to and accepted by customers;
8) Estimated water savings achieved through customer surveys; and
9) Estimated landscape area converted and water savings achieved through low water landscape design and conversion program.

Determination of Water Savings

Landscape surveys as described in this document are assumed to result in a 15 percent reduction in water demand for landscape uses by surveyed accounts. The utility should provide estimates of water savings from landscape irrigation survey programs based upon actual metered data. The water budget calculation is as follows:

80 percent ETo calculation: I = (ETo x Kc x AS) where I is the irrigation amount to be applied for a given period (daily, twice weekly, weekly, etc.), in inches or centimeters

ETo is the measured reference evapotranspiration over the irrigation period
Kc is a turf coefficient for turf grasses, and can be found at http://texaset.tamu.edu/
AS is allowable stress of 0.8 (or less if the landscape manager wishes)
For those wishing to convert inches of irrigation to gallons, multiply landscape area by 0.62. Irrigation Volume (gals.) = I (in.) x LA (sq ft) x 0.62

When applying irrigation, the equation should be modified to gain greater water savings by accounting for precipitation: I = (ETo x Kc x AS) – Pe where P is precipitation in inches or cm. In calculating an irrigation amount, it is important to consider effective precipitation (Pe). Effective precipitation is less than natural precipitation since some rainfall runs off or percolates below the root zone. The amount of effective precipitation will vary with region and rainfall trends. Each rainfall event will have a unique characteristic, and a good source for estimating Pe is the county office of the Texas Cooperative Extension Service.

Cost Effectiveness Considerations

Surveys can be performed by utility staff or by contractors. The labor costs range from $50 to $100 for a SF irrigation survey and start around $100 and go up from there for an ICI irrigation survey, depending on the efficiency in scheduling the surveys, the size of the landscape, and the scope of the survey.

There may be other one-time costs such as purchase of leak detection equipment and meters. Marketing and outreach costs range from $5 to $15 per survey. Administrative and overhead costs range from 10 to 20 percent of labor costs.

References for Additional Information

1) *Landscape Irrigation Scheduling and Water Management.* Water Management Committee of the Irrigation Association, September 2003. http://www.irrigation.org/PDF/IA_LIS_AND_WM_SEPT_2003_DRAFT.pdf
2) *Turf and Landscape Irrigation Best Management Practices*, Water Management Committee of the Irrigation Association, September 2003. http://www.irrigation.org/PDF/IA_BMP_SEPT_2003_DRAFT.pdf
3) *Waste Not, Want Not: The Potential for Urban Water Conservation in California,* Pacific Institute, November 2003. http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf
4) *Handbook of Water Use and Conservation*, Amy Vickers, Waterplow Press, May. 2001.
5) *ET and Weather Based Controllers CUWCC Web Page.* http://www.cuwcc.org/Irrigation_Controllers.lasso
6) *Smart Water Technology Initiative Web Page.* http://www.irrigation.org/swat1.asp
7) *Soil moisture instrumentation: Sensors & strategies for the 21st century*, Richard Mead, in Irrigation Journal, Sept/Oct 1998.
8) *San Antonio Water System Conservation Program.* http://www.saws.org/conservation/
9) *WaterWise Council of Texas.* http://www.waterwisetexas.org/
10) *Texas Evapotranspiration Network*. http://texaset.tamu.edu/
11) North Plains areas of Texas may find local historical data on potential evapotranspiration at: http://amarillo2.tamu.edu/nppet/whatpet.htm.

5.4 Park Conservation

Applicability

This BMP is intended for all Municipal Water User Groups ("utility") which manage parks or serve customers with parks which consume water. These include facilities such as irrigated parks, recreation centers, fountains or pools at which the visible use of water often comes under scrutiny by the public and water resource managers both because of large water demand to maintain a park and because of the perception that the water use may be excessive.

The specific measures listed as part of this BMP can be implemented individually or as a group. Utilities may already be implementing one or more these elements and they may want to adopt additional elements outlined in this document. Once a utility decides to adopt this BMP, the utility should follow the BMP closely in order to achieve the maximum water efficiency benefit from this BMP.

Description

Park irrigation conservation practices as well as the careful use of water in operation and maintenance of park facilities can effectively reduce water demands. Under this BMP, the utility requires the management of each park with an irrigation system to develop a conservation plan that includes the elements described in this section. A Municipal Park Department should develop comprehensive written water conservation policies and procedures that cover all irrigated parks under its jurisdiction. Maintenance and operations of park facilities such as pools are also addressed. All park facilities should be metered and water use billed as means of reinforcing the importance of water use efficiency to park management.

Under the plan the park manager implements a watering regimen that uses only the amounts of water necessary to maintain the viability of the turf and landscape material appropriate for the use of the park. Water should only be applied to areas that are essential to the use of the park. For parks with athletic fields, the fields should be irrigated in accordance with the guidelines of the Athletics Fields BMP. Utilities should consider methods to encourage park managers to cease irrigation of areas that do not affect the use of the park by the public.

The utility should coordinate with Park Department or customer staff to ensure implementation of a large landscape water-use survey of irrigated areas and develop reference evapotranspiration ("ETo")-based water-use budgets equal to no more than 80 percent ETo per square foot of landscape area. The landscape survey should include the following elements: measurement of landscape area; measurement of total irrigable area; irrigation system checks and distribution uniformity analysis; and review or development of irrigation schedules. Alternatively, the utility may allow individual customers to perform their own surveys with properly trained staff or consultants and provide documentation of the survey to the utility.

The statewide Texas Evapotranspiration Network (http://texaset.tamu.edu/) should be consulted for historical evapotranspiration data, historical precipitation, and methodology for calculating reference evapotranspiration and allowable stress. Communities located in the North Plains areas may find local historical data on potential evapotranspiration at http://amarillo2.tamu.edu/nppet/whatpet.htm

At a minimum, compliance with this BMP should require the replacement of all manually controlled or quick couple irrigation systems with automatic irrigation systems and controllers. The automatic controllers must be capable of shutting off flow when a sudden pressure loss occurs from a broken system. It is important that access to such controllers be limited to the authorized landscape manager, or be designed to shut off flow automatically if the irrigation system is activated manually. The authorized landscape manager should be trained in good soil management and cultural practices such as proper aeration, nutrient management, mowing and soil testing as well as in irrigation management.

When cost-effective, the park irrigation user should be required to provide methods for achieving enhanced water conservation through computer controlled irrigation systems ("CCIS") or similar technology. In order to achieve maximum efficiency a CCIS should include at least the following components: computer controller (digital operating system), software, interface modules, satellite field controller, soil moisture sensors, and weather station. A CCIS should be designed so as to prevent overwatering, flooding, pooling, evaporation, and run-off of water, and should prevent sprinkler heads from applying water at an intake rate exceeding the soil holding capacity. Park organizations with a number of remotely located park irrigation systems should consider a CCIS with satellite systems. The utility may choose to offer incentives for park irrigation management in direct relation to the size and sophistication of the system.

The utility implementing this BMP should consider offering training for park irrigation management or co-sponsoring training with qualified horticulture or park management programs. Documentation of cultural practices and soil management measures should be included in a successful program.

Water wasting practices during park irrigation should be eliminated, including water running in gutter, irrigation heads or sprinklers spraying directly on paved surfaces, operation of automatic irrigation systems without a functioning rain shut off device, operation of an irrigation system with misting or broken heads, and irrigation during summer months between the hours of at least 10 a.m. and 6 p.m.

Use of reclaimed, reused, and/or recycled water for park irrigation offers excellent opportunities for conservation of potable water. However, specific uses must meet Texas Commission on Environmental Quality ("TCEQ") water quality standards for reclaimed water and human contact and must be appropriate for the specific use of the park. Reclaimed water should be applied based on the appropriate water budget.

1) Park Facilities

Playground equipment and facilities such as recreational facilities, tennis courts, basketball courts, and park and pool buildings should be swept for regular sanitary purposes and only cleaned with the amounts of water needed for human health and safety purposes. Showerheads, faucets and toilets in park facilities should be retrofitted with efficient fixtures.

All public swimming pools should be equipped with recirculation and chlorination equipment. While not common, there are pools that are filled and drained everyday with potable water and that practice should be discontinued. Overflow drains should be plumbed back into the recirculation system. Swimming pools should be managed to minimize operational losses due to evaporation, splashing and filter backwashing. Proper design, optimal backwash scheduling, and use of a pool cover can help limit all these losses. Regular maintenance during the off-season should include testing for water loss and repair of leaks. Use of pool covers is also an important consideration for reducing water losses due to evaporation, although safety concerns where pools are accessible after hours require careful implementation.

Decorative water features at parks including fountains and augmented streams should use recirculation systems. During high temperature seasons reduced operating procedures and use of covers can reduce evaporation losses. Reuse of non-potable water such as reclaimed water should also be considered where available. Rainwater harvesting is also an option for many park facilities with large roof areas.

2) Botanical Gardens

Botanical Gardens or other related areas in parks are usually run by staff trained in proper water management techniques to meet plant needs. However, water saving opportunities should be explored in leak detection and repair, installation of low-water-use demonstration gardens, and the use of rainwater harvesting or alternative water supplies as conservation techniques. The planting and maintenance of low-water-use demonstration gardens can assist the utility in the implementation of the WaterWise Landscaping, School Education, and Public Information BMPs.

Soil improvement is an effective method for reducing irrigation water usage while maintaining healthy soils. Soil improvement programs on high visibility areas such as public parks can demonstrate to the public the effectiveness of this method. For parks, compost applications of 1/4 to 1/2 inch annually on turf areas and one inch annually on flower beds are recommended. Compost is most beneficial when applied in the fall.

Implementation

Prior to development of a specific park conservation plan, the utility should consider a series of planning meetings with park irrigation personnel and management to discuss water

conservation issues and to prepare an adequate scope of action for the plan. Additionally, a number of voluntary environmental management programs exist in which park irrigation staff could participate. There are two approaches to be considered for implementing the park irrigation conservation plan: an incentive or voluntary approach and an ordinance or other enforceable requirement approach.

1) Incentive or Voluntary Compliance Approach

The utility may provide staff or contract with a third party to develop the conservation plan, including a water audit of the park irrigation system and practices. The water-use survey, at a minimum, includes measurement of the irrigated turf areas; determination if hydrozones within the irrigation system are proper for the type of turf present; irrigation system checks and distribution uniformity analysis; review of irrigation schedules or development of schedules as appropriate; and provision of a customer survey report and information packet.

If indicated by survey results and if cost-effective, the utility may offer incentives to the park irrigation user for upgrading irrigation systems, installing or upgrading controllers, changing hydrozones to eliminate irrigation of areas that do not receive high foot traffic, or for reducing the amounts of potable water used.

When cost-effective, the utility should offer workshops by trained professionals on pesticide, soil and nutrient management for optimal water use efficiency. An advantage to using third parties is that assistance in implementation can be provided at minimal cost to the utility.

To ensure that water savings goals are met, the utility should be explicit about the efficiency expectations of any voluntary or incentive programs. Park facilities and operations other than irrigation systems should also be included in the incentive or voluntary compliance approach.

2) Ordinance or Enforceable Requirements Approach

For utilities with ordinance or rule making powers:
In the first twelve (12) months: Plan, develop, and pass an ordinance that requires development and implementation of the conservation plan, including stakeholder meetings as needed. Develop a plan for educating customers, especially those directly affected by the requirements of the ordinance. Plan customer follow-up compliance and education after ordinance passage. Implement ordinance and tracking plan for violations, compliance notifications, and enforcement.

After ordinance passage (in the 2nd year and on): Continue implementation and outreach program for customers. Continue compliance education and initiate

enforcement programs. Enforcement can include citations with fines and service interruption for repeat offenders.

For utilities that lack ordinance or rule making powers:
In the first twelve (12) months: Plan a program including stakeholder meetings as needed. Develop a plan for educating customers, especially those directly affected, about the requirements of park irrigation conservation plans. Develop follow-up compliance and education program. Implement water conservation program and tracking plan for violations and compliance notifications. Consider passing excess-use rates as a disincentive to park irrigation operations that do not stay within a budgeted amount of water (See Conservation Pricing BMP).

Schedule

To accomplish this BMP, the water user should do the following:

1) The utility with ordinance or rule making powers should adopt an incentive program or an ordinance or rules within twelve (12) months of commencing this BMP.
2) The utility with ordinance or rule making powers should implement the incentive plan or commence enforcement upon adoption of the ordinance or rule.

Scope

To accomplish this BMP, the utility should adopt park irrigation conservation policies, programs or ordinances consistent with the provisions for this BMP specified in Section C.

Documentation

To track the progress of this BMP, the utility should gather and have available the following documentation:

1) Copy of incentive plan or park irrigation conservation ordinances or rules enacted in the service area;
2) Metered water readings before and after any changes are implemented.
3) Copy of compliance or enforcement procedures implemented by utility, if applicable;
4) Survey of public swimming pools and actions taken to increase the efficiency of the pools.
5) Records of enforcement actions including public complaints of violations and utility responses, if applicable;
6) Where incentives are used, the number of park facilities completing the incentive plan;
7) Changes to irrigation systems, retrofits, or upgrades, regular leak detection and maintenance policies, and estimated water savings from conservation practices.
8) Water savings attributable to changes implemented; and

9) Costs of incentive plan(s) or ordinance if applicable.

Determination of Water Savings

Estimating total water savings for this BMP may be difficult; however, water savings can be estimated from each water-wasting measure eliminated through the actions taken under this BMP. For the replacement of inefficient equipment, the water savings are the difference in use between the new or upgraded equipment and the inefficient equipment. For landscape water waste, the savings can be calculated based on estimated savings from each water waste incident. For an irrigation survey, water savings can be expected in the range of 15 percent to 25 percent for park irrigation operations that do not yet have a CCIS and which choose to implement the efficiency measures recommended by the survey.

Switching to reuse or other nonpotable water or other alternatives can save up to 100 percent of the potable water supply used in irrigation. The savings are determined by comparing water use before and after the conversion to the new water supply. The savings for swimming pools that have been modified or repaired can be measured in the same way.

Cost-Effectiveness Considerations

The labor costs for an irrigation survey of a park range from $250 to more than $1000 for an irrigation survey depending on the efficiency in scheduling the surveys, the size of the facility, and the scope of the survey. Surveys can be performed by utility staff or by contractors.

Marketing and outreach costs range from $5 to $15 per survey depending upon whether parks are owned by the same municipality as the utility. Administrative and overhead costs are in the range of 10 to 20 percent of labor costs. Costs for upgrades to irrigation systems and controllers can be much more extensive depending upon the scale of changes needed. While less expensive, costs for pool leakage repair and other water efficient equipment are also very site specific. Incentive programs for park conservation equipment upgrades or maintenance will need to evaluate costs on a case-by-case basis.

References for Additional Information

1) *Handbook of Water Use and Conservation*, Amy Vickers, Waterplow Press, May 2001.
2) *Maintaining Park Irrigation,* J. A. Murphy. http://www.rce.rutgers.edu/pubs/pdfs/fs105.pdf
3) *Managing Bermudagrass Turf: Selection, Construction, Cultural Practices, and Pest Management Strategies*, L. B. McCarty, Grady Miller, John Wiley & Sons, July 2002.
4) *Managing Healthy Sports Fields: A Guide to Using Organic Materials for Low-Maintenance and Chemical-Free Playing Fields*, by Paul D. Sachs, John Wiley & Sons, January 2004.

5) *Water Management Stretches Irrigation Water*, E. K. Chandler. http://www.txplant-soillab.com/page32.htm
6) *Park Irrigation and Water Conservation,* Texas Agricultural Extension Service. http://soilcrop.tamu.edu/publications/pubs/b6088.pdf
7) *Irrigation System Design and Management Courses*, Irrigation Technology Center, Texas A&M, http://irrigation.tamu.edu/courses.php

5.5 Residential Landscape Irrigation Evaluations

Applicability

The Residential Landscape Irrigation Best Management Practice is intended for use by a municipal water user or water utility with a large majority of customers utilizing automatic in-ground irrigation systems. Outdoor irrigation constitutes about 60 percent or more of water used by households during the summer months, and much of that water is wasted due to overwatering and broken or maladjusted components. Helping customers identify these issues can amount to large water savings and a positive customer service image for the utility.

Description

Landscape irrigation evaluation training is an effective way to utilize existing staff to reduce summertime water usage and effect positive behavior change through face-to-face site visits and information sessions with individual customers. Automatic landscape irrigation systems typically operate in the early morning or late evening hours, leaving broken and maladjusted components, resulting in irrigation water run-off that goes unnoticed by the home resident. Having in-house staff to address customer complaints regarding a variety of irrigation issues such as high water bill complaints, watering schedule violations, complaints regarding broken irrigation components, or overwatering causing run off and/or ponding, is a valuable asset to the utility in terms of both water savings and customer service. This best management practice is designed to provide assistance and methods for a utility to gain the expertise to perform irrigation evaluations. Implementation can be accomplished by performing one or a combination of the approaches listed.

1. Off-Site Classroom Training
   Several training opportunities are available through accredited irrigation education providers around the state. The Texas Commission on Environmental Quality is the licensing agency for irrigators, technicians, and inspectors, and approves continuing education credits to maintain these licenses. To find a list of approved trainers and courses in your area of the state, visit http://www.tceq.texas.gov/licensing/training/trainers/li_cont_train. One does not need to be a licensed irrigator, technician, or inspector, or seeking one of the specified licenses, to attend courses. Many of the irrigation education service providers teach a variety of topics related to irrigation and water conservation.

   Texas Commission on Environmental Quality licensing regulations require that individuals who consult on the design, construction, or maintenance of irrigation systems hold irrigation licenses. The license ensures that any person giving advice regarding an irrigation system fully understands the function and regulations associated with the system. Individuals who are employees of water utilities may provide advice on irrigation scheduling and comment on irrigation maintenance challenges without a

license. However, obtaining an irrigation license is still desirable for utility employees to provide a higher level of service to customers.

Water providers seeking to utilize current staff should consider having staff attend a landscape irrigation auditing or evaluation course to gain a basic understanding of what landscape irrigation auditing involves and what tools and knowledge will be necessary to perform audits or evaluations. These courses can provide an understanding of basic irrigation principals to help with program development and potential troubleshooting while on-site performing an irrigation evaluation.

Training opportunities are also available through a number of different resources such as the Irrigation Association and Texas Agrilife Extension Service. Courses are available in many different areas around the state and will range from one to two days in length, depending on the course.

2. On-Site Training
   There are many water providers around the state with individuals on staff performing irrigation evaluations in a variety of methods. It may be possible to enlist the assistance of a landscape irrigation evaluation trained staff person from a nearby water provider to walk through their processes and procedures as well as offer advice and technical assistance for starting an irrigation evaluation program.

   The most beneficial opportunity would be a chance to “shadow” an experienced irrigation evaluator while evaluating properties within the water providers service area. The utility interested in starting the program would need to identify and schedule several properties to be evaluated. Setting up one or two city council or city official properties would be helpful to observe the process and see results first hand.

   Shadowing would require having scheduled staff time to accompany the evaluator, at least five properties lined up for evaluations over a two or three day period, and depending on the size of the properties to be evaluated, any materials necessary to provide evaluation results as well as other information for the property owner. Some additional tools would be necessary such as a stopwatch for reading and recording the flow rate from the meter and manuals for operating and programing various irrigation controllers. Shadowing an experienced evaluator, interacting with customers, seeing the variety of irrigation system components and problems typically encountered, and adjusting irrigation schedules firsthand provides the greatest level of education for beginning evaluators. Shadowing can provide a firsthand perspective of what to expect before scheduling those first evaluations.

Implementation

Water providers utilizing this best management practice should offer the program to customers with permanently installed in-ground landscape irrigation systems as a means of reducing wasteful irrigation practices and educating homeowners regarding proper maintenance and

operation of irrigation systems. This program should be targeted to water customers who use over a certain amount of water or as a response to high water usage or bill complaint. As an example focusing on high-use customers, such as the top 10 percent of water users, will provide a more manageable program while still achieving a large volume of water savings. Program marketing can be directed at customers through bill inserts or direct mailing of letters, post cards, or similar materials. The water provider can also approach homeowner associations of targeted high water use neighborhoods with articles regarding the program for publication in newsletters, or offer to give a presentation regarding program specifics, such as procedures and goals.

To incentivize the program a water provider could offer some type of rebate or giveaway to customers for participating. Some water providers offer, or have offered, free rain sensors to customers that did not have one. Others require an irrigation system evaluation as a prequalification to participate in irrigation equipment rebate programs. A utility that has imposed outdoor watering restrictions as a water use reduction measure, permanently or temporarily, could offer to waive a customer violation if they agree to an irrigation landscape evaluation where both the customer and utility benefit. The customer doesn't have to pay a fine and learns about their water use. The utility saves water and has had a positive impact on a customer.

Keeping detailed accounts of each site visited and the water use pre- and post-evaluation will help track water savings associated with the program. However, a follow-up survey with customers who participated in the program can show the effectiveness of the program and the overall satisfaction of the service.

Before the landscape irrigation evaluation program can be developed, it is important to establish defined goals. While the ultimate goal is to save water, the water provider will want to achieve several things along the way, such as a behavior change in how customers use water outdoors, provide a quality service that customers will recommend, and build a positive relationship between the water provider and the customer or end user.

Basic materials should be developed prior to conducting irrigation evaluations to provide results and information of the evaluation to the customer as well as tracking and monitoring evaluations and water use. This includes:

1. Irrigation evaluation forms that list elements of each irrigation station, such as plant type, soil, emitter, and light conditions. Also, this form should have sections for tracking water use per station, basic information recorded from the controller, and issues encountered in each station.
2. Manuals or access to manuals for various types of irrigation controllers which aids in programing and troubleshooting.
3. Irrigation schedule card to be affixed to the controller which current irrigation schedule.
4. Educational information for the customer regarding proper irrigation maintenance and scheduling.

5. Irrigation evaluator contact information for questions or comments regarding the evaluation.

Scope and Schedule

In the first 12 months the water provider should do the following for implementation of the Best Management Practice:

1. Obtain staff training and complete all necessary additional education, documents, and testing required to receive certifications.
2. Develop materials necessary for conduction, scheduling, and tracking irrigation system evaluations.
3. Develop materials and processes to promote program.
4. Look at historic and current water use of the utility and begin identifying target areas with high water use as potential areas for irrigation evaluations.

To accomplish this Best Management Practice, the water provider should do the following after the first year of implementation:

1. Look at water savings per irrigation evaluation and determine effectiveness of the program.
2. Develop and distribute a follow-up survey to customers who participated in the program and gauge the overall public perception of the program.
3. Identify aspects of the program that worked well and not too well. Look for opportunities to expand on what worked and change or remove aspects that did not.
4. Identify additional customers to target and expand the reach of the program through continued outreach and promotions.

Measuring Implementation and Determining Water Savings

Water savings associated with landscape irrigation system evaluations are estimated to last approximately three years. Beyond the three years it is assumed that the landscape needs or scheduling will have changed from what was originally observed and programmed as a direct result of the irrigation evaluation.

To measure savings of irrigation evaluations, exact documentation must be kept for each evaluation performed which must include flow rate measurements and specific run-times associated with each irrigation station. Calculations for each station and total water use must be included on the irrigation evaluation form that is provided to the customer and kept by the water provider as a record. Savings will be represented on each individual evaluation and can be averaged for an overall savings estimate.

Cost-Effectiveness Considerations

Landscape irrigation evaluation training courses can cost approximately $400.00, depending on the source and if an exam for certification is offered. Courses, typically referred to as Irrigation

System Auditing courses, are available several times annually around the state through the Texas Agrilife Extension Service and the Irrigation Association. Other irrigation education organizations may also offer similar courses as well.

It is also highly recommended the irrigation evaluator become a Texas Licensed Irrigator to ensure compliance with all state rules regarding landscape irrigation systems, and develop a greater awareness of the rules and regulations governing the irrigation industry in Texas.

To become a licensed irrigator in Texas a 40-hour course and examination is required. The course fee is around $500.00 and the exam fee another $100.00. Once licensed, the irrigator must complete 24 hours of continuing education credits every three years and pay a license renewal fee to maintain a current status.

Other cost considerations may include the purchase of tools and supplies for conducting irrigation evaluations; for example: soil probe to assess soil type and depth; utility key to access meters; irrigation controller remote controls to operate irrigation systems from various areas of the property; and water proof boots to keep feet dry.

References

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3. Texas AgriLife Extension Service. http://itc.tamu.edu/
4. Lower Colorado River Authority. http://www.lcra.org/water/save/irrigation/index.html
5. San Antonio Water System. http://www.saws.org/conservation/
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5.6 Outdoor Watering Schedule

Applicability

This best management practice (BMP) is intended for all utilities and is considered an essential component of a comprehensive outdoor water conservation program. Utilities across Texas are already familiar with the concept of water restrictions. However, utilities typically only impose water restrictions as a drought management strategy and maintain these limitations on outdoor water use for a temporary period. To promote continued water savings year-round regardless of drought conditions, this BMP provides a guiding framework for the adoption of mandatory, permanent outdoor watering schedules. Although all utilities can benefit from the implementation of outdoor watering schedules, utilities with high seasonal usage will see the greatest impact on outdoor water demands.

Utilities should consider combining the planning for and adoption of maximum outdoor watering schedules with other outdoor landscape education and incentive programs. Some of the programs that pair well with permanent outdoor watering schedules include robust education on regionally appropriate landscape practices, irrigation efficiency, and budgeting landscape water seasonally. These additional efforts are essential to achieving the maximum water savings from this BMP.

Description

In periods of drought and/or emergency, utilities often employ watering restrictions as an immediate response for reducing non-essential water uses such as irrigation for landscaped areas. Once certain conditions are triggered, utilities enforce these restrictions on a mandatory basis, as set forth in their drought or water emergency contingency plans. Utilities typically rescind these temporary restrictions when water supply levels return to normal. This can cause a rebound in water usage and send a message that high water use landscape practices should return.

Permanent, year-round watering restrictions deliver several benefits to the utility and broader community. Given that all regions in Texas are prone to drought, keeping water restrictions in place on a full-time basis is a proactive strategy for helping utilities meet their current and future municipal water needs. Having permanent, agreed upon landscape watering regulations also provides stability for the landscape and irrigation industries by incentivizing customers to select plants and technologies for long-term efficiency. A permanent outdoor watering schedule also avoids the challenge of negative perceptions that some community leaders associate with “drought restriction” landscape measures. A long-term efficiency regulation need not be seen as a deprivation message, but instead reflects the value a community places on water efficiency. If

permanent restrictions are effective, then drought-emergency restrictions might rarely be required.

A mandatory outdoor watering schedule generally limits the number of days per week and the hours during which customers can use water for irrigation purposes as well as the specific water delivering technologies that are being limited. Utilities can enforce mandatory outdoor watering schedules by adopting these provisions as part of an ordinance or rule.

This BMP is designed to help utilities develop deeper outdoor water savings and promote proper outdoor watering practices year-round. Utilities experiencing high seasonal water usage can benefit the most from implementation of this BMP; however, all utilities can use outdoor watering schedules to promote more efficient landscaping and irrigation practices as well as consistent customer messaging.

Each utility must consider what outdoor watering schedule will result in long-term savings and provide reasonable support for regionally appropriate landscapes. Because restrictions of no more than twice per week watering have been effectively implemented across much of Texas, this schedule is a recommended starting point. If a community has managed well with no more than once per week irrigation during long drought periods, then a no more than once per week rule should be considered. Rules that allow more than two days per week for irrigation do not fit with this voluntary BMP, which is intended to promote resilient, regionally appropriate landscapes that thrive with modest supplemental water applications.

Without adequate structure, compliance with the watering schedule can be difficult to track, so this BMP recommends that utilities identify specific days and times when each customer class is allowed to water outdoors. For instance, the utility may structure the watering schedule by customer class and identify specific watering days within each class according to odd- and even-numbered addresses, garbage pick-up day, or different municipality areas (i.e., zip codes). This BMP also recommends that utilities identify an ideal watering window (i.e., from 10:00pm to 5:00am) for customers to water their lawns and landscaping to avoid the natural indoor water peak. Another consideration utilities may choose to address is the distinction between the watering methods that are allowed (i.e., watering by hand, by hose-sprinkler, by automatic irrigation system, etc.). When determining these criteria, the utility should consider system capacity and restraints, customer water use patterns, and stakeholder feedback to ensure the most appropriate schedule for its customers and system operations.

Effective implementation of a watering schedule regulation requires careful planning, stakeholder input, education, and tracking to ensure compliance. While these steps are rigorous,

there are few other efforts that will yield as much peak water savings. When carefully planned and executed, utilities can also leverage outdoor watering schedules as a demand management strategy. Savings from outdoor watering schedules can lead to daily peak demand reductions, which have the potential to relieve system capacity constraints and delay the need for future system expansions. Utilities should consider the full benefits of outdoor watering restrictions when pursuing this BMP.

Implementation

1. Community input

The first step is to build consensus among stakeholder groups that an outdoor watering schedule is a reasonable, permanent water efficiency measure for the community. While it is unreasonable to expect agreement from all citizens, it is important to have a large base of supportive stakeholders. Working through rule details and implementation strategy with representatives of these stakeholder groups can help ensure a smoother rule or ordinance adoption process.

Some of the key stakeholders include:

- Neighborhood associations
- Property management companies
- Local irrigation association
- Local Texas Nursery Landscape Association chapter
- County extension services (Texas Master Gardener and Master Naturalist chapters)
- Local real estate council
- Gardening groups
- Athletic field managers
- Large campus sites

Utilities should invite representatives from these stakeholder groups to participate in an advisory committee overseeing the development of the outdoor watering schedule. Their input is critical to adopting an effective watering schedule that adequately meets local needs. During the early phases of implementing this BMP, it is also advantageous for the conservation coordinator to reach out to other utilities who have implemented outdoor watering schedules and obtain feedback from them, as well.

2. Assess existing water patterns

After conducting preliminary stakeholder review, the utility — led by its Conservation Coordinator — should evaluate outdoor water usage patterns in each of its municipal water use categories. Having a sound understanding of seasonal use patterns is necessary for determining the likely conservation benefit associated with this BMP. Utilities with higher seasonal use, for instance, can expect a greater savings potential from this BMP. Seasonal use customer profiles are also helpful for determining the scope of the outdoor watering schedule. If a utility observes higher seasonal use in one customer class, the utility may choose to implement a more stringent watering schedule for that user category.

Data on savings from past drought restrictions is also important to analyze. Seasonal use patterns during periods of drought compared to hot, dry periods when drought restrictions were not in place may help illustrate potential savings.

3. Consideration of potential watering schedules

When assigning the days of the week that different customer classes are allowed to water, utilities should pay careful attention to how the proposed watering schedule could impact daily peak demand. To avoid possible disruptions to the distribution system caused by increased peak demand – such as low pressure and depletion of storage — utilities should evaluate system capacity and compare system thresholds to projected future demands with the proposed watering schedule in place.

An example is that automatic spray irrigation concurrent with indoor morning peak water use times may be problematic. To avoid peak hourly demand issues, the conservation coordinator should work with the operations department to determine what the system's natural peak demands are using available Supervisory Control and Data Acquisition (SCADA) data. Utilities can use this insight to inform the specific days and watering window that customers are allowed to irrigate. In order to shift away from the natural peak hourly demand, utilities can designate a shorter watering window, such as between the hours of 10:00pm and 5:00am. If a utility decides to implement a broader watering window, the utility should use education and outreach to encourage residents to water during non-peak hours. This is especially critical if the utility observes a high penetration of automatic irrigation systems in its service area, which use a higher rate of water compared to hose sprinklers.

After addressing these concerns, utilities should work with the advisory committee of local stakeholders to finalize the proposed outdoor watering schedule and solicit additional feedback. The conservation coordinator can use this opportunity to discuss the potential

need for variances. Some of the variances to standard rules that may need to be considered include:

- Athletic field schedule
- New construction installation of landscapes
- Remodeled landscapes at homes and businesses
- Large properties
- Low application rate methods: drip irrigation
- City parks

Variances to normal rules must be defined carefully as to who qualifies for them, how long the variance will last, how to apply, and the consequence of violating the variance agreement granted. Variance approval can also be tied to efficiency measures such as improved irrigation design.

In addition to variances, utility staff and stakeholders can address strategies for transitioning to the new watering schedule. For instance, the utility can allow a temporary transition period before the watering schedule is enforced so that customers can acclimate their irrigation practices to the new schedule. The conservation coordinator should also take this time to gather input on recommended education and enforcement strategies.

After finalizing the proposed watering schedule and related provisions, the conservation coordinator should conduct a public review period to introduce the proposed outdoor watering schedule. Utilities may utilize these public engagement opportunities to convey the importance of the proposed watering schedule in achieving city-wide conservation objectives and long-term cost savings. Listening carefully to concerns and addressing them with adjustments to schedules, variance options, and education programs will build support for the rule or ordinance.

Other special considerations will vary with community characteristics. If there is a wide disparity in homes that have automatic irrigation systems and the homes without, it may be possible to devise distinct rules for both. Mandatory watering schedules are more of a burden for people exclusively using more manual watering application methods from hoses. Hose-end methods also generally result in lower water consumption. Exempting hand-held watering is another option to consider as it provides an outlet for people concerned about what to do if they miss their assigned day or have a malfunction with their irrigation schedule.

4. Ordinance/rule drafting and enforcement plan

After determining an appropriate outdoor watering schedule, utilities can move forward with drafting the rule or ordinance. This draft should be shared with all stakeholder groups for vetting and clarification well before adoption.

The enforcement plan is critically important to success. If the rules are part of city ordinance, they may be a criminal violation enforced by local peace officers and administered by the local municipal courts. The rules might also result in fees on the water bill which should have a cost basis for how the amount is set. The fee can reflect the costs of education and enforcement. The fee amount can also reflect the estimated volume of water wasted from non-compliance and apply long-term costs of new water supplies to generate a fee. If fees are collected, utilities should identify how funds will be used. Applying funds to other conservation or environmental needs in the community smooths over concerns that the rules exist for revenue needs of the utility.

There will be many decisions to discuss and logistics to plan. Consider carefully what steps are practical at all stages. For example, will it be practical to require a photo of the violation before a fine or citation can be issued? Under what circumstances will a violation have a penalty? Is it practical to require a warning first before each one? Utilities should think through answers to these common questions and consider talking with other utilities experienced with long-term enforcement processes. Utilities must also keep in mind who will maintain records of complaints and what the process will be for disputing a violation that is imposed.

5. Starting regulation

<u>Education and outreach</u>

a. Develop a public education and outreach campaign that delivers ongoing messaging to customers about the outdoor watering schedule and offers educational resources on landscape watering needs and efficient irrigation practices.
b. Promote educational opportunities both internally, as well as externally through the local landscaping community (e.g., at local nurseries, garden centers).
c. Team up with educational institutions and local organizations representing irrigators and landscapers to offer information-based tools and materials to water customers (e.g., Texas A&M Agrilife Extension's *Water My Yard* Program).
d. Engage with local media to broaden the reach of the messaging and awareness of the watering schedule.

Enforcement

a. Provide water customers with an easily accessible method for reporting watering violations, including an online form, hotline, web app, etc.
b. Dedicate at least some staff resources or contract with peace officers to patrol for watering violations.
c. Utilize violations as opportunities to amplify education and outreach efforts by making water customers more aware of watering schedules and effective irrigation practices.

Robust educational and enforcement efforts are essential for ensuring the greatest water savings possible. Utilities can enhance the implementation of outdoor watering schedules with time of day restrictions, which aim to prevent watering during the hottest and windiest part of the day, and water waste prohibitions, which aim to reduce water lost to wasteful activities.

6. Tracking progress

It is important to evaluate the success of the watering schedule, variance procedures, and enforcement mechanisms regularly. It is expected that adjustments will be needed periodically. Scheduling a six-month or one-year check-in with stakeholders is recommended so that they know their concerns will be considered.

Utilities can maximize the effectiveness of outdoor watering schedules by introducing measures to complement this BMP. These complementary BMPs include:

- Athletic Field Conservation
- Golf Course Conservation
- Landscape Irrigation Conservation & Incentives
- Park Conservation
- Residential Landscape Irrigation Evaluation

Scope & Schedule

The full scope and schedule depends on the utility's unique context. What follows is a recommended scope and schedule for utilities with or without ordinance making powers. These efforts should be tailored based upon what water customers are willing to accept and participate in, as well as resources available to the utility.

1) For utilities with regulatory authority:
    a. First 12 months
        i. Organize and conduct stakeholder process to gather community input and identify key stakeholders.
        ii. Plan, design, and propose outdoor watering schedule in coordination with an advisory committee of key stakeholders. Special items to consider include:
            1. Appropriate variance program for new landscapes, new construction, trees, athletic fields, etc.;
            2. Transitional period before watering schedule is enforced; and
            3. Potential strategies for education and enforcement.
        iii. Propose the inclusion of other outdoor watering provisions, such as time-of-day restrictions and water waste prohibition, if not already in place.
        iv. Identify enforcement mechanisms, including citations with fines and service interruption for repeat offenders.
        v. Conduct public review period to obtain additional feedback on the proposed ordinance, related provisions, and enforcement strategies.
        vi. Develop an education and outreach campaign for informing residents of the watering schedule and of the long-term cost-savings for delayed or avoided infrastructure and work with local landscape and irrigation professionals to promote proper landscaping and irrigation practices.
        vii. Develop an enforcement plan for ensuring compliance with the ordinance, including a mechanism for reporting violations or the enlistment of code enforcement officers.
        viii. Obtain final approval of ordinance.
    b. Following ordinance adoption
        i. Continue implementation and outreach efforts.
        ii. Initiate enforcement program.
        iii. Review effectiveness of education and enforcement strategies and refine as needed.
        iv. Review effectiveness of the watering schedule in reducing outdoor water use and adapt as appropriate to maximize savings. Consider whether a once per week watering schedule would be feasible.

2) For utilities without regulatory authority:

a. First 12 months
    i. Organize and conduct stakeholder process to gather general public input as well as input from the landscape and irrigation community.
    ii. Design and implement a voluntary, no more than twice per week watering schedule.
    iii. Assess potential to adjust fee structure to incentivize compliance with the watering schedule.
    iv. Develop an educational campaign for informing water customers of the voluntary program and work with local landscape and irrigation professionals to promote proper landscaping and irrigation practices.
b. Following program adoption
    i. Continue implementation and outreach efforts.
    ii. Review effectiveness of the education campaign and voluntary program and refine as needed.

Measuring Implementation & Determining Water Savings

The evaluation of BMP implementation should focus on education, customer engagement, and overall compliance. Utilities should conduct an internal review of their educational outreach and enforcement plans to assess the success of their implementation efforts. Utilities may address the following metrics:

1) Frequency of public messaging campaigns, including number of residents reached via social media or number of people signing up for newsletters;
2) Number of external educational opportunities pursued by the utility (i.e., teaming with garden centers or institutions to produce educational materials or tools);
3) Records of enforcement mechanisms, including number of violations reported online or via hotline and number of residents using the mobile app;
4) Records of enforcement actions, including number of reported violations, location of violations, time of violations, and amount of revenue generated by fines; and
5) Customer water use records prior to and after the ordinance was adopted in the context of seasonal, temperature, and precipitation changes.

Following the first year of implementation, utilities may wish to conduct a general survey to assess the public's general level of awareness of the watering schedule, the effectiveness of enforcement mechanisms, and opportunities for improving educational and enforcement initiatives. Utilities may consider additional stakeholder outreach to guide BMP review, depending on the results of the survey. After gathering input from the survey and stakeholder meetings, utilities should refine their education and enforcement strategies as needed.

When it comes to estimating the total water savings that will be achieved from this BMP, it is important to assess the baseline water habits of the utility customers. For utilities where most homes have automatic irrigation systems, the savings will likely be greater. A survey of current irrigation frequency habits and methods will help to assess the potential. A typical home irrigation system uses 1,400 to 2,000 gallons of water each time it is operated. This number can be applied to an estimate of the number of irrigation cycles that will be eliminated per month for a savings estimate.

According to a study based on savings data from multiple cities in Texas and other states, utilities can expect 2 to 11 percent savings on total municipal water usage from the implementation of no more than twice per week outdoor watering schedules for all municipal water use categories (Water Conservation by the Yard: A Statewide Analysis of Outdoor Water Savings Potential). The amount of effort a utility dedicates to educating the public and enforcing the watering schedule has a significant impact on the overall savings associated with this BMP. Utilities can refer to this study for additional information on how these factors affect the range of potential savings.

When assessing actual water savings, utilities should incorporate weather and other variables impacting outdoor water use patterns. Analytical approaches to calculating these savings can include linear regression modeling. Utilities should enlist the help of appropriate staff members to conduct these analyses. For smaller utilities lacking significant staff support, calculating precise savings may not be possible. However, these utilities can estimate general savings results by evaluating before and after water usage. All utilities should keep in mind that if they are concurrently pursuing other new initiatives to lower outdoor water consumption, such as incentive programs or conservation pricing, it may be difficult to tease these factors out of the savings calculations. Utilities should be transparent with these data limitations when measuring and presenting the savings from no more than twice per week watering schedules.

Cost-effectiveness Considerations

The primary costs associated with implementing this BMP will be ongoing administrative and staff costs. These costs will depend heavily on the extent to which the utility delivers education and outreach messaging, as well as enforces compliance with the watering schedule. Considerations when determining the cost-effectiveness of this BMP include:

1) Comparing the cost of enforcement versus expected water savings and projected cost of avoided/delayed additional water supply projects;

2) Benchmarking implementation costs against the cost of water – higher costs of water (new water supplies) can justify more expenditures on oversight;
4) Utilities can expect greater water savings with more robust education and enforcement efforts;
5) If fines are implemented as part of the enforcement program, the revenues can be included in the cost-effectiveness analysis;
6) Cost categories may include marketing, advertising, hiring of additional staff, etc.

References for Additional Information

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Case studies

Once per week watering schedule:

City of Austin (applies to automatic irrigation systems, only)

- Informational website
- Water Conservation Code

Twice per week watering schedule:

City of Frisco

- Informational website
- Water Management Plan

City of Dallas

- Informational website
- Water Conservation Ordinance

City of Lubbock

- Informational website
- Water Conservation Ordinance

Sample variances

City of Austin

- Variance ordinance
- Types of variances:
  i. New xeriscape landscape
  ii. Large property
  iii. Environmental
  iv. Health / safety
  v. Income
  vi. Medical / disability
  vii. Tree disease / pest control

City of Lubbock

- Variance ordinance
- New landscape variance

6.1 Public Information

Applicability

Any Municipal Water User Group ("utility") can adopt this BMP. A program for providing water conservation information to the public is an effective means of both promoting specific water conservation programs and practices and educating the public about the importance of using water efficiently. A utility may have already accomplished this BMP if it has a current public information program that meets the criteria of this BMP.

Once a utility decides to adopt this BMP, the utility should follow the BMP closely in order to achieve the maximum water efficiency benefit from this BMP.

Description

Public information programs, even though they may not be directly related to any equipment or operational change, can result in both short and long-term water savings. Behavioral changes by customers will only occur if a reasonable yet compelling case can be presented with sufficient frequency to be recognized and absorbed by customers. There are many resources that can be consulted to provide insight into implementing effective public information programs. Like any marketing or public information program, to be effective, water conservation public information should be planned out and implemented in a consistent and continual manner.

The goal is education of customers about the overall picture of water resources in the community and how conservation is important for meeting the goals of managing and sustaining existing water supplies and avoiding or delaying building of new facilities. An equally important part of the program is to provide data and information on specific actions and measures the customers should take to implement these community goals. Showing customers that the results of those actions have made a difference encourages greater participation in conservation efforts.

There are a variety of tools that can be effectively used to communicate water conservation public education. These include use of print, radio, and television media; billboards; direct distribution of materials; special events such as exhibits and facilities tours; and maintenance of an informative website.

Print media activities can include press conferences, articles and news releases. Regular columns and contributions to gardening and environmental reports are also good ways to reach a wide audience. Electronic media efforts include talk shows, news conferences, press releases, public service announcements, and even paid commercials.

Besides media, utilities can use direct distribution of materials such as inserts or messages on the utility bill, a newsletter, flyers, direct mail, and door hangers. Direct distribution allows targeting of specific messages to specific target audiences.

Special events provide excellent opportunities for direct interaction with the public. These events include facility tours, exhibits, participation in community events, trade shows, presentations to groups, water efficient landscape judging and competitions, and classes and seminars. Development of demonstration gardens and permanent exhibits are also effective.

Websites are now an essential element of public information. Much of the same printed material made available to the media and through direct distribution can be put on a website. Electronically delivered newsletters should include links to the utility's website.

An early step in development of the public information program is to identify the target audiences and what messages need to be conveyed. Themes should be selected that both convey the importance of water conservation and provide customers an opportunity to act. Thematic messages that stress the importance of water as a natural resource can be linked with specific tips or water conserving activities. The most successful public information campaigns also promote or "market" opportunities for customers to participate in utility sponsored conservation programs such as rebate and/or retrofit programs described in other BMPs.

Each public information program should be tailored to the utility and the community. The types of communication methods most effective for the target audience should be identified. Certain media outlets will be more effective than others. For example, television may be effective for large city utilities where it would not be for suburban or rural utilities. In those areas, a local newspaper or direct distribution of materials would likely be better choices.

There are many publications, brochures, videos, DVDs, etc. already available on water conservation that can be used as published or modified to meet the goals of the utility. The TWDB has brochures and guidebooks available at cost as well as TV and radio public service announcements. A statewide public awareness program is an additional resource anticipated for future years.

Some of the most effective education initiatives involve the participation of customers in the planning process. Creation of stakeholders committees, task forces, or advisory groups have proven effective for utilities in both defining the message and in recruiting allies in the community for promotion of water conservation. Such participatory programs should be well planned and may require an extensive process with numerous meetings or could be a relatively shorter process with representatives of key community organizations. The representative approach could involve neighborhood associations, business groups (i.e. nursery/landscape or other water-related businesses), academic institutions, not-for-profit agencies and environmental organizations among the mix of groups invited to participate. This process will be most successful if public input is sought not only for the public information plan but also for the entire Conservation Plan.

Partnership programs are another effective means of expanding the utility's public information efforts. Numerous not-for-profit agencies include environmental education among their goals. Integrating the utility's public information efforts with programs of other local agencies expands the impact of utility efforts. Other State agencies with offices around the state that include water conservation among their information programs include Texas Cooperative Extension offices, Texas Parks & Wildlife, Texas Soil & Water Conservation Board, Texas Commission on Environmental Quality, and Texas Forest Service.

Some business associations, neighborhood associations or not-for-profit groups may also provide partnering opportunities for the overall utility conservation program or specific BMPs. Together with these partners utility staff may be able to develop a speaker's bureau to offer adult education about specific water efficiency related topics such as Water Wise landscaping, irrigation system management, and retrofit and behavioral changes available to reduce water bills.

Another important marketing tool for successful conservation programs is public recognition of water-conserving customers. This is often used to focus attention on commercial customers as an incentive to promote greater efficiency by providing positive coverage of company conservation efforts. Awards or certification programs exist in a number of utility programs in Texas and across the nation[1]. These programs have also been used to recognize water-saving landscape designs.

For utilities that are pursuing a number of BMPs, it is important that the public information efforts be integrated with the promotion of implementation of the other conservation BMPs. Promotional efforts or "marketing" of rebates, retrofits, surveys, or educational events should be tied together in the Public Information Plan, much like commercial entities develop a marketing plan.

Implementation

The first step in implementation is to develop a Public Information Plan with goals and objectives and a schedule of activities for the first year and a tentative second year schedule. Forming a committee composed of customers and community leaders can help with the development of an effective plan. Committee members may be directly involved in implementing the plan, such as partnership programs with other agencies promoting water conservation, businesses or residents which implement BMPs and receive public recognition, or providing non-utility volunteers to promote conservation through a speakers bureau. Utilities should take advantage of and coordinate their efforts with State programs on conservation[2]. Another option is using firms that specialize in marketing and public information to develop a public information program.

The goal should be, at a minimum, to provide information to each customer at least four times each year on each action that the utility would like the customer to take. The plan should be updated every year continuing with a two-year time horizon. Every other year, the utility should

survey a sample of customers or consider the use of focus groups to determine if the utility messages are reaching customers and how effective the messages are in terms of customer actions.

The Public Information Plan should be a substantial part of the utility's overall Conservation Plan. Implementation of the Public Information program should be integrated with the implementation of specific BMPs included in the Conservation Plan. A successful public information effort will promote participation in other BMPs

Schedule

1) Utilities pursuing this BMP should begin implementing this BMP according to the following schedule: The utility should complete the Public Information Plan within six (6) months of adopting this BMP.
2) In the second year and each year thereafter, the utility should complete a revised Public Information Plan.
3) In the second year and every other year thereafter, the utility should conduct and complete a survey of customers to determine the effectiveness of its message and actions that customers have taken.
4) Every other year, the utility should survey customers or convene focus groups to assist in determining the effectiveness of materials used or to be used in the public information campaign.

Scope

The Public Information Plan should provide conservation information on each BMP being implemented to customers at least four times per year. For utilities focused on reducing summertime peak usage, themes and scheduling of message should be repeated numerous times during the late spring and early summer, rather than being spaced evenly throughout the year.

Documentation

To track the progress of this BMP, the utility should gather and have available the following documentation:

1) Number of activities and pieces of information and how many customers were at that activity or received each piece of information;
2) Number and schedule of activities or information pieces related to promoting specific BMPs adopted by the utility;
3) Number of news programs or advertisements that featured the utility message and how many customers had the opportunity to receive each message;
4) Total population in the utility service area;

5) Total budget by category for public information; and
6) Results of annual or biannual customer survey and/or focus groups to determine the reach and impact of the program.

Determination of Water Savings

Water savings due to public information efforts are difficult to quantify. If the public information effort was for a specific action such as a showerhead distribution, the savings can be calculated under this BMP if the utility did not implement the BMP containing the product or action. Water savings for other public information programs that result in specific actions by customers such as changes in irrigation scheduling or reduction in water waste occurrences could also be quantified through surveys or analysis of water waste reporting.

Cost-effectiveness Considerations

The costs for implementing this BMP depend on the scope of the public information effort. There may be costs for administration and materials. A comprehensive program would range in costs starting at $0.50 to $3.00 per customer per year depending on the size of the utility. Larger utilities should have lower unit costs due to economies of scale. The public information program can be developed and managed by utility staff or outside contractors. Media purchases with TV, radio and print media may be done directly by utility staff.

References for Additional Information

1) Texas Award Program Examples
   a. City of Austin Excellence in Conservation Award Program. http://www.cityofaustin.org/water/wwwssd_iw_award10.htm
   b. San Antonio Water System Annual Water Saver Awards for ICI Customers and Water Saver Landscapes. http://www.saws.org/conservation/
2) Texas Water Smart Program. http://www.watersmart.org
3) Educational Material on Outdoor Water Conservation, *Does Print Material Translate into Water Conservation Savings?* Kate Soroczan, Canadian Mortgage and Housing Corporation, AWWA Water Sources Conference, 2004.
4) *If They Help Write it, They'll Help Underwrite It*, Haring, T., AWWA Conserv 99, 1999.
5) *People are Watching – Public Participation in a Reuse Project*, Richardson, A.W., Janga, R.G., AWWA Water Sources Conference, 2002.
6) *Providing Incentives for Environmental Performance*, Brown, C., AWWA Water Sources Conference, 2004.
7) *Public Participation Methods to Increase Non-Residential Conservation*, Brown, C., AWWA Conserv 99, 1999.

8) *Stretching Your Marketing Dollar*, Mark Wieland, AWWA Water Sources Conference, 2004.
9) *Tuna Cans, Rain Gauges, and Soil Probes: High-Visibility Campaigns to Reduce Water Use*, DelForge and Platt, AWWA Water Sources Conference, 2002. http://www.awwa.org/waterwiser/references/abstract.cfm?id=53276&start=1&kw=public%20information
10) *Water Wise Awards: Incentive Based Conservation*, Bracciano, D., Holland, N., and Brown, S.P., AWWA Conserv 99, 1999.
11) *TWDB Education and Public Awareness Page.* http://www.twdb.state.tx.us/assistance/conservation/Education.htm
12) *A Consumer's Guide to Water Conservation (video and DVD),* AWWA, 1999. http://www.awwa.org
13) *Conserve Everyday Video,* AWWA, 2001. http://www.awwa.org
14) *H2O House Water Saving Home*, California Urban Water Conservation Council and EPA. http://www.h2ouse.org/

6.2 School Education

Applicability

This BMP is intended for a Municipal Water User Group ("utility") that serves schools as a part of its customer base. Lessons learned by students about good water use habits are often shared with the whole family. A utility may have already accomplished this BMP if it has a current school education program that meets the criteria of this BMP. Before deciding whether this BMP is necessary, review existing curriculum to see if the local school district is already offering a water conservation related curriculum.

Once a utility decides to adopt this BMP, the utility should follow the BMP closely in order to achieve the maximum water efficiency benefit from this BMP.

Description

School education programs, while not directly related to an equipment change, may result in both short and long-term water savings. Behavioral changes by the students based upon greater knowledge are often shared with parents and implemented at home. To be effective, a school education program should provide curriculum material appropriate to the grade level of the student, increasing in complexity from elementary school through high school. If such a curriculum does not already exist, local curriculum experts may be willing to help develop the desired materials.

A complementary aspect can be to include a water audit unit as part of the curriculum where the students take flow measurements of showerheads and faucet aerators at their homes. If the showerheads and faucet aerators are higher than the current standard, the students would receive efficient showerheads and faucet aerators to install with the assistance of their parents. This unit can be successfully implemented in grade 5 or higher and can meet the requirements of this BMP without additional curriculum development.

The circumstances and challenges of the local water resources should be considered in choosing or developing a conservation curriculum. Grade level appropriate material is important in ensuring that the students understand the information. When possible, curriculum material used in the classroom should address the Texas Essential Knowledge and Skills[6] ("TEKS") for the grade level and subject area. Texas state education guidelines for testing of skills are an important consideration as well. A quality water conservation program for schools provides teachers with materials that contribute to learning mathematics, science, social studies and history while educating the students about water conservation and local water resources. Already developed curriculum is available from the Texas Water Development Board, EPA, other public agencies, nonprofit organizations and private companies.

Another option beyond offering a supplemental curriculum is to offer an education entertainment show for grades 1 to 4. These shows can be very popular with teachers and often do not have the same requirement for the material to meet TEKS. In addition, the percentage of students that can be reached is often higher than for adoption of a curriculum.

To evaluate the effectiveness of the education materials, presentation or show, the utility should use an evaluation tool such as a pre- and posttest or survey.

Implementation

Implementation should consist of at least the following actions:

1) Evaluate local, regional, state or national resources available to determine applicability to the utility's local water conditions. Consider creating an advisory committee of local educators to assist in choosing or creating the curriculum;
2) Implement a school education program to promote water conservation and water conservation related benefits.

   Programs include working with school districts and private schools in the water suppliers' service area to provide instructional assistance, educational materials, and classroom presentations that identify urban, agricultural, and environmental issues and conditions in the local watershed and water service area. When possible, educational materials should meet the TEKS guidelines.

   A water oriented curriculum that is focused on conservation and resource issues should be made available for all grades.

   a. Grade appropriate programs and/or materials should be implemented for grade levels 1 to 6 initially. Alternatively, a presentation or educational show can be offered for some or all of these grade levels.
   b. For grades 7 to 8 and for high school students, the utility should do one of the following: distribute grade appropriate materials for high school science, political science, or other appropriate classes; present assembly type programs to high schools; sponsor science fairs with emphasis on conservation; or implement education programs with community groups like Scouts, 4-H clubs, etc.

The utility can elect to meet this BMP by focusing only on grades 1 to 6 or 7 to 12 and achieving higher participation rates.

In conjunction with the Showerhead and Aerator BMP, consider providing a water audit unit as part of the curriculum where the students take flow measurements of showerheads and faucet aerators at their homes. If the showerheads and faucet aerators are higher than the current

standard, the students would receive efficient showerheads and faucet aerators to install with the assistance of their parents. This unit can be successfully implemented in grade 5.

Schedule

Depending on the program option(s) selected, the following schedule should be followed:

1) Utility should adopt or develop the program in the first year and start implementation in the second year for grades 1 to 4.
2) Utility should adopt or develop the program in the second year and start implementation in the third year for grades 5 to 6.
3) Utility should adopt or develop the program in the third year and start implementation in the fourth year for grades 7 to 8.
4) Utility should adopt or develop the program in the fourth year and start implementation in the fifth year for grades 9 to 12.

Scope

Select items 1 and 2 or item 3.

1) The utility should strive to reach 10 percent of students in grades 1 to 6 with a presentation or curriculum each year by the third year of implementation, following the schedule above, and
2) The utility should strive to reach at least 10 percent of students in grades 7 to 12 with a presentation or curriculum each year by the third year of implementation following the schedule above. Or,

3) Alternatively this BMP will be met if the utility only focuses on grades 1 to 6 or 7 to 12. The program would be developed in the first year and implemented in the second year for either alternative. The utility should strive to reach either 15 percent of students in grades 1 to 6 each year by the third year of implementation or 15 percent of students in grades 7 to 12 by the third year of implementation.
4) The utility can count as participants students reached through clubs and educational events; and students impacted by utility sponsored program outside the utility service area.
5) For smaller utilities, or those in which service area boundaries overlap school district boundaries with another water utility, jointly operated or funded programs should be considered.

Documentation

To track the progress of this BMP, the utility should gather and have available the following documentation:

1) Number of school presentations made during reporting period;
2) Number and type of curriculum materials developed and/or provided by water supplier, including confirmation that curriculum materials meet state education framework requirements and are grade-level appropriate;
3) Number and percent of students reached by presentations and by curriculum;
4) Number of students reached outside the utility service area;
5) Number of in-service presentations or teacher's workshops conducted during reporting period;
6) Results of evaluation tools used, such as pre- and posttests, student surveys, teacher surveys;
7) Copies of program marketing and educational materials; and
8) Annual budget for school education programs related to conservation.

Determination of Water Savings

Water savings for school education programs are difficult to quantify and therefore estimated savings are not included in this BMP. If the retrofit kit is distributed, water savings can be calculated as described in the Residential Retrofit BMP**.** A 1991 study conducted for The Harris Galveston Coastal Subsidence District found an average savings of 18 percent or 1,400 gallons per month[1] in homes where the student and parent had installed efficient showerheads and aerators on bathroom and kitchen sinks.

Cost-effectiveness Considerations

A true cost-effectiveness analysis cannot be determined without a measure of water savings. By implementing this BMP, the utility will enhance its public image, increase customer goodwill, and increase the viability of its overall water conservation efforts.

School education costs vary widely due to the varying types of programs. Curriculum units can be developed and implemented for $1 to $3 per student. Educational entertainment programs can be developed or contracted out for $2 to $5 per student. There are prepackaged contractor programs with extensive features that cost up to $35 per student. Most programs will require utility staff oversight and outreach efforts to schools and students.

If showerhead and faucet aerator kits are distributed as part of this BMP, the costs for the kits will be similar to those described in the Residential Retrofit BMP.

References for Additional Information

1) *Effectiveness of Retrofit in Single Family Residences,* Prepared for Harris Galveston Coastal Subsidence District, Roger Durand, University of Houston , 1992.
2) *Water Savings and Beyond: A Multi-Resource Conservation Collaboration in the Seattle School District,* Broustis, D., et al*,* Water Sources Conference Proceedings, AWWA, January 2002.
3) *'Water in our World' and 'Down the Drain' Programs Close the Water Curriculum Gap for 5th and 6th Graders*, Jefferson, C., et al*,* Water Sources Conference Proceedings, AWWA, January 2002.
4) *Water Sourcebook,* Tennessee Valley Authority, Environmental Education Section, Knoxville, Tennessee, May 1994.
5) *Effectiveness of Retrofit in Single Family Residences and Multi-Family Projects,* Texas Water Development Board**,** Roger Durand, University of Houston-Clear Lake, 1993.
6) *Texas Essential Knowledge and Skills.* http://www.tea.state.tx.us/teks/
7) *Major Rivers,* Texas Water Development Board & Lower Colorado River Authority.
8) *Learning to be WaterWise.* http://www.getwise.org/wwise/
9) *Project Wet.* http://www.water-ed.org/projectwet.asp
10) *Conservation Curriculum Resources,* EPA*.* http://www.epa.gov/teachers/curriculumconservation.htm
11) *Gulf Coast Curriculum Resources,* EPA. http://www.epa.gov/gmpo/edresrc.html
12) *National Project for Excellence in Environmental Education***,** North American Association for Environmental Education (NAAEE). http://www.naaee.org/npeee/
13) *H2O House Water Saving Home,* California Urban Water Conservation Council and EPA*.* http://www.h2ouse.org/
14) *TWDB Education and Public Awareness Page.* http://www.twdb.state.tx.us/assistance/conservation/Education.htm
15) *What Education Program is Right for your Community,* Vogel, C., Water Sources Conference Proceedings, AWWA, January 2002.

6.3 Public Outreach and Education

Applicability

Any utilities initiating a water conservation program can adopt this best management practice (BMP). A program for providing water conservation information to the public is an effective means of both promoting specific water conservation programs and practices and educating the public about the importance of using water efficiently.

Once a utility decides to adopt this BMP, the utility should consider the many strategies it outlines and track the results closely to adjust efforts over time.

Why this is a Strategic BMP

The Texas Water Code §11.002 states that BMPs are voluntary efficiency measures that save "a quantifiable amount of water, either directly or indirectly...". BMPs that are useful in implementing other measures but for whom quantifiable savings cannot be identified are described as Strategic BMPs.

Description

Public outreach and education programs, though not directly related to equipment or operational change, can result in short- and long-term water savings. Increasing customer participation in conservation measures will only occur if a reasonable yet compelling case is presented with sufficient frequency to be recognized and absorbed by customers. To be effective, water conservation education and outreach should be planned and implemented in a consistent and continual manner. Many low-cost or free resources are available which can be used to effectively carryout public outreach and education efforts.

The goal of water conservation education is to educate customers on the overall picture of water resources in the community. This includes how conservation is important for meeting the goals of managing and sustaining existing water supplies and avoiding or delaying building of new facilities. Equally important, the program should provide information on specific actions and measures customers can take to implement community goals. Showing customers the results of those actions can encourage greater participation in conservation efforts.

Implementation

1. Target audience analysis:
   An early step in developing a public information program is to identify target audiences and what messages need to be conveyed. Themes should be selected that convey the importance of water conservation and provide customers an opportunity to act (for example, watering the lawn less frequently in the fall). Thematic messages that stress the

importance of water as a natural resource can be linked with specific tips or water conserving activities. The most successful public outreach programs allow customers to obtain information, understand their role in water conservation, and/or respond to a call to action, such as participating in utility programs.

2. Identify barriers and develop priority messages:
   Identify barriers to customer water conservation and to staff implementation of the communication plan. If barriers include lack of awareness from a specific segment of the customer base, then this provides a target group for a campaign. If a barrier is a lack of understanding of a particular program and how it helps customers, then this becomes a priority message.

3. Assess resources and develop strategies to meet priority needs:
   There are a variety of tools that can be effectively used to communicate water conservation to the public. When starting a program within a small utility, there is often limited budget to work with, but low-cost, effective resources are available. Examples include print and electronic media, community events such as spring clean-up days, public library events, the school district, collaboration with community groups, and state or federal agencies. Social media and internet opportunities are also low-cost with significant impact.

   a. Print options: Print media activities can include articles on internal publications such as utility bill stuffers, the actual water bill, and employee newsletters. They can also include external activities such as submitting articles to homeowner association newsletters or other local group newsletters. Printed material, specifically door hangers, can be left by meter readers to target specific neighborhoods.

   b. Internet options: An internet presence is crucial, as more and more residents turn to electronic media to locate information. A comprehensive website with pages dedicated to water conservation broken down into various subsections such as indoor use, outdoor use, rainwater harvesting, irrigation, appliances, graywater, landscaping, and other relevant topics is an invaluable tool that is relatively easy to maintain, edit, and expand on as needed. Websites offer an easy means to direct residents to other resources regarding water. In addition, creating an electronic newsletter to send out seasonal water conservation facts or reminders is possible to do with email addresses collected from the billing department.

   c. Social media options: Social media applications, such as Facebook and Twitter, are another avenue to reach residents. Short educational messages and news stories can be relayed quickly and frequently with no real cost and reach far more customers than a direct mailout. Choose the best social media platforms for the utility's audiences;

there is no need to be on every site. Consider staffing and plan 5-10 hours a week for someone to manage each account. Develop a social media policy and guidelines for employees, including any legal, regulatory, or utility requirements and best practices. It is important to ensure there is a process for training new employees and removing access as employees leave the utility.

Staff can be a great source of content for the utility's social media managers as they attend events or perform their day-to-day work. Provide employees with periodic training and encourage them to send photos and short videos for posting. Take time to develop online relationships with partner organizations, the media, and key influencers who may then be willing to share conservation messages. Utilities may also consider inviting a trusted employee, partner, or community member to do a social media "takeover" and guest host their account for an event or set period. Takeovers often bring new followers and increase engagement.

d. Community events: Community events are good opportunities to directly interact with customers and supply more specific topical information to them. These events could include staffing a booth, presenting special topics to groups as requested, homeowner association meetings, and school presentations.

4. Determine where partnerships can expand the message:
   Other utility departments, municipal staff, and local groups that are promoting the same message you are, such as Texas Master Gardeners, Texas Master Naturalists, gardening clubs, universities, the county Texas AgriLife Extension agent, river authorities, and conservation or environmental groups are all tremendous resources in distributing the water conservation message to a larger audience than a singular effort from any one source. Collaborating with other utilities in the area or utilities that share a similar water situation is another way to expand the water conservation program by working together on messages that will target all groups of customers. Joint mailouts, advertising, and products can be paid for by several groups to expand the audience and cost-effectiveness. Creating an environmental or conservation committee that incorporates staff from various departments within the utility or municipality will ensure that messages are promoted during community events that could include staff from parks, watershed protection, storm water management or drainage, forestry, recycling, water treatment, development and planning, and energy conservation. Consider establishing a collaborative online forum, such as a Facebook group, for members to ask questions or share best practices on an ongoing basis.

   An ambassador program can be a great opportunity for students or young professionals to develop skills and gain experience while providing valuable assistance to the organization.

A successful model involves training the participants, partnering them with a department or mentor, and requiring them to complete three projects: a service project, a social media project, and assisting with a community outreach. Projects must be completed within an appropriately established time frame dependent on project scale (i.e. six months, two months, one year, etc.).

If staff and resources are limited, utilities can also partner with university classes to offer project-based learning opportunities that are completed in shorter periods of time, such as a Digital Media 101 course that covers an event. Students complete media projects during the event and post them to their social media accounts to help share conservation messages with new audiences. The assignment might include short video interviews, Instagram posts, Facebook Live video, or Snapchat Story, and students agree to make the photos and video content available for the utility's future use.

5. Consider a recognition program:
   Creating a recognition program for water conservation efforts is another successful outreach tool. This can be focused on the commercial customers that perform a water saving measure such as water reuse at a laundry facility, regionally appropriate landscaping, or efficient irrigation. The positive attention focused on those customers promotes water efficiency to their customers and among their peers or competitors. The award could be a sign on the property, recognition at a city council meeting, or a picture and article on the utility's website. A positive image benefits the company and reiterates the importance of water conservation among all customer classes. Similarly, utilities can establish a loyalty program to reward customers who participate in water-saving measures and educational programs.

Scope and Schedule

Utilities using this BMP should implement it according to the following schedule:

1. Complete a conservation promotion plan within six months of adopting this practice.
2. In the second year and each year thereafter, complete a revised conservation promotion plan.
3. In the second year and every three years thereafter, conduct and complete a survey of customers to determine the effectiveness of the message and actions the customers have taken.

The conservation promotion plan should provide conservation information on those BMPs implemented at least four times per year. For utilities focused on reducing summertime peak usage, themes and scheduling of messages should be repeated numerous times during the spring and summer months, rather than spaced evenly throughout the year.

Measuring Implementation and Determining Water Savings

The first step in implementation is to develop a conservation promotion plan and calendar for the first year. It should focus on what the message will be, when it will be promoted, and what form(s) it will be in. At a minimum, conservation messages should be promoted at each season change or quarterly. Collaborate with internal staff in the public information or communications department so that messages will be coordinated with other utility or municipal promotional activities that may be happening. Outreach can also be planned around other national water conservation events such as "Fix-a-Leak" week or "Smart Irrigation" month. The plan should be updated each year thereafter to integrate new ideas and means of conveying the messages. Work with the public information or communications staff to determine if messages are effective in reaching customers; this may involve taking a survey of residents. Revise the conservation promotion plan as needed.

The conservation promotion plan should be a substantial part of the utility's overall water conservation plan. The implementation of the plan should be integrated with the implementation of specific BMPs included in the water conservation plan. A successful public education effort will promote participation in other practices.

To track progress of this BMP, the utility should gather and have the following documentation available on an annual basis:

1. Monthly water production volumes
2. Total population in the utility service area
3. Number and schedule of activities or information pieces related to promoting specific BMPs adopted by the utility
4. Number of pieces of information that were conveyed and what form they took (i.e. number of direct mailers, e-newsletters, articles in newspaper)
5. Number of web visits, unique and repeat visitors, average length of web visits per year, sources for incoming traffic, bounce rate, page views, conversions, etc.
6. Statistics regarding social media reach, impressions, and engagement, such as the number of page followers, posts, and link clicks
7. Number of activities (presentations, booths, etc.) conducted that year and participants at each activity
8. Results of customer survey to determine the reach and impact of the program
9. Total budget for conservation program and budget specifically for public education information, if applicable

This progress tracking can be completed as part of the Water Conservation Annual Report that is conducted and submitted to the Texas Water Development Board.

Water savings due to public information efforts are difficult to quantify, but digital engagement makes it easier than ever to quantify how many people are reached. If the public information effort was for a specific action, such as showerhead distribution, the savings can be calculated under this BMP if the utility did not implement the BMP containing the product or action, such as the Showerhead, Aerator, and Toilet Flapper Retrofit BMP. Water savings for other public information programs that result in specific actions by customers, such as changes in irrigation scheduling or reduction in water waste occurrences, could also be quantified through surveys or analysis of water waste reporting.

Cost-effectiveness Considerations

The cost for implementing this BMP depends on the scope of the public information effort. There may be costs for administration and materials. Within a small utility, the costs will be in the lower range, as the majority of the education efforts will be managed by utility staff. The largest cost will be printing of materials for mailouts, door hangers, or signs along with postage costs for direct mailouts. Internet outreach, collaboration with other groups, and community activities are virtually free from expense, as staff time is the largest cost. Purchasing of promotional or give-away materials, such as showerheads, aerators, and dye tablets, is an additional expense that is not necessary to have effective water conservation outreach, though it can enhance a water conservation education program. A comprehensive program would range in costs starting at $0.25 per customer per year, to several dollars per customer, depending on the budget and utility size.

References for Additional Information

Developing a Water Conservation Public Awareness Program: A Guide for Utilities: Texas Water Development Board:
www.twdb.texas.gov/conservation/outreach/doc/Public_Awareness_UtilityGuide.pdf

Water Conservation Brochures; Texas Water Development Board:
www.twdb.texas.gov/publications/brochures/conservation/index.asp

Raising Your Water IQ: *Texas Water Development Board:*
www.wateriq.org

EPA WaterSense:
https://www.epa.gov/watersense

American Water Works Association:
https://www.awwa.org/resources-tools/water-knowledge/water-conservation.aspx#2868249-resources-and-guidance

Texas A&M AgriLife Extension Service Water Education Network:
https://water.tamu.edu/water-conservation/
Take Care of Texas
http://takecareoftexas.org/
Texas Water Resources Institute:
http://twri.tamu.edu/resources/water-conservation/
Social Media Best Practices: U.S. Fish & Wildlife Service:
https://www.fws.gov/home/socialmedia/practices.html
Social Media Fact Sheets: Pew Research Center:
http://www.pewinternet.org/fact-sheet/social-media/
Texas State Parks Ambassador Program
https://tpwd.texas.gov/spdest/programs/state_parks_ambassador/

Other Resources to Consider:

- Councils of Government
- Economic Development Centers
- Nature Rocks Texas [Formal/Informal Education Opportunities] (www.naturerockstexas.org)
- Real Estate Councils
- Texas Master Gardeners (www.txmg.org)
- Texas Master Naturalists (www.txmn.org)

6.4 Partnerships with Nonprofit Organizations

Applicability

The use of volunteers to provide conservation information and techniques to their fellow citizens allows the water purveyor access to large numbers of water users across a spectrum of economic, ethnic, social, and geographic groups.

Description

Organizations such as the Master Gardeners, Master Naturalists, Botanical Gardens, and environmental entities with water conservation sympathies are enlisted to use their volunteers to deliver water conservation education to their typical and expanded audiences. The volunteers are provided special training and the organization may be subsidized based on audiences reached. The delivery vehicles are speaker bureaus, neighborhood events, school projects, and demonstration gardens but the volunteers may also respond to audit requests, rebate inspections, and conduct research.

Volunteer organizations can be selected that have membership recruited from diverse ethnic, age, geographic, or economic groups. It is also effective to utilize organizations that are willing and capable to expand their membership to targeted audiences.

In some cases social organizations that do not normally have water conservation goals can be recruited to the conservation cause. Their targeted audience such as low income households or senior citizens will benefit by the services (for example, high efficiency toilets and leak repairs) that are available related to water conservation.

To evaluate the effectiveness of the education materials, presentation or show, the utility should use an evaluation tool such as a pre- and post-test or survey.

Implementation

Contact is made with organizations with volunteers encouraging them to deliver a packaged program. In many cases it may be more effective, however, to communicate with the entity with a goal in mind and work with the organization and volunteers to develop a package to meet the desired goal. Volunteers often know the target audience's capabilities and are invaluable in developing a program that will work to meet the goal. Training should be developed to complement the volunteer's skills.

The financial arrangement may only involve expenses and training materials. To ensure administrative attention from understaffed, cash-strapped groups, providing funds upfront and linked to audience contacts and progress may accelerate progress. Simple contracts can be developed to encourage a more efficient process.

Scope and Schedule

If the volunteer organization partner is organized and operating with educational goals already in place, it is reasonable to expect that recruitment, negotiations, contracting, training, and program results can be accomplished in 12 months. A packaged "high efficiency toilet" giveaway program could be organized, and toilets distributed through churches and social service entities in a targeted section of a city in the year's period.

For example, a Master Gardener Chapter provided special one-day training to 20 of their volunteers from 10 different neighborhoods on low water landscapes. The trained volunteers then conducted a total of 10 neighborhood sessions and were able to reach a combined audience of 200 interested neighbors within one year.

Measuring Implementation and Determining Water Savings

Evaluation of this Best Management Practice can be very simple or more complex with volunteers or water purveyor staff used to do the necessary evaluation. Various measures are audience contacts, toilets delivered, newsletter sign-ups, and landscape conversions. In some cases, such as the high efficiency toilet conversions and landscape conversions, water usage changes are effective measures of program impact. For a volunteer program to be judged effective it should show measurable results in behavioral or technological changes that reduce water use.

Cost-effectiveness Considerations

Partnerships with volunteer organizations have political advantages in expanding the water conservation team; however, the major advantage involves cost effectiveness. Every person in the field trained in conservation techniques and who believes in water conservation can be expected to reach several hundred other individuals with varying degrees of effectiveness. The cost of using volunteers is very low compared to the cost of paid staff and can be nearly as effective when volunteers are well trained and working in a framework of an organized program.

References for Additional Information

1. Finch, C. (1997) – Profile of an Active Master Gardener Chapter, HortTechnology October-December Vol. 7 No. 4 371-376.

2. Bohne, D. (1996), Water Saver Rebate – San Antonio Water System, San Antonio, Texas.

Determination of the Impact on Other Resources

The advantage of using well organized volunteers to staff conservation outreach programs saves staff time. A poorly organized volunteer effort can be a negative force in the relationship between a water purveyor's ratepayers, local elected officials, and media along with little achievement in water conservation efforts.

7.1 Conservation Programs for Industrial, Commercial, and Institutional Accounts

Applicability

This BMP is intended for all Municipal Water User Groups ("utility") which serve industrial, commercial, and institutional ("ICI") customers. Conservation programs for ICI accounts are essential for increasing water efficiency among ICI users. For many utilities, consumption in the ICI sector is a significant proportion of total consumption, and average water use by ICI customers is higher than average water use by residential customers. In these circumstances significant overall reductions in water demand can be more rapidly achieved by developing a Conservation Program for ICI Accounts. Additional information regarding specific processes is found in the industrial section of the BMP guide.

Description

Under this BMP, the utility identifies ICI customers and sorts them according to water usage. The utility should focus its ICI Conservation Program toward the higher use customers and those sectors with the highest conservation potential. In addition to domestic water use by employees and customers, many industry-specific processes are captured in this BMP. Differences in this industry-specific category of water use result in unique opportunities for significant water savings within each utility service area. Similarities in overall water use by ICI customers create the opportunities for an ICI Water Conservation Program which is the subject of this BMP.

Utilities wishing to pursue efficiency among their ICI customers should consider programs which offer incentives for specific activities such as: retrofits of inefficient water cooled equipment with air cooled equipment (*See,* Cooling Systems BMP), cooling tower upgrades (*See,* Cooling Tower's BMP), installation and operation of internal recycling equipment, or conversion to reclaimed water from the local water treatment plant in processes where nonpotable water can be used (*See,* Industrial Alternative Sources and Reuse of Process Water BMP). In addition to process changes and cooling tower upgrades, incentives can be offered for condensate collection and reuse, using water quality ponds for permanent storage for irrigation or use of process water for irrigation. Efficient landscape water use should be evaluated and implemented by using appropriate elements of the Landscape Irrigation Conservation and Incentives BMP and the Rainwater Harvesting and Condensate Reuse BMP. For clothes washers in common area laundry rooms in apartment communities and for self-service laundromats, a clothes washer incentive program could be offered.

The incentive programs should start with direct communications through newsletters or direct mail to introduce the program and give examples of successful efficiency efforts (*See* Industrial BMP for Management and Employee Programs).

While a significant portion of conservation savings for industrial customers comes from modifications to water using equipment and processes, additional savings for the commercial and institutional customers comes from water used for domestic purposes. Programs and incentives for plumbing fixture retrofits and reduction in water wasting practices should be considered. Several municipal BMPs such as Prohibition of Wasting Water; Showerhead, Aerator, and Toilet Flapper Retrofit; and Residential Toilet Replacement Programs provide good guidance for the development of programs for ICI customers in these areas.

A water use survey program (*See,* Industrial Water Audit for guidance) is another program that can educate ICI customers about potential water savings. To accurately track water usage by ICI accounts, the utility should develop and market an ICI water-use survey. Water-use surveys should include a site visit; an evaluation of all water-using equipment and processes; a report identifying recommended conservation measures and their expected payback; and available agency incentives. The utility should conduct periodic follow-up visits to evaluate the status of recommended water-saving improvements.

In lieu of customer incentives programs and water-use surveys, the utility may choose to implement other efforts to reduce water usage in the ICI sector. All ICI customers should be encouraged to become familiar with BMPs that may be appropriate to their facilities including those related to fixture retrofits, landscape management, submetering, employee education, and reuse. The utility can also set goals for the ICI sector in relation to the utility's own gallons per capita per day ("GPCD") targets and goals from its overall conservation plan.

Implementation

Implementation should consist of at least the following actions:

1) Identify ICI Accounts

   Identify and rank commercial, industrial, and institutional accounts (or customers if the agency chooses to aggregate accounts) according to water use and highest conservation potential. For purposes of this BMP, ICI accounts are defined as follows:

   a. Commercial Accounts: any water user that provides or distributes a product or service, such as hotels, restaurants, office buildings, commercial businesses or other places of commerce. These do not include multi-family residences, agricultural users, or customers that fall within the industrial or institutional classifications.

   b. Industrial Accounts: any water users that are primarily manufacturers or processors of materials as defined by the Standard Industrial Classifications (SIC) Code numbers 2000 through 3999 or the North American Industry Classification System.

   c. Institutional Accounts: any water-using establishment dedicated to public service. This includes schools, courts, churches, hospitals, and government facilities. All facilities serving these functions are to be considered institutions regardless of ownership.

After ranking ICI accounts by water use, identify priority customers for incentives based upon cost-effectiveness or ease of program implementation.

2) 5-Year ICI Ultra Low Flush Toilet ("ULFT") Program

Implementation should consist of at least the following actions:

a. A retrofit program to replace 50 percent of existing high-water-using toilets with ultra-low-flush (1.6 gallons or less) toilets in commercial, industrial, and institutional facilities within 5 years.
b. Other programs that may be at least as effective as facilitating toilet replacements over a 10-year implementation period sufficient to produce cumulative water savings to 5 percent of total water savings potential per year for ULFT retrofits by the ICI sector.

3) ICI Customer Incentives Program and Water-Use Surveys

Implement an ICI and Customer Incentives Program. Develop a customer targeting and marketing strategy to provide customer incentives to ICI accounts such that each ICI sector's average annual water demand, after considering growth in demand that may occur from new ICI customers, is reduced 10 percent within 10 years of the date implementation is to commence. Directly contact (via letter, telephone, or personal visit) and offer water use surveys and customer incentives to at least 10 percent of each ICI sector on a recurring basis.

Financial incentives can be offered on a dollar amount per piece of equipment retrofitted such as toilets, clothes washers or cooling tower conductivity meters. Another option for determining the amount of potential incentives is offering an open-ended incentive per gallon per day saved so that facility managers propose the projects. This approach places utility staff in the role of evaluating such proposals.

For utilities which choose to offer water-use surveys, the surveys include a site visit, an evaluation of all water-using apparatus and processes, a customer report identifying recommended efficiency measures with their expected payback period, and available agency incentives. The Industrial Water Audit BMP can provide good guidance for development of the survey.

Within one year of a completed survey, there should be follow-up via phone or site visits with customers regarding facility water use and water-saving improvements. The utility should track customer contacts, accounts (or customers) receiving surveys, follow-ups, and measures implemented. Develop a customer targeting and marketing strategy to provide water-use surveys to ICI accounts such that 10 percent of each ICI sector's accounts are surveyed within 10 years of the date implementation is to commence. Directly contact (via letter,

telephone, or personal visit) and offer water use surveys and customer incentives to at least 10 percent of each ICI sector on a repeating basis.

4) ICI Conservation Performance Targets
Utilities may choose an alternative approach based upon local customer base and specific circumstances. To be effective as a BMP, they should implement programs designed to achieve annual water-use savings by ICI accounts of an amount equal to or exceeding 10 percent of the baseline use of ICI accounts in the utility's service area over a ten-year period, accounting for growth. The target amount of annual water-use reduction in ICI accounts is a static value calculated from the baseline amount of annual use. Baseline use is defined as the average annual use by ICI accounts in the five years prior to implementing the BMP.

Schedule

1) Within the first twelve (12) months of implementing this BMP, identify industrial, commercial, and institutional accounts and sort them by water use;
2) Replace at least 10 percent of existing high-water-using toilets with ultra-low-flush (1.6 gallons or less) toilets each year for 5 years;
3) By the end of year 5 contact and offer water-use surveys and customer incentives to 100 percent of ICI accounts;
4) By the end of year 10 complete water-use surveys for 10 percent of ICI accounts; and
5) If utilizing other programs in lieu of the water-use survey and customer incentives program: by the end of year 10, reduce ICI water usage by 10 percent of baseline ICI usage.

Scope

To accomplish this BMP, the utility should adopt ICI conservation policies, programs or ordinances consistent with the provisions for this BMP specified in Section C.

Documentation

To track this BMP, the utility should provide the following documentation:

1) The number of customers and amount of water used within the commercial, industrial, and institutional customer classes;
2) Number of toilets replaced each year;
3) A description of the plan to market water-use surveys to ICI accounts;
4) The number of ICI customers offered water-use surveys during the reporting period and the number of water-use surveys completed during the reporting period;
5) The number of follow-ups completed during the reporting period;
6) The type and number of water-saving recommendations implemented; and

7) If utilizing other programs in lieu of the water-use survey and customer incentives program, a description of the programs and estimated water-use reductions achieved through these programs. The utility should document how savings were realized and the method and calculations for estimating savings.

Determination of Water Savings

Calculate water savings as follows:

Using historical records and manufacturer data as appropriate, calculate water savings due to implemented operating procedures, equipment changes or alternative water sources.

Specific water savings calculations for cooling tower efficiency improvements can be found in the Cooling Tower BMP for industrial users.

For Water Surveys
Water Savings = Number of Surveys x Estimated Savings x Water Used

Where: Estimated Savings = 20 percent or percentage determined through survey results
Water Used = Average (5 year) annual water use by ICI customers receiving the survey

Source: A&N Technical Services, Inc. (1999)

Cost-Effectiveness Considerations

1) Toilet Rebates

If the rebate cost for the toilet is set too low, only those customers planning to retrofit will do so. If the rebate is set too high, the utility will be overpaying for customers to retrofit. Most utilities have found a rebate to work effectively if set between $75 and $130 for the toilet and flush valve.

Some utilities find it is more cost effective to provide toilets free of charge to their customers. Flush valve bowls and the flush valves can be purchased in bulk for approximately $50 to 60 and $35 to 40 respectively. Administration of the program can be conducted by utility staff or contracted out. There will be labor costs for application processing and inspections to verify installation. Labor costs range from $10 to $20 per toilet. Marketing and outreach costs range from $5 to $10 per toilet. Administrative and overhead costs range from 10 to 20 percent of labor costs. To calculate the total cost per unit, total all costs and divide by the number of units being retrofitted.

2) General ICI Rebate

The rebate can be based on a set amount such as $1 per gallon per day reduction up to a certain percentage of the actual customer costs of implementing the

project. Often the cap for the rebate is 50 percent of the actual costs of the project.

References for Additional Information

1) *A Water Conservation Guide for Commercial, Institutional and Industrial Water Users*, New Mexico Office of the State Engineer, July 1999. (http://www.seo.state.nm.us/water-info/conservation/pdf-manuals/cii-users-guide.pdf)
2) *Commercial and Institutional End Uses of Water*, AWWA Research Foundation, Summer 2000.
3) *Commercial Conservation Rebates & Audits*, San Antonio Water System. http://www.saws.org/conservation/commercial/
4) *Commercial/Industrial Rebate Program,* Metropolitan Water District of Southern California. http://www.mwd.dst.ca.us/mwdh2o/pages/conserv/program02.html
5) *Handbook of Water Use and Conservation*, Amy Vickers, Waterplow Press, May 2001.
6) *Waste Not, Want Not: The Potential for Urban Water Conservation in California,* Pacific Institute, November 2003.
7) http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf
8) *Water Efficiency Guide for Business Managers and Facility Engineers*, State of California Department of Water Resources, October 1994.

7.2 Residential Clothes Washer Incentive Program

Applicability

This BMP can be implemented by any Municipal Water User Group ("utility") that has residential customers. A utility that has initiated some of the program elements listed below prior to adopting the BMP can provide documentation of a previous clothes washer incentive program as described in Section F. Once a utility decides to adopt this BMP, the utility should follow the BMP closely in order to achieve the maximum water efficiency benefit from this BMP.

Description

Under this BMP, the utility would develop and implement an incentive program to encourage customers to purchase efficient clothes washers. Water efficiency for clothes washers is best described by using water factor ("WF") terminology. WF is calculated by dividing the gallons of water used to wash a full load of clothes by the capacity of the washer tub in cubic feet. An efficient washer using 27 gallons for a full load of clothes and a 3 cubic foot tub would have a WF of 9. According to the tiers recommended by the Consortium for Energy Efficiency ("CEE") in 2004, a clothes washer would need to have a WF equal to or less than 9.5 to be considered an efficient washing machine.[1]

In 2001, Texas passed legislation requiring washing machine manufacturers to report on the efficiency of clothes washers sold in Texas. The report for 2002 showed that only 4.4 percent of washers sold in Texas had a WF equal to or less than 9.5. The report[2] for 2003 showed that 9.4 percent of washers imported into Texas had a WF equal to or less than 9.5. While the trend in Texas is positive, the market share is well below the reported 30 percent market share in Washington State and 50 percent market share in the Seattle area where a regional incentive and marketing program for efficient washers has been in place for several years. [3]

Conventional top-loading clothes washers use 41 gallons per load on average while efficient clothes washers use 11 to 25 gallons per load. The typical household washes an average of just more than one load per day. [4,5] Manufacturers started producing efficient clothes washer models in the late 1990s in anticipation of rules being adopted by the Department of Energy ("DOE") setting higher efficiency standards. The DOE did adopt rules in 2001 with a two-step phase-in of higher efficiency standards. Clothes washers manufactured after 2004 will be required to meet a modified energy factor ("MEF") of 1.04 (20 percent more efficient than the current standard). This level will remain in effect until 2007, at which time an MEF of 1.26 (35 percent higher than the current standard) will be required.

If manufacturers continue with current trends in design of efficient clothes washers, the 2007 standard should result in significant water savings. However, some manufacturers may design washers with a normal cold-water wash and rinse cycle to be used with specially formulated soaps that could meet the 2007 standard without any increase in water efficiency.

It is possible for states to adopt more stringent standards than will result from the DOE rulemaking. For example, the California Energy Commission ("CEC") has adopted rules requiring that residential clothes washers not exceed a WF of 8.5 by 2007, decreasing to a WF of 6.0 in 2010.

To be effective, the incentive offered should bridge at least one-half of the gap in the price difference between the efficient machines and conventional ones. As with any incentive program, the amount of the incentive will impact the participation in the program. Fully featured inefficient machines cost approximately $400 while the least expensive efficient machines cost from $600 to more than $1000. So for the least expensive machines, the price difference is $200. The price difference is the most important part of the buying decision for low-income customers. In addition, low and moderate income customers would be more likely to purchase the efficient washer if they got the incentive in the form of a discount at the time of purchase rather than waiting four to six weeks for a rebate.

A clothes washer incentive program is most effective when offered in conjunction with local gas and/or electric utilities since the incentive can be increased and the marketing reach should expand. The energy savings are a result of more efficient motors, less energy required for heating hot water as less hot water is used, and shorter drying time because the spin cycle on efficient washers is much faster. Many water utilities in Texas and in other parts of the country have already successfully partnered with a local energy company.

Incentives should only be given to those customers who install washers that qualify as water efficient. A list of efficient washers is maintained and regularly updated by the Consortium for Energy Efficiency ("CEE"). CEE, a nonprofit public benefits corporation, develops national initiatives to promote the manufacture and purchase of energy-efficient products and services. The U.S. Department of Energy and Environmental Protection Agency both support CEE through active participation as well as funding. The CEE Residential Clothes Washer Program has tiers for both water and energy efficiency. The CEE list has been used by many utilities as the source of qualifying washers to receive an incentive.

Implementation

Develop and implement a clothes washer incentive program designed to increase the market share of efficient clothes washers to at least 20 percent by the second year of implementation. The program should be offered to customers in single-family homes (including duplexes and triplexes) and in multi-family units that have in-unit washer connections. Approach the local gas and/or electric utility to join in a partnership to implement the program. Organize stakeholder meetings. Develop a marketing plan for educating customers, appliance stores, and realtors about this program. Initiate the program.

Schedule

The following schedule should be considered:

1) Plan, implement and market an efficient clothes washer incentive program within six (6) months of adopting this BMP.
2) Continue marketing efforts to achieve at least 20 percent market penetration for efficient washers by the end of the second year after implementing this BMP.

Scope

In order to accomplish this BMP, the utility should perform the following:

1) Develop and implement a plan to offer incentives for the purchase of efficient clothes washers.
2) Within two years of implementing this program, increase the market share of efficient clothes washers to at least 20 percent of local clothes washer sales.

Documentation

To track this BMP, the utility should gather the following documentation:

1) The number of single-family homes and multi-family units with in-unit washer connections;
2) The average number of persons per household for single-family homes and for multi-family residences;
3) The number of efficient clothes washer incentives issued each year, by year, including brand, model, and water factor of each efficient washer;
4) Estimated water savings per efficient washer; and
5) Average total washer sales per year in the service area.

Determination of Water Savings

Savings = EWS x 5.6 x Hs + EWM x 5.6 x Hm

Where EWS = Number of single family efficient washer incentives
EWM = Number of in-unit multi-family washer incentives
Hs = Number of people in average single family household
Hm = Number of people in average multi-family household

Single Family:

5.6 = gallons saved per capita per day

Multi-Family In-Unit:

5.6 = gallons saved per capita per day

Cost Effectiveness Considerations

The rebates to the customers for installation of water efficient clothes washers are the most significant costs of this program. If the rebate cost for the clothes washer is set too low, only those customers already planning to buy an efficient washer will do so. If the rebate is set too high, the utility will be overpaying for customers to retrofit. Most utilities that implement this

BMP have found a rebate to work effectively if set between $50 and $100 per efficient clothes washer. If partnering with an energy utility, the gas or electric utility rebate will add an additional $50 to $100. Some utilities have started offering tiered rebates based on the efficiency of the washer; the higher rebates are offered for washers in the lowest water factor tier.

Administration of the program can be conducted by utility staff or contracted out. Washer inspections are sometimes performed in order to verify installation and discourage fraud. Labor costs range from $15 to $35 per clothes washer. Marketing and outreach costs range from $5 to $15 per clothes washer. Administrative and overhead costs range from 10 to 20 percent of labor costs.

To calculate the total cost per unit, total all costs and divide by the number of units being retrofitted.

References for Additional Information

1) Consortium for Energy Efficiency Clothes Washer Page http://www.cee1.org/resid/seha/rwsh/rwsh-main.php3
2) *Waste Not, Want Not: The Potential for Urban Water Conservation in California,* Pacific Institute, November 2003. http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf
3) Energy Star Clothes Washer Sales Data for Seattle and Washington State, Al Dietemann, Seattle Public Utilities, July 2004.
4) *Residential End Uses of Water,* AWWA Research Foundation, 1999.
5) *US DOE Volume Purchase Program,* Sandi Edgemon, Pacific NW National Laboratory, 1997.
6) *Impacts of Demand Reduction on Water Utilities,* AWWA Research Foundation, 1996.
7) *BMP Cost Savings and Guide,* California Urban Water Conservation Council, July 2000.
8) *Seattle Home Water Conservation Survey,* Aquacraft, Inc., 2001 http://www.aquacraft.com/
9) *Handbook of Water Use and Conservation*, Amy Vickers, Waterplow Press, May 2001.
10) California Energy Commission http://www.energy.ca.gov/appliances/clothes_washers/notices/2003-09-17_Washer_Final.PDF
11) Energy Star http://www.energystar.gov/index.cfm?c=clotheswash.pr_clothes_washers Austin WashWise Program http://www.ci.austin.tx.us/watercon/sfwasher.htm
12) *Seattle Home Water Conservation Study*, Aquacraft Inc., 1999 http://www.aquacraft.com

7.3 Residential Toilet Replacement Programs

Applicability

This BMP is intended for a Municipal Water User Group ("utility") that has at least 20 percent of its homes and apartment units in its service area constructed prior to 1995 and for which there has not been an active retrofit program to replace high flush volume toilets with 1.6 gallons per flush toilets ("ULFT"). A utility that has initiated some of the program elements listed below prior to adopting the BMP can provide documentation of a previous retrofit program or voluntary retrofits by customers as described in Section E. This BMP is often implemented in conjunction with the Showerhead, Aerator, and Toilet Flapper Retrofit and/or the Water Survey for Single-Family and Multi-Family Customers BMPs. Once a utility decides to adopt this BMP, the utility should follow the BMP closely in order to achieve the maximum water efficiency benefit from this BMP.

Description

ULFT replacement programs are an effective method of achieving water efficiency in the residential sector[1,2,3]. ULFTs are toilets that use 1.6 gpf or less including dual flush toilets that can flush at either 1.6 gpf or 0.8 to 1.0 gpf. State and federal requirements prohibit installation of new toilets using more than 1.6 gpf. Under this BMP, the utility would develop and implement a program to replace existing toilets using 3.5 gpf or more in single-family and multi-family residences. To accomplish this BMP, the utility first identifies single-family and multi-family residences constructed during or prior to 1995.

Implementation

Implementation should consist of at least one of the following:

1) A program for replacing existing pre-1995 high water-use toilets with efficient (1.6 gpf or less) toilets in single-family and multi-family residences. The Showerhead, Aerator, and Toilet Flapper Retrofit BMP outlines a method for determining the number of homes and apartments constructed before 1995.
   a. ULFT models that are used in retrofit programs should maintain 2.0 gpf or less regardless of what replacement flapper is used[11]
   b. ULFT replacement programs should offer free toilets or rebates for toilet replacement. Incentives and promotion of the program should be sufficient to retrofit at least 5 percent of eligible homes each year.
2) A retrofit ordinance triggered when ownership of the property changes. The ordinance would require all plumbing fixtures in the house or multi-family unit to meet current plumbing standards when the ownership of the property changes. For example, the Lower Colorado River Authority ("LCRA") requires homes that are being enlarged to be retrofitted with 1.6 gallon per flush toilets as part of its septic regulations[4]. The LCRA requires verification inspections. Several cities in California have implemented ordinances requiring retrofit upon change in

ownership. The buyer and seller certify that the plumbing fixtures meet the efficiency standards[5]. In these cities, no inspection is required.

3) A retrofit ordinance by date certain no later than five years after adoption of the BMP. The ordinance would require all plumbing fixtures in the house or multi-family unit to meet current plumbing standards by a specific date.

Schedule

Based on the program(s) selected, use the appropriate schedule**:**

1) Toilet Retrofit Program

In the first twelve (12) months: Plan a program including stakeholder meetings as needed. Locate plumbing contractors or retrofit companies who may be interested in bidding on this program. Develop a plan for educating homeowners, apartment owners and managers, plumbers, and realtors about this program. Solicit bids and initiate the program. Include inspections by utility personnel or third party to verify installation. In order to effectively implement this program, each year 5 percent of eligible single-family homes and 5 percent of eligible multi-family units should be retrofitted.

In the 2nd year and after: Each year 5 percent of identified eligible single-family homes and multi-family units are to be retrofitted. The program should be continued until 50 percent of eligible single-family homes and multi-family units are retrofitted in order to achieve a reasonable water efficiency benefit. Or,

2) Ordinance Approach: Upon Change of Ownership of Property

Consider offering rebates for all or a portion of the time this program will be in place. For example, offer rebates for five years and publicize this so customers can take advantage of rebates and retrofit early in the program.

In the first twelve (12) months: Plan a program including stakeholder meetings as needed. Develop a plan for educating realtors and title companies about this requirement. Determine how change of ownership can be obtained from County Appraisal Districts. Plan follow up inspection program or buyer/seller certification program to assure compliance[5] after retrofit. Develop and pass ordinance. Implement ordinance and tracking plan for number of units retrofitted.

In the 2nd year and after: Continue implementation and outreach program for realtors and title companies. Continue verification inspections or buyer/seller certification program to assure compliance as needed. Or,

3) Ordinance Approach: By Date Certain

Consider offering rebates for all or a portion of the time this program will be in place. For example, offer rebates up to Year 4 and publicize this so customers can take advantage of rebates and reduce the enforcement required in Year 5.

In the first twelve (12) months: Plan a program including stakeholder meetings as needed. Determine a plan for educating homeowners, multi-unit owners and managers, plumbers, and realtors about this requirement. Plan follow-up inspections or buyer/seller certification program to assure compliance after retrofits are completed. Develop and pass ordinance. Implement ordinance and tracking plan for number of units retrofitted.

Years 2, 3, and 4: Continue implementation. Continue educating homeowners, multi-unit owners and managers, plumbers, and realtors about this ordinance.

Year 5: If 50 percent of eligible homes and units have not been retrofitted, prepare education campaign about upcoming deadline and fines that may occur if retrofit does not take place by deadline. Prepare compliance program. After deadline, issue penalties for those not complying.

Scope

Annually, the ULFT replacement program should replace at least 5 percent of the estimated number of eligible toilets within the service area.

In order to accomplish this BMP, the utility should perform the following:

1) Develop and implement a plan to distribute or directly install high quality ULFTs to eligible single-family and multi-family units;
2) Implement the distribution or installation programs so as to achieve ULFT retrofits on at least 5 percent of eligible single-family units and 5 percent of eligible multi-family units each year. Utilities with more than 200,000 eligible connections should retrofit at least 20,000 eligible homes and units each year.
3) Within ten years of implementing this program, retrofit at least 50 percent of eligible single-family homes and multi-family units with ULFTs. For utilities with more than 200,000 eligible connections, at least 100,000 eligible homes and units should be retrofitted within ten years. Or,
4) Adopt an enforceable ordinance or rules requiring replacement of ULFTs greater than 1.6 gallons per flush, when ownership of the property transfers or by date certain no later than five years from adoption of the BMP, and implement the ordinance or rules with a verifiable inspection program for each property.

Documentation

To track this BMP, the utility should gather the following documentation:

1) The eligible number of single-family residences and multi-family units in the service area;
2) The average number of toilets per single-family residence; the average number of toilets per multi-family unit;
3) The average persons per household for single-family residences; the average persons per household for multi-family units;
4) The housing resale rate for single-family residences in service area; the housing resale rate for multi-family units in service area;
5) The number of ULFT installations credited to the program participant's replacement program, by year, including brand and model of toilets installed;
6) Description of ULFT replacement program, if applicable;
7) Estimated cost per ULFT replacement, if applicable;
8) Estimated water savings per ULFT replacement; and
9) Description of retrofit upon resale inspection and enforcement program, if applicable.

Determination of Water Savings

(*See,* Section I. References for Additional Information, 2 and 9*)*

Average Daily Savings = SF x (10.5 x Hs) / Ts + MF x (10.5 x Hm) / Tm

Where SF = Number of SF Toilets Retrofitted
MF = Number of MF Toilets Retrofitted
Hs = Number of people in average single family household
Hm = Number of people in average multi-family household
Ts = Average number of toilets per SF house
Tm = Average number of toilet per MF unit

For **Single Family Homes:**
10.5 = gallons saved per capita per day if all toilets replaced in each household[5]
Dual Flush ULFTs increase savings by 25 percent.

For **Multi-Family Units:**
10.5 = gallons saved per capita per day if all toilets replaced in each unit[8]
Dual flush ULFTs increase savings by 25 percent

Cost-effectiveness Considerations

The rebates to the customers for installation of ULFT toilets are the most significant costs of this program. If the rebate cost for the toilet is set too low, only those customers planning to retrofit will do so. If the rebate is set too high, the utility will be overpaying for customers to retrofit. Most utilities have found a rebate to work effectively if set between $70 and $100 per toilet.

Some utilities find it is more cost effective to provide toilets free of charge to their customers. Toilets can be purchased from wholesalers by the truckload for $50 to $70. There may be additional costs for storage and distribution of the toilets.

Administration of the program can be conducted by utility staff or contracted out. There will be labor costs for application processing and inspections to verify installation, determine if the water level in the tank is properly set, and discourage fraud. Inspection costs will be lower per toilet for multi-family retrofits due to the higher volume of toilets per application, but generally, labor costs range from $10 to $40 per toilet. Marketing and outreach costs range from $5 to $20 per toilet. Administrative and overhead costs range from 10 to 20 percent of labor costs. If this program is combined with the Showerhead, Aerator, and Flapper Retrofit BMP, there will be efficiencies in these costs.

To calculate the total cost per unit, total all costs and divide by the number of units being retrofitted.

References for Additional Information

1) *Handbook of Water Use and Conservation*, Amy Vickers, Waterplow Press, May 2001.
2) *Residential End Uses of Water,* AWWA Research Foundation, 1999.
3) *Jordan Valley (Utah) Study of ULF Toilet Fixture,* Paula Mohadjer. http://www.cuwcc.org/Uploads/product/Jordan_Valley_ULFT_study.pdf
4) *Lower Colorado River Authority Frequently Asked Questions about its On-Sewage Rules.* http://www.lcra.org/water/faq_septic.html
5) *Summary of Residential End Use Study.* http://www.aquacraft.com/Publications/resident.htm
6) *Impacts of Demand Reduction on Water Utilities,* AWWA Research Foundation, 1996.
7) *BMP Cost Savings and Guide,* California Urban Water Conservation Council, July 2000.
8) *Quantifying the Effectiveness of Various Water Conservation Techniques in Texas,* Texas Water Development Board, May 2002.
9) *Dual-flush Toilet Project,* Canada Mortgage and Housing Corporation, September 2002. http://www.cmhc.ca/publications/en/rh-pr/tech/02-124-e.pdf
10) *Dual Flush Toilet Fixtures,* John Koeller and Company, December 2003. http://www.cuwcc.org/Uploads/product/Dual_Flush_Fixture_Studies.pdf
11) *Water Closet Performance Testing,* National Association of Home Builders, September 2002. http://www.cuwcc.org/Uploads/product/NAHB_ToiletReport.pdf
12) *Maximum Performance Testing of Popular Toilet Models,* William Gauley and John Koeller, December 2003. http://www.cuwcc.org/Uploads/product/MaP_Final_Report.pdf

13) Performance Testing of Wall Mount Siphon Jet Toilets at the University of Washington, Roger van Gelder, June 2003. http://www.cuwcc.org/Uploads/product/MaP_Final_Report.pdf

14) *Marin Municipal Water District Plumbing Fixture Certificate.* http://www.marinwater.org/TOSforms.pdf

15) *Waste Not, Want Not: The Potential for Urban Water Conservation in Calofornia*, Pacific Institute, November 2003.

7.4 Showerhead, Aerator, and Toilet Flapper Retrofit

Applicability

This BMP is intended for a Municipal Water User Group ("utility") that has at least 20 percent of the homes and apartment units it serves constructed prior to 1995 and for which there has not been an active retrofit program for efficient showerheads and faucet aerators. This BMP is often implemented in conjunction with Residential ULFT Replacement BMP and/or the Water Survey for Single-Family and Multi-Family Customers BMP. Once a utility decides to adopt this BMP, the utility should follow the BMP closely in order to achieve the maximum water efficiency benefit from this BMP.

Description

Plumbing retrofits have usually included showerheads and kitchen and bathroom faucet aerators. Recent studies have shown that replacing toilet flappers[1] is also an effective method of conserving water in the residential sector. Four types of high quality, low flow plumbing devices are to be installed under this program: showerheads rated at 2.0 gallons per minute ("gpm") or less; kitchen faucet aerators of 2.2 gpm or less, bathroom faucet aerators of 1.5 gpm or less, and toilet flappers that flush the toilet at the design flush volume for that toilet model.

Studies have shown that many 1.6 gallons per flush ("gpf") toilets that have been installed are flushing at more than 1.6 gpf. If 1.6 gpf toilets are installed, the flush volume should be checked and, if needed, the water level in the tank should be adjusted to restore the flush volume to 1.6 gpf. If after the water level in the tank is adjusted, the flush volume is still well above 1.6 gpf, it is likely that the toilet originally had an early closure flapper. Using the model number, usually located on the inside of the tank and the research on compatibility of flappers[2] the flapper required to restore the flush volume to 1.6 gpf can often be determined. If the flapper is one of several early models of closure flappers, the flapper could be replaced during the survey and/or the information on the correct replacement flapper should be provided to the customer.

The utility may meet the requirements of this BMP through enforceable ordinances and inspection programs requiring replacement of inefficient plumbing when ownership of the property transfers or by date certain no later than five years.

Implementation

Under this BMP, the utility should:

1) Identify single-family ("SF") and multi-family ("MF") residences constructed prior to 1995. The utility may have data showing the number of SF homes existing at the end of 1994 or census data can be used. The 2000 Census data can be used to determine the total number of housing units constructed prior to 1995. The only drawback is that the construction data cannot be separated into SF and MF

units. Another approach would be to use the Census data from 1990 and 2000, which includes the number of housing units by type for 1990 and 2000. This data can be used to estimate SF Units (detached units in the Census data) at the end of 1994. A linear growth assumption yields the following approach. Take the difference (2000 detached units-1990 detached units) and multiply by 40 percent (4 years) and add this to the 1990 detached units. This produces an estimate of SF units at the end of 1994. A similar calculation can be done for MF units.

2) Develop a plan to directly install plumbing devices in single-family homes and multi-family residential facilities or, alternatively, provide kits for installation with follow up inspections; and
3) If feasible, include a program to restore the flush volume of 1.6 gpf toilets to the design flush volume.

After determining the potential number of participants, select at least one of these approaches:

1) Direct Install and Kit Distribution Program
2) Ordinance Approach: Upon Change of Ownership of Property
3) Ordinance Approach: By Date Certain

Schedule

Based on the approach(es) selected, the following schedule should be followed:

1) <u>Direct Install and Kit Distribution Approach</u>
In the first twelve (12) months: Plan a program including stakeholder meetings as needed. Locate plumbing contractors or retrofit companies who may be interested in bidding on this program. Determine plan for educating homeowners, apartment owners and managers, plumbers, and realtors about this program. Solicit bids and initiate the program. Include inspections by utility personnel or third party to verify plumbing device installation. Each year 10 percent of eligible single-family homes and 10 percent of eligible multi-family units should be retrofitted to maintain program development. Continue program until 50 percent of eligible single-family houses and multi-family units are retrofitted.

2) <u>Ordinance Approach: Upon Change of Ownership of Property</u>
In the first twelve (12) months: Plan a program including stakeholder meetings as needed. Consider offering rebates for all or a portion of the time this program will be in place. For example, offer rebates for five years and publicize this so customers can take advantage of rebates and retrofit in the early stages of the program. Develop a plan for educating realtors and title companies about this requirement. Determine how change of ownership can be obtained from County Appraisal Districts. Plan follow up inspection program or buyer/seller

certification program to assure compliance. Develop and pass ordinance. Implement ordinance and tracking plan for number of units retrofitted. In the second year of the program, continue implementation and outreach program for realtors and title companies. As long as the program is in place, continue compliance program.

3) Ordinance Approach By Date Certain
In the first twelve (12) months: Plan a program including stakeholder meetings as needed. Consider offering rebates for all or a portion of the time this program will be in place. For example, offer rebates up to Year 4 and publicize this so customers can take advantage of rebates and reduce the enforcement required in Year 5. Determine plan for educating homeowners, apartment owners and managers, plumbers, and realtors about this requirement. Plan follow up inspection program or buyer/seller certification program to assure compliance. Develop and pass ordinance. Implement ordinance and tracking plan for number of units retrofitted.

Years 2, 3, and 4: Continue implementation. Continue educating homeowners, apartment owners and managers, plumbers, and realtors about this ordinance.

Year 5: If 50 percent of eligible households have not been retrofitted, prepare education campaign about upcoming deadline and fines that may occur if retrofit does not take place by said deadline. Prepare compliance program. After deadline, issue citations for those not complying.

Scope

To accomplish this BMP, the utility should do the following:

1) Develop and implement a plan to distribute or directly install high quality, efficient plumbing devices to single-family and multi-family units constructed prior to 1995.
2) Implement the distribution or installation programs to achieve retrofits on at least 10 percent of eligible single-family units and 10 percent of eligible multi-family units each year. Utilities with more than 200,000 connections should retrofit at least 20,000 eligible homes and units each year.
3) Within five years of implementing this program, retrofit at least 50 percent of eligible single-family houses and multi-family units with the specified devices. For utilities with more than 200,000 connections, at least 100,000 eligible homes and units should be retrofitted within five years. Or,

Adopt an enforceable ordinance or rules requiring replacement of inefficient plumbing fixtures, including toilets greater than 1.6 gallons per flush, when ownership of the property transfers or by date certain no later than five years

from adoption of the BMP, and implement the ordinance or rules including a compliance program.

Documentation

To track the progress of this BMP, the utility should gather and have available the following documentation:

1) An inventory of the number of single-family and multi-family buildings completed prior to 1995, which are targeted by this BMP;
2) If applicable, certified copies of adopted ordinances and rules requiring retrofit of plumbing fixtures upon transfer of property ownership or by date certain for each utility that has selected this program option;
3) For each year of implementation, maintain records of the number of showerheads, bathroom faucet aerators, kitchen faucet aerators and toilet flappers (by category) installed in single-family and multi-family units.

Determination of Water Savings

Calculate water savings as follows:

Water Savings = *Number of Devices Retrofitted* x *Device Savings*
Where Device Savings may be found in the Retrofit Device Savings Table, and
Number of Devices Retrofitted = *1.0* x *Number Devices installed* (when using Ordinance Approach or Direct Installation Approach), or
Number of Devices Retrofitted = *0.3* x *Number Devices installed* (when using Kit Distribution Approach)

Retrofit Device Savings Table

Device	Initial Savings (gpd per device)	Device Life Span (Savings)
Showerheads and Faucet Aerators	5.5 gpd	Permanent*
Toilet Flapper	Up to 12.8 gpd **	5 years

Notes: (*) The actual device life span is 5 to 15 years; the savings are permanent because inefficient equipment can no longer be purchased. The Texas Performance Standards for Plumbing Fixtures[3] forbids importation or sale of inefficient fixtures into Texas. Plumbing standard provisions of the Energy Policy Act took effect in 1994 thereby ensuring that inefficient fixtures would not be manufactured in neighboring states[4].

(**) Residential End Use Study[5] average for toilet leakage was 9.5 gpcd, which can be translated to gpd per toilet by multiplying by average household size (2.7) and dividing by average number of bathrooms (2) per single-family

house. The utility should try to estimate actual savings based on measured leakage rate. (9.5gpcd x 2.7) / 2=12.8 gpd per toilet

Cost-Effectiveness Considerations

The significant expenses associated with this BMP will be the costs of purchasing the devices, the distribution costs, and administrative costs. Usually contractors have been hired to conduct kit installation and door-to-door distribution programs. Labor costs are usually bid based on a unit cost per showerhead, aerator or flapper installed or per kit delivered. There will be labor costs for utility staff to bid the project, oversee the contractor and conduct spot inspections of the contractor's work. Utility staff often run programs where customers pick up kits. Labor costs range from $10 to $30 per SF customer for showerhead and aerator installation and an additional $5 to $20 per toilet for replacement. MF customers will usually use their own staff for installation.

High quality showerheads purchased in bulk are available starting at less than $2 each with aerators costing less than $1 each. Flappers range in cost from $3 to $10. When choosing between models of equipment that have varying degrees of water efficiency, only the incremental cost of the more water efficient equipment should be compared with the benefits to the utility in order that the maximum water efficiency benefit can be developed.

Administration of the program can be conducted by utility staff or contracted out. If a utility chooses to implement the ordinance approach there may be costs for inspections in order to verify installation and discourage fraud. Marketing and outreach costs may range from $5 to $10 per SF customer. Administrative and overhead costs range from 10 to 20 percent of labor costs. If this program is combined with the Residential ULFT Replacement BMP, there should be efficiencies in these costs.

To calculate the total cost per unit, total all costs and divide by the number of units being retrofitted.

References for Additional Information

1) Department of Energy 1998 Plumbing Product Rules http://www.eere.energy.gov/buildings/appliance_standards/residential/pdfs/plmrul.pdf

2) *Maximum Performance Testing of Popular Toilet Models,* William Gauley and John Koeller, May 2004. http://www.cuwcc.org/Uploads/product/Map_Update_No_1_June_2004.pdf

3) *BMP Cost Savings and Guide,* California Urban Water Conservation Council, July 2000.

4) Texas Performance Standards for Plumbing Fixtures http://www.capitol.state.tx.us/statutes/docs/HS/content/word/hs.005.00.000372.00.doc

5) *Residential End Uses of Water*, AWWA Research Foundation, 1999.

6) *Handbook of Water Use and Conservation*, Amy Vickers, Waterplow Press, May 2001.
7) *Impacts of Demand Reduction on Water Utilities,* AWWA Research Foundation, 1996.
8) *Residential End Uses of Water,* AWWA Research Foundation, 1999.
9) *Quantifying the Effectiveness of Various Water Conservation Techniques in Texas,* Texas Water Development Board, May 2002.
10) *Waste Not, Want Not: The Potential for Urban Water Conservation in California,* Pacific Institute, November 2003. http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf
11) *Lower Colorado River Authority Frequently Asked Questions about its On-Sewage Rules* http://www.lcra.org/water/faq_septic.html
12) *Marin Municipal Water District Plumbing Fixture Certificate* http://www.marinwater.org/TOSforms.pdf
13) *Summary of Residential End Use Study* http://www.aquacraft.com/Publications/resident.htm
14) *Toilet Flappers: A Weak Link in Conservation,* John Koeller, P.E. , CUWCC, March 2002. http://www.cuwcc.com/Uploads/product/Flappers_Weak_Link.pdf

7.5 Water Wise Landscape Design and Conversion Programs

Applicability

This BMP is intended for a Municipal Water User Group ("utility") that has 20 percent or more residential customers that have landscapes consisting of high water use landscape materials that consume more than 20,000 gallon per month or use more than twice as much water in the summer as in the winter. Under this BMP, the utility would offer financial assistance as an incentive to customers to convert to a water wise landscape. Utilities impacted by repeated drought may also consider this BMP as a means of reducing outdoor water demand overall in their service area as a step toward long-term change of water use patterns. Once a utility decides to adopt this BMP, the utility should follow the BMP closely in order to achieve the maximum water efficiency benefit from this BMP.

Description

The utility offers financial incentives for landscape conversion to a water wise landscape or requires by ordinance that all new landscapes incorporate water wise principles. Water wise landscaping involves not only plant selection but also follows optimum landscaping principles listed below. Financial incentive programs that promote water wise landscaping contain an educational component involving the seven principles of water wise landscaping. Water wise landscaping material often consumes whatever quantity of water the customer supplies, so careful follow up is necessary to ensure that excess irrigation does not take place. Incentives should be designed to be rescinded if water use returns to previous levels or exceeds the projected water budget for the new landscape.

For new customers and change-of-service customer accounts, the utility should provide information on water wise landscape design and efficient irrigation equipment and management (*See* the Landscape Irrigation Systems Conservation and Incentives BMP for more detail on efficient irrigation equipment and management). The utility should install water wise landscaping at water agency facilities. Encouraging the use of rainwater capture and limiting irrigation to the quantity of water captured are also included.

Some cities with ordinance-making powers have adopted ordinances to define water-conserving landscapes to be installed in buffer areas, new commercial buildings, new homes, and apartment complexes. Any ordinance for new homes should incorporate requirements for water wise principles, specifically requiring only water efficient landscaping materials to be used. Irrigated turf areas can be reduced or eliminated in this BMP. Limiting turf areas can be accomplished by any number of means including reducing turf as a percent of total landscaped area, restricting irrigation systems to a portion of the landscaped area, encouraging shade tolerant species under trees, or encouraging the use of turfgrasses which have low water use rates.

In the typical landscape, turfgrass occupies the largest area and, when managed incorrectly, receives the largest amount of irrigation. Installing practical turf areas and irrigating only the turf in high impact, highly visible areas of the landscape, achieve water savings. Practical turf areas mean locating turfgrass in areas of the landscape where it provides the most functional benefit, such as recreational areas or on slopes to prevent erosion. In the case of irrigation of sloped turf grass areas adjacent to a sidewalk and needed for erosion control, the use of drip or subsurface irrigation and not sprinklers is recommended.

Grasses available for use in Texas lawns vary significantly in water requirements. This BMP may require limiting irrigated turf area within the landscape and/or requiring the lowest water use turfgrass adapted to the region and use in the landscape. Shrub beds, low water use groundcover, or hardscape in the landscape design should replace irrigated turfgrass in areas that are long and narrow or small and odd-shaped. Turfgrass requirements for new construction should include specifications for soil depth.

Soil improvement is an effective method for reducing irrigation water usage while maintaining healthy soils. Soil improvement programs on high visibility areas can demonstrate to the public the effectiveness of this method. For most landscapes, compost applications of 1/4 to 1/2 inch annually on turf areas, and one inch annually on flower beds are recommended. Compost is most beneficial when applied in the fall.

Water Wise Landscape programs follow the seven principles of Xeriscape™, from the Texas A&M Horticulture Website (*See*, Section I, References for Additional Information, 2), listed below and explained in greater detail in resources listed in the reference section:

- Planning and design
- Soil analysis and improvement
- Appropriate plant selection
- Practical turf areas
- Efficient irrigation
- Use of mulches
- Appropriate maintenance.

Implementation

Initially, the utility should consider offering the Water Wise Landscape Design and Conversion Program to customers with educational missions such as schools, universities, botanical gardens, and museums with large public landscapes. A focus on buffer areas and small landscaped areas that are inefficient to irrigate has also proven effective in some communities. The utility should consider also approaching local weather announcers, radio gardening show hosts and newspaper columnists for assistance in notifying the public about the program. Public-private partnerships should be pursued with gardening clubs, Cooperative Extension offices, landscape designers, maintenance companies and nurseries.

Calculation of rebates for landscape conversion or as incentives for new landscape installation should be based on careful consideration of the net present value of the water saved versus the size of rebate that helps motivate customers to install such a landscape. For new construction, another type of incentive would be a discount on the water capital recovery fee.

Careful design of the program is necessary to prevent overwatering after the water wise landscape is installed. Signed agreements with customers receiving rebates can assist the utility in recovering funds if water use does not decline after installation of the water wise landscape. Incentives including rebates should be rescinded if water use returns to previous levels within two years.

Awards programs can both reward the customer who has converted the landscape and help motivate others in the community to convert to low water use landscaping materials.

Schedule

1) The scope of this BMP, should be realized within ten years of the date implementation commences.
2) Develop and implement a plan to target and market landscape conversions to Industrial/Commercial/Institutional ("ICI") & Residential accounts with dedicated meters by the end of the first year from the date implementation commences.
3) Develop and implement a plan to target and market landscape conversions to all accounts by the end of the second year from the date implementation commences.
4) Develop and implement a customer incentive program by the end of the first year from the date implementation commences.

Scope

1) <u>Rebate and Incentive Approach</u>
   a. Within one year of implementation date, develop and implement a plan to market low-water requiring landscape design and conversion program;
   b. Within one year of implementation date, develop and implement a customer incentive program.
   c. Rescind incentives, including rebates, if water use returns to previous levels within two years.

2) <u>Ordinance Approach</u>
   In the first twelve (12) months: Plan a program including stakeholder meetings as needed. Consider offering rebates for all or a portion of the time this program is in place. For example, offer rebates for five years and publicize this so customers will take advantage of rebates and retrofit early in the program. Develop a plan for educating realtors and landscape companies about this requirement. Plan a follow up inspection program after retrofit. Develop and

pass ordinance. Implement ordinance and tracking plan for number of units retrofitted.

In the second year and after: Continue implementation and outreach program for realtors and landscape companies. Continue verification inspections.

Documentation

To track this BMP, the utility should gather the following documentation:

1) Number of dedicated irrigation meter accounts;
2) Number, type, and dollar value of incentives, rebates, and loans offered to and awarded to customers;
3) Estimated water savings based on customer surveys; and
4) Estimated landscape area converted and water savings achieved through low water landscape design and conversion program.
5) Customer water use records prior to and after conversion of the landscape. This data is best compared in years of similar rainfall and after sufficient time has passed for the landscape to establish itself.

Determination of Water Savings

Provide estimates of water savings from landscape conversions based upon actual metered data.

Cost-Effectiveness Considerations

The primary costs to implement this BMP are the incentives or rebates to customers for conversion to water wise landscape. Current incentives for landscape conversion range from $0.05 to $1.00 per square foot in Texas. Depending on program design and whether pre and postconversion inspections are required, staff labor cost should range from $50 to $100 per conversion.

Marketing and outreach costs range from $20 to $50 per conversion. Administrative and overhead costs range from 10 to 20 percent of labor costs.

References for Additional Information

1) *EARTHKIND™ Environmental Landscape Management*, http://aggie-horticulture.tamu.edu/earthknd/earthknd.html 2004.
2) *Handbook of Water Use and Conservation*, Amy Vickers, Waterplow Press, May 2001.
3) *Water Savings from a Turf Rebate Program in the Chihuahuan Desert*, El Paso Water Utilities, City of El Paso Water Utility, 2003.
4) *Waste Not, Want Not: The Potential for Urban Water Conservation in California,* Pacific Institute, November 2003.

http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf

5) *Xeriscape Handbook*, American Waterworks Association, Denver, 1999.
6) *Xeriscape Plant Guide*, American Waterworks Association, Denver, 1996.
7) *Xeriscape Color Guide - 100 Water-wise Plants for Gardens and Landscapes,* American Waterworks Association, Denver, 1998.
8) *City of Austin Landscape Regulations.* http://www.amlegal.com/austin_nxt/gateway.dll/Texas/Austin/code00000.htm/volume00157.htm/title00158.htm/chapter00160.htm?f=templates$fn=altmain-nf.htm$3.0#JD_25-2-981
9) *City of Austin Environmental Criteria Manual: Section 2 Landscape.* http://www.amlegal.com/austin_nxt2/gateway.dll?f=templates&fn=default.htm&vid=alp:austin_environment
10) *California Model Landscape Ordinance 1993*.http://www.owue.water.ca.gov/docs/WaterOrdIndex.cfm
11) *Austin Green Gardening Program* (http://www.ci.austin.tx.us/greengarden/)
12) *City of Corpus Christi Xeriscape Landscaping.* http://www.cctexas.com/?fuseaction=main.view&page=1047
13) *San Antonio Water System Conservation Program.* http://www.saws.org/conservation/h2ome/landscape/
14) *Texas Cooperative Extension for El Paso County.* http://elpasotaex.tamu.edu/horticulture/xeriscape.html
15) *WaterWise Council of Texas.* http://www.waterwisetexas.org/

7.6 Custom Conservation Rebates

Applicability

This best management practice (BMP) is intended for all utilities that serve significant industrial, commercial, and institutional ("ICI") customers. It is also appropriate for multi-family and homeowner association accounts.

A custom conservation rebate program should be considered to provide a way for staff and non-residential users to develop creative and large-scale savings deals that will not fit under any standard menu of programs. Such a rebate program can be instituted by all utilities that serve ICI customers and is especially effective for utilities that serve a diverse ICI customer class. By working with businesses to find innovative solutions to reduce water use, a custom conservation rebate program is able to create significant reductions in water use from a customer class that typically uses a large amount of water.

To have this program be successful, the utility must emphasize two things:

1. The utility needs to provide market competitive incentives by rebating water saved at the actual cost of water to the utility.
2. The utility needs to interact with participants as partners, not clients, where the participant's needs and concerns are as important as the water saving goals of the utility.

This BMP is best implemented in connection with analyses completed in the Customer Characterization BMP. Analysis on types of non-residential accounts and their water use patterns will be key to successfully launching a custom conservation rebate program.

Description

The traditional way of running commercial conservation programs is to create a "menu" of rebate options that a business can choose from. These menus are unique to each industry and customer category because water-saving technology is not universal among all industries. The water-saving technology available to a restaurant may not be the same as is available to a school. While this method can be effective if a utility is intending to provide many rebates within the same industry, it requires a whole new program be developed for each industry or category of ICI customer the utility serves.

A custom conservation rebate program reduces staff time because it includes the expertise of the customer as another path to identifying the water-saving technology that is most appropriate for their business. Because the program gives rebates based on water savings, not equipment types or costs, it is easily adaptable to any proposed retrofit project ranging from dental vacuum conversions and landscape irrigation reduction to large process water reclamation systems that might cost millions of dollars. This program is appropriate when a "one size fits all" program does not work.

Businesses won't participate in rebates to install water saving technology if they feel it puts them at an operational or economic disadvantage or if rebate amounts are not significant enough to be an effective incentive. By working with businesses to find innovative solutions to their unique water challenges, a custom conservation rebate program can create significant reductions in water use without decreasing the company's competitive edge. One way the program does this is by not setting specific requirements for technology that must be installed. The terms of the agreement/contract and the water-saving technology installed is decided through a collaborative process between the business owner and the utility. The program aims to make the best deal for both the business and utility by emphasizing the areas where interests overlap. In this process, the business owner's concerns and views are as important in determining the final contract as the water saving goals of the utility. By working collaboratively, utility customers benefit because they offset the costs of installing new technology that will improve their productivity. The utility benefits because water is being cost-effectively saved from a customer class that consumes a large amount of water.

A key tenant of a successful custom conservation rebate is to structure the program to provide financial incentives based on actual water saved – not based on the cost of installation of new technology. This distinction is important when calculating rebate amounts. The formula for the actual payment for water saved will depend upon the strategic needs to the utility offering the program. Some commercial rebate programs base their payments on gallons of peak water savings, others on total acre-feet over a defined time period.

The formula selected should reflect strategic priorities of the utility, the cost of water supply alternatives, or avoided production costs. One option is to average the cost of new supplies and set that as the amount to pay for savings over the determined life of the project. Another option is to determine the contribution of peak reduction and apply a formula based on avoided peak costs.

Implementation

1. Before beginning the program, consider contacting utilities that currently have a custom rebate program. These utilities will likely have suggestions that will improve the success of your program.

2. Stakeholder involvement in the program development will be important to its success. Examples of good program partners include chamber organizations, manufacturing associations, industry trade groups, and even sales representatives for water-efficient equipment. These parties are in a position to provide meaningful feedback on the effectiveness of incentives and will help to market the program.

3. This program can be offered to all non-single-family customers, including industrial, institutional, commercial, multi-family, and large property irrigation. Initially, it may be

necessary to market the program through targeted mailouts or newsletters, though an effective program can rely on word-of-mouth marketing once established. Direct contact with customers in high water use categories may also be needed to drive initial participation in the program. For example, a review of water use by customers may reveal opportunities for savings through car wash retrofits. If this is the case, then direct communication with car wash owners to discuss benefits of participation could be effective.

4. A written protocol is suggested for all rebate incentive programs. The program protocol outlines the steps to follow in considering applications, evaluating projects and issuing incentive payments, and it ensures consistency in program implementation. Writing a program protocol is also an important exercise in identifying basic administrative tools needed for tracking progress such as a database, filing system, and mechanism for obtaining water use history at sites under consideration. An example protocol document for a custom rebate is attached to this BMP.

5. Considerations in protocol development:

    a. Application:

        Include basic contact information as well as a plan for the process to be updated, the technology to be implemented, total project cost, and estimated yearly water savings.

    b. Proactive application requirement:

        The application for participation needs to be submitted and reviewed before the technology is installed or work starts. No rebate should be given if work is completed to avoid “free rider” use of incentive funds. This is also critical as a fraud deterrent, as applications may come in for equipment already owned and operated.

    c. Eligibility requirements:

        Consider eligibility rules that may include being a utility water customer, a minimum monthly consumption, being in good payment status with the utility, and being in compliance with regulatory requirements such as water quality standards.

d. Require above minimum standards:

The custom conservation rebate program may be applied to retrofits of existing technology or to upgrades that are above code requirements for new construction. It is important to clarify that no incentive will be paid for meeting a standard of equipment or water use pattern that is required by law. Similarly, no rebates should be given for installing technology that is required by local ordinance, state, or federal law.

e. Determine value of water saved for rebate amounts:

A key step in all conservation incentives is determination of the value of the gallons saved. Each utility will have a different value they place on reducing long-term demands. See the section on setting rebate value for two suggestions on this process.

f. Set maximum incentive:

Consider the limits on the incentive payment. This can be a total maximum payment to one customer, a limit on the percentage of costs, or a limit on how much the incentive reduces the payback for the customer. These limits should be determined and put in the program guidelines before the program begins to avoid controversy and misunderstandings.

g. Decide if untested technology is eligible:

Determine if your program will provide incentives on untested technology or if technology must have savings tested by third party reviewers. For projects that are less certain on savings, consider revising contracts to eliminate payments if field-verified savings cannot be measured and confirmed. For example, if a participant wants to make changes to improve a cooling tower, reference the Industrial BMP for Cooling Towers for background information.

h. Consider custom savings metrics:

Accepting the savings reports or estimates from the customer getting the rebate is not advised. Having a custom metric outlined in the custom rebate contract is suggested. While pre and post measurements may be useful, they may not tell the entire story on water efficiency if production increases. To remove the variable of increased or decreased production, water use should be looked at as a per unit ratio. An example might be getting verifiable data from a car wash operation on

the number of cars washed and using the measurement of gallons per vehicle in the efficiency metrics of the contract. Water use per unit of production for manufacturing might also work. For landscape water projects, consider a maximum usage for each month based on historical consumption, or gallons/minute/schedule metrics, or an evapotranspiration (ET) based water budget. The key for each project is to negotiate the expectations in advance and include them in the contract terms.

i. Consider a performance contract:

A contract between the utility and the customer is critical to clarifying expectations and ensuring that savings are firm. The contract may include provisions such as the ability to refund a portion of the incentive back to the utility if the water saving equipment or processes are discontinued before the expected life of the project. A contract can also provide a safeguard by documenting expected savings before payments are made. In the case of technology requiring human behavior, a multi-year contract that requires performance metrics be assessed before annual payments are issued is recommended. An example custom rebate contract template is included as an attachment to this BMP.

j. Inspections:

Determine inspection requirements in advance and clarify them in the program guidelines for customers. A pre-inspection and sub-metering may be needed to verify the pre-retrofit water use metric. If other data such as units produced are required for a water use-per-unit metric, consider how these data can be obtained in a way that verifies them independently. It may be necessary for some projects to require a sub-meter installation that directly measures water used for the operation being made more efficient. An example might be a sub-meter installed on the line leading to the hotel laundry operation.

k. Equipment lifetime:

The lifetime expectancy of equipment also contributes to the amount of water saved and should be established based on the time it would take for the technology to no longer be water efficient. In general, the lifetime for small equipment like shower heads or irrigation systems should be significantly less than larger industrial equipment like reclamation systems.

Scope and Schedule

The following steps should be followed to implement this BMP.

1. Analyze ICI customer base to determine if a custom rebate program is appropriate. If there is not a large variety in commercial and industrial businesses within the utility's service area, a menu of standard rebate programs may be more effective.
2. Plan, implement, and market a custom rebate program within 12 months of adopting this BMP.
    - Include appropriate regional stakeholders in a discussion of the program that should include the program goals, budget, application process, and evaluation plan.
3. Conduct an annual evaluation of the program. Program effectiveness should not be based on number of rebates given alone. Total acre-feet of water saved annually by the program and the cost per acre-foot for those savings should be calculated. If the strategic objective of the program is avoidance of peak production, the impact of participants on peak production should be reviewed. If the program is determined to be ineffective, analysis should be done to assess how it could be modified to gain better savings or increased participation.

Measuring Implementation and Determining Water Savings

1. Ensure firm savings with sound policies and procedures: The protocol development portion of this BMP includes several key suggestions for ensuring that water savings from the custom rebate program are among the firmest possible. If the rebate contract requires clear, independently verifiable measurements before payments are made then savings will be firm.
2. Predicting annual savings from custom rebate program: There are several strategies that can be deployed to forecast the annual savings from a custom rebate program. Because each project will vary in size and scope of savings, it is not possible to project savings based on the number of projects. Instead, consider these options:

    a. Set a target of annual confirmed savings from projects:

    A program target could be saving 2,000,000 gallons of permanent, annual water through custom rebates. These savings could be accomplished through one project with a very large water user or through five projects with smaller water users. Each project contract will have an associated contractual volume of water saved included.

    b. Set a budget based on annual savings target with $/acre-foot requirements:

    Another way of expressing annual targets is through budget allocation. A utility may decide that it will incentivize custom rebate projects at a rate of $1,000/acre-

foot for up to ten years of firm savings. By this metric, if the desire is to save 2,000,000 gallons of permanent, annual water for which savings is calculated by ten years, then the total savings is 20,000,000 gallons. At a rate of paying $1,000/acre-foot this means that the budget line item would be calculated by converting 20,000,000 to 61.378 acre-feet. At $1,000/acre-foot the budget allocation would have to be $61,378 for the year.

3. Considerations for setting incentive amounts:

   Incentives for participation should reflect the strategic value of the water saved to the utility. For communities where water saved is reducing the need for new supplies, a logical option to consider is providing an incentive comparable to the average cost of new water supply projects. For communities with peak production or treatment challenges, the value of water saved might include the value of avoided cost to deliver the water to the customer. Three examples are provided below:

   a. Incentive based on new water supply cost:

      To give market competitive rebates and to ensure the program is cost-effective, rebate amounts should be calculated based on the actual cost of water to the utility, including treatment and delivery costs. To determine the actual cost of water, calculate the average cost per acre-foot of all water sources available to the utility.

      Rebate amounts are calculated with the following formula:
      Rebate amount = (acre-feet saved annually) * (average cost per acre-foot for utility) * (lifetime of equipment)

   b. Incentive based on new peak/drought firm supply cost:

      The average cost of water may not be the same throughout the year because of changes in delivery costs or pumping allowances. During peak months, water may be more expensive to the utility. To address this, custom rebate projects like irrigation redesign that reduce water consumption during peak demand could be rebated at a higher cost per acre-foot amount. Custom rebate projects that improve water efficiency of processes that would be used consistently year-round would be rebated at the baseline cost per acre-foot amount described above.

Rebate amounts are calculated with the following formula:
Rebate amount = (acre-feet saved annually) * (average cost per acre-foot for utility) * (lifetime of equipment)

c. Incentive based on avoided peak production cost:

Efforts that reduce water usage year-round are important to conservation but those that reduce demand during peak season can be more strategically important, especially if the utility faces reductions in pumping allowances during peak season. To address this, the amount rebated per acre-foot should reflect the avoided peak production cost.

Rebate amounts can be calculated by either of the following formulas:
Rebate amount = [(gallons of water saved annually) / (1000 gallons)] * (cost for reduction in peak production) * (lifetime of equipment)

OR

Rebate amount = (gallons of water saved annually) * ($1.00) * (365 days)

Note: This type of incentive may not be as effective as the previous two because savings may not be high enough to incentivize participation.

References for Additional Information

Industrial and commercial BMP documents: BMPs written for industrial, commercial, and institutional customers are a fantastic resource for recommendations on how ICI processes should be implemented. Review these BMPs while reviewing participants' applications to help determine how effective the change in technology will be at saving water.

- Consider that advances in technology may result in outdated metrics within BMP documents. Before accepting a water-savings estimate or metric for standard usage, review the current market within the industry being considered. For example, if the proposed project is a commercial washing machine, check to determine what equipment competitors are using and request specifications from several vendors of similar equipment.

APPENDIX A: EXAMPLE CUSTOM REBATE PROGRAM PROTOCOL

Program Description

With commercial and nonresidential accounts representing ____ percent of our customer base, these customers account for ____ percentage of annual water sales. There is great potential for achievement of water savings within this customer class. Through the Custom Conservation Rebate Program, if water savings are confirmed, businesses may receive a rebate for the installation of water-saving equipment.

The Custom Conservation Rebate Program offers incentives, in the form of rebates, for General Class Customers instituting new water saving processes or installing new water saving equipment. The rebates are determined by the actual water savings, the life of the equipment, and the project's utility savings return on investment (ROI).

The Custom Conservation Rebate Program is easily adaptable to any proposed retrofit project ranging from dental vacuum conversions and landscape irrigation reduction to large process water reclamation systems with costs in the millions of dollars. Because of its adaptability, the Custom Conservation Rebate Program can be used as a tool for corporations conducting cost/benefit analyses on proposed projects.

These incentive rebates are designed to accelerate behavioral, process, and equipment changes that lead to lower water use over time. An ideal incentive rebate provides just enough assistance to entice more water users to engage in changes that they would not otherwise have made. Incentive rebates, combined with education, help overcome the hesitation regarding financial investment for water savings, thus making implementation more feasible from an economic standpoint.

Examples of qualifying projects include but are not limited to:

- Replacement of water-cooled equipment with new air-cooled equipment
- Process water reclamation systems
- Air conditioning condensate capture and reuse
- Elimination of water intensive industrial processes
- Cooling tower modifications
- Landscape irrigation reductions
- Industrial laundry equipment upgrades
- Commercial indoor fixture replacement
- More efficient reverse osmosis units
- Friction type car wash equipment
- Any other reduction of domestic water use

Funding Requirements

- Incentive rebates are calculated and provided at the following rates:
    - $____ per acre-foot for year round water savings
    - $____ per acre-foot for peak season (summer months) water savings
- Incentive rebate formula:
    - $_____ per acre-foot * Annual acre-feet of water savings * Equipment life
- Rebates and program participation are based on available funding during each fiscal budget year.

Custom Conservation Rebate Program Rules

In order to qualify for a rebate under the Custom Conservation Rebate Program, applicants and proposed projects must meet the following criteria:

- Applicant must be a General Class Water Customer.
    - Sewer only customers are not eligible for participation in the program.
- Applicant must have an "active account".
    - Inactive or finalized counts do not qualify.
- Applicant must be in good standing (all accounts current with payment, annual reports submitted to appropriate department, etc.)
- Applicant must apply for the rebate and show estimated savings prior to commencing with the project.
    - Retroactive rebates will not be considered.
- The program generally applies to the retrofit of existing equipment or processes.
    - However, retrofits on new equipment will be considered for those projects that are above and beyond the accepted standards for a given industry.
- Rebates for leak repair or regular owner's maintenance are not eligible.
- Rebates are determined based on the installed cost of the project, the projected water savings, and the equipment life up to a maximum of 10 years.
- Rebates will not be offered for systems that are already required by local ordinance or state or federal law.
- Proposed water savings must be shown and proven prior to rebate eligibility.
    - Applicant must provide documented proof of how they calculated the potential water savings.

- Applicant must provide documented proof that they plan to employ a "proven" technology.
    - New or unproven technology that claims to generate water savings must be tested and confirmed by an approved independent third-party testing facility prior to program implementation to ensure eligibility.
    - If there is any question as to the viability of the technology or its ability to achieve the predicted results, an observation period maybe requested. The observation period will provide time to monitor the new water consumption patterns and to determine the post-retrofit effectiveness of the technology in achieving the desired results.

- Accepted projects require the signing of a legally binding contract between _____ and the applicant. All contracts include a clause that requires the customer to repay the rebate should it be proven that the equipment was removed, shutdown, or failed to achieve the predicted results.

- Rebates in excess of $_____ require approval from the _____.

- Rebates are issued only after all invoices have been submitted and all equipment is installed and operational.

Program Steps

1. Open and date stamp application.
2. Look up account information.
3. Review customer application.
4. Contact customer to schedule pre-inspection.
5. Review application with customer and gather all data necessary for approval to proceed.
6. Verify account is in good standing by coordinating with assigned personnel in Billing Operations, Backflow Prevention, Resource Compliance, and Conservation.
7. Negotiate rebate amount, conditions of payment, and method of measurement of savings. Ensure that these terms are clearly included in a contract attachment.
8. Work with Legal Department to review contract.
9. Determine if level of rebate requires further review by Finance Department or if amount of rebate is subject to limits of payments requiring board or city council approval.
10. Once application is approved, send letter of approval to customer. If application is not approved, send letter detailing the required information
11. Upon completion, gather all invoices and conduct post-inspection. Set time-frame for additional inspections if this is a long-term performance contract.
12. Send two original copies of contract to customer for signature. Both copies need to be signed.
13. Executed contracts under $_____ need to be signed by _____ , and routed through legal and the vice president prior to approval.
14. If rebate is greater than $_____ prepare _____.
15. Upon approval, have contracts signed.
16. Upon signing of contracts, and completion of required inspections deliver rebate check to appropriate authority for the company under contract.

EXAMPLE COMMERCIAL CUSTOM REBATE AGREEMENT

THIS AGREEMENT is made and entered into effective as of the ___ day of _____, 2015 ("Effective Date") by and between the _____, an agency of the City of _____, and _____ (“Customer”), with an address of _____.

WITNESSETH

WHEREAS, the conservation of potable water benefits the City of _____ and its citizens, and its customers; and

WHEREAS, _____ is constantly seeking ways to reduce water consumption by providing economic incentives in the form of rebates to those customers that choose to convert to watersaving equipment and practices; and

WHEREAS, the Commercial Custom Rebate Program seeks to reduce water consumption by providing qualified customers with rebates based on water savings that offset some or all of the installed cost of new watersaving equipment; and

WHEREAS, Customer is a commercial user and seeks a rebate under the Commercial Custom Rebate Program for the installed cost of new watersaving equipment; and

WHEREAS, staff has reviewed Customer's Commercial Custom Rebate Application and determined that Customer meets the program eligibility requirements;

NOW THEREFORE, the Parties hereto agree as follows:

1.0 The Retrofit Project.

1.01. Retrofit Equipment. The watersaving equipment subject to this Agreement and for which a rebate is authorized, is listed and described in Section 1.0 of Attachment "A" hereto (the "Retrofit Equipment").

1.02. Retrofit Equipment Site. The site(s) at which the Retrofit Equipment is or will be installed is listed and described in Section 2.0 of Attachment "A" (the "Site").

2.0 Customer Obligations.

2.01. Purchase, Installation and Maintenance of Retrofit Equipment. At Customer's sole risk, cost and expense, Customer agrees to purchase and install the Retrofit Equipment at the Site prior to the application of any rebates. As of the Effective Date, Customer represents and warrants that it has installed the Retrofit Equipment at the site in compliance with the applicable

manufacturer's installation instructions, guidelines and directions covering the Retrofit Equipment. At customer's sole risk, cost and expense, Customer agrees to keep the Retrofit Equipment in good working condition at the Site(s) for the Term of this Agreement.

2.02 Term. The Term of this Agreement is as provided in Section 3.0 of Attachment "A".

2.03 Compliance with Laws, Regulations, and Ordinances. Customer shall be solely responsible for insuring that the installation and operation of the Retrofit Equipment meets all Federal, State, and local regulatory and permit requirements.

2.04 Provision of Invoices. Customer agrees to provide copies of all invoices, receipts or statements associated with the purchase and installation of the Retrofit Equipment prior to the issuance of any rebates, or as requested in writing. Customer agrees to provide any other information requested, which is related to the Retrofit Equipment, such as maintenance and repair records.

2.05 Right to Inspect. Customer agrees to grant authorized representative's reasonable access to the Site for the sole purpose of inspecting the use and operation of the Retrofit Equipment.

2.06 Compliance with Regulations. During the Term of this Agreement, Customer agrees to comply with all applicable (i) drought and water conservation laws, ordinances, rules and regulations and (ii) water quality laws, ordinances, rules and regulations (all of the foregoing being "Applicable Rules"). Notwithstanding the foregoing, if Customer is a governmental entity, Customer agrees that it will comply with said Applicable Rules as if Customer were a private entity, and there is no exemption to compliance with Applicable Rules in this Section 2.06 for governmental entities, nor may the Applicable Rules be deemed "not applicable" to governmental entities for purposes of this Section 2.06.

3.0 Obligations and Rights.

3.01 Payment of Rebate(s). _____ will pay Customer the rebate(s) provided in Attachment "A" for the installed cost of the Retrofit Equipment at the Site. The rebate will be paid to the Customer within 30 days following the Effective Date provided the utility has received and approved all invoices and verified installation of the retrofit equipment. The rebate will be given in a direct check as provided in section 5.0 of Attachment "A".

3.02 Administrator of Agreement. The designated administrator of this Agreement for _____ for all purposes is as provided in Section 6.0 of Attachment "A". _____ may, at its sole discretion, change the designated administrator of this Agreement at any time.

3.03 Data Compilation. _____ may, at its discretion, review, compile, and analyze pre and post-retrofit water consumption data in connection with this

Agreement. _____ will provide Customer with any analytical results of all compiled data upon receipt of Customer's written request for such information. The provisions of this Section 3.03 shall survive the expiration of this Agreement.

3.04 Publication of Data. Customer acknowledges and agrees that _____ may publish, advertise, or disclose any and all data or information compiled, gathered or assembled by _____ in connection with this Agreement, including but not limited to, water consumption data, watersavings, Retrofit Equipment, Site(s), installed costs, and rebate(s). _____ agrees to provide Customer with copies of any such publications, advertisements or disclosures upon receipt of Customer's written request for such information.

4.00 Conditions of Rebate.

4.01 Calculation of Savings. _____ shall have the right but not the obligation to calculate the total water savings, on an as needed basis, in order to determine the success of the retrofit in achieving the predicted results as set forth in Attachment A. The total water savings calculation will compare pre-retrofit consumption data with post-retrofit consumption data, taking into account occupancy rates, expansion and modifications, and any other factor affecting total water consumption.

4.02 Recovery of Rebates.

(a) If pursuant to the calculation set forth in section 4.01 herein, _____ determines that the retrofitted equipment has failed to achieve predicted results, or has been removed or not been maintained properly, Customer shall have 30 calendar days from receipt of _____determination to remedy the cause of the determination. If Customer fails to timely correct the cause of the determination, all or a portion of Customer's rebate(s) shall be repaid to _____. The amount to be repaid shall be determined by calculating the actual water savings as a percent of the predicted savings and multiplying that percentage by the initial rebate amount. The product of the calculation shall be then subtracted from the initial rebate amount to determine the amount to be repaid to _____.

(b) If _____ determines that Customer has violated Section 2.06 of this Agreement, Customer's rebate(s) shall be subject to repayment to _____ upon written notification from _____. Customer agrees that such repayment is not a penalty but rather represents an equitable termination and recovery of _____ monetary obligations under of this Agreement, as Customer's representations to _____ in Section 2.06 were a material inducement to _____ entering into this Agreement and paying Customer's rebate(s).

(c) Any amount to be repaid to _____ shall be due and payable within 5 business days of Customer's receipt of a bill or demand therefore. The terms and provisions of this Section 4.02 shall survive the expiration of this Agreement.

5.00 Miscellaneous

5.01 Governing Law. This Agreement shall be governed and construed in all respects, including validity, interpretation, and effect, by the laws of the State of Texas.

5.02 Venue. The obligations and undertaking of each of the parties to this Agreement shall be performed in _____ County, Texas, and venue for any litigation shall be in _____ County, Texas.

5.03 No Third Party-Beneficiary. _____ and Customer enter into this Agreement solely for the benefit of themselves and agree that nothing herein shall be construed to confer any right, privilege or benefit on any person or entity other than the parties hereto and their permitted assigns.

5.04 Captions. The captions and headings appearing in this Agreement are inserted merely to facilitate reference and are not to be considered a part of this Agreement and in no way shall they affect the interpretation of any of the provisions of this Agreement.

5.05 Modification. This Agreement may be modified only by an instrument signed by the duly authorized representatives of each of the parties.

5.06 Waiver. Any waiver at any time by either party with respect to a default or other matter arising in connection with this Agreement shall not be deemed a waiver with respect to any subsequent default or matter.

5.07 Approvals. All approvals and agreements by either party that are required or contemplated under this Agreement must be in writing unless other means are specifically permitted, and must be signed by the person authorized to give such approvals and make such agreements for that party. The persons authorized to give such approvals and make such agreements for the parties shall, until changed as hereinafter provided, be as follows: for Customer, the undersigned representative, and for _____, the undersigned representative. Each party shall have the right from time to time and at any time to change the person authorized to give such approvals and make such agreements by giving at least five (5) days' written notice to the other party.

5.08 Force Majeure. If either party is rendered unable by Force Majeure to carry out, in whole or in part, its obligations under this Agreement and such party gives the other written notice and full details of the event causing nonperformance within 10 business days of the event, including anticipated extent of such delay, then during the pendency of such Force Majeure but for no longer period, such party shall be excused from its obligations under this Agreement to the extent required, other than to make payments due, and shall not be liable for any loss or damage for delay or for nonperformance due to Force Majeure. For purposes of this Agreement, Force Majeure shall mean any event or act not reasonably within a party's control, including but

not limited to, acts of God, strikes, lock-outs, or other industrial disturbances, acts of the public enemy, orders of any kind of the federal or state government, or any civil or military authority, insurrection, riots, epidemics, landslides, lightning, earthquakes, fires, hurricanes, storms, floods, washouts, droughts, arrests, restraint of government and people, civil disturbances, explosions, breakage or accidents to machinery, pipelines or canals.

5.09 Indemnification. Customer agrees to and shall indemnify and hold harmless the City of _____, its officers, agents and employees from and against any and all claims, losses, damages, causes of action, suits, and liability of every kind, including all expenses of litigation, court costs, and attorney's fees, for injury to or death of any person, or for damage to any property, arising out this Agreement or in connection with the installation, maintenance, repair, use, or operation of the Retrofit Equipment, REGARDLESS OF WHETHER SUCH INJURY, DEATH, OR DAMAGE IS CAUSED IN PART OR THROUGH THE SOLE OR CONCURRENT NEGLIGENCE OF THE UTILITY OR ITS AUTHORIZED REPRESENTATIVES. It is the expressed intention of the parties hereto, that the indemnity provided for in this paragraph is indemnity by Customer to indemnify and protect the City of _____ FROM THE CONSEQUENCES OF THEIR OWN NEGLIGENCE.

5.10 Entire Agreement. This Agreement contains the entire agreement between _____and Customer and contains all of the terms and conditions agreed upon. This Agreement supersedes all other arrangements, oral or otherwise, regarding the subject of the Agreement.

5.11 Severability. Should any part, paragraph, sentence, clause, or word of this Agreement for any reason be held illegal, inoperative, or invalid, or if any exception to or limitation upon any general provision herein contained be held to be invalid or ineffective, the remainder shall nevertheless stand effective and valid as if this Agreement had been executed without the portion held to be invalid or ineffective.

IN WITNESS WHEREOF, the parties hereto have respectively caused this Agreement to be duly executed as of the _____ day of _____, 201__.

_____ _____

By_____ By_____

Capacity: _____ Capacity:_____

ATTACHMENT "A"

1.0 The Retrofit Equipment.

The Retrofit Equipment subject to this Agreement is (describe Retrofit Equipment): *The retrofit involves the retrofit and installation of the following water conserving process equipment.*

Project	Life	Installed Cost
Project description	___ Years	$
Total Acre-feet Water Saved	___ Years	
Total rebate amount		**$**

2.0 Site(s). The Retrofit Equipment has been installed at (*describe location*):

- _____

3.0 Term.

The Term of this Agreement is ___ years after the Effective Date.

4.0 Anticipated Annual Savings.

The anticipated annual water savings resulting from this retrofit is (in gallons):

- _____

5.0 Payment of Rebate.

- The total authorized rebate is _____
- The entire rebate will be supplied to Customer via direct check request: *one installment in the amount of $_____ upon submittal of all invoices and verification of installation of all equipment listed in Section 1.0 of Attachment A.*

6.0 Administrator.

The utility's designated administrator of this Agreement is _____.

7.0 Financial and Rebate Calculations.

- The $_____ rebate will result in _____ acre-feet of water saved of the __ year life term of the equipment. The cost per acre-foot for water saved over a __-year period is $_____ per acre-foot. The rebate calculations are based actual pre and post meter data.

Based on analysis of the information provided by the _____ and verification of production and equipment flow rates, the authorized rebate amount is $_____.

7.7 Plumbing Assistance Programs for Economically Disadvantaged Customers

Applicability

Plumbing assistance programs offer two types of savings: water conservation for utilities and reduced bills for customers. A utility may elect to establish a plumbing assistance program in order to achieve either or both types of savings. Although the savings goals may impact decision making in developing the program, the first, and most critical step, is ensuring there is actually an economically disadvantaged customer group significant enough to be engaged and to support the program. *Without this target customer base, the program will not be successful.* For example, The San Antonio Water System has successfully operated a plumbing assistance program for twenty years because at least 20 percent of San Antonio's population is at federal poverty levels[1]. Having a plumbing assistance program aimed at economically disadvantaged customers saves water and helps mitigate concerns about the impact of water and sewer rate increases.

The Customer Characterization BMP may assist a utility in assessing if this BMP if it is determined that the single-family customer base includes a significant number of economically disadvantaged households that will meet federal poverty guidelines.

Description

The Plumbing Assistance Programs for Economically Disadvantaged Customers BMP is focused on making plumbing repairs in single-family homes owned by economically disadvantaged customers. Utilities and socio-economists have both observed that economically disadvantaged homeowners are less likely to make water-saving repairs due to the cost, and that some repairs may be altogether cost prohibitive for economically disadvantaged customers.[2]

Additionally, it is often the case that customers incurring high water bills because of major leaks have difficulty not only in paying for the higher water bills, but also in paying for the cost of the repair. By making the necessary repairs, customers may experience lower, more manageable bills and become more reliable customers with respect to paying their bills.

This BMP is premised on the idea that by making plumbing improvements and repairs to potable water leaks in a home that might otherwise go without, customers are assisted in reducing their

[1] San Antonio, United States Census Bureau, (Oct. 14, 2015), *available at* http://quickfacts.census.gov/qfd/states/48/4865000.html.

[2] Beecher, Janice, et al., *Socioeconomic Impacts of Water Conservation* (2000). "Low-income households may have trouble raising and allocating the capital to invest in such repairs." *Id; See* Hasson, David S., *Water Utility Options for Low-Income Assistance Programs* 94:4 (Amer. Water Works Ass'n J 128 (Apr. 2002). The Water Utility in Portland Oregon instituted a fixture repair program designed to help low-income homeowners make plumbing fixture repairs that caused billing increases. *Id.* at 132-133. The program was expanded to include repairs that are in "relatively inaccessible locations because low-income customers tend to lack the resources to repair these leaks." *Id; see* Louie, Josephine, et al., *The Housing Needs of Lower-income Homeowners*, Harv. Univ. (1998). "Lower-income owners are also less likely than other owners to" make repairs such as plumbing repairs. *Id.*

overall consumption, thereby lowering bills and simultaneously conserving water for the utility as a whole.

In addition to making repairs to potable water leaks, the BMP may also include automatic replacement of high-flow fixtures found in a qualifying home. When high-flow toilets and showerheads are automatically replaced in addition to leak repair, the savings from the BMP will increase.

Implementation

These steps for implementation can be used as guidelines in developing a plumbing assistance program. Some of these steps may begin simultaneously, or they may be undertaken sequentially. Each step may need to be revisited and modified during the development process. It is beneficial to share ideas with other utilities throughout the development of this program.

1. Evaluate the customer base and develop a method or methods for reaching the target customer.
    - Determine the data source for evaluating customer base and identifying the target customer group. Evaluate the customer base to ensure there is a demographic that will be served by the program.
    - To develop criteria, identify what attributes make the customer ideal for the program, i.e., income, neighborhood, home value, or unusually high consumption for the household demographic group. *See below for an example list of criteria with rationale for each point.*

2. Talk to other utilities that have a program in place about their approaches and experiences. Ask if they are willing to share any of their planning or development documents, including bid documents, data collection programs, or past program analysis. Talk with them about the criteria you have established and any tentative goals for the program. ***It is important to note that what works for one utility may not work at another. This program is most effective when customized for a specific customer base.***

3. Establish program goals.
    - Program goals can include everything from testing pilot efforts to making certain types of repairs or replacements, engaging with a particular economically disadvantaged neighborhood, or achieving a certain volume of water savings.
    - Determine the extent of plumbing repairs/work that will be covered by the program.
    - Consider how the program will be promoted and any limitations such as caps on the number of homes served, limits on the number of visits to a single home, limits on the amount spent at each home, or time constraints.

4. Organize a referral or enrollment system to qualify participating customers in the program. Affordability or outreach departments within the utility itself may be a source

of referral. Alternatively, non-profit organizations or city offices like health departments may be able to help.

5. Identify what metrics need to be tracked to illustrate program progress, success and failure, and create a tool or approach for analyzing the program.
    - Some examples of performance metrics that may be useful in analyzing the program are water saved, average expenditure per home, zip code or city district, number and/or types of repairs made, and whether the homeowner is a senior, disabled, or falls into another identifiable group that may require home maintenance assistance.

6. Plan for the administrative process.
    - Consider who will take on which responsibilities and how information may need to be shared among staff.
    - Develop a database to store and track the collected data.
    - Consider creating a protocol that outlines the intent, rules, and various steps of the program.
    - Consider how plumbing invoices will be received, recorded, and tracked.
    - Have an approval process for plumbing services performed. It may be that when plumbing services reach a certain price point, those repairs merit planner/managerial approval, and that other amounts trigger directorial authorization, etc.
    - Pre-determine how participant information will be shared with the plumbing services provider.

7. Coordinate plumbing services.
    - The most common way to coordinate plumbing services is to contract with a plumbing company. In contracting for services, it is important to develop a price menu for services covered by the program. It is also important to include any price tiers that trigger approval requirements in the contract.
    - Alternatives to contracting may be more useful to some utilities. One example of an alternative is a Call for Participation that allows for participation by more than one plumbing company and more control over pricing.

8. Evaluate the program to determine what improvements should be made to improve efficacy.

Program Participant Criteria Example

Identifying the target customer group and then finding ways to reach them and make the program known to them is critical to program success. For this reason, it is important to think carefully about those customer attributes that will help identify participants who will benefit most and that will maximize the benefit to the utility. The following criteria are examples that may be used in establishing eligibility.

- Participant must be a residential class customer in a single-family residence.
    - This program is intended to aid homeowners who experience significant leaks resulting in substantial, often unmanageable, bills. Multi-family residences are generally operated by management companies or landlords who are responsible for maintenance services that maintain or repair plumbing and plumbing fixtures.

- Participant must both reside in and own the home in need of service
    - This criteria is an effort to ensure the longevity of the investment made by the program.

- Participant must be a water customer. Sewer only and storm water only customers are not eligible for this program.
    - This program targets high consumption of potable water sources. Some utilities operate separate programs that provide sewer assistance.

- Customers must meet 125% of federal poverty level guidelines. This standard is useful because health and human service departments in many places use this standard in qualifying people for a variety of assistance programs. The Federal Poverty Level Guidelines for 2015 are listed below.

Federal Poverty Level 2015[3]*

Size of family unit	125 Percent of Poverty
1	$14,712
2	$19,912
3	$25,112
4	$30,312
5	$35,512
6	$40,712
7	$45,912
8	$51,112

*For families with more than eight members, add $4,160 for each additional family member

- Home value should not exceed $300,000 (per county appraisal district).
    - This number is a sample, but whatever number chosen by the utility should be based on home values in the areas that will be served by the plumbing assistance program. Periodically, the home value requirement should be reviewed and adjusted for changes in home values in the areas served by the program.

- Home located in designated zip codes.
    - The designated zip codes are based on census data indicating areas that experience economic disadvantages and have low home value but high home ownership.

- Consumptive use must exceed the prescribed amount for the family size.

- Participant qualifies by either being referred through a partnering non-profit organization or through direct invitation from the utility or the qualifying entity.

- A participant remains qualified for six months, unless the utility or qualifying entity learns of a change in status of any of the qualifying criteria. A participant may also be disqualified if they are non-responsive to contact made by utility staff, a representative from the qualifying entity, and/or by the plumber to schedule an appointment for assessment and service.

[3] U.S. Dept. of Health and Human Serv., Federal Poverty Guidelines (Jan. 21, 2015), *available at* http://www.nclegalclinic.org/Portals/0/2015%20Federal%20Poverty%20Guidelines.pdf

Scope and Schedule

The scope and schedule may vary largely depending on the utility. For example, a utility that seeks referrals from non-profit organizations that it has worked with in the past may move more quickly to negotiate that service than a utility that needs to research local non-profits and start developing that relationship from scratch. Another variable is the time it may take to develop a tool to track the collected data.

Measuring Implementation and Determining Water Savings

Direct measurement of water savings from Plumbing Assistance Programs is challenging for several reasons. Economically disadvantaged households having chronic water leaks are likely to deploy strategies to minimize their losses that include turning off the water at their meter. They may also temporarily have household members shower at other locations or stop using the home bathroom. Once repairs are made, the water use may remain constant or may increase as people move back into the home and begin normal water usage.

1. Residential end use data: There are several reasonable methods for estimating what the water losses from the leaks would be if they were never repaired. One is to use data from the Water Research Foundation's Residential End Use Study which demonstrated that approximately 12 percent of single-family water usage is wasted due to repairable leaks. Using this 12 percent against the typical indoor usage of the utility service area could be a reasonable way to estimate how much water is saved by ensuring that there are no leaks. As an example, if the indoor water use average is 6,000 gallons/month or 72,000 gallons/year then a 12 percent reduction from this would be 8,640 gallons per year.

2. EPA estimates of leak waste levels: Another reasonable way to estimate water savings from plumbing assistance is to document what leaks are repaired and use data from the EPA Leak Education Program to estimate losses that have been eliminated.

   Example: leaking toilet repair & leaking faucet repair

   Assume at least six additional months of leaks
   Faucet Loss: 600 gallons
   Toilet Loss: 37,800 gallons

   Total Savings for Repair: 37,800 gallons

Table 1: Water waste estimates from common leaks (in gallons)*

Leak source	Per day	Per week	Per month	Per year
Leaking toilet	200	1,400	6,300	75,600
Faucet leak	4	25	100	300
Showerhead leak	6	42	167	500
Outdoor leak in irrigation (1/32" leak)	75	525	2100	6300
Outdoor leak in drip irrigation	720	5040	20160	262080

*Data from https://www.epa.gov/watersense/fix-leak-week

Cost Effectiveness Considerations

The primary expenses for this type of program are the plumbing services and repairs, expenses for referrals made from entities external to the utility (if any), and the value of staff time and resources used on the program.

Considerations for cost effectiveness should include the cost of operating the program against the dollar value associated with the water savings. Another way to evaluate cost effectiveness is by balancing the dollar value associated with the average water savings per home against the average cost per home to provide plumbing services. Savings over and against the cost of the project can be estimated in advance. Tracking the water savings and expenses allows utility staff to refine estimates and improve accuracy.

Determination of the Impact on Other Resources

This program requires significant administrative oversight if it is to be operated in a meaningful way. The greatest impacts in running this program are on utility staff who manage and oversee its operations. Early on, setting up the administrative process and negotiating the plumbing services will take some time. Once the program is fully operational, staff will have to do things such as manage the invoices, perform spontaneous and unscheduled site checks to inspect the plumbing services, track and record data, and handle referrals. Ultimately, the impact to staff will depend on the scope and scale of the project, as well as efficiency in program management. Some tools may help mitigate impacts, such as online application or referral systems or the format of referral information coming from outside sources or other departments within the utility. Databases or customer information systems (such as customer service or billing systems) that can generate reports in digital formats can also help reduce the manual labor otherwise required by staff.

References for Additional Information

Beecher, Janice, et al., *Socioeconomic Impacts of Water Conservation* (2000).

Hasson, David S., *Water Utility Options for Low-Income Assistance Programs* 94:4 (American Water Works Association Journal 128 (Apr. 2002).

Louie, Josephine, et al., *The Housing Needs of Lower-income Homeowners*, Harvard University (1998).

Wolff, Aubry, Customer Characterization: Analysis to Prioritize BMP Selection BMP

Wolff, Aubry, et al., *Utility Customer Profile Guide for Water Conservation Planning*, Texas Water Resources Institute (2015) *http://twri.tamu.edu/publications/educational-materials/*.

8.1 New Construction Graywater

Applicability

This BMPis intended for a Municipal Water User Group ("utility") that has new development in its service area where use of graywater can be an option for an additional water supply. This BMP does not include on-site wastewater treatment and reuse. Once a utility decides to adopt this BMP, the utility should follow the BMP closely in order to achieve the maximum water efficiency benefit from this BMP.

Description

Graywater has always been used in Texas. The most common example is using washing machine water for lawn or garden irrigation. Until 2003, Texas statutes contained very restrictive provisions for using graywater, primarily due to concerns about public health. In 2003, the Texas Legislature adopted House Bill ("HB") 2661 which provides a more comprehensive definition of graywater and provisions for facilitating the use of graywater in a safe manner.

Graywater is defined in Texas as wastewater from clothes washers, showers, bathtubs, hand washing lavatories and sinks not used for the disposal of hazardous or toxic ingredients. Graywater cannot include water from clothes washers used for washing diapers, sinks used for food preparation, toilets, nor urinals.

HB 2661, passed by the 78th Legislature Regular Session, added a provision that allows graywater use without treatment of up to 400 gallons per day at a private house for landscape irrigation, gardening or composting as long as the graywater:

1) Is used by the occupants of the residence for gardening, composting, or landscaping;
2) Is collected using a system that overflows into a sewage collection system or on-site wastewater treatment and disposal system;
3) Is stored in tanks that are clearly labeled and that have restricted access;
4) Uses purple pipe or purple tape around the pipe;
5) Is not allowed to pond or run off across property lines; and
6) Is distributed by a surface or subsurface system that does not spray into the air unless the graywater receives additional treatment.

HB 2661 also encourages builders of new homes to install dual piping that provides the capacity to collect graywater from allowable sources and to install subsurface graywater systems around the foundation of new houses to minimize foundation movement and cracking. This approach can also provide irrigation for landscaping planted up to four feet from the foundation.

New duplexes, triplexes, fourplexes, town homes, condo units and apartments can all be designed for utilization of graywater. Graywater generated from office buildings and other commercial buildings, primarily through faucet use, can be used for landscape irrigation. HB 2661 requires the Texas Commission on Environmental Quality to adopt rules for graywater use for commercial purposes as well as for industrial purposes and these rules are expected to be released for public comment sometime in 2004.

In many cases the quantity of water available as graywater is declining due to water efficiency gains from water conserving showerheads, faucet aerators and clothes washers. In a new home, which would have efficient plumbing fixtures, the amount of graywater produced will range from 22 to 30 gallons per person per day[1]. For an average size household of 2.7 persons that would be sufficient in most cases for both foundation stabilization and landscape irrigation in a four-foot strip around a 2,500 square foot house.

The suitability of graywater for irrigation will vary, and if graywater is the primary source for irrigation, a low water use landscape should be used. Irrigation systems should consider soil depth, soil permeability and flooding characteristics. Application options include drip, flood and subsurface irrigation. It is not appropriate to use spray irrigation unless the graywater is highly treated. Pumps may be required for pressure dosing and uniformity of flow.

Implementation

Implementation of this BMP includes following rules pertaining to graywater adopted by TCEQ (expected 2004) as well as any local City or County Health Department rules. To promote this BMP, stakeholder meetings should be held with builders, developers, realtors and other impacted groups.

Due to the high cost of retrofitting existing homes and buildings for collection and use of graywater, that option is not included in this BMP. A utility choosing to support such retrofits should include design standards as a component of its public information programs.
Under this BMP, the utility should:

1) Implement an incentive plan to encourage builders and owners of new homes and/or multi-unit properties to install plumbing that separately collects graywater from all eligible sources and distributes the graywater through a subsurface irrigation system around the foundation of the residence or building or for other landscape use. It may be effective for this BMP to be part of a Green Builder type rating system that also includes WaterWise landscaping, adequate soil depth and rainwater harvesting; or
2) Adopt regulations requiring all new homes and/or multi-unit properties to install plumbing that separately collects graywater from all eligible sources and distributes the graywater through a subsurface irrigation system either around the foundation of the residence or building or for other landscape use; or
3) Adopt regulations and/or incentives requiring new commercial properties to reuse graywater.

Schedule

The schedule for accomplishing this BMP depends upon the utility's choice of approach:

1) Incentive Approach: In the first six months, plan the program including stakeholder meetings as needed. Develop a plan for educating and training potential homebuyers, developers, plumbers, landscape professionals and realtors about this program. After six months, implement the program.
2) Ordinance Approach: In the first six months, hold stakeholder meetings to develop the ordinance. Consider offering incentives for the first year of implementation. Propose the ordinance or rules to local City Council or Board for approval. Develop plan for educating potential homebuyers, developers, plumbers, and realtors about this program. After six months, implement the program.

Scope

To accomplish this BMP, the utility should do the following:

1) Develop and implement an incentive program to encourage graywater use in new homes and/or multi-unit properties and/or certain new commercial developments such as office parks; Or,

2) Adopt an enforceable ordinance or rules requiring use of graywater on all new homes and/or multi-unit properties and/or certain new commercial developments such as office parks.

Documentation

To track the progress of this BMP, the utility should gather and have available the following documentation for each year of implementation:

1) Depending on which sectors the utility has decided to focus on, the number of new homes and/or multi-unit properties and/or certain new commercial developments such as office parks, started and completed after adoption of this BMP;
2) The number and type of graywater installations completed each year; and
3) The estimated graywater use in each graywater installation.

Determination of Water Savings

Water savings will vary depending on the type of installation and will likely be unique to each customer installing a graywater system. There may also be some cases where graywater use will provide more water for a purpose than is currently being met with potable water. Only the

reduction in potable water use should be calculated as the actual savings. In general, calculate water savings as follows:

- For single-family units, calculate gallons of potable water use replaced by graywater and multiply this estimated potable water savings per house times the number of houses installing a graywater system.
- For commercial and other properties, calculate gallons of potable water use replaced by graywater. In some cases, water savings for commercial developments can be calculated based on the number of employees and graywater discharge per employee.

Cost-Effectiveness Considerations

The costs to the utility will center around the administrative costs of working with existing and potential graywater projects, including review of plans and inspection of construction. Utilities may also consider offering incentives. Depending on program design and whether project inspections are required, staff labor cost should range from $50 to $100 per project. Marketing and outreach costs range from $20 to $50 per project. Administrative and overhead costs range from 10 to 20 percent of labor costs.

References for Additional Information

1) *Graywater System Guidelines, Green Building Program Sustainable Building Sourcebook.* http://greenbuilder.com
2) *Impacts of Demand Reduction on Water Utilities,* AWWA Research Foundation, 1996.
3) *Residential End Uses of Water,* AWWA Research Foundation, 1999.
4) *Quantifying the Effectiveness of Various Water Conservation Techniques in Texas,* Texas Water Development Board, May 2002.
5) *Waste Not, Want Not: The Potential for Urban Water Conservation in California,* Pacific Institute, November 2003. http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf
6) *Texas HB 2661.* http://www.capitol.state.tx.us/tlo/78R/billtext/HB02661F.HTM
7) *City of Austin Green Builder Program.* http://www.ci.austin.tx.us/greenbuilder/

8.2 Rainwater Harvesting and Condensate Reuse

Applicability

This BMP is intended for use by a municipal water user group ("utility") concerned with reducing outdoor irrigation demands on the potable water system. Calculation of potential savings will depend upon regional climate patterns. Rainwater harvesting and condensate reuse are applicable to ICI buildings, while private homes can benefit from rainwater harvesting. Utilities may benefit by targeting this BMP to help shave peak demand through customer education. For maximum water-use efficiency benefit, the utility should adhere closely to the measures described below.

Description

Rainwater harvesting and condensate reuse ("RWH/CR") conservation programs are an effective method of reducing potable water usage while maintaining healthy landscapes and avoiding problems due to excessive run-off. Using this BMP, the utility provides customers with support, education, incentives, and assistance in proper installation and use of RWH/CR systems. RWH/CR systems will be most effective if implemented in conjunction with other water efficiency measures including water-saving equipment and practices. Rainwater harvesting is based on ancient practices of collecting – usually from rooftops – and storing rainwater close to its source, in cisterns or surface impoundments, and using it for nearby needs. Industrial, Commercial, and Institutional ("ICI") users have found it to be cost effective to collect the condensate from large cooling systems by returning it into their cisterns as well. Facilities with large cooling demands will be in the best position to take advantage of condensate reuse, which due to its quality can potentially be used in landscape irrigation, as cooling tower makeup water, or in some industrial processes. The variability in rate and occurrence of precipitation events requires that rainwater or condensate be used with maximum efficiency. Incentives may include rebates for purchase and installation of water-efficient equipment.

Several factors should be considered in the design of rainwater harvesting and condensate reuse systems. System components include the collection area, a first flush device, a roof washer, an opaque storage structure with the capacity to meet anticipated demand, and a distribution system. Design consideration should be given to maintaining the highest elevations feasible for collection and storage systems for the benefit of gravity flow to storage or distribution. When using drip irrigation systems, filters are necessary to prevent particulates from clogging drip nozzles. For potable water uses, a higher degree of filtration and disinfection is needed to ensure water quality adequate for human consumption. Regular maintenance of RWH/CR systems includes changing filter media on a regular basis and cleaning the first flush filter. The utility should consider providing participants with reminders of regular maintenance requirements for their RWH/CR systems. Maximum expected daily demand, and knowledge of historical precipitation patterns, including amount, frequency and longest time between rainfall events, is important in designing the system. The Texas Water Development Board's *Texas*

Manual on Rainwater Harvesting, 2004, should be used as a resource, as well as technical assistance from professional installers and manufacturers of RWH/CR equipment for proper design and implementation of RWH/CR program guidelines.

In some parts of the state of Texas, RWH/CR has been used as a private water supply for both potable as well as nonpotable uses. Using rainwater for potable supply creates a responsibility on the part of the owner/operator of the system to operate and maintain the system to a higher level than nonpotable use. For this reason most RWH/CR programs run by utilities are likely to focus on non-potable water uses. Successful implementation of this BMP is accomplished by performing one or a combination of the approaches outlined below.

While residential cooling systems are unlikely to provide significant flows of condensate, Industrial/Commercial/Institutional ("ICI") installations with large cooling demands can produce significant amounts of condensate and should be evaluated for the dual RWH/CR system. Large ICI installations can implement rainwater harvesting (from roofs) as well as capture of stormwater for irrigation or other non-potable uses. New commercial developments are often required to have either stormwater detention ponds or water quality treatment structures. In either case, permanent storage can be added beyond that required and this storage can be used to retain runoff for later irrigation use. Large buildings that have or need French drain systems for foundation drain water should evaluate the potential for recovery of this resource as well.

The utility should consider sponsoring one or more demonstration sites. Potential partners include customers with educational missions such as schools, universities, botanical gardens, and museums with large public landscapes.

Although rainwater is recommended for all irrigation uses, it is most appropriate for use with drip or micro irrigation systems. Utilities implementing this BMP should consider offering a landscape water-use survey (*See*, the related BMP) to help customers ensure that RWH/CR systems are properly designed and sized.

The water-use surveys, at a minimum, include: measurement of the total irrigated area; irrigation system checks, review of irrigation schedules or development of schedules as appropriate; provision of a customer survey report and information packet. The utility should provide information on climate-appropriate landscape design and efficient irrigation equipment and management for new customers and change-of-service customer accounts (*See*, the Water Wise Landscape Design and Conversion Programs BMP for more detail).

Implementation

Programs should consider the following elements:

1) <u>Retrofit or Rain Barrel Program</u>
   Marketing the program to the customer via bill inserts will allow the utility to target the largest summer peak users first. The utility should consider also

approaching local weather announcers, radio gardening show hosts, and newspaper columnists for assistance in notifying the public about the program. Public/private partnerships with non-profits such as gardening clubs, neighborhood associations, Cooperative Extension offices and/or with green industry businesses such as rainwater harvesting companies and local sustainable building groups are potential avenues to market the program and leverage resources.

Incentives can include rebates for RWH/CR systems, recognition for RWH/CR systems through signage, award programs, and certification of trained landscape company employees and volunteer representatives to promote the program. Utility staff can also be trained to provide irrigation audits, which can include resetting irrigation controllers with an efficient schedule.

The initial step in assisting customers with landscape irrigation systems is a thorough evaluation of the potential water capture of a RWH/CR system.

The water customers who participate in this program will need to maintain and operate their irrigation systems in a water-efficient manner. The utility should consider implementing a notification program to remind customers of the need for maintenance and adjustments in irrigation schedules and to system filters as the seasons change.

The utility needs to ensure that RWH/CR system specifications are coordinated with local building and plumbing codes.

The American Rainwater Catchment Systems Association lists evaluation training for RWH/CR programs. ICI customers may want to consider performance contracting as an option for financing retrofitted RWH/CR systems.

2) <u>New Construction</u>

a. In addition to retrofitting existing homes and buildings with RWH/CR systems a utility may also choose to support implementation focused on new construction. Under this approach, the utility could:

b. Adopt regulations requiring all new ICI properties to install a RWH/CR system that collects and stores rainwater and condensate from all eligible sources and distributes it to irrigation and/or a cooling tower make-up system or

c. Implement an incentive program to encourage builders and owners of new ICI properties to install a RWH/CR system that collects and stores rainwater and condensate from all eligible sources and distributes it to irrigation and/or a cooling tower make-up system. In large ICI buildings requiring cooling towers, design consideration should be given to returning condensate flows from air conditioning coils to cooling tower

make-up. It may be effective for this BMP to be part of a Green Builder type rating system that also includes WaterWise landscaping and adequate soil depth;

d. Implement an incentive program to encourage homebuilders and homeowners to install a RWH system for landscape use to reduce potable water consumption from the utility in the summer season or

e. Adopt regulations requiring all new homes and/or multi-unit properties to install plumbing that separately collects and stores rainwater from all eligible sources and distributes the rainwater through a subsurface irrigation system either around the foundation of the residence or building or for other landscape use.

Such programs would need to be carefully coordinated with stormwater collection programs and meet all applicable regulations for stormwater collection and reuse.

Schedule

Depending on the option(s) selected, the corresponding schedule should be followed.

1) Incentive Approach
In the first six months, plan the program including stakeholder meetings as needed. Develop a plan for educating potential homebuyers, developers, plumbers, green industry trade groups, landscape architects and realtors about this program. After six months, implement the program.

2) Ordinance Approach
In the first six months, hold stakeholder meetings to develop the ordinance. Consider offering incentives for the first year of implementation. Propose the ordinance or rules to local City Council or Board for approval. Develop a plan for educating potential homebuyers, developers, plumbers, and realtors about this program. After six months, implement the program.

Scope

To accomplish the goals of this BMP, the utility should do one or more of the following:

1) Develop and implement an incentive program to encourage RWH/CR in new multi-unit properties and certain new commercial developments such as office parks. Or,

2) Develop and implement an incentive program to encourage RWH/CR in existing multi-unit properties and certain existing commercial developments such as office parks. Or,

3) Develop and implement an incentive program to encourage residential customers to install rainwater systems and rain barrels. Or.

4) Develop and implement an ordinance requiring condensate recovery in new non-residential construction as applicable.

Documentation

To track this BMP, the utility should gather and have available the following documentation for each year of operation:

1) The number of new RWH/CR developments for which design planning started after adoption of this BMP;
2) The number and type of RWH/CR installations completed each year;
3) The estimated rainwater and condensate use in each RWH/CR installation;
4) Aggregate water capacity of RWH/CR sites;
5) Number, type, and dollar value of incentives, rebates, or loans offered to and accepted by customers; and
6) Estimated water savings achieved through customer surveys.

Determination of Water Savings

Water savings from a RWH/CR program is determined by water volume harvested and used to replace other water sources. In programs which target new construction, the water savings should be estimated based upon known water consumptions for the proposed end use. A number of sources, including other BMPs, can be helpful in estimating potential water savings. A method for estimating potential water catchment and a monthly water balance equation for estimating water storage capacity are:

1) Catchment Potential (gals) = Area x 0.62 x 0.8 x Rainfall
Where Area = total area of catchment surface in square feet
0.62 = coefficient for converting inches per ft^2 to gallons (unit conversion from 7.48 gallons per ft^3)
0.8 = collection efficiency factor
Rainfall = average rainfall in inches.
Note: median and lowest recorded rainfall can also be calculated in order to develop a range of expected values.

2) Storage Capacity
A simple assumption is that up to three months may elapse without significant rainfall. So a storage capacity to provide for a three-month period of water demand may be desired.

More precise methods of estimating needed storage capacity or additional information for estimating water balance of RWH/CR systems and of accounting

for the variability in seasonal rainfall pattern is available in the *Texas Manual on Rainwater Harvesting.*

For condensate recovery, storage should be based on the anticipated maximum holding time before the condensate is reused for irrigation or other purposes.

Cost-Effectiveness Considerations

The costs of this BMP to the utility will include both administrative program management costs and incentives to customers for implementing rainwater harvesting or condensate reuse projects. Depending on program design and whether project inspections are required, staff labor cost should range from $50 to $100 per project. Current incentives provided by the City of Austin for complete rainwater harvesting system are up to $500 per SF home and for commercial customers, the incentive for condensate reuse is up to $1 per gallon per day recovered. Marketing and outreach costs range from $20 to $50 per project. Administrative and overhead costs range from 10 to 20 percent of labor costs.

The incentive for bulk purchase rain barrels in Austin is a $20 discount from the actual costs of the rain barrel. Labor costs range from $8 to $12 per rain barrel and warehouse storage costs may be an additional consideration.

References for Additional Information

1) American Rainwater Catchment Systems Association. http://www.arsca-usa.org/
2) City of Austin Water Conservation Program. http://www.ci.austin.tx.us/watercon/rainwaterharvesting.htm
3) *First American Rainwater Harvesting Conference Proceedings*, Gerston, J. and Krishna, H., editors, ARCSA, August 2003.
4) *Rainwater Harvesting Design and Installation,* Save the Rain. saverain@gvtc.com
5) *Texas Guide to Rainwater Harvesting*, Texas Water Development Board and Center for Maximum Potential Building Systems, 2nd Edition, 1997.
6) *Waste Not, Want Not: The Potential for Urban Water Conservation in California,* Pacific Institute, November 2003. http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf

8.3 Water Reuse

Applicability

This BMP is intended for Municipal Water User Groups ("utility") that may have potential applications for reusing water within its system. The utility may be a producer of reclaimed water or may work to bring in reclaimed water from outside sources. Reuse can be direct with reclaimed water substituted in end uses to replace potable water or raw water. Another method of reuse is indirect water reuse which involves the intentional planned use of system return flows.

Both direct and/or indirect reuse should be implemented as a supplement to other methods of reducing per capita water use or increasing the efficient use of water.

Upon review, utilities may find that they are already implementing one or more elements of this BMP and may want to adopt additional elements outlined below. Once a utility decides to adopt this BMP, the utility should follow the BMP closely in order to achieve the maximum benefit from this BMP.

Description

1) Direct Reuse

The direct use of reclaimed water is an effective method of reducing potable water usage. Reclaimed water is defined inTexas Administrative Code ("TAC") §210.3(24) as "Domestic or municipal wastewater which has been treated to a quality suitable for a beneficial use, pursuant to the provisions of this chapter and other applicable rules and permits." Direct use of reclaimed water is appropriate for a number of domestic, industrial and irrigation needs where the potential for human contact is limited. Some possible uses for reclaimed water are landscape irrigation, non-contact recreational use, cooling tower make up water, toilet or urinal flushing water, or manufacturing process water. Although differences in water quality between potable and non-potable water may change the quantity needed for a particular task, users of reclaimed water should view it as a valuable water resource and use it as efficiently as possible. Direct use of reclaimed water is regulated by the Texas Commission on Environmental Quality ("TCEQ") under Chapter 210 of the TAC (2) and Safe Drinking Water Act standards. Included in these rules are provisions that require permission from that agency before providing reclaimed water for beneficial use and design guidelines for reclaimed water systems.

Under this BMP, the utility should identify and rank industrial, commercial, and institutional ("ICI") customers according to volume of water use and investigate the feasibility of replacing some of potable water uses with reclaimed water. Municipalities should investigate reclaimed water opportunities within their own

accounts or with third parties outside their service area. The utility provides a description of effluent treatment facilities and distribution systems including the amounts and quality of effluent expected to be available for reuse. The utility should implement programs to provide as much reclaimed water to approved non-potable uses as is available and cost-effective to the utility.

2) Indirect Reuse

Indirect reuse can provide substantial water conservation by replacing or delaying the development of additional raw water resources for water supply. Indirect reuse can be for potable or non-potable uses. Indirect potable reuse is defined as follows by the Water Reuse Association[1] "A particular application where the recycled water (generally having received a substantial degree of treatment) is blended into a community's water supply (via groundwater recharge or surface water augmentation) prior to final treatment and distribution to the customer in the existing water distribution system."

The use of reclaimed water for augmentation of potable supplies as a BMP involves the intentional planned use of the reclaimed water for this purpose. Use of reclaimed water for augmentation of potable supplies must take into consideration the following:

- TCEQ Surface Water Quality Standards for the receiving water body.
- State laws and regulations directly applicable to authorizing water reuse, including those that consider the impact of reuse on instream uses, freshwater inflows to the bays and estuaries, and existing water rights under circumstances that the regulatory agency deems appropriate.

A water rights permit is required to withdraw reclaimed water that has been discharged to the waters of the state.

Implementation

Implementation should consist of at least the following actions:

1) Direct Reuse

a. Identify Potential Reuse Accounts

b. Identify and rank ICI accounts according to water use. Proximity to a reclaimed water distribution system, an existing wastewater treatment plant, or possible locations for new wastewater treatment plants should be considered in ranking potential reuse customers. A wastewater interceptor could be designed to divert wastewater flows from a wastewater line for treatment and use in the nearby area. Careful consideration should be given to the water quality needs of the end user. For purposes of this BMP, potential direct reuse accounts are defined as:

1. Irrigation Accounts: any water user that uses potable water to irrigate large turf, shrubs, trees or other landscaped area. Care should be taken to ensure that such irrigation is in compliance with the human contact standards in TAC Chapter 210 and that the plant material can tolerate the water quality of available reclaimed water
2. ICI Accounts: any water users that are defined as ICI in the Conservation Programs for Industrial, Commercial, and Institutional Accounts BMP. Care should be taken to ensure that identified potential uses are in compliance with the human contact standards in TAC Chapter 210.
3. New Construction: Reclaimed water can be used for toilet and urinal flushing if it meets TCEQ standards. This would only be feasible in new construction of an office building or adult residential facility such as a dormitory. For new subdivisions, dual distribution systems could be installed to use reclaimed water to irrigate common areas, medians, parks and home landscapes. The utility could also adopt an ordinance and regulations requiring all or specific customers to use reclaimed water for irrigation and other suitable purposes if reuse water is available.

c. Implement a Reclaimed Water Customer Incentives Program. Financial incentives can be offered on a dollar amount per acre-foot of potable water use replaced. Another potential incentive is to offer discount rates or grants to assist a reuse end user in connecting to the reclaimed water system and replumbing facilities from potable to non-potable water use. Purple pipe is required for all reuse water to prevent cross connections. Proper backflow prevention measures must be implemented when a facility has both potable and non-potable water uses or has an irrigation system installed.

2) Indirect Reuse

a. Identify indirect reuse opportunities for augmentation of potable supply.
b. Identify the source of reclaimed water that could be used to augment the potable raw water supply.
c. Identify the potential water body that would receive the reclaimed water. Careful consideration should be given to the water quality requirements for the augmented water supply to be suitable for potable use. The augmentation of a potable supply should involve multiple barriers to ensure compliance with applicable regulatory standards, including high levels of treatment of the reclaimed water, blending with substantial amount of natural water, retaining the reclaimed water in the receiving water body for significant amounts of time, high degree of treatment of the potable water, and monitoring (sampling and testing) to ensure compliance with applicable regulations.

d. Determine potential impacts on instream uses, freshwater inflows to bays and estuaries, and existing water rights with regulatory agency input.

Schedule

Utilities pursuing this BMP should begin implementing this BMP within twelve (12) months of adoption of the official resolution to initiate the program.

Scope

In order to accomplish this BMP, the utility should perform the following:

1) Direct Reuse

To the extent that reclaimed water is available for reuse, replace the use of potable water on golf courses, in large cooling plants, and in other industrial or landscape processes identified by the municipal utility.

2) Indirect Reuse

To the extent that reclaimed water is available, that a receiving water body is available, and a water rights permit is obtained from the TCEQ, augment the potable water supply sources with reclaimed water in a manner determined by the utility to be financially and technically feasible.

Documentation

To track this BMP, the utility should gather the following documentation based on whether direct and/or indirect reuse is selected:

1) Direct Reuse

a. Description of wastewater treatment facilities and reclaimed water distribution systems.
b. Documentation of its efforts to find reuse opportunities within its customer base, including lists of potential users.
c. Number of gallons or acre-feet of water use replaced by reclaimed water or new water demands served by reclaimed water since implementation of this BMP.

2) Indirect Reuse

a. Description of indirect reuse project(s).
b. Number of gallons or acre-feet of previous potable water use replaced by reuse water or new water demands served by reuse since implementation of this BMP.

Determination of Water Savings

Water savings are estimated at up to 100 percent of total amount of water replaced by reuse. Changes in operating parameters or water balance calculations which depend upon water quality parameters, such as the impact of TDS in irrigation water, may require different quantities of reuse water to be applied for the same end uses.

Cost-Effectiveness Considerations

The costs for direct or indirect reuse include capital costs of facilities, engineering, regulatory costs, and operations costs. There will also be outreach costs to gain public acceptance. The benefits will be the avoided costs for water supply acquisition and additional potable water treatment capacity.

These benefits of direct reuse can be taken into account when setting the reclaimed water rate. If a utility can adopt a regulation requiring reclaimed water use for certain purposes within the proximity of a reclaimed water supply line, more customers will tie on to the reclaimed water system and the utility will be able to charge a rate that recovers its costs.

References for Additional Information

1) *Water Reuse Association: Fact Sheets and Studies.* http://www.watereuse.org/Pages/information.html
2) *Recycled Water Users' Handbook, San Antonio Water System.* http://www.saws.org/our_water/recycling/handbook/recycle_water_hb.pdf
3) *Chapter 210 Rules, Texas Commission on Environmental Quality.* http://www.tnrcc.state.tx.us/oprd/rules/pdflib/210a.pdf through 210e.pdf
4) *AWWA M24 Manual: Dual Water Systems.* http://www.awwa.org/bookstore/product.cfm?id=30024
5) *Using Reclaimed Water to Augment Potable Water Resources,* Water Environment Federation and American Water Works Association, 1998. (2.16c)

9.1 Prohibition on Wasting Water

Applicability

This BMP is intended for all Municipal Water User Groups ("utility"). This BMP should be considered by utilities that have customers who continue to waste water despite the efforts of the utility to educate customers to reduce waste of water. Many customers who are cooperating with conservation efforts may lose their inclination to conserve water if other water customers are ignoring efficient water management practices and continuing to irrigate the streets and parking lots or allow outside leaks to run visibly for long periods. In these circumstances, the utility's efforts in limiting water waste should find acceptance by the general public. The specific measures listed as part of this BMP can be implemented individually or as a group. Upon review, a utility may find that it is already implementing one or more these elements and it may want to adopt additional elements outlined below.

Once a utility decides to adopt this BMP, the utility should follow the BMP closely in order to achieve the maximum water efficiency benefit from this BMP.

Description

Water waste prohibition measures are enforceable actions and measures that prohibit specific wasteful activities. Under this BMP, the utility enacts and enforces ordinances to prohibit wasteful activities including: water waste during irrigation, failure to fix outside faucet leaks, service line leaks (on the customer side of the meter), sprinkler system leaks; once-through use of water in commercial equipment, non-recirculation systems in all new conveyer and in-bay automatic car washes and commercial laundry systems; non-recycling decorative water fountains; and installation of water softeners that do not meet certain regeneration efficiency and waste discharge standards.

Water waste during irrigation includes: water running along the curb of the street, irrigation heads or sprinklers spraying directly on paved surfaces such as driveways, parking lots and sidewalks in public right of ways; operation of automatic irrigation systems without a functioning rain shut off device or soil moisture sensor; a wind sensor and/or freeze sensors in some areas of the State; operation of an irrigation system with misting heads caused by water pressure higher than recommended design pressure for the heads, or broken heads; and spray irrigation during summer months between the hours of 10 a.m. and 6 p.m. Summer months are generally considered June 1 through September 30, but utilities may select a longer or shorter timeframe. Utilities may want to consider not allowing spray irrigation until as late as 8 pm in summer months. An exemption for these watering hours should be included for newly installed landscapes for a limited period of time.

Implementation

The utility should consider stakeholder group information meetings, especially for those affected by the landscape component of this BMP. Working with stakeholder groups is important to achieving "buy in" from the landscape industry and water customers.

Utilities with ordinance making powers may want to consider amending landscaping or irrigation ordinances that may have provisions that could be changed to increase water efficiency. For example, Corpus Christi has irrigation system regulations[1] requiring drip irrigation in landscaped areas between the sidewalk and the street. Plan customer follow-up compliance and education after ordinance passage. Implement ordinance and tracking plan for violations, compliance notifications, and enforcement.

Utilities that lack ordinance making powers may want to develop a plan for educating customers, especially those directly affected, about the requirements of a water waste prohibition program; plan a program including stakeholder meetings as needed; plan a follow-up compliance and education program; and implement a water waste program and tracking plan for violations and compliance notifications.

Schedule

Utilities pursuing this BMP should begin implementing this BMP according to one of the following approaches:

1) <u>For utilities with ordinance making powers</u>
   a. In the first twelve (12) months: Plan, develop, and pass an ordinance, including stakeholder meetings as needed. Develop a plan for educating customers, especially those directly affected by the requirements that are enforced as a result of the ordinance.
   b. After Ordinance Passage (In the 2nd year and on): Continue implementation and an outreach program for customers. Continue compliance education and initiate enforcement programs. Enforcement can include citations with fines and service interruption for repeat offenders. Or,

2) <u>For tilities that lack ordinance-making powers</u>
   In the first twelve (12) months: Plan a program including stakeholder meetings as needed. Implement a water waste program and tracking plan for violations and compliance notifications.

Scope

To accomplish this BMP, the utility should adopt water waste prohibitions policies, programs or ordinances consistent with the provisions for this BMP specified in Section C.

Documentation

To track the progress of this BMP, the utility should gather and have available the following documentation:

1) Copy of water waste prohibition ordinances enacted in the service area;
2) Copy of compliance or enforcement procedures implemented by utility; and
3) Records of enforcement actions including public complaints of violations and utility responses.

Determination of Water Savings

Total water savings for this BMP can be estimated from each water wasting measure eliminated through the actions taken under this BMP. For the replacement of inefficient equipment, the water savings are the difference in use between the new or upgraded equipment and inefficient equipment (*See* Industrial Cooling Processes BMP for additional information). For landscape water waste, the savings can be calculated based on estimated savings from each water waste warning or enforcement. There will be additional savings from the education of customers who may change some of their inefficient water use practices. These savings could be determined by surveys.

Cost Effectiveness Considerations

The primary costs associated with implementing this BMP will be ongoing administrative and staff costs. There may some one time only costs associated with developing and adopting ordinances and enforcement structures. If a utility chooses to implement fines as part of its program, the revenues from those can be included in the cost effectiveness analysis.

References for Additional Information

1) *Corpus Christi Irrigation System Regulations* http://www.cctexas.com/
2) *A Water Conservation Guide for Public Utilities,* New Mexico Office of the State Engineer, March 2001.
3) *City of Wichita Falls Drought Emergency Ordinance,* http://www.cwftx.net/drought/ordinance.PDF
4) *El Paso Water Conservation Ordinance,* http://www.epwu.org/ordinance.html
5) *Handbook of Water Use and Conservation*, Amy Vickers, Waterplow Press, May 2001.

9.2 Conservation Ordinance Planning and Development

Applicability

This Best Management Practice is intended for use by municipalities as part of a comprehensive approach to water conservation.

Description

This Best Management Practice is designed to provide guidance in developing and implementing a successful conservation ordinance that addresses permanent year-round water savings. Short-term cut backs based on temporary drought conditions is not the focus of the practice but should be considered to address short term conditions.

Developing a Comprehensive Conservation Ordinance

The most successful conservation ordinances have support from a community with a knowledgeable and engaged customer base, whether through education and awareness or a voluntary conservation program. A community that is considering this Best Management Practice should first determine what goals they wish addressed, such as long-term resources, peak or seasonal demand, capacity issues, or reduced waste water flows and then analyze end uses to help identify what may have the greatest potential for water savings. Stakeholders associated with those end uses should be brought into the process as early as possible. A good source for additional information and approaches to identifying opportunities for water conservation is Texas Water Developments Board's "Guidance and Methodology for Reporting on Water Conservation and Water Use."

1. End Use Analysis
   An end use analysis is the first step in identifying conservation provisions that will have the greatest impact on water use reductions in a given community. Basic questions include:
   - How old is the predominant housing stock?
   - Is the community "built-out" or still growing?
   - Are there industrial or manufacturing operations that are served?
   - Is there only light commercial and office?
   - Is there extensive use of irrigation systems?
   - Are there a significant number of multi-family housing, schools, golf courses?

Use basic billing information and utility employee knowledge of your customer base to gather the information. For smaller communities enough information can be gathered this way. Other sources of information include economic development offices, chambers of commerce, builders associations, school districts, metropolitan transit authorities, city planning, and permitting offices.

2. Provision Mix
   Communities with a very homogeneous customer base may need only a few provisions to address in a conservation ordinance; however, communities with more varied customer bases should consider provisions that address more than one sector. As the stakeholder process moves forward it is beneficial for all sectors that use water to be included in the community effort to save water as everyone who uses water has a part to play.

3. Stakeholder Process
   To assist in identifying that best provisions for the community are determined, a stakeholder process should be developed. Besides the ongoing implementation and enforcement, this is the most time consuming step and should be as inclusive and extensive as possible. This is the time to organize the stakeholder process for general public input and end user sector input. Reasons the community has determined the need for this ordinance should be included in any presentations or communication. These stakeholders should become advocates for the provisions to their colleagues. Communication and defense of the provisions can be shared between staff and stakeholders when the package is presented to the public and entities such as city councils.
   a. General public input process
      Broad or homeowner related provisions need input from the general public, accomplished in several forms. Distribute a general survey asking for public comment for or against the provisions proposed collected through online survey tools, hard copy in utility bill materials, or distributed at public events. Presentations can be developed and offered to community service groups such as Rotary or Lions clubs, church groups, garden clubs, homeowners associations, or any number of groups unique to your community. If this is the first effort by the community to develop an ordinance addressing conservation, a citizens advisory group should be considered appointed for the duration of the process and continued through the implementation process.

   b. End use sector stakeholder: Business Community
      Parallel to the general public input effort, input should be sought from specific end use sector stakeholders dependent on the provision proposed. For example, if you are proposing that certain standards need to be implemented when installing new landscapes you will want to meet with landscape and irrigation professionals and homebuilders at a minimum. If proposing provisions that address cooling towers you will want to meet with building owners and managers as well as cooling tower management companies. If you include provisions on pool construction standards you will want to meet with pool companies. Local chambers of commerce, landscape and irrigation groups, apartment associations, the local school district, city parks, homeowner associations, and other business groups that have a

general interest should also be included. Do not overlook the Texas county extension service as well. All meetings and comments received should be documented as you move through this process.

Implementation

Each community will have a different process to adopt ordinances. Most cities adopt final provisions through their home rule authority to pass ordinances and include them in their city codes. There are a variety of enforcement mechanisms which often depend on the specific mix of provisions adopted. Many conservation ordinance provisions have elements that come up in the building process and may be best addressed and enforced through the permitting process used for new construction requirements. Other provisions may be associated with facility management that may affect billing and can be enforced through billing requirements. Other items may fit better into a fine or citation system. The implementation phase will be challenging and buy-in from those directly responsible for enforcement is essential. Those responsible for the enforcement mechanism should be considered a stakeholder as the effectiveness of the ordinance depends on it.

Scope and Schedule

The water provider should allow for approximately 12 to 24 months realizing the full scope of this Best Management Practice. A schedule for creating, implementing, and evaluating this Best Management Practice should look similar to this:

1. Creation and support of permanent or special citizen/stakeholder advisory groups to provide programming and enforcement input.
2. End use analysis conducted by staff and special stakeholder work groups to determine proposed provisions.
3. Incorporate input and finalize provisions for staff to present to governing body such as a city council.
4. Establish enforcement mechanism.
5. Establish buy-in from the enforcement sector.
6. Develop materials and processes to inform those directly affected of the new requirements.
7. Evaluate the effectiveness of provisions implemented as well as the enforcement mechanisms.
8. Make adjustments to the provisions or enforcement mechanisms as needed.

Measuring Implementation and Determining Water Savings

To accomplish this Best Management Practice, the water provider should do the following after the first year of implementation:

1. A general survey should be sent to those sectors specifically and directly affected by the provisions to assess the general level of awareness of the provision, how compliance is occurring, and what could improve the process in the actual provision to continue to conserve water. Include both the end use sector as well as the “enforcement” sector.

2. A second round of stakeholder outreach should be considered depending on the initial survey results.
3. Identify aspects of the program which may or may not have succeeded. Look for opportunities to expand on what worked well and change or remove aspects that did not work as well.
4. A general accounting of the number of warnings, citations, corrective actions, or other statistics should be collected and compared to the number of total associated activities to get a sense of compliance rates.

The ease of determining water savings will greatly depend on the mix of provisions selected. Provisions addressing water saving equipment will have specific savings that can be calculated by determining the number of pieces of equipment installed compared to the higher use alternative. High efficiency plumbing fixtures or air cooled equipment compared to their higher water using equipment is an example of a straightforward comparison.

Less straightforward are provisions associated with outdoor water use. In these cases, comparing use before and after the provision is implemented along with overall water use, incorporating weather and other variables may be necessary to get a true determination of water savings.

Though water savings from reduced outdoor end use is the most difficult to determine in many ways, it is often critical to the provision mix because many communities are trying to address peak demand.

Cost-Effectiveness Considerations

The cost-effective water conservation ordinance provisions will be determined by the provision mix and choice of enforcement mechanism. Elements include:

1. Choice and number of provisions included in the ordinance.
2. Enforcement mechanism chosen.
3. Current and projected water resource portfolio specific to the community.
4. Marginal cost and need of the next available water source.
5. Availability of voluntary conservation programs in the community.

References

1. San Antonio Water System. http://www.saws.org/conservation/
2. City of Austin, Austin Water Utility. http://www.ci.austin.tx.us/water/water_portal2.htm
3. Alliance For Water Efficiency. http://www.allianceforwaterefficiency.org
4. American Water Works Association. http://www.awwa.org
5. Texas Water Development Board. http://www.twdb.texas.gov/conservation

Determination of the Impact on Other Resources

Effective implementation of a comprehensive conservation ordinance can have significant positive impact on both economic and environmental resources.

1. Economic Resources
   A reduction in water use by either voluntary or mandatory methods including the adoption of a conservation ordinance can reduce the cost for both water and wastewater treatment capacity, energy use, and the need to secure additional sources of raw water. While some provisions may initially cost the implementing stakeholder more, in the current water resource environment as well as the significant and ever-increasing costs in treatment and energy costs, those upfront costs can be recouped with low rate increases or in some cases the ability to have enough water for the stakeholder will outweigh the initial costs of the provision.

2. Environmental Resources
   A reduction in water use by either voluntary or mandatory methods including the adoption of a conservation ordinance will allow more water resources for environmental flows that can also lead directly or indirectly to economic benefits for the fishing and shrimping industry. In the urban environment, provisions can lead to land use that is more beneficial to urban wildlife including birds that are protected under migratory bird act and indirectly to increase in environmental tourism such as bird watching that can account for a significant portion of tourism dollars in many Texas communities.

9.3 Enforcement of Texas Irrigation Standards

Applicability

Irrigation systems are becoming a standard feature with many Texas homes. Studies have shown that homes with automatic irrigation systems can use 50 percent more water than homes without irrigation systems over the course of a year and up to 70 percent more during the summer months (Water by the Yard, 2018). Having well-designed, properly installed, and efficient landscape irrigation systems is critical to managing future municipal water use. This Best Management Practice (BMP) is focused on ensuring that irrigation systems being installed meet the rigorous design standards set by the Texas Commission on Environmental Quality (TCEQ).

A poorly designed system makes it difficult for the homeowner to use their system efficiently because water may be wasted due to excessive pressure or because the system is not zoned to allow for selective irrigation of different landscape areas, such as grass or bedded plants. In order to reduce initial costs, an installer may choose not to install the required rain sensor.

Utilities that serve fast-growing areas of the state where new homes and businesses are being built should work with city officials to enforce the Texas Irrigation License regulations of the TCEQ to ensure efficiency in newly installed landscape irrigation systems. This can be achieved through required permits and inspections.

Fortunately, Texas has one of the strongest irrigation licensing programs in the United States. The design and installation of all landscape irrigation systems must be completed only by licensed individuals following the efficiency rules outlined in the TCEQ's landscape irrigation regulations (30 TAC Ch. 344). These rules are most effectively enforced at the local level, through a combination of local ordinances, education, and required permits and inspections.

Description

Local Government Code (Section 551.006) directs all municipalities with populations over 20,000 to adopt ordinances relating to irrigation. TCEQ is responsible for the enforcement of this requirement.

Key requirements of the statute include

- that the installer holds a license issued under the TCEQ Occupations Code for Irrigation,
- that a permit be obtained before installing a system within the territorial limits or extraterritorial jurisdiction of the municipality, and
- that a licensed irrigator or irrigation technician be present on site during the installation of the irrigation system (2010 Texas Administrative Code update).

Other requirements include

- minimum standards and specifications for designing, installing, and operating irrigation systems in accordance with the TCEQ, and landscape irrigation rules, and
- that a municipality which has adopted a landscape irrigation ordinance must employ or contract with a licensed plumbing inspector or licensed irrigation inspector to enforce the ordinance.

Municipalities may require proof of current license and charge a fee for obtaining or renewing a permit. The fee should be set to recover the cost of administering the rule. Water districts may also adopt and enforce irrigation rules, and both municipalities and districts may collect fees to cover costs of the licensing program. These requirements do not apply to on-site sewage disposal, irrigation for agriculture operations, or irrigation connected to groundwater wells operated for domestic use.

In 2011, House Bill 2507 made an important advancement in strengthening irrigation licensing in Texas, making it a Class C misdemeanor to install an irrigation system without an irrigation license. Although exceptions still apply for homeowners and plumbers, this law makes it possible to enforce regulations against unlicensed individuals who are installing irrigation systems across the state. This bill took effect in September of 2011, and it allows peace officers to file cases in any Texas court, and citizens to file cases in Justice of the Peace courts against individuals who conduct irrigation installations without irrigation licenses. For more information, see the TCEQ's Landscape Irrigation page.

Implementation

A draft irrigation standards ordinance should be written with collaboration and input from stakeholders. Additionally, it must be passed by a legal body to be enforceable. For municipalities, this legal body is the city council, and for a water district, their board of directors.

The successful implementation of a landscape irrigation ordinance requires education regarding the ordinance and clearly defined penalties for those who do not follow the ordinance. Education should be rigorous and include as many stakeholder groups and individuals as possible to ensure compliance.

Suggested educational activities include speaking at local irrigator and green industry meetings about the ordinance and enforcement timelines. Meetings with local builders and developers are also key to long-term success, as they may need to revise contracts with irrigators completing installations in order to ensure that all aspects of the irrigation regulations are being followed. Signs at supply stores where builders and irrigators buy their irrigation materials are also a good practice for getting information to anyone working in the irrigation field.

Local ordinance penalties for completing irrigation work without a license are likely to be similar to those incurred for a speeding ticket. The penalties can escalate for repeat offenses. For irrigators who fail inspections, the logical penalty is that the building project does not pass inspection until the quality is improved to the satisfaction of the inspector. Pausing a building project before completion is likely to be a highly effective measure to improve quality on future projects.

Scope & Schedule

There are several key steps to putting effective enforcement of irrigation regulations into place. Allowing several months for city staff, stakeholders, and other interested parties to review the ordinance will lead to success and decrease any associated controversy. These steps include the following:

1. Review of Existing Ordinance
   Determine if the existing municipal ordinance provisions cover all of the requirements outlined in the Chapter 344 regulations. Having a local ordinance that references TCEQ standards is recommended. This will make it easier to enforce in local courts. It should be noted that local jurisdictions can use the ordinance requirement to adopt local rules that are more stringent than TCEQ requirements as needed.
2. Drafting Ordinance Revisions
   Produce a draft document that amends portions of the code that are inadequate. This is also a good time to review whether additional costs will be incurred in the process of the additional enforcement. Estimates of cost are key to developing a cost-recovery fee structure associated with the permits.
3. Stakeholder Discussions
   Stakeholders who will have an interest in local irrigation regulations may include local developers, local builders, local irrigators, local landscape companies, and area plumbers. It is important to note that plumbers are a key exemption in the Occupations Code for irrigation licensing, as a licensed plumber may repair and install irrigation systems. If there is a local irrigation association, that group is likely to be supportive of any efforts to enforce the rules of their license. The Texas Irrigation Association spends significant time and energy working to improve enforcement of licensing rules in Texas.
4. Revision of Inspection Processes
   A critical step in making the enforcement program effective is ensuring that a meaningful inspection takes place. A plumbing inspector already completes inspections on new homes, but there may be no inspection of the irrigation system installed in the yard. If inspecting irrigation systems will be a new task for your local plumbing inspector, it is recommended to set up a series of meetings and possible field visits to discuss inspection requirements, thresholds, and what is working and isn't working once the inspections

begin. It is ideal to hire an experienced irrigator who obtains the Irrigation Inspector License from TCEQ for irrigation inspections. If this is not possible, having plumbing inspectors trained through a TCEQ-approved training provider is a key step.

An ideal inspection process should look for several key indicators of quality work, such as

- A Plan: A detailed as-built plan for the irrigation system must exist and be provided to the new owner. Residential systems are not exempt from this regulation, but it is often skipped in large developments. The lack of a plan is a signal that the system may have pressure that is too low or too high, may not be using manufacturer equipment to specifications, or may not be zoned to separate grass from bedding areas.
- Master Valve: The system may have a master valve that stops flow from the main supply line to the main irrigation line when there is no scheduled operation. The master valve helps prevent significant underground leaks.
- Information at Controller: The controller for the system must be provided with a sticker which includes the irrigator's name and license number, the name and phone number of the company that completed installation, and the warranty information.
- Zoned Design: The system should have separate operational zones for grass and for beds each with matched precipitation rates. The water needs of the grass and the other landscape plants are too different to be watered by the same zone.
- Pressure Regulation: Water should not mist when coming out of irrigation heads. Such misting results in water waste due to excess evaporation and a compromised distribution pattern. If this occurs, the pressure is too high and must be regulated.
- Rain Sensor: A rain or moisture sensor must be properly installed to minimize operation of the system during and after rain events.

5. <u>Owner Education</u>

Another key step in enforcement of irrigation regulations is education of the homeowner. Municipalities and utilities will improve compliance with irrigation standards by helping new and existing homeowners understand the irrigation regulations and the requirement for licensed individuals to provide a properly installed and functioning irrigation system. Irrigators who install new systems must provide an owner's manual for the controller, a design of the system showing all underground components, a suggested watering schedule, a maintenance checklist, and information on the system warranty. Another key component of education for the homeowner is that irrigators must perform a final walk-through with the owner to explain the operation of the system.

If owners believe that irrigation standards are not being met, they can look to local ordinances or they can file a complaint with the Texas Commission on Environmental Quality Landscape Irrigation Program. This group will check into the complaint, which can

impact the license holder. Depending on the circumstances, the TCEQ enforcement process may take several months to a year to be completed. For this reason, it is recommended that local ordinances have consequences such as citations or increased future permit fees associated with failure to follow regulations.

Measuring Implementation and Determining Water Savings

Water savings due to the adherence to the landscape irrigation standards are difficult to quantify because it is difficult to determine how many poor-quality systems exist and how much water they waste. Based on anecdotal evidence of poorly installed landscape irrigation systems, the volumes of water that might be saved when irrigation standards are enforced are likely to be significant.

When irrigation systems are procured through a low-bid process and oversight is lax, there is the potential for inefficiency within these systems. Systems put in under these conditions are likely to have the following problems

- Lack of Zoning: When grass and landscape beds are watered in the same zones, it is impossible for the owner to water one less than the other. Grass requires more water than established woody plants to maintain a good appearance. As a result, homeowners may apply twice as much water to their landscape beds as necessary if zoning is poor.
- High Pressure: All irrigation components are designed to work under a range of water pressure conditions. If pressure exceeds this acceptable range, each irrigation head may spray significantly more water than it should. The pattern of the water spray becomes poor and much of the water may be lost to misting. Improving pressure regulation has been shown to decrease water usage by up to 20 percent.
- Poor Spray Head Layout: Manufacturers specifications exist for all irrigation components. Often a system is installed cheaply by increasing the distance between spray heads beyond what is appropriate for the equipment. This results in a poor distribution of water with some areas getting twice as much water as needed and others nearly none. If a customer increases their run-time to compensate for this problem, they may dramatically increase consumption.
- Lack of As-Built Plan: An as-built plan is invaluable in order to locate valves, pipes, and irrigation head locations if a problem arises in the future. Irrigation systems are subject to water flow, water pressure fluctuations, and shifting soils. At some point, repairs may be needed. The lack of an as-built plan complicates the repair process, leading to unnecessarily wasted water.

Irrigation systems vary greatly in water consumption, usually related to the area they cover. Another key variable is how often systems are operated. If a community has regulations limiting how many times per week the irrigation system may be used, this will impact total consumption

and therefore the savings range. For this reason, the table below is suggested as a way for a utility to create a logical estimate of long-term savings. Note that savings achieved will be on the higher end of the range suggested if a strong education program helps irrigation system owners understand options, such as watering zones differently.

Table 1: Potential water savings due to enforcement of irrigation standards*

Lot size range	Typical one cycle usage (gallons)	Potential water savings (percentage of irrigation volume)	With additional homeowner education (percentage of irrigation volume)
Estate Lots: Over One Acre	7,000	10	15
½-1 acre	4,000	10	15
¼-1/2 acre	2,000	10	15
Small Lots (under ¼ acre)	1,400	10	15

*Summary of water use data collected from 1,326 residential irrigation sites in San Antonio, Texas.

Cost Effectiveness Considerations

The cost of enforcing irrigation requirements can be passed on to builders and home owners through permit fees. Permit fees should be designed to recover the cost of collecting and processing the permit, as well as inspecting the system. A repeat inspection fee may be necessary should more detailed work be required.

References for Additional Information

EPA WaterSense
https://www.epa.gov/watersense/when-its-hot

The Texas Commission on Environmental Quality website includes information on the license program, irrigation regulations, and how to file a complaint against an irrigator.
https://www.tceq.texas.gov/drinkingwater/irrigation

Texas House Bill 2507, 82nd Legislature.
https://capitol.texas.gov/tlodocs/82R/billtext/html/HB02507S.HTM

Texas Living Waters Project, Water Conservation by the Yard: Estimating Savings from Outdoor Watering Restrictions
https://texaslivingwaters.org/wp-content/uploads/2018/03/WCBTY-II_Final_031918.pdf?pdf=WCBTY-2018