



**EDWARDS AQUIFER
AUTHORITY**

Groundwater Conservation Plan

(as Adopted November 2014)

TABLE OF CONTENTS

Summary.....	1
Introduction.....	2
Figure 1.1: The Edwards Aquifer Authority Boundary Within the Edwards Aquifer Region.....	2
Purpose.....	5
Table 2.1: Total Water Demand Projections for the Planning Area.....	5
Approach.....	6
Applicability.....	7
General Plan Requirements.....	7
Municipal Plan Requirements.....	8
Industrial Plan Requirements.....	9
Irrigation Plan Requirements.....	10
Variances.....	11
Appendix A: Edwards Aquifer Authority Conservation Programs.....	1-A
Appendix B: Municipal BMPs	
Muni-1: System Water Audits, Leak Detection and Repair.....	1-B
Muni-2: Metering of All New Connections and Retrofit of Existing Connections.....	2-B
Muni-3: Water Waste Prohibition.....	4-B
Muni-4: Conservation Pricing (for Purveyors Only).....	5-B
Muni-5: Public Information and School Education Programs.....	6-B
Muni-6: Landscape Conservation Programs.....	8-B
Muni-7: Conservation Coordinator.....	10-B
Muni-8: Water Use Survey Programs.....	11-B
Muni-9: Residential Plumbing Retrofit and Rebate Programs.....	12-B
Muni-10: Reuse of Treated Effluent.....	15-B
Appendix C: Industrial BMPs	
Ind-1: System Water Audits, Leak Detection and Repair.....	1-C
Ind-2: Water Waste Prohibition.....	2-C
Ind-3: Sub-Metering.....	3-C
Ind-4: Landscape Conservation Programs.....	4-C
Ind-5: Golf Course Conservation.....	5-C

Ind-6:	Athletic Field Conservation.....	7-C
Ind-7:	Nursery Conservation.....	9-C
Ind-8:	Cooling Tower Conservation.....	10-C
Ind-9:	Conservation Programs for Industrial Users.....	12-C
Appendix D:	Irrigation BMPs	
Irr-1:	Surge Flow Irrigation System.....	1-D
Irr-2:	Sprinkler and Micro Irrigation Systems.....	2-D
Appendix E:	Acronyms and Definitions.....	1-E

SUMMARY

The Edwards Aquifer Authority (EAA) requires certain groundwater withdrawal permit holders to develop and implement individual groundwater conservation plans as specified in ch. 715 (Comprehensive Water Management), subch. C (Groundwater Conservation and Reuse) of the EDWARDS AQUIFER AUTHORITY RULES and in accordance with the Aquifer Authority Act (Act). In order to assist permit holders in completing their groundwater conservation plans, the EAA developed a regional Groundwater Conservation Plan (GCP) to act as a guidance document to encourage, promote, and document year-round conservation measures. This GCP is comprised of several components: a discussion of purpose, approach, applicability and requirements, EAA conservation programs, best management practices, water savings assumptions, and acronyms and definitions. The Act also requires the EAA to submit the GCP to the Texas State Legislature by January 1 of each odd-numbered year.

Due to increasing water demands, extreme weather variability, and mandated water usage reductions, regional and individual groundwater conservation planning has become an essential element to the region's overall water management. Thus, the EAA has implemented numerous regional conservation programs designed to promote water conservation and to educate and assist all Edwards Aquifer groundwater withdrawal permit holders. A complete listing of the EAA's conservation programs is provided in Appendix A.

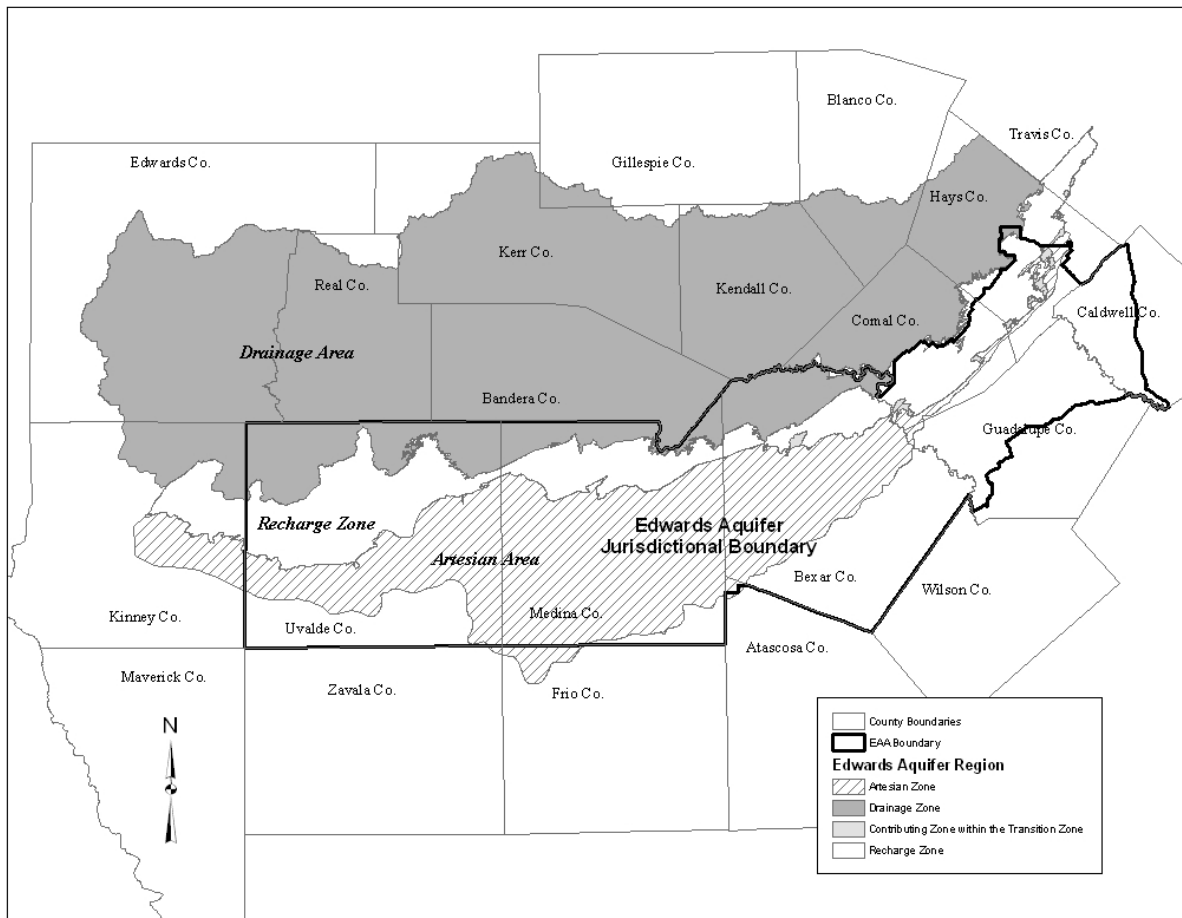
According to the Act and EAA rules, each municipal, industrial, and irrigation user within the EAA's jurisdictional boundaries must implement a minimum number of conservation practices within specified time frames to improve water-use efficiency. Owners of permitted municipal and industrial wells authorized to withdraw no more than three acre-feet of groundwater annually and irrigation permit holders with an application efficiency of 60% efficiency or greater are not required to implement a groundwater conservation plan. These conservation programs are to be documented through the preparation of individual GCPs. Conservation is to be achieved through the implementation of Best Management Practices (BMPs), which are defined as practices that have shown documented improvements in water-use efficiency. Specific BMP information for municipal, industrial, and irrigation permit holders is provided in Appendices B, C, and D respectively. Appendix E provides a complete listing of acronyms and definitions to help explain the terminology used throughout the GCP.

INTRODUCTION

The Edwards Aquifer is one of the most permeable and productive limestone aquifers in the United States. The San Antonio segment extends from the groundwater divide near Brackettville in Kinney County to the groundwater divide near Kyle in Hays County. The aquifer provides water to approximately 1.7 million people in the region.

The EAA jurisdictional area covers all or parts of an eight-county region located in south central Texas, including Uvalde, Medina, Bexar, Atascosa, Comal, Hays, Guadalupe, and Caldwell counties (Figure 1.1). The Authority was created in 1993 by the Texas Legislature as a “conservation and reclamation district” to replace the Edwards Underground Water District and to manage, preserve, and protect the San Antonio segment of the Balcones Fault Zone Edwards Aquifer. The EAA is governed by a 17-member board of directors, including voting members elected to represent the 15 districts across the region, and two non-voting members appointed by other entities. Directors represent agricultural, industrial, municipal, environmental, and downstream user groups.

Figure 1.1: The Edwards Aquifer Authority Boundary Within the Edwards Aquifer Region.



The Texas Legislature mandated the EAA to take all reasonable measures to effectively control

the resource in order to protect domestic and municipal water supplies, the operation of existing agriculture and industries, terrestrial and aquatic life, and the economic development of the region. To accomplish these goals, the EAA is vested with all of the powers, rights, and privileges necessary to manage, conserve, preserve, and protect the Edwards Aquifer. The Texas Legislature, in enacting the Edwards Aquifer Authority Act (the Act), directed the EAA to:

- protect the water quality of the aquifer;
- protect the water quality of the surface streams to which the aquifer provides streamflow;
- achieve water conservation;
- maximize the beneficial use of water available for withdrawal from the aquifer;
- recognize the extent of the hydro-geologic connection and interaction between surface water and groundwater;
- protect aquatic and wildlife habitat;
- protect species that are designated as threatened or endangered under state or federal law;
- provide for instream uses, bays and estuaries;
- protect domestic and municipal water supplies;
- protect the operation of existing industries;
- protect the economic development of the State;
- prevent the waste of water from the aquifer; and
- increase recharge of water to the aquifer.

The EAA Act and the EAA rules include a “Critical Period Management Plan” that mandates pumping reductions triggered by declining aquifer levels or springflow as follows:

Table 1.2 – Critical Period Triggers, Stages, and Withdrawal Reductions*

SAN ANTONIO POOL				
COMAL SPRINGS FLOW (CFS)	SAN MARCOS SPRINGS FLOW (CFS)	INDEX WELL J-17 LEVEL (MSL)	CRITICAL PERIOD STAGE	WITHDRAWAL REDUCTION – SAN ANTONIO POOL
< 225	< 96	< 660	I	20%
< 200	< 80	< 650	II	30%
< 150	N/A	< 640	III	35%
< 100	N/A	< 630	IV	40%
<45/40**	N/A	<625	V	44%

UVALDE POOL				
COMAL SPRINGS FLOW (CFS)	SAN MARCOS SPRINGS FLOW (CFS)	INDEX WELL J-27 LEVEL (MSL)	CRITICAL PERIOD STAGE	WITHDRAWAL REDUCTION – UVALDE POOL
N/A	N/A	N/A	I	N/A
N/A	N/A	< 850	II	5%
N/A	N/A	< 845	III	20%
N/A	N/A	< 842	IV	35%
N/A	N/A	<840	V	44%

* A change to a critical period stage with higher withdrawal reduction percentages, including initially into Stage I for the San Antonio Pool and Stage II for the Uvalde Pool, is triggered if the 10-day average of daily springflows at the Comal Springs or the San Marcos Springs or the 10-day average of daily aquifer levels at the J-17 or J-27 Index Wells, as applicable, drop below the lowest number of any of the trigger levels for that stage. A change from any critical period stage to a critical period stage with lower withdrawal reduction percentages, including exiting from Stage I for the San Antonio Pool and Stage II for the Uvalde Pool, is triggered only when the 10-day average of daily springflows at the Comal Springs and the San Marcos Springs and the 10-day average of daily aquifer levels at the J-17 or J-27 Index Wells, as applicable, are all above the same stage trigger level.

** Applicable springflow trigger is either less than 45 cfs based on a ten-day rolling average or less than 40 cfs based on a three-day rolling average. Expiration of Stage V is based on a ten-day rolling average of 45 cfs or greater.

In addition to its specific powers, the EAA is granted the rule making and enforcement powers of other Texas groundwater districts created under Chapter 36 of the Texas Water Code. However, it should be noted that the EAA’s responsibilities only apply to the use and management of the Edwards Aquifer within the EAA’s boundaries. Water quality protection programs may be enforced up to five miles outside the EAA’s boundaries. Other than water quality powers, the EAA has no regulatory powers over portions of the Edwards Aquifer that lie outside of its boundaries, or over any other groundwater or surface water resources within its boundaries.

PURPOSE

The development and implementation of the EAA's GCP and individual GCPs will help both the EAA and permit holders improve water-use efficiency in order to: meet statutory Edwards Aquifer withdrawal limitations, address increasing regional water demands, account for weather variability, and prepare for critical period water-use reductions.

The Act makes numerous references to conservation, and clearly conveys that all parties must make reasonable efforts to be conservative in water use. Conservation is defined in the Act as "any measure that would sustain or enhance water supply." The EAA Board of Directors is given the duty to conserve Edwards Aquifer groundwater, and is granted the general power to manage and conserve the aquifer and to prevent waste. The EAA is directed by the Act to take all reasonable measures to ensure efficient water use. Consequently, each permit holder is required to "take all reasonable measures to be conservative in water use."

Precipitation is the primary source of recharge to the Edwards Aquifer. Variability in regional precipitation has a direct influence on aquifer levels and springflows, and therefore affects all aquifer permit holders.

In order to maintain business operations during times of drought, aquifer permit holders must be prepared to utilize groundwater resources as efficiently as possible. Year-round conservation measures implemented through GCPs will help prepare Edwards Aquifer permit holders for water-use reductions in dry years.

APPROACH

Article 1, Section 1.23(c) of the Act states "the Authority biennially shall prepare and update enforceable and effective conservation and reuse plans." The EAA must deliver these plans to the Legislature no later than January 1 of each odd-numbered year.

Permit holders are to achieve year-round conservation through the implementation of Best Management Practices (BMPs). BMPs are conservation practices that have been shown through research and documented implementation to achieve measurable water savings. Each BMP includes four sections: (1) Description section - defines and sets the scope of each practice; (2) Coverage Requirements section - sets forth actions that must be accomplished in order to properly complete BMP implementation; (3) Documentation Requirements section - outlines the information that must be submitted to the EAA to confirm BMP implementation; and (4) Water Savings Assumptions section - Water savings assumptions are estimates and demonstrates how savings should be calculated for some BMPs.

Specific information concerning individual GCP requirements may be found under the General Plan Requirements section of this document. Permit holders must also comply with the appropriate

requirements set forth under Municipal Plan Requirements, Industrial Plan Requirements, or Irrigation Plan Requirements.

APPLICABILITY

The need to use aquifer water for beneficial purposes and to prevent waste extends to all uses and users of Edwards Aquifer groundwater with a withdrawal permit of more than three acre-feet that are directly regulated by the EAA. Thus, the requirement to develop and implement a GCP applies to permit holders, and transferees of permitted water rights with a withdrawal permit for more than three acre-feet, including the following:

- All permit holders; except those irrigation permit holders that demonstrate the required application efficiency;
- Transferees of groundwater rights from a permit holder; and
- Transferees of leased groundwater rights from a permit holder for a term more than three years.

GENERAL PLAN REQUIREMENTS

1. Irrigation permit holders are required to have an on-farm application efficiency of no less than 60% and shall submit an Agricultural Irrigation Assessment Form to determine the on-farm application efficiency. Irrigation permit holders failing to exhibit the required efficiency are required to submit an individual GCP.
2. Permit holders, except those irrigation permit holders that demonstrate the required application efficiency; must prepare and submit one individual GCP for each groundwater withdrawal permit.
3. Permit holders required to submit a GCP must provide the following general information:
 - a. GCP form, permit number, or transfer number assigned by the EAA;
 - b. address, telephone number, and fax number of the permit holder, or transferee;
 - c. name of the contact person or individual completing the permit holder's GCP;
 - d. address, telephone number, and fax number of the contact person; and
 - g. type of water use (municipal, industrial, or irrigation) and brief description of water use (golf course, feed lot, athletic field, etc.).
4. Permit holders required to submit a GCP must provide a list of BMPs that are being implemented, and an implementation schedule.
5. Permit holders required to submit a GCP must submit a triennial status report summarizing the status or implementation of BMPs.

6. Permit holders proposing an alternative to a mandatory BMP must submit a variance request application to the EAA. The alternative to the mandatory BMP must include the following elements: description, implementation schedule, coverage requirements, documentation, and water savings assumptions.
7. Permit holders may work with the EAA or with other permit holders or agencies to achieve BMP implementation. When implementing BMPs through cooperative programs with other permit holders, water savings must be calculated for each permit holder separately, so as not to double count savings.
8. Permit holders may submit equivalent Groundwater Conservation Plans and related status reports which have been prepared for other public entities to the EAA.

MUNICIPAL PLAN REQUIREMENTS

1. In addition to the information enumerated under General Plan Requirements, all municipal permit holders must provide the following information:
 - a. types of accounts (residential, commercial, industrial, institutional, etc.) and number of each, and use by volume and by percent for each type of account;
 - b. estimated per capita water usage in gallons per person per day; and
 - c. water conservation enforcement measures.
2. All municipal permit holders must provide programs to accomplish BMPs Muni-1 through Muni-3.
3. Implementation of BMPs Muni-4 – Muni -10 are optional and are encouraged when appropriate.
4. All municipal permit holders must commence BMP operation within 90 days of GCP approval.

Appendix B - Municipal BMPs

Muni-1	System Water Audits, Leak Detection and Repair
Muni-2	Metering of All New Connections and Retrofit of Existing Connections
Muni-3	Water Waste Prohibition
Muni-4	Conservation Pricing for Purveyors Only
Muni-5	Public Information and School Education Programs
Muni-6	Landscape Conservation Programs
Muni-7	Conservation Coordinator
Muni-8	Water Use Survey Programs
Muni-9	Residential Plumbing Retrofit, Rebate and Replacement Programs
Muni-10	Reuse of Treated Effluent

INDUSTRIAL PLAN REQUIREMENTS

1. In addition to the information enumerated under General Plan Requirements, all industrial permit holders must provide information on the types (processes) of water use, and use by volume and by percent for each type of use.
2. All industrial permit holders must provide programs to accomplish BMPs Ind-1 and Ind-2.
3. When applicable, industrial permit holders are encouraged to provide programs to accomplish applicable BMPs Ind- 3 through Ind-9.
4. All industrial permit holders must commence BMP operation 90 days after GCP approval.

Appendix C - Industrial BMPs

- Ind-1 System Water Audits, Leak Detection and Repair
- Ind-2 Water Waste Prohibition
- Ind-3 Sub-Metering
- Ind-4 Landscape Conservation Programs
- Ind-5 Golf Course Conservation
- Ind-6 Athletic Field Conservation
- Ind-7 Nursery Conservation
- Ind-8 Cooling Tower Conservation
- Ind-9 Conservation Programs for Industrial Users

IRRIGATION PLAN REQUIREMENTS

1. All irrigation permit holders must complete an Agricultural Irrigation Assessment Form (AIAF) supplied by the EAA and provide the following information:
 - a. current number of irrigated acres per farm;
 - b. current irrigation methods; and
 - c. number of acres for each respective irrigation method, if more than one irrigation method is utilized for the farm.
2. All irrigation permit holders, except those that demonstrate an irrigation application efficiency of 60% or greater on the AIAF, are required to prepare a GCP that will improve the application efficiency to 60%. All information supplied on the AIAF is subject to verification.
3. All irrigation permit holders required to submit a GCP must generally describe how leaks are detected and repaired. All uses of unlined ditches are prohibited.

4. All irrigation permit holders must utilize one of the irrigation methods described under BMPs Irr-1 and/or Irr-2. All irrigation permit holders must, at a minimum, utilize surge flow irrigation systems, or a sprinkler or micro irrigation system described in BMP Irr-2 that overall achieves at least 60% application efficiency. If other irrigation systems are used, the permit holder must provide results of a current efficiency evaluation confirming that the systems used achieve at least a 60% application efficiency.
5. Irrigation permit holders installing new equipment on multiple fields may stagger implementation over the course of several years.
6. Portable equipment, such as surge systems, may be utilized on multiple fields.
7. All irrigation permit holders must commence BMP operation 90 days after GCP approval.
8. Irrigation permit holders must calculate water savings according to the water savings documentation form.

Appendix D - Irrigation BMPs

- Irr-1 Surge Flow Irrigation System
- Irr-2 Sprinkler and Micro Irrigation Systems

VARIANCES

Permit holders may submit requests for variances from GCP requirements to the EAA's Board of Directors. Variances from individual GCP requirements may include, but are not limited to, the following: substitution of BMPs, proposal of new BMPs, and alteration or elimination of existing BMPs.

Requests for variances should include the following information:

- a. Name, address, telephone number, and permit number of the permit holder requesting the variance;
- b. A statement identifying the specific request from which a variance is sought;
- c. A detailed explanation of why the variance should be granted, including an explanation of how granting the variance will promote conservation;
- d. If requesting to use a new BMP, a full description of the BMP, including information on how it will be implemented, and documented or estimated water savings; and
- e. A statement indicating that alternatives to the variance have been considered and an explanation of why no other reasonable alternative is available.

In granting variances, the EAA Board may impose any terms and conditions that are deemed appropriate, and may require additional information relevant to monitoring the terms and conditions of the variance. Variances may be rescinded at any time.

APPENDIX A:

**EDWARDS AQUIFER AUTHORITY
CONSERVATION PROGRAMS**

EDWARDS AQUIFER AUTHORITY CONSERVATION PROGRAMS

The EAA has developed numerous conservation programs to promote conservative and efficient water-use throughout the region. These programs are designed to educate, inform, and assist all permit holders of Edwards Aquifer groundwater.

Public Outreach Efforts:

Doc Edwards & Aquifriends

The award-winning Doc Edwards™ program joins the Aquifriends to take 2nd and 3rd grade students on educational, interactive journeys by exploring the underground world of the Edwards Aquifer. Live school presentations creatively engage children through the use of technology, songs, audience participation, and a question and answer sessions to recap all that they learned. Students gain a new awareness of the various aspects of the aquifer, including hydrology, geology, and the importance of water conservation and aquifer protection. The new *Aquifriends* program is education based, and was created in an effort to meet the Texas Essential Knowledge and Skills or *TEKS* in a fun and interactive way.

Karston, a Texas Blind Salamander

Kinder- 1st grade children enjoy learning about the Edwards Aquifer from *Karston*, a fictional Texas Blind Salamander. Educators can schedule the walkabout *Karston* for live appearances to school groups and events. Also, an eBook, *Little Karston, Big Helper: Conservation* allows children to listen, read along, and become active participants in the EAA's mission to conserve groundwater.

Little Karston, Big Helper

This colorful and fun eBook gives children the opportunity to follow Karston throughout the day as he thinks of practical ways to conserve water.

The EAA continues to offer an array of free supplemental classroom materials for students of all ages. While *Karston* brings conservation tips to Kinder- 1st grade and the Aquifriends live presentations are tailored for grades 2nd-3rd graders, the EAA Staff offers Career Day presentations for 4th-5th graders.

To schedule a presentation or to invite Karston to your event, contact the EAA's education & outreach department.

Educator assessment forms and student post- and pre-exams are also available on the EAA's website.

The EAA prides itself on educating the public through a variety of activities designed to increase awareness of the Edwards Aquifer and the role of the EAA in managing and protecting our natural resource. A common theme of many outreach efforts is the importance and necessity of water conservation. The EAA's education programs encourage the development of life-long water conservationists from a young age.

Management and staff participate in numerous region-wide public events, including speaking engagements, community events, and Earth Day celebrations. Additionally, the EAA maintains close relationships with regional media contacts who are instrumental in conveying critical information to the public, especially during times of drought conditions.

Rainwater Harvesting Demonstration Site

A Rainwater Harvesting Demonstration site at the EAA's main offices provides a working model for permit holders and individuals interested in using rainwater to reduce their dependence on the Edwards Aquifer. The demonstration includes components for the capture, distribution, storage, and use of harvested rainwater. The demonstration site harvests rainwater, which is used to maintain xeriscaped landscape. The demonstration is available for viewing and educational purposes.

Water Conservation Grants Program

The EAA has established and maintains a water conservation grant fund. Water conservation grants are made for capital equipment or materials, labor, preparation cost, and installation costs to improve the efficiency of water delivery, use, or application for existing systems. Conservation projects that may also be considered for approval through this program include but are not limited to rainwater harvesting systems, leak detections surveys, high water efficiency plumbing retrofit programs and school and public educations programs. The grant program is open to permit holders and exempt well users of Edwards Aquifer groundwater withdrawal rights.

APPENDIX B:
MUNICIPAL BMPs

Muni-1: SYSTEM WATER AUDITS, LEAK DETECTION AND REPAIR

A. DESCRIPTION

System Water Audit, Leak Detection and Repair programs are effective methods of accounting for all water usage within a service area, and are essential to a sound water management program.

System Water Audit

Under this BMP, all purveyors and non-purveyors with more than 10 connections and mobile home communities with more than 50 connections must conduct annual pre-screening system audits to determine if full-scale system audits are necessary. If a permit holder fails to account for a minimum of 85% of a system's water use, the permit holder must conduct a full scale distribution system water audit.

Leak Detection and Repair Program

Under this BMP, all permit holders, regardless of their number of connections, must implement a leak detection and repair program; leaks must be repaired immediately when detected. In addition the permit holder must make every effort to inform customers when leaks exist on the customer's side of the meter.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. System Water Audit: Annually complete a pre-screening system water audit to determine the need for a full-scale system water audit. The pre-screening system water audit must be calculated as follows:
 - a. determine metered sales and other system verifiable withdrawals;
 - b. determine total supply into the system; and
 - c. if metered sales plus other verifiable uses represent less than 85% of total supply into the system, a full-scale system audit is necessary.
2. If you're pre-screen audit results in a water loss of more than 15%, annually conduct a distribution system water audit using methodology consistent with TWDB water loss audit requirements;
3. Leak Detection and Repair Program: Perform distribution system leak detection, and repair identified leaks; and
4. Advise customers when it appears that leaks exist on the customer's side of the meter.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Pre-screening audit results along with supporting documentation;
2. Records of audit results or the completed TWDB Audit Worksheets for each completed audit period; and

3. Description of the Leak Detection and Repair Program.

D. WATER SAVINGS ASSUMPTIONS

Water savings is based on increased efficiency of distribution systems and recovered water through leak repairs.

Muni-2: METERING OF ALL NEW CONNECTIONS AND RETROFIT OF EXISTING CONNECTIONS

A. DESCRIPTION

Metering of all connections within a service area is an effective method of accounting for all water usage, and is essential to a sound water management program. Under this BMP, all purveyors must meter all new connections within the service area, and must develop and implement a program to install meters on existing unmetered accounts within the service area. All non-purveyors with more than 10 connections and mobile home communities with more than 50 connections must install meters by zone(s) for all connections within the service area.

Many purveyors have industrial, commercial, and institutional (ICI) accounts that use significant amounts of water for landscape irrigation. Unless these accounts have dedicated landscape irrigation meters, it is difficult to track and control landscape water usage. For this reason, the permit holder must determine the feasibility of adding dedicated landscape irrigation meters. If it is determined that adding dedicated landscape irrigation meters is a feasible method of reducing landscape water usage, the permit holder must develop a plan to install dedicated landscape irrigation meters, either through incentive programs or mandates.

For purveyors and non-purveyors, meters may begin to provide inaccurate readings of water usage with age and use. To ensure meters are reading accurately, the permit holder must develop and implement a program to timely replace water meters within the service area. The permit holder must install pressure regulators on replaced meters when needed.

For purveyors, many multi-family and ICI accounts require large meters that cannot measure water usage during low-flow periods. In order to account for all water usage for large users, the permit holder must determine the feasibility of retrofitting multi-family and ICI accounts with turbo meters or similar technology.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, purveyors must accomplish the following:

1. Install meters on all new connections within service area;
2. Within one year of implementation date, develop and implement a plan to install meters on all existing unmetered connections within the service area;
3. Within one year of implementation date, determine the feasibility of adding dedicated landscape irrigation meters on ICI accounts;
4. Within one year of implementation date, determine feasibility of retrofitting multi-family and ICI accounts with turbo meters or similar technology.
5. Within three years of implementation date, develop a plan to install dedicated landscape irrigation meters on ICI accounts;
6. Within three years of implementation date, develop a plan to establish a schedule for testing and replacing meters within the service area; and
7. Install pressure regulators on replaced meters, when needed.

To receive credit for this BMP, non-purveyors must accomplish the following:

1. Within one year of implementation date, if more than 10 connections exist or if more than 50 connections exist within a mobile home community, install meters by zone(s) for all connections within the service area. Connections per zone cannot exceed ten connections; and
2. Within two years of implementation date, develop a plan to establish a schedule for testing and replacing meters.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, a purveyor must provide the following documentation:

1. Number of total number connections metered during the reporting period;
2. Number of unmetered accounts in the service area;
3. Results of feasibility study to add dedicated landscape meters;
4. Number of meters tested and replaced during the reporting period;
5. Number of retrofitting multi-family and ICI accounts with turbo meters or similar technology , if needed.

To receive credit for this BMP, a non-purveyor must provide the following documentation:

1. Total Number of connections metered during the reporting period;
2. Number of existing unmetered connections in the service area;
3. Number of meters tested and replaced during reporting period; and
4. Number of pressure regulators installed on replacement meters.

Muni-3: WATER WASTE PROHIBITION

A. DESCRIPTIONS

Water Waste Prohibition measures are enforceable actions intended to prohibit specific wasteful activities.

Under this BMP, municipalities with the ability to adopt and implement ordinances must enact and enforce ordinances to prohibit wasteful activities including: runoff from property, irrigation during peak water loss due to evapotranspiration (typically between the hours following 10:00 a.m. and 8:00 p.m.), single-pass cooling systems in new connections, non-recirculating systems in new conveyer car washes, non-recirculating systems in new commercial laundry systems, non-recycling decorative water fountains, and other wasteful activities.

Under this BMP, privately owned utilities must enact and enforce policies and tariffs to prohibit wasteful activities including: runoff from property, landscape irrigation during peak water loss due to evapotranspiration (typically between the hours following 10:00 a.m. and 8:00 p.m.), single-pass cooling systems in new connections, non-recirculating systems in new conveyer car washes, non-recirculating systems in new commercial laundry systems, non-recycling decorative water fountains, and other wasteful activities.

Under this BMP, non-purveyors must enact policies to prohibit wasteful activities including: runoff from property, landscape irrigation during peak water loss due to evapotranspiration (typically between the hours following 10:00 a.m. and 8:00 p.m.), non-recirculating systems in new conveyer car washes, non-recirculating systems in new commercial laundry systems, non-recycling decorative water fountains, and other wasteful activities.

The permit holder should encourage customers to water each landscape zone no more than one day a week except by means of a hand-held bucket, hand-held hose, or properly installed micro irrigation system. The permit holder should encourage that restaurants serve water upon request only.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Within six months of implementation date, adopt and enforce water waste prohibitions consistent with the descriptions above.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Copy of water waste prohibition ordinances, policies or tariffs enacted in the service area.

Muni-4: CONSERVATION PRICING (FOR PURVEYORS ONLY)

A. DESCRIPTION

Conservation Pricing is a method of encouraging efficient water use through quantity-based pricing structures. In order to provide economic incentives for efficient water use, the permit holder must bill by metered volume of use, and must use an Increasing Block Rate pricing structure. An Increasing Block Rate Structure provides for an increase in the unit price of water as the volume of water used increases.

The permit holder should also impose seasonal or excess-use surcharges to reduce demand during summer months. Permit holders should establish rates based upon long-run marginal costs, or the cost of adding the next unit of capacity to the system.

Permit holders that supply water but not sewer service should work with sewer agencies so that those sewer agencies adopt conservation pricing for sewer service.

The adoption of lifeline rates for low-income customers will neither qualify nor disqualify a rate structure as meeting the requirements of this BMP.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Establish and maintain a year-round Increasing Block Rate pricing structure;
2. Impose seasonal or excess-use surcharges to reduce demand during summer months; and
3. If you do not supply sewer service, work with sewer agencies so they may adopt conservation pricing for sewer service.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following information:

1. Copy of rate structure used for each customer class; and
2. A copy of the rates charged in order to reduce demand during summer months.

D. WATER SAVINGS ASSUMPTIONS

If available, provide calculated water savings and calculation methodology.

Muni-5: PUBLIC INFORMATION AND SCHOOL EDUCATION PROGRAMS

A. DESCRIPTION

Public Information Programs are effective methods of promoting water conservation and informing the public of the necessity to use water efficiently. Under this BMP, the permit holder must establish and maintain an active public information program to educate and inform the public about water conservation.

An effective public information program should include, but is not limited to: providing speakers to employees, community groups, and the media; using paid and public service advertising; using bill inserts; providing trend and comparison information on bills; and providing informational pamphlets, flyers, and manuals. In order to maximize available resources, the permit holder should coordinate with government agencies, industry groups, public interest groups, and the media.

School Education Programs are a proven and widely accepted method of achieving water conservation. Under this BMP, the permit holder must establish and maintain an active school education program to inform and educate students within the service area of the importance of efficient water use.

An effective school education program should include, but is not limited to, classroom presentations, instructional assistance, and distribution of educational materials. Grade-appropriate materials and presentations should be available for grade levels K-12. The permit holder is encouraged to coordinate with government agencies, industry groups, public interest groups, and the media to maximize available educational resources. Education materials must meet the state education framework requirements.

The permit holder may receive credit for this BMP by utilizing resources available through the Authority.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Establish and maintain active public information and school education programs to promote and educate the public about water conservation.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Number and type of public speaking events related to conservation during the reporting period, and approximate attendance for each;
2. Number and type of media events relating to conservation during reporting period;

3. Number and type of paid or public service announcements relating to conservation produced or sponsored during reporting period; and
4. Types of written information (bill inserts, flyers, pamphlets, etc.) relating to conservation provided to customers during the reporting period;
5. Number of school presentations made during the reporting period;
6. Number of in-service presentations or teacher's workshops conducted during the reporting period; and
7. Number and type of curriculum materials developed or provided by the permit holder.

D. WATER SAVINGS ASSUMPTION

If available, provide calculated water savings and calculation methodology.

Muni-6: LANDSCAPE CONSERVATION PROGRAMS

A. DESCRIPTION

Landscape conservation programs are an effective method of accounting for and reducing outdoor water usage. Under this BMP, the permit holder must provide non-residential and residential customers with methods for improving landscape water-use efficiency, customer support and education.

The permit holder must identify accounts with dedicated irrigation meters and for those irrigators showing excessive use, assist in determining precipitation rate and assigning reference evapotranspiration (ET_o) based irrigation schedules equal to no more than 80% of reference evapotranspiration per square foot of landscape area. Customers can be directed to an ET based website, such as Texas ET Network, where they can be emailed weekly sprinkler irrigation recommendations.

The permit holder shall develop and implement a plan to market landscape water-use surveys to ICI and residential accounts. The water-use surveys shall include: measurement of the total irrigable area; irrigation system checks and distribution uniformity analysis; review and development of irrigation schedules; provision of a customer survey report and information packet. When cost-effective, the permit holder should offer the following: financial incentives to reduce irrigated landscape area, convert landscape material to Xeriscape; and installation of dedicated landscape meters.

For new customers and change-of-service customer accounts, the permit holder are encouraged to provide information on climate-appropriate landscape design, and efficient irrigation equipment and management. The permit holder must install climate-appropriate water-efficient landscaping at water agency facilities, and install landscape meters where appropriate. Permit holders with ordinance-making powers may consider adopting ordinances that require all new homes, and all new apartment complexes and commercial buildings to install a water conserving landscape.

The permit holder may consider offering the following services:

1. Training in landscape maintenance and irrigation system maintenance and design;
2. Financial incentives to convert landscape material to Xeriscape;
3. Rebates and incentives to purchase conservation equipment to improve efficiency including rain sensors or soil-moisture sensors;
4. Notices at the start and end of the irrigation season alerting customers to check irrigation systems and to make repairs and adjustments as necessary.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Within one year of implementation date, identify accounts with dedicated irrigation meters and assist with determining precipitation rates and reference ET_o based

irrigation schedules equal to no more than 80% of reference evapotranspiration per square foot of landscape area;

2. Within one year of implementation date, develop and implement a customer incentive program to include financial incentives, converting landscape material to xeriscape;; and installation of dedicated landscape meters. ;
3. If applicable, provide information on climate appropriate landscape design and efficient irrigation equipment and management; and
4. If applicable, consider adopting ordinance requiring new home, apartment complexes and commercial buildings to install a water conserving landscape.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Number of accounts with dedicated irrigation meters and assigned reference ETo based schedules;
2. Number, type, and dollar value of incentives, rebates, and loans offered to and completed by customers;

Muni-7: CONSERVATION COORDINATOR

A. DESCRIPTION

A conservation coordinator is an individual designated to oversee and coordinate conservation efforts within a permit holder's service area. Under this BMP, the permit holder is required to designate a conservation coordinator who will be responsible for preparation and implementation of the permit holder's Groundwater Conservation Plan, preparation and submittal of annual conservation status reports, and implementation of BMPs.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Designate a conservation coordinator to oversee conservation activities;
2. Provide the conservation coordinator with the necessary resources to prepare and implement the Groundwater Conservation Plan; and
3. Provide support staff if necessary.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Conservation coordinator name, staff position, address, and phone number;
2. Date the conservation coordinator was identified by the purveyor;
3. Duties of the conservation coordinator; and
4. Number of conservation coordinator staff (if applicable).

D. WATER SAVINGS ASSUMPTIONS

If available, provide calculated water savings and calculation methodology.

Muni-8: WATER USE SURVEY PROGRAMS

A. DESCRIPTION

Water use survey programs are an effective method of tracking and controlling water usage. To accurately evaluate current water-use efficiency by account, permit holder must develop and market water-use surveys and customer incentive programs.

Water use surveys for ICI customers must 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 permit holder should conduct annual follow-up visits to evaluate the status of recommended water-saving improvements.

Water use surveys for residential customers must include: meter checks; leak checks for toilets and faucets; determination of flow rates for showerheads, aerators, and toilets; irrigation system and timer checks; and review or development of irrigation schedules. Residential water-use surveys should also include measurement of currently landscaped and total irrigable areas. The permit holder must provide the customer with an information packet including evaluation results and water saving recommendations.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Contact and offer water-use surveys and customer incentives; and
2. Begin surveying.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. A description of the plan to market water-use surveys per customer class;
2. The number of customers offered water-use surveys per customer class during the reporting period and the number of water-use surveys completed during the reporting period; and
3. The number of follow-ups completed per customer class during the reporting period.

D. WATER SAVINGS ASSUMPTIONS

Calculate water savings as follows:

Water Savings = Number of Surveys [No. of Customers] * Estimated Savings * Water Used [Gal/Yr Per Customer]

Where: Estimated Savings = 20% 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)

Muni-9: RESIDENTIAL PLUMBING RETROFIT, AND REBATE PROGRAMS

A. DESCRIPTION

Plumbing retrofits and high efficiency washing machines are an effective method of achieving conservation in the residential sector. Under this BMP, the permit holder must identify single-family and multi-family residences constructed prior to 1992, and must develop a plan to distribute or directly install high-quality, low-flow plumbing devices as needed. High-quality, low-flow plumbing devices include: showerheads rated at 2.5 gpm or less, faucet aerators rated at 2.2 gpm or less, toilet displacement devices, toilet flappers, and ultra-low-flush toilets that use 1.6 gallons per flush or less. The permit holder must maintain the distribution or installation programs so as to achieve retrofits on at least 10% of single-family residences and 10% of multi-family residences each reporting period. The permit holder may meet the requirements of this BMP through enforceable ordinances requiring replacement of inefficient plumbing fixtures.

Under this BMP, the permit holder must offer cost-effective financial incentives to encourage the purchase and use of high-efficiency washing machines. Incentive levels should be calculated using methods found in *A Guide to Customer Incentives for Water Conservation*, prepared by Barakat and Chamberlain (February 1994). Incentives and rebates may be offered in conjunction with rebate programs sponsored by local energy providers.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Identify single-family and multi-family residences constructed prior to 1992;
2. Develop and implement a plan to distribute or directly install high-quality, low-flow plumbing devices to single-family and multi-family residential customers and/or rebates for high efficiency washing machines;
3. Distribute and retrofit at least 10% single-family and multi-family accounts constructed prior to 1992 with high-quality, low-flow plumbing devices, and/or provide rebates for high efficiency washing machines; and
4. Offer cost-effective financial incentives to encourage purchase and use of high efficiency washing machines.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. The number of pre-1992 single-family and multi-family accounts in the service area;
2. The number and type of low-flow plumbing devices distributed to single-family and multi-family residences during the reporting period;
3. The number and type of low-flow plumbing devices retrofitted to single-family and multi-family residences during the reporting period; and

4. The number of high-efficiency washing machine rebates given each reporting period.

D. WATER SAVINGS ASSUMPTIONS

Calculate water savings as follows:

1. Water savings assumptions for retrofitted devices

$$\text{Annual Water Savings} = \text{Number of Devices Retrofitted} * \text{Device Savings} * 365$$

Probability of Installation may be determined by the purveyor using the following guidelines, or may be determined by the purveyor:

- a. 100% for retrofits conducted by the purveyor;
- b. 80% for retrofits resulting from customer requests for survey kits; and
- c. 50% for retrofits resulting from survey kit distributed to the public.

Where: Device Savings may be found in the Retrofit Device Savings table found in the municipal GCP form.

2. Water savings assumptions for high-efficiency washing machines

For single-family machines:

$$\text{Annual Water Savings} = \text{Savings per Load in gallons} * \text{Water use per Load} * [\text{Loads per Person} * \text{Persons per Household}] * 365 * \text{Number of Machines}$$

For multi-family machines:

$$\text{Annual Water Savings} = \text{Savings per Load in gallons} * \text{Water use per Load} * [\text{Loads per Person} * \text{Persons per Household} * \text{Units per Machine}] * 365 * \text{Number of Machines}$$

$$\text{Water Savings per Load in gallons} = 37.8\% * \text{Water Use per Load in gallons}$$

Where: Water Savings = Gallons per Year

Water Use per Load = 48.5 Gallons

Loads per Person = 0.45

3. Water savings assumptions for ultra-low-flush toilets

For single-family dwellings:

$$\text{Annual Water Savings} = [6.693 * \text{Persons per Dwelling} - 0.529 * (\text{Persons per Dwelling})^2 + 7.826] * 365 * \text{Number of Toilets}$$

OR

$$\text{Annual Water Savings} = [29.9 * \text{Number of First Toilets Replaced} + 20.6 * \text{Number of Second Toilets Replaced} + 19.1 * \text{Number of third (or higher) Toilets Replaced}] * 365$$

For multi-family dwellings:

$$\text{Annual Water Savings} = [19.138 * \text{Persons per Unit} - 0.942 * (\text{Persons per Unit})^2 + 2.181] * 365 * \text{Number of Toilets}$$

OR

$$\text{Annual Water Savings} = [44 * \text{Number of First Toilets Replaced} + 34 * \text{Number of Second Toilets Replaced}] * 365$$

Where: Water Savings = Gallons per Year

Muni-10: REUSE OF TREATED EFFLUENT

A. DESCRIPTION

The use of treated effluent is an effective method of reducing groundwater usage. Use of treated municipal effluent is regulated by the TCEQ under Chapter 210 of the TAC. Use of treated effluent is considered an alternative source of water, and is therefore free from restriction during the Authority's critical periods. For Groundwater Conservation Plan purposes, the reuse water should be clearly related to a decrease in reliance on the aquifer. For water quality protection purposes, the use of treated effluent on the Edwards Aquifer Recharge Zone is discouraged.

Under this BMP, the permit holder must identify ICI customers according to use, and must investigate the feasibility of replacing their Edwards Aquifer groundwater use with treated effluent. The permit holder must provide a description of effluent treatment facilities.

The permit holder must implement programs to provide as much treated effluent to as many customers as possible.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. To the extent that treated effluent is available for reuse, replace the use of Edwards Aquifer groundwater on golf courses, in large cooling plants, and in other industrial or landscape processes identified by the permit holder.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Description of effluent treatment facilities.
2. Number of gallons or acre-feet of previous average groundwater use for customers served by reuse water.
3. Number of gallons or acre-feet of current groundwater use.
4. Number of gallons or acre-feet of current treated effluent use.

D. WATER SAVINGS ASSUMPTIONS

Water savings are estimated at 100% of total amount that would have been used with Edward's water.

APPENDIX C:
INDUSTRIAL BMPs

Ind-1: SYSTEM WATER AUDITS, LEAK DETECTION AND REPAIR

A. DESCRIPTION

System Water Audit, Leak Detection and Repair programs are effective methods of accounting for all water usage within a service area and are essential to a sound water management program.

System Water Audit

Under this BMP, industrial permit holders must conduct annual pre-screening system audits to determine if full-scale system audits are necessary. If a permit holder fails to account for a minimum of 85% of a system's water use, the permit holder must conduct a full scale distribution system water audit. Unaccounted water losses must be no more than 15% of total water in the system.

Leak Detection and Repair Program

Under this BMP, all permit holders, regardless of their number of connections, must implement a leak detection and repair program; leaks must be repaired immediately when detected.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. System Water Audit: Annually complete a pre-screening system water audit to determine the need for a full-scale system water audit. The pre-screening system water audit must be calculated as follows:
 - a. determine metered end-uses and other verifiable withdrawals;
 - b. determine total supply; and
 - c. if metered end-uses plus other verifiable uses represent less than 85% of total supply, a full-scale audit is necessary.
2. Leak Detection and Repair Program: Perform distribution system leak detection and repair identified leaks when cost-effective.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Pre-screening audit results along with supporting documentation;
2. Records of audit results; and
3. Description of the leak detection and repair program; and

D. WATER SAVINGS ASSUMPTIONS

Water savings are based on increased efficiency of distribution systems and recovered water through leak repairs.

Ind-2: WATER WASTE PROHIBITION

A. DESCRIPTION

Water Waste Prohibition measures are actions intended to prohibit specific wasteful activities. Under this BMP, the permit holder must implement and enforce measures to prohibit wasteful activities including: runoff from property, landscape watering irrigation during peak water loss due to evapotranspiration (typically between the hours following 10:00 a.m. and 8:00 p.m.), single pass cooling systems in new connections, non-recirculating systems in new conveyer car washes, non-recirculating systems in new commercial laundry systems, non-recycling decorative water fountains, and other wasteful activities.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Within six months of implementation date, implement and enforce water waste prohibition measures consistent with the description above.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Description of water waste prohibition measures implemented by the permit holder.

D. WATER SAVINGS ASSUMPTIONS

If available, provide calculated water savings and calculation methodology.

Ind-3: SUB-METERING

A. DESCRIPTION

Sub-metering is an effective method of tracking water usage when water is used in multiple and distinctly different processes. Under this BMP, permit holders with more than five connections must perform a feasibility study to determine the benefits of installing sub-meters on facilities or equipment which comprise 20% or more of the permit holder's total water use, and have a distinctly different end-use. The permit holder must also conduct a study to determine the feasibility of installing dedicated landscape sub-meters.

Many industrial uses require large meters that cannot measure water usage during low-flow periods. In order to account for all water usage, the permit holder should determine the feasibility of converting to turbo water meters or similar technology.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Conduct a feasibility study to determine the benefits of installing sub-meters on facilities or equipment that comprise at least 20% of the permit holder's total water usage; and
2. Conduct a feasibility study to determine the benefits of installing dedicated landscape sub-meters.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Results of feasibility study to determine the benefits of installing sub-meters on facilities or equipment that comprise at least 20% of the permit holder's total water usage; and
2. Results of feasibility study to determine the benefits of installing dedicated landscape sub-meters.

Ind-4: LANDSCAPE CONSERVATION PROGRAMS

A. DESCRIPTION

Landscape conservation programs are an effective method of accounting for and reducing outdoor water usage. Under this BMP, the permit holder must conduct a landscape water-use survey. The landscape water-use survey must at a minimum include: measurement of the total irrigable area; irrigation system checks and distribution uniformity analysis; and review or development of irrigation schedules.

The permit holder must also develop reference evapotranspiration (ET_o)-based irrigation schedules equal to no more than 80% of ET_o. If landscape use is determined to exceed 20% of total use, the permit holder must install a dedicated irrigation meter.

The permit holder should develop and implement a program to maintain irrigation systems. Maintenance programs should include pre-irrigation system checks, adjustment of irrigation timers when necessary, installation of rain sensors, and regular review of irrigation schedules.

When cost effective, the permit holder should provide the following: training personnel in landscape maintenance, irrigation system maintenance, and irrigation system design; installation of climate-appropriate water efficient landscaping; and dual metering where appropriate.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Conduct a landscape water-use survey;
2. Develop ET_o-based irrigation schedules equal to no more than 80% of evapotranspiration;
3. Install a dedicated landscape meter if landscape use is determined to exceed 20% of total use; and
4. , Implement and maintain an irrigation system.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Results of landscape survey with estimated ET_o-based irrigation schedule and annual water savings; and
2. Results of program to maintain irrigation system.

D. WATER SAVINGS ASSUMPTIONS

Assume landscape surveys will result in a 15% reduction in demand for landscape uses.

Ind-5: GOLF COURSE CONSERVATION

A. DESCRIPTION

Golf course conservation is an effective method of reducing regional groundwater demands. Under this BMP, the permit holder must conduct a landscape survey to determine reference evapotranspiration (ET_o)-based irrigation schedules. The permit holder must also implement a watering regimen that uses only the amount of groundwater necessary to maintain the viability of the course and maintain the course in a safe condition. Groundwater must only be applied to areas that are essential to the use of the course. Roughs should not be irrigated at any time, and water hazards using potable water should be eliminated when economically or environmentally feasible. Additional educational references and supplemental information on water efficiency and golf course management can be provided by the United States Golf Association can be found at www.usga.org.

The permit holder must provide methods of achieving enhanced groundwater conservation through utilization of a computer controlled irrigation system (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 over-watering, 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 plan shall provide an analysis of the cost effectiveness of utilizing a CCIS.

If non-Edwards aquifer water is available, or may be available to the course within three years of the effective date of the permit holder's groundwater conservation plan, the permit holder must convert to use of such non-Edwards aquifer water as soon as is practicable. The permit holder must include projected implementation dates to convert to alternative water supplies. Use of reclaimed, reused, and/or recycled water by golf courses located on the Recharge Zone is discouraged.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. , Perform a landscape survey to determine ET_o-based irrigation schedules;
2. Establish a watering regimen that uses only the amount of groundwater necessary to maintain the viability of the course and maintain it in a safe condition;
3. Install and operate a CCIS using ET_o-based irrigation schedules; and
4. Convert to a non-Edwards water supply if available and if environmentally feasible.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. A description of the location and dimensions of the golf course, and type(s) of turf;

2. Results of the landscape survey with estimated ETo-based irrigation schedule and annual water savings;
3. A description of the watering regimen used to maintain the viability of the course and maintain it in a safe condition;
4. A description of the water-delivery system and CCIS (or similar irrigation control system) used, and how and when it is used;
5. A description of management practices employed to control the amount of water applied to the golf course;
6. A statement of any actions or plans to obtain alternative water source(s), and a copy of the letter of commitment from the appropriate agency; and
7. Copy of TCEQ permit to use treated effluent (if applicable).

D. WATER SAVINGS ASSUMPTIONS

Assume landscape surveys and CCIS will result in a reduction in demand for landscape uses. Replacement of Edwards groundwater with an alternative water source(s) may result in up to 100% reduction in Edwards groundwater demand.

Ind-6: ATHLETIC FIELD CONSERVATION

A. DESCRIPTION

Athletic field conservation is an effective method of reducing regional groundwater demands. Under this BMP, the permit holder must implement a watering regimen that uses only the amount of groundwater necessary to maintain the viability of the turf and maintain the turf in a safe condition. Groundwater must only be applied to areas that are essential to the use of the field.

The permit holder must also conduct a landscape water-use survey and develop reference evapotranspiration (ET_o)-based irrigation schedules equal to no more than 80% of reference evapotranspiration. The survey must include the following elements: measurement of total irrigable area; irrigation system checks and distribution uniformity analysis; and review or development of irrigation schedules. If landscape use is determined to exceed 20% of total water use, the permit holder must install a dedicated landscape meter.

When cost-effective, the permit holder should provide methods for achieving enhanced groundwater conservation through utilization of a computer controlled irrigation system (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 over-watering, 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 plan shall provide an analysis of the cost-effectiveness of utilizing a CCIS.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Establish a water regimen that uses only the amount of groundwater necessary to maintain the turf in a safe condition;
2. Perform a landscape survey to determine ET_o-based irrigation schedules;
3. Install a dedicated landscape meter if landscape use is determined to exceed 20% of total use; and
4. If cost-effective, , install and operate a computer controlled irrigation system (CCIS) to achieve enhanced groundwater conservation.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. A description of the location and dimensions of the athletic field, and type of turf;
2. A description of the water regimen for maintaining the viability of the turf and maintaining it in a safe condition;
3. Results of landscape survey with estimated ET_o-based irrigation schedule and annual water savings; and

4. If applicable, a description of the water delivery system and CCIS (or similar irrigation control system) used, and how and when it is used.

D. WATER SAVINGS ASSUMPTIONS

Assume landscape surveys will result in a 15% reduction in demand for landscape uses.

Ind-7: NURSERY CONSERVATION

A. DESCRIPTION

Nursery conservation is an effective method of reducing regional groundwater demands. Under this BMP, the permit holder must implement a watering regimen that uses only the amount of groundwater necessary to replace evapotranspiration and to maintain the viability of plants. To accommodate a variety of crops with different water requirements, the permit holder must create and maintain use of multiple watering zones. Groundwater must be applied through usage of current irrigation techniques such as low-pressure sprinklers and/or micro irrigation systems.

To increase the moisture holding capacity of soils, the permit holder should use soil amendments such as wetting agents, polymers/gels, peat moss, or compost. To reduce evaporative losses, the permit holder should utilize mulch on plants in large containers.

When appropriate, the permit holder must utilize recycling ponds to capture and reuse runoff water. Recycling ponds must be lined or sealed to prevent water losses to percolation.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Implement and maintain use of multiple watering zones;
2. Maintain use of current irrigation techniques; and
3. When appropriate, install and maintain use of a water recovery and reuse system.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Description of irrigation techniques and watering zones;
2. Description of mulching practices and soil amendments used; and
3. Description of water recovery and reuse system.

D. WATER SAVINGS ASSUMPTIONS

If available, provide calculated water savings and calculation methodology.

Ind-8: COOLING TOWER CONSERVATION**A. DESCRIPTION**

Cooling towers can be among the largest water using systems in industrial processes. The greatest opportunity to conserve water in cooling towers applications can be realized by controlling the amount of bleed-off and make-up water required by the system.

Under this BMP, industrial permit holders are encouraged to utilize processes or equipment that increases cooling tower efficiency by minimizing the amount of required make-up water, while still meeting the operating parameters of the cooling system. Permit holders may institute, but are not limited to the following:

- perform an efficiency audit on each cooling tower to identify areas of improvement;
- use shielding to minimize evaporative loss;
- utilize safe chemical additives to control scaling and corrosion and extend useable “life” of water in cooling tower;
- run system with increased cycles of concentration;
- install filtration systems to remove solids and biological matter;
- install conductivity or pH monitoring systems to control bleed-off;
- install meters to monitor amount of bleed-off and make up water;
- if feasible, install an automatic shut-off system to power-down cooling tower when not in use;
- collect water from other on site uses that is suitable for make-up water or can be treated for such use;
- if feasible, utilize recycled water for cooling tower make-up water;
- harvest rainwater as available to use as make-up water; and
- reuse bleed-off water for other processes on site.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Reduce the amount of make-up water required by the cooling tower by increasing the cycles of concentration to the maximum level the cooling system can handle; and
2. Utilize any other method available to reduce the amount of make-up water required by the cooling tower.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Number of cooling towers, and cooling capacity (in tons) for each tower;
2. Description of the process the cooling tower is used for;
3. System requirements for cooling including temperature, volume, and duration of flows (hr/day);

4. Water use records for each tower that include the number of gallons of bleed-off water and the number of gallons of make-up water used daily;
5. Number of cycles of concentration;
6. Description of conductivity or pH sensors used to control bleed-off;
7. Description of chemical compounds and amounts used to amend water quality for cooling tower use; and
8. Description of any alternate water source or system used for composing make-up water.

D. WATER SAVINGS ASSUMPTIONS

If available, provide calculated water savings and calculation methodology.

Ind-9: CONSERVATION PROGRAMS FOR INDUSTRIAL USERS

A. DESCRIPTION

Conservation programs for industrial users are essential for reducing water usage in the industrial sector. Under this BMP, the permit holder must conduct an industrial water-use survey. The water-use survey must include an evaluation of all water-using equipment and processes, and must result in a report identifying potential conservation measures and their expected payback.

In lieu of the water-use survey, the permit holder may choose to implement other programs to reduce water usage. The permit holder must reduce water usage by an amount equal to 10% of baseline usage. Baseline usage is defined as the permit holder's total verified maximum historical water use.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Conduct an industrial water-use survey consistent with the guidelines above; and
2. Implement an alternative program, in lieu of the water-use survey, that reduces water by 10% of baseline usage.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Water-use survey results and potential conservation measures identified through the survey; and
2. If utilizing other programs in lieu of the water-use survey and customer incentives program, a description of the programs and estimated water use equal to 10% of baseline use must be documented.

D. WATER SAVINGS ASSUMPTIONS

Calculate water savings as follows:

Water Savings = Estimated Savings * Water Used

APPENDIX D:
IRRIGATION BMPs

Irr-1: SURGE FLOW IRRIGATION SYSTEM

A. DESCRIPTION

A surge irrigation system applies water intermittently to furrows so as to create a series of on-off periods of either constant or variable time intervals. Under this BMP, the permit holder must install and maintain use of a surge irrigation system. The system, must, at a minimum, include butterfly valves or similar equipment that provides equivalent alternating flows with adjustable time periods, and a solar or battery powered timer. The permit holder should consider soil types and infiltration rates to maximize effectiveness of the system. The system must also include tailwater recovery and reuse equipment, or measures to prevent tailwater accumulations.

Surge flow irrigation systems, or other systems that achieve documented application efficiencies of at least 60% will be considered the minimum irrigation method for all irrigators within the Edwards Aquifer region.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. \Within one year of implementation date, install and maintain a surge irrigation system consistent with the description above.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Copies of equipment invoices or other evidence for equipment purchase.

D. WATER SAVINGS ASSUMPTION

See water savings calculations attached to the irrigation GCP form.

Irr-2: SPRINKLER AND MICRO IRRIGATION SYSTEMS**A. DESCRIPTIONS**

A side roll sprinkler system consists of a lateral pipe that serves as the axle for a series of wheels (usually 3' in diameter or larger). The sprinkler heads are located along the length of the lateral pipe. The system is powered mechanically, generally by a power unit located at the center of the lateral pipeline. Under this BMP, the permit holder must install and maintain use of a side-roll sprinkler system. When necessary, the permit holder should utilize low pressure heads (25-35 psi operating pressure) and install pressure or flow regulators to maintain low pressures.

A linear move sprinkler system consists of a continuous, self-moving, straight lateral that irrigates a rectangular field. Low-pressure and dropped spray heads are generally used with a linear system to reduce wind and evaporative losses. Under this BMP, the permit holder must install and maintain use of a linear move irrigation system.

A center pivot sprinkler system consists of a continuously moving, horizontal rotating lateral that is supported by towers and anchored at a fixed pivot point at the center of the field. Under this BMP, the permit holder must install and maintain use of a center pivot sprinkler system.

Optimum water efficiency can be obtained by using either a Low Energy Precision Application (LEPA) or Low Pressure In-Canopy (LPIC) pivot system. Both systems have dropped sprinkler heads to reduce evaporative losses resulting from spray. The LEPA system has pressure-regulated dropped nozzles that hang from 8-18 inches above the ground. Socks or furrow dikes are often used with the LEPA system to further prevent evaporative water loss and to improve water infiltration to the root zone. A LPIC or Low Elevation Spray Application (LESA) system has dropped sprinkler heads that hang approximately four feet above the ground surface.

A micro irrigation system consists of hoses that are placed above or below the ground surface. Emitters are spaced evenly along the hoses to apply water optimally to the plant. These emitters deliver water in three different modes, drip, bubbler and micro-sprinkler. Micro irrigation systems drastically reduce water losses to evaporation and percolation, and have been shown to be applicable in some vegetable and cotton crops. Under this BMP, the permit holder must install and maintain use of a sprinkler and/or micro irrigation system.

B. COVERAGE REQUIREMENTS

To receive credit for this BMP, the permit holder must accomplish the following:

1. Install and maintain a sprinkler and/or micro irrigation system.

C. REQUIREMENTS FOR DOCUMENTATION

To receive credit for this BMP, the permit holder must provide the following documentation:

1. Copies of equipment invoices or other evidence of equipment purchase.

D. WATER SAVINGS ASSUMPTIONS

See water savings calculations attached to the irrigation GCP form.

APPENDIX E:
ACRONYMS AND DEFINITIONS

Terms and Abbreviations Used in the Authority's GCP are Defined as Follows:

BMPs - Best Management Practices

Bleed-Off – the circulating water in the tower which is discharged to waste to help keep the dissolved solids concentration of the water below a maximum allowable limit. As a result of evaporation, dissolved solids concentration will continually increase unless reduced by bleed off.

CCIS - Computer Controlled Irrigation System

Commercial Customers - municipal water customers that provide or distribute a product or a 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.

Credit - acknowledgment that a BMP has been implemented correctly and completely.

Distribution Uniformity (DU) - a measure of the uniformity of irrigation water distribution over a field.

ET_o - Reference Evapotranspiration or PET - the quantity of water evaporated and transpired from a reference crop (cool season turf grass), if water supplies are not limiting.

ICI - Industrial, Commercial, Institutional

Industrial Customers - municipal water customers that are primarily manufacturers or processors of materials as defined by the Standard Industrial Classifications (SIC) Code, numbers 2000 through 3999.

Institutional Customers - municipal water customers that use water for public service facilities. These include schools, courts, churches, hospitals, and government facilities.

Irrigation Ditch/Canal - any ditch or canal that supplies water to an irrigated crop.

Marginal Cost Pricing - the incremental cost of producing or acquiring additional supplies including conserved water; the cost of providing more water service. Long-run marginal costing methods can identify costs that can be avoided through more efficient use or non-use (conservation).

Multi-Family Accounts - municipal water accounts where one water meter serves more than one dwelling unit, as in apartment complexes.

Non-Purveyor – Any entity other than a public utility, mutual water company, county water district or municipality that delivers drinking water.

Per Capita Water Usage - the sum total of water diverted into a water supply system for residential, commercial, and public and institutional uses divided by actual population served.

Purveyor – A public utility, mutual water company, county water district or municipality that delivers drinking water to customers.

Retrofit - the replacement of water using fixtures or equipment with more efficient equipment.

TCEQ - Texas Commission on Environmental Quality

TWDB - Texas Water Development Board

ULFT - Ultra-Low-Flush Toilet