UC Merced
Water Action Plan

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University of California, Merced

UCM WATER ACTION PLAN
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INTRODUCTION

Purpose

UCM Water Action Plan (WAP) is a strategic planning document intended to identify water systems or processes that:

a. Maximize campus water use conservation and efficiency.
b. Optimize water resource management.
c. Protect resources in the context of the local watershed.
d. Enhance economic, social and environmental sustainability while meeting operational objectives.

The UCM WAP takes into account relevant regional conditions and regulatory requirements, recognizes historical progress and acknowledges current location best practices being implemented.

Mission

SSP (p. 10) Ensure leadership in sustainability through teaching, research and public service.

Vision

SSP (p. 26) Create a model 21st century sustainable water management plan.

FOOTNOTES:

1. SSP: UCM Sustainability Strategic Plan (2010)

CONTEXT

Regional

Historically, water in California has been treated as an inexpensive and abundant commodity with the only cost being transportation and treatment. The state's $2 trillion economy is built on inexpensive, abundant water. However, natural and anthropogenic climate change is resulting in less precipitation in the West and forcing a rethinking of the price and availability of water. Given the polarizing conflicts arising from increased competition for decreasing water, it is useful to discuss water from a systems approach such as sustainability. A sustainable water system balances economic, social and environmental needs to establish a balanced framework for sharing water.

Water realities are location-dependent and differ significantly throughout the state and, therefore, differ for the UC campuses and medical centers. For example, a significant portion of the water used by the Southern California coastal campuses (UCI, UCLA, UCSB, UCSD) is imported from Northern California or the Rocky Mountains via the Colorado River. This imported water is more expensive than the groundwater available to UCR, UCM and UCD. A reservoir in the Santa Cruz Mountains provides the City of Santa Cruz and UCSC with most of its water. UCB and UCSF use surface water imported from the Central Sierra which is relatively inexpensive.

Given this backdrop, it is easy to see there is no "one size fits all" water reduction strategy for the UC System. Moreover, because the cost of water varies significantly between campuses, water efficiency strategies that "pencil out" for campuses with high water costs usually cannot be justified by campuses with lower water costs based on a simple return on investment analysis. For this reason, full-cost pricing of water needs to be explored as a tool to more accurately capture the cost and benefits of implementing sustainable water systems.

Water practitioners divide water use reduction into two general categories: conservation and efficiency. Water conservation is using less water through modifications in behavior, such as taking a shorter shower or turning off the faucet when brushing your teeth. Water efficiency is employing technology or procedures to reduce water use, such as low-flow toilets or cooling tower "blowdown" procedures. As a general rule, water conservation requires continuous education and awareness campaigns to minimizing "backsliding" into old behaviors. In contrast, water efficiency requires proper maintenance of equipment to maintain the water savings.

Admittedly, the boundaries between water conservation and efficiency overlap at times, nonetheless, it is an important distinction when considering water use reduction strategies. For example, numerous water conservation goals can be put in place immediately, such as shorter showers or reducing landscape irrigation. Conversely, water efficiency goals may require planning time, funding, installation and ongoing maintenance.

Campus

Water was added to the UC Sustainable Practices policy in August 2013. This policy requires UC campuses and medical centers to reduce per capita water consumption 20% by 2020. UCM used the 2007-10 period to set its water use baseline—which was 22,500 gallons per person per year. Campus per capita water use in 2012-13 was less than 13,000 gallons, representing a 43% reduction and far exceeding the Systemwide 20% by 2020 goal. However, this dramatic water use reduction is largely the result of growing the UCM campus population on a fixed campus footprint. It is important to understand UCM's per capita water use will improve when the campus population is expanding and, conversely, will degrade when new buildings and grounds come online. Nonetheless, UCM total water use will increase from the current 71 million gallons per year to as much as 525 million gallons at campus build-out.

UCM's water comes from a groundwater well located near the intersection of Lake Road and Bellevue Avenue. The City of Merced owns this 800-foot deep well. In 2012-13, the campus used over 71 million gallons of potable water from this well at a cost of $440,000. This cost includes the campus's water and sewer expenses, which is a combined charge to the campus. The campus's annual water consumption is projected to increase to over 120 million gallons by 2020 and to 525 million gallons at full development.

2020 Project

The 2020 Project represents the second phase of the UC Merced campus development under the 2009 Long Range Development Plan (LRDP). This campus expansion supports projected enrollment growth from 6,200 currently to 10,000 students by the year 2020.

The project will involve 219 acres, which includes the existing 104-acre campus, and generate up to 1.85 million square feet of new facilities space. Academic, student services, recreational and administrative buildings will comprise approximately 1.2 million square feet. An additional 650,000 square feet will be student housing and dining services. The 2020 Project envisions mixed-use development integrating students, faculty and staff in a sustainable living and learning environment.

Sustainable design is central to the UC Merced ethos and the campus has embraced leading-edge approaches in energy use, data monitoring and water consumption in new buildings. Additionally, the campus's Triple Zero Commitment set a goal of zero net energy, zero landfill waste and zero net emissions by 2020.

The 2020 Project development criteria will be consistent with the policies in the 2009 UCM LRDP in evaluating water-related infrastructure, including low impact development, sustainable stormwater management, onsite wastewater treatment, wastewater or biomass energy generation and utility infrastructure for reclaimed water, sanitary sewer and stormwater management.

Campus Water Use History

The Campus's current water use breakout is approximately 50% for irrigation, 30% for buildings (which includes residence halls and dining commons) and 20% industrial (which includes building heating and cooling). Currently, the only source of UCM Campus water is the city well, so 100% of UCM's water use is potable water. The campus is exploring potential sources of non-potable water for irrigation and possibly industrial uses. There are no sources of reclaimed water at this time. It should be underscored UCM's building water use is already 40% less than comparable building stock because every campus building is certified LEED silver or better. UCM buildings already have low-flow fixtures and touchless water faucets, for example, and as a rule, earn 80% of the USGBC LEED water credits.

Campus irrigation accounts for half of the campus's current water use. It is typical for irrigation to account for 50-70% of residential water use in the Central Valley due to the climate and existing landscape norms, such as large turf lawns. Nonetheless, UCM can reduce irrigation water use by upgrading its landscape irrigation control system to a modern weather-controlled evapotranspiration (ET) control system and replace decorate turf areas with drought-tolerant, native species landscapes.

Preliminary estimates by UCM Design & Construction suggest the potential for a 30% reduction in campus landscape water usage if weather-controlled ET control systems were implemented and the irrigation infrastructure were modernized. UCM Facilities Management has started this process and it could result in a reduction of approximately 11 million gallons of water and a $65,000 reduction in the water-sewer billing annually.

The campus should consider substituting non-potable water sources for irrigation and, to the degree possible, industrial water use. However, it must be underscored that simply substituting non-potable water for potable water is only marginally more sustainable than sticking with the campus's current potable water source. The campus will not be using any less water, but the greenhouse gas emissions related to water delivery will be less for UCM's possible non-potable water sources than pumping from the 800-foot deep potable city well. That said, there will be an ongoing savings in substituting non-potable water for potable water. The campus's 2012-13 city water/sewer bill was approximately $440,000 and half of the campus water use is for irrigation. So, there will be a significant potential savings in switching to a non-potable source for landscape irrigation. UCM Design & Construction has done some studies examining the options and costs for the campus to develop non-potable water sources.

UCM started using wireless data sensor technology to capture 100% of the campus's water use in near real-time in 2011. Currently, the campus has over 50 sensors monitoring irrigation, building and industrial water meters throughout campus. These sensors provide continuous water use monitoring and rapid leak detection for facilities maintenance. During the initial sensor installation, the campus identified water leaks totally over 2,500 gallons per day.

The campus's water data sensors are also used by students for classroom projects and annual residence hall water conservation competitions. UCM's *PowerSave Green Campus* student interns ran the first residence hall water conservation competition in 2011. This competition raises student awareness about water conservation and efficiency. Almost one-quarter of UCM undergraduate students have participated in one or more water conservation competitions. The fall 2013 competition involved over 2,000 students and generated a 10% reduction in potable water use during the month-long event. UCM regularly competes—and places—in the national ASE Campus Conservation Nationals. UCM undergraduate Martin Figueroa won a Brower Youth Award in national recognition for his water conservation leadership in 2012. UCM students have presented their water competition program at the *PowerSave Green Campus* Summit and the California Higher Education Sustainability Conference (CHESC). UCM received a best practice award at the 2014 CHESC conference for its residence hall water conservation competition.

UC Merced Campus Water Use Data

			BASELINE YEARS			Baseline Average 3-year consecutive	UCM Campus Use	Percent Change from 3-year Baseline	UCM Campus Use	Percent Change from 3-year Baseline	UCM Campus Use	Percent Change from 3-year Baseline
		2005	FY 2007-08	FY 2008-09	FY 2009-10	FY 2007-10	FY 2010-11	FY 2010-11	FY 2011-12	FY 2011-12	FY 2012-13	FY 2012-13
Campus Water Use												
	Gallons used for the fiscal year	51,289,592	53,297,066	69,808,026	64,508,092		63,655,315		67,315,000		71,249,244	
	Campus utility bill - WATER		$49,976	$71,991	$72,431		$77,501		$90,246		$93,434	
	Campus utility bill - SEWER		$156,737	$258,370	$272,180		$287,621		$326,380		$345,007	
	Total water & sewer bill		$206,713	$330,361	$344,611		$365,122		$416,626		$438,440	
	Cost for Water & Sewer (per 1,000 gallons)		$3.88	$4.73	$5.34		$5.74		$6.19		$6.15	
Breakout of Water by Source												
	Potable		53,297,066	69,808,026	64,508,092		63,655,315		67,315,000		71,249,244	
	Non-Potable		0	0	0		0		0		0	
Breakout of Water by Use												
	Buildings - potable		n/a	n/a	n/a		n/a		25,565,064		23,198,145	
	Buildings - nonpotable											
	Landscape - potable		n/a	n/a	n/a		n/a		37,131,374		34,739,244	
	Landscape - nonpotable											
	Central Plant - potable		n/a	n/a	n/a		n/a		4,618,562		13,311,855	
	Central Plant - nonpotable											
Gross Square Feet												
	OGSF50		722,026	836,461	871,611		958,758		1,060,149		1,092,650	
	Weighted Campus Users	1,458.8	2,098.5	2,922.0	3,505.1	2,841.9	4,397.9		5,065.1		5,540.0	
	Gallons per Year /Weighted Campus User	35,160.0	25,398.0	23,890.5	18,404.2	22,564.2	14,473.9	-35.9%	13,290.0	-41.1%	12,860.9	-43.0%
	Gallons per Year /OGF50		73.8	83.5	74.0	77.1	66.4	-13.9%	63.5	-17.6%	65.2	-15.4%
	On-campus residents (ie students living on-campus)	398	784	1,111	1,170		1,602		1,568		1,568	
	Percent of students living in UC-owned housing		45%	44%	37%		39%		32%		27%	
	Percent of students living off-campus or commute		55%	56%	63%		61%		68%		73%	
	Total students from IPA data (headcount)		1,871	2,718	3,414		4,381		5,198		5,760	

THE PLAN

Reduce Water Use

Campus Policies

LRDP SUST-1 (p. 110): Adhere to principles of sustainable environmental stewardship, conservation and habitat protection in the planning, design and construction of the campus and individual projects, adopting an approach of continuous improvement in the sustainability of campus development, operations and management.

LRDP SUST-2 (p. 110): Design campus facilities to achieve U.S. Green Building Council LEED Gold certification at a minimum, when employing all campus base credits. Establish a minimum of 20-25 LEED campus base credits by creating and implementing planning and design standards for all campus facilities and site development. Temporary facilities (less than fifteen years life expectancy) shall strive for LEED Silver equivalence, unless recommended for exemption from policy by the Campus Physical Planning Committee and approved by the Chancellor.

LRDP SUST-8 (p. 111): Explore the feasibility of achieving water neutrality by determining UC Merced's "water footprint" [(i.e., consumptive use of rainwater (green water), consumptive use of water withdrawn from groundwater or surface water (blue water) and pollution of water (grey water)]; Establish water footprint reduction targets for UC Merced and employ mechanisms to offset the environmental and social impacts of residual water footprints, such as, employing state of the art technologies, education, modeling new and cost-effective approaches in design and product selection.

LRDP SUST-9 (p. 111): Minimize consumption of potable water resources through the design of landscapes that minimize the use of irrigation water after the plants' initial growing phase, and providing for use of recycled water for all irrigation.

LRDP SUST-10 (p. 111): Design campus landscaping to emphasize regional natives, avoid invasive or allergenic species, and select plantings that are compatible with campus infrastructure, developing a palette of approved plant, ground cover and tree lists, as well as landscape design guidelines. Explore the feasibility of seasonal use of irrigation water from the Merced Irrigation District.

LRDP SER-4 (p. 105): Use life-cycle cost-based design criteria in lieu of first cost in the planning and design of utility systems for campus and for specific projects.

LRDP SER-5 (p. 105): Provide for the short-and long-term collection and treatment of campus wastewater, initially by the City of Merced's Wastewater Treatment Facility, with the possible long-term addition of a recycled water treatment facility either on the campus or in the University Community, which will allow the campus to augment its other water supplies and create a source for recycled and industrial water, biomass energy and compost.

LRDP SER-6 (p. 105): Minimize water use by permitting spray irrigation only in large turf areas, primarily used for formally landscaped, organized recreation or athletic fields. Irrigation systems will be designed to utilize smart controls, such as using information gathered from local weather stations, and tailored to soil types and plant types, adjusting water distribution on a daily basis as needed, thus minimizing runoff.

LRDP SER-8 (p. 105): Create a campus district utility plan to enable shared costs of deploying infrastructure.

SSP (p. 26): Optimize UC Merced and University Community water footprint.

UCSPP (p. 24) Encourage implementation of innovative water-efficient technologies as part of capital projects and renovations (e.g., installation of WaterSense certified fixtures and appliances, graywater reuse, rainwater harvesting, and watershed restoration).

UCSPP (p. 24) Analyze the identified water use reduction strategies using a full cost approach by considering: (a) projected costs and savings of the identified water use strategies, (b) indirect costs and savings associated with reduced energy consumption due to the energy use embodied in water use, (c) savings associated with reduced or avoided infrastructure costs, and (d) other avoided costs.

FOOTNOTES:

2. LRDP SUST: Sustainability Section of UCM Long Range Development Plan (2009)
3. LRDP SER: Services Section of UCM Long Range Development Plan (2009)
4. SSP: UCM Sustainability Strategic Plan (2010)
5. UCSPP: UC Sustainable Practices Policy (2013)

Set Potable Water Consumption Reduction Targets

Achievements to Date

- Reduced UCM Campus per capita water consumption 43% by FY 2012-13 from FY 2007-10 baseline—exceeding the UC Sustainable Practices Policy target of 20% by 2020.
- Created UC Merced Tree Planting and Early Care Guidelines (April 1, 2010).
- Created supplementary information to "Species Selection Candidates" Section in UC Merced: Tree Planting and Early Care Guidelines (August 3, 2010).

Short Term Actions (0-3 Years)

- Implement landscape irrigation practices meeting or exceeding AB 1881 (Model Water Efficient Landscape Ordinance).
- Meet or exceed "Urban Water Conservation" elements of SB X7-7 (Water Conservation Act of 2009).
- Complete Sustainable Sites Initiative pilot landscape around SE2 building.
- Maximize USGBC LEED water conservation credits for LEED-NC and LEED-EBOM.
- Maximize AASHE STARS water conservation credits.
- Install weather-controlled, ET landscape water monitoring system.
- Meter, monitor and share UCM real-time water use data using online dashboards.
- Transition unnecessary turf to energy smart, California-friendly landscapes or hardscape.

Intermediate Term Actions (3-5 Years)

- Implement campus landscape master plan.
- Consider adopting Sustainable Sites Initiative Guidelines and Performance Benchmarks.
- Create demonstration arboretum for energy smart, Central Valley-friendly plantings.

Long Term Actions (5-10 Years)

- Explore developing student internships for implementation of water neutrality projects.

Implement Innovative Water-Efficient Technologies

Achievements to Date

- All campus buildings are certified LEED Silver or better.
- Campus fully water metered with automated usage captured by Badger Meter BEACON system and available in online dashboard at https://beaconama.net/

Short Term Actions (0-3 Years)

- Maximize USGBC LEED water conservation credits for LEED-NC and LEED-EBOM.
- Maximize AASHE STARS water conservation credits.
- Optimize water early leak detection by leveraging Badger Meter Beacon system.
- Install only US EPA WaterSense and/or Energy Star approved fixtures and appliances.
- Explore using water budgets as a tool to foster innovation and creativity in water efficiency.
- Experiment with monitoring-based commissioning approach to water use reduction and leak detection.
- Conduct regular campus water audits.

Intermediate Term Actions (3-5 Years)

- Consider piloting use of low-flow water measurement sensors in residence halls.
- Consider water-efficient and conservation practices for campus cooling towers and central plants.

Long Term Actions (5-10 Years)

- Explore feasibility and implementation of distributed wastewater treatment opportunities such as on-site wastewater treatment facility.
- Explore amending campus planning, design and construction policies to require leading-edge sustainable water systems.
- Explore the use of full-cost pricing in analyzing payback periods for sustainable water systems.

Substitute Non-Potable Water Sources

Achievements to Date

- Conducted study to deploy surface water for non-potable irrigation use (October 2009).
- Developed well irrigation study to evaluate an existing campus irrigation well (September 2009).
- Installed campuswide purple pipe system for non-potable irrigation use.

Short Term Actions (0-3 Years)

- To be determined.

Intermediate Term Actions (3-5 Years)

- Explore use of existing Little Lake well for non-potable irrigation use.
- Explore use of non-potable water for all landscape watering.
- Explore use of non-potable water for campus cooling towers.
- Explore use of non-potable water for industrial water use.

Long Term Actions (5-10 Years)

- Consider implementation of conjunctive use, non-potable water plan, such as golf course well and/or MID irrigation canal.
- Consider requiring all campus water be used more than once before being discarded.

Manage Stormwater & Protect Watershed

Campus Policies

LRDP SUST-1 (p. 110): Adhere to principles of sustainable environmental stewardship, conservation and habitat protection in the planning, design and construction of the campus and individual projects, adopting an approach of continuous improvement in the sustainability of campus development, operations and management.

LRDP SUST-8 (p. 111): Explore the feasibility of achieving water neutrality by determining UC Merced's "water footprint" [(i.e., consumptive use of rainwater (green water), consumptive use of water withdrawn from groundwater or surface water (blue water) and pollution of water (grey water)]; Establish water footprint reduction targets for UC Merced and employ mechanisms to offset the environmental and social impacts of residual water footprints, such as, employing state of the art technologies, education, modeling new and cost-effective approaches in design and product selection.

LRDP SUST-12 (p. 111): Design roadways, parking lots and circulation pathways to minimize, detain and filter stormwater runoff.

LRDP SER-4 (p. 105): Use life-cycle cost-based design criteria in lieu of first cost in the planning and design of utility systems for campus and for specific projects.

LRDP SER-5 (p. 105): Provide for the short-and long-term collection and treatment of campus wastewater, initially by the City of Merced's Wastewater Treatment Facility, with the possible long-term addition of a recycled water treatment facility either on the campus or in the University Community, which will allow the campus to augment its other water supplies and create a source for recycled and industrial water, biomass energy and compost.

LRDP ENV-12 (p. 82): Implement conservation measures in the 2009 UC Merced Conservation Strategy for fragile resources such as grasslands and vernal pools.

LRDP ENV-13 (p.82): To the extent possible, work towards percolation of precipitation into groundwater by the use of the Low Impact Development (LID) strategies, or equally effective measures, such as clustering of structures, bioretention areas, planted swales and permeable pavement where appropriate and feasible.

UCSPP (p. 24) Encourage stormwater quality elements such as appropriate source control, site design (low impact development), and stormwater treatment measures to be considered during the planning stages of projects in order to most efficiently incorporate measures to protect stormwater quality.

UCSPP (p. 24) Address stormwater management from a watershed perspective in a location-wide, comprehensive way that recognizes stormwater as a resource and aims to protect and restore the integrity of the local watershed(s).

UCSPP (p. 24) Reference the location's best management practices for preventing stormwater pollution from activities that have the potential to pollute the watershed.

UCSPP (p. 25) Include—to the extent feasible—full cost evaluation of stormwater management initiatives.

FOOTNOTES:

1. LRDP SUST: Sustainability Section of UCM Long Range Development Plan (2009)
2. LRDP SER: Services Section of UCM Long Range Development Plan (2009)
3. LRDP ENV: Environments Section of UCM Long Range Development Plan (2009)
4. UCSPP: UC Sustainable Practices Policy (2013)

Protect & Restore Integrity of Local Watershed

Achievements to Date

- Capture 100% of stormwater on campus at Little Lake, Lower Pond and North Pond under normal precipitation conditions.
- Incorporated bioswales throughout campus to manage stormwater quantity and quality.
- Developed Lake Lot 2 parking lot to capture stormwater in gravel parking stalls to slow and filter stormwater before discharge into Lower Pond.
- Use native species and other drought-resistant species landscaping throughout campus.
- Incorporated underground retention basins to slow stormwater rate and quantity in Housing 4.
- Developed watershed maps for campus and adjacent lands to show campus hydrology for campus master plan, 2020 project and future build-out.

Short Term Actions (0-3 Years)

- Continue reducing stormwater runoff volume and improve water quality.
- Maximize USGBC LEED and AASHE STARS stormwater credits.

Intermediate Term Actions (3-5 Years)

- Explore creation of applied model for UCM watershed.
- Incorporate green infrastructure and low-impact development strategies into site design in order to manage 30-50% of total volume runoff on-site.
- Continue incorporating retention basins into site design and development to capture 100% of campus stormwater under normal precipitation conditions.

Long Term Actions (5-10 Years)

- Explore feasibility and implementation of distributed wastewater treatment opportunities such as on-site wastewater treatment facility.
- Explore feasibility of using captured rainwater for irrigation and non-potable use in buildings.

Prevent Stormwater Pollution Resulting from Campus Activities

Achievements to Date

- Include requirements in campus construction contracts to develop stormwater pollution prevention plans.
- Conduct monthly trainings for contractors on stormwater pollution prevention.
- Monitor campus regularly and install stormwater best management practices as needed.
- Incorporate permeable pavement solutions, including Lake Lot 2 gravel parking stalls.
- Installed bioswales and rock swales to reduce stormwater runoff and reduce erosion to improve stormwater quality.
- Installed continuous deflection separation units for Little Lake and North Pond to clean contaminants from stormwater.
- Enlarged North Pond to accommodate future build-out.
- Participation by UCM faculty and staff in creation of Merced Integrated Regional Water Management Plan

Short Term Actions (0-3 Years)

- Include and coordinate stormwater management plan with 2020 project.
- Continue labeling stormwater inlets to remind constituents that dumping in the storm sewer is harmful to water quality.
- Develop and implement a campus and community outreach program on the importance of keeping campus free of trash and other threats to stormwater quality.
- Inventory herbicides and pesticides used on campus to assess risk they may have to stormwater.

Intermediate Term Actions (3-5 Years)

- Develop and implement UC Merced's Stormwater Management Plan (SWMP) based on mitigation of UC Merced Campus high-risk pollutants.

Long Term Actions (5-10 Years)

- Continue to implement campus SWMP and revise as needed to address emerging threats to stormwater.

Protect Stormwater Quality

Achievements to Date

- Certified two employees as certified erosion, sediment and stormwater inspectors.
- Monitor the entire campus stormwater regularly and install best management practices as need to protect stormwater quality and prevent storm water erosion.
- Developed Lake Lot 2 parking lot to capture stormwater in the gravel parking stalls to slow and filter stormwater before discharge into Lower Pond.
- Incorporated bioswales using native and drought tolerant species to help filter stormwater contaminates before discharging into North Pond and Little Lake.
- Monitor the entire campus regularly and install best management practices as needed.
- Installed continuous deflection separation units for Little Lake and North Pond to clean contaminants from stormwater.
- Conduct monthly trainings to campus contractors on stormwater pollution prevention.

Short Term Actions (0-3 Years)

- Include stormwater monitoring and protection measures in construction contract language.
- Develop and implement a campus and community outreach program on the importance of keeping campus free of trash and other threats to stormwater quality.
- Inventory herbicides and pesticides used on campus to assess the risk they may pose to stormwater.

Intermediate Term Actions (3-5 Years)

- Develop and implement UC Merced's Stormwater Management Plan (SWMP) based on mitigation of UC Merced Campus high-risk pollutants.

Long Term Actions (5-10 Years)

- Continue to implement the campus SWMP and revise as needed to address emerging threats to stormwater.

Conduct Education & Outreach

Campus Policies

LRDP SUST-1 (p. 110): Adhere to principles of sustainable environmental stewardship, conservation and habitat protection in the planning, design and construction of the campus and individual projects, adopting an approach of continuous improvement in the sustainability of campus development, operations and management.

LRDP SUST-8 (p. 111): Explore the feasibility of achieving water neutrality by determining UC Merced's "water footprint" [(i.e., consumptive use of rainwater (green water), consumptive use of water withdrawn from groundwater or surface water (blue water) and pollution of water (grey water)]; Establish water footprint reduction targets for UC Merced and employ mechanisms to offset the environmental and social impacts of residual water footprints, such as, employing state of the art technologies, education, modeling new and cost-effective approaches in design and product selection.

LRDP SER-4 (p. 105): Use life-cycle cost-based design criteria in lieu of first cost in the planning and design of utility systems for campus and for specific projects.

UCSPP (p. 25) Present potential opportunities to serve as a living laboratory for sustainable water projects.

UCSPP (p. 25) Identify opportunities for pilot projects that illustrate the University's commitment to sustainable water practices through teaching, research, and service.

SSP (p. 26): Optimize UC Merced and University Community water footprint.

SSP (p. 26): Define water at UC Merced in terms of social, environmental and economic sustainability.

SSP (p. 26): Train UC Merced water sustainability leaders.

SAV (p. 26): Build an integrated research and educational program on ecological systems, energy, water and other natural resources, climate change and security threats associated with global change that will help build a sustainable environment.

UCSPP (p. 25) Support efforts of students, faculty and staff to implement sustainable water systems on campuses and other locations.

UCSPP (p. 25) Identify opportunities for new practices that could create behavior change with regard to water use and watershed management.

FOOTNOTES:

1. LRDP SUST: Sustainability Section of UCM Long Range Development Plan (2009)
2. LRDP SER: Services Section of UCM Long Range Development Plan (2009)
3. SAV: UCM Strategic Academic Vision (2009)
4. UCSPP: UC Sustainable Practices Policy (2013)

Use Campus as Living Laboratory for Sustainable Water Systems

Achievements to Date

- First UCM Campus water use audit by Dannique Aalbu (2009).
- Campus water use is captured in real-time by Badger Meter BEACON system and available in online dashboard at https://beaconama.net/
- LEED water credits resulting in Silver or better rating for all campus buildings.
- AASHE STARS water credits resulting in Silver rating for UCM Campus.

Short Term Actions (0-3 Years)

- Determine feasibility of using water budgets—similar to UCM energy budget model.
- Explore use of US EPA Sustainable Water Systems model for UCM Campus.
- Involve organizations outside UCM to leverage the campus as a living laboratory for sustainable water systems, including UC Cooperative Extension, Native Plant Society.
- Plant material test plots testing for plant adaptability and water usage/conservation.

Intermediate Term Actions (3-5 Years)

- Consider creating a UCM water scorecard.
- Consider adopting UCM principles of sustainable water
- Explore creation of a Central Valley-friendly, energy-smart demonstration arboretum.

Long Term Actions (5-10 Years)

- To be determined.

Support Faculty, Staff & Students in Implementing Sustainable Water Systems

Achievements to Date

- Campus water data and database used for undergraduate student capstone projects.
- Campus community garden established.
- Secured $10,000 to support Engineering Service Learning educational kiosk on San Joaquin River restoration research by Professor Tom Harmon.
- River conservation education and outreach at Merced River Fair.

Short Term Actions (0-3 Years)

- Improve access to campus water data and dashboards for students, faculty, staff and local community.
- Support and collaborate with faculty in fostering use of campus sustainable water systems in teaching, research and service programs.
- Install interpretive signage on campus watershed and stormwater management.

Intermediate Term Actions (3-5 Years)

- Explore applied model for UCM water full-cost pricing.
- Explore applied model for UCM water/energy nexus.
- Explore applied model for UCM water footprint and water neutrality.

Long Term Actions (5-10 Years)

- Project UCM Campus's smallest practicable water footprint—consider water neutrality, full-cost pricing and water/energy nexus.
- Support and collaborate with faculty in developing programs and internships around sustainable water systems on the UCM Campus.

Create Behavior Change Regarding Water Use & Watershed Management

Achievements to Date

- Initiated program to install hydration stations on campus.
- Annual residence hall water conservation competition.
- Water conservation YouTubes (1, 2, 3, 4).
- Sustainable water systems webpage
- ASE Campus Conservation Nationals winner.
- Finalist in White House Campus Champions of Change Challenge (2012).
- Brower Youth Award winner for water conservation leadership (2012).
- CHESC Best Practice Award for residence hall water conservation competition (2014).
- Social media for water conservation competition by Prof. John Haner's classes.
- Core 1, World Water Day and Earth Day presentations.

Short Term Actions (0-3 Years)

- Define water in terms of environmental, social and economic sustainability.
- Work with campus student organizations and faculty to raise UCM student awareness and understanding about California water issues.
- Explore use of UCSD's Aquaholics program on UCM campus.
- Outreach to UCM ECEC students to promote awareness of water issues, including conservation, pollution and environmental stewardship.

Intermediate Term Actions (3-5 Years)

- Create river education program for students participating in campus-sponsored whitewater rafting trips.
- Expand sustainable water educational opportunities for local Merced communities.
- Establish campus water evangelists program.

Long Term Actions (5-10 Years)

- Establish a UCM student, faculty and staff water champion award.
- Establish outreach and education program to create awareness about Central Valley water use and watershed issues, such as groundwater overdrafting and contamination, surface water sustainability and local anadromous fisheries.

APPENDIX

References

UC Merced Long Range Development Plan 2009
UC Merced Strategic Academic Vision 2009
UC Merced Sustainability Strategic Plan 2010
UC Sustainable Practices Policy 2013

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