Water Action Plan

January 17, 2014

Office of Sustainability
Acknowledgments
Office of Sustainability
Environmental Health & Safety
Physical Plant
Capital Resource Management
Strategic Communications
Impact Sciences
BMS Design Group
Strategic Academic Research
Housing, Dining and Residential Services

Summary
UCR faces several significant challenges in achieving the UC Sustainable Practices Policy for potable water reduction of 20%, adjusted for growth, by 2020. Given its location in the Inland Valley of Southern California with a semi-desert climate, large volumes of water are needed for irrigation of agriculture and landscaping. Cooling and research on campus drive water usage up as well. But most significantly, and most expensive to address, is on-campus housing water usage, as we expect housing and dining to be the largest growth sector over the next six years. UCR currently houses 30% of its student population on-campus, with aspirations of housing 50% by 2020. Metering is extremely scarce on the campus given the financial structure for utilities, further complicating any analysis of usage patterns and cost benefits for efficiency projects.
One unusual aspect of UCR’s water is that it is extremely inexpensive, due in part to the fact that the campus received a large water grant with the land grant for the University. Over time, UCR has acquired rights to more water from gifts and bequests. UCR sells its surplus water not used for irrigation of the agricultural research lands on the West campus to the city for blending. The processed potable water returned to the campus is used for 100% of the water needs on the East Campus. Two projects, one recently completed, and one currently underway will reduce our consumption by 5 - 11%, but fall short of the needed 31% reduction for meeting the 2020 goal.
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**Introduction**

UCR’s History

In 1907 Riverside Citrus Experiment Station was founded as part of the University of California agricultural research program. In 1954 the UC Citrus Experiment Station became UC Riverside, the fourth campus of the University of California. Since then the campus has grown from 131 students and 65 faculty to 21,297 students and 915 faculty. Situated in the City of Riverside, population 313,673, UCR currently is the largest employer and the largest user of natural resources in the city with a combined workforce of 7,549.
Part I: Water in the Inland Empire

Where does our water come from?

As described in the 2005 Long Range Development Plan Environmental Impact Report, the UCR campus is located within the Santa Ana River watershed, a drainage area of approximately 2,650 square miles. The Santa Ana River begins as a series of tributary streams in the San Bernardino Mountains and flows over 100 miles southwesterly, discharging into the Pacific Ocean in Huntington Beach. Surface and groundwater from the Upper Santa Ana River basin collect behind the Prado Dam, at the head of the Santa Ana River Canyon, and then continue to the Lower Santa Ana River basin to the Pacific Ocean.

Natural flows in the river and tributaries are supplemented by water imported from the State Water Project and the Colorado River, and discharge from publicly owned treatment works (POTWs). The use of imported water and discharge from POTWs has increased as a result of increased population in the Upper Santa Ana River Basin. Between 1970 and 1990, the total average volume rose from less than 50,000 to over 130,000 acre-feet per year (AFY), as measured at Prado Dam. Base flow is expected to rise to 230,000 AFY by 2020, a projected increase of 77 percent above 1990 levels.

Groundwater

The Riverside area is located within the Upper Santa Ana Valley Groundwater Basin. The UCR campus is located near the southeastern edge of the Riverside-Arlington sub-basin, which is bound by impermeable rocks of Box Springs Mountains on the southeast, Arlington Mountain on the south, La Sierra Heights and Mount Rubidoux on the northwest, and the Jurupa Mountains on the north. The northeast boundary of this sub-basin is formed by the Rialto-Colton Fault, and a portion of the northern boundary is a groundwater divide beneath the City of Bloomington. The Santa Ana River flows over the northern portion of the sub-basin. Groundwater in the sub-basin is replenished by infiltration from Santa Ana River flow, underflow past the Rialto-Colton Fault, intermittent underflow from the Chino groundwater sub-basin, return irrigation flow, and deep percolation of precipitation.

Groundwater may also be contained in isolated perched water tables that are separated from the regional aquifer by unsaturated rock. Based on historical well data in the vicinity, it is estimated that groundwater depths vary throughout the campus, from approximately 60 feet below the ground surface at the base of the Box Springs Mountains, to 200 feet below ground surface in the flat western portion of the campus.

Groundwater in the regional aquifer is pumped by local water agencies, including the City of Riverside, and used for domestic and agricultural purposes.\(^1\)

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\(^1\) The following is directly extracted from the 2005 Long Range Development Plan prepared for UCR.
How does it get to campus?

UCR receives potable water service from the City of Riverside via the Western Municipal Water District. The East Campus water system is independent from the West Campus and comprises almost the entire current potable UCR water consumption.

Potable water for East Campus domestic, landscape irrigation, and fire protection uses is provided by the City of Riverside through two connections. The primary source is the five million gallon (MG) reservoir located adjacent to University Avenue, immediately east of I-215/SR-60. The reservoir, which is owned and operated by the City, pumps the potable water by means of UCR-owned pumps to two inter-connected UCR-owned storage tanks located in the southeast corner of the campus. The one million and 50,000-gallon capacity storage tanks are located approximately 200 feet above the East Campus mean elevation.

The secondary potable water source is a City water main located at the intersection of Linden and Florida Streets. This secondary connection is only used for emergency fire protection and as a fail-safe backup to the five MG reservoir connection.

The storage capacity, provided by the two existing University storage tanks, is currently adequate to meet UCR domestic water needs. This system can also meet fire flow demand as long as the storage tanks are supplemented by the second connection on Linden and the booster pumping station drawing water from the City’s 5 MG reservoir. This system does not, however, provide the storage or the emergency flow capacity required to meet future demands.
The West Campus is not connected to the East Campus water system. There are existing City lines running east-west in University Avenue, Everton Place, and Martin Luther King Boulevard and north-south lines in Chicago Avenue, Iowa Avenue and the Cranford Avenue alignment. International Village receives water from a City service line extending south in Iowa Avenue from University Avenue and turning east in Everton Place. UNEX, the Human Resources Building, and Highlander Hall receive potable water from service connections in the University Avenue main line.

The agricultural lands of the West Campus are irrigated with water from the Gage Canal. Landscape irrigation for the large parking lot is supplied from the UCR East Campus system via a pipe under the freeway.²

Figure 2 Current water infrastructures

² Taken from the 2005 LRDP prepared for UCR.
What happens to water when it leaves campus?

Much of the water used for agricultural land irrigation that is not absorbed is reclaimed, though still a sizable portion is lost to evapotranspiration on-site and through the reservoirs.

East Campus irrigation run-off is captured by the Auroras and other detention basins. This is discussed in more detail in Section 2: Storm Water Management. Domestic water leaves the East Campus through existing City of Riverside sewage lines. See below for more detail. The lines are expected to accommodate growth through 2020 for the East Campus, but if the West Campus develops other lines, or an alternative waste water treatment facility, will need to be installed.

Existing Sewage Lines
The existing sanitary sewer infrastructure shown in Figure 3 is primarily located on the East Campus with the exception of two collection lines, one in the northeast corner of the West Campus and the other in Martin Luther King Boulevard and Chicago Avenue. A 15-inch City owned trunk sewer line services the East Campus west from Valencia Hill Drive following the general alignment of University Avenue.

The City of Riverside Regional Water Quality Control Plant (RRWQCP) provides treatment of all campus-generated wastewater, with UCR operating its own collection system. The RRWQCP currently treats 32 MGD and has a capacity of 40 MGD. The City of Riverside has indicated that they do not anticipate any problems in accommodating future UCR growth at the RRWQCP.

East Campus
UCR currently discharges approximately 1 MGD of wastewater into the 15-inch City trunk line in University Avenue as measured during a monitoring event in November/December 2001. This wastewater discharge is higher than flows that would be expected based on sustainable water use factors. This is not surprising, considering that the East Campus was constructed before sustainable water use practices and policies were implemented. As a side note, areas of the City east of the campus discharge into this line as well.

The City and UCR have a sewer discharge agreement that allows the campus to discharge 1.55 cfs, (approximately one MGD) into the portion of the 15-inch City trunk sewer within the East Campus between Valencia Hill Drive and Canyon Crest Drive. Approximately sixty percent of the current sewer flow of 1 MGD, or approximately 0.6 MGD, discharges into this portion of the trunk line; therefore there is additional sewer capacity based on the agreement.

Additional East Campus sewer collection systems run southward from the north and northward from the south and connect directly to the City trunk line on University Avenue at the intersection of Canyon Crest Drive. The University does have additional sewer capacity in an eight-inch line located in University Avenue running parallel to the 15-inch line beginning on the corner of University Avenue and Canyon Crest.
West Campus

The West Campus primarily consists of agricultural land, and has only two existing sewer lines. One line services the International Village housing complex. This line is City owned and gravity flows west on Everton Place and North on Iowa Avenue connecting to the University Avenue trunk line. The other line is University owned and services an agricultural operations building south of Martin Luther King Boulevard near the Gage Canal. This line gravity flows west in the south shoulder of Martin Luther King Boulevard and turns north on Chicago connecting to the University Avenue trunk line. The UNEX, Human Resources and Highlander Hall facilities are serviced from sewer laterals extending from the trunk line in University Avenue.

Figure 3
Part II: UCR Watershed

Water use at UCR

UCR is located in a semi-arid climate and receives about ten inches of rain annually. Potable water is supplied to the campus by the City of Riverside, which takes most of its water from underground aquifers in the San Bernardino/Riverside area. Historically, 60 percent of the potable water used at UCR was applied to landscaping. Recently through sprinkler replacement and computer based weather monitoring landscape irrigation water usage has moved closer to 50:50. A significant amount of new landscaping is anticipated as UCR develops the West Campus. The 2005 Long Range Development Plan (LRDP) and UCR’s Sustainability Action Plan recommend that drought-tolerant and native and/or adapted plants, in conjunction with low-water landscape design strategies and technologies, be standard practice for new development to reduce irrigation potable water use. This will also aid in UCR achieving its Green Building Policy by making it easier to earn site and water credits.

Approximately fifty percent of the campus’s building stock is 1960s vintage, when UCR experienced a boom in construction and enrollment. For the two decades following little construction occurred until the university’s next growth spurt in the 1990s. This pattern of growth means that numerous campus buildings are equipped with plumbing fixtures and fittings that meet less stringent water efficiency standards than those required by current building code. Further, due to a lack of funding for deferred maintenance in recent years, many of the installed fixtures may not be functioning at their optimum specifications.

UCR is now anticipating another sustained increase in enrollment, which will have a significant impact on potable water use. The campus is planning for the student population to swell to 25,000 by 2020, a 96 percent increase in enrollment as compared to 2000. The 2005 Long Range Development Plan sets a goal to house 50 percent of students on campus by 2015. Due to the financial crisis of 2007-2010 this date has been revised to 2020. Adding thousands of beds will unavoidably drive up UCR’s potable water consumption. Additionally, academic and staff employment levels will need to be augmented to support the added students. The LRDP projects potable water demand in 2015 to be 3.0 million gallons per day on the East Campus and 1.2 million gallons on the West Campus. These figures factor in sustainable water use practices and policies. In 2005, the East Campus used 2.1 million gallons daily and the West Campus used less than 0.2 million gallons daily. Current water usage is estimated at 1.5-1.9 million gallons per day. Given the revisions in the 2011 amendment to the LRDP, campus demand of 3.0 million gallons per day for the East Campus should be pushed out to 2020. The West Campus expansion may be even slower.

As the strain on potable water resources grows with each passing year, the need for aggressive water conservation efforts and the deployment of new water-saving technologies heightens. The U.S. Environmental Protection Agency reports that “at least 36 states are anticipating local, regional, or statewide water shortages by 2013, even under non-drought conditions.” California is most certainly among these 36 states. A fundamental change in the way water resources are valued and used is essential in the face of this chronic shortage.
Water consumption is also strongly tied to greenhouse gas emissions. A 2005 report by the California Energy Commission entitled “California’s Water-Energy Relationship” states that “water-related energy use consumes 19 percent of the state’s electricity, 30 percent of its natural gas, and 88 billion gallons of diesel fuel every year.” Additionally, “water conveyance requires more than 50 times the energy for Southern California than it does for Northern California,” which is “five times the national average”. This is because most of the state’s rain falls in the north, which requires that water be pumped hundreds of miles over varying elevations changes before its delivery to end-users. In essence, saving water means saving energy. UCR’s footprint differs from much of Southern California as the distance from aquifer to campus is much closer. However, the calculations also account for water treatment, distribution and wastewater treatment, all relevant to UCR. Currently UCR does not include water use in its Scope 1 or Scope 2 emissions reporting.

The Water Action Plan covers both landscape irrigation and indoor water use issues. It does not cover irrigation use for UCR’s agricultural research lands on the West campus as they are irrigated by non-potable water pumped directly from the Gage canal.

**Current Best Practices**

In 1980 UCR installed a computer-based irrigation system to manage its water use. To capitalize on developments in irrigation technology since then, the campus is converting the original system to a Toro Sentinel weather-based irrigation system. The Sentinel system adjusts the irrigation schedule based on local atmospheric data collected by the onsite weather station and the water needs of plants located near irrigation controllers placed throughout campus. Matching delivered water to actual conditions on the ground helps eliminate the potential for over and under watering. Currently, about 90 percent of the campus has been converted to the new the Toro Sentinel irrigation system, 5 percent uses the old system, and 5 percent is controlled manually.

UCR converted a soccer field on the East Campus to artificial turf in July 2007, eliminating water and fertilizer use and reducing maintenance requirements. This project saves an estimated one million gallons of water per year, and has been well-received by students. The campus plans to convert additional athletic fields in the future.

The campus mulches freshly-mowed turf grass on-site to reduce irrigation requirements and improve soil health. This in practice creates a protective layer that obstructs direct sunlight and helps the soil retain moisture. Dropped clippings also return nutrients and organic matter to the soil, creating a healthier lawn that is better able to resist drought.

**Metrics**

UCR has had difficulties in establishing accurate metrics for water usage and sewage. We are currently researching our data to firmly establish our baseline for the Water Action Plan and for STARS (Sustainability Tracking, Assessment and Reporting System). These values are the university’s best estimate at the time of writing this plan based on billing data, and may be revised in the future. The campus does not have separate metering for domestic and irrigation water. UCR uses yearly
evapotranspiration rates for its landscaped areas on the East Campus to estimate its annual irrigation water use.

**Table A: Annual Water Use in Millions of Gallons**

<table>
<thead>
<tr>
<th></th>
<th>2010/11</th>
<th>2011/12</th>
<th>2012/13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Water Purchases</td>
<td>611.2</td>
<td>624.7</td>
<td>690.2</td>
</tr>
<tr>
<td>Per Capita Water Use</td>
<td>.03000</td>
<td>.03067</td>
<td>.03408</td>
</tr>
</tbody>
</table>

**Greenhouse Gas Emissions**

A significant amount of electricity is required to convey, treat and distribute water, and to treat wastewater. The California Energy Commission reports that the energy intensity of water used by Southern California communities is 13,022 kWh per million gallons for domestic use and 11,111 kWh for irrigation. UCR’s water-related greenhouse gas emissions are calculated using this value and Riverside Public Utilities’ verified emission factors. RPU’s significant reduction of its emission factor for 2012 is the reason for the 11% reduction of GHG from 2011, even though potable water usage increased by 19% during the same time period.

GHG emissions due to potable water use in 2012 would account for 2.5% of the total if they were included in our annual report.

**Table B: Greenhouse Gas Emissions in Metric Tons of CO₂ Equivalent**

<table>
<thead>
<tr>
<th>GHG Emissions</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions</td>
<td>2,844</td>
<td>3,218</td>
<td>2,591</td>
</tr>
</tbody>
</table>

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3 In conversation with Physical Plant Energy Management and Riverside Public Utilities we have not be able to determine the reasons for the sustain increase in water use from 2010 through 2012. Historic water use data has shown significant fluctuation since FY 1999-2000, with a steady use just close to 2012/13 levels from 03/04 onwards. Again we have not been able to determine the cause(s) for these discrepancies. Please see Table C below for data.
Main uses of water on campus:

Process
Steam Plant, Thermal Energy Storage Tanks, Chillers and Research Labs

Domestic
Sinks, showers, toilets, water fountains/bottle filling and swimming pools

Landscaping/Irrigation
Turf grass, shrubs, flowers, trees and various plants across East campus and the large student parking lot (Lot 30) on West campus.

Metering
UCR does not, with a few exceptions, meter landscaping water separate from domestic water use on the East Campus. New construction, as of 2010, requires separate water meters to be installed for fire, domestic and irrigation lines. Meters do exist, and are working as of 2012, at the following locations:

- Material Sciences & Engineering
- Aberdeen & Inverness
- Lothian
- Pentland
- Chemical Sciences
- INTS North
- INTS South
- School of Medicine Research Building
- Glen Mor 1

Historical Data
The following historic data is based on reports sent to UCOP and recent re-evaluations of data from 2006 to present. As more accurate and verifiable data becomes available the Water Action Plan will be updated.

Table C: Historic Water Usage reported to UCOP

<table>
<thead>
<tr>
<th>UC Riverside</th>
<th>Total Usage (ccf)</th>
<th>Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 99-00</td>
<td>779,790.30</td>
<td>583,361,125</td>
</tr>
<tr>
<td>FY 00-01</td>
<td>1,075,130.45</td>
<td>804,197,574</td>
</tr>
<tr>
<td>FY 01-02</td>
<td>1,188,004.00</td>
<td>888,626,992</td>
</tr>
<tr>
<td>FY 02-03</td>
<td>1,022,644.27</td>
<td>764,937,912</td>
</tr>
<tr>
<td>FY 03-04</td>
<td>937,862.05</td>
<td>701,520,812</td>
</tr>
</tbody>
</table>
The planned development of the West Campus acreage, as described in the 2005 LRDP and subsequently amended in the 2011 LRDP EIR, is not expected to proceed at the stated timeline. Currently no projects have been funded for development on the West Campus. The Water Action Plan will be updated if projects that will impact potable water use receive budget approval before 2020.

**Repurposing of UCR land**

216 acres of agricultural research land have been reclassified for alternative use on the West Campus. The 2005 LRDP and 2011 LRDP amendment partition the area into three regions: Academic, School of Medicine and Housing. The latest Capital Finance Plan, 2013-2023, identifies a much smaller scope of
development with limited acreage for Academics, School of Medicine and the recently approved 11 acre solar farm. At the time of writing it is unclear if the proposed building projects will significantly alter campus potable water usage before 2020.

**Housing and Residential water usage**

UCR provides on-campus housing through traditional dormitories, apartment style residence halls and small low-rise apartment complexes for approximately 30% of the student body. Three of the four residential halls, accounting for 50% of on-campus residents, house approximately 1,000 students each. Two are over 50 years old with only minor upgrades to the fixtures during that time. UCR has been able to receive funding for apartment toilet upgrades, but no rebates have been made available for the commercial style toilets used in the residential halls. It is expected that a complete interior remodel of Lothian Residential Housing will be completed just prior to 2020 that will include 100% replacement of existing water fixtures.

Of the buildings monitored during the preliminary water analysis, the residence hall far exceeded gallons per square foot usage than any other building. However, per capita usage, adjusted for occupancy time and usage, accounts for a smaller percentage reduction needed to reach the 20% below baseline goal. In other words, in the baseline years UCR used more gallons per square foot than per person proportionally. While the most effective conservation measures may come from housing, the most effective efficiency measures will come from landscaping.

**Storm Water Management**

**Purpose and Goals**

The purpose of UC Riverside storm water management is to identify actions necessary to reduce the discharge of pollutants in storm water, to the maximum extent practicable, in a manner designed to achieve compliance with water quality standards and objectives.

UC Riverside storm water management also seeks to improve campus sustainability by taking additional steps to minimize erosion, reduce impervious area and encourage infiltration, such as consideration for the preservation of existing trees and natural open space during new project development.

Goals of UC Riverside storm water management are set and realized by several campus departments based on campus interests such as sustainability, regulatory requirements, and UC system policies. The location of the campus within the watershed presents opportunities for improvements to the natural landscape that would serve multiple benefits. The initial goals of the UC Riverside 2013 storm water management plan are:

1. To achieve and maintain compliance with the Phase II Small MS4 General Storm Water Permit adopted February 5, 2013 according to the implementation schedule; and

2. To fund and conduct feasibility studies for a watershed-based campus storm water plan capable of achieving up to 100 percent capture of annual storm water runoff for treatment and infiltration or harvest and use
The scope of the initial feasibility studies will be to:

- Characterize site design issues related to capture for storage, treatment and infiltration
- Characterize supply and demand for harvest and use
- Analyze financial constraints

**Campus Hydrology**

The UC Riverside campus is located on westward sloping alluvial deposits at the base of the Box Springs Mountains in the Upper Santa Ana River Watershed. The campus is located within two sub-watersheds, generally divided by the I-215/SR-60 freeway. Most of the East Campus drains to the University Arroyo Watershed, while portions of the West Campus drain to the Box Springs Arroyo Watershed.

Campus hydrology and topography provide several natural opportunities for several vegetated above ground storm water channels, and three large detention basins: 1) Gage Detention Basin, 2) Glade Detention Basin, and 3) Botanic Garden Detention Basin.

**Leadership in Energy and Environmental Design (LEED)**

UC Riverside has achieved LEED certification for its most recently completed new construction project, the School of Medicine Research Building. The campus has also achieved the LEED Existing Buildings: Operations and Maintenance Campus portfolio storm water quantity control credit.

**Current Storm Water Regulatory Applicability and Requirements**

The UC Riverside campus was designated a non-traditional permittee under the Phase II Small MS4 General Storm Water Permit that was adopted February 5, 2013 and became effective on July 1, 2013.

The US EPA 1999 Storm Water Phase II Final Rule defines a small MS4 storm water management program as a program comprising six elements (six minimum control measures) that, when implemented, are expected to result in significant reductions of pollutants. The Phase II Small MS4 General Permit is organized into program elements based on the six minimum control measures, and contains additional requirements phased in over the five-year permit term. The Phase II Small MS4 permit requirements and implementation schedule for non-traditional permittees is summarized at Table D.

<table>
<thead>
<tr>
<th>Phase II Small MS4 General Storm Water Permit Element</th>
<th>Permit Compliance Year (June 30th)</th>
<th>Permit Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal Authority</td>
<td>2015</td>
<td>2</td>
</tr>
<tr>
<td>Education and Outreach Program</td>
<td>2014</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2016</td>
<td>3</td>
</tr>
<tr>
<td>Public Involvement and Participation Program</td>
<td>2016</td>
<td>3</td>
</tr>
<tr>
<td>Illicit Discharge Detection and Elimination</td>
<td>2015</td>
<td>2</td>
</tr>
</tbody>
</table>
Many of the Phase II Small MS4 permit requirements are currently fulfilled through existing campus programs and practices that prevent storm water pollution, minimize erosion, reduce impervious area and encourage infiltration wherever possible. Implementation of the Phase II Small MS4 permit requirements will, in many cases, consist of documenting existing storm water management practices.

### Campus Drainage
Full cost evaluation of storm water management initiatives
UCR is currently exploring possibilities for evaluating the costs of a comprehensive stormwater management strategy and the infrastructural requirements to achieve 100% retention of stormwater and run-off on campus.

Part III: Implementing Water Sustainability

UCOP Mandate

In line with the State of California’s law establishing a goal to reduce per capita potable water consumption by 20%\(^4\), each campus will strive to reduce potable water consumption adjusted for population growth by 20% by the year 2020. This target will be re-evaluated and recommendations for adjustments will be made as necessary by the Sustainable Water Systems Working Group. Campuses that

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\(^4\) For more information on this goal, see [http://www.swrcb.ca.gov/water_issues/hot_topics/20x2020/](http://www.swrcb.ca.gov/water_issues/hot_topics/20x2020/)
have already achieved this target are encouraged to set more stringent goals to further reduce campus potable water consumption.

Each campus will develop and maintain a Water Action Plan that identifies the campus’ long term strategies for achieving sustainable water systems.

- Current use is defined by the most current FY complete year data for Potable Water use by UCR
- Per Capita is calculated by calculating the weighted average users and then dividing total potable water use by that number
- OGSF50 is calculated by taking latest building data as reported to UCOP and dividing the total gallons by that number

### Campus baseline and goals

<table>
<thead>
<tr>
<th>Water Use</th>
<th>Gallons Annual</th>
<th>Per capita Gallons</th>
<th>Per OGSF50 Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 2012-2013</td>
<td>690,230,464</td>
<td>34,083.20</td>
<td>98.21</td>
</tr>
<tr>
<td>FY 2011-2012</td>
<td>624,769,244</td>
<td>30,675.04</td>
<td>91.35</td>
</tr>
<tr>
<td>Baseline (FY07-09 AVG)</td>
<td>667,892,691</td>
<td>38,193.35</td>
<td>103.33</td>
</tr>
<tr>
<td>Goal</td>
<td>534,314,152.80</td>
<td>30,554.68</td>
<td>82.67</td>
</tr>
</tbody>
</table>

### Needed reductions from current use (FY 2012-2013)

<table>
<thead>
<tr>
<th>Input</th>
<th>Reduction</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>34,083.2</td>
<td>10.3%</td>
<td>30,554.68</td>
</tr>
<tr>
<td>98.21</td>
<td>16%</td>
<td>67.54</td>
</tr>
</tbody>
</table>

Calculations:
Weighted user is calculated by using October data from SARS to determine total number of full-time students. Part-time students and FTE count for combined faculty and staff. Housing Services provides October data for on-campus student residents. The following values are used to determine total FTE count:

<table>
<thead>
<tr>
<th>Group</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-time on-campus students</td>
<td>1</td>
</tr>
<tr>
<td>Full-time students off-campus, FTE staff &amp; faculty</td>
<td>.75</td>
</tr>
<tr>
<td>Part-time students</td>
<td>.5</td>
</tr>
</tbody>
</table>
**2020 20% reduction goal**

A twenty percent reduction in potable water use per capita from our baseline would mean a real reduction from 2012 performance year of 10%, or approximately 70 million gallons. Current projects, implemented and proposed, provide an annual reduction of 22-23 million gallons; 32% of the total needed to meet our goal.

With projected growth to 25,000 students and 50% on-campus residency the reductions needed for meeting and maintaining our 2020 goals pose significant challenges.

**Water Goals (expanded in Appendix A)**

- Establish minimum flow standards
- Conduct building water audits
- Reduce potable water used to irrigate landscape
- Install sub-metering for irrigation water
- Design an educational component to water conservation efforts
- Pilot high-efficiency and dual flush toilet fixtures
- Develop a water efficiency retrofit program
- Pilot water-saving urinals
- Formally adopt water-saving toilet specifications
- Demonstrate best practices in landscape water conservation
- Perform feasibility study on retaining 100% of stormwater run-off on campus
- Pilot gray water technology
- Pilot eco-living machine waste water treatment

**Project costs and savings of the identified water use strategies**

**Toilet replacement**

Project 1 Oban Apartments

Replaced three gallon per flush commodes with high efficiency 1.6 gpf commodes.

<table>
<thead>
<tr>
<th># of toilets replaced</th>
<th>280</th>
<th>Cost Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 gpf</td>
<td>724,680</td>
<td></td>
</tr>
<tr>
<td>1.6 gpf</td>
<td>386,496</td>
<td></td>
</tr>
<tr>
<td>Total gallons saved annually</td>
<td>338,184</td>
<td>$339</td>
</tr>
<tr>
<td>Total cost/benefit to UCR</td>
<td>$0</td>
<td>$339</td>
</tr>
</tbody>
</table>

**Reconnecting UCR Botanical Gardens to Gage Canal non-potable water source**

Approximately 20-25 years ago the irrigation system at the Botanical gardens was switched from Gage Canal water from Agricultural Operations to potable water provided through the City’s mains. The reason
given for the switch was clogging of irrigation lines from the water coming from holding pond and storage tank.

Estimations of the amount used for irrigation at the Botanical Gardens range from 1-6 million gallons monthly. This project holds the most potential for a quick and cost effective reduction of potable water use.

UCR is currently in discussion with the City of Riverside concerning grant opportunities that might fund a feasibility study for this project, and ultimately partially fund the project under its innovation in water efficiency program. Costs are unknown at this time. UCR is seeking a $5,000 Water Innovation Grant from Riverside Public Utilities to conduct a feasibility study for the reconnecting of the Botanical Gardens to the Gage Canal water supply.

Indirect costs and savings associated with water reduction
UCR is currently undergoing negotiations on a new water contact with the City of Riverside. Pricing for potable water delivery and sewage are not available for the projections. However, as sewage is not metered, but costs are derived from a formula applied to potable water usage, any reductions in water usage should provide savings in sewage costs regardless of how the water actually would have left the campus. If UCR does decide to include potable water use in its GHG inventory, then any reduction would have a cost benefit towards the cost of reducing our GHG emissions.

Savings associated with reduced or avoided infrastructure costs
UCR is currently exploring alternative approaches to water usage and sewage removal associated with the expansion plans for West Campus. As the program is in a state of flux at the time of preparing the report, no analysis has been started yet. Conceptually, by providing an alternative to installing traditional water and sewage infrastructure, a cost effective program for on-site water recycling waste water treatment could be developed that would not only provide for reduced water usage, but also serve as a research and educational opportunities.

Sustainability Reporting

LEED
Pursuant to the UC Sustainable Practices Policy of 2013, all new construction and major renovation projects must achieve LEED Certification at the level of Silver and achieve two water points. Further, all projects in the Inland Empire can earn Regional Credits in the areas of Innovative wastewater technologies and Water use reduction, thus serving to reduce future water consumption while helping to fulfill our Green Building Policy.

STARS – Sustainability Tracking, Assessment and Rating System by AASHE provides a tool by which campuses across the US can measure their progress towards achieving Sustainability. Three credits make up the water assessment in STARS 2.0: OP 26 Water use, OP 27 Rainwater Management and OP 28 Wastewater Management.
STARS recognizes that some campuses are located in higher water stress or scarcity zones. Using the World Resources Institute’s Aqueduct Water Risk Atlas for determining the level of “Physical Risk Quantity,” STARS awards more points for campuses in higher risk zones. UCR falls in the second to highest risk zone on WRI’s Atlas. STARS uses a 30% reduction threshold for achieving maximum points across the credit based on weighted user, square feet of building space and per acre of vegetated grounds.

*Sierra Cool Schools* includes the credits from STARS, plus the following additional credits: a ban or restriction on selling or distributing bottled water, metering of non-potable usage, and percentage of waterless urinals on campus.

*Princeton Review Green Colleges* uses the data collected for STARS without supplemental data requests.

### 2045 Potential for Net Zero water use in Built Environment
As part of UCR’s commitment to a sustainable future the campus has set 2045 as the goal for reaching Net Zero on for all its Green House Gas emissions. Retrofitting the existing built environment will be costly and difficult, but it also offers an opportunity to address water efficiency. The campus does expect to grow significantly over the next thirty years. One consideration then in planning for this growth is to extend the Net Zero GHG goal to include potable water consumption.

### Education and outreach
UCR’s sustainable community garden, R’Garden, provides space and opportunities for all campus stakeholders to learn about water efficient irrigation techniques. The R’Garden is being constructed using a permaculture design for natural agriculture. Water is provided from the Gage Canal and pumped by a solar powered hydraulic water pump. Restroom facilities, soon to be constructed, utilize a dehydrating toilet that does not require any water for its operation.

A recently formed sustainability team, the H2O Highlanders, has been tabling with the Office of Sustainability once a week to promote water conservation awareness. They recently started conducting flow tests on bathroom fixtures across the campus to evaluate the actual flow rates of old and new fixtures.

### Potential Opportunities for sustainable water projects as “Living Laboratory”
UCR is currently exploring the possibility of piloting an Eco-Living Machine to treat wastewater at the building level. Ecologically engineered to treat the specific effluents discharged from the building by replicating the natural purification properties of wetlands, ponds and bioswales, the Eco-Living Machine would provide a cost-effective alternative to installing new wastewater infrastructure, while providing a Living Learning Laboratory for faculty and students at UCR. Successful Eco-Living Machines have been established at Oberlin College, Emory University, Penn State University, and the University of Vermont.
Conclusion
The most cost effective approach to meeting UC Policy will be to make most of our reductions by transforming campus vegetation rather than major retrofits in buildings. RPU has plans to pipe recycled water throughout the City of Riverside, but it is expected to be 15 years or more before the recycled water would reach the campus. Conservation will be the next valuable and cost effective strategy. To keep the trend moving down aggressive water reductions must be built into the new building projects and planned retrofits.

Glossary

Key Water Terms

**Blackwater** – Wastewater originating from sources that have a high likelihood of fecal contamination (e.g., toilets)

**Direct Potable Reuse** – Treated wastewater reused for human consumption

**Domestic Water** – Potable and non-potable water provided for domestic indoor (e.g., toilets, urinals, showers, and faucets) and outdoor (e.g., landscape irrigation) use.

FTE - Full Time Equivalent; 40 hours per five day week.

**Graywater** – Wastewater originating from clothes washers, bathtubs, showers, bathroom sinks, or any other source that has a low likelihood of fecal contamination. Graywater may be treated or untreated prior to reuse.

**Indirect Potable Reuse** – Treated wastewater blended with natural water sources reused as potable or non-potable water.

**Industrial Water** – Water provided for specific industrial applications. The water may be classified as potable or non-potable. Additionally, the water could meet very strict water quality standards that go beyond potable water treatment requirements (e.g., semiconductor manufacturing).

**Native vegetation** – plants that are indigenous to a locality; plants in America that evolved in a given area prior to the time of settlement by people of European descent

**Non-Potable Reuse** – Treated wastewater reused for purposes other than human consumption, such as irrigation, fire suppression, and industrial processes.

**Non-Potable water** – Water not suitable for human consumption.

**OGSF50** – Outside Gross Square Feet 50 % = Total Gross Square Feet of Building and 50% of Gross Square Feet of covered unenclosed areas.

**Reclaimed or Recycled Water** – Wastewater treated with the intention of reuse.

**Potable water** – Water suitable for human consumption.
Storm Water Best Management Practices (BMPs) – Site amenities such as oil/grease traps or bioswales designed to improve storm water quality.

Water Conservation – Practices that reduce water use with in indoors and outdoors in residential, commercial, municipal, and industrial settings.
Water Reuse – Use of graywater (treated or untreated) or treated wastewater, commonly classified as direct potable, indirect potable, or non-potable.

Wastewater – A blend of graywater and blackwater.

WaterSense – A product label indicating the product meets all the criteria in EPA’s specifications for water efficiency and performance.

Water Use Efficiency - Technologies and practices that reduce water use while maintaining or improving services, such as high-efficiency clothes washers and drip irrigation.

Weather-Based Landscape Irrigation Controllers – automated systems which use local weather and landscape conditions to tailor irrigation schedules to actual conditions on-site.

Appendix A: Water Conservation Projects
A.1 Establish minimum flow standards
Guarantee that high-efficiency fixtures will be installed in all new construction and retrofit projects.

- Adopt standards that exceed code requirements.
- The fixtures included in this goal are kitchen faucets, restroom faucets, showers, urinals, and toilets.
- Test plumbing fixtures new to campus including waterless urinals and dual flush toilets. Adopting the flow rate of these devices as UCR’s minimum standard will produce significant water savings.

A.2: Pilot high-efficiency and dual flush toilet fixtures
High-efficiency toilets use just 1.28 gallon per flush (GPF). Dual flush toilets generate substantial water savings by providing different amounts of water to dispose of liquid or solid waste.

- Replace several older fixtures that are over 1.6 GPF, or specify water-saving toilets in new construction.
- Test different brands and products with the intent of creating a water-saving toilet specification for inclusion in campus design standards for both new buildings and restroom retrofits.
- Test UpperCut™ flushometers on existing toilets that are relatively new. This dual-flush handle provides a reduced flush when pushed up and a full flush when pushed down (based on research conducted at UCSB, we may choose to reverse the direction of the flush as most people are in the habit of flushing downwards. UCSB found that much of the water savings were negated by improper use). The device retrofits to most existing valves. 5
- Install educational signage to encourage proper use of dual flush fixtures.

5 www.sloanvalve.com/index_3036_ENU_HTML.htm
• Gather feedback from the campus on performance and ease of use.
• Gather feedback from maintenance and custodial workers.

A.3: **Reduce potable water used to irrigate landscape**
• Convert water-intensive turf areas that are not programmatically necessary to drought-tolerant plantings.
• Design landscaping for the West Campus with few grassy malls, placing emphasis on drought-tolerant and Southern California native plants.
• Design landscaping with plantings grouped based on water needs, a practice known as hydrozoning. This best practice strategy reduces the amount of water that must be delivered to a given area because one high-water use species is not dictating the overall level of irrigation. Grouping plants according to preferred microclimate also improves the efficiency of the weather-based irrigation system.
• Create a plan and timetable for installing flow sensors on the weather-based irrigation system. These devices detect leaks by determining when a flow exists where none should. This feature will immediately alert staff of any leaks, expediting maintenance activities that prevent irrigation runoff and save potable water.
• Pilot gray water systems in new student housing projects to offset some potable water used for irrigation.

A.4: **Conduct building water audits**
UCR has a large number of older buildings that were designed under building codes that required less-efficient plumbing fixtures and fittings. These buildings provide a good opportunity to implement low-cost water conservation devices. Water audits performed in these buildings will support certifying buildings through the LEED EBOM program, which requires water efficiency calculations for indoor plumbing fixtures and fittings as a prerequisite to certification.
• Identify five to ten buildings of different building types, e.g. academic/administrative, housing, light research, heavy research, performing arts/theater, and gymnasium, to analyze the effect of conservation activities in a representative sample of campus buildings.
• Conduct water audits in these buildings. Catalogue all installed fixtures and determine flow rates for each fixture type, using manufacturer’s product literature or measured flow rates.
• Calculate each building’s baseline water usage.
• Audits to be performed by H2O Highlanders with assistance from the Plumbing Shop.
• Install low-cost water saving devices such as sink faucet aerators that meet or surpass current WaterSense or Energy Star specifications.
• Repair all broken fixtures or fittings identified through the audit.
• Calculate water usage with the new devices and compare to the building baseline to determine water savings.

A.5: **Design an educational component to water conservation efforts**
Building user’s understanding of water issues can hugely impact the amount of water consumed in a building. Inspiring behavioral change is an important component to any water conservation effort. A simple and clear educational outreach campaign should be designed for UCR and implemented consistently throughout campus in all water conservation projects.
• Create a signage campaign that is simple, clear and can be easily installed in existing buildings of any architectural style.
• Where appropriate, include facts about the impacts of water usage on California’s environment, the energy required to convey and dispose of potable water and regional water shortages. As water conservation on campus improves, include metrics to keep the campus community motivated to continue water saving efforts.
• As waterless and pint sized urinals are installed, post semi-permanent educational signage that identifies new units and UCR’s water saving goals. Installed signage or stickers is preferable to posted paper fliers.
• Install appropriate signage as new water saving technologies are adopted, such as dual flush toilets or gray water.

A.6: Develop a water efficiency retrofit program
Developing a list of water efficiency projects will allow the campus to strategically prioritize implementation of cost-effective projects. The list can be modeled off the Strategic Energy Plan (SEP), a comprehensive list of energy efficiency projects developed to guide the campus in its energy and emission reduction efforts.

• Use the water audit results to develop the project list.
• Use rebates offered through Riverside Public Utilities, when appropriate, to help fund projects. Include rebates in project analysis to obtain accurate paybacks and prioritize projects.
• Contact vendors of water-saving technologies the campus is interested in testing. Vendors may be willing to donate fixtures and partner with UCR to implement projects from the water efficiency list.

A.7: Install sub-metering for irrigation water
Collecting reliable data on irrigation water use is the first step to developing water management practices that reduce overall consumption. Metering is necessary to populate irrigation water use metrics with accurate data.

• Installing meters on individual existing buildings may be costly. Consider installing meters at representative locations and then interpolating data.

A.8: Pilot water-saving urinals
A waterless urinal saves roughly 45,000 gallons of potable water per year. The touch-free feature improves restroom sanitation, and waterless urinals eliminate odors with proper care. Installing waterless urinals also reduces sewage costs. Low-flow urinals that use 1/8 gallon per flush (GPF) also hold tremendous water-saving potential and may find broader user acceptance than waterless urinals.

• Combine water-saving urinal installations and retrofits with LEED certification efforts.
• Install waterless and 1/8 GPF urinals in high-use restrooms to introduce a larger percent of the campus to the technology and create a larger pool of individuals from which to solicit feedback.
• Waterless urinals are often disliked by users due to improper maintenance. Train all custodial workers on new urinal maintenance, even those that do not regularly clean buildings with waterless urinals. This will allow proper care to continue should crew member substitutions or other unforeseen crew changes occur.

A.9: Formally adopt water-saving toilet specifications
Adopting design specifications will provide for the uniform adoption of low volume fixtures in all new construction and restroom retrofit projects. After testing dual flush products in the short term goals timeframe, UCR can use performance data to determine if this technology is a reliable, cost effective way to conserve water. Alternately, UCR may choose to adopt low volume, 1.28 GPF toilets as the campus standard.

- Evaluate feedback gathered from campus community and maintenance and custodial workers from the pilot dual flush fixture testing completed in the short term goals timeframe.
- Consider the first cost and the operational savings that will be generated over the lifetime of different low volume fixtures, using appropriate escalation factors for potable water prices.
- Formally adopt water-saving toilet specifications.

A.10: Demonstrate best practices in landscape water conservation
Over half of the potable water consumed at UCR is applied to landscaping. Planned campus growth lends many opportunities to demonstrate landscaping water conservation best practices in new construction.

- Consider combining water-conserving landscaping with projects pursuing LEED certification.
- Select drought-tolerant species with water requirements that are appropriate to the semi-arid climate.
- Select native and/or adapted vegetation that is suited to the local climate and requires little active maintenance such as pest protection, irrigation or fertilization once root systems are established.
- Design landscaping with grouped plantings based on water needs. This best practice strategy, known as hydrozoning, reduces the amount of water that must be delivered to a given area because one high-water use species is not dictating the overall level of irrigation.
- Connect all new building landscapes to UCR’s water-efficient irrigation system.
- Work with the Office of Development to solicit donor funding for natural landscape installations.
- Highlight sustainable practices at the R’Garden and Botanical Gardens.

A.11: Pilot gray water technology
Using gray water for purposes that do not require drinking-quality water, such as irrigation, is an environmentally responsible way to offset some potable water consumption. Using gray water also reduces burdens on municipal sewer systems. By piloting gray water technologies on campus, UCR can mitigate some of its upcoming future growth and model a best practice for the region. The City of Riverside does allow the installation of gray water systems, which removes an important barrier currently preventing other campuses from piloting gray water systems using municipal gray water lines.

- New student housing projects present UCR with a good opportunity to install gray water systems, as domestic water use is higher in these buildings than other campus building types.

Appendix B: Eco-living Machines
A man-made wetland that replicates the bioremediation principals of natural systems used to treat wastewater on site.
Appendix C: Bottle Filling Stations

In an effort to provide easily accessible and sanitary water for reusable bottles, UCR has installed 15 chilled filtered bottle filling stations across the campus with several more planned for 2014. The Office of Sustainability provided seven of the bottle filling stations in 2012 and 2013 for the campus. Housing, Dining and Residential Services and Student Recreation have installed the others in their facilities. UCR’s Associated Students Program Board recently incorporated more sustainability features into their events by providing water filling stations at the Spring Splash concert 2013. Future goals include providing a cost effective alternative to single use bottled water for departmental meetings, conferences, graduation and other special events.

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6 http://ucrtoday.ucr.edu/15172
Water Bottle Delivery Service
UCR Sustainability is piloting a water bottle delivery service that will provide departments with filtered water in glass bottles for use in small meetings or for guests in lieu of offering plastic water bottles.