WATER MANAGEMENT PLAN, REVISION 3

EPA Region 7, Kansas City Science and Technology Center, Kansas City, Kansas

Office of Mission Support, Safety and Sustainability Division May 2019

Overview

This plan summarizes the findings and recommendations associated with a water use and conservation assessment conducted at the U.S. Environmental Protection Agency's (EPA's) Region 7 Kansas City Science and Technology Center (hereafter referred to as the STC) located in Kansas City, Kansas. Under this Water Management Plan revision, the STC will consider implementing the potential water conservation opportunities identified during the water assessment, which are summarized in Table 1. The Water Management Plan also describes the facility's water reduction goals, water use trends, end uses of water, drought management plans and stormwater management efforts.

Background

Executive Order (EO) 13834, *Efficient Federal Operations,* Section 2(c) requires agencies to reduce potable and non-potable water consumption in federal facilities and comply with stormwater management requirements. In addition, the Energy Independence and Security Act (EISA) of 2007 directs agencies to complete comprehensive energy and water evaluations for 25 percent of covered facilities (i.e., those accounting for 75 percent of total agency energy use) each year, resulting in each covered facility being assessed once every four years.

Figure 1. Rendering of the Region 7 Kansas City Science and Technology Center.

To achieve greater facility and agency-wide water efficiency and to meet EISA requirements, a water assessment was conducted by the Office of Mission Support, Safety and Sustainability Division (SSD) at the STC April 1 and 2, 2019. Since 2002, the SSD's Sustainable and Transportation Solutions Branch (STSB) has conducted water assessments at EPA-owned and operated laboratories to improve water efficiency and comply with EISA 2007. The assessment team (Praveen KC of the STSB, and Robert Pickering of contractor Eastern Research Group, Inc. [ERG]) conducted the water assessment at the STC to review existing conditions and update the facility's 2014 Water Management Plan.

Table 1. Potential Water Conservation Opportunities at the STC

<table>
<tr><th>Suggested Priority</th><th>Project Description</th><th>Number of Fixtures</th><th>Initial Project Cost</th><th>Potential Annual Water Savings (Gallons)</th><th>Potential Annual Energy Savings (Million Btu)</th><th>Potential Annual Utility Cost Savings[1]</th><th>Potential Payback (Years)</th><th>Notes</th></tr>
<tr><td colspan="9">Low and No-Cost Maintenance</td></tr>
<tr><td>1</td><td>Monitor water meters and submeters on a monthly basis and record meter readings.</td><td>N/A</td><td>N/A</td><td colspan="5">Tracking water use regularly can help establish water use trends and identify potential leaks or malfunctions.</td></tr>
<tr><td>2</td><td>Repair air-handler condensate piping that runs to the cooling towers on the roof.</td><td>N/A</td><td>N/A</td><td colspan="5">Repair is part of regular maintenance and will not result in additional water savings beyond what has already been achieved from air handler condensate collection at the STC.</td></tr>
<tr><td>3</td><td>Reduce cooling tower basin water level and/or fix rusted bolt causing basin leak.</td><td>N/A</td><td>N/A</td><td colspan="5">Repair is part of regular maintenance and will not result in significant water or cost savings.</td></tr>
<tr><td>4</td><td>Install 0.5 gallons per minute (gpm) faucet aerators on the three 2.2 gpm lavatory faucets on the second floor.</td><td>3</td><td>$30</td><td>7,000</td><td>1</td><td>$100</td><td>0.3</td><td>None</td></tr>
</table>

[1] Estimated water cost savings are based on the Kansas City Board of Public Utilities' water rate of $3.28 per ccf ($4.38 per Kgal) and the Unified Government of Wyandotte County and Kansas City, Kansas' sewer rate of $4.47 per ccf ($5.98 per Kgal). Estimated energy cost savings are based on a natural gas rate of $7.30 per Mcf and an electricity rate of $0.1218 per kWh, estimated based on the average costs from the STC's FY 2018 and FY 2019 utility bills.

Suggested Priority	Project Description	Number of Fixtures	Initial Project Cost	Potential Annual Water Savings (Gallons)	Potential Annual Energy Savings (Million Btu)	Potential Annual Utility Cost Savings[1]	Potential Payback (Years)	Notes
Capital Improvements[2]								
5a	Assess necessity of centralized vacuum system and eliminate if possible.[3]	N/A	N/A	902,000	89	$12,500	Immediate	None
5b	If centralized vacuum system is still necessary, replace existing system with a dry, air-cooled model.	N/A	$30,800	902,000	37	$10,700	2.9	None
6a	Install water softener on cooling tower system to improve incoming water quality and increase cycles of concentration.	N/A	$15,565	358,000	Not quantified	$3,700	4.2	None
6b	Alternatively, if deemed beneficial for other purposes (e.g., to improve water taste, to reduce scale on appliances, fixtures, and mechanical systems, to improve energy efficiency), install water softener on incoming city water line to provide softened water for the entire STC facility.	N/A	$23,980	269,000[4]	Not quantified	$2,780	8.6	A building-level water softener may result in decreased equipment maintenance and improved efficiency of mechanical equipment (e.g., water heaters).

[2] For capital project cost information, see Appendix A: Capital Project Cost Estimates.

[3] Per discussions with O&M staff, laboratory and research personnel have bench-scale vacuum pump units, which are used when the vacuum system is down for maintenance. Depending on the facility's research needs, the STC should consider utility costs and evaluate whether a centralized vacuum system is still necessary.

[4] If the project team pursues project 5a/5b to decommission or replace the existing vacuum pump system prior to installing the water softener, water savings would be higher (approximately 313,000 gallons per year), because less water would need to be generated through the water softener, resulting in less water used for backflushing the resin beds. The resulting project payback would be reduced to approximately 6.8 years.

Suggested Priority	Project Description	Number of Fixtures	Initial Project Cost	Potential Annual Water Savings (Gallons)	Potential Annual Energy Savings (Million Btu)	Potential Annual Utility Cost Savings[1]	Potential Payback (Years)	Notes
7	Replace current water-cooled ice maker in Lab L55 with ENERGY STAR certified, air-cooled model.	N/A	$3,000	22,200	Not quantified	$230	13.0	None

Facility Information

The STC houses the EPA's Region 7 Laboratory and is focused on environmental monitoring, analytical support and data assessments. The laboratory contains 71,955 square feet of conditioned space. The building is privately owned and leased by the U.S. General Services Administration (GSA) for the EPA through 2023.

The STC 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) LEED® for New Construction (Version 2.0).

The STC is occupied by approximately 75 employees; however, the building is typically occupied by approximately 70 percent of employees at any given time, based on telework policies and fieldwork. The laboratory operates on a flextime schedule and is typically occupied Monday through Friday.

Water Management

The STC'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.

To continue progress toward meeting the EPA's agency-wide and Region 7 water efficiency goals, the STC will strive to meet annual facility-specific goals set by the STSB under its ConservW program.

Water Supply, Measurement and Historical Use

The STC uses water for miscellaneous laboratory and research purposes, cooling tower make-up, vacuum pump seal water, sanitary needs, generation of laboratory grade water through reverse osmosis, ice machine single-pass cooling, dishwashing, and clothes washing. The following sections provide additional details on the facility's water use.

Water Supply

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

The STC does not use any sources of nonpotable fresh water, but it does use onsite alternative water sources. The STC'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; however, the recovered condensate lines have since been routed directly to the cooling towers to serve as make-up water.

Figure 2: The potable water meter that totalizes water serving the STC is located in a manhole outside the security gate.

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 permeate water submeter
- RO reject water submeter to graywater system

Table 2 provides a summary of the meters and submeters installed at the STC, the area or subsystem each meter serves, and the meter reading collected at the time of the assessment.

Table 2. List of Meters and Submeters at the STC, April 2019

Meter Location	Area/System Served by Meter	Meter Number	Utility Account Number	Water Source	Meter Reading From Assessment
Below grade, northeast of STC, outside fenceline near gate	Main laboratory	AM09031610	#2007265	City potable water	41,828.1 ccf
Northeast corner of mechanical room	East cooling tower make-up water	N/A	N/A	City potable water	11,494,500 gallons
Mechanical room, between boilers	East cooling tower blowdown water	16240572	N/A	Cooling tower blowdown	744,720 gallons

Meter Location	Area/System Served by Meter	Meter Number	Utility Account Number	Water Source	Meter Reading From Assessment
Northeast corner of mechanical room	West cooling tower make-up water	N/A	N/A	City potable water	14,316,700 gallons
Mechanical room, between chilled water loop piping	East cooling tower blowdown water	66530568	N/A	Cooling tower blowdown	2,714,160 gallons
Second floor North mechanical penthouse	North recovered air handler condensate for cooling tower make-up	66530564	N/A	Recovered air handler condensate	2,559,530 gallons
Second floor South mechanical penthouse	South recovered air handler condensate for cooling tower make-up	N/A	N/A	Recovered air handler condensate	790,200 gallons
Northern wall of mechanical room, near floor	Graywater system water use	11777605	N/A	Graywater	276,490 gallons
Above RO system	RO permeate water	99046725	N/A	RO permeate	410,661 gallons
Left of RO system	RO reject water to graywater system	66530565	N/A	RO reject	1,076,880 gallons

System submeters are not regularly monitored nor recorded by facility management or operations and maintenance (O&M) staff. Regular monitoring of meters can ensure irregular use, leaks or other malfunctions can be quickly identified. Under this Water Management Plan, facilities management and O&M staff should begin to record meter readings at least monthly and report values to the facilities manager so that water use trends can be monitored on an ongoing basis. Any unexpected changes in water use should be investigated and resolved immediately.

Historical Water Use

In response to various executive orders and laws addressing federal sustainability, the STC established an FY 2007 water use intensity baseline of 43.81 gallons per gross square foot (gsf) based on 3,152,291 gallons of water used that fiscal year. In FY 2018, water use intensity had increased to 60.14 gallons per gsf, or 4,327,480 gallons of water—an increase of 37 percent compared to the FY 2007 baseline. The STC used less water over the most recent 12-month period for which water use data was available during the water assessment (May 2018 through April 2019) to 56.11 gallons per square foot based on 4,037,237 gallons of water used. Figure 3 provides a graph of the STC's water use from FY 2007 through FY 2018.

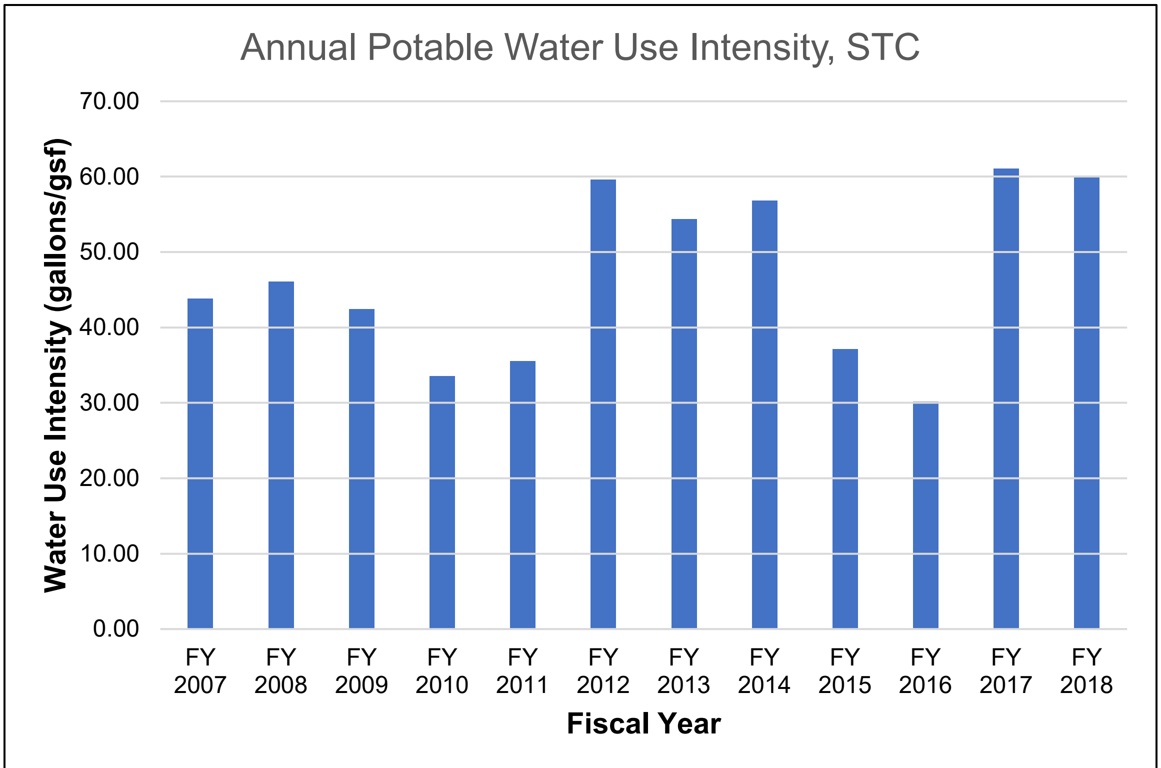

Figure 3: The STC's Water Use Intensity, FY 2007 to FY 2018

End Uses of Water

Table 3 and Figure 4 identify the end uses of water at the STC based on the facility's water use from May 2018 through April 2019. Figure 5 identifies sources of water at the STC. The uses are described in more detail below.

Table 3. Major Potable Water Uses at the STC, May 2018 Through April 2019

Major Process	Annual Water Use (gallons)	Total Water Use (percent)	Basis of Estimate
Potable Water Use			
Cooling tower make-up (potable water)	2,240,000	50.4	Engineering estimate based on comparison of baseline facility water use during winter months and water use during the cooling season when the cooling towers are operational.
Research and other miscellaneous water uses	1,064,564	24.0	Calculated by difference from known total water use and all other calculated water uses.

Major Process	Annual Water Use (gallons)	Total Water Use (percent)	Basis of Estimate
Vacuum pump seal water	902,000	20.3	Based on April 2014 measured flow coming from the vacuum pump drain during full flow (4.45 gpm) and reduced flow (0.35 gpm). Flows could not be taken in 2019 because the floor drain was rusted shut. Flows alternate at 15 seconds high flow and 30 seconds reduced flow, 24 hours per day, 365 days per year. Full flow rate = 4.45 gpm x 20 minutes/hour x 24 hours x 365 days = 779,640 gallons Reduced flow rate = 0.35 gpm x 40 minutes/hour x 24 hours x 365 days = 122,640 gallons
Restroom fixtures	97,000	2.2	Engineering estimate based on fixtures installed, occupancy, and daily usage factors.
RO permeate water	58,340	1.3	Engineering estimate based on 1:1 ratio of RO permeate to RO reject flow.
RO reject water[5]	58,340	1.3	Annualized estimate based on meter readings taken between the April 2014 water assessment and the April 2019 water assessment.
Water-cooled ice machine	22,200	0.5	Engineering estimate based on measured flow taken during this assessment.
Kitchenette dishwasher	1,190	<0.1	Engineering estimate based on one dishwasher load per workday.
Clothes washer	650	<0.1	Engineering estimate based on 1.5 loads per week for four months of the year and 1.5 loads per month for eight months of the year (based on conversations with lab staff).
Total Potable Water Use	**4,037,237**	**100**	Metered total.
Onsite Alternative Water Use			
Recovered air handler condensate (used as cooling tower make-up)	309,464	-	Annualized estimate based on meter readings taken between the April 2014 water assessment and the April 2019 water assessment.

[5] The amount of RO reject water captured by the meter (and subsequently, the estimated water generated as RO permeate) might be low because the water line running from the RO system to the graywater reclamation system was valved off during the assessment. O&M staff did not know when this was shut off; therefore, the full amount of RO reject water from the RO system was likely not captured between the April 2014 and April 2019 meter readings.

Major Process	Annual Water Use (gallons)	Total Water Use (percent)	Basis of Estimate
Rainwater and RO reject routed through the graywater reclamation system (used for toilet and urinal flushing and cooling tower make-up)	97,585	-	Annualized estimate based on meter reading taken during the April 2019 water assessment. The meter was replaced in June 2016.
Total Onsite Alternative Water Use	**407,048**	-	Sum of onsite alternative water sources.
Total Water Use	**4,444,285**	-	Sum of metered totals.

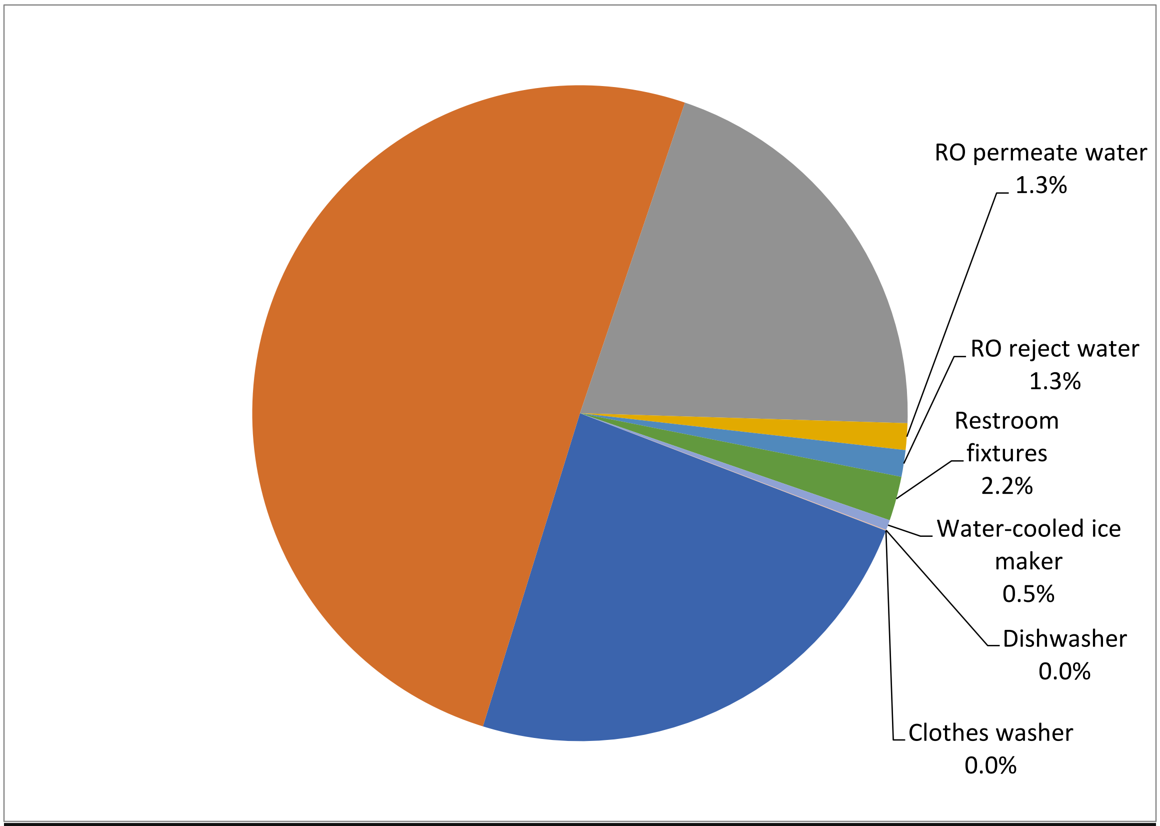

Figure 4: The STC’s Water End Uses, May 2018 Through April 2019

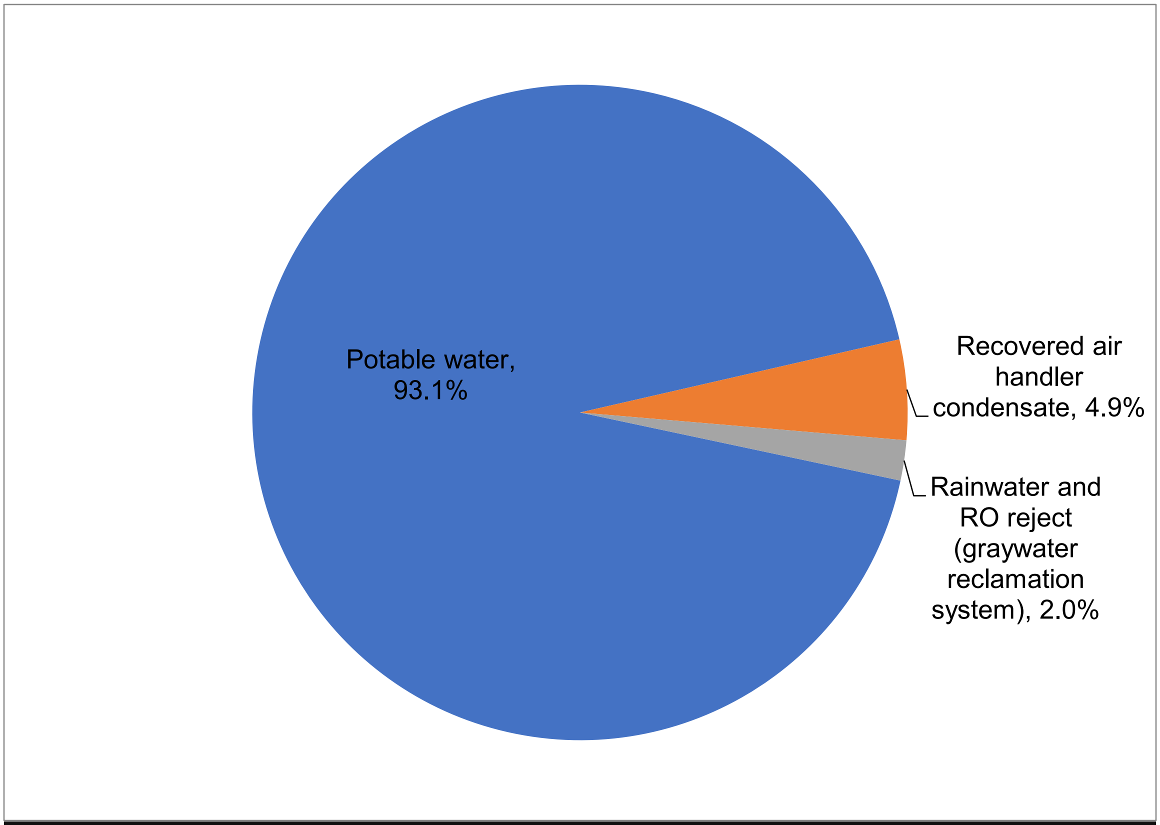

Figure 5: The STC's Sources of Water, May 2018 Through April 2019

Cooling Towers

Figure 6: Two 700 ton cooling towers provide space and equipment cooling for STC.

The STC's largest water user is its cooling tower system—using approximately half of the facility's total potable water. The STC is equipped with two 700-ton cooling towers. A cooling tower maintenance contractor (Rochester Midland Corporation) 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 1,600 microSiemens per centimeter (uS/cm) and are used to control blowdown. City make-up water has a relatively high dissolved solids load, with a resultant conductivity between 730 and 800 uS/cm. Therefore, the cooling tower system achieves a relatively low cycles of concentration between 2.0 and 2.5, depending on the time of year.

Both cooling towers are equipped with make-up and blowdown meters. The meter readings are not currently recorded; however, O&M staff and the facilities manager should begin monitoring these meters to record trends.

In July 2013, the STC 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. Annually, approximately 310,000 gallons of condensate are collected and used in the cooling tower as make-up water, reducing the STC's need for potable make-up water by nearly 18 percent.

During the assessment, it was noted that condensate piping running along the room to the cooling towers was broken. The piping should be repaired or replaced as soon as possible before the cooling season begins to ensure that collected condensate is properly piped to the cooling tower as make-up water.

Figure 7: A broken condensate pipe running to the cooling towers should be fixed prior to the cooling season.

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.

The STC is considering implementing a water conservation project that would install a water softener either to soften water used for cooling tower make-up, or to soften all water entering the building, which would include cooling tower make-up water. Based on discussions with the cooling tower maintenance contractor, a water softener could reduce water used in the tower between 20 and 33 percent (based on increasing the cycles of concentration to 4).[6] There is some required water use to backflush the water softening systems, off-setting some of the water and cost savings that would result from this project; however, based on discussions with the cooling tower maintenance vendor, the volume of water used for backflushing is small (approximately 5 percent of the volume of softened water) in comparison to the potential cooling tower savings.

Because of the high water hardness at the STC, water softening for the whole building could provide ancillary benefits to other equipment and for building occupants, such as reducing scaling on mechanical systems and plumbing fixtures, increasing system energy efficiency, and improving water taste.

Research and Other Miscellaneous Water Uses

Nearly one-quarter of the STC's potable water use is for research purposes or is otherwise unaccounted for. Water is used as necessary in individual laboratories for bench-scale experimentation and glassware preparation. The STC 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.

---

[6] This assumption is based on increasing the cycles of concentration from 2.0-2.5 to 4); however, water savings could be higher depending on improvements in water quality from water softening and chemical management. The water reduction percentage was established from the EPA's *WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities*. Table 6-1. Percent of Make-Up Water Saved by Maximizing Cycles of Concentration. www.epa.gov/sites/production/files/2017-02/documents/watersense-at-work_final_508c3.pdf

While laboratory water use can be significant, depending on research and field activities at the STC, the magnitude of the volume of water presumed to be for laboratory research could be the result of unaccounted-for water use at the STC, including, but not limited to, a leak or unidentified source of water use. The STC should regularly monitor and record submeter readings at least monthly to determine if leaks or other unidentified water uses are likely.

Vacuum Pump Seal Water

More than 20 percent of the STC's water use goes to its vacuum pump seal. The STC is equipped with a central vacuum system, which generates vacuum using a liquid-ring vacuum pump. The STC previously had a pump installed that continuously discharged seal water and added fresh water to dissipate heat and remove impurities. The STC 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.

Figure 8: The STC's centralized vacuum system could be replaced with a dry, air cooled model.

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.

The vacuum system was not functional during the water assessment, as motors in each pump that comprise the system had failed and were in the process of being replaced. However, the system that maintains the pump seal was able to be activated at the assessment team's request. Similar to the assessment from 2014, and based on discussions with facility O&M staff, the vacuum system operates with a flow of water through it at all times. Based on observations, it was determined that the vacuum pumps alternate on for 15 seconds, followed by a period of 30 seconds where the vacuum pumps are off. The floor drain that receives the wastewater was rusted shut, so the assessment team was unable to obtain updated flow rate measurements; however, it is assumed to be the same flow rates from the 2014 assessment. While the pumps operate, the discharge water flow rate was approximately 4.45 gpm. While the pumps are idle, the discharge flow was approximately 0.35 gpm. These alternating flows occur 24 hours per day, 365 days per year (when the vacuum system is functional), and result in approximately 900,000 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.

While the centralized vacuum system is non-functional, lab personnel utilize bench-scale vacuum systems for research needs. The STC should consider whether a centralized vacuum system needs to be maintained, or if bench-scale units are sufficient to support research at the STC. If a centralized vacuum system must be maintained, the STC will consider replacing the existing unit with a dry, air-cooled system that would eliminate the use of water, while also improving the energy efficiency of the system.

Restroom and Other Sanitary 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 19 lavatory faucets at the STC. 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 O&M staff. Leaks or maintenance problems are corrected immediately.

Domestic hot water is provided through natural gas hot water heaters. Table 4 provides an inventory of sanitary fixtures.

Table 4. Restroom Fixtures Inventory, the STC

Fixture Type	Flow Rate	Total Number
Toilets	1.6 gpf	23
Urinals	1.0 gpf	6
Lavatory faucets	0.5 gpm	16
	2.2 gpm	3
Showerheads	2.5 gpm	2
	2.0 gpm	2

To reduce restroom water use, the STC should consider installing 0.5 gpm faucet aerators on the remaining three lavatory faucets located in each of the second-floor restrooms.

Based on discussions with facility staff, the showers are not regularly utilized by the STC employees. If the showers begin to be used more frequently, the STC should consider replacing existing showerheads with WaterSense labeled models that flow at 1.75 gpm or less.

Replacement of urinals or toilets with WaterSense labeled models flushing at 0.125 gpf or 1.28 gpf, respectively, is not life-cycle cost effective. However, O&M staff indicated that replacement of some fixtures has been required recently due to malfunction. If future urinal or toilet replacement is necessary, the STC should install WaterSense labeled models in place of existing models.

Reverse Osmosis System

Figure 9. The STC RO system provides RO water for laboratory research.

The STC has an RO system that provides purified water to laboratories and water for humidification. The RO system was not operational during the 2019 water assessment. In 2014, the ratio of permeate water to reject water was approximately 1:1, and it is assumed to be the same.

RO reject water is routed to the STC's graywater system for reuse as cooling tower make-up or toilet and urinal flushing water. During the assessment, it was noted that the water pipe running from the RO reject to the graywater reclamation system was valved off, instead directing RO reject water to a floor drain. O&M staff could not identify when or why the RO reject line to the graywater reclamation system was valved off. Therefore, while the water meter on the RO reject line was used to estimate annual water use from the STC's RO system, this should be considered a conservative number, since the length of the pipe to the graywater reclamation system has been valved off is unknown.

In March 2019, the service provider that manages and maintains the RO system installed a flow totalizing meter on the RO permeate line. O&M staff should monitor this meter, along with the flow meter on the RO reject water line, to understand RO usage and patterns and to ensure a 1:1 ratio is maintained in the RO system.

Water-Cooled Ice Machine

Figure 10. A water cooled ice machine is the only equipment at the STC that uses single pass cooling.

While most of the laboratory equipment at the STC is supplied with process chilled water, there is one remaining water-cooled ice machine. The ice machine is a Manitowac Model QY0325W. Based on flow measurements taken during the assessment, the ice machine uses 160 milliliters (mL) per minute (0.042 gpm) for machine cooling. Because the equipment is operated year-round, this results in approximately 22,200 gallons of water used for cooling. When the ice machine reaches the end of its useful life, the STC should replace it with an ENERGY STAR certified, 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

The STC 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

The STC uses a washing machine to wash laboratory coats and clothes from field activities. The machine, an LG Model WM8100HWA, is ENERGY STAR certified and has a capacity of 5.2 cubic feet. It is located in Lab L16. During spring and summer when field work of the STC staff is more prevalent, the machine is run once or twice per week. The machine is only operated once or twice per month during other times of year. Therefore, its water use is relatively small.

Onsite Alternative Water Use

The STC 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, potable water is used to supply the necessary water for these uses.

Figure 11. The graywater reclamation system is controlled by PRVs and a pressure actuated pump on the graywater supply.

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 the 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.

In FY 2016, the STC performed service on the graywater reclamation system to recalibrate the pump and install a new water meter. The graywater reclamation system was not operating during the assessment, presumably because the graywater storage tank was empty.

During the assessment, it was noted that the water pipe running from the RO reject to the graywater system was valved off, instead running to a floor drain. O&M staff could not identify when or why the RO reject line to the graywater system was valved off. The valve was reopened by O&M staff, again directing RO reject water to the graywater system.

The 2014 STC Water Management Plan (Revision 2) included a graywater reclamation system water balance and comparison of supply and demand. This information compared metered graywater use with the theoretical graywater availability, based on expected rainwater and metered RO reject water. Because submeters have not been regularly monitored in recent years, a similar comparison could not be performed as part of this Water Management Plan.

Completed Water Efficiency Projects

As described in Table 5, the STC has completed three projects to improve water efficiency and water management since FY 2007.

Table 5. Completed Water Efficiency Projects at the STC Since FY 2007

Project	Estimated Annual Water Savings (Gallons)	Completion Year	Additional Notes
Faucet aerators	14,000	FY 2014	The STC installed 0.5 gpm faucet aerators on most of its faucets in late 2013.
Air handler condensate recovery	300,000	FY 2013	The STC 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[7]	800,000	FY 2009	Water savings resulting from the project are no longer being realized by the STC. As background, the STC worked with its vacuum pump vendor to install an alternate configuration on the seal water recirculation tank that allowed for a nearly complete recycle of the seal water. The system was intended to recirculate water 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 supposed to reduce vacuum pump water use by an estimated 90 percent. However, based on the water assessments conducted in 2014 and 2019, the system is no longer operating efficiently.

Drought Contingency Plan

Drought Risk

The STC is located in an area that periodically experiences drought, most recently in 2018 and 2012. Water is supplied by the Kansas City Board of Public Utilities, which obtains water from the Missouri River aquifer.

In the event of a drought or other water supply shortage, the STC 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, the STC 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: www.kwo.org/reports_publications/Drought.htm.

[7] Resulting water savings from this project are no longer being realized.

Recent Contributions to Drought Contingency

In FY 2018, the STC's water use intensity was close to its highest level since the baseline was set in FY 2007. The STC should monitor water meters and submeters to understand use patterns. Further, the STC plans to pursue projects to reduce facility water use in accordance with this Water Management Plan.

Potential Capital Improvement Projects to Reduce Water Use

Potential capital improvement projects are identified in Table 1. These projects represent the STC's plans to reduce facility water use, particularly if the facility is faced with water supply limitations or undergoes a major renovation. If necessary, all of the projects could be implemented relatively quickly, although some do not have short-term payback periods. If fully implemented, these projects are estimated to reduce facility water use by nearly 29 percent.

Opportunities for Short-Term Response to Local Drought

In the event of a drought or other water supply shortage, the STC will follow any water use recommendations and restrictions from the Kansas Water Office and the Kansas City Board of Public Utilities.

Because the majority of the laboratory's water usage is for sanitary, research and laboratory functions that are critical to the STC's mission, there is not much opportunity for short-term response to local drought. However, because the STC has bench-scale vacuum systems available, the centralized vacuum system could be turned off to curtail facility water use until drought conditions cease. This could result in water savings approximately 75,000 gallons per month.

Considerations for New Construction

If the EPA decides to pursue further expansion of the STC through new construction or major renovations, the design choices listed below should be considered to reduce water use intensity and exhibit water efficiency.

1) Install restroom fixtures with flush volumes or flush rates at or below the maximum flush volume/flow rate and performance requirements provided in Table 6.

Table 6. Requirements for Restroom Fixtures in New Construction/Major Renovation

Fixture Type	Maximum Flush Volume/Flow Rate	Performance Requirement
Toilets	1.28 gpf	WaterSense labeled
Urinals	0.125 gpf	WaterSense labeled
Lavatory faucets	0.5 gpm	None
Kitchen faucets	1.8 gpm	None
Showerheads	1.75 gpm	WaterSense labeled

2) Incorporate air handler condensate collection and/or rainwater collection into the initial design for use as cooling tower make-up, toilet and urinal flushing, or other non-potable water end uses.

3) Carefully size laboratory systems, such as the RO system and vacuum system. Consider more efficient, point-of-use models, where feasible.

Stormwater Management

The STC operates under a Municipal Separate Storm Sewer System (MS4) permit with the city of Kansas City. Stormwater mostly collects in storm drains on site.

Onsite Green Infrastructure

The STC does not currently have any onsite green infrastructure, aside from the graywater reclamation system that collects rainwater from the roof.

Contact us

For more information about our services:

Rafael Hernandez
hernandez.rafael@epa.gov
202.564.2827

Praveen KC
kc.praveen@epa.gov
202.564.5044

Visit us on the web at:
www.epa.gov/greeningepa

Appendix A: Capital Project Cost Estimates

Priority Project 5b: Replace existing centralized vacuum system with a dry, air-cooled model.

Description	Source	Qty.	Total Cost ($)
Duravane 5-Hp Dry Vacuum Pump	Fluid Technology (Bidder)	1	$27,000
Installation	Bidder	1	$1,000
		Subtotal	$28,000
Contingency (10%)			$2,800
Total			**$30,800**

Priority Project 6a: Install water softener on cooling tower system to improve incoming water quality and increase cycles of concentration.

Description	Source	Qty.	Total Cost ($)
290/128T Part # 502154 Fleck 2900 system; two 16 x 65 mineral tanks; one 24 x 40 brine tank	Rochester Midland Corporation	1	$7,075
Installation[8]	Estimate from Bidder	1	$7,075
		Subtotal	$14,150
Contingency (10%)			$1,415
Total			**$15,565**

Priority Project 6b: Install water softener on incoming city water line to provide softened water for the entire STC facility.

Description	Source	Qty.	Total Cost ($)
290/352 Part # 502161 Fleck 2900 system; two 24 x 72 mineral tanks; one 39 x 48 brine tank	Rochester Midland Corporation	1	$10,900
Installation[9]	Estimate from Bidder	1	$10,900
		Subtotal	$21,800
Contingency (10%)			$2,180
Total			**$23,980**

[8] Rochester Midland Corporation does not do installation of systems; however, representative estimates that cost of installation is typically commensurate to equipment cost.

[9] Rochester Midland Corporation does not do installation of systems; however, representative estimates that cost of installation is typically commensurate to equipment cost.