Water Management Plan

United States Environmental Protection Agency
Research Triangle Park Campus

109 T.W. Alexander Drive
Research Triangle Park, NC 27711

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK CAMPUS

WATER MANAGEMENT PLAN

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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 wise, 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. As municipalities and regions deal with chronic drinking water shortages due to drought and changes in climate patterns, water conservation becomes even more important to the sustainability of our mission.

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's Research Triangle Park Campus (EPA-RTP). The plan is organized according to the Federal Energy Management Program (FEMP) Facility Water Management Planning Guidelines.

2.0 FACILITY DESCRIPTION

EPA-RTP is EPA's largest operation outside of Washington, D.C. in terms of people, buildings, and laboratories and is the Agency's major center for air pollution research and regulation, and health and environmental effects research. The campus consists of over 1.1 million square feet of offices, laboratories, computer and conference spaces, and child care facilities situated on 132 wooded acres. The EPA campus is situated on a 512 acre federally owned tract, shared with the National Institute of Environmental Health Sciences (NIEHS). A central feature of the wooded campus is a 28-acre lake situated between the EPA and NIEHS facilities. The lake is managed by NIEHS.

The EPA-RTP campus includes an office tower (Building C), four research wings housing over 400 laboratories (Buildings A, B, D, and E), and a High-Bay research building. Collectively, Buildings A through E and the High Bay are referred to as the Main Building and include 1,042,611 square feet of conditioned space. The EPA-RTP complex also includes a 95,322 square foot National Computer Center (NCC), and a 25,400 square foot Childcare Facility.

Main Building construction was completed in 2001. The facility was designed and built using sustainable practices, and is recognized by the Department of Energy as a “high performance building”. The NCC achieved a Silver rating from the U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED^{TM}) for New Construction program. The Childcare Facility has also achieved a Silver rating under the LEED-NC program.

Research activities include chemical and biological testing, materials testing, electronics laboratories, automobile testing, and other specialized research. The High Bay houses pilot-scale combustion research facilities, and large indoor air exposure chambers. The NCC is a state-of-the-art computer facility hosting computer training facilities, high performance scientific computers, and large-scale central computing systems. The Childcare Facility provides infant care, and 20 classrooms for toddlers through preschool aged children.

The EPA-RTP complex facilities are EPA-owned and EPA-operated. EPA also operates two other facilities in the RTP area, the Human Studies Facility (HSF) in Chapel Hill, and the Reproductive Toxicology Facility (RTF) in Durham. Water use and conservation at HSF and RTF are addressed in separate water management plans.

3.0 FACILITY WATER MANAGEMENT GOALS

The resource conservation goals of EPA-RTP are achieved through the implementation of its Environmental Management System (EMS). The EMS is established and implemented consistent with RTP’s Comprehensive EMS Implementation Policy. The EPA-RTP EMS policy statement and water management objectives and targets are provided in the following sections.

Environmental Management System Policy

The mission of the U.S. Environmental Protection Agency (EPA) is to protect human health and safeguard the natural environment. The Agency accomplishes this mission by setting standards for environmental protection, assisting others in reducing and preventing pollution, conducting research, sharing information and enforcing environmental standards.

It is a core value of EPA at Research Triangle Park (EPA-RTP) to serve as a model enterprise for environmental stewardship. To accomplish this, and to support the Agency’s mission, we must properly manage the environmental impacts of our own operations and facilities.

EPA-RTP is the Agency’s largest field operation. As such, we recognize our obligation and opportunity to provide leadership in protecting the environment, addressing emerging environmental issues, advancing the science and technology of risk assessment and risk management, and promoting environmental education.

We commit to reduce the environmental impacts of our operations and limit our natural resource consumption. Our comprehensive EMS framework will address the following goals:

- Develop a collaborative EMS that covers the EPA organizations in RTP;
- Comply with relevant environmental laws, regulations and other requirements which we subscribe;

- Seek to continually reduce the environmental impacts of EPA-RTP activities;
- Consider environmental impacts in planning, constructing and operating facilities;
- Incorporate source reduction and pollution prevention into research activities;
- Establish, track and review environmental performance goals associated with significant environmental aspects of day-to-day operations;
- Educate our employees about the EMS, seek their participation and involve them in making environmental improvements;
- Share information about our EMS with interested parties; and
- Strive to continually improve EPA-RTP's collective environmental performance.

Objectives and Targets

To fulfill this environmental policy, EPA-RTP has identified water consumption as a significant environmental aspect and has established reduction of water consumption intensity (measured on a gallon/square foot basis from a FY 2007 baseline) as an objective under its Water Management Environmental Management Program (EMP). The water management EMP lead is the Facility Energy Manager. With respect to this objective, EPA-RTP has established a target to reduce water use by 2 percent annually through the end of FY 2015, for a total reduction of 16 percent. As required under EO 13423 and the RTP EMP, this plan provides the FY 2007 baseline in Table 1.

4.0 UTILITY INFORMATION

Rate Schedule and Contact Information

Potable water and sewer service is provided by:

City of Durham
P.O. Box 30040
Durham, NC 27702-3040

919-560-4411

Water service is provided to the federal campus as a whole through two main meters that feed a water main the supplies the entire campus. EPA-RTP's portion of the water and sewer bill is prorated based on submetering conducted at Main Building, NCC, Childcare Facility, NIEHS, and a Central Utility Plant (CUP) that serves both EPA and NEIHS. Additional detail on the prorating algorithm is provided in Section 5 and Appendix B.

On average, in FY 2007, the cost for water and sewer service at EPA-RTP was $7.70 per 1,000 gallons.

Payment Office

Glen Lowery
Facility Management Support Division
US EPA, C604-01
Research Triangle Park, NC 27711

Phone: 919-541-0914

5.0 FACILITY WATER USE INFORMATION

EPA facilities at the RTP campus include the Main Building, Childcare Facility, and NCC. EPA shares the campus complex with NIEHS, and obtains High Temperature Hot Water (HTHW) and Chilled Water from a CUP operated by NIEHS. Water used at the Main Building, Childcare Facility, and NCC is measured directly by meters located at these buildings. In addition, EPA is responsible for a prorated share of water consumed at the CUP, based on a detailed accounting that apportions CUP water use between EPA and NIEHS based on the relative quantities of water-based utilities consumed by each, as described below.

Major Water Using Processes

Estimates of water consumption by major use area are provided in Table 1. These data reflect average annual facility water use between October 2006 and September 2007 (FY 2007).

Table 1. EPA-RTP Campus Major Water Using Processes (FY 2007)

Major Process	Annual Consumption (gallons)	Percent of Facility Total	Comments
Main Building			
Sanitary water (restroom use)	4,200,000	7.9	Engineering estimate
Cafeteria	500,000	0.9	Engineering estimate
Building A, cage and rack washing	7,800,000	14.7	Engineering estimate
Building A, animal watering, daily flush	800,000	1.5	Engineering estimate
Steam sterilizer tempering water	1,100,000	2.1	Engineering estimate
Non-contact cooling water, XRF lab	400,000	0.8	Engineering estimate
Non-contact cooling water, Dennis Tabor's lab	100,000	0.2	Engineering estimate
Vacuum pump seal water	500,000	0.9	Engineering estimate
Boiler blowdown tempering water – Building D basement	100,000	0.2	Engineering estimate
Boiler blowdown tempering water – Building B penthouse	500,000	0.9	Engineering estimate
Building A steam humidification condensate coolers	300,000	0.6	Engineering estimate
Softened water for boiler make-up and humidification	4,076,662	7.7	Metered quantities from softener log books
High bay cooling tower make-up water	2,100,000	4.0	Engineering estimate

Table 1. EPA-RTP Campus Major Water Using Processes (FY 2007)

Major Process	Annual Consumption (gallons)	Percent of Facility Total	Comments
Miscellaneous uses	851,745	1.6	Calculated by difference from metered subtotal
CUP make-up attributed to Main Building (almost all cooling tower makeup)	29,739,547	56.0	Water allocation algorithm (Appendix B)
RTP Main Total Water Use	**53,067,954** **=50.90 gal/ft^2**	100	Total of metered subtotal from building B and D meters, October 2006 to September 2007, and algorithm for the CUP allocation
National Computer Center			
Sanitary water (restroom use)	465,931	12.5	Metered total, October 2006 to September 2007
CUP make-up attributed to NCC (almost all cooling tower makeup)	3,254,666	87.5	Water allocation algorithm (Appendix B)
NCC Total Water Use	**3,720,597** **=39.03 gal/ft^2**	100	Total of building metered subtotal for October 2006 to September 2007, and algorithm for the CUP allocation
Childcare Facility			
Laundry	105,000	13.5	Engineering estimate
Sanitary water and kitchen	414,122	86.5	Calculated by difference
Childcare Total Water Use	**519,122** **=20.44 gal/ft^2**	100	Metered total

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

Measurement Devices

The Main Building is supplied by two water mains that enter in the Building B basement and Building D first floor. Each supply main is equipped with a meter; metered flow is recorded every 15 minutes in a central data management system (ION System provided by Duke Power). Both mains tie together within the facility to supply the entire Main Building complex. In addition, the cooling tower in the High Bay is equipped with a flow totalizing meter on the make-up line, also linked to the ION System.

NCC is equipped with a meter located where the water supply main enters the building in the mechanical room. Metered flow is recorded every 15 minutes in the ION System.

The Childcare Facility is equipped with a meter where the water supply main enters the building in the mechanical room. Data from this meter is not currently recorded but will be recorded monthly and reported to the Energy Manager under this plan.

CUP water use is measured and allocated between the Main Building, NCC, and NIEHS as follows (NIEHS is not addressed under this plan and the Childcare Facility does not receive utilities from the CUP). First, make-up water for the High Temperature Hot Water (HTHW) and cooling towers are each metered in the ION System. These two metered flows are apportioned between Main Building, NCC, and NIEHS based on hot water demand and the chilled water demand measured at each of the facilities, respectively (NCC has a chilled water demand only). Second, Non-metered other CUP water use is calculated as the difference between the total of the two water bill meters feeding the federal campus main line, minus all the direct measured water uses (EPA Building B and D meters, NCC direct meter, Childcare Facility direct meter, NIEHS direct meter, and the CUP direct meters described above). This other CUP water use is allocated between EPA Main Building, NCC, Childcare Facility and NIEHS on a prorated bases, based on the metered CUP water allocation described above. The method of allocating CUP water use is described in more detail in Appendix B.

Note that water source heat pumps at the Childcare Facility are tapped into the NCC chilled water return line. There is not a separate direct accounting of CUP water associated with the heat load from this use, which is anticipated to be minimal compared to NCC, the EPA Main Building, and NIEHS.

Duke Power is responsible for calibrating the ION System meters. The two water bill meters feeding the campus main line are calibrated by the city of Durham every 2 years.

Shut-off Valves

Shut off valves for each building are located upstream from the main water meters, described above.

Occupancy and Operating Schedules

EPA-RTP operates on a flex time schedule, one shift per day, Monday through Friday. An estimate of building occupancy is provided in Table 2.

Table 2. EPA-RTP Building Occupancy

Facility	Number of People
Main Building	1800 Adults
NCC	200 Adults
Childcare Facility	48 Adults, 188 Children

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. This target is incorporated into the EPA-RTP Water Management EMP as noted above. 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 14 possible areas to help facilities identify and target water use reductions. EPA-RTP has adopted BMPs in eight of the areas, as checked below:

☑ Water Management Planning
☑ Information and Education Programs
☑ Distribution System Audits, Leak Detection and Repair
☑ Water Efficient Landscaping
NA Water Efficient Irrigation
☑ Toilets and Urinals
☐ Faucets and Showerheads
☐ Boiler/Steam Systems
☑ Single-Pass Cooling Equipment
☐ Cooling Tower Management
☑ Commercial Kitchen Equipment
☑ Laboratory/Medical Equipment
NA Other Water Use
☐ Alternate Water Sources

NA – Not applicable.

Water Management Planning

This plan addresses the recommended elements of a water management plan and satisfies best management practice related to water management planning.

Information and Education Programs

Employees have been educated on water and other resource conservation topics through implementation of the RTP EMS. Water consumption is identified as a significant environmental aspect, and water management and water conservation are included as topics in annual EMS awareness training. Posters are used throughout the EPA facilities to call employee attention to the importance of water conservation. Use of the EMS program to educate 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 help desk, operated by the O&M contractor. Reported maintenance problems are assigned a work order, which is completed promptly by the O&M staff. Work orders are tracked until the job is completed and the work request closed out. In addition, O&M staff perform a visual inspection of core building and mechanical spaces each morning. Any leaks or other mechanical problems are corrected promptly. Janitors and security guards also are trained to report any observed problems to the O&M staff.

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

Under this plan, trends in monthly water use also will be monitored by the Energy Manager and changes that are not understood or expected will be investigated and resolved. In addition, on a quarterly basis, directly metered uses (Main Building Direct Water, Main Building CUP Water 1, NCC Direct Water, NCC CUP Water 1, and Childcare Direct Water) will be compared to the total EPA-RTP complex water consumption. If directly metered uses do not account for 90% or more of total consumption, action will be taken to identify and resolve the difference between direct metered uses and total consumption.

BMP status has been achieved in this area.

Water-Efficient Landscaping

The complex was designed with minimal impact on the native woodland landscape. Those areas that were impacted by site development are landscaped with native or drought tolerant plants, and no irrigation is required. No potable water is used for landscape irrigation. BMP status is achieved in this area.

Water-Efficient Irrigation

No potable water is currently used for landscape irrigation. On occasion, when spot watering is required for newly planted trees or shrubs, water is transported in a small tank carrier from the on-site lake, and applied via hand watering. However, the facility is equipped with a landscape irrigation system. The system consists of 4-inch distribution mains that run along one side of four of the campus roadways, fed from the 14-inch potable water main from two points. The 4-inch mains feed approximately 120 quick connect valves spaced approximately every 150 feet along the shoulders of both sides of the roads. The system is designed to supply up to 10 quick connect valves at a time for manual watering. The system has been valved off and is not in use. Because of the dispersed nature of the system, it presents a high risk for developing leaks. If this system is used in the future, the 4-inch distribution mains should be equipped with totalizing flow meters. If used, these meters should be routinely monitored, at least monthly, to track irrigation water use and check for leaks.

Toilets and Urinals

Toilets and urinals throughout EPA-RTP 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). In addition, non-water urinals have been installed in high traffic location on the ground floor of Building C, and the 6th floor of Building C. An inventory of sanitary fixtures is provided in Table 3.

Table 3. EPA-RTP Inventory of Sanitary Fixtures

Fixture Type	Flow Rate	Total Number
Toilets	1.6 gpf	291
Urinals	1.0 gpf	58
	Non-water	7
Lavatory faucets	2.0 gpm 0.5 gpm	213 total. Faucets at Main Building are 0.5 gpm. Faucets at NCC and Chilcare Facility are 2.0 gpm
Showers	1.5 gpm	15

gpf – gallons per flush.
gpm – gallons per minute.

Janitorial staff and employees are trained to report leaks or other maintenance problems to the facilities help desk, 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. The lavatory faucets in the Main Building have a flow rate of 0.5 gpm. The faucets in the NCC and Childcare Facility have maximum flows of 2.0 gpm.

Showerheads have been replaced with models that flow at 1.5 gallons per minute, for highly-efficient performance. Water pressure is 65 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 in the NCC and Childcare Facility with ones that have a maximum flow of 0.5 gpm.

Boiler/Steam Systems

HTHW is used to generate 70lb process steam in two steam generators located in Building D. This process steam is used in the high bay, animal rooms, cage and rack washers, and steam sterilizers. Process steam condensate is captured and returned to the boilers via a deaerator tank. The steam generators are blown down manually two times per day, with several short bottom blows of 5 to 10 seconds each. The boiler blowdown is routed to a flash tank, equipped with a temperature activated tempering water flow. Tempered blowdown flows to drain. Softened water is used to supply the steam generators with make-up water.

A gas-fired steam boiler is maintained in standby mode in Building A, ready to supply process steam in back-up capacity if the HTHW system is not operational. Steam condensate from this boiler is also recovered. Softened water is used to supply steam boiler make-up.

Clean steam is generated in the Building B penthouse, used for direct injection humidification in the seven Building A air handlers. The clean steam generators are supplied with deionized water generated through a reverse osmosis process. Excess condensate from the injection system in each air handler is routed through a condensate cooler, equipped with a temperature activated cooling water flow (note that softened water is used for tempering). Cooled condensate flows to drain. Periodic blowdown from the steam generator is routed to a flash tank, equipped with a temperature activated tempering water flow. Tempered blowdown flows to drain.

Routine preventive maintenance of steam traps and other components of the condensate recovery system will be implemented under this plan. In addition, routine inspection and maintenance if the temperature activated tempering water flows to the boiler blowdown coolers in the Building D basement (Room D-175) and Building B penthouse will be implemented to ensure that tempering water only flows when blowdown is occurring. Best Management status will be achieved once these procedures are in place.

HTHW is supplied to heat exchangers to make 170° F hot water for building heat, and domestic hot water. No condensate is generated from these operations.

Single-Pass Cooling

Single pass cooling was used in two laboratories in Building D, in one case to cool the temperature control unit on an X-ray fluorescence instrument, in another case to cool bench-scale, glass condensers on an experimental apparatus. This use in reflected in the water balance presented in Table 1, and reflects conditions in November 2007. These uses have now been eliminated and BMP Status has been achieved in this area.

Chilled water loop pumps in the CUP are cooled with single pass-cooling water. This water is captured and then pumped to the cooling tower basin as make-up water. The current configuration may lead to excess water consumption, since make-up water supplied via this route may be provided to the tower when there is no demand. Cooling the chilled water loop pumps with recirculating condenser water is being evaluated (see Section 9).

Cooling Tower Management

Two cooling tower systems are relevant to EPA RTP operation. First, EPA operates two, two-cell cooling towers, in parallel, to cool a process water loop for experimental equipment in the high bay. This cooling tower system is equipped with a conductivity controller to control blowdown. However, the control system is not used; instead, a continuous bleed from each tower is maintained by opening the drain line valve. This approach causes the towers to operate at less than two cycles of concentration, which is not efficient water use. In addition, the towers are not maintained regularly. Best management practice will be achieved under this plan by substantially upgrading tower operation, or relying on an alternate source for process cooling water in the high bay. See Section 9 for additional information.

Second, all other chilled water needs in the Main Building and NCC are supplied from the federal complex chilled water loop, which originates at the CUP. Chiller condenser cooling water at the CUP is cooled in two sets of cooling towers, a three-cell tower with 8,500 tons capacity, and a four-cell tower with 10,500 tons capacity. The CUP is operated by a contractor under the supervision of NIEHS. Cooling tower water chemistry is carefully monitored and controlled. Chemical treatment is provided to control scale and corrosion; treatment chemical addition rates are controlled to be proportional to the quantity of water blowdown. Conductivity meters set between 1,400 and 1,600 *u*S/cm are used to control blowdown. This provides approximately 8.5 cycles of concentration with average makeup water quality of 175 *u*S/cm, and a high degree of water efficiency.

Some recent changes in water chemistry of water supplied by the City of Durham have been affecting CUP cooling tower operation. The city began adding phosphate to the water supply in the summer of 2007 to prevent lead leaching within the water supply system. Phosphate dosing rates as high as 2.5 mg/L were measured in the city water used for make-up at the CUP. This presented a problem, because phosphate needs to be maintained at under 18 mg/l in the condenser water loop to prevent phosphate scale formation on heat exchange surfaces; 15 mg/L has been set as an upper limit of operation to provide some margin of safety. This required the conductivity controller set point to be dropped to 800 to 900 *u*S/Cm, to reduce cycles of concentration and associated phosphate build up. As of December 2007, the city has been more carefully controlling phosphate addition rates to below 1 mg/L, and the conductivity controller set point has been reestablished at 1,400 and 1,600 *u*S/cm. This situation and associated cooling tower water use will continue to be monitored under this plan[1]. The CUP cooling tower is operated under best management practices.

Commercial Kitchen Equipment

A full service cafeteria in Building C serves approximately 300 breakfast meals and 700 lunch meals per day. Table ware is washed in a tunnel washer; the washer is configured to recycle wash water and use fresh water only for final rinsing. Pots and other large items are washed at three pot washing sinks, each equipped with a kitchen faucet and pre-rinse sprayer. The pre-rinse sprayers are equipped with high-efficiency nozzles flowing at 1.6 gpm or less.

The Childcare Facility is equipped with a kitchen used to prepare lunchtime meals and snacks. Water using equipment includes a pot washing sink and an automatic dishwasher. The dishwasher is typically only run under full-load conditions. Best management practices have been adopted in this area.

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[1] Note that in November 2007, makeup water conductivity had increased to 266 *u*S/cm, possibly associated with prevailing drought conditions and associated impact on local water quality. If this situation persists, it will have a negative impact on cooling tower cycles and associated water efficiency.

Laboratory Equipment

Seven steam sterilizers are located throughout the Main Building, as indicated on Table 4. In several instances, as indicated on the table, condensate tempering water flows continuously, even when the sterilizer is not operating.

Table 4. EPA-RTP Steam Sterilizers

Room	Model	Continuous Water Flow (approximate rate)
E386	Amsco Century	No
A390E	Steris Eagle 3012	No
A490E	Steris Eagle 3012	No
A580	Amsco Steris 3000SL	Yes – 1 gpm
B478A	Amsco Steris 3000SL	Yes – 1 gpm
B367	Amsco Steris 3000SL	Yes – 0.5 gpm
B367	Amsco Steris 3000SL	Yes – 0.5 gpm

Best Management practice can be achieved by installing retrofit kits to eliminate the continuous flow of tempering water, or instituting operational controls to eliminate cooling water flow to times when the sterilizer is being used. These operational controls were implemented in November 2007 and will be maintained under this plan.

Building A houses an laboratory animal care operation. Animal cages are washed in two Basil 6000 tunnel washers. Racks are washed in two Basil 4600 walk-in rack washers. Collectively, the cage and rack washing operation is the most significant use of water at the Main Building. Under this plan, the operating schedule and operating sequence of the washers will be optimized to minimize the consumption of water. A second significant use of water associated with the animal care operation is the twice per day purge of the animal watering system. The system is purged to ensure that stagnant water does not accumulate in the system.

A central laboratory vacuum system is provided by three liquid ring vacuum pumps operated in parallel. On each pump, seal water is recirculated through a tank and heat exchanger. The heat exchanger is cooled with process chilled water to prevent excess heat build-up. Make-up water is periodically added to each recirculation tank through a solenoid valve activated using an automatic timer, to make-up for any water lost in the vacuum discharge, and to maintain water quality. Any excess water added is discharged to the drain. In November 2007, the control timer sequence was adjusted to minimize water use by reducing the water supply by two thirds.

Humidification is provided in A Building to maintain between 40 and 60 percent relative humidity in the animal rooms. Humidification is provided by directly injecting steam from a clean steam boiler into the Building A air handlers. Clean steam is provided by a steam boiler discussed above under steam generation. The clean steam boiler is supplied by a skid-mounted reverse osmosis (RO) system. Reverse osmosis reject water is routed through the clean steam generator blowdown flash tank, to provide some residual cooling on its way to the drain. A second RO system is available in the Building D/E penthouse, to provide direct injection humidification for Buildings D and E; however, this system is typically not used.

Water use in each of the areas discussed above has been minimized and BMP status is claimed in this area.

Other Water Use

Significant uses of water are discussed in the sections above, no other significant water uses have been identified.

Alternate Water Sources

Several alternate water sources are currently being evaluated, as described further in Appendix C. Best management practice can be established in this area if these alternate water sources are developed and adopted.

7.0 DROUGHT CONTINGENCY PLAN

EPA-RTP will follow the water use recommendations and restrictions of the City of Durham, North Carolina. Durham's Water Conservation Ordinance is available at:

http://www.ci.durham.nc.us/departments/wm/ordinance.cfm .

The ordinance establishes six stages of drought response:

Stage I - Continuing Voluntary Conservation Practices
Stage II - Voluntary Conservation
Stage III - Moderate Mandatory Conservation (30 % consumption reduction goal)
Stage IV - Severe Mandatory Conservation (50 % consumption reduction goal)
Stage V - Stringent Mandatory Conservation (Stage IV goals plus other restrictions)
Stage VI – Rationing (No industrial use of water)

The level of drought response is established by the City Manager and communicated through public announcements.

As a matter of general operating practice, the EPA-RTP already follows the applicable recommended water conservation practices up through the Stage III drought response level. Water is not used for landscape irrigation, maintenance of paved surfaces, or washing of mobile equipment.

Water reduction goals of 30 percent and greater for industrial and commercial enterprises are required beginning at the Stage III level. At the Stage V level, evaporative cooling devices that recycle water (such as cooling towers) can only be operated during "business hours." The Energy Manager met with Durham officials on January 11, 2008 and determined that business hours for a laboratory operation are 24 hours per day, 7 days per week. At Stage VI, all industrial uses of water are prohibited.

If a Stage III level drought or higher is declared, the Facility Management Support Division Director will convene a task force that includes the Facility Operations Branch Chief, Energy Manager, and representatives of Office of Research and Development to identify and implement modifications to facility operations to achieve additional specified reductions in water consumption. The Facility Management Support Division Director will document all actions taken.

Additional information related to Durham water management is available at:

http://www.ci.durham.nc.us/departments/wm/

8.0 COMPREHENSIVE PLANNING

The Energy 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 laboratory managers, the facility operations branch, and purchasing agents prior to the purchase and installation of any water using equipment. Where applicable, EPA RTP will purchase WaterSense® labeled products.

9.0 OPPORTUNITIES FOR FURTHER WATER CONSERVATION

EPA-RTP is implementing or considering several projects to achieve additional reductions in water use. These projects, along with the associated projected water savings and cost impacts, are provided in Table 5. In addition to projects to reduce water demand, EPA-RTP will also evaluate opportunities to recover and use water from alternate sources, such as rainwater, and air handler condensate. A preliminary analysis of these options in provided in Appendix C.

Table 5. EPA-RTP Water Conservation Opportunities

Building	Project Description	Projected Annual Savings: Water (gallons)	Projected Annual Savings: Water and Sewer Cost	Order of Magnitude Capital Cost Estimate	Simple Payback (Years)	Status (January 2009)
All	1) Replace urinals with non water, or high efficiency models (≤ 0.25 gpf).	750,000	$5,800	$180,000	31	Being Evaluated
All	2) Replace bathroom faucet end-of-spout flow controllers (aerators) with devices rated at 0.5 gpm.	500,000	$3,800	$3,000	≤ 1	Being Implemented
C	3) Replace cafeteria pre-rinse spray valves with high efficiency models (≤ 1.25 gpm).	60,000	$500	$300	≤ 1	Completed
A, B, D, E, High Bay	4) Provide regular preventative maintenance on steam condensate return system. Should reduce boiler makeup demand. See also project 12.	Not Quantified	Not Quantified	None	Immediate	Being Implemented
B, D	5) Repair/maintain control valves on tempering water flow to boiler blowdown flash tanks.	500,000	$3,800	None	Immediate	Being Implemented
D	6) Eliminate single pass cooling water in XRF Lab. Provide with recirculating chilled water.	400,000	$3,100[2]	$10,000	4	Completed
D	7) Eliminate single pass cooling water in Dennis Tabor Lab. Provide with recirculating chilled water.	100,000	$800[3]	$3,000	4	Completed
High Bay	8a) Eliminate use of High Bay cooling tower by replacing cooling towers with a heat exchange system tied into the EPA Main Building chilled water loop. An engineering feasibility study is required to determine if the chilled water loop can provide sufficient cooling capacity at the High Bay.	2,100,000	$16,000	Unknown, pending engineering feasibility study	Unknown	Under consideration
High Bay	8b) As an alternative to opportunity 8a, or until 8a is implemented, a regular cooling tower O&M and water chemistry monitoring protocol should be adopted. Protocol should include use of the conductivity controllers to control blowdown, achieving at least 6 cycles of concentration.	1,900,000	$14,000	None	Immediate	Being Implemented, cooling tower is currently off line, except when needed.

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[2] Cost savings will be partially offset by increased chilled water demand, or increased electrical plug loads, depending on approach implemented.

[3] Cost savings will be partially offset by increased chilled water demand, or increased electrical plug loads, depending on approach implemented.

Table 5. EPA-RTP Water Conservation Opportunities

Building	Project Description	Projected Annual Savings		Order of Magnitude Capital Cost Estimate	Simple Payback (Years)	Status (January 2009)
		Water (gallons)	Water and Sewer Cost			
A, B, E	9) Implement operational controls on steam sterilizers to stop flow of cooling water to sterilizers when they are not in use.	860,000	$6,600	None	Immediate	Completed
A	10a) Adjust animal cage and rack washing operating schedule to maximize efficiency and minimize days/times of operation.	1,600,000	$12,000	None	Immediate	Completed
A	10b) Animal cage and rack washing. Evaluate/ adjust sequence of washes and rinses in each washer to achieve additional water savings, if possible.	Unknown	Unknown	None	Immediate, if feasible	Being Evaluated
E	11a) Adjust timing on vacuum pump seal make-up water addition to reduce consumption.	340,000	$2,600	None	Immediate	Completed
E	11b) Reconfigure vacuum pump seal water recirculating tanks so pump seal water is added based on level control, rather than automatic timer.	160,000	$1,200	$15,000	13	Under Consideration
A, B, D	12) Install meters to monitor quantity of boiler feed and RO system make-up water use. Investigate and resolve any unexpected trends. Would allow tracking and optimization of significant laboratory water use.	Not quantified	Not quantified	$4,000	N/A	Under Consideration
Main Building	13) Install meters to monitor irrigation water use on water distribution network along roadways	Not quantified	Not quantified	$4,000	N/A	Under Consideration if distribution network is returned to service
CUP	14) Convert cooling water flow on chilled water pumps at CUP from single pass potable water to recirculated condenser water.	Not quantified	Not quantified	Project scope being developed by NIEHS		Being implemented by NIEHS
Childcare	15) Install ultra high efficiency clothes washers (water factor ≤ 5 gallon/ft3/cycle) in Childcare Facility.	60,000	$460	$2000	5	Under Consideration
A, B, C, D, E, CUP	16) Evaluate options to capture and use alternate sources of water such as roof-top rainwater and air handler condensate. Implement options that are cost effective. See Appendix C for additional information.					Being Evaluated

Appendix A

WATER USE AND WATER BALANCE SUPPORTING CALCULATIONS

EPA RTP Campus FY 2007 Water Use

Building	Total Annual Flow (Oct 2006 - Sept 2007)	Water Use Component	Estimated Annual Flow (gallons)	Basis of Estimate
New Main Core Laboratory (Building A, B, C, D, E)	23,328,407	Sanitary Water	4,200,000	1800 people * 9.3 gallon/day * 250 days
		Cafeteria	500,000	1000 meals/day * 2 gallons/meal * 250 days per year
		Building A, Cage and Rack Washing	7,800,000	100 gallon/minute * 60 minute/hr * 5 hours/day * 260 days/year
		Building A, Animal Watering Daily Flush	800,000	6 minutes/day * 3 gallon/minute * 118 units * 365 days/year
		Steam Sterilizer Tempering Water (4 Amsco Steris Model 3000SL, Rooms A580, B478, B367 (2))	1,100,000	4 Sterilizers * 0.5 gallon/minute * 60 minute/hr * 24 hours/day * 365 days/year
		Building D, XRF Lab, Non-contact cooling water	400,000	2 gallon/minute * 20 minute/hour *24 hours/day * 365 days/year
		Building D, Dennis Tabor's Lab, Non-contact condenser cooling	100,000	3 units * 1.5 liter/min * 1 gallon/3.785 liter * 60 minutes/hr *16 hrs/day * 100 days/year
		Vacuum Pump Seal Water	500,000	1 gallon/minute * 60 minute/hour * 24 hours/day * 365 days/year
		Steam Condensate Blowdown and Tempering - Building D Basement	100,000	0.25 gallon/minute * 60 minute/hour * 24 hours/day * 365 days/year
		Steam Condensate Blowdown and Tempering - Building B Penthouse	500,000	1 gallon/minute * 60 minute/hour * 24 hours/day * 365 days/year
		Building A, Steam Humidification Condensate Coolers	300,000	1 gallon/minute * 60 minute/hour * 24 hours/day * 180 days/year
		Softened Water for Boiler Make-up and Humidification	4,076,662	Total of readings from softener log books
		High Bay Cooling Tower Blowdown and Splashout	2,100,000	4 gallon/minute * 60 minute/hour * 24 hours/day * 365 days/year
		Unquantified miscellaneous uses	851,745	Calculated by difference based on metered building total
CUP	29,739,547	CUP Makeup Attributed to New Main	29,739,547	Per Water Use Algorithm
RTP Main Total	53,067,954		53,067,954	
NCC	465,931	Direct Meter (Primarily Sanitary)	465,931	Metered Total
CUP	3,254,666	CUP Makeup Attributed to NCC	3,254,666	Per Water Use Algorithm
NCC Total	3,720,597		3,720,597	
Childcare	519,122	Laundry	105,000	10 load/day * 250 days/year * 3.5 ft3/load * 12 gallon/ft3
		Sanitary and Kitchen	414,122	Calculated by difference based estimated building total
Childcare Total	519,122		519,122	Metered Total
Total	57,307,673		57,307,673	

Appendix B

WATER USE ALGORITHM

Summary of Proposed ION Algorithms for Reporting Water

Draft: 5-31-07

Section One: NEW MAIN Algorithms

DIRECT WATER: This value can be calculated using the ION system, trending data from midnight to midnight, the first day of the quarter until the first day of the next quarter. The total direct water for EPA is calculated by summing the direct water measured by the meters in Building D and in Building B.

CUP WATER: This value must consider two calculations: Metered CUP water and Non-Metered CUP water:

Metered CUP Makeup Water (Value #1):

- This value accounts for the High Temp Hot Water and Condenser water makeup at the CUP that can be attributed to the EPA.
- The ION meters available at the Central Utility Plant (CUP) allow for accurate trending of the makeup water used for both of these systems. An estimate of EPA's metered CUP makeup water can be calculated, by multiplying all HTHW makeup water by EPA's portion of the hot water load (EPA and NIEHS only), and multiplying all condenser water makeup by EPA's portion of the chilled water load (EPA, NIEHS, and NCC)

Other Non-Metered CUP Water (Value #2):

- This value accounts for all other water used at the CUP in order to run and operate the hot water and chilled water generating facility. This includes the chilled water makeup, and all potable and non-potable water consumed by the CUP, not previously metered by the makeup meters mentioned above.
- First, since this water is not directly metered, a calculation must be made in order to determine how much water needs to be attributed to "Other" non-metered CUP water. This can be done by adding together the two water bills (feeding the loop), and then subtracting all other known metered consuption values. These values include New Main Direct Water, New Main CUP Makeup Water, NCC Direct Water, NCC CUP Makeup Water, NIEHS Direct Water, NIEHS CUP Makeup Water, and Childcare Center Direct Water. Since the Childcare Center Direct Water consumption is not a metered endpoint on the ION system, EPA must manually read this meter and report this value to RMF each month. Also, even though it is not required for EPA to report NIEHS water consumption values, it is imperative that these values be known so that this calculation can be made. (See attachment One for this calculation)
- Second, now that the total "Other" non-metered CUP water is known, it must be determined how much of this water to attribute to EPA. This is done by multiplying this total by EPA's percentage of the total CUP makeup water, which is the best indication of EPA's overall impact on the plant's potable and non-potable water systems.

The SUM of these two values comprises the total CUP Water attributed to EPA.

Proposed New Main ION Algorithms for Reporting Water

Draft: 5-31-07

Building: **New Main**
Commodity: **Direct Water**

Value Name	Data Type	Metered Endpoint	Metered Value	
EPA Direct Water Area D	ION EEM Physical Data	EPA.AreaD	City Water gallons int	
SUM EPA Direct Water Area D	Calculated Data	Expression:	SUM([EPA Direct Water])	
EPA Direct Water Area B	ION EEM Physical Data	EPA.AreaB	City Water gallons int	
SUM EPA Direct Water Area B	Calculated Data	Expression:	SUM([EPA Direct Water])	
Total EPA Direct Water	Calculated Data	Expression:	[SUM EPA Direct Water Area D]+[SUM EPA Direct Water Area B]	<----------------- **VALUE TO REPORT**

Date Range: Fixed Date

	Start Date	Start Time	End Date	End Time	**EPA REPORTED VALUE** SUM New Main Direct Water (gal)
1Q FY 2007	10/1/2006	12:00 AM	1/1/2007	12:00 AM	5,709,516
2Q FY 2007	1/1/2007	12:00 AM	4/1/2007	12:00 AM	6,968,719
3Q FY 2007	4/1/2007	12:00 AM	7/1/2007	12:00 AM	
4Q FY 2007	7/1/2007	12:00 AM	10/1/2007	12:00 AM	

Building: **New Main**
Commodity: **CUP Makeup Water**

Value Name	Data Type	Metered Endpoint	Metered Value	
Boilers Makeup	ION EEM Physical Data	CUP105.BoilersMakeup	City Water gallons int	
SUM Boilers Makeup	Calculated Data	Expression:	SUM([Boilers Makeup])	
Cooling Tower Makeup	ION EEM Physical Data	CUP105.CoolingTowers	City Water gallons int	TOTALS ALL CUP MAKEUP METERS
SUM Cooling Tower Makeup	Calculated Data	Expression:	SUM([Cooling Tower Makeup])	
TOTAL CUP WATER	Calculated Data	Expression:	[SUM Cooling Tower Makeup]+[SUM Boilers Makeup]	
EPA HTHW gpm	ION EEM Physical Data	EPA.AreaD	Hot Water GPM	
NIEHS HTHW gpm 1	ION EEM Physical Data	BLD101.B_Basement	Hot Water GPM	
NIEHS HTHW gpm 2	ION EEM Physical Data	BLD101.F_Basement	Hot Water GPM	
NIEHS HTHW gpm	Calculated Data	Expression:	[NIEHS HTHW gpm 1]+[NIEHS HTHW gpm 2]	
SUM EPA HTHW gpm	Calculated Data	Expression:	SUM([EPA HTHW gpm])	CALCULATES New Main's PORTION OF CUP HTHW MAKEUP
SUM NIEHS HTHW gpm	Calculated Data	Expression:	SUM([NIEHS HTHW gpm])	
EPA and NIEHS HTHW gpm	Calculated Data	Expression:	[SUM EPA HTHW gpm]+[SUM NIEHS HTHW gpm]	
EPA Percent HTHW gpm	Calculated Data	Expression:	[SUM EPA HTHW gpm]/[EPA and NIEHS HTHW gpm]	
EPA HTHW MAKEUP	Calculated Data	Expression:	[EPA Percent HTHW gpm]*[SUM Boilers Makeup]	
EPA CHW kBtu	ION EEM Physical Data	EPA.AreaD	Chilled Water kBTU int	
SUM EPA CHW kBtu	Calculated Data	Expression:	SUM([EPA CHW kBtu])	
NIEHS CHW kBtu	ION EEM Physical Data	NIEHS.Direct_Water	Chilled Water kBTU int	
SUM NIEHS CHW kBtu	Calculated Data	Expression:	SUM([NIEHS CHW kBtu])	
NCC CHW kBtu	ION EEM Physical Data	NCC.Water	Chilled Water kBTU int	
SUM NCC CHW kBtu	Calculated Data	Expression:	SUM([NCC CHW kBtu])	CALCULATES New Main's PORTION OF CUP TOWER MAKEUP
Total CHW kBtu	Calculated Data	Expression:	[SUM EPA CHW kBtu]+[SUM NIEHS CHW kBtu]+[SUM NCC CHW kBtu]	
EPA Percent CHW kBtu	Calculated Data	Expression:	[SUM EPA CHW kBtu]/[Total CHW kBtu]	
EPA COOLING TOWER MAKEUP	Calculated Data	Expression:	[EPA Percent CHW kBtu]*[SUM Cooling Tower Makeup]	
EPA TOTAL CUP MAKEUP	Calculated Data	Expression:	[EPA COOLING TOWER MAKEUP]+[EPA HTHW MAKEUP]	<----------------- **VALUE #1**

(Accounts for all CUP makeup water associated with HTHW and CDW Systems attributed to New Main)

Date Range: Fixed Date

	Start Date	Start Time	End Date	End Time	**EPA REPORTED VALUE #1 (DOES NOT INCLUDE 0.8** SUM New Main CUP Makeup Water (gal)
1Q FY 2007	9/21/2006	12:00 AM	12/21/2006	12:00 AM	3,192,547
2Q FY 2007	12/21/2006	12:00 AM	3/21/2007	12:00 AM	2,754,390
3Q FY 2007	4/1/2007	12:00 AM	7/1/2007	12:00 AM	
4Q FY 2007	7/1/2007	12:00 AM	10/1/2007	12:00 AM	

Data Type	Details	Description
Bill Data	City Of Durham Bill # 3035051-5	This is the bill value, converted from Ccf to Gallons by multiplying by 748.

Bill Data	+	City Of Durham Bill # 6289300-2	This is the bill value, converted from Ccf to Gallons by multiplying by 748.
ION Data	-	EPA Direct Water	This is the result of the algorithm mentioned above.
ION Data	-	EPA CUP Makeup Water Value #1	This is the result of the algorithm mentioned above.
ION Data	-	NCC Direct Water	This is the result of the algorithm mentioned below.
ION Data	-	NCC CUP Makeup Water Value #1	This is the result of the algorithm mentioned below.
ION Data	-	NIEHS Direct Water	This is the result of the algorithm mentioned below.
ION Data	-	NIEHS CUP Makeup Water Value #1	This is the result of the algorithm mentioned below.
Manual Reading	-	Childcare Center Direct Water	This value needs to be read monthly and reported to RMF each month.

DETERMINES HOW MUCH BILLED WATER IS NOT ALREADY ACCOUNTED FOR

(TOTAL 1)

$$\frac{\text{(EPA CUP Makeup Water Value \#1)}}{\text{(EPA CUP Makeup Water Value \#1) + (NCC CUP Makeup Water Value \#1) + (NIEHS CUP Makeup Water Value \#1)}} = \textbf{\% Attributed to EPA}$$

DETERMINES HOW MUCH OF THIS VALUE TO ATTRIBUTE TO EPA

(TOTAL 1) **X** **(% Attributed to EPA)** **=** **TOTAL 2** **<---** **VALUE #2**

(Accounts for all other non-metered CUP water usage attributed to New Main)

Date Range: Fixed Date

	Start Date	Start Time	End Date	End Time	**EPA REPORTED VALUE #2 (DOES NOT INCLUDE 0.8** SUM New Main CUP Makeup
1Q FY 2007	9/21/2006	12:00 AM	12/21/2006	12:00 AM	(Cannot Calculate yet since no data is available for Childcare Center)
2Q FY 2007	12/21/2006	12:00 AM	3/21/2007	12:00 AM	
3Q FY 2007	4/1/2007	12:00 AM	7/1/2007	12:00 AM	
4Q FY 2007	7/1/2007	12:00 AM	10/1/2007	12:00 AM	

VALUE #1 + VALUE #2 <------------------------------ VALUE TO REPORT

Date Range: Fixed Date

	Start Date	Start Time	End Date	End Time	**EPA REPORTED TOTAL VALUE** SUM New Main CUP Makeup Water (gal)
1Q FY 2007	9/21/2006	12:00 AM	12/21/2006	12:00 AM	(Cannot Calculate yet since no data is available for Childcare Center)
2Q FY 2007	12/21/2006	12:00 AM	3/21/2007	12:00 AM	
3Q FY 2007	4/1/2007	12:00 AM	7/1/2007	12:00 AM	
4Q FY 2007	7/1/2007	12:00 AM	10/1/2007	12:00 AM	

Summary of Proposed ION Algorithms for Reporting Water (Continued)

Draft: 5-31-07

Section Two: NCC Algorithms

DIRECT WATER: This value can be calculated using the ION system, trending data from midnight to midnight, the first day of the quarter until the first day of the next quarter. The total direct water for NCC is calculated by trending a single metered endpoint measured by the meter in NCC.

CUP WATER: This value must also consider two calculations: Metered CUP water and Non-Metered CUP water:

Metered CUP Makeup Water (Value #1):

- This value accounts for the Condenser water makeup at the CUP that can be attributed to the NCC.
- The ION meters available at the Central Utility Plant (CUP) allow for accurate trending of the makeup water used for the Condenser water system. An estimate of NCC's metered CUP makeup water can be calculated by multiplying all Condenser water makeup water by NCC's portion of the chilled water load (EPA, NCC, and NIEHS).

Other Non-Metered CUP Water (Value #2):

- This value accounts for all other water used at the CUP in order to run and operate the hot water and chilled water generating facility. This includes the chilled water makeup, and all potable and non-potable water consumed by the CUP, not previously metered by the makeup meters mentioned above.
- First, since this water is not directly metered, a calculation must be made in order to determine how much water needs to be attributed to "Other" non-metered CUP water. This can be done by adding together the two water bills (feeding the loop), and then subtracting all other known metered consuption values. These values include New Main Direct Water, New Main CUP Makeup Water, NCC Direct Water, NCC CUP Makeup Water, NIEHS Direct Water, NIEHS CUP Makeup Water, and Childcare Center Direct Water. Since the Childcare Center Direct Water consumption is not a metered endpoint on the ION system, EPA must manually read this meter and report this value to RMF each month. Also, even though it is not required for EPA to report NIEHS water consumption values, it is imperative that these values be known so that this calculation can be made. (See attachment One for this calculation)
- Second, now that the total "Other" non-metered CUP water is known, it must be determined how much of this water to attribute to NCC. This is done by multiplying this total by NCC's percentage of the total CUP makeup water, which is the best indication of NCC's overall impact on the plant's potable and non-potable water systems.

The SUM of these two values comprises the total CUP Water attributed to NCC.

Proposed NCC ION Algorithms for Reporting Water

Draft: 5-31-07

Building: **NCC**
Commodity: **Direct Water**

Value Name	Data Type	Metered Endpoint	Metered Value	
NCC Direct Water	ION EEM Physical Data	NCC.Water	City Water gallons int	
SUM NCC Direct Water	Calculated Data	Expression:	SUM([NCC Direct Water])	<----------------- **VALUE TO REPORT**

Date Range: Fixed Date

EPA REPORTED VALUES

	Start Date	Start Time	End Date	End Time	SUM NCC Direct Water (gal)
1Q FY 2007	9/21/2006	12:00 AM	12/21/2006	12:00 AM	106,899
2Q FY 2007	12/21/2006	12:00 AM	3/21/2007	12:00 AM	111,390
3Q FY 2007	4/1/2007	12:00 AM	7/1/2007	12:00 AM	
4Q FY 2007	7/1/2007	12:00 AM	10/1/2007	12:00 AM	

Building: **NCC**
Commodity: **CUP Makeup Water**

Value Name	Data Type	Metered Endpoint	Metered Value	
Cooling Tower Makeup	ION EEM Physical Data	CUP105.CoolingTowers	City Water gallons int	TOTALS COOLING TOWER WATER MAKEUP
SUM Cooling Tower Makeup	Calculated Data	Expression:	SUM([Cooling Tower Makeup])	
EPA CHW kBtu	ION EEM Physical Data	EPA.AreaD	Chilled Water kBTU int	CALCULATES NCC'S PORTION OF CUP TOWER MAKEUP
SUM EPA CHW kBtu	Calculated Data	Expression:	SUM([EPA CHW kBtu])	
NIEHS CHW kBtu	ION EEM Physical Data	NIEHS.Direct_Water	Chilled Water kBTU int	
SUM NIEHS CHW kBtu	Calculated Data	Expression:	SUM([NIEHS CHW kBtu])	
NCC CHW kBtu	ION EEM Physical Data	NCC.Water	Chilled Water kBTU int	
SUM NCC CHW kBtu	Calculated Data	Expression:	SUM([NCC CHW kBtu])	
Total CHW kBtu	Calculated Data	Expression:	[SUM EPA CHW kBtu]+[SUM NIEHS CHW kBtu]+[SUM NCC CHW kBtu]	
NCC Percent CHW kBtu	Calculated Data	Expression:	[SUM NCC CHW kBtu]/[Total CHW kBtu]	
NCC COOLING TOWER MAKEUP	Calculated Data	Expression:	[NCC Percent CHW kBtu]*[SUM Cooling Tower Makeup]	<----------------- **VALUE #1**

(Accounts for all CUP makeup water associated with CDW System attributed to NCC)

Date Range: Fixed Date

EPA REPORTED VALUE #1 (DOES NOT INCLUDE 0.8

	Start Date	Start Time	End Date	End Time	SUM NCC CUP Makeup Water (gal)
1Q FY 2007	9/21/2006	12:00 AM	12/21/2006	12:00 AM	461,999
2Q FY 2007	12/21/2006	12:00 AM	3/21/2007	12:00 AM	462,714
3Q FY 2007	4/1/2007	12:00 AM	7/1/2007	12:00 AM	
4Q FY 2007	7/1/2007	12:00 AM	10/1/2007	12:00 AM	

Data Type		Details	Description	
Bill Data		City Of Durham Bill # 3035051-5	This is the bill value, converted from Ccf to Gallons by multiplying by 748.	DETERMINES HOW MUCH BILLED WATER IS NOT ALREADY ACCOUNTED FOR
Bill Data	+	City Of Durham Bill # 6289300-2	This is the bill value, converted from Ccf to Gallons by multiplying by 748.	
ION Data	-	EPA Direct Water	This is the result of the algorithm mentioned above.	
ION Data	-	EPA CUP Makeup Water Value #1	This is the result of the algorithm mentioned above.	
ION Data	-	NCC Direct Water	This is the result of the algorithm mentioned below.	
ION Data	-	NCC CUP Makeup Water Value #1	This is the result of the algorithm mentioned below.	
ION Data	-	NIEHS Direct Water	This is the result of the algorithm mentioned below.	
ION Data	-	NIEHS CUP Makeup Water Value #1	This is the result of the algorithm mentioned below.	
Manual Reading	-	Childcare Center Direct Water	This value needs to be read monthly and reported to RMF each month.	
		(TOTAL 1)		

$$\frac{\text{(NCC CUP Makeup Water Value \#1)}}{\text{(EPA CUP Makeup Water Value \#1) + (NCC CUP Makeup Water Value \#1) + (NIEHS CUP Makeup Water Value \#1)}} = \textbf{\% Attributed to NCC}$$

DETERMINES HOW MUCH OF THIS VALUE TO ATTRIBUTE TO NCC

(TOTAL 1) **X** **(% Attributed to NCC)** **=** **TOTAL 2** <--- **VALUE #2**

(Accounts for all other non-metered CUP water usage attributed to NCC)

Date Range: Fixed Date

EPA REPORTED VALUE #2 (DOES NOT INCLUDE 0.8

	Start Date	Start Time	End Date	End Time	SUM NCC CUP Makeup Water (gal)
1Q FY 2007	9/21/2006	12:00 AM	12/21/2006	12:00 AM	(Cannot Calculate yet since no data is available for Childcare Center)
2Q FY 2007	12/21/2006	12:00 AM	3/21/2007	12:00 AM	
3Q FY 2007	4/1/2007	12:00 AM	7/1/2007	12:00 AM	
4Q FY 2007	7/1/2007	12:00 AM	10/1/2007	12:00 AM	

VALUE #1 + VALUE #2 <------------------------------ **VALUE TO REPORT**

Date Range: Fixed Date

EPA REPORTED TOTAL VALUE

	Start Date	Start Time	End Date	End Time	SUM NCC CUP Makeup Water
1Q FY 2007	9/21/2006	12:00 AM	12/21/2006	12:00 AM	(Cannot Calculate yet since no data is available for Childcare Center)
2Q FY 2007	12/21/2006	12:00 AM	3/21/2007	12:00 AM	
3Q FY 2007	4/1/2007	12:00 AM	7/1/2007	12:00 AM	
4Q FY 2007	7/1/2007	12:00 AM	10/1/2007	12:00 AM	

(Attachment One): Proposed NIEHS ION Algorithms

Draft: 5-31-07

Building:	**NIEHS**
Commodity:	**Direct Water**

Value Name	Data Type	Metered Endpoint	Metered Value
NIEHS Direct Water Area B	ION EEM Physical Data	BLD101.B_Basement	City Water gallons int
SUM NIEHS Direct Water Area B	Calculated Data	Expression:	SUM([NIEHS Direct Water])
NIEHS Direct Water Area F	ION EEM Physical Data	BLD101.F_Basement	City Water gallons int
SUM NIEHS Direct Water Area F	Calculated Data	Expression:	SUM([NIEHS Direct Water])
Total NIEHS Direct Water	Calculated Data	Expression:	[SUM NIEHS Direct Water Area B]+[SUM NIEHS Direct Water Area F]

Date Range: Fixed Date

	Start Date	Start Time	End Date	End Time	SUM New Main Direct Water (gal)
1Q FY 2007	10/1/2006	12:00 AM	1/1/2007	12:00 AM	8,319,322
2Q FY 2007	1/1/2007	12:00 AM	4/1/2007	12:00 AM	8,892,970
3Q FY 2007	4/1/2007	12:00 AM	7/1/2007	12:00 AM	
4Q FY 2007	7/1/2007	12:00 AM	10/1/2007	12:00 AM	

Building:	**NIEHS**
Commodity:	**CUP Makeup Water (1)**

Value Name	Data Type	Metered Endpoint	Metered Value	
Boilers Makeup	ION EEM Physical Data	CUP105.BoilersMakeup	City Water gallons int	
SUM Boilers Makeup	Calculated Data	Expression:	SUM([Boilers Makeup])	
Cooling Tower Makeup	ION EEM Physical Data	CUP105.CoolingTowers	City Water gallons int	TOTALS ALL CUP MAKEUP METERS
SUM Cooling Tower Makeup	Calculated Data	Expression:	SUM([Cooling Tower Makeup])	
TOTAL CUP WATER	Calculated Data	Expression:	[SUM Cooling Tower Makeup]+[SUM Boilers Makeup]	
EPA HTHW gpm	ION EEM Physical Data	EPA.AreaD	Hot Water GPM	
NIEHS HTHW gpm 1	ION EEM Physical Data	BLD101.B_Basement	Hot Water GPM	
NIEHS HTHW gpm 2	ION EEM Physical Data	BLD101.F_Basement	Hot Water GPM	
NIEHS HTHW gpm	Calculated Data	Expression:	[NIEHS HTHW gpm 1]+[NIEHS HTHW gpm 2]	
SUM EPA HTHW gpm	Calculated Data	Expression:	SUM([EPA HTHW gpm])	CALCULATES NIEHS'S PORTION OF CUP HTHW MAKEUP
SUM NIEHS HTHW gpm	Calculated Data	Expression:	SUM([NIEHS HTHW gpm])	
EPA and NIEHS HTHW gpm	Calculated Data	Expression:	[SUM EPA HTHW gpm]+[SUM NIEHS HTHW gpm]	
NIEHS Percent HTHW gpm	Calculated Data	Expression:	[SUM NIEHS HTHW gpm]/[EPA and NIEHS HTHW gpm]	
NIEHS HTHW MAKEUP	Calculated Data	Expression:	[NIEHS Percent HTHW gpm]*[SUM Boilers Makeup]	
EPA CHW kBtu	ION EEM Physical Data	EPA.AreaD	Chilled Water kBTU int	
SUM EPA CHW kBtu	Calculated Data	Expression:	SUM([EPA CHW kBtu])	
NIEHS CHW kBtu	ION EEM Physical Data	NIEHS.Direct_Water	Chilled Water kBTU int	
SUM NIEHS CHW kBtu	Calculated Data	Expression:	SUM([NIEHS CHW kBtu])	
NCC CHW kBtu	ION EEM Physical Data	NCC.Water	Chilled Water kBTU int	
SUM NCC CHW kBtu	Calculated Data	Expression:	SUM([NCC CHW kBtu])	CALCULATES NIEHS'S PORTION OF CUP TOWER MAKEUP
Total CHW kBtu	Calculated Data	Expression:	[SUM EPA CHW kBtu]+[SUM NIEHS CHW kBtu]+[SUM NCC CHW kBtu]	
NIEHS Percent CHW kBtu	Calculated Data	Expression:	[SUM NIEHS CHW kBtu]/[Total CHW kBtu]	
NIEHS COOLING TOWER MAKEUP	Calculated Data	Expression:	[NIEHS Percent CHW kBtu]*[SUM Cooling Tower Makeup]	
NIEHS TOTAL CUP MAKEUP	Calculated Data	Expression:	[NIEHS COOLING TOWER MAKEUP]+[NIEHS HTHW MAKEUP]	

Date Range: Fixed Date

	Start Date	Start Time	End Date	End Time	SUM NIEHS CUP Makeup Water (gal)
1Q FY 2007	9/21/2006	12:00 AM	12/21/2006	12:00 AM	1,696,874
2Q FY 2007	12/21/2006	12:00 AM	3/21/2007	12:00 AM	1,518,405
3Q FY 2007	4/1/2007	12:00 AM	7/1/2007	12:00 AM	
4Q FY 2007	7/1/2007	12:00 AM	10/1/2007	12:00 AM	

Appendix C

ALTERNATE WATER SUPPLY AND REUSE OPTIONS

Background

EPA RTP OARM and operations staff convened a brainstorming meeting on December 5, 2007 to identify potential opportunities for alternate water supply or water reuse. At that meeting, all significant sources of water supply and water demand were considered. Potential alternate supplies or reuse supplies were identified, as well as potential demand opportunities they could be paired with. The ideas generated were then evaluated by the meeting participants to identify the supply sources that could potentially provide water of sufficient quantity and quality to be viable. Similarly, meeting participants screened the demand opportunities to identify those with sufficient magnitude, quality requirements, and supply configuration to be viable. Potential supply and demand opportunities identified at that brainstorming session are presented in Table C1.

Table C1 - Potential Alternate or Reuse Water Supply and Demand Opportunities

Water Supply	Water Demand
• AHU Condensate (mostly summer) • Roof Top "Rain Harvesting" • Lake Water • Groundwater (wells)	• Cage and Rack Washing • CUP Cooling Tower Make-up (mostly summer) • Humidification/Steam (mostly winter)

Subsequent to the brainstorming meeting, further technical research and discussions with state officials indicated that using groundwater wells for additional water supply at EPA-RTP was not advisable, and this opportunity was eliminated from further consideration.

Based on the list in Table C1, we conducted further evaluation to pair the supply and demand opportunities into specific options. When conducting this analysis, we determined it was most appropriate to think about the lake as a storage unit associated with rain or stormwater events, rather than a stand alone supply point.

Five potential options for using alternate or reuse water supplies were developed and evaluated. The options were developed with a goal of matching supplies with demands, considering generation and use patterns over time, and the physical locations of the impacted systems. The options are listed in Table C2, and discussed in the following sections.

Table C2 - Options to Use Alternate Water Supplies

Option	Supply	Storage Method	Demand
1	1. Air handler condensate (Building A)	Tank	Cage and Rack Washing (Building A)
2	2. Air handler condensate (Buildings A, B, D, and E)	Tank – limited, use as generated	CUP Cooling Tower Make-Up
3	3. Rainwater harvesting (Building A Roof)	Tank	Cage and Rack Washing (Building A)
4	4. Rainwater harvesting (Main Building and CUP roof)	Lake	CUP Cooling Tower Make-Up
5	Rainwater harvesting (CUP roof)	Tank	CUP Cooling Tower Make-up

On the demand side, we did not develop and option for steam generation or humidification. The very high water quality requirements associated with those uses, necessary to prevent scale formation, and air quality concerns associated with using an alternate water supply for humidification, led us to conclude that cage and rack washing and cooling tower make-up would be better destinations for any alternate water supplies developed.

Option 1: Air handler condensate from Main Building A captured and used for cage and rack washing

Water Balance Considerations:
Air handler condensate is a seasonal source of water, as most of the air conditioning occurs during the summer months. To limit cost and infrastructure impacts, this option is limited to reusing air handler condensate from Building A in cage and rack washing operations, also conducted in Building A. The quantity of air handler condensate generated was calculated by first determining the difference between the quantity of water supplied to the EPA-RTP buildings and the water measured in the sewer monitoring station associated with those buildings. The flow in the sewer exceeds the water supplied, with a peak flow in August. This difference between supply and discharge quantity is attributed to air handler condensate. The condensate flow was then prorated among the 25 laboratory air handlers on an equal portion basis. The volume of water attributed to Building A’s seven air handler units fluctuates from around 0 gallons in winter (December through March) to approximately 460,000 gallons per month in August, as shown in Figure C1. Cage and rack washing is operational year round (four days per week) with a steady demand estimated at 520,000 gallons of water per month (direct measurement data is not available). If 100 percent of the air handler condensate from Building A is captured and used for cage and rack washing operations, the resulting potential savings associated with this option is approximately 1.7 million gallons per year.

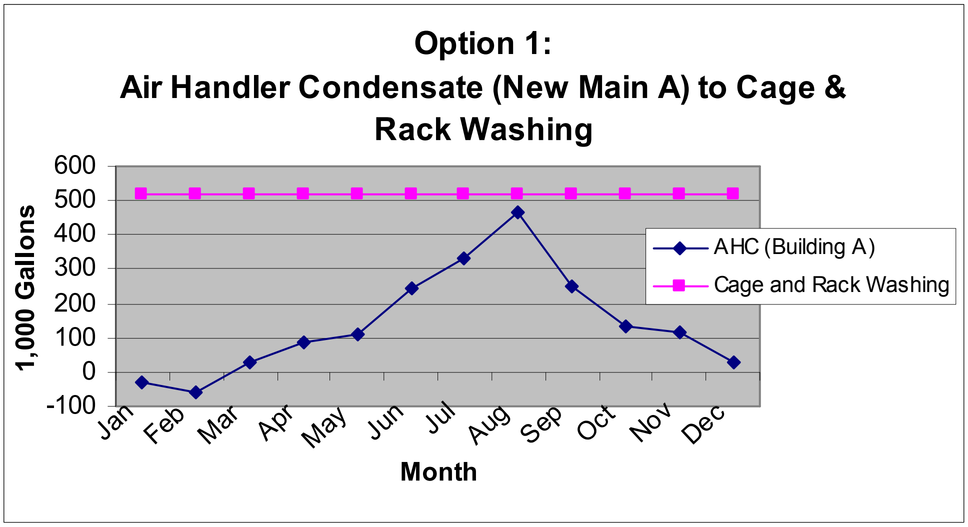

Figure C1. Air Handler Condensate (Building A) Supply vs Cage and Rack Washing Demand

Storage Considerations:
The demand of approximately 30,000 gallons per day for cage and rack washing operations occurs four days per week under the typical operating schedule. To provide maximum captured flow to cage and rack washing, it is assumed that three days of air handler condensate storage would be provided at the maximum generation rate. This approach would allow condensate to be collected over the entire weekend, assuming draw down for cage and rack washing operations begins on the third day. This is roughly equivalent to 50,000 gallons of storage necessary for the air handler condensate. As an alternative, the storage tank could be sized to capture one day of condensate flow at the maximum flow rate, or approximately 20,000 gallons. This approach would allow for all condensate to be captured during most of the year, and flow during the week (when the cage and rack washing operation is drawing water out on a daily basis) during the peak summer months. Condensate flow during the weekends during the peak summer months would not be captured with the smaller storage tank. With the smaller storage volume, there would not be sufficient capacity to capture condensate when generation rates exceeded 300,000 gallons per month. This approach would reduce projected savings from 1.7 to 1.5 million gallons per year.

Complexity/Cost Considerations:
This option is of moderate cost and complexity because it will require some change to existing infrastructure to pipe air handler condensate from the seven air handler units in Main Building A to a storage tank (20,000 to 50,000 gallons), which then needs to be piped for use in cage and rack washing operations, also in Building A. The plumbing configuration to the cage and rack washing system would need to be configured and controlled to allow use of condensate when it is available, and potable city water when it is not.

Quality Considerations:
Condensate is drawn from the atmosphere, and should be relatively pure and of sufficient quality to use in cage and rack washing. However, it may be necessary to continually monitor the quality of the water to ensure that the condensate has not been cross contaminated with cooling fluid in

the air handler. This monitoring may be as simple as installing an automated conductivity meter in the feed line to the storage tank, with appropriate alarms and controls.

Thermodynamic Considerations:
Air handler condensate is typically cold (50^{o}F). Using this water for cage and rack washing will create some energy penalty compared to using a supply of city water at ambient conditions. However, this penalty may be minimized as the temperature can be equalized to some degree by storage at ambient conditions.

Option 2: Air handler condensate from all of Main Building (Buildings A, B, D, E) for use as CUP cooling tower make-up

Water Balance Considerations:
Both air handler condensate generation and cooling tower make-up requirements are seasonal in nature, with peak supply and demand occurring in the hot, humid summer months. Cooling tower make-up water is also the largest demand of water at EPA-RTP. To significantly impact the amount of municipal water used for cooling tower water make-up, it may be necessary, as presented in this option (see Figure C2), to utilize condensate from all 25 air handler units in Main Buildings A, B, D, and E. This would provide approximately 6 million gallons of reusable water per year, which is approximately 18 percent of the EPA-RTP's annual cooling tower make-up consumption.

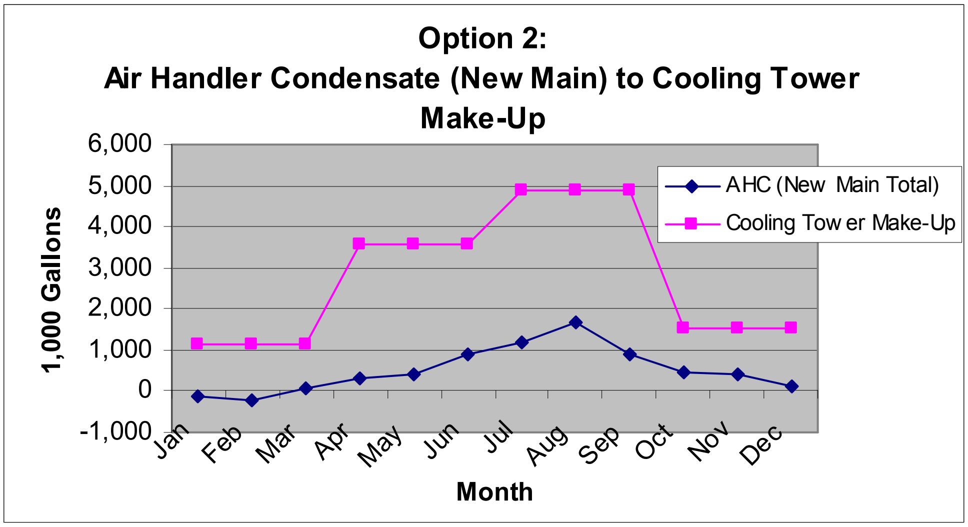

Figure C2. Air Handler Condensate (All Main Building) Supply vs CUP Cooling Tower Make-Up Water Demand

Storage Considerations:
Storage under this option would be minimal, as the patterns for supply of air handler condensate and demand of cooling tower make-up are synchronized. Condensate can be routed to the cooling towers as it is generated. Only storage capacity to efficiently capture and convey the condensate would be required.

Complexity/Cost Considerations:
This option is potentially complex and costly, compared to the other options, because it requires condensate from 25 air handlers in 4 buildings to be piped to a central header system. In addition, there is a minimum traverse of at least 1,000 feet to convey condensate from the Main Building to the CUP, even if a direct route can be established. This distance could be significantly greater if direct routing is not possible.

Quality Considerations:
Air handler condensate is drawn from the atmosphere and should be of sufficient quality for direct use in the CUP cooling towers. Condensate has typically has a very low dissolved solids content, and therefore should help increase cooling tower cycles of concentration.

Thermodynamic Considerations:
This option would have a positive thermodynamic impact, as the cold condensate would help cool the water in the cooling tower.

Option 3:Rainwater harvesting from Main Building A roof stored in a tank and transferred for use in cage and rack washing

Water Balance Considerations:
The amount of rainfall that can be harvested per month is dependent upon the amount of precipitation and the volume of area over which the precipitation is captured. This works out to equal approximately 560 gallons of water per inch of rain per 1,000 square feet of capture area. Rooftop area from Main Building A (estimated from Google satellite imagery) is approximately 16,000 square feet. To estimate the potential volume of rainwater that can be captured given this rooftop area, we downloaded monthly precipitation data from the State Climate Office of North Carolina for Durham from January 2004 through January 2008 and averaged the precipitation for each month. Rainwater captured from the rooftop of Building A has the potential to generate on average approximately 32,000 gallons per month or 390,000 gallons of reusable water per year (see Figure C3). Cage and rack washing demand is around 520,000 gallons per month or 6.2 million gallons per year.

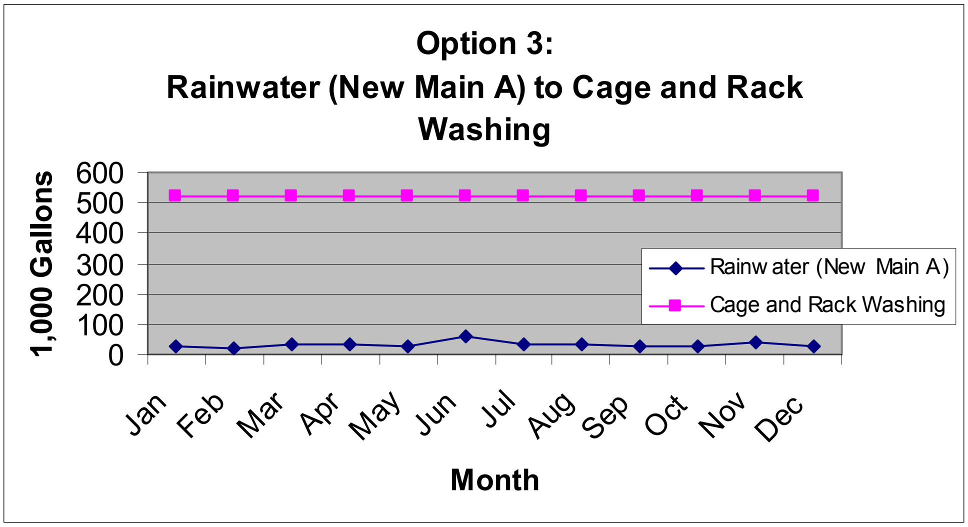

Figure C3. Rainwater Supply from Main Building A Rooftop vs Cage and Rack Washing Demand

Storage Considerations:
Data from the Southeast Regional Climate Center indicates that on average, for the Raleigh Durham area, the probability of a precipitation event over a 24-hour period that totals greater than an inch is unlikely (less than 5 percent). A 10,000 gallon storage tank would be able to capture a rainfall event of up to an inch, so would serve as a practical size for a storage vessel. This quantity of water would be consumed in less than one day by the cage and rack washing operation.

Complexity/Cost Considerations
This option is of moderate cost and complexity as it would require changes to existing infrastructure to capture rainwater from the Main Building A rooftop, pipe rainwater to a storage tank, and then transfer that water for use in cage and rack washing operations. Annually, rainwater is only capable of providing about six percent of the water demand for cage and rack washing.

Quality Considerations
Rainwater will carry accumulated dirt and debris from the building roof, so will require some filtration and possibly disinfection prior to use in the cage and rack washers.

Thermodynamic Considerations
None.

Option 4: Rainwater from all Main Building, High-Bay, and CUP rooftops pumped from lake for use in CUP cooling tower make-up

Water Balance Considerations:
Rooftop area from Main Buildings A, B, C, D, and E, the High-Bay building, and the CUP (estimated from Google satellite imagery) is approximately 190,000 square feet. To estimate the potential volume of rainwater that can be captured given this rooftop area, we downloaded

monthly precipitation data from the State Climate Office of North Carolina for Durham from January 2004 through January 2008 and averaged the precipitation for each month. Rainwater captured from these rooftops has the potential to generate on average approximately 4.6 million gallons of reusable water per year (see Figure C4). EPA's share of CUP cooling tower make-up demand is approximately 33 million gallons per year.

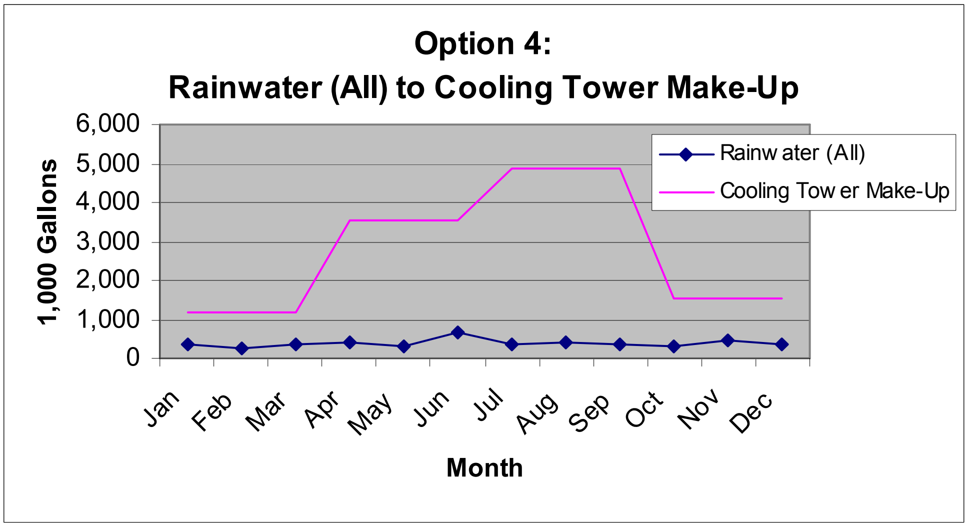

Figure C4. Rainwater Supply (All) vs Cooling Tower Make-Up Demand

Storage Considerations:
With this option, the most practical storage unit is the lake, which would be used to draw rainwater for use in cooling tower make-up demand. Thus no additional storage is necessary as all rainwater is currently routed to the lake. Note that once roof rain water is mixed with lake water, the quality of the water will be degraded and additional treatment may be necessary to achieve quality requirements for cooling tower make-up water. At present, virtually all rainwater runoff for south of the dam, including all rooftop runoff, in collected in the lake. However, the existing dam outlet structure does not allow the management of the capacity to "store" this runoff. Increasing the lake storage capacity will require modifying the outlet structure. However, pumping from the lake, without changing the storage capacity, should be considered.

Complexity/Cost Considerations:
The cost and complexity of this option is relatively low as no significant change to rainfall collection infrastructure or additional storage is necessary. A pump station would need to be established at the lake and transfer piping constructed from the lake to the CUP, a linear distance of at least 700 feet. In addition to engineering considerations, permission would need to be obtained to make surface water withdrawals from the lake for use as cooling tower make-up water.

Quality Considerations:
Cooling tower make-up demand requires water that is low in solids and hardness. Investigation of lake water quality with respect to these parameters will be necessary to determine if lake water is of sufficient quality for use as cooling tower make-up water.

Thermodynamic Considerations:
None.

Option 5: Rainwater harvesting from CUP rooftop stored in a tank for use in cooling tower make-up

Water Balance Considerations:
Rooftop area from the CUP (estimated from Google satellite imagery) is approximately 55,000 square feet. To estimate the potential volume of rainwater that can be captured given this rooftop area, we downloaded monthly precipitation data from the State Climate Office of North Carolina from January 2004 through January 2008 and averaged the precipitation for each month. Rainwater captured from the CUP rooftop has the potential to generate on average approximately 1.3 million gallons of reusable water per year (see Figure C5). Annually CUP rooftop rainwater can supply approximately 4 percent of EPA's share of the CUP cooling tower demand.

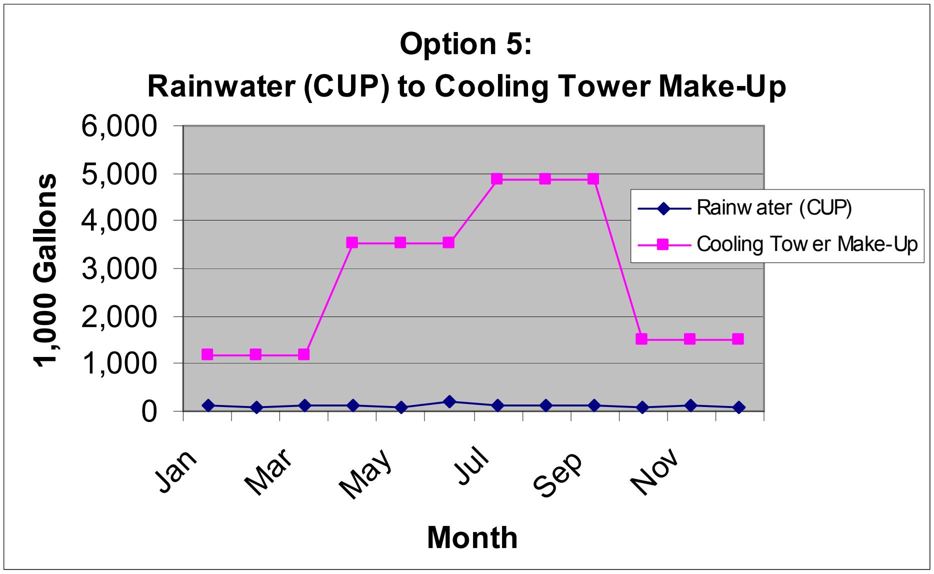

Figure C5. Rainwater Supply (CUP Rooftop) vs Cooling Tower Make-Up Demand

Storage Considerations:
Data from the Southeast Regional Climate Center indicates that on average, for the Raleigh Durham area, the probability of a precipitation event over a 24-hour period that totals greater than an inch is unlikely (less than 5 percent). A 30,000 gallon storage tank would be able to capture a rainfall event of up to an inch, so would serve as a practical size for a storage vessel. This quantity of water would be consumed in less than one day by the cooling tower make-up.

Complexity/Cost Considerations:
This option is of moderate to high cost and complexity as it would require changes to existing infrastructure to capture rainwater from the CUP rooftop, pipe rainwater to a storage tank, and then transfer that water for use in cooling tower make-up. Annually, rainwater is only capable of providing about four percent of the water demand for cage and rack washing.

Quality Considerations:
Rainwater is expected to be of sufficient quality for use as cooling tower make-up water.

Thermodynamic Considerations:
None.

Summary of Options

The key aspects of each option are summarized in Table C3.

Option 2 (air handler condensate from all of the Main Building used in cooling tower make-up) offers the highest level of potential savings, but also the highest level of technical challenge. This option is attractive if the challenge of collecting water from multiple sources and transferring it to the CUP can be addressed. Option 1 (air handler condensate from Building A used in cage and rack washing) offers a simpler approach for the use of air handler condensate, but with reduced water savings. Potential ORD concerns related to use of an alternate water source will need to be addressed for Option 2 to be viable.

Option 4 (rainwater from all buildings pumped from lake for use in cooling tower make-up) is an attractive option if permission is obtained to draw water from the lake. Option 4 as presented here focuses only on rooftop rainwater; however, the option could be expanded to address runoff from paved surfaces as well. Option 5 (rainwater from CUP rooftop used for cooling tower make-up) provides an alternative to Option 4, if it is not possible to draw water from the lake, or if the lake water quality is not sufficient for cooling tower make-up. Option 3 (rainwater from Building A used in cage and rack washing) appears to be the least favorable rainwater harvesting option, although it is the one rainwater option that could be implemented by EPA without NIEHS coordination.

Table C3 - Summary of Water Reuse Options

Option	Supply	Storage	Demand	Potential Annual Savings (gal)	Value of Recovered Water	Water Storage Capacity Required (gal)	Projected Complexity/ Cost	Water Quality	Thermodynamic Considerations
1	Air handler condensate (Building A)	Tank	Cage & Rack Washing	1,700,000	$13,000	50,000	Moderate	Good, monitor	Negative
				1,500,000	$12,000	20,000			
2	Air handler condensate (All Main Building)	Tank	Cooling Tower Make-Up	6,000,000	$47,000	Minimal	High	Good	Positive
3	Rainwater (Building A rooftop)	Tank	Cage & Rack Washing	390,000	$2,700	10,000	Moderate	Good	None
4	Rainwater (All)	Lake	Cooling Tower Make-Up	4,600,000	$35,000	None (Lake)	Low, but need permission to tap Lake water	Investigate	None
5	Rainwater (CUP rooftop)	Tank	Cooling Tower Make-Up	1,300,000	$10,000	30,000	Moderate to High	Good	None