Water Management Plan

Revision 2

U.S. Environmental Protection Agency
Region 7
Kansas City Science and Technology Center
300 Minnesota Avenue
Kansas City, Kansas 66101

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Point of Contact:
Mr. John Begley, Facilities Manager
913-551-7597

EPA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 7
KANSAS CITY SCIENCE AND TECHNOLOGY CENTER
KANSAS CITY, KANSAS

WATER MANAGEMENT PLAN, REVISION 2

Approved by:

11/19/2014
Mr. John Begley, Facilities Manager — Date

17 Nov 14
Dr. Chris Taylor, EMS Coordinator — Date

11/19/2014
Mr. Michael Davis, Laboratory Director — Date

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1.0 IDENTIFIED WATER CONSERVATION OPPORTUNITIES

In April 2014, a water use and conservation assessment was conducted at the U.S. Environmental Protection Agency's (EPA's) Region 7 Kansas City Science and Technology Center (KCSTC) in Kansas City, Kansas. Under this Water Management Plan, KCSTC will consider implementing the potential water conservation and management opportunities identified during the water assessment, which are summarized in Table 1.

The rest of this Water Management Plan describes KCSTC's water reduction goals, water use trends, end uses of water, completed water efficiency projects, and drought management plans.

2.0 BACKGROUND AND PURPOSE

In 2007, Executive Order (EO) 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, called for federal agencies to reduce water use intensity by 2 percent per year between fiscal year (FY) 2007 and FY 2015 for a total reduction of 16 percent, compared to a FY 2007 baseline. This goal was revised and extended by EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*. EO 13514 calls for reducing potable water use intensity by 2 percent annually through FY 2020, relative to the FY 2007 baseline, for a 26 percent total reduction. Water use intensity is measured in gallons per gross square feet (gsf).

The implementation instructions for water efficiency and management provisions of EO 13514 direct that agencies replacing fixtures or other water-using products should purchase Federal Energy Management Program-designated or WaterSense® labeled products.

In addition to the potable water use reduction requirements, EO 13514 requires agencies to reduce industrial, landscaping, and agricultural (ILA) water use by 2 percent annually or 20 percent by the end of FY 2020, relative to an FY 2010 baseline (including non-potable sources). The EO also directs agencies to identify, promote, and implement water reuse strategies that reduce potable water use.

The Energy Independence and Security Act of 2007 directs agencies to complete comprehensive energy and water evaluations of 25 percent of covered facilities (i.e., those accounting for 75 percent of total energy use) each year; implement cost-effective measures identified through life cycle analyses; and measure and verify water savings.

In summary, existing EOs and federal law require substantial reductions in all forms of water use, as well as ongoing, regular assessments of facility water use to identify and implement saving opportunities.

This Water Management Plan has been developed to document and promote the efficient use of water at KCSTC, so that the facility can contribute to meeting these Agency-wide objectives.

Table 1. Potential Water Conservation Opportunities, KCSTC

Suggested Priority	Project Description	Project Cost	Potential Water Savings (gallons)	Potential Energy Savings (MMBtus)	Potential Utility Cost Savings	Potential Payback (years)
1	Install 0.5 gallon per minute (gpm) faucet aerators on the two 2.2 gpm lavatory faucets on the second floor.	$20	7,000	5	$80	0.3
2	Evaluate and adjust graywater system set points on pressure reducing valves and graywater pressure sensor so graywater is fully utilized when it is available.	$1,600	286,000	N/A	$2,400	0.7
3	Service the central vacuum system and adjust sequence of operations to reduce the amount of water being continuously discharged to the drain.	$9,000	1,060,000	N/A	$9,000	1.0
4	Calibrate or replace cooling tower make-up and blowdown meters in order to obtain sewer deduction credit from the Unified Government of Wyandotte County and Kansas City, Kansas.	$8,000	N/A	N/A	$3,800	2.1
5	Replace existing showerheads with WaterSense labeled models flowing at 1.75 gpm or less.	$120	3,000	2	$30	4.0

3.0 FACILITY INFORMATION

KCSTC houses EPA's Region 7 Laboratory and is focused on environmental monitoring, analytical support, and data assessments. The laboratory contains 71,995 square feet of conditioned space. The building is privately owned and leased by the U.S. General Services Administration (GSA) for EPA through 2023.

KCSTC is a state-of-the-art laboratory facility completed in 2003. Designed and built on a brownfield site with many green and sustainable features, the facility received Gold certification from the U.S. Green Building Council's (USGBC's) Leadership in Energy and Environmental Design (LEED®) for New Construction (Version 2.0).

KCSTC is occupied by approximately 70 employees. The laboratory operates on a flex time schedule and is typically occupied Monday through Friday.

4.0 WATER MANAGEMENT GOALS

KCSTC's resource conservation goals are achieved through the implementation of the Sustainable Facilities Management Program, which is part of the Region 7 Environmental Management System (EMS). The primary objective of this program is to minimize Region 7's

greenhouse gas emissions by maximizing its energy and water efficiency capabilities. Targets established under this objective call for:

- Monitoring energy and water use and, where practical, creating plans and acquiring funding for projects to improve energy and water efficiency; and

- Working with the facility management company to identify and resolve equipment deficiencies that waste energy and/or water.

Although not expressly stated, the desire to achieve a 26 percent water reduction by the end of FY 2020, compared to a FY 2007 baseline, as set forth in EO 13514, is implied in Region 7's objectives and targets for sustainable facilities.

To continue progress toward meeting EO requirements and EMS goals, KCSTC will strive to meet annual facility-specific goals set by EPA's Sustainable Facilities Practices Branch (SFPB) under its ConservW program. These ConservW goals are calculated for each EPA facility based on the facility's previous water use reduction and its potential identified projects.

5.0 WATER USE INFORMATION

KCSTC uses potable water primarily for research, the laboratory vacuum system, and cooling tower make-up. Discussed further in Section 5.3, KCSTC's potable water use has increased since the FY 2007 baseline year. The facility has implemented some suggested water-saving projects from the last Water Management Plan; however, KCSTC should optimize the operation of its vacuum pump and graywater recovery systems to achieve its full water-saving potential. The following sections provide additional details on KCSTC's water use.

5.1 Water Supply

The Kansas City Board of Public Utilities provides KCSTC's potable water service, and the Unified Government of Wyandotte County and Kansas City, Kansas, provides KCSTC's sewer service.

KCSTC does not use any sources of non-potable fresh water, but it does use onsite alternative water sources. KCSTC's graywater reclamation system is used to collect rainwater from a portion of the roof as well as reverse osmosis (RO) reject water. Reclaimed water is stored in a 10,000-gallon tank and is used for toilet and urinal flushing and cooling tower make-up water. The system once collected air handler condensate as well, but the recovered condensate line has since been routed directly to the cooling towers to serve as make-up water.

5.2 Meters and Submeters

Incoming potable water supply is metered. Flow totalizing meters are also installed on many of the major subsystem flows. Meters and submeters include:

- Potable water supply meter to laboratory
- East cooling tower make-up water submeter
- East cooling tower blowdown water submeter

- West cooling tower make-up water submeter
- West cooling tower blowdown water submeter
- North recovered air handler condensate submeter to cooling tower make-up
- South recovered air handler condensate submeter to cooling tower make-up
- Graywater system water use meter
- RO reject water submeter to graywater system

EMS staff record readings weekly from each of these meters and report the results to the Facilities Manager. Water use trends are monitored on an ongoing basis, and unexpected changes in water use are investigated and resolved.

5.3 Historical Water Use

In response to EO 13423, KCSTC set a FY 2007 potable water use intensity baseline of 43.81 gallons per gsf. In FY 2013, water use intensity had increased to 54.33 gallons per gsf—a 24.0 percent increase compared to the FY 2007 baseline. Figure 1 illustrates KCSTC's potable water use intensity from FY 2007 to FY 2013.

As described in Table 2, KCSTC completed three water efficiency projects since FY 2007. One of the major projects included replacing the existing vacuum pump system with a closer loop system. That system needs to be serviced to achieve its true water savings potential.

Figure 1. Annual Water Use Intensity, KCSTC, FY 2007–FY 2013

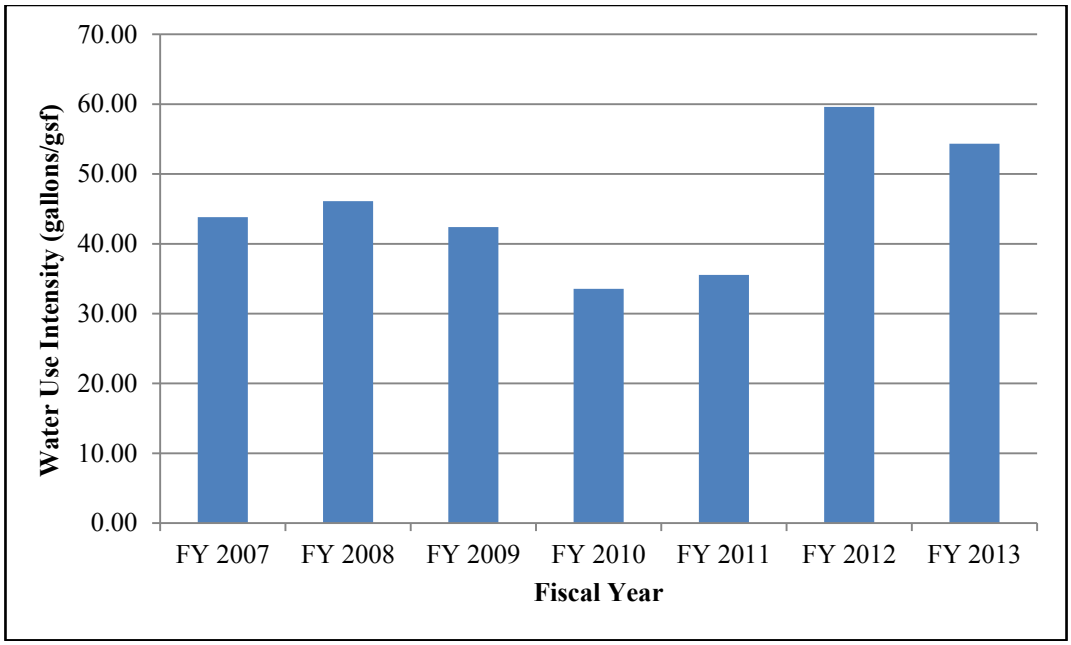


Table 2. Completed Water Efficiency Projects Since FY 2007, KCSTC

Project	Implementation Cost	Estimated Annual Water Savings (gallons)	Completion Year	Additional Notes
Faucet aerators	$160	14,000	FY 2014	KCSTC install 0.5 gpm faucet aerators on most of its faucets in late 2013.
Air handler condensate recovery	$54,000	137,000	FY 2013	KCSTC completed a project to route air handler condensate directly to the cooling tower as make-up water instead of sending it through the graywater reclamation system. Since air handler condensate is a perfectly matched source for the cooling tower's end use, it makes sense to use this water in the cooling tower directly.
Vacuum pump	$57,000	800,000	FY 2009	KCSTC worked with its vacuum pump vendor to install an alternate configuration on the seal water recirculation tank that allowed for almost compete recycle of the seal water. In the new system, water is recirculated through a closed loop, equipped with a liquid-to-liquid heat exchanger to dissipate heat from the seal water. Retrofitting the vacuum pump system with this recovery device was estimated to reduce vacuum pump water use by 90 percent.

5.4 End Uses of Water

Table 3 and Figure 2 describe the end uses of water at KCSTC. Figure 3 provides a graph of KCSTC's monthly potable water use in FY 2013, which illustrates KCSTC's seasonal water use pattern that can be attributed to high cooling tower make-up water use in the summer months. Figure 4 illustrates KCSTC's water use by source.

KCSTC's end uses of water are described in more detail in this section. Potential projects discussed in this section are summarized in Table 1.

Table 3. Major Water Uses, KCSTC, FY 2013

Major Process	FY 2013 Annual Water Use (gallons)	Percent of Potable Water Use (%)	Estimated Utility Costs[a]	Supporting Calculations and Source Documentation
Potable Water Use				
Research and other miscellaneous water uses	1,308,180	31.1	$11,100	Calculated by difference from known total water use and all other calculated water uses.
Vacuum pump seal water	1,260,000	30.0	$10,700	Based on measured flow coming from vacuum pump drain during full flow (4.45 gpm) and reduced flow (0.35 gpm). Flows alternate every 10 minutes, 24 hours per day, 365 days per year. Full flow rate = 4.45 gpm x 30 min/hr x 24 hrs x 365 days = 1,171,000 gallons Reduced flow rate = 0.35 gpm x 30 min/hr x 24 hrs x 365 days = 93,150 gallons.
Cooling tower make-up (potable water)	1,214,100	28.9	$10,300	FY 2013 meter readings.
RO permeate water	133,460	3.2	$1,100	Engineering estimate based on observed 1:1 ratio of RO permeate to RO reject flow.
RO reject water	133,460	3.2	$1,100	FY 2013 meter readings.
Restroom fixtures	130,000	3.1	$1,100	Engineering estimate based on fixtures installed, occupancy, and daily usage factors.
Water-cooled ice machine	19,000	0.5	$200	Engineering estimate based on equipment size.
Kitchenette dishwasher	1,190	0.0	$10	Engineering estimate based on one dishwasher load per work day.
Clothes washer	480	0.0	$4	Engineering estimate based on one load of laundry per month.
Total Potable Water Use	**3,909,320**	100	$35,600	FY 2013 metered total.
Onsite Alternative Water Use				
Recovered air handler condensate (used as cooling tower make-up)	207,400[b]	-	-	FY 2013 metered total.

Table 3. Major Water Uses, KCSTC, FY 2013

Major Process	FY 2013 Annual Water Use (gallons)	Percent of Potable Water Use (%)	Estimated Utility Costs[a]	Supporting Calculations and Source Documentation
Rainwater and RO reject routed through the graywater reclamation system (used for toilet and urinal flushing and cooling tower make-up)	83,150	-	-	FY 2013 metered total.
Total Onsite Alternative Water Use	**290,550**	-	-	Sum of onsite alternative water sources.
Total Water Use	**4,199,870**	**-**	-	Sum of FY 2013 metered totals

[a] Utility costs are calculated using the most current water and sewer rates available. Water rates are determined on a tiered rate structure, depending on monthly use. Based on its average monthly usage, KCSTC is charged $3.28 per hundred cubic feet (ccf) [$4.38 per thousand gallons (Kgal)] for water use between 161 ccf and 2,000 ccf. Sewer charges are assessed based on water use at a rate of $3.05 per ccf ($4.08 per Kgal).

[b] The amount of air handler condensate recovered and directed to the cooling towers may be low because the meter on the south air handler did not capture the flow for the full season. The meter was replaced in July 2013 and is now functioning correctly.

Figure 2. Percentage of Potable Water End Uses, KCSTC, FY 2013

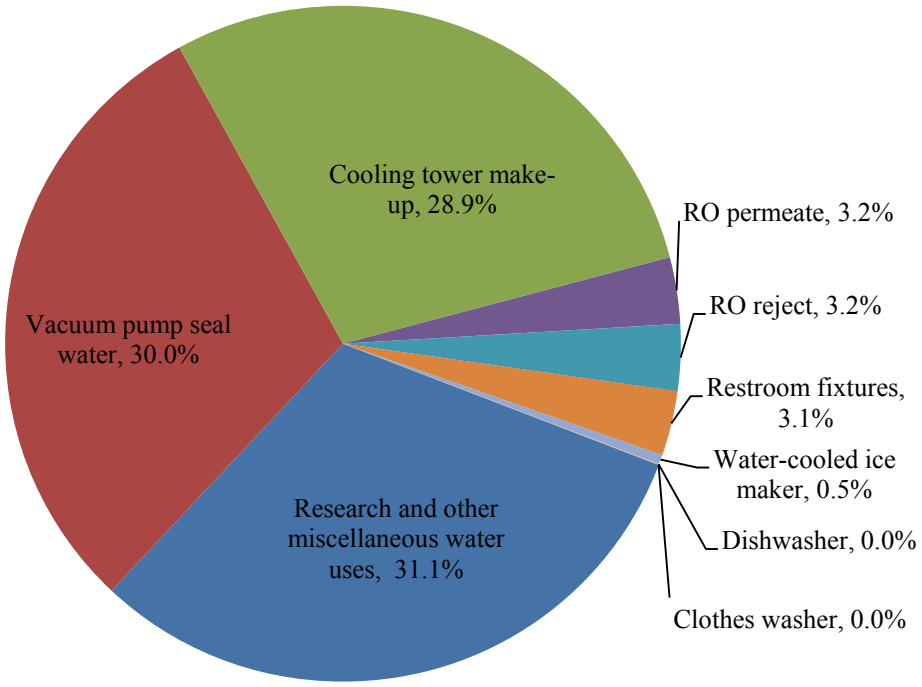


Figure 3. Monthly Potable Water Use, KCSTC, FY 2013

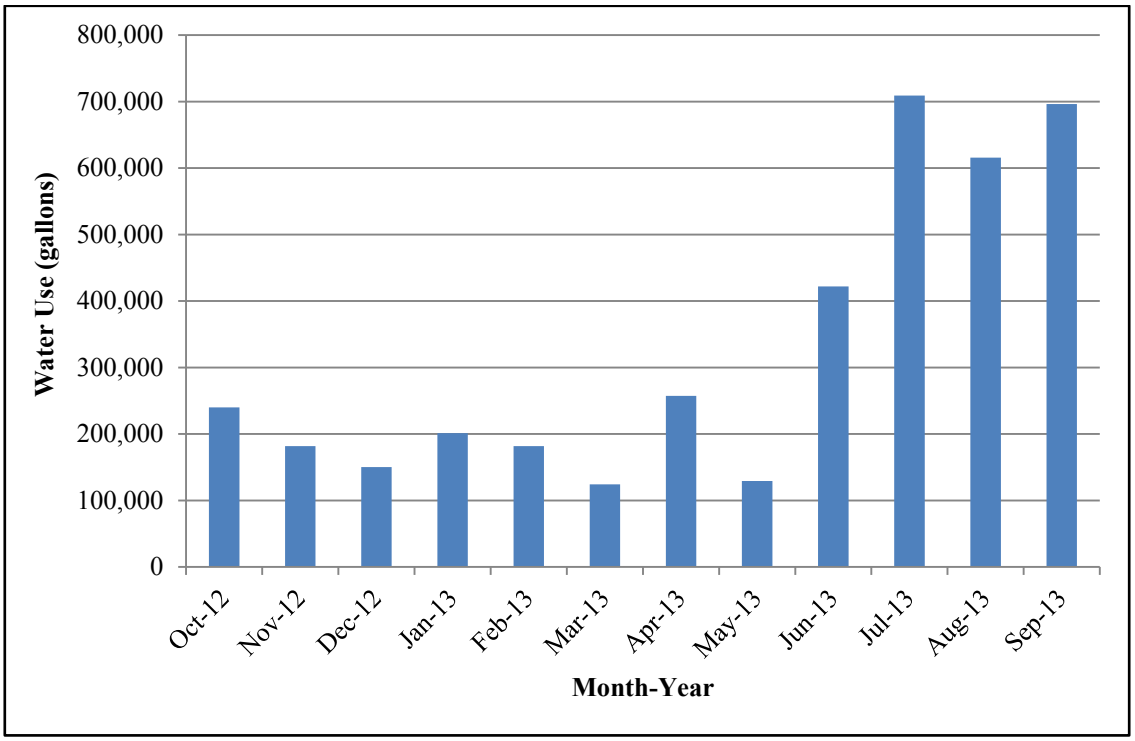
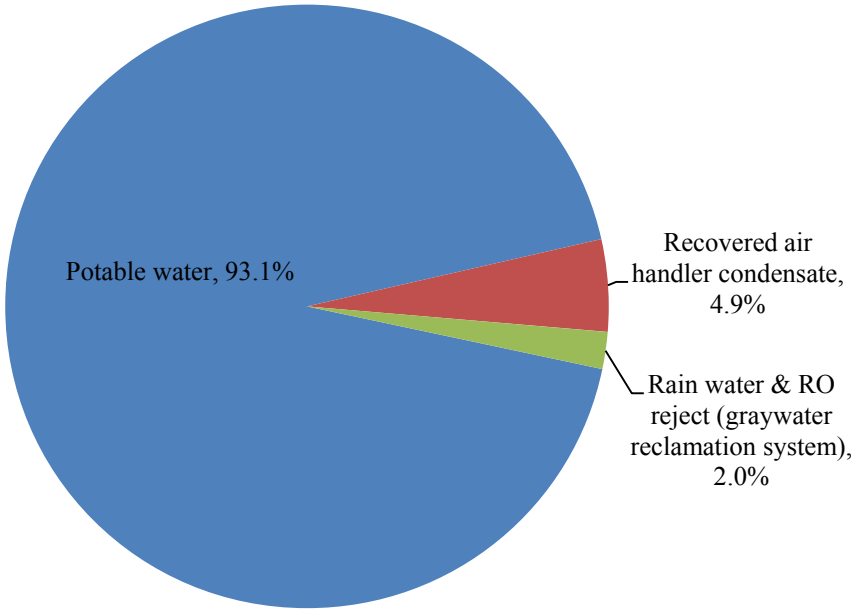


Figure 4. Percentage of Water Use by Source, KCSTC, FY 2013



Research and Other Miscellaneous Water Uses

KCSTC uses approximately one-third of its potable water for research purposes. Water is used as necessary in individual laboratories for bench-scale experimentation and glassware preparation. KCSTC operates three glassware washers. Two of the glassware washers are in Lab L23 and one is in Lab L45. All three glassware washers are Miele Professional model G7825.

Vacuum Pump Seal Water

Almost another third of KCSTC's water use goes to its vacuum pump seal. KCSTC is equipped with a central vacuum system, which generates vacuum using a liquid-ring vacuum pump. KCSTC previously had a pump installed which continuously discharged seal water and added fresh water to dissipate heat and remove impurities. KCSTC replaced this pump in 2008 with a liquid-ring pump with a recovery and recirculation system. Based on the design of this new system, ring water should be collected from the discharge side of the pump and reused. The recirculated water should pass through a heat exchanger, where the heat from the recirculated water is transferred to the building comfort chilled water loop. By design, some water should still be discharged regularly to remove impurities, but this retrofit is estimated to reduce water use by 80 percent.

One constraint on the current system is that it dissipates heat to the building comfort chilled water loop through a heat exchanger, but the comfort chilled water loop is only operational during the cooling season. Therefore, for part of the year, water from the vacuum pump is still discharged to the sewer to dissipate heat.

During the water assessment, it was noted that the vacuum system had a flow of water through it at all times. Based on observations, it was determined that the vacuum pumps alternate on and off every 10 minutes. While the pumps operate, the discharge water flow rate was measured to be approximately 4.45 gallons per minute (gpm). While the pumps are idle, the discharge flow was measured at approximately 0.35 gpm. These alternating flows are occurring 24 hours per day, 365 days per year, and result in approximately 1,260,000 gallons of water use per year. This water use is substantially greater than its anticipated use of approximately 200,000 gallons with the installation of the recovery and recirculation system.

To achieve the expected water efficiency of the vacuum pump, KCSTC should work with the vacuum pump vendor to service the system and adjust the sequence of operations.

Cooling Tower Make-Up

KCSTC's third largest water user is its cooling tower system—using approximately 29 percent of KCSTC's total potable water. KCSTC is equipped with two 700-ton cooling towers. A cooling tower maintenance contractor performs a monthly quality, performance, and water chemistry review of cooling tower operation. Chemical treatment is provided to control scale and corrosion. Conductivity meters on each tower water loop are set at 2,000 microSiemens per centimeter (*u*S/cm) and are used to control blowdown, although the cooling tower typically operates with circulating water at about 1,750 *u*S/cm. City make-up water has a relatively high

dissolved solids load, with a resultant conductivity of 710 *u*S/cm. Therefore, the cooling tower system achieves a relatively low cycles of concentration—approximately 2.6.

Both cooling towers are equipped with make-up and blowdown meters. The meter readings are recorded weekly, and the EMS Coordinator and Facilities Manager monitor trends in cooling tower water use are. Meter readings and trend assessment will continue under this plan. KCSTC is in the process of working with Unified Government of Wyandotte County and Kansas City to pursue a sewer credit for water that is evaporated from the cooling tower. To do so, KCSTC will need to calibrate or replace its cooling tower make-up and blowdown meters.

In July 2013, KCSTC rerouted collected air handler condensate directly to the cooling tower basin as make-up water. The air handler condensate had previously been directed to the graywater reclamation system; however, since condensate is typically generated when the cooling tower requires the most make-up water, the recovery line was rerouted directly to the cooling towers to better match the water source with its desired end use. The collected condensate is metered and readings are recorded weekly. In FY 2013, 207,400 gallons of condensate were collected and used in the cooling tower as make-up water, reducing KCSTC's need for potable make-up water by approximately 15 percent.

To the extent it is available, some cooling tower make-up water is supplied from the collected rainwater and RO reject water in the graywater reclamation system.

Reverse Osmosis Permeate and Reject Water

KCSTC has a RO system that provides purified water to laboratories and water for humidification. The ratio of permeate water to reject water is approximately 1 to 1. The reject water is sent to the graywater reclamation system for reuse as cooling tower make-up or toilet and urinal flushing water.

Restroom Fixtures

Toilets and urinals are compliant with 1992 Energy Policy Act (EPAct 1992) water efficiency requirements [1.6 gallons per flush (gpf) for toilets and 1.0 gpf for urinals]. Flushing water for the toilets and urinals is supplied from the graywater collection system to the extent it is available.

High-efficiency faucets with a maximum flow rate of 0.5 gpm are used on 16 of the 18 lavatory faucets at KCSTC. The 0.5 gpm flow rate is lower than the EPAct requirement for faucets and is compliant with the American Society of Mechanical Engineers/Canadian Standards Association (ASME/CSA) standard for lavatory faucets in public use. This flow rate is sufficient for hand washing and is considered a best practice for lavatory sinks in public settings.

EPAct compliant showerheads (2.0 or 2.5 gpm) are installed in all shower stalls available for use.

Janitorial staff and employees are trained to report leaks or other maintenance problems to the Facilities Manager or operations and maintenance (O&M) staff. Leaks or maintenance problems are corrected immediately.

Table 4 provides an inventory of sanitary fixtures.

Table 4. Restroom Fixtures Inventory, KCSTC

Fixture Type	Flow Rate	Total Number
Toilets	1.6 gpf	22
Urinals	1.0 gpf	6
Lavatory faucets	0.5 gpm	16
	2.2 gpm	2
Showers	2.5 gpm	2
	2.0 gpm	2

To reduce restroom water use, KCSTC should consider installing 0.5 gpm faucet aerators on the remaining two lavatory faucets located on the second floor and should consider replacing existing showerheads with WaterSense labeled models that flow at 1.75 gpm or less.

Water-Cooled Ice Machine

While most of the laboratory equipment at KCSTC is supplied with process chilled water, there is one remaining water-cooled ice machine. The ice machine is a Mantiowac Model QY0325W. When the ice machine reaches the end of its useful life, KCSTC should replace it with an air-cooled model. It is not cost-effective to replace the ice machine based on water savings alone prior to the end of its useful life.

Dishwasher

KCSTC operates a dishwasher within its kitchenette for employee use. The dishwasher is a GE Model GLDT696TSS-00. The dishwasher is operated once per day and accounts for a small amount of water use.

Clothes Washer

KCSTC uses a washing machine to wash laboratory coats. The machine, a Kenmore Model 110.24812200, is ENERGY STAR qualified. It is located in Lab L16. The washing machine is only run once or twice a month; therefore, its water use is negligible.

Onsite Alternative Water Use

KCSTC is equipped with a graywater reclamation system that collects rainwater from 18,000 square feet of the roof and RO reject water. The RO reject water and rainwater are first collected and sent to the graywater system's 1,500-gallon sediment tank. The water is then stored in a 10,000-gallon, pre-cast concrete, fiberglass-lined underground tank just outside the building. A sump pump in the holding tank is used to supply a pressure tank in the mechanical room. When graywater is available to supply and pressurize the pressure tank, the graywater is used for toilet and urinal flushing and cooling tower make-up. When graywater is not available, city water is used to supply the necessary water for these uses.

The system is designed to use graywater preferentially, when it is available, based on a control scheme of pressure reducing valves (PRVs) and a pressure actuated pump on the graywater supply. The set point on the PRV installed on the graywater supply line is intended to be set higher than the set point on PRV on the potable water line, so water will flow preferentially from the graywater supply. However, if there is not a sufficient pressure differential between the two PRVs, water could be supplied simultaneously from both the graywater supply and the potable water supply, or preferentially from the potable water supply.

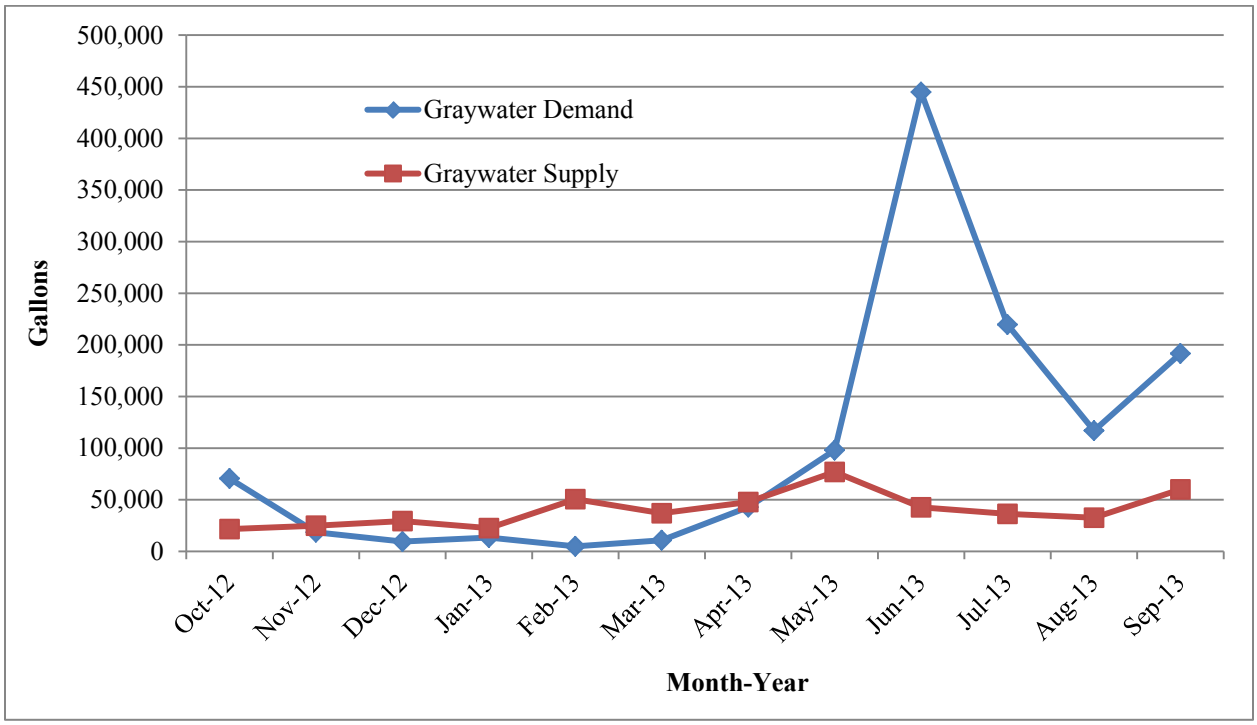
Table 5 provides a water balance for the graywater reclamation system, showing theoretical maximum quantities of graywater that could be recovered from each source and the amount of graywater used within the facility for FY 2013. Note that the source quantities are theoretical maximums—some portions of these quantities, particularly for rain water, will not be recovered when the 10,000-gallon storage tank is full, such as during a high intensity storm event (e.g. any event with greater than 0.9 inches of rain).

Table 5. Graywater Reclamation System Water Balance, KCSTC, FY 2013

Graywater Use (gallons/year)		**Graywater Sources, Theoretical Recovered Quantity (gallons/year)**		
		RO reject	133,460	Based on metered total
		Rain water	348,000	Engineering estimate based on FY 2013 precipitation and roof area
		Excess generation, November to April	(112,000)	Engineering estimate
Total metered use	83,150	**Total**	**369,460**	Sum of recovered quantities

The quantity of graywater used in FY 2013 was less than theoretical data suggest could be recovered. A graphical comparison of theoretical graywater supply to cooling tower and toilet and urinal flushing demand is provided in Figure 5. Note that for warmer months of the year, all captured graywater can be used, primarily because of the high cooling tower make-up demand. However, between November and April, when cooling tower make-up demand is low, some excess graywater is captured that cannot be put to productive use.

Figure 5. Comparison of Graywater Supply and Demand, KCSTC, FY 2013



KCSTC should evaluate and adjust the PRV set points to make sure the graywater system is operating as intended. Additional recommissioning will also ensure that all available, recovered water is being used to the maximum extent practicable.

6.0 DROUGHT CONTINGENCY PLAN

In the event of a drought or other water supply shortage, KCSTC will follow the water use recommendations and restrictions of the Kansas Water Office and the Kansas City Board of Public Utilities. In the event that voluntary or mandatory water conservation reductions are instituted, KCSTC will form a task force of facilities and operating personnel to identify and implement modifications to facility operations to achieve additional specified reductions in water use.

Regional drought conditions and general information on drought management can be found at the Kansas Water Office drought management website: http://www.kwo.org/reports_publications/Drought.htm.