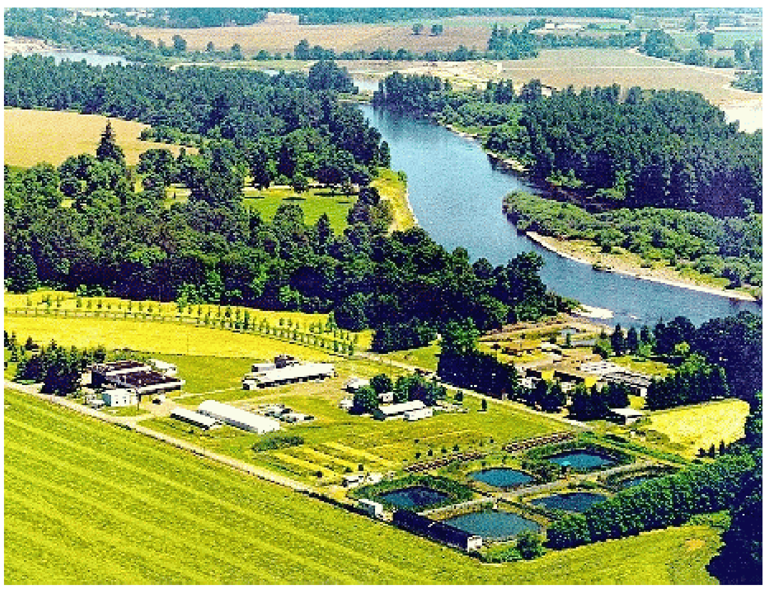
Water Management Plan

Revision 1

U.S. Environmental Protection Agency
National Health and Environmental Effects Research Laboratory
Western Ecology Division

Willamette Research Station
1350 SE Goodnight Avenue
Corvallis, Oregon 97333



June 23, 2011

Point of Contact:
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541-754-4418

U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL HEALTH AND ENVIRONMENTAL RESEARCH LABORATORY
WESTERN ECOLOGY DIVISION
WILLAMETTE RESEARCH STATION
CORVALLIS, OREGON

WATER MANAGEMENT PLAN, REVISION 1

Approved by:

[signature] 11-1-11

Mr. Primo Knight, Facilities Manager — Date

[signature] 11-1-11

Mr. Thomas Connolly, Associate Director for Program Operations — Date

[signature] 11-3-11

Mr. David Burr, EMS Coordinator — Date

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1.0 EPA'S STATEMENT OF PRINCIPLES ON EFFICIENT WATER USE

To meet the needs of existing and future populations and ensure that habitats and ecosystems are protected, the nation's water resources 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 the country faces 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 EPA's 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 (EO) 13423, *Strengthening Federal Environmental, Energy, and Transportation Management,* and EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance.*

This Water Management Plan has been established to document and promote the efficient use of water at EPA's National Health and Environmental Effects Research Laboratory (NHEERL) within its Office of Research and Development (ORD), at the Western Ecology Division Willamette Research Station (WRS) located in Corvallis, Oregon. The plan is organized according to the Federal Energy Management Program (FEMP) Facility Water Management Planning Guidelines.

2.0 FACILITY DESCRIPTION

WRS, owned and operated by EPA, comprises laboratories and field research facilities on a 10-acre site adjacent to the Willamette River. The site has seven buildings with 13,297 gross square feet (GSF) of facility space, including a main laboratory building, a wet laboratory, two greenhouses and several support spaces. Six ponds are located on WRS's grounds, which were supplied with well water for research purposes, but flow was turned off in April 2011. Currently, the facilities are used to support contractor activities associated with sample preparation and sample processing.

The main laboratory building and other structures were originally constructed in the 1970s, with an addition to the main laboratory completed in 1995. WRS is occupied by EPA employees and some U.S. Geological Survey (USGS) employees and contractors. USGS conducts amphibian research in Building 600 and has offices for some employees.

Research at WRS is focused on developing an understanding of the structure and function of ecological systems and conducting analyses of ecological phenomena at the ecosystem, landscape, and regional scales.

3.0 FACILITY WATER MANAGEMENT GOALS

As of October 2010, WRS's resource conservation goals are achieved through the implementation of the ORD-wide Environmental Management System (EMS) program. The Water Management Environmental Management Program (EMP) within ORD's EMS sets objectives and targets related to potable and non-potable water use to reduce the facility's impact on natural resources by reducing the consumption of water by facility and laboratory operations and landscaping, industrial, and agricultural (ILA) activities, and by properly managing stormwater runoff.

The primary objective of the Water Management EMP is to improve water use efficiency and stormwater management. Targets established under this objective call for:

> Achieving annual facility-specific goals set by EPA's Sustainable Facilities Practices Branch (SFPB) under its ConservW program (these ConservW goals are calculated for each EPA facility based on the facility's previous water use reduction and its potential identified projects);
>
> Establishing an ORD fiscal year (FY) 2010 baseline for non-potable industrial, landscaping, and agricultural (ILA) water use by March 31, 2011; and
>
> Evaluating the potential to improve stormwater management at each ORD facility by September 30, 2011.

Although not expressly stated, ORD's objectives and targets for water management imply a goal of achieving a 26 percent potable water reduction by the end of 2020, compared to a 2007 baseline, and of achieving a 20 percent ILA water reduction by the end of 2020, compared to a 2010 baseline, as set forth in EO 13514.

WRS's FY 2007 potable water intensity baseline is 10.75 gallons per GSF. WRS's FY 2010 ILA water use baseline is 112,000,000 gallons.

To continue progress toward meeting federal requirements and EMS goals, ORD facilities are to implement site-specific water conservation projects geared towards achieving the facility ConservW target, and to investigate and install corrective actions to maintain cooling towers, restrooms, autoclaves, dishwashers, and other water-using equipment, among other tasks outlined under the Water Management EMP.

4.0 UTILITY INFORMATION

Contact Information

Potable water supply and sewer service is provided by:

City of Corvallis
500 SW Madison Avenue
P.O. Box 3015
Corvallis, OR 97339-3015
541-766-6949

Rate Schedule

WRS has one 1-inch potable water supply meter. Monthly water bills are based on a tiered rate structure, provided in Table 1.

Table 1. Water Use Rate Structure (Effective February 1, 2011)

Meter Size	1-inch
Tier 1 at $1.61 per hundred cubic feet (ccf)	0-43 ccf
Tier 2 at $1.99 per ccf	44+ ccf
Base rate per month	$34.44

The sewer use fees for WRS are based on the water use through the 1-inch meter. WRS is charged a base rate of $10.07 per month and $3.49 per ccf water use from the meter.

The facility is also billed $12.00 per month for a fire water supply line.

Payment Office

Research Triangle Park Finance Center (RTP-FC)

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

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

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

5.0 FACILITY WATER USE INFORMATION

WRS contains laboratory space for sample preparation and processing and constant temperature chambers for sample storage.

Potable water is obtained from the local water utility and used as process water in the laboratories, for evaporative cooling of the greenhouses, and for sanitary supply.

Non-potable well water was used at WRS to supply six large aquatic research ponds with a continuous flow of water, but this use was discontinued in April 2011. Well water is still used to supply aquaria in the Building 600 research lab used for amphibian research, and to supply noncontact cooling water to refrigeration compressors on two constant temperature control rooms.

Potable Water Use

Annual average potable water use in FY 2010 by major process is shown in Table 2.

Table 2. Major Potable Water Using Processes, WRS

Major Process	FY 2010 Annual Consumption (gallons)	Percent of Total WRS Water Use	Comments
Reverse osmosis (RO) permeate	650	0.2	Submetered
RO reject	6,230	1.9	Calculated from submeter readings
Sanitary	50,000	11.7	Engineering estimate
Miscellaneous process and other laboratory water	264,034	86.2	Calculated as remaining difference from metered total
Total Water Use at WRS	320,914	100.0	Metered

Additional details on assumptions and calculations supporting these water use estimates are provided in Appendix A. Estimated monthly total water use in FY 2010 is provided in Appendix B.

Industrial, Landscaping, and Agricultural Water Use

Historically, WRS was used for aquatic research, and the facility is supplied with a continuous supply of fresh water from shallow groundwater wells located adjacent to the nearby Willamette River. The well water is supplied by two 10-horsepower pumps. The pumps are operated sequentially, with one in operation and the other on standby. This well water is used at WRS to supply six large aquatic research ponds with a continuous flow of water, to supply aquaria in the Building 600 research lab used for amphibian research, and to supply noncontact cooling water to refrigeration compressors on two constant temperature control rooms. The well water flow through Building 600 and the overflow from the ponds is returned to the Willamette River. The noncontact cooling water is sent to sanitary sewer. The ponds are currently dormant and not used for research purposes.

This water use falls into the agricultural and industrial categories per EO 13514, and WRS is now required to reduce its FY 2010 baseline of 112,000,000 gallons by at least 20 percent by FY 2020. Additional details on WRS's ILA water use are included in a memorandum in Appendix C. Corvallis WRS eliminated water flow to the unused ponds in April 2011.

Measurement Devices

Incoming city water is metered through a 1-inch supply line. ILA water use from the groundwater wells is not metered.

Supply water to RO systems and permeate water from the RO systems is submetered.

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

Shut-off Valves

The city water shut-off valve is located in the hazardous material storage room.

Occupancy and Operating Schedules

WRS is occupied by approximately five EPA employees, including SEEs and contractors, doubling to 10 during the summer field work season. Approximately 12 USGS employees and contractors occupy some of the smaller buildings at WRS. USGS staffing can double during the field work season. Typical operating hours are from 7:30 a.m. to 4:30 p.m. Monday through Friday, with occasional use during nights and weekends.

6.0 Best Management Practice Summary and Status

EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, signed in January 2007, calls for federal agencies to reduce potable water use intensity by 2 percent per year between FY 2007 and FY 2015, for a total reduction of 16 percent. This goal was extended by EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, signed in October 2009. EO 13514 calls for reducing potable water consumption intensity by 2 percent annually through the end of FY 2020, for a total reduction of 26 percent. It also calls for reducing ILA water use (non-potable water use) by 2 percent annually through the end of FY 2020, for a total reduction of 20 percent. Facilities should implement best management practices (BMPs) related to water use, taking life-cycle cost effectiveness into consideration, to achieve this water reduction goal. FEMP has identified BMPs in 14 areas to help facilities identify and target water use reductions. WRS has adopted BMPs in nine of the areas, designated by checkmarks in the list below. Three areas are deemed inapplicable for WRS, designated by "NA" in the list below. The status of each BMP at WRS is as follows:

☑ Water Management Planning
☑ Information and Education Programs
☑ Distribution System Audits, Leak Detection and Repair
☑ Water-Efficient Landscaping
☑ Water-Efficient Irrigation

☑ Toilets and Urinals
☑ Faucets and Showerheads
NA Boiler/Steam Systems
☐ Single-Pass Cooling Equipment
NA Cooling Tower Management
NA Commercial Kitchen Equipment
☑ Laboratory/Medical Equipment
☑ Other Water Use
☑ Alternate Water Sources

Information and Education Programs

WRS currently tracks water use on a monthly basis. All staff members are required to take annual EMS awareness training. Water conservation goals, as defined within the annually updated Water Management EMP, are covered during the training.

WRS promotes water conservation and awareness using the EPA laboratory "Every Drop Counts" water conservation poster series. Conservation posters are displayed in prominent locations within the laboratory.

WRS has achieved BMP status in this area.

Distribution System Audits, Leak Detection and Repair

Facility staff submit maintenance requests through work order requests that are logged in the existing computerized management maintenance system (CMMS). The requests go to the facilities manager for approval before being directed to the operation and maintenance (O&M) contractor. Work order requests cover a broad range, including leaks and malfunctioning water-using equipment. The work order requests are tracked in CMMS through to completion.

Any problems or leaks identified are addressed immediately. Janitors are trained to report any observed problems to the facilities manager.

A screening-level system review was conducted in November 2010. Known water uses account for over 90 percent of water consumption.

Under this plan, O&M contractor staff will make a daily walk-through inspection of all mechanical spaces. The facilities manager will monitor trends in monthly water use. Changes that are not understood or expected will be investigated and resolved.

WRS has achieved BMP status in this area.

Water-Efficient Landscaping

Facility grounds are covered with pasture grass, which is allowed to go dormant during dry periods and is naturally restored when precipitation occurs.

WRS has achieved BMP status in this area.

Water-Efficient Irrigation

No irrigation is used to maintain the facility landscape.

WRS has achieved BMP status in this area.

Toilets and Urinals

Toilets throughout WRS are dual-flush models (with 1.6 gallons per flush [gpf] and 1.1 gpf flushing options). Urinals throughout WRS are non-water models. An inventory of sanitary fixtures is provided in Table 3.

Table 3. WRS, Inventory of Sanitary Fixtures

Fixture Type	Flow Rate	Total Number
Toilets	Dual flush (1.6 / 1.1 gpf)	4
Urinals	Non-water (0 gpf)	2
Lavatory faucets	0.5 gallons per minute (gpm)	3
Showers	2.5 gpm	1

Janitorial staff and employees are trained to report leaks or other maintenance problems in the CMMS or directly to the facilities manager or O&M contractor staff. Leaks or other problems are immediately corrected.

WRS has achieved BMP status in this area.

Faucets and Showerheads

Table 4 provides an inventory of faucets and showerheads installed at WRS. All faucets are compliant with the American Society of Mechanical Engineers (ASME) standard for lavatory faucets in public use (captured in ASME A112.18.1), which sets a maximum flow rate of 0.5 gpm. This flow rate is sufficient for hand washing and is considered a best practice for lavatory sinks in public settings.

An Energy Policy Act of 1992 (EPAct 1992)-compliant showerhead (2.5 gpm) is installed in the shower stall available for use.

System pressure is maintained between 20 to 80 pounds per square inch.

Janitorial staff and employees are trained to report leaks or other maintenance problems in the CMMS or directly to the facilities manager or O&M contractor staff. Leaks or other problems are immediately corrected.

WRS has achieved BMP status in this area.

Boiler/Steam Systems

Heat is supplied by electrical strip heaters in the original portion of the laboratory and by a gas-fired furnace in the 1995 addition. No steam is utilized for building or domestic hot water heating. BMP status is not applicable in this area.

Single-Pass Cooling Equipment

Unmetered well water, estimated at 1 to 2 gpm, is tapped from the supply that flows through the laboratory and is used to cool the compressors on two temperature control chambers. After cooling, this water is discharged to the sanitary sewer.

WRS can achieve BMP status in this area by installing air-cooled compressors and eliminating the need for single-pass cooling.

Cooling Tower Management

Laboratory space is cooled with an air-cooled, electric air conditioner; the laboratory is not equipped with a cooling tower. BMP status is not applicable in this area.

Commercial Kitchen Equipment

WRS does not operate commercial kitchen equipment. BMP status is not applicable in this area.

Laboratory/Medical Equipment

Purified water for laboratory use is generated through a multi-step process consisting of cartridge filtration, carbon adsorption, and RO. The system was installed in October 2010 to replace a less efficient system. The system is anticipated to reject approximately 1 to 1.5 gallons of water for every gallon of RO permeate produced—an upgrade from the previous systems which rejected 2.4 gallons per 0.4 gallons produced.

WRS has achieved BMP status in this area.

Other Water Use

The greenhouses at WRS are equipped with evaporative coolers to cool and humidify greenhouse air during hot weather. The greenhouses are not consistently occupied and the evaporative coolers are turned off when the building is not in use.

Unmetered well water was provided continuously to unused research ponds on site, but this flow was eliminated in April 2011. Well water is also used for amphibian research in Building 600.

Because WRS eliminated well water flow to the unused research ponds, WRS has achieved BMP status in this area.

Alternative Water Sources

WRS recently installed two 1,325-gallon aboveground cisterns that will store stormwater runoff from the roof of the main laboratory. This water will be used for vehicle washing.
WRS has achieved BMP status in this area.

7.0 DROUGHT CONTINGENCY PLAN

In the event of a drought or other water supply shortage, WRS will follow the water use recommendations and restrictions of the City of Corvallis. The City has a Water Supply Emergency Curtailment Plan, late updated in April 2010, available on its website at: http://www.ci.corvallis.or.us/index.php?option=com_content&task=view&id=842&Itemid=2942

This plan has four defined response levels:

Stage 1 - Early Warning for a Potential Water Supply Shortage
The Stage 1 warning is reached when maximum daily production is just meeting the daily demand, or when there is expectation of a potential supply deficiency. The City will request that customers voluntarily reduce or eliminate nonessential water use, to follow odd/even outdoor watering schedules based on address, and to limit outdoor watering to the early morning or late evening.

Stage 2 - Water Supply Shortage
A Stage 2 water shortage is reached when maximum production is not meeting daily demand and reservoir storage falls to 90 percent capacity. The City may ask customers to voluntarily restrict all irrigation and other nonessential outdoor water use.

Stage 3 - Severe Water Supply Shortage
A Stage 3 water shortage is reached when maximum production is not meeting daily demand and reservoir storage falls to 80 percent capacity. All nonessential outdoor water use, including irrigation, is prohibited.

Stage 4 - Critical Water Shortage
A Stage 4 water shortage is reached when maximum production is not meeting daily demand and reservoir storage falls to 60 percent capacity. All nonessential outdoor water use is prohibited. All large industrial and institutional accounts shall restrict water use to fire protection and other critical functions only.

When voluntary or mandatory water use restrictions are instituted by the City of Corvallis under its Water Supply Emergency Curtailment Plan, the requirements are communicated through public announcements. The facilities manager will assemble a task force of facility and O&M personnel to identify and implement modifications to facility operations to achieve additional specified reductions in water consumption if a water supply emergency at Stage 2 or higher is enacted.

8.0 COMPREHENSIVE PLANNING

The facilities manager will ensure the water supply, wastewater generation, and water efficiency BMPs are taken into account during the initial stages of planning and design for any facility renovations or new construction. These factors will also be considered prior to the purchase and installation of any equipment that would measurably change facility water consumption. Where available, WRS will purchase or specify WaterSense labeled products and use WaterSense irrigation partners (see <www.epa.gov/watersense> for more information about WaterSense).

9.0 STATUS UNDER GUIDING PRINCIPLES FOR FEDERAL LEADERSHIP IN HIGH PERFORMANCE AND SUSTAINABLE BUILDINGS

The Interagency Sustainability Working Group (ISWG), formed as a subcommittee of the EO 13423 Steering Committee, established *the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings (Guiding Principles)* to assist agencies in meeting the high performance and sustainable buildings goals of EO 13423, section 2(f). The December 1, 2008, version of the ISWG's *Guiding Principles for Sustainable Existing Buildings*, a subset of the *Guiding Principles* targeting existing buildings, established six supporting principles for protecting and conserving water. WRS's status toward achieving the supporting principles for protecting and conserving water at existing buildings is documented in Table 4.

Table 4. Status of Guiding Principle to Protect and Conserve Water, WRS

Topic	Status
Indoor Water	EPA Headquarters tracks quarterly and annual water usage and intensity for each of its reporting facilities. Annual water tracking data (water consumption in gallons per GSF per year) shows that WRS reduced water consumption by 38.1 percent compared to a water baseline calculated for the building.
Outdoor Water	WRS does not perform irrigation.
Water Metering	WRS meters all water provided by the city. In addition, WRS submeters RO supply and reject water.
Stormwater Management	The stormwater collection system at WRS receives stormwater runoff through inlets. The system discharges off site. Many paved surfaces at WRS were constructed without curbs, allowing stormwater to sheet-flow onto adjacent vegetation before entering the storm sewer system in some areas, while in other areas storm drains collect stormwater runoff directly. WRS uses downspouts that discharge to vegetation next to the buildings. WRS recently installed two 1,325-gallon aboveground cisterns that will store roof stormwater runoff for vehicle washing.
Process Water	WRS does not use potable water to improve the facility's energy efficiency at the expense of water efficiency.
Water-Efficient Products	The Sustainable Acquisitions EMP requires the purchase of water-efficient products. WRS retrofitted restrooms with dual-flush toilets (1.6 and 1.1 gpf), waterless urinals, and low-flow faucets (0.5 gpm). The O&M, janitorial, and landscaping contracts do not reference water-efficient products.

10.0 OPPORTUNITIES FOR FURTHER WATER CONSERVATION

WRS is pursuing the following projects to achieve reductions in ILA water use:

1) **Reduce well water flow to the research ponds.** In FY 2010, WRS reduced flow to the ponds from 112 million gallons per year to 73 million gallons per year by fully valving off flow to two of the research ponds and partially valving off flow to one of the research ponds.

2) **Eliminate well water flow to unused research ponds.** The six ponds that use constant-flow through well water at WRS have not been used for more than 10 years. To eliminate over 90 percent of WRS's ILA water use, WRS valved off the pipe that flows to the ponds in April 2011. WRS is still considering regrading the area to remove the ponds and associated berms and covering the area with turfgrass or other landscaping. As part of this project, WRS may consider reducing the size of the pumps that supply the well water to WRS. This project is estimated to cost approximately $100,000. The facility would see significant electrical energy reduction related to the reduction in pumping requirements, potentially reducing electricity use of the entire facility by 12 percent. Energy savings are estimated to be approximately 70,000 kilowatt hours (kWh) and $5,000 per year.

Appendix A

WATER BALANCE SUPPORTING CALCULATIONS

Table A-1. Water Balance Supporting Calculations – FY 2010, WRS

Major Process	Annual Consumption (gallons)	Supporting Calculations and Source Documentation
RO permeate	650	Meter readings of 9,670 (10/1/2010) and 9,020 (10/5/2009) were used to calculate one year of RO permeate. RO permeate = 9,670 gallons - 9,020 gallons = 650 gallons / year.
RO reject	6,230	Calculated by difference from the RO supply water and the RO permeate. RO reject = 6,880 gallons / year - 650 gallons / year = 6,230 gallons / year.
Sanitary	50,000	Engineering estimate based on 20 people using 10 gallons / day for 250 operating days / year. 20 people * 10 gallons / person / day * 250 days / year = 50,000 gallons / year.
Miscellaneous process and other laboratory water	264,034	Calculated by difference from the total and other water uses.
Total Water Use at WRS	**320,914**	**Metered by the City**

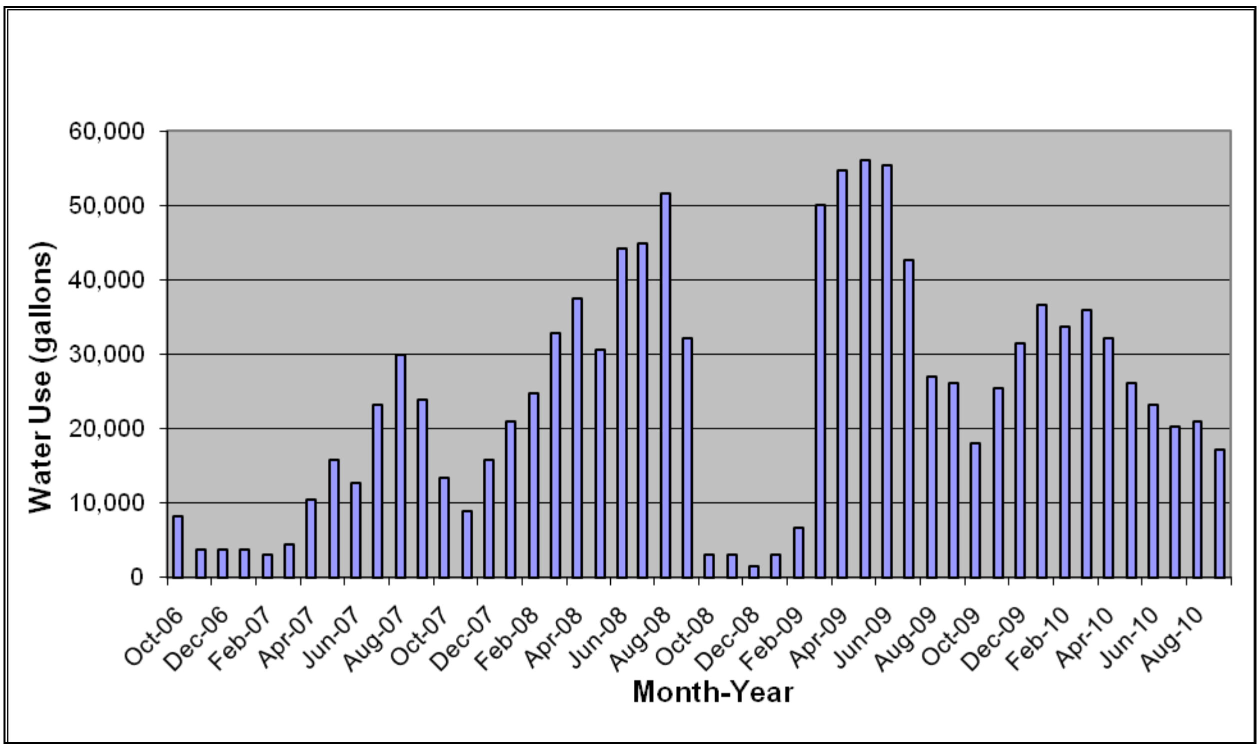
Appendix B

MONTHLY WATER USE IN FY 2010

Table B-1. Monthly Water Use in FY 2010, WRS

Month	Total Water Use (gallons)
October 2009	17,953
November 2009	25,434
December 2009	31,418
January 2010	36,655
February 2010	33,662
March 2010	35,906
April 2010	32,166
May 2010	26,182
June 2010	23,190
July 2010	20,197
August 2010	20,945
September 2010	17,205
Total	320,914

Table B-1. Water Use from FY 2007 through FY 2010, WRS



Appendix C

MEMORANDUM: ESTIMATE OF NON-POTABLE WATER USE AT CORVALLIS WRS

MEMORANDUM

TO: Dexter Johnson, EPA

FROM: Roy Sieber, ERG

DATE: December 22, 2010

SUBJECT: **Estimate of Non-Potable Water Flow Rate at Corvallis WRS**

This memorandum presents estimates of non-potable water flow rates at EPA's National Health and Environmental Effects Research Laboratory, Willamette Research Station, located in Corvallis, Oregon (hereafter referred to as Corvallis WRS). Estimates of the baseline flow in FY 2010 and the flow as of November 2010 are provided. The estimates are based on a field investigation conducted at Corvallis WRS on November 3 and 4, 2010.

Background

Non-potable water is used at Corvallis WRS to supply six large aquatic research ponds with a continuous flow of water, to supply aquaria in the Building 600 research lab used for amphibian research, and to supply noncontact cooling water to refrigeration compressors on two constant temperature control rooms. The ponds are currently dormant and not used for research purposes. None of the flows are metered.

All non-potable water is supplied by one of two groundwater pumps located in wells adjacent to the Willamette River. One pump is operated, and the other pump is kept available in standby mode. The well pumps are manifolded together at the surface, and connected to the research station though two PVC pipes. Based on the January 1975 Revised Map Submitted with Permit to Appropriate Ground Waters (Drawing C86251), the wells are connected to the ponds by 1,816 feet of 4 inch diameter PVC pipe. The wells are connected to the laboratory building though 942 feet if 6 inch diameter PVC pipe.

Field Observations

Building 600. A trickle of water was supplied individually to approximately 20 aquaria. The total flow for this use was estimated to be 2 gallons per minute (gpm) through direct observation.

Noncontact cooling. The water flow to each of two compressors was estimated to be 1 gpm based on the size of the tubing supplying the cooling water. The flow could not be directly observed because the space where the drain was located was not accessible.

Pond Supply. There are six 10,000 square foot ponds arranged in a 2 by 3 rectangle on the south end of the property. Well water can be continuously supplied to each pond through a supply pipe.

Excess water overflows from each pond to an overflow drain. The overflow drains are combined in a sump which ultimately flows back to the Willamette River. On the day of the site visit, three of the ponds were receiving water at an apparent, high rate of flow, and one was receiving flow at a partial rate of flow (compared to the high flow ponds). Two ponds were not receiving any flow. The flow was occurring as indicated on the sketch provided in Figure 1. The facility manager reported that the flow to the ponds had been reduced over the past year. In approximately March 2010, flow to two of the ponds was reduced. In October 2010, flow to an additional two ponds was reduced. While attempts have been made to eliminate or reduce flow at four of the ponds, only three of the ponds had clearly visible reductions compared to the others. However, the observed flows reported here are somewhat subjective. Two of the flows (Pond 6 and Pond 1) could be directly observed. Flow into both Pond 4 and 5 was occurring at or slightly below the water surface.

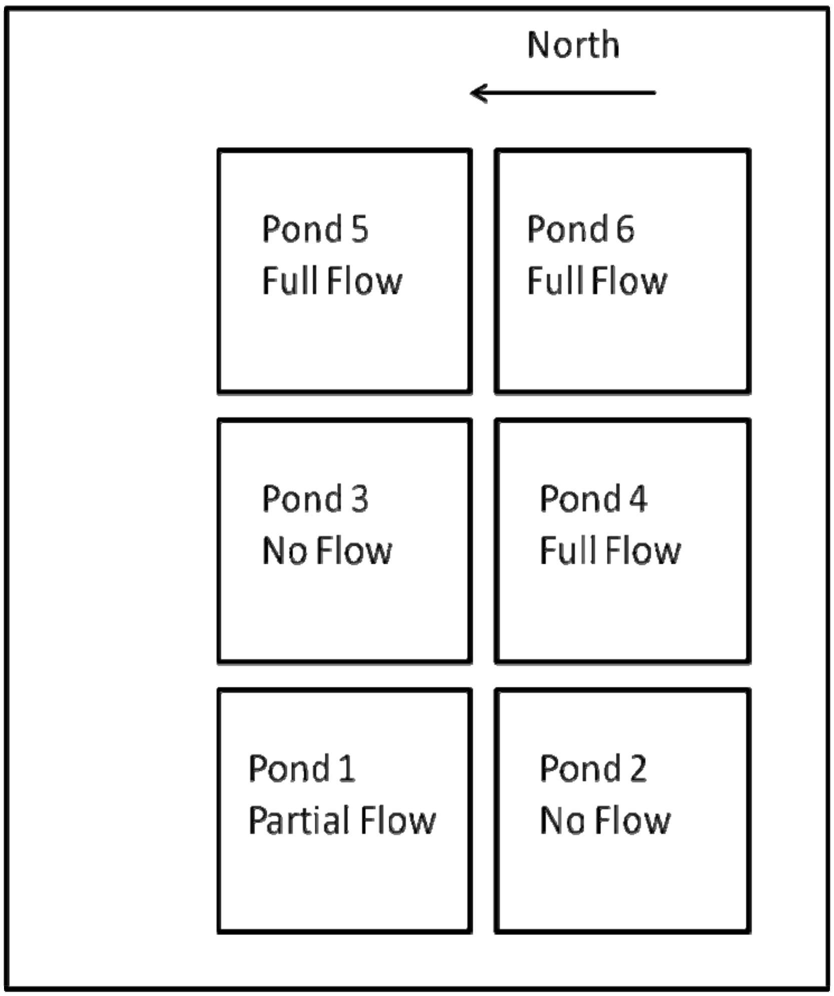


Figure 1 – Sketch of Relative Pond Layout and Flows

Specifications for the groundwater pumps in service are not available. The electrical panel supplying energy to one of the pumps indicates the pump is rated at 10 horsepower. The maintenance supervisor indicated he thought that was an accurate rating for both pumps in operation.

A pressure gage in the pump pit indicated that the operating pump was supplying water at a flowing pressure of 90 pounds per square inch (psi).

Calculations

The flow rate of water occurring in early November 2010 can be calculated based on a pump curve for a 10 horsepower pump generating flow under 90 psi.

First, converting gage pressure to feet of water head:

90 (psi) x 2.3106 (feet of head/psi)[1] = 207 feet of head

From Grundfos company product literature, we have identified a submersible well water supply pump rated at 10 horsepower that delivers water at 200 feet of head. See pump specification and pump curve provided in Attachment A. Under these conditions this pump will deliver water at 138 gpm. This is the assumed flow rate of all non-potable water used as of November 2010. On an annual basis, this equals:

138 (gallons/minute) x 60 (minutes/hour) x 24 (hours/day) x 365 (days/year) = 73 million gallons/year.

To calculate the 2010 baseline flow, we must adjust this flow to account for the fact that some of the flow to the ponds has been valved fully or partially closed over the past several months. For this estimate we can make the following assumptions based on available information:

- Assume that flow to all six ponds was fully open at the start of FY 2010 (October 2009), the flow was part way reduced in March 2010, and reduced again to its present level in October 2010.
- Assume that the flow reduction in March 2010 and the flow reduction in October 2010 achieved similar savings.
- Assume the ratio of full flow to six ponds versus the November 2010 situation of full flow to three ponds and partial flow to one pond is 6/3.5.
- Assume the magnitude of the Building 600 flow and non-contact cooling flow is negligible compared to the magnitude of the pond flows.

Thus we have the following situation:

Flow rate in October 2010 is 138 gpm.

Flow rate in October 2009 is 138 gpm x 6/3.5 = 237 gpm.

Flow rate in March 2010 changed to mid point between 237 and 138 gpm, or 188 gpm.

[1] http://www.engineeringtoolbox.com/pressure-head-converter-d_406.html

Therefore, to calculate the FY 2010 baseline water use, we have six months flow at 238 gpm, and then six months of flow at 188 gpm, or:

(237 + 188)/2 (gallons/minute) x 60 (minutes/hour) x 24 (hours/day) x 365 (days/year) = 112 million gallons/year.

Summary

FY 2010 non-potable baseline flow is estimated to have been 112 million gallons.

The non-potable flow as of November 2010 is estimated to be 73 million gallons per year based on the pond configuration described in this memo.