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A TOOLKIT FOR WATER AUDITORS

RESIDENTIAL SECTOR

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Zamboanga City Water District and AECOM International Development

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ABBREVIATIONS

Be Secure	Water Security for Resilient Economic Growth and Stability
BMP	best management practices
cm	centimeter
cm^3	cubic centimeters
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
HET	high-efficiency toilets
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	National Statistical Coordination Board
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 Toolkit for the Residential Sector*** 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 Toolkit for the Residential Sector.***

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.

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 prepare a water 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 discussion of WDM, WDM concepts and strategies, and WDM best 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 residential water fixtures and appliances. This section will guide the water auditor on how these fixtures work, typical water use, and how to measure water use and savings; includes sample photographs and illustrations.

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

Section Six: Provides additional water efficiency opportunities and a section describing various water sources, including alternate water sources.

Section Seven: Explains how to conduct a residential water audit and the key objectives of a water audit. Step-by-step instructions on how to complete the water audit form, calculation worksheet and residential water audit report are included.

Appendices: Includes sample forms, production reports, a quick reference guide and a sample water audit report.

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

COMPONENTS OF WATER AUDIT FORMS

Form 1: The Residential Data Collection Form consists of general information related to the residence being audited, including: home and background information, water sources, water meter, and outdoor water use information.

Form 2: The Fixtures Worksheet provides actual data for all identified fixtures, including existing water rates/volumes and usage.

HOW TO CONDUCT A WATER AUDIT?

Water-using fixtures are identified and measured in order to determine flow and volume rates. Leak detection is also conducted throughout the residence. After data are captured, calculations are completed in order to provide information on customer water usage and potential water savings.

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 actual audit.
- **Local youth and civic groups** as part of an effort to educate the public on the current local water situation and to provide them with the tools to understand how water is used and where any savings opportunities can be garnered.
- **Water service providers,** such as a local water district that wants to implement WMD strategies, including conducting water audits.
- **Residential developers** 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.
- **Residential customers** who 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 water audits for residential water auditors.
- Educate implementers on the best practices for both conserving water and creating efficient use of water, and give them an understanding of the importance of WMD.

HOW TO USE THIS TOOLKIT

This toolkit contains information you need in order to conduct a basic residential water audit.

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

Step-by-step process – this icon indicates 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 I. 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 water use 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 implementation of 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, complementing each other such that the combined effect is greater than the sum of each effort. For example, it is more effective to 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 rainwater 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 affects the water supply and water costs.

A **conservation water rates schedule** has been proven to be an effective tool for WDM. The implementation of increasing tiered rates and noticeable jumps in rate tiers for high water users encourages consumers to manage their water use more efficiently and to 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 should be able to easily identify water-efficient products by a common label or logo. Labeling requirements will 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 laws should 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 form of 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 audits are a crucial BMP that achieve several beneficial results. For example, data collected from water audits help us to better understand customers' 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 water and 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. It is 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.

TUMAGA RIVER

ZCWD WATER SUPPLY SYSTEM

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 1911 for the purpose 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.

FIGURE 1OLD RESERVOIR / SAND AND GRIT REMOVAL BASIN

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 basin just functioned as a storage facility.

WATER TREATMENT PLANT AT PASONANCA

WTP PHASE I

The Zamboanga City Water Sewerage System was 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 assistance 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 one of the prime engines tasked to generate revenues for the water utility firm.

The MRS takes charge of reading the water meters and tendering the bills on a regular schedule. The Billing Section is primarily tasked in generating the bills of all active accounts that fall within the scheduled zones following a billing cycle. The Billing Section also does 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 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 for the 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.

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%

[1] Source: Management Information Services Division – July 2016 Data
The tabulated data below illustrate the number of active accounts per meter size per classification for the month of July 2016.

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

Class	Meter Size	Active Service Connections	Disconnected Connections	Total Service Connections	%Total
	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.
Below is the average consumption data for the different classifications for the 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

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

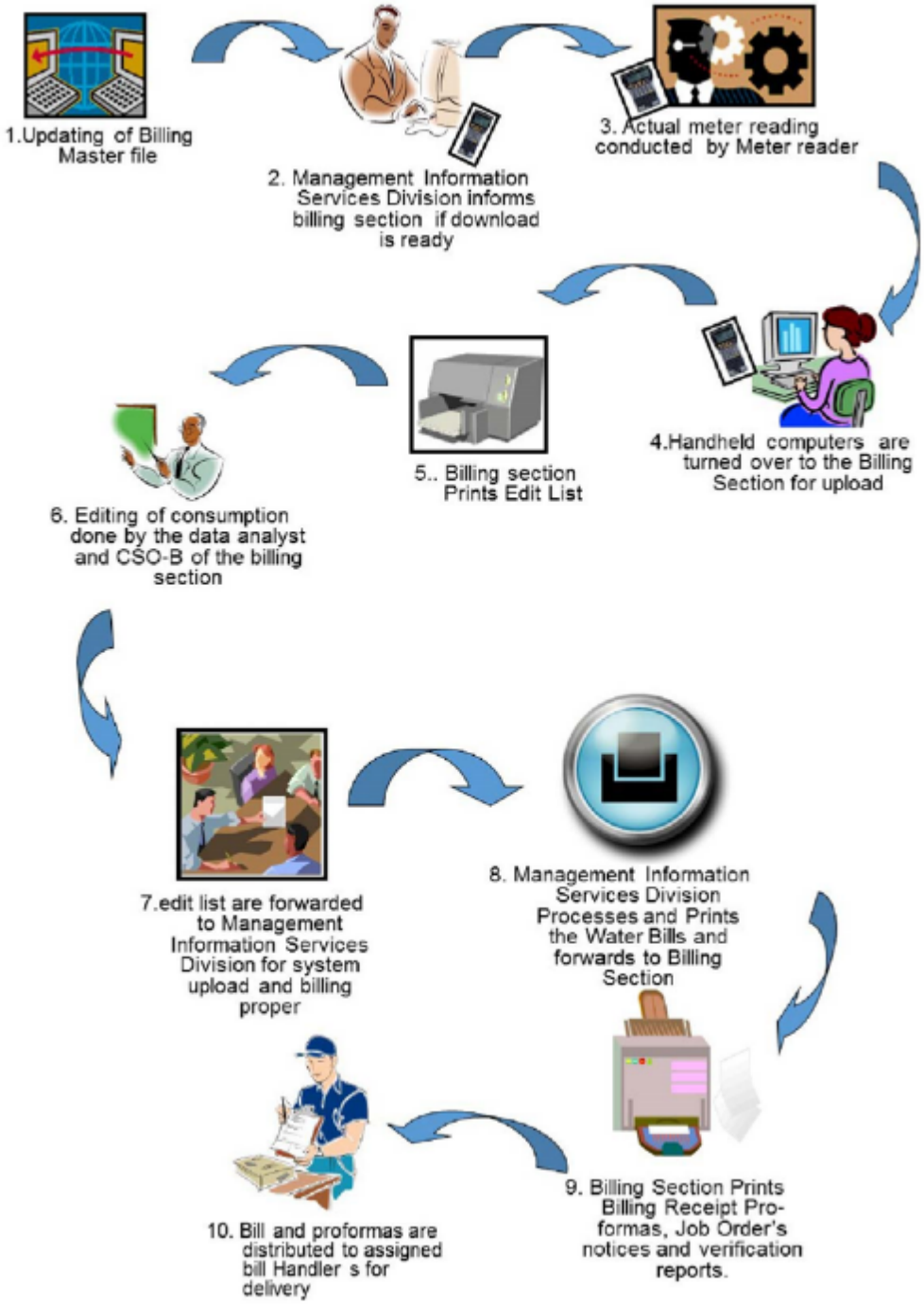
Classification	Monthly Average Consumption
Commercial	44.9 cubic meters
Industrial	566.9 cubic meters
Government – Local	167.0 cubic meters
Government – National	607.5 cubic meters
Overall Average per Connection	29.0 cubic meters

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 is able to 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 Billing Section after reading activity is done. Contents are then uploaded to the database server for proper billing, editing, and downloading.


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.

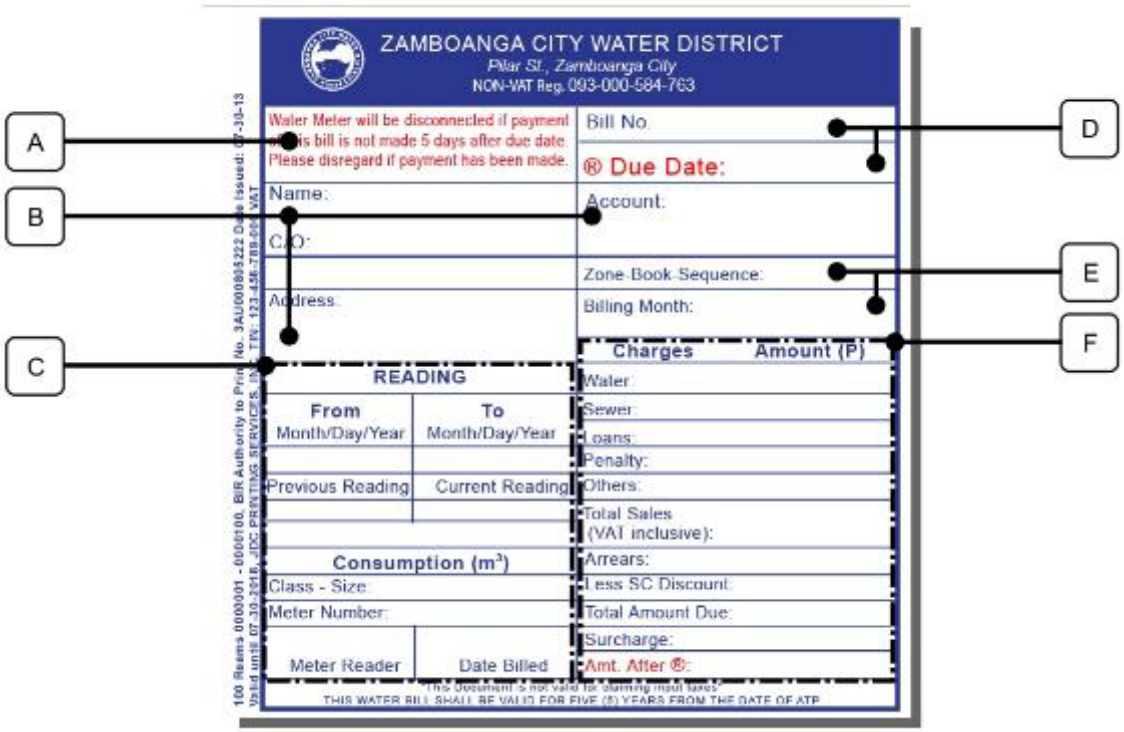
Moreover, accounts with irregular consumptions due to leak, air presence, and other inconsistencies in billing are adjusted pursuant to the amended Policy on Adjustment. Bill adjustment is done once a year per account.

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.
6. 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 reading 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-metering involves 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 should be 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.

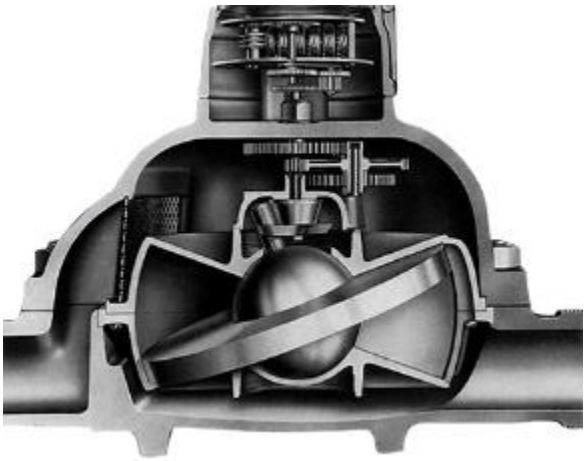
TYPES OF WATER METERS

I. Positive Displacement or Volumetric Meters

Positive displacement (PD) water meters[4] 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] 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]



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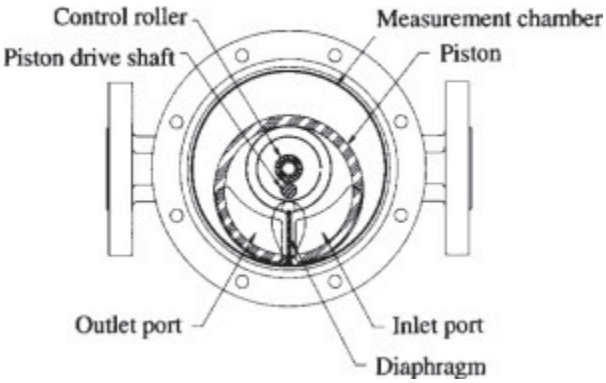


Rotary or Oscillating Piston

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 WATER VELOCITY

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.

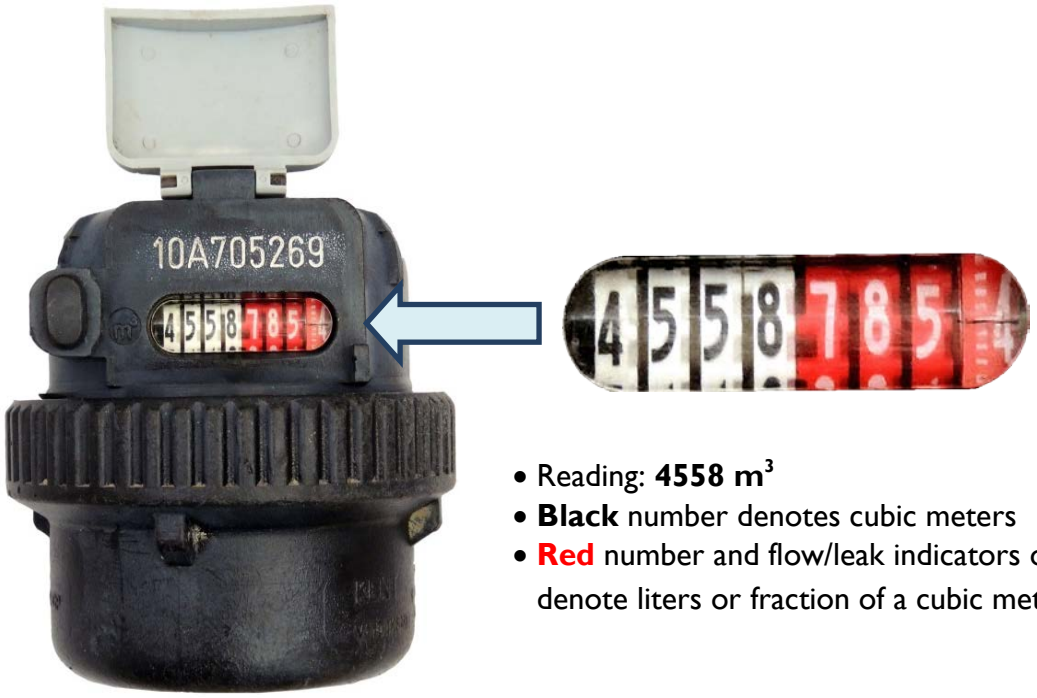
3. **Compound Meters**
   A compound meter is used where high flow rates are necessary and at times when there are smaller rates of flow that need to be accurately measured. It is a combination of a main meter and a by-pass meter, where the main meter is used to measure high flows while the by-pass

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

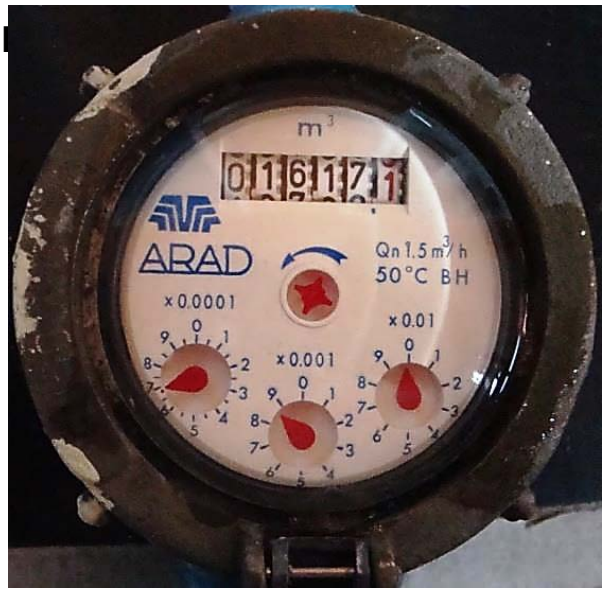
= **678.5** liters

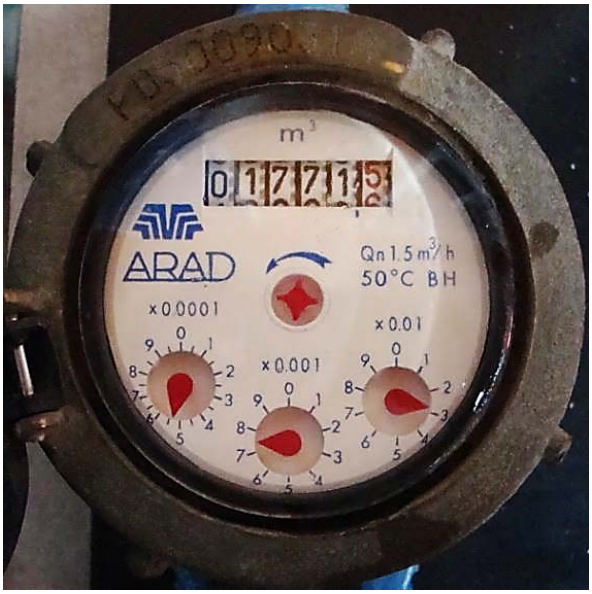
Reading:
119.8582 cubic meters
or
119 cubic meters and **858.2** liters

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 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. RESIDENTIAL FIXTURES AND APPLIANCES

This section describes how residential water fixtures and appliances work and their typical water use and describes how to measuring water use and savings.

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
Private lavatory faucets	1.5 gpm (5.7 L/min)
Kitchen faucet	2.2 gpm (8.3L/min)
Showerheads	2.0 gpm (7.6 L/min)
Clothes washer	Water factor of 4.0 gal/ft^3 of drum capacity normal cycle (0.53 L/L of drum capacity normal cycle)

Table 5: Water Efficient Technology Opportunities

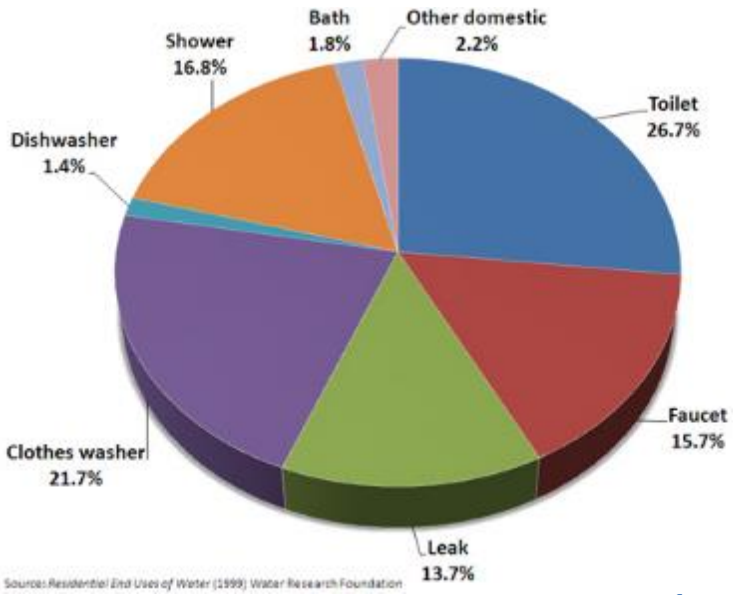
Residential End Uses	Water-Efficient Technology Opportunities
Bathroom	
Toilet	4.8 liters per flush (LPF); 3/6 LPF dual flush
Faucets – aerators	5.7 liters per minute (LPM) private bathrooms
Showerheads	7.6 LPM
Kitchen	
Faucets – aerators	8.3 LPM
Dishwashers	Water-efficient models
Laundry	
Washing machine	Water factor of 4.0 gal/ft^3 of drum capacity normal cycle (0.53 L/L of drum capacity normal cycle)
Cleaning	
Indoor/outdoor cleaning	Dry cleaning methods; automatic shut-off valves
Car washing	Wastewater reuse
Landscaping	
Spraying	Automatic timers, spray nozzles with shut-off valves
Planting	Replace grass; drought-tolerant plants

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 min/person	5 – 15 min	10 min
Bathroom faucet min/person/day (Residential)	.50 – 3.0 min	3.0 min
Kitchen faucet min/person/day (Residential)	.50 – 5.0 min	5.0 min
Toilet flushes/person/day (Non-residential full-time employee)	3.0	1 every 2.5 hours
Bathroom faucet min/person/bathroom use (Non-residential)	15 seconds – 1 min 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



BREAKDOWN OF RESIDENTIAL END USES OF WATER[6]

BATHROOMS

SHOWERHEADS

Replacing high-flow showerheads can be one of the most cost-effective retrofits a homeowner can make. In addition to saving water, they can also save on energy costs 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. They are economical, easy to install, and are 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, the new water-efficient showerhead design also takes into consideration spray pattern, water velocity, and temperature gradient. These factors ensure that the showerhead provides sufficient coverage to wet the body, has a strong enough velocity to properly wash and rinse, and offers 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.

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.

[6] The 1999 study results are included here instead of results from the more recent 2016 study because the earlier study more accurately portrays residential end use statistics that exist at the beginning of major WDM efforts. The 2016 study reflects significant improvements due to conservation efforts over the last 17 years.

- 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

IWATER AUDITOR MEASURING THE SHOWERHEAD FLOW RATE

HOW TO MEASURE SHOWERHEAD FLOW RATE

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

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 gathered in 5 sec: 900 milliliters (ml)
= 900 ml x (60 sec / 5 sec)
= 10,800 ml/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.

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

Example:
Existing shower 108 L/shower – 76 L water-efficient shower = 32 L saved/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 water used from flow rate test.

BATHTUB BEST PRACTICES

- If using a tub, close the drain before filling it.

- Fill the tub 1/3 full instead of filling it to the top.
- Do not leave water running.
- Do not let children play in the bathtub.

BATHROOM FAUCETS

Water-efficient residential bathroom faucets restrict water to 5.7 LPM. Older bathroom faucets can use anywhere between 8.3 to 26 LPM. Water-efficient faucets can reduce the water flow by 30 percent or more without sacrificing performance. The residential (private) bathroom faucet standard takes into consideration that the faucet is used for other tasks besides hand washing, such as teeth brushing, shaving, and face washing. If replacing a water-wasting faucet is not practical, at minimum, retrofit the faucet with an aerator. Bathroom faucets can be easily retrofitted with faucet aerators to achieve a flow of 5.7 LPM or less.

As with all fixtures, flow rates can change as the valves or aerators degrade over time.

FAUCET BEST PRACTICES

- Install faucet aerators to reduce the bathroom faucet flow to 5.7 LPM.
- 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 the less time a flow is measured. Flow rates can be measured up to 15 sec and would require at least a 1 L pitcher.

Bathroom faucet tested for 5 sec:

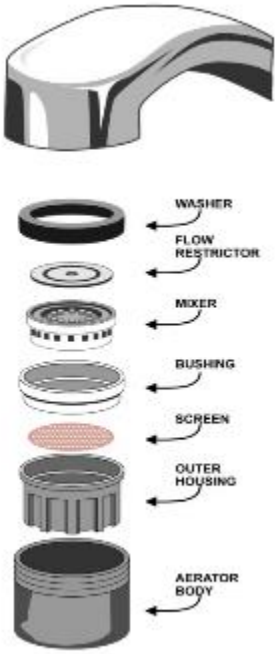
- Turn on faucet to full volume (both cold and hot water)
- Using a stopwatch, measure with a graduated measuring device (2L +) under flow of water

Volume of water gathered in 5 sec: 700 ml
= 700 ml x (60 sec / 5 sec)
= 8,400 ml/min
= 8,400 ml/1,000 = 8.4 LPM
Water-Efficient Faucet Private Bathroom = 5.7 LPM

Flow-gauge bags that automatically provide the flow rate conversion are also available for purchase. These plastic bags 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 screens, 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, along with 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 of retrofit is minor, making it a very cost-effective option.

Half of faucet use is primarily for rinsing, as such, velocity is more important than volume of water needed. In cases where a faucet is used primarily for filling a container, higher-flow aerators could be appropriate.

TOILETS

TYPES OF TOILETS AND HOW THEY WORK

Gravity tank toilets are the most common type of toilets 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 located 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 (or auto fill valve) is tripped to allow water to re-fill 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 LPF. Most are composed of two pieces, but some are one-piece (usually more expensive), with a smaller tank, and are 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. Please 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 two 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 6.0 LPF or less. If the low-volume flush is used for solid waste, this can clog the toilet or require double flushing. Dual flush toilets are reliable when used properly. It is important to educate users, particularly children, on how to use them correctly. Most often, people that are not familiar with them flush the wrong button or double flush. Dual flush toilets are generally not recommended for heavy use commercial settings.

1ST FLOOR REST ROOM – ZCWD MAIN OFFICE

JOLLIBEE PILAR STREET

Flush-o-meter (FOM) 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, but occasionally can be found in residential multi-family units. They operate 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 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 in the same way. 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 to hidden 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.

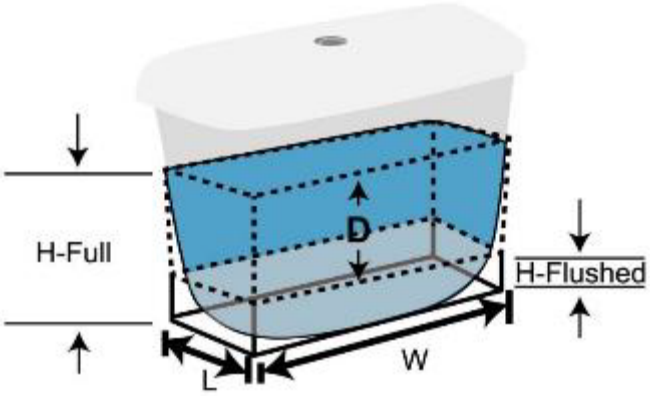
Automatic flushing sensor toilets are commonly found in commercial restrooms and used for FOM valve toilets or urinals primarily for customer convenience and to reduce the spread of germs. Automatic flushing sensors do not always save water and often waste water when the sensor is incorrectly working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

Important: Do not hold handle down, 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 it 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

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 handle down, press down and immediately release to begin flush.

FOM toilet flush rate approximately = 1.6 L/sec
Number of sec x 1.6 L/sec = _____ LPF for FOM toilets
Example: 3 sec x 1.6 L/sec = 4.8 LPF

TOILET WATER USAGE

Average 6 flushes per person/day in a home.
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) being 6 LPF and a low-flow toilet (LFT) being 13 LPF. Toilet water savings can vary depending on the frequency of toilet flushes.

It is important to note that water consumption by toilets should NOT be based upon the number of toilets installed in the home, but rather upon number of persons occupying the home. After conducting the audit and calculating toilet usage, it may show, for example, that it would be beneficial to replace the toilet in the main hallway where most of the occupants use it, as opposed to the toilet in the master bedroom. For this reason, when conducting the audit, we also capture what percentage each toilet is used for.

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

TOILET BEST PRACTICES

- Replace older water-wasting toilets with a HET. If this is not practical, install a temporary toilet displacement device.
- Periodically check for leaks and repair immediately.
- Educate occupants on proper toilet use and maintenance. Water-efficient toilets cannot be used as trashcans. Excessive toilet paper is the most common cause of a clogged toilet.

BEST PRACTICES 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. Make sure 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 stop after the flapper valve is replaced, consider replacing the flapper seat.

BEST PRACTICES 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's 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 manufacturers' 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 to avoid double or phantom flushing. Alternatively, remove sensor systems and replace with manually activated flush valves, which are shown to significantly reduce water consumption at the toilet.
- Other tips 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.

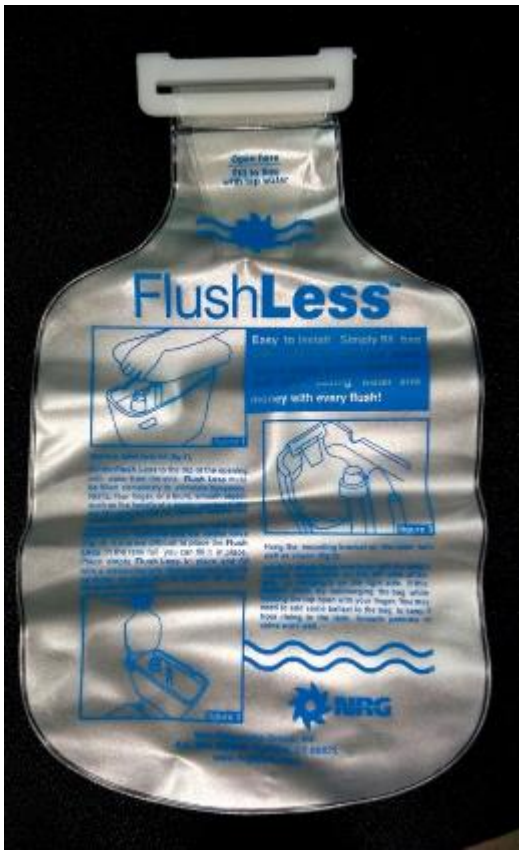
Note: Some homes may have handheld bidet sprays in the bathroom. At this time, we are capturing data to determine saturation rates, water usage, and potential for water efficiencies. Currently, there are no water-efficiency ratings or standards for bidet sprays. However, it may be possible to retrofit them in the future.

LOW BOY ONE-PIECE WATER-EFFICIENT TOILET

ULFT

WATER DISPLACEMENT DEVICES

A water displacement device is a device designed to reduce the amount of water available in the tank for completing the flush. There are various types of water displacement devices, for example: 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 above. 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-term solution for saving water. It is preferred that the entire toilet be replaced with a HET. Installed displacement devices should not interfere 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

KITCHENS

There are many water-saving opportunities in a kitchen, ranging from simply retrofitting faucets with aerators, to replacing faucets and old inefficient dishwashers, and by changing behavior when using water. Kitchen faucets are the most heavily used water source in a kitchen. Another advantage to replacing kitchen faucets and dishwashers with water-efficient equipment are the energy costs saved to heat the water used.

KITCHEN FAUCETS

A water-efficient kitchen faucet restricts flow to a maximum of 8.3 LPM. Older kitchen faucets can use between 11 to 26 LPM. If replacing the faucet is not practical, most faucets can easily be retrofitted with a water-efficient aerator. Water-efficient aerators for kitchen faucets are available with a variety of spray patterns and flow-control features.

While kitchen faucet use is primarily for dishwashing and handwashing, it can also be used for tasks that are volume-based, such as filling pots or buckets. It is important to install an appropriate aerator. Installing an aerator that provides an extremely low flow in the kitchen will most likely result in the user removing it so that they may accomplish their task quicker.

KITCHEN FAUCET BEST PRACTICES

- Regularly check for leaks and repair immediately.

- Retrofit faucets with the appropriate water-efficient aerator.
- Do not let water run when washing dishes. Fill a basin with soap water to clean dishes and another with water to rinse.
- Avoid using a food disposal grinder that requires running water to operate it. Instead, hand scrape the dishes prior to washing.
- Do not thaw frozen food under running water. Thaw in the refrigerator overnight or in a microwave.
- Wash fruits and vegetables in a basin instead of under running water.
- Adjust flow valves to the faucet. Keep in mind that this modification can also be easily changed by users.

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 sec and would require at least a 2 L pitcher.

Kitchen faucet tested for 5 sec:
Bathroom faucet tested for 5 sec:

- 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 sec: 800 ml
= 800 ml x (60 sec / 5 sec)
= 9,600 ml/min
= 9,600 ml/1,000 = 9.6 LPM
Water-Efficient Kitchen Faucet
= 8.3 LPM or less

DISHWASHERS

Many water-efficient dishwashers use less water than hand washing dishes, provided that the dishwasher is fully loaded and the dishes are not pre-rinsed using a faucet. Energy Star–qualified dishwashers can reduce energy use by 12 percent and water use by 30 percent. Old pre-1994 dishwashers can use anywhere between 38 to 57 liters per cycle. Newer water-efficient dishwashers can use 20 liters per cycle or less depending on whether it is a compact or standard-sized dishwasher. These water-efficient dishwashers operate using advanced technology, including: more efficient water jets, soil sensors, better rack design, and improved water filtration. As with all appliances, select the appropriately sized dishwasher based on your home's needs.

DISHWASHER BEST PRACTICES

- Purchase a water-efficient dishwasher when your old dishwasher comes to the end of its life cycle.
- Do not pre-rinse the dishes before loading the dishwasher.
- Locate and repair any leaks.
- Only operate with full loads.
- Use the lightest cycle possible when washing dishes that are not heavily soiled.

ADDITIONAL KITCHEN BEST PRACTICES

Practice dry clean-up methods using brooms, vacuums, scrapers, and other utensils to clean material instead of using water. Sweep floors instead of hosing them down with water.

LAUNDRY

Clothes washing consume a significant amount of water in a home. On average, a full-sized Energy Star–qualified water-efficient clothes washer uses about 45 percent less water and 25 percent less energy. New high-efficiency washers (HEWs) use between 56.8 to 113.6 liters per load, compared to older machines that use between 109.7 to 170 liters per load. Water efficiency is rated in terms of water factor (WF). The WF measures the quantity of water in gallons used to wash each cubic foot of laundry. The lower the WF is, the better the water savings. WF is determined by: gallons per load / cubic foot capacity. It is important to note that, at this time, there is no metric equivalent for WF. HEWs, which do not have center agitators, also have the advantage of being gentler on clothes during the wash, in addition to saving energy and water.

At this time, we do not have water use information for the single- or double-tub washing machines that many people use in the Philippines. While most machines provide the kilogram capacity, they do not have specifications available for water use. In addition, these machines are often used strictly for the wash cycle. Based on residential audits conducted to date, after clothes are washed, they are then removed and rinsed in a basin by hand. It is recommended that as much data are captured as possible in regards to the machine model and capacity while conducting the on-site audit in order to establish a baseline for future use.

LAUNDRY BEST PRACTICES

- Be sure to launder full loads only.
- Reuse rinse water for the wash cycle in the next load, particularly for single-/double-tub machines or hand washing.
- For washers with different water settings, choose the minimum amount required per load.

- Pre-treat stains to avoid double washing clothes.
- Use the shortest cycle for lightly soiled loads.
- Check hoses regularly for leaks and repair immediately.
- If washing by hand, do not leave the faucet running. Fill basins as needed.

Note: Replacing large appliances immediately with water-efficient equipment is not recommended as it is most likely not cost-effective. It is better to replace older equipment with a water-efficient model when it reaches the end of its life cycle.

CAR WASHING BEST PRACTICES

- Use a commercial car wash that recycles water, if available.
- Limit the amount of times a vehicle is washed in a month.
- Soap and wash the vehicle using a bucket.
- Install an automatic shut-off nozzle on the hose so that water does not flow continuously.
- Use recycled water to wash the car.

LANDSCAPING AND OUTDOOR WATER USE BEST PRACTICES

- Use an efficient spray nozzle with automatic shut-off on the end of the hose.
- If possible, decrease the amount of turf area, 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.

POOLS

A properly designed and managed swimming pool can avoid water being wasted. 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. It 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 is to:

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.
4. If the water level in the bucket is higher than the water level in the pool, they may be losing water 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 pool 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.

OTHER RESIDENTIAL BEST PRACTICES

- Turn off running water when not in use.
- Recycle and reuse water whenever feasible. Check with the proper authorities first.
- Read and monitor water use billing records monthly.
- Read and monitor water meters on a regular basis.
- Regularly check for all leaks (equipment, connections, valves, etc.).
- Dry sweep instead of using a hose to clean floors and other hard surfaces.

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. Leaks from a dripping faucet or defective toilet may seem small on a daily basis, 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 are hidden, such as broken water supply lines or toilets. Routine checks for leaks should be conducted by reading the water meter. While this may indicate a leak, it will require further investigation as to what the source of the leak may be. It is also important to note that, as meters age, their sensitivity declines, thus affecting their ability to detect smaller leaks.

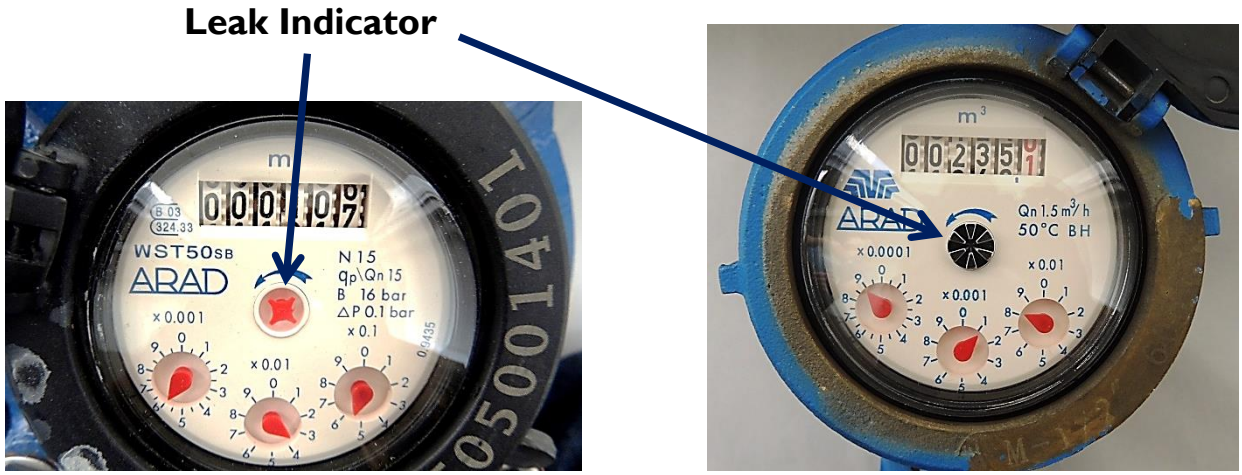
WATER SUPPLY LINE

There may be a leak in the water supply line between the meter and the home. 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 irrigation, or if you can hear the sound of water running outside your house, there may be a leak in the supply line. Most often, leaks between the meter and the home 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 the home.

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 shut off inside and outside the home for at least 15 minutes. First, 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.



Computation for Leak/s

Example:

Registered leak = 2 L in 15 min

To get the volume of the leak in L per m^3 in a month's time:

$$= \frac{2\ L}{15\ min} \times \frac{4\ (60\ min/15)}{1\ hour} \times \frac{24\ hours}{1\ day} \times \frac{30.4\ days}{1\ month}$$

= 5,837 L/month

= 5,837 L/1,000 (to get the volume in cubic meters)

= 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 References for 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. It can be due to the chain prohibiting the flapper to drop completely and seal, or because the flapper and/or the seal can be worn.

Performing a dye test will allow for the detection of leaks inside 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 themselves. 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 expectancy 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.

WATER LEAK AT THE CONNECTION HOSE

FAUCETS 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 drops / minute = L/month).

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

Check for faucet leaks at the faucet head, along with 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 leaks can still occur. Each type of faucet has 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 leak include water stains on the shower walls and floor, dripping showerheads, or dripping shower arms.

HOW TO MEASURE A SHOWERHEAD OR FAUCET LEAK

Faucet and Showerhead Leak Measurement

1. Use a drip gauge
2. Count the number of drips per minute

To calculate the number of leaks in liters per month:
Formula: No. of drips per min x 13.5
Example: 90 drips/min

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

5 drips per second is considered a steady stream.

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 L/month

43.8 = 60 (60 min x 24 hours x 365 days/12 months)

FIXING LEAKS

Leaks should be fixed immediately since they can quickly lead to major water loss. Wrapping leaks with tape is a temporary fix.

SECTION VI: ADDITIONAL WATER-EFFICIENCY OPPORTUNITIES AND WATER SOURCES

NEW CONSTRUCTION

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

With water supply becoming a high priority, designing homes for maximum water efficiency is becoming more important. With water and sewer rates increasing and new water supplies being unavailable, there is an increased recognition of the potential water savings that can be realized as a result of an efficiently designed home. As a result of implementing water-efficiency technology and strategies into the home 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 has already been completed.

NEW CONSTRUCTION BEST PRACTICES

PLUMBING FIXTURES

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

APPLIANCES AND EQUIPMENT

Only install water-efficient appliances such as washing machines and dishwashers.

ALTERNATE WATER SOURCES

Alternate water use sources can also be cost-effective if included in the design of a new home, potentially making some of them net zero. Use of a graywater system should be considered to supply water for toilets and for irrigating landscape. If reclaimed water is an option, installing color-coded water pipes to minimize cross-connection problems can be incorporated into the home design. A rainwater harvesting system can also be incorporated into the design of a new home. Not only would it provide an alternate source of water, it would also help 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 of meter will not record the true water usage and it will be harder to detect leaks.

Water sub-metering is the installation of water meters in individual tenant units, or at specific end uses, such as a pool or for large landscape irrigation to determine consumption and to help locate and isolate possible leaks.

BUILDING WATER PRESSURE

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

LANDSCAPE AND IRRIGATION

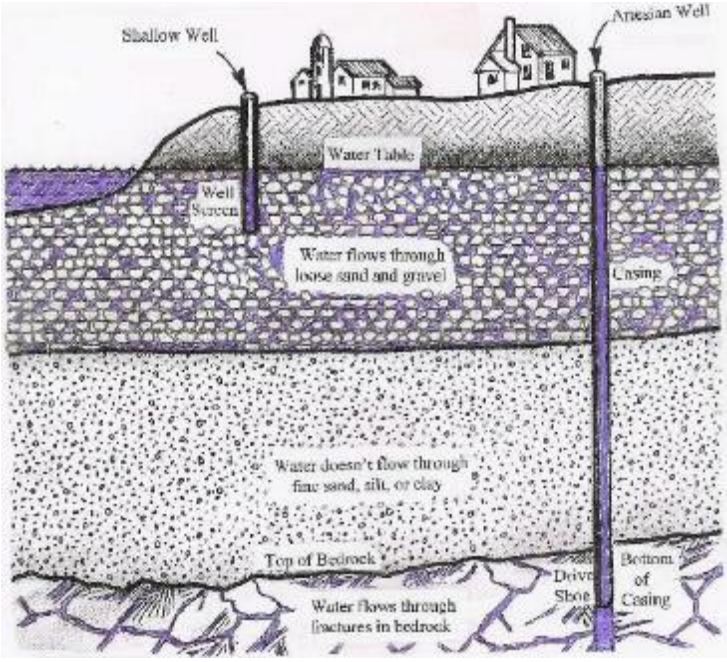
Design a water-efficient landscape to include drought-tolerant and climate-appropriate turf, trees, shrubs, and ground cover. Minimize the amount of turf area in the landscape as turf requires significantly more water. Water-efficient landscapes can reduce irrigation water use to better withstand drought,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

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 place 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 water from 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. Deep wells are classified into two classes: (1) deep well (modified), and (2) deep well (standard). Deep well (modified) are 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 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 where the 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).



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

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 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 water 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 hotels where rinse water is used in the next load for soap water or where shopping mall 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 from 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 United States, 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 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 homes 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 VII: CONDUCTING THE RESIDENTIAL AUDIT

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. Since water use varies from one type of home to another, it is important to conduct a water audit specific to the particular home, so that recommendations can be made.

Because this is the beginning of a new endeavor, the focus is on conducting basic water audits that provide the greatest effect at minimal costs. The water audit focuses on these factors: water end uses most common in residential homes; 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 can easily be retrofitted. Domestic sanitary fixtures, kitchen, and laundry appliances meet these criteria. Non-domestic opportunities, such as outdoor landscape irrigation, are currently not a part of this 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 for the residential sector.

To determine which customers to audit, it is beneficial to first assess the profile of the overall residential customer base, including who are the highest water users, what are the predominate types of customers, and what type of rates apply. This information is usually available through the customer billing system. Knowing the customer base will assist with determining who the preferred target market is.

Thorough preparation will maximize the efficiency of the water audit. The auditor should be prepared and have the customer billing information that could show seasonal differences or fluctuations and a general idea of how much water is being used.

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)
- Visit identified customer
- Introduce and present review of audit process

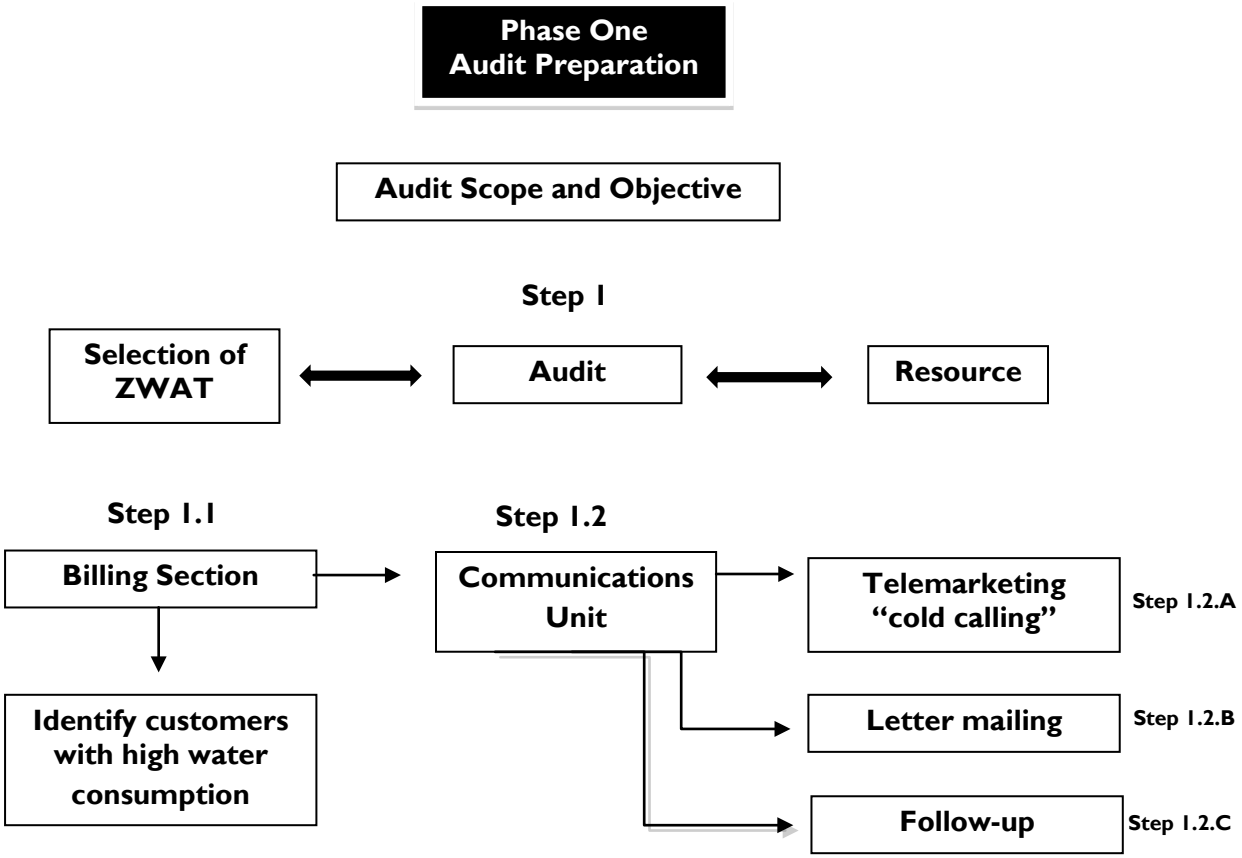
Step 3:
Water Auditor: (Refer to forms)
- General home information
- Occupancy information
- Water meters/areas served
- Detect and measure leaks
- Measure LPM and LPF of fixtures
- Determine water usage of appliance
- Estimate water savings by frequency of use

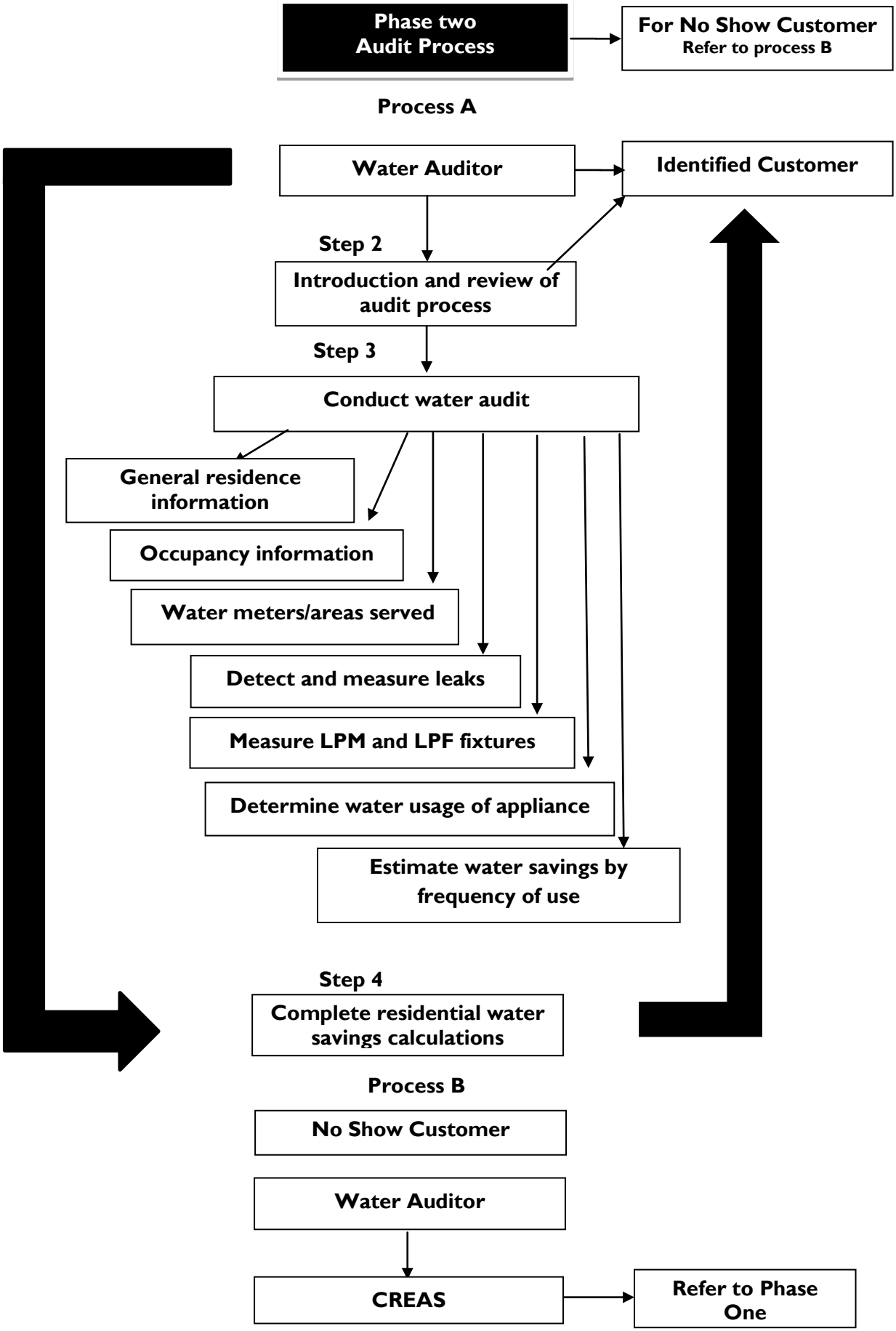
Step 4:
Process A: Audit findings, recommendations presented to the customer.

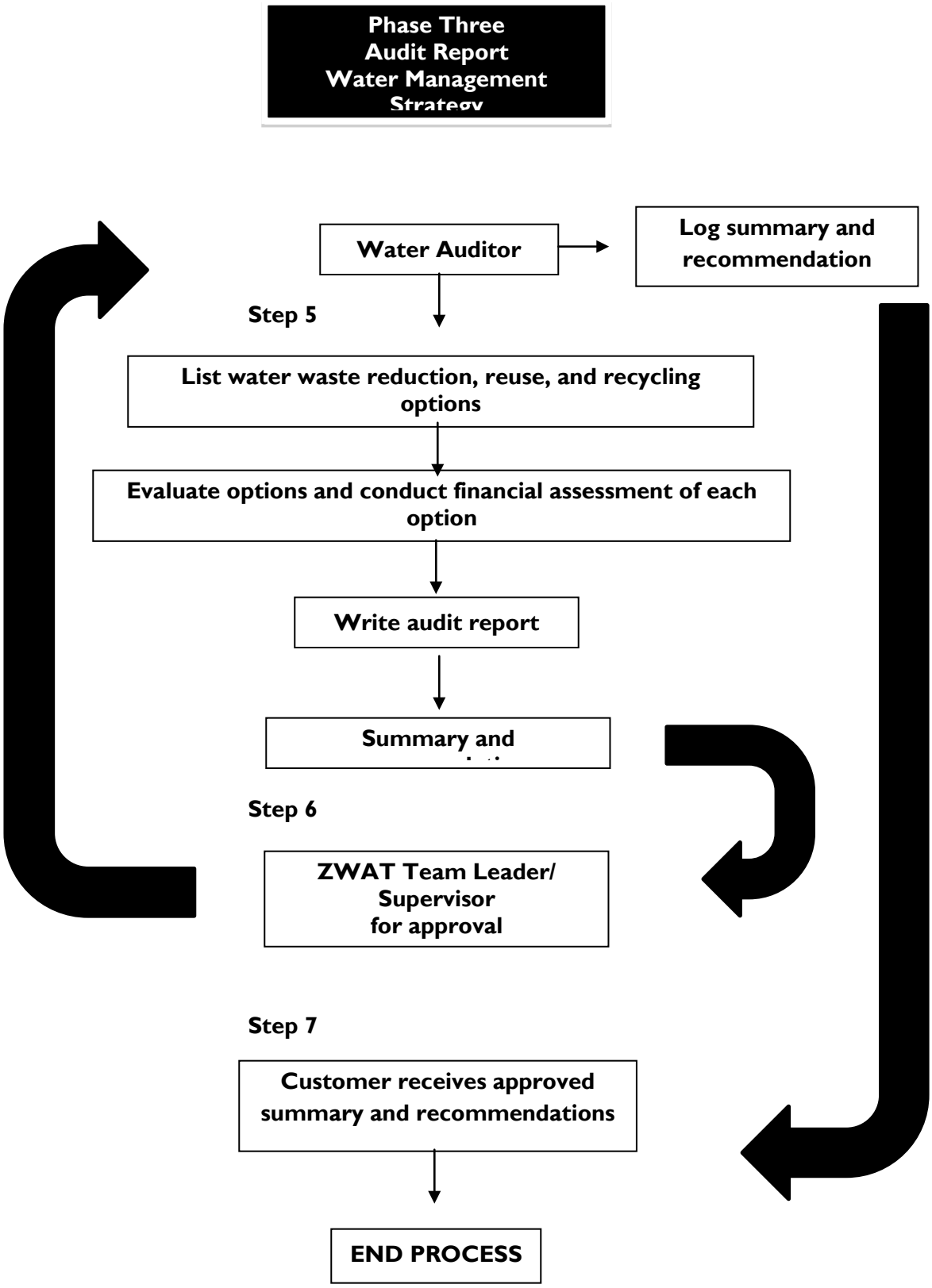
Process B (No show customer)
- Water auditor informs Communications Unit
- Communications Unit will call back identified customer for rescheduling

PHASE THREE: AUDIT REPORT

Step 5:
Water Auditor:
- List water waste reduction, reuse, and recycling options.
- Summary and recommendation.
- Forward summary and recommendation to Supervisor for approval.
- Log summary and recommendation and send approved summary and recommendations to customer.


Phase One
Audit Preparation
Audit Scope and Objective
Step 1
Selection of ZWAT
Audit
Resource
Step 1.1
Step 1.2
Billing Section
Communications Unit
Telemarketing "cold calling"
Step 1.2.A
Identify customers with high water consumption
Letter mailing
Step 1.2.B
Follow-up
Step 1.2.C


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 process
Step 3
Conduct water audit
General residence information
Occupancy information
Water meters/areas served
Detect and measure leaks
Measure LPM and LPF fixtures
Determine water usage of appliance
Estimate water savings by frequency of use
Step 4
Complete residential water savings calculations
Process B
No Show Customer
Water Auditor
CREAS
Refer to Phase One


Phase Three
Audit Report
Water Management
Strategy
Water Auditor
Log 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. A good first impression is critical.

- 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.
- You are representing your water agency. The water auditor is a representative of the water agency and should behave accordingly.

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 or 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 the homeowner with you. If the homeowner leaves, you must leave also.

Before you start

- Explain that the homeowner has to stay within sight of you at all times.
- Ask to make other people at the home (domestic help, etc.) aware of your presence.
- Ask whether there are any special needs or concerns (broken plumbing, etc.), or special access required.
- Explain the procedures and expected time required for the audit.

ON-SITE AUDIT STEPS

- Conduct the interview, fill out the Residential Audit Master Form. The quality of the audit is dependent on obtaining accurate information. It is important when possible to speak directly with the person that is familiar with how water is used in the home.
- Identify general site information and site water use data taking into account seasonal fluctuations.
- Identify the physical size of the home.
- Identify meters and locations.
- Conduct a leak detection test by meter reading.
- Identify the site: alternate supply sources, number of occupants.
- Identify all leaks encountered throughout the walk-through aside from those located in the bathrooms and kitchens. Measure the leaks when possible.

- Document any habits or practices that may affect water-use efficiency in the notation section of the Audit Form.
- Audit bathrooms: conduct toilet leak detection test, conduct toilet flush rate measurements, along with faucet and showerhead flow rates measurements. Obtain frequency of use information.
- Audit kitchens: conduct faucet flow rates measurements, document all water-using appliances. Obtain frequency of use and volume information.
- Audit laundry equipment if present. Obtain frequency of use and volume information.
- Audit outdoor water uses, including car washes.
- Document any other information that will help to determine water usage, as needed with a diagram or photo

See Auditor Inventory Form in Appendix A.

Note: If conducting a large multi-family (apartment) audit for four or more units, it is recommended that a Commercial Audit Form be used, particularly if units are not sub-metered. Residential Audit Forms can be used for each individual unit; however, water usage and savings calculations should be completed using the commercial savings and analysis spreadsheet, and a comprehensive report should be provided to the building owner.

HOW TO USE THE RESIDENTIAL AUDIT DATA COLLECTION FORM (FORM 1)

HOUSE INFORMATION

1. Account Number – as shown on the water bill
2. Account Name – as shown on the water bill
3. Tenant Name – list, if different from the account name
4. House/Lot#/Subdivision – address as shown on the water bill
5. Street – as shown on the water bill
6. Barangay – as shown on the water bill
7. City – as shown on the water bill
8. Control Number – generated and assigned by the water agency
9. Surveyor – list name of surveyor(s)
10. Survey Date – list the date of the survey
11. Contact Person – name of contact person
12. Person at Site – if different than the contact person at the time of the survey
13. Phone 1 Home – home phone number for the contact person
14. Phone 2 Mobile – mobile phone number for the contact person
15. Email – email address for the contact person

BACKGROUND INFORMATION

1. Type of Home – note the structure type of the home: Single, Family, Detached, Duplex, Condo, Apt., or other

2. No. of Occupants – total number of occupants living in the home full-time
3. Individual Home Meter – Yes or No, if the home has an individual meter
4. Individual Landscape – Yes or No, if the home has landscape, regardless of size
5. Dedicated Landscape Meter – Yes or No, if the home has a dedicated landscape meter
6. Lot Size Square Meter – approximate size of the total lot, including the home
7. Year Home Built – year the home was built, note if there have been any major renovations
8. Year Residency Established – year the current occupant moved in
9. No. of Bathrooms – list the total number of bathrooms in the home (include all bathrooms on the property, such as domestic help quarters, etc.)
10. Water Bill Paid By – list if water is paid by tenant or owner

SOURCES OF WATER

This section describes what the various sources of water are for the home. If available, list what percentage of water is provided according to the 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 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

Meter: Ensure that all water-using fixtures and appliances are turned off and no water is being used inside or outside the house at the time of the meter reading test.

1. Meter movement – did the meter move after all water use ceased?
2. Initial Meter Read – list the initial meter reading when starting the test
3. Final Meter Read – list the final meter reading after the test is done (at least 15 minutes)
4. Net Meter Reading – list Final Meter read minus Initial Meter Read
5. Meter # – list the meter number
6. Elapsed Time – amount of time the test was conducted in minutes

POOL

1. Cover – check if the pool has a cover, Yes or No
2. Estimated Volume – calculate the volume of the pool based on length x width x average depth = volume in cubic meters

OTHER OUTDOOR WATER USES/LANDSCAPING

Note if there are any outdoor water uses, such as decorative fountains or 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.

CAR WASHING

1. No. of Vehicles Washed – list the total number of vehicles (include motorcycles, etc.) washed
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 harvested rainwater
4. Method of Carwash – check if they are using a hose, hose with a shut-off valve, or a bucket

OTHER LEAKS AND REMARKS

Note any leaks other than what is shown on Forms 2 and 3. List any other remarks that will help to calculate water savings or to provide recommendations.

HOW TO USE THE RESIDENTIAL AUDIT DATA COLLECTION FORM 2

Control Number – note the control number as shown on Form 1 of the Audit Form

TOILET INFORMATION

1. Location – note which bathroom the toilet is located in (main hallway, master bathroom, maid's quarters)
2. % used – note what percentage of time each bathroom is used, for example: main hallway = 90%, master bathroom = 10% (% used should always total 100 for the combined bathrooms)
3. Type – list type of toilet: Gravity (G), Dual Flush (DF), Flush-o-meter (FOM), Bucket (B) not plumbed for water supply, uses a bucket to flush the toilet
4. Length (cm) – list the length inside the toilet tank
5. Width (cm) – list the width inside the toilet tank
6. Initial Depth (cm) – list the depth of the water inside the toilet tank
7. Remaining Depth (cm) – list the depth of the water remaining in the tank, immediately after flushing the toilet (net depth will automatically be calculated in the Excel worksheet)
8. No. of Sec./Flush (FOM) – list the number of seconds it takes to complete the flush
9. Existing 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
10. Retrofit Liters/Flush – list the retrofit liters per flush, 4.8, or 6.0 for DF
11. Liters Saved/Flush – Existing liters/flush minus Retrofit liters/flush = liters saved/flush
12. Leaks (Y/N) – note whether the toilet is leaking
13. 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 whether the flapper is worn or defective

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 faucet (location will usually also determine type of faucet, i.e., kitchen or bathroom)
2. Percent used – note what percentage of time each faucet is used, for example: main hallway bathroom = 90%, master bathroom = 10% (% used should always equal 100% for the same type of faucet, for example: 2 bathrooms should total 100%, 2 kitchens should total 100%)
3. Type – note the type of faucet: Bathroom (B), Kitchen (K), Handheld Sink Spray (HHS), Utility (U)
4. It is especially important to note the location and type of faucet, as the water-efficiency standard is based upon whether the faucet is a bathroom or a kitchen faucet. Utility faucet examples would include: laundry room faucet, outdoor cleaning faucet, etc.
5. Volume (ml) – the total volume of water accumulated or measured 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 recommended 5 seconds
7. Existing Liters/Minute – volume ml x 12 (based on 5 sec) = _____ ml/1,000 = LPM
8. Retrofit Liters/Minute – list the retrofit LPM based on the type of faucet
9. Liters Saved/Minute – existing LPM minus retrofit LPM = Liters saved/minute
10. Aerators (Y/N/NA) – Y = There is an aerator present; N = There is no aerator present; NA = It is not feasible or applicable to place an aerator on the faucet
11. Leak (Y/N) – Y = The faucet is leaking; N= The faucet is not leaking
12. No. of Drips or ML/Min – note the number of drips counted for 1 minute, or measured ml/min
13. Leaks Liters/Month – 13.5 x number of drips per min = leaks L/month or ml/min x 43.8 = leaks L/month
14. Remarks – note any additional remarks regarding faucets or leaks

HOW TO USE THE RESIDENTIAL AUDIT DATA COLLECTION FORM 3

SHOWERHEAD/OTHER BATHROOM SPRAYHEAD INFORMATION

1. Location – note which bathroom the shower is located in
2. Percent used – note what percentage of time each bathroom shower is used, for example: main hallway = 90%, master bathroom = 10% (% used should always total 100 for the combined bathrooms)
3. Type – note the type of showerhead/sprayhead: Showerhead (SH), Toilet Bidet Spray (TBS), Bucket = B
4. Volume (ml) – the total volume of water accumulated/measured based on the number of seconds tested
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 recommended 5 seconds.

6. Existing Liters/Minute – volume ml x 12 (based on 5 sec) = _____ ml/1,000 = LPM
7. Retrofit Liters/Minute – list the showerhead standard of 7.6
8. Liter Saved/Minute – existing LPM minus Retrofit LPM = Liters saved/minute
9. Leaks (Y/N) – Y = The faucet is leaking; N = The faucet is not leaking
10. No. of Drips or ML/Min – note the number of drips counted for 1 minute, or measured ml/min
11. Leaks Liters/Month – 13.5 x number of drips per minute = leaks L/month, or ml/min = leaks L/month
12. Showers/person/day – average number of showers per person per day
13. Remarks – note any additional remarks regarding showerheads

Note: At this time, we are capturing data on bidet 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.

APPLIANCE INFORMATION (DISHWASHERS, CLOTHES WASHERS)

1. Type – note the type of appliance: Washing Machine Horizontal (WMH), Washing Machine Vertical (WMV), Washing Machine Manual (WMM), Handwash Clothes (HW), Dishwashing Machine (DW)
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; note model name if model number is not available
4. No. of Loads/Wk– list the number of loads that are washed per week
5. Remarks – note any additional remarks, for example: if any water is being reused

RESIDENTIAL AUDIT DATA COLLECTION FORM 1

Home Information		Control Number	
		Surveyor	
Account Number		Survey Date	
Account Name			
Tenant Name		Contact Person	
House / Lot #/ Subdivision		Person at site	
Street		Phone 1 - Home	
Barangay		Phone 2 - Mobile	
City		Email	

Background Information		**Sources of Wate**	**Usage (%)**	**Purpose**
Type of Home	☐ Single Family Detached	Water District		
	☐ Duplex ☐ Condo☐ Apt.	Rain Harvest		
	☐ Other: _____	Deep Well		
No. of Occupants	___	Shallow Well		
Individual Home Meter	☐ Yes ☐ No	Delivery Truck (Private)		
Individual Landscape	☐ Yes ☐ No			
Dedicated Landscape Me	☐ Yes ☐ No			
Lot Size Square Meter				
Year Home Built				
Year Residency Established				
No. of Bathrooms				
Water Bill Paid by				

Meter			
Meter Movement	☐ Yes ☐ No	Meter #	
Initial Meter Read (m^3.liters)		Elapsed Time	_____ Minutes
Final Meter Read (m^3.liters)			
Net Meter Reading	0		

Pool		**Other Outdoor Water Uses/Landscaping**
Pool Cover	☐ Yes ☐ No	
Estimated Volume (L x W x Ave. Depth = m3)		

Other Leaks and Remarks:	**Car Washing**	
	No. of Vehicles	
	Frequency of Washing	
	Source of Water	
	☐Hose ☐Hose w/ Shut Off ☐ Bucket	

RESIDENTIAL AUDIT DATA COLLECTION FORM 2

Toilet Standard: 4.8 LPF DF 3.0/6.0 LPF

Control #

Toilet Location								
% Used								
Type								
Length								
Width								
Depth								
Net Depth								
No. of Sec./ flush (FOM)								
Existing Liters/Flush								
Retrofit Liters/Flush								
Liters Saved/Flush								
Leak (Y/N)								
Remarks								

Toilet Type: Gravity = G Dual Flush = DF Flush-O-Meter = FOM Bucket = B

Faucet Standard: Bathroom 5.7 LPM, Kitchen 8.3 LPM, Utility 8.3 LPM

Faucet Location								
% Used								
Type								
Volume (ML)								
No. of Seconds	5	5	5	5	5	5	5	5
Existing Liters/Minute								
Retrofit Liters/Minute								
Liters Saved/Minute								
Aerator (Y/N/NA)								
Leak (Y/N)								
No. of Drips / Min								
Leaks Liters/Month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Remarks								

Type: Kitchen = K Bathroom = B Handheld Sink Spray = HHS Utility = U

RESIDENTIAL AUDIT DATA COLLECTION FORM 3

Control #

Showerhead Standard: 7.6 LPM

Showerhead Location								
% Used								
Type								
Volume (ML)								
No. of Seconds	5	5	5	5	5	5	5	5
Existing Liters/Minute								
Retrofit Liters/Minute								
Liters Saved/Minute								
Leak (Y/N)								
No. of Drips / Min								
Leaks Liters/Month								
Showers p/person /day								
Remarks								

Type: Showerhead = SH Toilet Bidet Spray = TBS Bucket = B

Computation: Drips Liters/Minute = (Volume(ML)*20)/1000 Drips Liters/Month = No. of Drips/Min * 1.5

Appliances	App 1	App 2	App 3	App 4	App 5	App 6	App 7	App 8
Type								
Make								
Model								
No. of Loads/Wk								
Remarks								

Type: Washing Machine Horizontal = WMH Washing Machine Vertical = WMV

Washing Machine Manual = WMM Handwash Clothes=HW Dishwashing Machines= DW

CONCLUDING THE RESIDENTIAL AUDIT

Ask the customer if you may take a few additional minutes to conduct calculations of their water usage.

1. Complete calculations for water usage of fixtures on the Residential Audit Form.
2. Complete the Residential Water Savings Calculations Worksheet (see below).
3. Fill out the Customer Water Audit Report using the Savings Calculations worksheet (see below).
4. Review findings with the customer.
5. Review water-efficient equipment and retrofit or replacement options.
6. Provide general recommended savings tips, fixing leaks (brochure or flyer).
7. Educate and encourage good water use practices.
8. Thank the customer for their time and participation, encourage them to contact the water district if they have any additional questions regarding the water audit or report.

Residential Water Savings Calculations Worksheet

Control #

Toilets (location)	Liters saved/flush	% Used	No. of flushes per toilet/day	Liters saved per toilet/month
Total Toilets Liters saved/month				

No. of Occupants	Total No. of Flushes per day

INSTRUCTIONS

1)Enter Toilet Location, Liters saved/flush and % used from Audit Form

2)Enter # of occupants from Audit Form

3) # of occupants x 6 flushes p/day = Total # of flushes per day

4)Total # of flushes per day x % used = # of flushes per toilet/day

5) Liters saved/flush x # of flushes per toilet/day x 30.4 = Liters saved per toilet/month

6) Add Liters saved per toilet/month for all toilets = Total Toilet Liters saved/month

Residential Water Savings Calculations Worksheet

Showerheads (location)	LPM saved p/shower	% Used	No. of shower mins p/day	Liters saved per SH/ month
Total Showerhead Liters saved/month				

No. of Occupants	
No. of Showers per day	
Total # of showers per day	
No. of Shower minutes/day	

INSTRUCTIONS

1)Enter Showerhead Location, Liters saved/min and % used from Audit Form

2)Enter # of occupants, # of showers per person/day from Audit Form

3) # of occupants x # of showers p/day = Total # of showers per day

4) Total # of showers per day x 10 min/shower = # of shower minutes per day

5)Total # of shower minutes per day x % used = # of shower mins per sh/day

6) Liters saved p/shower x # of shower mins p/day x 30.4 = Liters saved per SH/month

7) Add Liters saved per SH/month for all Showerheads = Total Showerhead Liters saved/month

Residential Water Savings Calculations Worksheet

Bathroom Faucets (location)	LPM saved p/faucet	% Used	No. of faucet mins p/day	Liters saved per faucet/ month
Total Bathroom Faucets Liters saved/month				

No. of Occupants	Total No. of bath faucet mins p/day

INSTRUCTIONS

1)Enter Bathroom Faucet Location, Liters saved/min and % used from Audit Form

2)Enter # of occupants

3) # of occupants x 3 min p/day = Total # of bathroom faucet minutes p/day

4)Total # of bath faucet minutes per day x % used = # of faucet mins p/day

5) Liters saved p/faucet x # of faucet mins p/day x 30.4 = Liters saved per faucet /month

APPENDICES

Appendix A: Sample Audit Program Forms and Reports
Appendix B: Quick Reference Guide
Appendix C: Sample Completed Water Audit Form

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 Summary Report
   - 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	

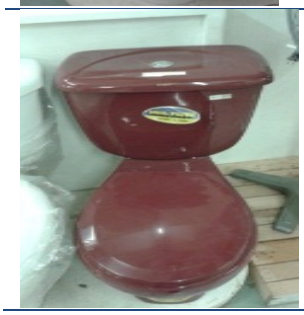
Prepared by:

Water Auditor

Noted by:

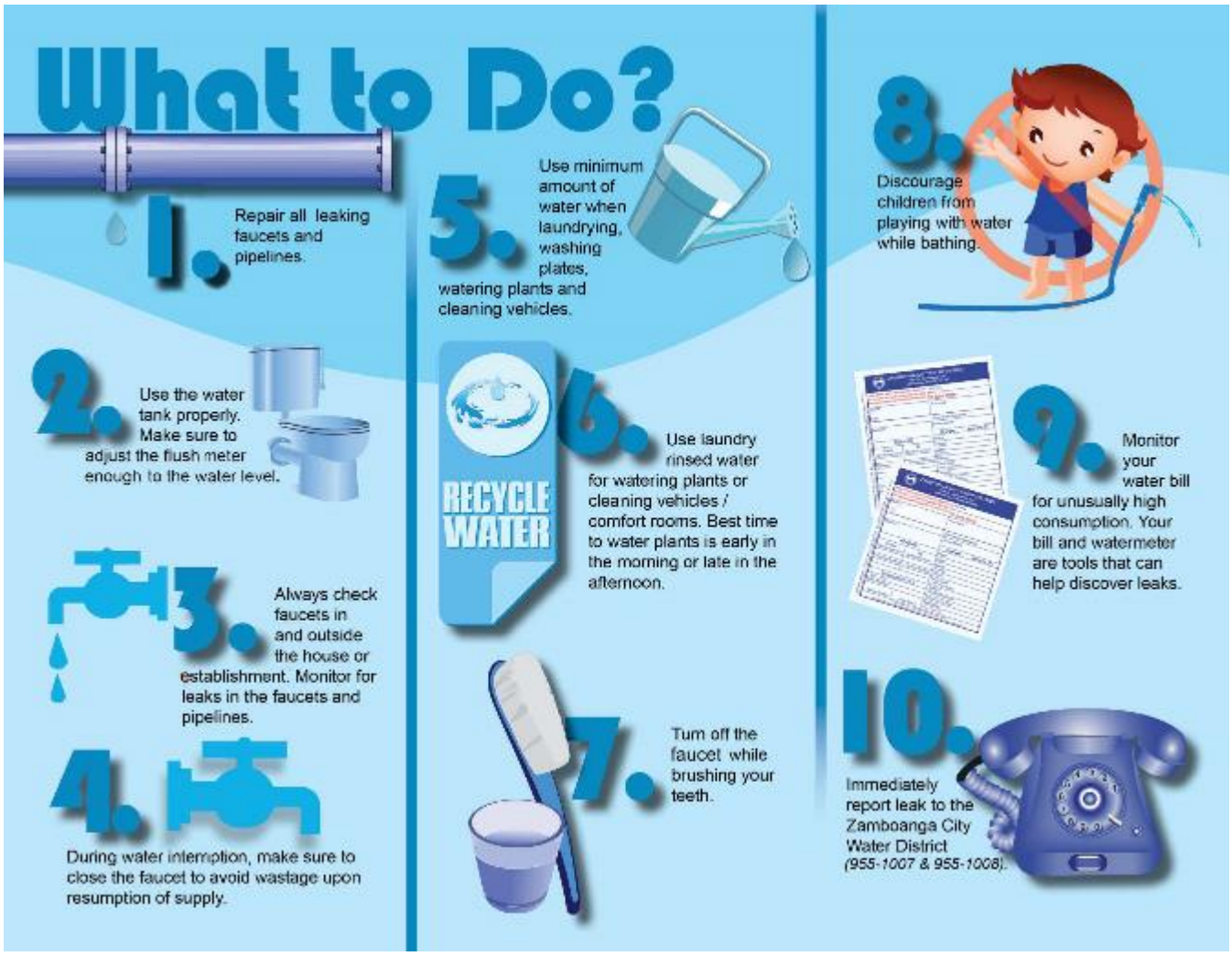
Water Audit Supervisor

DIRECTORY OF LOCALLY AVAILABLE FIXTURES

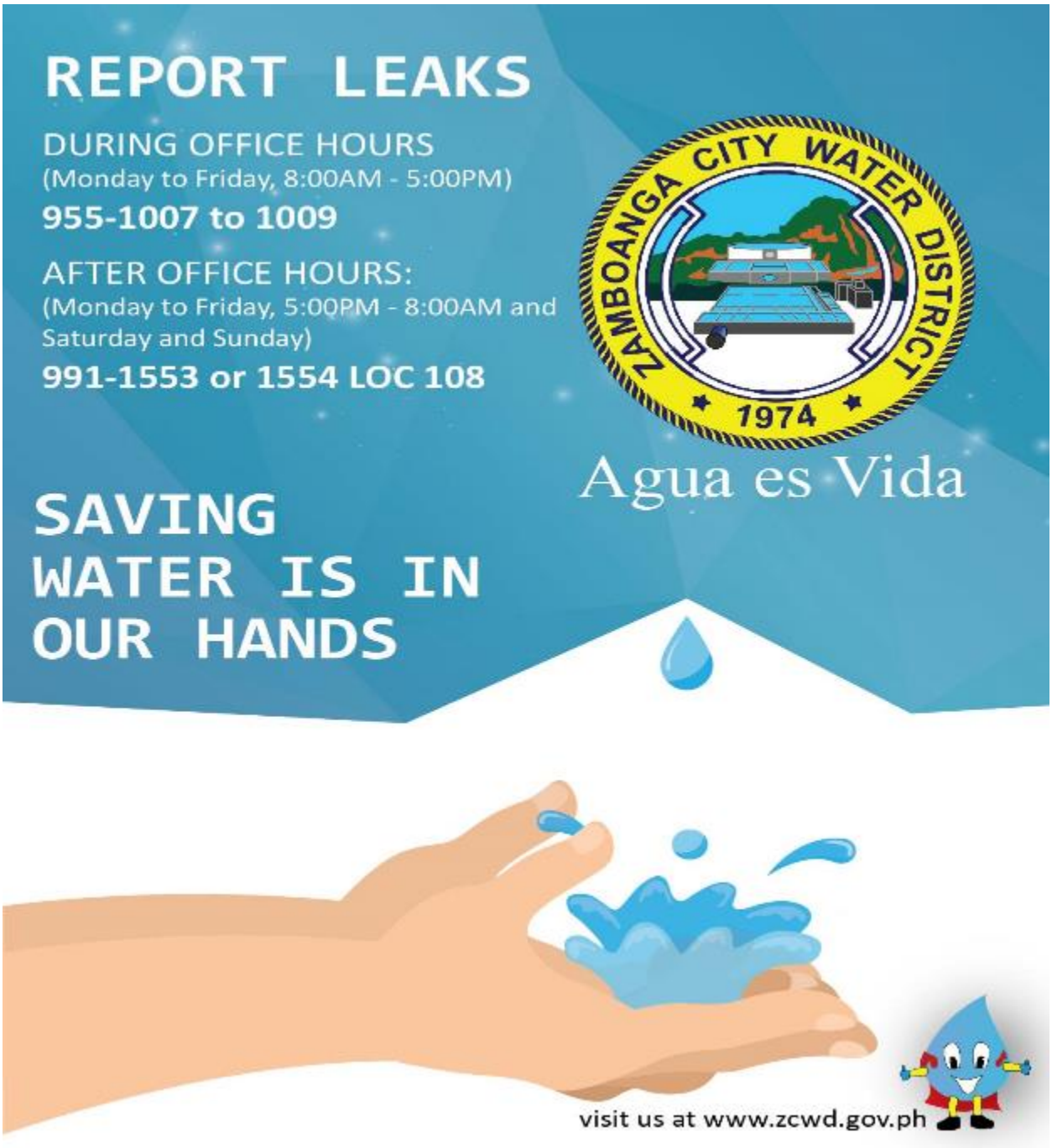
Fixture	Manufacturer	Model	Key Water Saving Feature	Store	Price
	Royal Tern Ceramics Philippines		Push button water saver 6 liters	Asiatic Hardware	P4,900.00
	Save Flush		3 and 6 liters Dual Flush	Asiatic Hardware	P6,030.00
	Royal Tern Ceramics Philippines	Sparrow	6 liters Lever Type	Asiatic Hardware	P4,180.00
	Save Flush	Redwine	3 and 6 liters Dual Flush	Asiatic Hardware	P7,165.00

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	WF 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 cm3 / 1000 = 16.24 LPF
Remember to use net depth (initial depth of water – remaining 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 WATER AUDIT REPORT

Control #:
Prepared for: Teodora G. Ramirez
Property Address: San Roque, Budlong Compound
Presented By: Engr. Roderick H. Concepcion
Date: Sept. 24, 2016

Thank you for participating in our residential water audit program. The results listed below are based on the water audit conducted at your residence.

LEAKS

Leaks from pipes, plumbing fixtures and fittings are a large source of water waste for many households. Water wasting leaks can account for up to 14% or more of overall water consumption in a typical home.

Based on our observations we located the following leaks:

Location of Leak	Volume of Leak

You can save approximately ____ liters per month by fixing these leaks. We recommend fixing leaks as soon as possible. Monitor leaks inside and outside of your home on a regular basis.

FAUCETS

Faucet water use accounts for 15-18% of the overall water consumption inside a typical household. An average household uses between 68.5 and 101.1 L per day for all faucets (bathroom, kitchen, and utility sink).

Findings:

Faucet Location	Existing Flow Rate

You can save approximately ____ liters per month by replacing your faucet with a water efficient faucet or installing aerators. Aerators save water by reducing the flow rate and splash, while increasing effectiveness. A basic faucet aerator is inexpensive and easy to install. Water efficient bathroom faucets should not exceed a flow rate of 5.7 LPM. Kitchen faucets and utility faucets should not exceed a flow rate of 8.3 LPM. Aerators for kitchen faucets are available with a variety of spray patterns and flow-control features.

Tips: Shut off faucets whenever possible. Make sure your faucets don't drip or leak.

SHOWERHEADS

Findings:

Showerhead Location	Existing Flow Rate

You can save _____ liters of water per month by replacing your showerheads with water efficient showerheads.

Tips:

Pay attention to the length of time spent in the shower. Try taking a shorter shower of around 5- 8 minutes. If your shower is equipped with an on-off switch, use it while you are soaping and shampooing. If you wait for the water to get hot before showering, collect the normally discarded cold water in a bucket to use for other tasks, such as watering plants, laundry or car washing.

TOILETS

Toilet flushing is the single highest use of water in the average home. With the average person flushing six times a day, toilets make up about 31% of overall household water consumption.

Findings:

Toilet Location	Existing Liters/Flush

You can save _____ liters of water per month by replacing your toilets with water efficient toilets using 4.8 liters per flush.

Tips:

If you cannot replace your toilet, consider installing a displacement device so that less water fills the tank. Do not use the toilet as a trash can. If your home has a dual flush toilet, try to use the low volume flush mode as much as possible.

Comments and Recommendations:

_____

_____

_____

_____

_____

You can save approximately _____ liters of water per month, and about _____ in monthly water costs by following the recommendations shown above. We have included a flyer with additional and easy to do water saving tips for your household.

Thank you again for allowing us to conduct an audit of your home water use. If you have any questions, kindly give us a call at _____.

For information on approved water efficient fixtures and appliances, including where you may purchase approved fixtures and appliances, go to our website at _____.

Estimates are based on observations at the time of the audit and may not reflect your exact water usage. Actual savings may vary and are not guaranteed.

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

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

Handbook of Water Use and Conservation, Amy Vickers, 2001

Practical Plumbing Handbook, California Urban Water Conservation Council, 2014

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

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 Auditing: A Practitioners Guide, WaterWise Council and Water Corporation, Government of Western Australia, Department of Water

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

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, Waster Reduction Partners, May 2009

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

WEBSITES REFERENCED

http://www.allianceforwaterefficiency.org.
http://www.cuwcc.org/
http://www.denverwater.org/Conservation/
https://www.ebmud.com/
https://www.energystar.gov/
https://www3.epa.gov/watersense/
http://www.home-water-works.org/
http://www.iapmo.org/
http://www.kirklandwa.gov/depart/Public_Works/Utilities/Water/
https://www.snwa.com/consv/indoor.html
http://www.swfwmd.state.fl.us/conservation/indoors/
https://www.wbdg.org/resources/

ADDITIONAL RESOURCES

http://www.arcs.org for rain harvesting
https://www.buildinggreen.com/water-efficiency

http://www.conserveh2o.org/how-to-videos-water-conservation/how-toilet-workshttp://www.conserveh2o.org/water-lost-toilet-leaks how to detect and fix toilet leaks
https://www3.epa.gov/watersense/product_search.html for water efficient products
http://www.map-testing.com/ for performance tested toilets and urinals
https://www.youtube.com/watch?v=QqgF_0kfzp4 how to fix a leaking faucet

Zamboanga City Water District

www.acwd.gov.ph

U.S. Agency for International Development/Philippines

www.usaid.gov