

Water Management Plan

United States Environmental Protection Agency
Kansas City Science & Technology Center

300 Minnesota Avenue
Kansas City, Kansas 66101



14 November 2008

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CENTER HILL RESEARCH LABORATORY
CINCINNATI, OHIO

WATER MANAGEMENT PLAN

Approved by:


Richard D. Koch, Director, Facilities Management and Services Division 3/2/09 Date

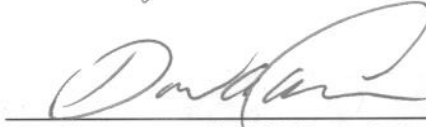

David Carson, Chief, Waste Management Branch 27 FEB 2009 Date

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1.0 EPA'S STATEMENT OF PRINCIPLES ON EFFICIENT WATER USE

In order to meet the needs of existing and future populations and ensure that habitats and ecosystems are protected, the nation's water must be sustainable and renewable. Sound water resource management, which emphasizes careful, efficient use of water, is essential to achieve these objectives.

Efficient water use can have major environmental, public health, and economic benefits by helping to improve water quality, maintain aquatic ecosystems, and protect drinking water resources. As we face increasing risks to ecosystems and their biological integrity, the inextricable link between water quality and water quantity becomes more important. Water efficiency is one way of addressing water quality and quantity goals. The efficient use of water can prevent pollution by reducing wastewater flows, recycling process water, reclaiming wastewater, and using less energy.

EPA recognizes that regional, state, and local differences exist regarding water quality, quantity, and use. Differences in climate, geography, and local requirements influence the water efficiency programs applicable to specific facilities. Therefore, EPA is establishing facility-specific Water Management Plans to promote the efficient use of water and meet the water conservation requirements under Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management.

This Water Management Plan has been established to document and promote the efficient use of water at the EPA Kansas City Science & Technology Center. The plan is organized according to the Federal Energy Management Program (FEMP) Facility Water Management Planning Guidelines.

2.0 FACILITY DESCRIPTION

The Kansas City Science & Technology (KCSTC) houses the EPA Region 7 Laboratory, and is focused on environmental monitoring, analytical support, and data assessments.

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 a Gold sustainable design rating from the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED™) program.

Prominent water conservation and efficiency features include the use of high efficiency plumbing fixtures, landscape design using native species, and a graywater recovery system that captures rain water, air handler condensate, and reverse osmosis reject water for reuse as toilet flushing water and cooling tower makeup water.

The laboratory contains 71,995 square feet of conditioned space. The building is owned and operated by GSA. EPA holds a 20 year lease that runs through 2023.

3.0 FACILITY WATER MANAGEMENT GOALS

The resource conservation goals of KCSTC are achieved through the implementation of the Region 7 Environmental Management System (EMS). The EPA Region 7 EMS policy statement is provided below.

Environmental Management System Policy

Environmental protection is the very foundation of our mission and activities. Thus, our environmental policy and our day-to-day operations should reflect the fact that we are national experts in the field of environmental management. The following policy statements stem from a conviction that we can maintain Agency credibility only if we lead by example. It is imperative that our own environmental management system (EMS) be among the very best if we are to lead and critique others on their EMS implementation.

- As we compel statutory and regulatory compliance by the regulated community, we must ensure that we ourselves meet and usually exceed all applicable legal and other requirements.
- We will demonstrate continual improvement in our own environmental performance as an example of our expectation of environmental improvement by those we regulate.
- Continual improvement requires a consideration of pollution prevention and source reduction approaches within our office as well as in our external operations.
- Public involvement is a vital part of all Agency activities. We will take positive steps to consult and inform the public concerning our environmental policy and performance information, during both the development and the implementation of our EMS.

Various Agency directives and executive orders impose other specific environmental requirements in a number of different areas. Even beyond these specific requirements, we recognize that other opportunities for environmental and organizational improvement abound. Through our personal attention and example, we pledge ourselves to provide effective leadership to meet these challenges, and through our annual EMS review we will monitor our environmental performance and the specific objectives and targets developed under our EMS.

EMS Water Management Objectives and Targets

Region 7 has established the reduction of total water use as an objective under the EMS. As a specific objective, Region 7 will reduce water use intensity (gal/GSF) at the Regional Office and KCSTC by 16% from a FY 2007 baseline by September 30, 2015, for a total reduction of 16 percent.

The following specific targets are established to help meet this objective:

- Complete a water use assessment at KCSTC (has been completed under this plan)
- Establish and initiate execution plans for water use reduction opportunities deemed practical for implementation during water use assessment (See Section 9 of this plan)
- Monitor water use on an ongoing basis.

4.0 UTILITY INFORMATION

Rate Schedule and Contact Information

Potable water is provided by:

Kansas City Board of Public Utilities
540 Minnesota Avenue
Kansas City, KS 66101

913-573-9190

Monthly water bills are based on a tiered rate structure, provided in Table 1.

**Table 1. Water Use Rate Structure
(effective 1 January 2008)**

Monthly amount	Rate per 100 cubic feet (ccf)	Rate per 1,000 gallons
0 to 7 ccf	2.959	3.956
8 to 160 ccf	2.945	3.937
161 to 2000 ccf	2.750	3.676

In addition to the tiered rate structure, the facility is also billed \$44.05 per month for a fire line, and a \$47.09 monthly customer use fee.

Sewer service is provided by:

Unified Government of Wyandotte County and Kansas City, Kansas
701 North 7th Street,
Kansas City, KS 66101

913-573-5400

Sewer use fees are based on water use, at a rate of \$1.84/ccf (\$2.46/1000 gallons), effective July 1, 2007.

Payment Office

Research Triangle Park Finance Center (RTP-FC)
Kim Poteat, 919-541-1468

(Pouch and Regular Mail)
Environmental Protection Agency
Mail Code - D143-02
Research Triangle Park, NC 27711

(FEDEX)
Environmental Protection Agency
Mail Code - D143-02
4930 Page Road
Research Triangle Park, NC 27711

The fax number for RTP-FC is: 919-541-4975

5.0 FACILITY WATER USE INFORMATION

The laboratory building contains a mixed use of laboratory and office space. The laboratory space is configured for bench scale organic and inorganic analyses of environmental samples. Water is used for sanitary needs, building mechanical systems, and laboratory processes. Additional details on facility water use are provided in the following sections.

Major Water Using Processes

Estimates of water consumption by major use area are provided in Table 2. These data reflect average annual facility water use between October 2006 and September 2007 (FY 2007). Note that water consumption includes both potable water supplied by the city, and reclaimed graywater, as indicated on the table.

Table 2. KCSTC Major Water Using Processes (FY 2007)

Major Process	Annual Consumption (gallons)	Percent of Total	Comments
Water Use			
Sanitary water	150,000	4.5	Engineering estimate
Cooling tower make-up water	1,930,300	57.7	Metered total
Reverse osmosis reject	63,000	1.9	Based on metered total
Reverse osmosis permeate	59,000	1.8	Based on ratio of permeate to reject flow
Humidification	60,000	1.8	Engineering Estimate
Vacuum pump seal water	1,000,000	29.9	Engineering estimate
Miscellaneous laboratory water use	85,992	2.6	Calculated by difference
TOTAL Water Use	3,348,292	100	From total metered supply, calculated below.
Water Supply			
City water supply	3,152,292	94.1	Metered total, October 2006 to September 2007
Reclaimed water supplied by graywater system	196,000	5.9	Based on metered total
TOTAL Water Supply	3,348,292	100	Total

Additional detail on assumptions and calculations supporting these water use estimates are provided in Appendix A.

Measurement Devices

Incoming water is supplied by the Kansas City Board of Public Utilities through a single metered supply line.

The KCSTC is equipped with a graywater capture and reuse system. The system is used to collect rainwater from a portion of the roof, air handler condensate, and reject water from the reverse osmosis system. Reclaimed water is stored in a 10,000 gallon tank, and used for toilet flushing, and cooling tower make-up water. Flow totalizing meters are installed on the RO reject flow to the reclaim tank and the air handler condensate flow to the reclaim tank. Water reclaimed from the tank and used to supply the cooling tower and toilets is also metered.

There are two cooling towers at KCSTC, each is equipped with meters on the make-up and blowdown lines.

Under this plan, water use on each meter will be recorded monthly. Water use trends will be evaluated by the facility manager and unanticipated usage trends will be investigated and resolved.

Shut-off Valves

A shut off valve for the main laboratory supply is located in the main mechanical room.

Occupancy and Operating Schedules

Approximately 50 people work at KCSTC. The facility operates on a flex time schedule, one shift per day, Monday through Friday.

6.0 BEST MANAGEMENT PRACTICE SUMMARY AND STATUS

The President has established Water Reduction Goals under Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management. Under the Executive Order, Agencies must establish a FY 2007 water use baseline, and then reduce water use intensity by 2 percent annually through the end of FY 2015, for a total reduction of 16 percent. Facilities should implement Best Management Practices (BMPs) related to water use, considering life-cycle cost effectiveness, to achieve these water reduction goals. The Federal Energy Management Program (FEMP) has identified BMPs in 10 possible areas to help facilities identify and target water use reductions. KCSTC has adopted BMPs in seven of the areas, as checked below:

- Public Information and Education Programs
- Distribution System Audits, Leak Detection, and Repair
- Water-Efficient Landscape
- Toilets and Urinals
- Faucets and Showerheads
- Boiler/Steam Systems
- Single-Pass Cooling Systems
- Cooling Tower Systems
- Miscellaneous High Water-Using Processes
- Water Reuse and Recycling

Public Information and Education Programs

Employees have been educated on water and other resource conservation topics through implementation of the Region 7 EMS. Use of the EMS program to educate on employees and communicate progress toward water conservation targets and objects is considered a best management practice and credit is claimed in this area.

Distribution System Audits, Leak Detection, and Repair

Facility staff are trained to report leaks and malfunctioning water-using equipment to the facilities manager. Reported maintenance problems are then communicated by email to the building engineer, who tracks the job until it is completed and then replies to the facilities manager by email to indicate the job is completed and the request is closed out.

The on-site building engineer performs a visual inspection of core building and mechanical spaces each morning and again before leaving for the day. In addition, the building engineer is paged by the building automation system any time key control parameters are out of range. Any leaks or other mechanical problems are corrected promptly. Janitors are trained to report any observed problems to the facilities manager.

A screening level system review was conducted in November 2007, and known water uses account for over 90% of water consumption.

Under this plan, trends in monthly water use will be monitored by the facilities manager and changes that are not understood or expected will be investigated and resolved.

BMP status has been achieved in this area.

Water-Efficient Landscape

No landscape irrigation is used at KCSTC. The facility is located on a redeveloped brownfield site. The facility is landscaped with native species that do not require supplemental use of water and no irrigation system is installed. Proper use of soil types and mulches also helps to maintain appropriate soil moisture levels. Hose bib outlets are supplied with water from the graywater collection system. BMP status has been achieved in this area.

Toilets and Urinals

Toilets and urinals are compliant with 1992 Energy Policy Act (EPAct) water efficiency requirements (1.6 gallons per flush for toilets and 1.0 gallons per flush for urinals). Flushing water for the toilets and urinals is supplied from the graywater collection system, to the extent it is available. An inventory of sanitary fixtures is provided in Table 3.

Table 3. KCSTC, Inventory of Sanitary Fixtures

Fixture Type	Flow Rate	Total Number
Toilets	1.6 gpf	21
Urinals	1.0 gpf	6
Lavatory faucets	2.2 gpm	16
Showers	2.5 gpm	5

gpf – gallons per flush
gpm – gallons per minute

Janitorial staff and employees are trained to report leaks or other maintenance problems to the facilities manager or O&M staff, which are immediately corrected.

BMP status has been achieved in this area.

Faucets and Showerheads

Faucets are compliant with 1992 Energy Policy Act (EPAct) water efficiency requirements (2.2 gallons per minute for faucets). An inventory of sanitary fixtures is provided in Table 3. However, the American Society of Mechanical Engineers has established a standard for lavatory faucets in public use (essentially all applications but domestic residences) with a maximum flow rate of 0.5 gpm (ASME A112.18.1). This flow rate is sufficient for hand washing and is considered a best practice for lavatory sinks in public settings.

Water pressure is 60 pounds per square inch, within the range for optimum system performance.

Janitorial staff and employees are trained to report leaks or other maintenance problems to the facilities manager designee or O&M staff, which are immediately corrected.

No BMP credit is claimed in this area, pending replacement of existing faucets or faucet aerators with ones that flow at 0.5 gpm.

Boiler/Steam Systems

KCSTC is equipped with 5 natural gas fired hot water boilers. No steam condensate is generated; therefore, BMPs are not applicable in this area.

Single-Pass Cooling

No single pass cooling is used within KCSTC. All laboratory equipment that requires cooling is supplied with process chilled water. BMP status has been achieved in this area.

Cooling Tower Systems

The laboratory 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; treatment chemical addition rates are controlled to be proportional to the quantity of makeup water. Conductivity meters on each tower water loop are set at 2,000 $\mu\text{S}/\text{cm}$ and are used to control blowdown. City make-up water has a relatively high dissolved solids load, with a resultant conductivity of 780 $\mu\text{S}/\text{cm}$. Therefore, the cooling tower system achieves relatively low cycles of concentration – approximately 2.5. Some cooling tower make-up water is supplied from the graywater collection system, to the extent it is available.

Both cooling towers are equipped with make-up and blowdown meters. The meter readings will be recorded monthly and trends in cooling tower water use will be monitored by the building engineer and facilities manager under this plan.

BMP status for cooling tower operation is not claimed at this time. A recommended minimum target for cycles of concentration is 3. KCSTC will work with the building owner to evaluate if at least 3 cycles of concentration can be achieved. The quality of graywater supplied to the cooling tower will be included as part of this assessment.

Miscellaneous High Water-Using Processes

KCSTC is equipped with a central vacuum system. The Vacuum is generated by a water-sealed vacuum pump. Pump seal water is recirculated from a holding tank. Each time the pump runs, fresh water is supplied to the seal water system to dissipate heat. The fresh water supplied causes an overflow from the seal water holding tank. BMP status has not been achieved in this area, pending more full control over the seal water discharge process. Control options are discussed in Section 9.

Water Reuse and Recycling

KCSTC is equipped with a graywater collection and reuse system that collects rainwater from 18,000 ft² of the roof, reverse osmosis reject water, and air handler condensate discharge. After passing through a 1,500 gallon sediment tank, the water is 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 flushing and cooling tower makeup. When graywater is not available, city water is used to supply the necessary water for these uses.

Table 4 provides a water balance for the graywater system, showing theoretical maximum quantities of graywater that could be recovered from each source, and the amount of graywater used within the facility. Note that the source quantities are theoretical maximums, some portions of these quantities, particularly for rainwater, will not be recovered when the 10,000 gallon storage tank is full, for example during a high intensity storm event (e.g. any event with greater than 0.9 inches of rain).

Table 4. KCSTC Graywater System Annual Water Balance (FY 2007)

Graywater Use (gallons/year)		Graywater Sources, Theoretical Recovered Quantity (gallons/year)		
Total Metered Use (see appendix A)	196,000	RO Reject	63,000	See Appendix A
		Air Handler Condensate	237,000	Prorated based on metered total between 8/05 and 11/07
		Rainwater	315,000	Based on 18,000 ft ² surface area and 31.2 inches of rainfall, 90% capture efficiency.
		Excess Generation, November to March	(61,000)	See Appendix A
		Total	554,000	

The quantity of recovered graywater in FY 2007 was less than theoretical data suggest is possible. A graphical comparison of theoretical graywater supply to cooling tower and toilet and urinal flushing demand is provided in Figure 1. Note that for most months of the year, all captured graywater can be used, primarily because of the close correlation between cooling tower make-up demand and air handler condensate generation. However, between November and March, when cooling tower make-up demand is low, some excess graywater is captured that can not be put to productive use. BMP status is claimed in this area because 196,000 gallons of graywater was recovered. However, it may be possible to optimize the operation of this system to recover more water, and thereby further offset demand for city water.

Comparison of Graywater Supply and Demand - FY 2007

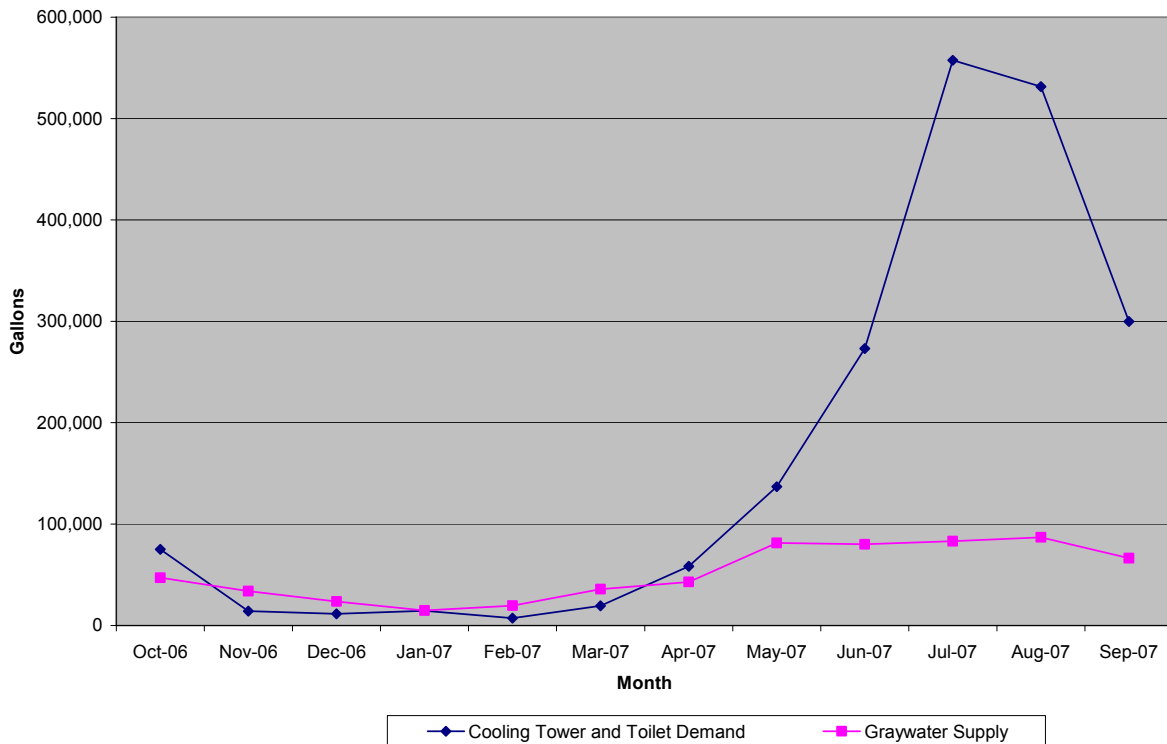


Figure 1. Comparison of Graywater Supply and Demand – FY 2007

7.0 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 facility and operating personnel to identify and implement modifications to facility operations to achieve additional specified reductions in water consumption.

Regional drought conditions and general information drought management can be found at the Kansas Water Office drought management Web page:

<http://www.kwo.org/reports%20&%20publications/drought/kwo%20drought%20report.htm>

8.0 COMPREHENSIVE PLANNING

The facilities manager will ensure that water supply, wastewater generation, and water efficiency BMPs are taken into account during the initial stages of planning and design for any facility renovations or new construction. These factors will also be considered prior to the purchase and installation of any water using equipment. Where applicable, KSCTC will purchase WaterSense® labeled products.

9.0 OPPORTUNITIES FOR FURTHER WATER CONSERVATION

KCSTC is implementing or considering the following projects to achieve additional reductions in water use:

1. **Install 0.5 gpm faucet aerators on bathroom sinks.** High efficiency faucet aerators can be purchased and installed for approximately \$5 each, for a total cost of less than \$100. Projected savings are estimated to be 14,000 gallons and \$80 per year in water and sewer costs.
2. **Install Full Water Recovery System on Liquid Ring Vacuum Pump.** The vacuum pump vendor offers an alternate configuration on the seal water recirculation tank that allows for almost complete recycle of the seal water. 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 is estimated to reduce vacuum pump water use by 90%, saving 900,000 gallons and \$5,000 per year in water and sewer costs.
3. **Increase Cooling Tower Cycles of Concentration.** The cooling towers currently operate at about 2.5 cycles of concentration. KCSTC will work with the building owner and their cooling tower maintenance contractor to evaluate whether it will be possible to achieve at least 3 cycles of concentration. Modifying the operating procedure to achieve at least 3 cycles of concentration will reduce cooling tower water use by 10%, saving 190,000 gallons and \$1,100 in water and sewer costs.
4. **Optimize Operation of the Graywater Recovery System.** The data presented in Table 4 suggest that it may be possible to obtain a higher quantity of recovered water from the graywater system. Monthly water use recorded on the RO reject water meter, air handler condensate meter, reclaimed graywater flow meter, and the cooling tower make-up meter should be recorded, tracked and evaluated, along with rainfall data. If this data confirms that some opportunity is being missed, the sequence of operations of the graywater reclaim system should be evaluated to determine how to optimize graywater recovery. A specific savings quantity can not be assigned at this time, pending further evaluation. However, savings on the order of 100,000 to 200,000 gallons per year may be possible.

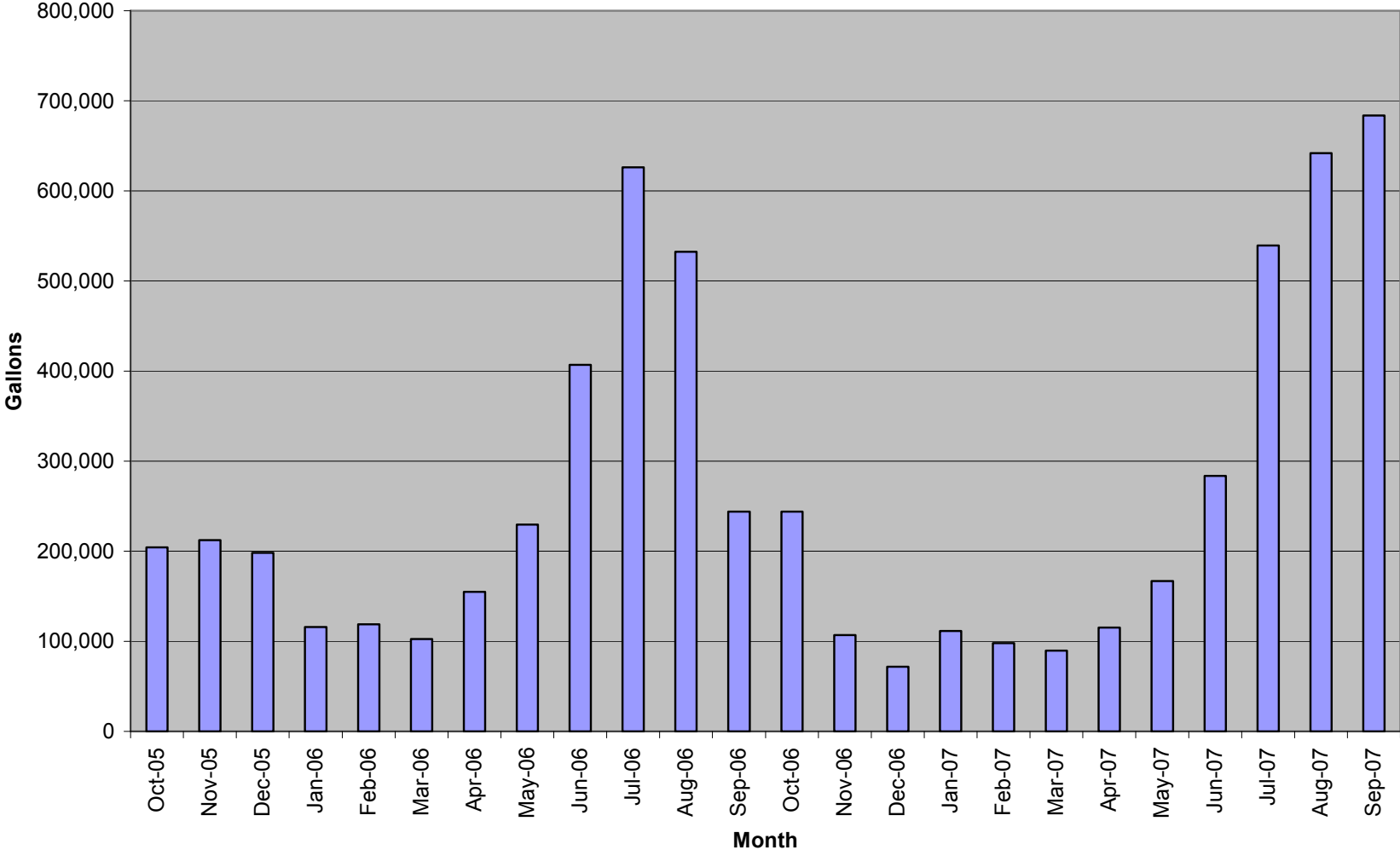
Appendix A

WATER USE AND WATER BALANCE SUPPORTING CALCULATIONS

**Kansas City Science & Technology Center
Water Balance Supporting Calculations
Based on Water use Data from October 2006 to September 2007**

Major Process	Annual Consumption (gallons)	Supporting Calculations
Water Use		
Sanitary water	150,000	Engineering estimate based on 50 people using 12 gallons/day, 250 days per year. $50 \times 12 \times 250 = 150,000$ gallons.
Cooling tower make-up water	1,930,300	Metered total, October 2006 to September 2007
Reverse osmosis reject	63,000	Based on metered reject flow from 8/2005 until 11/2007 prorated to 12 months: $141,630 \text{ gallons} \times 12/27 = 62,946$ gallons reject per year.
Reverse osmosis permeate	59,000	Ratio of permeate to reject flow is 9.5 /10.2. Therefore permeate is $62,946 \text{ gallons reject} \times 9.5/10.2 = 58,626$ gallons
Humidification	60,000	Estimated at 500 gallons/day * 120 days/year
Vacuum pump seal water	1,000,000	Based on engineering estimate of 4 gal/min * 30 minutes/hour * 24 hour/day * 365 days/year = 1,051,200 gallons
Miscellaneous laboratory water use	85,992	Calculated by difference: $3,348,292 - 150,000 - 1,930,300 - 63,000 - 59,000 - 60,000 - 1,000,000 = 145,992$
Total Water Use	3,348,292	From total metered supply, calculated below.
Water Supply		
City water supply	3,152,292	Metered total, October 2006 to September 2007
Reclaimed water supplied by graywater system	196,000	Metered from 7/10/06 to 11/6/07, prorated to 12 months: $(1,024,680 \text{ gal} - 763,590 \text{ gal}) \times 12/16 = 195,817$ gallons
TOTAL Water Supply	3,348,292	Average annual metered usage, April 2005 to March 2007

Kansas City STC City Water Use FY 2006, 2007



KCSTC City Water Use

Month	Gallons
Oct-05	204,218
Nov-05	212,447
Dec-05	198,234
Jan-06	115,948
Feb-06	118,940
Mar-06	102,483
Apr-06	154,847
May-06	229,652
Jun-06	406,940
Jul-06	626,120
Aug-06	532,613
Sep-06	243,865
Oct-06	243,865
Nov-06	106,971
Dec-06	71,813
Jan-07	111,460
Feb-07	97,995
Mar-07	89,766
Apr-07	115,200
May-07	166,816
Jun-07	283,512
Jul-07	539,345
Aug-07	641,829
Sep-07	683,720

Month by Month Water Balance Around Graywater System

Month	Graywater Demand			Graywater Supply				
	Total Cooling Tower Use	Toilet Use	Total Graywater Demand	Graywater Supply	RO Reject	AHU Condensate	Rainfall (inches)	Rainfall (gallons)
Oct-06	69,400	5,700	75,100	46,995	5,250	8,521	3.29	33,225
Nov-06	8,400	5,700	14,100	33,750	5,250	1,031	2.72	27,468
Dec-06	5,900	5,700	11,600	23,748	5,250	724	1.76	17,774
Jan-07	8,800	5,700	14,500	14,712	5,250	1,080	0.83	8,382
Feb-07	1,400	5,700	7,100	19,560	5,250	172	1.40	14,138
Mar-07	13,700	5,700	19,400	35,713	5,250	1,682	2.85	28,781
Apr-07	52,700	5,700	58,400	42,925	5,250	6,470	3.09	31,205
May-07	131,200	5,700	136,900	81,345	5,250	16,109	5.94	59,986
Jun-07	267,300	5,700	273,000	80,079	5,250	32,819	4.16	42,010
Jul-07	551,800	5,700	557,500	82,997	5,250	67,749	0.99	9,998
Aug-07	525,700	5,700	531,400	87,064	5,250	64,545	1.71	17,269
Sep-07	294,000	5,700	299,700	66,291	5,250	36,097	2.47	24,944
Total	1,930,300		1,998,700	615,180	63,000	237,000	31	315,180