APPENDIX I

METRO CONSERVATION DISTRICTS
CAMPUS GROUNDWATER CONSERVATION PLANNING

This workbook contains the primary worksheets for onsite water use data collected as part of the Campus Groundwater Conservation Planning protocol.

Worksheet tabs are categorized and color-coded as either 'WS' (Worksheet) or 'BMPs' (Best Management Practices). 'WS' tabs are designed to facilitate field data collection of campus water use. Information on the tabs is formatted to fit on 8.5"x11" paper so they can be printed for use in the field. Alternatively, data could be entered directly into the 'WS' tabs if a tablet is available during the data collection phase. 'BMPs' tabs provide best management practices and other water conservation considerations for each category. These tabs include tips for water conservation specific to their corresponding category (e.g. faucets, toilets, and mechanical systems). Bolded lines within the 'BMPs' tabs represent low and no-cost actions to conserve water.

Tab order from left to right represents one possible sequence of the protocol. However, because each campus is unique, the order and content of the worksheets may need to be customized to best fit the site-specific conditions.

TAB COLOR CODING KEY
WS = Worksheet
BMPs = Best Management Practices

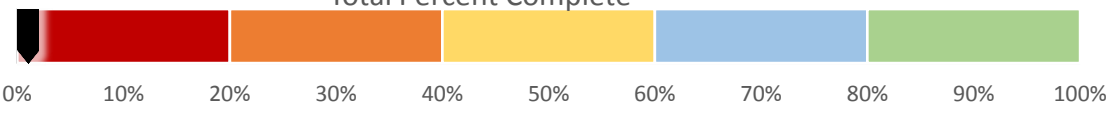
Worksheets and Best Management Practices adapted from:

EPA. 2012. *WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities* . U.S. Environmental Protection Agency, Washington, DC.

South Florida Water Management District Water Supply Development Section. 2013. *Water Efficiency and Self Conducted Water Audits at Commercial and Institutional Facilities: A Guide for Facility Managers, Second Edition* . West Palm Beach, FL.

Water Audit Checklist

Total Percent Complete



Off-Site Data Collection **Complete 0 out of 7**

- ☐ Contact Information
- ☐ Building Information
- ☐ Building Occupancy
- ☐ Water Consumption History
- ☐ Utility Bills & Daily Use
- ☐ Water Meters and Submeters
- ☐ Facility Leak Detection

On-Site Data Collection **Complete 0 out of 12**

Sanitary Fixtures and Equipment Complete 0 out of 4

- ☐ Faucets
- ☐ Showerheads
- ☐ Toilets
- ☐ Urinals

Residential Grade Equipment Complete 0 out of 1

- ☐ Residential Grade Appliances

Commercial Grade Equipment Complete 0 out of 2

- ☐ Commercial Grade Appliances
- ☐ Commercial Grade Fixtures

Mechanical Systems Complete 0 out of 2

- ☐ Cooling Tower
- ☐ Boiler

Outdoor Water Use Complete 0 out of 3

- ☐ Irrigation System
- ☐ Landscaping & Irrigation
- ☐ Pool

On-Site Data Collection **Complete 0 out of 3**

- ☐ Onsite Alt. Water Use-Reuse Opportunities
- ☐ Groundwater Recharge Oppertunities
- ☐ Facility Water Balance

CONTACT INFORMATION - WORKSHEET

Site Name:				
Address:				
Facility Operations Manager:	Name:		Phone:	
	Email:			
CGCP Auditor(s):	Name:		Phone:	
	Email:			
Date of Audit:				

GENERAL BUILDING INFORMATION - WORKSHEET

Building:		Year Built:		Foundation SF:		Months/Year Operation:	
		Floor(s):		Total SF:			
Building:		Year Built:		Foundation SF:		Months/Year Operation:	
		Floor(s):		Total SF:			
Building:		Year Built:		Foundation SF:		Months/Year Operation:	
		Floor(s):		Total SF:			
Building:		Year Built:		Foundation SF:		Months/Year Operation:	
		Floor(s):		Total SF:			
Building:		Year Built:		Foundation SF:		Months/Year Operation:	
		Floor(s):		Total SF:			
Building:		Year Built:		Foundation SF:		Months/Year Operation:	
		Floor(s):		Total SF:			

SITE MAP

Attach site map showing campus with building footprints and area (SF).

BUILDING INFORMATION - BEST MANAGEMENT PRACTICES	
1	Incorporate water-efficient best management practices (BMPs) into all Standard Operating Procedures (SOPs) for O&M throughout the facility (including those for both maintenance and cleaning staff).
2	Incorporate water efficiency criteria into procurement policies along with energy efficiency (e.g. ENERGY STAR certified and WaterSense labeled products).

METRO CONSERVATION DISTRICTS
CAMPUS GROUNDWATER CONSERVATION PLANNING

BUILDING OCCUPANCY DATA - WORKSHEET

Building: _____

Full-time Employees Population #1: Males: _____ Females: _____ Age Range: _____

Full-time Employee Population #1 Frequency and Duration (hours)

January	Weekdays		Saturday		Sunday		Holiday	
February	Weekdays		Saturday		Sunday		Holiday	
March	Weekdays		Saturday		Sunday		Holiday	
April	Weekdays		Saturday		Sunday		Holiday	
May	Weekdays		Saturday		Sunday		Holiday	
June	Weekdays		Saturday		Sunday		Holiday	
July	Weekdays		Saturday		Sunday		Holiday	
August	Weekdays		Saturday		Sunday		Holiday	
September	Weekdays		Saturday		Sunday		Holiday	
October	Weekdays		Saturday		Sunday		Holiday	
November	Weekdays		Saturday		Sunday		Holiday	
December	Weekdays		Saturday		Sunday		Holiday	

Full-time Employees Population #2 Males: _____ Females: _____ Age Range: _____

Full-time Employee Population #2 Frequency and Duration (hours)

January	Weekdays		Saturday		Sunday		Holiday	
February	Weekdays		Saturday		Sunday		Holiday	
March	Weekdays		Saturday		Sunday		Holiday	
April	Weekdays		Saturday		Sunday		Holiday	
May	Weekdays		Saturday		Sunday		Holiday	
June	Weekdays		Saturday		Sunday		Holiday	
July	Weekdays		Saturday		Sunday		Holiday	
August	Weekdays		Saturday		Sunday		Holiday	
September	Weekdays		Saturday		Sunday		Holiday	
October	Weekdays		Saturday		Sunday		Holiday	
November	Weekdays		Saturday		Sunday		Holiday	
December	Weekdays		Saturday		Sunday		Holiday	

Visitor Group Males: _____ Females: _____ Age Range: _____

Visitor Frequency and Duration (hours)

January	Weekdays		Saturday		Sunday		Holiday	
February	Weekdays		Saturday		Sunday		Holiday	
March	Weekdays		Saturday		Sunday		Holiday	
April	Weekdays		Saturday		Sunday		Holiday	
May	Weekdays		Saturday		Sunday		Holiday	
June	Weekdays		Saturday		Sunday		Holiday	
July	Weekdays		Saturday		Sunday		Holiday	
August	Weekdays		Saturday		Sunday		Holiday	
September	Weekdays		Saturday		Sunday		Holiday	
October	Weekdays		Saturday		Sunday		Holiday	
November	Weekdays		Saturday		Sunday		Holiday	
December	Weekdays		Saturday		Sunday		Holiday	

	BUILDING OCCUPANCY - BEST MANAGEMENT PRACTICES
1	Instruct staff and visitors with clear signage on how and where to report leaks at all points of water use.
2	Educate facility staff, building occupants, employees, and visitors on water management program goals and initiatives.
3	Form a green team to engage employees in saving water throughout the building.
4	**Educate employees to turn off equipment, including all continuous flow equipment, between uses; use automatic shut-off valves where appropriate.**
5	**Educate employees to use "dry" cleaning methods to avoide washing down equipment or areas with a water hose or mop; sweep or mop instead of spray washing with water.**
6	**Place signage at all major points of water use to remind employees to turn off the tap and report leaks.**

METRO CONSERVATION DISTRICTS

CAMPUS GROUNDWATER CONSERVATION PLANNING

WATER CONSUMPTION HISTORY - WORKSHEET

Year	Monthly Consumption by Billing Units: Thousands of Gallons or CCF											
	Indoor Uses						Landscape Uses					
Month	Account #	Account #	Account #	Account #	Billed Days	Average GPWD[1]	Account #	Account #	Account #	Account #	Billed Days	Average GPWD[1]
Jan.												
Feb.												
Mar.												
Apr.												
May												
Jun.												
Jul.												
Aug.												
Sep.												
Oct.												
Nov.												
Dec.												

[1] Gallons per workday, assuming five days per week.

WATER USE SUMMARY - WORKSHEET

Months Per Year of Operation:

Water Utility Information — Provider: _____ Billing Rate: _____

Gas Utility Information — Provider: _____ Billing Rate: _____

Building wastewater is currently: Treated on site | Connected to city sewer system | Other

Is recycled water currently used (e.g. toilets, urinals, cooling towers, irrigation)?

Cooling Towers

- Cooling Capacity:
- Typical Operating Tonnage:
- Hours Per Day of Operation:
- Days Per Month of Operation:
- Months Per Year of Operation:

Are Sewer Credits Received?

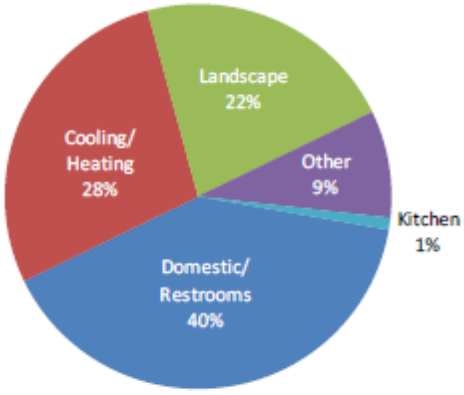
Irrigation System? Submetered?

Other large or significant points of on-site water use (e.g. commercial kitchen, vehicle washes, etc.)?

Office Buildings

Restroom/domestic, cooling and heating, and landscape use account for approximately 90 percent of the water use in a typical office building. Effective conservation measures for office buildings often include:

- Bathroom fixture replacement
- Public education promoting conservation among building tenants
- Cooling tower efficiency retrofits such as improved system controls
- Irrigation efficiency measures such as weather- or moisture-based irrigation controllers and landscaping changes using native or climate adaptive plants



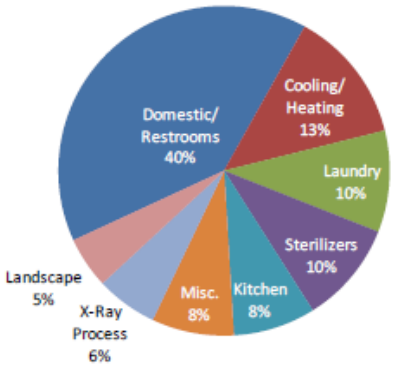
Source: City of San Jose, Environmental Services Department

Introduction

Hospitals

Domestic/restroom uses account for 40 percent of water use in hospitals. Additionally, hospitals use a large percentage of water for processes such as x-ray development, sterilization, and laundry. Effective water efficiency measures for hospitals may include:

- Bathroom fixture replacement
- Cooling tower efficiency retrofits
- Laundry equipment and process changes
- Condensate return systems for sterilizers
- Conversion from x-rays to digital imaging

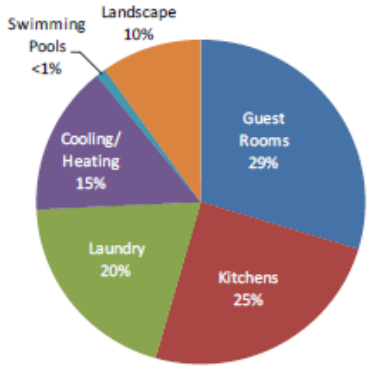


Source: City of San Jose, Environmental Services Department

Hotels and Motels

The combination of guestroom use, kitchens, and laundries accounts for 75 percent of water use in hotels and motels. Water efficiency measures may include:

- Bathroom fixture replacement
- Laundry equipment and process changes
- Guest conservation awareness programs to promote less frequent linen exchanges to reduce laundry

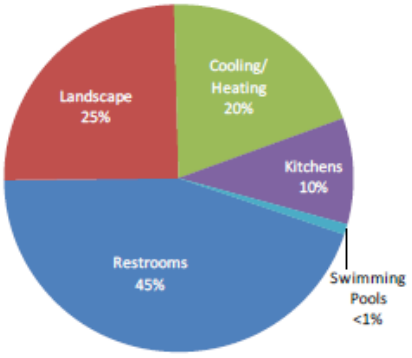


Source: City of San Jose, Environmental Services Department

Schools

Nearly half of the water used in schools is related to restrooms. Other large uses include landscaping and heating and cooling. Because of these uses, effective conservation measures often include:

- Bathroom fixture replacement
- Cooling tower efficiency retrofits
- Irrigation efficiency measures such as weather- or moisture-based irrigation controllers

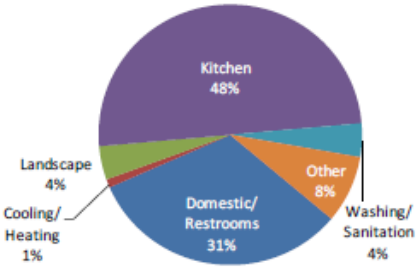


Source: City of San Jose, Environmental Services Department

Restaurants

Kitchen use accounts for just under half of the water used in restaurants with domestic/ restroom use accounting for almost a third. Water use efficiency measures applicable to restaurants include:

- Water efficiency training and information for kitchen staff
- Use air-cooled equipment such as icemakers
- Bathroom fixture replacement
- Water efficient appliances and best management practices during their use

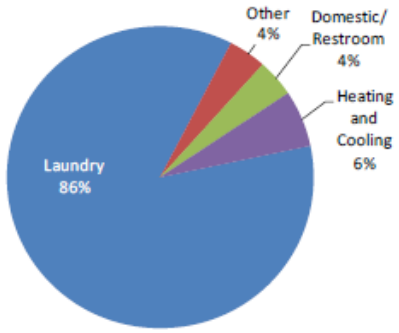


Source: EPA WaterSense Water Efficiency in the Commercial and Institutional Sector, 2009

Laundries

Virtually all water use in laundries is in the wash process. Possible efficiency measures include:

- Replace conventional washing machines with high efficiency front-load machines
- Install a reclaim system to capture rinse water for use in the wash cycle
- Install a continuous-batch washer for large laundry operations

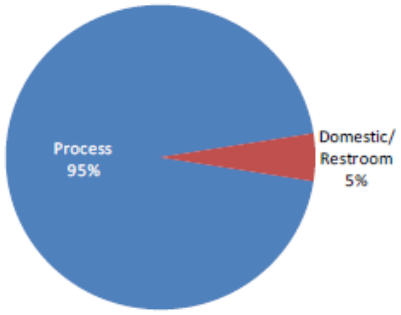


Source: EPA WaterSense Water Efficiency in the Commercial and Institutional Sector, 2009

Car Washes

As with laundries, virtually all water use in car washes relates to the cleaning process. Car wash water use reduction can be achieved by the following:

- Install a recycling system for wash water
- Increase conveyor speed to reduce the rinse cycle
- Maintain equipment to ensure nozzles are properly set and not excessively worn



Source: EPA WaterSense Water Efficiency in the Commercial and Institutional Sector, 2009

METERS & SUBMETERS - WORKSHEET					
Water Billing Account Number(s)	Meter/Submeter Number & Location	Type (Straight-Reading or Round-Reading)	Pipe Size (inches)	Date of Last Accuracy Check & Calibration	Records Used for Which Areas of Building or Campus

Table 3. Recommended testing intervals for various water meter sizes.

Meter Size	Testing Interval
½ and ⅝ inch	Every 10 years
¾ inch	Every 8 years
1 inch	Every 6 years
1½ and 2 inches	Every 4 years

Source: AWWA 1999

	METERS & SUBMETERS - BEST MANAGEMENT PRACTICES
1	**Read water meters and record monthly water use; verify that all meters and submeters are installed properly.**
2	Install submeters on all major water-using equipment, systems, or processes (e.g., cooling towers, tenant spaces, irrigation systems, single-pass cooling, and HVAC systems).
3	Test water pressure regularly on each floor of the facility to ensure it is within optimal range for fixture and equipment performance; use pressure regulating valves to correct any issues (i.e. optimal pressure is between 20 and 80 PSI for most fixtures).
4	Install a separate meter to measure water used for irrigation and monitor it regularly to find leaks and problems.
5	**Contact your local wastewater utility to find out if credits are available for the water being applied to the landscape, instead of being discharged to the sewer system.**

FACILITY LEAK DETECTION - WORKSHEET

Note: Digital water meters may show real time flow rates for leak detection.

Meter Location: ____________________

Meter Type: ____________________

Date and Time	Initial Meter Reading	Date and Time	End Meter Reading	Known Water Consumption During Shutdown	Leaks/Other Observations

Meter Location: ____________________

Meter Type: ____________________

Date and Time	Initial Meter Reading	Date and Time	End Meter Reading	Known Water Consumption During Shutdown	Leaks/Other Observations

Meter Location: ____________________

Meter Type: ____________________

Date and Time	Initial Meter Reading	Date and Time	End Meter Reading	Known Water Consumption During Shutdown	Leaks/Other Observations

	LEAK DETECTION - BEST MANAGEMENT PRACTICES
1	**Include leak detection and repair in all operation and maintenance (O&M) programs.**
2	Regularly check all fixtures and valves for scaling and clean as needed.

UTILITY BILL REVIEW & ESTIMATING DAILY FACILITY WATER USE - WORKSHEET

Refer to SFWMDWSDS 2013 page 40, Box 5 for guidance.

Daily Indoor Water Use = _____

Daily Indoor Water Cost = _____

Water Utility Information Provider: _____ Billing Rate: _____

Daily Outdoor Water Use = _____

Daily Outdoor Water Cost = _____

Box 5. Flowcharts for Determining Daily Water Use and Cost

Preliminarily, request copies of your facility's water billing records from the accounts payable office. Then, starting with #1 below, examine the following seven scenarios to determine which one applies to your facility based on irrigation, water source, and submeters. After identifying the appropriate scenario, complete **Worksheet 3** to determine daily water use and daily water cost.

1. Q: *Does the facility have an irrigation system?*

If no (Indoor water use only):

$$\text{Daily water use} = \frac{\text{Total water use (gals)}}{\text{Number days in billing cycle}} \qquad \text{Daily water cost} = \frac{\text{Total cost for billing cycle}}{\text{Number days in billing cycle}}$$

If yes: **Continue to 2.**

2. The facility has an irrigation system.

Q: *Is the irrigation system water self-supplied?*

If yes (irrigation water is supplied by a well or pond):

Indoor Water Use:

$$\text{Daily water use} = \frac{\text{Metered use (gals)}}{\text{Number days in billing cycle}} \qquad \text{Daily water cost} = \frac{\text{Total water and sewer costs}}{\text{Number days in billing cycle}}$$

Outdoor Water Use: Determined by a professional

If no: **Continue to 3.**

3. The facility has an irrigation system and it is supplied by potable or reclaimed water (not a well or pond).

Q: *Is reclaimed or reuse water used to supply the irrigation system?*

If yes (reclaimed water is used for irrigation):

Reclaimed Water Line Meter → To Irrigation System

Domestic Water Line Meter → To Domestic System

Indoor Water Use:

$$\text{Daily water use} = \frac{\text{Metered potable use (gals)}}{\text{Number days in billing cycle}} \qquad \text{Daily water cost} = \frac{\text{Total water and sewer costs}}{\text{Number days in billing cycle}}$$

Outdoor Water Use:

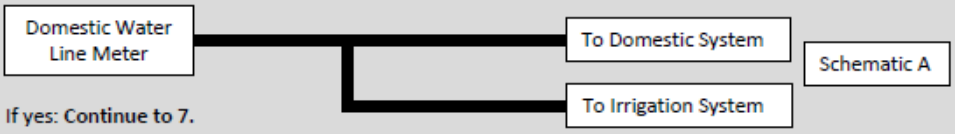
$$\text{Daily water use} = \frac{\text{Metered reclaimed use (gals)}}{\text{Number days in billing cycle}} \qquad \text{Daily water cost} = \frac{\text{Reclaimed water costs}}{\text{Number days in billing cycle}}$$

If no (reclaimed water is not used): **Continue to 4.**

Box 5 (Continued)

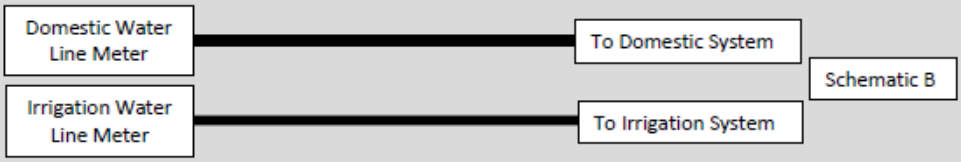
4. The facility has an irrigation system that is supplied by potable water.

Q: *Are irrigation water use and domestic water use recorded by the same meter as in the schematic below?*



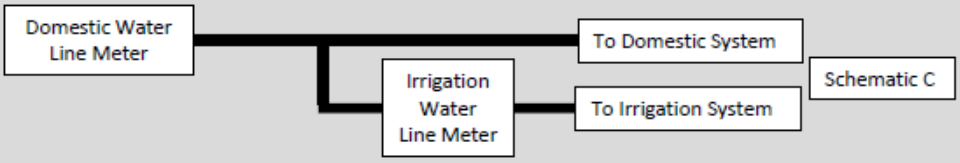
If yes: **Continue to 7.**

If no, (the irrigation water use and domestic water use are not recorded by the same meter) the irrigation line can be either metered independently from the main domestic inflow as in:



Continue to 5 for this scenario.

Or, it can be submetered off of the main domestic inflow, as in the schematic below. If it is submetered off the main, **continue to 6**.



5. Irrigation is supplied by potable water and is metered separately from the main domestic inflow line.

Use for Schematic B (from above).

Indoor Water Use:

$$\text{Daily indoor water use} = \frac{\text{Metered potable use (gals)}}{\text{Number days in billing cycle}} \qquad \text{Daily indoor water cost} = \frac{\text{Total water and sewer costs}}{\text{Number days in billing cycle}}$$

Outdoor Water Use:

$$\text{Daily outdoor water use} = \frac{\text{Metered irrigation use (gals)}}{\text{Number days in billing cycle}} \qquad \text{Daily outdoor water cost} = \frac{\text{Total irrigation water costs}}{\text{Number days in billing cycle}}$$

Examining Utility Bills & Estimating Daily Facility Water Use – Basic Audit

Box 5 (Continued)

6. Irrigation is not metered completely separately from domestic inflow.

Use for Schematic C (from above).

Indoor Water Use:

$$\text{Daily water use} = \frac{\text{Total facility metered use – Submetered potable use (gals)}}{\text{Number days in billing cycle}}$$

$$\text{Daily water cost} = \frac{\text{Total water costs}}{\text{Number days in billing cycle}}$$

Outdoor Water Use:

$$\text{Daily water use} = \frac{\text{Submetered irrigation use}}{\text{Number days in billing cycle}}$$

$$\text{Daily water cost} = \frac{\text{(Total water costs - Submetered gals) multiplied by cost per gallon}}{\text{Number days in billing cycle}}$$

7. The irrigation water use and domestic water use are recorded by the same meter.
Use the table below and refer to the Spreadsheet Guidance subsection on page 44.

Use for Schematic A (from above).

* The *Irrigation Schedule and Controller – Basic Audit* (page 86) within this guide provides instructions for determining the number of times per week the irrigation system is set to run.

	Date and Time of Initial Reading	Meter Reading	Date and Time of End reading	End Meter Reading	Irrigation System Used? (Yes or No)
Day 1					
Day 2					
Day 3					
Day 4					
Day 5					

There should be a 24-hour lapse between readings.

Refer to the Spreadsheet Guidance subsection (page 44) for more information.

METRO CONSERVATION DISTRICTS
CAMPUS GROUNDWATER CONSERVATION PLANNING

FAUCETS - WORKSHEET

Building Name:

Flow Measurement Container (circle one): Cups / Pints / Quarts / Flowbag

Location	In Lav. Fac.	User Group (Male or Female)	Manual, Sensor, or Spring	Metered (Sensor or Spring) Seconds of Flow	Flow Rate				NA=No Action R=Replace M=Maint.	Leaks? Other Comments
					Marked Flow Rate (gpm)	Timed				
						Num. Cups/ Pints/ Quarts	Num. Secs.	Calc. Rate or Flowbag (gpm)		

High efficiency standards: Toilets 1.28 gpf; **Lavatory Faucets: 0.5 gpm; Res. Kitchen Faucets: 1.5 gpm**; Urinals: 0.5 gpf; Showerheads: 2.0 gpm.

Be sure to indicate individual fixtures in group lavatories as in: Toilet 1, Toilet 2, etc. Suggested methods include initiating a count at "A" or "1" with the fixture closest to the door or beginning to the left upon entering the room.

Place a check mark in the second column (In Lav. Fac.) if the faucet is located in a lavatory. Leave blank otherwise.
Faucet aerators modify the flow rate, so measuring the flow rate is recommended.

General use assumptions: people in commercial facilities use restrooms three times per day (males use urinals twice per day and toilets once, females use toilets three times per day), each toilet or urinal use is accompanied by faucet use, half of all visitors to a facility will use a lavatory, all fixtures within a single lavatory are assumed to be used equally each day, and all lavatory use in a facility is distributed equally.

FAUCETS

Additional Notes:

	FAUCETS - BEST MANAGEMENT PRACTICES
1	Check and adjust automatic sensor and metering faucets regularly to ensure accurate timing and delivery of water per cycle.
2	Replace all lavatory faucets or faucet aerators in private-use restrooms (e.g. hotel guest rooms, dorms, and hospital patient rooms) with WaterSense labeled models, which flow at 1.5 GPM or less.
3	Replace old lavatory faucets or faucet aerators in public-use restrooms with 0.5 GPM models or metered faucets that deliver no more than 0.25 gallons per cycle.

SHOWERHEADS - WORKSHEET

Building Name:

Flow Measurement Container (circle one): Cups / Pints / Quarts / Flowbag

Location	Flow Rate				NA=No Action R=Replace M=Maint.	Leaks? Other Comments
	Marked Flow Rate (gpm)	Timed				
		Num. Cups/ Pints/ Quarts	Num. Secs.	Calc. Rate or Flowbag (gpm)		

High efficiency standards: Toilets 1.28 gpf; Lavatory Faucets: 0.5 gpm; Res. Kitchen Faucets: 1.5 gpm; Urinals: 0.5 gpf; **Showerheads: 2.0 gpm**.

Showerheads installed in 1994 or later will have a flow rate of 2.5 gpm or less. Older showerheads may flow as high as 3.0 to 5.0 gpm.

Be sure to indicate individual fixtures in group lavatories as in: Toilet 1, Toilet 2, etc. Suggested methods include initiating a count at "A" or "1" with the fixture closest to the door or beginning to the left upon entering the room.

SHOWERHEADS - BEST MANAGEMENT PRACTICES	
1	Replace old showerheads with WaterSense labeled models, which flow at 2.0 GPM or less.

TOILETS - WORKSHEET

Building Name:

Location	User Group (Male or Female)	Manual or Sensor	Tank or Valve	Marked Valve Flush Rate (gpf)	Marked China Flush Rate (gpf)	Timed Flush Num. Sec.	Calc. Rate (gpm)	NA=No Action R=Replace M=Maint.	Leaks? Dye Test Results? Other Comments

For tank toilets, record measurement in square inches of the tank volume.
Tank length x width x height of water fill = Volume

Commercial toilet flush valves flush at approximately 25 GPM (0.42 gallons per second); a properly functioning 1.6 GPF flush valve should not have a flush cycle longer than four seconds.

High efficiency standards: **Toilets 1.28 gpf**; Lavatory Faucets: 0.5 gpm; Res. Kitchen Faucets: 1.5 gpm; Urinals: 0.5 gpf; Showerheads: 2.0 gpm.

Be sure to indicate individual fixtures in group lavatories as in: Toilet 1, Toilet 2, etc. Suggested methods include initiating a count at "A" or "1" with the fixture closest to the door or beginning to the left upon entering the room.

General use assumptions: people in commercial facilities use restrooms three times per day (males use urinals twice per day and toilets once, females use toilets three times per day), each toilet or urinal use is accompanied by faucet use, half of all visitors to a facility will use a lavatory, all fixtures within a single lavatory are assumed to be used equally each day, and all lavatory use in a facility is distributed equally.

Box 7. Valve-Flush Toilet Timed-Flush Test

1. Flush the toilet or urinal and count the number of seconds that elapse during the flush.
2. Multiply that number by 0.42 for toilets or 0.25 for urinals according to the following formula:
3. Seconds flushing x 0.42 (for toilets) or 0.25 (for urinals) = ____ gallons per flush

Box 8. Tank Toilet Flow Verification (Volumetric Method)

1. Mark the water height inside the tank with a waterproof marker.
2. Flush the toilet and mark where the water level drops just before it begins to refill, since some tanks do not use their entire contents for a single flush.
3. Measure the internal dimensions (in inches) of the tank from where the water level drops to and up to the fill line.
4. Convert square inches to gallons using the following formula:

Tank height x width x length x 0.004329 = _____ gallons
1 in^3 = 0.004329 gallons

General Domestic Water Use – Basic Audit

Table 9. Flush volume flow rate calculator for the valve-flush, timed-flush test[1].

Fixture	Number of Seconds Flushing	Flow Rate in Gallons per Minute	Gallons per Flush
Toilet	1	25	0.42
	2	25	0.83
	3	25	1.25
	4	25	1.67
	5	25	2.08
	6	25	2.50
	7	25	2.92
	8	25	3.33
	9	25	3.75
Urinal	1	15	0.25
	2	15	0.50
	3	15	0.75
	4	15	1.00
	5	15	1.25
	6	15	1.50
	7	15	1.75
	8	15	2.00
	9	15	2.25

Table 10. Tank flush volumetric calculator.

Cubic Inches	Gallons	Cubic Inches	Gallons
300	1.30	700	3.03
350	1.52	750	3.25
375	1.62	800	3.46
400	1.73	850	3.68
450	1.95	900	3.90
500	2.16	1000	4.33
550	2.38	1100	4.76
600	2.60	1150	4.98
650	2.81	1200	5.19

Cubic inches = Tank fill height x width x length

[1] If you use the *Domestic Plumbing Fixtures* spreadsheet, it will complete this calculation for you.

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	TOILETS - BEST MANAGEMENT PRACTICES
1	**Test and calibrate all automatic and sensor-flushing devices regularly to prevent double/phantom flushes.**
2	Check tank-type toilets for leaks, broken flappers, and other parts failures regularly.
3	**Display instructional signage with all dual-flush devices to ensure proper use.**
4	Replace old tank-type and flushometer-valve toilets with WaterSense labeled models, which flush at 1.28 GPF or less.
5	All tankless toilets have piston flush valves.
6	All older toilets have been outfitted with water displacement devices such as bags or small filled plastic bottles. Verify proper toilet function after installation of water displacement devices.

URINALS - WORKSHEET

Building Name:

Location	Manual or Sensor	Marked Valve Flush Rate (gpf)	Marked China Flush Rate (gpf)	Timed Flush Num. Sec.	Calc. Rate (gpm)	NA=No Action R=Replace M=Maint.	Leaks? Other Comments

Commercial urinal flush valves flush at approximately 15 GPM (0.25 gallons per second)

High efficiency standards: Toilets 1.28 gpf; Lavatory Faucets: 0.5 gpm; Res. Kitchen Faucets: 1.5 gpm; **Urinals: 0.5 gpf**; Showerheads: 2.0 gpm.

Be sure to indicate individual fixtures in group lavatories as in: Toilet 1, Toilet 2, etc. Suggested methods include initiating a count at "A" or "1" with the fixture closest to the door or beginning to the left upon entering the room.

General use assumptions: people in commercial facilities use restrooms three times per day (males use urinals twice per day and toilets once, females use toilets three times per day), each toilet or urinal use is accompanied by faucet use, half of all visitors to a facility will use a lavatory, all fixtures within a single lavatory are assumed to be used equally each day, and all lavatory use in a facility is distributed equally.

	URINALS - BEST MANAGEMENT PRACTICES
1	**Test and calibrate all automatic and sensor-flushing devices regularly to prevent double/phantom flushes.**
2	Replace old flushing urinals with WaterSense labeled models flushing at 0.5 GPF or less.

RESIDENTIAL-GRADE APPLIANCES - WORKSHEET

DISHWASHER		Low Temp.		High Temp.				
Location		Make/Model	Quantity	Racks washed per day	Building hot water fuel type	Booster water heater fuel type	Operating days per year	ENERGY STAR Qualified?
	Under Counter							
	Door Type							
	Single Tank Conveyor							
	Multi-Tank Conveyor							
Leaks or other comments:								

ICE MACHINE							
Location		Make/Model	Quantity	Havest rate (pounds ice per day)	Potable water use (gallons per 100 pounds of ice)	Operating days per year	ENERGY STAR Qualified?
	Ice Making Head						
	Remote Condensing Unit/Split System						
	Self Contained Unit						
Leaks or other comments:							

CLOTHES WASHER							
Location	Water heat source	Make/Model	Quantity	Average number of loads per week	Type of clothes dryer	Electric or gas dryer	ENERGY STAR Qualified?
	Electric Heat						
	Gas Heat						
Leaks or other comments:							

Table 6. Gallons per use of common residential indoor water fixtures and appliances.

	Toilets (per flush)		Shower-heads (per min.)	Faucets (per min.)	Urinals (per flush)	Dish-washers[1] (per load)	Clothes Washers[1] (per load)
	Tank	Flush Valve					
Pre 1984	5.0 – 7.0	5.0 – 7.0	5.0 – 8.0	4.0 – 7.0	5.0	14	56
1984 – 1994	3.5 – 4.5	3.5 – 4.5	2.75 – 4.0	2.75 – 3.0	1.5 – 4.5	10.5 – 12	39 – 51
Post 1994[2]	1.60	1.60	2.5	2.5	1.0	10.5	27[3]
WaterSense[4] Maximum	1.28	–	2.0	1.5	0.5	–	–
Highest Efficiency	0.8 – 1.0	1.28	1.2 – 1.5	0.5 – 1.0	0[5] – 0.125	4.5 – 6.5	16 – 22

1. Residential
2. Current federal standard for all fixtures; dishwashers and clothes washers are not covered
3. Post 1998
4. See page 19
5. Waterless urinals are only recommended under specific conditions

Table 7. Comparison of water and energy use, consumption, and cost of standard and efficient ice machines[1]

Performance	Standard Water-Cooled Model	Standard Air-Cooled Model	Energy and Water Efficient Air-Cooled Model
Energy Consumption (kWh/100 lbs ice)	6	7.6	5.6
Water Consumption (gals/100 lbs ice)	156	28	20
Annual Energy Use (kWh)[2]	9,855	12,483	9,198
Annual Water Use (gals)[2]	256,230	45,990	32,850
Annual Energy Cost[3]	$986	$1,248	$920
Annual Water & Sewer Cost[4]	$1,713	$307	$220
Total Annual Utility Cost	$2,699	$1,555	$1,140

Source: Food Service Technology Center, 2011

1. Assumptions are 550 pound capacity machine versus Tier III ENERGY STAR certified model
2. Annual energy use based on 75% duty cycle, 365 days per year
3. Energy costs based on $0.10/kWh
4. Water and sewer costs are based on $2 per ccf and $3 per ccf, respectively.

	RESIDENTIAL-GRADE APPLIANCES - BEST MANAGEMENT PRACTICES
1	**Only wash full loads of laundry.**
2	**Program clothes washers to use the lowest amount of water, detergent, and chemicals necessary.**
3	Evaluate wash cycles and detergent/chemical formulation for maximum efficiency (least number of wash and rinse cycles).
4	Replace old single-load clothes washers with ENERGY STAR certified models or consider a lower water factor when purchasing larger commercial or industrial-sized laundry machines.
5	Regularly check faucets, dishwashers, steam equipment, and other kitchen equipment for leaks.
6	Eliminate or replace ice machines that are cooled with single-pass cooling water; retrofit to distribute chilled water or use an air-cooled model instead.
7	**Regularly clean coils on the heat exchange unit of an ice machine to maintain efficiency.**
8	Match ice shape and quality to desired uses; use equipment that makes flakes instead of cubes whenever possible.
9	Clean ice machines periodically to remove lime and scale build up and sanitize them to kill bacteria and fungi.
10	Install a timer to shift ice production to nighttime or off-peak hours to reduce peak energy demand.
11	Set ice machine rinse cycles to the lowest possible frequency to provide sufficient ice quality; if available, use a sensor to initiate rinse cycle based on mineral content.
12	**Keep lids closed to keep cool air inside ice machines and maintain appropriate temperature.**
13	Replace old ice machines with ENERGY STAR certified models.
14	Efficient ice machines should use 20 gallons per 100 pounds of ice.

COMMERCIAL-GRADE APPLIANCES - WORKSHEET

DISHWASHER		Low Temp.		High Temp.				
Location		Make/Model	Quantity	Racks washed per day	Building hot water fuel type	Booster hot water fuel type	Operating days per year	ENERGY STAR Qualified?
	Under Counter							
	Door Type							
	Single Tank Conveyor							
	Multi-Tank Conveyor							
Leaks or other comments:								

ICE MACHINE							
Location		Make/Model	Quantity	Havest rate (pounds ice per day)	Potable water use (gallons per 100 lbs ice)	Operating days per year	ENERGY STAR Qualified?
	Ice Making Head						
	Remote Condensing Unit/Split System						
	Self Contained Unit						
Leaks or other comments:							

STEAM COOKER								
Location		Make/Model	Quantity	Pounds cooked per day per unit	Number of pans per unit	Operating hours per day	Operating days per year	ENERGY STAR Qualified?
	Electric							
	Natural Gas							
Leaks or other comments:								

COMBI OVEN						
Location		Make/Model	Quantity	Operating hours per day	Operating days per year	Pounds cooked per day per oven
	Electric Heat					
	Gas Heat					
Leaks or other comments:						

CLOTHES WASHER							
Location	Water heat source	Make/Model	Quantity	Average number of loads per week	Type of clothes dryer	Electric or gas dryer	ENERGY STAR Qualified?
	Electric Heat						
	Gas Heat						
Leaks or other comments:							

	COMMERCIAL-GRADE APPLIANCES - BEST MANAGEMENT PRACTICES
1	**Only wash full loads of laundry.**
2	**Program clothes washers to use the lowest amount of water, detergent, and chemicals necessary.**
3	Evaluate wash cycles and detergent/chemical formulation for maximum efficiency (least number of wash and rinse cycles).
4	Retrofit clothes washers with water reuse or recycling systems.
5	Retrofit clothes washers with ozone injection systems.
6	Replace old single-load clothes washers with ENERGY STAR certified models or consider a lower water factor when purchasing larger commercial or industrial-sized laundry machines.
7	Regularly check faucets, dishwashers, steam equipment, and other kitchen equipment for leaks.
8	Eliminate or replace ice machines that are cooled with single-pass cooling water; retrofit to distribute chilled water or use an air-cooled model instead.
9	**Regularly clean coils on the heat exchange unit of an ice machine to maintain efficiency.**
10	Match ice shape and quality to desired uses; use equipment that makes flakes instead of cubes whenever possible.
11	Clean ice machines periodically to remove lime and scale build up and sanitize them to kill bacteria and fungi.
12	Install a timer to shift ice production to nighttime or off-peak hours to reduce peak energy demand.
13	Set ice machine rinse cycles to the lowest possible frequency to provide sufficient ice quality; if available, use a sensor to initiate rinse cycle based on mineral content.
14	**Keep lids closed to keep cool air inside ice machines and maintain appropriate temperature.**
15	Replace old ice machines with ENERGY STAR certified models.
16	Efficient ice machines should use 20 gallons per 100 pounds of ice.
17	Load steam cookers, steam kettles, and combination ovens to capacity; only use as many compartments as needed.
18	**Keep doors closed and lids secured on all steam equipment while in operation.**
19	Replace gaskets and tighten hinges on steam equipment doors to provide a good seal to retain heat or steam.
20	**Use steam and combi-mode sparingly; maximize the use of hot air or convection mode.**
21	**Turn ovens, cookers, and kettles off or down at slow times or when not in use; use a timer to return to standby mode after use; use standby mode only when necessary.**
22	Consider using a condensate return system to reduce potable water needed for make-up water in boiler-based equipment.
23	Switch to connectionless combination ovens, steam cookers, and steam kettles whenever possible.
24	Routinely check equipment cooling water lines for leaks corrosion; inspect shutoff valves to ensure they are properly functioning.
25	Replace old steam cookers and combination ovens with ENERGY STAR certified models.
26	Replace old water-cooled wok stoves with waterless models.
27	**Load dischwashers to capacity before running.**
28	Run dishwasher close to or at the minimum flow rate and rinse cycle time recommended by the manufacturer; verify that the final rinse pressure and water temperature are within manufacturer recommendations.
29	Ensure manual fill valves close completely after the wash tank is full. Ensure valves and rinse nozzles are inspected and repaired periodically.
30	For conveyor-type dishwashing machines, ensure the rinse bypass drain is adjusted so the wash tank is properly replenished during dishwashing operation.
31	Install wash curtains to retain heat in conveyor-type dishwashing machines; operate conveyor-type machines in auto-mode to save energy.
32	Replace old dishwashers with ENERGY STAR certified models.
33	Conveyor-type dishwashers are run only when dishes ar on the belt (sensors can be installed to ensure this).
34	Carpet cleaning uses dry methods (e.g. powder or steam).

COMMERCIAL-GRADE FIXTURES - WORKSHEET

Flow Measurement Container (circle one): Cups / Pints / Quarts / Flowbag

Location	Hand Faucet	Pre-Rinse Spray Valve	Marked Flow Rate (gpm)	Timed			Leaks? Comments
				Num. Cups/ Pints/ Quarts	Num. Secs.	Calc. Rate or Flowbag (gpm)	

It is not recommended to retrofit pot filling faucets with low flow fixtures.

	COMMERCIAL-GRADE FIXTURES - BEST MANAGEMENT PRACTICES
1	**Shut down or use standby mode for all continuous flow equipment between uses.**
2	Install automatic shutoffs so water doesn't run when garbage disposal or faucets are not in use.
3	**Do not use running water to melt unwanted ice or thaw frozen food; instead thaw frozen food in a refrigerator, microwave, or water bath**
4	**Install aerators on all kitchen handwashing sinks.**
5	Regularly check faucets, dishwashers, steam equipment, and other kitchen equipment for leaks.
6	Install in-line flow restrictors to reduce dipper wells' flow rate to 0.3 GPM or less.
7	Install a push-button, metering faucet, or undercounter dishwasher to clean utensils instead of using dipper wells.
8	**Train employees to use always-on clamps on pre-rinse spray valves only when necessary; encourage employees to report leaks and broken/loose parts.**
9	Replace old, inefficient pre-rinse spray valves with WaterSense labeled models, which flow at 1.28 GPM or less. Retrofitting pre-rinse spray valves can be one of the most cost-effective retrofits.
10	**Hand scrape food from dishes or install food strainers, and use the scraps to compost food waste.**
11	**Turn off water to food disposal systems during idle periods and when the kitchen is closed; consider installing a timer to stop the flow after 15 minutes, so users must reactivate it periodically.**
12	**Operate disposal systems to only run cold water to minimize hot water and energy use.**
13	Retrofit disposal systems with load sensors that regulate water use based on the disposal motor's load. This can reduce idle flow rates.
14	Replace food disposals with food pulpers or strainers to minimize water use.
15	Extract and recirculate water within the food disposal system to use for pre-rinsing dishes, or use in a sluice trough instead of potable water.
16	Ensure wash-down sprayers have a self-closing nozzle and are shut off when not in use.
17	**Use a broom or mop instead of a wash-down sprayer to clean floors when possible. Use pressure washers or water brooms when water is needed.**

COOLING TOWER - BASIC AUDIT WORKSHEET

Cooling Tower General Observations

1) Cooling tower location
2) Tons of cooling capacity (if known)
3) Are flow meters or submeters present on feedlines (circle one)? YES / NO
4) Are flow meters or submeters present on drainlines (circle one)? YES / NO
5) Is the tower a closed loop (not once through) (circle one)? YES / NO
6) At how many cycles is the tower currently run at?
(you may have to consult with your maintenance vendor). _____

7) Looking at Table 14 (below), what percentage of total water use would be saved if the cycles of concentration were increased from the current level to five or six? _____
8) Inidicate the visible condition of the cooling tower:

	None	Very little*	Some	A lot	Where?
Noticeable leaks					
Noticeable corrosion					
Mineral precipitate scaling on the heat exchangers, condenser tubes, or elsewhere					
Algae or slime (biofouling)					
Drift (misting)					

*This would account for a small amount at the interface where the air hits the corrugated heat exchangers, condenser tubes, etc.

Table 14. Water savings from increased concentration ratios in cooling towers.

Before Increasing Cycles	Concentration Ratio After Increasing Cycles											
	2	3	4	5	6	7	8	9	10	12	15	20
1.5	33%	50%	56%	58%	60%	61%	62%	63%	63%	64%	64%	65%
2		25%	33%	38%	40%	42%	43%	44%	44%	45%	46%	47%
3			11%	17%	20%	22%	24%	25%	26%	27%	29%	30%
4				6%	10%	13%	14%	16%	17%	18%	20%	21%
5					4%	7%	9%	10%	11%	13%	14%	16%
6						3%	5%	6%	7%	9%	11%	12%
7							2%	4%	5%	6%	8%	10%
8								2%	3%	5%	6%	8%
9									1%	3%	5%	6%
10										2%	4%	5%
12											2%	4%
15												2%

Increases are expressed as a percentage of total cooling tower water use (Vickers 2001).

Cooling towers often represent the largest use of water on a campus, most of which is due to evaporation and cannot be avoided (2.4 gallons per minute per 100 tons of operating load for every 10 degrees of cooling capacity)

COOLING TOWER - ADVANCED AUDIT WORKSHEET

Table Set 1: Use if the cooling tower is equipped with makeup and bleed-off meters.

1. Enter average or typical load in tons	
2. Enter hrs/day of operation	
3. Enter days/month operation	
4. Enter the percent reduction in water consumption that would occur if the concentration ratio was increased from the current level to at least five (see Table 14 on 'Cooling Tower - Basic Audit' sheet).	

Meter Data Input Table

Water Consumption Calculations	Date	Time	Hours between readings		Make-up meter reading	Bleed-off meter reading
Day 1				Begin		
				End		
Day 2				Begin		
				End		
Day 3				Begin		
				End		

Table Set 2: Use if the cooling tower is equipped with conductivity meters or another means to calculate dissolved solid concentrations in make-up and bleed-off water.

1. Enter tons of cooling	
2. Enter hrs/day of operation	
3. Enter days/month operation	
4. Enter the percent reduction in water consumption that would occur if the concentration ratio was increased from the current level to at least five (see Table 14 on 'Cooling Tower - Basic Audit' sheet).	

Water Consumption Calculations	Date	Make-up concentration (TDS)	Bleed-off concentration (TDS)

Cooling towers should be sub-metered to avoid paying unnecessary sewer charges. Sub-meters cost $1,800-$4,500 and can have a payback period of less than one year.

BOILER - WORKSHEET

Reference EPA WaterSense at Work - Boiler section.

	MECHANICAL SYSTEMS - BEST MANAGEMENT PRACTICES
1	Eliminate all instances of single-pass cooling. Inventory all mechanical systems and mark the equipment that uses single-pass cooling: - point-of-use chillers or other refrigeration systems - condensers, air compressors, air conditioners - hydraulic equipment, degreasers, welding machines - vacuum pumps - CAT scanners, X-ray equipment - ice machines - steam sterilizers - wok stoves - boilers
2	Use the minimum flow rate required to cool all mechanical systems as recommended by the manufacturer.
3	Install solenoid valves to shut off single-pass cooling water when equipment is off.
4	**Regularly check operation of water control valves so cooling water only flows when heat load needs to be removed.**
5	**Clean coil loops to maximize heat exchange.**
6	Retrofit systems to reuse cooling water with an air-cooled point-of-use chiller or by connecting to an existing recirculating chilled water or cooling tower water loop.
7	Take advantage of energy-efficiency measures wherever possible to reduce the cooling load on cooling towers and chilled water systems.
8	Install and monitor flow meters on the make-up and blowdown lines of cooling towers, boilers, and chilled water systems.
9	Hire a treatment vendor with knowledge of water-efficient operation to monitor cooling tower and boiler chemistry and maximize cycles of concentration.
10	Install a control system to control chemical feed and initiate blowdown based on conductivity.
11	Clean conductivity meters and probes monthly to reduce unneccesary blowdown.
12	Regularly maintain and clean chillers, air handler coils, heat exchangers, condensers, and evaporator coils to prevent scale, biological growth, and sediment buildup.
13	Properly insulate all piping, chillers, and storage tanks.
14	**Read conductivity meters and make-up and blowdown flow meters regularly to create a detailed log of quantities, conductivity, and cycles of concentration to identify performance problems and make adjustments.**
15	**Include water efficiency requirements in contracts and service agreements with water treatment vendors.**
16	Ensure water discharged to the sewer meets allowable water quality standards.
17	Read all water chemistry reports produced by water treatment vendor to ensure conductivity and cycles of concentration are within target ranges.
18	Regularly check and maintain boilers, steam lines, and steam traps.
19	Check steam and hot water lines for leaks regularly.
20	Inspect and clean boiler water and fire tubes regularly.
21	Recover steam condensate for other uses when possible.
22	Temper hot condensate by using expansion tanks rather than adding water to cool it before it is discharged to the sewer.
23	Cooling towers are set to shut down during off-hours (typically 21:30 - 05:00 for an 08:00 - 18:00 workday)
24	Consider the use of side-stream filtration on cooling tower.

POOL - WORKSHEET

Reference EPA WaterSense at Work - Pool and Spa section.

	POOL - BEST MANAGEMENT PRACTICES
1	**Avoid heating pools above 79°F to minimize evaporation.**
2	Use pool covers or liquid barriers to control evaporation loss.
3	Reduce water losses from splashing by maintaining the water level a few inches below the top of the pool.
4	Install a pool gutter and grate system along the edges of the pool to reduce losses from splashing and drag-outs.
5	**Monitor water levels in pools regularly - if a pool is losing more than 2" per week, a leak is likely present.**
6	Maintain proper pool chemistry to limit pool cleaning and drainage events.
7	Refill pool only when needed.
8	Promptly repair any leaks.
9	Maintain a clean pool to reduce the frequency of backwashing filters.
10	Identify alternative uses for backwash water when chlorine levels are sufficiently low (i.e. <3 ppm chlorine).
11	Overflow drains should be plumbed back into the recirculation system.
12	Turn off unnecessary waterfalls and fountains when not needed.
13	Use plants and fences to reduce wind evaporation.

METRO CONSERVATION DISTRICTS

CAMPUS GROUNDWATER CONSERVATION PLANNING

IRRIGATION SYSTEM - BASIC AUDIT WORKSHEET

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Permitted Irrigation (Hours)							
Current Setting (Hours)							

Is the current run schedule in accordance with local permitted watering days? YES / NO

Zone/Station Number	Type of Head (rotor, spray, micro)	Runtime Duration (minutes)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

Zone/Station Number	Type of Head (rotor, spray, micro)	Runtime Duration (minutes)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

Zone/Station Number	Type of Head (rotor, spray, micro)	Runtime Duration (minutes)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

Zone/Station Number	Type of Head (rotor, spray, micro)	Runtime Duration (minutes)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

SITE MAP

Attach site map showing campus with irrigation system layout.

RAIN AND SOIL MOISTURE SENSOR SURVEY WORKSHEET

Rain Sensor Survey - Basic Audit		
Rain sensors should not be located under anything which could impede rainfall or allow water from sources other than rain to fall upon it.		
The cork should be fresh and spongy. They typically last between two and three years. The wires should be connected, unfrayed, and protected from the elements.		
Rain sensor location:		
Is the sensor located away from all building eves, gutter downspouts, trees, or other structures that would impede rainfall?	Yes	No
Is the sensor located close to an air conditioning condensate line or another source of water that may saturate the sensor?	Yes	No
Sensor Visual Inspection		
Does the cork look fresh and soft, not brittle and dry?	Yes	No
Do the wires look intact?	Yes	No
Rain Sensor Survey - Advanced Audit		
Did the sensor successfully interrupt the irrigation event?	Yes	No

Rain Sensor Survey - Basic Audit		
Soil moisture sensors should not be located in an area where rainfall could be impeded or where water from a source other than rain could cause soil moisture in the immediate area to increase.		
Soil moisture sensors should be located near the mid-point of any on-site slope in an open area among vegetation with the highest watering requirements.		
Soil moisture sensors should be located equidistant from sprinkler heads.		
Soil moisture sensor location:		
Is the sensor located away from all building eves, gutter downspouts, trees, or other structures that would impede rainfall?	Yes	No
Is the sensor located close to an air conditioning condensate line or another source of water that may saturate the sensor?	Yes	No
Is the sensor located at or near the mid-point of an on-site slope?	Yes	No
Is the sensor located equidistant from the closest group of sprinkler heads?	Yes	No
Soil Moisture Sensor Survey - Advanced Audit		
Did the sensor successfully interrupt the irrigation event?	Yes	No

All 'No' responses should be reviewed for corrective action.

	IRRIGATION SYSTEM - BEST MANAGEMENT PRACTICES
1	Install WaterSense labeled weather-based irrigation controllers or consider irrigation controllers with rain or soil moisture sensors instead of setting clock timers to water.
2	Use drip irrigation to water plant beds, trees, and shrubs.
3	Ensure irrigation schedule is appropriate for climate, soil conditions, plant materials, grading, and the season.
4	Have an irrigation professional certified by a WaterSense labeled program conduct a full audit of the irrigation system every three years.
5	**Inspect and repair all irrigation system parts and components regularly as part of standard maintenance procedures. Repair all broken sprinkler heads immediately.**
6	**Check the position and location of sprinkler heads to ensure they are working properly and water is not being directed onto non-landscaped areas, such as sidewalks.**
7	**Visually inspect the landscape for water pooling or puddling regularly to prevent damage to plants from overwatering.**
8	**Don't "Set It and Forget It"; adjust irrigation schedules frequently to reflect actual site conditions, including climate, soil conditions, plant materials, grading, and the season.**
9	Adjust the intensity and frequency of watering schedules to fit the soil types and landscape features to encourage deep watering and deep root growth for more healthy plants.

METRO CONSERVATION DISTRICTS

CAMPUS GROUNDWATER CONSERVATION PLANNING

IRRIGATION AND LANDSCAPE FIELD AUDIT WORKSHEET

	Irrigation Need	If Tree/Shrubs			General Plant Type		Sprinkler Types				Sprinkler Functionality	
Note	1	2-4			5		6-8				9	
Zone	Does this zone need irrigation?	Trees/ shrubs recently installed?	Is there adequate mulch (3")?	Is micro-irrigation used?	Turf, annual/ perennial, or trees/ shrubs	More than one plant type in zone?	Indicate type: rotor, sprayhead, or micro	All same type throughout zone?	All same brand throughout zone?	Sprinkler type matches plants?	Indicate clogged, tilted, obstructed, or broken heads	Wetting pattern covering only the intended area?
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												

IRRIGATION AND LANDSCAPE FIELD AUDIT WORKSHEET

	Prudent use of turf?		Plants in plantbeds	
	10			
Zone	Does the zone contain turf?	If turf is present, does it serve a purpose (e.g. swale, recreation, erosion control)?	Do all plants in this zone have similar light and irrigation needs?	Additional Notes
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

Irrigation and Landscape Cheat Sheet

The notes below correspond to a line on the Irrigation and Landscape Audit Worksheet indicated by the number preceding each notation.

This cheat sheet is not meant to take the place of the Post-Audit sections of the Irrigation and Landscape audit procedures. It is meant to serve as a quick reference. The Post-Audit sections of each relevant procedure should be reviewed after conducting the survey.

In general, you will be investigating the most basic settings of the controller as well as the landscape plantings and irrigation hardware in each zone. **Although presented separately for descriptive purposes, you will be performing more than one audit procedure concurrently (by default) as you survey each zone.** For this reason, the irrigation and landscape worksheets have been combined for your convenience.

1- Zones or parts of zones that may not necessitate irrigation include areas with mature trees and shrubs, areas not used, viewed or visited by facility staff or the general public, such as a narrow, non-traffic alleyway or an area behind a dumpster etc. Be sure to investigate the watering needs of small shrubs before removing them from the irrigation system.
2- Zones with annual or perennial plants should have approximately 3 inches of mulch; zones dominated by trees/shrubs may also benefit from a mulch layer.
3- If they are mature or were installed more than one year ago, they may not require irrigation. This zone should be further evaluated for removal from the irrigation system.
4- Microirrigation is the only class of sprinkler which should be used for annuals, perennials, trees and shrubs.
5- There should be only type one per zone. The three 'General' plant types are: turfgrass; annuals/perennials; trees/shrubs.
6- Rotors and sprayheads should be used for lawns or turfgrass (sprayheads are not recommended for irrigation of plants and shrubs); only microirrigation should be used for plants and shrubs. See the next page for photos of each.
7- There should be only one.
8- Matched brands are more likely to have matched application rates.*
9- If the emitters are spraying impervious areas or structures, they should be adjusted to maintain patterns covering only the landscaped material.
10- Turfgrass has high irrigation requirements. It should be used to fulfill needs such as recreational areas or in swales, etc. and should not be used as a space filler.
11- Rain sensors should not be located under anything which could impede rainfall or allow water from source other than rain to fall upon it.
12- The cork should be fresh and spongy. They typically last between two and three years. The wires should be connected, unafraid, and protected from the elements.
13- Soil moisture sensors should not be located in an area where rainfall could be impeded or where water from a source other than rain could cause soil moisture in the immediate area to increase.
14- Soil moisture sensors should be located near the mid-point of any on-site slope in an open area among vegetation with the highest watering requirements.
15- Soil moisture sensors should be located equidistant from sprinkler heads.

* Irrigation sprinklers do not always clearly indicate their flow rate in gallons per minute. Determining the precipitation rate of installed sprinklers requires a high level of familiarity with irrigation equipment or requires substantial time and effort for research. This is not part of this simplified audit. Instead, check all sprinkler heads in the zone to ensure they are the same type (rotor, spray, or micro) and the same brand. While being the same type and brand does not necessarily indicate uniformity of precipitation rate, more than one type or brand in a zone most likely means water is delivered unevenly.

(Continued on next page)

	LANDSCAPING AND IRRIGATION - BEST MANAGEMENT PRACTICES
1	Plant native or drought-tolerant species.
2	Use mulch (3") around trees and plant beds.
3	Hire landscape professionals trained and certified in water-efficient or climate-appropriate landscaping.
4	**Incorporate water, chemical, and energy-efficient requirements/performance standards into all landscape and irrigation service and maintenance agreements.**
5	Maintain 4" to 6" of good topsoil to capture and release precipitation back to plants over time.
6	Balance soil composition with topsoil or compost to restore the soil's water holding capacity and proper drainage.
7	**Remove weeds from any irrigated landscape so water is available for the desired landscaping; pull weeds manually instead of using herbicides.**
8	**Raise the blade on mowers to allow grass to grow longer and more drought-resistant.**
9	**Consider letting turfgrass turn brown during dry periods if the species will recover when rainfall returns.**
10	Plant additional trees and shrubbery to increase the amount of shaded area.
11	Limit the use of turfgrass to areas with functional purposes (e.g. erosion control, recreation, etc.).
12	Avoid installing "strip grass" or small, disconnected patches of grass, which are hard to maintain and difficult to water efficiently.
13	Group plants with similar irrigation needs together so they can be watered effectively using the technique of hydrozoning.
14	Substitute water from alternative sources for irrigation and decorative water features instead of using potable water.
15	Recirculate water in decorative fountains, ponds, and waterfalls and consider using non-potable water in these systems.
16	**Shut off water features when possible to reduce evaporation losses and check water recirculation systems annually for leaks and other damage.**
17	**Do not hose down sidewalks, driveways, parking lots, tennis courts, pool decks, or other hardscapes; sweep these areas instead, or use a water broom for greater time and water efficiency.**

ONSITE ALTERNATIVE WATER USE/REUSE OPPORTUNITIES - WORKSHEET

Location	Type	Notes

	ONSITE ALTERNATIVE WATER USE - BEST MANAGEMENT PRACTICES
1	Explore all alternative sources of water to be used in place of potable water and mark which are available at your facility: - Rainwater/stormwater - Air handler condensate - Boiler condensate - Water from single-pass cooling equipment - Cooling tower blowdown - Onsite treated graywater and wastewater - Water treatment system reject water - Fountain drainwater
2	Use onsite alternative water for irrigation, cooling tower make-up, toilet and urinal flushing, fume hood scrubbers, and other uses not requiring potable water.
3	Match alternative water sources with the expected uses and verify that the sources will provide consistent water supply and quality.
4	Collect rainwater to irrigate landscapes (where rainwater harvesting is allowed).
5	Use air handler condensate as cooling tower make-up to offset potable water use where possible.
6	Recycle rinse water in dishwashers and clothes washers whenever possible (e.g. the last rinse water becomes the next load's wash water).

GROUNDWATER RECHARGE OPPORTUNITIES - WORKSHEET

Location	Type	Notes

	OTHER OUTDOOR - BEST MANAGEMENT PRACTICES
1	All hoses have self-cancelling shut-off handle valves.
2	Wash vehicles only when needed and on permeable surfaces.
3	Vehicle washing done "as required", not on a schedule.
4	Window cleaning done "as required", not on a schedule.

	LABORATORY AND MEDICAL EQUIPMENT - BEST MANAGEMENT PRACTICES
1	**Only purify water when necessary. Treat water to a quality that matches the process requirements.**
2	Program water purification regeneration based on the incoming water hardness and/or flow through the system.
3	Turn off vacuum pumps and steam sterilizers when not in use and program them to only discharge the amount of water necessary to remove impurities and cool the unit.
4	Adjust the tempering water needle valve flow rates to the minimum manufacturer recommendations; change needle valves annually.
5	Install thermostatically actuated valves to control the flow of cooling water for steam sterilizer condensate discharge.
6	Replace old steam sterilizers and vacuum pumps with newer models that do not use single-pass cooling or condensate discharge tempering water.
7	Ensure that water flow rates in fume hoods do not exceed manufacturer specifications and recirculating systems do not blowdown or overflow unnecessarily.
8	Replace old fume hoods with a filtration system that does not require water (e.g. activated carbon).
9	Inspect and repair worn cage-and-rack washer valves and rinse nozzles.
10	**Run glassware and cage-and-rack washers only when full.**
11	Ensure that water flows in film processors at the minimum acceptable rate specified and is turned off when the unit is not in use.
12	**Check solenoid valves regularly to ensure flow is stopped when equipment is in standby mode.**
13	Convert traditional film equipment to digital X-ray equipment.

The laboratory section in the EPA WaterSense at Work manual includes additional information.

FACILITY WATER BALANCE - WORKSHEET

Water Use	Gallons per Month/Quarter/Year
Boiler make-up	
Cooling tower make-up	
Processes and equipment operations	
Steam cleaning	
Materials transport	
Domestic (restrooms, breakrooms)	
Toilets	
Urinals	
Faucets	
Showerhead	
Other faucets (non-lavatory)	
Residential dishwasher	
Commercial-grade kitchen	
Pre-rinse spray valves	
Dishwashers	
Ice machines	
Commerical clothes washers	
Vehicle fleet wash	
Once-through cooling	
Landscape irrigation	
Breakroom water use	
Other:	
Other:	
Other:	
Other:	
Other:	
Other:	
Other:	
Other:	
Known leaks	
Water purchased + well pumpage	

FACILITY WATER BALANCE - BEST MANAGEMENT PRACTICES	
1	**Track water and cost savings over time in ENERGY STAR's Portfolio Manager or another utility management system.**