A TOOLKIT FOR WATER AUDITORS

COMMERCIAL AND INSTITUTIONAL SECTORS

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COMMERCIAL AND INSTITUTIONAL SECTORS

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Zamboanga City Water Districtand AECOM International Development

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ABBREVIATIONS

Be Secure	Water Security for Resilient Economic Growth and Stability
BMP	best management practices
CI	commercial and industrial
cm	centimeter
cm^3	cubic centimeters
DF	dual flush
FCSO	frontline customer service officer
FOM	flush-o-meter
ft^3	cubic feet
gal	gallon
GOCC	government-owned and controlled corporation
Gpm	gallons per minute
HA	horizontal access
HET	high-efficiency toilets
HEU	high-efficiency urinals
HVAC	heating, ventilation, and air conditioning
L	liter
lbs	pounds
LFT	low-flow toilet
LPF	liters per flush
LPM	liters per minute
LWUA	Local Water Utilities Administration
m^3	cubic meters
min	minute
MISD	management information system division
ml	milliliter
MRMS	meter reading management system
MRS	meter reading section
NSCB	NationalStatistical Coordination Board
OPL	on-premise laundries
PD	positive displacement
PRSV	pre-rinse spray valve
ROI	return on investment
sec	second
ULFT	ultra-low-flow toilet
VA	vertical access
WDM	water demand management
WSM	water supply management
WTP	water treatment plant
ZCWD	Zamboanga City Water District
ZWAT	Zamboanga City Water Audit Team

PREFACE

This toolkit is intended as a guide to those water districts and/or companies, agencies or academic institutions wishing to take first steps to becoming more water efficient and ecologically responsible. Please note that it does not substitute for expert technical guidance and advice. The technical information in this toolkit is standard practice and state of the art at the time of writing. Every user and every location needs to adapt these tools to their own circumstances. Not all the tools may be necessary or available, and some tools may not work well depending on the specific setting, plumbing variables and conditions.The authors hope that each user will add the results and experience of adapting this guide, successful and otherwise, and share these through their professional associations and at local fora, so everyone can benefit from the practical efforts to make this guide operational. In this way, it will remain a dynamic and ever-evolving support to the water community.

The Zamboanga City Water District (ZCWD) is grateful to the USAID Be Secure Project and its consultant Valerie Pape for providing technical assistance for the creation of this toolkit.Be Secure introduced water demand management (WDM) to ZCWD in 2015 as a climate change adaptation measure to address some of the water-related vulnerabilities facing Zamboanga City.In response to the threat of worsening droughts, floods, storms and sea level rise, ZCWD created a WDM Program and a water audit team. The team has been assisted by Be Secure to clearly understand and value how WDM can help local communities, and has accepted the challenge of creating this water audit toolkit—the first in the Philippines. The following individuals contributed their time, expertise and commitment to make this toolkit possible.

Zamboanga City Water District:

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General Manager's Message

I wish to offer my heartfelt salutations to the Zamboanga Water Audit Team (ZWAT) and USAID Be Secure on the development of the first-ever ***Water Audit Toolkitfor Commercial and Institutional Sectors*** in the Philippines.

This is a remarkable feat not only for ZCWD but for the entire water industry as well. I have personally witnessed the time, effort and dedication that the ZWAT has poured into the production of this toolkit, complemented with the support and guidance of USAID Be Secure.

We are indeed fortunate to have been given the opportunity to be a recipient of the water audit trainings, which were conducted last year as a key component of the Water Demand Management (WDM) Program of USAID Be Secure in the city.

This paved the way for the formulation of the toolkit, which is an effective mechanism in evaluating water use, efficiency, leaks and opportunities to save water.

In the light of the challenges that we are facing on water resource sustainability and security due to increasing water demand and recurring drought condition, this toolkit will serve as a vital step towards water conservation and, coupled with the application of a water loss reduction plan, can assist the customers in reducing their water consumption while improving efficiency.

In a nutshell, our primary objective in coming up with this toolkit is to let our customers appreciate the value of every drop of water that they consume. Water is a finite resource so we have to utilize each drop efficiently because we believe that *Agua es vida* (water is life).

LEONARDO REY D. VASQUEZ
General Manager

Message from USAID

The United States Agency for International Development (USAID) congratulates the Zamboanga City Water District (ZCWD) for completing and launching the ***Water Audit Toolkitfor Commercial and Institutional Sectors.***

ZCWD is the first water district in the Philippines to develop a toolkit that guides water service providers in making concrete steps to promote efficient water use and eliminate wasteful practices in homes and work places.

Efficient water use saves costs for small and large users alike, and also conserves water that is paramount, especially in times of water scarcity. Such measures enable water service providers to allocate water for unserved areas and provide 24-hour daily water service for underserved communities. Ultimately, this benefits the people of growing urban hubs like Zamboanga City—one of USAID's partners through the Cities Development Initiative, which supports cities outside Metro Manila to fulfill their potential as engines of inclusive economic growth.

USAID looks forward to journeying with ZCWD in seeking innovations and creative solutions to pressing water security concerns faced by both water service providers and consumers. We hope that other water service providers will be inspired to follow your example.

USAID is proud to be a partner of ZCWD in this endeavor. We share ZCWD's commitment to achieve long-term water security not only for Zamboangeños but for all Filipinos now, and for the coming generations.

USAID
FROM THE AMERICAN PEOPLE

JEREMY GUSTAFSON
Chief, Environment Office
USAID/Philippines

INTRODUCTION

BACKGROUND

Following the introduction of water demand management (WDM) by the USAID Water Security for Resilient Economic Growth and Stability (Be Secure) Project, the Zamboanga City Water District (ZCWD) formally launched its WDM Program on February 16, 2016, with support from the City Government of Zamboanga; Philippine Information Agency; Cagayan De Oro, Isabela (Basilan), and Lamitan Water Districts; national government agencies; and academe.

The ZCWD management and Board of Directors approved a budget to support the implementation of the program and created the Zamboanga City Water District Water Audit Team (ZWAT). The team's first activity was a 4-day basic Water Audit Training held February 15-19, 2016 facilitated by the Be Secure Project. It covered the basics of WDM, climate change effects on water supply, and concepts of a water audit. The participants also experienced actual on-site water audit training for the first time at various local commercial establishments and residential accounts.

Part of ZCWD's WDM Program is the development of the water audit toolkit and development of local advocacy materials. Mona Grieser, Be Secure's Chief of Party, gave a 2-day lecture and workshop on March 16-17, 2016 on formulation of toolkit procedures, WDM guidelines, communication tools, and advocacy materials.

In March 2016, after another round of lectures and review of the results of the audits conducted in February, ZWAT set the foundation for developing a water audit toolkit—the very first water audit toolkit in the Philippines.

THE ZAMBOANGA CITY WATER DISTRICT WATER AUDIT TEAM

ZWAT was created after the formal launching of the ZCWD WDM Program in February 2016. It was tasked to prepareawater audit toolkit and a WDM operations toolkit, and to train future water auditors, as major activities in mainstreaming WDM in Zamboanga City.

The team is composed of ZCWD employees in middle management who are knowledgeable in billing and metering, accounts management, customer care, community relations, planning, and monitoring.

The goal of the team is to develop a water audit toolkit that can be shared with other local water districts, water service providers, and other governmental and private institutions. Another goal is to educate people—especially youth and those working in large commercial establishments—on WDM concepts and strategies, and to promote the efficient use of water through utilization of water-saving technologies.

THE WATER AUDIT TOOLKIT

This user-friendly water audit toolkit aims to provide a guide for implementing WDM in Zamboanga City, particularly in regards to conducting water audits. It can also be modified by other water districts for their use in developing a water audit program.

The toolkit defines and illustrates various protocols, approaches, and processes to be adopted and applied by the water auditors and other users.

WHAT IS A WATER AUDIT?

A water audit provides a better understanding of customer water use patterns, characteristics, and consumption. The data gathered during a water audit will also assist in establishing a baseline for various customer segments and for future strategic and policy planning. The results of the water audits will provide customers with a specific understanding of where water is used, as well as water-efficiency opportunities, including achieving water savings from leak detection.

Water audits are great opportunities to motivate and educate customers on efficient water use behavior. The on-site audit is an opportunity to customize the recommendations to each customer, and allows a person-to-person discussion of water use,savings potential, and recommendations.

COMPONENTS OF THE WATER AUDIT TOOLKIT

Section One: Consists of a brief introduction of WDM, WDM concepts and strategies, and WDM best management practices.

Section Two: Provides information on ZCWD's history and current water situation, including their water supply system and sewerage facilities.

Section Three: Provides a guide for ZCWD water auditors on billing and meters, including account classifications and water rates, sizes and types of water meters, consumption per classification and per capita, meter reading, and billing management systems.

Section Four: Presents the various types of commercial water fixtures, appliances, and equipment. This will guide the water auditor on how these fixtures work, typical water use, measuring water use and savings, and includes sample photographs, diagrams, and illustrations.

Section Five: Provides information on the importance of detecting, quantifying, and fixing leaks; includes photographs, illustrations, and sample computations.

Section Six: Briefly provides an overview of commercial and institutional customers, challenges, statistics, and opportunities.

Section Seven: Describes additional water-efficiency opportunities, including rainwater harvesting, new construction, and new water sources.

Section Eight: Explains how to conduct a commercial audit, including key objectives of a water audit, components of a comprehensive water audit, auditor etiquette, and a step-by-step process on how to use the water audit forms.

Section Nine: Discusses water usage and savings, simple sample of payback computations, and parameters for estimating water use.

Section Ten: Describes customer report generation and recommendations.

Appendices: Includessample forms, production reports, a quick reference guide and a sample completed water audit form.

References: Includes a list of publications and websites used to develop this toolkit and other useful resources.

COMPONENTS OF THE COMMERCIAL WATER AUDIT DATA COLLECTION FORM

Part One: The master audit form consists of general information related to the site being audited, including: water sources, water meter and account information, and any supplemental information based on different types of businesses.

Part Two: The population worksheetprovides actual data as to how to how many employees and visitors are on-site based on hours per day and percentage of female versus male population.

Part Three: The bathroom fixtures worksheet provides actual data for all identified fixtures, including existing water rates, volumes, and usage.

Part Four: Kitchen/laundry fixtures and appliances worksheets provides actual data for all identified fixtures, including existing water rates, volumes, and usage; general information about the type of water fixtures; whether water fixtures have leaks; and other data on other water use.

CONDUCTING A WATER AUDIT

Water-using fixtures are identified and measured in order to determine water flow and volume rates. The auditors use a stopwatch and graded bucket to measure flow rates, and visually check fixtures for leaks. After data are captured, calculations are done in order to provide water usage and potential water savings.

Water auditors are guided by the Water Audit Form and the step-by-step process. The auditors are also provided with worksheets and easy-to-understand instructions. Most people who have undergone training can perform the water audit using this toolkit.

WHO IS THIS TOOLKIT FOR?

This toolkit is for implementers. They may include:

- **Water auditors** tasked to conduct the on-site audit.
- **Local government units**tasked by the city mayor to implement WDM strategies.
- **Water service providers,** such as a local water district that want to implement WDM strategies, including conducting water audits.
- **New commercial businesses**interested in new construction water-efficiency opportunities and best practices.
- **Government institutions** (i.e., Department of Public Works and Highways, Department of the Interior and Local Government, Department of Science and Technology, Department of Trade and Industry, Bureau of Product Standards) that would like an understanding of where and how their water is used and potential water-efficiency opportunities, including achieving water savings from leak detection.

- **Commercial businesses and institutions**that would like an understanding of where and how their water is used and potential water-efficiency opportunities, including achieving water savings from leak detection.

PURPOSE OF THE TOOLKIT

This toolkit will:

- Serve as a step-by-step guide in conducting a basic water audits for commercial businesses and government institutions.
- Educate implementers on the best practices forefficient use of water, and provide an understanding of the importance of WDM.

HOW TO USE THIS TOOLKIT

This toolkit contains information needed in order to conduct a basic commercial water audit.

To help navigate this toolkit, the following icons are used to present key information:

Step-by-step process – this icon indicates a step-by-step process. Look for it and follow steps to complete a given task.

Best Practice – this icon indicates a WDM best practice.

SECTION 1. WATER DEMAND MANAGEMENT

A BRIEF INTRODUCTION TO WATER DEMAND MANAGEMENT

Traditionally, water purveyors were only concerned with water supply management (WSM), which involves planning and developing new water resources based on the existing demand. With the increase in water demand and water scarcity, a new strategy of managing water demand has emerged. Water demand management (WDM) complements traditional WSM for meeting existing and future water demands by minimizing or avoiding development of new water resources. WDM refers to getting the most use from the available water supplies through water conservation and increased water efficiency. It consists of reducing the quantity of water required to accomplish a task as it flows from the source through use and disposal. WDM also promotes the use of lower-quality water for non-potable uses on-site, such as flushing toilets. Additionally, WDM includes strategies that shift the timing of wateruse from peak to off-peak periods, for more efficient WSM. More importantly, managing water demand ensures the ability of the water system to serve society even during times when water is in short supply. Successful WDM can provide ample water supply for all. WDM is one of the most sustainable alternatives for water supply, providing multiple benefits.

WDM includes the use of public policies, laws, water rates, and measures and practices to reduce water use, with the goal of securing long-term, reliable, affordable, and safe supply of water for the benefit of society and the environment. WDM is of equal status to supply-side water management, regardless of water source. All of these practices must work in conjunction with each other in order for WDM to be successful.

Maintaining public health and safety is paramount when implementing a WDM program. Managing water demand does not include creating unsanitary conditions that threaten public health, such as shutting off access to water fixtures or closing access to bathrooms. Water-efficiency measures must be consistent with public health and environmental requirements.

WDM is a long-term strategy with sustainable results, not just implementing drought response actions as a quick short-term solution to a time-sensitive problem; it should be ongoing and implemented as a long-term solution. WDM is imperative for many reasons, including: increases in population and growth of economies also increase the demand for water supply; changes in lifestyle require additional water supply; fresh water supplies are limited and seawater desalination is very costly; and continued over-extraction of ground water and surface water supplies can have permanent detrimental effects on the environment. WDM can minimize the impact of new water supply projects and prevent over-drafting of aquifers, as once seawater permeates the aquifer, the aquifer is no longer a viable source for clean and potable water. Climate change has significantly affected the supply of water. With a proactive approach, WDM practices can mitigate the effects of emergency water shortages and droughts.

Climate change has, and will continue to have, far-reaching implications on all aspects of water management. We have already seen significant impact on water supply due to climate change effects. With less rainfall in many areas, continued erratic and extreme weather, and increased incidence of droughts, climate change is a crucial factor as to why a WDM program should be in place. Rising temperatures increase water demand in many sectors, including agricultural irrigation, while also increasing evaporative losses on already low-surface water supplies and reservoirs.

WDM BEST MANAGEMENT PRACTICES

There are many best management practices (BMPs), which are most effective when implemented as a whole. Many of the BMPs work in tandem, complementingeach other such that the combined effect is greater than the sum of each effort. For example, it is more effectiveto require new construction codes if there are commerce laws to restrict the sale of inefficient fixtures and appliances.

First and foremost, **government should lead by example**, motivating and teaching employees to use and practice efficient use of water. Water audits should be conducted at all government facilities, and water leaks should be promptly located and repaired. Non-efficient sanitary fixtures and water appliances in all government buildings should be retrofitted or replaced. Also, as sensor-activated valves have been proven to work improperly or they are used longer or more frequently than intended, it is recommended that these valves be removed and replaced with efficient water valves. Government facilities should implement water reuse and rain water capture projects, particularly for landscaping or grounds cleaning. They should also limit or eliminate unnecessary outdoor water usage where possible. As examples, decorative water fountains can be shut off and brooms can be used to clean concrete walkways instead of hoses to hose them down. Additionally, monitoring water use at each facility is an essential tool; by monitoring how, where, and when water is used, facility managers can best determine what action should be taken to achieve more efficient use of water.

Public awareness and education is an important tool for WDM. The public should have an understanding of the water supply situation and how it affects them. Increased demand for water requires obtaining new supplies that are costly, such as the increased costs to pump, sanitize, and deliver water, regardless of water supply availability. Climate change will adversely impact the demand for water while decreasing the water supply. It is inevitable that the cost of water, regardless of its source, will increase. It is important to recognize that how much water is used and how water is being used, will affect the water supply and water costs.

A **conservation water rates schedule**has been proven to be an effective tool for WDM. By implementing increasing tiered rates and noticeable jumps in rate tiers for high water users, customers are incentivized to manage their water use more efficiently and practice conservation. Rates should include an allowance for low-income customers to meet their basic water needs at an affordable price, while increasing costs for discretionary use. Revenue collected as a result of higher tiers can also be used to fund water conservation programs.

Implementing a **national water-efficient product labeling program**, first and foremost, will serve as the foundation to educating customers as to which fixtures are water-efficient. Consumers shouldbe able toeasilyidentify water-efficient products by a common label or logo. Labeling requirementswill also be the basis for restricting the sale of inefficient fixtures and appliances, as well as enacting new construction codes. The product labeling program will facilitate testing for both performance and water use. USA Energy Star and WaterSense protocols can be easily replicated for local use.

Commerce lawsshould be enacted to restrict the sale of inefficient water fixtures and appliances. Based on the product labeling program, maximum water use regulations for new products can be determined and set.

Enacting new construction codes will improve water efficiency and minimize future water waste. **Model codes** in the **Uniform Plumbing Code** of the Philippines have already been vetted. Requiring all new construction to include the best water-conserving fixtures, fittings, and appliances is an opportunity to build it right, rather than replacing it later.

Offering **financial incentives** for early product replacements of inefficient fixtures and appliances through purchasing coupons, rebates, or water bill discounts is another BMP. Incentives are often used to motivate customers to participate in the water audit program, including rebates for the replacement of fixtures with water-efficient products, coupons for the purchase of water-efficient products, and discounts on water bills.

Water auditsare a crucial BMP that achieve several beneficial results. For example, data collected from water audits help us to better understandcustomers' water use patterns, characteristics, and consumption. The data will also assist in establishing a baseline for various customer segments and assist with future strategic and policy planning. The results of the water audits will provide the customer with a specific understanding of where water is used, along with water-efficiency opportunities, including achieving water savings from leak detection.

Water audits are a great opportunity to motivate and educate customers on efficient water use behavior. The on-site audit is an opportunity to tailor recommendations to each customer, and allows a face-to-face discussion about water use, savings potential, and recommendations for increasing water efficiency.

Water audits are generally conducted by targeting a population most likely to benefit. For example, segments that will yield the greatest water savings include schools or large buildings where occupancy per bathroom is higher. Water audits can also identify top consumers and those with exceptional or abnormal water use. Additionally, water audits can be offered to customers with complaints about high bills, as it is likely that those customers will be very highly motivated to implement water-efficiency strategies.

The success of any audit program is also based on the marketing efforts for water audits. Provide marketing materials through water bill messages and inserts, newsletters, and official letters. Forming partnerships is a fundamental tool for marketing water audits. Partnerships can be formed with manufacturers, retailers, distributors, plumbers, and community-based groups or schools. Advertising the waterand financial savings from conducted water audits is a fundamental tool for marketing the benefits of water audits.

WDM requires strategic planning. It is crucial to analyze and determine the level of efficiency based on how water is used, when water is used, by whom water is used, and for what purpose the water is used. Determining the potential reduction in water use through improvements to water-using fixtures, appliances, and behaviors enables water agencies to develop programs that will achieve a reduction in water use. By identifying potential water efficiencies, they may determine that it is more cost-effective to run a program that saves water than it is to increase water supply by building new infrastructure or reservoirs, adding pumps, or acquiring new sources of water.

A crucial part of a successful audit program is ensuring that data can be tracked, monitored, and measured accurately. Capturing information for purposes of reporting and evaluation allows the program administrator to monitor the audit program and make timely changes as necessary. See Appendix A for sample forms, reports, and materials that will assist in providing consistent data tracking and program operation.

SECTION II. ZAMBOANGA CITY WATER DISTRICT

It has been an era of great change for the Zamboanga City Water District (ZCWD), a government-owned and -controlled corporation (GOCC). ZCWD has adapted to scarce supply, greater water demand, and climate uncertainty, while keeping its vision, mission, and core values intact.

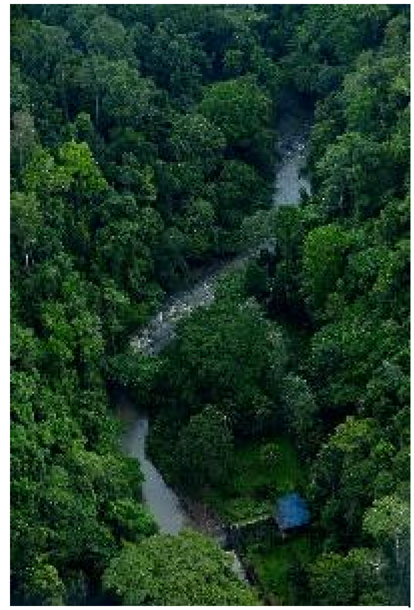
Since it was formally created in 1974, ZCWD has established its presence in 58 barangays, with a total of 55,760 active water connections as of December, 2015. With four decades of experience providing quality and unceasing service to the people of Zamboanga, ZCWD has maintained a strong network of water system infrastructure through the construction and/or rehabilitation of its various water projects.

With an increase in population and commercial developments, a limited supply of water, and the drought caused by the 2015-2016 El Niño, ZCWD decided to develop a Water Demand Management (WDM) Program in the latter part of 2015. The USAID Be Secure Project provided technical support, including seminars and trainings on water supply and demand, and downscaled climate projections for Zamboanga City to serve as a guide for developing policies for water sustainability and vulnerability assessments. For water sustainability, the Project is currently providing ZCWD technical support for the Pre-Feasibility Study of the Impounding Water Facility, which is also part of the WDM Program. Additionally, ZCWD rehabilitated a total of 51,593 linear meters of pipelines in 2015, complementing a meter replacement program already in place since 2008. ZCWD is also working to reduce non-revenue water from 50% to 25% through a joint venture agreement with Manila Water Company. Another joint venture project is with PrimeWater Infrastructure Corporation. Itis a bulk water supply project for an additional water supply of 50 million liters per day serving the west coast and will soon serve the central area after completion of the transmission pipeline project. These are initial and major projects to address sustainability of water in the city. However, ZCWD has also considered addressing the problem by integrating other WDM strategies and concepts into its policies, such as implementing water audits and educating customers on the efficient use of water through information, education, and communication activities in schools, government institutions, and barangays.

ZCWD's efforts on sustainability of water supply are still lacking considering that Zamboanga City is a highly urbanized city with a population of 861,799 people according to the 2015 census, making it the sixth most populous city in the Philippines. The average annual population growth of 2.98 percent exceeds the national average Philippine growth rate of 1.90 percent. Additionally, the city is the third largest by land area in the Philippines.The city's major industries are shipping lines, hotels, canning factories, food and restaurant industry, and agriculture—all businesses that are high in water demand.

The El Niño phenomenon greatly affects the lives of the people in the city, especially those involved in businesses. Vulnerability assessment reports suggest that Zamboanga City will be experiencing hotter years and humidity will rise, hence affecting water supply. These are the main reasons why ZCWD has decided to implement the WDM Program—to ensure the sustainability of its water supply for the next 50 years and beyond.

ZCWD WATER SUPPLY SYSTEM



TUMAGA RIVER

The weighty and vital task of providing sustainable and affordable water to Zamboanga City is a mandate of the ZCWD, whose franchise area is the entire city. Its primary source of supply is surface water from the Pasonanca Watershed through the Tumaga River.

The original water system in Zamboanga City was built by the United States colonial government in 1911withpurpose of serving the needs of U.S. forces in the city during that time. The water system consisted of an intake box, grit removal basin, three-kilometer reinforced concrete aqueduct, reservoir, and distribution system, which was further expanded in the 1930s. Three years later, expansion began with the building of the sewerage system, which had a capacity of 9,000 cubic feet.

OLD RESERVOIR (LEFT) SAND AND GRIT REMOVAL BASIN (RIGHT)

The next major expansion of the water system in the city took place in the late 1960s. This involved the 1969 construction of a treatment plant consisting of a cylindrical clarifier and rapid sand filter units to improve the quality of the water supply. However, the cylindrical clarifier was not operationalized due to technical issues, and the sedimentation basinfunctioned strictly as a storage facility.

WATER TREATMENT PLANT AT PASONANCA

WTP PHASE 1

The Zamboanga City Water Sewerage Systemwas later renamed the Zamboanga City Water District in 1974, and has since been established as an independent entity from the local government. In its inaugural year, it constructed its first three deep wells (Camins PW, Sta. Maria PW, San Roque PW) and a laboratory through a grant from the Local Water Utilities Administration (LWUA), which included the purchase and installation of 5,000 water meters. This was followed by the construction of a diversion weir and intake facilities on the upstream of the Tumaga River; the construction of a 35,000 cubic meter water treatment plant (WTP);

the laying of a 4.1-kilometer raw water transmission pipeline; and the creation of 33 kilometers of a main distribution and pipeline network in 1978. On October 29, 1981, WTP Phase II, which comprised 4 kilometers of a 700-millimeter diameter transmission line, became operational and augmented raw water supply by another 35,000 cubic meters.

The diversion weir, which has an elevation of 74.20 meters above sea level, is a reinforced concrete embankment to provide and direct raw water supply to the WTP Phase I. Any excess water flows freely towards the river connections of Barangay Pasonanca, Santa Maria, Tumaga, Guiwan, Tetuan, and Tugbungan.

PRODUCTION WELLS AND BOOSTER STATIONS

Wells normally provide the domestic water supply needs of residents in areas not or inadequately served with potable water by the water utility firm. Many of the wells are of shallow-to-moderate depths and are of low designed capacity. Well casing diameters range from 64 millimeters for household boreholes, to 300 millimeters for industrial wells. Depths range from 9 meters to 183 meters, although more than 75 percent are not more than 25 meters deep.

ZCWD has 21 production wells that are strategically located within ZCWD's service area. Each of these is equipped with submersible/turbine pumps and a generator set that runs for 23 hours a day to augment surface and spring water supply with about 19,000 cubic meters per day. ZCWD has two booster stations that help distribute supply in supply-critical areas like Lunzuran and Talon-Talon.

PRODUCTION WELL

SPRING WATER SOURCES

Currently, ZCWD is maintaining six spring water sources. These are:

- Lamisahan water system
- Labuan water system
- Vitali water system
- Lumayang-Lumbangan water system
- Tolosa-Guisan-Lanzones water system
- Dumalon water system (Baluno)

Except for the Lamisahan water system, the other water sources were implemented in partnership with the city government. The spring sources in Lumayang and Baluno are integrated into the ZCWD network structure. The other four are independent water systems.

SEWERAGE FACILITIES

Sewerage includes, but is not limited to, any system or network of pipelines, ditches, channels, or conduits. This includes pumping stations, lift stations and force mains, service connections and other constructions, and devices and appliances appurtenant thereto, which involves the collection, transportation, pumping, and treatment of sewage to a point of disposal.

ZCWD's sewerage system was constructed in 1933 by the United States. It currently covers about 80 hectares in four urban barangays, with a combined population of 9,083, according to the August 2015 census.

SEWERAGE PUMPING STATION

The collection system consists of approximately 11,400 linear meters of vitrified clay pipes of 100, 150, 250, and 300 millimeter diameters. This type of material is relatively durable and can last over a hundred years in the ground.

The facility includes two pumping stations. The East Pumping Station has three vertically mounted sewage pumps that have a combined capacity of 9,230 cubic meters per day. The West Pumping Station, on the other hand, has two vertically mounted sewage pumps with a combined capacity of 11,535 cubic meters per day. The sewage collected at the West Pumping Station is discharged via a 300-millimeter cast iron pipe. The two pumping stations are connected by two 200-millimeter cast iron pressure pipes.

SECTION III. ZCWD'S CUSTOMER BILLING SYSTEM AND METERS

The ZCWD Billing Division is composed of two sections, the Meter Reading Section (MRS) and the billing section. This division is responsible for the important task of generating revenue for the water district.

The MRS is responsible for reading the water meters and tendering the bills on a regular schedule. The billing section is primarily responsible for generating the bills of all active accounts that fall within the scheduled zones following a billing cycle. The billing section also conducts comprehensive editing of bills to ensure accuracy and data integrity before final data are submitted to the Management Information System Division (MISD) for downloading and printing of the water bills.

CUSTOMER CLASSIFICATIONS AND RATES

The charge for water is in proportion to the amount and classification of use. Metering of service connections has long been acknowledged as a cost-effective and balanced scheme for arriving at appropriate water charges. Metered rates are levied on the basis of actual volume of water consumed for a billing period.

The approved rate structure consists of two components:

- Minimum charge – is fixed depending on the size and the classification of service connection
- Commodity charge – pertains to the amount charged per cubic meter in excess of the minimum, which is ten cubic meters. A different amount of commodity charge is applied per bracket.

There are five classifications and eight different sizes of meters, which follow different minimum charges and commodity charges pursuant to the approved water rates by the LWUA.

General definitions of the classifications listed below may differ among utilities, but in very broad terms these definitions are common. The classifications and their definitions are:

1. **Residential** – Water used is domestic in nature and for day-to-day living (cooking, washing, bathing, drinking, lawn watering, and any other uses to maintain everyday life).
2. **Semi-Commercial** – Residential users that have an attached business establishment whose business activities have a start-up capitalization of more than P20, 000; also includes multi-family apartments whose owner assumes payment of the monthly water bill.
3. **Commercial/Industrial** – Business establishments whose start-up capitalization is more than P20,000; residential users with two or more families dwelling under separate roofs but using one central meter; residential users who supply/sell to or share water with others; establishments drawing water from the system for the purpose of using this water directly or indirectly to promote trade or to produce a commercial or saleable product; government institutions doing business directly with the public (such as the Philippine National Bank, Philippine Ports Authority); and government-owned establishments that are being rented, leased, utilized, and/or contracted by the private sector for the purpose of doing business with the public.
4. **Government** – All government institutions, offices, public schools, and similar entities that are presumed to be performing public service and that consume water, in connection with the performance of these public duties.
5. **Bulk/Wholesale**– Establishments drawing water from the system,withthe purpose of reselling without transforming into a new product.

CONSUMPTION PER CLASSIFICATION AND PER CAPITA

When a water consumer falls distinctly under any of the classifications enumerated above, classification for billing purposes becomes easy. As of the latest journal entry for the billing month of July 2016, the percentages of customers per classification were:

Table 1:Consumption per Classification[1]

Class	Active Service Connections	Disconnected Connections	Total Service Connections	% Total
Bulk	1	–	1	0.001%
Bulk -Commercial	–	2	2	0.003%
Commercial	4,137	2,285	6,422	8.577%
Government	444	240	684	0.914%
Industrial	23	41	64	0.085%
Residential	50,917	14,789	65,706	87.757%
Semi Commercial	1,560	434	1,994	2.663%
Total	**57,087**	**17,791**	**74,873**	**100%**

The tabulated data below illustrate the number of active accounts per meter size per classification for the month of July 2016.

[1]Source: Management Information Services Division – July 2016 Data

Table 2:Consumption per Capita[2]

Class	Meter Size	Active Service Connections	Disconnected Connections	Total Service Connections	%Total
Bulk	N/A	1	–	1	0.001%
Bulk - Commercial	N/A	–	2	2	0.003%
Commercial	11/2”	–	3	3	0.004%
	1”	101	46	147	0.196%
	1/2”	3,957	2,185	6,142	8.203%
	2”	28	20	48	0.064%
	3”	2	2	4	0.005%
	3/4”	49	29	78	0.104%
Government	1 1/2”	–	3	3	0.004%
	1”	41	40	81	0.108%
	1/2”	347	169	516	0.689%
	2”	23	21	44	0.059%
	3”	4	1	5	0.007%
	3/4”	28	5	33	0.044%
	4”	1	1	2	0.003%
Industrial	1”	1	4	5	0.007%
	1/2”	8	23	31	0.041%
	2”	11	8	19	0.025%
	3”	–	3	3	0.004%
	3/4”	2	2	4	0.005%
	4”	1	1	2	0.003%
Residential	1”	20	16	36	0.048%
	1/2”	50,855	14,740	65,595	87,608%
	2”	–	1	1	0.001%
	3/4”	39	23	62	0.083%
	3/8”	3	8	11	0.015%
	4”	–	1	1	0.001%
Semi Commercial	1”	4	4	8	0.011%
	1/2”	1,547	428	1,975	2.638%
	2”	2	–	2	0.003%
	3”	–	1	1	0.001%
	3/4”	7	1	8	0.011%
TOTAL		**57,082**	**17,791**	**74,873**	**100%**

The focus on water as a necessity for life obscures the fact that in present societies only a very small fraction of water consumption is used for drinking and for sustaining human life. A large proportion of water usage is for convenience, comfort, and aesthetics. The concern for determining the basic or minimum water requirement for a person to maintain good health and proper sanitation comes about in light of the current state of water resources and the growing scarcity vis-a-vis a rapidly rising population.

The growing problem of sustainability of current water use has become a matter of great importance. A review of water usage literature shows that while the absolute quantities vary, there is an observable pattern of use across sources, income levels, and locations. Depending on the type of technology used, consumption for a specific activity can differ greatly.

[2] Source: Management Information Services Division – July 2016 Data

Below is the average consumption data for the different classifications based onthe period of June 2011 to June 2016:

Table 3:Average Consumption Data[3]

Classification	Monthly Average Consumption
Residential	25.6 cubic meters
Semi-Commercial	43.9 cubic meters
Commercial	44.9 cubic meters
Industrial	566.9 cubic meters
Government – Local	167.0 cubic meters
Government – National	607.5 cubic meters
Overall Average per Connection	29.0 cubic meters

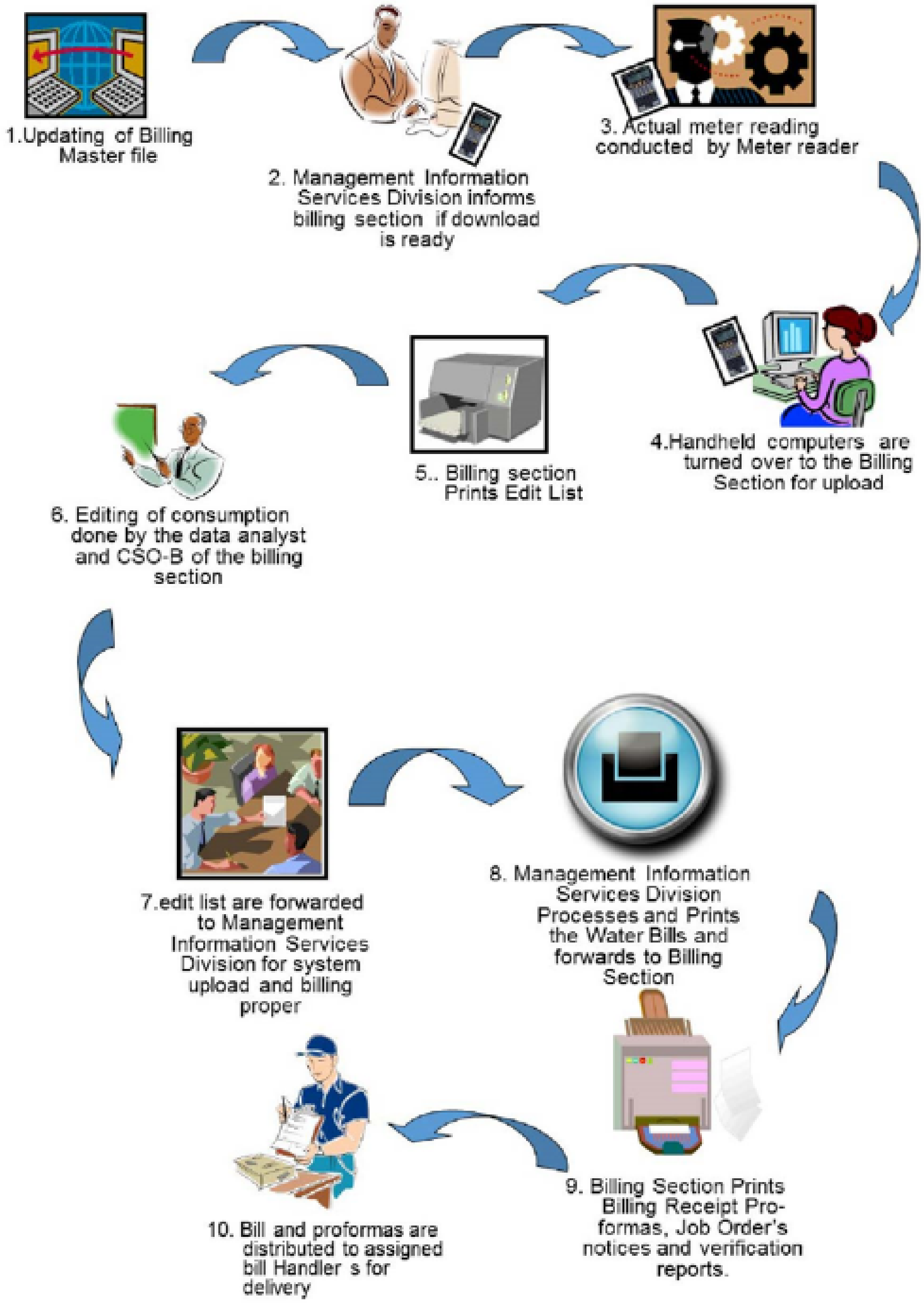
The data show that per capita consumption of a household of six family members based on Philippine Statistics Authority standard is 142.2 liters per day.

In Zamboanga City, ZCWD also provides water to secondary customers. Secondary customers are those that do not have a direct water connection with the water district. A secondary customer can purchase water directly from a primary water customer. Methods of delivery can take place by hose hook-up or water buckets.

METER READING AND BILLING MANAGEMENT SYSTEM

Meter readings on active accounts are conducted on a monthly basis with the use of Psion handheld computers and in accordance with the approved monthly schedule and routes per district metering areas/zone ID. This handheld equipment is turned over to the BS after reading activity is done. Contents are then uploaded to the database server for proper billing, editing, and downloading.

[3]Source: Billing Division and Management Information Services Division


1.Updating of Billing Master file
2. Management Information Services Division informs billing section if download is ready
3. Actual meter reading conducted by Meter reader
4.Handheld computers are turned over to the Billing Section for upload
5.. Billing section Prints Edit List
6. Editing of consumption done by the data analyst and CSO-B of the billing section
7.edit list are forwarded to Management Information Services Division for system upload and billing proper
8. Management Information Services Division Processes and Prints the Water Bills and forwards to Billing Section
9. Billing Section Prints Billing Receipt Pro-formas, Job Order's notices and verification reports.
10. Bill and proformas are distributed to assigned bill Handler s for delivery

Irregular billings and inconsistencies in the monthly consumptions are flagged by the Meter Reading Management System (MRMS) based on certain range brackets subjected to further assessment and editing.

All accounts that are flagged are temporarily redirected to the generated Edit List per zone ID after daily uploading into the MRMS. Determination of irregular billing is done by manually scrutinizing every account in the generated Edit List. The average consumption per classification previously mentioned cannot be utilized for these individual accounts.

Accounts with irregular consumption appearing in the generated Edit List with no known cause of inconsistencies are subjected to account verification through ocular and actual inspection by assigned bill handlers.

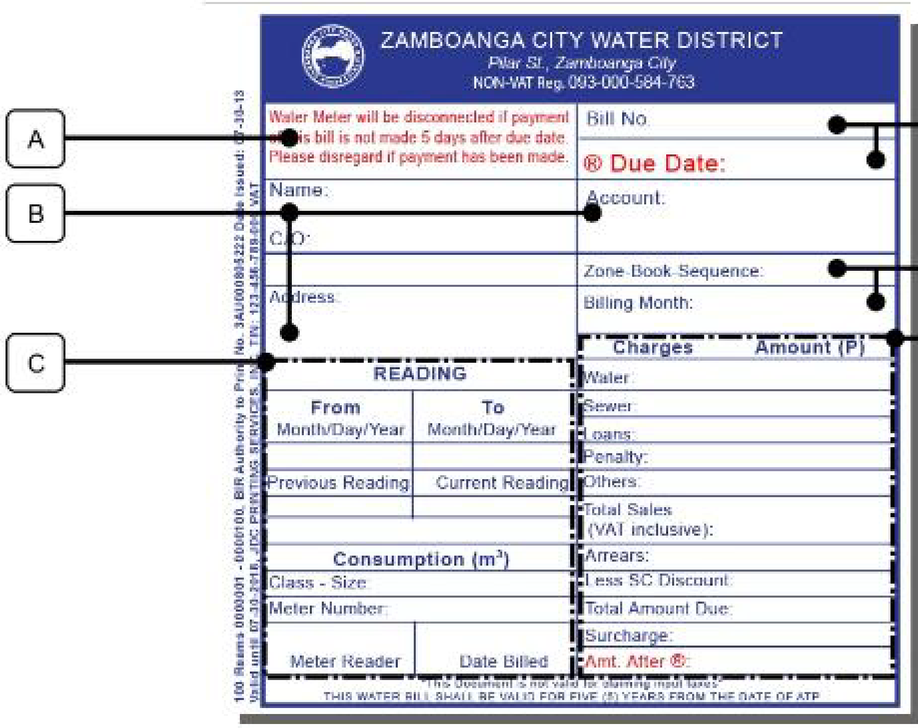
Moreover, accounts with irregular consumptions due to leak, air presence, and other inconsistencies in billing are adjusted pursuant to the amended Policy on Adjustment. Bill adjustment is done once a year per account.

STEP-BY-STEP PROCESS IN ADDRESSING CUSTOMER CONCERNS

1. Customer reports a concern.
2. Frontline Customer Service Officer (FCSO) interviews the customer and checks customer's record on database.
3. FCSO generates Job Order for Inspection.
4. FCSO informs customer of the scheduled inspection.
5. FCSO endorses the Job Order to field personnel for inspection.
6. Field personnel inspect on-site and submit findings.
7. FCSO calls customer to inform about the result of the inspection.
8. In the event the concern was posted before customer's billing due date, the inspection results in the following:
   a. with leak
   b. wrong reading
   c. water meter not functioning

   The FCSO then prepares an Adjustment Memo.
9. In the event the findings of the inspection are not in accordance with the customer's concern, customer is requested to proceed to cashier for payment.

How to Read the Water Bill



a. The disconnection policy reminder.
b. Basic customer for account identification, including the account number.
c. Billing details:Reading dates, meter readings, consumptions, meter number and size, date billed and meter reader.
d. Billing number used to identify the current monthly bill and the due date.
e. Customer's zone/book information and sequence number.
f. Details of current month's charges, including Senior Citizen's discount.

WATER METERS

Metering alone does not reduce water use, but it is one of the most important tools to measure and identify water use and leaks. Accurately measuring water use can help to identify and track areas for implementing water-efficiency measures. Metering for the purpose of billing users based on water consumed, as opposed to charging customers a flat rate regardless of consumption, has proven to be one of the most effective measures a water provider can implement.

It is important for a facility to understand how much water it uses. It is recommended that customers conduct regular meter readings as a method to monitor water use and establish baselines. By doing so, they can determine a pattern of water use based on seasonal fluctuations. Any significant changes should be cause for investigation as to the reason why. Regular meter readings will also help in monitoring water use and gauging water savings after implementing water-efficiency measures.

Some facilities have on-site wells and/or springs as a water source and do not pay for water. If a facility has multiple sources of water, source meters should be installed so that each can be tracked separately. The installation of water meters will enable the facility to establish a baseline and monitor its water use.

A water meter is a device used to record the amount of water that passes through a pipe from a water source, usually for billing purposes. Often, sewer or wastewater charges are also based on the water used. Aside from measuring the volume of water that passes through the water meter, it can also provide information if there is a leak in the plumbing system or in water-using processes, fixtures, appliances, and equipment.

Installing the correct meter type and size is critical to accurately measuring water usage. There are several different types and sizes of meters, each intended for different use. For example, an undersized meter can potentially cause undesirable pressure loss and reduced flow.

Meter sensitivity to slow water flows will vary greatly among the meter makes and models. As meters' age, they become less sensitive and their ability to detect small leaks can be affected. Inaccurate readings can occur as a result of a meter deteriorating, causing underreporting in actual water usage. Customers should contact their water agency if they have concerns regarding the accuracy of their water meter.

SUB-METERING

Water sub-meteringinvolves the installation of water meters in individual tenant spaces, or at specific end uses to determine the individual consumption and to help locate and isolate possible leaks. Sub-metering is one of the most important water-efficiency steps, particularly for commercial and industrial customers, as it can aid in the detection and location of abnormal water use. It helps in understanding where water use occurs and helps employees monitor discretionary use. Sub-metering also helps to detect leaks and determine when repairs are necessary, or where new water-efficient equipment is justified. In many commercial sites, there shouldbe sub-meters that measure specific areas, equipment, or processes. Common uses for sub-meters include: laundry equipment; cooling towers; kitchens; swimming pools; heating, ventilation, and air-conditioning (HVAC) systems; single-pass cooling systems; and outdoor irrigation. Sub-metering should also be installed for a facility that conducts on-site reclaim. In addition, sub-meters can provide facilities with cost savings by avoiding wastewater charges for water that does not go back to the wastewater treatment plant, since most discharge fees are often based on water consumption. For example, cooling tower evaporation water and irrigation water does not return to the treatment plant. It is important when conducting an audit to note the location of each meter and/or sub-meter, and to note what area or function is associated with the meter.

Many apartments, large buildings, and retail malls receive water through one "master" meter. Sub-metering tenant spaces can make each tenant accountable for their water use. It gives tenants a financial incentive to be responsible and to use water more efficiently. Studies have shown that customers who are metered use less water than those that are not. One of the obstacles in implementing sub-metering is the design of the older plumbing systems and the costs associated with modifications in order to accommodate the individual source pipe into each unit. Implementing national regulations that would require new apartments or individual tenant units within a new building to be plumbed for sub-meters should be considered.

METER BEST PRACTICES

- Meter all sources of water delivered to the facility.
- Install sub-meters in individual tenant spaces, large end uses, and processes.
- Choose the correct size and type of meter or sub-meter based on water usage.
- Properly maintain meters to ensure that they are working properly.
- Monitor and record water use by routinely conducting meter reads.

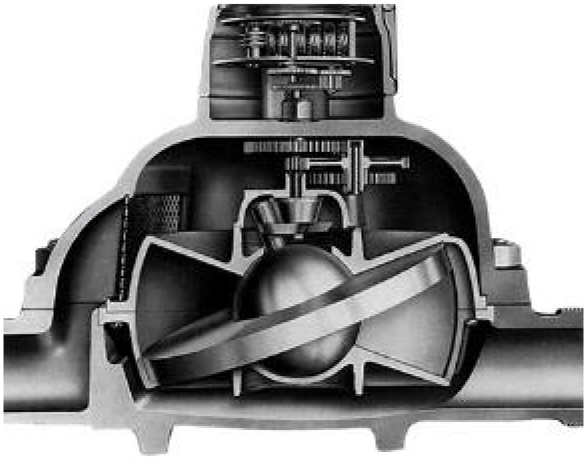
TYPES OF WATER METERS

I. Positive Displacement or Volumetric Meters

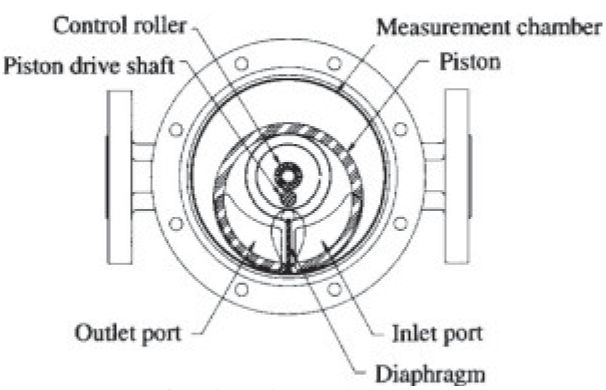
Positive displacement (PD) water meters measure how much water occupies a given space over a preset time. The water flow displaces the measuring device according to the volume of water. PD meters are generally very accurate at the low-to-moderate flow rates typical of residential and small commercial users, and commonly range in size from 5/8 inches to 2 inches. Because PD meters require that all water flows through the meter to "push" the measuring element, they generally are not practical in large commercial applications requiring high flow rates or low pressure loss. PD meters normally have a built-in strainer to protect the measuring element from rocks or other debris that could stop or break it. PD meters usually have bronze, brass, or plastic bodies with internal measuring chambers made of molded plastic and stainless steel.[4]

[4] Disclaimer: The products pictured in this toolkit are solely for informative and training purposes and should not be used for marketing. The Zamboanga City Water District (ZCWD) does not, in any way, advertise the products indicated, nor is it officially connected to the product manufacturers. Any use of the photos beyond the purpose of this toolkit is not legally bounded by ZCWD.

TWO COMMON TYPES OF PD METERS[5]



Nutating Disc



Rotary or Oscillating Piston

Either method relies on the water to physically displace the moving measuring element in direct proportion to the amount of water that passes through the meter. The piston or disk moves a magnet that drives the register.

[5] http://niagarameters.com/liquid-flow-measurement/

II. Velocity-Based Meters

A velocity-type meter measures the velocity of flow through a meter. The speed of the flow can then be converted into volume of flow to determine the usage. These meters can be calibrated to adjust the accuracy of their measurement.

TYPES OF METERS THAT MEASURE WATERVELOCITY

1. **Jet Meters**
   Single- and multi-jet meters are very accurate in small sizes and are commonly used in 5/8 to 2 inch sizes for residential and smaller commercial uses. The water flow turns an impeller that rotates at a known speed compared to the water speed. Multi-jet meters use multiple ports surrounding an internal chamber to create multiple jets of water against an impeller. The impeller rotation speed depends on the velocity of water flow. Multi-jets are very accurate at low flow rates.

2. **Turbine Meters**
   Turbine meters are less accurate than displacement and jet meters at low flow rates, but the measuring element does not occupy or severely restrict the entire path of flow. The flow direction is generally straight through the meter, allowing for higher flow rates and less pressure loss than displacement-type meters. They are not usually recommended for commercial, institutional, or residential buildings because the water flows are in constant fluctuation, with very low minimum flow rates. Turbine meters are generally available for 1-1/2 to 12 inch or larger pipe sizes and are normally used for high-volume industrial factories, large commercial complexes, fire protection, and master meters for distribution systems.

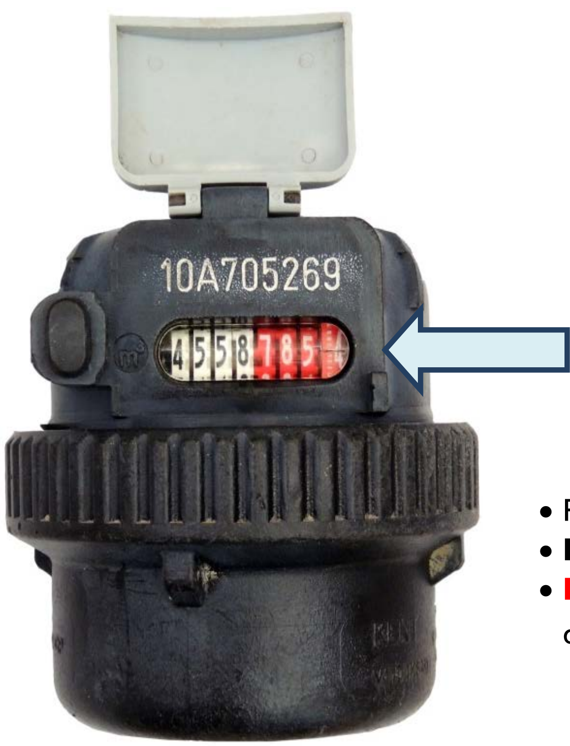
3. **Compound Meters**

A compound meter is used where high flow rates are necessary and at times when there are smaller rates of flow that need to be accurately measured. It is a combination of a main meter and a by-pass meter, where the main meter is used to measure high flows while the by-pass meter is used to measure low flows. Compound meters have two measuring elements and a check valve to regulate flow between them. At high flow rates, water is normally diverted primarily or completely to the turbine part of the meter. When flow rates drop to where the turbine meter cannot measure accurately, a check valve closes to divert water to a smaller meter that can accurately measure the lower flow rates. The low-flow meter is typically a multi-jet or PD meter. By adding the values registered by the high and low meters, the utility has a record of the total consumption of water flowing through the meter.

4. **Smart Meters or Advance Meter System**

A smart water meter measures water similarly to a standard meter, but it also has the ability to store and transmit consumption data. It can be read remotely at any given time by both the customer and the water provider. Not only does it measure water consumption, it also provides the date and time of consumption. As such, smart water meters are also known as "time of use" meters. Because of this, they can also make it easier to detect leaks. For example, if abnormal water use occurs during the evening when there normally might not be any activity, this would most likely be due to a leak. In addition, a smart meter can provide cost savings to the water provider because there will no longer be a need for a meter reader to go from site to site.

How to Read Water Meters



- Reading:**4558 m^3**
- **Black** number denotes cubic meters
- **Red** number and flow/leak indicators or test dials denote liters or fraction of a cubic meter

Reading:
6927.6785 cubic meters
or
6927 cubic meters and **678.5** liters

To read the remaining fraction of a cubic meter into liter:

.6785 cubic meters x 1,000 liters / 1 cubic meter

= **678.5** liters

Reading:
119.8582 cubic meters
or
119 cubic meters and **858.2** liters

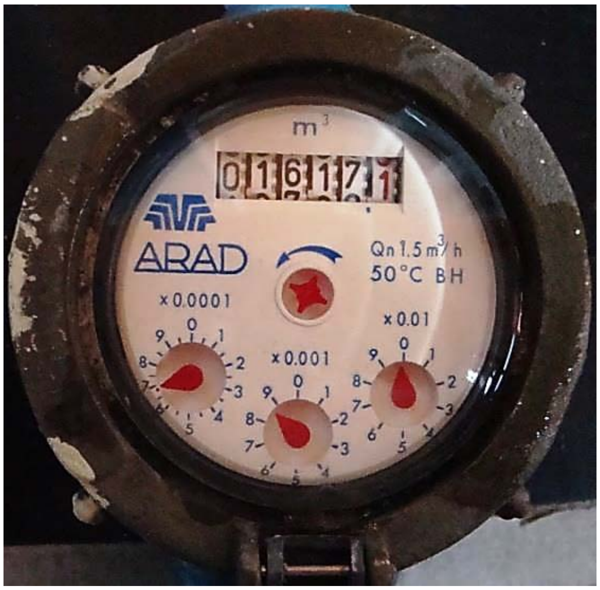
To read the remaining fraction of a cubic meter into liter:

.8582 cubic meters x 1,000 liters / 1 cubic meter

= **858.2** liters

Reading Previous Versus Current Meters in Cubic Meters

Previous



Current

Previous Reading:
1,617 cubic meters

Current Reading:
1,771 cubic meters

Consumption for the month = Current Reading – Previous Reading

= 1,771 cubic meters – 1,617 cubic meters

= **154** cubic meters

SECTION IV. COMMERCIAL FIXTURES, APPLIANCES, AND EQUIPMENT

This section describes how commercial fixtures, appliances, and equipment work, how much water they typically use, and their applications. It also describes how to measure water use and savings from each. Best practices are provided for each fixture, appliance, or equipment.

Table 4:Fixtures and Appliances Water-Efficiency Standards

Fixture, Fitting, Appliance	Maximum Water Use
Water Closets (toilets)	1.28 gal (4.8 L) per flush
Urinals	0.5 gal (1.9 L) per flush
Public Lavatory Faucets	0.5 gpm (1.9 L/min)
Private Lavatory Faucets	1.5 gpm (5.7 L/min)
Public Metering Self-closing Faucet (sensor, metered/timed)	0.25 gal (1.0 L) per metering cycle
Kitchen Faucet	2.2 gpm (8.3 L/min)
Showerheads	2.0 gpm (7.6 L/min)
Clothes Washers	Water factor of 4.0 gal/ft^3 of drum capacity normal cycle (0.53 L/L of drum capacity normal cycle)
Dipper Well	1 gpm (3.8 L/min)
Pre-rinse Spray Valve	1.6 gpm (6.0 L/min)
Food Steamers	2 gal (7.6 L) per tray per hr
Ice Makers	20 gal per 100 lbs of ice

Table 5:Water-Efficient Technology Opportunities for Commercial End Uses

Commercial End Uses	Water-Efficient Technology Opportunities
Bathroom	
Toilet	4.8 liters per flush (LPF); 3/6 LPF dual flush
Urinal	1.9 LPF or waterless
Faucets – Aerators	1.9 liters per minute (LPM) public; 1.0 L *per metering cycle self-closing faucet* 5.7 LPM private bathrooms (residence, hotel room, hospital patient room)
Showerheads	7.6 LPM
Kitchen	
Faucets – Aerators	8.3 LPM
Pre-rinse spray valves	6.0 LPM
Dishwashers	Water-efficient models and automatic shutoff
Ice makers	Air-cooled efficient model

Commercial End Uses	Water-Efficient Technology Opportunities
Food steamers	Connectionless steamer
Combi ovens	Connectionless oven with self-contained water reservoir
Wok stoves	Air-cooled efficient model
Dipper wells	3.8 LPM, automatic shutoff
Food disposal	Strainer, automatic shutoff
Laundry	
Washing machine	Horizontal axis washing machine; continuous batch washer; wash or rinse water recycle/reuse; automatic shutoff
Sanitation	
Indoor/outdoor cleaning	Dry cleaning methods; automatic shutoff valves
Equipment washing	Wastewater reuse
Landscaping	
Spraying	Rainfall sensors; automatic timers
Planting	Replace grass; drought-tolerant plants
Decorative water items	Recycle; reuse of water

END- USE PARAMETERS

There are a multitude of end use studies conducted in various countries during different time periods. Listed below are some ranges from various end use studies. Also listed are the parameters for what we are currently using in this toolkit for the purposes of estimating water use and calculating savings. The lower daily per capita use based on those various studies could be attributed to countries that have been implementing water conservation programs for some time and have local codes and standards for limiting water use of fixtures and appliances. The parameters that we are currently using should be adjusted based on local conditions as data become available.

Table 6:End-Use Parameters

	Various Studies	Used in this Toolkit
Toilet flushes/person/day (Residential)	4 – 7 flushes/person/day	6 flushes/person/day
Shower minutes/person	5 – 15 minutes	10 minutes
Bathroom faucet minutes/person/day (Residential)	.50 – 3.0 minutes	3.0 minutes
Kitchen faucet minutes/person/day (Residential)	.50 – 5.0 minutes	5.0 minutes
Toilet flushes/person/day (Non-residential full time employee)	3.0	1 every 2.5 hours

	Various Studies	Used in this Toolkit
Bathroom faucet minutes/person/bathroom use (Non-residential)	15 seconds – 1 minute Per use	.20 seconds per toilet flush
Urinal flushes (if urinals are available for use)	2 out of 3 flushes	2 out of 3 flushes

BATHROOMS

SHOWERHEADS

Replacing high-flow showerheads can be one of the most cost-effective retrofits a facility can make. In addition to saving water, it can also save on energy cost from the heated water. Older showerheads can emit anywhere from 9.5 to 30 liters per minute (LPM), while water-efficient showerheads use 7.6 LPM. Water-efficient showerheads are economical, easy to install, and designed for customer satisfaction. Water savings can only be achieved if the new showerhead is retained and not altered so that it provides a higher flow rate. As such, it is especially important to choose a replacement showerhead that is known to have a high level of user satisfaction. In addition to water flow, new water-efficient showerhead designs also take into consideration spray pattern, water velocity, and temperature gradient. These factors ensure that the showerhead provides sufficient coverage to wet the body, has strong enough velocity to properly wash and rinse, and has a temperature that is constant throughout the spray so that the bottom half of the spray is not cold. Avoid retrofitting old showerheads with flow restrictors or flow control valves. Such restrictors normally result in user dissatisfaction due to performance and can easily be removed or adjusted.

Showers with automatic/timed shutoff systems automatically cut the water flow once a predetermined amount of water has been used and requires user input to re-activate the water flow. These systems are particularly well-suited for schools and sports facilities.

SHOWERHEAD BEST PRACTICES

- Replace showerheads with water-efficient showerheads using 7.6 LPM or less.
- Take a shorter shower of 5-8 minutes, not to exceed a maximum of 10 minutes.
- Use a bucket to capture the water while waiting for the shower water to heat. This water can be used for other tasks, such as laundry or watering plants.
- Check for leaks on a regular basis and ensure that users know to report leaks when they occur.
- Periodically clean showerheads.

Showerheads are prone to clogs and scale in hard water conditions, thus decreasing the efficiency of the showerhead flow. In this case, regularly clean and unclog the showerhead:

1. Remove showerhead
2. Rinse out sediment

3. Soak in vinegar for 1 to 2 hours
4. Rinse and re-install

Or – tie a plastic bag filled with vinegar around the showerhead

HOW TO MEASURE SHOWERHEAD FLOW RATE

Note:The margin of error increases with less time a flow is measured; flow rates can be measured up to 15 seconds (sec) and require at least a 2 liter (L) pitcher.


IWATER AUDITOR MEASURING THE SHOWERHEAD FLOW RATE

Showerhead flow tested for 5 seconds:

1. Turn on shower to full volume (both cold and hot water)
2. Using a stop watch, measure with a graduated measuring device (2L +) under flow of water

Volume of water in 5 seconds: 900 milliliters (ml)
= 900 ml x (60 sec / 5 sec)
= 10,800 ml per minute (min)
= 10,800 ml/1,000 = 10.8 LPM

Water-Efficient Showerhead: 7.6 L/min

HOW TO CALCULATE SHOWER WATER USAGE

Based on average 10 minutes per shower:

1. Measure showerhead flow
2. LPM x 10 min = existing L/shower
3. Existing L/shower – 76 L/retrofit shower = L savings/shower
4. Savings/shower x showering frequency = L savings

Example:
Existing shower 108 L/shower – 76 L = 32 L savings/shower
7 showers/week = 971 L/month savings

Note:Make sure that all faucets and showerheads tested are completely shut off when you are done.Be sure to carefully wipe the area around the shower or tub when you are done testing the flow rate. If there is a bucket in the tub or shower, save the water used from the flow rate test.

BATHROOM FAUCETS

Water-efficient bathroom faucets restrict flow from 1.9 to 5.7 LPM depending on use. Private bathroom faucets, including hotel guest rooms, dormitory rooms, and hospital rooms, have a water-efficient standard of 5.7 LPM. This is higher than the 1.9 LPM water-efficient standard for public bathroom faucets. It is assumed that a public bathroom faucet is used primarily for washing hands after use of the toilet, while a private bathroom faucet allows for other tasks, such as teeth brushing, shaving, and face washing. Older bathroom faucets can use anywhere between 8.3 and 26 LPM, compared to water-efficient faucets, which can significantly reduce the water flow without sacrificing performance.

Public metered faucets allow flow when a spring is pressed, as the valve opens until the spring returns to its original location. Sensor-activated metered faucets operate the same way, set to remain open for a certain time. The flow rate can be measured based on how long the faucet is running per activation cycle. Based on the water efficiency standards, a metered faucet should not exceed 1.0 liters per activation cycle. As with all fixtures, flow rates and amount of cycle time can change as the valve or aerators degrade over time.

It is not recommended to replace mechanical metering valves with infrared sensor type valves. There is no scientific evidence that sensor-activated faucets save water. Multiple studies have shown that sensor faucets result in greater water use compared to manually activated faucets. While sensor-activated faucets provide user convenience, they are also known to be potential water wasters.

If replacing a water-wasting faucet is not practical, at minimum, retrofit the faucet with an aerator. As with all fixtures, flow rates can change as valves or aerators degrade over time.

BATHROOM FAUCET BEST PRACTICES

- Install faucet aerators to reduce the bathroom faucet flow to 1.9 to 5.7 LPM, depending on use.
- Turn off the faucet while lathering hands, brushing teeth, and shaving. Do not leave the water running continuously.
- Check for leaks on a regular basis and repair immediately.

HOW TO MEASURE BATHROOM FAUCET FLOW RATE

Note:The margin of error increases with less time a flow is measured; flow rates can be measured up to 15 seconds and would require at least a 1 L pitcher.Some bathroom faucets may not facilitate using a measuring device larger than 1 L.

Bathroom faucet tested for 5 seconds:

- Turn on faucet to full volume (both cold and hot water)
- Using a stopwatch, measure with a graduated measuring device (2L +) under flow of water

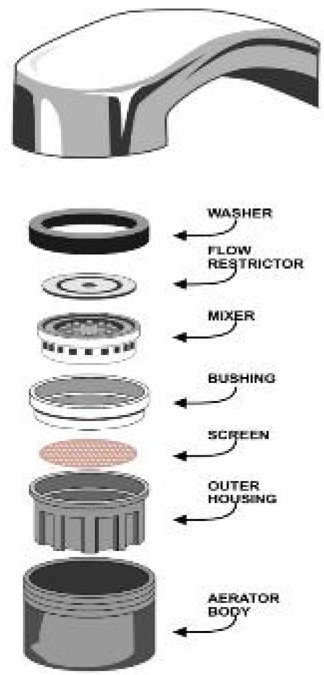
Volume of water gathered in 5 seconds: 700 ml
= 700 ml x (60 seconds / 5 seconds)
= 8400 ml/min
= 8400 ml/1,000 = 8.4 LPM
Water-Efficient Faucet Private Bathroom = 5.7 LPM or less
Water-Efficient Faucet Public Bathroom = 1.9 LPM

HOW TO MEASURE A METERED FAUCET

1. Place measuring device under faucet.
2. Press down on handle or activate sensor.
3. Measure the volume captured, which should not exceed 1.0 liters per activation cycle.

Flow-gauge bags that automatically provide the flow rate conversion are also available for purchase. They are plastic bags that measure the rate of flow in LPM.

AERATORS



Aerators save water by reducing the flow rate and splash while increasing effectiveness. An aerator reduces volume while increasing velocity by adding air to the water. The aeration also increases the water's scrubbing action. Having a screen is not an indication that it is a water-efficient aerator. The screen is meant to prevent sediment from entering the water flowing out. It is recommended that the screen, which can be easily removed, be cleaned on a regular basis. Aerators are available in a wide range of water-efficient flow rates from 1.3 to 8.3 LPM. Special pressure-compensating aerators are also available, as well as adapters for faucets that are not threaded on either the inside or outside. Aerators for kitchen faucets are available with a variety of spray patterns and flow-control features.

Retrofitting faucets with aerators is one of the most common conservation strategies and is relatively inexpensive. The water savings are small when compared to replacing toilets, but the cost toretrofit is minor, making it a very cost-effective option.

Projected savings are usually calculated based on usage frequencies similar to toilet and urinal use. For public handwashing faucets, flow durations are often estimated to average 5 to 30 seconds per use for every toilet/urinal flush. Private bathroom usage is calculated at 3 minutes/person/day.

TOILETS

TYPES OF TOILETS AND HOW THEY WORK

Gravity tank toilets are the most common type of toilet installed. They operate when the handle is pulled, causing the flush (flapper) valve at the bottom of the tank to open and start releasing water from the tank into the bowl. The weight of this water, which is pressured by gravity because the tank is above the bowl, causes the water to rush out of the tank and into the bowl. It is either released through rim holes at the top of the bowl, a siphon hole, or both. The rushing water creates a vacuum or siphon that pulls solid and liquid waste from the bowl into the trapway (outlet) and into the sewer drain. As the bowl is emptied, the flapper valve inside the tank closes to create a seal, and the ballcock auto fill valve is tripped to allow water to refill the tank. Gravity toilets usually require 10 to 15 psi of water pressure to work properly. Most low-volume toilets have smaller tanks, steeper bowls, a redesigned flapper, and a ballcock valve. High-efficiency toilets (HETs) use 4.8 liters per flush (LPF); most are composed of two pieces, but some are one-piece (usually more expensive), with a smaller tank and lower to the floor. It is important to note that simply replacing the toilet tank will not make it a water-efficient toilet. Water-efficient toilets are designed to function properly with matching tanks and bowls. Consult manufacturer specifications to determine if the tank and bowl match.


TOILET WITH HANDHELD BIDET SPRAYER


TOILET WITH LEAK AFTER DYE TEST

Dual flush toilets have two buttons or handles that flush at different water levels depending on the function. Low-volume flushes for liquid waste are only 3.0 LPF or less, and solid waste flushes are 6.0 LPF or less. If the low-volume flush is used for solid waste, they can clog or require double flushing. They are reliable when used properly. It is important to have signs posted to instruct users, particularly children, on how to use them correctly. Most often, people who are not familiar with them flush the wrong button or double flush. Dual flush toilets are generally not recommended in heavy use commercial settings.


1ST FLOOR REST ROOM – ZCWD MAIN


JOLLIBEE PILAR STREET

Flush-o-meter (FOM) valve toilets are tankless fixtures consisting of a wall- or floor-mounted bowl and a FOM valve operated by a hand lever or activated sensor. FOMs are common in offices and high-traffic commercial operations, operating on the principle of using pressurized water from the supply pipe. Wall-mounted FOM valve toilets are most commonly found in new buildings, while floor-mounted toilets are more common in older buildings.

There are two common types of flush valves, a diaphragm and a piston valve. The diaphragm and piston valves differ in both design and function, with the diaphragm being the more popular. It is designed for clean water applications and is simple to operate and care for. Diaphragm flush valves are usually the right choice for the average commercial restroom. While typically more expensive, a piston valve is designed for special environmental conditions and the ability to handle low pressure and weak system situations. Piston valves generally require less maintenance, offer more precise performance, and can last longer.

MANUALLY ACTIVATED FOM VALVE TOILET

SENSOR ACTIVATED FOM VALVE TOILET

When selecting and installing a FOM, it is important to consider the type of restroom traffic, water quality, and operating conditions. For example, in a high-traffic restroom, the diaphragm valve can accommodate the quick recovery needed to flush again. However, poor water quality or corrosive water can also compromise performance and reliability.

Diaphragm and piston FOMs fundamentally operate the same way, as each has an upper control chamber and a lower chamber connected by a bypass. The bypass connecting the upper control and lower supply chamber in both of the valves is a small hole or orifice.

In a diaphragm valve, a flexible rubber disk or diaphragm separates the upper and lower chambers. When the toilet is flushed, the relief valve is tilted. This creates a pressure imbalance in the valve that allows the diaphragm gasket to flex, thereby moving the water at a consistent flow rate through the valve and into the bowl. Immediately after the flush, water fills the upper valve chamber through the diaphragm's bypass orifice, which is a small hole in the gasket. As water enters the bypass orifice, the water pressure differential between the upper and lower chambers pushes the diaphragm back into place. This seals the valve and shuts off the water flow. A dirty or worn gasket may not seal properly and should be replaced. If the water pressure is not sufficient, the diaphragm may not fully seal. This can cause the valve to remain open, resulting in continuous water flow.The diaphragm within the valve is preset to flush with a set amount of water and removes waste for a few seconds before it creates a water seal, refilling the bowl. FOMs with diaphragm valves require water pressure to be between 30 and 80 psi to operate properly.

In a piston valve, a plastic or brass contoured cup bordered with a narrow rubber lip seal separates the upper from the lower chambers. When the toilet is flushed, the relief valve is tilted. This creates a lower pressure in the upper chamber, which causes the contoured cup (acting as a piston) to rise, and allows water to flow quickly from the inlet pipe, under the piston, and into the bowl. Immediately after the flush, a small water stream flows through a bypass orifice in the piston to restore water and pressure to the upper valve chamber. This return of pressure subsequently pushes the piston assembly down to shut off the water flow. A piston valve may contain a debris screen that may help to limit clogging in the bypass orifice. However, the piston can leak water through the relief valve and may not seal properly if the rubber seal is worn. The piston valve remains closed under conditions of low water pressure. Piston valve FOMs require water pressure to be between 15 and 80 psi to operate properly.

Caveat: Do not assume that a FOM toilet will properly perform and be water-efficient just by replacing the flush valve without replacing the bowl, or vice versa. The bowls are manufactured and tested to perform with a matching flush valve. In most instances, both the bowl and the flush valve must be replaced to assure water savings and adequate flushing performance. This can be problematic, especially when the bowl or flush valve does not indicate a flush volume. Consult manufacturer specifications to determine whether the valve and bowl are compatible in order for them to perform properly and to assure water savings.

Pressure assist tank(pressurized) toilets are used in residential and light commercial settings. The toilet looks just like a gravity tank toilet, except for a pressurized plastic vessel that holds the water for flushing. Compressed air forces the water out of the tank and into the bowl, inducing siphonic action that pushes the contents of the bowl. Pressurized toilets can clear the bowl much quicker than a standard gravity tank toilet. These toilets are usually more expensive than gravity tank toilets, and for that reason are not very common.

Flapperless gravity tank toilets are less prone tohidden leakage and provide reliable flow rates because they are more difficult to adjust and require less maintenance. Disadvantages of this type of toilet are: limited durability, noisier operation, and potential backflow problems.

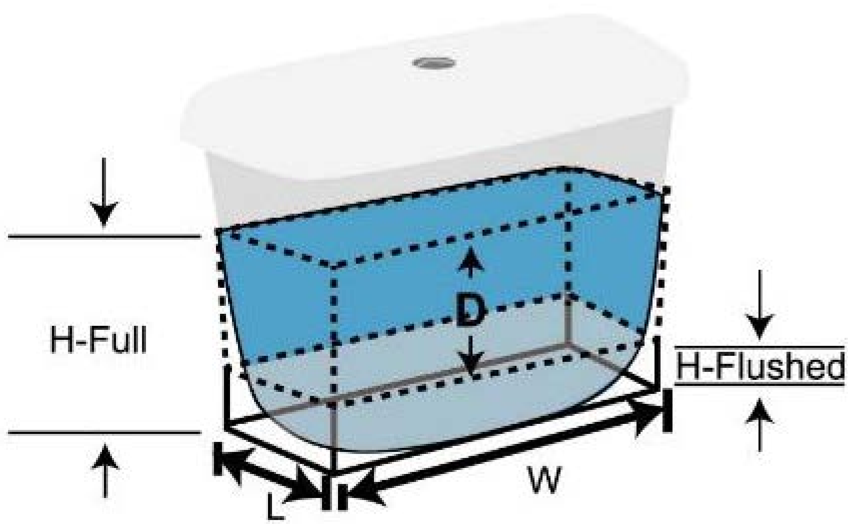
Automatic flushing sensor toilets are commonly found in commercial restrooms and used for FOM valve toilets or urinals primarily for customer convenience and to reduce the spread of germs. Automatic flushing sensors do not always save water and often waste water when the sensor is incorrectly working and causes multiple flushing. Due to this, automatic flushing sensor toilets are not recommended.

HOW TO MEASURE TOILET FLUSH VOLUME

1. Measure inside of tank: length x width x depth of water
2. Flush toilet; after water leaves the tank into the bowl, immediately measure the water remaining in the tank before the tank starts refilling
3. Subtract the remaining water from the initial depth of water for net depth
4. Length x width x net depth = flush volume

Important: Do not hold the handle down. Instead, press down and immediately release to begin flush.

Example: 58 cm x 20 cm x 14 cm = 16,240 cm^3 / 1,000 = 16.24 LPF



Note: Use caution when removing the lid of a toilet in order to measure the flush volume. Toilets are made of vitreous china and can crack or break easily just like glass. Always place the lid on the floor, never on the toilet bowl or the side of a tub.

Testing for flush rates can also be conducted by reading the meter while *all* other water-using fixtures are inactive.

HOW TO MEASURE FOM TOILET FLUSH VOLUME

Liters per flush (LPF) is based on how long it takes to complete the flush, measured in seconds (when the valve is open until it closes, as indicated by the sound of the valve stopping, water flushing out of the bowl, and/or water ceasing to enter the bowl). Important: Do not hold the handle down. Instead, press down and immediately release to begin flush.

FOM toilet flush rate approximately = 1.6 L/second (sec)

Number of seconds x 1.6 L/sec = _____ LPF for FOM toilets
Example: 3 seconds x 1.6 L/sec = 4.8 LPF

TOILET WATER USAGE

Water savings can be achieved by replacing older-model toilets with new HETs using 4.8 LPF. Older toilet models can range from 6 to 26 LPF, with an ultra-low-flow toilet (ULFT) using 6 LPF and a low-flow toilet (LFT) using 13 LPF. Toilet water savings can vary depending on the frequency of toilet flushes. In addition, savings can vary depending on the type of facility. For the purpose of calculating water usage, taking into account various shifts and visitors, it is reasonable to assume that each person flushes every 2.5 hours. When conducting water savings and cost analysis, it is important to separate the calculations for women's toilet use versus men's toilet use, because men will most often use urinals (when available) rather than toilets. Every facility is unique in its flushing frequency. While it is reasonable to use average toilet usage estimates for program planning, performing toilet retrofit projections on individual facilities requires calculations based on unique site data.

It is important to note that water consumption by toilets and urinals should *not* be based upon the number of fixtures installed in the building, but rather upon number of personnel occupying or visiting the building and the total hours they are on-site. After conducting the audit and calculating toilet usage, it may show, for example, that due to more women on-site at a facility, it would be beneficial to replace the toilets in the women's restrooms prior to replacing the men's toilets and urinals.

Note: If toilets are already functioning at 6 LFP, water savings can still be achieved; however, it may not be cost-effective to replace them with a 4.8 LPF toilet.

COMMERCIAL TOILET BEST PRACTICES

- Replace older water-wasting toilets with HETs. If this is not practical, install a temporary toilet displacement device.
- Periodically check and repair leaks.
- Educate users on proper toilet use and maintenance.
- Educate users if flushing trash is an issue. Water-efficient toilets cannot be used as trashcans. Excessive paper (toilet paper, disposable seat covers, and paper towels) are the most common causes of clogged toilets.
- Train users to report continuously flushing, leaking, or otherwise improperly operating toilets to the appropriate personnel.
- Provide signs for dual flush toilets instructing the user on how to properly use the toilet.

For Tank-Type Toilets

- Periodically check to ensure that fill valves are working properly and the water level is set correctly. Remove the toilet tank and check to see if water is flowing over the top of the overflow tube inside the tank. Ensure that the refill water level is set below the top of the overflow tube. Adjust the float lower if the water level is too high. If the toilet continues to run after the float is adjusted, replace the fill valve.
- Annually test toilets to ensure that the flappers are not worn or allowing water to seep from the tank into the bowl and down the sewer. Conduct a dye test to see if the toilet is leaking. If there is a leak, check for a tangled chain in the tank or replace a worn flapper valve. If leaking does not subside after a flapper valve is replaced, consider replacing the flapper seat.

For FOM Toilets

- Inspect valves and replace any worn parts at minimum on an annual basis.
- If replacing valve inserts, confirm that the replacements are consistent with the valve and existing bowl according to the manufacturer specifications, including the rated flush volume. If replacing the entire valve, ensure that it has a rated flush volume consistent with manufacturer specifications for the existing bowl.
- Upon installation of a FOM toilet, adjust the flush volume in accordance with manufacturer instructions to ensure optimum operation for the facility's specific conditions.
- If automatic sensors are present, make sure they are adjusted properly to ensure proper settings and operation and avoid double or phantom flushing. Alternatively, remove sensor systems and replace with manually activated flush valves, which are shown to significantly reduce water consumption of the toilet.

Other Considerations when Retrofitting Toilets

- Replace the most frequently used toilets first; this will provide the quickest payback.
- Carefully choose toilet type depending on use level and the potential for misuse.
- Make sure the building's water pressure is adequate if switching from a gravity toilet to a FOM toilet.
- More expensive toilets will not necessarily mean better performance.

WATER DISPLACEMENT DEVICES

A water displacement device is designed to reduce the amount of water available in the tank for completing the flush. There are various types of water displacement devices, such as a toilet "dam" or displacement object (a bag, brick, plastic soda bottle, or other item intended to displace a quantity of water in the tank). Displacement products should be used ONLY in toilets with a rated flush volume of 13 LPF or higher. Use of a displacement device in lower-volume toilets could potentially affect the flush performance of the fixture and may result in double flushing, thus increasing water consumption. Displacement products are not meant to be a long-termsolution for saving water. It is preferred that the entire toilet be replaced with a water-efficient toilet. Displacement devices should be installed without interfering with the flushing mechanism. They should also be checked regularly to see if they require adjustment.

HOW TO DETERMINE THE VOLUME OF DISPLACEMENT SAVINGS

Determine flushes per day

Example: 1 L displacement x 18 flushes/day = 540 L saved per month

URINALS

TYPES OF URINALS AND HOW THEY WORK

Urinal water use can range anywhere from water wasting of 0 to 15 LPF depending on the type, and can even have a constant flow.

Washout/washdown urinals operate when water runs down the rim holes and washes the back wall, flooding the sump (bowl area) and creating a water exchange exiting through the trap. This process is similar to a dilution process. Washout urinals require the activation of a FOM valve and are intended to remove liquid waste only.

Siphonic jet urinals have an elevated flush tank and operate by using a siphon device to automatically empty the tank's contents when the water level reaches a certain height. The siphon device creates a siphon action to empty the trap. The flushing action will remove solid material that other urinals cannot, which makes them very effective in high-use public facilities. Water is constantly running with this type of urinal.

Blowout valve urinals operate similarly to siphonic jet urinals in that they also have an elevated flush tank. However, in contrast, they rely on a hydraulic flushing mechanism similar to FOM toilets to regularly empty the tank's contents and flush waste out of the urinal. This is the most aggressive flush, and as a result, the noisiest. With this method, the entire amount of liquid is displaced when flushed. These urinals are often found in heavy-use public facilities, such as airports, stadiums, and prisons.

TROUGH URINAL

Trough urinals can accommodate multiple users. Older models continuously run water to flush the urinal. They are not water-efficient and should be replaced. Newer trough models may have a preset timed FOM valve or an automatic sensor for flushing.

WATERLESS URINAL

Waterless urinals require no water for flushing and can often replace conventional urinals connected to a standard 2-inch drain line. Waterless urinals use no water, but some require a trap seal liquid that must be replenished after a certain amount of use. Trap replacement cartridges need to be replaced periodically. Waterless urinals require different maintenance than flush urinals, and it is crucial that maintenance workers be instructed on how to replace the trap seal when necessary. Additional benefits of a waterless urinal include no risk of overflow and fewer valverepairs. When calculating water cost savings with replacement of waterless urinals, it is important to consider the cost of any additional materials or labor needed to maintain a waterless urinal.

HOW TO MEASURE FOM URINAL FOR FLUSH VOLUME

LPF is based on how long it takes to complete the flush, measured in seconds (when the valve is open until it closes, as indicated by the sound of the valve stopping, water flushing out of the bowl, and/or water ceasing to enter the bowl). Important: Do not hold the handle down. Instead, press down and immediately release to begin flush.

FOM urinals flush rate approximately = .95 L/sec
Number of sec x .95 L/sec = _____ LPF for FOM urinals
Example: 2 sec x .95 L/sec = 1.9 LPF

URINAL WATER USAGE

It is reasonable to assume one flush per person every 2.5 hours. If urinals are available, men will use them for approximately two out of three of their flushes. Sensor-activated valves may greatly increase the quantity of flushes.

WATER-EFFICIENT URINALS

Depending on the type, there are several options for urinal retrofits and replacements: the urinal may be replaced; the FOM valve and fixture may be replaced with a 1.9 LPF high-efficiency urinal (HEU); or the model may be replaced with a waterless urinal. It is important that the proper FOM valves are matched with the proper urinal fixture. If an incorrect valve is installed, it can result in higher water use per flush. As such, it cannot be assumed that the urinal is flushing according to the LPF marking shown on the valve. A flush volume test should be conducted to validate the LPF markings. In some cases, marginal water savings can be achieved by retrofitting the urinal FOM valve with a lower LPF diaphragm, though many older urinals, including siphonic jet urinals, will not function properly at these reduced flows. Unfortunately, this type of retrofit can easily and mistakenly be reverted to the higher flush volume during routine maintenance; thus, a "partial" measure is not recommended. To ensure that water savings are sustained over time, the best strategy is to replace the entire urinal and flush valve with a HEU. Careful consideration should be given to determine the best type of retrofit or replacement of urinals. Consult manufacturer specifications.

In order for high-volume urinals (like siphonic, blowout, and trough urinals) to be HEUs, they require removal of the old fixture and flushing apparatus with installation of a whole new water-efficient fixture and valve.

URINAL BEST PRACTICES

- At least annually (or more often, depending on volume of use), inspect the FOM diaphragm or piston valves and replace any worn parts. If replacing valve inserts, verify that the replacements are consistent with the manufacturer specifications, including the rated flush volume.
- If replacing the entire valve, ensure that it has a rated flush volume consistent with manufacturer specifications for the urinal fixture itself.

- Annually check and adjust automatic sensors, if installed, to ensure that they are operating properly to avoid double or phantom flushing. Sensor-activated flush mechanisms often result in more frequent urinal flushing than manual flush valves.
- Flushing urinals equipped with automatic flush sensors will often have an override switch, allowing maintenance personnel or users to activate the flush manually. Activating the override switch may release a larger volume of water than is typical for the standard flush. Train maintenance personnel on how to clean and maintain urinals with automatic flush sensors to ensure that the urinal is returned to its intended flush volume after maintenance operations are completed.
- Train users to report continuously flushing, leaking, or otherwise improperly operating urinals to the appropriate management or maintenance personnel.
- Prior to installing waterless urinals, it is important to contact local authorities having jurisdiction over plumbing codes to ensure that it is not prevented by code.

KITCHENS

Commercial kitchens require a significant amount of water to operate. As such, they are one of the largest water-using segments in the commercial sector. Inefficient uses of water in a kitchen operation are mostly due to equipment design and behavioral patterns. There are many water-saving opportunities in a kitchen, ranging from simply retrofitting faucets with aerators to replacement of appliances and equipment with water-efficient models. Replacing fixtures, appliances, and equipment will also garner energy costs saved from using less-heated water.

KITCHEN FAUCETS

Faucets can waste large amounts of water and are often the most heavily used water source in a kitchen. Many faucets are older fixtures with rubber gaskets that wear easily due to high hot water use. A water-efficient kitchen faucet restricts flow to a maximum of 8.3 LPM. Older kitchen faucet flows range from 11 to 26 LPM. Most faucets can be easily retrofitted with a water-efficient aerator designed specifically for kitchen use with a variety of spray patterns and flow-control features.

Higher-flow faucets are needed in kitchens for filling pots, while some faucets are used mostly for handwashing and dishwashing, requiring less volume of water. Many kitchen faucet uses are not discretionary. Regardless of the flow rate, the volume of water needed is still the same. If a faucet is used for the purpose of filling pots or buckets, most often kitchen staff will remove the faucet aerator to ensure that the tasks of filling a container for water takes less time. To ensure that this does not happen, it would be appropriate to have a faucet that is specific to the task it is used for. If the sink is frequently used to fill buckets with water, it may make sense to use a higher-flow aerator. If the utility sink is mostly used for handwashing or cleaning, a lower flow rate will most likely suffice.

KITCHEN FAUCET BEST PRACTICES

- Regularly check for leaks and repair immediately.
- Retrofit faucets with the appropriate water-efficient aerator.
- Adjust the flow valves to the faucet. Keep in mind this modification can also be easily modified by users.

- Do not let water run when washing dishes. Fill a basin with soap water to clean dishes and another with water to rinse.
- Do not thaw frozen food under running water. Thaw it in the refrigerator overnight or in a microwave.
- Wash fruit and vegetables in a basin instead of under running water.
- Avoid using a food disposal grinder that requires running water from the faucet to operate. Instead, hand scrape the dishes prior to washing.

HOW TO MEASURE KITCHEN FAUCET FLOW

Note: The margin of error increases with less time a flow is measured; flow rates can be measured up to 15 seconds and would require at least a 2 L pitcher.

Kitchen faucet tested for 5 seconds:
Bathroom faucet tested for 5 seconds:

1. Turn on faucet to full volume (both cold
2. and hot water)
3. Using a stopwatch, measure with a graduated measuring device (2L +) under flow of water

Volume of water gathered in 5 seconds: 800 ml
= 800 ml x (60 seconds / 5 seconds)
= 9,600 ml/min
9,600 ml/1,000 = 9.6 LPM

Water-Efficient Kitchen Faucet
= 8.3 LPM or less

PRE-RINSE SPRAY VALVES

Replacing existing older pre-rinse spray valves (PRSVs) is one of the most cost-effective retrofits for a commercial kitchen. PRSVs are hand-operated devices connected to a hose, used to remove food from dinnerware prior to washing or placing in the dishwasher. Older standard PRSV flow rates are about 11 to 17 LPM. A water-efficient PRSV's flow rate is 6 LPM or less. They are designed with an automatic shutoff valve at the hose head to supply water only when needed.

Older, inefficient PRSV design differs in that it employs a traditional showerhead type of spray pattern. Water flows through multiple small orifices in a wide spray pattern similar to a home showerhead. Over time, they tend to clog due to mineral buildup, making them less effective.

New PRSVs do not use multiple orifices. Instead, the new design provides a "knife-like" continuous spray pattern that is more efficient in removing food and is not subject to mineral buildup. Efficient models are equally effective in cleaning dishware and can take less time.

PRSVs specifically designed for a commercial kitchen are different from spray valves used for cleaning kitchen areas, such as counters and floors. Spray valves used for cleaning kitchen areas usually have higher flow rates and different usage patterns.

WATER EFFICIENT PRSVS

PRSV BEST PRACTICES

- Periodically check for leaks and repairs.
- Routinely inspect and clean for scale buildup to ensure flow is not being restricted.
- Train users on how to properly use the shutoff clamp, instead of having a constant flow of water.
- Manually scrape and pre-soak dirty dishes in a basin of water as much as possible.

DISHWASHERS

Commercial dishwashers are one of the largest water users in commercial kitchens. They clean and sanitize dishware and utensils. Dishwashers can vary in design based on application. Older machines usually discard the water after each cycle. New water-efficient commercial dishwashers reuse water from one wash cycle to the next by using a holding tank. Based on the type of dishwasher, chemicals may be used to sanitize the dishes. As such, they can operate at lower temperatures. High-temperature machines do not need chemicals to sanitize.

Under-counter machines are typically used in smaller facilities. They are similar to residential dishwashers in that the door opens downward with a rack rolling out for access. These can often be found in bars for washing glasses.

Stationary door/hood-types require that dishes are loaded onto a rack that fits inside the machine.The rack stays in place during the wash cycle.Instead of having a handle that slides both doorsup and down, the hood-type has an entire hood similar to a box that lifts up in order for the rack to enter or exit. Typically, these are found in medium-sized restaurants.

STATIONARY HOOD TYPE DISHWATER

Conveyor type/C-line machine dishes are manually loaded on removable racks onto a conveyor belt that travels through a large tank with separate wash and rinse compartments. Multiple racks can be washed at a time, with the racks being pulled through the washer to complete each cycle. Typically, they are used in large restaurants and schools. All rack conveyor machines have a timer control for the speed of the conveyor. Once the machine is operational, the spray arms run constantly, regardless of whether a dish rack is present or not.

Flight-type machines also use a conveyor, but dishes are loaded onto the conveyor that has pegs or fingers serving as a rack instead. The conveyor belt continuously moves as dishes complete each cycle. These are used in facilities with the highest volume, such as institutional facilities, hospitals, or large hotels with banquet facilities.

Energy Star–qualified commercial dishwashers exist that can reduce energy and water use by 25 percent and set a maximum water use in gallons per rack. When replacing a commercial dishwasher, look for Energy Star–qualified models, which can save water and energy. As with other commercial equipment, consider the appropriate-sized dishwasher based on your kitchen's volume.

In order to calculate water use and savings, the water use per rack (liters per rack) for the current dishwasher and for the replacement dishwasher will have to be determined.

(See Energy Star linkand additional website resource in the Resources Section at the end of the manual.)

HOW TO CALCULATE WATER USAGE

Water use per rack x racks washed per day x number of days operating per year = L/year

HOW TO CALCULATE WATER SAVINGS

Current dishwasher L/year – replacement dishwasher L/year = water saved per year

It is important to remember that there can be a significant reduction in energy costs as a result of using less heated water.

DISHWASHER BEST PRACTICES

- Locate and repair any leaks.
- Routinely inspect valves and rinse nozzles to ensure that they are working properly.
- Educate users on how to properly operate the dishwasher.
- Only operate with full loads, making sure that all racks are filled to capacity.
- Reuse final rinse water in the following wash cycle.
- Make sure that the dishwasher is operating at the minimum flow rate and the rinse cycle times are set according to manufacturer recommendations.
- Equip conveyor-type dishwashers with automatic shutdown devices to turn off water pumps when dishes are not passing through the system.
- Turn off dishwashing machines when the kitchen is closed and they are not being used.

FOOD DISPOSAL GRINDER

A commercial food disposal grinds solid waste into smaller particles for disposal into the sewer system. The ground garbage passes into a mixing chamber where it blends with water for disposal. In some larger systems, a scraping and pre-flushing system may precede this. The average flow rate of water to feed the disposal grinder can be between 7.6 and 30 LPM per minute.

FOOD DISPOSAL GRINDER BEST PRACTICES

- Eliminate garbage disposal grinders. A more water-efficient solution is using a strainer or trap that allows food waste to be composted or disposed of in a trash receptacle. In addition to saving water, this can also reduce the burden on water treatment facilities.
- If a disposal grinder must be used, use an automatic timer, making sure it is shut off when it is not operating.
- Turn off water when the grinder is not being used and the kitchen is closed.

SINK WITH FOOD DISPOSAL GRINDER

FOOD STEAMERS

Food steamers are used to prepare foods in a sealed container that limits the escape of air or liquids below a preset pressure.

Traditional boiler-based steamers use water to condense the steam and to cool the water before it is discarded into the sewer system. They are connected to a central boiler that delivers steam to the heating compartment. Most boiler-based steamers have a continuous water flow even when the steamer is in standby mode. Some steamers allow the condensate cooling water to be turned off when the steamer is in standby mode. Boiler-based steamers can use as much as 151 liters of water per hour.

Efficient, connectionless steamers do not need water and drain connections associated with steam cookers. Some may be connected to a water supply for the purpose of keeping the water reservoir full, unlike a boiler-based steamer. Water does not continuously flow, and is instead poured manually into a reservoir. Heating elements inside or underneath the reservoir create steam, which then rises into the cooking compartment. They are also more energy efficient because steam that does not condense on the food remains in the cooking compartment rather than draining as condensate. Efficient steamers use an average of 11 liters of water per hour and can use 50 percent less energy. In addition, the absence of water and drain connections makes it simple to install and lowers maintenance costs. It is important to note that not all connectionless steamers are water-efficient.

OMMERCIAL FOOD STEAMER[6]

FOOD STEAMER BEST PRACTICES

- Locate and repair leaks.
- Keep the doors closed while the steamer is operating.
- When using a multi-pan steamer, fill the steamer to capacity instead of cooking one pan at a time.

[6] Source: https://www.alibaba.com/product-detail/Professional-commercial-food-steamer-machine-for_2005806335.html

- Use a timer to ensure that the steamer returns to standby mode after use.
- Make sure that gaskets are maintained so that the doors provide a good seal to retain heat or steam.
- For boiler-based models, periodically remove deposit buildup for maximum operating efficiency.
- Turn the steamer off when the kitchen is closed.

COMBI OVENS

Combination (Combi) ovens combine different types of cooking in one oven. The steam mode is used for quick cooking for food such as vegetables and shellfish. The circulating hot air mode is used similarly to a convection oven for baking or roasting meats. In combi-mode, it will reheat, roast, and bake. Because the steam and combi-mode require generating steam, it is an extremely water- and energy-intensive process.

Traditional boiler-based combi ovens use a continuous stream of water from a boiler system to maintain humidity and to cool the condensed steam before it is discarded into the sewer system. They can use as much as 151 L of water per hour. Efficient, connectionless combi ovens contain a water reservoir and heat source that creates the needed steam. They are usually drained and refilled each day and do not require water for cooling or a drain. Water-efficient, connectionless combi ovens use no more than 57 L of water per hour. Replacing a traditional combi oven can decrease water usage to as low as 75 L of water per hour or less.

COMBI OVEN BEST PRACTICES

- Locate and repair leaks.
- Keep the oven doors completely closed while in operation.
- Maximize the amount of food cooked per use by loading the oven to full capacity.
- Make sure that gaskets are maintained, so that the doors provide a good seal to retain heat or steam.
- For boiler-based models, periodically remove deposit buildup for maximum operating efficiency.
- Turn the oven off or down during slow times and when not in use.

DIPPER WELLS

Dipper wells usually have a spigot and a valve that controls the flow of hot or cold water into a receptacle for the purpose of rinsing utensils after each use. They are often found on a food counter in coffee/juice houses, ice cream shops, cafeterias, and restaurants. In order to reduce the potential for bacterial growth, dipper wells are often running constantly, providing a continuous exchange of water in the receptacle. They usually have a continuous flow of 2 to 4 LPM. Dipper wells with a permanent water supply installed should have a shutoff valve and flow control. A metered or sensor-activated flow should not exceed the water capacity of the dipper well, and should not exceed 3.8 LPM per activation. For continuous flows, it should not exceed 3.8 LPM. Health codes should be consulted when retrofitting or replacing a dipper well.

DIPPER WELL

DIPPER WELL BEST PRACTICES

- Retrofit dipper well with an in-line flow restrictor on the supply line, reducing it to 3.8 LPM.
- Turn it off when not in use so that it does not continuously flow and waste water.
- Consider rinsing utensils with a sink faucet only as needed instead of using a dipper well.

WOK STOVE

Water-cooled wok stoves require a constant flow of water that is needed to cool surfaces that surround the wok stove due to the high temperature of the cooktop. Water is also used to clean the wok in between uses. In some cases, there is a separate reservoir for cooking that is constantly being filled and can often overflow. The faucets are usually located on the wall in front of the wok, directly over the cooktop. Air-cooled wok stoves isolate the cooktop from the wok ring and chimney, allowing heat to escape without the use of water.


WOK STOVE

WOK STOVE BEST PRACTICES

- Replace the water-cooled wok stove with an air-cooled wok stove.
- Make sure that the faucet is off when it is not being used to rinse the wok.
- Limit the flow rate of the faucet to 8.3 L/min or less.

ICE MACHINES

Commercial ice makers use much more water than just the water contained in the ice itself. Ice machines generate a significant amount of heat that requires either water or air to remove the residual heat from the refrigeration unit. Most water-cooled machines pass water through the machine once to cool it, and then discard the water down the drain. Efficient air-cooled ice machines eliminate the use of cooling water by using fans or blowers to move air through the refrigeration unit, thus removing the residual heat.


AIR-COOLED ICE MACHINE

There are three types of ice that can be made, the most popular being cubed ice. Ice cube making is a batch process with the goal of producing clear ice cubes, particularly in the case for use in a restaurant. Most ice cube machines are designed to wash the frozen surface of the cube as it forms, eliminating mineral deposits off the ice. This in turn creates run-off water. Flake ice is another type. Flake ice is most often used in healthcare operations, product preservation, such as salad bars, and food presentation where clear ice is not necessary. The third type of ice, nugget ice, is often used for drinks in convenience stores and healthcare operations. As nugget ice can be easily saturated with the drinking liquid, it is becoming more popular in operations that provide soft drinks. Flake and nugget ice machines tend to be more water-efficient.

Ice machine water efficiency is measured by liters of water used to produce 45.36 kilograms of ice. Water-cooled ice machines can vary in the amount of water that they release (bleed off) per units of ice produced. Combining the ice-making and cooling processes, water-cooled ice machines with single-pass cooling can use between 378 and 1135 liters of water to make 45.36 kilograms of ice. An efficient air-cooled ice machine can use less than 189 liters of water to make 45.36 kilograms of ice.

HOW TO CALCULATE WATER USE AND SAVINGS

To Calculate Water Usage:

Harvest rate (kilograms of ice per day) x water use rate (liter per 45 kg of ice) x day operating/year = water usage

To Calculate Water Savings:

Current ice machine liters used per year – replacement ice machine liters used per year = water saved/year

It is recommended to replace water-cooled units with air-cooled units. It is important to consider the size of the ice machine when purchasing a new ice machine. Make sure it is properly sized for the demands of the operation. Buying a larger unit than needed will waste water and cost more to operate.

ICE MACHINE BEST PRACTICES

- Keep the ice machine coils clean to ensure that it is running as efficiently as possible.
- Keep the lid closed to keep cool air inside.
- Install a timer to shift ice production to off-peak hours.

ADDITIONAL KITCHEN BEST PRACTICES

- Periodically check and fix any faucet leaks and worn gaskets.
- Install water-efficient aerators where feasible.
- Install automatic shutoff faucets for bar sinks.
- Use hand-scraping before dishwashing.
- Reduce the amount of water used for prewashing before using the dishwasher and reuse wastewater from the dishwasher for prewashing.
- Run full machines and fill racks to capacity.
- Repair leaks in steam, hot water, and cold water lines.
- Do not thaw food under running water; plan ahead and thaw in the refrigerator or defrost in the microwave oven.

- Install foot-activated kitchen faucets to ensure valves are closed when not in use.
- Practice dry clean-up using brooms, brushes, vacuums, scrapers, and other utensils to clean material or waste before water is used.
- Do not use a hose as a broom; sweep floors instead of hosing with water.
- Vacuum or sweep dry materials that spill.
- Use squeegees and scrapers first to remove waste before washing.

LAUNDROMATS AND LAUNDRIES

Commercial laundry equipment can vary greatly depending on the type of laundry facility, the volume of laundry, and the type of fabrics being cleaned. Self-service laundromats provide a centralized location where individuals can bring their personal laundry. Most often, these facilities use commercial coin-operated, single-load washers similar to residential washing machines. Dormitories, apartments, and long-term hotels/motels may have a self-service laundromat. On-premise laundries (OPLs) are on-site facilities dedicated to washing fabrics used at the same location. Examples of facilities with an OPL could be hotels, hospitals, barracks, and prisons. Industrial laundries are centralized contract laundries that launder fabrics from other businesses, such as uniforms, bed linens, towels, and restaurant linens.

TYPES OF COMMERCIAL WASHERS

Commercial coin-operated, single-load washers can be vertical axis (VA) or horizontal axis (HA). Similar to residential washing machines, the HA is more efficient.

COMMERCIAL COIN OPERATED SINGLE LOAD WASHERS

Multi-load, coin-operated washers can also be VA or HA. Compared to conventional commercial washers with a capacity of 9 kilograms of laundry per load, a multi-load washer can exceed 36 kilograms of laundry per load. These washers may also provide programmable control settings that can adjust the amount of water used depending on the number of wash cycles, thus improving water efficiency.

Conventional washer-extractors have a chamber that fills and empties each time a new step in the wash cycle begins. They are similar to a multi-load washer, but they may have a larger capacity ranging from 13 to 362 kilograms of laundry per load. Small- to medium-sized laundries mostly rely on washer-extractors. Washer-extractors remove water and detergent from clothes using high-speed, centrifugal force spin cycles, making them more efficient. The number of wash cycles can be adjusted depending on how soiled the laundry may be. For washer-extractors without built-in recycling features, there are auxiliary recycling systems that can be attached to filter and sanitize the rinse water to be reused for the wash water supply.

Tunnel batch washers are large-volume, continuous-batch washers. As such, they are water-efficient and highly automated to maximize the laundry process. Long chambers with a series of compartments (referred to as pockets) slowly pull laundry through the different pockets using a large auger. Laundry items pass automatically from one module to the next. Water moves in a counter-flow direction to the laundry and is used several times before being sent to the drain. Use of the counter-current flow saves up to 60 to 70 percent of the volume of water and steam required by washer-extractors. Tunnel washers are expensive to install, but they can save more water than washer-extractors and require less maintenance. They are capable of handling 900 kilograms of laundry per hour. An additional benefit is that there are energy savings due to recovery of heat from the laundry itself during the rinse cycles and labor cost savings as a result of the automated process.

Water and wastewater costs can represent more than 50 percent of the total operating costs in a typical commercial laundry. The greatest water-conservation opportunities exist in the various methodsof reuse or recycling of the water from the machines, while maintaining the effectiveness of cleaning the fabrics.

Reuse systems ranging from simple to complex can be set up for some laundry equipment to recycle a portion or all of the water used in the following wash cycles. This requires installation of a holding tank for the rinse water. A machine may have two separate drain ports—one for draining the rinse water to the holding tank, and one for draining the wash water to the sewer. If not, the machine may be retrofitted with additional valves on the supply and drain piping.

Water reclamation equipment is available for commercial laundry settings. Reclaim systems can be different, but can also reduce the cost of water, soap, and energy for heating and sewer fees. Unless reclaimed water is already available from a water provider, on-site reclaim is more involved and includes commercial treatment systems that require filtration and chemicals.

LAUNDRY BEST PRACTICES

- Be sure to launder full loads only.
- For washers with different settings, choose the minimum amount needed per load.
- Consider recycling rinse water for use in wash cycle.
- Investigate laundry water reclamation systems for your facility.
- Consider the use of a continuous-batch washer for new laundry facilities or expansion of an existing laundry facility.
- Educate staff on how to properly use the laundry equipment.
- Place "save water cards" in hotel rooms, urging guests to save water by limiting the changing of linens and towels.
- Note that we do not recommend replacing large equipment immediately with water-efficient equipment, as it may not be cost-effective. We recommend considering replacing older equipment with a water-efficient model when it reaches the end of its life cycle. Sources such as Energy Star or CEE can be consulted for equipment that meets water-efficiency and energy standards.

Note: See the Energy Star link in the Reference section, under additional website resources.

POOLS

A properly designed and managed swimming pool can avoid water waste. Most swimming pool owners believe that water loss in a pool is due to evaporation; however, often it is also due to leaks. Minor swimming pool leaks can go undetected, not only causing an increase in the water bill, but also causing substantial damage by eroding the soil. An exposed pool can lose up to 101 centimeters of water per year due to evaporation. Pool covers can reduce evaporation by up to 90 percent. They can also save energy and reduce the use of chemicals needed. Installing a water meter on the pool makeup line can also reduce excessive backwashing and identify leaks.

A SIMPLE WAY TO CHECK FOR POOL LEAKS

1. Turn off the automatic fill valve.
2. Place a bucket on a step where the bucket rim is at least a few inches above the water line. Place a heavy weight in the bucket and add water until the water level inside the bucket is equal with the water level in the pool.
3. Leave the bucket and pool undisturbed for several hot days, then compare the water level in the bucket to the water level in the pool.

   If the water level in the bucket is higher than the water level in the pool,theremay bewater loss due to a leak or high evaporation. Consult a leak specialist.

POOL BEST PRACTICES

- Limit the frequency of pool refilling. Do not overfill the pool.
- Cover with an insulated cover when not in use.
- Lower the pool water level to reduce the amount of water splashed.
- Check regularly for cracks and leaks and make repairs immediately, or consult a leak specialist.
- Install a meter on the pool makeup line.
- Reuse filter backwash water for irrigation where possible.

CAR WASHING BEST PRACTICES

- If available, use a commercial car wash that recycles water.
- Limit the amount of times fleet vehicles are washed in a month.
- Soap and wash the vehicle using a bucket.
- Install an automatic shutoff nozzle on the hose so that water does not flow continuously.
- Use recycled water to wash the car.
- Sweep the surfaces and driveway instead of using a hose.
- Make sure that all shutoff valves are working correctly.
- Regularly check for leaks and repair immediately.

LANDSCAPING/OUTDOOR BEST PRACTICES

- Use an efficient spray nozzle with an automatic shutoff on the end of the hose.

- If possible, decrease grass areas, keeping only areas that are beneficially used for activities, such as a children's playground.
- When designing your landscape, select only drought-resistant ground cover.
- Water only during early morning or late evening to prevent evaporation and run-off.
- Water only as necessary and avoid watering after rainfall.
- Use recycled water to irrigate landscape where possible.
- Use a broom to clean exterior sidewalks and driveways rather than using a hose.
- Discourage use of decorative water features, such as water fountains.

OTHER COMMERCIAL AND INSTITUTIONAL BEST PRACTICES

- Use timers to shut off process water rinses when a process is completed.
- Turn off running water when not in use.
- Recycle and reuse water whenever feasible.
- Consider opportunities for reuse of cleaning and rinsing water. Be careful and wary of rules and regulations regarding this. Check with the proper authorities first.
- Read and monitor water use billing records monthly.
- Read and monitor water meters monthly.
- Regularly check for all leaks (equipment, connections, valves, etc.) and repair leaks immediately.
- Shut off water supply to areas and equipment not in use.
- Dry sweep instead of using a hose to clean floors and other hard surfaces.
- Educate staff on how to use equipment properly, implement efficient use of water, and promptly report leaks.

SECTION V: LEAKS

DETECTING, QUANTIFYING, AND FIXING LEAKS

Leaks from pipes and plumbing fixtures are a major source of water waste for the customer and the water agency. As part of a facility's water management plan, leaks should be the first area targeted. On average, leaks can account for more than 6 percent of a facility's water use. On a daily basis, leaks from a dripping faucet or defective toilet may seem small, but on a monthly basis such leaks can add up to thousands of liters of water being wasted. Leaks may be easily identified, such as dripping faucets. Other leaks may be hidden, such as broken water supply lines or toilets.

Routine checks for leaks should be conducted by reading the water meter. Once a leak is detected, further investigation may be required to determine the source of the leak. Installing sub-meters on large end uses, such as laundry equipment, cooling towers, pools, and processes, is key to quickly identifying leaks and malfunctioning equipment. Some leaks, such as underground leaks, may require specialized firms to conduct the leak detection.

There may be a leak in the water supply line between the meter and the facility. These are harder to detect because the supply pipe is usually buried below the ground surface. There are several possible ways to determine if the water supply line is leaking. If there is a wet spot on the lawn or property that is not due to rain or irrigating, and if you can hear the sound of water running outside of the building, there may be a leak in the supply line. Most often, leaks between the meter and the building are the responsibility of the property owner. A leak in the water supply line requires the services of a trained professional, such as a plumber or leak specialist. It is best to contact the water utility company before making any repairs to the water supply line outside of the home.

A key aspect to managing leaks is making sure that all employees and facility occupants are educated to report leaks immediately. They should be provided with information as to whom leaks can be reported. As a result, leaks should be repaired immediately to show that management is committed to water efficiency.

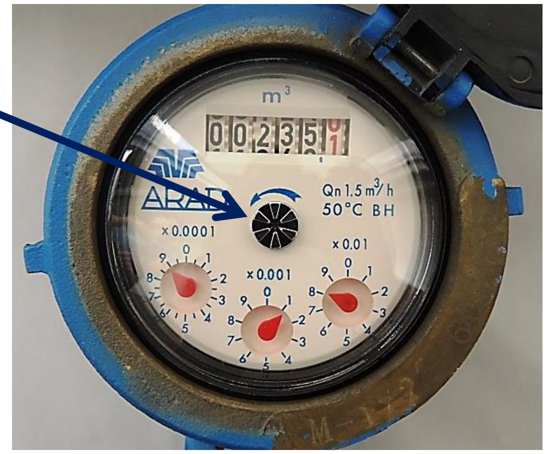
Leaks should be repaired immediately to show that management is committed to water tape is a temporary fix.

DETECTING LEAKS BY METER READING

Leaks that are not easily identified require leak detection by reading the meter. It is generally best to do this when the facility is closed and not operating. All water-consuming equipment and processes must be off inside and outside of the facility for at least 30 minutes to an hour. Record the meter numbers. After the test is concluded, record the meter numbers again. If the meter dial continues to move and the meter readings show a difference, there is a leak. It may be necessary to repeat this in order to determine if a leak is present.

Some meters may have leak indicators that make it easy to detect a leak. When the leak indicator is moving, there is a leak present.

Leak Indicator



COMPUTATION FOR METERED MEASURED LEAK(S)

Example:

Registered leak = 2 L in 15 min
To get the volume of the leak in L per cubic meters (m3) in a month's time:

= 2 L x 4 (60 min/15) x 24 hours x 30.4 days
15 min   1 hour   1 day   month

= 5,837 L/month
= 5,837 L/1,000 (to get the volume in m^3)
= 5.84 m^3/month

TOILET LEAK DETECTION

Toilets are one of the most common sources of leaks in bathrooms. Most toilet leaks send wasted water directly to the sewer line without detection. Leaks, especially in gravity tank toilets, are often silent, allowing losses to go undetected for long periods of time. Toilet leaks are a potentially large source of water loss that can often be recovered through simple repairs. (Please see the Resources Section for a video link.)

Flapper valves are the most common reason for a toilet leaking. Fortunately, they are easy and inexpensive to replace. The occasional sound of water entering the tank usually means the flapper is leaking. The flapper provides the barrier, holding the water in the tank until the flush handle is activated, thus pulling the chain attached to the flapper valve. When the flapper is raised, the water in the tank rushes into the bowl, creating the flush. After the flush is complete, the flapper falls back down on to the valve seat to retain the water as the tank refills. Leaks occur when the flapper valves cannot create a water-tight seal. There are many reasons why the flapper valve does not seal properly, such as the chain prohibiting the flapper from dropping completely and sealing, or the flapper and/or the seal can be worn.

Performing a dye test will allow detection of leaks in the flapper valve. Test procedures include placing dye tablets into the tank water to turn the water dark blue. If dark blue water appears in the bowl within 15 minutes, there is a leak in the flapper valve. If the customer does not want the test to be done, leave the tablets and encourage the customer to perform the test. A leak test can also be conducted using about 10 drops of blue food coloring or powder under the rim. The quicker the dye appears in the toilet bowl, the larger the leak is.

A continuous trickling of water when the toilet is not in use usually means water is running over the top of the overflow tube inside the tank. To lower the water level, adjust the float lower. The water level should be adjusted so that it is less than 1 inch below the top of the overflow tube. It can also be due to the float or the ballcock assembly being worn and needing to be replaced.

Malfunctioning flush valve toilets and urinals can lose a significant amount of water when they lock in an open position (the default setting on most flush valves).They are often loud, releasing a large amount of water or continuously flushing.

Toilet tank parts life expectancies can vary due to corrosive water conditions, poor-quality materials, and improper sizing.

To avoid liability, avoid contact with all moving parts inside the toilet tank as much as possible. Repairs should be performed by the owner, not the water auditor.

FAUCET AND SHOWERHEAD LEAK DETECTION

A faucet dripping 10 drops per minute can waste 1,620 liters per month. Slow-dripping faucet leaks are common and can add up over time. Fortunately, they are usually fairly inexpensive and easy to repair.

To estimate the volume of water wasted per year due to drips, count the number of drips per minute: (13.5 x number of drips per minute = L/month).

When inspecting faucets for leaks, do not forget other water valves around the site, such as water heaters, hose bibs, laundry basins, utility sinks, outdoor faucets, etc.

WATER LEAK AT THE CONNECTION HOSE

Check for faucet leaks at the faucet head, the base for seepage, and its connections. Compression faucets (washer type) are usually found in older buildings and tend to leak more frequently because of old gaskets (O-rings) or corroded valve seats. Washerless faucets include those that have ball valves, cartridge valves, or ceramic disks.They usually do not leak as often, as they are designed to minimize friction and wear, but they can still leak. Each type of faucet requires a different method of repair. With so many types of faucets on the market, the best source for repair information may be on the manufacturer's website. Fortunately, most faucet repairs are inexpensive and can be done quickly and easily.

Showerhead leaks are usually visible. Visual signs of a showerhead leaking include water stains on the shower walls and floor, dripping showerheads, or dripping shower arms.

HOW TO MEASURE A FAUCET OR SHOWERHEAD LEAK

- Use a drip gauge (measure the drips for 5 seconds) the drip gauge will automatically measure the leaks per month listed on the side of the vial   OR:
- Count the number of drips per minute

To calculate the number of drips intoin L/month:

Formula: No. of drips per min x 13.5

Example: 90 drips/min

= 90 drips/min x 13.5
= 1,215 L/month

To measure stream leaks in L/month:

Place a measuring cup under the stream and measure the volume gathered for 1 minute.
Example: 200 ml x 43.8 = 8,760 L/month

Note: 60 min x 24 hours x 365 days/12 = 43,800/1000 = 43.8 /month

SECTION VI: COMMERCIAL AND INSTITUTIONAL CUSTOMERS

Increasing water costs and water supply restrictions create many challenges for businesses. Regardless of the water costs and restrictions, they are expected to continue operations and production, and improve the effectiveness of the facility while maintaining the safety and health of employees, customers, and tenants.

There are many challenges in implementing WDM for commercial and institutional (CI) customers. For many businesses, water is not perceived as a major cost of conducting business. More importantly, water cost is often not perceived as an expense they can control through changing practices or retrofitting water-using equipment. These businesses need motivation to participate; it helps to talk in business terms by using certain terms, such as "cost-effective," "return on investment," "save money," and "free audit." Contacting businesses can also be difficult, as it often requires persistence in order to get a hold of the right person who is then able to make decisions. Funding is often lacking and/or funding for projects is usually on an annual budgetary process.

It is crucial to have the support of top management. There are many reasons managers should support WDM. Investment in efficient, long-term WDM can reduce operations costs such as water supply and wastewater treatment costs and/or fees. Improved water efficiency may make additional water available for increased production without the need to purchase additional water supplies.

Raising awareness with employees or tenants and encouraging cooperation with management efforts to practice water efficiency are essential. Awareness should begin with a letter to all employees or tenants from someone in authority, such as an owner, mayor, etc., describing the water-efficiency program. In addition, a water education program should be established as part of employee training programs that stress the need for individual responsibility as part of a team effort to achieve water-efficiency goals. This can encourage and promote suggestions from employees. Employees should be encouraged to report all leaks, including leaking toilets and faucets, and recognition and rewards should be given to those employees with water-saving achievements.

Immediate action should be taken by doing the obvious first, such as identifying leaks and fixing them immediately. There should be regularly scheduled walk-throughs of the facility during working hours to locate broken pipes, leaks, and faulty hoses. Some leaks can only be found during shutdown by checking meters. All areas should be checked thoroughly, including: kitchens, laundry, janitor areas, bathrooms, outdoor water uses, and any other plumbing or water processes.

Ways to eliminate waste and unnecessary uses should be identified, such as: water reuse opportunities, landscaping, shutting down ornamental water fountains, and reducing fleet vehicle washing. Install timers to automatically shut off unnecessary water flows after work hours have ceased. Eliminating hot water where unnecessary will also save water by avoiding water running while people wait for it to get hot. By implementing even simple ways to conserve small amounts of water, this attention to WDM increases awareness, shows company commitment, and sets an example for employees, tenants, and visitors.

End Uses of Water in Various Types of Commercial and Institutional Facilities[7]

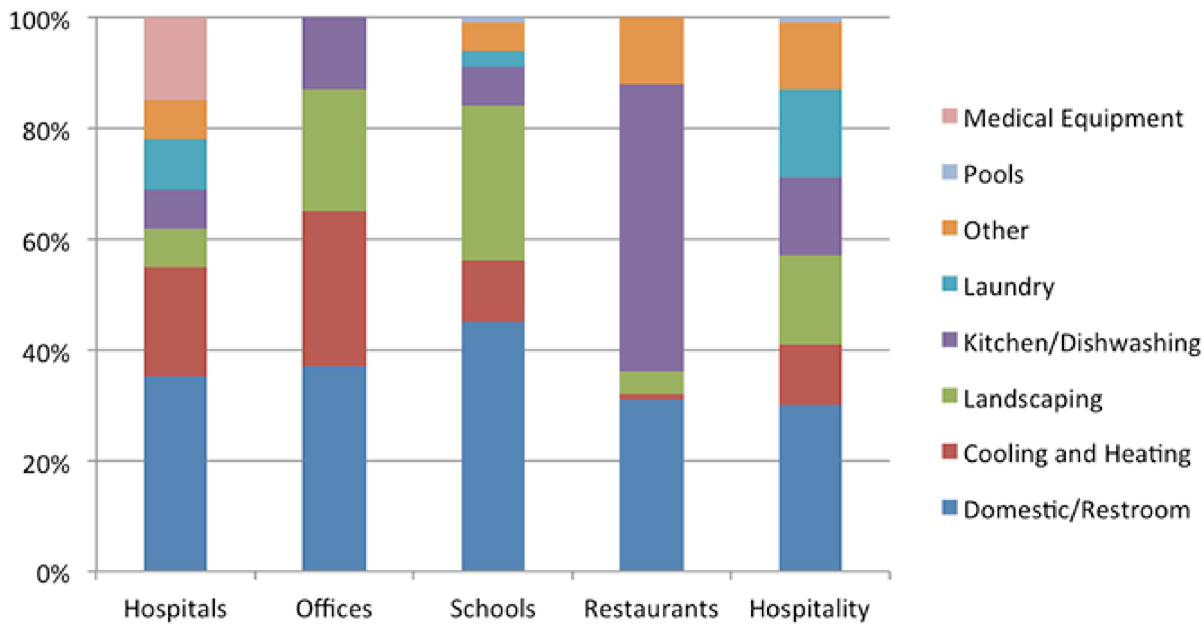


Table 7:Commercial Customer Segments and Water-Efficiency Opportunities

Offices and Retail	Hotels	Restaurants	Schools	Government
Educate employees Leak repair Toilets retrofit Urinals retrofit Faucets retrofit Landscaping Recycle/reuse Rainwater harvesting	Educate employees Leak repair Toilets retrofit Urinals retrofit Faucets retrofit Showerheads Pre-rinse spray valves Dishwashers Ice machines Food steamers Combi ovens Food disposal grinders Wok stoves Dipper wells Laundry Pools Landscaping Recycle/reuse Rainwater harvesting	Educate employees Leak repair Toilets retrofit Urinals retrofit Faucets retrofit Pre-rinse spray valves Dishwashers Ice machines Food steamers Combi ovens Food disposal grinders Wok stoves Dipper wells Landscaping Recycle/reuse Rainwater harvesting	Educate employees Leak repair Toilets retrofit Urinals retrofit Faucets retrofit Showerheads Pre-rinse spray valves Dishwashers Ice machines Laundry Pools Landscaping Fleet car washing Recycle/reuse Rainwater harvesting	Educate employees Leak repair Toilets retrofit Urinals retrofit Faucets retrofit Showerheads Pre-rinse spray valves Landscaping Fleet car washing Recycle/reuse Rainwater harvesting

[7] Source: https://www3.epa.gov/watersense/commercial/

GOVERNMENT BUILDINGS

In addition to the private sector taking part in WDM, it is even more important for government and facilities to set an example. Given that WDM is a new endeavor in the Philippines, many local and national officials are eager to promote water-efficient practices, including using their facilities as an example for installing new water-efficient fixtures and implementing water-efficient practices. In doing so, not only can they establish a water education program for employees that emphasizes the importance of water efficiency, they also benefit the public they serve by providing them with the knowledge they need to achieve savings.

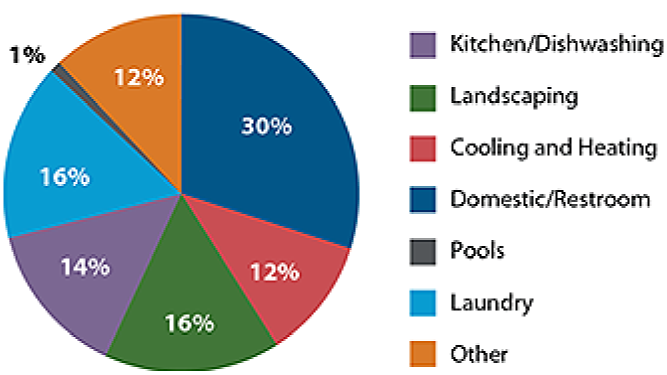
Similar to office buildings, government buildings usually have a high ratio of persons per sanitary fixtures. Not only do they have a high number of people working on-site, but often the number of public visitors is significant as well. The potential for water savings can be great. For example, City Hall receives a large quantity of visitors six days a week coming in to pay their utility bills.

While there are many water-saving opportunities, similar to the private sector, implementing them is contingent on annual fiscal budgets getting approved.

HOTELS

Water use affects a hotel's operating costs and environmental footprint. Given that the costs of water and wastewater disposal continue to rise, implementing water-efficient practices can decrease operating costs and improve operations. With environmental sustainability being a factor in customer decisions, for many hotels, adopting water-efficient practices can also help meet customer needs and earn recognition from programs that identify green hotels.

End Uses of Water in Hotels[8]



Hotels vary in types in regards to different sizes, functions, and water use patterns. Hotels and motels not only vary by size, but also by category of services and amenities. Guest rooms are not the only area of water usage. Many large hotels use a significant amount of water for banquets, conferences, restaurants, gyms, etc. Larger hotels may have OPLs, while smaller hotels may have coin-operated washing machines for their guests to use. It is important to separate different functions accordingly when calculating water usage and potential savings.

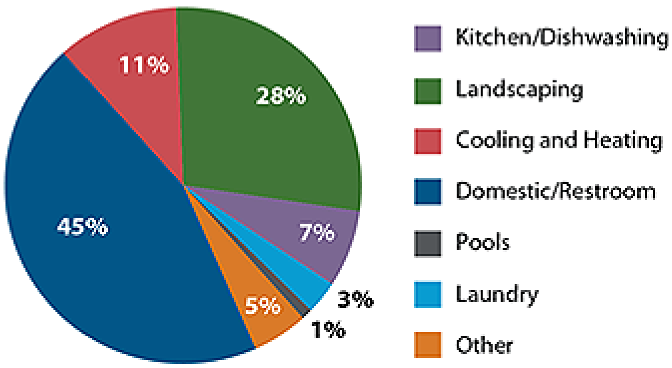
Given that hotel guest rooms are a significant source of water use, it is important that hotel managers understand when replacing fixtures that they should purchase those that have been tested for performance and water efficiency. By doing so, this will ensure the satisfaction of the hotel guests. Water-efficiency measures may include bathroom fixtures, kitchen fixtures and appliances, laundry, pool, and landscaping. There is an opportunity to also promote water conservation awareness by placement of water conservation cards for guests, suggesting less frequent changing of linens. In some cases, hotels offer an incentive for guests when customers participate by giving them extra reward points, financial discounts, or free services, such as Wi-Fi.

[8] Source: https://www3.epa.gov/watersense/commercial/

SCHOOLS AND UNIVERSITIES

Implementing water efficiency at schools, colleges, and universities has multiple benefits. Water is saved and the students have an opportunity to learn about and experience the benefits of practicing water efficiency. Given that many schools have a large range of facilities and functions, there are many water-saving opportunities. These opportunities not only include retrofitting fixtures and equipment with water-efficient models, but also allow the schools to demonstrate their commitment to sustainable principles and practices. While the savings potential can be significant, implementation is sometimes impeded by budgetary restrictions of the schools.

End Uses of Water in Schools[9]



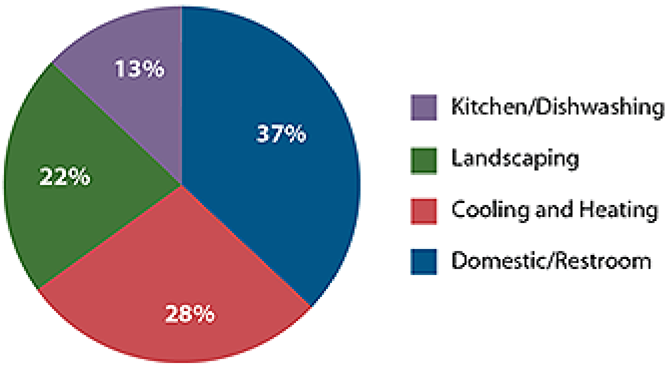
Similar to other large sites, it is important to audit each building or facility separately in an organized manner based on how they use water and who uses the water. It is not practical or reasonable to perform one audit with a simple analysis for the entire site. For example, the water usage and savings potential for showers in dormitories could be significantly different than for showers in the gym. Building design, fixture types, and types of users can also affect the water usage and potential savings. For example, a female dormitory with toilets in private bathrooms is different compared to a male dormitory with mostly urinals in a group bathroom. In addition, it is important to take note of the school's yearly schedule. Some schools, particularly large universities, are operational all year long. Some are known to rent out their dormitories during the summer for retreats. All of these factors should be taken into consideration when conducting the audit.

When recommending water-efficient equipment for replacement, it is important to consider durability and tamper-resistant fixtures.

[9] Source: https://www3.epa.gov/watersense/commercial/

OFFICE FACILITIES

End Uses of Water in Office Buildings[10]

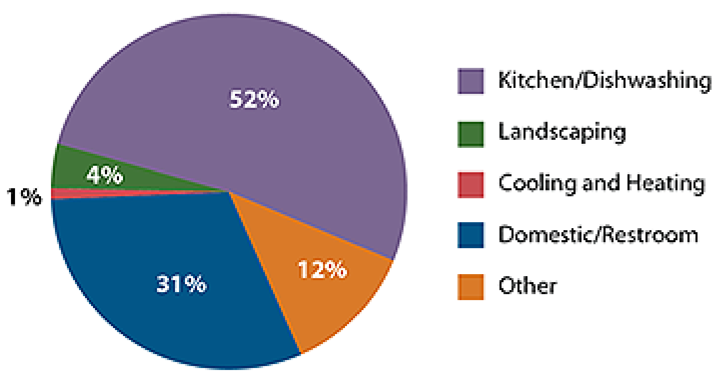


Water used in office buildings often accounts for a large portion of total water use in the commercial sector. The three largest uses of water in an office building are restrooms, heating and cooling, and landscaping, although there are other water-efficiency opportunities in areas such as kitchens, cafeterias, and gyms. Given that most offices usually have a higher ratio of persons per sanitary fixtures, there can be significant potential water savings from retrofitting toilets. Some office buildings, particularly in the Philippines, are multi-use buildings. It is important to conduct audits separately, based on the type of user and how they use water. Results can be combined and submitted as one report to the building owner.

RESTAURANTS/COMMERCIAL KITCHENS

Commercial kitchen operations vary in size and type. However, dishwashing operations almost always consume most of the water used. As such, there can also be significant energy savings due to hot water savings when water-efficient measures are implemented. Water-cooled ice machines and refrigeration equipment can be replaced with water-efficient, air-cooled units. Steamer equipment connected to a central boiler can be replaced with connectionless steamers.

End Uses of Water in Restaurants[10]



Inefficient water use is also due to behavioral patterns. Typically, time is of the essence when food is being prepared and served, with little thought given to how water is being used. Educating kitchen employees to use water efficiently and on how to use equipment properly is an important best practice. Use of water conservation cards for customers that include optional water for the table is highly recommended.

[10] Source: https://www3.epa.gov/watersense/commercial/

MALLS/RETAIL

A challenge of large malls is that they are often master metered, despite having multiple tenants that vary in type and size. Individual tenants often do not pay the utility bill directly and have no incentive to participate in the audit, let alone to save water. Similar to buildings with multiple tenants, it is especially important for the owner/management to notify the tenants that their units will be audited. When calculating water usage and savings, particularly in respect to toilets, it is important to note which bathrooms are used the most. Having a public bathroom that serves most of the women visitors, for example, may mean that it would be appropriate to retrofit those toilets first based on the higher volume of water used and saved. Because a mall may serve several types of businesses (i.e., restaurants, movie theaters, gyms, shops, eye doctors, etc.), it is important to audit each type of business separately to properly account for water usage. Results from the different businesses may be combined, so that one audit report can be provided to the owner. Malls are an excellent candidate for sub-metering.

SECTION VII: ADDITIONAL WATER-EFFICIENCY OPPORTUNITIES AND WATER SOURCES

NEW CONSTRUCTION

There is a wide range of opportunities for water efficiency in construction of new buildings. Many of these can be integrated into the design and building, including installing water-efficient fixtures and designing a water-efficient landscape.

With water supply becoming a high priority, designing a site and building for maximum water efficiency is becoming more important. In addition, with water and sewer rates increasing and new water supplies being unavailable, there is increased recognition of potential water savings that can be realized as a result of an efficiently designed building.Implementing water-efficiency technology and strategies into the design, wastewater discharge costs can also be significantly reduced. Building with water efficiency in mind eliminates potential future costs. For example, it is cheaper to install piping for water reuse and recycling during the initial build, as opposed to retrofitting and installing separate pipes after building is already completed.

NEW CONSTRUCTION BEST PRACTICES

PLUMBING FIXTURES

Only install water-efficient plumbing fixtures such as: toilets, urinals, faucets, showerheads, and PRSVs.

APPLIANCES AND EQUIPMENT

Only install water-efficient appliances and equipment such as: washing machines, dishwashers, air-cooled ice makers, connectionless steamers and combi ovens, air-cooled wok stoves, and dipper wells.

WATER REUSE AND ALTERNATE SOURCES

Alternate water use sources can be cost-effective if included in the design of a new facility. Use of a graywater system should be considered to supply water for toilets, urinals, for irrigating landscape, and make-up water in cooling towers. If reclaimed water is an option, installing color-coded water pipes to minimize cross-connection problems can be incorporated into the facility design. A rainwater harvesting system can also be incorporated into the design of a new building. Not only would it provide an alternate source of water, it also helps to manage stormwater by reducing run-off and easing flooding and erosion. Design of the rainwater harvesting system would include gutters, downspouts to the cistern, and a method to deliver water from the cistern for supply. It is important to consult national and local regulations prior to incorporating alternate water sources as part of the facility design.

METERING AND SUB-METERING

Make sure that the meter is appropriately sized and is the correct type for the water demand. An incorrect meter or improper size will not record the true water usage and make it harder to detect leaks.

Water sub-metering is the installation of water meters in individual tenant spaces or at specific end uses to determine the individual consumption and help to locate and isolate possible leaks. Sub-metering is one of the most important water-efficiency steps for CI customers. It helps people to understand where water use occurs and helps employees monitor their discretionary use. Sub-metering also helps to detect leaks and determine when repairs are necessary or where new water-efficient equipment is justified. In many commercial sites, there should be sub-meters that measure specific areas, equipment, or tasks. Common uses for sub-meters include: laundry equipment, cooling towers, kitchens, pools, and outdoor irrigation.

BUILDING WATER PRESSURE

Ensure that water pressure is maintained below 60 psi throughout the facility, since there is a direct correlation between water leaks and excessive water pressure.

ONCE-THROUGH COOLING SYSTEMS

If possible, eliminate any once-Through Cooling Systems If possible, eliminate any once-through cooling equipment, or use equipment that recirculates water. Once-through cooling systems circulate water through equipment with the purpose of removing heat load generated by the equipment, and the water is then disposed of down the drain. To maximize water savings, eliminate once-through cooling to operate a closed loop system that recirculates water instead of discharging it. Plan on using air-cooled equipment if available.

LANDSCAPE AND IRRIGATION

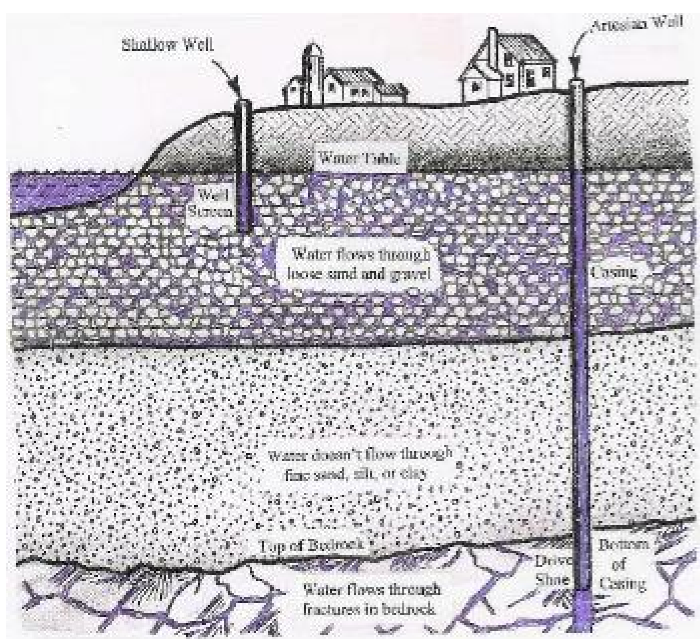
Design a water-efficient landscape to include drought-tolerant and climate-appropriate turf, trees, shrubs, and ground cover. Minimize the amount of turf area in the landscape, as turf requires significantly morewater. Water-efficient landscapes can reduce irrigation water use to better withstand drought, reduce drought loss or damage, and require less time and money to maintain. Design irrigation systems that use any available alternate sources of water.

Note: There is also efficiency potential for cooling towers, large landscapes, and water treatment equipment that is currently not discussed as part of this toolkit.

WATER SOURCES

Potable water is treated to sufficient quality for human consumption and is obtained from public water systems or natural freshwater sources, such as lakes, streams, and aquifers that are classified, permitted, and approved for human consumption.Non-potable water is obtained from natural freshwater (not including seawater) sources that are deemed to be of sufficient quality, and have not been treated, permitted, or approved for human consumption. It is important to put signs up if non-potable water is being used in an area where the public may have access to it. The signs should state that the water is non-potable and not for drinking. Water utilities obtain waterfrom wells, lakes, and/or water aquifers.

Wells: Shallow wells are suitable in areas where the level is not more than 6 meters (20 feet) below the ground surface. It is also applicable in places where people fetch water in containers for their requirements. Deep wells are classified into two classes: (1) deep well (modified) and (2) deep well (standard). Deep well (modified) is suitable in areas where the water level is lower than 30 meters (98 feet) and with average cylinder setting of 40 meters (130 feet). It is also applicable in areas where the water



SHALLOW WELL AND DEEP WELL (Source: http://wumopis.com/shallow-well-water-pump-install/

system may eventually be converted into a communal faucet system (Level II). Deep well (standard) is suitable in coastal areas where modified deep well hand-pumps are susceptible to corrosion and water level is lower than 30 meters (98 feet). It is also applicable in areas where the water system may eventually be converted into a communal faucet system (Level II).

Alternate water sources (generally considered non-potable): In the U.S., these are most often used via purple pipes. Check with local health and building codes as these are relatively new options; rules and definitions are fluid and constantly changing.

RAINWATER HARVESTING

When rain falls, it usually runs into drains or water bodies. Rainwater harvesting can provide a readily available alternate water source. Using rainwater as a non-potable source can reduce demand for potable water and reduce stormwater discharge. A simple way of harvesting rain consists of a rain barrel placed under the downspouts of a building. Larger rainwater systems, such as a holding tank or cistern, collect rainwater on the rooftops, which can be used to replace potable water for a range of uses, including: toilet flushing, landscaping (caution should be used when using harvested rainwater to irrigate crops intended for human consumption), laundry, and outdoor/vehicle cleaning. Rainwater generally has low levels of pollutants, making required treatment relatively simple and inexpensive. However, it can easily be contaminated with various contaminants, such as toxins from the roof, solvents, bird and rodent feces, and mosquitoes, making it necessary to filter for most uses. It is strongly recommended that health and building codes be consulted prior to developing a large rainwater harvesting system.

Rainwater must be used regularly to ensure that tanks are emptied frequently and have enough room to capture additional rainwater as needed. More importantly, stored rainwater can become septic or a breeding place for mosquitoes and pathogens if care is not taken.

In existing facilities, the added cost of equipment to get the water to an end use could hamper the overall cost-effectiveness. In general, larger rainwater storage systems will often be more cost-effective than rain barrels if water is used beyond landscape irrigation. In some cases, cisterns are designed to hold additional alternate water sources (graywater, etc.) along with the rainwater for uses beyond irrigation. The various water sources are collected in the cistern, filtered, and sanitized for use in flushing toilets and urinals throughout the facility.

FORMS OF RECYCLE OR REUSE

Graywater (a form of recycling) – on-site untreated or can be treated and disinfected depending on use, is always non-potable, and then reused on-site (such as commercial washing machines at a hotel, where rinse water is used in the next load for soap water, or in a shopping mall where basin water is used to flush the toilet). Graywater does not include any toilet discharge, unhealthy bodily waste, or manufacturing waste. It is wastewater from showers, baths, bathroom sinks, and clothes washing machines. Wastewater from kitchen sinks, dishwashers, and laundry of soiled diapers is not included. It does not contain human waste. It can be used sub-surface to irrigate landscaping and plants, but not root crops or edible parts of food crops. It can also be used for toilet flushing. (Before using graywater, it is recommended that local health codes and building codes are consulted.)

Reclaimed – non-potable, treated, recycled wastewater that is redistributed back for use, often for landscaping irrigation. Monitored by a third party government agency, off-site municipal (rare that it is on-site) wastewater is treated until it meets drinking water standards, or if on-site, treatment is with chlorine or sanitizer to kill germs. In order to be considered "reclaimed water" in the U.S., it has to be treated until it meets drinking water standards; however, it is still considered non-potable. It cannot be used for drinking water or direct consumption, but can be used for irrigation (non-food crops and below surface, such as drip irrigation), power generation, fountains, fire protection, and cooling towers. It requires its own distribution system separate from the potable water entering the facility. It is the only water besides rainwater that is allowed to be used to spray irrigate above-ground landscapes.

On-Site Recycling (reuse) – depending on use, may be treated and disinfected to provide non-potable water supply. Often, it is used for the same process. For example, rinse water from a washing machine can be used for the wash water cycle. It can also be used in certain industrial processes and for flushing toilets and urinals in non-residential buildings. Depending on the quality, it may be used to irrigate above ground (not including food crops).

While many facilities may have the opportunity to use alternative on-site water sources, careful evaluation and consultation with the proper authorities should be conducted to determine health and safety requirements.

SECTION VIII: CONDUCTING A COMMERCIAL AUDIT

CI water audits can vary from basic to complex audit and analysis, depending on the segment type, water uses, and size of the facility. For some, the water savings potential may be large, but identifying and achieving the water savings requires skill, technical expertise, and detailed audit techniques. The key objectives of a water audit are to: identify water use patterns; identify deficiencies in the water system, such as leaks and waste; identify water-efficiency opportunities, including water reuse; and develop water benchmarks and site-specific targets.

A comprehensive CI water audit includes identifying all water uses from source through on-site processes, machines, buildings, landscape irrigation, evaporation, and wastewater discharge. Water balancing is conducted to account for all water uses, with the total input of water equal to the total output of water plus water consumed by balancing water bills (for various seasons), and determining the true cost of water as it relates to other costs, such as energy costs.

Because this is the beginning of a new endeavor, we are focusing on conducting basic water audits that provide the greatest effect at minimal costs. This water audit toolkit focuses on these factors: water end uses most common in CI facilities; end uses that are easily identified and measured with a moderate level of plumbing and water use experience; and end uses that are known to garner the greatest benefits per cost to retrofit and that can easily be retrofitted. Domestic sanitary fixtures, commercial kitchens, and laundry appliances meet these criteria. Non-domestic opportunities, such as cooling towers and outdoor landscape irrigation, are currently not part of our water audit toolkit. While these opportunities may have good potential for water-efficiency improvements, they require a high level of expertise in many areas, and may likely be covered in subsequent editions of this toolkit. For now, focusing on common end uses will provide core data that can be used in development of benchmarking tools and future water-efficiency guides.

To determine which customers to audit, it is beneficial to first assess the profile of the overall CI customer base by determining who are the highest water users, what are the predominate types of businesses, what type of rates apply, etc. This information is usually available through the customer billing system. This task is much easier when the utility billing records include National Statistical Coordination Board (NSCB) codes. Knowing the customer base will aid in determining the preferred target market and the skill level needed to perform the audits.

Thorough preparation will maximize the efficiency of the water audit. This should include exact location of the site, physical size of the facility, number of buildings, and water utility records. If possible, obtain facility blueprints or a map of the site. Identify a contact person familiar with operations.

The auditor should be prepared and have the customer billing information that could show seasonal differences/fluctuations and a general idea of how much water is being used. The auditor should be familiar with general site questions based on the type of facility. Obtaining as much information before conducting the on-site audit by conducting a phone questionnaire with the appropriate person would be beneficial. This information might include details such as: hours of operation, various worker shift schedules, male-to-female ratio, visitor information, etc. Most often, the facility manager tasked with accompanying the auditor will not have this information readily available at the time of the on-site audit.

For sites that have a large range of buildings, facilities, or functions, it is not practical to perform one simple analysis of the water use and potential water savings. It is best to use a separate audit form for each building, and then combine the analyses into one comprehensive report. Having site informationprior to conducting the audit will better allow the auditor to prepare an organized approach when conducting the on-site audit.

While conducting the audit, take note of any water use behaviors that may be changed in order to garner water efficiencies and savings.

BASIC WATER AUDITING PROCESS

3 PHASES

PHASE ONE: AUDIT PREPARATION
Identify Scope and Objective:

Step 1:
Selection of ZWAT; audit schedule; resources

Step 1.1
Billing Section identifies customer(s) with high water bill consumption; refers customer(s) to Communications Unit

Step 1.2
Communications Unit will do the telemarketing "cold calling" (steps 1.2.A), letter sending (steps 1.2.B), and follow-up (steps 1.2.C)

PHASE TWO: AUDIT PROCESS

Process A

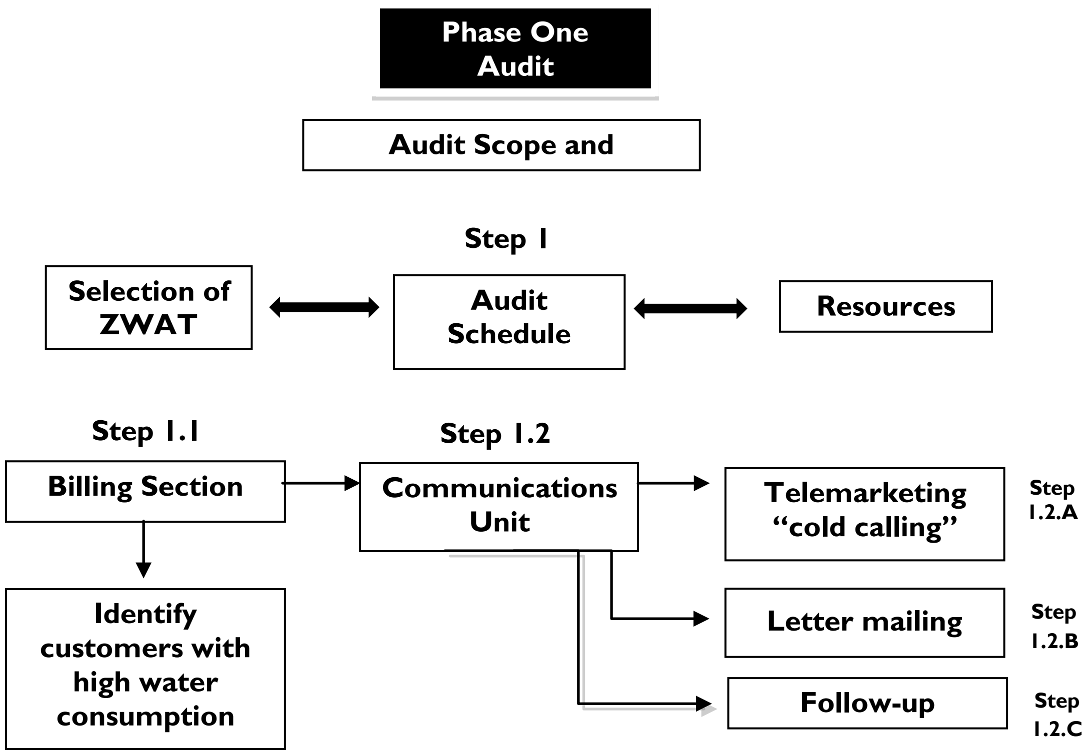
Step 2:
Water Auditor: (refer to etiquette)
Visits identified customer
Introduces and presents review of audit process

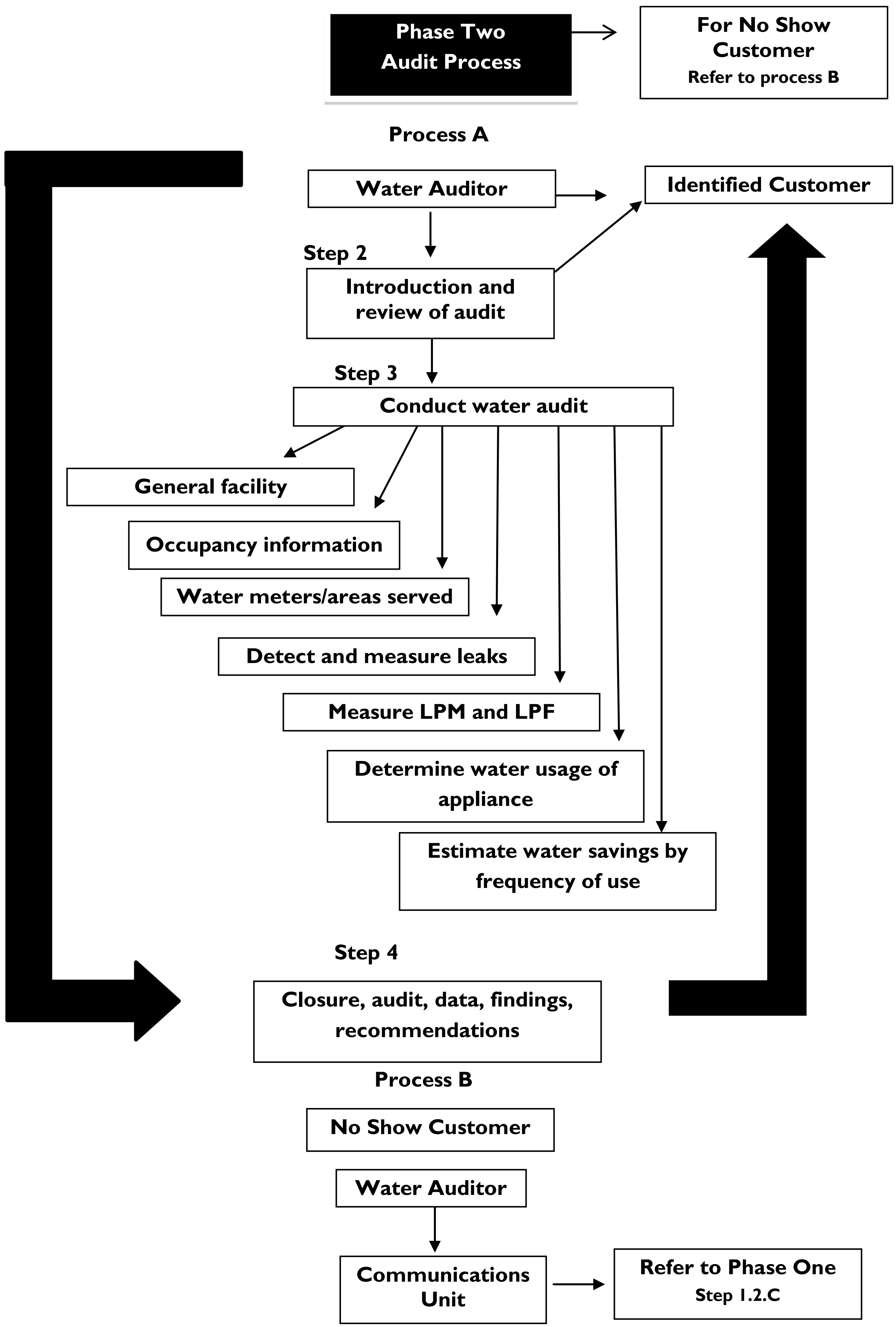
Step 3:
Water Auditor: (refer to forms)
Obtain general facility information
Obtain occupancy information
Take note of water meters/areas served
Detect and measure leaks
Measure LPM and LPF of fixtures
Determine water usage of appliance
Estimate water savings by frequency of use

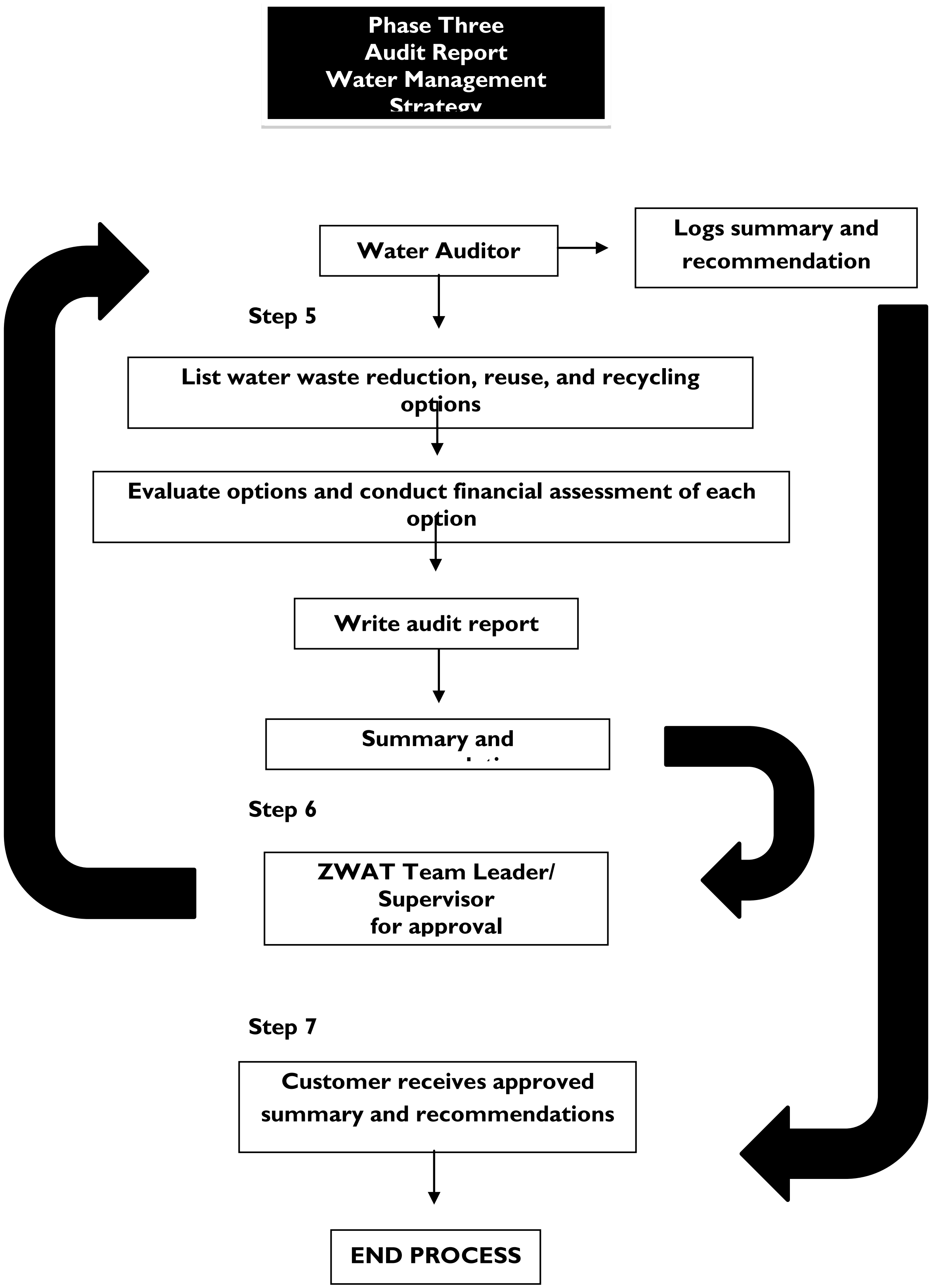
Step 4:
Process A audit findings, recommendations presented to the customer.
Process B (no-show customer):
Water auditor informs Communications Unit; Communications Unit will call identified customer for rescheduling.

PHASE THREE: AUDIT REPORT

Step 5:
Water Auditor:
List water waste reduction, reuse, and recycling options
Evaluate options and conduct financial assessment of each option
Provide summary and recommendation
Forward summary and recommendation to Supervisor for approval
Log summary and recommendation and send these to customer




Phase Two
Audit Process
For No Show Customer
Refer to process B
Process A
Water Auditor
Identified Customer
Step 2
Introduction and review of audit
Step 3
Conduct water audit
General facility
Occupancy information
Water meters/areas served
Detect and measure leaks
Measure LPM and LPF
Determine water usage of appliance
Estimate water savings by frequency of use
Step 4
Closure, audit, data, findings, recommendations
Process B
No Show Customer
Water Auditor
Communications Unit
Refer to Phase One
Step 1.2.C


Phase Three
Audit Report
Water Management
Strategy
Water Auditor
Logs summary and recommendation
Step 5
List water waste reduction, reuse, and recycling options
Evaluate options and conduct financial assessment of each option
Write audit report
Summary and
Step 6
ZWAT Team Leader/ Supervisor for approval
Step 7
Customer receives approved summary and recommendations
END PROCESS

ETIQUETTE

Arrive on time and be prepared to make a positive first impression:

- Greet without sunglasses, make eye contact, and SMILE.
- Identify yourself and provide your water agency ID.
- Ask for the contact person listed on your schedule.
- Remember you are representing your water agency.
- Confine conversation to water audit
- No politics, no religion, no jokes, no rate issues, no opinions.

Take care:

- Clean shoes only when inside the facility.
- Keep hands clean.
- Do not stand/sit on tubs, toilets, basins, etc.
- Do not touch if fixture or device is broken.

Safety always:

- When in doubt, walk away and call office.
- Always keep facility manager with you. If facility manager leaves, you must leave also.

Before you start:

- Explain that a facility representative has to stay within sight of you at all times.
- Ask that other people at the facility (security guards, etc.) be made aware of your presence.
- Ask whether there are any special needs or concerns (such as broken plumbing, etc.), or special access required.
- Explain the procedures and expected time required for the audit.

ON-SITE AUDIT STEPS

- Conduct the interview and fill out the Commercial Audit Master Form. The quality of the audit is dependent on obtaining accurate information. It is important, when possible, to speak directly with the same staff that works in the water-consuming operation. For example, speak with the kitchen manager when gathering information regarding how often kitchen equipment is used, what the volume of use is, etc.
- Identify general site information and site water use data, taking into account seasonal fluctuations.
- Identify the physical size of facilities (number of buildings, floors, space, etc.).
- Identify meters and locations/areas served and/or processes associated with meters.
- Identify the site: alternate supply sources, employees and shifts, and visitors.
- Identify all leaks encountered throughout the walk-through aside from those located in the bathrooms and kitchens. Measure the leaks when possible.

- In the notation section of the audit form, document any work habits, practices, or policies that may affect water use efficiency.
- Audit bathrooms: conduct leak detection tests, conduct toilet/urinal flush rates, faucet and showerhead flow rates. Obtain information on frequency of use.
- Audit kitchens: conduct leak detection tests, conduct faucet flow rates, document all water-using equipment. Obtain information on frequency of use and volume.
- Audit laundry equipment if present. Obtain information on frequency of use and volume.
- Audit outdoor water uses, including car washes.
- Document any other information that will help to determine water usage, as needed, with a diagram or photograph.

See the Auditor Inventory Equipment Form in Appendix A, as well as the Quick Reference Guide in Appendix B.

CRITERIA FOR AUDITING BATHROOMS

In order to gain valid water usage data, it is important to audit all bathrooms. However, this may not always be feasible. The recommended minimum sampling is described below.

Office example: 10 floors, audit each floor

- If fewer than 20 bathrooms, audit at least 50 percent.
- If 20-50 bathrooms, audit 25 percent
- If more than 50 bathrooms, audit 10 percent

Hotel example: Audit all public (lobby, spa, restaurant) and employee bathrooms.

- At minimum, audit at least 10 percent of guest bathrooms on each floor.
- For multiple toilets inside a bathroom, audit at least one or two stalls; if they are different types of toilets, increase audit sample.
- The more variations of fixtures you identify, the more fixtures you should audit.

Note: When auditing bathroom fixtures, be consistent. List fixtures from left to right, beginning from the one closest to the door.

HOW TO USE THE COMMERCIAL AUDIT MASTER FORM (PAGE 1)

FACILITY INFORMATION

1. Name of Facility – this should be the name of the facility, not the account name on the water bill
2. Control Number – generated and assigned by the water agency
3. NSCB Facility Code – identifies the business classification; assigned by the water agency
4. Type of Facility – Government, Office, Hotel, Restaurant, School, Retail
5. Account Name – as shown on the water bill
6. Address – actual address of the facility being audited, including what building (for example, Dormitory, Cafeteria, Conference Center). If buildings at the site are served by individual meters, it may be beneficial to use separate audit forms. When conducting audits on a large site

with multiple buildings and different functions, it is advisable to do a separate audit form for each building. These can be combined later to determine total usage and savings for the site.

7. City – city in which the facility is located
8. Contact Person – name of contact person; if there is another contact person on-site, make a note of their name, position, and contact phone number. Often, there may be two points of contact—one may be the facility manager and the other could be the facility engineer or maintenance person designated to meet with the auditor.
9. Phone – phone number of listed contact person; do not insist that they provide you with their mobile number unless they give it willingly. A business phone number will be sufficient.
10. Email – email address of listed contact person
11. Year Built (approx.) – year the building was built; note any significant remodels, but if they do not have that information an estimate is acceptable. Having the year built can help determine what types of fixtures are installed once a program has been ongoing, especially if new construction and commerce laws are enacted.
12. Square Meters – approximate total square meter area of the building being audited as it pertains to the address listed above
13. Number of Floors – number of floors as it pertains to the building being audited shown in the address listed above.
14. Lot Size – approximate lot size of the building being audited (in square meters) as shown in the address listed above

DATA FORMS

This is a tracking method to ensure that all forms used for the audit are properly accounted for. A note should be made if there are any other forms used that accompany the audit form. For example, if maps or diagrams are attached.

1. Master Form – there should only be one master form for each audited building
2. Population Form – most likely there will only be one population form; however, for large sites, additional sheets can be used
3. Bathroom Form – depending on the size of the building, there may be several bathroom forms; it is generally recommended that a separate bathroom form be used for each floor
4. Kitchen/Laundry Form – most likely there will only be one kitchen/laundry form; however, if there are multiple utility sinks throughout the facility you may need to use an additional form

SOURCES OF WATER

This section describes what the various sources of water are for the facility. If available, list what percentage of water is provided according to source and what purpose it is used for. Water usage should total 100 percent.

1. Local Water District – water provided directly from the water district through a water meter; make a note if the water district provides additional deliveries via a truck to supplement their water delivered via pipes
2. Rain/Storm Harvest – rainwater that is collected into a cistern
3. Well – 20 meters = shallow, 40 meters = deep

4. Delivery Truck (Private) – water that is delivered to the customer via a truck from a private vendor, typically used to supplement their water supply. For example, a customer who relies on well water may receive truck-delivered potable water
5. Graywater – non-potable, on-site, untreated wastewater recycled for reuse
6. On-Site Recycle – non-potable, on-site wastewater may be treated or untreated depending on use; often used for the same process. For example, washing machine rinse water is used for the next wash cycle.
7. Reclaim – non-potable, treated wastewater, usually treated off-site by a third party government and re-distributed back to a site for reuse; reclaim is rarely done on-site

SCHOOL SUPPLEMENT

1. Enrollment for School Year – list the months that the school is in session
2. No. of Students – provide the total number of students and the percentage of male versus females; make note if there are part-time students versus full-time students and how many hours a day they are on school grounds, since water usage will be calculated based on how many hours they are on-site. Be sure to take into account whether there are weekend and evening classes.
3. No. of Faculties – provide the total number of faculty members and the percentage of males versus females; make note of how many hours faculty are on-site. For example, if there are 20 part-time faculty staff working 4 hours a day versus 40 full-time staff working 10 hours a day.
4. No. of other Employees – this may include administration staff, janitorial staff, maintenance staff. Provide the total number of employees and the percentage of males versus females; make note of how many hours an employee is on-site.
5. Months/weeks that school is not operating – list the total period of time that a school is not operating. Keep in mind, most schools provide summer courses and some may rent out their school facilities for summer activities (retreats, etc.) Make note of any additional or unusual schedules.

OTHER OUTDOOR WATER USES/LEAKS DETECTED

Note if there are any outdoor water uses, such as decorative fountains and landscaping. If there is landscaping, note what type (grass, decorative shrubs, trees, etc.), what type of method is used for watering, and how often watering occurs.

Cooling Tower: Mark the appropriate box if the facility uses a cooling tower.

SURVEYOR DATA

1. Auditor/s – list name or auditor, or auditors if more than one
2. Audit Date – list the date the audit is conducted

RESTAURANT SUPPLEMENT

1. Number of seats – list the seating capacity of the restaurant
2. Avg. Number of Meals Served/Day – list the average number of meals served per day

3. Sit Down or Fast Food – list whether the restaurant is sit down or fast food as this helps to determine the type of restaurant operation; if no dishware is provided (only disposable), make a note

HOSPITAL SUPPLEMENT

1. Number of Hospital Beds – list the total number of hospital beds available for overnight stay
2. Ave. annual occupancy % – list the average annual occupancy rate for hospital beds
3. Meals Served/Day – list the number of meals served per day for hospital bed patients only
4. Number of Outpatients seen per day – list the number of outpatients who are seen per day; be cautious not to double count and include with visitors

HOTEL SUPPLEMENT

1. Number of Guest Rooms – list the total number of guest rooms
2. Number of Floors – list the total number of floors for the building
3. Ave. Annual Occupancy – list the average annual guest room occupancy; note any seasonal changes that may affect the occupancy rate
4. No. of Restaurant Seats – list the total capacity of restaurant seats; for large hotels where there may be more than one restaurant, add a supplemental sheet noting the additional restaurants
5. No. of Meals Served/Day – list the average number of meals served per day
6. No. of Function Rooms – list the number of function rooms; some hotels have multiple function rooms, ranging in sizes; if so, provide additional notes
7. Function Room Capacity – list the capacity of each function room
8. Ave. No. of Functions/week – list the average number of functions held each week
9. No. of Function Meals Served/Day – list the number of meals served for each function room

It is important to gather population data for function rooms, similar to worker/visitor hours. This information can be used to calculate population for the purpose of determining water use.

FLEET CAR WASHING

1. No. of Cars Washed – list the total number of fleet cars washed; be careful to note if employees are washing their cars on-site in addition to fleet cars
2. Frequency of Washing – list the frequency of washing (daily, weekly, 2x a week, etc.)
3. Source of Water – list the source of water used. For example, is it potable water from the local provider, well water, or possibly on-site reuse.
4. Method of Carwash – check whether they are using a hose, hose with a shutoff valve, or a bucket

POOL

1. No. of Pools – list the number of pools on site; be sure to note above if the pool has a separate sub-meter
2. Cover – check if the pool has a cover, yes or no

3. Estimated Volume – calculate the volume of the pool based on length x width x average depth to get volume in m^3

METERS

Accurate water meters are essential to conducting a valid water audit. Source water meters indicate the amount of water supplied to the site by a water provider. Sub-meters indicate water use for specific processes, equipment, or individual tenants at the site. Locate and identify as many of the meters and sub-meters as possible.

1. Areas Served – list the area that the meter serves; for sub-meters, list the area, process, or equipment
2. Acct. No. – list the account number associated with the master meter
3. Meter No. – list the meter number if it is a master meter; if it is a sub-meter, note sub-meter and location

Note: A site may have more than one master meter. If a master meter is associated with one building, it would be preferable to have a separate audit form for each building. However, this is not always the case. For example, a large office complex may have more than one master meter serving it, making it difficult to determine which buildings each meter serves. Note if the meter is measuring water supply provided from an on-site well/spring. If you have blueprints or a site map, make a note of where meters are located.

HOW TO USE THE COMMERCIAL AUDIT POPULATION FORM (PAGE 2)

POPULATION

1. On-Site Groups – it is important to list on-site groups according to the number of hours they work. For example, Group 1 may work 8 hours per day, Group 2 may work 4 hours per day. Visitors should be listed separately. (See example.)
2. Daily No. of People – provide the total number of people for each group
3. Male % – list the percentage of workers and visitors that are male.
4. No. of hours per person/shift per day – because each group is listed according to the hours/shifts they are on-site, this number should be the same across the column

When the data are input into an Excel spreadsheet, the totals will automatically be calculated. These figures are used to calculate the number of toilet flushes and other end uses according to the total number of hours workers or visitors were on-site each day. If the site has multiple audit forms, be sure to only use occupancy for the particular building you are auditing. For example, a cafeteria occupancy would be different from a dormitory or classroom. Also note any unusual schedules, for example, dormitories may be closed during summer.

You can never capture too much information when you are at the site. Make note of any factors that may affect calculation of water use. Collecting as much data as possible is a tool for benchmarking and to balancing water usage with activities and occupancy.

HOW TO USE THE COMMERCIAL AUDIT MASTER BATHROOM FORM (PAGE 3)

FLOOR INFORMATION

1. Floor Level – note the floor this information represents
2. Total No. of Toilets – list the total number of toilets on this floor
3. Total No. of Faucets – list the total number of bathroom faucets on this floor
4. Total No. of Urinals – list the total number of urinals on this floor
5. Total No. of Showerheads – list the total number of showerheads on this floor
6. Control Number – note the control number as shown on page 1 of the audit form

TOILET INFORMATION

1. Location – note which bathroom the toilet is located in, for example, front lobby public, admin office, gym facility, hallway public
2. Gender – note if Female (F), Male (M), Unisex (U)
3. Type – list type of toilet: Gravity (G); Flush-o-meter (FOM); for Flush-o-meter Sensor Activated (FOM), list SA under the remarks; Dual Flush (DF); Bucket (B) not plumbed for water supply, uses a bucket to flush the toilet
4. Length (cm) – list the inside length of the toilet tank
5. Width (cm) – list the inside width of the toilet tank
6. Initial Depth (cm) – list the initial depth of the water inside the toilet tank
7. Net Depth (cm) – list the depth of the water remaining in the tank immediately after flushing the toilet (Net Depth will automatically calculate in the Excel spreadsheet.)
8. No. of Sec./Flush (FOM) – list the number of seconds it takes to complete the flush
9. Liters/Flush – (length x width x (depth – net depth))/1,000) for G type only; for DF toilets use the #2 button when testing for flush volume. For FOMs it is the number of seconds to complete the flush x 1.6 liters per second = liters per flush (This formula calculates automatically when entering results in the Excel Worksheet.)
10. Leaks (Y/N) – note whether the toilet is leaking
11. Remarks – note where leak is located if other than from the dye test; if possible, measure the volume of the leak, note if the toilet is defective and not being used, or, for example, flapper is worn/defective
12. If the toilet bowl, tank, or valve is marked with an LPF, note the LPF under remarks. (To date, the majority of toilets audited in the Philippines are not marked. As WDM efforts progress and codes, standards, and labeling programs are implemented it will be easier to determine what type of retrofit is applicable.)

FAUCET INFORMATION

1. Location – note location of bathroom faucet, for example, men's lobby
2. Type – note the type of faucet: Regular (R); Sensor Activated (SA); Metered (M) used for bathroom only; and Utility (U) used for other activities
3. It is especially important to record the location and type of faucet, as the water-efficiency standard is based upon whether the faucet is a private bathroom faucet (residences, hotel guest rooms, hospital patient rooms) or public bathroom faucet.

4. Volume (ml) – the total volume of water accumulated based on the number of seconds tested. Note that metered faucets are measured by liters per activation cycle; note how many seconds a cycle is.
5. No. of Seconds – the number of seconds used to measure the volume of water. It is assumed that the flow rate test will be conducted for a recommended 5 seconds. If you use a different time, be sure to cross out 5 and note how many seconds you test the flow rate for, so the calculation will be accurate.
6. Liters/Minute – Volume ml x 12 (based on 5 seconds) = ____ ml/1,000 = LPM (This formula calculates automatically when entering results in the Excel Worksheet.)
7. Aerators (Y/N/NA) – Y = There is an aerator present; N = There is not an aerator present; NA = It is not feasible or applicable to place an aerator on the faucet
8. Leak (Y/N) – Y = The faucet is leaking; N = The faucet is not leaking
9. No. of Drips or ML/Min – note the number of drips counted for 1 minute
10. Leaks Liters/Month – 13.5 x number of drips per minute = drips L/ month (This formula calculates automatically when entering results in the Excel Worksheet.)
11. Remarks – note any additional remarks regarding faucets or leaks

URINAL INFORMATION

1. Location – note which bathroom the toilet is located in, for example, front lobby public, admin office, gym facility, hallway public
2. Type - note if urinal is Flush-o-meter (FOM); for FOM Sensor Activated (FOM), list SA under remarks; Waterless (W); Trough (T)
3. No. of sec./flush – list the number of seconds it takes to complete the flush
4. Liters/Flush – number of seconds x .95 liters per second = liters per flush
5. Leaks (Y/N) – note whether the urinal is leaking; Y = Yes, N = No
6. Remarks – if possible estimate the leak based on 1 minute

SHOWERHEAD/OTHER BATHROOM SPRAYHEADS INFORMATION

1. Location – note which bathroom the shower is located in, for example, women's gym, men's locker room, hotel room (number)
2. Type – note the type of showerhead/sprayhead: Showerhead (SH), Toilet Bidet Spray (TBS), Urinal Bidet Spray (UBS), Foot Wash Spray (WFS)
3. Volume (ML) – the total volume of water accumulated based on the number of seconds tested
4. No. of Seconds – the number of seconds used to measure the volume of water. It is assumed that the flow rate test will be conducted for a recommended 5 seconds. If you use a different time, be sure to cross out 5 and note how many seconds you test the flow rate for, so the calculation will be accurate
5. Liters/Minute – Volume ml x 12 (based on 5 seconds) = ____ ml/1,000 = LPM (This formula calculates automatically when entering results in the Excel Worksheet.)
6. Leaks (Y/N) –Y = The faucet is leaking, N = The faucet is not leaking
7. No. of Drips or ML/Min - note the number of drips counted for 1 minute
8. Leaks Liters/Month – 13.5 x number of drips per minute = drips L per month (This formula calculates automatically when entering results in the Excel Worksheet.)

9. Showers/Week – depending on the type of facility, this will vary; try to get an estimate of the number of showers per week from the owner/manager; hotels and dormitories can be calculated based on occupancy rate
10. Notes – note any additional remarks or leak estimates
11. Notes – list any other applicable notes
12. Page _ of _ – note the page number. For large facilities, there may be a need for additional Bathroom Forms. If so, be sure to note how many pages were used.

Note: At this time, we are capturing data on bidet and foot wash sprays to determine saturation rates, water usage, and potential for water efficiencies. Currently, there are no water-efficiency ratings or standards for these fixtures. However, it may be possible to retrofit them in the future. The prevalence of these fixtures may vary according to different regions.

HOW TO USE THE COMMERCIAL AUDIT MASTER KITCHEN/LAUNDRY FORM (PAGE 4)

1. Floor level – note the floor this information represents
2. Control Number – note the control number as shown on page 1 of the Audit Form

FAUCET INFORMATION

1. Location – note which bathroom the toilet is located in, for example, front lobby public, admin office, gym facility, hallway public. In some cases, cafeterias will have a separate handwashing sink in the dining hall.
2. Type – note the type of faucet: Regular (R), Utility (U), Pre-Rinse Spray Valve (PRSV), Foot Activated (FA)
3. It is important to note if a regular faucet in the kitchen is used strictly for handwashing, as the water-efficiency standard is different from a kitchen faucet used for dishwashing, etc.
4. Aerators (Y/N/NA) – Y = There is an aerator present; N = There is not an aerator present; NA = It is not feasible or applicable to place an aerator on the faucet. It may not be appropriate to install an aerator if the faucet is strictly used for filling cooking pots or buckets.
5. Volume (ML) – the total volume of water accumulated based on the number of seconds tested
6. No. of Seconds – the number of seconds used to measure the volume of water. It is assumed that the flow rate test will be conducted for a recommended 5 seconds. If you use a different time, be sure to cross out 5 and note how many seconds you test the flow rate for, so the calculation will be accurate.
7. Liters/Minute – Volume ml x 12 (based on 5 seconds) = ____ ml/1,000 = LPM (This formula calculates automatically when entering results in the Excel Worksheet.)
8. Leak (Y/N) – Y = The faucet is leaking; N = The faucet is not leaking
9. No. of Drips or ML/Min – note the number of drips counted for 1 minute
10. Liters/Month – 13.5 x number of drips per minute = drips L per month (This formula calculates automatically when entering results in the Excel Worksheet.)
11. Remarks – note any additional remarks regarding faucets or leaks

DISHWASHER INFORMATION

1. Location – note the location of the dishwasher

2. Type – note the type of dishwasher: Under-Counter (UC), Stationery Door (SD), Hood Type (H), Conveyor or C-Line (C), Flight (F)
3. Make – note make or manufacturer; can often be found on the serial plate
4. Model Number – note model number if available; can often be found on the serial plate
5. Racks/Day – list the number of racks that are washed each day
6. Remarks – note if the dishwasher is currently reusing water from the previous load

FOOD STEAMER INFORMATION

1. Qty.(Pans) – list the number/capacity of boiler pans in the food steamer
2. Condensation Return (Y/N) – Yes = condensation from the steamer is returned to the boiler; No = condensation is sent directly to the sewer
3. Hrs. Used/Day – list the number of hours per day the food steamer is operating

FOOD DISPOSAL GRINDER INFORMATION

1. Make – note make or manufacturer; can often be found on the serial plate
2. Model Number – note model number if available; can often be found on the serial plate
3. Volume (ML) – the total volume of water accumulated based on the number of seconds tested
4. No. of Seconds – the number of seconds used to measure the volume of water. It is assumed that the flow rate test will be conducted for a recommended 5 seconds. If you use a different time, be sure to cross out 5 and note how many seconds you test the flow rate for, so the calculation will be accurate.
5. Liters/Minute – Volume ml x 12 (based on 5 seconds) = ____ ml/1,000 = LPM (This formula calculates automatically when entering results in the Excel Worksheet.)
6. Continuous Run (Y/N) – note if water is continuously running: Y = Yes, N = No
7. Automatic Shutoff (Y/N) – note if there is an automatic shutoff after activation of food grinder, Y = Yes, N = No

COMBI OVEN INFORMATION

1. Qty.(Pans) – list the number/capacity of pans in the combi oven
2. Condensation Return (Y/N) – Yes = condensation from the steamer is returned to the boiler; No = condensation is sent directly to the sewer
3. Hrs. Used/Day – list the number of hours per day the combi oven is operating

WOK STOVE INFORMATION

1. Air/Water (A/W) – note whether the wok stove is Air-cooled (A) or Water-cooled (W)

ICE MACHINE INFORMATION

1. Make – note make or manufacturer; can often be found on the serial plate
2. Model Number – note model number if available; can often be found on the serial plate
3. Type – note the type of ice produced: Cube (C), Flake (F), Nugget (N)
4. Air/Water – note if the ice machine is: Air-cooled (A), Water-cooled (W)

DIPPER WELL INFORMATION

1. Type – note the type of dipper well: Continuous Run (C), Metered (M), if they use a faucet and container as a dipper well note as In-Sink (IS)

2. Make – note make or manufacturer; can often be found on the serial plate
3. Model Number – note model number if available; can often be found on the serial plate
4. Hours/Week – the number of hours per week that the dipper well is used
5. No. of Seconds – the number of seconds used to measure the volume of water. It is assumed that the flow rate test will be conducted for a recommended 5 seconds. If you use a different time, be sure to cross out 5 and note how many seconds you test the flow rate for, so the calculation will be accurate.
6. Volume (ML) – the total volume of water accumulated based on the number of seconds tested
7. Liters/Minute – Volume ml x 12 (based on 5 seconds) = ____ ml/1,000 = LPM (This formula calculates automatically when entering results in the Excel Worksheet.)

LAUNDRY EQUIPMENT INFORMATION

1. Type – note the type of laundry equipment: Residential V Axis (RVA), Residential H Axis (RHA), Coin-Op V Axis (CVA), Coin-Op H Axis (CHA), Multi-Load V Axis (MVA), Multi-Load H Axis (MHA), Conventional Washer Extractor (CWE), Continuous Tunnel (CT)
2. Make – note make or manufacturer if available
3. Model Number – note model number if available
4. Recycle Water (Y/N) – note if water is being reused/recycled, Y = Yes, N = No
5. Loads/Week – list the number of loads washed per week
6. Other Leaks Detected – note any other leaks
7. Notes – list any other applicable notes
8. Page _ of _ – note the page number. For large facilities, there may be a need for additional Kitchen/Laundry Forms. If so, be sure to note how many pages were used.

A sample completed Water Audit Form is available for review in Appendix B.

ZCWD WATER DEMAND AUDIT DATA COLLECTION FORM 1 (Commercial)

Name of Facility	
NSCB Facility Code	
Type of Facility	
Account Name	
Address	
City	
Contact Person	
Phone	
Email	
Year Built (Appox.)	
Square Meter (Bldg)	
Number of Floor/s	
Lot Size (Sq. M.)	

Data Forms:	Number of Forms
Master Form	
Population	
Bathroom	
Kitchen/Laundry	

Sources of Water	**Usage (%)**	**Purpose**
Local Water District		
Rain/Storm Harvest		
Well ☐ Deep ☐ Shallow		
Delivery Truck (Private)		
Gray Water		
On-site Recycle		
Reclaim		

School Supplement

Enrollment for School Year _________ to __________			
	Total #	**% M**	**% F**
No. of Students			
No. of Faculties			
No. of other Employees			
Months/weeks that school is not operating (if portion of month, show no. of week/s)			

Other Outdoor Water Uses/Landscaping:

Cooling Tower: Yes ☐ No ☐

Control Number:	

Surveyor Data

Auditor/s	
Audit Date	

Restaurant Supplement

No. of Seats	
Avg. No. Meals served/Day	
Sit Down or Fast Food	

Hospital Supplement

No. of Hospital Beds	
Avg. Annual Occupancy (%)	
Avg. No.Meals Served/Day	
No. of Outpatient seen per day	

Hotel Supplement

No. of Guest Rooms	
No. of Floors	
Avg. Annual Occupancy	
No. Restaurant Seats	
No. Meals Served/Day	
No. of Function Rooms	
Function Room Capacity	
Avg. No. of Functions/Week	
No. Function Meals Served/Day	

Fleet Car Washing

No. of Cars Washed	
Frequency of Washing	
Source of Water	
Hose ☐ Hose with Shut Off ☐ Bucket ☐	

Pool

No. of Pools	
Cover	☐ Yes ☐ No
Estimated Volume (L x W x Ave. Depth = m3)	

Meters

Areas Served	Acct. No.	Meter No.

Poulation WorkSheet (used for data input only)Blank worksheet for auditor follows **Control Number:**

On-Site Groups	Daily No. of People		No. of hours per person per day							Weekly hrs	Female hrs	Male hrs
	No. of People	% Male	Mon	Tues	Wed	Thurs	Fri	Sat	Sun			
										0.00	0.00	0.00
										0.00	0.00	0.00
										0.00	0.00	0.00
										0.00	0.00	0.00
									Total Hours	0.00	0.00	0.00

Female hrs per week	0.00	Female Toilet Flushes per week	0	Total Toilet Flushes per week	0
Male hrs per week	0.00	Male Toilet Flushes per week	0	Total Urinal Flushes per week	0
		Male Urinal Flushes per week	0	Total Flushes per week	0
		Net Male Toilet Flushes per week	0		
				Bathroom Faucets Rinse minute per week	0

Legend:

Female hrs per week	= Females hrs
Male hrs per week	= Male hrs
Femele Toilet Flushes per week	= Female hrs per week / 2.5
Male Toilet Flushes per week	= Male hrs per week / 2.5
Male Urinal Flushes per week	= Male Toilet Flushes per week / 0.67
Net Male Toilet Flushes per week	= Male Toilet Flushes per week - Male Urinal Flushes per week
Total Toilet Flushes per week	= Female Toilet Flushes per week + Net Male Toilet Flushes per week
Total Urinal Flushes per week	= Male Urinal Flushes per week
Total Flushes per week	= Total Toilet Flushes per week + Total Urinal Flushes per week
	= Other Fields that are automatically computed

Note: All cells that are not shaded are user-input data.

page ___ of ___

Poulation WorkSheet **Control Number:**

On-Site	Daily No. of People		No. of hours per person/shift per day						
Groups	No. of People	% Male	Mon	Tues	Wed	Thurs	Fri	Sat	Sun

Notes:

page ___ of ___

ZCWD WATER DEMAND AUDIT DATA COLLECTION FORM FOR COMMERCIAL

Floor Level	______	**Total No. of Faucets**	______	Control Number	
Total No. of Toilets	______	**Total No. of Urinals**	______	**Total No. of Shower Heads**	______

	Toilet 1	Toilet 2	Toilet 3	Toilet 4	Toilet 5	Toilet 6	Toilet 7	Toilet 8
Location								
Gender								
Type								
Length (cm)								
Width (cm)								
Depth (cm)								
Net Depth (cm)								
No. of Sec./ flush (FOM)								
Liters/Flush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leak (Y/N)								
Remarks								

Type: Gravity = G Flush-O-Meter = FOM FOM Sensor Activated = FOM Note SA in Remarks Dual Flush = DF Bucket = B

BATHROOM	Faucet 1	Faucet 2	Faucet 3	Faucet 4	Faucet 5	Faucet 6	Faucet 7	Faucet 8
Location								
Type								
Volume (ML)								
No. of Seconds	5	5	5	5	5	5	5	5
Liters/Minute	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aerator (Y/N/NA)								
Leak (Y/N)								
No. of Drips/ Min.								
Liters/Month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Remarks								

Type: Regular = R Sensor Activated = SA Metered = M Utility =U

	Urinal 1	Urinal 2	Urinal 3	Urinal 4	Urinal 5	Urinal 6	Urinal 7	Urinal 8
Location								
Type								
No. of sec./flush								
Liters/Flush	-	-	-	-	-	-	-	-
Leak (Y/N)								
Remarks								

Type: Flush-o-meter = FOM FOM Sensor Activated = FOM Note SA in Remarks Waterless=W Trough= T

	SH 1	SH 2	SH 3	SH 4	SH 5	SH 6	SH 7	SH 8
Location								
Type								
Volume (ML)								
No. of Seconds	5	5	5	5	5	5	5	5
Liters/Minute	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leak (Y/N)								
No. of Drips/ Min.								
Liters/Month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Showers / Week								
Remarks								

Type: Urinal Bidet Spray = UBS Toilet Bidet Spray = TBS Wash Foot Spray = WFS Shower Head = SH

Notes: ______________________________

page ____ of ____

ZCWD WATER DEMAND AUDIT DATA COLLECTION FORM FOR COMMERCIAL KITCHEN/LAUNDRY SERVICES

Floor Level ____________

Control Number	

Faucets/PRSV	Faucet 1	Faucet 2	Faucet 3	Faucet 4	Faucet 5	Faucet 6	Faucet 7
Location							
Type							
Aerator:Y/N/NA							
Volume (ML)							
No. of Seconds	5	5	5	5	5	5	5
Liters/Minute	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leak (Y/N)							
No. of Drips/ Min.							
Liters/Month	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No. of Minutes/Day							

Type: Utility = U Pre-rinse Spray Valve = PRSV Handheld Spray = HHS Regular = R Foot Activated = FA

Dishwasher (DW)	DW 1	DW 2	DW 3
Location			
Type			
Make			
Model Number			
Racks/Day			
Remarks			

Type: Stationary Door = SD Hood = H UnderCounter = UC Conveyor/C-Line = C Flight = F

Combi-Oven	Qty. (Pans)	Condensation Return	
Connected to Boiler			
Connectionless			
Hrs. Used /Day			

Wok Stove (WS)	WS 1	WS 2	WS 3
Air/Water (A/W)			

Air/Water: Air cooled = A Water cooled = W

Food Steamers (S)	Qty. (Pans)	Condensation Return (Y/N)	
Connected to Boiler			
Connectionless			
Hrs. Used /Day			

For Connected to Boiler:
Condensation Return = Yes - if returned to the boiler
No - if discharged to sewer

Ice Machine (IM)	IM 1	IM 2	IM 3
Make			
Model Number			
Type			
Air / Water (A/W)			

Type: Cube = C Flake = F Nuggett = N
Air/Water: Air cooled = A Water cooled = W

Food Disposal Grinder	FDG 1	FDG 2	FDG 3
Make			
Model Number			
Volume (ML)			
No. of Seconds	5	5	5
Liters / Minute	0.0	0.0	0.0
Continuous Run (Y/N)			
Auto Shutoff (Y/N)			

Auto Shutoff: No auto shutoff = N
Water and motor will automatically shutoff within 5 minutes of activation = Y

Dipper Well	DW 1	DW 2	DW 3
Type			
Make			
Model Number			
Hours / Week			
Volume (ML)			
No. of Seconds	5	5	5
Liters / Minute	0.0	0.0	0.0

Type: Metered = M, Hand Operated = H, Continuous Run = C
Make: If they use a faucet and container as dipper well, write in "in-sink" as make

Laundry	L1	L2	L3
Type			
Make			
Model Number			
Recycle Water (Y/N)			
Loads / Week			

Notes:

Type: Residential V-Axis = RVA, Residential H-Axis = RHA, Coin-Op V-Axis = CVA, Coin-Op H-Axis = CHA, Multi-Load V Axis = MVA, Multi=Load H Axis = MHA, Conventional Washer Extractor = CWE, Continous Tunnel = CT

Other Leaks Detected

page ___ of ___

CONCLUDING THE AUDIT

1. Review your findings with the customer.
2. Describe water-efficient equipment retrofit/replacement options.
3. Provide general tips on saving water and fixing leaks (hand out brochure or flyer).
4. Educate and encourage the customer to follow good water use practices.
5. Explain that a final report will be given to them in two to four weeks and will include the following: water use findings and observations, potential water-efficiency opportunities, potential water savings and cost savings, and recommendations.
6. Thank the customer for their time and participation and encourage them to contact the water district if they have any questions regarding the water audit.

SECTION IX: CALCULATING WATER USAGE AND SAVINGS

Transferring the audit form data to the Excel Audit Spreadsheet:

1. Enter the information collected on the audit data forms into the Excel audit spreadsheet.
2. If there are multiple data collection forms for bathrooms or kitchens, create duplicate worksheets in your file. Make sure to rename them according to the description of the floor level shown on your audit data collection form. For example, Floor 1 may have a separate bathroom worksheet, Floor 2, etc.
3. After entering the data, conduct a review to ensure that all of the data were entered correctly.

Transferring the fixtures data from the Excel Audit Spreadsheet to the Water Savings and Cost Analysis Excel Spreadsheet:

1. Enter the information on fixtures and existing water usage from the Excel audit spreadsheet into the savings and cost analysis Excel spreadsheet.
2. There are six worksheets:
   - Toilet Worksheet
   - Urinal Worksheet
   - Showerhead Worksheet
   - Bathroom Faucet Worksheet
   - Kitchen and Other Faucet Worksheet
   - Leaks Worksheet
3. Toilet Worksheet:
   - Enter the Consumer Pesos/Cubic Meter (from the water bill) – This may include sewer costs also, if it is based on water usage. The consumer cost should not include fixed fees.
   - Enter the Water Purveyor Avoided Costs per Cubic Meter – Avoided costs include chemical treatment and pumping costs, as these are variable costs based on the amount of water supplied. Fixed fees such as overhead, salaries, scheduled pipe maintenance, and repairs are not included.
   - Enter the Toilet Type – For example: G, FOM, or Waterless. Do not enter fixtures that are not functioning or defective. These will still need to be included on the report, but for purposes of calculating water use and savings, they should not be included. Toilet type will determine the Retrofit Liters/Flush (based on the water-efficiency standards).
   - Enter the QTY Fixtures – Enter the quantity of fixtures based on the toilet type and LPF. For example, there may be five gravity toilets that flush at 9 liters, three gravity toilets that flush at 11 liters, and three FOM toilets that flush at 6 liters each.
   - Enter the Total Toilet Flushes per week based on the population worksheet – (Be careful not to enter the total flushes per week that combines the toilet and urinal flushes.) The total toilet flushes per week for each row will automatically calculate by taking the total toilet flushes per week entered and dividing the total quantity of fixtures on the worksheet. For example, 2,000 toilet flushes per week/10 toilet fixtures = 200 toilet flushes per week per fixture.
   - Retrofit Liters/Flush – enter the water-efficiency standard based on the toilet type in the first column. For example, G toilet = 4.8, FOM = 4.8, DF = 6.0
   - It is important to enter fixtures that are found to be water-efficient, as these toilets are being used and will be taken into account when calculating toilet flushes per week. However, so that they do not negatively impact water savings and costs, enter the retrofit liters per flush. For example, an existing G toilet measured at 3 LPF should be entered as 4.8 LPF.

- Consumer Annual Savings Cubic Meter – automatically calculates by taking (existing liters per flush – retrofit liters per flush) x toilet flushes per week x 52 weeks/1,000 = m^3 saved (if the facility is open less than 52 weeks a year, this can be changed)
- Consumer Annual Saving Pesos – automatically calculates by taking m^3 saved x consumer pesos cost
- Purveyor Savings Pesos – automatically calculates by taking m^3 saved x water purveyor pesos cost
- Cost to Replace – Enter the estimated cost to retrofit/replace the toilet. If there are multiple fixtures in that row, be sure to multiply the number of fixtures by the cost per fixture (include labor estimates if available)
- Consumer ROI – automatically calculates consumer annual savings/cost to replace (most businesses require at least a 20 percent return on investment [ROI], which equates to a payback period of 5 years or less)
- Payback – automatically calculates cost to replace/consumer annual savings

4. Urinal Worksheet:
   - Enter the Consumer Pesos/Cubic Meter (from the water bill) – This may include sewer costs also, if it is based on water usage. The consumer cost should not include fixed fees.
   - Enter the Water Purveyor Avoided Costs per Cubic Meter – Avoided costs include chemical treatment and pumping costs, as these are variable costs based on the amount of water supplied. Fixed fees such as overhead, salaries, scheduled pipe maintenance, and repairs are not included.
   - Enter the Urinal Type – For example, FOM or Waterless. Do not enter fixtures that are not functioning or defective. These will still need to be included on the report, but for purposes of calculating water use and savings, they should not be included. Urinal type will determine the Retrofit Liters/Flush (based on the water-efficiency standards).
   - Enter the QTY Fixtures – Enter the quantity fixtures based on the urinal type and LPM.
   - Enter the Total Urinal Flushes per week based on the population worksheet – (Be careful not to enter the Total Flushes per week that combines the toilet and urinal flushes.) The total urinal flushes per week for each row will automatically calculate by taking the total urinal flushes per week entered and dividing the total quantity of fixtures on the worksheet. For example, 2,000 urinal flushes per week/10 urinal fixtures = 200 urinal flushes per week per fixture.
   - Retrofit Liters/Flush – enter the water-efficiency standard based on the urinal type in the first column.
   - It is important to enter fixtures that are found to be water-efficient, as these urinals are being used and will be taken into account when calculating toilet flushes per week. However, so that they do not negatively impact water savings and costs, enter the retrofit LPF. For example, an existing urinal measured at .5 LPF should be entered as 1.9 LPF.
   - Consumer Annual Savings Cubic Meter – automatically calculates by taking (existing LPF – retrofit LPF) x urinal flushes per week x 52 weeks/1,000 = m^3 saved (if the facility is open less than 52 weeks a year, this can be changed)
   - Consumer Annual Saving Pesos – automatically calculates by taking m^3 saved x consumer pesos cost
   - Purveyor Savings Pesos – automatically calculates by taking m^3 saved x water purveyor pesos cost
   - Cost to Replace – Enter the estimated cost to retrofit/replace the urinal. If there are multiple fixtures in that row, be sure to multiply the number of fixtures by the cost per fixture (include labor estimates if available)

- Consumer ROI – automatically calculates consumer annual savings/cost to replace (most businesses require at least a 20 percent ROI, which equates to a payback period of 5 years)
- Payback – automatically calculates cost to replace/consumer annual savings

5. Showerhead Worksheet:
    - Enter the Consumer Pesos/Cubic Meter (from the water bill) – This may include sewer costs also, if it is based on water usage. The consumer cost should not include fixed fees.
    - Enter the Water Purveyor Avoided Costs per Cubic Meter – Avoided costs include chemical treatment and pumping costs, as these are variable costs based on the amount of water supplied. Fixed fees such as overhead, salaries, scheduled pipe maintenance, and repairs are not included.
    - Enter the Showerhead – location of the shower. Do not enter fixtures that are not functioning or defective. These will still need to be included on the report, but for purposes of calculating water use and savings, they should not be included.
    - Enter the QTY Fixtures – Enter the number of fixtures for that location, based on existing LPM. For example, women's gym has two showerheads at 10 LPM and two showerheads at 12 LPM.
    - Enter the Total Showers per week from the audit forms – The showers per week for each row will automatically calculate by taking the total showers per week entered and dividing the total quantity of fixtures on the worksheet. For example, 100 showers per week/10 showerhead = 10 showers per week per showerhead.
    - Retrofit Liters/Minute – enter the water-efficiency showerhead standard.
    - It is important to enter fixtures that are found to be water-efficient, as these showerheads are being used and will be taken into account when calculating showers per week. However, so that they do not negatively impact water savings and costs, enter the retrofit LPM. For example, a showerhead with an existing 6 LPM should be entered as 7.6 LPM (the water-efficient standard).
    - Consumer Annual Savings Cubic Meter – automatically calculates by taking (existing LPM – retrofit LPM) x showers per week x 10 (average 10 min per shower) x 52 weeks/1,000 = m^3 saved (if the facility is open less than 52 weeks a year, this can be changed)
    - Consumer Annual Saving Pesos – automatically calculates by taking m^3 saved x consumer pesos cost
    - Purveyor Savings Pesos – automatically calculates by taking m^3 saved x water purveyor pesos cost
    - Cost to Replace – Enter the estimated cost to retrofit/replace the showerhead. If there are multiple fixtures in that row, be sure to multiply the number of fixtures by the cost per fixture (include labor estimates if available)
    - Consumer ROI – automatically calculates consumer annual savings/cost to replace (most businesses require at least a 20 percent ROI, which equates to a payback period of 5 years)
    - Payback – automatically calculates cost to replace/consumer annual savings

6. Bathroom Faucet Worksheet:
    - Enter the Consumer Pesos/Cubic Meter (from the water bill) – This may include sewer costs also, if it is based on water usage. The consumer cost should not include fixed fees.
    - Enter the Water Purveyor Avoided Costs per Cubic Meter – Avoided costs include chemical treatment and pumping costs, as these are variable costs based on the amount of water supplied. Fixed fees such as overhead, salaries, scheduled pipe maintenance, and repairs are not included.

- Enter the type of faucet – A public bathroom will have a different water-efficiency standard than a private bathroom. Do not enter fixtures that are not functioning or defective. These will still need to be included on the report, but for purposes of calculating water use and savings, they should not be included.
- Enter the QTY Fixtures – Enter the number of fixtures for each type, based on existing LPM.
- Enter the Total rinse minutes per week from the population forms – The rinse minutes per week for each row will automatically calculate by taking the total rinse minutes per week entered and dividing the total quantity of fixtures on the worksheet. For example, 100 rinse minutes per week/10 faucets = 10 rinse minutes per week per faucet. Note: Rinse minutes per week from the population form are based on total flushes per week x 20 seconds per rinse = total rinse minutes per week. If private faucets are being used (for example, in hotel rooms), you should use a separate bathroom faucet worksheet. Private faucet rinse minutes per week will be calculated based on the total number of private faucets x 3 minutes average per day
- Retrofit Liters/minute – enter the water-efficiency bathroom faucet standard.
- It is important to enter fixtures that are found to be water-efficient, as these faucets are being used and will be taken into account when calculating rinse minutes per week. However, so that they do not negatively impact water savings and costs, enter the retrofit LPM.
- Consumer Annual Savings Cubic Meter – automatically calculates by taking (existing LPM – retrofit LPM) x rinse minutes per week x 52 weeks/1,000 = m^3 saved (if the facility is open less than 52 weeks a year, this can be changed)
- Consumer Annual Saving Pesos – automatically calculates by taking m^3 saved x consumer pesos cost
- Purveyor Savings Pesos – automatically calculates by taking m^3 saved x water purveyor pesos cost
- Cost to Replace – Enter the estimated cost to retrofit/replace the faucet. If there are multiple fixtures in that row, be sure to multiply the number of fixtures by the cost per fixture (include labor estimates if available). Remember that most often a faucet can be retrofitted with an aerator instead of being replaced.
- Consumer ROI – automatically calculates consumer annual savings/cost to replace (most businesses require at least a 20 percent ROI, which equates to a payback period of 5 years)
- Payback – automatically calculates cost to replace/consumer annual savings

7. Kitchen and Other Faucet Worksheet:
   - Enter the Consumer Pesos/Cubic Meter (from the water bill) – This may include sewer costs also, if it is based on water usage. The consumer cost should not include fixed fees.
   - Enter the Water Purveyor Avoided Costs per Cubic Meter – Avoided costs include chemical treatment and pumping costs, as these are variable costs based on the amount of water supplied. Fixed fees such as overhead, salaries, scheduled pipe maintenance, and repairs are not included.
   - Enter the type of faucet and location – Other faucets consist of: utility faucets, PRSV, and handwashing faucets that are not located in a bathroom. Do not enter fixtures that are not functioning or defective. These will still need to be included on the report, but for purposes of calculating water use and savings, they should not be included.
   - Enter the QTY Fixtures – Enter the number of fixture for each type, based on location and existing LPM.
   - Enter the minutes per week from the audit form. Unlike the bathroom faucet worksheet, this will not automatically calculate. This is based on the information provided at the time of the

audit per faucet. For example, kitchen faucet x 20 minutes per day = 140 minutes per week or a utility faucet x 60 minutes per day = 420 minutes per week

- Retrofit Liters/minute – enter the water-efficiency standard based on type.
- It is important to enter fixtures that are found to be water-efficient, as these faucets are being used and will be taken into account when calculating rinse minutes per week. However, so that they do not negatively impact water savings and costs, enter the retrofit LPM.
- Consumer Annual Savings Cubic Meter – automatically calculates by taking (existing LPM – retrofit LPM) x rinse minutes per week x 52 weeks/1,000 = m^3 saved (if the facility is open less than 52 weeks a year, this can be changed). Note that while the spreadsheet shows rinse minutes, some faucets may actually be used for other tasks.
- Consumer Annual Saving Pesos – automatically calculates by taking m^3 saved x consumer pesos cost
- Purveyor Savings Pesos – automatically calculates by taking m^3 saved x water purveyor pesos cost
- Cost to Replace – Enter the estimated cost to retrofit/replace the faucet/PRSV. If there are multiple fixtures in that row, be sure to multiply the number of fixtures by the cost per fixture (include labor estimates if available). Remember that most often a faucet can be retrofitted with an aerator instead of being replaced.
- Consumer ROI – automatically calculates consumer annual savings/cost to replace (most businesses require at least a 20 percent ROI, which equates to a payback period of 5 years)
- Payback – automatically calculates cost to replace/consumer annual savings

8. Leaks Worksheet:
   - Enter the Consumer Pesos/Cubic Meter (from the water bill) – This may include sewer costs also, if it is based on water usage. The consumer cost should not include fixed fees.
   - Enter the Water Purveyor Avoided Costs per Cubic Meter – Avoided costs include chemical treatment and pumping costs, as these are variable costs based on the amount of water supplied. Fixed fees such as overhead, salaries, scheduled pipe maintenance, and repairs are not included.
   - Enter the type of leak and location
   - Enter the leaks L per month from the audit form according to each leak
   - Liters per year is automatically calculated = leaks L per month x 12
   - After repair – automatically assumes 0 L/year
   - Consumer Annual Savings Cubic Meter – automatically calculates by taking L per year/1,000
   - Consumer Annual Saving Pesos – automatically calculates by taking m^3 saved x consumer pesos cost
   - Purveyor Savings Pesos – automatically calculates by taking m^3 saved x water purveyor pesos cost
   - Cost to Replace – automatically assumes it is 0 cost to replace a leak, although if a cost is incurred, it can be entered if the estimated cost is available
   - Consumer ROI – automatically calculates 0 unless a cost to replace was entered
   - Payback – automatically calculates 0 unless a cost to replace was entered

In order to determine the estimated labor costs for water-efficient fixtures/equipment, research will need to be conducted based on the local market.

In order to estimate water use and water savings for kitchen/laundry equipment, research will need to be conducted based on the type and models of the existing equipment. Because much of the equipment is often older, it is difficult to determine their water usage. For this purpose and because the cost of replacing the equipment may not be cost-effective, we recommend replacing them with water-efficient equipment once they reach the end of a life cycle. This should still be included as a recommendation on the report. Should you be able to identify the water usage, estimates can be provided on potential water savings.

Simple payback calculation:
Cost to retrofit or replace annual savings = payback (years)

ROI calculation:
Annual savings/cost to retrofit or replace

Note that while some measures may not yield an acceptable payback, the payback could be acceptable by providing a cumulative total of all combined measures. Indirect energy savings can also be garnered from implementing water-efficiency measures.

SAMPLE COMPLETED WATER SAVINGS AND COST ANALYSIS FORM

Toilet Water Efficiency Standards:

Gravity or FOM Toilet 4.8 L per flush

Dual-Flush Toilet 3.0 L per partial flush 6.0 L per full flush

	Consumer	Water Purveyor
	Pesos/Meter3	Avoided Costs/M3
	52.6	15.78

Sample Worksheet

Pre-Existing Equipment			Total Toilet Flushes per week	Retrofit	Consumer Annual Savings		Purveyor Savings	Cost to Replace		
Toilet Type	Qty Fixtures	Liters/ Flush	4289.00	Liters/ Flush	Cubic Meter	Pesos	Pesos	Total Pesos/ row	Consumer ROI Annual	Payback (yrs.)
G	5	9.3	974.77	4.8	228.1	11997.89	3599.37	40,000	30%	3.33
G	2	6.6	389.91	4.8	36.5	1919.66	575.90	16,000	12%	8.33
G	2	11.1	389.91	4.8	127.7	6718.82	2015.65	16,000	42%	2.38
G	1	10.7	194.95	4.8	59.8	3146.11	943.83	8,000	39%	2.54
G	1	10.4	194.95	4.8	56.8	2986.14	895.84	8,000	37%	2.68
G	1	11.7	194.95	4.8	69.9	3679.35	1103.81	8,000	46%	2.17
G	2	8.6	389.91	4.8	77.0	4052.62	1215.79	16,000	25%	3.95
G	1	10.3	194.95	4.8	55.8	2932.82	879.85	8,000	37%	2.73
G	2	10.6	389.91	4.8	117.6	6185.58	1855.67	16,000	39%	2.59
G	1	9.9	194.95	4.8	51.7	2719.52	815.86	8,000	34%	2.94
G	1	11.3	194.95	4.8	65.9	3466.06	1039.82	8,000	43%	2.31
G	1	12.5	194.95	4.8	78.1	4105.95	1231.78	8,000	51%	1.95
FOM	1	11.2	194.95	4.8	64.9	3412.73	1023.82	0	0%	0.00
DF	1	8.0	194.95	6.0	20.3	1066.48	319.94	0	0%	0.00
	22			Total	1,110	58,390	17,517	160,000	36%	2.74
	sanity check numbers				1110.1	58389.74	17516.92	160,000		

Estimated cost to retrofit:

Gravity toilet	8000.00
FOM valve & fixture	14100.00
Dual Flush	10000.00
Only replace FOM diaphragm valve	4700.00
Only replace FOM piston valve	7050.00
Displacement device	0 - 200

Note: It is important to verify that the replacement valve is compatible with the existing fixture, so that it functions properly and at the proper performance rate.

Handicapped, elongated and one piece toilets are more expensive

Urinal Water Efficiency Standards: 1.9 L per flush

	Consumer	Water Purveyor
	Pesos/Meter3	Avoided Costs/M3
	52.6	15.78

Sample Worksheet

Pre-Existing Equipment			Total Urinal Flushes per week	Retrofit	Consumer Annual Savings		Purveyor Savings	Cost to Replace		
Urinal Type	Qty Fixtures	Liters/ Flush	1,978	Liters/ Flush	Cubic Meter	Pesos	Pesos	Total Pesos/ row	Consumer ROI Annual	Payback (yrs.)
FOM	4	8.6	989.00	1.9	344.6	18124.26	5437.28		0%	0.00
FOM	2	7.6	494.50	1.9	146.6	7709.57	2312.87		0%	0.00
FOM	1	9.5	247.25	1.9	97.7	5139.71	1541.91		0%	0.00
FOM	1	6.7	247.25	1.9	61.7	3246.14	973.84		0%	0.00
	8		1,978.0	Total	651	34,220	10,266	0	0%	0.00

sanity check numbers 650.6 34219.68 10265.90 0

Estimated cost to retrofit:

Entire urinal valve and fixture	23500
Only Replace diaphragm valve	5000
Only Replace piston valve	7050

Note: It is important to verify that the replacement valve is compatible with the existing fixture, so that it functions properly and at the proper performance rate.

dog name

Showerhead Water Efficiency Standards: 7.6 L per minute

	Consumer	Water Purveyor
	Pesos/Meter3	Avoided Costs/M3
	52.6	15.78

Sample Worksheet

Pre-Existing Equipment			Total Showers per week	Retrofit	Consumer Annual Savings		Purveyor Savings	Cost to Replace		
Showerhead	Qty Fixtures	Liters/ Minute	120	Liters/ Minute	Cubic Meter	Pesos	Pesos	Total Pesos/ row	Consumer ROI Annual	Payback (yrs)
Gym W	1	10.8	60	7.6	99.8	5251.58	1575.48	1,000	525%	0.19
Gym M	1	13.2	60	7.6	174.7	9190.27	2757.08	1,000	919%	0.11
	2			Total	275	14,442	4,333	2,000	722%	0.14

sanity check numbers 274.6 14441.86 4332.56 2,000

Estimated cost to retrofit:

Showerhead 1000

dog name

Bathroom Faucet Water Efficiency Standards:

Public bathroom faucet 1.9 L per min Private bathroom faucet 6.8 L per min

Public metered faucet 1.0 L per cycle

	Consumer	Water Purveyor
	Pesos/Meter3	Avoided Costs/M3
	52.6	15.78

Sample Worksheet

Pre-Existing Equipment			Total Rinse Mins. P/ week	Retrofit	Consumer Annual Savings		Purveyor Savings	Cost to Replace		
Faucet	Qty Fixtures	Liters/ Minute	2087	Liters/ Minute	Cubic Meter	Pesos	Pesos	Total Pesos/ row	Consumer ROI Annual	Payback (yrs.)
R	4	13.2	379.45	1.9	223.0	11728.09	3518.43	1,200	977%	0.10
R	8	10.8	758.91	1.9	351.2	18474.34	5542.30	2,400	770%	0.13
R	5	9.6	474.32	1.9	189.9	9989.63	2996.89	1,500	666%	0.15
R	1	9.0	94.86	1.9	35.0	1842.24	552.67	300	614%	0.16
R	2	15.6	189.73	1.9	135.2	7109.51	2132.85	600	1185%	0.08
R	1	10.2	94.86	1.9	40.9	2153.61	646.08	300	718%	0.14
R	1	12.0	94.86	1.9	49.8	2620.66	786.20	300	874%	0.11
	22			Total	1,025	53,918	16,175	6,600	817%	0.12
	sanity check numbers				1025.1	53918.08	16175.42	6,600		

Estimated cost to retrofit:

Aerator	300
Bathroom Fauc	3500

dog name

Faucet Water Efficiency Standards:

Utility/kitchen faucet 8.3 L per minute PRSV 6 L per minute

Public bathroom faucet 1.9 L per minute Private bathroom faucet 6.8 L per minute

	Consumer	Water Purveyor
	Pesos/Meter3	Avoided Costs/M3
	52.6	15.78

Sample Worksheet

Pre-Existing Equipment				Retrofit	Consumer Annual Savings		Purveyor Savings	Cost to Replace		
Faucet	Qty Fixtures	Liters/ Minute	Total Rinse Min p/week	Liters/ Minute	Cubic Meter	Pesos	Pesos	Total Pesos/ row	Consumer ROI Annual	Payback (yrs.)
Kitchen PRSV	1	13.2	180	6.0	67.4	3544.82	1063.45	3,300	107%	0.93
Kitchen Utility	1	10.8	720	8.3	93.6	4923.36	1477.01	300	1641%	0.06
Café. Handwash Or	1	10.8	120	1.9	55.5	2921.19	876.36	300	974%	0.10
Basement Janitor	1	10.8	480	8.3	62.4	3282.24	984.67	300	1094%	0.09
				Total	279	14,672	4,401	4,200	349%	0.29
	sanity check numbers				278.9	14671.61	4401.48	4,200		

Estimated cost to retrofit:

Aerators	300
Kitchen/ Faucet	3500
PRSV	3300

dog name

Leaks:					Consumer	Water Purveyor			
Number of drips per minute x 13.5 = LPM					Pesos/Meter3	Avoided Costs/M3	Sample Worksheet		
					52.6	15.78			
Leaks			After Repair	Consumer Annual Savings		Purveyor Savings	Cost to Replace		
Location	liters p/month	litersp/yr	liters/yr	Cubic Meter	Pesos	Pesos	Total Pesos/ row	Consumer ROI Annual	Payback (yrs.)
Faucet 1 Com W Basement	540.0	6480	0.0	6.5	340.85	102.25	0	0%	0.00
Faucet 1 Com M Basement	284.0	3408	0.0	3.4	179.26	53.78	0	0%	0.00
Faucet 1 Com W 1st Fl	810.0	9720	0.0	9.7	511.27	153.38	0	0%	0.00
Faucet 2 Com M 1st Fl	567.0	6804	0.0	6.8	357.89	107.37	0	0%	0.00
Faucet 2 Com W 2nd Fl	675.0	8100	0.0	8.1	426.06	127.82	0	0%	0.00
Faucet 2 Com W 3rd Fl	540.0	6480	0.0	6.5	340.85	102.25	0	0%	0.00
			Total	41	2,156	647			
sanity check numbers				40.99	2156.18	646.85			

If leak is a stream, measure volume for 1 minute:
ML x (60* 24*30)/ 1000ML = L per month or
ML x 43.2 = L per month
Note: Assumption that it is leaking 30 days per month

SAMPLE CALCULATION OF TOILET VS. URINAL FLUSHES BASED ON STAFF HOURS

Example: 150 Workers (60% male)
8 hours per day
= 1,200 hrs / 2.5 hrs (1 flush per person every 2.5 hrs)
= 480 flushes x .6 (60% male)
= 288 flushes male toilets
= 192 flushes female toilets (480-288)

288 x .67 (2 out of 3 flushes are urinals)
= 193 urinal flushes

288 male flushes – 193 urinal flushes
= 95 flushes male toilets

Total toilet flushes 287 per day x days per week
Total urinal flushes 193 per day x days per week

SAMPLE CALCULATION OF VISITORS AT A MALL, ASSUMING THEY SPEND ON AVERAGE 3 HRS AT THE MALL

180,500 visitors / 7 days = 25,786 visitors per day
Female 60% = 15,472 women x 3 hrs = 46,416 hrs /flushes 2.5 hrs = 18,566 flushes per day
Male 40% = 10,314 men x 3 hrs = 30,942 hrs/flushes 2.5 hrs = 12,377 flushes per day
12,377 flushes men x .67 (urinal flushes) = 8,292 urinal flushes per day
= 4,085 toilet flushes per day

Women flushes per day 18,566 + Men flushes per day 4,085 = 22,651 toilet flushes per day

SECTION X. CUSTOMER REPORT GENERATION

Once data from the audit have been processed, including calculating water use and potential savings, an audit report can be prepared. It is recommended that a CI customer receive a concise report at least two to four weeks after the initial audit. The audit report should provide the customer with:

1. Introduction
   - The purpose of the audit was to identify potential water and cost savings opportunities by educating and encouraging the facility owner to implement those measures.
   - The scope of the audit included providing a thorough assessment of water use by identifying and measuring water-using fixtures, appliances, equipment, leaks, and practices in order to recommend potential water-saving opportunities.

2. Methodology
   - Theaudit approach(when, who with, facility type/use, and characteristics; schedule of operations, including population and shifts, parameters, etc.).
   - Describe the facility – for example, five-story building with four floors being used for offices and the first floor dedicated to individual retail establishments; building age and whether any remodels/additions were completed.
   - Occupancy rates, including any seasonal fluctuations; number of employees and visitors with male versus female percentages; schedule of operations.
   - Criteria used specific to the business type (for example, the restaurant provides an average of 200 meals per day/5 days a week).
   - Describe all water sources and historical water usage according to the water bills if it is available.
   - Describe the *method* of measuring fixtures, equipment, appliances, and leaks
   - Include water-efficiency standards for fixtures, equipment, and appliances.

3. Audit findings and observations
   - Provide a list of identified water-using fixtures, equipment, and appliances with measured flow rates and other water use observations (for example, bathroom faucets in the common area are also used for brushing teeth twice a day; water use for this practice was determined to be 5 minutes per day for about 50 percent of the population).
   - Provide the estimated water usage based on the measured flow rates and population.
   - Note any defective or non-functioning fixtures.
   - Note particular fixtures and locations that are most frequently used; this can help determine which fixtures to retrofit/replace first.
   - Note what was not included in the audit. For example, the outdoor landscaping was observed to be a mixture of grass, trees, and flowers. Based on our visual inspection, they appear to be well maintained with no visible water run-off.

4. Water savings and cost-benefit analysis (savings from retrofitting/replacing fixtures, eliminating leaks)
   - List the potential annual water savings and cost-benefit analysis with payback and ROI by type of fixtures/appliances/equipment.
   - List the potential annual water savings that can be achieved from eliminating leaks.

5. Recommendations
   - List recommendations according to priority, from highest to lowest, including retrofit/replacement of fixtures with water-efficient fixtures. Provide a description of water-efficient fixtures and their water-efficiency standards. Describe why it may not be cost-effective to replace certain appliances/equipment.
   - Provide best practices for each end use/equipment.
   - List next steps, such as monitoring water use through water bills and meter reading.
   - Implement water-efficiency action plan that includes educating employees and routine leak detection.

6. Additional references
   - Provide a list of any incentive programs.
   - Provide a list of sources from which they can obtain product information, performance ratings, and water efficiencies ratings.
   - Provide a list of water-efficient products currently available on the local market.

Budgetary considerations usually require implementation to be scheduled according to funding availability, and benefit-cost ratios often indicate prioritization of different implementation options. As such, it is important to list recommendations from highest to lowest priority.

Given that the audit report will most likely be shared with a wide audience, including different groups of management and other levels of staff, it should be prepared in a way that is concise and easy for everyone to comprehend. Be specific about the issues identified; try to avoid making broad statements. Avoid using words that can be interpreted differently and, in some cases, negatively. Based on the audit report provided to them, management should be able to efficiently and effectively implement recommendations.

Note that all applicable laws, codes, standards, and more importantly, health and safety requirements associated with fixtures, devices, and appliances, or related to plumbing or water system connections, should be observed. Prior to implementing water-efficiency measures, facility managers should verify that they can be implemented without any adverse health, safety, environmental, or regulatory impact. Water-efficiency measures for certain water uses and industries, such as medical or food facilities, should be reviewed with appropriate regulatory agencies before being implemented.

APPENDICES

APPENDIX A: SAMPLE AUDIT PROGRAM FORMS AND REPORTS

1. Sample Forms for Program Operation
   - Customer Liability/Waiver Release Form
   - Auditor Inventory Form

2. Sample Reports to Monitor Program Progress:
   - Water Audit Production SummaryReport
   - Water Audit Production Report (Details)
   - Water Audit Quality Assurance Report
   - Water Audit Activity Report

3. Sample Marketing and other Materials:
   - Directory of Local Available Fixtures
   - Save Water Flyer
   - Water Saving Tips Brochure
   - Report Leaks Flyer
   - Save Water Logos

CUSTOMER LIABILITY/WAIVER RELEASE FORM

ZAMBOANGA CITY WATER DISTRICT
Pilar Street, Zamboanga City
Tel. No. 991-1556 (loc. 8119)

CUSTOMER LIABILITY/WAIVER RELEASE FORM

(For Commercial Water Audit)

DATE ______________________

Establishment Name: ______________________
Name of Customer/Representative: ______________________
Designation: ______________________
Address: ______________________
Account No. ______________________
Contact No. ______________________

TYPE OF ESTABLISHMENT:

__________ ***Hotel*** __________ ***Mall/Department Store*** __________ ***Hospital***
__________ ***Restaurant/Fastfood*** __________ ***Laundry Shop*** __________ ***Gov't. Office***
__________ ***Commercial Building*** __________ ***School/University***

Water Meter Details:

Initial Reading: __________ *Meter Brand:* __________
Final Reading: __________ *Meter Size:* __________

FIXTURES AUDITED

Fixture	Location Installed	Efficient	Not Efficient	Action Taken by WAT	Remarks	Recommendation

I acknowledge to have allowed and witnessed the actual conduct of water audit by the ZCWD Water Audit Team to the above stated fixtures. I further acknowldge to have received, witnessed and noted that the information in the remarks as filled up by ZCWD Personnel is true and correct. As ZCWD Customer, the undersigned hereby agrees that ZCWD shall not be held liable to any damage incurred to the fixtures and other accessories installed and audited by the ZCWD Water Auditor.

____

Name of Customer and/or his/her authorized Representative
(Signature over Printed Name)

____

Water Auditor
(Signature over Printed Name)

AUDITOR INVENTORY FORM

Auditor Inventory Form

The following items should be included in the surveyors tool box. Approximate costs of some items are included (for canvass)

ITEM CODE	ITEMS	PURPOSE	APPROXIMATE PRICES	EXPENDABLE OR NON-EXPENDABLE
TOOLS (T)				
T-1				
T-2	Flathead Screwdriver			
T-3	Teflon Tape			
T-4	Latex Gloves			
T-5	Rechargeable Flashlights			
T-6	Small Paint Brush			
T-7	First Aid Kit			
T-8	Procket Knife			
T-9	Meter pick/hook			
T-10	2 Channel Locks			
T-11	Soil probe			
T-12	Nylon Mesh Bag			
FIXTURES (F)				
F-1	Aerators			
F-2	Toilet Displacements Devices			
F-3	Low-flow Showerheads & Adapters			
F-4	Faucets			
F-5				
DEVICES (D)				
D-1	Cellular Phones			
D-2	Calculators			
D-3	Flow Rate Measuring Pitcher			
D-4	Camera			
D-5	Sign Board with Program Details (include ZCWD Logo and Contact Number)			
UNIFORMS				
U-1	Rubber Boots			
U-2	Name Tags			
U-3	Hand Towels			
U-4	Field Shirt (with ZCWD Logo)			
U-5				
SUPPLIES				
S-1	Post it			
S-2	Ballpen/Pencils			
S-3	Clipboards			
S-4	Rags			
S-5	Powder/Food Dye/Dye Tablet			
S-6	Alcohol/Hand Sanitizer			
FORMS				
F-1				
F-2				
F-3				

WATER AUDIT PRODUCTION SUMMARY REPORT

``

Residential

Number of Audits					
Number of Toilets	Efficient	Not Efficient	# of Leaks	Total	% Efficient
Number of Shower Heads	Efficient	Not Efficient	# of Leaks	Total	% Efficient
Number of Basins	Efficient	Not Efficient	# of Leaks	Total	% Efficient

Commercial

Number of Audits					
Number of Toilets	Efficient	Not Efficient	# of Leaks	Total	% Efficient
Number of Urinals	Efficient	Not Efficient	# of Leaks	Total	% Efficient
Number of Shower Heads	Efficient	Not Efficient	Leaks	Total	% Efficient
Number of Basins	Efficient	Not Efficient		Total	% Efficient

Summary By Surveyor

Surveyor	Residential	Comml	Total

Sample ZCWD Water Audit Production Report (Details)

From MM/DD/YYYY to MM/DD/YYYY

	Customer & Survey Info				Toilets				Shower Heads				Faucets			
	Residence	Address	Surveyor	Date Survey	Efficient	Not Efficient	% Efficient	# of Leaks	Efficient	Not Efficient	% Efficient	# of Leaks	Efficient	Not Efficient	% Efficient	# of Leaks
1																
2																
3																
4																
5																
	Total															

	Customer & Survey Info				Toilets				Urinals				Showers				Faucets			
	Facility	Address	Surveyor	Date Survey	Efficient	Not Efficient	% Efficient	# of Leaks	Efficient	Not Efficient	% Efficient	# of Leaks	Efficient	Not Efficient	% Efficient	# of Leaks	Efficient	Not Efficient	% Efficient	# of Leaks
1																				
2																				
3																				
4																				
5																				
	Total																			

Sample ZCWD Water Audit Quality Assurance Report

Particulars			Review Type			Problem		Type of Problem							Action Taken		
Date Review	Survey Address	Contact Person	PH	PR	SV	Yes	No	SNP	SI	DNI	ISNP	NIT	NLD	ID	CR	SA	OA
		TOTAL															

Legend:

PH - Phone	SV- Site Visit
PE - Paperwork Review	
DNI - Device not installed	ID - Illogical Data
SNP - Survey not performed	SI - Survey Incomplete
NIT - No irrigation timer	NLD - No leaks detected
ISNP - Irrigation schedule not provided	
CR - Corrected Report	SA - Survey Again
OA- Other Action	

Sample ZCWD Water Audit Activity Report

Name of Establishment	Date Audited	Time Audited		Audited by	No. of Buildings	Status		Issues Encountered	Remarks	Recommended Action	Referred to	Person Infomed	Designation	Contact Number	Signature
		Start	End			Audited	Unaudited								
City Hall	05/17/2017	8:00AM	9:50AM	Alva Conti's Team	1	X						Ms. X	Executive Assistant	(062) 991-1111	
Ateneo de Zamboanga University	05/17/2017	10:05AM	5:00PM	Alva Conti's Team	6	X						Mr. Y	PPO Head	(062) 991-3333	
Ateneo de Zamboanga University	05/17/2017	2:25PM	3:00PM	Alva Conti's Team	1	X		1 broken toilet tank cover at 2nd flr., JMR Bldg	Improper handling by Karen	For replacement	Water Audit Supervisor	Mr. Y	PPO Head	(062) 991-3333	
Ateneo de Zamboanga University					2		X		Lack of time	For rescheduling	Water Audit Supervisor	Mr. Y	PPO Head	(062) 991-3333	
Lantaka Hotel					1		X	Establishment requested for audit's re-schedule		For rescheduling	Water Audit Supervisor	Mr. Z	Manager	(062) 991-2222	

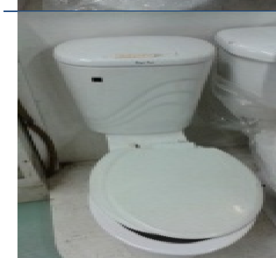
Prepared by:

Water Auditor

Noted by:

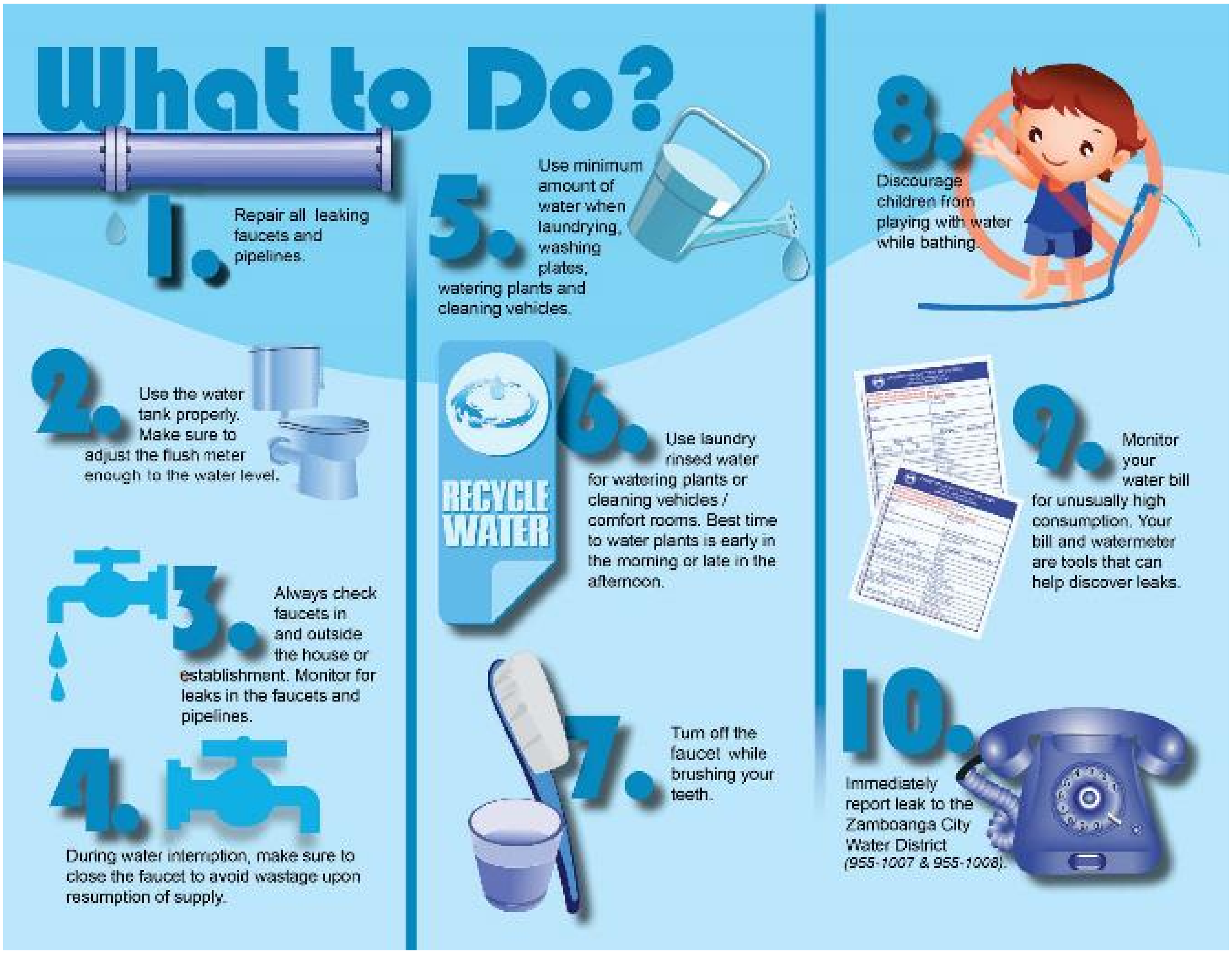
Water Audit Supervisor

DIRECTORY OF LOCALLY AVAILABLE FIXTURES

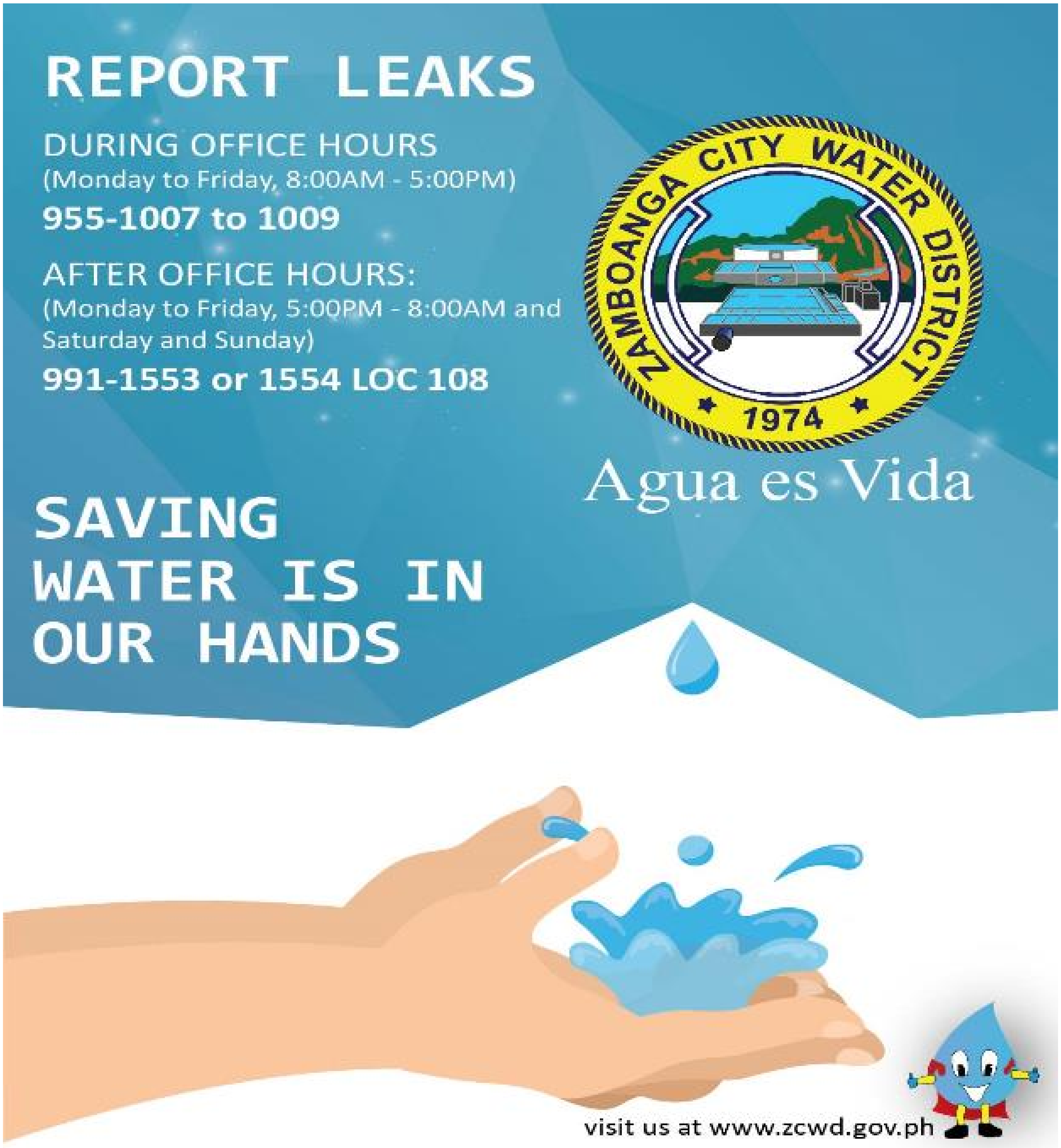
Fixture	Manufacturer	Model	Key Water Saving Feature	Store	Price
	Royal Tern Ceramics Philippines		Push button water saver 6 liters	Asiatic Hardwa re	P4,900.0 0
	Save Flush		3 and 6 liters Dual Flush	Asiatic Hardwa re	P6,030.0 0
	Royal Tern Ceramics Philippines	Sparrow	6 liters Lever Type	Asiatic Hardwa re	P4,180.0 0
	Save Flush	Redwine	3 and 6 liters Dual Flush	Asiatic Hardwa re	P7,165.0 0

SAVE WATER FLYER

WATER SAVING TIPS BROCHURE


What to Do?
1. Repair all leaking faucets and pipelines.
2. Use the water tank properly. Make sure to adjust the flush meter enough to the water level.
3. Always check faucets in and outside the house or establishment. Monitor for leaks in the faucets and pipelines.
4. During water interruption, make sure to close the faucet to avoid wastage upon resumption of supply.
5. Use minimum amount of water when laundrying, washing plates, watering plants and cleaning vehicles.
RECYCLE WATER
6. Use laundry rinsed water for watering plants or cleaning vehicles / comfort rooms. Best time to water plants is early in the morning or late in the afternoon.
7. Turn off the faucet while brushing your teeth.
8. Discourage children from playing with water while bathing.
9. Monitor your water bill for unusually high consumption. Your bill and watermeter are tools that can help discover leaks.
10. Immediately report leak to the Zamboanga City Water District (955-1007 & 955-1008).

REPORT LEAKS FLYER



SAVE WATER LOGOS

APPENDIX B: QUICK REFERENCE GUIDE

FIXTURE, FITTING, APPLIANCE	MAXIMUM WATER USE
Water Closets (toilets)	1.28 gal (4.8 L) per flush
Urinals	0.5 gal (1.9 L) per flush
Public Lavatory Faucets	0.5 gpm (1.9 L/min)
Private Lavatory Faucets (Residential, Hotel Room, Dormitory, Hospital Room)	1.5 gpm (5.7 L/min)
Public Metering Self-Closing Faucet (sensor, metered/timed)	0.25 gal (1.0 L) per metering cycle
Kitchen Faucet (and Utility Faucets)	2.2 gpm (8.3 L/min)
Showerheads	2.0 gpm (7.6 L/min)
Clothes Washers	Water factor of 4.0 gal/ft^3 of drum capacity normal cycle (0.53 L/L of drum capacity normal cycle)
Dipper Well	1 gpm (3.8 L/min)
Pre-Rinse Spray Valve	1.6 gpm (6.0 L/min)
Food Steamers	2 gal (7.6 L) per tray per hour
Ice Makers	20 gal per 100 lbs of ice

USAGE PARAMETERS	
Toilet Flushes/Person/Day (Residential)	6.0 flushes
Shower Minutes/Person	10 minutes
Bathroom Faucet Minutes/Person/Day (Residential)	3.0 minutes
Kitchen Faucet Minutes/Person/Day (Residential)	5.0 minutes
Toilet Flushes/Person/Day (Non-residential full time employee)	1 every 2.5 hrs
Bathroom Faucet Minutes/Person/Bathroom Use (Non-residential)	0.20 seconds per toilet flush
Urinal Flushes (If urinals are available for use)	2 out of 3 flushes

HOW TO MEASURE FAUCET OR SHOWERHEAD FLOW

Faucet/Showerhead flow tested for 5 seconds**:**
Turn on faucet/shower to full volume (both cold and hot water)
Using a stop watch, measure with a graduated measuring device (1L +) under flow of water

Volume of Water gathered in 5 seconds: 900 ml
= 900 ml x (60 seconds / 5 seconds)
= 10,800 ml/min
= 10,800 ml/1000 = 10.8 LPM

HOW TO CALCULATE SHOWER WATER USAGE

Based on average 10 minutes per shower:

- Measure showerhead flow
- LPM x 10 minutes = existing L/shower
- Existing L/shower – 76 L/ Retrofit shower = L Savings/Shower
- Savings/Shower x showering frequency = L Savings

  Example:
  Existing shower 108 L/shower – 76L = 32 L saved/shower
  (7 showers/week x 32 L) x 52) /12 = 971 L/month savings

Note:Make sure that all faucets and showerheads tested are completely shut off when you are done.Be sure to carefully wipe the area around the shower or tub when you are done testing the flow rate. If there is a bucket in the sink, tub or shower, save the water used from flow rate test.

HOW TO MEASURE GRAVITY TANK TOILET FLUSH VOLUME

- Measure inside of tank: length x width x depth of water
- Flush toilet; after water leaves the tank into the bowl, immediately measure the water remaining in the tank before the tank starts refilling
- Subtract the remaining water from the initial depth of water for net depth
- Length x width x net depth = LPF

Example: 58 cm x 20 cm x 14 cm = 16,240 cm^3 / 1,000 = 16.24 LPF

Remember to use net depth (initial depth of water – depth of water after immediately flushing and water leaves the tank = Net depth

Important: Do not hold handle down, press down and immediately release to begin flush.

For Dual-Flush Toilets test using #2 button.

HOW TO MEASURE FOM TOILET FLUSH VOLUME

FOM toilet flush rate approximately = 1.6 Liters per second
Number of seconds x 1.6 Liters per second = _____ liters per flush for FOM toilets
Example: 3 seconds x 1.6 liters per second = 4.8 LPF

HOW TO MEASURE FOM URINAL FLUSH VOLUME

FOM urinals flush rate approximately = .95 Liters per second
Number of seconds x .95 Liters per second = _____ liters per flush for FOM urinals
Example: 2 seconds x .95 liters per second = 1.9 LPF

HOW TO MEASURE LEAKS

To calculate the number of leaks in liters per month:
No. of drips per minute x 13.5 = liters/month
Example: 90 drips / minute x 13.5 = 1,215 liters/month leak

OR:

To measure stream leaks in liters per month:
Place a measuring cup under the stream and measure the volume gathered for 1 minute.
Example: 200 ml x 43.8 = 8,760 liters/month

Remember to:

- Note all leaks, even if not measured or fixtures are inoperable.
- Dye-test toilets for leaks.
- Note whether the faucet has an aerator, or if it is not applicable.
- Look for all water using fixtures including outdoors.

APPENDIX C: SAMPLE COMPLETED COMMERCIAL WATER AUDIT FORM

ZCWD WATER DEMAND AUDIT DATA COLLECTION FORM 1 (Commercial)

Sample Audit Form

Name of Facility	Eco Office Park
NSCB Facility Code	230
Type of Facility	Office
Account Name	Rizal Holdings, Inc.
Address	23 Makati Ave.
City	Zamboanga
Contact Person	Joy Hapay
Phone	63907712952
Email	Jhapay@RizalHold.com
Year Built (Appox.)	1976
Square Meter (Bldg)	2500
Number of Floor/s	4 + basement
Lot Size (Sq. M.)	1250

Data Forms:	Number of Forms
Master Form	1
Population	1
Bathroom	5
Kitchen/Laundry	1

Sources of Water	**Usage (%)**	**Purpose**
Local Water District	95	Potable
Rain/Storm Harvest		
Well ■ Deep ☐ Shallow	5	landscaping
Delivery Truck (Private)		
Gray Water		
On-site Recycle		
Reclaim		

School Supplement

Enrollment for School Year _________ to _________

	Total #	**% M**	**% F**
No. of Students			
No. of Faculties			
No. of other Employees			
Months/weeks that school is not operating (if portion of month, show no. of week/s)			

Other Outdoor Water Uses/Landscaping:

Landscaping consists of a small area of grass, shrubs and flowerbeds. Watered using well water, the well is not metered. Avg. 30 min per day

Carwash avg. 30 min per car

Cooling Tower: Yes ☐ No ■

Control Number:	101

Surveyor Data

Auditor/s	Ligaya Dias
Audit Date	23 07 2016

Restaurant Supplement

No. of Seats	60
Avg. No. Meals served/Day	120
Sit Down or Fast Food	Sit Down

Hospital Supplement

No. of Hospital Beds	
Avg. Annual Occupancy (%)	
Avg. No.Meals Served/Day	
No. of Outpatient seen per day	

Hotel Supplement

No. of Guest Rooms	
No. of Floors	
Avg. Annual Occupancy	
No. Restaurant Seats	
No. Meals Served/Day	
No. of Function Rooms	
Function Room Capacity	
Avg. No. of Functions/Week	
No. Function Meals Served/Day	

Fleet Car Washing

No. of Cars Washed	4
Frequency of Washing	2x per week
Source of Water	water district potable
Hose ■ Hose with Shut Off ☐	Bucket ☐

Pool

No. of Pools	
Cover	☐ Yes ☐ No
Estimated Volume (L x W x Ave. Depth = m3)	

Meters

Areas Served	**Acct. No.**	**Meter No.**
Entire building	23-6302496	2036
Basement Kitchen		Sub-Meter 1

Poulation WorkSheet (used for data input only)Blank worksheet for auditor follows

Sample Audit Form

On-Site Groups	Daily No. of People		No. of hours per person per day							Weekly hrs	Female hrs	Male hrs
	No. of People	% Male	Mon	Tues	Wed	Thurs	Fri	Sat	Sun			
Workers Day Shift	240.00	40%	8.00	8.00	8.00	8.00	8.00	0.00	0.00	9,600.00	5,760.00	3,840.00
Workers Eve Shift PT	120.00	60%	6.00	6.00	6.00	6.00	6.00	6.00	0.00	4,320.00	1,728.00	2,592.00
Weekend Day Shift	120.00	40%	0.00	0.00	0.00	0.00	0.00	8.00	0.00	960.00	576.00	384.00
Security Day Shift	4.00	100%	12.00	12.00	12.00	12.00	12.00	8.00	0.00	272.00	0.00	272.00
Security Eve. Shift	2.00	100%	10.00	10.00	10.00	10.00	10.00	8.00	0.00	116.00	0.00	116.00
										0.00	0.00	0.00
Training Class	30.00	40%	0.00	0.00	0.00	0.00	0.00	8.00	0.00	240.00	144.00	96.00
Visitors Weekday	20.00	50%	1.50	1.50	1.50	1.50	1.50	0.00	0.00	150.00	75.00	75.00
Visitors Weekend	8.00	50%	0.00	0.00	0.00	0.00	0.00	1.00	0.00	8.00	4.00	4.00
									Total Hours	15,666.00	8,287.00	7,379.00

Female hrs per week	8,287.00	Female Toilet Flushes per week	3,315	Total Toilet Flushes per week	4,289
Male hrs per week	7,379.00	Male Toilet Flushes per week	2,952	Total Urinal Flushes per week	1,978
		Male Urinal Flushes per week	1,978	Total Flushes per week	6,266
		Net Male Toilet Flushes per week	974		

Bathroom Faucets Rinse minute per week 2,087

Note: Do not enter data in shaded cells, they will automatically calculate

Legend:

Female hrs per week	= Females hrs
Male hrs per week	= Male hrs
Femele Toilet Flushes per week	= Female hrs per week / 2.5
Male Toilet Flushes per week	= Male hrs per week / 2.5
Male Urinal Flushes per week	= Male Toilet Flushes per week / 0.67
Net Male Toilet Flushes per week	= Male Toilet Flushes per week - Male Urinal Flushes per week

Total Toilet Flushes per week	= Female Toilet Flushes per week + Net Male Toilet Flushes per week
Total Urinal Flushes per week	= Male Urinal Flushes per week
Total Flushes per week	= Total Toilet Flushes per week + Total Urinal Flushes per week
	= Other Fields that are automatically computed

Poulation WorkSheet

Sample Audit Form

On-Site Groups	Daily No. of People		No. of hours per person/shift per day						
	No. of People	% Male	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
Workers Day Shift	240.00	40%	8.00	8.00	8.00	8.00	8.00	0.00	
Workers Eve. Shift PT	120.00	60%	6.00	6.00	6.00	6.00	6.00	6.00	
Weekend Day Shift	120.00	40%	0.00	0.00	0.00	0.00	0.00	8.00	
Security Day Shift	4.00	100%	12.00	12.00	12.00	12.00	12.00	8.00	
Security Eve. Shift	2.00	100%	10.00	10.00	10.00	10.00	10.00	8.00	
Training Class	30.00	40%	0.00	0.00	0.00	0.00	0.00	8.00	
Visitors	20.00	50%	1.50	1.50	1.50	1.50	1.50	1.50	
Visitors Weekend	8.00	50%	0.00	0.00	0.00	0.00	0.00	1.00	

Notes: A class is held every Saturday in the conference room on the 3rd floor for about 28 participants with 2 employees present.

ZCWD WATER DEMAND AUDIT DATA COLLECTION FORM FOR COMMERCIAL

Floor Level	Basement	**Total No. of Faucets**	4	Control Number	101
Total No. of Toilets	4	**Total No. of Urinals**	2	**Total No. of Shower Heads**	0

	Toilet 1	Toilet 2	Toilet 3	Toilet 4	Toilet 5	Toilet 6	Toilet 7	Toilet 8
Location	Common W	Common W	Common W	Common Men				
Gender	F	F	F	M				
Type	G	G	G	G				
Length (cm)	39	39	39	39				
Width (cm)	17	17	17	17				
Depth (cm)	21	16	19	17				
Net Depth (cm)	7	6	5	7				
No. of Sec./ flush (FOM)								
Liters/Flush	9.3	6.6	9.3	6.6	0.0	0.0	0.0	0.0
Leak (Y/N)	Y	N	N	Y				
Remarks		No toilet seat						

Type: Gravity = G Flush-O-Meter = FOM FOM Sensor Activated = FOM Note SA in Remarks Dual Flush = DF Bucket = B

BATHROOM	Faucet 1	Faucet 2	Faucet 3	Faucet 4	Faucet 5	Faucet 6	Faucet 7	Faucet 8
Location	Common W	Common W	Common Men	Common Men				
Type	R	R	R	R				
Volume (ML)	1100	800	900	750				
No. of Seconds	5	5	5	5	5	5	5	5
Liters/Minute	13.2	9.6	10.8	9.0	0.0	0.0	0.0	0.0
Aerator (Y/N/NA)	N	N	N	N				
Leak (Y/N)	Y	N	Y	N				
No. of Drips / Min	40	0	21	0				
Liters/Month	540.0	0.0	283.5	0.0	0.0	0.0	0.0	0.0
Remarks								

Type: Regular = R Sensor Activated = SA Metered = M Utility =U

	Urinal 1	Urinal 2	Urinal 3	Urinal 4	Urinal 5	Urinal 6	Urinal 7	Urinal 8
Location	Common Men	Common Men						
Type	FOM	FOM						
No. of sec./flush	9	8						
Liters/Flush	2.3	2.0	-	-	-	-	-	-
Leak (Y/N)	N	N						
Remarks								

Type: Flush-o-meter = FOM FOM Sensor Activated = FOM Note SA in Remarks Waterless=W Trough= T

	SH 1	SH 2	SH 3	SH 4	SH 5	SH 6	SH 7	SH 8
Location								
Type								
Volume (ML)								
No. of Seconds	5	5	5	5	5	5	5	5
Liters/Minute	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leak (Y/N)								
No. of Drips/ Min.								
Liters/Month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Showers / Week								
Remarks								

Type: Urinal Bidet Spray = UBS Toilet Bidet Spray = TBS Wash Foot Spray = WFS Shower Head = SH

Notes:

ZCWD WATER DEMAND AUDIT DATA COLLECTION FORM FOR COMMERCIAL

Floor Level	1st Floor	**Total No. of Faucets**	4	Control Number	101
Total No. of Toilets	4	**Total No. of Urinals**	2	**Total No. of Shower Heads**	0

	Toilet 1	Toilet 2	Toilet 3	Toilet 4	Toilet 5	Toilet 6	Toilet 7	Toilet 8
Location	Common W	Common W	Common W	Common Men				
Gender	F	F	F	M				
Type	G	G	DF	G				
Length (cm)	45	46	39	46				
Width (cm)	17	15	17	15				
Depth (cm)	19	19	16	23				
Net Depth (cm)	5	4	6	6				
No. of Sec./ flush (FOM)								
Liters/Flush	10.7	10.4	8.0	11.7	0.0	0.0	0.0	0.0
Leak (Y/N)	N	N	N	N				
Remarks								

Type: Gravity = G Flush-O-Meter = FOM FOM Sensor Activated = FOM Note SA in Remarks Dual Flush = DF Bucket = B

BATHROOM	Faucet 1	Faucet 2	Faucet 3	Faucet 4	Faucet 5	Faucet 6	Faucet 7	Faucet 8
Location	Common W	Common W	Common Men	Common Men				
Type	R	R	R	R				
Volume (ML)	1300	800	850	900				
No. of Seconds	5	5	5	5	5	5	5	5
Liters/Minute	15.6	9.6	10.2	10.8	0.0	0.0	0.0	0.0
Aerator (Y/N/NA)	N	N	N	N				
Leak (Y/N)	Y	N	N	Y				
No. of Drips / Min	60	0	0	42				
Liters/Month	810.0	0.0	0.0	567.0	0.0	0.0	0.0	0.0
Remarks								

Type: Regular = R Sensor Activated = SA Metered = M Utility =U

	Urinal 1	Urinal 2	Urinal 3	Urinal 4	Urinal 5	Urinal 6	Urinal 7	Urinal 8
Location	Common Men	Common Men						
Type	FOM	FOM						
No. of sec./flush	9	8						
Liters/Flush	8.6	7.6	-	-	-	-	-	-
Leak (Y/N)	N	N						
Remarks								

Type: Flush-o-meter = FOM FOM Sensor Activated = FOM Note SA in Remarks Waterless=W Trough= T

	SH 1	SH 2	SH 3	SH 4	SH 5	SH 6	SH 7	SH 8
Location								
Type								
Volume (ML)								
No. of Seconds	5	5	5	5	5	5	5	5
Liters/Minute	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leak (Y/N)								
No. of Drips/ Min.								
Liters/Month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Showers / Week								
Remarks								

Type: Urinal Bidet Spray = UBS Toilet Bidet Spray = TBS Wash Foot Spray = WFS Shower Head = SH

Notes:

ZCWD WATER DEMAND AUDIT DATA COLLECTION FORM FOR COMMERCIAL

Floor Level	2nd Floor	**Total No. of Faucets**	4	Control Number	101
Total No. of Toilets	4	**Total No. of Urinals**	2	**Total No. of Shower Heads**	0

	Toilet 1	Toilet 2	Toilet 3	Toilet 4	Toilet 5	Toilet 6	Toilet 7	Toilet 8
Location	Common W	Common W	Common Men	Common Men				
Gender	F	F	F	M				
Type	G	G	G	FOM				
Length (cm)	39	39	39	0				
Width (cm)	17	17	17	0				
Depth (cm)	21	21	19	0				
Net Depth (cm)	7	8	5	0				
No. of Sec./ flush (FOM)				7				
Liters/Flush	9.3	8.6	9.3	11.2	0.0	0.0	0.0	0.0
Leak (Y/N)	Y	N	N	N				
Remarks								

Type: Gravity = G Flush-O-Meter = FOM FOM Sensor Activated = FOM Note SA in Remarks Dual Flush = DF Bucket = B

BATHROOM	Faucet 1	Faucet 2	Faucet 3	Faucet 4	Faucet 5	Faucet 6	Faucet 7	Faucet 8
Location	Common W	Common W	Common Men	Common Men				
Type	R	R	R	R				
Volume (ML)	1100	1300	900	800				
No. of Seconds	5	5	5	5	5	5	5	5
Liters/Minute	13.2	15.6	10.8	9.6	0.0	0.0	0.0	0.0
Aerator (Y/N/NA)	N	N	N	N				
Leak (Y/N)	N	Y	N	N				
No. of Drips/ Min		50						
Liters/Month	0.0	675.0	0.0	0.0	0.0	0.0	0.0	0.0
Remarks								

Type: Regular = R Sensor Activated = SA Metered = M Utility =U

	Urinal 1	Urinal 2	Urinal 3	Urinal 4	Urinal 5	Urinal 6	Urinal 7	Urinal 8
Location	Common Men	Common Men						
Type	FOM	FOM						
No. of sec./flush	9	8						
Liters/Flush	8.6	7.6	-	-	-	-	-	-
Leak (Y/N)	N	N						
Remarks								

Type: Flush-o-meter = FOM FOM Sensor Activated = FOM Note SA in Remarks Waterless=W Trough= T

	SH 1	SH 2	SH 3	SH 4	SH 5	SH 6	SH 7	SH 8
Location								
Type								
Volume (ML)								
No. of Seconds	5	5	5	5	5	5	5	5
Liters/Minute	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leak (Y/N)								
No. of Drips/ Min.								
Liters/Month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Showers / Week								
Remarks								

Type: Urinal Bidet Spray = UBS Toilet Bidet Spray = TBS Wash Foot Spray = WFS Shower Head = SH

Notes:

ZCWD WATER DEMAND AUDIT DATA COLLECTION FORM FOR COMMERCIAL

Floor Level	3rd Floor	**Total No. of Faucets**	4	Control Number	101
Total No. of Toilets	4	**Total No. of Urinals**	2	**Total No. of Shower Heads**	0

	Toilet 1	Toilet 2	Toilet 3	Toilet 4	Toilet 5	Toilet 6	Toilet 7	Toilet 8
Location	Common W	Common W	Common W	Common Men				
Gender	F	F	F	M				
Type	G	G	G	G				
Length (cm)	41	41	39	39				
Width (cm)	18	18	17	17				
Depth (cm)	22	21	19	20				
Net Depth (cm)	7	7	6	6				
No. of Sec./ flush (FOM)								
Liters/Flush	11.1	10.3	8.6	9.3	0.0	0.0	0.0	0.0
Leak (Y/N)	Y	N	N	N				
Remarks								

Type: Gravity = G Flush-O-Meter = FOM FOM Sensor Activated = FOM Note SA in Remarks Dual Flush = DF Bucket = B

BATHROOM	Faucet 1	Faucet 2	Faucet 3	Faucet 4	Faucet 5	Faucet 6	Faucet 7	Faucet 8
Location	Common W	Common W	Common M	Common M				
Type	R	R	R	R				
Volume (ML)	900	1100	1000	900				
No. of Seconds	5	5	5	5	5	5	5	5
Liters/Minute	10.8	13.2	12.0	10.8	0.0	0.0	0.0	0.0
Aerator (Y/N/NA)	N	N	N	N				
Leak (Y/N)	N	Y	N	N				
No. of Drips/ Min.		40						
Liters/Month	0.0	540.0	0.0	0.0	0.0	0.0	0.0	0.0
Remarks								

Type: Regular = R Sensor Activated = SA Metered = M Utility =U

	Urinal 1	Urinal 2	Urinal 3	Urinal 4	Urinal 5	Urinal 6	Urinal 7	Urinal 8
Location	Common Men	Common Men						
Type	FOM	FOM						
No. of sec./flush	9	10						
Liters/Flush	8.6	9.5	-	-	-	-	-	-
Leak (Y/N)	N	N						
Remarks								

Type: Flush-o-meter = FOM FOM Sensor Activated = FOM Note SA in Remarks Waterless=W Trough= T

	SH 1	SH 2	SH 3	SH 4	SH 5	SH 6	SH 7	SH 8
Location								
Type								
Volume (ML)								
No. of Seconds	5	5	5	5	5	5	5	5
Liters/Minute	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leak (Y/N)								
No. of Drips/Min.								
Liters/Month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Showers / Week								
Remarks								

Type: Urinal Bidet Spray = UBS Toilet Bidet Spray = TBS Wash Foot Spray = WFS Shower Head = SH

Notes:

ZCWD WATER DEMAND AUDIT DATA COLLECTION FORM FOR COMMERCIAL

Floor Level	4th Floor	**Total No. of Faucets**	6	Control Number	101
Total No. of Toilets	6	**Total No. of Urinals**	2	**Total No. of Shower Heads**	2

	Toilet 1	Toilet 2	Toilet 3	Toilet 4	Toilet 5	Toilet 6	Toilet 7	Toilet 8
Location	Common W	Common W	Common Men	Common Men	Gym Women	Gym Men		
Gender	F	F	M	M	F	M		
Type	G	G	G	G	G	G		
Length (cm)	39	39	39	39	41	41		
Width (cm)	17	17	17	17	18	18		
Depth (cm)	21	19	21	21	20	21		
Net Depth (cm)	5	4	5	4	5	4		
No. of Sec./ flush (FOM)								
Liters/Flush	10.6	9.9	10.6	11.3	11.1	12.5	0.0	0.0
Leak (Y/N)	N	N	N	N	N	N		
Remarks								

Type: Gravity = G Flush-O-Meter = FOM FOM Sensor Activated = FOM Note SA in Remarks Dual Flush = DF Bucket = B

BATHROOM	Faucet 1	Faucet 2	Faucet 3	Faucet 4	Faucet 5	Faucet 6	Faucet 7	Faucet 8
Location	Common W	Common W	Common M	Common M	Gym W	Gym M		
Type	R	R	R	R	R	R		
Volume (ML)	900	800	900	1100	800	900		
No. of Seconds	5	5	5	5	5	5	5	5
Liters/Minute	10.8	9.6	10.8	13.2	9.6	10.8	0.0	0.0
Aerator (Y/N/NA)	N	N	N	N	N	N		
Leak (Y/N)	N	N	N	N	N	N		
No. of Drips/ Min.								
Liters/Month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Remarks								

Type: Regular = R Sensor Activated = SA Metered = M Utility =U

	Urinal 1	Urinal 2	Urinal 3	Urinal 4	Urinal 5	Urinal 6	Urinal 7	Urinal 8
Location	Common Men	Common Men						
Type	FOM	FOM						
No. of sec./flush	7	9						
Liters/Flush	6.7	8.6	-	-	-	-	-	-
Leak (Y/N)								
Remarks								

Type: Flush-o-meter = FOM FOM Sensor Activated = FOM Note SA in Remarks Waterless=W Trough= T

	SH 1	SH 2	SH 3	SH 4	SH 5	SH 6	SH 7	SH 8
Location	Gym W	Gym M						
Type	SH	SH						
Volume (ML)	900	1100						
No. of Seconds	5	5	5	5	5	5	5	5
Liters/Minute	10.8	13.2	0.0	0.0	0.0	0.0	0.0	0.0
Leak (Y/N)	N	Y						
No. of Drips/Min.		45						
Liters/Month	0.0	607.5	0.0	0.0	0.0	0.0	0.0	0.0
Showers / Week	40	90						
Remarks								

Type: Urinal Bidet Spray = UBS Toilet Bidet Spray = TBS Wash Foot Spray = WFS Shower Head = SH

Notes: **gym showers based on daily sign-in log, assuming all visitors take a shower**

ZCWD WATER DEMAND AUDIT DATA COLLECTION FORM FOR COMMERCIAL KITCHEN/LAUNDRY SERVICES

Floor Level Basement/ Cafeteria

Control Number	101

Faucets/PRSV	Faucet 1	Faucet 2	Faucet 3	Faucet 4	Faucet 5	Faucet 6	Faucet 7
Location	Cafeteria Kitch	Cafteria Kitch	Cafeteria Hall	Janitor	Outside Front	Outside Right	
Type	PRSV	U	R	U	U		
Aerator:Y/N/NA	NA	N	N	NA	NA		
Volume (ML)	1100	900	900	900	900		
No. of Seconds	5	5	5	5	5	5	5
Liters/Minute	13.2	10.8	10.8	10.8	10.8	0.0	0.0
Leak (Y/N)	N	N	Y	Y	Y		
No. of Drips/ Min.				60	45		
Leaks Liters/Month	0.0	0.0	0.0	810.0	607.5	0.0	0.0
No. of Minutes/Day	30	120	20	80	60		

Type: Utility = U Pre-rinse Spray Valve = PRSV Handheld Spray = HHS Regular = R Foot Activated = FA

Dishwasher (DW)	DW 1	DW 2	DW 3
Location			
Type			
Make			
Model Number			
Racks/Day			
Remarks			

Type: Stationary Door = SD Hood = H UnderCounter = UC Conveyor/C-Line = C Flight = F

Combi-Oven	Qty. (Pans)	Condensation Return	
Connected to Boiler			
Connectionless			
Hrs. Used /Day			

Wok Stove (WS)	WS 1	WS 2	WS 3
Air/Water (A/W)			

Air/Water: Air cooled = A Water cooled = W

Food Steamers (S)	Qty. (Pans)	Condensation Return (Y/N)	
Connected to Boiler			
Connectionless			
Hrs. Used /Day			

For Connected to Boiler:
Condensation Return = Yes - if returned to the boiler
No - if discharged to sewer

Ice Machine (IM)	IM 1	IM 2	IM 3
Make			
Model Number			
Type			
Air / Water (A/W)			

Type: Cube = C Flake = F Nuggett = N
Air/Water: Air cooled = A Water cooled = W

Food Disposal Grinder	FDG 1	FDG 2	FDG 3
Make			
Model Number			
Volume (ML)			
No. of Seconds	5	5	5
Liters / Minute	0.0	0.0	0.0
Continuous Run (Y/N)			
Auto Shutoff (Y/N)			

Auto Shutoff: No auto shutoff = N
Water and motor will automatically shutoff within 5 minutes of activation = Y

Dipper Well	DW 1	DW 2	DW 3
Type			
Make			
Model Number			
Hours / Week			
Volume (ML)			
No. of Seconds	5	5	5
Liters / Minute	0.0	0.0	0.0

Type: Metered = M, Hand Operated = H, Continuous Run = C
Make: If they use a faucet and container as dipper well, write in "in-sink" as make

Laundry	L1	L2	L3
Type			
Make			
Model Number			
Recycle Water (Y/N)			
Loads / Week			

Notes: PRSV is used primarily for washing dishes and silverware (avg. 30 min p/day, utility faucet is used for washing pots/pans and cooking avg. 60 min. p/day. Most food is brought in prepared. Cafeteria Hall sink is only for handwashing, avg. 20 min. p/day Outside faucets have a hose attached, recommend efficient spray nozzles with a shut off valve

Type: Residential V-Axis = RVA, Residential H-Axis = RHA, Coin-Op V-Axis = CVA, Coin-Op H-Axis = CHA, Multi-Load V Axis = MVA, Multi=Load H Axis = MHA, Conventional Washer Extractor = CWE, Continous Tunnel = CT

Other Leaks Detected:

REFERENCES

PUBLICATIONS REFERENCED

Best Practice Guidelines for Water Conservation in Commercial Office Buildings and Shopping Centres, Sydney Water Corporation, 2007

A Comparison of "Green" – Summarizing Key Water Efficiency Provisions, John Koeller, P.E., June 24, 2015

A Water Conservation Guide for Commercial Institutional and Industrial Uses, New Mexico Office of the State Engineer, July 1999

Commercial Laundry Facilities, J. Koeller, J. Riesenberger, 2005

EPA WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities, October 2012

Handbook of Water Use and Conservation, Amy Vickers, 2001

Potential Best Management Practices, Commercial Dishwashers Year 4, Koeller and Company, H.W. Hoffmand & Associates LLC, June 2010

Potential Best Management Practices, Commercial Ice Machines Year 3.5, Koeller and Company, June 2008

Water Efficiency and Self-Conducted Water Audits at Commercial and Institutional Facilities: A Guide for Facility Managers, Second Edition, South Florida Water Management District Water Supply Development Section, July 2013

Water Efficiency Toolkit for Commercial, Industrial and Institutional Facilities, N.C. Department of Environment and Natural Resources, Division of Pollution Prevention and Environmental Assistance, Division of Water Resources, Land-of-Sky Regional Council, Waste Reduction Partners, May 2009

Water-Efficient Equipment and Design: A Guide for Non-Residential Construction and Development, Austin Water Utility Water Conservation Division, 2006

Watersmart Guidebook: A Water-Use Efficiency Plan, East Bay Municipal Utility District, 2008

WEBSITES REFERENCED

http://cuwcc.org/

http://energy.gov/eere/femp/water-efficiency-federal-buildings-and-campuses

http://www.allianceforwaterefficiency.org.

http://www.denverwater.org/Conservation/TipsTools/Commercial/

http://www.iapmo.org/Pages/IAPMOgroup.aspx

https://www.wbdg.org/resources/water_conservation.php

https://www3.epa.gov/watersense/commercial/index.html

ADDITIONAL RESOURCES

http://fishnick.com/savewater/resources/watersense/ for commercial kitchen equipment

https://www.arcs.org for rain harvesting

https://www.buildinggreen.com/water-efficiency

http://www.conserveh2o.org/how-to-videos-water-conservation/how-toilet-works

http://www.conserveh2o.org/water-lost-toilet-leaks for how to detect and fix toilet leaks

http://www.map-testing.com/ for performance-tested toilets and urinals

https://www.youtube.com/watch?v=QqgF_0kfzp4 for how to fix a leaking faucet

https://www3.epa.gov/watersense/product_search.html for water-efficient products

Zamboanga City Water District

www.acwd.gov.ph

U.S. Agency for International Development/Philippines

www.usaid.gov