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Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

# Handbook: Performing a Comprehensive Walk-Through Water Survey

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FEMP

Federal Energy Management Program

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# List of Acronyms

| | |
|---|---|
| BMP | best management practices |
| CEWE | comprehensive energy and water evaluations |
| COC | cycles of concentration |
| DHW | domestic hot water |
| EISA | Energy Independence and Security Act of 2007 |
| FEMP | Federal Energy Management Program |
| gpf | gallons per flush |
| gpm | gallons per minute |
| LPG | liquid propane gas |
| O&M | operation and maintenance |
| psi | per square inch |

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# Introduction

The Federal Energy Management Program (FEMP) developed the Water Evaluation Data Tool to provide a method for collecting comprehensive water data during building and/or campus walk-through survey. The data will help energy and water managers collect the necessary information to conduct a comprehensive water evaluation. A comprehensive water evaluation is a multi-step process that includes these major elements:

- Data collection on water using end-uses via a walk-through survey
- Data analysis using the collected data to estimate water consumption for each end-use, which is then used to formulate a water balance
- Development of water-efficiency measures with the objective of reducing water use and increasing efficiency.

This FEMP tool focuses on the first step of the comprehensive evaluation process to help conduct a comprehensive walk-through survey. Comprehensive water evaluations are required per Section 432 of the Energy Independence and Security Act of 2007 (EISA). EISA directs that comprehensive energy and water evaluations (CEWEs) be conducted yearly for approximately 25% of the covered facilities of an agency, with the goal of having all covered square footage evaluated over a four-year period. EISA also encourages agencies to implement identified water-saving measures within two years of the water evaluation[1]. This tool is intended to help support the completion of water evaluations as part of the CEWE requirement.

The Water Evaluation Data Tool allows users to collect data on a single building or a campus'[2] water end-uses and compile the information into a summary table. This summary allows the user to organize the walk-through survey data by specific buildings and end-uses. Ultimately, the tool provides the necessary information that a water evaluator can use to estimate water consumption, develop a water balance, and identify future water-efficiency measures.

Three components comprise the walk-through Water Evaluation Data Tool:

1. Handbook: *Performing a Comprehensive Walk-Through Water Survey* – A document that provides general instructions on performing a walk-through water survey to collect the required data for a comprehensive water evaluation.
2. Walk-through data collection forms – Printable forms that provide a format to document the key information during the walk-through survey portion of the water evaluation. These are provided in a PDF format to be filled out during the walk-through and copies of the forms can be found at the end of this handbook.
3. Electronic data summary workbook – An Excel-based workbook used to store and organize the data gathered during the walk-through survey. The workbook provides a summary both by building and by water end-uses after all data are entered, which is useful to organize the data needed to perform the comprehensive water evaluation. Note: This electronic workbook does not calculate water use, it only provides a summary of the water uses entered by the user.

This handbook provides information on the key data that needs to be collected during a walk-through survey by specific end-use categories. The data collection forms provided in this tool are the following:

[1] A copy of EISA 2007 can be found here: https://www.sustainability.gov/policy.html
[2] A campus is defined as a collection of two or more co-located buildings

- General building information
- Occupancy information
- Domestic hot water
- Plumbing fixtures (restroom, locker rooms and/or kitchenettes)
- Laundry
- Commercial kitchen
- Vehicle wash
- Landscape irrigation
- Cooling towers

Some buildings or campuses will have water end-uses that are not covered by this tool. These may include single-pass cooling, medical or laboratory equipment, or water softeners. Evaluators are encouraged to capture information on these systems, if present. FEMP's Water-Efficiency Best Management Practices (BMPs)[3] provide additional information on these end-uses.

# Getting Started

The following information provides general guidance on what is needed before starting the walk-through survey. Tips for conducting a walk-through survey, along with a list of useful equipment, is provided.

## General Tips

Consider the following items in conducting a comprehensive walk-through water survey:

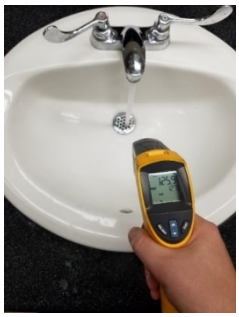
- Identify building(s) to be evaluated and gather building details (e.g., building age, building use type, square footage). For large campuses where all buildings cannot be evaluated, the buildings evaluated should be representative of the campus' composition. Chose buildings that are expected to have high water use, such as high-occupancy buildings and those with long operating hours and large water using processes (e.g., cooling towers).
- Collect information on these buildings prior to the walk-through survey. Include data such as building square footage, use type, construction age.
- Print out building floor plan(s) to help locate water using equipment.
- Create an inventory of all water using activities before starting the walk-through survey. Make sure to develop a comprehensive list of equipment types. The FEMP Water-Efficiency BMPs has a list of ten water using equipment categories, which can be a helpful starting place.
- Tap the expertise of others at the facility who have direct knowledge of building water equipment and end-uses to generate a complete inventory.
- During the walk-through survey, interview occupants to understand any operational problems with the water-consuming equipment and gain insight on potential efficiency measures.

[3] FEMP's Water Efficiency Best Management practices can be found at https://www.energy.gov/eere/femp/best-management-practices-water-efficiency

- Take multiple pictures (e.g., overview of room; close ups of equipment, equipment ratings, and name plates).

### Tools to Use for a Walk-Through Water Survey

The equipment listed below is useful in obtaining accurate water use data during the walk–through portion of an evaluation:



Infrared temperature sensor/gauge

- Infrared temperature sensor/gauge – for measuring water temperatures
- Metered flow bag – a plastic bag with graduated lines that is used to measure the flow rate of faucets, showerheads, and other nozzles
- Watch with a second hand – for timing flushes and filling flow bag
- Camera – for taking photos of room layouts, water using equipment and fixtures, and equipment nameplate data
- Clipboard and pen – for holding survey forms and taking notes
- Small towel – for drying hands and flow bags

Metered flow bag

## Instructions for the Water Data Collection Forms

The following information provides a general guide on using the data collection forms to gather information on specific water end-uses. Data is gathered for each water end-use by building or use area. Grey cells on the forms indicate that information is not applicable or not needed for a particular fixture or piece of equipment. If only a portion of the equipment can be evaluated, the data collected may be extrapolated to other portions of a large building, or to other buildings with the same type of equipment. For this reason, it is important to document when only a portion of a building is evaluated and whether information gathered in one building will be used to estimate water use in similar buildings.

The following sections provide instructions for the Walk-Through Data Collection Forms. The underlined terms indicate specific data entries that are filled out on each form. The data should be entered into the Electronic Data Summary Workbook after the walk-through has been completed.

### General Building Information

In this section, general information on the building being evaluated is captured. Note that the workbook tool allows inputs for multiple buildings when evaluating a campus or installation and for multiple spaces within a single building. General information on the building is important because it provides the basic information to identify the operational patterns and equipment type that can be helpful when extrapolating data across similar building types.

Collect the following general information on the building:

- Building number/name
- Primary building type[4]: retail, education, lodging, office, medical, dining, physical fitness, and other. If the building type is identified as "other," include notes describing the function of the building. Building type provides important information such as the typical amount of time an occupant spends in the building.
- Square footage of building – This information is collected from properties prior to the survey but should be verified during the walk-through of the building. Building square footage can be used to extrapolate water survey results over similar buildings.
- Date of construction – Similar to square footage, the construction date will likely not be collected during the walk-through survey but collected from real property data prior to the survey. The date the building was built can provide useful information on the equipment in the building. For example, buildings constructed before 1997 may have toilets with higher water consumption toilets and urinals than those built after 1997 because U.S. standards for these fixtures changed after 1997.
- Year of last major water-related renovations
- Types of water renovations completed
- Building address, city, state, and zip code

Collect the following general evaluator information:

- Evaluator name
- Date of survey

Collect the following rate information (note that this information will likely be collected prior to the walk-through survey and will likely be provided from the facility manager or gathered from utility bills. This information is important in estimating water and associated energy costs when evaluating a building for water-efficiency improvements. These inputs are entered into the workbook tool:

- Water utility provider
- Marginal[5] water rate – rate paid for each unit of water provided (be sure to include the units)
- Sewer utility provider
- Marginal sewer rate, including units
- Types of energy available – relevant to domestic hot water
- Marginal energy rate for each type of energy available, including units

Use the comments section for any general observations such as whether only a portion of the building was evaluated, whether a portion of the building is a different type from the primary building type, or the general condition of the building.

[4] This building list is a simplified version of the building types available in Energy Star Portfolio Manager. For more information, see https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/identify-your-property-type.

[5] A marginal rate is the amount a consumer would pay (or save) for a single unit of a delivered utility and does not take into account base charges that are not impacted by a change in use. For water, sewer, and liquid fuels, the marginal rate is generally the unit cost, in dollars, of 1,000 gallons (1 kgal) or 100 cubic feet of the delivered or treated commodity. The marginal cost of electricity is dollars per kilowatt-hour.

## Occupancy

A key piece of information necessary to determine water use is the occupied or operating hours of the building over the timeframe of the study (typically annual). Occupancy information is important because population drives water use for plumbing fixtures. The percentage of male and female occupants is important because restroom water use differs between genders when urinals are present.

Collect the following occupancy information for **weekdays** and **weekends**:

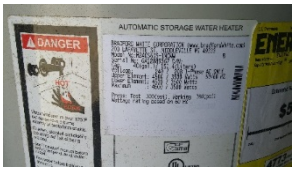
- Typical occupied hours
- Typical number of building occupants
- Number of weeks per year building is occupied
- Percentage of female occupants (or count of females)
- Percentage of male occupants (or count of males)

Note: The percentage of male and female building occupants is typically estimated based on the observations of the water evaluator or provided by the facility/building manager; these percentages should add up to 100%.

Use the comments section for any general observations or information learned in discussion with building occupants.

## Domestic Hot Water (DHW)

Documenting information on domestic hot water is important in determining energy use from hot water consumed in end-uses such as faucets and showers, and the potential energy savings that could result from decreased hot water use.



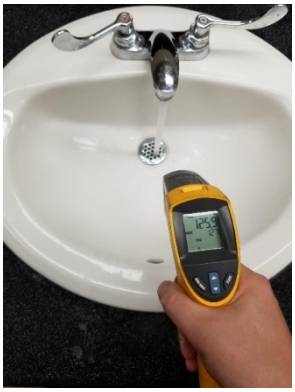


Hot water tank nameplates with make and model

Collect the following information:

- Hot water fuel source – Natural gas/electricity/distillate oil/residual oil/ LPG (propane) /steam/other/none
- Make and model of water heating equipment – Generally found on the equipment nameplate (take a photo of the nameplate)
- Hot water heating efficiency – If not listed on the nameplate, this information can most likely be obtained online by searching the make and model information
- Hot water heater tank capacity – The tank capacity should be marked on the nameplate. If the tank capacity is not printed on the equipment nameplate, the information can probably be obtained online on the manufacture's website using the make and model information.
- Hot water temperature – Can be measured either with an infrared temperature sensor at an end-use point such as a faucet or at the hot water outlet of the tank. If a temperature measurement is taken at the tank outlet, make sure to take a reading on bare metal, not insulated piping.

Use the comments section to make note of any general observations, including the presence of tank and piping insulation.



Measuring water temperature

## Plumbing Fixtures

Plumbing fixtures are present in restrooms, locker rooms, and kitchenettes. Fixtures include toilets, urinals, faucets, and showerheads. The following information describes the data collected for plumbing fixtures and general information and tips for gathering the information. It is recommended that at least 10% of a building's plumbing fixtures be evaluated in large buildings with a large number of plumbing fixtures. The fixtures evaluated should be representative of all the fixture types in the building.


Tank toilet

Collect the following general information for spaces containing plumbing fixtures. This information will help identify the location of the spaces after the survey.

- Plumbing area type – Restroom, locker room, kitchenette
- Restroom/locker room type: male/female/unisex

The data discussed below can be used to estimate plumbing fixture consumption in buildings outlined in the FEMP guidelines (https://www.energy.gov/eere/femp/estimating-methods-determining-end-use-water-consumption).


Pressure-assisted tank toilet

### Toilets and Urinals

There are two primary types of toilets, tank and flush valve. There are also two types of urinals, flush valve and non-water urinals. The following information provides a brief overview of these fixtures.

***Tank toilets:*** Tank toilets operate in one of two ways: gravity or pressure-assisted. Gravity tank toilets send water via gravity from the tank into the bowl by releasing a flapper valve between the tank and the bowl. Pressure-assisted tank toilets contain a vessel inside the tank filled with pressurized air. When the toilet is flushed, the pressurized air pushes the water into the bowl at a high velocity to create the flush.


Diaphragm flush valve

***Flush valve toilets and urinals:*** Flush valve toilets and urinals send pressurized water directly from the supply line through a valve and into the bowl to create the flush. There are also two types of flush valves-diaphragm and piston.

Diaphragm flush valves have a rubber gasket, or diaphragm, that separates the upper and lower chambers in the valve housing. When the toilet is flushed, the diaphragm gasket flexes, moving water through the valve and into the bowl. In a piston flush valve, the valve houses a piston that separates the upper and lower chambers in the valve housing. This valve housing has a smaller diameter than the diaphragm valve. When the toilet is flushed, the piston lifts, allowing water to flow from the inlet pipe under the piston and into the bowl.


Piston flush valve

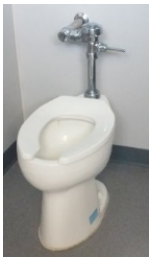
***Non-water urinals***: Non-water urinals have no flushing mechanism and use no water to flush waste down the drain line. The fixtures utilize a cartridge containing liquid that prevents odors from permeating the restroom.

Collect the following information for toilets and urinals:


Non-water using urinal

- Count of fixtures
- Primary fixture type – Toilet only:
    - Tank– Gravity or pressure assisted
    - Flush valve
- Fixture type:
    - Flush valve toilet/urinal – Diaphragm or piston (see description above)
- Fixture Mounting:
    - Toilet - Note whether the toilet bowl is wall-mounted, floor-mounted, or floor-mounted with rear discharge. Floor-mounted with rear discharge are bolted to the floor *and* the wall, with the discharge outlet facing toward the wall. The type of fixture mounting is important because future replacement fixtures should discharge to the same location as existing fixtures.
    - Urinal: Note whether the urinal is wall or floor-mounted.
- Operation type:
    - Toilet - Manual, sensor, dual flush (note that sensor only applies to flush valve toilets)
    - Urinal – Manual or sensor
- Urinal discharge tube diameter –The discharge tube is the pipe (¾″ or 1¼″) that connects the flush valve to the fixture. A thin pipe denotes a ¾″ diameter tube (as shown in the photo of the wall-mounted urinal below).
- Rated Flush rate
    - Tank – The rated flush rate is generally given in gallons per flush (gpf) stamped either on the china near the bowl or inside the tank itself
    - Flush valve toilet or urinal – the rated flush rate can typically be found stamped either on the china near the bowl or on the flush mechanism just under the lever
- Measured average flush time – Flush valve toilet and urinal:
    - The actual flush rate of a flush valve toilet and urinal can be estimated by counting the number of seconds from the time the lever is actuated until the valve closes
    - The flush rate is calculated using the time to complete a flush using the following equation:

$$\text{Flush Volume} = [\text{Time to flush (sec)} - 1]/2$$



Floor-mounted toilet

Wall-mounted toilet

Floor-mounted urinal

Wall-mounted urinal

Manual flush

Dual flush system

Note: For tank toilets, it is not necessary to collect flush times, as they flush a set amount of water. The actual flush rate can only be determined by measuring the volume of water in the tank, which is difficult to determine during a walk-through survey. Therefore, the rated flush rate marked on the toilet is used to determine the water consumption for tank toilets. ***However, lift the tank top and note whether the tank water level is over the marked level inside the tank or whether water is leaking over the overflow tube or continously running.***

Use the comments section to make notes of any general observations. Include observations of long flush times for flush valve toilets and urinals, which can indicate an eroding or incorrectly sized gasket inside the flush valve, and tank toilets that run longer than expected, which may be an indication of a tank flapper that is not sealing properly.

### Faucets

The majority of faucets in buildings can be separated into two categories – public faucets and private faucets. Public faucets are intended to be used in high-traffic public areas and are generally found in restrooms. Public faucets should not have a flow rate in excess of 0.5 gallons per minute (gpm)[6]. Private faucets are intended to be used in lower-traffic areas, primarily breakrooms or kitchenettes, and are required to have a flow rate no greater than 2.2 gpm[7]. High-efficiency private faucets are not to exceed 1.5 gpm[8].

Collect the following information for faucets:

- Total count of faucets in the use area
- Primary fixture type – With aerator or without aerator: The vast majority of faucets will either have an aerator attached, or have threads to which an aerator can be attached, which controls the flow of water coming out of the fixture. In rare instances there will be no aerator and no threads. Typically, these are old faucets that require whole-fixture replacement. Note any non-threaded faucet encountered it in the comments.


Faucet flow rating

Metered flow bag

- Fixture operation – Manual, sensor, or metered:
  - Manual faucets may have either two handles, one each for hot and cold water, or a single handle that mixes hot and cold water before it exits the faucet
  - Sensor faucets operate by sensing when an object is in front of the faucet and opening a valve to allow water to flow
  - Metered faucets, also called self-closing faucets, are activated by the user. Once activated a pre-set amount of water is dispensed and then the valve automatically closes.
- Rated Flow rate – This value is generally provided in gpm and is stamped on the faucet where water exits into the basin
- Measured average flow rate – Can be measured using the metered flow bag by turning the faucet on to the maximum flow and capturing the flow for 5 seconds (using a stop watch). Then hold the bag top with two hands and read the gpm according to the graduated lines on the metered flow bag. Note that if there are hot and cold handles, both should be open.

[6] Standard based on American Society of Mechanical Engineers A112.18.1/Canadian Standards Association B125.1 Plumbing Supply Fittings
[7] Federal standards 10 CFR 430.32(o)
[8] EPA WaterSense Specification: https://www.epa.gov/watersense/bathroom-faucets

### Showerheads

There are four general categories of showerheads: threaded (fixed and handheld), wall-mounted, and gang-type.

- Threaded showerheads are the most common type. These heads can be removed or replaced by simply unscrewing the existing showerhead and attaching a new one.
- Wall-mounted showerheads are mounted either directly to the wall or are included in a box that also contains the water controls. These showerheads cannot be unscrewed from the pipe coming from the wall; instead the whole fixture must be replaced where it attaches to the plumbing distribution system. These types of showerheads are typically more expensive to retrofit than threaded style showerheads, but are fairly rare.
- Gang showers consist of multiple showerheads on a single stand or "tree"

Threaded fixed showerhead

Threaded handheld showerhead

Wall-mounted showerhead

Gang shower

Collect the following information for showerheads:

- Count of showerheads in the use area
- Primary fixture type – Threaded (fixed), threaded (handheld), wall-mounted, gang (see the descriptions above)
- Rated flow rate – This value is typically provided in gpm and is often marked in the center or around the outside of the showerhead
- Measured average flow rate – The flow rate can be measured using the metered flow bag by turning the showerhead on to maximum flow and capturing the flow for 5 seconds. Hold the top of the bag with two hands and read the gpm. Note that if there are separate hot and cold handles, both should be open. When encountering a gang shower, measure the flow rate of 50% of the attached heads and make a note of how many heads are present on the tree.
- Percentage of building occupants that use showers on weekdays and weekends – Interview the building facility manager or occupants to estimate how often occupants shower. If they are unsure of shower use, an estimate can be made based on observation of the shower. For instance, the presence of janitorial equipment in the shower stall likely means it is not used at all, whereas the presence of bathing items (soap, shampoo, etc.) means the shower is likely used with some regularity.

When performing restroom, locker room, and/or kitchenette surveys, use the comments section to make notes of any general observations and also note any problems with the equipment such as leaks or broken equipment.

## Laundry

The following provides specific information that should be collected for laundry facilities, typically found in barracks, hotels, medical facilities, and residential buildings. Notes should be taken regarding the condition of equipment.

Collect the following information on laundry use:

Estimated loads of laundry per person, weekdays and weekends – interview facility manager or occupants to estimate the typical number of loads per week. Note that if this information is not readily available, estimate water use based on two loads of laundry per week for each building occupant.

Collect the following information on **ENERGY STAR** and **non-ENERGY STAR** machines:


Front loader washing machine

- Count of washing machines
- Make and model number of machines – This information can be found on a sticker that is located either at the top edge on the back of the washer, inside the door (front loaders), or at the top of the wash bin (top loaders)
- Capacity of machines in cubic feet, typically noted on name plate or available on manufacturers website using the model number
- Water factor of machines, gal/cycle/cubic foot (note that this may be determined by looking up the model number online on the manufacturer's website)


Top loader washer

- General condition of machines – Excellent, good, or poor[9]

When performing a laundry room survey use the comments section to make notes of any general observations and also note any issues with the equipment such as leaks or broken equipment.

This data can be used to estimate consumption using the "batch process" provided in the FEMP guidelines: https://www.energy.gov/eere/femp/estimating-methods-determining-end-use-water-consumption

## Commercial Kitchen

Commercial kitchens contain a variety of water using equipment typically found in dining facilities, hospitals, and administrative buildings. The following provides the type of information that should be collected for these specific equipment types. It is recommended that the water evaluator performs the walk-through survey with the kitchen manager that will likely be able to provide useful information on the needed data.

Collect the following general information for the commercial kitchen:

- Average number of meals served per day
- Average number of kitchen staff


Batch dishwasher

Commercial dishwashers - collect the following information on commercial dishwashers (If there is more than one type of dishwasher, enter the predominant type):

- Count of number of dishwashers
- Dishwasher Type – Continuous or Batch[10]. Knowing the type of dishwasher is important to estimating water use.

[9] Note the visual inspection of the equipment. Poor – equipment looks to be in bad shape, old and/or has maintenance issues (e.g. leaks). Average - equipment looks to be okay with minor maintenance issues. Good - equipment looks to be fairly new or new with little or no maintenance issues.
[10] The two types of continuous dishwashers are conveyor and flight. Conveyor dishwashers move racks loaded with dishes through the machine. Flight-type dishwashers have pegs on the conveyor belt that allow dishes to be loaded directly into the conveyor and does not require dishracks

  - Continuous dishwashing machines utilize a moving track that circulates through the dishwasher while it is running. Batch machines run a single load of dishes at a time. A dishrack is loaded into the dishwasher, its hood is lowered and the washing cycle begins.


Conveyor-type dishwasher


Flight-type dishwasher

- Note whether equipment is ENERGY STAR rated – yes or no
- Rated Flow rate – For continuous dishwashers (note that this may be determined by looking up the model number on the manufacturer's website)
- Batch water use – For batch dishwashers (Note that this may be determined by looking up the model number online on the manufacturer's website)
- Make and model of equipment – This information can be used to look up information not readily available in the field
- Hours operated per day/loads per day – Hours operated for continuous machines or number of loads per day for batch machines
- General condition of equipment – Poor/average/good[9]

Pre-rinse spray valve - collect the following information on pre-rinse spray valve (the fixtures used to remove food residue from dishes before they are loaded into a dishwasher):


Pre-rinse spray valve

- Count of pre-rinse spray valves
- Rated Flow rate - Typically provided in gpm and is often marked in the center or around the outside edge of the pre-rinse spray valve
- Measured average flow rate - Determined using the metered flow bag by squeezing the pre-rinse spray valve handle to achieve the maximum flow and capturing the flow for 5 seconds. Hold the top of the bag with two hands and read the gpm.
- Hours operated per day – Ask a staff person the estimated time they use the pre-rinse spray valve. Try to obtain an estimate of the amount of time the valve is actually operating
- General condition of equipment – Poor/average/good[9]

Hand wash faucets - collect the following information:

- Count of faucets in the commercial kitchen
- Equipment type – manual, sensor, or metered (see Faucet section)
- Rated Flow rate – this value is generally stamped on the faucet where water exits into the basin
- Measured average flow rate – determined using the metered flow bag by turning the faucet on to the maximum flow and capturing the flow for 5 seconds. Hold the top of the bag with two hands and read the gpm. Note that if there are separate hot and cold handles, both should be open.

Prep faucets - collect the following information on prep faucets (faucets that are used to fill pots and defrost frozen food and are not typically used for hand washing):


Prep faucets

- Count of faucets in the commercial kitchen
- Rated Flow rate – This value is generally stamped on the faucet where water exits into the basin
- Actual flow rate – Determined using the metered flow bag by turning the faucet on to the maximum flow and capturing the flow for 5 seconds. Hold the top of the bag with two hands and read the gpm. Note that if there are hot and cold handles, both should be open.
- Hours operated per day

Pots/Pans washing sink faucets - collect the following information on pots/pans washing sink faucets (faucets that are used to wash pots and pans after use—most often these are used to fill multiple basins in series for use during washing):

- Count of faucets in the commercial kitchen
- Rated Flow rate – This value is generally stamped on the faucet where water exits into the basin
- Measured average flow rate – Determined using the flow bag by turning the faucet on to the maximum flow and capturing the flow for 5 seconds. Hold the top of the bag with two hands and read the gpm. If there are hot and cold handles, both should be open.
- Hours operated per day

Food steamers - collect the following information on food steamers (this equipment is used in commercial kitchens to cook foods. Cooking is done either with steam, circulating hot air, or a combination of steam and hot air):

- Count of food steamers
- Equipment type – Boiler-based or connectionless:
    - Boiler-based food steamers are connected to a central boiler. Boiler-based systems run hot water through the equipment continuously while it is running. In addition, a supply of cold water is needed at the drain to temper water before it enters the sewer system. Boiler-based systems can be identified by the presence of an incoming water line in addition to an outlet to the drain.
    - Connectionless food steamers are self-contained, with an internal water reservoir and heat source to create the steam needed for cooking. Connectionless equipment is generally drained at the end of the day and refilled the next day. Connectionless systems can be identified by the presence of a pan under the unit that serves as the water reservoir. Note, connectionless food steamers are much more water and energy efficient than boiler-based steamers.
- Equipment is ENERGY STAR rated – Yes or no
- Rated Flow rate – For boiler-based food steamers (note that this may be determined by looking up the model number on the manufacturer's website)
- Batch water use – For connectionless food steamers (note that this may be determined by looking up the model number on the manufacturer's website)

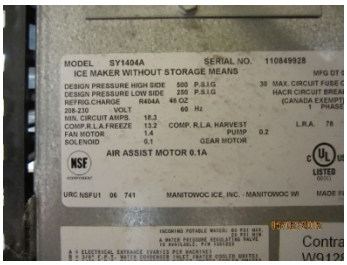
- Make and model of each food steamer
- Hours operated per day
- Loads cooked per day
- General condition of equipment – Poor/average/good[9]

Garbage disposals - collect the following information for food waste disposals (this equipment is used in commercial kitchens to grind food waste to a size that will easily flow through the waste piping without clogging the system). Food waste disposals often use water to help flush the ground food down the drain—the water may be integral to a disposal sink or may be delivered via a faucet or pre-rinse spray valve:

- Count of garbage disposals
- Make and model number of the garbage disposal
- Hours operated per day
- General condition of equipment – Poor/average/good[9]

Ice machines - collect the following information on ice machines (if there is more than one type of ice machine, enter the predominant type):

- Count of ice machines
- Equipment type –
    - Water cooled – Water cooled ice machines typically run water through the system to reject heat and then discharge the water to the drain. This type of system is called "single-pass" or "once-through". A water cooled system is typically noted with "W" in the model number. In addition, typically a water cooled machine has a discharge water line that can be seen underneath the unit.
    - Air-cooled – Air-cooled ice machines use a typical refrigerant cycle to discharge heat from the unit. Air-cooled ice machines are much more water efficient. Note, all ENERGY STAR ice machines are air cooled. An air-cooled ice machine is often denoted by an A in the model number. An air-cooled ice machine can also be identified by looking for refrigerant information on the nameplate.



Air-cooled ice machine

- Equipment is ENERGY STAR rated – Yes or no
- Makes and model numbers of ice machines
- Hours operated per day – Should be recorded for machines that produce ice at the location where it will be used, such as an ice machine integrated into a beverage dispenser
- Loads per day – Should be recorded for ice machines that produce ice that is moved from the attached bin to be used elsewhere
- General condition of equipment – Poor/average/good[9]

When performing a commercial kitchen survey, use the comments section to make notes of any general observations and also note any problems with the equipment such as leaks or broken equipment, or operational observations such as pre-rinse spray valves running continually.

This data can be used to estimate consumption using the "batch process" provided in the FEMP guidelines: https://www.energy.gov/eere/femp/estimating-methods-determining-end-use-water-consumption

## Vehicle Wash

The following information provides the type of data that is collected for vehicle wash systems and the vehicles that are washed. There are two types of vehicle wash systems that may be evaluated: open-hose and pressure-washer. An open-hose system may be similar to a garden hose with a nozzle or no nozzle. A pressure washer is one in which the water enters the system under low pressure and is sprayed out of a nozzle under higher pressure. Information not obtained from a visual inspection of the equipment will need to be gathered from the vehicle wash operator or facility manager.

Collect the following information for open-hose and/or pressure-washer vehicle wash systems:

- Average number of vehicles washed per week – Note the type of vehicles washed, such as large trucks or tracked vehicles. The type of vehicle can help when estimating the amount of wash time, which is needed to estimate water use.
- Average number of weeks vehicles are washed per month
- Approximate wash time per vehicle (minutes) – Ask the staff that is responsible for the system, who should have a general estimate of the wash time per vehicle, which is typically 20 – 30 minutes.
- Flow rate of hose (open hose only) (gpm) – The flow rate can be measured using the metered flow bag by turning the hose on to the maximum flow and capturing the flow for 5 seconds. After this, hold the bag top with two hands and read the gpm (as described previously). If the flow rate is high enough to overflow the bag in 5 seconds, this online calculator calculates the flow rate based on hose diameter, pressure, and hose length: http://irrigation.wsu.edu/Content/Calculators/Residential/Garden-Hose-Flow.php
- Nozzle manufacturer – May be found on the nozzle
- Nozzle rating – The nozzle rating (gpm) may be found on handle of wand; it is not recommended to try to measure the flow rate with a flow bag as the water is under high pressure
- Pressure washer manufacturer and model number – Usually found on a label on the pressure washer
    - If the nozzle rating is not provided, use the pressure washer information on the equipment to obtain the specification of the unit on the manufacturer's website. This should provide the rated flow rate.

Pressure washer and nozzle (wand)


Pressure washer rating and manufacture's information

When performing a vehicle wash survey, use the comments section to make notes of any general observations and also note any problems with the equipment such as leaks, broken equipment, and missing nozzles.

This data can be used to estimate consumption using the "batch process" for Vehicle Wash Systems provided in the FEMP guidelines: https://www.energy.gov/eere/femp/estimating-methods-determining-end-use-water-consumption

## Landscape Irrigation

Use the data collection forms to gather data on irrigated areas such as building landscape, ball fields, parks, and golf courses. Information not obtained from a visual inspection of the equipment and irrigated grounds will need to be gathered from the grounds or building manager and the staff that irrigates and manages the grounds.

- Landscape irrigation area description– Describe the irrigated landscape area, including general information on locations and types of plant. Some landscaped areas will not be associated with a building, and this description will help identify the irrigated landscape area.
- Landscape area type – Select the landscape area that best describes the area (e.g., landscape around a building, athletic field, golf course, parade field, park, family housing).
- Water supply type – Identify the type of water that supplies the irrigation system. This can typically be provided by the grounds manager. Knowing the water source of the irrigation is important in the water balance analysis and can help identify potential alternative sources of water.
    - Potable – Water from freshwater sources, such as surface water or groundwater, that is safe to drink
    - Non-potable – Water from freshwater sources, such as surface water or groundwater, that is not safe to drink
    - Alternative – Water that is not from freshwater sources, such as rainwater harvesting, graywater, condensate capture

Irrigation start and end months will provided the growing season of the landscape and identify how long irrigation water is applied.

- Month irrigation start – Identify the month when landscape irrigation is typically started
- Month irrigation end – Identify the month when landscape irrigation is typically shut down for the season

Turfgrass or mixed beds – Identify the general type of landscaping (areas can be broken out into multiple sub-areas depending on landscape type):

- Turfgrass – Landscape areas consisting of grass
- Mixed beds – Landscape areas consisting of a variety of planting such as shrubs, trees and turf
    - If a mixed bed has more than 50% turf, fill out separate survey forms for the turf area and mixed bed area


Turf grass landscape


Mixed bed landscape

Mixed beds: for mixed beds, identify the following information on the data collection form:


Low-density mixed bed


Medium-density mixed bed


High-density mixed bed

- General level of supplemental irrigation needed by the mixed bed area:
    - Low – Plants are native or well adapted/drought tolerant to the specific area and do not require much water over the growing season to stay healthy
    - Moderate – Plants that require some additional water to stay healthy over the growing season and are not native or adaptive to the area
    - High – Plants that need ample supplemental water to stay healthy
- Mixed bed plant density – Identify the density level of plantings that best matches the following types (if the area has more than one type, choose the predominant type):
    - Low –Sparsely planted landscape
    - Moderate – Full coverage, but predominantly one vegetation type
    - High – Mix of plant types with full coverage
- Mixed bed level of protection/exposure – identify how exposed the plants are to heat, wind, and sunlight, using these three categories (if the area has more than one type, choose the predominant type):
    - Protected – Areas shaded from sunlight and protected from wind and heat gain
    - Open – Areas in an open, flat field
    - Intense exposure – Areas exposed to high heat or windy conditions


Example of cool season grass


Example warm season grass

Turfgrass: for turfgrass, identify the following information on the data collection form:

- Type of turfgrass - See Table 1 for examples of turfgrass season types
    - Cool-season grass –Thrives in cooler climates and generally requires more water than warm-season grass to thrive and generally have dark green, thin blades that are densely packed
    - Warm-season grass – Better suited for hot summers and generally more drought tolerant than cool-season grasses and generally have lighter green, thick blades that are less densely packed

Table 1. Examples of Turfgrass Season Type[11]

| Turfgrass Type | Season Type |
|---|---|
| annual bluegrass | cool |
| annual ryegrass | cool |
| colonial bentgrass | cool |
| creeping bentgrass | cool |
| hard fescue | cool |
| highland bentgrass | cool |
| Kentucky bluegrass | cool |
| meadow fescue | cool |
| perennial ryegrass | cool |
| red fescue | cool |
| rough-stalked | cool |
| tall fescue | cool |
| Bermuda grass | warm |
| buffalo grass | warm |
| kikuyu grass | warm |
| seashore paspalum | warm |
| St. Augustine grass | warm |
| Zoysia grass | warm |

[11] Sources: California Department of Water Resources. 2000. A Guide to Estimating Irrigation Water Needs of Landscape Planting in California – The Landscape Coefficient Method and WUCOLS III. https://water.ca.gov/LegacyFiles/wateruseefficiency/docs/wucols00.pdf; University of Florida, Irrigation Research, Southwest Florida Water Management District. 2009. *Turfgrass Crop Coefficients Website, Institute of Food and Agricultural Sciences Extension*. https://abe.ufl.edu/faculty/mdukes/

For both mixed beds and turfgrass, collect the following information on the data collection form:

- Landscape condition – Determine the best match of the landscape's appearance to the following descriptions (if the walk-through survey is not during the growing season, obtain this information from the grounds manager/building manager):
    - Stressed – Landscape appearance is not a priority and may be under-watered at times during the growing season
    - Average – Landscape is kept green but not lush throughout the growing season
    - High quality – Landscape is kept green and lush during the entire growing season
- Soil type – Select landscape area general soil type. (The grounds manager will likely know the soil type. If not, this information may not be easy to obtain during the walk-through. If this is the case, the soil type can be obtained by searching online for the soil type of the general region.)
    - Sandy –Soil will not form a ball
    - Loam – Rich soil that is a combination of sand and clay; soil will form a well-shaped ball that will break apart easily
    - Clay –Soil will form a well-shaped ball that does not break apart easily
- Landscape area – Estimate the square footage of landscape area. This information will likely be not obtained during the walk-through, but can be estimated using online mapping tools (e.g., Google maps)

Rotor type sprinkler heads

Irrigation equipment information and operation and maintenance: The following data provides information on the irrigation equipment that can be used to determine how well the system is maintained and how efficiently it irrigates the landscape. Additional information is provided below on how this information can be used in subsequent steps of a water evaluation.

Spray type sprinkler head

- Irrigation equipment type – Irrigation equipment relates to the type of sprinkler head that waters the landscape. There are three main types of heads, which can be identified either visually while the sprinklers are running or by asking the staff.
    - Rotor – Water delivered by rotating stream
    - Spray – Water delivered in fan shaped pattern
    - Micro-spray and drip – Water delivered at lower pressures directly to the root zone of the plant
    - Manual – Water delivered with hoses, nozzles and/or aboveground sprinklers

Micro-spray/drip irrigation

- Irrigation maintenance – Interview the grounds manager or building manager to obtain the following:
    - Poor – Equipment is non-functional, broken or leaking; grounds staff rarely or never operate and maintain the irrigation system, or check for leaks or misaligned heads

Manual watering equipment

  - Average – Equipment is maintained but some equipment is broken or not functioning properly; there is an adequate number of grounds staff to operate and maintain the irrigation system, periodically checking system for leaks and misaligned heads (at least twice in a growing season)

  - High – Equipment is well maintained with few broken heads; there is a robust team of grounds managers that regularly checks the irrigation system for leaks and misaligned heads and adjusts the irrigation schedule with changing weather (at least once per month)

- Irrigation controls

  - Manual – The irrigation system is manually controlled, with the grounds manager determining the irrigation schedule

  - Clock – The irrigation system is controlled via a clock or timer

  - Weather-based – The irrigation system is controlled automatically based on weather and soil condition that precisely schedules the irrigation based on the actual needs of the plants

- Note any observations on irrigation efficiency and system operation – During the walk-through, observe whether there are visible puddles, runoff, leaks, broken sprinkler heads, irrigation during rain or high winds or of watering impervious surfaces (e.g., parking lots, roadways), etc.

- Note any best practices observed such as mulch, xeriscape/adaptive plants that are well adapted to the area, irrigating at night, etc.

- Number of days per week the irrigation system is operated

- Total number of minutes per day the system operated

When conducting an irrigation survey, use the comments section to make notes of any general observations and also note any additional problems such as leaks, broken equipment and poor maintenance. Also note grounds maintenance practices, such as how often systems are checked for leaks and operational issues.

Landscape irrigation could potentially be a high water use activity, depending on how much irrigated landscape exists, condition of the system, and irrigation management (e.g., amount and timing of the water applied). This form provides the data needed to estimate landscape irrigation water use. However, measuring actual water use through flow meters is the surest method of determining the amount of irrigation water used. If irrigation is not metered, the data collected using the tool provides the necessary information to estimate irrigation using the evapotranspiration method[12]. This method calculates the amount of water needed to maintain a healthy landscaped area for a given location based on the amount of water transpired from the plants and evaporated.

Information collected on the irrigation equipment and operation and maintenance will help estimate a system's efficiency. System efficiency is an expression of what portion of the irrigation water consumed is actually used by the turfgrass and/or plants. The system efficiency is based on the type of irrigation equipment installed as well as the maintenance and scheduling of the system. A perfect system, operating at 100% efficiency, would have no leaks, losses or waste. But no system is 100% efficient; for example, water is lost though runoff, leaks, and evaporation. Efficiency can also be affected by poor maintenance, such as broken sprinkler heads or pipes, or caused by scheduling problems such as watering during windy periods.

[12] For a more precise method to estimating irrigation use (irrigation audit method) see the Irrigation Associations website at https://www.irrigation.org/IA/Resources/Technical-Resources/Irrigation-Auditing/Audit-Guidelines/IA/Resources/Audit-Guidelines.aspx?hkey=d3af0807-efe0-4779-a31f-c6011b23c6d3

The data collected can be used to estimate water use using the method described in FEMP's guidelines for *Estimating Unmetered Landscaping Water Use*: https://www.energy.gov/sites/prod/files/2013/10/f3/est_unmetered_landscape_wtr.pdf

## Cooling Towers

Cooling towers dissipate heat to the ambient air from recirculating water used to cool chillers, air conditioners, or other process equipment[13]. The following information describes the data to be collected during a cooling tower walk-through survey. Some of the information can be gathered by looking at the key components of the system, including the cooling tower(s), chillers and heat exchangers, piping configuration and pumps. However, most of the information listed below will need to be gathered from control systems connected to the cooling system and/or from interviews with the facility operations and maintenance staff.


Example of a cooling tower

- For what process is the cooling tower used? Cooling towers commonly provide comfort cooling to buildings, but also can provide cooling for industrial processes. It is important to determine the cooling demand the cooling tower is used for because it provides insight on the operating conditions and whether the cooling tower operates seasonally or continuously.
- Cooling season start and end months – Identify the first and last month the cooling system operates. The facility manager, operating logs, or connected controls systems can provide this information. If the system provides comfort cooling, climate data and cooling degree day data can reveal the operational months.
- Operating time – hours per day and days per month. It is important to gather information on the operating time of the cooling system because it is a key data point in estimating cooling tower water consumption. This information can be gathered from operating logs or from connected controls systems. If logs are not available, this data can be calculated based on cooling degree day data.
- How is the operation of the system monitored?
    - Automated control system with data logging
    - Manual with log sheets

**Makeup water**: Makeup water is the water supplied to the cooling tower to "make up" water lost to evaporation or discharged from the cooling tower when dissolved solids concentration becomes too high in the circulating water.

Gather the following information on the cooling tower makeup water:

- Makeup water source – Knowing the type of water source of the makeup supply is important because the quality of the incoming water can have a large impact on the overall operating conditions. There are three main categories of water sources:
    - Potable – Water from freshwater sources such as surface water or groundwater that is safe to drink

[13] For more information on cooling towers, go to FEMP's Cooling Tower Best Management Practice: https://www.energy.gov/eere/femp/best-management-practice-10-cooling-tower-management

  - Non-potable – Water from freshwater sources such as surface water or groundwater that is not safe to drink
  - Alternative – Water that is not from freshwater sources such as rainwater harvesting, graywater, condensate capture

- How is makeup water tracked?
  - Metered – If makeup water is metered:
    - take a photo of the meter
    - ask whether the data is logged
    - obtain the data if available
  - Estimated – If makeup water is estimated:
    - obtain the water use estimate if available
    - note the timescale of the estimate (e.g., daily vs. monthly)
  - Not tracked – If makeup water is not metered or estimated, this can be a good indication that the cooling tower is not well monitored and may benefit from operational improvements.
- Amount of makeup water used per month – Depending on the answer of the previous question, enter the total amount of monthly makeup water if available during the walk-through survey. This data may be available on log sheets or meter readings.

**Blowdown**: Blowdown is the deliberate discharge of water to prevent the dissolved solids from getting too concentrated in the system.

Gather the following information on cooling tower blowdown:

- Blowdown controls – How is the cooling tower blowdown controlled? Blowdown can be controlled in primarily three different mechanisms:
  - Manual – If blowdown is manually controlled, ask the facility manager or cooling tower operator the frequency.
  - Clock – A clock timer can be used to discharge cooling water on a regular interval. This is typically located on a drainage pipe from the cooling tower basin or on a drainage pipe connected to the recirculating piping between the cooling tower and the chillers or heat exchangers.
  - Conductivity-Based – Blowdown can be controlled based on the conductivity of the recirculating water.
- How is blowdown water tracked?
  - Metered – If blowdown water is metered:
    - take a photo of the meter
    - ask whether the data is logged
    - obtain the data if available

  - Estimated – If makeup water is estimated:
    - obtain the water use estimate
    - note the timescale of the estimate (e.g., daily vs. monthly)
  - Not tracked – If blowdown water is not metered or estimated, this may indicate that the cooling tower is not well monitored and may offer opportunities for operational improvements.

- Amount of blowdown water used per month – Enter the total amount of monthly blowdown water, if available, during the walk-through survey. This data may be available on log sheets or meter readings.

Gather this general information:

- What is the tonnage rating of the cooling system? The system tonnage can be obtained from the nameplate on the chiller system and can also be found on the manufacturer specifications.

- What are the typical operating cycles of concentration of the system? Ask the system operator whether the system operates under a set number of cycles of concentration (COCs).

  COC is the ratio of the concentration of dissolved solids in the blowdown water compared to the makeup water, which is approximately equal to the ratio of volume of makeup to blowdown water. COC is an important parameter in understanding how efficiently the system runs[14].

- What is the recirculating rate? The recirculation rate is the amount of water that flows across the cooling tower, or the condenser water flow rate. This value is typically provided in gpm and can be found on operator logs or monitored in a connected automated system. This value can also be determined from the pump ratings on the condenser water loop that recirculates the water to the cooling tower(s).

- Condition of the cooling tower – It is important to observe the condition of the cooling tower to determine whether there are any specific areas that can be improved. Note whether the following issues are present:
  - Leaking – Water may be leaking from different components in the system such as the tower basin, system piping, or malfunctioning valves.
  - Corrosion – Look for rust and degraded areas on the cooling tower structure and drift eliminators.
  - Mineral buildup – Look for white scale in the cooling tower fill. If the interior of chillers or other heat exchangers can be inspected, look for mineral deposits on the heat-exchange surfaces. Mineral scale will impact the overall efficiency of the cooling system by restricting flow in the tower fill and by acting as insulation on the heat exchanger surfaces.


Mineral buildup on cooling tower fill

  - Biological fouling – Look for evidence of algae on the tower fill or gathered on the distribution deck on the top of the tower structure. Also, look for evidence of slimy buildup on the tower fill, and chillers or other heat exchangers if they can be inspected. Biological fouling can lead to

[14] Find information on COCs and estimating methods in the FEMP Cooling Tower Factsheet: https://www.energy.gov/sites/prod/files/2013/10/f3/waterfs_coolingtowers.pdf

localized corrosion and also act as insulation on heat exchange surfaces, reducing the efficiency and overall performance of the cooling system.

  - Mechanical problems – Look for malfunctioning basin level controls that may lead to tower overflow and unnecessary system losses. Inspect for broken, damaged, or plugged spray nozzles in the distribution system on the tower deck. Also inspect for the proper operation of the tower fan, broken or missing drift eliminators, and other structural problems.

- Are sewer credits are received? Sewer credits are provided a water supplier to account for the amount of water that actually is discharged to the sewer system. If sewer credits are not applied, a building may be charged sewer fees for the amount of water that is being supplied to the system.

When performing a cooling tower survey, use the comments section to make note of any general observations as well as any problems such as broken or poorly maintained equipment.

For more information on cooling towers:

- FEMP Best Management Practice: https://www.energy.gov/eere/femp/best-management-practice-10-cooling-tower-management
- FEMP Cooling Tower Factsheet: https://www.energy.gov/sites/prod/files/2013/10/f3/waterfs_coolingtowers.pdf

Cooling towers can be a large water use at a building or campus, consuming significant volumes of water through the process of evaporation to provide process or comfort cooling. Therefore, use the data collected during the walk-through survey to estimate the cooling tower water consumption using the FEMP guidelines: https://www.energy.gov/eere/femp/estimating-methods-determining-end-use-water-consumption

## Summary Table

After all the data for the building or campus has been collected, enter the data into the Excel-based Electronic Data Summary Workbook to generate a general summary table of water using equipment. This table should help the user pinpoint building water end-uses, or for a campus, buildings that should be investigated first.

The following information is included in the summary table:

- Building number and name/description
- Date building was constructed
- Occupancy count, weekday and weekend
- Plumbing Information
  - Toilets – Count of fixtures and average rating for the building
  - Urinals – Count of fixtures and average rating for the building
  - Faucets – Count of fixtures and average rating for the building
  - Showers – Count of fixtures and average rating for the building

- Laundry Information
    - ENERGY STAR – Count of machines and average water factor for the building
    - Non-ENERGY STAR – Count of machines and average water factor for the building
- Commercial Kitchen
    - Dishwashing machine – Count of equipment
    - Pre-rinse spray valve – Count of fixtures and average rating for the building
    - Handwashing faucets – Count of fixtures and average rating for the building
    - Prep sink faucets – Count of fixtures and average rating for the building
    - Pots/Pans Washing sink – Count of fixtures and average rating for the building
    - Food steamer – Count of equipment
    - Garbage disposal – Count of equipment
    - Ice machines – Count of equipment
- Vehicle Wash
    - Open hose – Count of equipment and average rating for all equipment in wash area
    - Pressure washer – Count of equipment and average of all stamped ratings for equipment in the wash area
- Landscape Irrigation
    - Irrigation controls – Count of equipment and the general level of supplemental irrigation required (low/medium/high)
- Cooling Tower
    - Cooling tower process – Comfort Cooling, Process Load, Other
    - Amount of makeup water used per month

# Next Steps – Comprehensive Water Evaluation

Data collected and entered into the Water Evaluation Data Tool for the water end-uses of a building or campus can be used to generate a water balance, identify operation and maintenance issues that need to be addressed, and help identify water-efficient retrofit opportunities. The data can be used to complete the water portion of a CEWE.

## Water Balance

The data can be used to estimate a site's water use at the end-use level and produce a water balance for the building or campus. Determining water use at the equipment or application level can be challenging. Most buildings or campuses have metered data for the total water supply but may have limited building metering and often no sub-metering of water end-uses. A water balance compares the total water supply baseline to water that is used by equipment and applications across the building or campus.

A water balance is an important step in determining efficiency and demand-reduction opportunities because it uncovers the high water use activities and system losses, which will help to prioritize water-saving opportunities. Installations may use different types of water supply of varying quality (e.g., potable water, non-potable water, or alternative water) for different end-uses. An engineered estimate will need to be calculated for unmetered water end-uses.

## Resources for more information

FEMP has developed resources for developing a water balance:

- General methods for determining water use of unmetered major water-consuming equipment: https://www.energy.gov/eere/femp/estimating-methods-determining-end-use-water-consumption
- Information on developing a water balance: https://www.energy.gov/eere/femp/developing-water-management-plan

## Water Efficiency Operation and Maintenance and Retrofits/Replacements

Using the water balance, the next step is to evaluate operation and maintenance (O&M) changes and water-efficiency retrofit opportunities for the fixtures and equipment observed. Use FEMP's BMPs as a starting place for O&M improvements and retrofit and replacement ideas. A retrofit analysis is often performed to determine whether upgrading to higher efficiency fixtures or equipment is cost effective. Using data collected, such as actual flow and flush rates, occupancy patterns, and utility rates coupled with other available data, including replacement fixture/equipment costs, and labor rates, can help determine whether a higher efficiency piece of equipment will save money over time.

FEMP has developed several resources on water efficiency and water management:

- Streamlined O&M guidelines for the common water-using equipment: https://www.energy.gov/eere/femp/technical-operations-and-maintenance-guidelines-common-water-equipment
- Screen for water efficiency projects using the Water Project Screening Tool: https://www.energy.gov/eere/femp/water-efficiency-federal-buildings-and-campuses
- Water efficiency best management practices to increase water efficiency: https://www.energy.gov/eere/femp/best-management-practices-water-efficiency
- Water-savings technologies that offer opportunities for significant water savings potential: https://www.energy.gov/eere/femp/water-efficient-technology-opportunities

The Environmental Protection Agency's WaterSense program developed "WaterSense at Work," which discuss a variety of water-efficiency BMPs (https://www.epa.gov/watersense/best-management-practices).

# Walk-Through Data Collection Forms

The following pages contain the forms discussed throughout the instructions. These forms include

# WATER EVALUATION DATA COLLECTION FORM

| General Building Information | | |
|---|---|---|
| | | **Comments** |
| **Building number** | | |
| **Building name** | | |
| **Primary building type (circle the most appropriate building type)** | Retail / Education / Lodging / Office / Medical / Dining<br>Physical Fitness / Other | |
| **Square footage of building** | | |
| **Date of construction (year)** | | |
| **Year of last major water-related renovations** | | |
| **List types of water-related renovations** | | |
| **Building address** | | |
| **City, State, Zip Code** | | |
| **Evaluator name** | | |
| **Date of survey** | | |

| Utility Information | | |
|---|---|---|
| **Water utility provider** | | |
| **Marginal water rate,* including units** | | |
| **Sewer utility provider** | | |
| **Marginal Sewer rate,* including units** | | |
| **Types of energy available - relevant to domestic hot water** | | |
| **Marginal energy rate for each type available, including units** | | |

***Utility rates may not be available during onsite evaluation. Site's point of contact may need to be contacted for this information.**

| Occupancy Information | | | |
|---|---|---|---|
| **Building number and name** | | | |
| | **Weekday** | **Weekend** | **Comments** |
| **Occupied hours (typical)** | | | |
| **Number of building occupants (typical)** | | | |
| **Number of weeks per year building is occupied** | | | |
| **Female occupants (percentage)** | | | |
| **Male occupants (percentage)** | | | |

| Domestic Hot Water | | |
|---|---|---|
| **Building number and name** | | |
| | | **Comments** |
| **Hot water fuel source (circle)** | Natural Gas / Electricity / Distillate Oil / Residual Oil / LPG (Propane) / Steam / Other / None | |
| **Make and model of water heating equipment** | | |
| **Hot water heating efficiency*** | | |
| **Hot water heater tank capacity (gallons)*** | | |
| **Hot water temperature** (°F) | | |

***This may not be available during the onsite evaluation but may be obtained online using the water heater make and model.**

# WATER EVALUATION DATA COLLECTION FORM

## Plumbing Fixtures - Restrooms, Locker Rooms and/or Kitchenettes

**Building number and name**

| **Location of plumbing fixtures:** | | | | | **Restroom type:** Male / Female / Unisex |
|---|---|---|---|---|---|
| | **Toilets** | **Urinals** | **Faucets*** | **Showers** | **Comments** |
| **Count of fixtures** | | | | | |
| **Primary fixture type (circle )** | Tank (Gravity) / Tank (Pressure Assisted) / Flush Valve | | With Aerator / Without Aerator | Threaded Fixed / Hand Held Wall Mount/ Gang | |
| **Flush valve only - Primary flush valve type (circle)** | Diaphragm / Piston | Diaphragm / Piston / Non-water | | | |
| **Flush valve only - Fixture mount type (circle)** | Floor Mount / Wall Mount / Floor with Rear Discharge | Floor Mount / Wall Mount | | | |
| **Operation type (circle)** | Manual / Sensor/ Dual Flush | Manual / Sensor | Manual / Sensor / Metered | | |
| **Urinal only - Discharge tube diameter (check)** | | ¾"____; 1¼"____ | | | |
| **Rated flush rate - gallons per flush (gpf)** | | | | | |
| **Rated flow rate - gallons per minute (gpm)** | | | | | |
| **Flush valve only - Average flush time (sec)** | | | | | |
| **Measured average flow rate (gpm)** | | | | | |
| **Percentage of occupants showering daily, weekdays** | | | | | |
| **Percentage of occupants showering daily, weekends** | | | | | |

***This includes faucets located in bathroom, locker room and/or kitchenettes.**

# WATER EVALUATION DATA COLLECTION FORM

## Laundry - Washing Machines

**Building number and name**

| | | | |
|---|---|---|---|
| **Estimated loads of laundry per person per week, weekdays** | | | |
| **Estimated loads of laundry per person per week, weekends** | | | |
| | **ENERGY STAR Machines** | **Non-ENERGY STAR Machines** | **Comments** |
| **Count of washing machines** | | | |
| **Make of washing machines** | | | |
| **Model of washing machines** | | | |
| **Typical capacity of washing machines cubic feet*** | | | |
| **Water factor of washing machines gallons/cycle/cubic feet*** | | | |
| **General condition of machines (circle)** | Excellent / Good / Poor | Excellent / Good / Poor | |

***This may not be available during the onsite evaluation but may be obtained online using the washing machine make and model.**

# WATER EVALUATION DATA COLLECTION FORM

## Commercial Kitchen

**Building number and name**

| | | Weekday | Weekend | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Average numbers of meals served per day** | | | | | | | | | |
| **Average number of kitchen staff** | | | | | | | | | |
| | **Dishwashing Machine** | **Pre-Rinse Spray Valve** | **Handwashing Faucets** | **Prep Sink Faucets** | **Pots/Pans Washing Sink Faucets** | **Food Steamer** | **Garbage Disposal** | **Ice Machine** | **Comments** |
| **Count of fixtures or equipment** | | | | | | | | | |
| **Equipment Type (circle)** | Continuous / Batch | | Manual / Sensor / Metered | | | Boiler-Based / Connectionless | | Air-Cooled / Water-Cooled | |
| **Equipment is ENERGY STAR (circle the appropriate answer)** | Yes / No | | | | | Yes / No | | Yes / No | |
| **Rated flow rate - gallons per minute (gpm)** | | | | | | | | | |
| **Batch water use (gallons per cycle)** | | | | | | | | | |
| **Measured average flow rate - gallons per minute (gpm)** | | | | | | | | | |
| **Make of equipment** | | | | | | | | | |
| **Model number of equipment** | | | | | | | | | |
| **Hours operated per day** | | | | | | | | | |
| **Loads per day** | | | | | | | | | |
| **General condition of equipment** | Poor / Average / Good | Poor / Average / Good | | | | Poor / Average / Good | Poor / Average / Good | Poor / Average / Good | |

# WATER EVALUATION DATA COLLECTION FORM

## Vehicle Wash

**Building number and name**

| | Open Hose | Pressure Washer | Comments |
|---|---|---|---|
| **Average number of vehicles washed per week** | | | |
| **Average number of weeks vehicles washed per month** | | | |
| **Approximate wash time per vehicle (minutes)** | | | |
| **Flow rate of open hose - measured average flow rate gallons per minute (gpm)** | | | |
| **Nozzle manufacturer** | | | |
| **Nozzle rating - (gpm)** | | | |
| **Manufacturer** | | | |
| **Model number** | | | |

# WATER EVALUATION DATA COLLECTION FORM

## Landscape Irrigation

### Building number and name

**Landscape irrigation area description**

| | Turfgrass | Mixed Beds | Comments |
|---|---|---|---|
| **Landscape area type (circle)** | Landscape Around Building / Athletic Field / Golf Course / Parade Field / Park / Family Housing / Other | | |
| **Water supply type (circle)** | Potable / Non-potable / Alternative | | |
| **What month does irrigation start?** | | | |
| **What month does irrigation end?** | | | |
| **What is the general level of supplemental irrigation needed by the mixed bed? (circle)** | | Low / Moderate / High | |
| **How dense is the mixed bed area planted? (circle the appropriate answer)** | | Low / Moderate / High | |
| **How protected/exposed is the mixed bed area? (circle)** | | Protected / Open / Intense Exposure | |
| **What type of turf species is present? (circle)** | Cool Season / Warm Season | | |
| **How is the condition of the landscape? (circle)** | Stressed / Average / High Quality | Stressed / Average / High Quality | |
| **What type of soil is at the site? (circle)** | Sandy / Loam / Clay | Sandy / Loam / Clay | |
| **Enter the landscape area in square feet** | | | |
| **Irrigation equipment type (circle)** | Rotor /Spray / Micro-spray / Drip / Manual | Rotor /Spray / Micro-spray / Drip / Manual | |
| **Irrigation maintenance (circle)** | Poor / Average / High | Poor / Average / High | |
| **Irrigation controls (circle)** | Manual /Clock / Weather-Based | Manual /Clock / Weather-Based | |
| **Observations on irrigation efficiency and system operations (puddles visible, runoff, leaks, broken sprinkler heads, irrigation during rain or high winds, watering impervious surfaces, etc.)** | | | |
| **Best practices being used (mulch, xeriscape, irrigating at night, etc.)** | | | |
| **How often is the irrigation system operated? (days per week)** | | | |
| **How long is the irrigation system operated? (minutes per day)** | | | |

# WATER EVALUATION DATA COLLECTION FORM

## Cooling Tower

### Building number and name

| Cooling tower location description | | Comments |
|---|---|---|
| | | |
| For what process is the cooling tower used? (Circle) | Comfort Cooling (HVAC) / Process Load / Other | |
| Cooling season start month | | |
| Cooling season end month | | |
| Enter hours per day of operation | | |
| Enter days per month of operation | | |
| How is the operation of the system monitored? (circle) | Automated Control System with Data Logging / Manual with Log sheets | |
| Makeup water source (circle) | Potable / Non-potable / Alternative | |
| How is makeup water use tracked? (circle) | Metered / Estimated / Not Tracked | |
| Amount of makeup water used per month (gallons) | | |
| Blowdown controls (circle) | Manual / Clock / Conductivity-Based | |
| How is blowdown water tracked? (circle) | Metered / Estimated / Not Tracked | |
| Amount of blowdown water used per month (gallons) | | |
| What is the tonnage rating of the cooling system? (Chillers may provide this information) | | |
| What are the typical operating cycles of concentration of the system? | | |
| What is the recirculating rate? - gallons per minute | | |
| Condition of cooling tower (circle all that apply) | Well-Maintained / Leaking / Corrosion / Mineral Build Up / Biological Fouling / Mechanical Issues / Other | |
| Are sewer credits received? (circle) | Yes / No | |

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U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

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