# Water Management Plan
Revision 2

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Atlantic Ecology Division
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EPA

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**
**REGION 1**
**NATIONAL HEALTH AND ENVIRONMENTAL RESEARCH LABORATORY**
**ATLANTIC ECOLOGY DIVISION**
**NARRAGANSETT, RHODE ISLAND**

# WATER MANAGEMENT PLAN, REVISION 2

Approved by:

10/30/2014

Mr. Russ Ahlgren, Facilities Manager — Date

10/30/2014

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## 1.0 IDENTIFIED WATER CONSERVATION OPPORTUNITIES

In May 2014, a water use and conservation assessment was conducted at the U.S. Environmental Protection Agency's (EPA's) National Health and Environmental Effects Research Laboratory (NHEERL) Atlantic Ecology Division (AED) in Narragansett, Rhode Island. Under this Water Management Plan, AED will consider implementing the potential water conservation and management opportunities identified during the water assessment, which are summarized in Table 1.

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

## 2.0 BACKGROUND AND PURPOSE

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

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

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

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

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

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

**Table 1. Potential Water Conservation Opportunities, AED**

| Suggested Priority | Project Description | Project Cost | Potential Water Savings (gallons) | Potential Energy Savings (MMBtus) | Potential Utility Cost Savings | Potential Payback (years) |
|---|---|---|---|---|---|---|
| 1 | Install 0.5 gallons per minute (gpm) faucet aerators on 15 existing faucets flowing at either 1.5 gpm or 2.2 gpm. [COMPLETED FOLLOWING ASSESSMENT] | $380 | 74,000 | N/A[a] | $500 | 0.8 |
| 2 | Replace two existing showerheads flowing at greater than 1.75 gpm with WaterSense labeled models flowing at 1.75 gpm or less. [COMPLETED FOLLOWING ASSESSMENT] | $60 | 2,000 | N/A[a] | $10 | 6.0 |
| 3 | Install plumbing to route recovered air handler condensate to the cooling towers to use as make-up water. [PROJECT CURRENTLY IN DESIGN] | $10,000 | 145,000[b] | -0.5[c] | $1,600 | 6.3 |
| 4 | Replace one existing urinal that flushes at 1.0 gallons per flush (gpf) with a WaterSense labeled model flushing at 0.125 gpf. [COMPLETED FOLLOWING ASSESSMENT] | $1,000 | 5,000 | N/A | $30 | 33.3 |

[a] Potential energy savings is expected to be negligible, as the majority of AED's hot water is provided by a solar hot water system.
[b] This potential water savings estimate is based on actual air handler condensate recovered and used for cooling AED's dissolved oxygen system vacuum pump, which only operates during intermittent periods. If air handler condensate was routed to the cooling towers to use as make-up water, it is likely that even more condensate could be collected and utilized to offset make-up water needed at the cooling tower. In addition, there is expected to be some ancillary cooling tower water use reductions from the increase in cycles of concentration achieved from the low-conductivity condensate.
[c] It takes a small amount of electricity to pump the air handler condensate to the towers to be used as make up water.

## 3.0 FACILITY INFORMATION

AED is a state-of-the-art aquatic research facility under EPA's Office of Research and Development (ORD). It is located approximately 30 miles south of Providence, Rhode Island, on an 11-acre site overlooking the West Passage of Narragansett Bay. AED's 13 buildings provide 89,922 square feet for research and research-support activities.

The AED facility is owned and operated by EPA. The majority of the space (approximately 66,000 square feet) is contained in a main laboratory/office building complex that houses the reception area, administrative support and scientific staff office space, conference rooms, dry- and wet-laboratory space, seawater tempering equipment, and space for the storage of scientific samples. Other structures include the support services building, containing various workshops, field operations spaces, and boat storage; a pier and associated pump house that provides seawater to the laboratory; and the hazardous materials building containing segregated waste and chemical supplies. Additional activities take place in various small external structures such as the pollutant abatement building, walk-in cold storage, and a greenhouse.

AED has two marine wet-laboratory facilities. The original wet laboratory, which is the smaller of the two, contains two microcosm rooms, one marine algae culture chamber, 10 wet tables, and office space for scientific staff. The main wet laboratory, constructed in the mid-1970s, contains the following areas: a high-hazard testing area, a low-hazard testing/holding area, a marine algae/plant laboratory, a general purpose and glass fabrication shop, a seawater filtration system room, and an electronic control room. Seawater can be supplied to laboratory spaces either unfiltered (i.e., directly from Narragansett Bay) or filtered before use. Both types of water can be temperature-controlled by heating and cooling.

Approximately 126 employees work at AED year-round, with an additional 20 personnel on site during the summer season. The laboratory operates on a flex time schedule and is typically occupied between 5:30 a.m. and 7 p.m., Monday through Friday.

## 4.0 WATER MANAGEMENT GOALS

AED achieves its resource conservation goals by implementing the ORD Multi-Site Laboratory Environmental Management System (EMS) program. Within the EMS and otherwise, ORD's collective water management goals include:

- Annually, achieve the Agency ConservW targets (set by EPA's Sustainable Facilities Practices Branch) as a cumulative total of all seven ORD locations.

- By September 30, 2014, identify at least one water conservation project or stormwater management project for ORD to complete in FY 2015 and obtain funding.

## 5.0 WATER USE INFORMATION

AED uses potable water primarily for cooling tower make-up, a temporary steam boiler system, research, and restroom use. Discussed further in Section 5.3, AED's potable water use has decreased since the FY 2007 baseline year. The following sections provide additional details on AED's water use.

### 5.1 Water Supply

United Water Rhode Island provides AED's potable water service, and the University of Rhode Island provides AED's sewer service.

In September 2009, AED installed a 200,000-gallon aboveground storage tank to provide consistent water pressure for the fire suppression system. Potable water to service the fire suppression system is provided by the local water utility but is not metered.

Seawater is obtained directly from the bay via a pump house mounted on a pier at approximately 300 gallons per minute (gpm). After flowing through the various supply headers, wet labs, and microcosms, the seawater is collected and returned to the bay.

## 5.2 Meters and Submeters

Incoming potable water supplied by United Water of Rhode Island is provided through four metered service lines, as indicated in Table 2.

**Table 2. AED Metered Water Service**

| Meter Number | Meter Location |
|---|---|
| 51211228 | Support services building |
| 51211231 | Hazardous materials building |
| 60499954 | Main laboratory #1 |
| 60589808 | Main laboratory #2 |

AED also meters cooling tower make-up and blowdown lines.

AED reads all meters at least monthly and monitors water use trends on an ongoing basis. Unexpected changes in water use are investigated and resolved.

## 5.3 Historical Water Use

In response to EO 13423, AED set a FY 2007 potable water use intensity baseline of 29.28 gallons per gsf. In FY 2013, water use intensity had decreased to 22.09 gallons per gsf—a 24.5 percent reduction compared to the FY 2007 baseline. Figure 1 illustrates AED's potable water use intensity from FY 2007 to FY 2013.

As described in Table 3, AED has completed several water efficiency projects to contribute to its water use reduction.

**Figure 1. Annual Potable Water Use Intensity, AED, FY 2007–FY 2013**

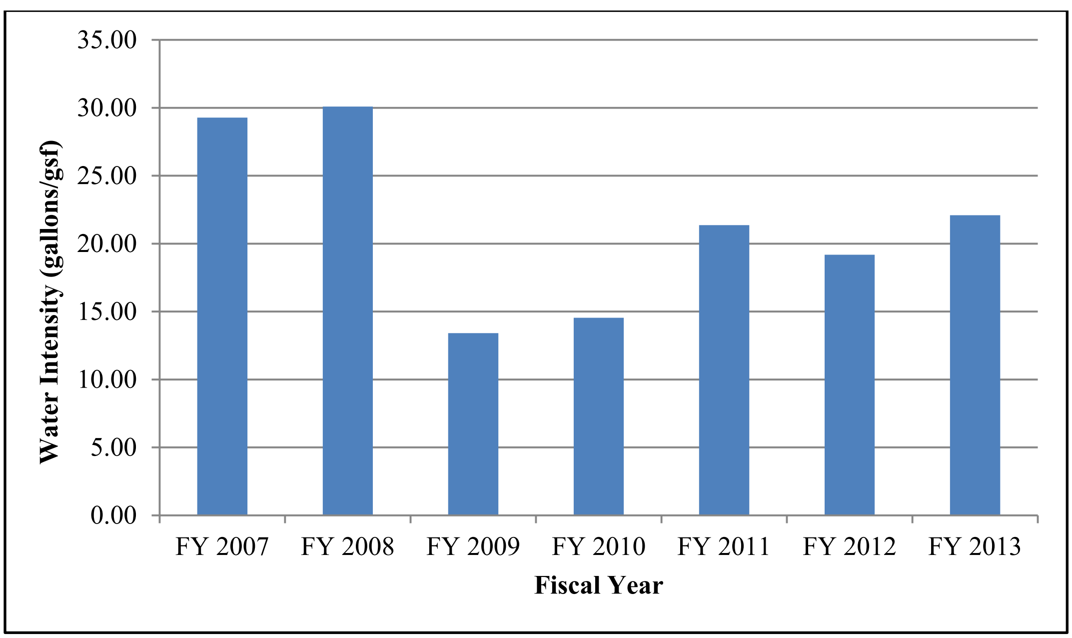


**Table 3. Completed Water Efficiency Projects Since FY 2007, AED**

| Project | Implementation Cost | Estimated Annual Water Savings (gallons) | Completion Year | Additional Notes |
|---|---|---|---|---|
| Steam boilers | Unknown | 12,000 | FY 2013 | AED replaced its steam boilers with a recirculating hot water system, which eliminated the need to blow down water from the boilers. |
| Rainwater collection/reuse | $5,000 | 2,000 | FY 2011 | AED began collecting rainwater to irrigate the green roof and to water greenhouse plants. |
| Air handler condensate recovery | $5,000 | 145,000 | FY 2011 | AED installed an air handler condensate recovery system to collect condensate and route it to the dissolved oxygen system vacuum pump to use as cooling water. AED plans to plumb the recovered condensate to the cooling towers to use as make-up water in the future. |
| Toilets | Unknown | Unknown | FY 2008 | AED replaced all of its toilets except two with dual-flush fixtures offering 1.6 and 1.1 gpf flushing options. |
| Urinals | $9,500 | 65,000 | FY 2008 | AED renovated its restrooms and replaced eight of its nine urinals with high-efficiency, 0.125 gpf models or non-water models. |
| Faucets | Unknown | 40,000 | FY 2008 | AED installed high-efficiency faucet aerators on eight of its 23 faucets. |

## 5.4 End Uses of Water

Table 4 and Figure 2 describe the end uses of water at AED. Figure 3 illustrates AED's water use by source.

Figure 4 provides a graph of AED's quarterly potable water use in FY 2013. The graph illustrates AED's seasonal water use pattern, which can be attributed to higher cooling tower make-up water use in the summer months and the use of a temporary, portable steam boiler during the winter of 2012-2013.

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

## Table 4. Major Water Uses, AED, FY 2013

| Major Process | FY 2013 Annual Water Use (gallons) | Percent of Total Potable Water Use (%) | Estimated Utility Costs[a] | Supporting Calculations and Source Documentation |
|---|---|---|---|---|
| **Potable Water Use** | | | | |
| Cooling tower make-up (potable water) | 533,800 | 26.9 | $3,600 | FY 2013 metered total. |
| Temporary steam boiler system | 510,000 | 25.7 | $3,500 | Engineering estimate based on difference between 1st and 2nd Quarter meter readings from FY 2012 and 1st and 2nd Quarter meter readings from FY 2013. Temporary boiler was only installed during FY 2013. |
| Research and other miscellaneous uses | 493,899 | 24.9 | $3,400 | Calculated by difference from known total water use and all other calculated water uses. |
| Restroom fixtures | 231,000 | 11.6 | $1,600 | Engineering estimate based on fixtures installed, occupancy, and daily usage factors. |
| Dissolved oxygen (DO) system vacuum pump (potable water) | 140,000 | 7.0 | $900 | Engineering estimate based on instantaneous measurements. Collected air handler condensate water offset 145,000 gallons of total water use. |
| Support services building (restroom fixtures, boat washing, dive locker) | 47,127 | 2.4 | $300 | FY 2013 metered total. |
| Deionized (DI) water | 25,970 | 1.6 | $200 | Engineering estimate based on daily meter readings from seven DI units taken from April 1, 2014 to May 15, 2014. Extrapolated for a full year. |
| **Total Potable Water Use** | **1,986,826** | **100** | | FY 2013 metered total. |
| **Onsite Alternative Water Use** | | | | |
| Dissolved oxygen system vacuum pump (air handler condensate) | 145,000 | - | - | Average metered total from FY 2012 and FY 2013. |
| Rainwater collection for green roof/greenhouse watering | 2,000 | - | - | Engineering estimate. |
| **Total Water Use** | **2,131,826** | **100** | | Sum of potable and onsite alternative water use. |

[a] Utility cost is calculated using the most current water and sewer rates available. Water service is at a rate of $2.91 per 1,000 gallons. Sewer service is provided at a rate of $3.88 per 1,000 gallons.

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

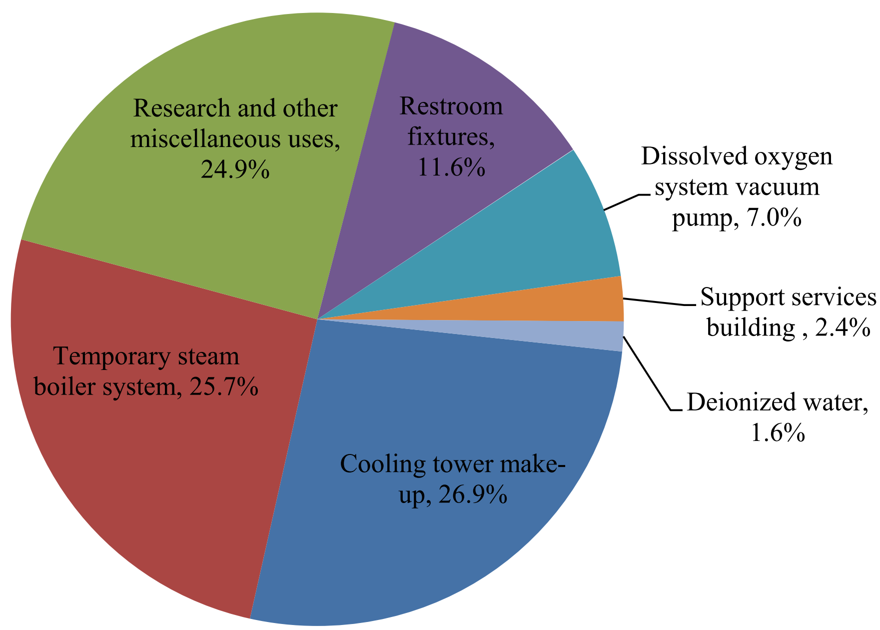



**Figure 3. Percentage of Water Use by Source, AED, FY 2013**

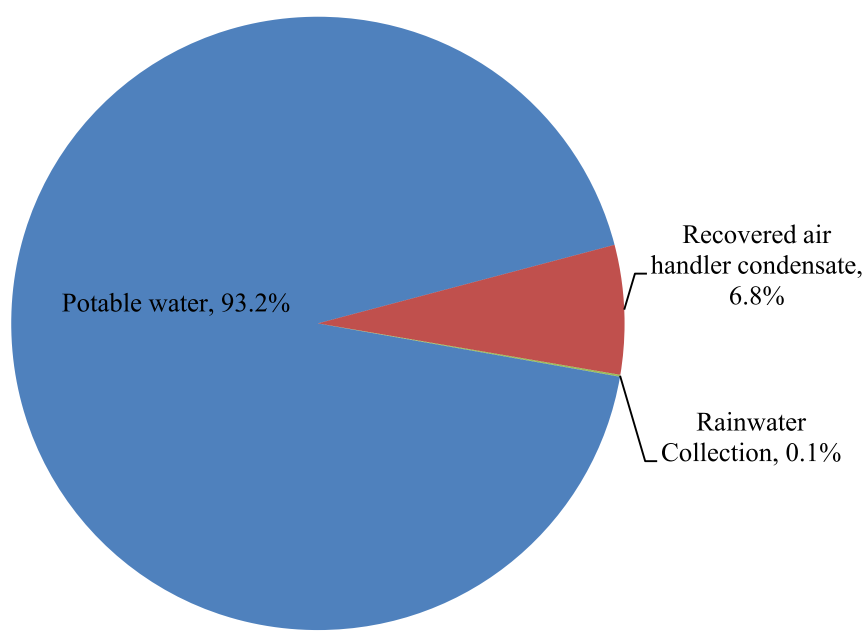
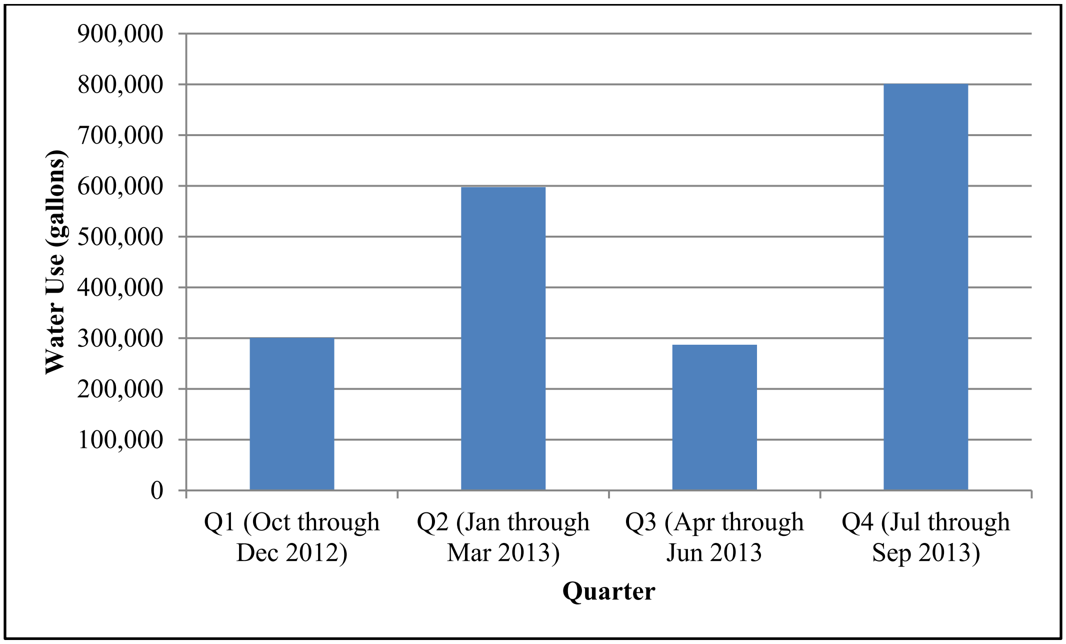


**Figure 4. Quarterly Water Use, AED, FY 2013**




**Cooling Tower Make-Up**

AED installed two cooling towers in 2001, each with a cooling capacity of 150 tons. Cooling tower make-up is the largest water end use at AED, accounting for nearly 27 percent of AED's total annual water use. The building operations and maintenance (O&M) contractor monitors and maintains cooling tower system performance regularly, reads and records make-up water flows daily, and maintains a conductivity meter to automatically control cooling tower blowdown. The incoming city water used for make-up has a conductivity around 150 microSiemens per centimeter (*u*S/cm). The conductivity target for the system is 800 to 1,000 *u*S/cm. This conductivity set point provides for approximately 5 to 7 cycles of concentration and efficient cooling tower water use.

A cooling tower maintenance contractor provides chemical treatment quarterly to control scale and corrosion. The contractor routinely monitors the cooling system water quality for optimum performance and understands that water conservation is one of AED's operational goals.

AED installed a system to collect condensate from the primary laboratory air handling units. Currently, this condensate is used as cooling water for a dissolved oxygen (DO) system vacuum pump that is used for research. Since the DO system vacuum pump is not used consistently, collected air handler condensate is not always fully utilized and is sometimes discharged to the sewer system. To utilize all condensate recovered from the air handlers, AED will consider installing additional plumbing to route the condensate to the cooling towers. If dedicated to the cooling towers, the condensate could offset 145,000 gallons or more of potable water currently used for make-up water (if not used for the DO system vacuum pump). In addition, because the condensate is very low in conductivity and mineral content, utilization of this water within the cooling tower could potentially improve the cycles of concentration.

### Temporary Steam Boiler System

Until October 2012, AED was equipped with two steam boilers that produced low-pressure steam. The steam was delivered to shell and tube heat exchangers to produce hot water that was circulated through preheat coils, reheat coils, perimeter radiation, and seawater processing heat exchangers. Steam was also used to produce domestic hot water in a steam heat exchanger. Between October 2012 and October 2013, AED upgraded its heating plant and eliminated the steam boiler system. The new system generates recirculated hot water and eliminates the need for steam boiler blowdown, saving approximately 12,000 gallons of water annually. In addition to the new recirculated hot water system, AED also installed a new solar hot water system that provides domestic hot water throughout the building. A natural gas-fired hot water heater provides supplemental hot water heating if required, although the facilities management staff estimate that the solar hot water system fulfills all of AED's hot water needs.

Between the removal of the old steam boiler system and the time the new recirculating hot water system became operational, a temporary, portable steam boiler system was utilized to provide steam to heat the facility. Because the temporary system did not have condensate recovery, it used a significant amount of water while in operation. It is estimated that the steam boiler consumed 510,000 gallons of water while in operation, accounting for approximately 26 percent of AED's total water use in FY 2013. Since the temporary system is no longer being utilized, this water use will not continue.

### Research and Other Miscellaneous Uses

AED uses another quarter of its water on mission-related research. AED operates some laboratory equipment including a steam sterilizer and glassware washers. This equipment is used intermittently. The steam sterilizer is a standalone system that utilizes high pressure steam generated from a built-in boiler. It is used approximately once per month. No tempering water flows when the sterilizer is not in use.

Water is used as necessary in individual laboratories for bench scale experimentation and glassware preparation. Occasionally, laboratory scientists test safety showers and eyewashes to assure proper functionality.

### Restroom Fixtures

AED uses approximately 12 percent of its water on restroom use. Where feasible, all restrooms have been renovated to include high-efficiency fixtures [dual-flush toilets with 1.6 and 1.1 gallons per flush (gpf) options and 0.125 gpf or non-water urinals]. Twenty-one of AED's 23 toilets have dual-flush flushometer valves installed. The remaining two toilets are tank-type toilets that flush at 1.5 gpf and 1.6 gpf. Of the nine urinals at AED, seven are non-water urinals, one flushes at 0.125 gpf, and one is an Energy Policy Act (EPAct)-complaint 1.0 gpf urinal. The non-water urinals are maintained by the janitorial staff using an aggressive cleaning, snaking, and cartridge changing regimen.

Eight of AED's 23 faucets have been retrofit with high-efficiency aerators flowing at 0.375, 0.5, or 0.895 gallons per minute (gpm). The remaining 15 faucets have flow rates of either 1.5 gpm or 2.2 gpm.

Of the five showerheads installed at AED, four are high-efficiency models flowing at 2.0 gpm or less. The remaining showerhead meets EPAct requirements (2.5 gpm).

Janitorial staff and employees are trained to report leaks or other maintenance problems to the facilities maintenance helpline. Reported problems are assigned a work order, which is completed by the facility O&M contractor. Work orders are tracked in an electronic database though completion and close out.

Table 5 provides a summary of AED's restroom fixtures.

**Table 5. Restroom Fixtures Inventory, AED**

| Fixture Type | Flow Rate | Total Number |
|---|---|---|
| Toilets | 1.6 gpf | 1 |
| | 1.5 gpf | 1 |
| | Dual flush (1.6 gpf/1.1 gpf) | 21 |
| Urinals | 1.0 gpf | 1 |
| | 0.125 gpf | 1 |
| | Non-water | 7 |
| Lavatory faucets | 2.2 gpm | 14 |
| | 1.5 gpm | 1 |
| | 0.895 gpm | 3 |
| | 0.5 gpm | 1 |
| | 0.375 gpm | 4 |
| Showerheads | 2.5 gpm | 1 |
| | 2.0 gpm | 1 |
| | 1.5 gpm | 1 |
| | 1.375 gpm | 2 |

To reduce restroom water use, AED will consider replacing its 15 faucets flowing above 1.0 gpm with faucets or faucet aerators that flow at 0.5 gpm. The 0.5 gpm flow rate is lower than the EPAct requirement for faucets and is compliant with the American Society of Mechanical Engineers/Canadian Standards Association (ASME/CSA) standard for lavatory faucets in public use. This flow rate is sufficient for hand washing and is considered a best practice for lavatory sinks in public settings.

In addition, AED will consider replacing its 2.5 and 2.0 gpm showerheads with WaterSense labeled models flowing at 1.75 gpm or less to further reduce restroom water use.

### Dissolved Oxygen System Vacuum Pump

AED operates a liquid-ring vacuum pump to maintain vacuum on an experimental apparatus to strip gas from seawater for DO analysis. The water used to maintain the liquid ring is recirculated through a reservoir, and when the pump is operating, water is allowed to continuously overflow the reservoir to remove excess heat generated by the pump. The DO system is used sporadically as experiments warrant its use.

Currently, AED recovers air handler condensate and directs it to a storage tank to use as cooling water for the vacuum pump. In FY 2013, while the DO vacuum pump was operational, AED utilized 145,000 gallons of collected condensate, offsetting that same amount of potable water that would have been needed for the vacuum pump.

**Support Services Building**

AED's support services building, which contains various workshops, field operations spaces, and boat storage, accounts for approximately 2 percent of AED's total water use. Water use at the support services building is mainly from restroom fixtures and use of the dive lockers.

**Deionized Water Use**

AED has several deionized water systems installed. DI water is generated through cartridge resin beds and blended with seawater to reduce the salinity of water supplied to the wet laboratory areas where estuary research is conducted. Each DI system is carefully monitored and controlled. Table 6 provides an inventory of DI systems and estimated water use from each.

**Table 6. DI Systems Inventory, AED**

| DI System | Location | Rooms/Labs Served | Meter Type | Estimated Annual Water Use (gallons) |
|---|---|---|---|---|
| DI-2 | Mezzanine – East (south end) | G-06, M-04, M-06, M-07 | Culligan | 240 |
| DI-4 | Mezzanine – West (north end) | 133, 138, 139 | Mettler Toledo Thornton 200CR | 17,600 |
| DI-5 | Mezzanine – West (south end) | 140, 141 | Thornton 200CR | 160 |
| DI-6 | Mezzanine – East (north end) | 143, 144, 145, 146, 147, 148 | Mettler Toledo Thornton M300 | 160 |
| DI-7 | Wet lab – East (outside G-14) | Wet lab | Balsbaugh 900 | 120 |
| DI-8 | Mezzanine – East (south end) | 154, 147A, wet lab sink (near supply lift) | Balsbaugh 900 | 1,360 |
| DI-9 | Mezzanine – East (south end) | Dish room, Room 172 | Balsbaugh 900 | 11,200 |

**Fire Suppression System Testing**

AED tests its fire suppression system for approximately one hour once per week. Fire suppression system water use is not metered or billed by United Water Rhode Island. AED uses approximately 62,000 gallons per year for this purpose.

**Rainwater Collection**

In FY 2011, AED installed a system that collects rainwater from a section of the facility's roof drains and holds it in two 600-gallon tanks. The collected rainwater is used to irrigate the green roof during dry periods and to water plants within the facility's greenhouse.

## 6.0 DROUGHT CONTINGENCY PLAN

AED will follow the water use recommendations and restrictions of United Water of Rhode Island, which typically establishes its drought response actions in coordination with the towns of Narragansett and Kingston. The overall drought management approach in Rhode Island is coordinated under the Rhode Island Drought Management Plan, which is available online at: http://www.wrb.state.ri.us/work_programs_drought.html.

As a matter of general operating practice, AED already follows most of the water conservation approaches that are recommended or could be required under drought conditions. Water is not used for decorative fountains, maintenance of paved surfaces, or landscape irrigation, and motor vehicles are washed at commercial car washes.

When voluntary or mandatory water use restrictions are instituted by United Water of Rhode Island, the requirements are communicated to the Facilities Manager. The Facilities Manager assembles a task force of facility and operating personnel to identify and implement modifications to facility operations to achieve specified water use reduction.