Final

Sustainability Baseline Audit REPORT

218884

Central Connecticut State University
New Britain, CT

July 2007

woodardcurran.com
COMMITMENT & INTEGRITY DRIVE RESULTS

TABLE OF CONTENTS

LIST OF TABLES

TABLE **PAGE NO.**

LIST OF FIGURES

LIST OF APPENDICES

1. EXECUTIVE SUMMARY

The purpose of this Executive Summary is to highlight some of the key information contained in this report, including CCSU's current sustainability successes, as well as the top recommendations for areas of improvement.

1.1 CCSU'S SUSTAINABILITY SUCCESSES

In general, CCSU has been involved in sustainability initiatives for years, the majority of which have not historically been widely publicized to the University or outside communities. The limited amount of publications regarding these initiatives may have led people to assume that the University is not committed to sustainability, but this is not the case. While this report includes recommendations to help the University become more sustainable, it also identifies and establishes a baseline of some of the excellent initiatives that CCSU has already implemented successfully over the last several years. These praise-worthy initiatives should be communicated to the University community. Some highlights of CCSU's successful sustainability initiatives are summarized below:

- **New Energy Center.** CCSU makes energy conservation a key priority and has a long history of prioritizing conservation and efficiency. The new, state-of-the-art, efficient Energy Center illustrates CCSU's dedication to energy conservation, particularly because it has cogeneration capabilities. The Energy Center is more efficient and cleaner-burning compared to regional plants and the antiquated 50-year old Power House that it replaced. The Energy Center project began with an evaluation of CCSU's infrastructure and the development of an energy conservation plan in the mid-1990s. Associate Chief Administrative Officer and the Director of Engineering and others on their staff have worked tirelessly to develop and build the Energy Center. Like most college campuses in New England, some of the buildings at CCSU are old and were built to inefficient standards. CCSU is committed to continuous improvement and has systematically identified key buildings and systems in need of renovation and upgrades to new, more efficient standards. All new buildings at CCSU are tied into the Energy Center for heat and chilled water. As older buildings are renovated, every effort is made to upgrade mechanical systems, lighting, windows, doors, and insulated roofing to the extent that upgrades are technically and economically feasible. In addition, CCSU is directly involved in creating newer, greener standards for the CSU System and its campus.
- **Recycling Program.** CCSU currently recycles cardboard, white paper, and scrap metal. The campus also recycles fluorescent lamps, batteries, used oil, and other items regulated as universal waste. CCSU's current recycling rate of 31% would have put it in 13th place out of the 45 schools participating in the nation-wide competition called Recyclemania in 2006 (if CCSU had participated). While CCSU's recycling program could be improved, the fact that the University is already involved in recycling a variety of waste streams should be publicized.
- **Water Conservation Measures.** CCSU has already enacted water conservation measures across campus. CCSU currently has individual water metering at each building, parking garage, and other water-using features on campus (this is not the case at most college campuses). The metering helps determine water usage issues, and the progress of current conservation efforts. The majority of residences on campus (five out of nine, or 56%) currently have low-flow features installed. These include low-flow showerheads and faucets, as well as reduced flush toilets. Vance Residence Hall also has low-flow showerheads, toilets.

- **Green Purchasing Practices.** CCSU's Purchasing Department has developed quite a few procedures to reduce waste, encourage recycling, and promote sustainability. One example is adding language to promote sustainability to some of the University's contracts. Also, where possible, Purchasing makes an effort to buy greener office supplies and reduce packaging, as well as only buying what is needed for classes to reduce storage.

- **Hazardous Waste Minimization.** Individual CCSU departments have done an excellent job of culling out old chemical inventories, re-organizing stocks of teaching/research chemicals, and streamlining and categorizing chemical inventories. In comparison with other schools its size, CCSU generates a relatively small quantity of hazardous waste.

  Ten years ago, CCSU began a program of identifying excess chemicals for elimination while reducing inventory of on hand storage. Chemical requests are reviewed by the Purchasing and the Health and Safety Officer and each department makes efforts to reduce any storage and purchase a level of chemical needed for current semester classroom experiments.

- **Green Building Design.** With respect to building design and construction, CCSU and the State of Connecticut make an attempt to design buildings that are as green as possible. Some of the buildings on campus have efficiencies such as energy-efficient lighting, motion-sensored fixtures, daylighting, low-flow water systems, and central HVAC systems. Also, CCSU has committed to constructing new buildings in accordance with Leadership in Energy and Environmental Design (LEED and CCSU) standards, in accordance with State law.

- **Green Cleaning Chemicals.** Housekeeping makes a conscious effort to purchase and use green chemicals for cleaning purposes, which are dispensed in custodial rooms. These purchases are reviewed with industry initiatives and the Health and Safety Officer.

Please note that these are just a few examples of successful initiatives that CCSU has enacted to become more sustainable. More examples of successful programs are described throughout this report. Additional baseline data are provided in each section of this report. Other specific sustainability initiatives at CCSU include the construction of a sustainable building, student involvement in Earth Day activities, biology classes that label trees, and athletic teams' programs for collecting redeemable bottles and cans.

1.2 POTENTIAL AREAS FOR IMPROVEMENT

For each section of the report, Woodard & Curran has described recommendations for programs, procedures, and/or processes that will help the University become more sustainable. Recommendations that, if implemented, could have the most positive environmental impact, include the following:

- **Sustainability Coordinator.** CCSU is seriously considering hiring a part- or (preferably) full-time Sustainability Coordinator to oversee implementation of CCSU's sustainability efforts. This person could also spent some of their time ensuring that CCSU's recycling program is implemented and maintained. A Sustainability Coordinator could also work with a web developer to get a CCSU Sustainability Website up and running.

- **Evaluate the Financial Feasibility of Increasing Cogeneration.** While the Energy Center is clearly more efficient than the old equipment it replaced, CCSU should continue to explore the environmental benefit of the cogeneration capabilities of the plant. Specifically, the cogeneration engines have not been used to generate a significant portion of the campus's electricity demand

because of the relatively high cost of natural gas over the past few years. Steam for heat and chilled water is provided almost exclusively by the combustion of natural gas using traditional (although efficient and clean-burning) boiler technology. Electricity is provided almost exclusively by Connecticut Light & Power (CL&P) and is derived from predominantly non-renewable sources such as coal, gas, oil, and nuclear. While the electricity and steam generated by these engines is not "renewable," it is more efficient than generating steam in a traditional boiler and buying power from the grid (and would reduce CCSU's carbon footprint).

- **Implement Recycling Management Plan.** Overall, CCSU is recycling some waste streams successfully; however, compared with other comparable institutions, there are waste streams that CCSU is not currently recycling. Specifically, while CCSU recycles white paper and cardboard, it does not recycle other types of paper or containers, and its white paper recycling program is implemented on an inconsistent basis throughout the campus. White paper and cardboard are typically large portions of the waste stream, so capturing a significant portion of these streams was sufficient to achieve competitive recycling rates with other institutions. One way to help ensure that the recycling program is successfully implemented is to hire a full-time recycling coordinator. CCSU had indicated that it prefers to rely on existing staff to implement the recycling program. Also, if CCSU hires a sustainability coordinator, this person can spend some of their time on the recycling program.
- **Launch Educational Campaign on Water Conservation, Energy Conservation, and Personal Reduce, Reuse, Recycle.** CCSU should consider implementing a campus-wide educational campaign focused on water conservation, energy conservation, and personal habits of reuse, reduce, and recycle. Following an educational campaign, CCSU should aim to increase student involvement in sustainability efforts.
- **Develop, Adopt, and Implement an Environmentally Preferable Purchasing Policy.** This could also be called a Sustainable Purchasing Policy or Green Purchasing Policy. This policy should have sign-off by University administration, and be enforced. The policy should also reflect the requirements of any applicable Executive Orders and State Statutes, as well as describing how CCSU can work within the confines of State contracts to promote sustainability.
- **Continue Hazardous Waste Minimization Efforts.** Even though CCSU currently generates small quantities of hazardous waste, there are still numerous ways that the campus can continue to decrease its waste generation, as well as reducing the overall number of chemicals used on campus.
- **Develop, Adopt, and Implement a Green Building Policy.** While CCSU currently has a number of green building practices that it has employed for new building construction (as well as building renovations), the University should consider formalizing its commitment with a Green Building Policy. This Policy could be very broad and explain in general terms how the University plans to comply with CT State LEED building standards, as well as adhering to its own set of standards. Conversely, the policy could be detailed enough to include the specific types of green building standards that the University aspires to. It should be noted here that CCSU is currently directly involved in creating newer, greener standards for the CSU System and the State.

  In conjunction with the Office of Policy and Management, the "Connecticut State Facilities Building Standard Guidelines Compliance Manual for High Performance Buildings" has been developed for new construction and renovations in State facilities.

- **Green Cleaning and Maintenance.** CCSU should continue to ensure that proposals from outside cleaning and maintenance companies use green chemicals to the maximum extent possible. The facilities department, as well as Environmental Health & Safety, can continue to work with Purchasing to draft RFPs to include this condition. These current policies should be formalized as part of a green purchasing policy.
- **Transportation Impacts and Related Emissions.** CCSU should consider developing a trip reduction program to encourage carpooling, mass transit, bicycling and the use of alternative fueled vehicles, as well as optimizing routes to reduce trip time and idling time for campus vehicles. CCSU should also gradually replace CCSU vehicles with alternative fueled vehicles or traditional vehicles that are at least more fuel efficient. The University should also strongly consider adopting a formal policy to reduce the amount of vehicle idling time, possibly installing hour meters in an effort to reduce unnecessary idling.
- **Reduce the Use of Disposable Containers.** Suggestions for achieving this include: (1) providing pitchers of water at meetings and catered events instead of bottled water; (2) provide reusable silverware and dishes at catered events instead of disposable; (3) provide a discount for students who provide their own mug or container at takeout facilities.

Please note that these are just a few examples of recommendations that are included in this report. Additional recommendations are provided in the Recommendations part of each section.

Also, where possible, we have included sample policies as Appendices to this Plan to facilitate CCSU's creation of their own policies (see Appendices C - E).

1.2.1 Top Five Recommendations

While the above list highlights some of the recommendations in the report that are considered the most important, the following five recommendations are ones that CCSU should focus on over the next two years. These "Top Five" recommendations, if implemented, can result in the greatest cost savings and are the best ways to reduce the campus's overall environmental footprint:

1. **Assign Sustainability/Recycling Coordinator to Implement Recycling Management Plan**
2. **Launch Educational Campaign on Water Conservation, Energy Conservation, and Reduce/Reuse/Recycle**
3. **Re-Evaluate Financial Feasibility of Increasing Cogeneration**
4. **Develop, Adopt, and Implement a Green Building Policy**
5. **Develop, Adopt, and Implement an Environmentally Preferable Purchasing Policy (see manual)**

Collectively, these Top 5 recommendations show that sustainability initiatives are incredibly interconnected. For example, when green buildings are built in accordance with a green building policy, water conservation is realized, energy use is lower, there are facilities in the building for recycling, and the materials that are purchased for the building (and used to furnish the building) are more sustainable.

Overall, these five elements represent the most significant ways that CCSU can reduce its environmental footprint.

If an additional recommendation were to be added to the Top Five, it would likely be increasing the sustainability of food service operations on campus. However, this recommendation is not included in the Top 5 because CCSU's level of food service is not very large, considering that it is primarily a commuter school. CCSU should strongly consider the recommendations listed in the food service section of this report, but these recommendations were not significant enough to appear in the top five. Another recommendation that is important but does not appear in the Top Five is decreasing transportation impacts. CCSU is a commuter school and therefore impacts the environment through all of the vehicles used by students to access the campus on a daily basis. It is likely that improving the transportation program at the University will be a long-term effort, which is why this recommendation is not included in the Top 5, which is for shorter-term initiatives.

1.3 BENCHMARKING

Throughout this report, we present information that is intended to benchmark CCSU against other comparable institutions with respect to sustainability. Where possible, we have included information on the sustainability programs of CCSU's peer institutions. These institutions include:

- Bridgewater State College (Bridgewater, MA)
- Central Missouri State University (Warrensburg, MO)
- CUNY Brooklyn College (Brooklyn, NY)
- East Stroudsburg University of PA (East Stroudsburg, PA)
- Montclair State University (Upper Montclair, NJ)
- Southern Illinois University-Edwardsville (Edwardsville, IL)
- University of Massachusetts-Dartmouth (N. Dartmouth, MA)
- University of Southern Maine (Portland, ME)
- Valdosta State University (Valdosta, GA)
- William Paterson University of NJ (Wayne, NJ)

Where possible, we included information in the report about the sustainability programs at these peer institutions. In general, these schools are not considered leaders with respect to sustainability. Information from schools with mature sustainability programs (e.g., Harvard, Yale, Duke, Bowdoin, University of Michigan, Stony Brook University, etc.) was included as a way to glean "lessons learned." Often, the most useful benchmarking information comes from learning how successful programs were developed.

CCSU, in comparison with the 10 peer institutions listed above, would definitely appear towards the top of a sustainability program ranking. With its Energy Center, building efficiency efforts, and current recycling practices, CCSU can publicize its efforts knowing that the University is clearly on the path towards sustainability, and ahead of most of its peers. The following "quick ranking" of CCSU against its peer institutions shows that CCSU is near the top of the list.

Table 1-1: Quick Ranking of CCSU's Sustainability Efforts Compared with Peer Institutions

RANKING	SCHOOL	SUSTAINABILITY INITIATIVES
1	UMass Dartmouth	Various sustainability initiatives, including energy conservation, an energy management system, a robust recycling program, energy performance contracting, alternative steam plant fuels, geothermal HVAC. The University also offers a Minor in Sustainability.
2	University of Southern Maine	Energy efficiency initiatives, recycling program, LEED-certified educational center and parking garage; part-time Sustainability Coordinator; sustainability awareness training for faculty; wind turbine feasibility study.
3	CCSU	See Baseline Audit Report for current sustainability initiatives; formal sustainability program has not yet been established.
4	Montclair State University	Has started a formal sustainability program, with a small website. Last year, participated in Recyclemania for the first time. In 2005, participated in a New Jersey energy conservation program called "Operation Kill-A-Watt."
7	Bridgewater State College	Started the Center for Sustainability at Bridgewater State College, although it is not clear what this Center does or has accomplished. The Center "views a sustainable society as economically vibrant, environmentally sound, and socially just, now and into the future."
5	William Paterson University of NJ	Participates in the New Jersey Higher Education Partnership for Sustainability
6	Valdosta State University	Working with the City of Valdosta, Georgia on a new recycling initiative with the assistance of the student-run recycling initiative, "Students Against Violating the Environment" (SAVE).
8	CUNY Brooklyn College	No formal sustainability program.
9	East Stroudsburg University of PA	No formal sustainability program.
10	Southern Illinois University-Edwardsville	No formal sustainability program.
11	Central Missouri State University	No formal sustainability program.

1.4 DRAFT PRESS RELEASE

For the purposes of capturing the University community's excitement for Earth Day 2007, CCSU should consider publishing a press release on the CCSU's commitment to pursuing sustainability. The following provides draft language that could be used by CCSU as a starting point for a press release:

For Immediate Release

CCSU Announces Commitment to Environmental Sustainability

CCSU has always strived to be a leading institution of higher education on all fronts and has been recognized as a leadership institution. Consistent with its leadership goals, CCSU is currently striving to become a university leader with respect to environmental sustainability. Sustainability means "meeting the needs of the present without compromising the ability of future generations to meet their own needs."[1] CCSU is deeply committed to this concept, and has already been involved in initiatives to further this goal. Recognizing that universities should be models of sustainability in all aspects of their functioning, in 2006, CCSU President Jack Miller convened an Advisory Committee on Environmental Sustainability.

This Committee has already made significant strides towards sustainability. Early in 2007, the Committee retained an environmental sustainability consulting firm (Woodard & Curran) to perform a Sustainability Baseline Audit. The purpose of this audit was to gather data and information on CCSU's current sustainability initiatives and identify areas for improvement. The preliminary results of the audit indicate that CCSU already has successful sustainability initiatives in place, including energy conservation programs; a new, efficient Energy Center; energy-efficient and water-saving features in buildings; green purchasing efforts; and a hazardous waste minimization program.

The audit also identified areas for improvement, including improving recycling programs, launching an educational campaign on water conservation, energy conservation, and personal reduce/reuse/recycle, as well as improving the sustainability of food service operations, reducing transportation impacts, and formalizing some of CCSU's current programs (e.g., purchasing, green building) with formal policies. CCSU is in the process of establishing goals for the future that are aligned with these recommendations, including developing an Energy Conservation Plan and Recycling Plan. Also, the University plans to develop an Institutional Sustainability Plan that will help ensure that environmental sustainability becomes central to the University culture.

[1] Gro Harlem Brundtland, 1987.

2. OVERVIEW OF BASELINE AUDIT

In 2006, CCSU convened a Presidential Sustainability Committee to help guide the University towards sustainability. The Committee determined that one of the first necessary steps in pursuing sustainability was to assess the University's current environmental impacts and the status of current sustainability initiatives by performing a baseline sustainability audit. The University retained Woodard & Curran to perform a sustainability baseline audit and report the findings to the University. On March 13th - 14th 2007, an audit team from Woodard & Curran performed a Baseline Sustainability Audit of CCSU's campus in New Britain, Connecticut. Woodard & Curran's audit team included Charlotte Perry, Jason Eisenhuth, Kelley Begin, David Krochko, and Erik Osborn.

2.1 AUDIT OBJECTIVES

The specific objectives for the sustainability baseline audit were as follows:

- Establish a baseline of CCSU's current environmental sustainability impacts with respect to: Energy Use & Air Emissions; Solid Waste & Recycling; Water; Purchasing; Hazardous/Chemical Waste; Building Design and Construction; Property Maintenance, Landscaping & Pesticides; Transportation; and Food Service Operations.
- Learn about areas where CCSU has already been successful with respect to environmental stewardship.
- Engage internal CCSU stakeholders and learn about their issues, values, and concerns.
- Use the data gathered during the audit to create recommendations for reducing the campus' environmental footprint and suggestions for initiatives.
- Gather quantitative and qualitative data as specified in the Draft Proposal for Sustainability Services, dated December 22, 2006.
- Benchmark CCSU's current sustainability programs with other institutions, using readily available information.
- Consider campus quality of life and cost/financial impacts associated with potential program recommendations.

The data gathered during this baseline effort was, in part, used to help determine the implementation strategies in CCSU's draft Energy Conservation Plan and Recycling Management Plan, both of which were prepared by Woodard & Curran.

2.2 AUDIT PROCESS

The sustainability baseline audit began with the preparation and submission of a comprehensive Pre-Environmental Sustainability Baseline Audit Questionnaire and Data Request (see Appendix A) by Woodard & Curran to CCSU. This request was intended to gather some background information about potential environmental impacts at CCSU and inform CCSU personnel of the data required during the audit. Woodard & Curran's audit team leader then met with CCSU to identify CCSU personnel responsible for each piece of information requested.

The on-site portion of the audit consisted of the following tasks:

- Performing interviews of personnel who were listed on the pre-audit questionnaire;
- Attending a Facilities staff meeting;
- Attending sustainability audit kick-off meeting with the CCSU Sustainability committee;
- Visually observing campus facilities, departments, Energy Center, rooms, buildings, laboratories, green spaces, dining services, residential life, and other areas at CCSU with potential environmental impacts;
- Reviewing relevant and available records, data and documentation; and
- Engaging CCSU staff and internal stakeholders (including students) in a dialogue about environmental sustainability.

After the on-site audit, Woodard & Curran sustainability auditors called or submitted follow-up information requests via e-mail to CCSU personnel to gather information and data that were not readily available during the audit.

2.3 AUDIT SCOPE

During the on-site portion of the Environmental Sustainability Audit, Woodard & Curran gathered data through document review, visual observations, and personnel interviews. Much of the data required for the Environmental Sustainability Audit were outlined in the Pre-Environmental Sustainability Questionnaire and Data Request. As described above, Woodard & Curran also developed a list of staff to be interviewed and functional areas to be visited during the audit (see Appendix A).

The following media were focused on during the Environmental Sustainability Audit:

- Energy Use & Air Emissions
- Solid Waste & Recycling
- Water Use
- Purchasing
- Hazardous/Chemical Waste
- Building Design and Construction
- Property Maintenance, Landscaping, and Pesticides
- Transportation
- Food Service Operations

At each functional area visited, the audit team interviewed faculty, staff and students and made visual observations of the activities. A list of CCSU people involved in the audit, and the functional areas visited during the audit are included in each section of this report. Throughout this report are numerous ideas from students and faculty about ways that they can contribute to sustainability efforts on campus.

2.3.1 Stakeholder Engagement and Interviews

Overall, everyone at CCSU who was interviewed was helpful and interested in making the University more sustainable.

The following table provides a complete list of the various CCSU faculty, administration, staff and students who were interviewed, contacted, or involved in stakeholder engagement during the audit.

Table 2-1: CCSU Stakeholders Interviewed During the Audit

Name	Title	Department
Administration		
Richard Bachoo	Chief Administrative Officer	Administrative Affairs
Dan Moran	Associate Chief Administrative Officer	Facilities Management
Kimberly Chagnon	Budget & Accounting Director	Budget Office
Gerald Cotter	Associate Director	Connecticut State University System
Thomas Brodeur	Director	Purchasing
Tarome Alford	Director	Residence Life
Alfred Bonvicini	Associated Director	Residence Life
Jane Higgins	Assistant Vice President, Dean of Students	Student Affairs
Barbara DeMaio	Assistant Director	Facilities Support
Staff		
Ernest Frick	Quality Craftworker - HVAC	Craftworkers
Neal Palmese	Maintenance Supervisor 1 - Plumbing	Craftworkers
Rick Knowles	Carpenter	Craftworkers
Robert LeBaron	Director	Engineering
David Honyotski	Hazardous Waste Specialist	Environmental Health & Safety
Rob Gagne	Plant Facilities Engineer II	Facilities
Frank Scarlett	Facilities Contract Administrator	Facilities Management
Rene Karas-Johnson	Administrative Assistant	Facilities Management
Tim Dowling	Lead Custodian, Copernicus Hall	Facilities Support
Debbie Bleau	Head Custodian, Burritt Library	Facilities Support
Robert Tajmajer	Building Supervisor	Facilities Support

Name	Title	Department
Domenic Forcella	Environmental Health & Safety Officer	Police
Donald DeGruttola	General Manager	Sodexho Campus Services
Faculty		
Abigail Adams	Associate Professor and Secretary of Faculty Senate	Anthropology
Mary Anne Zabick	Science Technical Specialist/Lecturer	Biology
Clayton Penniman	Professor	Biology
Guy Crundwell	Associate Professor and Chair	Chemistry
Laura Lee Kelly	Laboratory Technician	Chemistry
Sanford Rich	Professor	Computer, Electronics, Graphics Technology
Vincente Garcia	Associate Professor	Fine Arts
Charles Button	Assistant Professor	Geography
Students		
Jim Phillips '08	Representative, Student Government Association	Business Major; and member of SGA Election Committee
Chris Brine '07	President of the Student Government Association	History, Political Science Major

Other individuals interviewed include personnel from the Key Shop, the Mail Room, Shipping & Receiving, and custodians.

2.4 AUDIT PROTOCOLS

The data to be gathered during the audit was specified in the scope of services dated December 22, 2006. If data were not available during the audit and not provided after the audit, data gaps are identified in this report.

At each of the functional areas inspected, Woodard & Curran asked detailed questions, obtained records and data, where available, and reviewed documents relevant to the potential environmental impact of each activity. Most of the questions were specific to the kind of activities examined, but some of the general questions asked of CCSU staff included:

1. What is your name?
2. What are your responsibilities?
3. To whom do you report?
4. Please describe the activities that occur in this area.
5. What do you see as your environmental impacts?

6. What do you do to reduce the environmental impact of your operations?
7. Do you have any ideas for what else could be done to promote efficiency/sustainability?

In general, people at CCSU were not aware of the term "sustainability".[2] Where appropriate, Woodard & Curran provided on-site training to CCSU personnel to teach them about the concept of sustainability and what it means in a University setting.

Woodard & Curran also sought input from students, including the President of the Student Government Association. During our meeting with students, the students shared their ideas about implementing a recycling program at CCSU and expressed how they felt CCSU could reduce its impact on the environment. This discussion enabled Woodard & Curran to understand how much the students knew and cared about the environment, and what they thought CCSU could do to minimize environmental impacts. We also discussed how stakeholders might be willing to participate in certain initiatives.

2.5 AUDIT REPORT

Upon completion of the on-site work, the Woodard & Curran audit team compiled their notes from on-site visits, document review, and data gathering efforts. Documents and data obtained from CCSU were examined. Some observations noted during the audit were researched further before this draft report was prepared. Some sections of this report address specific campus areas, while other sections refer to the university as a whole. Woodard & Curran has included information to the extent that it was available during the on-site visit or provided afterwards in response to specific requests. If data were not provided or did not exist, these data do not appear in this report. Where possible, Woodard & Curran has provided recommendations for specific additional data that CCSU may wish to collect to enable future assessment of environmental impact and the progress of sustainability initiatives. This report presents the results of the audit organized by media or program.

Where possible, Woodard & Curran has used available data to develop a baseline for CCSU's environmental impacts. In some cases, sufficient data were not available with which to develop a baseline. In these cases, Woodard & Curran has provided recommendations for collecting data that will facilitate the development of an accurate baseline. For each media addressed, there is a summary of the available data (the baseline), a description of current practices, if any, that have reduced environmental impacts, and recommendations for program improvement. As CCSU implements the recommendations made in this report, it should document quantitative data in order to gauge the success of its programs, and to measure its performance over time and against similar institutions.

[2] Sustainability means meeting the needs of the present generation without compromising future generations' ability to meet their own needs. Gro Harlem Brundtland, 1987.

This audit report is a fourth and final draft. Woodard & Curran incorporated several rounds of edits, comments and revisions offered by CCSU. If CCSU wants to add more data, observations, or comments to this audit report, CCSU personnel should add them to this draft as they deems appropriate.

3. ENERGY USE AND AIR EMISSIONS

3.1 INTRODUCTION

Woodard & Curran evaluated energy use and the resulting emissions of regulated air pollutants. For the purposes of the baseline audit, electricity purchases and natural gas use at the Energy Center were the primary focus of the evaluation. We also reviewed use of refrigerants. Regulated air pollutants include nitrogen oxides (NOx), carbon monoxide (CO), particulate matter (PM) volatile organic compounds (VOCs) and sulfur dioxide (SO_2). These pollutants are all byproducts of the combustion process. Electricity and fuel use (as well as other campus activities such as transportation) also generate emissions of Greenhouse Gases (GHG), primarily carbon dioxide, which contribute to global warming. Global warming is one of the most pressing environmental issues we face as a society today and it promises to remain a critical concern for generations to come.

Until recently, the Environmental Protection Agency (EPA) has not had the authority to regulate GHG emissions. On April 2, 2007, the Supreme Court ruled that GHGs are a pollutant and that EPA should re-examine its refusal to regulate GHGs.[3] A key component of a campus sustainability program is a comprehensive climate action plan which begins with an inventory of current GHG emissions. A climate action plan should establish a target to reduce emissions and identify specific measures to achieve the reductions including energy conservation, increased reliance on renewable energy, trip reduction measures (e.g., optimizing routes to reduce trip times, decreasing idling time, reducing hours), and green building techniques. While the development of a GHG inventory was not part of this baseline audit effort, Woodard & Curran will be working with CCSU to develop an Energy Conservation Plan in the next phase of this project.

The following sections provide baseline electricity consumption, on-site fuel consumption and air emissions data from which to measure future progress.

3.1.1 Areas Included in Baseline

The primary focus of the energy and air portion of the baseline audit was campus electricity purchases and fuel use at CCSU's Energy Center. The Energy Center was completed in 2004 and provides steam and chilled water to the 294-acre campus. The Energy Center consists of three 65,000 pounds per hour (pph) dual fuel boilers (natural gas and No. 2 oil), two 1,250 kilowatt (kW) natural gas-fired engines each equipped with a 2,500 pph Heat Recovery Steam Generator (HRSG), one steam absorption chiller and one electrical centrifugal chiller, each rated at 1,500 tons. The boilers generate steam which is distributed throughout the campus via an underground tunnel system. The steam generated by the boilers is also used to drive the steam absorption chiller which provides chilled water to many of the campus buildings for air conditioning. The boilers utilize "low NOx burners" and "flue gas recirculation" technologies to reduce emissions of nitrogen oxides (NOx) which are generated as a by-product of the combustion process. The engines are operated to generate electricity primarily during high electricity demand periods (generally during the summer) and during power outages. These engines are considered "co-generation" engines because the HRSGs which are connected to the engines utilize the waste heat from the engine exhaust (at 950 ^{o}F) to generate steam for absorption cooling or domestic water heating. Each engine is equipped with

[3] Massachusetts v. Environmental Protection Agency (549 U.S. 2007).

an air pollution control device that utilizes "Selective Catalytic Reduction" (SCR) technology to reduce NOx emissions.

3.1.2 Interviews

The following stakeholders were interviewed during the audit for the purpose of establishing an energy use baseline:

- Director of Engineering
- Associate Chief Administrative Officer
- Plant Facilities Engineer II
- Environmental Heath & Safety
- President, Student Government Association

3.1.3 Existing Energy Conservation Initiatives

CCSU's newly formed Presidential Sustainability Committee is currently developing an Institutional Sustainability Plan with a particular focus on energy conservation. While this committee is relatively new and the energy conservation plan will be developed soon, CCSU has made energy conservation a key priority for many years. The new Energy Center illustrates CCSU's dedication to energy conservation. Specifically, the Energy Center is more efficient and cleaner burning than the antiquated 50-year old Power House that it replaced. The Energy Center and tunnel project began with an evaluation of CCSU's infrastructure and the development of an energy conservation plan in the mid-1990s. The Associate Chief Administrative Officer, the Director of Engineering, and others on their staff have worked tirelessly to develop and build a state-of-the-art Energy Center at CCSU. Overall, CCSU's strategy has been to use large energy conservation projects (e.g., Energy Center) to, in turn, fund smaller initiatives (e.g., steam tunnel design and installation).

Like most college campuses in New England, some of the buildings at CCSU are old and were built to inefficient standards. CCSU's Facilities Department is committed to continuous improvement and has systematically identified key buildings and systems in need of renovation and upgrades to new, more efficient standards. All new buildings at CCSU are tied into the Energy Center for heat and chilled water. As older buildings are renovated, every effort is made to upgrade mechanical systems, lighting, windows, doors, and insulated roofing to the extent that upgrades are technically and economically feasible. In addition, CCSU is directly involved in creating newer, greener standards for CSU and the State. Recently completed energy-efficiency related projects include:

- The Energy Center and tunnel – completed 2004
- Centralized temperature control for most campus buildings ("Invensys" computerized control system)
- Re-lamping of garages, classrooms and Residence Halls
- High-efficiency pool heater installed
- New football field and gymnasium lighting with high and low lighting schemes (high lighting for televised events)

- Obtained software (Square D Power Logic) to collect and analyze data from electricity meters already in place in campus buildings

In addition, CCSU recently submitted a $1 million grant to install a 1.2 MW generator.

3.1.4 Additional Opportunities and Potential Challenges

CCSU has done a tremendous amount of work over the years evaluating campus infrastructure and energy use, and prioritizing projects and upgrades geared toward improving the energy efficiency throughout the campus buildings. The most significant challenge to implementing additional infrastructure-related energy efficiency projects at CCSU is funding. CCSU has identified the following projects which have been approved but have not yet been funded:

- Extend chilled water line to Carroll Hall, North Hall, Beecher Hall, Barrows Hall and May Hall
- Window upgrades – 5 buildings (General Fund Buildings)
- Fix main steam line traps
- Barnard Hall HVAC upgrades
- Burritt Library HVAC upgrades
- Davidson Hall HVAC building upgrades
- Founders Hall/Energy Center HVAC upgrades
- Kaiser Hall HVAC upgrades
- Old Power House renovation/demolition
- Mahoney HVAC upgrades
- Memorial Hall renovation (will be LEED silver certified)
- Carroll Hall LEED renovations including temperature controls
- Barrows Hall renovations including replacement windows
- Vance Hall renovations including replacing window air conditioning units with central HVAC system, as well as installing new windows
- James Hall – remove 10 year old gas-driven chiller and connect James to chilled water line

Another challenge will be to unite administrators, faculty, staff and students to agree on a goal for CCSU's climate action plan. While CCSU has implemented critical energy conservation and efficiency-related projects and has more planned in the near future, increased reliance on renewable energy will be key to reducing GHG emission on campus and globally in the future. Embracing the concept of renewable energy and taking steps to either generate some quantity of renewable power on campus (e.g., solar cells, wind, etc.), and/or to financially support off-campus larger-scale renewable projects could be a significant internal challenge, particularly considering the financial constraints that most public (and private) colleges have to operate within.

Additional challenges include lack of student awareness of global warming and energy conservation issues, and lack of personnel availability to track and analyze energy use and monitor progress toward

conservation and efficiency goals. One of the most difficult challenges is implementing behavior change. This requires creating enough awareness so that individual members of the entire community understand how their actions impact the whole. Measures such as turning off computers and lights, closing windows and doors, and reducing thermostat settings — when multiplied over dozens of buildings and thousands of people on campus — can have a dramatic impact on energy consumption. Educating everyone on the impact and the steps they can take individually, and then actually implementing the steps is often a time consuming and challenging process.

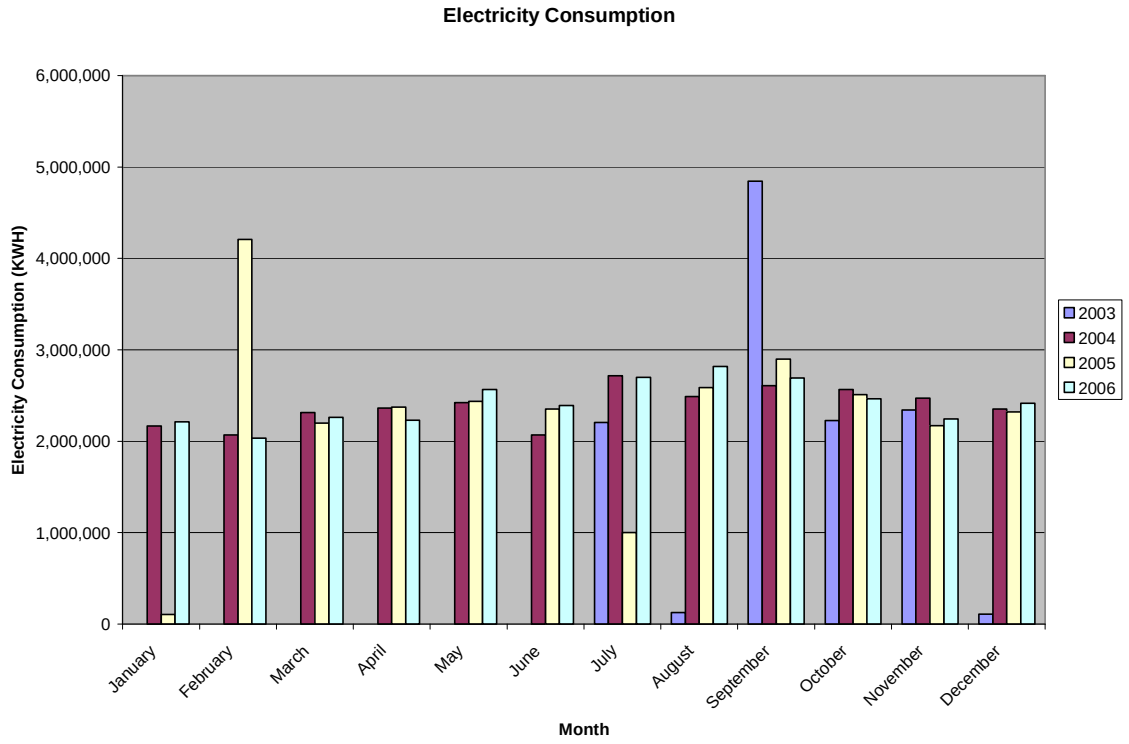
3.2 BASELINE AUDIT RESULTS

3.2.1 Quantitative Data

Electricity and natural gas consumption data were provided to Woodard & Curran for the period July 2003 (when the Energy Center was coming online) through December 2006. The electricity and natural gas data are presented in Figures 3-1 through 3-10. The data are presented in terms of total consumption, consumption per square foot of building space, and consumption per student. Note, however, that the campus building square footage and the number of students remained relatively constant between 2003 and 2006. CCSU has the dual-fuel capability to burn fuel oil in the Energy Center boilers and generators, but the amount of oil burned in the past few years has been negligible relative to the quantity of gas burned.

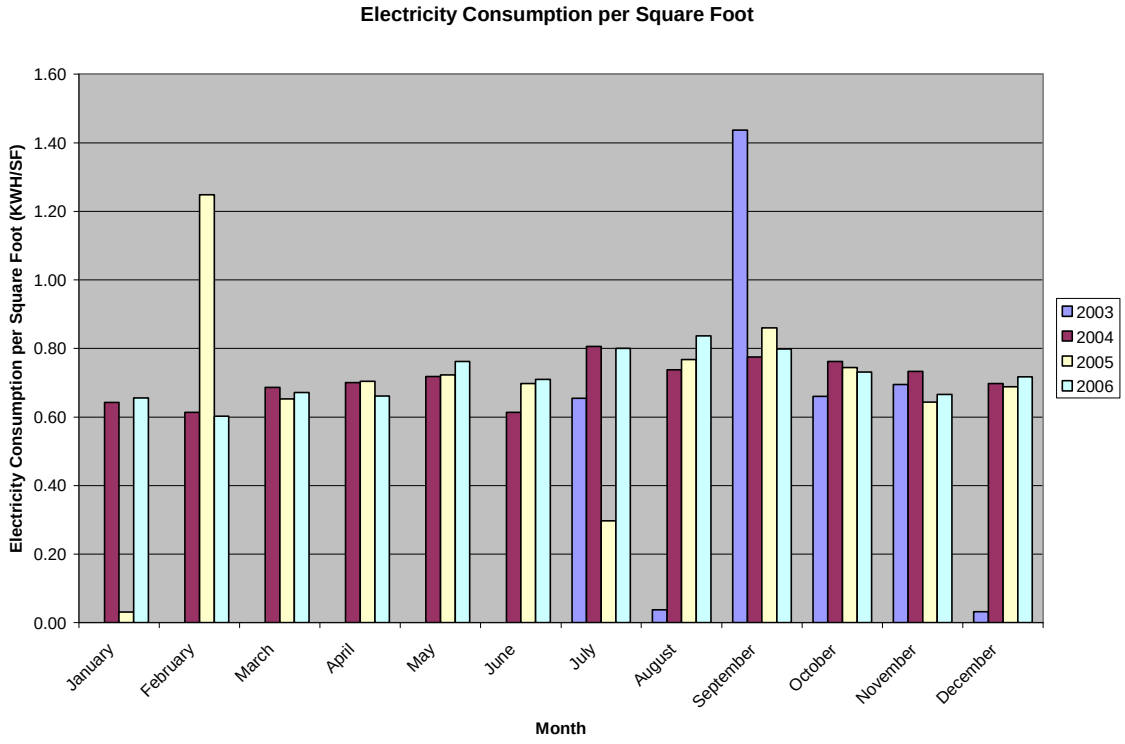
3.2.1.1 Electricity Consumption

Figure 3-1: Electricity Consumption (2003-2006)



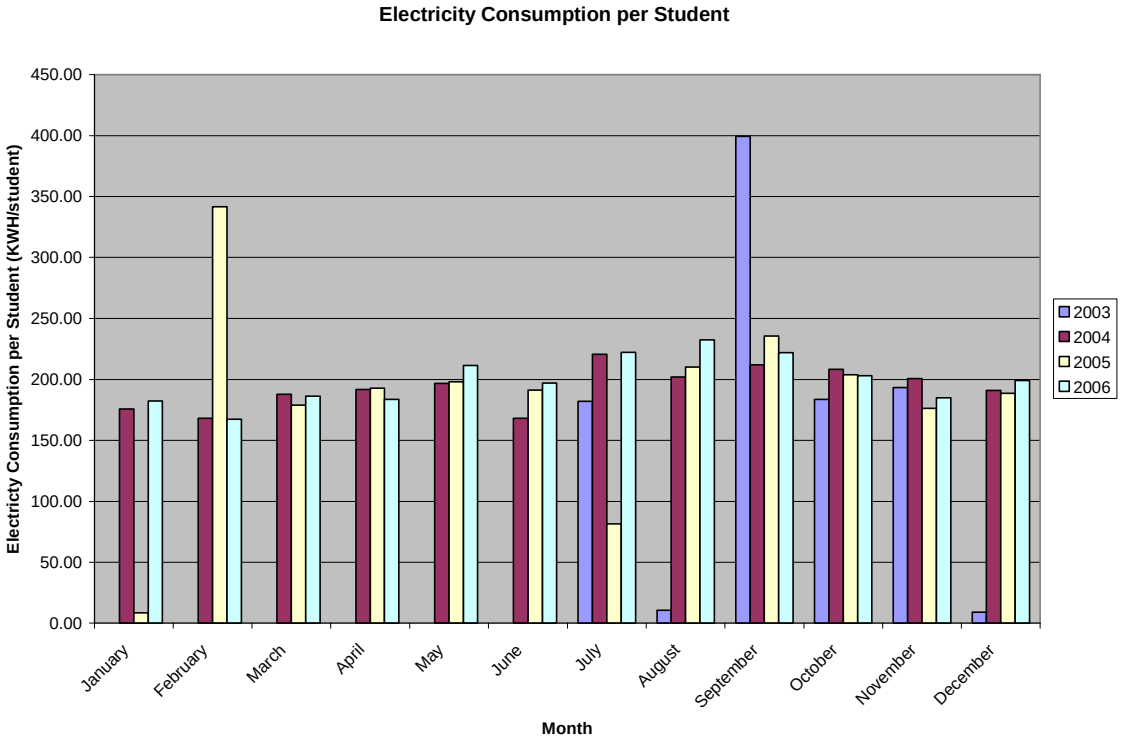
It appears that the August 2003 and January 2005 data were reported with the September 2003 and February 2005 data, respectively. In general, electricity use is highest in the late summer and early fall.

Figure 3-2: Electricity Usage per Square Foot (2003-2006)



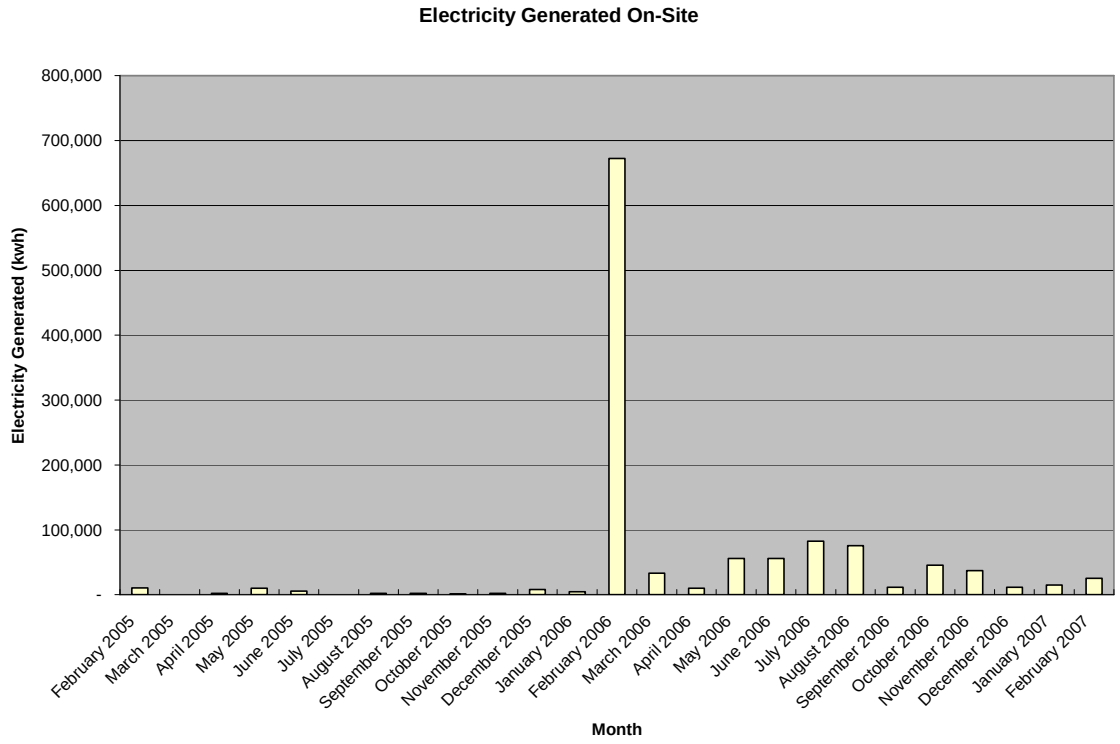
Similarly, the August 2003 and January 2005 data appear to have been reported with the September 2003 and February 2005 data, respectively. Since the campus square footage did not change between 2003 and 2006, this graph shows the same trend as the total electricity usage presented in Figure 3-1.

Figure 3-3: Electricity Usage per Student (2003-2006)



The August 2003 and January 2005 data appear to have been reported with the September 2003 and February 2005 data, respectively. Since the number of students each year has remained nearly constant, this graph shows the same trend as the total electricity usage presented in Figures 3-1 and 3-2.

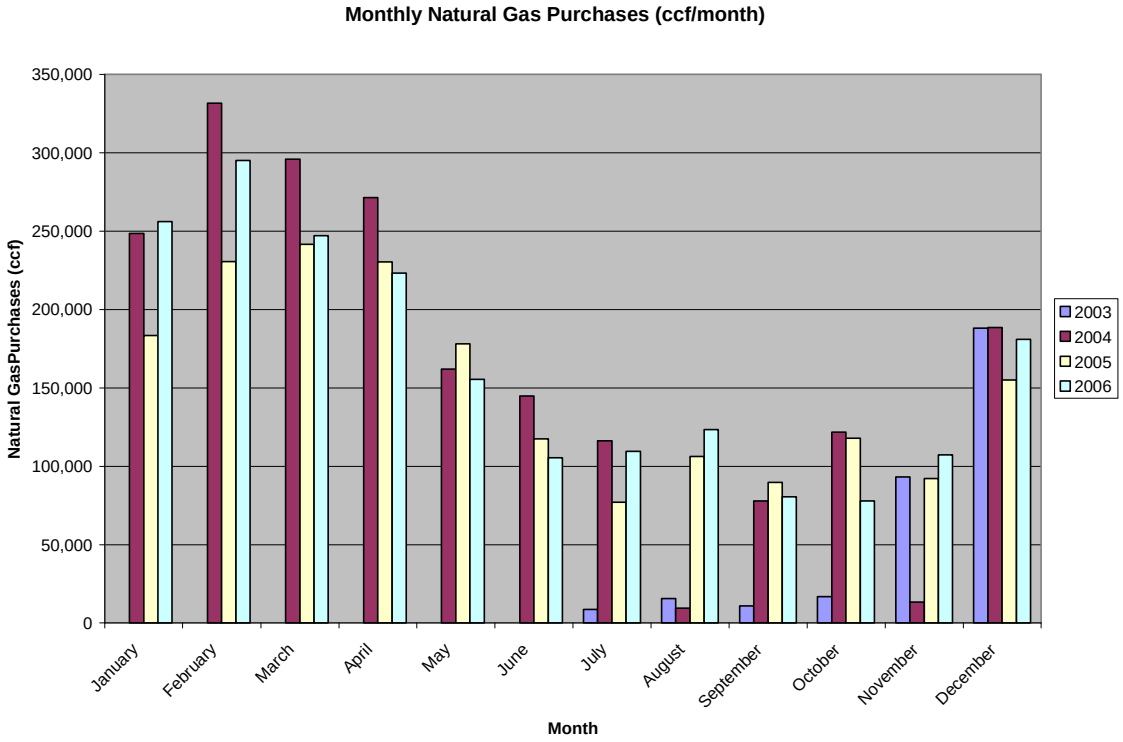
Figure 3-4: Electricity Generated On-Site (March 2005-February 2007)



The co-generation engines operate relatively infrequently and typically contribute less than 1% of the total monthly campus electricity demand (although if they were operated continuously, they could provide a significant portion of the campus electricity demand). The engines were included in the Energy Center design in order to improve the reliability of electrical service and to provide potential cost savings during peak periods. There are generally three scenarios during which the engines are generally called into service: (1) during an emergency power outage; (2) when the cost of electricity from Connecticut Light & Power exceeds the cost to run the engines (estimated by CCSU to be about $0.13/kWh including gas, maintenance and labor); and (3) when CCSU anticipates that its demand will exceed 5 MW (at which point CCSU becomes subject to an increased rate structure). CCSU generated over 650,000 kWh of electricity in February 2006 when the engines were run on request in anticipation of a potential brownout situation.

3.2.1.2 Natural Gas Purchases

Figure 3-5: Natural Gas Purchases (2003-2006)



As expected, natural gas usage is generally highest during the coldest winter months. Gas purchases during the summer months increased in 2004, most likely because natural gas was being burned in the new Energy Center boilers to run the steam-driven chillers to provide air conditioning.

Figure 3-6: Natural Gas Usage per Square Foot (2003-2006)

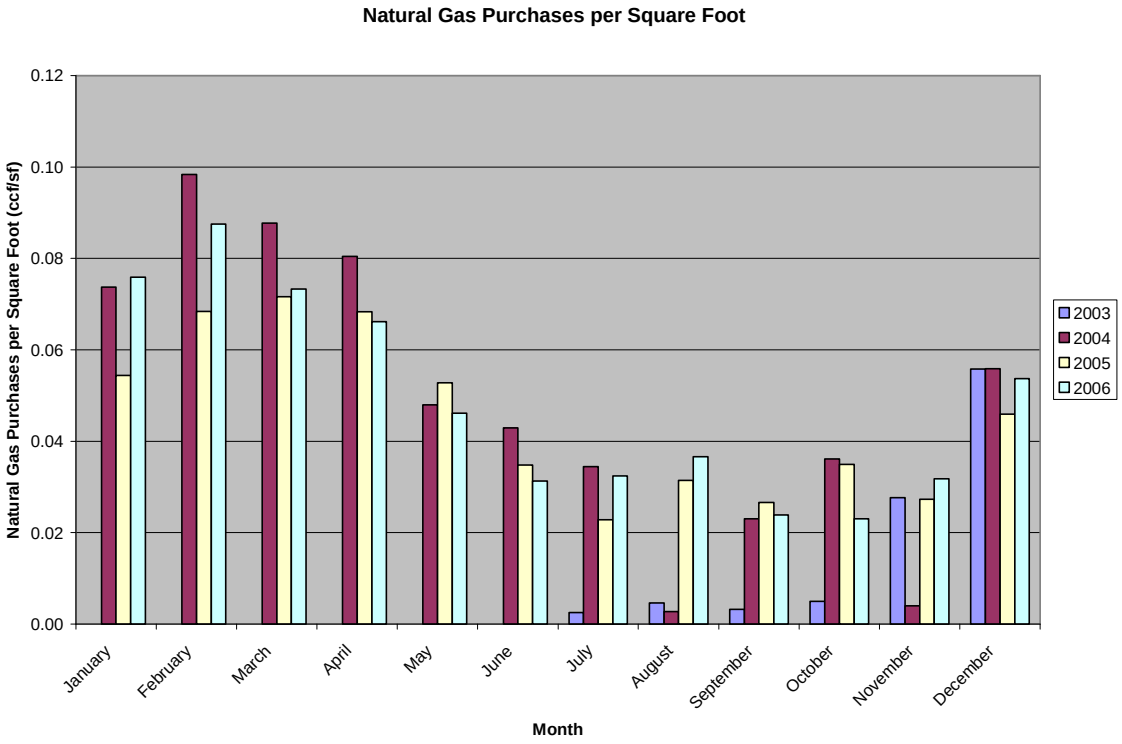


Figure 3-6 is similar to Figure 3-5 since building square footage did not increase between 2003 and 2006.

Figure 3-7: Natural Gas Use per Student (2003-2006)

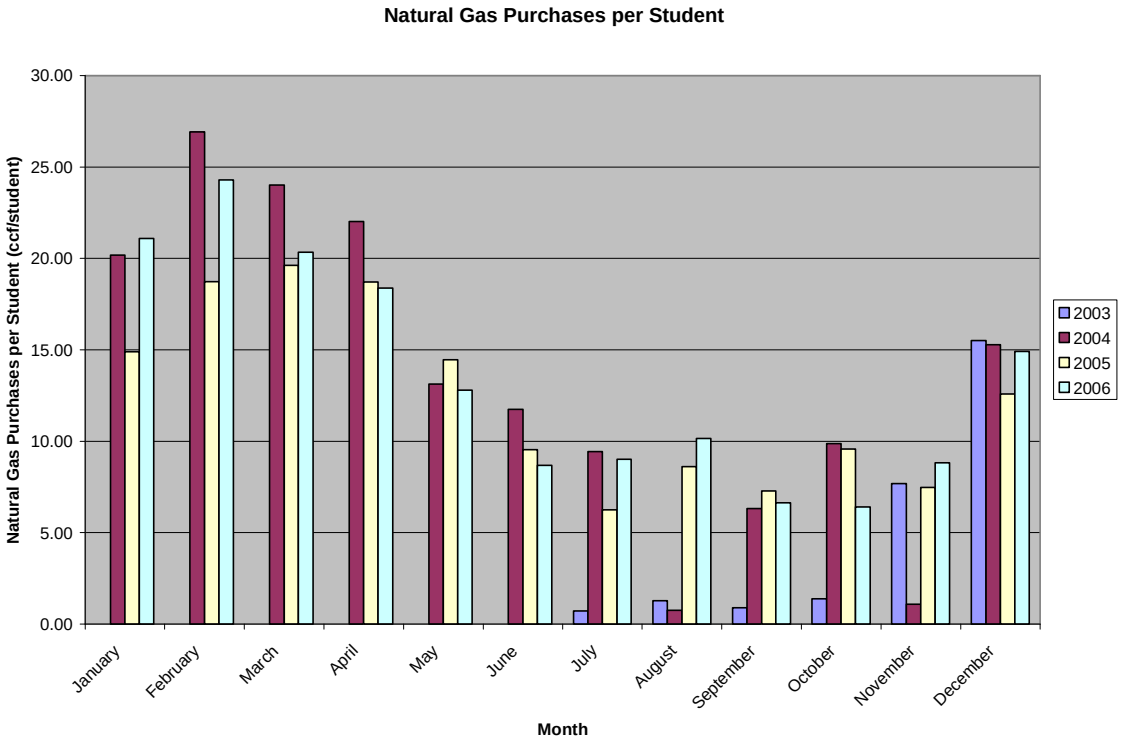


Figure 3-7 is similar to Figures 3-5 and 3-6 since the number of students remained relatively constant between 2003 and 2006.

3.2.1.3 Air Emissions

Figure 3-8: Emissions of Regulated Air Pollutants, tons per year (2003-2006)

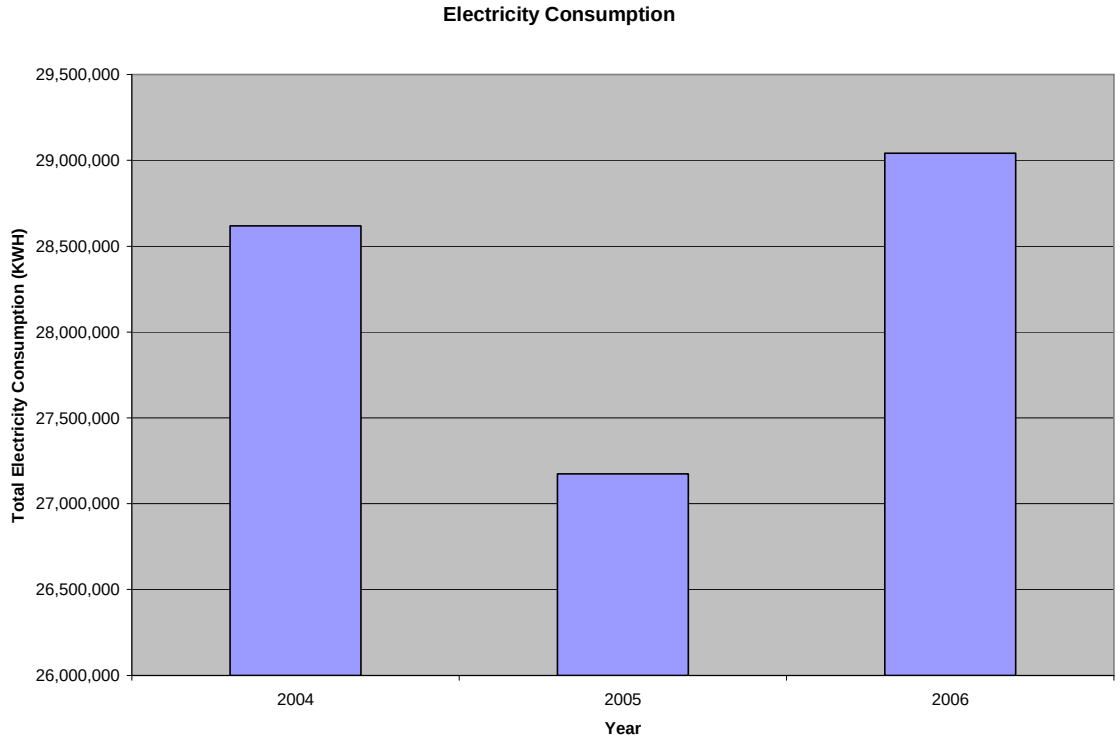
Nitrogen oxides (NOx), carbon monoxide (CO), respirable particulate matter (PM-10), volatile organic compounds (VOCs) and sulfur dioxide (SO_2) are all byproducts of the combustion process. Carbon dioxide (a GHG), however, is the primary product of combustion. A GHG emission inventory should be conducted to establish CCSU's baseline GHG emissions.

3.2.2 Data Analysis

3.2.2.1 Electricity Consumption

The total annual electricity usage data for the years 2004 through 2006 is presented in Figure 3-9. Electricity use decreased in 2005 by 5% over 2004 levels but then increased in 2006 by 7.8% over 2005 levels. The fluctuation in electricity usage each year may have been due in part to the more efficient Energy Center coming online and it may also have been affected by fewer cooling degree days in 2005 relative to 2004 and 2006. It is also possible that some of the 2005 data may be missing or inaccurate.

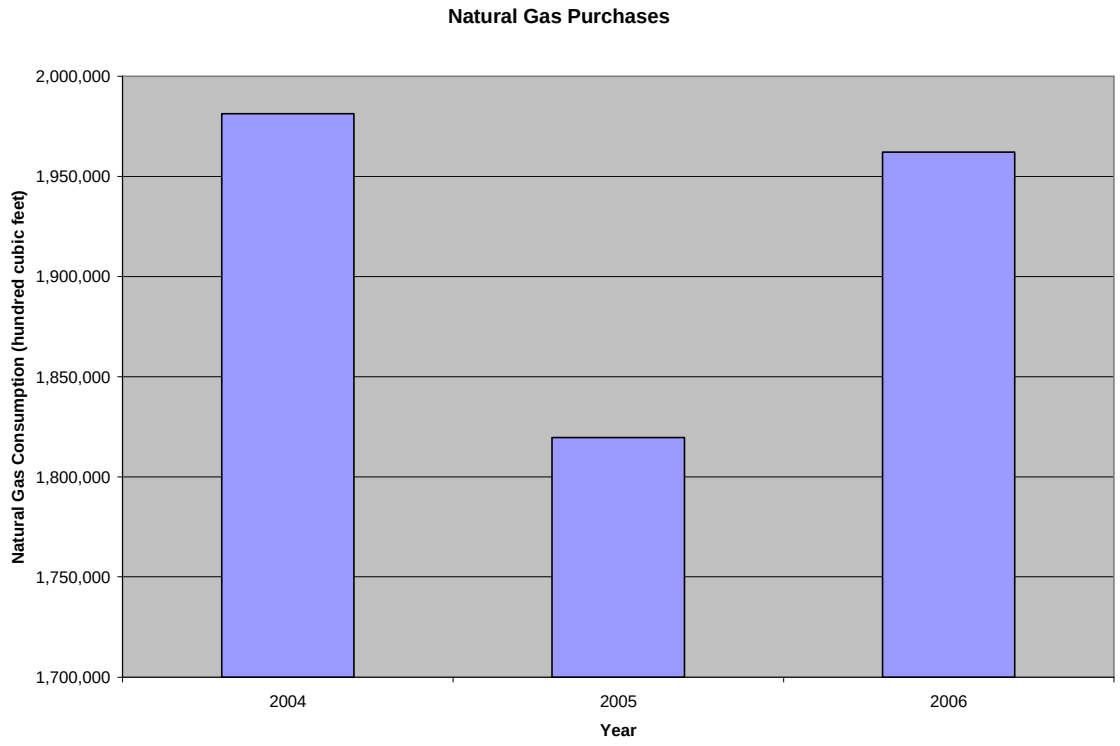
Figure 3-9: Annual Electricity Consumption (2003-2006)



3.2.2.2 Natural Gas Purchases

The total natural gas consumption data for the years 2004 through 2006 is presented in Figure 3-10. Natural gas consumption decreased in 2005 by slightly more than 8% below 2004 levels. However, gas consumption increased in 2006 by almost 8% over 2005 levels. The 2006 gas consumption was nearly equal to the gas consumption in 2004. During 2004, CCSU was transitioning between the old Power House and the new Energy Center which became fully operational March 2005. While the new Energy Center is more efficient than the old Power House, fuel use is directly related to the number of heating and cooling degree days in any one year. The fluctuation in gas usage each year may have been due in part to the more efficient Energy Center coming online and it may also have been affected by possible warmer winter and/or cooler summer temperatures in 2005 relative to 2004 and 2006. It is also possible that some of the 2005 data may be missing or inaccurate.

Figure 3-10: Natural Gas Purchases (2004-2006)



3.2.3 Gap Analysis

The fuel use and electricity data are based on utility bills and are useful for observing campus-wide monthly and annual trends. CCSU also has the metering in place to track electricity and steam usage by building. However, at the time of the audit, the software to record and analyze the building electricity

data was not in place and the steam meters were malfunctioning. Consequently, it was not possible to compare energy use in different types of buildings. According to CCSU, these steam meters have since been repaired.

It is difficult to quantitatively measure the efficacy of previous energy conservation efforts, such as the Energy Center, without additional historical fuel use data coupled with weather data. The Energy Center, built to be more efficient than the old Power House, is an on-going project slated for additional planned improvements.

3.2.3.1 Percent of Energy Star Equipment

EPA's Energy Star program encompasses nearly every type of office and household equipment including computers, TVs, vending machines, water coolers, copiers, exit signs, refrigerators, printers, washers, light bulbs and more. In general, most computers and monitors at CCSU are Energy Star-rated and have a "sleep mode" to reduce energy consumption when not in use. Based on discussions with CCSU students, many of the washer/dryers are not Energy Star rated. CCSU is working with Alliance Energy Solutions to re-lamp certain buildings with Energy Star compact fluorescent bulbs. Vending machines at CCSU are not Energy Star rated. CCSU does not currently maintain a database of equipment.

CCSU contracts with Trane to service equipment that contains refrigerants. Woodard & Curran was provided a 1997 inventory of refrigerant-containing equipment. This inventory included seven buildings with window air conditioning units (Davidson, Barnard, Sanford, DiLoreto, Windsor, the pump house and the police station) and twelve chiller units (located at White, Welte, Willard, Sanford, Student Center, Memorial, Burritt, Copernicus, Maloney and James). Most of the window units utilized R-11, which is a "Class I" ozone depleting substance, the highest rating for ozone depleting potential. R-11 is a chlorofluorocarbon (CFC) and its production was phased out in 1995. All R-11 purchased now is reclaimed refrigerant. To the extent possible, window air conditioning units are being phased out and most buildings are tied to the Energy Center's chilled water line for air conditioning. For any remaining window units, CCSU may want to consider working with Trane to evaluate the feasibility of replacing R-11 with other products on the market now (such as R-410A) which may have a lower ozone depleting potential.

The satellite chillers listed on the 1997 inventory contain R-22 (a "Class II" ozone depleting substance). R-22 is a hydrochlorofluorocarbon (HCFC). R-22 is being phased out gradually (production will cease in 2020). Based on conversations with CCSU personnel, the use of R-22 at CCSU has since been discontinued and equipment containing R-22 is slated for removal.

3.2.4 Qualitative Observations

During the stakeholder interviews Woodard & Curran made the following qualitative observations:

- Students reported that the dorms are often so hot in the winter (even with individual thermostats turned off) that they have to open the windows. Students reported that the excessive heat was coming predominantly from the hallways and common areas.
- Most buildings are not equipped with motion detectors to turn lights off when rooms are unoccupied. In particular, students reported that lights in the library are left on all night and that lights in other buildings are also left on when unoccupied.

3.3 BENCHMARKING

Colleges and universities worldwide are leading the challenge to stop global warming by using or supporting renewable energy and through energy conservation and efficiency. U.S. campuses have developed greenhouse gas emission inventories as an important first step and have further committed to tracking and reducing those emissions. In fact, the Connecticut State University (CSU) system has committed to support the Conference of New England Governors and Eastern Canadian Premiers Climate Action Plan goal to reduce greenhouse gas emissions by 10% below 1990 levels.

In its 2005 Annual Report, the ISE reported that upcoming projects for 2006 would include, "assisting in the development of comprehensive energy efficiency plans for all four CSU campuses. The studies provide a five year history of energy use and emissions inventory, benchmarking services, and evaluation tool for assessing building efficiency, and targeted preliminary facility evaluations to identify the most cost effective efficiency projects for the least efficient facilities at each campus." During the audit, Woodard & Curran was not made aware of any projects conducted in 2006 in cooperation with the ISE as described in the Annual Report. The ISE can be an important resource for CCSU and CCSU may want to seek input from the ISE as CCSU develops its sustainability program.

The Sustainable Endowments Institute (SEI)[4] has identified 21 Climate Change and Energy leaders in its "College Sustainability Report Card 2007."[5] In New England, the list includes Bowdoin College, Cornell University, Harvard University, Middlebury College, Smith College, Tufts University and Yale University. Please note that none of these are CCSU's peer institutions. The programs at these schools are included as examples of what could be done. CCSU is, in fact, a leader in energy conservation among its peer institutions. Some of the efforts these institutions have taken are described below:

- The Tufts Climate Initiative at Tufts University won the EPA's Climate Protection Award in 2005 for changing its utilities contract in 2006 to include small hydro-electric power, reducing its carbon emissions to 21% below the New England average.[6]
- Yale University formed a Yale Energy Task Force in 2004 and has committed to reducing greenhouse gas emissions by 10% below 1990 levels by the year 2020 through investment in energy conservation, alternate energy sources, and the purchase of Renewable Energy Certificates (RECs). Yale has also committed to implementing on-site renewable and clean energy demonstration projects. Yale installed solar panels on one campus building which provides two thirds of the building's electricity consumption. Yale also encourages students to conserve

[4] The Sustainability Endowments Institute (SEI) was founded in 2005 and is funded by the Rockefeller Philanthropy Advisors. SEI conducts research and education on the sustainability of higher education endowments. See: http://www.endowmentinstitute.org/index.html.

[5] Sustainable Endowments Institute, College Sustainability Report Card 2007: A Review of Campus & Endowment Policies at Leading Institutions," obtained from http://www.endowmentinstitute.org/sustainability/.

[6] Sustainable Endowments Institute, College Sustainability Report Card 2007: A Review of Campus & Endowment Policies at Leading Institutions," obtained from http://www.endowmentinstitute.org/sustainability/.

energy by offsetting one third of the electricity consumption (through the purchase of Renewable Energy Certificates) of any residential college that reduces its energy use by 5%.[7]

- Bowdoin College committed to purchase 100% of its electricity from renewable sources by entering into a 3-year agreement with a local hydro-electric project to directly compensate the project developers for the use of any electricity purchased off the grid from non-renewable sources.[8]
- Harvard University developed a $3 million clean energy revolving loan fund. The savings realized through, for example, lighting retrofits, efficient climate control and ventilation, and awareness programs are used to fund other energy conservation projects. Harvard also established a program to set aside $100,000 annually toward the purchase and development of renewable energy. [9]
- Middlebury College received the 2005 Climate Champion Award for "advancing campus solutions to global warming" from Clean Air Cool Planet, a non-profit organization dedicated to finding and promoting solutions to global warming. Middlebury completed a greenhouse gas emissions inventory, appointed a Carbon Reduction Initiative Working Group to develop a plan for reducing emissions, and added courses focused on climate change, environmental economics, and carbon neutrality. In one of the courses, students developed a credit card that enables users to become carbon neutral by using 1% of the money charged on the card to purchase carbon offsets.[10]

3.4 RECOMMENDATIONS

The formation of CCSU's new Sustainability Committee and the Institutional Plan that the committee is developing is an excellent first step toward a greener campus. While the new Energy Center, the completed and upcoming building upgrades, the re-lamping project at the garage and the purchases of Energy Star equipment are all examples of the important steps that CCSU is already taking to increase energy conservation on campus, more can be done. The focus for the future should be on renewable energy and reducing GHG emissions. Woodard & Curran recommends the following:

- The biggest challenge to reducing energy use at CCSU is funding. CCSU has already identified at least 15 critical projects (many in the design phase) that could significantly reduce energy use on campus. Many of the projects have been on the books since November of 2005 but have not

[7] Association for the Advancement of Sustainability in Higher Education (AASHE), AASHE Digest, "A Review of Campus Sustainability 2005," Compiled by Julian Dautremont-Smith, March 2006, obtained from: http://www.aashe.org/resources/pdf/AASHEdigest2005.pdf.

[8]Bowdoin College, Sustainable Bowdoin Campus News, obtained from: http://www.bowdoin.edu/news/archives/1bowdoincampus/003120.shtml.

[9] The Apollo Alliance and Energy Action, "New Energy for Campuses," obtained from: http://www.fypower.org/pdf/campus_energy.pdf.

[10] Association for the Advancement of Sustainability in Higher Education (AASHE), AASHE Digest, "A Review of Campus Sustainability 2005," Compiled by Julian Dautremont-Smith, March 2006, obtained from: http://www.aashe.org/resources/pdf/AASHEdigest2005.pdf.

gone forward because they still have not received funding. CCSU should consider developing a program (perhaps a revolving loan fund) through which the savings generated by energy conservation projects fund future projects. This fund should not be used to reduce the Energy Center's annual operating budget. It is also critically important that energy conservation and efficiency efforts made by CCSU faculty and staff should be widely recognized and publicized. Publicly recognizing these efforts and successes is critical to a successful energy conservation program.

- While the Energy Center is clearly more efficient than the old equipment it replaced, CCSU has not taken full advantage of the environmental benefit of the cogeneration portion of the plant. Specifically, the cogeneration engines have not been used to generate a significant portion of the campus' electricity demand. Steam for heat and chilled water is provided almost exclusively by the combustion of natural gas using traditional (although efficient and clean-burning) boiler technology and electricity is provided almost exclusively by Connecticut Light & Power (CL&P) and is derived from predominantly non-renewable sources such as coal, gas, oil, and nuclear.[11] While the electricity and steam generated by these engines is not "renewable," it is more efficient than generating steam in a traditional boiler and buying power from the grid (and would reduce CCSU's carbon footprint). Woodard & Curran understands that the engines were intended to provide increased reliability and cost savings during peak periods and that the steam output rating of the HRSGs is only about 3% of the capacity of the main boilers (i.e., the HRSGs alone can not provide a significant portion of the campus steam demand). Woodard & Curran also understands that the cost of gas has been high since the engines were installed and that, consequently, it has been more expensive to run the engines than to buy electricity off the grid. Nevertheless, Woodard & Curran recommends that CCSU conduct an in-depth study of the cost of running the engines. Such a review might be able to identify additional market scenarios when it would be cost effective to run the engines.
- Conduct a green house gas emission inventory and confirm whether CCSU will indeed pledge to meet the National Governor's Conference goal of reducing greenhouse gas emissions by 10% below 1990 levels by the year 2020. Once this goal (or an alternate goal) is confirmed, develop an implementation plan with measurable milestones designed to achieve the goal.[12]
- Consider obtaining funding to support personnel (e.g., an energy manager) to monitor, track and analyze building level and campus-wide energy use. The job description for such a position could also include: investigating renewable energy project funding options and working with CL&P and others to identify eligible rebate programs. In our experience, a dedicated experienced

[11] Note that Connecticut does have a mandatory Renewable Portfolio Standard (RPS) which requires electric suppliers to provide electricity from renewable sources (up to 7% Class I renewable by 2010). The program is administered through the Connecticut Department of Public Utility Control (DPUC). See http://www.state.ct.us/dpuc/.

[12] Note: Connecticut state agencies are collaborating to reduce greenhouse gas emissions in Connecticut. The Governor's Steering Committee, made up of leaders from key state agencies including the Department of Environmental Protection, Public Utility Commission, Transportation, Administrative Services, The Office of Policy and Management, and The Connecticut Clean Energy Fund led a collaborative effort that developed a Climate Change Action Plan for Connecticut. The plan will help Connecticut reduce greenhouse gas emissions to 1990 levels by 2010 and 10% below that by 2020:
http://www.ct.gov/dep/cwp/view.asp?a=2684&q=322070&depNav_GID=1619

person in the position can pay for itself in cost savings. A faculty member at CCSU has expressed the opinion that hiring an energy manager is a crucial recommendation. Alternatively, if funding is not available for such a position, CCSU may consider revisiting the job descriptions for existing positions and including specific sustainability-related duties within those descriptions.

- Contract with an Energy Service Company (ESCo) to optimize Energy Center and HVAC equipment operation, and to conduct a comprehensive energy audit to identify the most cost effective conservation opportunities and projects eligible for CL&P rebate programs and other sources of funding.
- Consider participating in CL&P's voluntary "Connecticut Clean Energy Options" program. CL&P customers can select a clean energy offering for a fraction (or 100%) of their power from one of two independent renewable energy companies (Community Energy and Sterling Planet). A premium is billed in addition to the CL&P supplier charges. In effect, by participating in this program the customer is financially supporting renewable generation, although the electricity provided is the same grid power that is provided to all other customers not participating in the Clean Energy program.[13] Woodard & Curran understands that CCSU, like other campuses, is struggling to keep up with the rise in energy costs and that participation in this program would further increase energy costs. CCSU may not be in a financial position to take part in such a program at this time, but it is mentioned in this report since it is an option, particularly for campuses that have limited opportunities for on-site renewable generation.
- Install motion detectors in campus buildings to turn lights off when not in use.
- Lower the banded temperature setting for temperature controlled residence halls (particularly in common areas) and other buildings.
- Consider working with faculty to develop sustainability-related courses.
- Evaluate options (e.g., software) for optimizing classroom scheduling to minimize electricity and heat use in under-occupied buildings.
- Develop and implement an awareness program to educate students, faculty and staff about energy conservation measures.
- Seek input from the Student Government Association and other student and faculty groups regarding the creation of a student-run or student supported sustainability organization. Such groups have led energy conservation efforts at other colleges and universities across the nation. The Campus Climate Challenge is an organization that seeks to unite students on college campuses to work together on renewable energy issues.[14]

[13] Connecticut Light & Power, Clean Energy Options webpage: http://www.cl-p.com/community/environment/clean.asp.

[14] For more information on the Campus Climate Challenge, see: http://climatechallenge.org/.

- Retrofit vending machines with VendingMiser® which reduces vending machine energy use by an average of 46%.[15]
- Replace vending machines with new Energy Star equipment and surge protectors to reduce electrical costs.
- Replace traditional "Exit" signs with LED signs which use up to 85% less energy than incandescent signs. According to CCSU personnel, a survey of Exit signs is slated to be conducted.
- Evaluate opportunities for incorporating solar panels (or possibly semi-transparent solar glass for windows of new buildings) to offset electricity use for certain buildings.[16]
- Continue to publicize recent conservation efforts to raise campus and community awareness of CCSU energy conservation initiatives. CCSU recently published and article in "The Recorder" regarding sustainability on campus and is planning to publish another article on CCSU's energy conservation efforts in the November issue. This is an excellent way to raise awareness and recognize the important conservation efforts made by CCSU faculty, staff and students. Another key component in publicizing CCSU's sustainability program is the development of a sustainability website.

3.5 CONSIDERATIONS FOR INSTITUTIONAL PLAN

The recommendations in this section will likely be incorporated into CCSU's Institutional Plan. With regard to energy, a critical first step for CCSU is to conduct a greenhouse gas emission inventory. From there, a plan to reduce emissions can be developed with tangible targets, implementation dates and measurable milestones. While CCSU has implemented important energy conservation and efficiency-related projects, increased reliance on renewable energy will be the key to reducing greenhouse gas emissions on campus and globally. Embracing the concept of renewable energy and taking steps to either generate renewable power on campus (e.g., solar cells) and/or to financially support off-campus renewable projects could be a significant internal challenge, particularly considering the financial constraints most public colleges have to work within.

With regard to CCSU's Institutional Plan, particular consideration should be given to the public relations, actions needed, implementation, budgetary, milestones and program assessment requirements to develop a robust energy conservation and climate action plan. For example, the Public Relations section should address "selling" the concept of renewable energy and getting buy-in from the administration, faculty and staff; the Actions Needed section should identify the need for a greenhouse gas emission inventory; the Implementation and Budgetary sections should address how a plan to reduce greenhouse gases will be implemented and how it will be funded (e.g., work with CL&P); the Milestones section should identify measurable targets for tracking progress; and the Program Assessment section should include re-

[15] USA Technologies, Energy Management, VendingMiser website: http://www.usatech.com/energy_management/energy_vm.php.

[16] For more information on "Building Integrated Photovoltaics" including thin film solar cells, see XsunX website: http://www.xsunx.com/technology-intro.htm.

inventorying emissions annually or bi-annually to determine whether the plan is successfully being implemented or whether goals or implementation measures need to be revisited.

3.5.1 Tips for Sustainability Website

There are great campus sustainable energy websites that can serve as examples to CCSU. Williams College, for example, has an excellent site which displays real-time electricity use by building.[17] Most websites describe the campus physical plant, type of equipment used, type of fuels used, sources of electricity, and historical trends in quantity of fuels and electricity used and resulting GHG emissions. Websites also describe on-going energy efficiency programs, promote student energy reduction contests, provide awareness training and describe current conservation projects and upgrades. Harvard University's Green Campus Initiative is one example of a website that contains all of these elements.[18]

[17] Williams College Sustainability website: http://www.williams.edu/resources/sustainability/electricity_buildings.php?form=dorm.

[18] For more information see Harvard's Green Campus Initiative webpage: http://www.greencampus.harvard.edu/ggi/.

4. SOLID WASTE & RECYCLING

4.1 INTRODUCTION

The U.S. EPA has ranked the most environmentally sound strategies for managing solid waste. Source reduction (including reuse) is the preferred method, followed by recycling and composting, and, lastly, disposal in combustion facilities and landfills.

According to the National Wildlife Fund's "State of the Campus Environment" survey, most campuses in the United States have a recycling program for aluminum cans and paper. Approximately 50% of U.S. campuses recycle glass, plastic, construction materials, and compost food waste and grass trimmings, and have programs to encourage purchase of recycled materials.

4.1.1 Regulatory Background

In December 2006, the Connecticut Department of Environmental Protection (DEP) adopted amendments to the state's Solid Waste Management Plan. The plan established a statewide target recycling rate of 58% by 2024.

Recycling is a regulatory requirement for colleges and universities in Connecticut. Specifically, Connecticut[19] requires recycling of the following items:

- Glass and metal food and beverage containers
- Newspaper
- White office paper
- Corrugated cardboard
- Scrap metal
- Alkaline batteries
- Waste oil
- Lead acid storage batteries
- Ni-Cd rechargeable batteries
- Leaves (must be composted)

4.1.2 Areas Included in Baseline

Quantitative generation data for the following waste streams generated at CCSU were gathered during the audit:

[19] The items required to be recycled (listed above) are required by Sections 22a-208v and Section 22a-256a of the Connecticut General Statutes and Section 22a-241b of the Regulations of the Connecticut State Agencies.

- Trash includes: (1) food waste from the cafeterias; (2) waste generated in the kitchen; (3) waste that is scraped off plates; (4) disposable take out containers; and (5) any other materials that are not recycled on campus).
- Scrap Metal
- Construction Debris (refers to dumpsters which are filled from facilities construction projects and end-of-semester residence hall cleanouts. Waste from major construction projects by outside contractors is not included or recorded).
- Cardboard
- Electronic Equipment
- Grease
- Recycled Paper (includes white paper only; other types of paper are disposed in the regular trash.)

The following buildings were surveyed to understand the extent of the existing recycling system, future recycling needs, and the space and logistical limitations.

Table 4-1: Buildings Surveyed for Recycling Assessment

Building Number	Building Name
01	Lawrence J. Davidson Hall
05	Henry Barnard Hall
07	Harrison J. Kaiser Gym
08	Catherine Beecher Hall
11	Emma Hart Willard Hall
13	Student Center
15	Frank DiLoreto Hall
18	Memorial Hall
22	Elihu Burritt Library
23	Copernicus Hall
25	James J. Maloney Hall
36	F. Don James Hall
37	Robert C. Vance Academic Center

4.1.3 Stakeholder Engagement

The following stakeholders were interviewed during the audit:

CCSU:

- Facilities Contract Administrator, Facilities Management
- Administrative Assistant, Facilities Management

- General Manager, Sodexho Campus Services
- Assistant Professor, Geography
- Lead Custodian, Copernicus, Facilities Management
- Head Custodian, Burritt Library, Facilities Management
- Facilities Management

Other:

- Sales Representative, All Waste, Inc.
- Waste Management Recycle America, Berlin Connecticut Automated Material Handling Facility.
- Manager, Recycling and Resource Management, Stony Brook University

4.1.4 Existing Sustainability Initiatives

CCSU currently recycles cardboard, white paper, and scrap metal. The campus also recycles fluorescent lamps, batteries, used oil, and other items regulated as universal waste (these waste streams are addressed in Section 7 of this report). CCSU donates, recycles, or uses for spare parts the majority (>95%) of its computers and electronic equipment. CCSU collects unwanted furniture from campus buildings and stores it in East Hall. Unwanted furniture is first made available to the campus community, then donated to area schools to make room for incoming equipment.

CCSU provides furniture for residence hall rooms and suites, including beds, mattresses, desks, chairs, couches, tables, and TV stands. By providing sturdy, long-lived furnishings, CCSU reduces the amount of furniture that students need to bring with them onto campus, and also reduces the amount of waste generated during student move out.

Overall, CCSU is recycling some waste streams successfully; however, compared with other comparable institutions, there are waste streams that CCSU is not currently recycling.

4.1.5 Improving Recycling on Campus

There are potential challenges with improving recycling at CCSU so that its program is comparable to other colleges and universities. These include management, education, custodial and grounds workload, and space. Also, due to the fact that CCSU is a commuter campus, students are more likely to bring disposable goods onto campus (like disposable beverage and water bottles).

Past efforts to manage recycling at CCSU and other universities have failed when they rely on the efforts of student volunteers alone. In the past, motivated students have come forward to lead recycling improvements at CCSU. These efforts have declined after the students have left CCSU. Successful recycling programs are typically managed by a staff coordinator who can maintain consistency despite student turnover.[20]

[20] Stony Brook University, the University of North Carolina, and the University of Oregon are examples of schools with one or more staff members dedicated to recycling.

Cross-contamination of recyclables (i.e., food waste contaminating paper or other waste streams commingling or being put into the wrong containers) has also been an issue. CCSU attempted to recycle beverage containers using large, centrally-placed bins, but the effort was not successful due to high levels of contamination with trash. Using appropriate container recycling bins (i.e., the kind with the small, round hole), better education about recycling procedures, and a consistent recycling program should help solve this issue.

The success of a recycling program also depends on education. Effective education on recycling is especially challenging in a college environment where new students must be trained every year. Educational tools including consistent containers and signs, tables at student events, information at student orientations, and a well designed web-site should all be part of a campus recycling program.

Another concern with improving the effectiveness of CCSU's recycling program is increased workload for custodial and grounds staff and contractors. It is often assumed that handling one or more recycling streams in addition to trash will unduly burden the already busy janitorial staff, leading to increased costs and potential union concerns. This need not be the case for a well-designed program, because the total amount of material to be moved remains the same. CCSU does not foresee union concerns, and has begun the consultation with housekeeping staff around recycling. Recycling and trash collection procedures should be kept parallel for simplicity. For example, if trash is collected from bins using a cart and brought to a central place in the basement, recycling should be collected in the same manner and brought to the same place. The same strategy should also be applied to minimize workload for the grounds staff. Finally, students and staff should accept some of the burden for recycling. For example, they can be required to bring trash and recycling from their office to central locations on each floor.

One potential challenge with changing staff responsibilities is potential union concerns. If CCSU is serious about recycling, it will need to work closely with existing staff to ensure that they are on-board. Helping them understand that recycling is the standard of practice among the vast majority of colleges and universities (and that union members are likely involved in recycling to some extent) will help facilitate this conversation.

Another challenge is floor space. Most of the buildings surveyed have crowded trash rooms or narrow hallways already crowded with trash cans. Again, it will be key to recognize that recycling will not increase the total amount of material that must be collected. Recycle bins can replace some of the existing trash cans rather than be in addition to them. CCSU will have the Fire Marshall review the recycling program before placing bins in hallways.

It will also require some funds to ensure that a formalized recycling program can be successful. Typically, the position of a recycling coordinator can pay for itself. This is based on our knowledge of other recycling programs at colleges and universities. For specific cost estimates for formalizing CCSU's recycling program, refer to the Recycling Management Plan.

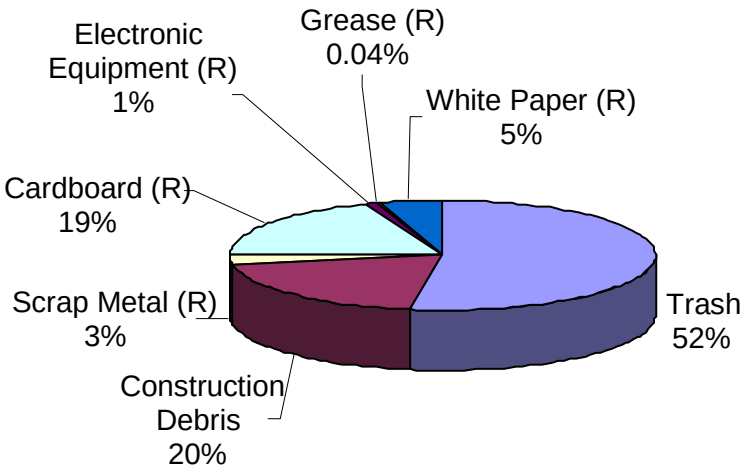
4.2 BASELINE AUDIT RESULTS

4.2.1 Quantitative Data

Figure 4-1 summarizes the available solid waste data. 28% of the total trash waste stream at CCSU is recycled. The remaining 72% consists of trash and construction debris. As mentioned above, construction debris is generated from facilities construction projects and end-of-semester residence hall

cleanouts. Waste from major construction projects by outside contractors is not included. Trash includes food waste.

Figure 4-1: Waste Streams Quantified in the Baseline Audit



Note: Streams that are recycled are indicated with an (R).

4.2.2 Data Analysis

Solid waste data were compiled into two statistics: recycling rate and per capita waste generation. These statistics are commonly used for evaluating solid waste management. Per capita waste generation is a measure of the total amount of waste generated per person (including faculty, staff, students — i.e., everyone at CCSU). It indicates the effectiveness of a solid waste management program in minimizing the total amount of waste generated. Recycling rate is a measure of the percentage of total waste that is recycled, and therefore indicates the successfulness of recycling efforts. Considered together, these two statistics provide a valuable summary of waste management.

Recycling rate and per capita waste generation were calculated in two different ways for this report: using all available data, and using the same method as Recyclemania which excludes certain streams. Recyclemania is a recycling competition between colleges and universities which is discussed in more detail in Section 4.3 below. Calculating statistics using the Recyclemania method facilitates comparison with other schools.

Recycling rate and per capita waste generation for CCSU are shown in Table 4-2.

Table 4-2: CCSU Recycling and Waste Statistics

	Recycling Rate	Per Capita Waste Generation
Using All Data	28%	260 pounds/person/year
Using Recyclemania Method	31%	198 pounds/person/year

Note: The university population for estimating per capita waste generation was calculated using the Recyclemania FTE method, which is described in more detail in Section 4.3 below.

Recycling rates calculated by the two methods are similar. The Recyclemania recycling rate is slightly higher because construction debris, which is not recycled, is not included. A recycling rate of 30% reflects the fact that CCSU makes an effort to recycle two of its largest waste streams: white paper and cardboard. Per capita waste generation results are discussed in more detail in Section 4.3 below.

4.2.3 Gap Analysis

Data were not available on the constituents of the trash portion of the waste. For example, the percentage of food waste or potentially recyclable containers, paper, and other materials that are discarded as trash is unknown.

Data were not available on the amount of construction and demolition waste generated by outside contractors. This is a potentially large waste stream.

Data were not available on the amount of grounds waste generated. However, aside from grass clippings (which are mulched onsite), CCSU reports that this is not a large portion of the waste stream.

4.2.4 Qualitative Observations

The implementation of the white paper recycling program is inconsistent. Ten of the thirteen buildings surveyed (77%) had large green wheeled totes which the custodians use on their rounds to collect white paper. Only six buildings (46%) had bins for collecting white paper from students and staff. Some of the bins were the standard blue plastic type with generic text or symbols indicating that they are for recycling. The bins lacked more specific labels indicating exactly what could be recycled. In some offices employees had established makeshift bins using cardboard boxes, but it was not clear if custodians would recognize these as recycle bins.

There are no outdoor locations for recycling. Recycling is not available for other types of paper or glass, metal, or plastic containers.

USA Today provides free papers to students, and collects used and unwanted papers each day, presumably for recycling.

CCSU has not made any formal attempts to educate the university community about the need and procedures for recycling.

Despite the limited and inconsistent nature of the existing recycling program, some members of the university community were clearly aware of recycling and make an extra effort to recycle. In the anthropology department, some staff members had established their own recycling program by setting up bins and taking recyclables home. Custodians were generally aware of the need for improved recycling. One custodian in Barnard Hall requested at least ten additional 25-gallon square blue bins for collecting paper. One custodian at the library collected unwanted children's books for donation. In the past, students have come forward to try to improve recycling at CCSU. The most recent and effective effort was initiated by a student. The student headed the Environmental Club and was able to recruit student volunteers to collect bottles and cans from university buildings. Unfortunately this effort dwindled without his leadership after he graduated.

Table 4-3 shows flow paths for the three of CCSU's largest waste streams. These flow paths were determined by conversations with facilities staff and waste and recycling contractors (CWPM and All-Waste).

Table 4-3: Current Flow Paths for Three of CCSU's Major Waste Streams

	White Paper	Cardboard	Trash (Food Waste, Plastic, Metal, and Glass Containers, Other Types of Paper)
Step 1	Deposited in blue recycling bins.	Collected by custodial staff and placed in compacting dumpsters or outside buildings	Deposited in gray trash bins.
Step 2	Collected by custodial staff in large totes and placed outside the building	Collected by grounds contractor and hauled to compacting dumpsters	Collected and bagged by custodial staff and placed in compacting dumpsters or outside buildings
Step 3	Collected by All-Waste and sold to various mills for recycling.	Collected by CWPM and sold to various mills for recycling.	Collected by grounds contractor and hauled to compacting dumpsters
Step 4			Dumpsters collected by CWPM.
Step 5			Incinerated in Bristol, CT Trash-to-Energy facility.

4.3 BENCHMARKING

4.3.1 Recyclemania Statistics from Other Colleges and Universities

An excellent source of benchmark data for campus recycling comes from the results of the annual Recyclemania competition. In 2006, 45 colleges and universities from across the U.S. provided recycling

rate and per capita waste generation data for the competition. These data are especially useful because the measurement method is consistent between schools. Recyclemania includes only conventional trash and recyclables (paper, cardboard, and containers). It excludes scrap metal, construction debris, computer waste, and food waste. Data from other sources are difficult to compare because different waste streams are included or excluded.

Results from Recyclemania in 2006 are summarized in Figures 4-2 and 4-3.

Figure 4-2: 2006 Recyclemania Results — Recycling Rate

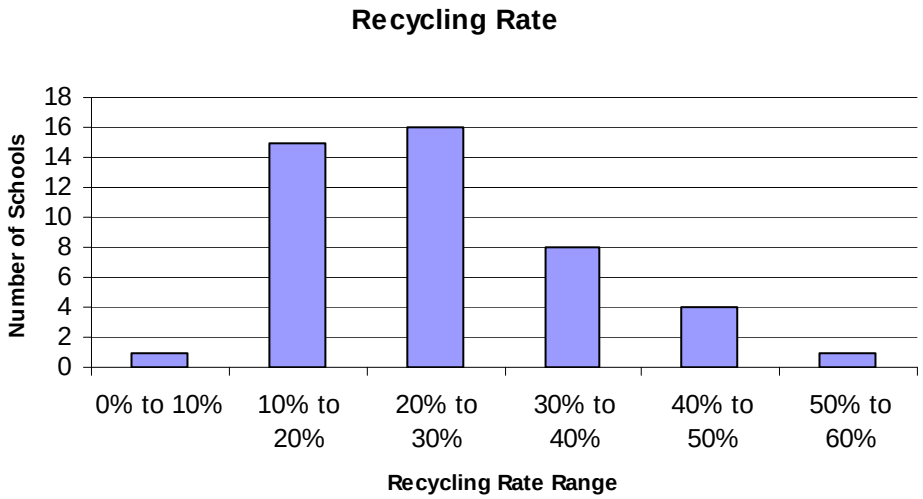
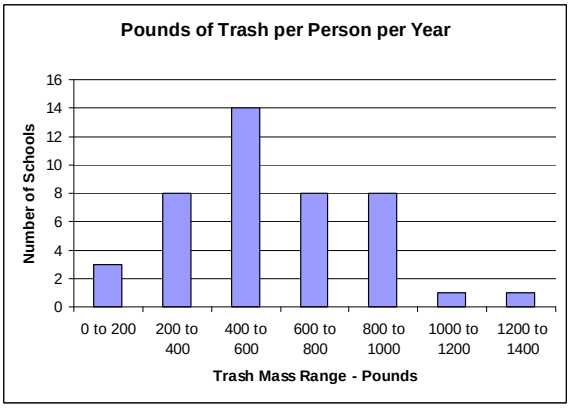


Figure 4-3: 2006 Recyclemania Results — Pounds of Trash per Person per Year



During the 2006 competition, most schools recycled 20 to 30% of their solid waste. The school with the highest recycling rate (51%) was Cal State San Marcos. Middlebury College had the highest recycling rate of any New England school (35.7%).

Most schools generated solid waste at a rate of 400 to 600 pounds of trash per person per year.[21] The schools with the lowest waste generation are Point Loma Nazarene University (182 pounds/person/year) and Colorado State University (188 pounds/person/year). The New England School with the lowest waste generation was the University of Vermont (367 pounds/person/year).

University of Rhode Island, a southern New England school of comparable size to CCSU (15,000 total students in 2006) had a recycling rate of 17% and a waste generation rate of 447 pounds per person per year.

4.3.2 How CCSU Compares

CCSU's recycling rate of 31% would have put it in 13th place out of the 45 schools participating in this category in 2006. This result is very good and should be publicized. Nevertheless, CCSU can still improve. Specifically, while CCSU recycles white paper and cardboard, it does not recycle other types of paper or containers, and its white paper recycling program is implemented on an inconsistent basis throughout the campus. White paper and cardboard are typically large portions of the waste stream, so capturing a significant portion of these streams is sufficient to achieve competitive recycling rates.

CCSU's per capita trash generation would have been among the lowest of the 45 schools participating in this category in 2006. This result is slightly surprising because CCSU does not have a waste reduction program. It could indicate that CCSU has an inherently conservative culture. It may also point to missing or erroneous data, although Woodard & Curran checked trash data using copies of invoices from the waste hauler (CWPM), and it does not appear that other major waste streams are missing from the total. Construction debris generated by outside contractors is a potentially large waste stream that is not recorded by CCSU, but this stream is not counted in Recyclemania so it would not affect the total.

CCSU faculty have expressed concerns that the material sent to All Waste may not be getting recycled. All Waste indicated to Woodard & Curran that it is indeed recycling the materials generated by the campus. If CCSU has questions for All Waste (or any of its other vendors), it should raise this issue directly with its vendor representatives. During the audit, we had no reason to believe that the recyclables that are currently generated by CCSU and that are being sent off-site as recyclables are not being recycled.

4.4 RECOMMENDATIONS

The primary way to improve the recycling program at CCSU is by developing a Recycling Management Plan and by hiring a full-time recycling coordinator. Woodard & Curran is currently in the process of drafting a Recycling Management Plan. Please note that the Recycling Management Plan reiterates the

[21] Population is expressed in terms of Full Time Equivalents (FTE). Residential Students count for 1 FTE each, Full-Time Staff and Non-Residential Students (Commuting Students) are 0.75 FTE each, and Part-Time Staff and Part-Time Students are 0.5 FTE each.

suggestions included here (and includes many others), as well as outlining how a comprehensive recycling program can be successful at CCSU.

4.4.1 Reduce, Reuse, Recycle

Solid waste reduction strategies should follow this widely promoted hierarchy:[22]

- Reduce
- Reuse
- Recycle

Source reduction and reuse are the preferred strategies. They result in the smallest environmental footprint and the greatest cost savings. Examples of reduction include encouraging the use of reusable containers, sharing infrequently-used equipment between departments, or requiring double-sided printing.

When materials must be purchased and cannot be reused, recycling and composting are the next best choices.

If recycling is not feasible, incineration at a waste to energy facility is the next option. This is the current fate of trash from CCSU. Incineration without energy recovery and/or landfilling are the least desirable options. State contracts govern how trash facilities can incinerate to create energy.

One idea introduced by members of the EHS staff was to introduce bottle redemption machines on campus. This idea could be researched by students willing to participate in the pilot recycling program.

4.4.2 Connections to Purchasing

Reducing solid waste requires more than simply changing disposal practices. It is crucial to remember that recycling is a cycle. Clearly, purchasing policies need to be reviewed as well. While CCSU's Purchasing Department is currently involved in initiatives to promote sustainability, there are other areas that can be improved. The following are some examples of purchasing policies for reducing waste:

- Service contracts for food, grounds and construction should require reuse, recycling, and composting.

- Procurement of goods should favor products made with a higher content of post consumer recycled materials, products that are easily recyclable or compostable, and products containing fewer toxic materials.

- Durable good such as computers and furniture should be long-lived, repairable, and ultimately recyclable to the greatest extent possible. CCSU is already purchasing some durable items, but the extent to which these items are purchased can be increased (for example, disposable food service items like plastic knives and forks in the dining hall are not long-lived or durable).

[22] This hierarchy is promoted by the United States Environmental Protection Agency and the Connecticut Department of Environmental Protection.

- Consider reusable alternatives to disposable products.

Specific purchasing recommendations for specific waste streams are included in Section 4.4.3.

4.4.3 Specific Waste Stream Reduction and Recycling Strategies

Paper, food and beverage containers, grounds waste, and construction and demolition waste are typically the largest waste streams produced at colleges and universities.[23] Paper and container recycling are typically the most visible components of a recycling program, because these waste streams are generated by almost everyone in the community on a regular basis. Strategies for reducing and recycling these and other waste streams are presented in Table 4-4.

[23] It is difficult to say what percentages of the total waste generation these four streams represent because of differences in reporting methods and recycling programs.

Table 4-4: Strategies for Source Reduction and Recycling of Campus Waste Streams

Note: Items marked with a "☆" are connected with purchasing of equipment and materials.

Waste Stream	Source Reduction Strategies	Recycling Strategies	Current Strategies	Recycling Required by CT Statute?
Paper (office paper, newspaper, paperboard, etc)	• Require double-sided printing. Set equipment to print double-sided by default. ☆ Only purchase equipment which can print double-sided. • Encourage electronic alternatives and printing multiple pages per sheet.	• Place collection bins throughout campus (see specific implementation strategy in the Recycling Management Plan). • Sign contract for hauling and recycling. ☆ Require purchase of paper with a high post-consumer recycled content (CCSU currently purchases 30% post-consumer).	Paper is recycled in some buildings and offices. Paper is hauled off campus for recycling by All Waste.	Yes (newspapers and white office paper).

Waste Stream	Source Reduction Strategies	Recycling Strategies	Current Strategies	Recycling Required by CT Statute?
Containers (plastic, metal, and glass).	• Encourage use of reusable foodware (cups, flatwear, dishes) of the University. ☆ Work with Sodexho to maximize bulk purchasing, minimize packaging and increase reusable foodware.	☆ Place collection bins throughout campus (see specific implementation strategy in the Recycling Management Plan). ☆ Sign contract for hauling and recycling. ☆ When disposable containers must be used, purchase containers that are easily recyclable (#1 and #2 plastic), or compostable.	There is currently no program in place for recycling containers. They are thrown away in the regular trash.	Yes (metal and glass containers).
Corrugated Cardboard	☆ Require vendors to minimize cardboard packaging. • Reuse boxes on campus.	• Sign contract for hauling and recycling from central locations.	Currently, cardboard is collected from each building and placed in dumpsters. CWPM is contracted to empty the dumpsters. They process the cardboard and sell it to mills where it is used as a raw material for fiber products.	Yes

Waste Stream	Source Reduction Strategies	Recycling Strategies	Current Strategies	Recycling Required by CT Statute?
Scrap Metal	• Encourage on-site repair of metal objects. • Use scrap metal as raw material for metal fabrication classes and art projects.	• Contract for hauling and recycling from B&G building.	Scrap metal is collected in a central dumpster at the B&G building. CWPM is contracted to empty the dumpster. They sell the metal as a raw material to mills.	Yes
Leaves and grass clippings	• Use mulching equipment (as conditions permit).	• Require contractors to compost organic waste, which is not mulched on location. • Consider developing an on-site composting program for food waste.	Leaves and grass clippings are currently mulched by the grounds contractor.	Yes (leaves)

Waste Stream	Source Reduction Strategies	Recycling Strategies	Current Strategies	Recycling Required by CT Statute?
Organic food waste (pre and post-consumer)	• Donate unused food. • Encourage students to take only what they will eat (this can be done through signs). Try eliminating trays to reduce temptation to take too much food.	• Provide bins to collect plate scrapings in food service areas. • Collect organic waste from food production areas. • Consider storing food waste in walk-in coolers to reduce spoilage. • Contract with a local farm or other entity to haul organic waste for compost or animal feed. • Consider on-site composting with grounds waste.	There is currently no program in place for recycling food waste. Food waste is disposed in the regular trash.	No. However, CT DEP recommends composting or using food waste as animal feed.
Waste Grease from Food Production	• Grease is a byproduct of certain ingredients and cooking techniques (e.g., fryalators). Source reduction would require different menu choices.	• Contract to have grease rendered or converted to biofuels.	Baker Commodities is currently contracted to remove waste cooking grease from the campus. They render grease into tallow, which is a raw material for industrial and consumer products.	No, although there are requirements for proper management of waste grease per federal/EPA Oil SPCC regulations.

Waste Stream	Source Reduction Strategies	Recycling Strategies	Current Strategies	Recycling Required by CT Statute?
Construction and Demolition Waste	• Incorporate reused and reusable materials and fixtures into new buildings to the extent possible. For example, wash basins or lockers could be salvaged and reused.	• Implement green building standards such as LEED which require recycling for new building and renovations. • Crush asphalt, brick, and concrete waste for use as backfill under roads and structures.	There is currently no policy for recycling construction debris. Any recycling that is done is at the discretion of the contractor.	No. Although CT does require all new public buildings in the state to be LEED Silver-Certified.
Pallets and wood waste.	• Sell unwanted pallets for reconditioning.	• Chip unwanted pallets and wood waste for use as mulch on campus.	The majority of pallets which are received at CCSU are reused for shipping obsolete computers. There is currently no policy for recycling wood waste from grounds activity. According to Facilities, this is a small waste stream. Any recycling that is done is at the discretion of the grounds contractor.	No.

Waste Stream	Source Reduction Strategies	Recycling Strategies	Current Strategies	Recycling Required by CT Statute?
Electronic Waste	☆ Increase obsolescence cycle for computers. For example, replace only upon failure instead of every 3 years. • Donate unwanted but otherwise functional computers, cell phones, and other electronics. • Collect and refurbish working parts from nonworking systems.	☆ Consider adding end-of-life take-back requirement to purchasing contracts for electronic equipment. • After exhausting options for reuse, repair, and refurbishment, contract for hauling and proper disposal of e-waste.	The majority of unwanted computers (>95%) are donated.	Yes, electronic waste should be managed in accordance with applicable hazardous waste regulations or recycled as universal waste.
Residential and Office Furnishings	☆ Provide standard, durable furnishings for offices and residence halls. This discourages students and employees from providing their own cheaply made disposable furniture. • Repair furniture to the greatest extent possible. • Collect and redistribute unwanted furnishings.	• Break down furniture into component materials (metal, wood) as necessary to increase recycleability.	Students are provided with durable dorm furniture. Unwanted furniture is collected and redistributed to the campus community and local schools.	No
Toner Cartridges	• Encourage electronic alternatives to printing and copying. • Set equipment to print in toner economy mode by default.	☆ Only purchase equipment which has a toner economy mode. ☆ Buy reconditioned cartridges and return spent cartridges for reconditioning.	CCSU currently purchases mostly recycled toner cartridges, and OfficeMax takes the cartridges back for recycling.	No

4.5 CONSIDERATIONS FOR INSTITUTIONAL PLAN

Efforts to improve recycling at CCSU could begin with a clear policy from the University administration. The policy will help provide the top-down focus, motivation, and authority missing from previous student-initiated efforts. The policy should support the establishment of a recycling committee of stakeholders, and hiring a full-time recycling coordinator. This policy can be streamlined with the University's Institutional Sustainability Plan.

4.5.1 Tips for Sustainability Website

The sustainability web site should include a recycling page. The page should be updated regularly and should include:

- Information on campus recycling procedures for various material streams
- Suggestions for reducing waste such as printing double-sided and using re-useable food containers
- Annual recycling statistics
- Contact information for recycling questions, issues, and requests
- Answers to frequently asked recycling questions
- Lists of furniture, equipment, and other items available for reuse. This could be simple text list which is periodically updated by the Facilities department, or it could be a database with a web front-end allowing anyone in the campus community to post unwanted items or search for items they need.
- Links to web resources outside of CCSU, including Connecticut DEP recycling information, Recyclemania,[24] and the College and University Recycling Council.[25]
- Identify and publicize programs that have been successful on campus and the people responsible for them.

[24] http://www.recyclemaniacs.org/

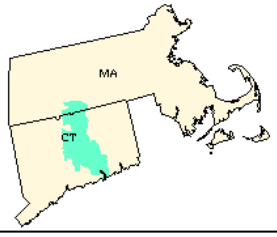
[25] http://www.nrc-recycle.org/councils/CURC/default.htm

5. WATER

5.1 INTRODUCTION

5.1.1 Areas Included in Baseline

The CCSU campus lies within the Lower Connecticut Watershed, USGS ID # 01080205. This watershed region lies along the Connecticut River, and contains most of the land area in Central Connecticut, as well as some land in the Southwestern portion of Massachusetts, extending from the Long Island Sound to the City of Springfield, MA. CCSU obtains its water from the New Britain Water Department. Wastewater is discharged through the sewer system back to the Water Department for treatment.



Picture obtained from the US EPA.
http://cfpub.epa.gov/surf/huc.cfm?huc_code=01080205

Water use on campus includes drinking water, water used for cleaning, showering, and operating toilets, the dining facilities, energy use in the Energy Center (as well as throughout the cooling water, process water, and steam distribution systems), and irrigation. Additionally, the entire campus maintains stormwater drains for the management of excess rainwater. Much of this stormwater appears to run off into Bass Brook, on the North of Campus, and Sandy Brook, which is piped underneath campus. It does not appear that any data currently exists on the amount of water discharged through storm drains, although gathering this data is not a regulatory requirement.

As the entire CCSU campus uses water for some purpose, all areas of campus were included in the scope of this baseline audit. The audit included visual inspections of areas around campus, data collection, and interviews with a variety of stakeholders.

5.1.2 Stakeholder Engagement

Multiple members of the CCSU community were interviewed regarding water use and related issues on the campus. All of the interviews were helpful in collecting data, opinions, and revealing current and potential issues with water conservation on campus. The following is a specific list of people interviewed regarding water use at CCSU:

- Director, Engineering
- Administrative Assistant, Facilities Management
- Environmental Health & Safety Officer
- Associate Chief Administrative Officer
- Representative, Student Government Association
- EH&S Officer
- Plumbing, Facilities
- Plumbing, Facilities
- Professor, Biology

- President, Student Government Association

5.1.3 Existing Sustainability Initiatives

While there is no official Water Conservation policy at CCSU, the University has already enacted some conservation measures across campus. The following are examples of existing water related sustainability initiatives that CCSU has implemented:

- CCSU currently has individual metering at each building, parking garage, and other water-using features on campus. This is of great assistance in determining water usage issues, and the success of future conservation efforts.

- The majority of residences on campus (five out of nine, or 56%) currently have low-flow features installed. These include low-flow showerheads and faucets, as well as reduced flush toilets. Vance Residence Hall also has low-flow showerheads.

- In the summer of 2007, CCSU signed laundry service contracts that install new Energy Star washers and dryers, with ability for users to choose cold water washing complete with a cost incentive.

- CCSU has spent a total of $60,480 on water saving fixtures, which does not include labor costs associated with installation.

Table 5-1: Water Conservation Features in Residences

Residence Hall	Low Flow Showers (2.5 gallons per minute [gpm])	Low Flow Faucets (2.2 gpm)	Low Flow Toilets (1.6 gpf)
Clarence Carroll Hall	No	No	No
Catherine Beecher Hall	Yes	Yes	Yes
Samuel J. May Hall	Yes	Yes	Yes
Seth North Hall	No	No	No
Robert E. Sheridan Hall	Yes	Yes	Yes
Thomas A. Gallaudet Hall	Yes	Yes	Yes
Mildred Barrows Hall	No	No	No
Robert Vance Hall	Yes	No	No
F. Don James Hall	Yes	Yes	Yes

5.1.4 Reduction Opportunities and Potential Challenges

There are measures CCSU can implement to reduce water consumption. Some of these measures include potential challenges. Quality of life is an extremely important factor in attracting faculty, staff, and students. CCSU is faced with the challenge of reducing water use at the campus without affecting the quality of life. Staff in the facilities department indicated that some of the low-flow features currently established at CCSU may be negatively affecting students, as they felt that the students had to flush the toilets multiple times, and that shower pressure may not be great enough.

Stormwater management is another potentially significant issue at CCSU. The campus directly borders two surface water bodies, Sandy Brook and Bass Brook. Sandy Brook runs directly under campus, and the storm drains in the middle of the campus drain directly into it. Coupled with the fact that a large proportion of the campus is covered with impervious surface (sidewalks, paved areas, buildings with roofs, etc.), this creates the potential for increased impacts to the stream. During in an interview with a Biology professor, an example of the potential impact on Sandy Brook was discussed. Research conducted a few years ago by his students demonstrated the effects that runoff from campus can have on chemical parameters of the stream.

Prior to a snowstorm, Sandy Brook passed through the campus with a chloride content of ~ 50 mg/l. Chloride is a constituent of deicing salts used to keep the campus walkways and roadways safe for passage during the winter months. While naturally occurring in some small quantities, chloride at high concentrations can greatly reduce biodiversity in aquatic and streamside ecosystems. Additionally, chloride is toxic to organisms over certain levels. Following a snowstorm the next day, the stream discharged from campus with a chloride content of ~ 8,000 mg/l. While it is likely that some of this increase was due to areas external to the campus, given the large amount of impervious surface at CCSU, it can be assumed that much of the increase arose as a direct result of runoff from the campus.

In addition to runoff from winter deicing practices, surface waters are subject to runoff from parking lots, which can include heavy metals and oils, runoff from maintenance areas, as well as other areas of campus. This can result in the introduction of hazardous chemicals to the surface water bodies surrounding the University. During the course of the site visit, Woodard & Curran observed practices that could potentially result in pollutant releases to surface waters. One instance included spilled latex paint being carried by snowmelt water into a nearby stream. Another instance was a minor oil spill, which did not reach the stream, but was close to it. CCSU will need to ensure that instances such as these do not occur in order to reduce the campus environmental impact.

5.2 BASELINE AUDIT RESULTS

5.2.1 Quantitative Data

Water use at CCSU is primarily related to Academics, Residential Living, Energy, and Food Service. The remaining volume used is split between Athletics, Irrigation, and other departments. Data regarding campus-wide water use at CCSU is displayed in the following figures and tables. At the time of the baseline audit, it did not appear that CCSU was implementing any formal water reuse programs on-campus. Some campuses around the country are engaged in water-reuse activities (e.g., roof cisterns, stormwater retention ponds for reuse in irrigation systems), although none of CCSU's peer institutions are.

Figure 5-1: Water Use at CCSU by Campus Area (Spring 2005-Spring 2006)

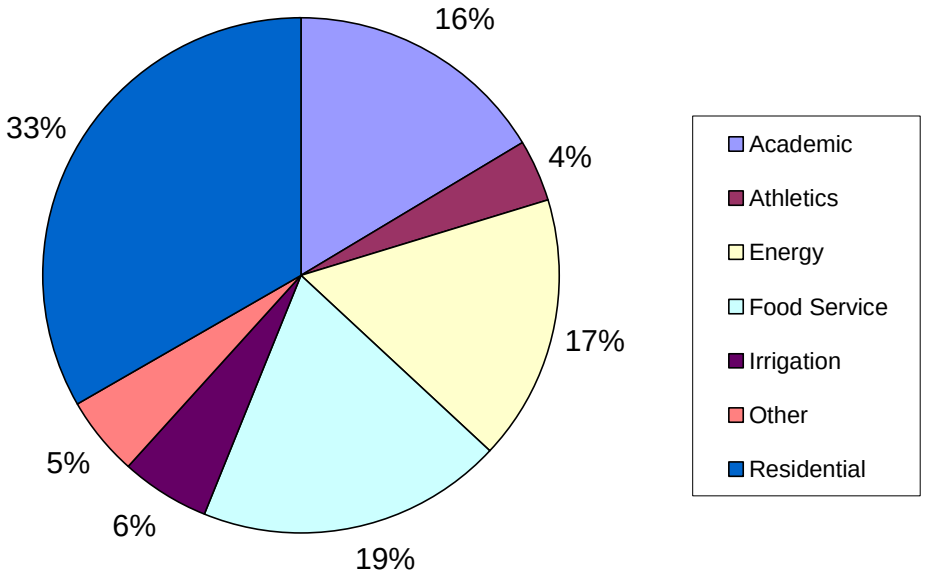


Table 5-2: Water Use at CCSU in Gallons (Spring 2005-Spring 2006)

AREA	USE (gallons)
Residential	17,823,000
Food Service	10,221,750
Energy	8,850,000
Academic	8,738,250
Irrigation	2,949,000
Other	2,640,750
Athletics	2,026,500

Table 5-2 provides the actual data used to generate the pie chart in Figure 5-1 (above). The data provided is based on the billing period from Spring 2005 through Spring 2006, for which CCSU was able to provide Woodard & Curran complete data. Table 5-3, below, lists water use by building during this time

period. The month listed represents the billing month for usage, and these data were gathered directly from information provided by CCSU.[26] For example, the amount of water listed for September 2005 represents the entire usage during the six-month billing period March 2005-August 2005. Similarly, the data for March 2006 represents the water usage from September 2005-February 2006.

Table 5-3: Water Use at CCSU by Building (in Cubic Feet)[27]

Water Meter Location	Low-Flow Features?	September 2005	March 2006
Welte Garage	No	340,000	203,000
Welte Hall	Yes	918,000	0
Kaiser Gym	Yes	194,500	133,200
Memorial Hall	No	622,800	717,800
Balf Savin	No	246,400	82,000
Copernicus	Yes	240,000	284,000
Business Office	No	1,100	1,100
Fine Arts	No	37,000	30,000
Beecher	Yes	42,000	53,000
Barrows	No	95,000	149,000
Central Oval	No	50,200	45,400
Student Center	Yes	52,000	62,000
Sam May	Yes	52,000	68,000
Gallaudet	Yes	0	37,000
Sheridan	Yes	107,000	154,000
Vance Hall	Yes	201,000	200,000
Parking Garage	No	200	100
Library	No	41,000	52,000
Butler Building	No	0	0
Wells St. Plant	No	8,000	7,000
Iwo Jima	No	200	
Arute Press Box	Yes	7,100	15,900
Barnard	No	35,000	45,000

[26] To convert cubic feet to gallons, multiply by 7.5.

[27] Data for this chart was taken directly from a table provided by the CCSU Facilities Department

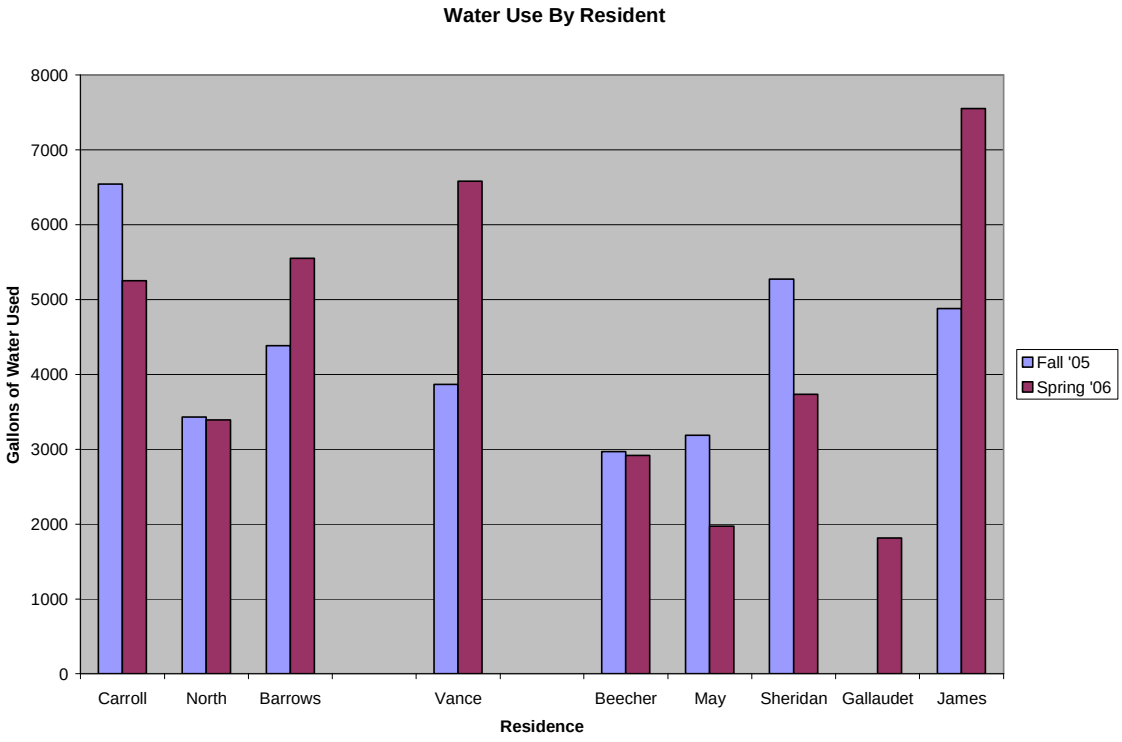
Water Meter Location	Low-Flow Features?	September 2005	March 2006
Davidson	No	28,000	33,000
Powerhouse	No	0	0
James	Yes	354,000	265,600
Vance Academic	No	133,100	
DiLoreto	No	37,000	35,000
Seth North	No	49,000	54,000
Carroll	No	108,000	178,000
Marcus White	No	70,000	48,000
Willard	No	0	
180 Manafort Drive	No	3,700	4,400
Wells St. Plant	No	629,400	409,200
201 Manafort Drive	No	0	83,700
Totals:		**470,2700**	**3,450,400**

Currently, no water is extracted from the ground by CCSU for use on campus for drinking water or process wells. All water that is used is provided by the City of New Britain.

Figure 5-2, below, demonstrates the water use per student living in each residence. The three buildings at the left of the figure have no low-use features, and the five buildings at the right of the figure have low flow faucets, shower heads, and toilets. The average student living in one of the three buildings without low flow fixtures installed used 9,925 gallons per year in 2005-2006. The average student living in one of the buildings equipped with low-flow features used 8,961 gallons per year, or nearly 1,000 gallons less per year. In the 2005-2006 year, CCSU had an average of 560 students occupying buildings without low-flow features. If CCSU had low-flow features installed in those buildings, the likely savings would have been 540,000 gallons of water, which represents over $2,000 in combined water and sewer utility fees.[28]

[28] Statistics determined using the provided rate of $18.78 per 1,000 cubic feet for water, and $17.32 per 1,000 cubic feet for sewer use.

Figure 5-2: Residence Hall Water Use Per Resident (2005-2006)



5.2.2 Gap Analysis

While the one year of data provided by CCSU presents a "snapshot" of water use on the CCSU campus, it was not sufficient to compare current usage to previous years or to gauge the effectiveness of the water reduction measures that have been implemented. Long-term data on water use was not provided so Woodard & Curran could not present time-based trends for water use on campus. It does appear that historical water use data exists; however, it has not been assimilated by any member of the CCSU staff before. CCSU was extremely helpful in obtaining the data from the 2005-2006 academic year, which is included in this baseline report.

Additionally, while each building is individually metered, it is difficult to determine if water is piped from buildings for additional reasons, such as irrigation, property maintenance, washing equipment, or other uses. The lack of certainty regarding the exact water usage made an exact determination of water use per student difficult to ascertain. Because there are laundry facilities in each residence hall, it is difficult to determine the overall amount of water that is used for just laundry. This information is not currently obtainable from the available data.

5.3 BENCHMARKING

Comparing CCSU's water use to that of other institutions is a difficult task, in part because the University has unique features (discussed below) that separate it from other schools; and some college institutions do

not publish their water use data. The majority of the data in this section comes from a survey conducted by the National Wildlife Foundation (of which CCSU was one of over 400 responding institutions) and student research that was published in the public domain.

Water use at CCSU is influenced by unique factors that do not exist at all institutions. For example, over 8,000,000 gallons of water are used by the campus's new Energy Center, which is a highly efficient cogeneration plant. While the amount of water used at this facility is high, a great amount of energy is conserved through the operation of this plant. As energy accounts for 17% of the water use on campus, the operation of the co-gen plant increases the per-capita water use on campus compared to institutions that do not have a cogeneration heating plant. Conversely, because CCSU is primarily a commuter campus, its daily per capita water usage is lower than institutions with a large residential student population.

CCSU uses approximately 50 million gallons of water annually. This is almost double the average campus water use of 27 million gallons annually, as reported in the National Wildlife Foundation "State of the Campus Environment" Report (NWF Report), which includes data based on statistics from 134 reporting institutions. However, these statistics do not include information on institution size, or status as a commuter, residential, or mixed University.

Some important statistics from the survey include:

- CCSU is among the 64% of campuses that do not have a written water conservation policy, although CCSU is currently working on this. Should CCSU decide to draft a written water conservation policy, it would be one of 21% of college campuses that currently have one. (Not all institutions participating in the survey responded to all questions.)

- The average campus (regardless of size) uses 27 million gallons of water annually (As reported in the NWF Survey). This equates to an average of 14,671 gallons per student at the reporting institutions. At approximately 4,400 gallons used per student on annual basis, CCSU is well below this average. It should be noted, however, that this is a difficult comparison to make, based on CCSU's large proportion of commuter students.

- Currently, more than half of the college campuses responding to the survey had implemented some sort of water conservation measures. CCSU is one of those institutions, with low-flow fixtures installed in some campus buildings.

5.3.1 Peer Institution Information

The University of Southern Maine (USM) founded a sustainability committee in 2002, and the University has published water use data on their sustainability website for the years 1998-2003. In 2003, USM's nearly 11,000 students used approximately 33,750,000 gallons (4,500,000 cubic feet) of water, or about 3,100 gallons per student annually.[29] CCSU uses a total of 50 million gallons (nearly 7 million cubic feet) of water annually, or about 4,400 gallons of water per student, which is significantly more that what is used, total or per student, at USM.

[29] http://www.usm.maine.edu/sustain/index.htm

5.4 RECOMMENDATIONS

A brief summary of recommendations for CCSU is outlined below. More detailed explanations of the recommendations follow in subsequent pages.

- Implementing a campus-wide educational campaign about the need to conserve water could be extremely effective. Special attention should be paid to the particular needs of the water district. The New Britain Water Department may be able to provide additional resources and help.

- Following an educational campaign, CCSU can increase student involvement in the water conservation efforts. One of the more common ways to do this is to hold a water conservation contest. As the residences at CCSU are already individually metered, this is an easier task to accomplish. The money saved through reduced usage could be used to fund additional conservation projects, and/or there could be some incentive for the winning residence.

- CCSU will continue to replace outdated fixtures with new, reduced flow features on an as-needed basis. The average use in residences with reduced flow fixtures is evidence that end usage is reduced as a result of their installation.

- Based on observations during the baseline audit, surface water discharges may be an issue at CCSU, particularly as a result of the large amount of impermeable surface and contractor activity. The University should examine options for ways to better handle runoff, including permeable pavement and a man-made retention pond (an idea which has been supported by CCSU stakeholders); and should actively monitor the activities of contractors on campus that have the potential to impact stormwater quality (painters, construction activity, landscapers, etc.).

- CCSU will continue to monitor current maintenance practices, including those at the garage area and the outdoor washing of machinery. During the course of Woodard & Curran's time on campus, practices were observed which could result in hazardous substances reaching surface water bodies. CCSU staff were alerted to these activities.

- Large spikes in water use have occurred at CCSU over the past few years. Interviews with Engineering staff have indicated that CCSU's monitoring has confirmed the amounts used, but staff were unable to explain the increased usage at places such as Welte Garage. This particular issue seems to have corrected itself, but should an issue such as this arise in the future, CCSU could consider installing leak detection in its piping.

- In addition to the above mentioned recommendations regarding water conservation, CCSU may want to consider maintaining more long-term water use records, to help document changes in water use over time. This information will be useful in determining success that CCSU has achieved in terms of water conservation since the baseline audit.

- CCSU could consider forming a committee of interested parties to draft a written Water Conservation Plan. This Plan would require the buy-in of all involved parties, and a commitment to provide the resources necessary to implement the Plan at CCSU. Some examples of water conservation policies and fact sheets are included in Appendix D.

Because the supply of water seems endless in the Northeast, conservation efforts have historically been low in regards to water use. Only more recently, as populations have continued to expand, and area water levels have began to decrease, has greater attention been paid to water usage and conservation efforts. Often, conservation efforts have taken effect through increased communication and education about the issues. Examples of these types of conservation efforts include education campaigns to:

- Reduce excess length of shower time;
- Alert facilities professionals of leaking fixtures;
- Shut off water while brushing teeth, washing dishes, and other time consuming processes; and
- Ensure all community members are conscious about water usage on and off campus.

An educational campaign can be implemented on various levels. The effort can be run through the Residential Life Department, distributing information through the residence halls. Residence Hall Directors can assist with the education process through informational programming for residents. CCSU could also develop material at a more institutional level and distribute it around all campus buildings, possibly with the assistance of the facilities, maintenance, and cleaning crews.

Currently, there is no environmental club or student group at CCSU that is actively examining water issues. While on campus, students indicated that there would be interest in beginning a campus environmental organization. Often, a student-run campaign can be successful because it involves peers of the largest proportion of the campus community. Should a student environmental club begin meeting at CCSU, one of its initial tasks might be to develop water conservation initiatives. However, a student-run campaign will not be successful without overall institutional support.

To help encourage and advertise a campus-wide water conservation program, some Universities sponsor contests to encourage friendly competition between residence halls. As all of the buildings at CCSU are already individually monitored, it would be relatively easy to monitor the contest results. At the conclusion of the contest period, the residence hall with the greatest reduction of water use could receive a reward, with the bulk of the savings be used to fund additional projects. In order for this program to be a success, it requires the buy-in of the student body, and a student environmental group could be extremely helpful in ensuring this buy-in.

At the time of this baseline audit, CCSU had successfully installed low-flow showerheads, faucets, and reduced-flush toilets in 56% of its residences. These residences have demonstrated reduced water use on a per capita basis in comparison to residences without low-use features. Not only do these low-use features reduce CCSU's demand on the surrounding watershed, they reduce the combined water/sewer bill by thousands of dollars each year.

However, it should be noted, an immediate campus-wide switch to low-flow features would be extremely expensive and likely not the best use of money that CCSU has earmarked for conservation efforts. CCSU may be better served to convert their buildings to low-use features on a gradual basis, as renovations, repairs, and necessary replacements dictate. With this in mind, CCSU should consider:

- Continuing to monitor per capita water use before and after installation of low-use features;
- Replacing features, as repairs and renovations dictate, with low-use features; and
- Exploring future technologies to further help reduce everyday water use.

There are multiple reasons to be concerned about the water used at CCSU for property maintenance and landscaping, as well as stormwater. Not only does CCSU pay for water used for irrigation, the University also pays an additional "sewer fee" for this water, which it will likely never discharge back into the sanitary sewer system.

CCSU uses approximately 3,000,000 gallons of water annually to irrigate outdoor areas. Due to the large percentage of impervious surfaces on campus, most of the precipitation that falls is discharged as stormwater to the POTW rather than absorbed by flora. Institutions have examined and implemented permanent stormwater retention ponds, which have advantages for their campuses, including:

- Retention ponds reduce sediment loads in stormwater discharges, helping to maintain the condition of surrounding surface water bodies.
- The extra water can be used for irrigation or other non-potable water needs around campus. This eliminates the cost of purchasing water, sewer fees, and eases strain on the water system.
- The area around a retention pond can serve as an additional campus laboratory, home to some of the native species of the area. See Section of this report for more information on this topic.

Multiple institutions currently have a system like this in place. Among these institutions is Bryn Mawr, which has some excellent information about their system and its implementation on their website.[30] Additionally, other facilities utilize cisterns or other holding tanks to collect rainwater from the roofs of larger campus buildings. Similar to retention ponds, this water can be used for irrigation, to flush toilets, or for other non-potable purposes.

While installing a retention pond on the existing portion of campus may prove difficult, CCSU has an excellent opportunity to create this feature in the new East Campus area. In addition to its practical features, an artificial pond could also serve as a visual attraction for that area of campus, and help CCSU demonstrate more sustainable practices to the community. Additionally, a retention area would help to alleviate concerns about run-off to the local surface waters.

5.5 CONSIDERATIONS FOR INSTITUTIONAL PLAN

As an institution of higher learning and a sizable consumer of water, CCSU can implement an education program for the campus community regarding water conservation. In addition to the on-campus benefits of reduced water use, CCSU will be helping to prepare its students to be more conscious of their water, and other use, as they graduate and become independent members of our society.

5.5.1 Tips for Sustainability Website

In developing a campus-wide sustainability website, CCSU has an opportunity to help to educate students about how to conserve water on a daily basis. The website can be used to help to reinforce and provide additional materials as a follow-up to a greater campus-wide educational campaign.

---

30 http://www.brynmawr.edu/facilities/documents/AnInnovativeandCollaborativeApproachtoStormWaterManagement.pdf

CCSU has implemented some water conservation fixtures in some of the campus's buildings, and the website could provide some additional information about how much money those features save the campus, both in terms of water use and annual costs. Additionally, as CCSU intends to install more water and energy efficient washers in the Summer of 2007, the website could contain information about amounts of water saved by these new machines, either per load, or as an annual approximation.

6. PURCHASING

6.1 INTRODUCTION

"Green products and bidding are becoming more acceptable and desirable in campus purchasing offices."[31] In addition, for at least some products, state agencies in Connecticut are required to at least prioritize environmentally-friendly cleaning products in its contracts and procurement agreements. The purchase of certain green products can also lead to decreases in hazardous waste generation and disposal costs, while reducing the regulatory burden of managing hazardous waste.

6.1.1 Regulatory Background

Connecticut Executive Order No. 14, dated April 2006, specifies that:

"The procurement and the proper use and application of cleaning and sanitizing products that perform well and that have positive environmental attributes such as biodegradability, low toxicity, low volatile organic compound content, reduced packaging, and low life cycle energy use will reduce the environmental impacts of routine cleaning and sanitizing activities while also ensuring clean and sanitary State facilities."

The Executive Order requires state agencies to prioritize the procurements of environmentally-friendly cleaning products in contracts and procurement agreements.

A Connecticut law that promotes purchasing environmentally-friendly products is summarized below:

Section 4a-59 (in part) allows for giving a price preference of up to ten per cent for (A) the purchase of goods made with recycled materials or the purchase of recyclable or remanufactured products; (B) the purchase of motor vehicles powered by a clean alternative fuel; or (C) the purchase of motor vehicles powered by fuel other than a clean alternative fuel and conversion equipment to convert such motor vehicles allowing the vehicles to be powered by either the exclusive use of clean alternative fuel or dual use of a clean alternative fuel and a fuel other than a clean alternative fuel.

Additional parts of the State statute pertain to standards for the purchase of recycled paper, and the recycling and remanufacture of laser printer toner cartridges. These can be found in the Connecticut State University System Procurement Manual.[32]

6.1.2 Areas Included in Baseline

For the purposes of establishing a baseline, this audit focused primarily on the purchasing practices employed by CCSU. While some of the contracts are executed through the State purchasing office, CCSU does have control over some of its own contracts. Additionally, the campus has the right to reject state contracts and put out their own. Individual departments order their own office supplies and other

[31] Society for College and University Planning, "Trends to Watch in Higher Education," March 2005.

[32] http://www.finance.ccsu.edu/Purchasing/CSU%20Procurement%20Manual%2012-9-05%20FINAL.pdf

small non-recurring needs using their procurement cards ("P-cards"). CCSU has a central purchasing department that processes orders for all supplies, equipment, services, etc. that exceed $1,000 (single order value) or $10,000 annually. An example of a state contract includes the fuel oil/gasoline contract.

6.1.3 Stakeholder Engagement

The primary point of contact for learning about purchasing practices at CCSU was the Director of Purchasing. Other stakeholders included department personnel who may engage in department-specific purchasing with a P-card.

6.1.4 Existing Sustainability Initiatives

CCSU does not currently have a green purchasing policy, but the Purchasing Department has developed quite a few procedures to reduce waste, encourage recycling, and promote sustainability. The following is a summary of the current sustainability initiatives that CCSU's Purchasing Department has established:

- CCSU uses Office Max as its office supply contractor, and Office Max provides toner cartridge recycling services to the University. OfficeMax takes old toner laserjet cartridges back for recycling. Some individual inkjet cartridges are returned to Staples for recycling.
- Office Max provides desktop-delivery services. Office supplies were delivered previously in separate boxes (one box for each delivery), but the Purchasing Director convinced CCSU's Office Max account representative to consolidate deliveries in one box to reduce packaging waste.
- CCSU has requested that all Hewlett Packard printer cartridges that are purchased are recycled; Purchasing has implemented a system that ensures when anyone orders HP cartridges, the request automatically defaults to selecting the recycled cartridges.
- 95% of CCSU's printers and computers are Energy Star rated. The exceptions may be very old printers and computers that departments have been holding on to, or printers that were purchased but not approved by CCSU's ITS department.
- CCSU's contracts usually specify that contractors are required to follow all applicable regulations, including environmental regulations.
- The new vending machine contracts will require Energy Star rated equipment, as well as surge protectors and vending misers.
- In the summer of 2007, CCSU signed laundry service contracts that install new Energy Star washers and dryers, with ability for users to choose cold water washing complete with a cost incentive.
- The Purchasing Department recently requested that Office Max run a report on high usage items and cross-reference them with comparable recycled products they offer. The Purchasing Department is planning to use increased volume of recycled products to drive down prices (e.g., instead of buying 5 different note pads, have everyone buy the recycled version).
- The Purchasing Department has recently added the following language to all of its RFPs, to reduce waste:

  RFP Section 1.17: Sustainability and Green Campus Initiative

In the interest of supporting CCSU's initiative to reduce waste and extraneous use of natural resources, CCSU is requesting the following –

  - All proposals should be submitted on two-sided recycled paper where possible.
  - Proposers should refrain from using excessive and unnecessary packaging when shipping or mailing their responses.
  - Proposers should refrain from using superfluous binders where possible, especially for the copies being requested.
  - Proposers should consider presenting peripheral information (i.e., company and product brochures) on CD or DVD where possible or practical.

- In some instances, Purchasing inserts specific requirements for recycling into contracts. For example, in a recent RFP for fencing services, Purchasing included the following: "The contractor shall also be responsible for recycling old metal fencing material by bringing such materials to a local scrap metal recycling center. The contractor shall provide the CCSU Director of Purchasing a quarterly report stating the amount in total weight of the material recycled and the name(s) of the scrap metal recycling center(s) used."
- Similarly, Purchasing will insert language promoting sustainability into an upcoming bid for emergency lighting system maintenance and repairs – "The contractor shall be responsible for disposing of all replaced parts, supplies, debris etc in accordance with all applicable federal, state and local laws. Where possible, contractor shall recycle electronics, lights, batteries and other items in order to promote CCSU's Environmental Sustainability initiative. Provide information in the appropriate section on the General Information About The Company sheet."
- CCSU recently had to replace 40 emergency lighting batteries in one of the residence halls. Purchasing researched (and found) a facility within the State that not only sells new batteries but has an EPA permit that allows them to pick up the old ones and recycle them according to EPA standards.

6.1.5 Green Purchasing Opportunities and Potential Challenges

While CCSU has implemented some very successful Green Purchasing strategies, CCSU may face challenges with respect to implementing a campus-wide green purchasing policy. First of all, some of the University purchases are required to be made through State contracts. Some of these contracts may not include provisions for sustainability. Also, because the University does not currently have an Environmentally Preferable Purchasing Policy, the Purchasing Department faces a certain amount of institutional inertia with respect to changing the way purchases are made. Similarly, because departments and individuals have the ability to make purchases with P-cards outside on central purchasing, it is difficult to control what is bought, even in areas where informal Green Purchasing strategies are in place and being implemented.

Additionally, CCSU does not typical operate under a "warehouse" system. In other words, while it has a central shipping and receiving department, this area does not operate as a warehouse. If it did operate more as a warehouse, the University would be able to take advantage of buying in bulk, particularly green products that may be more cost-effective to buy in bulk.

The Director of Purchasing, however, has made a number of important steps to ensuring that CCSU makes smart, sustainable purchases. These steps are described below.

6.2 BASELINE AUDIT RESULTS

6.2.1 Materials Purchases

The following table highlights the amount of money spent by CCSU on materials that are purchased in the greatest quantity:

Table 6-1: CCSU Purchases

Account	Description	Amount Spent for Fiscal Year (FY) '05-'06	Amount Spent to date in FY '07
713135	**Educational Supplies**[33]	**$605,498.98**	**$377,327.66**
742100	Fuel Oil #2	$48,601.39	$782.21
742120	Gasoline	$81,810.54	$24,795.85
744100	Maintenance Paper Supplies	$495.64	$992.00
744105	Maintenance Cleaning Supplies	$68,074.75	$5,945.85
744110	**Maintenance General Supplies**	**$375,835.32**	**$311,512.84**
744125	Grounds and Landscaping Supplies	$1,985.26	$1,184.00
771100	**Office Supplies**	**$438,859.91**	**$223,067.53**
771105	Copier Paper and Supplies	$21,301.85	$2,312.00
771115	**Data Processing Supplies**	**$186,517,23**	**$21,607.43**
772105	Compressed Gases	$96.27	$34.85
772120	Food	$34,293.50	$20,128.05
772125	Laboratory Supplies	$1,725.52	$651.31
772155	Hazardous Material Supplies	$762.67	$0.00
784302	Carpet and Window Treatments	$56,818.60	$65,497.96
784304	**Furniture and Furnishings**	**$1,252,521.29**	**$1,134,909.00**
784306	Motor Vehicles	$70,801.00	$0.00
784307	**Office Equipment**	**$369,618.70**	**$57,939.64**
784401	**Computer Equipment**	**$1,589,663.49**	**$828,243.19**

[33] "Educational supplies" refers to any and all non-equipment non-computer non-taggable (inventoried) items used in the classroom setting or to support educational initiatives.

The items highlighted in bold represent the largest expenditures (> $100,000). Recommendations for reducing the costs associated with the purchase of these items and increasingly the overall sustainability of the items purchased are addressed in the Recommendations section, below.

It should be noted that most of the furniture that CCSU purchases is manufactured in Southern States. While there are environmental impacts associated with the transportation of large furniture shipments from several states away, Southern states are closer to CT than some alternative furniture manufacturing states such as California. CCSU can attempt to minimize the impacts associated with the furniture it purchases by buying furniture made from sustainably-harvested wood (see below for more recommendations with respect to furniture).

6.2.1.1 Paper

Paper is one of the largest and most costly campus purchases. Therefore, environmentally sound paper choices can be particularly important when considering a campus's environmental impact. Based on data provided by the Purchasing department, 100% of the paper purchased by CCSU contains recycled content. Some of the paper is 30% post-consumer content paper, while other paper purchased in 100% post-consumer recycled content. For the years 2003 through 2006, the vast majority of paper purchased was 30% post-consumer recycled content (see below).

Table 6-2: CCSU's Annual Purchase of Recycled Paper

	Percentage of Paper Purchased that contained 30% post-consumer recycled content	Percentage of Paper Purchased that contained 100% post-consumer recycled content
2003	96%	4%
2004	96%	4%
2005	97%	3%
2006	99%	1%

6.2.2 Gap Analysis

The Purchasing Department should consider quantifying the money saved from certain sustainability initiatives. For example, Duke University has calculated that since switching exclusively to remanufactured printer cartridges, average savings range from 28% for inkjet cartridges to 33% for laser cartridges. Also, Duke expects to save $400,000 per year as a result of this change.[34] CCSU's goal can be to keep track of the money saved on sustainability initiatives and communicate these savings as a way to promote the overall sustainability initiative on campus and raise awareness that sustainability can save

[34] http://www.duke.edu/sustainability/2005-12-01envirotemp.html

money. Currently, CCSU is not keeping track of the amount of money savings through green purchasing practices.

6.2.3 Qualitative Observations

The University does not currently have a green purchasing policy, or any purchasing policies specifically established to reduce material use. CCSU also does not have any policies to encourage the purchase of materials that are recyclable or "eco-friendly." The Purchasing Department is, however, aware of the Connecticut Law and Executive Order, which are summarized above. According to the Director, The Purchasing Department currently does not follow the Statute to the extent that it could. In other words, CCSU could include even stronger language in its contracts and RFPs to express the University's commitment to sustainability and green purchasing.

Science department representatives interviewed during the audit (e.g., Chemistry, Biology, etc.) who are responsible for purchasing chemicals indicated that they make an attempt to reduce the amount of chemicals they purchase. In fact, the inventories of both the Biology and the Chemistry Departments have been reduced by over 50% in recent years. See Section 7 of this report for more information on chemicals and chemical purchasing.

One CCSU stakeholder indicated that duplex printers should be required in CCSU's green purchasing policy (if one is established).

6.3 BENCHMARKING

The following table highlights some of the quantitative and qualitative information presented in the baseline described above, and compares this information with available data for other universities in the U.S.

Table 6-3: Benchmarking Campus Purchasing Policies

CCSU Data Point	Current Available Data	Source
Currently, 3.6% of paper purchased contains recycled content.	29% of campuses specify that paper purchased must contain a minimum of 25% post-consumer waste and, to reduce pollutants emitted at the point of manufacture, 8% of campuses have chlorine-free requirements for office paper.	"State of the Campus Environment." A National Wildlife Federation Report. Survey Conducted by Princeton Survey Research Associates.
CCSU does not currently have a formal campus-wide program in place that specifically encourages sustainable purchasing practices.	49% of campuses have programs in place to encourage environmentally sound purchasing, such as specifying that products must contain certain % recycled content.	"State of the Campus Environment." A National Wildlife Federation Report. Survey Conducted by Princeton Survey Research Associates.
CCSU does not have a Green Purchasing Coordinator	7% of campuses have a Green Purchasing Coordinator. Duke University recently hired a Green Purchasing Specialist to help the University implement its EPP Policy which "gives preference to environmentally friendly products whose quality, function, and cost are equal or superior to more traditional products."	"State of the Campus Environment." A National Wildlife Federation Report. Survey Conducted by Princeton Survey Research Associates. AASHE Digest, 2005.[35]

6.4 RECOMMENDATIONS

6.4.1 Primary Recommendation: Sustainable Purchasing Policy

The primary recommendation is for CCSU to develop, adopt, and implement an Environmentally Preferable Purchasing Policy (this could also be called a Sustainable Purchasing Policy or Green Purchasing Policy). This policy should have sign-off by the highest level in the University administration, and be enforced. The policy should also reflect the requirements of any applicable Executive Orders and State Statutes, as well as describing how CCSU can work within the confines of State contracts to promote sustainability. Finally, the policy should attempt to place equal emphasis on cost-savings and sustainability. A current perception is that schools have to pay a premium for green products, but this is not always the case. One excellent example of a University policy is Duke University's Environmentally Preferable Purchasing Policy. Duke has been very active in the area of

[35] http://www.aashe.org/resources/pdf/AASHEdigest2005.pdf

sustainable purchasing, and their experiences can be helpful to CCSU. Examples of sustainable purchasing policies are included in Appendix E.

6.4.2 Specific Recommendation for Reducing Costly Purchases

Based on the data of the high-volume items purchased (listed above in Table 6-1), the following table specifies some opportunities to reduce the amount of these items purchase and/or purchase them in "greener ways." Items listed below are listed in order of expenditure, from greatest to least.

Table 6-4: Recommendations for Reducing Costly Purchases

Description	Amount Spent for FY 05-06	Opportunities for EPP and Cost Reduction
Computer Equipment	$1,589,664	Choose Liquid Crystal Display (LCD) monitors over Cathode Ray Tube (CRT) monitors (which can contain up to 5 lb of lead); increase obsolescence cycle of computers and computer-components to longer than 3-4 years to increase life-span and cut down on costs (note that monitors, keyboards and mice can be reused with a new computer). Buy smaller monitors (a 17-inch monitor uses 40% more energy than a 14-inch one). Buy ink jet printers rather than laser printers (ink jets use 80-90% less energy). Request recycled/recyclable packaging from your computer vendor. Buy vegetable (or non-petroleum-based) inks, which are made from renewable resources, require fewer hazardous solvents, do not generate hazardous waste during cleaning operations, and in some cases produce brighter, cleaner colors. Purchase only Energy Star computers and computer components. Where possible, purchase components that meet environmental standards such as TCO 99 (a worldwide, environmental product standard). Consider purchasing refurbished computer systems and parts, which can offer substantial savings.

Description	Amount Spent for FY 05-06	Opportunities for EPP and Cost Reduction
Furniture and Furnishings	$1,252,521	Purchase used furniture, where possible; Ensure that furniture does not contain old growth wood (purchase furniture made with Forest Stewardship Council [FSC]-certified wood; Purchase furniture made from materials derived from sustainably harvested materials and recycled content (i.e., specify this in purchasing contracts and ask vendors/suppliers for life cycle analysis [LCA] of products). Currently, cost is a "huge" driver for the carpeting purchased on campus (as well as ease of cleaning and maintenance); CCSU should consider switching to low, VOC, recycled carpeting (e.g., Interface or Shaw), which can be very competitive (cost-wise) with traditional carpeting, but can be substantially greener.
Educational Supplies	$605,499	The type of educational supplies purchased by CCSU can vary, and can be anything that is required for use in the classroom. Overall environmental sustainability awareness training should be provided to departmental staff who are responsible for purchasing.
Office Supplies	$438,860	For paper products, CCSU can try to purchase high-post consumer recycled content, and tree-free[36] materials, Totally Chlorine Free (TCF) paper or Elemental Chlorine Free (ECF) paper; standardizing the paper used throughout the campus may result in price breaks if larger quantities are purchased. For liquid-based office supplies (e.g., correction fluid, glue, etc.), purchase non-toxic, Low or No Volatile Organic Compounds (VOCs).

[36] "Tree-free refers to a variety of alternative materials used to make paper, including recycled content and bark from Mulberry bushes. Source: http://www.rainforestweb.org/Rainforest_Protection/Wood_Alternatives/Tree-Free_Paper/

Description	Amount Spent for FY 05-06	Opportunities for EPP and Cost Reduction
Maintenance General Supplies	$375,835	There are ways to reduce the environmental impacts associated with maintenance supplies. CCSU already uses cleaning chemicals that are eco-friendly (see Section 9). Examples of attributes of green maintenance supplies include non-toxic, not tested on animals, made of biodegradable ingredients that are derived from renewable resources (e.g., vegetables) and non-solvent based.
Office Equipment	$369,619	For trash and recycling bins, as well as desk organizers, purchase those manufactured with recycled content. For equipment like fax machines, copiers, etc., purchase Energy Star label products, and energy efficient products.

6.4.3 Additional Recommendations

- The Director of Purchasing indicated that he could continue to revisit the product list of materials ordered by CCSU and determine if any of them can be replaced or substituted with greener products.
- CCSU's contract with Sodexho, the contractor that provides food services, is due to be renewed in 8 years. While this seems long-term, CCSU can consider aspects of this contract that can become more sustainable (see Section 11 of this report). Sodexho representatives are currently very amenable to sustainable ideas, and have been working with CCSU to become more sustainable.
- With respect to long-term recommendations, the "next generation" of sustainable purchasing that is being considered by campuses with mature sustainability programs include purchasing more organic foods, chlorine-free paper, and performing life-cycle cost assessments for the materials that are purchased.
- Another long-term recommendation is to further explore ways to reduce the cost of green items by purchasing them as part of a larger group of campuses (i.e., with other members of the Connecticut Colleges Purchasing Group). Campuses together can leverage their buying power to support green products and put pressure on suppliers to be greener.
- A recent survey commissioned by the Center for a New American Dream indicates that 88% of students want their campus store to offer more environmental and fair trade products.[37] If CCSU develops a Sustainable Purchasing Policy, it could include a general requirement to try to provide more environmentally- and socially-responsible items for students to purchase on campus. Students should particularly be reminded how sustainable products can improve their quality of life.

[37] http://www.newdream.org/about/BTSRelease.pdf

- CCSU may want to consider providing basic environmental training to staff and faculty members with purchasing authority. This will help in controlling the types of products that are brought to campus.
- Because card-access is used extensively throughout campus, CCSU should consider switching to cards that are not made from PVC. PVC is a highly hazardous material that contains toxic material and results in the release of dioxins when incinerated during disposal. There are a variety of alternatives to PVC that can be used for similar applications, such a biological-based materials and plastic alternatives.

6.5 CONSIDERATIONS FOR INSTITUTIONAL PLAN

Based on its size and prominence within the State of CT and within the CT State University system, CCSU has a significant amount of financial capital that can be used to promote sustainability within the State and within the country. In addition, Connecticut requires and or strongly encourages state agencies to buy environmentally-friendly products and have its vendors to likewise. For these and other reasons, it is important for CCSU to establish a sustainable purchasing policy, or green purchasing policy, or environmentally preferable purchasing (EPP) policy. The Institutional Sustainability Plan should indicate that a purchasing policy will be established and specify how it will be developed (e.g., stakeholder involved, draft policy, review, "enforcement," etc.). If the Institutional Plan places appropriate emphasis on a sustainable purchasing policy, the University will be committed to developing one and adhering to it.

6.5.1 Tips for Sustainability Website

There are at least two groups that are important to reach with respect to communicating sustainable purchasing practices to the University community: (1) students; and (2) faculty/staff with procurement cards. If CCSU develops a "green campus website" to provide information to the University community about sustainability initiatives, this website can be used as a forum to educate students on how the University attempts to buy green and include sustainability considerations in its purchases. This will help educate and inspire students, who are current consumers/purchasers and who will soon be young professionals that may have their own purchasing responsibilities. The website should also publicize the green purchasing strategies that Purchasing has established and follows.

Another important group to reach out to on the website is the faculty/staff members who have p-cards. Educating these individuals on the University green purchasing policies (if any are developed), as well as ways to save money while being sustainable, will help to ensure that purchasing practices throughout the entire University become more sustainable.

To effectively reach these two groups of individuals, CCSU's sustainability website should/could contain:

- A list of CCSU's current purchasing practices that support sustainability (this report could be used as a source for them);
- A list of tips/tricks for faculty/staff members with p-cards to purchase more sustainably, including a reminder to check with other departments to see if materials can be shared or purchased in bulk;
- Specific information about the type of post-consumer recycled paper that the University should purchase (based on a paper purchasing policy, if CCSU decides to adopt one).

- Tips/reminders to encourage students to think about their purchasing, to avoid waste, increase the use of durable goods, purchase post-consumer recycled materials, and to reduce packaging materials.
- Links to sustainability websites of campus sustainability leaders that address purchasing (e.g., Harvard, University of Colorado at Boulder, etc.).
- Include links to other areas of the sustainability website, to help bridge the gap between purchasing decisions and other areas of sustainability (i.e., reminding purchasers that Energy Star products should be prioritized when making appliance purchases.
- Feature facts on how the campus is saving money from sustainable purchases (See "Gap Analysis" section, above).

The website could also include "consumer" facts that might interest students, such as a recent survey that indicates that 93% of college students agree that "American consumers can conserve resources, protect workers, and build a better world by shopping carefully for environmental and fair trade products."[38]

[38] http://www.aashe.org/resources/pdf/AASHEdigest2005.pdf

7. HAZARDOUS WASTE & CHEMICAL USE

7.1 INTRODUCTION

Woodard & Curran evaluated chemical use and hazardous and chemical waste production and disposal practices at the campus to identify potential pollution prevention opportunities. Various departments at the University were visited, including the areas that generate the most hazardous waste (i.e., science departments, facilities, art, etc.), and personnel were interviewed. Hazardous waste manifests were reviewed, as well as waste generation reports. The results of the baseline audit indicate that CCSU is already implementing waste minimization procedures, including scrap metal recycling, the application of some green chemistry principles, and a number of waste reduction methods designed to reduce the amount of hazardous waste generated. Overall, the campus generates small quantities of hazardous waste and falls under the Small Quantity Generator (SQG) hazardous waste category.

7.1.1 Areas Included in Baseline

The following campus areas were visited during the audit in order to make observations that enabled the development of a baseline for hazardous/chemical waste generation:

- Barnard Hall: contractor waste/dumpster area
- East Hall:
  - Environmental Health & Safety
  - Shipping & Receiving
  - Key Shop
  - Mail Room
- Buildings & Grounds: solid waste management area
- Maloney Hall (Samuel S.T. Chen Art Center)
  - Room L06 (Scenery Shop)
  - Costume Shop
  - Mural Painting
  - Sculpture
  - Printmaking
  - Ceramics (including stock room)
  - Painting/Drawing Studios
- Copernicus Hall:
  - Electromagnetic Engineering
  - Thermal & Mechanical Engineering
  - Robotics
  - Fluid Mechanics

- Print Shop (Room 125)
- Chemistry Department (including chemical stock rooms and labs)
- Biology Department (including teaching labs, research labs, herbarium, ecology/marine biology labs, and chemical stock room/prep area)

7.1.2 Stakeholder Engagement

The primary personnel at CCSU who are responsible for hazardous and chemical waste management are the Environmental Health & Safety Director; and the EH&S Officer. These individuals were interviewed extensively with respect to the types and quantities of hazardous and chemical wastes that are generated on campus. Additional departments and individuals who were interviewed for the purpose of learning about chemical procurement practices, waste generating activities, and chemical inventories included:

- Biology
- Chemistry Department Chair
- Chemistry
- Print Shop
- Ceramics
- Personnel in Engineering Labs
- Personnel in Energy Center
- Personnel at Buildings & Grounds

7.1.3 Existing Sustainability Initiatives

In comparison with other schools its size, CCSU generates a relatively small quantity of hazardous waste. In fact, as indicated above, CCSU is regulated as a Small Quantity Generator (SQG) of Hazardous Waste. CCSU has made great strides in recent years to improve its hazardous waste management program, including hiring a hazardous waste technician to oversee the program. The EH&S Officer has extensive background in hazardous and chemical wastes, and is able to provide assistance to faculty and staff around campus who purchase chemicals and manage wastes.

Individual CCSU departments have done an excellent job culling out old chemical inventories, re-organizing stocks of teaching/research chemicals, and streamlining and categorizing chemical inventories. Specific examples of current hazardous waste minimization and pollution prevention efforts include:

- EH&S performs weekly inspections of waste generating areas on campus.
- Printing activities within the Print Shop have greatly reduced over the years; very few printing chemicals are still used and the inventory of printing chemicals has been reduced.
- Most photo processing on-campus is digital and does not generate a waste stream.
- Used computer equipment generated by CCSU is donated to a not-for-profit organization called Urban Renewal, which is located in New Jersey. This company accepts monitors and Central Processing Units (CPUs) and refurbishes them for reuse or recycles them.

- Batteries and electronic equipment generated at CCSU are sent out with Clean Harbors for recycling, and fluorescent light bulbs are sent out with Northeast Recycling.
- CCSU is planning to replace its pool chemical system with an Ultraviolet (UV) system. The current pool system uses sodium hypochlorite to treat water for the pool. The new system, which will cost approximately $33,000, will eliminate the need for using chemicals to chlorinate the water.
- CCSU has installed stainless steel showers in all of the residence halls. In addition to being easier to clean and maintain, these showers result in a significant decrease in the type of cleaning chemicals required to clean them.
- The Biology Department has made efforts to greatly decrease the quantity of chemicals maintained in its inventory. All chemicals are kept in a central location in order to reduce duplicate chemicals and ensure that the inventory is kept up-to-date. Expiration dates are periodically checked, and the Biology Department facilitates chemical exchange between professors.
- Only non-pathogenic strains of bacteria and other biologicals are used in the Biology Department for research and teaching. This reduces the amount of biomedical waste generated.
- For preserving biological specimens, the Biology Department switched from using formalin to preserve its biological specimens to using Carosafe, which is a less flammable, less toxic alternative to formalin. Carosafe, when it becomes a waste, is not typically regulated as hazardous waste.
- Similar to the Biology Department, the Chemistry Department has made significant strides in reducing its inventory of old, unused chemicals. In fact, the Chemistry Department indicates that it has reduced its chemical inventory by 50% in recent years. The chemical inventory is updated every year.
- Chemistry research laboratories are able to use chemicals that are left over from Chemistry teaching labs. This decreases the amount of new chemicals that need to be purchased for research. Also, the Chemistry research labs are engaged in similar types of research, and procedures that may require similar chemicals. This further promotes the sharing of chemicals and lessens the need to purchase a larger inventory of different chemicals.
- The Chemistry Department has switched to using smaller bottles to hold chemicals, when possible, if larger quantities of a particular chemical are not needed.
- The Chemistry Department has replaced dichloromethane, a toxic (and expensive) solvent with hexane and alcohols.
- EH&S has a master Chemical Inventory for the entire campus that is updated on an annual basis. This inventory is organized by person, as well as chemical. Individual departments are required to update their portion of the inventory annually. An up-to-date inventory allows people to review their inventory quickly to determine if they have a particular chemical – this may prevent them from ordering excess chemicals that aren't needed. The process of inventorying chemicals also helps ensure that chemical containers are checked for expiration dates, loose labels, etc. CCSU has indicated that it will coordinate the chemical inventory with the Fire Marshal's MSDS system to ensure consistency.

- The Energy Center does not currently have any chlorinated solvents in its inventory of aerosol cans and other products used for maintenance.
- The Ceramics Studio has eliminated the use of glazes that contain lead.

7.1.4 Additional Opportunities and Potential Challenges

While CCSU has seen significant reductions in its chemical inventories, has substituted a number of less toxic chemicals for more toxic ones, and has almost completely done away with chemical photo developing, additional waste minimization opportunities exist (e.g., microscale chemistry, setting up a chemical repository, etc.). Typical challenges associated with pollution prevention initiatives include:

- People who want to use the same materials they have always used;
- Environmentally-friendly materials may be more expensive;
- Certain potentially toxic materials are required to be used for academic purposes; and
- The university-setting in general must generate a certain quantity of waste to operate efficiently and in a way that maintains a good quality of life for the entire university community

7.2 BASELINE AUDIT RESULTS

In general, the vast majority of the hazardous waste generated at CCSU is generated by the Chemistry Department, including most of the acutely toxic wastes[39].

7.2.1 Quantitative Data

Table 7-1: Hazardous and Chemical Waste Generation in 2006

Type of Waste	Quantity (lb)
Waste Diesel Fuel and Water	1,200
Acetone, Ethyl Acetate	270
Cumene, Ethyl Acetate Mixture	200
Methylene Chloride, Hydroquinone	200
Dichloromethane, Methanol	150
Acetone, Hexane	110
Non DOT Regulated Material	100
Methanol, Petroleum Distillates	98

[39] Please note that acutely toxic waste refers to EPA listed P-waste, which is a specific listing of wastes that are considered to be acutely toxic by EPA's definitions of hazardous waste. CCSU's Chemistry Department currently generates P-waste. Most college chemistry departments around the country routinely generate P-waste.

Type of Waste	Quantity (lb)
Silver, Formalin	80
Hydroquinone	75
Mercuric Chloride, Sulfuric Acid	70
Acetone, Dichloromethane	57
Waste Aerosols	35
Dichlorobenzene, Dichloromethane	30
Potassium Dichromate, Potassium Nitrate	15
Waste Mercury	12
Potassium Hydroxide	10
Waste Acetic Acid Solution	8
Waste Potassium Persulfate	5
Waste Liquefied Petroleum Gas	5
Waste Formaldehyde Solutions	5
Waste Ammonium Sulfide Solution	3
Sulfuric Acid, Hydrobromic Acid	3
Sodium Hypochlorite, Potassium Dichromate	3
Compressed Gas Flammable	2
Sulfur Dioxide	2
Soda Lime	2
Dinitrogen Tetroxide	1
Waste Sulfuric Acid	1
Total:	**2,752**

Table 7-2: Hazardous and Chemical Waste Generation in 2005[40]

Type of Waste	Quantity (lb)
Waste Latex Paint	1,465
Waste Oil and Oily Solids	1,200
Batteries for Recycling	970
Computers for Recycling	600
Acetone, Methylene Chloride	525

[40] Please note that some of these wastes are regulated as "Special Wastes" within the State of CT.

Type of Waste	Quantity (lb)
Potassium Hypochlorite, Calcium Hypochlorite	400
Mineral Spirits	235
Non DOT Non RCRA Regulated material	175
Methylene Chloride, Toluene	170
Sodium Hypochlorite	122
Acetone, Heptane	120
Dicholorophenol	105
Acetone, Methanol	95
Acetic Acid, Lactic Acid	90
Ethyl Acetate, Hexane	80
Hydrochloric Acid, Fluoride Salts	80
Waste Aerosols	78
Phenol, Formalin	75
Nitric Acid, Arsenic Oxide	70
Dichloromethane, Silver	60
Waste Mercury	36
Hydrochloric Acid, Sulfuric Acid	30
Phenol, Hexane, Acetone, Methylene Chloride	30
Sodium Hydroxide	25
Chromium Nitrate, Barium Chloride	20
Waste Formaldehyde Solutions	20
Waste Glacial Acetic Acid Solution	10
Cadmium Compounds (Universal Waste)	10
Waste Hydrochloric Acid	10
Waste Acetic Anhydride	10
Waste Hypochlorite Solutions	10
Nitric Acid, Chromium III	10
Muriatic Acid	5
Waste Sodium Nitrite	5
Waste Ammonium Sulfide Solution	5
Benzoyl Peroxide	2
Waste Sodium Nitrate	1
Ammonia Cyanurate	1
Waste Sodium Hydride	1

Type of Waste	Quantity (lb)
Waste Chlorosulfonic Acid (with or without Sulfur Trioxide)	1
Total:	**6,957**

Table 7-3: Hazardous and Chemical Waste Generation in 2004

Type of Waste	Quantity (lb)
Rags with Methanol, Paint Thinner, and Solvents	410
Waste Latex Paint	350
Waste Oil and Oily Solids	350
Non-Regulated Waste Chemical Liquids	300
Antifreeze	250
Batteries	235
Lead Acetate, Cadmium	100
Methanol, Ethyl Acetate	100
Pyridine, Xylene	50
Acetone, Methylene Chloride	40
Waste Mercury	25
Waste Aerosols	20
2,6 Dichlorophenol	10
Acetic Acid, Chloroform	7
Sulfuric Acid, Nitric Acid	5
Waste Lithium Alkyls	2
Waste Sodium Cyanide	2
Sodium Hydroxide, Mercury	1
Potassium Cyanide	1
Ferric Nitrate	1
Total:	**2,259**

Table 7-4: Annual Comparison of Waste Generation Rates

Year	Total Quantity of Chemical Waste Generated (lb)
2004	2,259
2005	6,957
2006	2,752
Three-Year Average	3,989

The following graph shows how the amount of waste generation has changed over the past three years. Clearly, CCSU had a large waste cleanout in 2005.

Figure 7-1: Chemical Waste Generation at CCSU 2004-2006

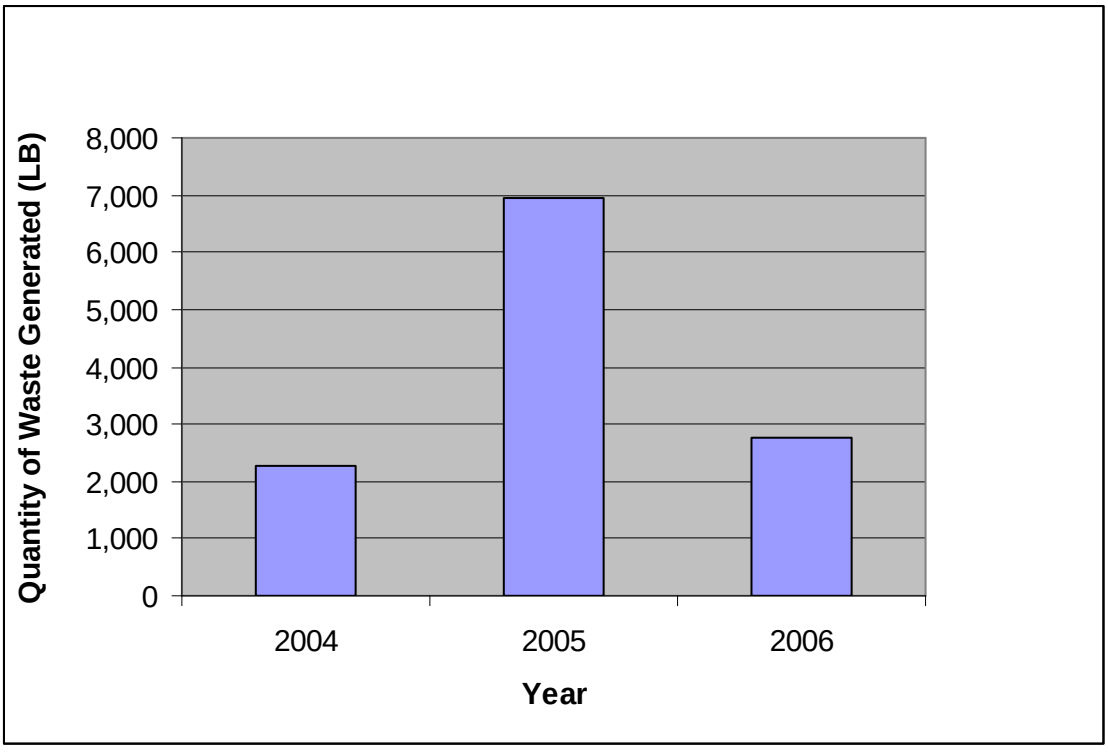
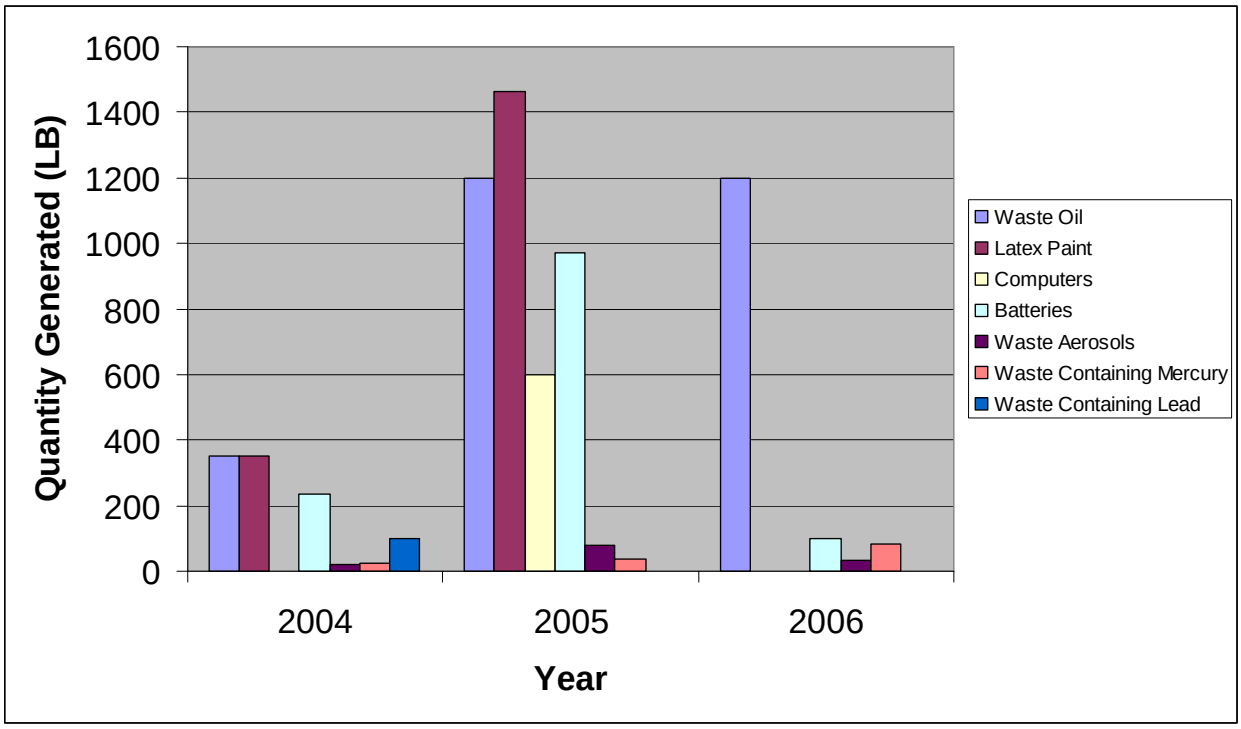


Figure 7-2: CCSU Waste Generation by Category



CCSU also has some general data on scrap metal generation – over the past 5 years, the University has generated approximately 176 tons of scrap metal.

7.2.2 Data Analysis

In general, it appears that CCSU's level of waste generation has remained constant, with the exception of 2005. During this year, the University made an effort to clean-out chemical inventories, including a large quantity of latex paint. Also, quite a few batteries and computers were shipped out as waste in 2005, which added to the overall waste generation for that year. Waste containing mercury has increased during this time period, from 26 to 82 lb. The increase in 2006 is due to a combined waste stream of sulfuric acid and mercuric chloride.

7.2.3 Gap Analysis

The following subsections describe areas where CCSU could gather additional data to supplement its current baseline of chemical waste generation.

7.2.3.1 Printmaking

During the baseline audit, the audit team was not able to gather information about the types of chemicals used in the printmaking studio. Printmaking is traditionally an art form that requires a variety of chemicals and wastes including (potentially) acids, solvents, and heavy-metal containing inks and tarlatan

rags. While the printmaking studio was visited during the audit, the faculty member was not available. Also, it does not appear that the printmaking chemicals have been included in the most recent chemical inventory. This lack of information about the printmaking chemicals represents a data gap in this report.

7.2.3.2 Ceramic Frits

During observations in the Ceramics Studio, it was noted that powdered frits[41] are used as ingredients for making glazes. It is unclear if any of these frits contain heavy metals. Material Safety Data Sheets (MSDS) for the frits could be reviewed thoroughly to identify possible pollution prevention measures. Depending on the waste streams generated, they may be regulated as hazardous waste. CCSU should determine if any of the frit wastes generated is regulated hazardous waste.

7.2.3.3 Scrap Metal Data

CCSU does not currently have complete data for the amount of scrap metal that is generated by the campus. Multiple campus areas currently generate scrap metal, including: Engineering, Facilities (e.g., Key Shop), Residence Halls, and Buildings & Grounds. CCSU should track the amount of scrap metal that is generated each year, and maintain records of which scrap metal recycler is accepting the waste. Currently, CCSU only keeps track of the overall quantities of scrap metal that gets recycled.

7.2.4 Qualitative Observations

Due to the relatively small quantity of hazardous waste generated at CCSU, it is likely that the total quantity of chemical waste generated can not be greatly reduced. Product substitution can be an effective way of reducing hazardous waste generation throughout the entire campus. In shops and departments on campus, materials were identified which currently generate hazardous waste streams. These materials are generally small quantities of solvents, cleaners and degreasers, typically stored in flammable cabinets and used for minor projects. It is recommended that the EH&S Department assist staff and faculty in any additional research necessary to select appropriate alternatives. There are alternatives currently available for traditional solvents and other materials.

The Ceramics Studio continues to use some materials that contain heavy metals. Specifically, two of the ingredients used to make glazes, barium carbonate, and chromium oxide, have the potential to generate relatively large quantities of hazardous waste due to the barium and chromium (which are both EPA-regulated toxic metals). While it is understandable that these ingredients are used for the wonderful colors they can produce, elimination of these two compounds should be considered. Additionally, some of the frits may also be a source of waste generation and should be researched further (see Gap Analysis, above).

It was also observed that most personnel at CCSU were not aware of the term "sustainability" and had not given much thought to waste minimization. It is therefore strongly encouraged that a Pollution Prevention Training Program be developed and initiated at the University. Staff and faculty appeared to be enthusiastic about reducing their waste generation, reducing management obligations, and potentially saving money. This training program could be a great way to get student groups and academic programs

[41] "A **frit** (sometimes spelled fritt) is a ground glass or glaze used in pottery.

involved as well. The training could be held in classrooms, offered as seminars, include real-world and hands-on examples, and involve community experts as well. Raising the level of awareness of pollution prevention alternatives can greatly benefit the University's compliance status as well as nurturing healthy relationships with regulators and the local community. Adopting a proactive, P2 approach to waste management, rather than the classic "end-of-pipe" approach will serve the University well.

7.3 BENCHMARKING

In comparison to other schools that are similar in size and complexity to CCSU, the University generates a relatively small amount of regulated waste. The University of Vermont, for example, generates approximately 40,000 lb of chemical waste each year. This is roughly four times CCSU's average waste generation per year.

However, one metric that can be used for comparison is the fact that 43% of schools have programs to encourage microscale lab experiments. CCSU's Chemistry Department is not currently involved in microscale laboratory techniques

7.4 RECOMMENDATIONS

Even though CCSU currently generates small quantities of hazardous waste, there are still numerous ways that the campus can continue to decrease its waste generation, as well as reducing the overall number of chemicals used on campus. The recommendations listed below are organized by department or area.

7.4.1 Campus-Wide

- Continue to reduce the amount of old, unused chemicals within existing chemical inventories. Areas that could still benefit from a clean-out include: Print Shop and Scenery Shop.
- Managing contractors' waste is an issue at most college campuses. CCSU has also indicated that it had issues with contractors failing to manage the wastes they generate appropriately, or leaving the waste they generate on-campus for CCSU to manage. In contracts, CCSU should continue to specify that contractors should take their own waste off-site and manage it appropriately. According to the Director of Purchasing, CCSU is already putting some of this language into their contracts (see the Purchasing Section of this report).
- Include pollution prevention measures and hazardous waste minimization techniques in hazardous waste generator training that is provided to people who generate and manage hazardous waste on campus.
- Heavy vehicle traffic from students often leads to releases of oil, antifreeze and gas.
- Poor housekeeping practices and faulty equipment lead to releases of oil, antifreeze, and gas by staff.

7.4.2 Chemistry

- The Chemistry Department should consider using microscale organic chemistry techniques to the extent possible. According to the Chemistry Department Chair, the organic chemists at CCSU are not currently utilizing microscale organic techniques due to the specific nature of their research, which requires larger quantities of product for use in spectroscopy. However, to the

extent they could be used for some procedures, and in teaching labs, microscale techniques can greatly reduce the volume of solvents needed for synthesis, as well as reducing the amount of chemical wastes generated. The Chemistry Department recently acquired a green chemist who could serve as an excellent resource to others within the department with respect to teaching them about green chemistry principles. He should consider giving a presentation to Chemistry faculty (including laboratory staff) on green chemistry or discussing green chemistry principles in routine meetings with faculty and staff. Faculty who are knowledgeable about green chemistry (perhaps from discussions with the new faculty member) should use green chemistry principles and teach them to students. The application of these principles will provide a platform for discussing environmental issues. If taught about green chemistry principles during their undergraduate education, students are more likely to become "greener" researchers. Specific ways to analyze reaction conditions and finding greener alternatives teaches students to: (1) assess potential hazards and the changes for exposure/release; (2) identify new ways that reduce hazards; (3) understand how alternative methods and product substitutions affect the overall reactions; and (4) determine the larger impact of changing the process on safety and the environment.[42]

- The Chemistry Department should consider tracking its hazardous waste generation and, after continuing to employ green chemistry practices and making additional product substitutions, measure how the rates of hazardous waste generation are decreasing.
- Where possible, researchers and lab staff should consider substituting less hazardous solvents for chlorinated, toxic ones. Attempt to eliminate (minimize) hazardous solvents, including reaction media and in solvent-dependent separations. Identify and use reagents that are benign. Often, milder, more selective reagents work better than traditional reagents, which are too reactive. A few resources to consult for potential solvent substitution ideas are included in Appendix B.
- Faculty and lab staff should be educated in the 8 regulated heavy metals and encouraged to replace them with non-toxic metals, where appropriate. This can reduce the amount of heavy metal waste (i.e., arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver).

7.4.3 All Departments Where Chemicals Are Used

- Post clear guidelines in each lab as to what can and can not be drain-disposed.
- Provide secondary containment (i.e., Rubbermaid containers) under hazardous waste containers in fume hoods or on lab benches.
- Paint thinner was noticed in various flammable cabinets around campus, including in the print shop, the engineering department, the art department, and the scene shop. A more environmentally friendly thinner could be used, such as BioShield Natural Citrus Thinner, which is a citrus-based solvent for thinning oils and oil-based paints. It is a natural product derived from the peels of citrus fruits, and it is free of petroleum distillates, mineral spirits, and other synthetics. http://www.greenbuildingsupply.com/
- Faculty should be more involved in the chemical inventory process. Some departments indicated that there is typically one person who is responsible for maintaining the chemical inventory, purchasing chemicals, and determining which chemicals should remain in the inventory. If

[42] http://www.uoregon.edu/~hutchlab/greenchem/whygreen.html

faculty members also help in reviewing the chemical inventories, they may be able to identify additional opportunities to reduce the number of chemicals within existing inventories, as well as the number of new chemicals that need to be ordered.

7.4.4 Performing Arts

- Personnel in the Scenery Shop in Maloney Hall indicated that they use both acetone and denatured alcohol for cleaning steel. Because both of these solvents can be used interchangeably, the Scenery Shop should phase-out acetone and use only denatured alcohol. This should decrease the amount of hazardous waste generated by this area.

7.4.5 Fine Arts

- Environmental Health and Safety and Fine Arts should continue working closely together to reduce or eliminate the use heavy metals in glazes. The types of heavy metals currently in use in the ceramics studio include barium and chromium.
- CCSU should consider eliminating all heavy metals from its Fine Arts Department. This would involve phasing out all of the paints that contain lead and cadmium and eliminating the chromium- and barium-containing ingredients from the glazes. If this occurs, Fine Arts and the Clay Studio will likely generate little to no toxic hazardous waste.

7.4.6 Facilities

The Key Shop occasionally generates metal waste in the form of key shavings and key blanks. While the amount generated is small, it should be quantified. According to Key Shop personnel, the metal is taken to a scrap metal dealer for recycling. In the future, the amount of scrap metal should be weighed to keep track of the overall amount of metal that is recycled. Currently, Key Shop personnel estimate that (1) 5-gallon bucket of scrap metal is generated per year.

7.4.7 Product Substitutions in Laboratories

University of Illinois at Urbana-Champaign conducted a study to find safer substitutes for commonly used lab chemicals. Table 7-5 presents some of the substitutes recommended by the study. It should be noted that some of these substitutions may not work as well, and some substitutes, though less dangerous are still unsafe.

Table 7-5: Safer Substitutes for Common Laboratory Chemicals [43]

Hazardous Chemical	Safer Substitute	Used for
Acetamide	Stearic Acid	Freezing point depression
Benzene	Xylene or Hexane	Various solvent uses
Benzoyl Peroxide	Lauryl Peroxide	Some polymer catalysts

[43] Source: Ecodemia, Campus Environmental Stewardship at the Turn of the 21st Century, by Julian Keniry, National Wildlife Federation Publication, 1995.

Hazardous Chemical	Safer Substitute	Used for
Carbon Tetrachloride	Cyclohexane	Qualitative test for halides
Formaldehyde (Formalin)	Ethanol	Specimen storage
Halogenated Solvents	Non-halogenated Solvents	Some extractions and other solvent uses
Sodium Dichromate	Sodium Hypochloride	Some oxidation reactions
Toluene-based Scintillation Cocktail	Non-ignitable Scintillation Cocktail	Studies using radioactive materials

7.5 CHEMTRACKER

CCSU currently has a chemical inventory system that results in a hard copy chemical inventory of all the chemicals on campus. This inventory is updated every year. Additionally, the Chemistry Department is using a barcode system to track its chemicals. CCSU may want to consider using ChemTracker, which is a chemical inventory tool that colleges and universities are implementing. ChemTracker Consortium is a collaborative group of academic organizations (founded in 2001 by Stanford University) that provides access to the ChemTracker chemical tracking and regulatory reporting system.

7.6 CONSIDERATIONS FOR INSTITUTIONAL PLAN

CCSU's Institutional Sustainability Plan should include a general statement of the University's overall commitment to pollution prevention, reducing chemical waste, and preventing impacts to the environment from hazardous waste. Secondly, the Institutional Plan should reiterate CCSU's commitment to environmental compliance, and ensuring that hazardous and chemical wastes, as well as electronic waste, is managed in compliance with applicable rules and regulations.

7.6.1 Tips for Sustainability Website

While students may not routinely purchase chemicals and generate hazardous waste, they are involved in academic activities that may generate waste. Teaching and research laboratories, as well as art studios, are areas where students can learn pollution prevention lessons. These lessons can be reiterated on a campus sustainability website. Specific ways that CCSU's sustainability website can promote pollution prevention include:

- Educating students (as well as faculty and staff) on ways to use product substitution as a way to reduce the use of toxic materials and chemicals that could generate hazardous waste.
- Reminders about which types of chemical wastes (if any) can be drain-disposed.
- Developing a web page about green computing, power savings tips for monitors and laptops, and ways to purchase computer components in an environmentally-friendly way.

Figure 7-3: The 12 Green Chemistry Principles

- **Prevent waste:** Design chemical syntheses to prevent waste, leaving no waste to treat or clean up.
- **Design safer chemicals and products:** Design chemical products to be fully effective, yet have little or no toxicity.
- **Design less hazardous chemical syntheses:** Design syntheses to use and generate substances with little or no toxicity to humans and the environment.
- **Use renewable feedstocks:** Use raw materials and feedstocks that are renewable rather than depleting. Renewable feedstocks are often made from agricultural products or are the wastes of other processes; depleting feedstocks are made from fossil fuels (petroleum, natural gas, or coal) or are mined.
- **Use catalysts, not stoichiometric reagents:** Minimize waste by using catalytic reactions. Catalysts are used in small amounts and can carry out a single reaction numerous times. They are preferable to stoichiometric reagents, which are used in excess and work only once.
- **Avoid chemical derivatives:** Avoid using blocking or protecting groups or any temporary modifications if possible. Derivatives use additional reagents and generate waste.
- **Maximize atom economy:** Design syntheses so that the final product contains the maximum proportion of the starting materials. There should be few, if any, wasted atoms.
- **Use safer solvents and reaction conditions:** Avoid using solvents, separation agents, or other auxiliary chemicals. If these chemicals are necessary, use innocuous chemicals.
- **Increase energy efficiency:** Run chemical reactions at ambient temperature and pressure whenever possible.
- **Design chemicals and products to degrade after use:** Design chemical products to break down to innocuous substances after use so that they do not accumulate in the environment.
- **Analyze in real time to prevent pollution:** Include in-process real-time monitoring and control during syntheses to minimize or eliminate the formation of byproducts.
- **Minimize the potential for accidents:** Design chemicals and their forms (solid, liquid, or gas) to minimize the potential for chemical accidents including explosions, fires, and releases to the environment.

8. BUILDING DESIGN AND CONSTRUCTION

8.1 INTRODUCTION

8.1.1 Regulatory Background

In October 2006, Connecticut introduced legislation requiring that standards are implemented by January 1, 2007 to require that all new state buildings be LEED-certified. This would impact new construction projects at CCSU. Specifically, the CT Office of Policy Management's standards apply to new construction of all State facilities that have a project cost of $5 million or greater. Buildings can be exempted from the new standards upon completion of a cost-benefit analysis, which must be done in consultation with the CT Department of Public Works (DPW).

8.1.2 Areas Included in Baseline

With respect to building design, demolition, and construction, the sustainability baseline audit included a general discussion with CCSU administration and facilities personnel about the way buildings are maintained, renovated, designed, constructed, and retrofitted.

8.1.3 Stakeholder Engagement

Our primary point of contact was the Associate Chief Administrative Officer.

8.1.4 Existing Sustainability Initiatives

- CCSU recently redesigned the roads on campus to be equipped with gates that have openings for people to walk through (this increases the walkability of the campus overall for people walking from building to building).
- CCSU recently switched to angled copper roofs, and eliminated flat roofs. The new roofs decrease the maintenance costs associated with the roofs, and they are easier to maintain.
- Some of the buildings on campus, while not LEED-certified, do have efficiencies such as energy-efficient lighting, motion-sensored fixtures, daylighting, low flow water systems, and central HVAC systems.
- CCSU is involved with CSU in developing building standard guidelines for the new compliance manual for "high performance buildings."

Please note that certain energy-efficient aspects of the campus buildings may also be described in the Energy and water sections of this report.

8.1.5 Potential Challenges

Universities face similar challenges when performing renovations and new constructions – budgetary constraints, institutional "red-tape," trying to meet the needs of various groups within the University, and external pressures (e.g., community, neighbors) – are all potential challenges. For construction projects, CCSU has to face these challenges, as well as others due to the fact that CCSU is part of a larger

university-system and is a State entity. Every project that exceeds $2 million in cost must be managed by the Connecticut Department of Public Works (DPW). This adds an extra layer of control to each large project, which can lengthen the process. It is also difficult because DPW has decreased its employees, which means there are fewer people to work on projects, which (in turn) drives up cost. It might be simpler for other universities to engage in construction projects, because the hierarchy of the project typically consists of University project managers and contractors. With certain funding, contractors can be enticed into various accelerated project schedules. CCSU, on the other hand, has to go through DPW, who is responsible for hiring the contractors (i.e., architects and engineers).

According to CCSU personnel, it took 10 years to construct the last residence hall, and it also took 10 years to construct the last classroom building. This appears to be a longer time schedule than one required for a private school (and other state institutions) that may have ready funds for projects. Previously, the State would supply 40-60% of the operating costs to CCSU. Now, the State supplies less than 40%. This means that CCSU has to rely more on its own funds for projects and routine operations. Also, the bonding process represents another limit to the planning process.

While LEED certification is an excellent way to ensure that State buildings are more sustainable (and efficient), the process of certification adds extra cost. CCSU has been adding an extra 10% to its construction budgets to account for the cost required to pursue LEED certification.

8.2 BASELINE AUDIT RESULTS

8.2.1 Quantitative Data

Most of the data pertaining to CCSU's buildings pertains to energy usage, water usage, energy-efficiency, etc. These types of data are addressed in other sections of this report. There are some metrics, however, that depend on how much of CCSU's buildings are considered "green." Currently, CCSU does not have any existing buildings or new buildings that are LEED-certified. There is currently a total of 3,372,010 gross square feet (ft^2) on campus. While none of this is LEED-certified, there are a variety of green building elements in some of the buildings. For example, in the Vance Academic Center, which was built in 2000, there are automatic faucets and low-flow fixtures.

With respect to construction waste, over the past 5 years, CCSU has generated 1,248 tons of construction waste. This represents approximately 250 tons per year.

8.2.2 Gap Analysis

CCSU does not currently have data on how much construction waste/debris is generated in each project. CCSU does not currently track how much of the construction waste/debris generated during campus construction projects is reused or recycled. The total amount of waste that gets generated is kept track of (see above), but there are no data to indicate how much of this waste (if any) gets recycled.

8.2.3 Qualitative Observations

Based on interviews with CCSU personnel, the following are drivers that determine how buildings get built and renovations are made at CCSU:

- Cost constraints based on the amount specified by the CT Office of Policy Management, which is primarily based on square footage
- CCSU has a Project Manual that includes all of the technical specifications for building design
- Purchasing cost constraints (i.e., everything is put out to bid and the lowest bidder is often accepted)
- Building specifications based on CCSU standards
- National Fire Protection Association (NFPA) standards and requirements, as well as Fire Marshal requirements
- Applicable building codes
- State law (e.g., LEED silver certification required for all public buildings, see above)
- Life safety codes
- Federal laws (e.g., handicapped accessibility requirements)
- Aesthetic requirements
- Building operations should be streamlined into CCSU's existing systems (i.e., asset reporting system, inventory system, work order system, energy management system, etc.)
- Improved building practices (improvements over what was in place before)
- Function requirements of the space should meet occupants' needs
- Security (for example, CCSU recently installed cameras in all of the building elevators to discourage vandalism
- Promote built-in redundancies for power generation
- Plan for future additions (e.g., adding concrete pads for extra generators or setting the stage for a new central HVAC system)
- Resiliency (the State's goal is for buildings to last for ~ 50 years, but CCSU wants them to last ~ 100 years)
- CCSU wants buildings to be as sound-proof as possible

Overall, CCSU attempts to construct buildings and renovations in a way that results in an improvement over what existed before, while also prioritizing what is required by law. Sustainability measures are implemented for efficiencies and to improve quality of life. Additionally, CCSU tries to go back to new building occupants and ask them what they think about certain aspects of the building or building improvements. Without this feedback, it is difficult to ensure that continuous improvements are made.

During the audit, some people at CCSU who were interviewed expressed concern about the fact that the campus "bleeds" energy. Specifically, a concern was made on the renovation of the Copernicus building. Reportedly, the lights in the hallways stay on all the time, which is unnecessary. A CCSU faculty member went on to suggest that the CCSU Engineering Department should consider developing solar energy demonstrations on the roof of Copernicus, and to suggest that CCSU should build a showcase "green sustainable" building to house environmental/teaching/research programs on campus (this building

could be the most visible public focus Please note that the auditors did not verify these opinions, they are included here as qualitative information that is important to consider with respect to stakeholder concerns.

8.3 BENCHMARKING

It is hard to benchmark CCSU against other schools with respect to green building, because while CCSU has employed green building practices in its construction projects, there are currently no LEED-certified buildings on campus. However, it is useful to consider what some campuses have been doing with respect to green building. Specifically, a few campuses that have received an "A" in the area of green building are mentioned below:

- Carnegie Mellon University: building policy requires that all new buildings and renovations be LEED Silver-certified at a minimum. Three buildings have attained LEED Silver certification, four renovations will soon be Silver-certified, and one building has a LEED Gold rating. The University was a pilot partner in the EPA Lab21 program for designing green laboratory spaces. Four campus buildings at Carnegie Mellon have green roofs installed. [44]
- Emory University: committed to certifying all buildings under the LEED Gold-certification. The Business School at Emory was actually the first LEED-Existing Building Gold-certified building on a university campus in the country. The University has four other LEED-New Construction certified buildings for a total of 1.1 million square feet that has been or is in the process of acquiring LEED certification. As a result, Emory currently has one of the highest numbers of certified green buildings of any campus in the country. [45]
- University of Illinois: committed to all new construction and major renovation projects greater than $1 million will pursue some level of LEED certification. The Springfield campus is requiring that all new buildings meet LEED Silver certification and the University's Business Instructional Facility at the Urbana campus may be the first major building in the city of Urbana to be LEED-certified. [46]
- Amherst College has "High Performance Building Design Strategies" guidelines, which allow the College to make informed value judgments about which design strategies have the highest environmental and financial returns.
- Boston College recently set contractual limits in its construction waste management that follow LEED requirements.
- New York University joined the U.S. Green Building Council in October 2006, and plans to increase the use of green technology in future projects. Retrofits include high-efficiency restroom fixtures, occupancy sensors, an HVAC system that complies with the New York energy conservation code, and a demand-controlled ventilation system.

[44] Sustainable Endowment Institute. "College Sustainability Report Card: A Review of Campus & Endowment Policies at Leading Institutions." 2007.

[45] Ibid.

[46] Ibid.

- The University of Virginia has not formally adopted the LEED building guidelines into its master plan, but the University does rely on its own sustainability guidelines which incorporate various sustainability initiatives in all aspects of campus planning. Additionally, the University is implementing a major construction project that will be its first LEED-certified facility.
- Washington State University has required that all project managers within the WSU Capital Planning and Development (CPD) department are or will be LEED-certified.

The following provides some benchmarking information specific to colleges and university within Connecticut.

- Wesleyan University has one building that has been built to LEED standards (certification is pending). Wesleyan's Construction Services team has established a goal to recommend that all building follow the LEED design guidelines wherever feasible. Some of the specific measures that Wesleyan has taken include: purchasing recycled and recyclable building materials; using products with low volatile organic compounds (VOCs); separating and recycling most demolition debris; utilizing three electric maintenance vehicles, and using an energy management system to monitor and manage energy consumption.
- Yale University's "University Design Standards" incorporate principles that are in-line with LEED Silver certification. A Sustainable Building Design and Construction committee is in the process of reviewing, analyzing, and preparing a set of recommendations for campus-wide design guidelines. A campus-wide retrofit of inefficient light bulbs, windows, HVACs, and other facilities is currently in place, as well.
- The University of Connecticut has established Sustainable Design Guidelines that were designed to augment LEED as a sustainability benchmark. The final phases of UConn's $2.3 billion facility improvement investment will add over 1.2 million GSF in new construction and renovate over 600,000 GSF of real estate across its eight campuses by year 2014. Recognizing the environmental impact associated with such phenomenal growth, UConn's leadership has emphasized a strong sustainable ethic in implementing the program vision.[47]
- Connecticut College has also been involved in a number of sustainability initiatives, including installing solar panels on top of the Park Residence Hall as part of their renewable energy policy. The college also instituted a Green Building Policy in 2000 that includes the following requirements[48]:
  - Use a recognized set of green building guidelines, such as LEED.
  - Use green building materials and recycled materials, green cleaning products and maintenance methods;
  - Use energy efficient systems for heating, lighting and transportation which exceed local and national standards for conservation and green house gas emissions; where possible use alternative sources of energy;
  - Install water-conserving systems and products and do appropriate plantings; and

[47] http://www.ecohusky.uconn.edu/sustainabledesign.html

[48] http://greenliving.conncoll.edu/GreenBuildingPolicy.pdf

- Improve indoor air quality through the use of appropriate building materials, ventilation and filtration systems.

The following is a list of all of the LEED-certified buildings that are currently located in CT, according to the Connecticut Green Building Council:[49]

- Eastern CT State University Science & Classroom Building (currently under construction)
- Eastern CT State University Residential Village
- Southern CT State University Residence Hall
- Western CT State University Science Building
- University of Connecticut - The Burton Family Football
- Complex/The Mark R. Shenkman Training Center
- Wesleyan Residence Hall & Parking Garage
- Yale University Engineering Research Building (laboratory)

8.4 RECOMMENDATIONS

8.4.1 Primary Recommendation – Establish Green Building Policy

While CCSU currently has a number of green building practices that it has employed for new building construction (as well as building renovations), the University should consider formalizing its commitment with a Green Building Policy. This Policy could be very broad and explain in general terms how the University plans to comply with CT State LEED building standards, as well as adhering to its own set of standards. Conversely, the policy could be detailed enough to include the specific types of green building standards that the University aspires to.

An example of a general Green Building Policy is the University of California's Green Building Policy and Clean Energy Standard. Other examples of green building policies are included in Appendix C. The following is an excerpt from this policy:

"The Green Building Policy and Clean Energy Standard calls for:

- "The University to adopt principles of energy efficiency and sustainability in its capital projects to the fullest extent possible, consistent with budgetary constraints and regulatory and programmatic requirements.
- The University to maximize its impact on the environment and reduce non-renewable energy use by purchasing green power from the electrical grid, promoting energy efficiency, and creating local renewable power sources.

[49] http://www.ctgbc.org/greenbldgs2.htm

- The development and implementation of this policy for all proposed and existing University facilities. The UC Board of Regents will be provided with an annual report that examines impacts of the policy on energy utilization and building design and on operating costs."

CCSU should consider establishing a formal, written statement that specifies that the University's standard for building renovations that meets (or exceeds) the LEED requirements mandated on the State level for new building construction. Currently the State of CT has only enacted legislation for new public buildings to be LEED silver certified and has not extended a similar requirement for renovations or existing buildings.

8.5 CONSIDERATIONS FOR INSTITUTIONAL PLAN

Capital design and construction is central to any university's planning. As such, CCSU's Institutional Plan should include a general goal for building design and construction on campus to be as sustainable as possible. The Institutional Plan should also refer to the University's Green Building Policy, if one is established. Placing emphasis on green building within the Institutional Plan will help to enforce the Green Building Policy and ensure that green building is central to the University's planning.

8.5.1 Tips for Sustainability Website

Some universities who may be doing less than CCSU with respect to green building may be getting better press. CCSU's sustainability website can be an excellent way to highlight some of the efficiencies that CCSU has achieved over the years. For example, Columbia University was recently featured in a sustainability publication, that gave Columbia an overall sustainability grade of "B". Under the topic of "Green Building," the following was written for Columbia: "Columbia is a new member of the U.S. Green Building Council and is utilizing LEED strategies as a planning tool, with the intention of registering new construction for LEED certification. The University has been upgrading its lighting systems for the past 15 years and has retrofitted its water infrastructure in order to maintain more efficiency facilities."

As evidenced by this baseline report, it is pretty clear that CCSU is doing far more than Columbia with respect to green building. The difference is the level of publicity devoted to what Columbia has done. "Getting the word out" with respect to CCSU's sustainability initiatives will not only be important for the University's sustainability website, but also an important topic to address in the Institutional Plan.

9. PROPERTY MAINTENANCE, LANDSCAPING, AND PESTICIDES

9.1 INTRODUCTION

The landscaping at CCSU is designed to make the campus a pedestrian-friendly environment. This includes a large proportion of paved sidewalk area and accessible gateways. The campus as a whole includes a normal percentage of impervious surface, including sidewalks, parking areas, buildings, and other paved areas at the University. These areas are salted during the winter months to ensure that they are safe for pedestrian and vehicular traffic.

Irrigation is used at CCSU primarily for maintenance of the athletic fields. In addition, key grassy areas are also irrigated in order to maintain a desirable appearance. Water for the irrigation of these areas is potable water that comes directly from the New Britain Water Department.

Custodial work in CCSU buildings is performed not only by CCSU employees, but also by two separate outside companies that are contracted to complete the work. CCSU has made an effort in recent years to convert to using more green chemicals for cleaning.

9.1.1 Areas Included in Baseline

The areas included in the Baseline audit encompassed the general land use and maintenance practices of CCSU. To the extent possible, Woodard & Curran evaluated CCSU's use of cleaning chemicals, pesticides, land use, landscaping practices, and the ability of CCSU to improve in these areas. Evaluations included visual campus observations, interviews with key stakeholders, and review of records concerning maintenance practices at CCSU.

9.1.2 Stakeholder Engagement

In addition to data gathered and visual observations made while on-site, the following people were interviewed by Woodard & Curran during the CCSU site visit on March 13-14, 2007:

- Director, Engineering
- Administrative Assistant, Facilities Management
- Environmental Health and Safety Officer
- Associate Chief Administrative Officer
- Representative, Student Government Association
- EH&S Officer
- Plumbing, Facilities
- Professor, Biology
- President, Student Government Association
- Assistant Director, Facilities Support
- Carpentry

- Facilities Contract Administrator, Facilities Management
- Director, Purchasing

9.1.3 Existing Initiatives

Currently, CCSU has programs in place that encourage more sustainable grounds practices, including the following:

- Housekeeping makes a conscious effort to purchase and use green chemicals, where possible, for cleaning purposes. More information about Housekeeping's use of green products is outlined below.
- CCSU will be converting athletic fields to synthetic turf in the near future. In terms of environmental impact, this conversion has benefits. The conversion will help to reduce pesticide use, irrigation, and costs of maintaining the fields.
- As of the 2006-2007 school year, CCSU staff indicated that sand is no longer being used for ice-melting on campus (although CCSU faculty disagreed with this statement). This should help to reduce sediment deposits into surrounding surface water bodies each winter. Currently, CCSU is using sodium chloride rock salt exclusively, and staff have indicated that next year, CCSU has budgeted for increased cost to use calcium chloride as an ice-melt chemical on campus.
- CCSU developed a Master Planting Plan in 2001, which specifies that native plants should be planted to the practical extent possible.
- The CCSU janitorial contract currently includes language regarding the use of green chemicals, and specifically refers to Governor Rell's Executive Order No. 14.

9.1.4 Benefits to Athletic Turf Fields

During the Baselining, CCSU indicated that it will be converting all of the athletic fields to synthetic turf. After the draft audit report was submitted, CCSU requested additional information about the potential environmental impacts of the athletic field conversion. This conversion will affect the Soccer Field, Softball Field, Balf-Savin Baseball Field, and the Practice Football Field, which total approximately 11 acres, based upon determinations made by the Engineering Department.

A conversion to synthetic turf can greatly reduce CCSU's use or potential use of water, fertilizers, pesticides, herbicides, fuel, field paint, and labor-hours in maintaining the field. Synthetic turf fields will reduce CCSU's environmental impact in the following ways:

- CCSU is currently using nearly 3,000,000 gallons of water for irrigation annually. More than 2/3 of this usage (2.1 million gallons) was used to irrigate the athletic fields (data obtained from Balf-Savin Field meter). Synthetic turf fields would eliminate the need for CCSU to use this water annually, and save CCSU over $5,000 in annual water fees.
- CCSU, like other colleges, must maintain a field that positively represents the institution. Due to this, athletic fields are often a high use area for fertilizers, pesticides and herbicides to maintain lush, green grasses. As artificial turf fields do not require the use of fertilizers, pesticides or herbicides, this conversion would eliminate the use of these products on CCSU's fields. By

eliminating these products, the quality of stormwater runoff to be managed on site would also benefit.

- Synthetic turf is typically manufactured with colored field lines integrated into the fibers. As a result, there is no need to use paint on the field. This is an added benefit over natural grass fields, which need repeated applications of paint to define field play lines.
- Athletic fields require grass to be at a specific length. With natural grass fields, this results in constant mowing, in order to maintain proper playing conditions. Synthetic turf fields eliminate the need for this, helping to reduce fuel use, greenhouse gas emissions from mowing equipment, and maintenance labor hours. Instead, synthetic turf fields require maintenance (to prevent the matting down effect of the turf) only four times per year.
- Constructing new synthetic turf fields provides CCSU with an opportunity to create a system to manage the stormwater from these areas, in a manner which is more controlled than the management of runoff and subsurface drainage from grass fields.

Leading synthetic turf manufacturers in the industry utilize a blended infill product which includes recycled rubber material. CCSU should ensure that new synthetic turf fields are constructed, to the maximum extent possible, with recycled materials.

One major concern with synthetic fields is the reduction of natural area, particularly regarding the loss of the carbon sequestration that would typically result from the grass on the field. Upper Canada College (Toronto, Ontario, Canada) undertook a life cycle study to determine the difference in greenhouse gas emissions over a ten-year period for a 9,000-square meter (slightly more than two acre) synthetic turf field, and its natural grass equivalent.[50] The study determined that a natural grass field of that size had a negative (reduced) greenhouse gas impact over a ten-year lifetime. This figure was determined using the natural grass carbon sequestration factor of 0.95 tons of carbon per hectare per year. The study found, that over the course of a ten-year lifetime, the synthetic field would result in an increase of greenhouse gas emissions from the field of 72.6 tons CO_2e,[51] as the natural grass field had an overall greenhouse gas contribution of -16.9 tons CO_2e, and the artificial turf field had a contribution of 55.6 tons CO_2e.

To resolve this issue, UCC took the initiative to offset the difference in greenhouse gas emissions by planting enough trees sufficient to sequester the difference in greenhouse gas emissions. In the case of UCC, 1,900 trees were required to be planted to offset their project over a ten-year period.

CCSU may consider conducting a similar study to determine greenhouse gas differences between their new fields and current natural grass fields. CCSU could look into an offset project, particularly if the University will be trying to meet greenhouse gas reduction goals. Should CCSU decide to pursue tree planting as a means of offset, the University should work with native species. The Biology Department has expressed an interest in assisting the school with creating an arboretum of native species.

[50] http://www.athenasmi.ca/projects/docs/UCC_project_ATHENA_technical_paper.pdf

[51] As measured in carbon dioxide (CO_2) equivalents. For example, Methane (CH_4) is twenty-one times as potent a greenhouse gas as carbon dioxide. To equate, then, one ton of methane is equivalent to 21 tons of carbon dioxide.

A synthetic turf field can also provide reduced maintenance costs. In a similar project, Woodard & Curran is in the process of designing and monitoring the construction of separate synthetic baseball, softball, and soccer/lacrosse fields for a school in Westchester County, New York. The estimated annual maintenance costs associated with a natural grass football field is approximately $70,000/year, excluding water usage. Based on practical experience, the maintenance costs for a synthetic turf field are estimated to be $8,000/year. Over the lifetime of the field, this provides for a significant cost savings in maintenance costs.

9.1.5 Potential Challenges

Typically, grounds maintenance is a very high priority for universities. As competition increases at institutions of higher learning, students are interested in attending a university that offers aesthetic and quality of life amenities in addition to a solid education – including well maintained grounds. CCSU is faced with the challenge of presenting the most visually appealing and safe campus possible, and at the same time, having a minimal impact on the overall environment.

CCSU has made a good effort to convert to more environmental friendly cleaning solutions over the past few years. However, some chemicals and cleaners do not yet have viable alternatives, and until reasonable alternatives are on the market, CCSU will be forced to continue to use the current products. Additionally, due to rising costs of maintaining cleaning staff, CCSU has contracted out more of the cleaning responsibilities. Outside agencies are responsible for their own cleaners as mandated through their contracts.

9.2 BASELINE AUDIT RESULTS

9.2.1 Quantitative Data

At the time of the audit, statistics did not exist regarding the number of Native and Non-Native species on campus. Visual observations regarding species on campus were limited, as the audit was performed during the winter. However, interviews with key stakeholders indicated that in the past, CCSU has not prioritized native species. For example, a non-native and invasive species used in landscaping included the Water Hyacinth in the central pond (according to staff in the Biology Department).

CCSU has a 312-acre campus, including the approximately 167-acre East Campus area. Information does not exist regarding the amount of impermeable surface at CCSU, but visual observations lead to an estimate of at least half of the main campus consisting of impermeable surface. Impermeable surface areas at CCSU include roads, sidewalks, parking areas, and buildings, as there are currently no buildings on campus with green roofs (i.e., roofs that have specifically been designed to include vegetation and green space that can absorb precipitation)[52]. This amount of impermeable surface increases the likelihood

[52] "A green roof is a roof of a building that is partially or completely covered with vegetation and soil, or a growing medium, planted over a waterproofing membrane. This does not refer to roofs which are merely colored green, as with green shingles. It may also include additional layers such as a root barrier and drainage and irrigation systems. Container gardens on roofs, where plants are maintained in pots, are not generally considered to be true green roofs, although this is an area of debate. The term "green roof" may also be used to indicate roofs that utilize some form of "green" technology, such as solar panels or a photovoltaic module. Green roofs are also referred to as eco-roofs, vegetated roofs, living roofs, and greenroofs." http://en.wikipedia.org/wiki/Green_roof.

of turbid and otherwise polluted discharges reaching surface water bodies, and negatively effecting ecosystems of Sandy Brook, Bass Brook, and other water bodies surrounding the campus.

Interviews with the Assistant Director of Facilities Support, revealed that CCSU has put increased emphasis on purchasing more green products for housekeeping and cleaning activities on campus. Data was provided on product use for the 2005-2006 year, and is shown below. While data was not provided for previous years' usage, the information provided below can be used as a baseline for future use.

Table 9-1: Green Cleaning Products used at CCSU (2005-2006 Year)

Green Usage	Quantity (units or containers)	Total Quantity
3M Floor Cleaner 24H (2 Liter)	19	38 Liters
3M Floor Cleaner 3H	53	
3M General Purpose Cleaner (8 Liter)	24	192 Liters
Cleaning Cloth - Reusable Microfiber	31	
Dusting Cloth - Microfiber Reusable	15	
Recycled Paper Towels	1,436	
Betco Peroxide Cleaner	11	
SCA Brand Toilet Paper	1,199	
Urinal Screen with Deodorizer	666	

Table 9-2: Other Cleaning Products Used at CCSU (2005-2006 Year)

Product	Quantity (units or containers)	Total Quantity
3M Bath/Shower Cleaner (1 Liter)	3	3 Liters
3M Floor Stripper Low Odor	112	
3M Glass Cleaner (20 Liter)	23	660 Liters
3M Non-Acid Bathroom Cleaner (19 Liter)	30	570 Liters
3M Pre Spot for Carpets, 10H	2	
3M Quat Disinfectant Cleaner 5H	57	
3M Carpet Shampoo 9H	3	
3M Tile, Grout, and Bowl Cleaner (2 Liter)	2	
Antimicrobial Lotion Hand Soap (4/Case)	688	2752
Baseboard Cleaner	26	
Bleach	74	

Product	Quantity (units or containers)	Total Quantity
Bowl Cleaner	12	
Ajax Cleanser	84	
Dishwashing Detergent	8	
Goof Off Remover	5	
Grafiti Remover Censor	3	
Simoniz Gum Remover	12	
Kaiblooey Restroom Cleaner	14	
Panel Magic Cleaner (Furniture Polish)	36	
Metal Polish	14	
Speedball 2000 Spray	59	
Super Shine All (For Gym Floor)	4	
Taski Profi	21	
Taski Wi-Wax	30	
Stetson Hardtop Floor Wax (5 gallon)	88	440 Gallons

The column for "Quantity" represents units or containers for each product, as a more exact measurement (i.e., Volume or Mass) was not provided for all products. The total amount used is listed in the "Total Quantity" category, as applicable. Data represents only what was used by CCSU staff during the 2005-2006 year. It should be noted that CCSU has contracted an increasing amount of their housekeeping and maintenance work to outside contractors, and this data does not include information on their usage. Information regarding products that are used by outside contractors was not available at the time of the audit.

At the time of the audit, CCSU used approximately 3,000,000 gallons of water annually for irrigation. The irrigated areas on campus consist of key campus green areas as well as the athletic fields. Based on stakeholder interviews, it can be estimated that approximately 20 acres are irrigated on campus, and the athletic fields comprise 11 of these acres.

Once CCSU converts to turf fields, the need to irrigate these fields will be eliminated, and this will reduce the amount of water required for overall campus irrigation. It may also be possible to completely eliminate the need to purchase water for irrigation on campus (See recommendation discussed in the Water section (Section 5) of this report).

CCSU is currently not managing any part of their campus for habitat conservation. Some campuses manage some of their campus specifically to support wildlife or specific species habitats. CCSU may want to consider designating some areas of campus (e.g., former orchard area or new East Campus areas) as wildlife habitats.

9.2.2 Data Analysis

The data on cleaning products was provided by the Facilities support department. While this data is very helpful in determining what was used, much of the quantity is displayed in a per-container, or unit, value, and does not represent the exact quantity used. However, CCSU can use this information to measure progress over future years towards increased green product use.

9.2.3 Gap Analysis

The following data was not available at the time of the baseline. Determining the following amounts and statistics may help CCSU to determine future progress made towards reducing the environmental impact of the University.

- The percentage of the campus covered with impermeable surface; the greater the impervious surface, the greater the amount of runoff from parking lots and other hard surfaces that ultimately discharges to surface water.
- The ratio of native to non-native species on campus; native species require less watering and are less likely to require pesticides because they are natural to the area; native species are also recommended in CCSU's Master Planting Plan.
- The exact area of campus requiring irrigation; this will help to determine how much of the campus is currently being irrigated (for water use baselining purposes); it may also help to determine if any areas on campus may not need to be irrigated.
- The amount of chemicals used for ice melting on campus; it is generally considered a sustainable practice (and it is in the best interests of waste minimization) to track how much of each hazardous chemical is used on campus each year for property maintenance.
- Continued documentation of chemical use on campus, including amounts of green vs. non-green seal certified chemicals. If CCSU is committed to decreasing the amount of chemicals used on campus (which will ultimately save the campus money), it should know how much of each type of chemical is used.
- CCSU has provided data indicating what lawn care products can be used on campus, but the data provided about what actually has been used over the past few years is scarce. Fully determining what has been used in the past will give a better idea of CCSU's typical lawn-care product use.

9.2.4 Qualitative Observations

CCSU currently utilizes pesticides to control pests such as roaches, ants, and mice in campus buildings, bees around campus, and weeds on turf fields and key campus outdoor areas. CCSU has provided documentation of pesticides used for extermination of interior pests, and applications are performed by an outside contractor on an as-needed basis. CCSU has also provided some documentation of Ornamental and Turf applications, but these records only include an application from July of 2006 and May of 2004. These records indicate that fertilizers and herbicides are applied to turf areas on main campus.

MSDSs have also been provided to Woodard & Curran, detailing pesticides, herbicides, fertilizers, and other property maintenance chemicals that can be used at CCSU. While a determination cannot be made of what was used at CCSU in recent years, some of the pesticides have MSDSs that indicate potential

negative effects, particularly to surrounding surface water ecosystems. CCSU should ensure that contractors use, to the maximum extent possible, lawn care products that minimize pesticide use. This should be required in contracts.

CCSU's Master Planting Plan, while it encourages the planting of native species, should include more requirements for increasing the sustainability of campus plant maintenance – including decreasing irrigation, and decreasing the use of pesticides, where possible.

A CCSU faculty member indicated that the most significant environmental impact with respect to water is the amount of stormwater runoff from campus (as opposed to domestic water use).

9.3 BENCHMARKING

Universities around the nation are taking the initiative to begin their own habitat management programs. Some of these examples are as follows:

- Ithaca College is experimenting with landscaping with only native grasses and flowers, as opposed to typical landscaping practices, which include non-native species. The College is working to determine the baseline conditions of the soil before this initiative. More information can be found on the Ithaca College website.[53]
- Over the past half-decade, Reed College has undergone a project to restore a 24-acre section of Reed Canyon, which makes up approximately one quarter of the campus. The efforts of the College have helped to remove trash and non-native species to the canyon. Members of the Reed College community have since planted over 75,000 native species and built a fish ladder to help return native species to the canyon.[54]
- In 2005, Washington State University announced that it would purchase Magpie Forest, a 14-acre area of nearby prairie. WSU intends to use the property not only for preservation, but as an outdoor laboratory for the natural sciences.[55]

In June of 2005, the State of Connecticut enacted a bill to ban the use of lawn care pesticides on the grounds of day care centers and elementary schools. The schools that fall under this new regulation will be allowed to continue with minimal applications until 2008, to phase their fields off of chemical dependence. At this point, the regulation only applies to day care and elementary school facilities, but may be expanded in the future.

9.3.1 Peer Institution Information

The University of Massachusetts, Dartmouth, has had a sustainability committee in place since 2001. Currently, the University is launching a pilot program to introduce vermiculture (composting with

[53] http://www.ithaca.edu/ithacan/articles/0510/06/news/3alternati.htm

[54] http://www.portlandtribune.com/news/story.php?story_id=30595

[55] http://www.wsunews.wsu.edu/detail.asp?StoryID=5205

worms) to its campus.[56] The program will use vegetable waste from campus dining facilities, and compost it. The very nutrient-rich compost will then be used on campus plantings.

William Paterson University of New Jersey (WPU) was the recipient of a nearly 23 acre land donation in 1998. By 2004, WPU had worked with five courses to closely utilize this land in their curriculum, for majors, non-majors, and graduate students. The property is being managed largely for course use and conservation, and a field laboratory station will eventually be housed on the property.[57]

9.4 RECOMMENDATIONS

- Biology classes at CCSU have researched and removed invasive species in two areas of CCSU's property. CCSU should continue these efforts, and look for additional ways to integrate sustainability practices into its curriculum. CCSU should continue to evaluate the species of plants used to landscape the campus, and ensure that primarily native species are used (to reduce the amount of irrigation and pesticides required to maintain the health of the plants). While the baseline audit was conducted during the winter months and visual observations of species on campus could not be made, interviews with key stakeholders indicate that invasive and otherwise non-native species are commonly used in campus plantings.
- CCSU can consider maintaining some of the campus as a natural area, planted with species native to the area. Some examples of other campuses that have already done this are provided in the Benchmarking section above. CCSU is in the process of developing the East Campus area, however, there could be potential to leave some of this area as natural habitat. Discussions with CCSU personnel have indicated that the Biology Department would be interested in assisting with this initiative.
- It appears that landscaping debris is currently being disposed of as trash, or removed by the outside contractor, if one is retained. CCSU should consider composting organic landscaping debris generated on campus. Allowing the organic debris to contact the open air (as opposed to a landfilling it) will allow the material to decompose at a faster rate. Additionally, the organic landscaping debris could generate excellent compost for future on-campus landscaping projects, or distribution to the surrounding community.
- CCSU should continue to ensure that proposals from outside cleaning and maintenance companies use green chemicals to the maximum extent possible. The facilities department can continue to work with the Purchasing Department to draft RFPs to include this condition (See the Purchasing section of this report). For a more complete list of products that are green seal certified, refer to the green seal website.[58]

[56] http://www.umassd.edu/sustainability/GroundsWorms.cfm

[57] http://www.nagt.org/files/nagt/jge/abstracts/Pardi_v52n5.pdf

[58] http://www.greenseal.org/findaproduct/index.cfm

- Review pesticide inventory used by contractors to ensure minimum chemicals are used. Look for less toxic substitutes and implement IPM[59] practices, wherever possible. For an excellent example of IPM practices in place at a University, refer to Harvard's UOS website.
- Strategically plan landscaping on sloped surfaces to minimize erosion.
- Reduce the amount of flowers that require watering; consider flowering trees and shrubs instead.
- One faculty member recommended that landscape maintenance activities should be performed using rakes and brooms, as opposed to gas-powered blowers.
- When selecting plants, take pesticide, fertilizer and water needs into account. CCSU should prioritize increasing the diversity of native plant species on campus, as well as consideration for protecting root systems.
- CCSU should work to decrease the amount of impervious pavement on campus. This will help to reduce the amount of runoff into bordering surface waters. This goal can be accomplished through replacing paved surfaces with pervious pavement and adding additional green areas to campus.

9.5 CONSIDERATIONS FOR INSTITUTIONAL PLAN

In writing and implementing the Institutional Plan, CCSU should consider requiring that all landscaping activities on campus involve only native species. Native species are best suited for the environment at CCSU and also have natural controls to help keep populations in control. Native species are not likely to negatively impact plants and animals in surrounding areas.

While CCSU is currently making an effort to purchase green cleaning chemicals, the University should consider adopting this as a requirement for the Institutional Plan. Although much of the custodial and grounds work is performed by contractors, this stipulation could be written into the contracts signed prior to the start of work. To better facilitate this, the Facilities department could work with the Purchasing department to ensure that outside contractors will be required to use green cleaning chemicals in the future.

9.5.1 Tips for Sustainability Website

CCSU should consider adding information to their sustainability website about the use of green chemicals. The University could add information to explain their current use of green chemicals, and how use of them has increased (or decreased) over time. Additionally, the University could add information about the benefits of using green chemicals. To potentially help increase the use of green chemicals by students on campus, CCSU could include a link to a list of green chemicals commonly used to clean individual rooms.

[59] Integrated Pest Management, or IPM, as defined by the National Foundation for IPM Education is: "a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks." http://www.ipm-education.org/whatisipmnew.htm. An example of IPM is using pesticides at times when pests are the most vulnerable to reduce the amount of pesticides required to control the pests. Another example of IPM involves using alternatives to chemical controls, such as natural predators.

Should CCSU decide to pursue landscaping the campus with only native species, the University should include information about benefits realized to the campus, in terms of species diversity, soil composition, and any other benefits that CCSU and the surrounding ecosystems may realize.

10. TRANSPORTATION

10.1 INTRODUCTION

10.1.1 Areas Included in Baseline

Woodard & Curran interviewed CCSU commuting students and obtained data on the CCSU vehicle fleet. CCSU has approximately 12,150 students of which approximately 82.3%, or 10,000, are commuters. CCSU has 417 full-time faculty, 468 part-time faculty and 550 administrators and staff members. CCSU has a total of 6,109 parking spaces and a vehicle fleet of 36 vehicles.

10.1.2 Stakeholder Engagement

Woodard & Curran interviewed select CCSU commuting students and EH&S.

10.1.3 Existing Sustainability Initiatives

The majority of CCSU students commute to campus, but the college does not currently have a carpooling or trip reduction program. CCSU does considerable advocacy for the Hartford-New Britain busline. However, the college does not currently coordinate with the Connecticut Busway Transit to offer reduced bus fares or to optimize the Connecticut Transit routes to encourage rider-ship. CCSU apparently did offer an on-campus shuttle at one point in the past, but it was discontinued due to low ridership. CCSU also tried at one point to get funding to study the use of biodiesel in vehicles, but the concept did not receive broad support. There are a few bicycle racks located on campus, but students report that they are not widely used.

10.1.4 Potential Challenges

It is particularly challenging for colleges to reduce student vehicle miles traveled to campus when the majority of the students commute to campus. Student schedules and travel routes often prohibit carpooling and the use of mass transit. The distance from home to campus may also discourage bicycle use.

10.2 BASELINE AUDIT RESULTS

10.2.1 Quantitative Data – Commuting

Woodard & Curran sought student input (via electronic survey) on the total miles traveled per week to and from campus. However, only two responses were received. Woodard & Curran therefore estimated the emissions from commuter vehicles based on the following assumptions:

- 9,944 students each commute 40 miles/trip, 3 days/week, 2 semesters/year
- 20% of the commuting student body commutes during the summer semester
- 417 full-time faculty commute 40 miles/trip, 5 days/week, 40 weeks/year
- 486 part-time faculty commute 40 miles/trip, 3 days/week, 40 weeks/year

- 550 staff members commute 40 miles/trip, 5 days/week, 50 weeks/year

The emissions from commuting vehicles, based on these assumptions are provided in Table 10-1.

Table 10-1: Air Emissions from Commuting Vehicles

Pollutant	Estimated Emission Rate per AP-42 (grams/mile)[60]	Annual Emissions Student Commuters (tons/year)	Annual Emissions Faculty & Staff Commuters (tons/year)	Total
HC	0.95	48	12	60
CO	14.54	738	179	916
NOx	0.89	45	11	56

10.2.2 Quantitative Data – CCSU Vehicle Fleet

The CCSU fleet includes 36 vehicles (22 trucks, 13 vans and one aerial lift). The majority of the vehicles are pickup trucks, cargo vans and minivans. The average vehicle age is about 10 years old (1996 model year) and the oldest vehicle is a 1986 Ford dump truck. CCSU does not operate any alternative fueled vehicles. Based on 2006 data, CCSU fleet vehicles travel about 81,000 miles per year and burn approximately 11,245 gallons of gasoline resulting in an average fleet fuel economy of about 7 miles per gallon (mpg). For comparison, a 2007 Ford Ranger pickup has a fuel economy rating of about 17 mpg city/22 mpg highway and a 2007 Ford Econoline cargo van has a fuel economy rating of 15 mpg city/19 mph highway. If the average fuel economy of the fleet were 17 mpg, the CCSU fleet would use about 3,600 fewer gallons of gasoline per year resulting in a savings of about $9,000 (assuming cost of gasoline is $2.50/gallon).

10.2.3 Data Analysis

The majority (well over 90%) of the air emissions generated by CCSU are generated by commuting students, faculty and staff, not the Energy Center.

[60] Mobile source emissions calculated using methods and factors from 5th Edition of AP-42, Vol. II., Appendix H. Calculations assume the typical CCSU student drives a light duty, gasoline powered vehicle manufactured in model year 1998 or later with a cumulative mileage of 65,000.

10.2.4 Gap Analysis

CCSU should conduct a more comprehensive survey of student, faculty and staff commuting distances and patterns in order to validate the assumptions used to estimate commuting emissions. CCSU should also determine (on average) how much campus vehicles are idled per day. This could be determined by sending out a survey.

10.2.5 Qualitative Observations

There are very few bike racks on campus and students commented that the lack of bike racks discourages students from biking to school. Students comments that very few students carpool or take mass transit. One staff member noted that the campus is bicycle-friendly, and that there are bicycles available for use by police and EHS staff. However, no bicycles were observed in use on the campus at the time of the baseline audit.

Also, CCSU staff complained of the heavy use of concrete walkways by CCSU police and staff cars. Certainly, an increased vehicle presence impedes the pedestrian-friendly environment on campus. Reducing the amount of vehicle travel across campus (and perhaps increasing use of bicycles) will not only save gas, but lower emissions and increase the overall walkability of the campus.

A CCSU faculty member suggested that all future purchases of vehicles by CCSU should be of alternative energy users (e.g., biodiesel, electric, LNG), although ethanol vehicles would not be considered alternative energy. Campus police force vehicles should be downsized and run on alternative fuels as well.

One specific recommendation to reduce transportation impacts that was suggested during the audit is an increase in on-line course offerings. If more courses were offered on-line, then fewer students would need to travel to campus. This is often a contentious recommendation as many people consider one-on-one tutelage and instruction to be ideal for a quality education.

10.3 BENCHMARKING

Campuses are taking the following steps to reduce GHG emissions such as:

- Offering parking permit discounts for hybrid vehicles and carpooling vehicles;
- Offering preferential parking for carpooling vehicles;
- Improving lighting and infrastructure (bicycle lanes) to encourage bicycle riding;
- Participating in car-share programs to reduce the need for students to own vehicles; and
- Offering reduced rates for public transportation passes.

Northeastern University has a student-run Alternative Vehicle Team committed to the development of hybrid electric vehicles.[61] The University of Minnesota's fleet includes 28 hybrid vehicles.[62] CCSU does

[61] See http://www.coe.neu.edu/Groups/nuav/noframes.html.

not currently have any alternative fueled vehicles in its fleet and does not have any carpooling or mass transit programs in place. Cornell University developed a series of transportation programs geared toward reducing vehicle miles traveled. The program includes priority parking spaces for carpooling vehicles and free public transportation for students, faculty and staff that forego a parking pass.[63] In addition, a school in Alabama has scheduled fewer days of classes to cut down on student commutes.

10.4 RECOMMENDATIONS

CCSU should consider developing a trip reduction program that encourages carpooling, mass transit, bicycling and the use of alternative fueled vehicles. Program objectives could include:

- Gradually replacing CCSU vehicles with alternative fueled vehicles or at least more fuel efficient traditional vehicles.
- Adding more bike racks and infrastructure to encourage bicycle riding.
- Reducing idling time for campus vehicles.
- Offering incentives for carpooling, using public transportation, and alternative fuel vehicles such as reduced parking permit fees and preferential or reserved parking spaces.
- Working with Connecticut Transit to optimize bus routes to CCSU and offer bus passes to students, faculty and staff at reduced rates.
- Consider resurrecting the biodiesel research project to gauge whether the project may now be able to obtain funding.
- Review student car policy to determine if there are any opportunities to revise it to reduce emissions.

[62] University of Minnesota website: http://www1.umn.edu/umnnews/news_details.php?release=070222_3173&page=UMNN.

[63] The Apollo Alliance and Energy Action, "New Energy for Campuses," obtained from: http://www.fypower.org/pdf/campus_energy.pdf.

11. FOOD SERVICE OPERATIONS

11.1 INTRODUCTION

11.1.1 Areas Included in Baseline

The baseline audit included all food service operations at CCSU's campus, including the dining halls at Memorial Hall and the Student Union.

11.1.2 Stakeholder Engagement

The following individuals were interviewed during the audit:

- General Manager, Sodexho Campus Services
- Fowler and Huntting Co. (produce supplier to CCSU)
- Assistant Professor, Department of Geography (teaches a Culinary Tourism Class)

11.1.3 Existing Sustainability Initiatives

There is no current emphasis on purchasing or featuring local and/or sustainably-produced food. Despite the lack of emphasis, there are still a limited number of sustainable food choices available on campus. Examples include:

- Organic and/or fair trade coffee and tea available at the Student Center and the library coffee shop.
- A vegan eggplant dish served at Memorial Hall which uses local ingredients.
- Locally produced dairy products are available.

A Geography Assistant Professor assigned his Culinary Tourism class a project on Fowler Produce, which is a supplier to CCSU. The project was an effort to: (1) help students understand how locally-produced food promotes sustainable local economies; and (2) help foster a connection between students, the food they eat, the people who produce it, and the land it is grown on.

In addition, a line of highly environmentally-friendly disposable paper products (manufactured by Greenwave) are in use at the Student Center.

No other examples of sustainability initiatives related to food services were observed on campus, though two of Sodexho's suppliers (Sysco and Fowler) have some sustainability-related initiatives. Refer to Section 11.2.3.

11.1.4 Potential Challenges

The largest challenge that CCSU faces in improving the sustainability of food service is that food service is contracted out to a large corporation (Sodexho) that has existing contracts in place. CCSU does not have direct control over food service decisions, which will make it more difficult to implement changes. Sodexho's General Manager at CCSU has demonstrated a willingness and interest both in improving

sustainability and soliciting feedback from the university community, but his ability to influence decisions made at the corporate level may be limited.

11.2 BASELINE AUDIT RESULTS

11.2.1 Quantitative Data

Quantitative data were not available during the audit (see Gap Analysis, below).

11.2.2 Gap Analysis

Quantitative data such as the average number of miles that food travels, percentage of food purchased locally, and total number of meals served were not provided.

11.2.3 Qualitative Observations

The Sodexho General Manager has demonstrated a willingness and interest in improving sustainability. He is participating on the sustainability committee, and has suggested improvements, including:

- Purchasing disposable containers made from recycled or renewable materials.
- Eliminating trays from the cafeteria to reduce dishwashing costs and discourage students from taking more food than they can eat.
- Redesigning the dishwashing system so that North and South dining facilities at Memorial Hall can share a single washer (redesign is currently underway). This could occur if a new dining facility is built or if the existing facility is renovated.

The Sodexho General Manager has also demonstrated a willingness to solicit feedback from the university community. A committee of resident students meets weekly and discusses menus, special events, and resident dining issues. A second committee meets monthly to discuss Food Service issues that affect the entire campus.

There is no current emphasis on minimizing solid waste. All of the food and beverage containers generated at Memorial Hall and the Student Center are thrown away, even those that are potentially recyclable. Food scraps from the kitchens and customers are also thrown away. The one food service byproduct that is recycled is grease. Grease is removed from campus by Baker Commodities who renders it into tallow; a raw material for commercial and industrial products. A local third party was at one time interested in taking the grease for processing into biofuel, but this did not materialize.

Table 11-1 presents information on Sodexho's food supply chain.

Table 11-1: Sodexho's Food Supply Chain

Supplier	Approximate Percentage of Food Supplied	Region of Operations	Evidence of Commitment to Sustainability
Sysco	80%	Sysco operates throughout North America. The regional distribution center for Sysco is located in Rocky Hill, CT, which is approximately 12 miles from CCSU.	According to Sysco, they are pursuing initiatives whose purpose is to contribute to "environmental sustainability and rural social vitality:" Sysco's ongoing commitment to integrated pest management has averted the use of 150 tons of active ingredient pesticides per year. Sysco plans to purchase more local produce from smaller farms. Sysco is a member of the newly formed Business Coalition for Sustainable Food. The Coalition recognizes the massive impact that large food corporations have on society and the environment, and commits its members to improving sustainability.
Guida's (Milk and Dairy Products)	5%	Southern New England, New York, and New Jersey.	No statement of sustainability.

Supplier	Approximate Percentage of Food Supplied	Region of Operations	Evidence of Commitment to Sustainability
Fowler & Huntting (Produce)	15%	Food is purchased worldwide, though emphasis is on purchasing as much locally as possible. In the summer, approximately 40% of produce comes from within a 250 mile radius. Fowler's distribution radius is approximately 150 miles from Hartford.	Fowler & Huntting cites the following reasons for their support of locally grown produce: "Purchasing locally encourages farmland preservation, enhances our historical culture, and beautifies our state. Purchasing locally supports our family farms and provides a true economic value to our local communities. Purchasing locally leads to a cleaner environment with less fuel burned when shipped from nearby farms. Purchasing locally grown produce promotes the use of less pesticides and chemicals, and provides for produce that is usually fresher and healthier. Purchasing locally promotes an added economic value with lower transportation costs."

11.3 BENCHMARKING

A review of food service sustainability initiatives on college campuses reveals common themes. These themes serve as both a benchmark for CCSU's current practices, as well as guidelines for improving sustainability at CCSU:

- Featuring meals that are based on local, in season ingredients. This maximizes the taste and nutritional value of food, improves the quality of life for students, supports the local economy, and minimizes the environmental impact associated with transporting food long distances.
- Purchasing food that is produced in a sustainable manner; one that benefits rather than degrades the health of workers, consumers, the local economy, and the environment. Pesticide use should be minimized through techniques such as organic growing or integrated pest management. Best management practices for animal waste, fertilizer, and pesticides should be employed to minimize impacts to water quality. Production should focus on taste and nutritional value rather than shelf life and durability.
- Reducing the waste generated by food service activities, and finding more responsible ways of managing the waste that is generated. This includes minimizing the use of disposable and

encouraging the use of reusable containers and utensils, minimize food waste, diverting food waste from the trash, and reducing energy consumption.

- Using the food service sustainability initiative as an opportunity to educate students about the connections between food, agriculture, the environment, economy, and society.

The following paragraphs present examples of how three campuses (the University of Southern Maine, Bridgewater State College, and Yale University) are implementing these concepts to improve the sustainability of their food service operations:

- **The University of Southern Maine (USM**), a peer institution of CCSU, has made progress toward improving the sustainability of dining services. Like CCSU, USM's food service is provided by an outside vendor (Aramark). USM is one of 25 Aramark accounts participating in a local produce purchasing pilot program. More than 28% of produce is purchased locally. USM food service is committed to providing local, organic, and seasonal choices where possible. Waste reduction is also a key component of USM's food service sustainability efforts. They provide reusable china and silverware at catered events, provide a discount for coffee customers that provide their own mug, and send their food waste to a local pig farm.

  USM is also testing a couple of new initiatives. They are involved in a trial project that eliminates trays to reduce waste and energy consumption, including recording data to verify the saving. They are also switching from plastic to compostable, corn-based containers for takeout and designing a system to sort and compost them.

- **Bridgewater State College** in Massachusetts is another peer institution of CCSU that has begun to look at campus sustainability. According to their sustainability plan, they have identified outsourced food services as an area requiring high priority action. They are working with their food suppliers (including Sodexho) to purchase more food that is locally and/or sustainably produced, and working to educate students about sustainable agriculture and understand their preferences for sustainable food choices.

- **Yale University** is a national leader in food system sustainability. The Yale Sustainable Food Project is an example of a well developed program which improves quality of life on campus and provides educational opportunities, while at the same time enhancing the local economy and environment. The Project "seeks to nourish a culture in which the pleasures of growing, cooking, and sharing food are integral to each student's experience at Yale." Highlights of the Project include composting of food waste, a one-acre organic farm on campus, and menu offerings featuring local, seasonal ingredients served year round in all of the dining facilities. The Project also provides educational opportunities to students through classes and internships, and to the larger community through workshops. Both the food and course offerings are extremely popular among students. The project has brought national attention to Yale and has been the subject of articles in the New York Times and the Wall Street Journal.

11.4 RECOMMENDATIONS

The following recommendations were based on the guidelines and benchmarking information presented above. In order to implement these recommendations, CCSU will need to work with the food service contractor (Sodexho).

- Work with suppliers and design menus that incorporate local, seasonal, and sustainably produced ingredients to the extent possible. Use signs and displays to advertise menu choices that highlight local food. Develop relationships with local producers.
- Try the suggestion of eliminating trays in the cafeteria to reduce food waste and dishwashing. Contact institutions (University of Hartford, University of Southern Maine) that are currently trialing this concept to find out if it is viable.
- Implement a system to divert food waste from trash to composting or animal feed. Contract with an outside vendor or implement composting on campus to provide organic soil amendment for landscaping and/or a university demonstration farm.
- Reduce the amount of disposable containers that are used. Suggestions include:
  - Providing pitchers of water at meetings and catered events instead of bottled water.
  - Provide reusable silverware and dishes at catered events instead of disposable.
  - Provide a discount for customers who provide their own mug or container at takeout facilities. Or test a system where students are given reusable containers for takeout and charged a refundable deposit.
- When disposable containers are desired, ensure that they are made from recycled and/or renewable materials, that they are recyclable or compostable, and that a system is in place for recycling or composting them. For example, the plastic bowls provided at the Student Center dining facility are #1 PET, which is recyclable, but no system exists for recycling them. Note that recycling plastic food containers may be a challenge because recycling services may require them to be washed. In this case, reusable or compostable containers might be better options.
- Minimizing energy use should be a criterion for purchasing equipment and designing new buildings and renovations for food service. For example, any design to renovate or replace the food service areas of the Memorial Hall should permit the use of a single dishwasher instead of the two that are required by the current floor plan.
- Use food service sustainability activities as an opportunity to educate students about the connections between food, environment, economy, and society:
  - Provide educational displays at dining facilities describing local ingredients, energy conservation, and waste reduction efforts.
  - Incorporate information about food service sustainability activities into the sustainability web site.
  - Build on the efforts of the Geography Assistant Professor to incorporate food service sustainability into classroom curricula.
  - Consider establishing a university demonstration farm on campus to provide students with hands-on experience in sustainable/organic practices.
- Incorporate the sustainability guidelines and recommendations presented here into Sodexho's contract when it comes up for renewal in eight years.

12. RECOMMENDATIONS FOR SUSTAINABILITY WEBSITE

12.1 A SUSTAINABILITY WEBSITE IS CRUCIAL TO EDUCATION AND COMMUNICATION

CCSU has expressed a strong interest in developing a sustainability website that communicates the various aspects of the University's nascent sustainability program to the entire University community (and beyond). CCSU is correct in believing that a good website will be an essential educational tool for ensuring buy-in from various stakeholders and heightening the overall awareness of environmental issues on campus. Based on the information gathered during the baseline report, we recommend that CCSU's sustainability website contain the following content. Our recommendations are also based on other campus sustainability websites that have been successful at other green institutions.

12.2 RECOMMENDATIONS FOR WEBSITE CONTENT

12.2.1 Main Page

The main page of the website should be eye-catching, particularly for students. It should convey the name of the sustainability initiative at CCSU (e.g., Green Campus or CCSU Sustainability Program, etc.) and make visitors to the site interested in learning more about sustainability on campus. Examples of excellent "front page" website materials include:

- Title Graphic and Sustainability Program Logo
- CCSU's Environmental Sustainability Mission Statement or Policy Statement
- Updates on Upcoming Events (e.g., Earth Day, speakers, etc.)
- New Articles or Press Releases
- Search Feature, User-Friendly Menus, and Contact Information
- Recycling Page (like Craig's List) were students, faculty, etc. can post items that are available for sale/trade.

12.2.2 Recycling and Solid Waste Reduction

This page should provide students and other campus members with all of the information they need on how to recycle certain waste streams (for example, describing what to do with waste cell phone batteries). This page should also include relevant data and information on how much CCSU is already recycling. This page could also include:

- Information on campus recycling procedures for various material streams
- Suggestions for reducing waste such as printing double-sided and using re-useable food containers
- Annual recycling statistics
- Contact information for recycling questions, issues, and requests
- Answers to frequently asked recycling questions

- Lists of furniture, equipment, and other items available for reuse. This could be simple text list which is periodically updated by the Facilities department, or it could be a database with a web front-end allowing anyone in the campus community to post unwanted items or search for items they need.
- Links to web resources outside of CCSU, including Connecticut DEP recycling information, Recyclemania,[64] and the College and University Recycling Council.[65]
- Descriptions of programs that have been successful on campus and the people responsible for them.

12.2.3 "Welcome to the Energy Center at CCSU"

This page could be devoted entirely to energy use on campus and the campus energy center. It should have energy conservation facts and tips, as well as data on how much energy the campus currently uses. This page should also be a way for the University to communicate how it has already enacted energy conservation measures.

There are numerous great campus sustainable energy websites that CCSU can look to for examples and tips. Williams College, for example, has an excellent site which displays real-time electricity use by building.[66] Most websites describe the campus physical plant, type of equipment used, type of fuels used, sources of electricity, and historical trends in quantity of fuels and electricity used and resulting GHG emissions. Some websites also describe on-going energy efficiency programs, promote student energy reduction contests, provide awareness training and describe current conservation projects and upgrades. Harvard University's Green Campus Initiative is one example of a website that contains all of these elements.[67]

12.2.4 Water

One of our primary recommendations in this report is launching a water conservation educational campaign designed to educate members of the University community about ways to conserve water. The website should include a page that is totally devoted to water conservation, as well as information on stormwater, surface water, and wastewater. The ultimate goal should be for students to leave the water page with a greater appreciation for how important water conservation is, as well as specific steps for how they can use less water (e.g., taking shorter showers).

---

[64] http://www.recyclemaniacs.org/

[65] http://www.nrc-recycle.org/councils/CURC/default.htm

[66] Williams College Sustainability website: http://www.williams.edu/resources/sustainability/electricity_buildings.php?form=dorm.

[67] For more information see Harvard's Green Campus Initiative webpage: http://www.greencampus.harvard.edu/ggi/.

CCSU has implemented some water conservation fixtures in some of the campus's buildings, and the website could provide some additional information about how much money those features save the campus, both in terms of water use and annual costs. Additionally, as CCSU intends to install more water and energy efficient washers in the Summer of 2007, the website could contain information about amounts of water saved by these new machines, either per load, or as an annual approximation. It is good for students to be reminded of how much water is used during clothes washing.

12.2.5 Green Purchasing

A page devoted to green purchasing can educate members of the campus community on ways to be green consumers, as well as specific methods for reducing overall consumerism. There are at least two groups that are important to reach with respect to communicating sustainable purchasing practices to the University community: (1) students; and (2) faculty/staff with procurement cards. If CCSU develops a "green campus website" to provide information to the University community about sustainability initiatives, this website can be used as a forum to educate students on how the University attempts to buy green and include sustainability considerations in its purchases. This will help educate and inspire students, who are current consumers/purchasers and who will soon be young professionals that may have their own purchasing responsibilities. The website should also publicize the green purchasing strategies that Purchasing has established and follows.

Another important group to reach out to on the website is the faculty/staff members who have p-cards. Educating these individuals on the University green purchasing policies (if any are developed), as well as ways to save money while being sustainable, will help to ensure that purchasing practices throughout the entire University become more sustainable.

To effectively reach these two groups of individuals, CCSU's sustainability website should/could contain:

- A list of CCSU's current purchasing practices that support sustainability (this report could be used as a source for them);
- A list of tips/tricks for faculty/staff members with p-cards to purchase more sustainably, including a reminder to check with other departments to see if materials can be shared or purchased in bulk;
- Specific information about the type of post-consumer recycled paper that the University should purchase (based on a paper purchasing policy, if CCSU decides to adopt one as part of its EPP policy).
- Tips/reminders to encourage students to think about their purchasing, to avoid waste, increase the use of durable goods, purchase post-consumer recycled materials, and to reduce packaging materials.
- Links to other campus sustainability websites that address purchasing (e.g., Harvard, University of Colorado at Boulder, etc.).
- Include links to other areas of the sustainability website, to help bridge the gap between purchasing decisions and other areas of sustainability (i.e., reminding purchasers that Energy Star products should be prioritized when making appliance purchases.
- Feature facts on how the campus is saving money from sustainable purchases (See "Gap Analysis" section, above).

The website could also include "consumer" facts that might interest students, such as a recent survey that indicates that 93% of college students agree that "American consumers can conserve resources, protect workers, and build a better world by shopping carefully for environmental and fair trade products."[68]

12.2.6 Feedback

Because stakeholder engagement is so crucial, there should be a mechanism whereby CCSU stakeholders can voice their sustainability concerns, brainstorm, and offer suggestions for program improvement. Feedback could be restricted to University faculty, staff, and students with current CCSU e-mail accounts. This would prevent unsolicited feedback from non-University groups. Ideally, the feedback should be submitted to the group at CCSU who is responsible for sustainability program implementation (e.g., Sustainability Committee), or a Sustainability Director, if CCSU decides to hire one.

12.2.7 Get Involved

Similar to the feedback page, this page should serve as a way to engage CCSU stakeholders. Hopefully, as aspects of CCSU's growing sustainability program continue to evolve, additional members of the campus community will express an interest in becoming more actively involved in program implementation. There should be a mechanism for students (and others) to volunteer their time, and the "Get Involved" page should indicate how they can do this (even if it is as simple as contacting a sustainability point person).

12.2.8 Links and Resources

All good websites usually include a page that includes links to other similar sites or additional educational resources. Examples of links that could be included in this page include:

- AASHE Digest: http://www.aashe.org/resources/pdf/AASHEdigest2005.pdf;
- Campus Ecology website (National Wildlife Federation);
- Other campus sustainability websites (e.g., Harvard Green Campus Initiative: http://www.greencampus.harvard.edu/ggi/); and
- Other links and websites referred to in this report (see Sections 3-12).

12.3 IMPLEMENTATION

In order for the website to be successful, CCSU will need to devote staff time to ensuring that the website is developed and continuously maintained. It is up to CCSU to determine who may be interested in assuming this responsibility. Also, Woodard & Curran has maintained web-based tools and sites for clients and would be more than happy to talk to CCSU about web-development and hosting services. A

[68] http://www.aashe.org/resources/pdf/AASHEdigest2005.pdf

sustainability website can also be streamlined with an Environmental Management System, where environmental sustainability baseline data can also be tracked.

APPENDIX A: PRE-AUDIT QUESTIONNAIRE AND DATA REQUEST

CENTRAL CONNECTICUT STATE UNIVERSITY

PRE-ENVIRONMENTAL SUSTAINABILITY BASELINE AUDIT

QUESTIONNAIRE AND DATA REQUEST

FOR AUDIT MARCH 2007

The Pre-Environmental Sustainability Audit Questionnaire and Data Request are intended to gather some background information about potential environmental impacts at your university. The first section of the questionnaire contains general questions. Subsequent sections ask for more detailed information in specific areas and media. Accurate and timely completion is greatly appreciated.

Information requested here provides preliminary data that will help Woodard & Curran plan and conduct the environmental sustainability audit. Some of these questions will be asked during the on-site portion of the audit, but completing the questionnaire will help us make more efficient use of time spent on-site and may decrease the amount of assistance we will require from university personnel during our audit. Some information required for the environmental sustainability audit is similar to the information required for the environmental compliance audit. Conversely, some areas that Woodard & Curran will assess during the environmental sustainability audit (i.e., construction, landscaping, sustainable building design, etc.) are not listed here as they are more effectively addressed during the on-site portion of the environmental sustainability audit, through interviews and visual observations.

If you are uncertain as to how to respond to a certain question, please feel free to call us or describe in a brief narrative the basis for your uncertainty. While we have provided space under each question for answers, CCSU can also provide actual records and documents.

General Information

1. Please provide data on number of students, number of faculty, and number of staff at the campus for the past five years. If this information is provided in a publication or a website, please provide the publication or the URL. **[Institutional Planning, Student Affairs]**

2. Of the number of students, please indicate how many are commuting students and how many live on campus. **[Institutional Planning, Student Affairs]**

3. Please provide data on building area (square feet) for each building on campus. Please provide a building inventory (name of building, size, etc.) if one is available. **[Dan Moran, Bob Lebaron]**

Energy Use and Air Emissions

1. Please provide a copy of CCSU's most recent renewal application for its General Permit to Limit Potential to Emit (GPLPE). **[Dom Forcella, Bob L.]**

2. Please provide copies of any New Source Review (NSR) permits issued by CTDEP for air emissions sources at CCSU. **[Dom F., Bob L.]**

3. Please provide electricity usage data (i.e., kilowatt-hours used monthly and/or annually) for the past five years. If this information is available per building, please provide this breakdown. **[Finance]**

4. How is electricity consumption on campus measured? Are electricity meters installed on individual buildings or groups of buildings? **[Finance]**

5. Please provide copies of any energy audits that were performed of individual buildings (or the entire) campus. Who performed this audit? **[Dan M.]**

6. Please provide copies of any feasibility studies that may have been performed prior to the construction of the cogeneration equipment. **[Dan M.]**

7. Please indicate if CCSU purchases any electricity from renewable energy sources. Please indicate how much was purchased over the past 2-3 years. **[Bob L., Rob Gagne]**

8. Has CCSU purchased any renewable energy credits? **[Rob Gagne]**

9. Please provide an inventory (or map) of outside lighting on campus? What is the typical type of fixture and bulb used in this lighting? **[Police Department, Electricians (Bob L.), also – see recent Vulnerability Analysis document that was prepared for campus.]**

10. What types of fuels are stored/burned on campus? Please provide data on fuel consumption (e.g., barrels of oil used annually, ft3 of natural gas, etc.) for the past five years. **[Rene]**

11. Does CCSU use any passive or solar energy? Thermal energy? Wind energy? **[Rob G.]**

12. Please provide an inventory of the large equipment on campus (e.g., chillers, boilers, generators, etc.), including ratings (kW output of MMBtu/hr heat input and efficiency) and types of fuel burned in each. This information is likely contained in your air emissions inventory for your GPLPE. **[Bob L., Ron McCullen, Rob G.]**

13. Please indicate if any equipment is fueled with alternative fuels (e.g., biodiesel, methane, wind, etc.). **[Rob G.]**

14. Please provide the campus's (actual) air emissions of regulated hazardous air pollutants for the past 5 years and copies of any air emission reports submitted to CTDEP. **[Dom F.]**

15. Please provide a list of the exempt/trivial sources of air emissions (e.g., fume hoods, spray booths, etc.). If these are listed in your air permit, please provide a copy of the permit.

16. Please provide data on any past or current energy conservation programs and energy management systems (i.e., program investment, energy/cost saving, etc.).

17. Please provide a list of the energy-conserving equipment on campus (e.g., occupancy sensor lighting) and energy-efficient equipment (i.e., computers, monitors, printers, fax machines, copiers, washers, dryers, etc.).

18. Does all computer equipment meet EPA's Energy Star or other energy saving requirements for energy efficiency? **[Lisa Rickie, Amy Magno, System Office, Purchasing]**

19. Has CCSU completed any de-lamping or re-lamping projects to eliminate unnecessary/excessive lighting or to change the type of lights used (e.g., re-lamping from standard fluorescent lights to low-mercury lights)? **[Dan M.]**

20. Please provide a list of the types of refrigerants used on campus (e.g., R-134A, R-22) and the equipment that uses refrigerants (e.g., chillers, motor vehicle air conditioners, etc.). **[Rob G.]**

21. Please provide the amount (in pounds) of ozone-depleting substances (ODS) used and recovered. **[Rob G.]**

22. For each type of fuel-burning equipment (boilers, generators, vehicles, etc.), please list the types of fuels used and the % sulfur in each fuel (i.e., 0.05% diesel used in emergency generators). **[Rob G.]**

23. Please provide a list of typical indoor air quality complaints. **[Dom F.]**

24. Please provide results from any asbestos surveys (these records can be reviewed on-site and do not need to be provided beforehand). **[Dom F.]**

Solid Waste & Recycling

1. What materials are recycled at CCSU (i.e., cardboard, white paper, newspaper, metal, batteries, lamps, furniture, cans, etc.)? **[Dom F., Frank Scarlett, Rene]**

2. Please provide solid waste generation and recycling data for the past five years (i.e., quantities of solid waste generated, types and quantities of solid waste recycled, etc.). Please categorize this data by type of waste, if possible. **[Dom F., Frank Scarlett, Rene]**

3. Please provide the amount of "dorm" waste generated at the end of the school year (or semester). Are dumpsters provided for students? How many dumpsters? What size? How many times are they filled and removed? **[Fred Bonvicini (Residential Life), Jane Higgins (Student Affairs)]**

4. Who provides waste hauling services for CCSU? **[Dom F.]**

5. Please provide the number (or weight) of computers and computer components disposed, sold, and recycled each year for the past 5 years, including CPUs, monitors, and printers (no need to break down the amount of each component). **[Dom F.]**

6. Are there any programs to compost organic waste (i.e., food waste, landscaping waste)? **[Don D. (Sodexho)]**

7. Does CCSU provide any opportunities for material reuse (solvent reuse program between science departments)? **[Paul Altieri, Guy Crundwell, Vincente Garcia]**

Water Use

1. Please provide data on water usage (e.g., gallons used monthly and/or annually) for the past five years by campus or building. **[Dan M.]**

2. How is water usage measured? Are water meters installed on individual buildings or groups of buildings? Where are the locations of all of the water meters on campus? **[Dan M.]**

3. Does the campus use any water in heating processes? If so, please provide data, if known, on the amount of water use for heating. **[Dan M.]**

4. What is the current cost/gallon (or per 1,000 gallons) for water at CCSU? **[Dan M.]**

5. Please provide a list of water conservation measures in place (e.g., low-flow faucets, automatic flush toilets, etc.). **[Dan M.]**

6. Please provide available data on water usage for irrigation of athletic fields, if available. Please include a list of all areas irrigated on campus, along with approximate times that irrigation occurs at each area. **[Frank Scarlett]**

7. How many laundry facilities are located on the campus? How many washing machines are located in each area? What is the make/model of each washing machine? Are they top load, front load, and/or high efficiency? **[Athletics – Michael Ansarra, Fred B. (Residential Life)]**

8. How many buildings on campus are equipped with low-flow toilets? For the older toilets, what is the most common type of toilet in the older buildings? What is the gallons per flush for these toilets? **[Dan M., Rob G.]**

9. How many dorms or athletic buildings have low-flow showerheads? **[Dan M., Rob G.]**

10. How many buildings have low-flow faucets? **[Dan M., Rob G.]**

11. How many dishwashers are on campus? What is the type and water use per load for each dishwasher? **[Dan M., Rob G.]**

12. Please provide the amount of water (GPD or GPM) used on campus for extractive use (drinking water or process wells). **[Dan M., Rob G.]**

13. How many cooling water towers are located on campus? What is the size of each? **[Dan M., Rob G.]**

14. Are there any water or graywater reuse programs/facilities on campus? **[Dan M., Rob G.]**

15. How many sprinkler systems are located on campus? When are they used? How often are they run per day? Also, what is the water used in the fire pump stations? **[Craig Nolan]**

16. Are there any plans for construction/renovation in the near future? If so, have plans for water conservation been incorporated into these plans? **[Dan M.]**

Purchasing

1. Please provide data on how much white paper is purchased on a monthly or annual basis for the past five years. **[Tom Brodeur]**

2. Is there a way to determine how much (in terms of pounds or total $) materials are purchased by CCSU on an annual basis? Materials include office supplies, fuel, vehicles, food, furniture, interior accents (e.g., carpeting, furniture, fixtures, etc.), computers printers, chemicals, pesticides, etc. The focus should be on the materials that are purchased in the greatest quantity,

as well as the materials that generate the most amount of waste at the end of their life. **[Tom Brodeur]**

3. Is there a central purchasing department that orders supplies for the entire campus or do individual department order their own supplies? **[Tom Brodeur]**

4. Please indicate if there are any purchasing/procurement procedures for green purchasing or buying environmentally-friendly items. **[Tom Brodeur]**

5. Does CCSU have any policies to reduce material use (i.e., paper conservation, encouraging use of reusable bags, coffee mugs, etc.)? **[Tom Brodeur, Don R.]**

6. Does CCSU have any policies to encourage purchase of materials that are recyclable or biodegradable? **[Tom Brodeur]**

Hazardous/Chemical Waste

1. Please provide any data on the amount (in pounds) of the following waste streams generated in the past 5 years: **[Dom F.]**

   Hazardous Waste;

   Universal Waste;

   Used Oil;

   Oily Rag Waste;

   Metal Waste;

Non-Hazardous Chemical Waste;

Biomedical Waste;

Acutely Toxic Waste; and

Radioactive Waste.

Darkroom Waste **[Sandy, Ron Todd]**

2. Please indicate if there are any solvent recovery or other types of waste recovery/recycling systems. **[Dom F., also art/science department chairs]**

3. Please provide data on the amount of scrap metal that has been recycled per year for the past 5 years.

Building Design, Demolition, and Construction

1. Please provide the amount (in tons) of demolition and construction debris generated in recent projects. **[Dan M.]**

2. Please indicate how many construction projects are currently underway on campus. **[Dan M.]**

3. How many buildings are LEED certified? To what level? **[Dan M.]**

4. How many building were (or are being) constructed to adhere to green building practices? **[Dan M.]**

5. What is the percent of materials recycled from recent renovations and demolitions? **[Dan M.]**

Property Maintenance, Landscaping & Pesticides

1. Please indicate the number of native and non-native species on campus, if this information is available. **[Frank S.]**

2. Please provide information on any campus policies pertaining to plantings or pesticide use. **[Frank S.]**

3. Please list the Integrated Pest Management procedures/methods currently employed on campus? **[Frank S.]**

4. What is the percent and total acreage of the campus that is managed for habitat conservation? **[Frank S.]**

5. Please indicate (or provide maps that show) the amount/percent of impermeable surface on campus. **[Dan M., Bob L.]**

6. Please list the location and size of any green roofs on campus, if any. **[Dan M.]**

7. What chemicals does the campus use for ice melt (please provide MSDS), and how/where are they stored? **[Rene, Frank S., Rob G., Paul Borowski]**

8. Please provide the number of acres that require irrigation. What water source is currently used for irrigation on campus? **[Frank S.]**

9. Please list the amount of landscaping debris that is generated (on average) every year. How much of this debris is composted or reused? **[Frank S.]**

10. Are there any composting systems currently in place on campus? If so, where, and what capacity? **[Frank S.]**

11. Are there any on-campus gardens used for growing produce to be consumed on-campus? If so, how much and what produce is grown there? **[Frank S.]**

Transportation

1. What are the policies for students with cars? Are all students allowed to have cars on campus? **[Student Affairs, Chris Cervoni – Police]**

2. What percentage of students on each campus commute? **[Institutional Planning, Student Affairs]**

3. What percentage of students on each campus live on campus? **[Institutional Planning, Student Affairs]**

4. Are there any ride share, car pool, or biking programs in place for commuting students/faculty/staff? **[Institutional Planning, Student Affairs]**

5. Does CCSU have a shuttle bus service to transport students around the campus and/or to satellite parking lots? What fuel do the buses run on and what is the make/model year of the buses? **[Institutional Planning, Student Affairs]**

6. Please provide a vehicle list for the vehicles maintained and used at each campus (i.e., trucks, buses, utility vehicles, etc.). Include any information concerning alternative fuel vehicles owned by CCSU). **[Chris C., Rene]**

7. Please provide the fuel efficiency (miles per gallon) for each vehicle in the vehicle fleet. **[Rene]**

8. Please indicate the type of fuel used by each vehicle (e.g., regular unleaded, diesel, etc.). **[Rene]**

9. Are there any hybrid or alternative-fueled vehicles on campus? **[Rene]**

10. How much parking space is available on each campus? Are the number of parking permits (if any) issued to faculty, staff, and students comparable to the amount of parking spaces available? **[Student Affairs, Chris C.]**

11. Does CCSU use its own buses/vehicles to transport sport teams or are buses rented? If CCSU uses its owns vehicles, please provide a list of the vehicles and mileage data for the past five years. **[Chris C.]**

12. Does CCSU or the City of New Britain have planning policies that encourage bicycle and pedestrian friendly development? **[Chris C.]**

13. Does CCSU or the City of New Britain have a bicycle and pedestrian coordinator, a bicycle and pedestrian advisory committee, and a bicycle and pedestrian plan? **[Chris C.]**

14. Does the CCSU or the City of New Britain have standards for pedestrian facilities, such as crosswalk standards, minimum sidewalk widths, requirements for sidewalks in new developments? Approximately what percentage of sidewalks on campus are ADA compliant? **[Chris C.]**

15. Does the CCSU or the City of New Britain have standards for bicycle facilities, such as minimum widths for bike lanes, wide curb lanes, bike-specific signs, bike racks? **[Chris C., Student Affairs]**

16. Do all major campus building have bike racks? Are they covered and located in safe (well lit and well traveled) locations? **[Chris C., Student Affairs]**

Food Service Operations

1. Who are the primary food suppliers to campus? Where do they ship from? **[Don R.]**

2. Who are the primary food service equipment suppliers to campus? Where do they ship from? **[Don R.]**

3. Does the campus purchase any organic food or food that is Fair Trade Certified? How much? **[Don R.]**

4. Is any food waste composted? How much? **[Don R.]**

5. Please estimate (or provide data for) the amount of food waste generated per month or per year. **[Don R.]**

6. How much of the food-related products (e.g., napkins, paper products, utensils) have post-consumer content or are reused/recycled after use? **[Don R.]**

7. How much waste kitchen grease is generated per month? Of this, how much is recycled or used in biodiesel generation? **[Don R.]**

8. What is the energy efficiency of the appliances used in the dining hall areas (this information may be gathered by auditors while on-site)? **[Don R.]**

9. How many vending machines are located on campus? Please provide the number and location. **[Amy M.]**

APPENDIX B: LABORATORY WASTE MINIMIZATION FACT SHEETS

Waste Minimization Fact Sheet #1
101 Ways to Reduce Hazardous Waste in the Laboratory

1. Write a waste management reduction policy
2. Include waste reduction as part of student employee training
3. Use manuals such as the American Chemical Society's ACS Less is Better or ACS Waste Management Manual for Laboratory Personnel as part of your training
4. Create an incentive program for waste reduction
5. Centralize purchasing of chemicals through one person in the laboratory
6. Inventory chemicals at least once a year
7. Indicate in the inventory where chemicals are located
8. Update inventory when chemicals are purchased or used up
9. Purchase chemicals in smallest quantities needed
10. If trying out a new procedure try to obtain the chemicals needed from another laboratory or purchase small amounts initially After you know you will be using more of these chemicals purchase in larger quantities unless you can obtain excess chemicals from someone else
11. Date chemical containers when received so that older ones will be used first
12. Audit your laboratory for waste generated quantity type source and frequency Audit forms are available from DRS Chemical Safety Section
13. Keep MSDSs for chemicals used on file
14. Keep information about disposal procedures for chemical waste in your laboratory on file
15. If possible establish an area for central storage of chemicals
16. Keep chemicals in your storage area except when in use
17. Establish an area for storing chemical waste
18. Minimize the amount of waste kept in storage Request a chemical pickup as often as you need
19. Label all chemical containers as to their content even those with only water
20. Keep halogenated solvents separate from non halogenated solvents
21. Keep recyclable waste excess chemicals separate from non recyclables
22. Keep organic wastes separate from metal containing or inorganic wastes

23. Keep nitric acid waste separate from other inorganic acid wastes

24. Keep hydrofluoric acid waste separate from other inorganic acid wastes

25. Keep nonhazardous chemical wastes separate from hazardous waste

26. Keep highly toxic wastes cyanides etc separated from the previous groups

27. Avoid experiments that produce wastes that contain combinations of radioactive biological and or hazardous chemical waste

28. Keep chemical wastes separate from normal trash paper wood etc

29. Develop procedures to prevent and or contain chemical spills purchase spill cleanup kits contain areas where spills are likely to occur

30. Use the least hazardous cleaning method for glassware Use detergents such as Alconox Micro RBS35 on dirty equipment before using KOH ethanol bath acid bath or No Chromix

31. Eliminate the use of chromic acid cleaning solutions altogether See Waste Minimization Fact Sheet No 3 for more information

32. Eliminate the use of uranium and thorium compounds naturally radioactive

33. Substitute red liquid spirit filled digital or thermocouple thermometers for mercury thermometers where possible

34. Use a bimetal or stainless steel thermometer instead of mercury thermometer in heating and cooling units Stainless steel laboratory thermometers may be an alternative to mercury thermometers in laboratories as well

35. Evaluate laboratory procedures to see if less hazardous or nonhazardous reagents could be used

36. Review the use of highly toxic reactive carcinogenic or mutagenic materials to determine if safer alternatives are feasible

37. Avoid the use of reagents containing arsenic barium cadmium chromium lead mercury selenium and silver

38. Consider the quantity and type of waste produced when purchasing new equipment

39. Purchase equipment that enables the use of procedures that produce less waste

40. Review your procedures regularly e g annually to see if quantities of chemicals and or chemical waste could be reduced

41. Look into the possibility of including detoxification and or neutralization steps in laboratory experiments

42. When preparing a new protocol consider the kinds and amounts of waste products and determine whether they can be reduced or eliminated

43. When researching a new or alternative procedure include consideration of the amount of waste produced as a factor

44. Examine your waste excess chemicals to determine if there are other uses in your laboratory. Neighboring laboratories departments or non laboratory areas garage paint shop art department might be able to use them

45. Review the ChemCycle list of chemicals available for redistribution or contact the chemical recycling coordinator 4-7213 to see if chemicals needed are available before purchasing chemicals

46. Inform the chemical recycling coordinator of the types of materials you can use from the recyclables

47. Call the chemical recycling coordinator to discuss setting up a locker or shelf for excess chemical exchange in a laboratory stockroom or hallway in your department

48. When solvent is used for cleaning purposes use contaminated solvent for initial cleaning and fresh solvent for final cleaning

49. Try using detergent and hot water for cleaning of parts instead of solvents

50. Consider using ozone treatment for cleaning of parts

51. Consider purchasing a vapor degreaser vacuum bake or bead blaster for cleaning of parts

52. Reuse acid mixtures for electropolishing

53. When cleaning substrates or other materials by dipping process multiple items in one day

54. Use the smallest container possible for dipping or for holding photographic chemicals

55. Store and reuse developer in photo laboratories

56. Precipitate silver out of photographic solutions for reclamation

57. Neutralize corrosive wastes that don't contain metals at the laboratory bench

58. Deactivate highly reactive chemicals in the hood

59. Evaluate the possibility of redistillation of waste solvents in your laboratory

60. Evaluate other wastes for reclamation in your laboratory

61. Scale down experiments producing hazardous waste wherever possible

62. In teaching laboratories consider the use of microscale experiments

63. In teaching laboratories use demonstrations or video presentations as a substitute for some student experiments that generate chemical wastes

64. Use pre weighed or pre measured reagent packets for introductory teaching laboratories where waste is high

65. Include waste management as part of the pre and post laboratory written student experience

66. Encourage orderly and tidy behavior in laboratory

Use the following substitutions where possible:

Original Material	Substitute	Comments
67. Acetamide	Stearic acid	In phase change and freezing point depression
68. Benzene	Alcohol	
69. Benzoyl peroxide	Lauryl peroxide	When used as a polymer catalyst
70. Carbon tetrachloride	Cyclohexane	In test for halide ions
71. Formaldehyde	Peracetic acid	In cleaning of kidney dialysis machines
72. Formaldehyde	Formalternate Flinn Scientific	For storage of biological specimens
73. Formaldehyde	Ethanol	For storage of biological specimens
74. Formalin	See Formaldehyde	
75. Halogenated Solvents	Nonhalogenated Solvents	In parts washers or other solvent processes
76. Mercuric chloride reagent	Amitrole (Kepro Circuit Systems)	Circuit board etching
77. Sodium dichromate	Sodium hypochlorite	
78. Sulfide ion	Hydroxide ion	In analysis of heavy metals
79. Toluene	Simple alcohols and ketones	

Original Material	Substitute	Comments
80. Wood's metal	Onions Fusible alloy	
81. Xylene	Simple alcohols and ketones	
82. Xylene or toluene based liquid scintillation cocktails	Nonhazardous proprietary liquid scintillations cocktails	In radioactive tracer studies
83. Mercury salts	Mercuryfree catalysts (e.g.CuSO 4 TiO 2 K 2 SO 4 3)	Kjeldahl digests

84. Use best geometry of substrate carriers to conserve chemicals

85. Polymerize epoxy waste to a safe solid

86. Consider using solid phase extractions for organics

87. Put your hexane through the rotavap for reuse

88. Destroy ethidium bromide using household bleach see Waste Minimization Fact Sheet No 7

89. Run mini SDS PAGE 2d gels instead of full size slabs

90. Treat sulfur and phosphorus wastes with bleach before disposal

91. Treat organolithium waste with water or ethanol

92. Seek alternatives to phenol extractions e g small scale plasmid prep using no phenol may be found in Biotechnica Vol 9 No 6 pp 676 678

93. Collect metallic mercury for reclamation

94. Investigate possibility for recovering mercury from mercury containing solutions

95. Recover silver from silver chloride residue waste and gold from gold solutions

96. Purchase compressed gas cylinders including lecture bottles only from manufacturers who will accept the empty cylinders back

97. When testing experimental products for private companies limit donations to the amount needed for research

98. Return excess pesticides to the distributor

99. Be wary of chemicals donations from outside the University. Accept chemicals only if you will use them within 12 months

100. Replace and dispose of items containing polychlorinated biphenyls PCBs

101. Send us other suggestions for waste reduction by campus mail or email to css@uiuc.edu

Waste Minimization Fact Sheet #2
Reducing or Eliminating the Use of Heavy Metals

Metals of concern due to their toxic characteristics are arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver. These are often found in corrosive liquids such as acids.

Possible ways of reducing or eliminating these metals include:

- Review all procedures for elimination or reduction of quantities of metals used. The use of microscale equipment or increased instrumentation can reduce the quantities of waste generated.
- Teaching labs can substitute less hazardous metals for those experiments involving heavy metals. Or a laboratory which brings the raw material through a series of steps to the product and then back to the raw material again can eliminate disposal of that metal.
- Metals used as catalysts can be eliminated by simply allowing more time for the reaction to come to completion.
- Precious and semiprecious metals can be precipitated out of solution. For instance the reclamation of silver from photographic solutions is a very common practice.
- Additional waste minimization ideas for chromium and mercury can be found in Waste Minimization Fact Sheets Nos. 3 and 4 respectively

If you have found other suitable alternatives to heavy metal use please notify us. For further assistance please call 4-7213 or contact us via email.

References:

Bush, K.J. and H. Diehl. "Recovery of silver from laboratory wastes." Journal of Chemical Education 56 1 pp. 54 55 1979

Chohji, T., et.al. "Removal efficiency of heavy metals from laboratory wastewater containing ligands by an aluminum hydroxide co precipitation system." Environmental Technology Vol. 11 pp 421 428 1990

Foust, D.F. "Recovery of silver and cobalt from laboratory wastes." Journal of Chemical Education 64 p. 924 1984

Gajda, A. "Disposal of mercury in chloride reagent waste." Clinical Chemistry Vol. 25 5 p 807 1979

Mills, J. and Hampton, M. Microscale Laboratory Manual for General Chemistry. Random House Inc., 201 E 50th New York, NY 10022. 1988

National Research Council Prudent Practices for Disposal of Chemicals from Laboratories National Academy Press, Washington DC 1983

APPENDIX C: SAMPLE GREEN BUILDING POLICIES

CONNECTICUT COLLEGE GREEN BUILDING POLICY

Environmental Model Committee
November 2000, Revised February 2004
Revised by senior administrators April 2004
Revised by Hammond, Dreyer, George and Turcotte December 7, 2004

In order to reduce its environmental impact and improve the quality of the residential and work environment **and** to maintain its position as a model for environmental stewardship and as a resource for environmental education the College will**,** for new building and major renovation projects, implement the following when appropriate and practical:

- Use a recognized set of green building guidelines, such as LEED[1].
- Use green building materials and recycled materials, green cleaning products and maintenance methods;
- Use energy efficient systems for heating, lighting and transportation which exceed local and national standards for conservation and green house gas emissions; where possible use alternative sources of energy;
- Install water-conserving systems and products and do appropriate plantings;
- Improve indoor air quality through the use of appropriate building materials, ventilation and filtration systems.

In applying this policy, the College will:

- Form a "green team" for new building construction and major renovation projects. This team will help sustain the green building objectives throughout pre-design, design, construction, and occupancy stages of the life cycle of the building; after construction, the building will be monitored during the occupancy and demolition stage by the EMC to ensure that the operation and maintenance is appropriate to keep the buildings within the sustainable "green building" frame of reference;
- Use three types of analyses that balance environmental and cost considerations to determine optimal systems and components of a new or renovated building: 1) a life cycle analysis of the environmental impact; 2) a pay back analysis to determine the length of time to recover the investment; and 3) a cost benefit analysis.
- With participation of the Environmental Model Committee, do an assessment of the need for renovation of existing systems and structures in order to improve energy efficiency and reduce green house gas emissions.

.

(Footnotes)
[1] LEED – Leadership in Energy and Environmental Design is a rating system developed by the US Green Building Council which provides a definitive standard for what constitutes a "green" building. It is used to evaluate the overall environmental performance of a building over its entire life cycle.

UNIVERSITY OF CALIFORNIA

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO

SANTA BARBARA • SANTA CRUZ

OFFICE OF THE PRESIDENT

Robert C. Dynes
President

1111 Franklin Street
Oakland, CA 94607-5200
Phone: (510) 987-9074
Fax: (510) 987-9086
http://www.ucop.edu

June 16, 2004

CHANCELLORS

Policy on Green Building Design and Clean Energy Standards

Dear Colleagues:

Enclosed is a new policy that underscores the University's commitment to reducing environmental consequences when designing and constructing new buildings and renewing existing structures. As efficient energy use is a central element of sustainability, it is expected that implementation of this policy will also provide a means to help stabilize this portion of campus budgets.

This policy derives from the July 17, 2003 Regents' approval of the recommendation of the Committee on Grounds and Buildings to authorize the President:

1. To adopt as University policy for all capital projects the principles of energy efficiency and sustainability within budgetary constraints and regulatory and programmatic requirements;

2. To implement programs to reduce consumption of non-renewable energy by creating a portfolio approach to energy use, including energy efficiency, local renewable power and green power purchases from the grid, with the intent of minimizing increased use of non-renewable energy for the University's built environment during this next decade of growth; and

3. To develop and implement this policy for all proposed and existing University facilities and provide an annual report to The Regents that examines the impacts on energy utilization and building design and the effects of this policy on capital and operating costs.

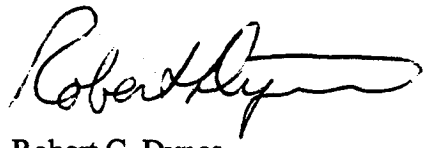
This policy was developed by the Green Building Design and Clean Energy Standards Steering Committee, consisting of administrators from several campuses and the Office of the President, faculty members with expertise in these disciplines, and officials from the California Energy Commission and the state Consumer Services Agency. It also reflects input from student representatives, Greenpeace, the U.S. Green Buildings Council and the Center for Resource Solutions.

The Regents have delegated authority to the President for promulgating policy regarding capital projects and existing University facilities. I have delegated authority to the Senior Vice President--Business and Finance for further definition of measures to implement University policy regarding sustainability. Chancellors are responsible for implementation in the context of individual building projects and facilities operations.

On an annual basis, the University will report to The Regents on the impact of the University's sustainability efforts. The guidelines will be reexamined every three years, with the intent of developing and strengthening implementation provisions.

Questions concerning the policy should be directed to the Senior Vice President--Business and Finance.

Sincerely,



Robert C. Dynes

Enclosure

cc: Members, President's Cabinet
Special Assistant Gardner
Principal Officers of The Regents

June 16, 2004

UNIVERSITY OF CALIFORNIA POLICY ON GREEN BUILDING DESIGN AND CLEAN ENERGY STANDARDS

Resource sustainability is critically important to the University of California, the State of California, and the nation. Efficient energy use is central to this objective, and renewable energy and energy-conservation projects provide a means to stabilize campus budgets, increase environmental awareness, reduce the environmental consequences of University activities, and provide educational leadership for the 21st century.

On July 17, 2003, The Regents of the University expressed their support for a Presidential policy to promote "...the principles of energy efficiency and sustainability in the planning, financing, design, construction, renewal, maintenance, operation, space management, facilities utilization, and decommissioning of facilities and infrastructure to the fullest extent possible, consistent with budgetary constraints and regulatory and programmatic requirements."

The University of California is committed to improving the University's effect on the environment and reducing the University's dependence on non-renewable energy. Guidelines for implementing practices in support of Green Building Design and Clean Energy Standards are explained in detail in the following plan for achieving these goals.

I. Green Building Design

a. Given the importance of energy efficiency to Green Building design, the University has set a goal for all new building projects, other than acute-care facilities, to outperform the required provisions of the California Energy Code (Title 24) energy-efficiency standards by at least 20 percent. Standards for energy efficiency for acute care facilities will be developed in consultation with campuses and medical centers.

b. The University of California will design and build all new buildings, except for laboratory and acute care facilities, to a minimum standard equivalent to a *LEED*™ 2.1 "Certified" rating.

c. Campuses will strive to achieve a standard equivalent to a *LEED*™ "Silver" rating or higher, whenever possible within the constraints of program needs and standard budget parameters.

d. Given the importance of specifically addressing sustainability in laboratory facilities, the University of California will design and build all new laboratory buildings to a minimum standard equivalent to a *LEED*™ *2.1* "Certified" rating and the *Laboratories for the 21st Century (Labs21) Environmental Performance Criteria* (EPC), as appropriate. The design process will include attention to energy efficiency for systems not addressed by the California Energy Code (Title 24).

e. Any proposed exception from the above standards may be requested administratively during preparation of the PPG. Any exception proposed after approval of the PPG will be treated as a scope change and processed in accordance with standard University procedures.

f. Further study will be conducted before a similar sustainable design policy for new acute-care facilities is adopted.

g. Any significant renovation projects involving existing buildings will also apply sustainability principles to the systems, components and portions of the building being renovated.

h. In consultation with the campuses, the Office of the President will develop an internal evaluation and certification standard based on the *LEED*™ and *Labs21* measures.

i. Campuses may choose to pursue external certification through the *LEED*™ process, augmented with *Labs21* criteria as appropriate for laboratory systems, in lieu of the internal process for a given project.

j. The measures required by this policy will be incorporated into all new building projects, other than acute care facilities, submitted for first formal scope and budget approval as of July 1, 2004

k. To the extent feasible within approved funding, campuses are encouraged to apply sustainability principles to all projects currently in design.

l. The University planning and design process will include explicit consideration of lifecycle cost along with other factors in the project planning and design process, recognizing the importance of long-term operations and maintenance in the performance of University facilities.

m. For existing buildings, the University will explore the development of a standard methodology for sustainable policies and standards for facilities management, including assessing the *LEED*™ Existing Building (*LEED*™ *EB*) evaluation tool being developed for this purpose. These policies and standards will address aspects of building cleaning, maintenance, and operation to include factors such as chemical usage, indoor air quality, utilities, and recycling programs.

n. The University will work closely with the U.S. Green Building Council, Labs21, the Department of Energy, the U.S. Environmental Protection Agency, State government, and other organizations to facilitate the improvement of evaluation methodologies to better address University requirements. Additionally, the University will work with the U.S. Green Building Council to develop a self-certification tool for University use.

o. The University will use its purchasing power to promote the availability of products that are resource-efficient, energy-efficient, water-efficient, and of recycled and rapidly renewable content for building materials, subsystems, components, equipment, and supplies.

p. The University will work with regulatory agencies and other entities to speed the development, approval, and implementation of products and technologies that improve energy efficiency and support sustainable design, construction, and operating practices.

q. The University will develop a program for sharing of best practices.

r. The University will incorporate the Green Building Design policy into existing facilities-related training programs, with the aim of promoting and maintaining the goals of the policy.

II. Clean Energy Standard

a. The University will implement a systemwide portfolio approach to reduce consumption of non-renewable energy. The portfolio will include a combination of energy efficiency projects, the incorporation of local renewable power measures for existing and new facilities, green power purchases from the electrical grid, and other energy measures with equivalent demonstrable effect on the environment and reduction in fossil fuel usage. The appropriate mix of measures to be adopted within the portfolio will be determined by each campus. Since each campus's capacity to adopt these measures is driven by technological and economic factors, the campus will need to reevaluate their energy measures mix on a regular basis. The portfolio approach will provide valuable analytical information for improving energy efficiency, resulting in an overall improvement in the University's impact on the environment and reduced reliance on fossil fuels during the next decade of capital program growth.

b. The University will strive to achieve a level of grid-provided electricity purchases from renewable sources that will be similar to the State's Renewable Portfolio Standard, which sets a goal of procuring 20 percent of its electricity needs from renewable sources by 2017. The University will initiate progress towards this objective in 2004 by purchasing 10 percent of grid-supplied electricity from renewable sources, subject to funding availability, and will track progress annually toward achievement of the year 2017 goal.

c. With a goal of providing up to 10 megawatts of local renewable power by 2014, the University will develop a strategic plan for siting renewable power projects in existing and new facilities. The plan will include demonstration projects for photovoltaic systems and other renewable energy systems, such as landfill gas fueled electricity generation or thermal energy production. The strategic plan will include criteria for evaluating the feasibility of a variety of projects, such as incorporating photovoltaic systems in replacement roofing projects and in new buildings, as well as forecasting the accommodations necessary for eventual installation of photovoltaic systems. The University will assess the progress of renewable energy technology improvements, both in terms of cost and technical efficiency. To achieve the renewable power goal, the University will maximize the use of available subsidies and negotiate pricing reductions in the marketplace, and will develop funding sources for financing the costs of renewable energy measures.

d. With a goal of reducing systemwide non-renewable energy consumption, the University will develop a strategic plan for implementing energy efficiency projects for existing buildings and infrastructure to include operational changes and the integration of best practices. The plan will identify opportunities to incorporate energy retrofit projects into major building renovations as funding is available, and to initiate standalone retrofit projects as justified by future energy savings. The University will monitor industry

progress in energy retrofits and implement technical improvements as they become available. As with renewable energy projects, the University will develop funding sources and establish a program for financing retrofit projects. The initial goal for energy efficiency retrofit projects will be to reduce systemwide growth-adjusted energy consumption by 10 percent or more by 2014 from the year 2000 base consumption level. The University will strive to achieve even greater savings as additional potential is identified and funding becomes available.

e. The University will continuously evaluate the feasibility of other energy-saving measures with equivalent demonstrable effect on the environment and reduction in fossil fuel usage. In particular, campuses will evaluate transportation services, including fleet vehicles, Transportation Demand Management (TDM) programs, public transit, and on-campus housing goals.

f. The University will develop a variety of funding sources and financing alternatives for energy efficiency, renewable energy, and clean energy projects that will enable campuses to be flexible in addressing their energy needs.

g. The University will pursue marketing of emissions credits as a means to bridge the cost-feasibility gap for green power projects.

III. Authority and Report Schedule

The Regents have delegated authority to the President for promulgating policy regarding capital projects and existing University facilities. The President has delegated authority to the Senior Vice President -- Business and Finance for further definition of measures to implement University policy regarding sustainability. Chancellors are responsible for implementation in the context of individual building projects and facilities operations.

On an annual basis, the President will provide a report to The Regents that details the impact of the University's sustainability efforts on the overall capital program and University operating costs. The University's sustainability guidelines will be subject to continuous review. The guidelines will be reexamined every three years, with the intent of developing and strengthening implementation provisions and assessing the influence of the guidelines on facilities capital and operating costs. The University will provide the means for the ongoing active participation of students, faculty, administrators, and external representatives in further development and implementation of this policy.

Policy V. 4.5.1.1

Responsible Official: Vice President for Finance and Administration

Effective Date: September 6, 2006

Environmental Design in New and Renovated Buildings

Policy Statement

This policy defines the University of Vermont commitment to a high level of environmental sustainability in all new buildings and in major renovations to existing buildings. At minimum, the University will achieve a score equivalent to LEEDTM "Certified" and will formally commission buildings.

Reason for the Policy

This policy supports the University's emphases on environment and health in teaching, research, outreach, and campus operations, and the University's special role as the flagship institution of higher education in Vermont. The goal of this policy is to bring new and renovated University buildings to the forefront of environmentally sustainable design, construction, and operation, thereby supporting positive impacts on natural resources, enhancing occupant health and productivity.

Strategic Direction

This policy supports the following goal in the University's Strategic Plan http://www.uvm.edu/president/?Page=strategic_planning/strategicplan.html :

- Strengthen and focus academic programs, emphasizing liberal education, health and the environment.
- Focus the human, fiscal, environmental, technological and physical resources of the University on institutional values and priorities.
- Recruit and retain excellent students, faculty and staff.
- Strengthen financial resources.

Applicability of the Policy

This policy applies to construction of all new buildings and major renovations.

Policy Elaboration

This policy requires that environmental objectives, with accompanying metrics, be developed specific to each new building and major renovation. At a minimum, environmental objectives will include achieving a level equivalent to LEEDTM "Certified" and formal building commissioning.

Definitions

Formal Building Commissioning: refers to LEEDTM Energy Credit 3: Additional Commissioning intended to verify and ensure that the entire building is designed, constructed, and calibrated to operate as intended.

LEEDTM: refers to the current version of the Leadership in Energy and Environmental Design (LEEDTM) Rating System developed by the US Green Building Council. LEEDTM includes criteria related to Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, and Innovation and Design Process. Version 2.1 includes 69 possible points, with prerequisites and four levels of certification: Certified 26-32 points; Silver 33-38 points; Gold 39-51 points; Platinum 52-69 points.

Procedures

The University will develop environmental design objectives for each new building and major renovation. At a minimum these objectives will include the following:

1. Use of the Leadership in Energy and Environmental Design (LEED*TM)* rating system. The University will design and build all new buildings and major renovations to a minimum standard equivalent to a "Certified" rating by the US Green Building Council in their Leadership in Energy and Environmental Design (LEEDTM) Rating System. UVM will strive to achieve a higher standard of LEEDTM equivalent certification, that of "Silver" or higher, whenever possible. Laboratory design will be guided by a standard equivalent to LEEDTM.
2. Formal Building Commissioning. Buildings will be fully and formally commissioned as described in the LEEDTM section on Energy & Atmosphere as "additional" commissioning.

The Director of Capital Planning and Management is responsible for developing operating procedures necessary for the implementation of this policy within one year of the effective date of this policy.

Contacts

Questions related to the daily operational interpretation of this policy should be directed to:

Director
Capital Planning & Management
(802) 656-1304

The Vice President for Finance and Administration is the official responsible for the interpretation and administration of this policy.

Related Documents / Policies

Procurement or Lease of Services and Goods

Effective Date

Approved by the President on September 6, 2006

APPENDIX D: SAMPLE WATER CONSERVATION POLICIES

EH&S Fact Sheet: Water Conservation for Building Managers – Lessons Learned

EH&S continues to work with Building/Facilities Managers and other technical staff supporting their efforts to identify water conservation opportunities in Harvard buildings. Conserving water benefits Harvard, as well as the environment, and has resulted in significant cost savings for building operations.

This fact sheet presents guidance on water conservation and focuses on "real-life" examples at Harvard where water conservation efforts have been successful. The hope is that all building managers can learn from these success stories and determine the potential for implementing water conservation at their facilities. Please contact EH&S (Gary Alpert 495-1983) for more information on these examples, as well as additional information on water conservation opportunities.

A recommended first step in developing a water conservation plan for your building is to evaluate your building's current water use and discharge levels. Establishing this baseline water use/discharge can help you to investigate seasonal flow or building operations flow fluctuations that can help to identify where to target your efforts. Water use and discharge data is available from your water meters (contact Engineering & Utilities for assistance), as well as flow meters installed on pH neutralization systems. Examining flow meter data to profile building water usage during evenings, weekends and holidays should reveal minimal discharge when the building is unoccupied. By paying attention to spikes in flow during low use periods, building managers have been able to track down and repair solenoids, identify and remove sinks aspirators and appreciate the contribution of a single source to water use and discharge.

- ***Inspect/Replace Water Solenoids:*** Water solenoids are plumbing valves used to shut off incoming flow when equipment is turned off. Water solenoids are present as inlet feed valves in washing machines, water purifiers, dishwashers, icemakers, vending machines, and coffee makers. When these solenoids are not properly operating or maintained they can become stuck in an open position resulting in tremendous water loss. You can determine if you might have a water solenoid stuck in the open position by disconnecting power to the device (e.g. dishwasher, water purifier, etc.). Shutting off power should immediately stop any water flow through the valve. If it doesn't, the solenoid is likely defective. You can ask your plumber to inspect existing water solenoids to ensure that they are operating properly (i.e. close completely when shut off, etc.).

  The New Research Building (NRB) on the Longwood Campus was able to save 25,000 gallons of water per day by addressing defective water solenoids. Working with EH&S, NRB building operations staff recognized that discharge flow data from their pH system flow meter indicated a considerable flow of water even after hours and on weekends when one would expect flow to be greatly reduced. NRB building operations staff conducted a survey of all water solenoids and found one of their cage washer solenoids stuck in the open position. After this solenoid was repaired, the discharge flow was reduced by 25,000 gallons per day.

- ***Recirculate Non-Contact Cooling Water***: The use of city water to cool equipment such as, refrigerators, emergency generators and other devices, produces non-contact cooling water. The MWRA does not allow discharge of non-contact cooling water to the sewer system. Reuse and recirculation of this water will result in significant water savings. This water must be plumbed to be re-used and re-circulated and not simply directly discharged.

  The Chemistry and Chemical Biology Department on the Cambridge Campus initiated a project several years ago to identify and eliminate sources of flow-thru non-contact cooling water. Older equipment was replaced with equipment using re-circulated water at a significant cost savings.

- ***Install Timer/Shut-off on Kodak X-Omat Photoprocessing Units***: When not in use, Kodak X-Omat photo-processing units discharge water continuously. A solenoid linked to a timer should be installed on these units to conserve water when these units are not in use. EH&S has identified a total of 50 X-Omat units at Harvard University. If all of these units were equipped with solenoids/timers, approximately 6 million gallons of water per year could be conserved. Contact Facilities Maintenance Operations (FMO) or your plumbing contractor for assistance with the installation of solenoid/timer.

- ***Monitor Temperature of Quench Water Discharges:*** Quench water is used to cool the discharge from autoclaves, dishwashers, cage washers and other high temperature equipment. Local plumbing regulations require hot water discharge to be cooled below 160 (Boston) or 150 (Cambridge) degrees Fahrenheit before mixing with building discharge. To meet this requirement, some equipment can "over-quench" the hot water discharge thereby resulting in significant water waste. Verify that discharge from high temperature equipment is quenched such that temperature levels are just below the temperature thresholds. You may also be able to adjust the thermometer reading on the piece of equipment so that significantly less water is required to cool the discharge on every cycle.

- ***Reuse of Reverse Osmosis Reject Water:*** The MWRA requires that RO reject wastewater be re-used before final discharge. The solution to how to re-use this water will vary from building to building, but all re-use applications will result in long-term water savings. Examples of RO reject reuse include "gray" water uses (e.g. toilets, non-potable sinks, etc.), quench water, etc.

  Research facilities including the New Research Building on the Longwood Campus and the newly designed Biology Research Infrastructure (BRI) building will use discharge RO reject water to make up a large portion of this quench water with significant savings.

Water Conservation, Reuse and Recycling Master Plan

Final

STANFORD UNIVERSITY
October 2003

Prepared by
Maddaus Water Management
and
Stanford University

County of Santa Clara

Environmental Resources Agency
Planning Office

County Government Center, East Wing, 7th Floor
70 West Hedding Street
San Jose, California 95110-1705
(408) 299-5770 FAX (408) 288-9198
www.sccplanning.org

September 9, 2003

Mr. Tom Zigterman
Ms. Marty Laporte
327 Bonair Siding
Stanford, CA 94305-7272

Dear Tom and Marty:

Thank you for all your work in revising and completing the Stanford University Water Conservation, Reuse, and Recycling Plan. Planning staff appreciates your July submittal of the creek diversion baseline information requested by our office. Staff also commends Stanford for the ongoing implementation of plan elements, such as the Water-Wise Garden at Ryan Park.

Continued compliance with this GUP condition will be evaluated during subsequent annual reports. Implementation of the plan will be the basis for continued compliance with the GUP condition. Updated status of the plan will be part of the annual reporting process for Stanford.

The County Planning Office staff has communicated clarifications to you regarding future exploration of recycled water usage and annual reporting requirements for this plan. This office has determined that, with the clarifications provided to you by staff, the Water Conservation and Recycling Plan satisfies the mitigation requirements of the General Use Permit, Condition P.4, and the Mitigation Monitoring and Reporting Program (MMRP) Measure PS-1C. This letter will serve as verification for your office that, as of August 31, 2003, Stanford was in compliance with these mitigation requirements. Thank you again for your work on this project.

Best regards,

Ann Draper, Planning Director

cc: Tim Heffington
Gary Rudholm
Charles Carter
Catherine Palter

Foreword from the County of Santa Clara Planning Office: The Stanford University Water Conservation, Reuse and Recycling Master Plan

Background

Stanford University was required to submit this plan to the County of Santa Clara Planning Office in December 2001. The purpose of this plan is to demonstrate that Stanford can feasibly mitigate the impact from increase in water consumption associated with Stanford's land use and development activity, as identified in the December 2000 Stanford Community Plan/General use Permit (GUP)/Environmental Impact Report (EIR). The EIR established an environmental mitigation monitoring and reporting program (MMRP). The MMRP was adopted by the Santa Clara County Board of Supervisors in December 2000. The mitigation measures identified in the MMRP must be implemented by Stanford and are monitored by the County.

Submittal of this plan was a specific mitigation requirement identified in the December 2000 MMRP and GUP. Detailed background for this requirement is contained within those documents. Those documents are available on the County Planning Office web site (see web address at end of this foreword). Excerpts from both of those documents are provided at the end of this foreword.

The Process

Stanford's draft plan was submitted in December 2001. The County provided opportunities for other jurisdictions and agencies to review and comment on the draft document. After internal review and consideration of comments received, the County provided consolidated feedback to Stanford. The Santa Clara Valley Water District was a partner to the County in providing thorough review and comment to Stanford University. The revised document was then submitted, reviewed, and approved by the County Planning Director.

For further information regarding the Stanford University Community Plan, General use Permit, and Environmental Impact Report, contact the County Planning Office or visit the County web site (contact information provided at the end of this foreword).

Future Use and Reporting on the Plan

The specific language of the mitigation program (PS-1C: Water Conservation and Recycling) is contained within this foreword. In addition to the MMRP, the General Use Permit (GUP) is the permit under which specific conditions of approval for Stanford

future development and land use activity are specified. Some of these conditions are specific for selected projects. Others, such as Condition P.4 require submittal of more generalized program/policy documents. These other plans and documents provide more detail regarding general measures outlined in the MMRP and GUP.

Essentially, this water conservation plan is intended to demonstrate how Stanford will conduct aggressive water conservation and recycling to keep demand below its present allocation. To comply with the requirements of the MMRP and the GUP condition, Stanford must implement water conservation measures and stay within the 3.033 mgd average daily allocation from SFPUC, apply for an increase in its water allocation, or seek other sources of water.

Ultimately, Stanford will need to reduce its projected demand from the Hetch Hetchy supply by six percent, or receive approval from the San Francisco Water Department to exceed the current allocation of 3.033 million gallons per day. Stanford is precluded from increasing withdrawals from Stanford creeks to achieve its water conservation goal. Stanford will submit water consumption information and summarize how elements of this conservation plan are being implemented on an annual basis, and that information will be presented in the County's Annual Report on Stanford University Compliance with the GUP and Mitigation Monitoring and Reporting Program.

County Planning Office Project Management:
Ann Draper: Planning Director
Gary Rudholm: Senior Planner, Post-Approval Monitoring
Tim Heffington: Associate Planner, Project Manager: Stanford University Environmental Mitigation Monitoring and Reporting Program

Santa Clara Valley Water District Review
William Springer, Community Projects Review Unit
Karen Morvay, Water Conservation Specialist

Draft Document Provided for Review and Comment to:
Santa Clara County Planning Office
City Of Palo Alto Department of Community Services
Town of Portola Valley
City of Menlo Park
City of Woodside

CONTACT INFORMATION
For further information, regarding this document or other Stanford University Community Plan and General Use Permit policy issues, contact the County Planning Office by phone or visit our web site.

PHONE: (408) 299-5784.

WEB SITE: www.sccplanning.org

End of County Planning Office Foreword

GUP Excerpt, Condition P.4

4. Within twelve months of General Use Permit approval, Stanford shall prepare and submit to the County Planning Office for review and approval a Water Conservation and Recycling Master Plan, which will identify measures for reducing potable water use on campus. Measures included in the plan may be required as conditions of approval for proposed building projects and/or through the annual General Use Permit monitoring process. The overall goal of the plan shall be to ensure that Stanford does not exceed its allocation of 3.033 million gallons per day (mgd). Increased water withdrawals from creeks shall not be used to meet this goal. The plan shall address the following items:

Mechanisms for use of recycled water for turf and landscaping irrigation, toilet flushing, and other appropriate activities;

a. Measures to reduce domestic water use in existing buildings;

b. Continued and new water conservation measures for new and remodeled buildings; and

c. Methods to reduce use of water for irrigation.

MMRP Excerpt

PS-1C: Water Conservation and Recycling

(a) Stanford shall embark on an aggressive program of water conservation and water recycling. The conservation program shall include measures to reduce domestic water use (e.g., retrofit existing residences with low-flow toilets and showerheads) and to reduce use of water for irrigation (e.g., require use of drought-tolerant landscaping). The recycling program shall include consideration of recycled water or gray water use for toilet flushing in new buildings. Stanford will continue to implement water conservation measures for proposed new buildings to minimize future water use. Stanford should consider the use of recycled water for turf irrigation for the golf course, athletic fields, and other landscaped areas.

To implement these recommendations, Stanford shall prepare and submit to the County Planning Office a Water Conservation and Recycling Master Plan, which will lay out the proposed measures for reducing potable water use on campus. The goal of the plan shall be to ensure that Stanford does not exceed its allocation of 3.033 mgd. The Plan shall be prepared following the adoption of the CP and approval of the GUP. Increased water withdrawals from Stanford creeks shall not be used to meet this goal. A ten percent reduction in average daily water use would keep water consumption well within Stanford's existing allocation of 3.0333 mgd, while a six percent reduction (0.18 mgd), would meet the current allocation. A ten percent reduction in average daily water use is feasible with implementation of the program described above.

(b) If conservation and recycling does not achieve at least a six percent reduction in potable water demand from Hetch Hetchy, the University would have to apply for an increase in the allocation of water from the San Francisco Water Department, and receive approval prior to exceeding the existing allocation. Alternatively, Stanford could reduce its water consumption or seek other sources of water.

Impacts Mitigated: Increase in water consumption.
Lead Agency: Stanford University [Santa Clara County]
Implementing Agency: Stanford University
Timing: Start: GUP Approval/individual project design/review
Complete: Ongoing

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 EXECUTIVE SUMMARY

1.1 Purpose

This Water Conservation, Reuse and Recycling Master Plan has been prepared to comply with Condition of Approval P4 and Mitigation Measure PS-1C of Stanford University's 2000 General Use Permit (2000 GUP). The condition specifically states the following:

Within twelve months of General Use Permit approval, Stanford shall prepare and submit to the County Planning Office for review and approval a Water Conservation, Reuse and Recycling Master Plan, which will identify measures for reducing potable water use on campus. Measures included in the plan may be required as conditions of approval for proposed building projects and/or through the annual General Use Permit monitoring process. The overall goal of the plan shall be to ensure that Stanford does not exceed its allocation of 3.033 million gallons per day (mgd).

This plan has been developed to demonstrate that Stanford can develop the academic and support buildings and housing units allowed under the 2000 GUP and remain within the current water allocation. This Master Plan provides a menu of potential water conservation measures for implementation. However, it is also possible that Stanford will identify other water conservation measures or reduce its customer base, or increase its supply in the next 10 years. Such measures may be substituted for measures in this plan providing that the water conservation measures comply with this GUP. The mechanism for monitoring compliance with Condition of Approval P4 and Mitigation Measure PS-1C will be the annual comparison of actual water consumption to the current water allocation. This will be reported to the County in the GUP Annual Report along with a description of conservation measures implemented by Stanford each year.

1.2 Overview of Stanford's Water Supply

The Stanford Facilities Operations Water Shop operates the domestic water system that provides potable water to the Stanford campus. The Stanford domestic water system meets all state and federal water quality requirements. The main source of water to the campus is the City and County of San Francisco through the San Francisco Public Utilities Commission (SFPUC; See Appendix A, listing SFPUC (Hetch-Hetchy and well sources of domestic water supply). The majority of the domestic system has been installed since the early 1960s, but parts of the system date from the early 1930s. Backup potable water supply is provided by three wells on Stanford property.

The Stanford Water Shop also operates a non-potable (lake) water system on the Stanford campus. The lake water supply (non-potable) is used for irrigation and backup fire protection. Since about 1985 there has been a program to maintain and expand the lake water system to irrigate areas with the non-potable water instead of the domestic water. The lake water system includes Searsville Lake and Felt Lake. Lake Lagunita is not part of the lake system.

1.3 Stanford's Water Use Compared to Other BAWUA Agencies

Of the 184 mgd allocated to the Bay Area Water Users Association (BAWUA) agencies, Stanford University's allocation is 3.033 mgd and for 1999-2000 its average daily consumption was 2.7 mgd. Stanford's average daily domestic water consumption represents only 1.5 percent of the total BAWUA supply from SFPUC. Using BAWUA's data that identifies SFPUC purchases among BAWUA agencies, Stanford ranks 19th in consumption volume - among the lowest consumers. Stanford University already has implemented an aggressive water conservation program. For 1999-2000, Stanford's total domestic

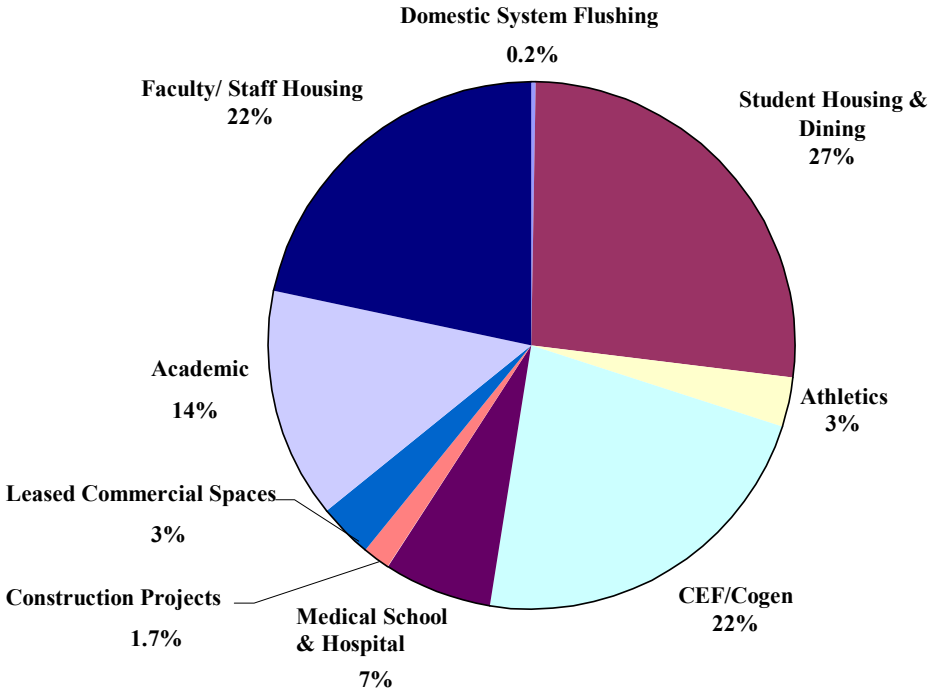
and non-potable gross per capita consumption was 147 gallons per capita per day (gpcd). Stanford's gpcd is low compared with neighboring cities (e.g., City of Menlo Park is at 366 gpcpd and City of Palo Alto at 227 gpcpd, BAWUA Annual Survey, December 2000; See Appendix B, Exhibit 15 from BAWUA Annual Survey Report, December 2000).

1.4 Review of Stanford's Water Demands

The 12-month moving average shows an average daily supply production of approximately 2.7 mgd. Metered consumption data were analyzed for specific categories of use. Monthly metering data were used from 1996 through 2000. From the five years of data, the 12-month moving average was calculated using twelve months of monthly data moving through time (i.e., each data point on the trend line represents the average of the previous 12 months of meter readings). The moving average data are used to determine consumption trends for the five years. Figure ES-1 presents an annual average domestic water system demand profile for the key categories of water use on campus. Note that student housing, faculty/staff housing and the Central Energy Facility (CEF/Cogen) are the three largest categories of use. The CEF/Cogen facility is described in Section 4.

The largest demands and the primary end uses of domestic water are toilet flushing and irrigation, which constitute over 30% of water use on campus. As a result, the internal use for toilet flushing and external use for irrigation are two key focus areas for conservation, reuse and recycling (See Section 4 for detailed discussion).

Figure ES-1. Average Annual Demand By Category for Domestic Water System



1.5 Baseline Water Use Projection

In order to determine the need for and level of meaningful water conservation, it is necessary to establish a baseline water use projection. First, historic campus development and water use were identified (See Appendix C – Data from 5 years of metered domestic water consumption), and then campus expansion plans under the 2000 GUP were reviewed with the Stanford University Architect/Planning Office, to determine potential increases in population and gross square footage. This information was used to project the growth in future water demand. The baseline water projection, assuming a certain development rate and without conservation, is provided in Figure ES-2. Absent implementation of this Master Plan, the projection could rise from the average daily demand in 2000 of 2.7 mgd to as much as 3.6 mgd in 2010 at the anticipated end of the 2000 GUP program. Therefore, the goal of the conservation/recycling Master Plan is to reduce the demand by approximately 16 percent or 0.57 mgd to keep the demand below 3.033 mgd.

Stanford's Master Plan is based on conservatively high estimates of future water use in order to best position Stanford for achieving the goal in the long term. The estimated water consumption projections in the GUP EIR were based on per capita use (BAWUA, 1999) and water consumed (per square foot) for existing campus academic and landscaped spaces. The projected water consumption estimates in this Master Plan are based on significantly more detailed review of projected increases in square footage for specific types of academic spaces, population, landscaped areas, and housing unit. The water use estimates are higher than those presented in the GUP EIR because, for planning purposes, it is better to estimate water use on the high side so that conservation measures will be designed to address the highest potential use.

1.6 Water Conservation, Reuse and Recycling Master Plan

Water conservation, reuse and recycling measures were evaluated based on analysis of water use trends from the metered water data and also during site visits and interviews with key Stanford personnel at representative or high volume water using facilities on campus. The 14 conservation measures listed in Table ES-1 were deemed applicable to Stanford University and further analyzed for cost effectiveness. Benefits accrue from lower water purchase costs, lower wastewater discharge costs, and deferred capital projects. The cost of water saved is the present value of the annual Master Plan implementation costs over 30 years, divided by the volume of water saved over 30 years (Table ES-2).

Nine of 14 conservation measures were individually cost effective with a utility benefit cost ratio above 1.0 (Table ES-1). At this point, this menu of measures appears to provide the most cost effective and reasonable means for Stanford to achieve the goal of staying within its current allocation. Over time, different measures may become feasible, or more cost effective, and may be substituted for some of these measures.

Table ES-1. Estimated Results of Individual Measures

No.	Measure	Evaluation Criteria		
		Average Water Savings, mgd*	Utility Benefit-Cost Ratio	Cost of Savings per million gallons, $
1.	Ultra Low Flush Toilet Replacement	0.084	1.09	1,451
2.	Showerhead Retrofit	0.007	2.77	581
3.	Urinal Replacement	0.023	1.54	1,026
4.	High-Efficiency Washer Replacement**	0.010	19.14	492
5.	Public Outreach Programs	0.026	1.02	3,180
6.	CEF Blow down Reuse	0.060	1.04	1,000
7.	Faculty/Staff Housing Water Audits	0.037	3.46	733
8.	Landscape Water Management	0.010	1.38	480
9.	Selective Landscape Retrofit	***	***	***
10.	New Water Efficient Landscape	0.022	0.27	3,230
11.	New Landscape on Lake Water	0.086	6.72	132
12.	ET Controllers on New Faculty/Staff Housing	0.124	0.96	321
13.	Selected Academic Areas on Lake Water	0.013	5.86	163
14.	Football Practice on Lake Water	0.011	12.31	78

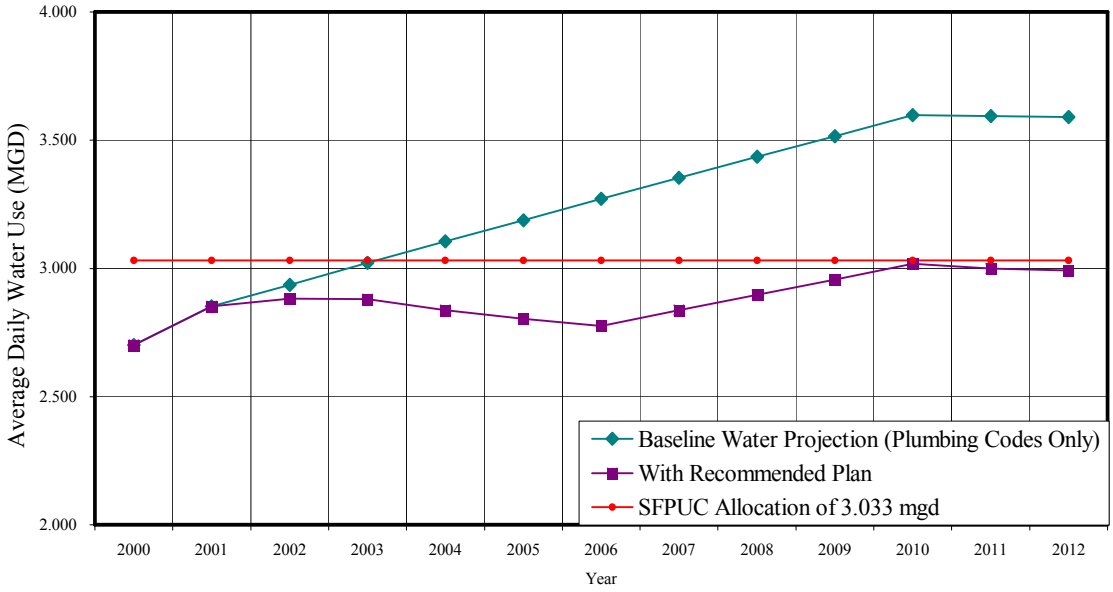
* Caution: savings cannot be added without handling measure overlap water savings averaged over 30 years. Actual savings in 2010 may be higher. (See Appendix D);

** This measure's benefit-cost ratio included a rebate of $200 per washing machine.

*** To be determined, the annual report will list specific projects completed during the reporting year and associated estimated water savings .

The overall water savings from conservation measures in the Water Conservation, Reuse and Recycling Master Plan are combined with the no-cost benefits of the National Plumbing Efficiency Standards. The plumbing standards result in natural conservation that occurs due to eventual replacement of the existing plumbing fixtures with more water-efficient models. Plumbing fixtures installed in all new and renovated buildings will meet the National Plumbing Efficiency Standards. The Master Plan compared to the baseline projection without conservation but including plumbing code benefits is presented in Figure ES-2. This graph illustrates that water demand will remain below 3.033 mgd even after the 2000 GUP build out is completed. Demand will actually decrease because of continued conservation (Appendix D contains a summary explaining the demand forecasting methodology).

Figure ES-2. Projected Water Demand With And Without Water Conservation Master Plan



The Master Plan has an overall projected water savings of 0.58 mgd in 2010. The estimated present value cost is $5.14 million, and estimated present value of the benefits is $5.48 million for a benefit/cost ratio of 1.06 (Appendix D includes detailed discussion of benefit/cost ratio). The overall results from the cost-effectiveness evaluation of the conservation, reuse and recycling Master Plan are presented in Table ES-2.

Table ES-2. Estimated Savings and Costs of Water Conservation, Reuse and Recycling Master Plan

Savings/Costs	Master Plan
Water savings in 2005, mgd	0.38
Water savings in 2010, mgd	0.52
Total Cost 2002-2005, million $	2.75
Total Cost 2006-2010, million $	1.78
Present Value of Costs, million $**	4.90
Present Value of Benefits, million $*	7.59
Cost of Water Saved $/million gallons**	965
Benefit/Cost Ratio	1.55

*Based on current cost of SFPUC water of $1,176 per million gallons.
**Present Value is based on 30-year actual costs and benefits.

1.7 Overview of Master Plan

The Master Plan contains the best package of conservation measures for Stanford (Table ES-3). Maddaus Water Management, with more than 25 years of professional experience and working with water

conservation programs throughout the world, has found that, typically, water conservation programs save about 0.5 to 1.0 percent of total water consumption per year for each year of the program. The Master Plan will save 1.6 percent of the domestic water per year and is considered very aggressive. Included in the Master Plan is a landscape retrofit measure, which includes selective re-landscaping with water-efficient landscapes instead of inefficient turf areas. These areas are to be determined by the Stanford University Architect/Planning Office and Grounds Department and could include non-use areas such as exterior portions of Escondido Village. Further details on the programs are contained in Section 6.0.

1.7.1. Additional Recommendations for New Buildings and Renovations – Recommended Plans Review Process

Besides conservation measures and the existing Stanford internal process to review plans for new buildings, the Master Plan includes additional recommendations. In addition, future Stanford plan reviews would focus on interior and exterior water use with additional specific criteria. The interior plumbing and equipment design review that Stanford undertakes would include review of efficiency of water consumption based on available technology. For example, to prevent disposal of steam condensate with poor quality (and use of additional domestic water), review of design of steam systems in buildings should include building heat load analysis and appropriate heating equipment sizing. Heat exchanger trapping and condensate return piping should be designed to prevent heat exchanger failures and steam condensate contamination.

1.7.2. Landscape Water Management for Recommended Best Management Practices

Although most landscape water use is on the lake system, landscape water use on the domestic system still amounts to almost 0.6 mgd or over 22 percent of current use. The Santa Clara County "Guidelines for Architecture and Site Approval" include landscape guidelines to encourage the use of drought tolerant, native plants. All Stanford applications for Architecture and Site Approval (ASA) include a landscape plan that identifies plantings consistent with these guidelines. Based on our evaluation the following strategy for increasing water efficiency is recommended.

1. Practice landscape water management on all large turf sites.
2. New and renovated landscaped areas should use only the lake water system for irrigation (unless prohibitively expensive).
3. Amend Stanford University Facilities Design Standards (FDS) to provide current details, specifications and plant lists, to ensure water efficient landscapes are installed.
4. Implement Stanford University Landscape Design Guidelines, March 1989 for all new and re-landscaped areas. Review all landscape and irrigation plans from the standpoint of achieving landscape water use efficiency.
5. Implement reuse of Central Energy Facility (CEF) cooling tower and Heat Recovery Steam Generator (HRSG) blow down water for landscape irrigation; investigate the feasibility of a connection to the lake water system.
6. Selectively retrofit landscape areas with low water use plant materials and efficient irrigation systems. Replace existing irrigation controllers with a link to the Maxicom system or similar wherever practical.
7. Investigate the application of new irrigation technology for the Stanford campus.

The use of lake water in-lieu of potable domestic water for irrigation demands will not cause Stanford to exceed its historic demands on its lake water system. The demand identified in the Master Plan is within the range of Stanford's historic diversions under its existing water rights, and is therefore consistent with

Condition of Approval P4 in Stanford's General Use Permit. No additional creek diversions or water rights are required to meet this demand.

1.8 Implementation and Staffing the Master Plan

Implementation of the Master Plan will be led and managed by the Utilities Division. Implementation of the specific programs will be the responsibility of individual departments, as shown in Table ES-3. Implementation of the Master Plan will involve staffing, funding and other resources. The Utilities Division will manage the Water Conservation, Reuse and Recycling Master Plan. In-house staff can carry out some of the work; other work can be done by contract.

Table ES-3 – Master Plan Measures and Implementation Responsibilities

No.	Measure	Brief Description	Responsible Departments
1.	Ultra Low Flush Toilet Replacement	Replace 90 percent of inefficient toilets with 1.6 gallon/flush models in all campus facilities.	Student Housing, Zones (Academic), Athletics, Medical School
2.	Showerhead Retrofit	Replace 90 percent of inefficient showerheads with low flow models in all campus facilities.	Student Housing, Athletics
3.	Urinal Replacement	Continue with current urinal replacement plans but hold-off on the remaining until 0.5 gal/flush units or valves are on the market and use these to attain a 90 percent replacement rate.	Student Housing, Zones (Academic), Athletics, Medical School
4.	High-Efficiency Washer Replacement	Replace existing washing machines in student housing with efficient (such as front loading) models. Retain pay-per-use machine types.	Student Housing
5.	Public Outreach Programs	Implement a multi-faceted public education program directed at departments, students, and employees stressing the need to conserve water. Highlight programs and rebates available.	Utilities
6.	CEF Blow Down Water Reuse	Prepare preliminary engineering and pilot testing of cooling tower and boiler blow down water for irrigation. Determine best way to integrate this source with the lake system and use to irrigate new and existing areas.	CEF, Utilities, Grounds
7.	Faculty/Staff Housing Water Audits	Offer indoor/outdoor water audits to not less than 30 percent of the faculty-staff housing on a repeating five-year cycle. Focus on reduction of irrigation, toilet and washer use.	Utilities/Contractor
8.	Landscape Water Management	Provide water budgets and tracking of performance on a monthly basis for large irrigated sites. Conduct large turf audits periodically.	Grounds, Utilities
9.	Selective Landscape Retrofit	Retrofit turf areas known or shown to be inefficient with low water use plant landscapes where feasible and cost-effective.	Planning, Grounds
10.	New Water Efficient Landscape	Amend and require use of Stanford's Landscape Design Guidelines and FDS to ensure predominant use of water efficient plant types is used. Develop and adhere to water budgets. Conduct water efficiency reviews of plans.	Planning, Grounds
11.	New Landscape on Lake Water	Put all new landscapes on the lake water system.	Utilities, Capital Planning Management
12.	ET Controllers on new Faculty/Staff Housing	Install evapotranspiration (ET) Controllers on all irrigated landscaped areas associated with new Faculty/Staff Housing units	Utilities, Grounds
13.	Selected Academic Areas on Lake Water	Switch irrigation of five specifically identified landscapes from the domestic to lake system.	Utilities, Grounds
14.	Football Practice Field on Lake	Extend the lake system to irrigate the football practice field.	Utilities, Athletics

2.0 INTRODUCTION

2.1 Goals and Objectives for Water Conservation, Reuse and Recycling Master Plan

This Water Conservation, Reuse and Recycling Master Plan (Master Plan) has been prepared to comply with Condition of Approval P4 and Mitigation Measure PS-1C of Stanford University's 2000 General Use Permit (2000 GUP). Condition of Approval P4 states:

> *Within twelve months of General Use Permit approval, Stanford shall prepare and submit to the County Planning Office for review and approval a Water Conservation, Reuse and Recycling Master Plan, which will identify measures for reducing potable water use on campus. Measures included in the plan may be required as conditions of approval for proposed building projects and/or through the annual General Use Permit monitoring process. The overall goal of the plan shall be to ensure that Stanford does not exceed its allocation of 3.033 million gallons per day (mgd). Increased water withdrawals from creeks shall not be used to meet this goal. The plan shall address the following items:*
>
> *a. Mechanisms for use of recycled water for turf and landscaping irrigation, toilet flushing, and other appropriate activities;*
> *b. Measures to reduce domestic water use in existing buildings;*
> *c. Continued and new water conservation measures for new and remodeled buildings; and*
> *d. Methods to reduce use of water for irrigation.*

The environmental analysis in the Stanford University Draft Community Plan and General Use Permit Application Environmental Impact Report (Stanford EIR December 18, 2000) for public services and utilities estimated the water demand of the development proposed in the 2000 GUP; See Appendix B, Exhibit 15 from BAWUA Annual Survey Report, December 2000). The resulting demand, added to current consumption, was greater than the current water allocation (3.033 million gallons per day) from San Francisco Public Utilities Commission (SFPUC). This was identified as a significant impact, which was mitigated to a less than significant level after implementation of Mitigation Measure PS-1C. Mitigation Measure PS-1C requires preparation of a Master Plan to show that Stanford can reduce water consumption to remain under the current water allocation. The EIR estimated that a 6 percent reduction would be needed by the time GUP-related development was completed if Stanford were to stay within its current allocation. The EIR found such a reduction to be feasible. (Note: the mitigation measure also states that if conservation and recycling does not achieve at least a 6 percent reduction in demand from SFPUC, Stanford will need to apply for an increase in the allocation of water from the SFPUC, and receive approval prior to exceeding the existing allotment.) This became Condition of Approval P5.

The estimated water consumption projections in the GUP EIR were based on per capita use (BAWUA, 1999) and water consumed (per square foot) for existing campus academic and landscaped spaces. The projected water consumption estimates in this plan are more conservative and based on significantly more detailed review of projected increases based on square footage and housing units. This more detailed review resulted in higher estimate of potential water demand than previously estimated in the 2000 GUP EIR.

The 2000 GUP does not have an expiration date, but the EIR assumed that the allowed development would occur within 10 years. This Water Conservation, Reuse and Recycling Master Plan also assumes that academic and housing developments will occur at a constant rate until it is completed in 10 years. Although the actual development rate may not be consistent, the conclusions about water demand and conservation at final build out are valid independent of when build out actually occurs. It should be noted

that the estimated water demand in this report should be considered a conservative maximum. Actual water demand would be less if, for example, faculty/staff housing units were constructed at the lower end of the density range.

This very conservative approach has been developed to demonstrate that Stanford can develop the academic and support buildings and housing units allowed under the 2000 GUP and remain under the current water allocation. It is foreseen that a menu of water conservation measures will be implemented. However, it is also possible that Stanford will identify other water conservation measures or reduce its customer base, or increase its supply in the next 10 years instead of implementing measures in this plan in order to remain under the current allotment. The mechanism for monitoring compliance with Condition of Approval P4 and Mitigation Measure PS-1C will be the annual comparison of actual water consumption to the current water allocation. This will be reported to the County in the GUP Annual Report along with conservation measures that were implemented during the reporting period, estimated water savings, and a map showing locations of projects.

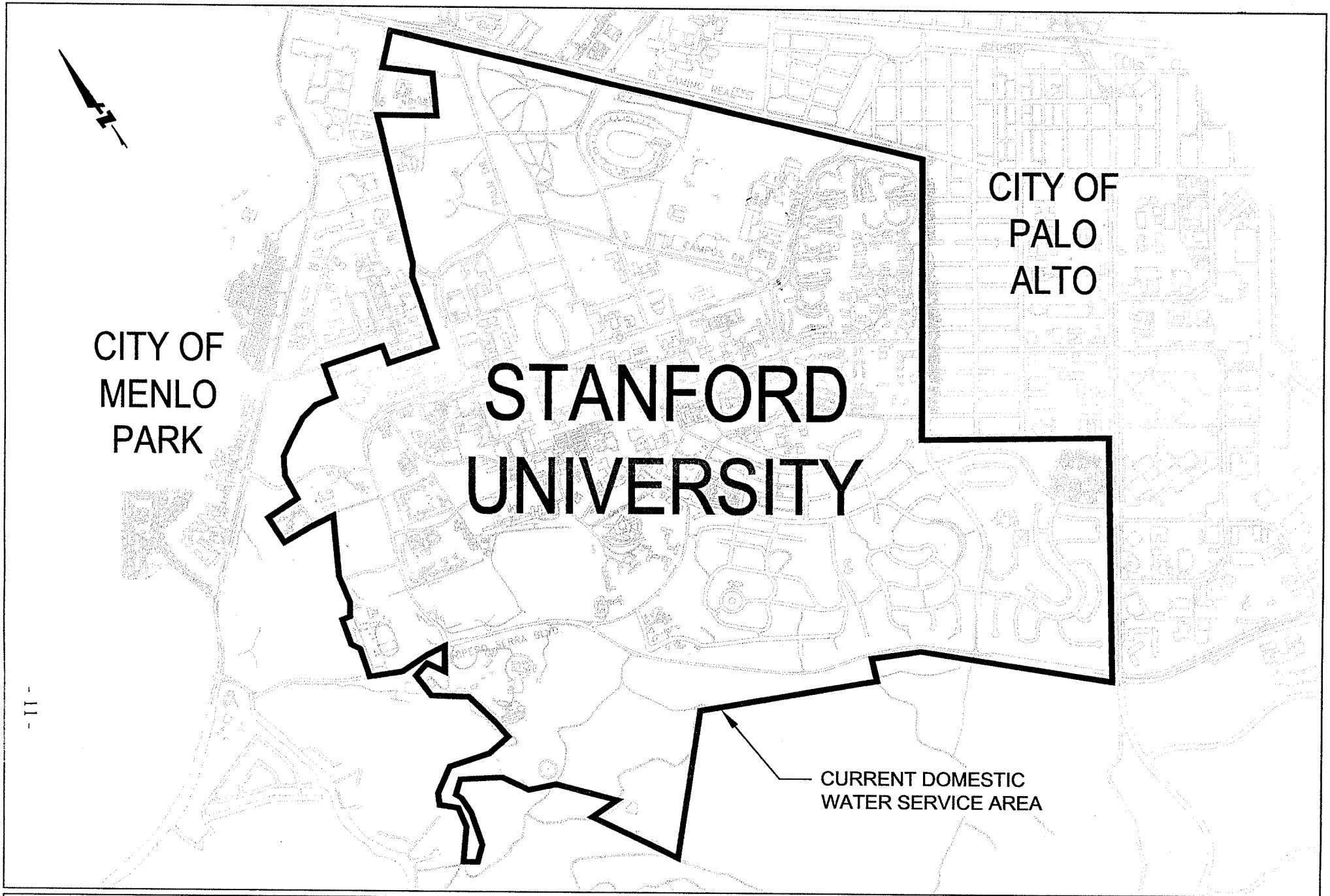
2.2 Description of Stanford's Domestic Water System

Stanford's domestic water system delivers potable water to the Stanford campus. The Stanford domestic water system meets all state and federal requirements. The main source of water to the campus is from the City and County of San Francisco through the (SFPUC). The majority of the domestic water from SFPUC is from the Hetch Hetchy Reservoir, located in the Sierra Nevada Mountains. The SFPUC water comes to Stanford through two turnouts in the foothills between Junipero Serra Blvd. and Highway 280 and one turnout off El Camino Real. Stanford has three active wells that can deliver 1,500 gallons per minute to either the domestic or non-potable system. There are three pressure zones on campus, all of which are supplied from the SFPUC system. The domestic water is stored in two domestic water reservoirs (See Appendix A for schematic diagram showing sources and uses of domestic water). Foothill Reservoir 1 serves the upper elevation areas above 150 feet, in pressure Zone 1, and Foothill Reservoir 2 serves the main academic area of the campus in pressure Zone 2. Pressure Zone 3, the El Camino Real connection serves the Escondido Village Graduate Student Housing area.

As shown in the Domestic Water Service Area Map (Figure 2-1), the domestic supply system delivers water throughout the campus via 145 miles of water mains to customers through over 1,600 water meters. Water pipe sizes range from one-inch to 24-inch diameter. The majority of the domestic system has been installed since the early 1960s, but parts of the system date from the early 1930s.

The domestic water distribution system is sampled on a continuing basis to verify that the water meets all state and federal requirements. All domestic water is fluoridated. This is done at each turnout by injecting a sodium fluoride solution into the water main. Water is then sampled, tested and the results recorded daily. Monthly reports are submitted to the State of California Department of Health Services.

The Stanford Facilities Operations, Utilities Division, Water Shop maintains the domestic water distribution system and has a pro-active annual flushing and maintenance program to prevent water quality problems and leakage from old piping. In the fall of 2003, SFPUC will be changing the disinfection process for the domestic water system from chlorine to chloramines. The change in disinfectant chemicals is being implemented by SFPUC to comply with new U.S. EPA disinfectant byproduct regulations. It is anticipated that water systems with chloraminated water will require additional domestic water flushing to maintain water quality.



STANFORD UNIVERSITY Facilities, Information & Technology 327 Bonair Siding Stanford, CA. 94305-7270	Figure 2-1. DOMESTIC WATER SERVICE AREA			
	Scale: 1"= 1800'	1 OF 1	By: LSM	Date: 05/09/02

The Stanford University Utilities Division meters campus water consumption and tracks the annual water consumption using the Utility Metering Database.

2.3 Availability of Domestic Water from San Francisco Public Utilities Commission and Other Water Sources

SFPUC's Domestic Water System

Stanford University is one of 29 water utilities that purchase water wholesale from the City and County of San Francisco through the SFPUC. The 29 water utilities are members of the Bay Area Water Users Association (BAWUA) and each water utility has a contract and associated water supply allocation with the City and County of San Francisco. The total supply assurance from SFPUC to BAWUA agencies is 184 mgd, although during most years additional water is available.

Stanford's Lake Water System (Non-potable Water)

The Stanford Water Shop also operates a separate water system that provides non-potable (lake) water to the campus. The lake water does not meet domestic water quality standards (without treatment) and is used for irrigation and backup fire protection. The lake water system includes Searsville Lake and Felt Lake. Lake Lagunita is not part of the lake system.

Reclaimed Water Availability

One potential alternative source of non-potable water is reclaimed wastewater from the City of Palo Alto Regional Water Quality Control Plant (RWQCP). The RWQCP prepared a Draft Environmental Impact Report (DEIR, August 1994) for the RWQCP Wastewater Reclamation Program. At that time, the RWQCP proposed the Wastewater Reclamation Program to facilitate increased use of reclaimed water and replace certain types of potable water use, such as irrigation. Another objective was to reduce the volume of the RWQCP's discharge of treated wastewater to San Francisco Bay. The reclaimed wastewater was to be used for landscape irrigation at city parks, freeway medians, and other large irrigated areas within the RWQCP's service area and the City of Menlo Park.

With the exception of the Foothill Main Project, the DEIR included information at a program level of detail. The Foothill Main Project included more detailed information about the development of a pipeline to the Santa Cruz Mountain foothills and the construction of a storage reservoir in the foothills southwest of Stanford University. At the time the DEIR was completed, the RWQCP had not entered into any formal agreements with the potential water users identified in the DEIR.

According to Santa Clara Valley Water District (SCVWD) staff (pers. commun. Bob Kenton,), although the SCVWD presently has no partnership agreement on specific recycled water programs with Palo Alto, the SCVWD may likely be a partner in the future on specific recycled water programs and may have significant financial incentives in place to promote the use of recycled water. According to the SCVWD, efforts are continuously being made to secure funding from the federal government for recycled water programs, and interest free loan may be available from the State of California's revolving fund loan program. Therefore, Stanford should assume that the full cost may not necessarily be paid by Stanford; but rather identify the marginal cost of other options in order to identify a reasonable cost for Stanford's share.

The DEIR did not specifically address costs of the project to customers. However, Palo Alto's estimated cost of recycled water is currently about $ 0 to 1,200 per acre-foot. Information from the Palo Alto Regional Water Quality Control Plant (RWQCP) Engineer, indicates that it is likely that the cost of recycled water would be about 50 percent of the price of domestic water (Daisy Stark, pers. commun. 4/24/02). This estimated cost did not include the customer's costs for design, installation, and maintenance of distribution system infrastructure, such as blending tanks, and distribution lines throughout Stanford University. In addition, costs to comply with regulatory requirements for recycled wastewater, such as training, labeling, sampling, documenting, and reporting were not evaluated. The reclaimed wastewater quality was reviewed for various non-potable uses. Stanford would continue to consider the use of recycled water in the future, especially if the water quality and cost-effectiveness improve. Stanford will also stay informed and participate in discussions about the availability of recycled water. The evaluation indicated that total dissolved solids (TDS) concentration was at 1000 mg/l (compared with cooling tower blow-down at 300-500mg/l), sodium concentration at 240 mg/l, and chloride at 400 mg/l (e.g., irrigation guideline listed in the RWQCP EIR , Table 3-2, is < 300mg/l,). Recent data from the RWQCP indicates that chloride levels are at about 300 mg/l. Local recycling of CEF/Cogen blowdown water was considered more effective because of its local availability and high quality.

For these reasons, a recycled water system supplied by Palo Alto is not recommended at this time. However, Stanford will continue to consider the use of recycled water in the future, especially if the water quality and cost-effectiveness improve.

Stanford's Water Use Compared to Other BAWUA Agencies

Of the average daily 184 mgd allocated to the BAWUA agencies, for 1999-2000, Stanford University's average daily consumption was 2.7 mgd. This average daily domestic water consumption by Stanford represents only 1.5 percent of the total BAWUA supply assurance from SFPUC. Using BAWUA's data that identifies SFPUC purchases among BAWUA agencies, Stanford ranks 19th in consumption volume, among the lowest consumers (Appendix B, Exhibit 15 from BAWUA Annual Survey Report, December 2000).

Stanford University already has an aggressive water conservation plan. For the past ten years, Stanford University has been converting domestic water irrigation systems to lake water irrigation for athletic fields and campus grounds. Additionally, Stanford uses drought tolerant plants in landscaping and has invested resources to install new irrigation systems that use evapotranspiration (ET) technology to indicate irrigation settings based on soil moisture and climate (Appendix E). Since the last drought, Stanford has also retrofitted 5-gallon toilets and high flow showerheads to low flow fixtures. For 1999-2000, Stanford's total domestic and non-potable gross per capita consumption was 147 gallons per capita per day (gpcpd), compared with neighboring cities (e.g., City of Menlo Park at 366 gpcpd and City of Palo Alto at 227 gpcpd, BAWUA Annual Survey, December 2000, (Appendix B, Exhibit 15 from BAWUA Annual Survey Report, December 2000).

3.0 DESCRIPTION OF STANFORD'S CURRENT CONSERVATION PROGRAMS

3.1 Water Conservation Efforts Undertaken To-Date

Various water conservation measures have been implemented at Stanford University for some time. Once-through cooling systems, where domestic water, which is less than 60 ^{o}F, is used once only (then discharged to sanitary sewer) to cool equipment is not permitted according to the Utilities Division Water Conservation Policy that was developed in 1998. A Stanford Facility Design Standard (FDS), applicable to both building retrofit and new buildings, provides guidelines for replacing once-through cooling systems with closed-loop process-cooling loops using campus chilled water or mechanical refrigeration/cooling.

Over the years, the Stanford Utilities Division has been converting campus irrigation from domestic SFPUC water to lake and ground water. Examples of projects where campus landscape irrigation was changed from domestic to lake water include the soccer fields, campus grounds areas such as The Oval and Lomita Mall, and landscaping around student housing in Toyon and Wilbur Hall areas. However, even if campus irrigation uses only lake and ground water, Stanford expects that water conservation will be integrated into design of new construction, planned renovation and retrofit projects owing to limited water availability. Many existing landscape areas have been retrofitted with Maxicom ET Controllers (Appendix E).

Recently, Stanford retrofitted some older student housing and academic buildings with low-flow bathroom fixtures. In FY 2001, the Student Housing Department worked with the Utilities Division and the Santa Clara Valley Water District Water Conservation Program and retrofitted more than 700 5-gallon-per-flush (gpf) toilets with 1.6-gpf ones. The Santa Clara Valley Water District (SCVWD) Water Conservation Program currently provides rebates for Water Efficient Technologies (WET), including high efficiency washing machines, high efficiency nozzle sprayers for cafeteria dishwashers, and reclamation and reuse of rinse waters. In 2001, Stanford received rebate funding from the SCVWD for toilet retrofit projects, where older 3.5- and 5- gpf toilets were retrofitted with 1.6-gpf ones. Stanford plans to participate in the WET program if it is still available when qualifying projects are started.

The goal of Stanford's Water Conservation Program is to promote efficient use of water by designing structures with equipment that uses water sparingly and by educating water users about the need to conserve water. The Utilities Division uses the Utility Metering Database to analyze important trends in campus water consumption. Utilities will work with Planning and other campus departments to develop options for improving efficiency in water use and to ensure that the best quality domestic water is conserved and continues to be available for academic and research use.

3.2 Current Industry Standards & Stanford Guidelines Related to Water Use for New Development

3.2.1. Interior Water Use

Current National Plumbing Efficiency Standards have requirements established in 1992, which reduce the water use of interior fixtures including:

- Toilets at 1.6 gpf
- Urinals at 1.0 gpf
- Showerheads at 2.5 gallons per minute (gpm)
- Faucets at 2.2 gpm

These requirements are regulated by the Energy Policy Act of 1992: Section 123: Energy Conservation Requirements for Plumbing Products. The SCVWD recommends that where fixtures with lower flow are available and are appropriate for the user, bathroom faucets could use 1.5 gpm and kitchen faucets could use 2.2 gpm. When new plumbing fixtures are installed in new or renovated buildings they are required to meet or exceed the current National Plumbing Efficiency Standards.

3.2.2. Exterior Water Use

Stanford will adhere to the principles and practices outlined in the Stanford University Landscape Design Guidelines, March 1989. New landscapes continue to be designed according to guidelines and criteria that emphasize water efficient plant material and efficient irrigation. The Stanford University Landscape Design Guidelines emphasize native landscaping.

Specific measures within the Stanford University Landscape Design Guidelines include:

1. Confine irrigated lands to areas of greatest human use. (p. 57)
2. Where irrigation is required, apply the latest, most successful water conserving technologies. (p. 57)
3. When appropriate, site new buildings so that foundation and buffer planting is drought tolerant and rural in character. ("As the University has grown, the contrast of a sophisticated built environment sitting next to open fields of oak trees and tall brown grass has remained central to the Stanford ambiance", p. 41)
4. Keep more water-intensive landscapes confined to courtyards, entry courts, or active recreation fields. (p. 41)
5. Choose drought tolerant species that do not require heavy application of energy intensive fertilizers, pesticides or herbicides, and water. (p. 67)

Current practices will continue to incorporate large areas of native and/or drought tolerant plants. Soils will continue to be treated prior to planting and exposed soil will be mulched. Stanford will continue to expand the coverage of the Maxicom or similar irrigation controller system, which is tied to a campus weather station for efficient water application. Current landscape maintenance practices include monitoring and reducing and/or eliminating water applications after the initial establishment of the plants.

3.3 Plans Review Process for New Buildings and Renovations

The current internal Stanford review process for plans includes review of the proposed design for both interior and exterior water use. Stanford Facilities engineers review the interior plumbing and equipment design. For example, once-through cooling systems are not allowed.

The plans are reviewed by Stanford staff from Utilities, Planning and Grounds Departments for exterior water use including review of landscape planting and irrigation design for type of plants and irrigation system components. The University's design guidelines for water conservation are listed above in Section 3.2.2.

4.0 HISTORICAL WATER USE AND PROJECTIONS OF FUTURE USE

4.1 Analysis of Historical Water Use

In order to accurately account for water conservation benefits from water conservation program savings, it is necessary to establish a baseline water use from historical data. The evaluation of historical water supply production for Stanford involved the analysis of available metering data between 1995 and 2000. Data show that the 12-month moving average from 1995 to 2000 for the domestic system is increasing slightly and was at approximately 2.7 mgd for fiscal year 1999-2000, the base year for the 2000 GUP. This report focuses specifically on water conservation for the domestic water supply system. The historical water use was further broken down into a water system profile to establish water demands by nine individual categories. The nine categories of water use analyzed are listed as follows:

- Student Housing & Dining
- Faculty/Staff Housing
- Academic
- Athletics
- Central Energy Facility (CEF/Cogen)
- Medical School
- Leased Commercial Spaces
- Construction Projects
- Domestic System Flushing

The categories were chosen to analyze domestic water use and consumption based on monthly-metered data from the Stanford Utilities Metering Database. The categories used represent specific types of water uses and are similar to those reported annually to BAWUA (BAWUA 2000). Analysis of the domestic water consumption trends included evaluation of monthly meter data for five years (1995 - 2000). A short description of the water use categories follows.

Student Housing and Dining. This category includes the undergraduate and graduate Student Housing and Dining Services. Included are dorms, fraternities and sororities, dining halls and kitchens, common use landscaped areas, and coin-operated laundry facilities.

Faculty/Staff Housing. This category includes approximately 900 single-family and multiple-family housing where approximately 2,500 university faculty and staff live. Included are common use landscaped areas, landscaped lands associated with homes, and internal and external house water use.

Academic. This category includes all the academic buildings, except the School of Medicine, and central campus landscaped areas. Included are laboratory, teaching, and administrative buildings, as well as libraries and the museum.

Medical School. This category includes all the buildings used by the School of Medicine that are located on campus in unincorporated Santa Clara County. Included are laboratory and administrative buildings and landscaped areas.

Athletics Department. This category includes all the athletic buildings, facilities, and playing fields. Included are swimming pools, gyms, administrative buildings, football practice field, football stadium, golf course (with minor interior use, irrigation is on the lake system), and common use landscaped areas.

Central Energy Facility/Cogen. The Central Energy Facility (CEF) produces electricity, chilled water, and steam for the campus and chilled water and steam for Stanford Hospital. Domestic water is used as the source supply for chilled water and steam make-up. There is also minor use of domestic water for bathrooms. The cogeneration (Cogen) facility is a power plant owned and operated by Cardinal Cogen, a subsidiary of General Electric. Commissioned in 1987, the plant consists of a natural gas powered turbine driving a 39.2 megawatt (MW) generator, waste Heat Recovery Steam Generator (HRSG), and a steam powered turbine driving a 10.7-MW generator. Waste heat from the gas turbine combustion process is used by the HRSG to generate high pressure steam, which is in turn used in the steam turbine to generate additional electricity. This is called a combined cycle process. Stanford uses about half the power generated by the Cogen plant, the balance is sold to PG&E.

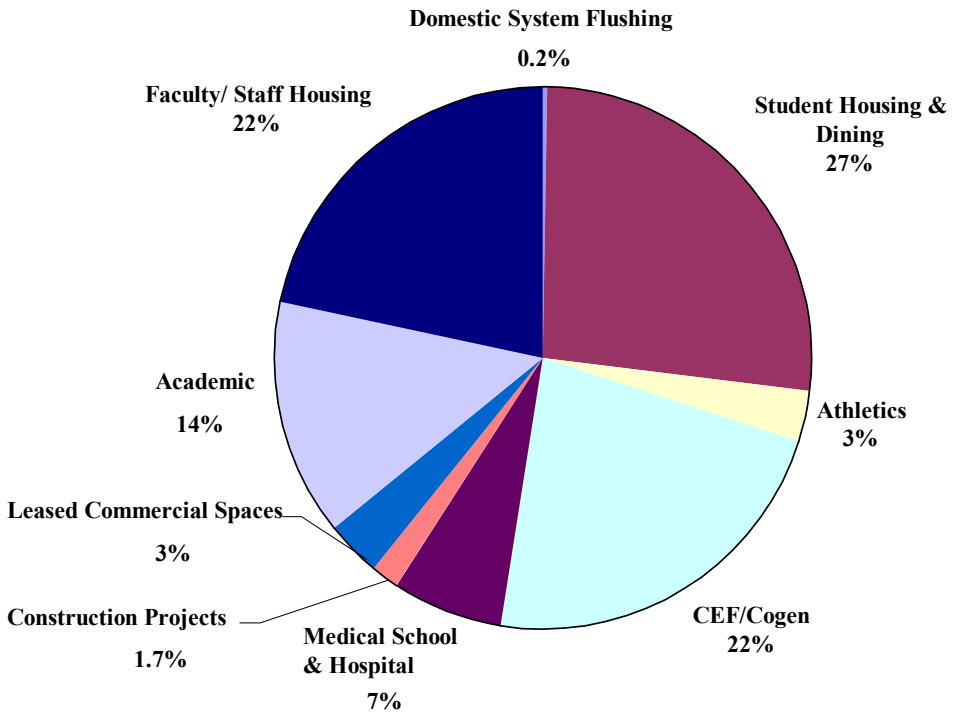
Leased Commercial Spaces. This category includes: the U.S. Post Office, Stanford Bookstore, various cafes and eateries, two Palo Alto schools (Escondido, Nixon), and Tresidder Union. Some minor landscaping is associated with these facilities.

Construction Projects. Buildings under construction or renovation are metered separately. The separate metering of construction projects began in 1998.

Domestic System Flushing. The Stanford Water Shop performs domestic water system flushing. Flushing is a routine maintenance practice for domestic water systems because it is necessary for maintaining water quality. Flushing is metered separately.

The respective percent of total annual average domestic water demand based on 5 years of metered data for each category is illustrated in Figure 4-1. This does not include unaccounted for water. Unaccounted-

Figure 4-1. Average Annual Demand By Category for Domestic Water System



for water is approximately 6.6 percent. Stanford's domestic system is very efficient compared to the industry goal of less than 10 percent unaccounted-for water as determined reasonable by the American Water Works Association (AWWA, 1996).

The following Table 4-1 represents the relative indoor and outdoor use patterns for the eight primary categories of use.

Table 4-1. Internal and External Domestic Water Use by Category

Category	Internal Water Use (percent)	External Water Use (percent)
1. Student Housing	70	30
2. Faculty/Staff Housing	40	60
3. Academic	80	20
4. Athletics	45	55
5. Construction Projects	0	100
6. Leased Commercial Spaces	50	50
7. Medical School	75	25
8. CEF	100	0

4.2 Major End Uses of Domestic Water

In addition to the historical water use by category presented in the above section, it is necessary to further review the data to determine major end uses of water and additional opportunities for water savings.

Where water savings are possible, water conservation measures target the appropriate major end uses. There are some end uses of water that are similar across nearly all categories. Two of these major end uses of domestic water are: (1) toilets; and (2) landscape irrigation, which are presented in Table 4-2 and Table 4-3 below.

Water use for toilet flushing is based on calibrating a fixture model to the various categories of water use. Estimates were made about the number of persons using the facilities in each category, and the number of times per day they do so.

Table 4-2. Domestic Water Use for Toilets by Category

Category	Average Water Use (gpd)	Percent of Total Daily Toilet Flushing
1. Student Housing	109,620	39.4
2. Faculty/Staff Housing	55,476	19.9
3. Academic	62,080	22.3
4. Athletics	8,511	3.1
5. Construction Projects	none	none
6. Leased Commercial Spaces	9,557	3.4
7. Medical School	33,100	11.9
8. CEF	negligible	negligible
Total	**278,344**	**100.0**

For indoor water use the total amount of water used for flushing toilets is 278,344 gallons per day, totaling about 10 percent of the total domestic water use on campus. Table 4-2 shows that the majority of the water use for toilets is in two housing categories: student and faculty/staff housing.

Table 4-3. Domestic Water Use for Landscape Irrigation

Category	Average Water Use (gpd)	Percent of Total Landscape Use
1. Student Housing	164,430	27.7
2. Faculty/Staff Housing	266,310	44.9
3. Academic	59,946	10.0
4. Athletics	31,624	5.3
5. Construction Projects	5,043	0.8
6. Leased Commercial Spaces	32,153	5.4
7. Medical School	35,306	5.9
8. CEF	negligible	negligible
Total	**594,812**	**100.0**

Irrigation water use, shown in Table 4-3, was based from review of the seasonal pattern of water billing data and assuming that nearly all of outdoor or seasonal use was for landscape irrigation. Irrigation is a significant use of domestic water, at about 22 percent of overall domestic use. Table 4-3 shows that over 70 percent of the irrigation using domestic water occurs in the housing areas, particularly in faculty/staff housing.

The two leading end uses of water: toilet flushing and landscape irrigation represent over 30 percent of the domestic water used on campus. Therefore, these two end uses are specifically targeted by conservation measures, in addition to evaluation of other end uses in Section 5.0.

Additional analysis was performed on historical irrigation water use patterns to assess the efficiency of water application rates in order to determine water conservation potential. The estimate for irrigation efficiency uses climate-adjusted water application rates for particular plant types and actual metered data for a specific area of a specific plant type to assess application rates. For example, Table 4-4 presents the water application rate for selected landscaped areas compared to the weather-adjusted water application rate theoretically required, based on the plant type. As a reference, the application rate is compared to water needs for cool season grass (local reference evapotranspiration value, ETo) as an upper bound (assuming 100 percent of ETo) and warm season grass irrigation needs (assuming 60 percent of ETo) on the lower bound to estimate irrigation efficiency for healthy plant growth. Local evapotranspiration data (ET) is measured hourly at a California Irrigation Management Information System weather station in San Jose. Evapotranspiration values for different plant types are defined in many irrigation publications (e.g., "Landscape Water Management for Water Savings", Municipal Water District of Orange County, 1998).

All application rates for the golf course and athletic fields, which have a full-time staff attending to playing surfaces quality, were relatively efficient compared to warm season grass application rates. Landscapes around academic buildings and student housing have been found to have higher application rates possibly resulting from one or a combination of any of these three factors: high water use plant types, old inefficient irrigation systems, or irrigation timers needing adjusting. The landscaped areas around academic and student housing areas are targeted for conservation measures as described in Section 5.0.

Table 4-4. Water Irrigation Application Rates for Selected Areas of Stanford Campus

Area	Water Source	Water Use, gpd (1)	Acreage			Application Rate (Inches water per year)
			Turf (2)	Shrubs (2)	Total	
Golf Course	Lake	250,000	110	---	110	30
Academic	Dom	60,000	6.3	6.4	12.7	62
Student Housing	Dom	164,400	40	2.6	42.6	52
Football Practice	Dom	15,800	5.4	---	5.4	38
Athletics on Lake	Lake	97,300	39.7	---	39.7	33
Totals	**-**	**490,200**	**201.4**	**9**	**210.4**	
				(3) Reference Cool Season Grass		*64*
				(4) Reference Warm Season Grass		*38*

Dom = Domestic Water Supply Source
gpd = gallons per day
(1) Estimated from seasonal variance in metered data from Stanford Utilities Metering Database
(2) Calculated from Landscapes at Stanford, map provided by Stanford Utilities (August 2001)
(3) Based on 100% of Eto (see text above)
(4) Based on 60% of Eto (see text above)

4.3 Campus Expansion Plans

The approved 2000 GUP campus expansion plans were used to develop the future water use projections. Data were provided and reviewed by the Stanford University Architect/Planning Office prior to initiation of modeling efforts and the development of the baseline water use

projection discussed in the following section. Projections shown in Table 4-5 assume a 10-year build out of the 2000 GUP.

Table 4-5. Campus Expansion as Approved in 2000 GUP and Used for Future Water Use Projections

CATEGORY	PROJECTIONS										
	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Gross Academic Square Footage	8,342,334	8,813,353	9,016,853	9,220,353	9,423,853	9,627,353	9,830,853	10,034,353	10,237,853	10,441,353	10,644,853
Student Housing Beds	9,354	10,039	10,239	10,439	10,639	10,839	11,039	11,239	11,439	11,639	11,839
Faculty/Staff Housing	882	984	1,086	1,168	1,290	1,392	1,494	1,596	1,698	1,799	1,900
Med School Occupants	4,082	4,194	4,306	4,418	4,530	4,462	4,754	4,866	4,978	5,090	5,201
Total Population	19,666	19,774	19,882	19,990	20,098	20,206	20,314	20,422	20,530	20,638	20,748

Notes:

1) FY 2000-2100 growth under 2000 GUP: 2,035,000 academic square footage, 668 faculty/staff housing units and 350 post-doc housing units, 2201 total increase in faculty, staff and students. Medical school population increase totals 1,119. General campus population increase totals 1,082.
2) All future academic building, housing units and population growth is distributed evenly across the FY 2000-2010 planning horizon with two exceptions: 1) The addition of 485 student beds constructed under 1989 GUP is included in 2000-2001 academic year; and 2) A balance of 267,519 sq. ft. of academic building constructed.
3) Academic GSF does not include student housing GSF (3,684,377 up to and including build out under 1989 GUP).
4) Faculty/Staff units exclude the 108 units served water by the City of Palo Alto.

4.4 Baseline Water Use Projections by Category through 2010 GUP Build out

Historical water use and campus expansion plans under the approved 2000 GUP were evaluated to develop a baseline water use projection for the Stanford University campus, assuming that additional water conservation measures were not implemented. The baseline water use projection is based on growth projections described in Table 4.5 and the analysis of 5 years of metered data for each of the eight categories described in Section 3.0.

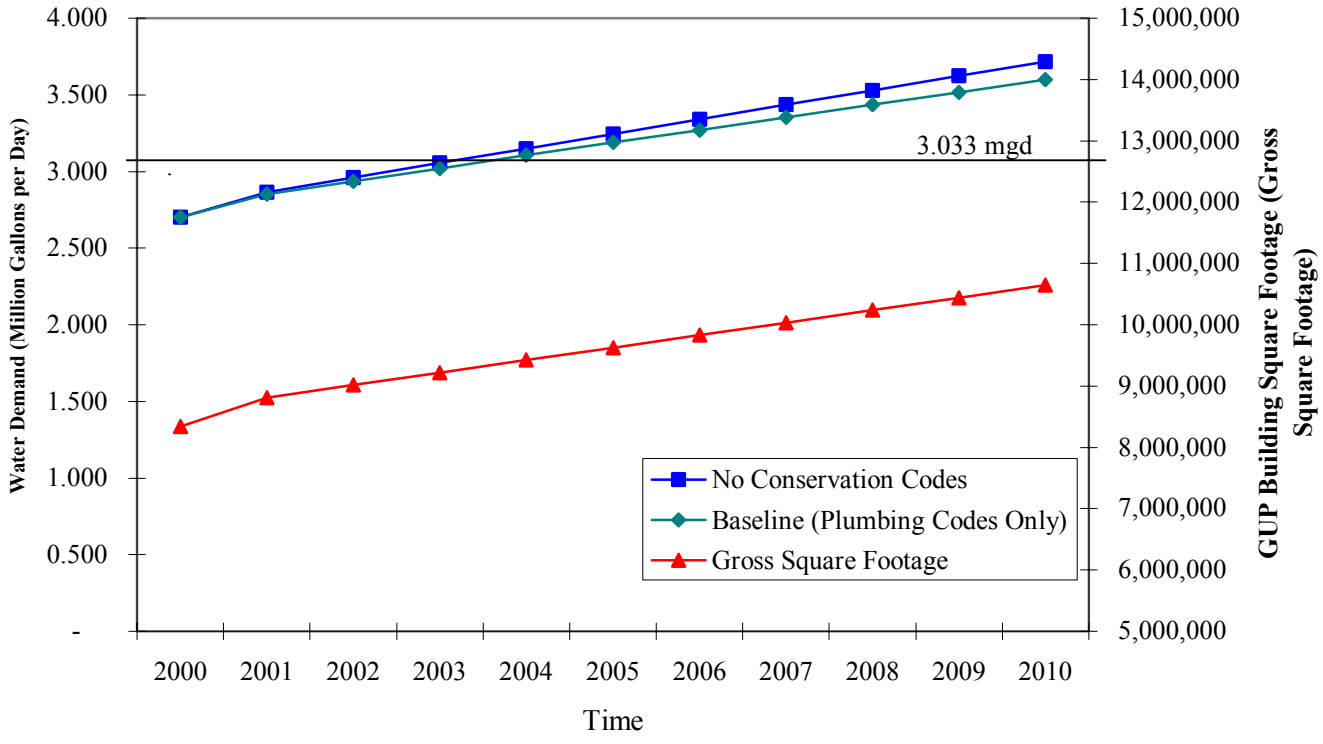
In developing the baseline water projection, each water use category was assumed to increase in proportion to one of the projections listed in Table 4-5. Specifically, the following relationships were assumed:

- Student Housing & Dining water demand increases with the number of new student beds
- Faculty/Staff Housing water demand increases with the number of new faculty staff housing units
- Academic water demand increases with academic square footage
- Athletics water demand increases with the campus population
- Central Energy Facility (CEF) water demand increases with academic square footage
- Medical School water demand increases with medical school occupants
- Construction Projects water demand increases with academic square footage
- Leased Commercial Spaces water demand increases with total campus population

This projection also takes into account current practices in water conservation such as the Landscape Design Guidelines and benefits of the expected natural replacement of plumbing fixtures to meet the National Plumbing Efficiency Standards that have been in place for almost 10 years (Appendix F). The future benefit of the Plumbing Efficiency Standards is especially significant and is also indicated as "baseline, (plumbing codes only)" and "No conservation codes**"** in Figure 4-2. The no conservation case shows that the water use would be higher if these plumbing standards were not in place.

Without water conservation (using conservatively high assumptions), the current average daily water use at 2.7 mgd, is projected to equal as much as 3.6 mgd by the end of the 2010 GUP build out. Therefore, it is clear that a water conservation, reuse and recycling program is needed to reduce campus-wide water use to stay within the 3.033 mgd daily allocation. Section 5.0 includes an evaluation of the water conservation measures potentially applicable for Stanford University and the resulting potential for water savings with associated costs of the conservation measures.

Figure 4-2. Projected Baseline Water Use Without Conservation and With Water Savings Benefits from Plumbing Codes Compared to Campus Growth



5.0 WATER CONSERVATION, REUSE, AND RECYCLING MEASURES

Water conservation, reuse and recycling should be based on the need for and benefit from saving water. The need to conserve water at Stanford, as in many communities throughout California and the world, is because of limited water supply. The cost savings from water conservation, reuse and recycling are primarily derived from reduced domestic purchases, reduced wastewater discharge costs and from the deferred need to acquire new water supplies.

5.1 Assessing Water Conservation, Reuse and Recycling Potential

Selection of water conservation, reuse and recycling measures that are applicable to Stanford is based on a review of projected water demands and growth on campus as discussed above in Section 4.0. The cost effectiveness of alternative conservation measures is evaluated in the following Sections.

5.1.1. Review of Water Metering Data

Analysis of water metering data indicated certain trends and areas where internal and /or external water use is relatively high (Table 4-1). High internal water use (especially for toilets, Table 4-2) is present in Student Housing, Academic areas and the Medical School, so for these categories conservation measures will focus on fixed end uses such as toilet flushing. Categories with high external uses were faculty/staff housing, athletics, and leased commercial spaces, so for these categories conservation measures will primarily focus on irrigation and landscape-related issues.

5.1.2. Site Visits

Maddaus Water Management performed site visits and interviews with Stanford staff knowledgeable about facility water use. Potential water conservation measures were discussed with Stanford staff. The following buildings were visited (with water use category listed in parenthesis):

- CIS (Academic)
- Gilbert Building (Academic)
- Beckman Building (Medical School)
- Central Energy Facility (CEF)
- Athletic Buildings and Fields (Athletic)
- Golf Course (Athletic) on Lake system
- Escondido, Stern, Toyon and Raines Buildings (Student Housing)

5.2 Spectrum of Measures for Water Conservation, Reuse, and Recycling Potential

Maddaus Water Management evaluated a comprehensive spectrum of water conservation measures in close collaboration with Stanford University utilities managers and individuals who will manage and implement the water conservation program (e.g., student housing representatives). Measures evaluated and included in this plan were determined to be appropriate for Stanford University.

In the assessment of conservation potential, consideration was given to a comprehensive list of conservation measures used by numerous utilities throughout California. Currently, over 165 utilities, including the Santa Clara Valley Water District and the San Francisco Public Utilities Commission, determine cost-effective conservation measures to implement in their service areas based on the Memorandum of Understanding (MOU) Regarding Urban Water Conservation in California. The 14

California Best Management Practices listed in the MOU are overseen by the California Urban Water Conservation Council and are presented in Table 5-1. Many of these measures are also used by utilities throughout California as part of the urban water supply planning process governed by the California Urban Water Management Planning Act, last amended in 1995. Some of these may be applicable for Stanford (CUWCC, 2001). The measures were considered when this Master Plan was developed, however only some are applicable to Stanford University's unique system and water use patterns. Site visits were used to refine the list of potential measures.

Table 5-1. Example of Water Conservation Best Management Practices

California Urban Water Conservation Council
As amended March 2001
(Completion Requirements in Italics)

1. **Water Survey Programs for Single-Family and Multi-Family Residential Customers** *(Survey 15 percent of residential customers within 10 years)*
2. **Residential Plumbing Retrofit** *(Retrofit 75 percent of residential housing constructed prior to 1992 with low-flow showerheads, toilet displacement devices, toilet flappers and aerators)*
3. **System Water Audits, Leak Detection and Repair** *(Audit the water distribution system regularly and repair any identified leaks)*
4. **Metering with Commodity Rates for All New Connections and Retrofit of Existing Connections** *(Install meters in 100 percent of existing unmetered accounts within 10 years; bill by volume of water use; assess feasibility of installing dedicated landscape meters)*
5. **Large Landscape Conservation Programs and Incentives** *(Prepare water budgets for 90 percent of all commercial and industrial accounts with dedicated meters; provide irrigation surveys to 15 percent of mixed-metered customers)*
6. **High-Efficiency Washing Machine Rebate Programs** *(Provide cost-effective customer incentives, such as rebates, to encourage purchase of these machines that use 40 percent less water per load)*
7. **Public Information Programs** *(Provide active public information programs in water agencies to promote and educate customers about water conservation)*
8. **School Education Programs** *(Provide active school education programs to educate students about water conservation and efficient water uses)*
9. **Conservation Programs for Commercial, Industrial, and Institutional Accounts** *(Provide a water survey of 10 percent of these customers within 10 years and identify retrofitting options; reduce water use by an amount equal to 10 percent of the baseline use within 10 years)*
10. **Wholesale Agency Assistance Programs** *(Provide financial incentives to water agencies and cities to encourage implementation of water conservation programs)*
11. **Conservation Pricing** *(Eliminate non-conserving pricing policies and adopt pricing structure such as uniform rates or inclining block rates, incentives to customers to reduce average or peak use, and surcharges to encourage conservation)*
12. **Conservation Coordinator** *(Designate a water agency staff member to have the responsibility to manage the water conservation programs)*
13. **Water Waste Prohibition** *(Adopt water waste ordinances to prohibit gutter flooding, single-pass cooling systems in new connections, nonrecirculating systems in all new car wash and commercial laundry systems, and nonrecycling decorative water fountains)*
14. **Residential Ultra-Low-Flush Toilet Replacement Programs** *(Replace older toilets for residential customers at a rate equal to that of an ordinance requiring retrofit upon resale)*

The SCVWD Water Conservation Program currently provides rebates for Water Efficient Technologies (WET), including high efficiency washing machines, high efficiency nozzle sprayers for cafeteria dishwashers, and reclamation and reuse of rinse waters in x-ray machines. Stanford will review the potential retrofit projects and opportunities for rebates available from the SCVWD WET program and work with the SCVWD staff to obtain rebate funding.

The potential applicability of the above and additional conservation measures such as greywater were reviewed according to the following criteria:

- **Technology/Market maturity.** Is the technology commercially available and supported by the necessary service industry?
- **Applicability.** Is the technology applicable to the climate, building stock, or equipment that are typical at Stanford University?
- **Customer acceptance/equity.** Are customers willing to implement the measure? Is it fair?
- **Secondary impacts.** Does the measure affect environmental health or safety, or raise political problems?
- **Better measure available.** If there is more than one measure that addresses a specific inefficiency of water use, is one measure equivalent in function and clearly more cost-effective than other(s)?

This screening removed the measures that were inappropriate for further consideration. For example, greywater usage requires specified treatment, storage, and specific types of irrigation to be used for landscape irrigation. This alternative incurs significant environmental health and safety risks and requirements and also would be cost prohibitive, thus the measure was eliminated from further evaluation.

5.3 Evaluation of Potential Water Conservation, Reuse or Recycling Measures

After reviewing a comprehensive list of measures using the criteria above, the following 14 water conservation measures are considered appropriate for Stanford University (Table 5-2). They are evaluated for water savings potential and cost-effectiveness in the Sections below. The plumbing fixture replacements (showerheads, toilets, urinals, faucets) in Student Housing, Athletics, and Academic areas are selected based on quality, ease of maintenance, customer acceptance, and durability. The estimated costs for fixture replacements include scheduling the work with student residents. Additionally, working hour restrictions, incidental repairs, key control and security, contract requirements for insurance and bonding also impact the cost. The SCVWD has experienced lower costs for fixture replacements in municipal retrofit programs. The SCVWD has provided samples of showerheads and faucets, which are currently being tested and could reduce the cost of these fixture replacements.

Table 5-2. Potential Water Conservation Measures

No.	Measure
1.	Ultra Low Flush Toilet Replacement
2.	Showerhead Retrofit
3.	Urinal Replacement
4.	High-Efficiency Washer Replacement
5.	Public Outreach Programs
6.	CEF Blow down Reuse
7.	Faculty/Staff Housing Water Audits
8.	Landscape Water Management
9.	Selective Landscape Retrofit
10.	New Water Efficient Landscape
11.	New Landscape on Lake Water
12.	ET Controllers on New Faculty/Staff Housing Units
13.	Selected Academic Areas on Lake Water
14.	Football Practice on Lake Water

5.3.1. ULF Toilet Replacement

Recommend Stanford continue to implement a toilet replacement program, replacing high water-use toilets with ultra low-flush (ULF) toilets. ULF toilets reduce toilet-flushing water to about 1.6 gallons per flush (gpf). This is a significant water savings from an average of 5-7 gpf for regular (pre-1980) toilets, and 3.5 gpf for post-1980 toilets.

This program could be applicable to all existing housing and academic and commercial buildings and athletic facilities. It would have an overall goal, such as, replacing 90 percent of existing toilets within a specified time (e.g., three years).

Recommend Stanford develop an incentive strategy for the various customer groups. Toilets could be installed as part of remodeling projects or as separate projects.

The cost of the program would include the cost of the toilet and installation by a contractor. Costs would vary from $300 for a gravity flush toilet to $550 to a flush-o-meter-type toilet. Once toilets are replaced, the customer's toilet water end use should decline about 50 percent (Residential End Uses of Water, AWWARF, 1999).

5.3.2. Showerhead Retrofit

Recommend Stanford identify buildings constructed before 1992 that have not been retrofitted. Stanford would develop an incentive strategy to install low-flow showerheads in buildings with high flow fixtures. Installation could continue until at least 90 percent of all buildings are so equipped. Showerheads cost about $25 each, including installation, and save about 21 percent of shower water use.

5.3.3. Urinal Replacement

Recommend Stanford identify buildings constructed before 1992 that have not been retrofitted. Stanford would develop an incentive strategy for departments to retrofit old, inefficient urinals. The current standard for urinal flush volume is 1.0-gallon per flush. It appears that the standard may soon change and 0.5-gallon per flush urinals will be available. For existing urinals that are of the wash down type (no pool of water in the fixture) it is possible to just change the valve and leave the fixture in place. This would conserve water and save the cost of installing a new urinal. Waterless urinals are also available, but they require special maintenance and soon will only save an extra 0.5-gallon per flush. The program could continue until at least 90 percent of all buildings are so equipped with 0.5-gal per flush units. Urinals could cost $650 each (installed). Valves cost about $200 installed. An average cost of $400 per urinal is assumed. Water savings would be about 75 percent of urinal water use (change from 2 gallons/flush to 0.5 gallon/flush).

5.3.4. High-Efficiency Appliance Promotion Programs

Recommend Stanford replace existing coin-operated washing machines in Student Housing with new efficient (front-loading, horizontal axis technology) coin-operated models. This could reduce the current wash volume from 31.5 gallons per load to 20 gallons per load with new machines , saving 35 percent of the water used for washing clothes. Studies presented by the Consortium for Energy efficiency (CEE) indicate that high-efficiency commercial washers save up to 50 percent of energy costs and use about 30 percent less water. The CEE states that data from a study of a senior citizens community showed that water savings ranged from 10.5 gallons/cycle (28 percent) to 22.5 gallons per cycle (59 percent) over the baseline washer (Appendix F, CEE, 2000-02). The Student Housing Department is currently investigating the feasibility of a large-scale replacement of clothes washers. It may be possible for Stanford to take advantage of the washer rebate offer from the Santa Clara Valley Water District and Pacific Gas & Electric (where gas water heating and/or dryers are used). Currently the combined rebates could provide up to $175 per machine.

The total cost of new washers is anticipated to approach $1200. For the purposes of a water savings and cost effectiveness evaluation, an incremental Stanford rebate cost of upgrading to efficient models is assumed at $200 per machine. This would be the assumed amount of a rebate to the Student Housing Department.

In addition, other privately owned washing machines could be upgraded if owners changed the machines and participate in the SCVWD rebate offer directly.

5.3.5. Public Outreach

Public information and outreach serve as the “glue” to tie all the other measures together. It would not only call attention to and publicize specific conservation measures but also promote water conservation awareness among Stanford Utility customers, students, and faculty and employees. Most importantly, it would convey to the Stanford community the importance and significance of water conservation. Water conservation awareness could include poster contests, T-shirt design contests, presentations and tours with hands-on demonstrations, and radio advertisements. Additionally, customer bill inserts could include printed educational material, such as information showing use in gallons per day for the last billing period compared to the same period the previous year.

The following steps could be used to design new public information programs:

- Develop water conservation specific theme and logo.
- Identify key target groups.
- Select members for a water conservation committee.
- Identify communication paths, resource materials, and volunteers.
- Design and implement specific campaigns.
- Ensure effective coordination and implementation.

It is assumed that the public outreach program could save 3 percent of targeted end uses. Assumed cost is $50,000 per year.

5.3.6. CEF Blow Down Water Reuse

Blow down of cooling tower water is necessary to maintain an acceptable mineral concentration balance in the recirculating cooling water. Stanford is fortunate to have low mineral concentration SFPUC water to use in its cooling towers. The CEF cooling towers run very efficiently with about 10 cycles of concentration, which means that the process allows the cooling tower water to recycle until it is 10 times its initial concentration before it is discharged to the sanitary sewer. In many other locations in the San Francisco Bay Area cooling towers only run at 3 to 6 cycles. Due to Stanford's existing very efficient and aggressive management to prevent corrosion by the cooling tower water, there is little room for additional water conservation through operational changes. The current blow down of cooling tower water is about 50,000 gallons per day (gpd). The blow down water was tested and the mineral concentration is less than 300 mg/l TDS. On the basis of TDS, the blow down is acceptable for other uses, such as landscape irrigation or toilet and urinal flushing in new buildings. In addition to cooling tower source the blow down from the Heat Recovery Steam Generator at the CEF is also a significant source of reuse water (13,000 gpd) and also of good quality (although not specifically tested in this project). Thus an estimated 63,000 gpd is available on average, but this varies during the year depending upon the steam and cooling load on the plant. For example, cooling tower blow down increases in the summer when more water is needed for irrigation. The amount of blow down water will increase in the future as the load on the plant increases due to new buildings coming on-line.

The CEF is centrally located but the blow down would require storage, piping and pumping to reuse sites. It may be possible to simply tie the blow down into the lake water system. Alternatively, a separate piping system may be required. Specific projects to distribute and reuse the water would need to be developed. At this preliminary planning level it is assumed that the blow down could be reused at a capital cost of $500,000 and an operating cost of $10,000 per year. For the purposes of this evaluation it is assumed that the reuse water can be tied directly into the lake system and used for existing landscape needs. Based on a comparison of reuse supply and domestic irrigation demands, about 25 percent of the area currently irrigated with domestic water will also need to be converted over to the lake system to make full use of this water source. The cost estimate above is for the tie-in and the conversion and extension of the lake system. Treatment of the blow down water will be needed to remove anti-corrosion additives. The cost of treatment has not been estimated.

5.3.7. Faculty/Staff Housing Water Audits

Stanford would offer an indoor and outdoor water survey to not less than 30 percent of metered existing faculty/staff single-family and multiple-family customers.

Specific activities for each indoor survey would include:

- Check for leaks including toilets, faucets, and meter check

- Check flow rates for showerheads and faucets, and offer to replace or recommend replacement with low flow models as appropriate
- Check toilet flow rates, recommend installation of displacement device or direct customer to Ultra Low Flush Toilet (ULFT) replacement program, as appropriate; replace leaking toilet flapper, as necessary

The outdoor survey would consist of the following:

- Check irrigation system and timers
- Review or develop customer irrigation schedule in minutes of watering time per week for spring, summer, and fall.
- Provide a rain shut-off device (optional)
- Measure currently landscaped area (optional)
- Measure total irrigable area (optional)

Customer will be provided with survey evaluation results and water savings recommendations and given an information packet. Stanford will track surveys offered, surveys completed, survey results, and survey costs. Surveys cost about $50 per home (when using student labor) and will save about 5 percent of indoor use and 10 percent of outdoor use. Audits have about a five-year life and so must be repeated every five years to maintain savings.

5.3.8. Landscape Water Management

Stanford would undertake projects to increase water use efficiency at existing landscapes in student housing, academic, athletics, and faculty/staff housing. Although this report focuses on domestic use, this measure is equally applicable to irrigation water on the domestic and lake systems.

For accounts with Dedicated Irrigation Meters:

- Identify irrigation only accounts and provide them with a landscape water budget based on published plant water needs for turf grass or shrubs as appropriate.
- Provide notices with each water bill that shows the relationship between actual use and the water budget
- For larger accounts, such as selected athletic fields and other large landscapes, provide graphical comparison of monthly water use and water budgets

For accounts with Mixed-Use Meters:

- Develop a strategy to market landscape water use surveys and other techniques to accounts with significant seasonal water use that includes, where cost-effective:

    1. Landscape water use analysis and audits
    2. Voluntary water use budgets
    3. Installation of dedicated landscape meters
    4. Training in landscape and irrigation system maintenance
    5. Financial incentives such as rebates for efficient irrigation systems
    6. Follow-up water use analysis/surveys

General:

- Install climate-appropriate water-efficient landscaping at new facilities
- Provide customer notices at the beginning and end of the irrigation season advising them to check and adjust irrigation systems and timers

The cost of providing this service is assumed to be $1,000 per acre for a large turf area (figured on turf area per water meter basis). Over a five-year period, the top 25 percent of accounts on the domestic system with significant irrigation would be covered. The program is assumed to have a five-year life so surveys must be repeated periodically to maintain savings. Accounts that are treated would save about 10 percent of irrigation use. The cost of this service, $1,000 per acre, is applied every five years.

5.3.9. Selective Landscape Retrofit

Existing accounts with significant turf (used for decorative purposes only) would be relandscaped with water efficient plant material. Such projects would also involve replacing sprinkler turf irrigation systems with systems appropriate for shrubs and ground covers. Narrow strips of turf would be replaced because of the difficulty of irrigating efficiently. The retrofit would apply to selective landscape in academic areas, housing and public areas where the turf is not required for playing fields, student recreation or departmental use. Low water use plant material can generally be irrigated with about 30 percent less water than required by turf. The cost of relandscaping is on the order of $100,000 per acre, depending on soil preparation, specific plant material selected (which is usually more expensive than turf), and need for irrigation system retrofit.

Actual sites for retrofitting are to be determined. Future work would involve creating a list of those areas where retrofitting is appropriate and could save water. Retrofitting would likely be done in conjunction with building construction and renovation.

5.3.10. New Water Efficient Landscape

Stanford has been including water conservation measures in its landscape for the past 25 years. Current practices that will continue to incorporate large areas of native and/or drought tolerant plants and/or mulch into the improved areas, treating soils prior to planting, mulching all exposed soil, and installing the Maxicom or similar controller system that is tied to a weather station for efficient irrigation.

New landscapes would continue to be designed according to guidelines and criteria that emphasizes water efficient plant material, efficiently irrigated. The Stanford University Landscape Design Guidelines emphasize native landscaping. For this measure Stanford will adhere to the principles and practices outlined in the Stanford University Landscape Design Guidelines, March 1989.

Landscape maintenance practices include monitoring and reducing and/or eliminating water applications after the initial establishment of the plants. Additionally, areas not currently on the Maxicom system could be retrofit. The addition of the Maxicom controller or equivalent could be expensive relative to the size of a landscape project, adding an additional $5,000 to $10,000 per project.

5.3.11. New Landscape on Lake Water

New landscapes would be irrigated with lake water, rather than a mix of lake water and domestic water, as is the present practice. Outdoor use for new academic square footage, student housing, athletics, and commercial building landscaping would see no additional outdoor use on the domestic system. This

would be a change in policy. The additional cost of this measure is assumed to range from $1,000 to $10,000 per account, depending upon the current distance of the new accounts from the current lake system. Since the landscape would be as originally planned, only the water connection would be altered. The water savings of this measure may be limited by the capacity of the lake system to take on new irrigated areas. Because of this uncertainty, long-term plans should rely on conservation measures to reduce the new irrigation demand, such as water efficient landscaping and reuse of cooling tower blow down.

5.3.12. ET Based Irrigation Controllers for New Faculty/Staff Housing Units

Stanford will install Evapotranspiration (ET) Controllers on newly constructed faculty-staff housing areas. These controllers place the responsibility for adjusting watering times to compensate for changing weather on the management company that provides the controllers. It is assumed that the controllers can be installed for approximately $300 each and maintained with a monthly fee (charged by the service provider) of approximately $4.00. Pilot tests have indicated that potential irrigation water savings are on the order of 15 to 25 percent. (Irvine Ranch Water District, 2001) Savings of 15 percent of irrigation use for new single-family homes and 20 percent of irrigation use for new multiple-family units.

5.3.13. Selected Academic and Medical School Landscaped Areas on Lake Water

The following five areas, currently irrigated with domestic water, could be switched over to the Lake System.

1. Law School
2. Kresge Auditorium
3. Brown Building
4. Alumni Center
5. Center for Clinical Sciences Research (CCSR) (Medical School)

Total turf area is 3-4 acres. The average water savings would be about 14,000 gallons per day (pending review of actual meter data). A water audit could be conducted for some of these areas to verify water savings. Cost for this conversion is assumed to be $5,000 per account, or $25,000 total.

5.3.14. Football Practice Field on Lake Water

The football practice field encompasses 5.4 acres of turf, irrigated with domestic water. Current use averages 15,800 gallons/day. The Lake system is located nearby and the retrofit to supply this area with Lake water would be relatively simple, and assumed to cost about $10,000.

6.0 CONSERVATION, REUSE AND RECYCLING MASTER PLAN EVALUATION

The measures described above were evaluated using a benefit-cost methodology to assess their value for implementation. A summary of the cost effectiveness analysis and results are provided below.

6.1 Water Savings and Costs of Measures

In order to combine measures into a cohesive program that Stanford could implement, evaluation of certain data is useful to include in the analysis of water savings, costs, costs per million gallons of water saved and benefit-cost ratio. Costs for implementing individual measures are derived from the best available industry knowledge and experience similar conservation programs.

The benefit-cost ratio and the cost of water saved in $/million gallons are presented in Table 6-1 based on the results of the measure evaluation. Our evaluation model, called the Decision Support System (DSS, See Appendix D), uses a 30-year analysis period for present value calculations. Savings are averaged over a 30-year period and can be different in selected years. In later years the water savings from the conservation measures will be higher than the values listed since all measures start at zero savings and ramp up to full effect after three to ten years. Water savings are presented for the whole program as a package of measures. However, Table 6-1 provides a rough estimate of the conservation potential of each individual measure.

Table 6-1. Results of Evaluation of Individual Measures

No.	Measure	Evaluation Criteria		
		Average Water Savings, mgd*	Utility Benefit-Cost Ratio	Cost of Savings per million gallons, $
1.	Ultra Low Flush Toilet Replacement	0.084	1.09	1,451
2.	Showerhead Retrofit	0.007	2.77	581
3.	Urinal Replacement	0.023	1.54	1,026
4.	High-Efficiency Washer Replacement**	0.010	19.14	492
5.	Public Outreach Programs	0.026	1.02	3,180
6.	CEF Blow down Reuse	0.060	1.04	1,000
7.	Faculty/Staff Housing Water Audits	0.037	3.46	733
8.	Landscape Water Management	0.010	1.38	480
9.	Selective Landscape Retrofit	***	***	***
10.	New Water Efficient Landscape	0.022	0.27	3,230
11.	New Landscape on Lake Water	0.086	6.72	132
12.	ET Controllers on New Faculty/Staff Housing	0.124	0.96	321
13.	Selected Academic Areas on Lake Water	0.013	5.86	163
14.	Football Practice on Lake Water	0.011	12.31	78

* Caution: savings cannot be added without handling measure overlap water savings averaged over 30 years. Actual savings in 2010 may be higher. (See Appendix D);

** This measure's benefit-cost ratio includes a rebate of $200 per washing machine.

*** To be determined, the annual report will list specific projects completed during the reporting year and associated estimated water savings.

6.2 Benefits of Saving Water

It is not certain where Stanford might acquire new water supplies in the future in the absence of water conservation. In our evaluation, the benefits are based on deferring the cost of a new well for Stanford and savings from reduced sewer flows. Specifically the benefits are based on the following assumptions:

- Cost of SFPUC water ($1,176 per million gallons currently)
- Cost of new well $1,000,000
- Operating cost of new well $150/million gallons pumped (energy and chemicals)
- Pump tax from Santa Clara Valley Water District at $330 per acre-foot pumped
- Maximum capacity of new well 500 gpm (0.72 mgd)
- Operating capacity of average 0.45 mgd
- Addition of new well is assumed if and when average day domestic demand reaches 3.25 mgd (which will occur about 2006 w/o additional conservation). This could be eliminated if additional conservation keeps domestic average daily use below 3.033 mgd.
- Cost of wastewater discharge to Palo Alto regional facility at $1000 per million gallons

The above benefits apply to reduction in indoor and outdoor use. Programs that reduce both will have benefits, however outdoor use reduction programs that reduce peak day water use will have the most impact on the timing of constructing a new well. Water supply capital projects are designed to meet peak day capacity needs, and the next increment of supply is constructed as the existing capacity approaches peak day demands.

Other benefits from the program include energy savings from the following measures: Showerhead Retrofit; High Efficiency Washers; and Faculty Staff Housing Water Audits. These benefits accrue to the water user (customer) and factor into their decision to participate in voluntary programs.

6.3 Cost-Effectiveness Analysis

Only a complete program consisting of individual conservation measures that has a benefit-cost ratio of more than 1.0 is considered cost effective (Appendix D). As a point of reference for the cost of water savings per million gallons, SFPUC water currently costs $1,176 per million gallons. Any cost of water saved that is less than this is cheaper than buying the water from SFPUC. As presented in Table 6-1, 10 out of 14 individual measures have a benefit-cost ratio over 1.0.

In order to achieve the goal of maintaining domestic water use within the 3.033 mgd allocation, all measures listed in Table 5-2 were needed for the Master Plan.

6.4 Evaluation of Master Plan

The program of measures described above was evaluated to determine combined water savings, costs and benefits. Results are shown in Table 6-3 and include water savings, cost by year for implementation, benefits, and benefit-cost ratio for the program. Note that the program is cost-effective, with a benefit/cost ratio over 1.0. The Master Plan would eliminate the need for a new well.

Figure 6-1 shows the projected water demand without conservation and then with the Master Plan. The baseline, or no additional conservation is labeled “Baseline (Plumbing Codes Only).” It should be used for comparison purposes only because the plumbing and appliance codes are already in place and providing “free” conservation over time as older fixtures and appliances are replaced with new more

efficient models that meet today's standards. Conservation savings are measured against this baseline. Furthermore, after the GUP 2000 build out is completed, the conservation measures will keep Stanford within the 3.033 mgd allocation.

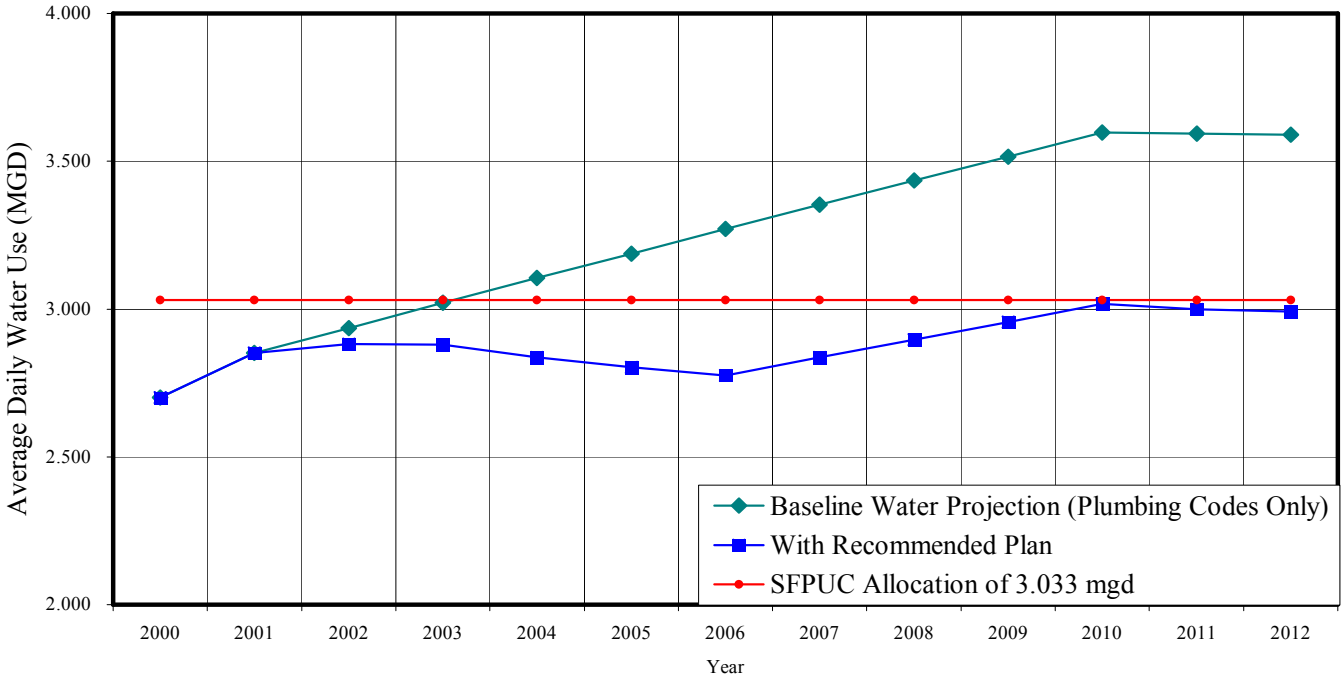
Table 6-2 shows the water savings and costs and benefits for the Master Plan. Note that total costs shown for the two five year-periods is coincidently close to but not the same as the 30-year present value of the costs. The benefits are based on the current costs of SFPUC water and the list described in section 6.1.

Table 6-2. Estimated Savings and Costs of Water Conservation, Reuse and Recycling Master Plan

Savings/Costs	Master Plan
Water savings in 2005, mgd	0.38
Water savings in 2010, mgd	0.52
Total Cost 2002-2005, million $	2.75
Total Cost 2006-2010, million $	1.78
Present Value of Costs, million $**	4.90
Present Value of Benefits, million $*	7.59
Cost of Water Saved $/million gallons**	965
Benefit/Cost Ratio	1.55

*Based on current cost of SFPUC water of $1,176 per million gallons.
**Present Value is based on 30-year actual costs and benefits.

Figure 6-1. Projected Water Demand with and without Water Conservation Master Plan



7.0 RECOMMENDED WATER CONSERVATION, REUSE AND RECYCLING MASTER PLAN

7.1 Recommended Master Plan Measures

Based on the evaluation in Section 6.0, the Master Plan was found to be the best plan for Stanford. The Master Plan measures are briefly described in Table 7-1. Note, measures are not listed in priority order.

Table 7-1. Master Plan Measures

No.	Measures	Brief Description
1.	Ultra Low Flush Toilet Replacement	Replace 90 percent of inefficient toilets with 1.6 gallon/flush models in all campus facilities.
2.	Showerhead Retrofit	Replace 90 percent of inefficient showerheads with low flow models in all campus facilities.
3.	Urinal Replacement	Continue with current urinal replacement plans but delay on the remaining until 0.5 gal/flush units or valves are on the market and use these to attain a 90 percent replacement rate.
4.	High-Efficiency Washer Replacement	Replace existing washing machines in student housing with efficient (such as front loading) models. Retain pay-per-use machine types.
5.	Public Outreach Programs	Implement a multi-faceted public education program directed at departments, students, and employees stressing the need to conserve water. Highlight programs and rebates available.
6.	CEF Blow down Reuse	Prepare preliminary engineering and pilot testing of cooling tower and boiler blow down water for irrigation. Determine best way to integrate this source with the lake system and use to irrigate new and existing areas.
7.	Faculty/Staff Housing Water Audits	Offer indoor/outdoor water audits to not less than 30 percent of the faculty-staff housing on a repeating five-year cycle. Focus on reduction of irrigation, toilet and washer use.
8.	Landscape Water Management	Provide water budgets and tracking of performance on a monthly basis for large irrigated sites. Conduct large turf audits periodically.
9.	Selective Landscape Retrofit	Retrofit turf areas and irrigation systems known or shown to be inefficient with low water use plant landscapes where feasible and cost-effective.
10.	New Water Efficient Landscape	Amend and require use of Stanford's Landscape Design Guidelines and FDS to ensure predominant use of water-efficient plant types is used. Develop and adhere to water budgets. Conduct water efficiency reviews of plans.
11.	New Landscape on Lake Water	Put all new landscapes on the lake water system.
12.	ET Controllers for New Faculty/Staff Housing	Install Evapotranspiration (ET) based controllers on all irrigated landscapes in new Faculty/Staff housing areas.
13.	Selected Academic Areas on Lake Water	Switch irrigation of five specifically identified landscapes from the domestic to lake system.
14.	Football Practice on Lake	Extend the lake system to irrigate the football practice field.

7.2 Additional Recommendations for New Buildings and Renovations – Recommended Plans Review Process

Besides conservation measures and the existing Stanford internal process to review plans for new buildings, the Master Plan includes additional recommendations. In addition, future Stanford plan reviews would focus on interior and exterior water use with additional specific criteria. The interior plumbing and equipment design review that Stanford undertakes would include review of efficiency of water consumption based on available technology. For example, to prevent disposal of steam condensate with poor quality (and use of additional domestic water), review of design of steam systems in buildings should include building heat load analysis and appropriate heating equipment sizing. Heat exchanger trapping and condensate return piping should be designed to prevent heat exchanger failures and steam condensate contamination.

7.3 Landscape Water Management for Recommended Best Management Practices

Although most landscape water use is on the lake system, landscape water use on the domestic system still amounts to almost an average of 0.6 mgd or over 22 percent of current use. Water conservation is also planned for the Lake System to ensure supply will be available. The proposed CEF reuse project will help in the supply area but there is still a need for improved campus wide landscape water management. Based on our evaluation the following strategy for increasing water efficiency is recommended.

1. Practice Landscape Water Management on all large turf sites (suggested cut-off is 0.5 to 1.0 acres per site). The Santa Clara Valley Water District has offered two water audits. These should be arranged by the Utilities Department and coordinated by the Grounds Department that is responsible for implementation of audit findings. Irrigation systems found to have low sprinkler uniformity should be scheduled for renovation. Suggested irrigation watering times resulting from the water audits should be programmed into the Maxicom system by the Grounds Department.
2. New and renovated landscaped areas should use only the lake water system for irrigation (unless prohibitively expensive). Separate meters will be placed on all large landscapes. Tie irrigation of all large sites into Maxicom system, including installation of flow sensors. Provide appropriate water budgets for each site.
3. Amend Stanford University Landscape Design Guidelines, March 1989, or Facilities Design Standards (FDS) to ensure water efficient landscapes are installed. Suggested amendments include:
    a. Provide a list of recommended drought tolerant plant materials including low water use turf, ground covers, shrubs and trees. There are a number of good books specific to the Bay Area such as "Water Conserving Plants and Landscapes for the Bay Area" by East Bay Municipal Utility District (1990).
    b. Require that irrigation plans and irrigation plans show a water budget for the project and a suggested baseline irrigation schedule.
    c. Provide criteria as to when and how to tie new landscaped areas into the Maxicom irrigation controller and include flow sensors.
    d. Review landscape plan for water efficiency.
4. Implement Stanford University Landscape Design Guidelines, March 1989, and FDS Guidelines for all new and relandscaped areas. Review all landscape and irrigation plans from the standpoint of achieving landscape water use efficiency. Adopt a goal of a water budget of three feet of applied water per year (not on individual projects, but overall). Do an annual water use review of all newly and recently planted areas to verify appropriate watering.

5. Create new supply for lake water system through implementation of reuse of CEF cooling tower and Heat Recovery Steam Generator blow down. Prior to tying these streams into the lake system do thorough chemical testing and if necessary, irrigation of test plots to verify the water is not harmful to plants.
6. Selectively retrofit landscape areas to save water. Criteria for retrofit projects could include:
    a. Eliminate narrow strips of turf (less than eight feet wide) by replacement with other drought tolerant plantings.
    b. Eliminate slopping turf that serves no purpose other than ornamental
    c. Replace high water use plants with low water use plants, except in flowerbeds and courtyards
    d. Connect irrigation systems to the Maxicom system where feasible and cost-effective (from a water savings standpoint)
7. Investigate the application of new irrigation technology to the Stanford Campus. The first new technology to investigate is installing ET Controllers on existing faculty/staff housing areas. Existing faculty/staff housing consumes almost half of the irrigation water on the domestic system (10 percent of total domestic use). The number of required controllers for Stanford faculty staff housing is not known. These controllers would replace existing controllers and shift the responsibility of adjusting watering times to compensate for changing weather to the management company that provides the controllers. Pilot testing a few brands of ET Controllers in the existing faculty/staff housing area is recommended to find the most advantageous and easy to implement. It is appropriate that a consistent brand is selected. Installation on new housing units is included in the Water Conservation, Reuse and Recycling Master Plan

7.4 Implementing and Staffing the Master Plan

Implementation of the Master Plan will involve staffing, funding and other resources. The Utilities Division will manage the Water Conservation, Reuse and Recycling Master Plan. Implementation of the specific programs will be in collaboration with individual departments, as shown in Table 7-2. In-house staff can carry out some of the work; other work can be done by contract.

In order to effectively manage this program Stanford Utilities Division will need to allocate resources to manage the Water Conservation Master Plan. Duties would include:

- Coordinate, communicate implementation of all measures/programs
- Develop budget and track expenses and progress
- Develop and carry-out the Public Outreach Program
- Interface with other outside groups such as the Santa Clara Valley Water District, SFPUC and the BAWUA
- Participate in the activities of the California Urban Water Conservation Council, as appropriate
- Investigate and potentially pilot-test new technology
- Provide timely information to departments on their water use, develop water budgets, and compare water budgets to actual use for large landscape users.

Table 7-2. Responsible Departments for Implementation of Measures

No.	Measure	Responsible Departments
1.	Ultra Low Flush Toilet Replacement	Student Housing, , Zones (Academic), Athletics, Medical School
2.	Showerhead Retrofit	Student Housing, Athletics
3.	Urinal Replacement	Student Housing, Zones (Academic), Athletics, Medical School
4.	High-Efficiency Washer Replacement	Student Housing
5.	Public Outreach Programs	Utilities
6.	CEF Blow down Reuse	CEF, Utilities, Grounds
7.	Faculty/Staff Housing Water Audits	Utilities/Contractor
8.	Landscape Water Management	Grounds, Utilities
9.	Selective Landscape Retrofit	Planning, Grounds
10.	New Water Efficient Landscape	Planning, Grounds
11.	New Landscape on Lake Water	Utilities, Capital Planning Management (CPM)
12.	ET Controllers	Utilities, Grounds
13.	Selected Academic Areas on Lake Water	Utilities, Grounds
14.	Football Practice on Lake Water	Utilities, Athletics

Note: Zones, Utilities, and Grounds are departments within the Stanford University Facility Operations Department.

8.0 REFERENCES

American Water Works Association, Leak Detection and Water Accountability Committee, "Committee Report: Water Accountability, Journal American Water Works Association, July 1996.

A&N Technical Services, "BMP Costs and Savings Study", California Urban Water Conservation Council, July 2000. (Used for water savings for water conservation measures.)

Bay Area Water Users Association (BAWUA), Annual Survey, December 2000.

Beatty, R., Chapman, S. and Maddaus, w. "Benefit-Cost Analysis with an End Use Model", Proceedings AWWA Water Sources Conference, Las Vegas Nevada, January 27-30, 2002.

Dziegielewski, B, et al "Commercial and Institutional End Uses of Water", American Water Works Association Research Foundation, 2000. (Used for commercial water use rates, gallons/employee/day)

Municipal Water District of Orange County, "Landscape Management for Water Savings", Fall 1998.

California Urban Water Management Planning Act, as amended 1995.

California Urban Water Conservation Council (CUWCC), Memorandum of Understanding Regarding Urban Water Conservation, as amended March 2001

Consortium for Energy Efficiency, Inc., 2000-02 http://www.cee1.org/com/cwsh/cwsh-main.php3

East Bay Municipal Utility District, Water Conserving Plants & Landscapes for the Bay Area, 1990.

"Exhibit 6: Assumptions and Methodology for Determining Estimates of Reliable Water Savings from the Installation of ULF Toilets", in Memorandum of Understanding Regarding Urban Water Conservation in California, California Urban Water Conservation Council, July 1992 as amended. (Used for toilet replacement rates)

Mayer, P. et al, "Residential End Uses of Water", American Water Works Association Research Foundation, 1999.

Stanford University Landscape Design Guidelines, March 1989.

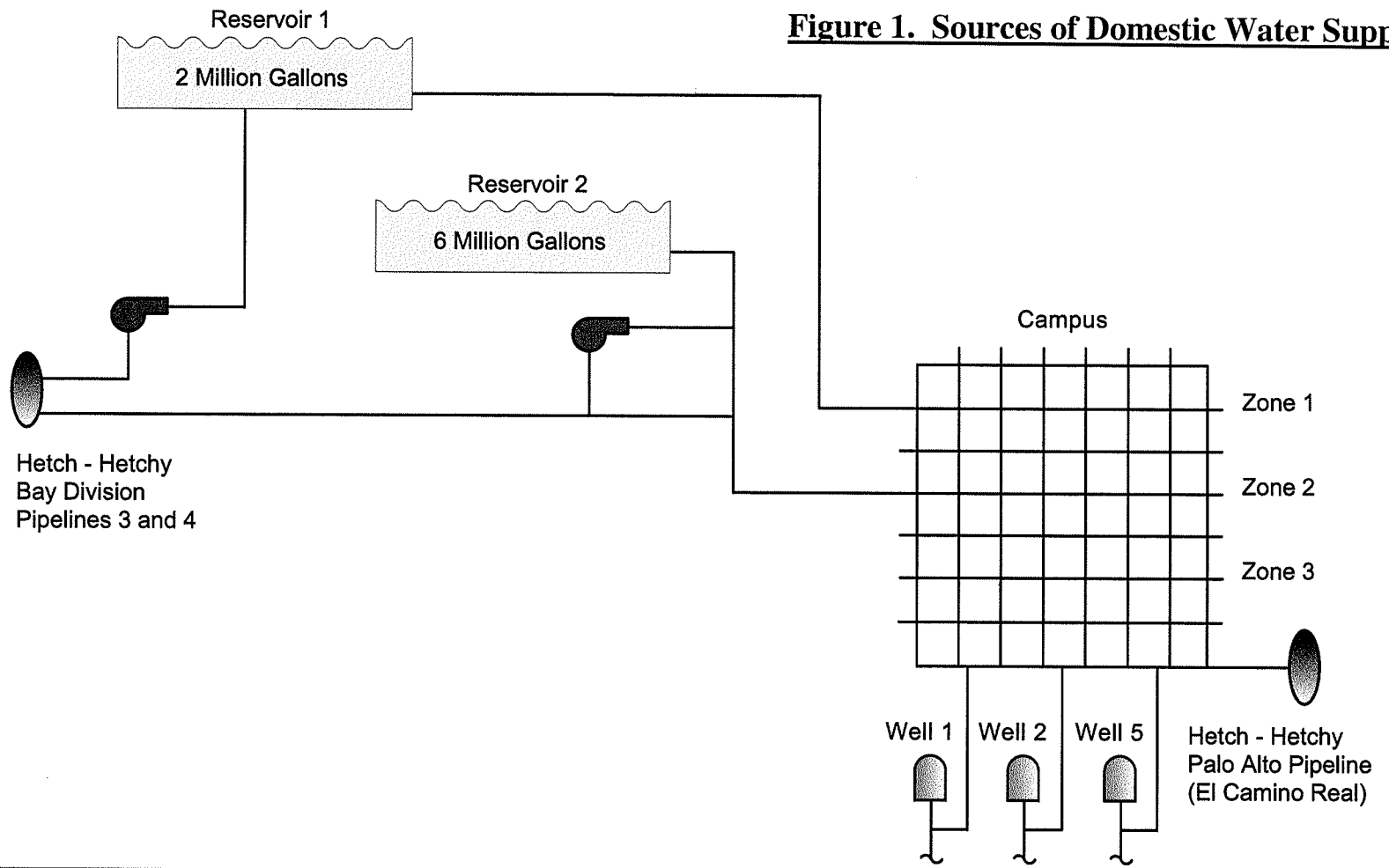
Stanford University Draft Community Plan and General Use Permit Application**,** Final Environmental Impact Report, Volume I, December 18, 2000.

Irvine Ranch Water District, "Residential Weather-Based Irrigation Scheduling: Evidence from the Irvine "ET Controller" Study", June 2001.

LIST OF APPENDICES

Appendix A

Figure 1. Sources of Domestic Water Supply



STANFORD UNIVERSITY - Utilities Division

DOMESTIC WATER SUPPLY DIAGRAM

5/15/02

5-15-02_DW_Supply_Diag-B.ai

Appendix B

Exhibit 15, BAWUA Annual Survey Report, 2000

Gross Per Capita Consumption Among BAWUA Members
FY 1999-00

Agency	Service Area Population	Total Consumption* (ccf)	Gross Per Capita Consumption (GPCPD**)
Guadalupe Valley County WD	10,800	130,412	24.7
East Palo Alto WD	27,300	996,890	74.8
City of Daly City	104,571	4,138,917	81.1
North Coast WD	39,667	1,690,405	87.3
Los Trancos Water District	1,230	59,273	98.8
Westborough WD	9,990	504,272	103.4
City of San Bruno	41,750	2,148,394	105.5
Skyline County WD	1,631	84,702	106.4
Brisbane Water Department	4,063	227,801	114.9
Coastside County WD	17,990	1,060,573	120.8
City of Millbrae	21,394	1,268,771	121.5
CWS - Mid Peninsula	120,820	8,231,977	139.6
Mid Peninsula (Belmont WD)	25,500	1,744,963	140.2
City of Redwood City	83,000	5,784,279	142.8
City of Hayward	128,000	9,133,496	146.2
Stanford University	24,700	1,772,457	147.1
Alameda County WD	318,250	24,654,808	158.8
Cordilleras	40	3,105	159.1
CWS - South San Francisco	54,060	4,218,788	159.9
City of Burlingame	30,000	2,383,663	162.8
Estero Municipal ID	34,252	2,765,373	165.5
City of Mountain View	76,025	6,274,818	169.1
City of Sunnyvale	131,200	11,276,687	176.1
City of Milpitas	65,000	5,831,829	183.9
CWS - Bear Gulch	65,830	6,150,566	191.5
City of Palo Alto	61,200	6,779,838	227.0
City of Santa Clara	102,500	12,317,089	246.3
Town of Hillsborough	11,760	1,720,719	299.9
Purissima Hills WD	5,800	1,033,036	365.0
City of Menlo Park	10,200	1,819,883	365.6
City of San Jose (North)	7,000	2,469,789	723.1
Totals	**1,635,523**	**128,677,573**	**161.2 (Average GPCPD)**

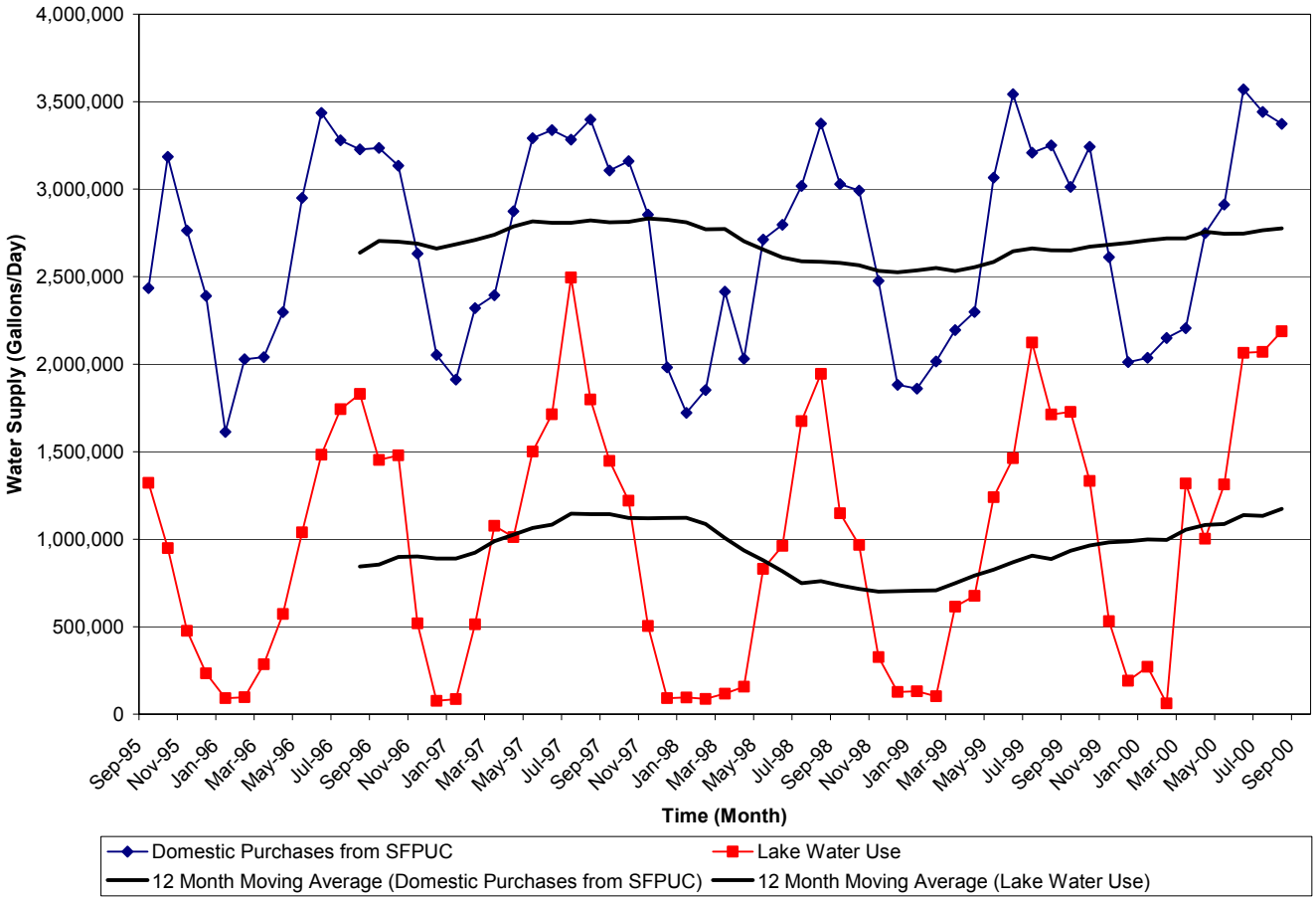
*Inclusive of recycled water

**GPCPD = Gallons Per Capita Per Day

APPENDIX C- HISTORICAL WATER USE

In order to accurately account for water conservation benefits from water conservation program savings, it is necessary to establish a baseline water use from historical data. The evaluation of historical water use for Stanford involved the analysis of available metering data between 1995 and 2000. The following graph (Figure C-1) presents the baseline historical use of domestic and lake water systems for Stanford. The 12-month moving average from 1995 to 2000 for the domestic system is increasing slightly and was at approximately 2.7 mgd for fiscal year 1999-2000, the base year for the 2000 GUP. The Master Plan report focuses specifically on water conservation for the domestic water supply system.

Figure C-1. Stanford's Historical Water Supply Production 1995-2000



The following graphs in Figures C-2 through C-9 present the detailed data for each of the seven categories described in Section 4.2 of the report. Each graph illustrates both seasonal patterns and general trends of use with a 12-month moving average displayed and linear trends in use. In addition, the end uses of the CEF water are presented in Figure C-10.

Student housing represents approximately 27% of total domestic use purchased from SFPUC. Figure C-2 below presents the historical domestic use for student housing with an average daily use of approximately 675,000 gallons per day. The linear trend and 12 month moving average indicates a general increase in water demand.

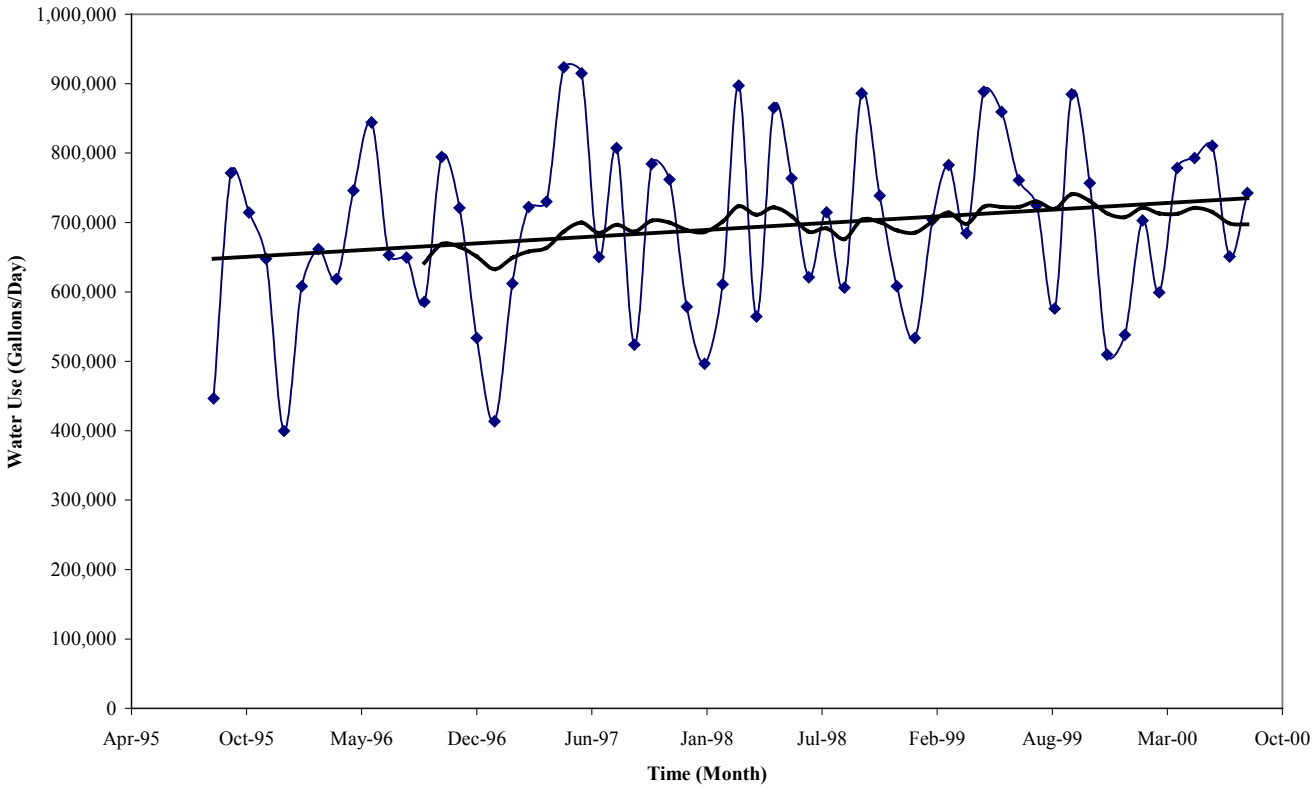


Figure C-2. Domestic Historical Monthly Water Use for Student Housing & Dining

Faculty Staff housing represents approximately 22% of total domestic use. Figure C-3 below presents the historical domestic use for faculty and staff housing with an average daily use of approximately 550,000 gallons per day. The linear trend and 12 month moving average indicates a general increase in water demand.

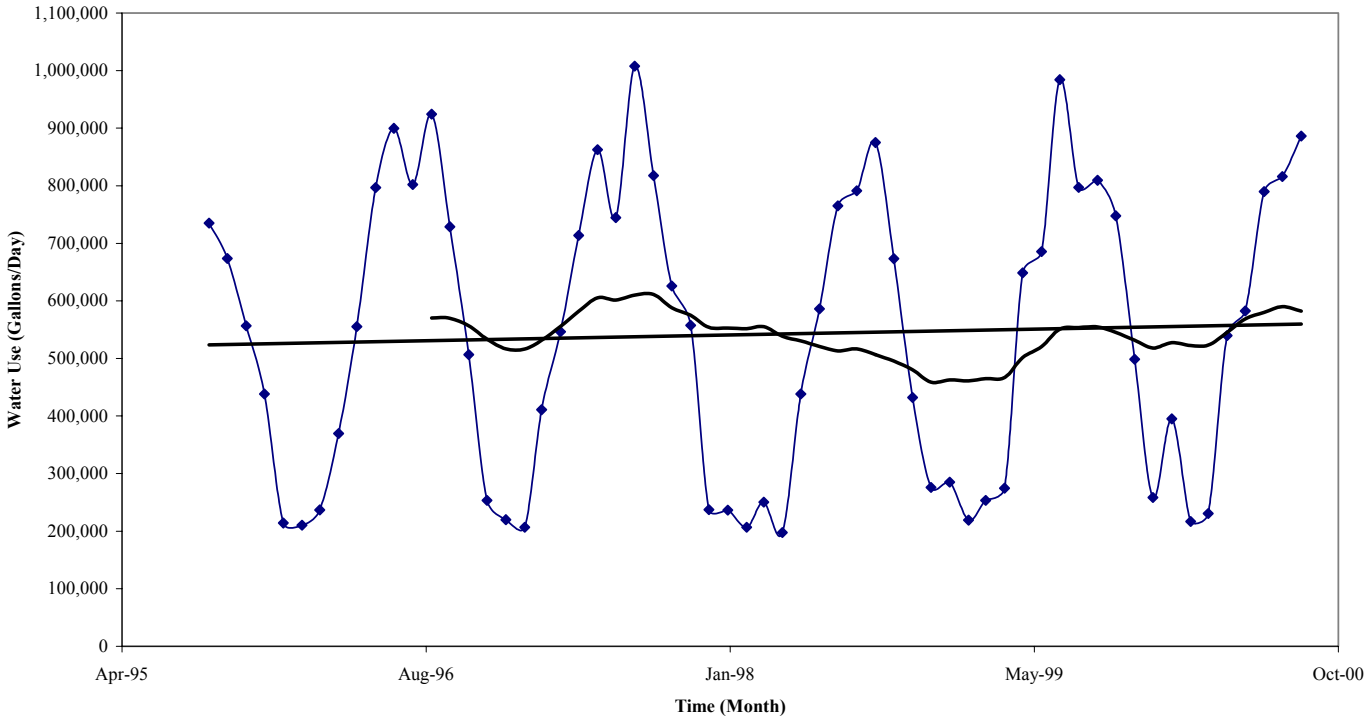


Figure C-3. Domestic Historical Monthly Water Use for Faculty/Staff Housing

Academic departments represent approximately 14% of total domestic use. Figure C-4 below presents the historical domestic use for academic departments with an average daily use of approximately 600,000 gallons per day. The linear trend and 12 month moving average indicates a general decrease in water demand. This downward trend is considered attributable to the metering program, which is systematically reducing the unmetered data with the installation of new meters. See the following Figure C-5 for the representation of unmetered versus metered use and note that the Academic metered data presents a relatively flat trend in use. The unmetered use was found to be 6.6 percent of the domestic supply. This indicates a relatively low level of leakage and other unaccounted for water for the domestic system.

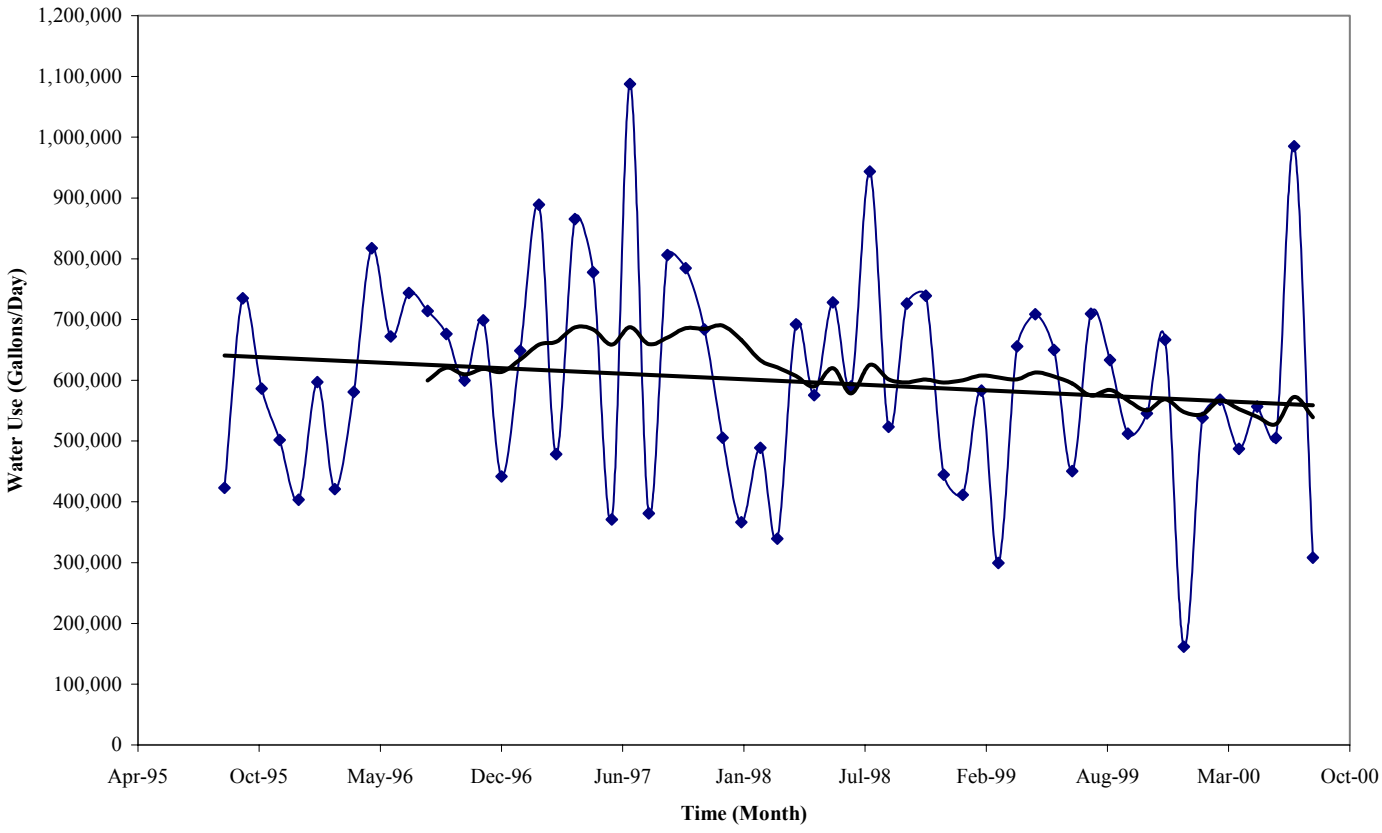


Figure C-4. Domestic Historical Monthly Water Use for Academic With Unmetered Data (or Unaccounted for Water)

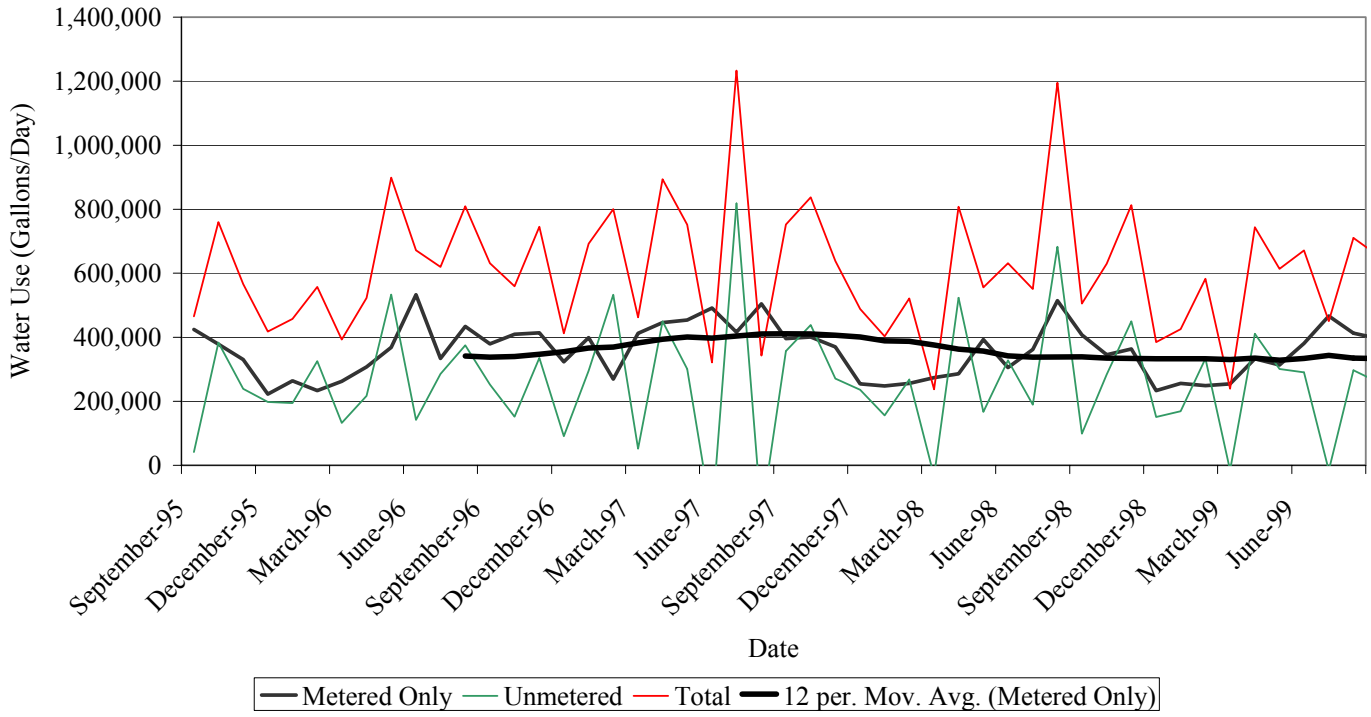


Figure C-5. Domestic Historical Daily Water Use for Academic without Unmetered Data

Commercial spaces represent approximately 3% of total domestic use. Figure C-6 below presents the historical domestic use for commercial spaces with an average daily use of approximately 60,000 gallons per day. The linear trend and 12 month moving average indicates a general increase in water demand.

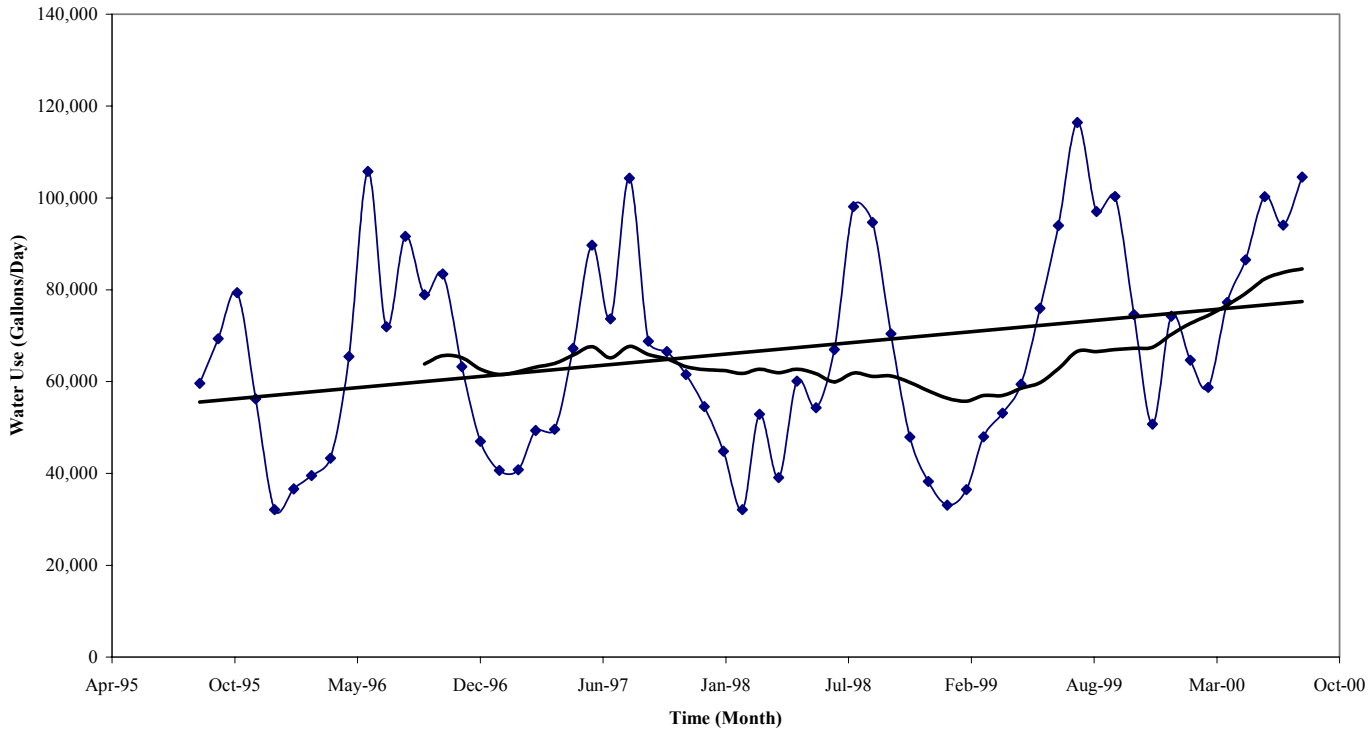


Figure C-6. Domestic Historical Monthly Water Use for Commercial Spaces

Medical School water use represents approximately 7% of total domestic use. Figure C-7 below presents the historical domestic use for Medical School with an average daily use of approximately 175,000 gallons per day. The linear trend and 12 month moving average indicates a general increase in water demand.

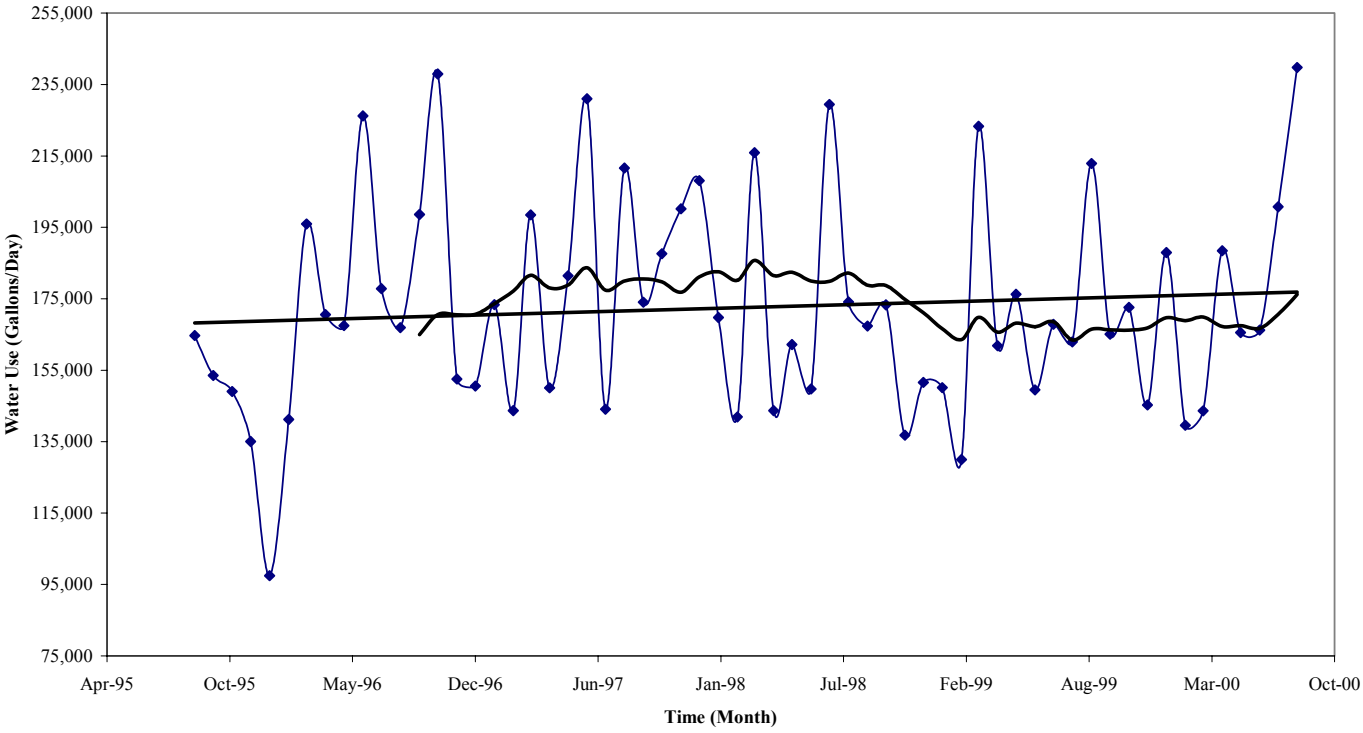


Figure C-7. Domestic Historical Monthly Water Use for Medical School

Athletics water use represents approximately 3% of total domestic use. Figure C-8 below presents the historical domestic use for athletics with an average daily use of approximately 75,000 gallons per day. The linear trend and 12 month moving average indicates a general increase in water demand.

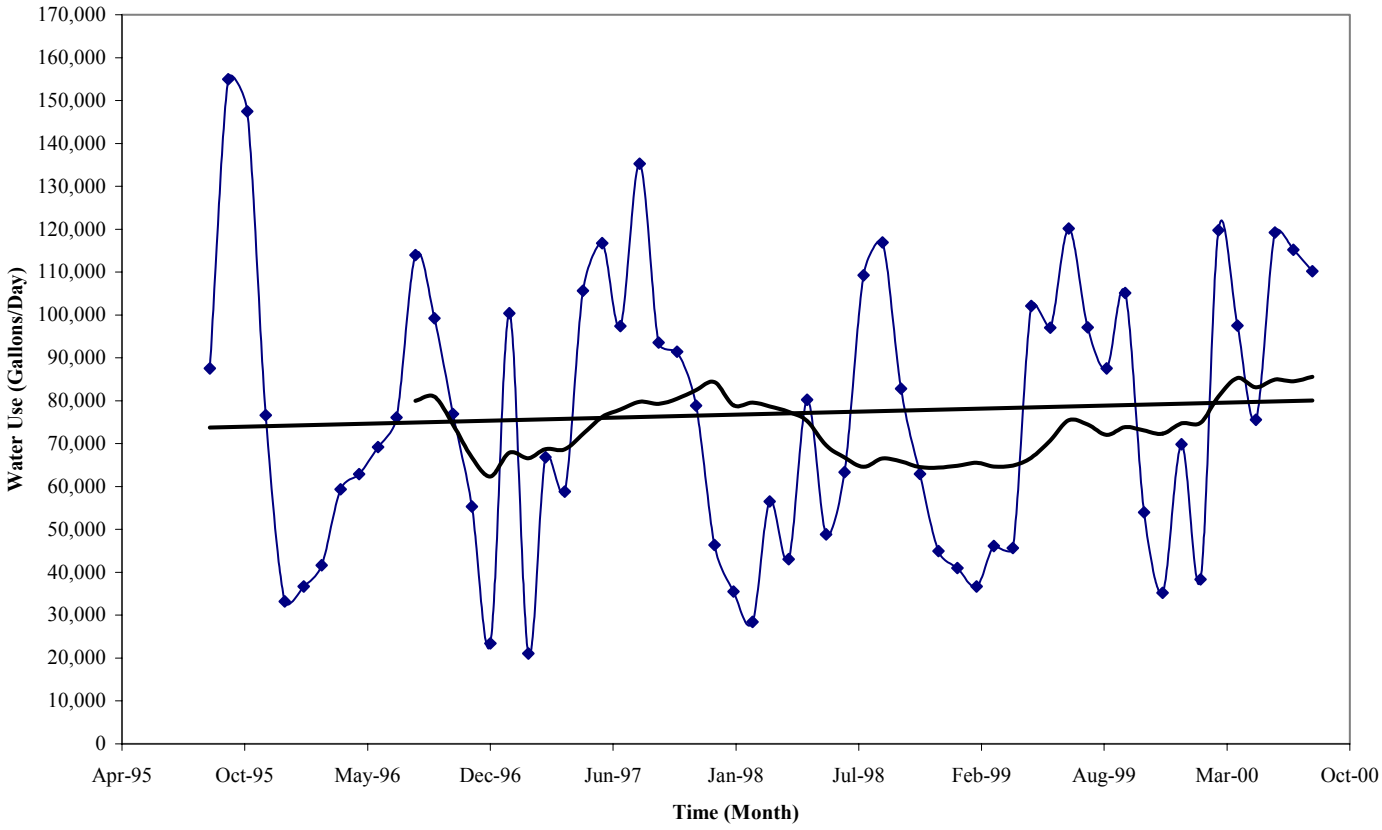


Figure C-8. Domestic Historical Monthly Water Use for Athletics

CEF water use represents approximately 22% of total domestic use. Figure C-9 below presents the historical domestic use for CEF with an average daily use of approximately 500,000 gallons per day. The linear trend and 12 month moving average indicates a general increase in water demand. The unusually high use in June 1999 of over 1,000,000 gallons per day was a result of firefighting water needs at the facility.

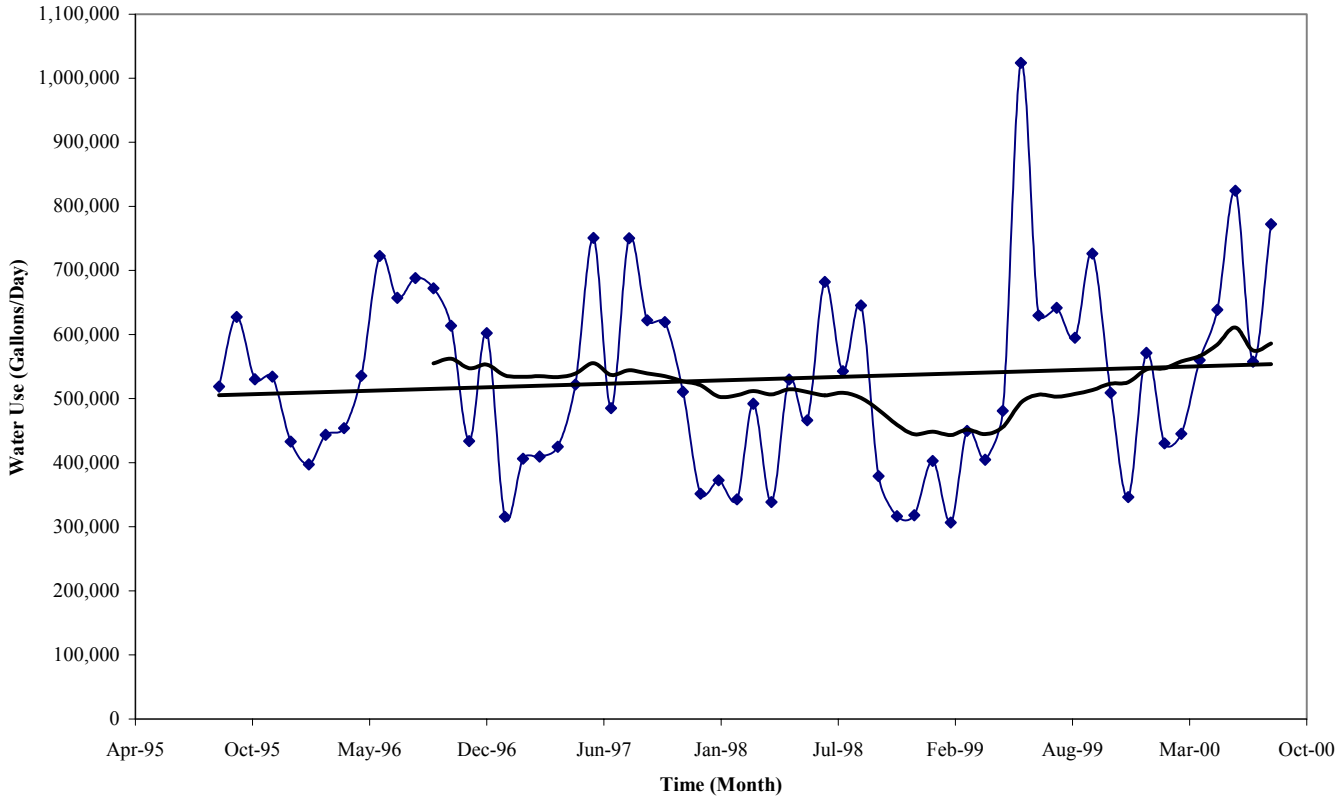


Figure C-9. Domestic Historical Monthly Water Use for Central Energy Facility (CEF)

For general reference the CEF water usage was further broken down into end uses and is presented in Figure C-10.

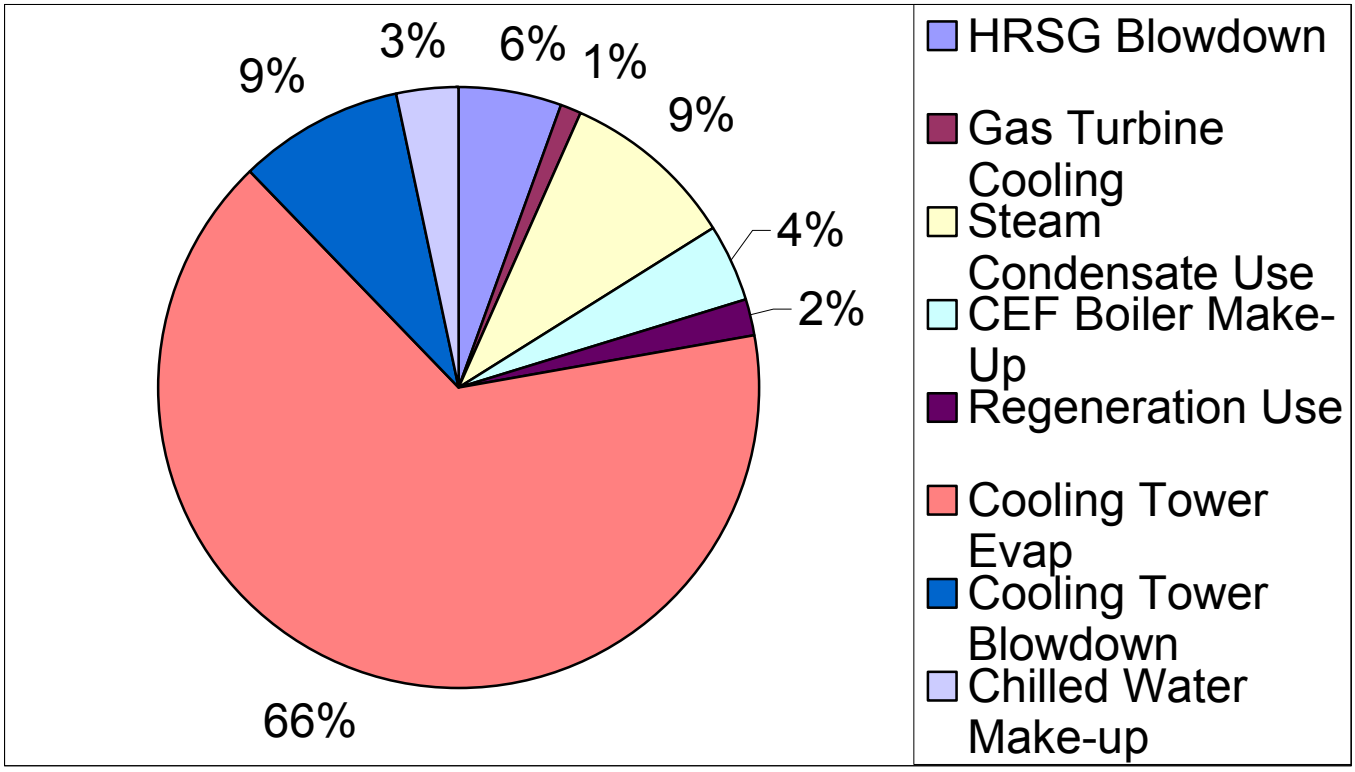


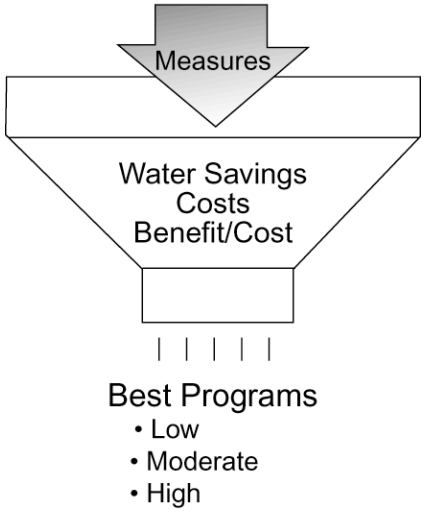
Figure C-10. Chart of CEF End Use

APPENDIX D – METHODOLOGY AND RESULTS OF EVALUATION OF LONG-TERM WATER CONSERVATION MEASURES

Introduction

The Master Plan Report presented a description of alternative water conservation measures considered for possible implementation and summarized the results of the benefit-cost analysis. This Appendix explains methodology for estimating the water savings, costs, and benefit-cost ratios for the measures is explained. From this analysis benefits and costs are compared in a present-value analysis and conclusions are drawn about which measures produce cost-effective water savings. This process can be thought of as an economic screening process, shown in Figure D-1.

Figure D-1. Evaluation Process



The text that follows assumes the reader is generally familiar with benefit-cost analysis, as it is used for evaluating conservation measures, so that the results can be emphasized and the description of the methodology can be brief. Additional background can be obtained from Maddaus et al.'s article "Integrating Conservation into Water Supply Planning" in *Journal AWWA* (November 1996).

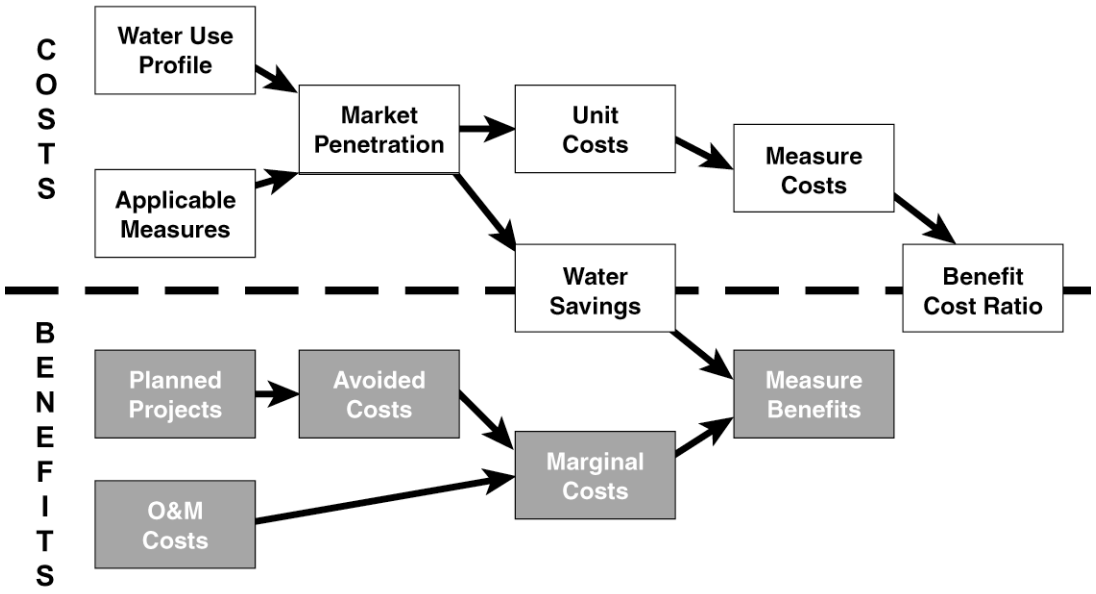
Overview of the Benefit-Cost Evaluation Methodology

The evaluation of alternative measures was done using benefit-cost analysis. The purpose of this analysis is to identify which of the above measures are cost-effective for Stanford to pursue. Benefit-cost analysis requires a locale-specific set of data, such as historical water consumption patterns by customer class, population and employment projections, age of housing stock, and prior conservation efforts.

The following nine steps are used to compute the water savings, costs and benefit-cost ratios, as shown graphically in Figure D-2.

1. Develop baseline water use projections without additional conservation. Projections should cover each key customer category and be broken down into indoor end uses and outdoor end uses. These were presented in Section 4 of the Master Plan Report.
2. Identify possible water conservation measures and screen the measures qualitatively to identify those that are applicable to the service area. Develop appropriate unit water savings and cost factors for each measure. The unit cost and savings were developed by using analogous data from work with Municipal systems (Beatty, 2002) because there are no similar data available for college campuses.
3. Estimate the affected population (or number of accounts) for each conservation measure by multiplying the total service area population (accounts) by the measure's projected market penetration or installation rate (in percent).
4. Estimate total annual average and peak day water savings. The water savings are computed by multiplying unit water savings, per measure, by a market penetration or installation rate, and then multiplying by the number of units in a particular service area (such as dwelling units) targeted by a particular measure.
5. Identify types of benefits to the water agency including capital projects that could be deferred or downsized and reduced operation and maintenance costs.
6. Quantify total benefits for each year in the planning period by multiplying average water savings by the computed value of the cost savings.
7. Determine initial and annual costs to implement the measures based upon pilot projects, local experience, and the costs of goods, services, and labor in the community. This is multiplied by the number of accounts participating each year and then added to overall administration and promotion costs to arrive at a total measure cost, which may be spread over a number of years.
8. Compare benefits and costs of measures by computing the present value of costs and benefits over the 30-year planning period.
9. Develop a recommended plan from the most attractive measures(s). Detail the plan by providing budgets, schedule and a staffing plan.

Figure D-2. Benefit-Cost Analysis Methodology



The Least Cost Planning Decision Making System

Benefit-Cost analysis has been used for 25 years to evaluate and prioritize potential demand management measures. Often the limiting factor in such analysis is the water savings assumptions. With the advent of recent and better data on how customers use water, such as provided by the American Water Works Association Research Foundation (AWWARF) Residential End Use Study, the water savings estimates can be made at the end use level. This increased level of complexity is justified by more reliable results. The task of computing estimated water savings and doing benefit-cost analysis is facilitated by the use of an end use model.

The model was used to analyze alternative measures for the Master Plan is called the Least Cost Planning Decision Making System (DSS), a Microsoft-excel based program, programmed in Visual Basic. Additional details are contained in "Benefit-Cost Analysis with an End Use Model", Proceedings AWWA Water Sources Conference, Las Vegas, Nevada, February 2002. The DSS Model has the following components:

- A breakdown of current water use by customer class and then by end use;

Maddaus estimates are based on Stanford Utilities Metering Database for Faculty/Staff and Student Housing and on single family home water use from AWWARF (1999) Residential End-Use Study. For Academic and Athletic buildings, Maddaus estimates the toilet, urinal, and shower use separately, based on estimated occupancy and 4 flushes per person per day and 1 shower daily per person.

- Parameters to forecast growth in water demand;
- Fixture models to aid in calibrating the model to current water use conditions;
- A careful evaluation of the benefits in terms of operation and maintenance (O&M) cost savings and the present value of capital deferrals and/or downsizing;
- Worksheets for different types of conservation programs including fixture rebates, audits and other promotional programs, unaccounted for water reduction and pricing programs; and
- A way to combine individual measures into programs with multiple measures so as to avoid double counting water savings

The output of the model includes the following features:

- A baseline water demand forecast with no additional conservation beyond the current codes and standards already in place;
- Water savings, benefits, costs, and costs per unit water saved for individual conservation measures evaluated;
- The present value of benefits, costs and benefit-cost ratios for a combination of measures called a program;
- New demand forecasts with a conservation program in place.

Maddaus Water Management and others developed the model in 1999 by refining methods that had been used for many years. The model has been used for more than ten projects in the US and several in Australia since 1999.

The End-Use Methodology

The model performs its calculations at the end-use level. An end use could, for example, be the amount of water per day used in a single-family home to flush toilets, or wash clothes or irrigate. Every type of customer modeled has its water use broken down into end uses. The development of an accurate end-use model is a difficult but necessary exercise if accurate benefit cost analysis is to be undertaken and realistic estimates of water savings are to be made. Very few water utilities have detailed information about the end-use of water, although a number of end-use studies have been carried out in recent times that provide more detailed information on residential end-uses. The development of an end-use model requires the use of as much of the available information as possible.

In developing a model of water end use, the best approach is to use a combination of ”top-down” and “bottom-up” information to help us to determine the individual end uses. The approach is summarized in Figure D-3. Top-down information is information that allows broad estimates of internal and external water use to be derived and demand to be divided into different consumer categories. This includes:

- Water production data; and
- Customer meter (billing) database. The frequency of use per resident was based on the AWWARF (1999) Residential end-uses study for faculty/staff housing and dormitories. Maddaus assumed 4

flushes per employee per day for other buildings. The replacement rates for fixtures were based on recommendations developed by the California Urban Water Conservation Council.

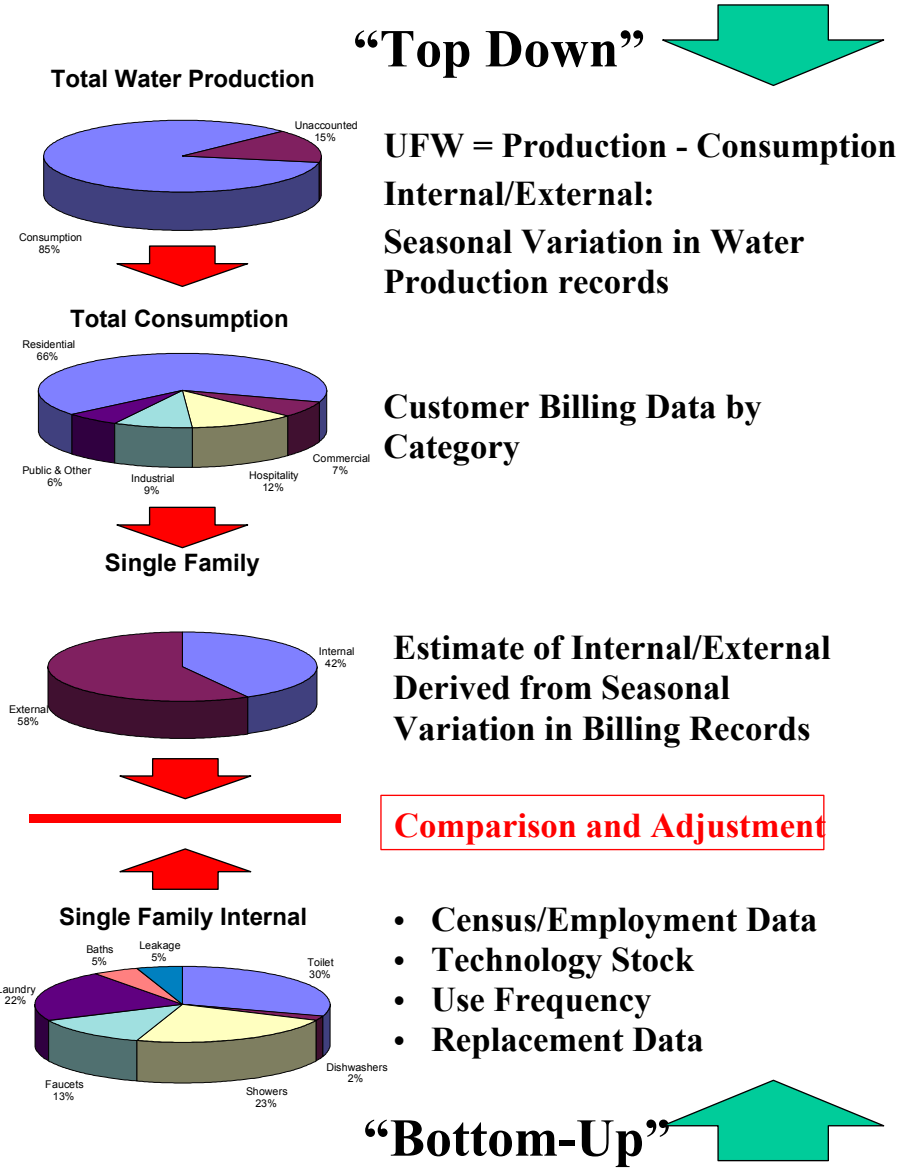


Figure D-3: Use of Available Data to Generate the End-Use Model

At the top of the end use model is the total water production record. Using this information and water consumption totals, the level of Unaccounted for Water (UFW) can be estimated. Consumption data from billing records can then be used to break the total consumption into different consumer categories. Seasonal fluctuations in billing records can also provide an indication of the level of internal and external use in each consumer category.

Bottom-up information is detailed information on water use and technology such as:

- Frequency of use per resident, student or employee;
- Stock of different types of water using appliances;
- Replacement rates for older appliance stock; and
- Housing and campus population data.

Model Calibration

The calibration of the end-use model is perhaps the most important step in the planning process. By combining top-down water consumption figures with bottom-up frequency of use and appliance ownership data, accurate estimates of end use can be made. The calibration process imposes a discipline on the model user to make the estimates of the breakdown in use agree with known point of use information. This provides the whole process with a reality check that ensures that the estimates of end use and the water savings that follow are in the right ballpark.

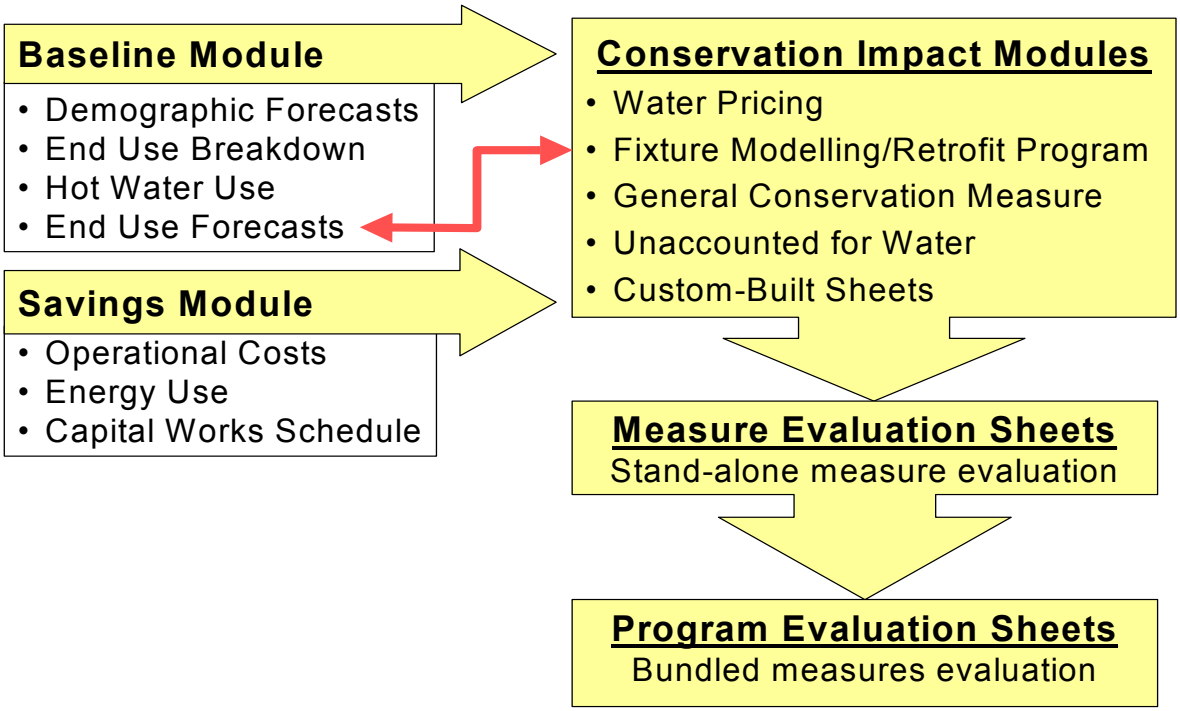
Steps in the model calibration process are:

1. Estimate the total amount of water use in gallons per account per day for each interior and exterior end use by customer class from analysis of the seasonal pattern of the Stanford Utilities Metering Data.
2. Set up a fixture model for each end use where a fixture or appliance code exists for each building type. For example a toilet fixture model would be needed for single-family and multi-family housing due to the Energy Policy Act of 1992. Another toilet fixture model might be needed for commercial buildings, student dormitories, etc.
3. Use the building age and retrofit history to estimate the current distribution of high, moderate and low efficiency fixtures in the current stock.
4. Estimate the current number of water users per account using demographic data.
5. Use the cited AWWARF Residential End Use Study to estimate the range in fixture use in uses per account user per day.
6. Estimate the natural replacement rate for each fixture and the expected changes in codes over time. The replacement rates for fixtures were based on standards developed by the California Urban Water Conservation Council (1992, 2000).
7. Calibrate the fixture models together so that the current total per capita or per employee use per day is within reasonable limits for each customer category. In calibrating the model the key parameter is frequency of use for the fixture being modeled, so the model is calibrated if the frequency of use is comparable to published data in the AWWARF 2000 study.
8. Use the above information to generate the baseline water use projection that reflects current codes.

Benefit – Cost Analysis with the DSS Model

The determination of the economic feasibility of water conservation programs depends on comparing the costs of the programs to the benefits provided. The water savings, cost estimating and benefit-cost analysis was performed using a program called Demand Management Least Cost Planning Decision Support System ("DSS") see Figure D-4.

Figure D-4. Structure of the DSS Model



The DSS model calculates savings at the end use level, such as the amount of water saved in a single family home or account per day that replaces toilets with low flush models as a result of toilet rebate program. Benefits are based on savings in water and wastewater facility O&M, as well as savings from deferring or downsizing any identified candidate future capital facilities. Facility design criteria, such as peak or average day water demand or average dry weather wastewater flow, are used to calculate future facility timing with and without conservation. Present value analysis is used to discount costs and benefits to the base year. From this analysis benefit-cost ratios of each measure are computed. When measures are put together in programs the interactions are accounted for by multiplying water use reduction factors, at the end use level, together. A water use reduction factor is 1.0 minus the water savings, expressed as a decimal. This avoids double counting when more than one measure acts to reduce the same end use of water.

Perspectives
Benefit-cost analysis can be performed from several different perspectives, based on who is affected. For planning water conservation programs for utilities, the perspectives most commonly used for benefit-cost analyses include the Utility and the Community. The "utility" benefit-cost analysis is based on the benefits and costs to Stanford. The "community" benefit-cost analysis includes the utility benefit and costs together with account owner/customer benefits and costs. These include customer energy benefits and customer costs of implementing the measure, beyond what the utility pays.

The time value of money is not ignored. The value of all future costs and benefits is discounted to 2000 (the base year) at the real interest rate of 3.0%. The DSS Model calculates this real interest rate adjusting the current nominal interest rate (assumed to be approximately 6.1%) by the assumed rate of inflation (3%). Cash flows discounted in this manner are referred to as "Present Value" sums throughout this report.

Menu of Water Conservation Alternatives

The list of measures selected for the evaluation process is shown in Table D-1. A description of the selected measures is given in Section 5 of the Master Plan Report. This Appendix covers the expected market penetration, water savings and costs of the measures.

Water Savings

Estimated water savings are useful to help utility planners forecast how future demands may be impacted by water conservation. Savings normally develop at a measured and predetermined pace; reaching full maturity after full market penetration is achieved. This may occur three to ten years after the start of implementation, depending upon the implementation schedule.

Methodology and Sources of Data
Data necessary to forecast water savings of measures include specific data on water use, demographics, market penetration, and unit water savings. These are described as follows:

Base Water Use
Base water use (without conservation) projections were developed through the year 2010 in Section 4. Base water use was projected to increase from 2.70 (mgd) in 2000 to just over 3.60 mgd in 2010 without the Master Plan. The base water use includes the effects of the current plumbing and appliance codes.

Demographics
Demographic data were presented in Section 4. Service area population, total dwelling units, building square footage, together with residential and non-residential demand, were used to evaluate measures.

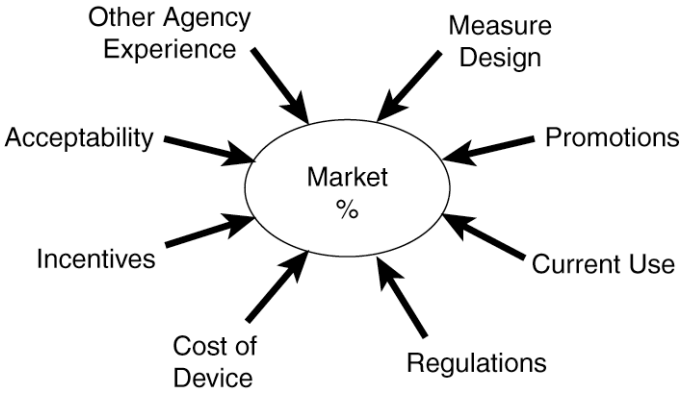
Table D-1. Measures Selected For Further Evaluation

No.	Measure	Measure Evaluated in Benefit/Cost Analysis
1.	Ultra Low Flush Toilet Replacement	YES
2.	Showerhead Retrofit	YES
3.	Urinal Replacement	YES
4.	High-Efficiency Washer Replacement	YES
5.	Public Outreach Programs	YES
6.	CEF Blow down Reuse	YES
7.	Faculty/Staff Housing Water Audits	YES
8.	Landscape Water Management	YES
9.	Selective Landscape Retrofit	YES
10.	New Water Efficient Landscape	YES
11.	New Landscape on Lake Water	YES
12.	ET Controllers	YES
13.	Selected Academic Areas on Lake Water	YES
14.	Football Practice on Lake Water	YES

Market Penetration

The market penetration (installation rate) for existing customers is the estimated percentage of customers that will be participating in the measure by the end of measure implementation. Estimates are based on measure design, and experience from similar measures implemented by other water agencies (see Figure D-3). Market penetrations adopted for use in this project are shown in Table D-2.

Figure D-3. Assess Market Penetration



The concept of market penetration can be explained by way of an example utilizing residential water surveys. If approximately 1,000 residential dwellings exist when a measure begins, and

the ultimate penetration rate of 10 percent will be reached after three years, then 100 customers would have participated by the third year. Each year 33 new dwellings would be surveyed until all 100 had been audited. Certain measures require maintenance or repetition, i.e. they have a finite life. For example, surveys would need to be done every year in order to maintain savings because the effects of the surveys may have a limited life. Thus, if water savings from the surveys are assumed to last five years (the life of the measure), then additional surveys (in this case 33) or other appropriate follow-up with prior surveyed homes may be done every year to ensure the water savings are permanent.

If there are errors in market penetration estimates for each measure it could be due to the fact that they are based on previous experience, chosen implementation methods, and projected effort and funds allocated to the measure. The potential error can be corrected, through re-evaluation of the measure, as the implementation of the measure progresses. For example, if the market penetration required to achieve the needed savings turns out to be more or less than predicted, adjustments to the implementation efforts can be made. Larger rebates or more promotions may be used to increase the market penetration, for example. The process is iterative to reflect actual conditions and helps to ensure the market penetration and needed savings are achieved regardless of future variances between estimates and actual conditions.

End Use Water Savings

End use water savings, presented in Table D-3, are expressed as a percent reduction in water use per end use. The percentages only apply to the amount of water identified as the end use, not the entire category of use. End uses by customer category were described in Section 4. Long-term savings are those that are sustainable. Measure life is also shown in the table. When the measure life is exceeded the water savings erode, unless steps are taken to maintain them, such as replacing an expiring water audit with a new one.

Table D-2. Market Penetration of Conservation Measures

Measure	Applicable Customer Classes	% of Accounts Participating by 2010
Ultra Low Flush Toilet Replacement	SH, FSH ACD, ATH, LCS	61, 90, 80, 90, 90, 80
Showerhead Retrofit	ATH, FSH	55,70
Urinal Replacement	ATH, ACD, LCS, MSH	70, 81, 95, 90
High-Efficiency Washer Replacement	SH	80
Public Outreach Programs	ALL	100
CEF Blow down Reuse	ACD, SH, ATH, LCS, MSH	18-21
Faculty/Staff Housing Water Audits	FSH	30
Landscape Water Management	ACD, SH	25
Selective Landscape Retrofit	ACD, SH, ATH, LCS, MSH	--
New Water Efficient Landscape	ACD, SH, LCS, MSH	28, 39, 6, 27[1]
New Landscape on Lake Water	SH, ACD, ATH, LCS, MSH	28, 39, 6, 27[1]
ET Controllers	SH, FSH, ACD, LCS, MSH	90, 90, 70, 70, 70
Selected Academic Areas on Lake Water	ACD, MSH	100
Football Practice on Lake Water	ATH	100

Customer Types:

SH: Student Housing
FSH: Faculty/Staff Housing
ACD: Academic
ATH: Athletics
MSH: Medical School & Hospital
LCS: Leased Commercial Spaces
ALL: All customer types

(1) Targeted at new accounts only.

Table D-3. End Use Water Savings of Conservation Measures

Measure	Applicable Customer Classes	Water Use Reductions Per End Use	Measure Life, years
Ultra Low Flush Toilet Replacement	SH, FSH ACD, ATH, LCS	52% of Toilet use	permanent
Showerhead Retrofit	ATH, FSH	21% of Shower use	permanent
Urinal Replacement	ATH, ACD, LCS, MSH	75% of Urinal use	permanent
High-Efficiency Washer Replacement	SH	35% of Laundry use	permanent
Public Outreach Programs	ALL	3% all end uses	2
CEF Blow down Reuse	ACD, SH, ATH, LCS, MSH	80-100% of selected irrigation uses 75% of selected toilet uses	permanent
Faculty/Staff Housing Water Audits	FSH	5% Internal 25% Leaks and Exterior	5
Landscape Water Management	ACD, SH	10% all end uses	5
Selective Landscape Retrofit	ACD, SH, ATH, LCS, MSH	--	permanent
New Water Efficient Landscape	ACD, SH, LCS, MSH	15% of irrigation use	permanent
New Landscape on Lake Water	SH, ACD, ATH, LCS, MSH	100% of irrigation use	permanent
ET Controllers	SH, FSH, ACD, LCS, MSH	25% of irrigation use	permanent
Selected Academic Areas on Lake Water	ACD, MSH	15% of irrigation use	permanent
Football Practice on Lake Water	ATH	100% of irrigation use	permanent

Estimated Water Savings

The projected total water savings associated with the affected market are shown in Table D-4. The snapshot of annual savings is given for two specified years: 2005 and 2010. The total savings assume the measures begin in 2002. These savings are for measures acting alone, without interaction or interference from other measures. However, these savings are net of any

plumbing code effect, which is the reason the savings could be reduced in the future, because the measure involves a plumbing fixture replacement that would have occurred anyway. The other reason savings could go down is if the measure life is exceeded and no action is taken to maintain the savings. Measure interaction is handled when packages of measures are put together as a program. Therefore the savings shown are approximations and may not be final estimates of savings, particularly where multiple measures target the same end uses, as is common with landscape and irrigation measures. As a point of reference the total baseline water production in 2000 is 2.70 mgd, increasing to 3.60 in 2010 without the Master Plan.

Table D-4. Projected Water Savings by Year (MGD)

Measure	2005	2010
Ultra Low Flush Toilet Replacement	0.07	0.10
Showerhead Retrofit	0.01	0.01
Urinal Replacement	0.02	0.03
High-Efficiency Washer Replacement	0.01	0.01
Public Outreach Programs	0.03	0.03
CEF Blow down Reuse	0.06	0.07
Faculty/Staff Housing Water Audits	0.03	0.04
Landscape Water Management	0.01	0.01
Selective Landscape Retrofit	--	--
New Water Efficient Landscape	0.01	0.03
New Landscape on Lake Water	0.04	0.10
ET Controllers	0.12	0.14
Selected Academic Areas on Lake Water	0.01	0.01
Football Practice on Lake Water	0.01	0.01

Costs of Measures

Costs were determined for each of the measures based on industry knowledge and past experience. Costs may include incentive costs, usually determined on a per-participant basis; fixed costs, such as marketing; variable costs, such as the costs to staff the measures and to obtain and maintain equipment; and a one-time setup cost. The setup cost is for measure design by staff or consultants, any required pilot testing, and preparation of materials that will be used in marketing the measure. Measure costs were estimated for each year between 2002 and 2010. Costs were spread over the time period depending on the length of the implementation period for the measure. Some of the costs occur uniformly over the planning period; others occur only in

the first three to five years, after which implementation is finished and only the costs to maintain the measure are incurred.

Lost revenue due to reduced water sales is not included as a cost because the conservation measures evaluated herein generally take effect over a span of time that is sufficient to enable timely rate adjustments, if necessary, to meet fixed cost obligations.

The measure unit costs are shown in Table D-5. These are based on our experience with these measures.

Benefits

In our evaluation, the benefits are based on deferring the cost of a new well for Stanford and savings from reduced sewer flows. Specifically the benefits are based on the following assumptions:

- Cost of SFPUC water ($1,176 per million gallons currently)
- Cost of new well $1,000,000
- Operating cost of new well $150/million gallons pumped (energy and chemicals)
- Pump tax from Santa Clara Valley Water District at $330 per acre-foot pumped
- Maximum capacity of new well 500 gpm (0.72 mgd)
- Operating capacity of average 0.45 mgd
- Addition of new well is assumed if and when average day domestic demand reaches 3.25 mgd (which will occur about 2006 w/o additional conservation). This could be eliminated if additional conservation keeps domestic average daily use below 3.033 mgd.
- Cost of wastewater discharge to Palo Alto regional facility at $1000 per million gallons

The above benefits apply to reduction in indoor and outdoor use. Programs that reduce both will have benefits, however outdoor use reduction programs that reduce peak day water use will have the most impact on the timing of constructing a new well. Water supply capital projects are designed to meet peak day capacity needs, and the next increment of supply is constructed as the existing capacity approaches peak day demands.

Other benefits from the program include energy savings from the following measures: Showerhead Retrofit; High Efficiency Washers; and Faculty Staff Housing Water Audits. These benefits accrue to the water user (customer) and factor into their decision to participate in voluntary programs.

Table D-5. Unit Cost of Conservation Measures

No.	Measure	Utility Unit Cost
1.	Ultra Low Flush Toilet Replacement	$200-550/toilet
2.	Showerhead Retrofit	$25/unit
3.	Urinal Replacement	$400/urinal
4.	High-Efficiency Washer Replacement	$200 rebate/washer
5.	Public Outreach Programs	$50,000/year
6.	CEF Blow down Reuse	$550,000
7.	Faculty/Staff Housing Water Audits	$50/FSH unit
8.	Landscape Water Management	$1,000/acre
9.	Selective Landscape Retrofit	--
10.	New Water Efficient Landscape	$43,600/acre
11.	New Landscape on Lake Water	$1,000-10,000/account
12.	ET Controllers	$150-300/unit
13.	Selected Academic Areas on Lake Water	$25,000
14.	Football Practice on Lake Water	$10,000

Results of Benefit-Cost Analysis

Table D-6 shows a comparison of alternative measures and programs with respect to these criteria and provides the complete detail to allow selection of the individual measures and programs. Water savings are expressed two ways: the average over the 30-year forecast period and water savings in one year (2010). Net utility benefits are the utility benefits minus the utility costs. A negative value means that costs exceed benefits.

Table D-6 also shows the benefit-cost ratio from the utility and the customer or community perspective. A benefit-cost ratio greater than one means the present value of the benefits over 30-years is greater than the present value of the costs. Community benefit-cost ratios are higher for those measures that save hot water. Water savings over the DSS forecast period range from a high of 0.14 MGD to low of less than 0.01 MGD. The utility benefit-cost ratios range from a low of 0.29 for the New Water Efficient Landscape measure to 12.23 for the Football Practice Field on Lake measure.

Table D-6. Comparison of Conservation Measures

Measure	30-year Average Water Savings MGD	Utility Benefit Cost Ratio	Cost of Water Saved, $/MG
Ultra Low Flush Toilet Replacement	0.084	1.09	1,451
Showerhead Retrofit	0.007	2.77	581
Urinal Replacement	0.023	1.54	1,026
High-Efficiency Washer Replacement**	0.010	19.14	492
Public Outreach Programs	0.026	1.02	3,180
CEF Blow down Reuse	0.060	1.04	1,000
Faculty/Staff Housing Water Audits	0.037	3.46	733
Landscape Water Management	0.010	1.38	480
Selective Landscape Retrofit	***	***	***
New Water Efficient Landscape	0.022	0.27	3,230
New Landscape on Lake Water	0.086	6.72	132
ET Controllers on New Faculty/Staff Housing	0.124	0.96	321
Selected Academic Areas on Lake Water	0.013	5.86	163
Football Practice on Lake Water	0.011	12.31	78

* Caution: savings cannot be added without handling measure overlap water savings averaged over 30 years. Actual savings in 2010 may be higher.
** This measure's benefit-cost ratio includes a rebate of $200 per washing machine.
*** To be determined, the annual report will list specific projects completed during the reporting year and associated estimated water savings.

Combination of Measures into the Master Plan

The measures described above were evaluated to determine combined water savings, costs and benefits. In order to meet the water savings goal all measures listed in Table D-6 were selected for the Master Plan. Because the measures overlap the water savings from the individual measures cannot be simply added together. Measure interaction factors are used to account for the incremental reduction in end uses due to each measure (when more than one measure targets the same end use). For example, if two measures reduce the same end use 10 per cent then the effect of them working together is not the sum of the savings (20 percent), it is the product, expressed as a decimal. In this case the combined savings would be 1-(0.90*0.90=0.81) = 0.19 or 19 percent. Measure interaction is an important factor for Stanford as there are several measures that reduce landscape irrigation using different techniques, for example.

The Master Plan water savings, costs, benefits, and benefit-cost ratio are shown in Table D-7. The program has a benefit/cost ratio over 1.0.

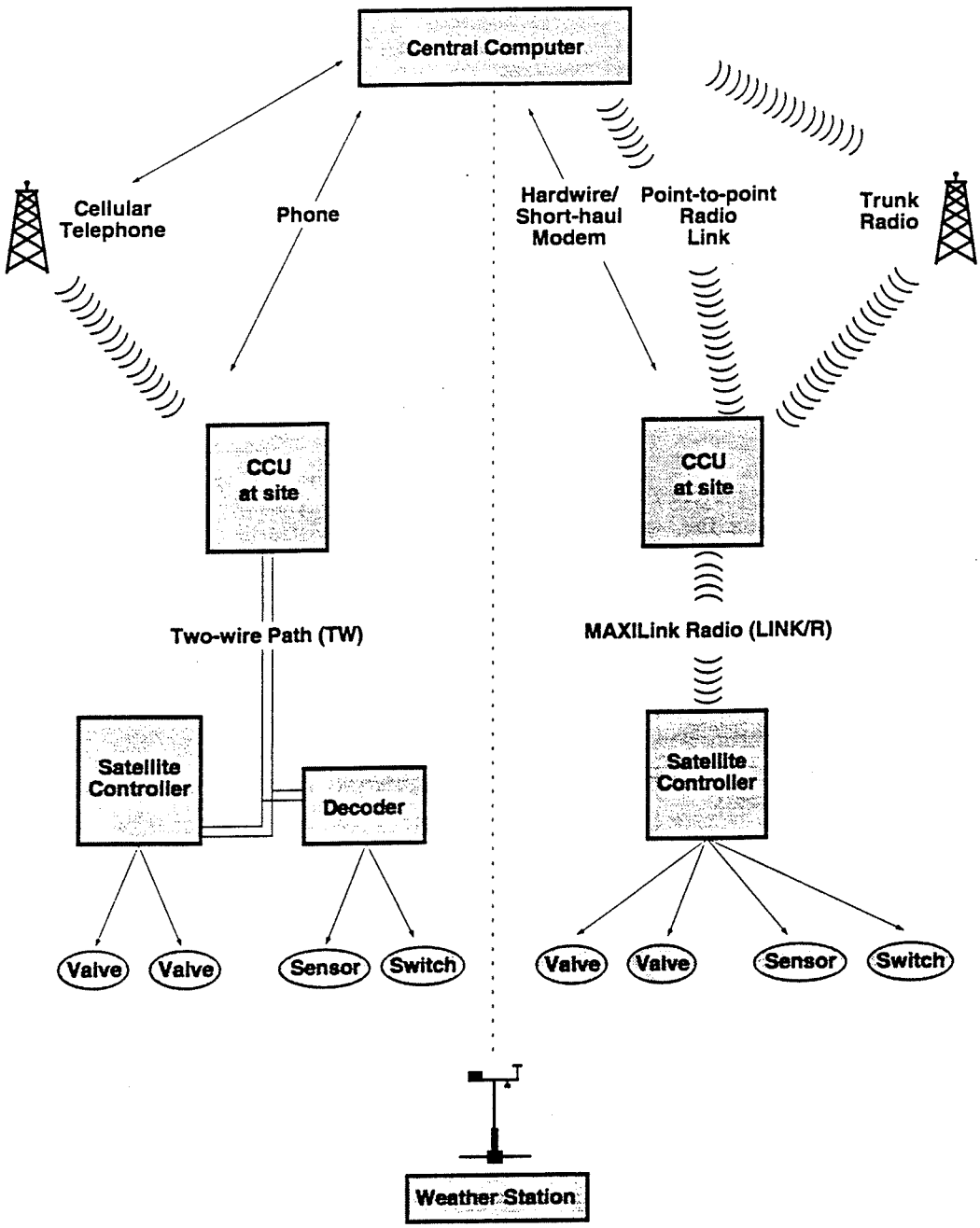
Table D-7. Estimated Savings and Costs of Water Conservation, Reuse and Recycling Master Plan

Savings/Costs	Master Plan
Water savings in 2005, mgd	0.38
Water savings in 2010, mgd	0.52
Total Cost 2002-2005, million $	2.75
Total Cost 2006-2010, million $	1.78
Present Value of Costs, million $**	4.90
Present Value of Benefits, million $*	7.59
Cost of Water Saved $/million gallons**	965
Benefit/Cost Ratio	1.55

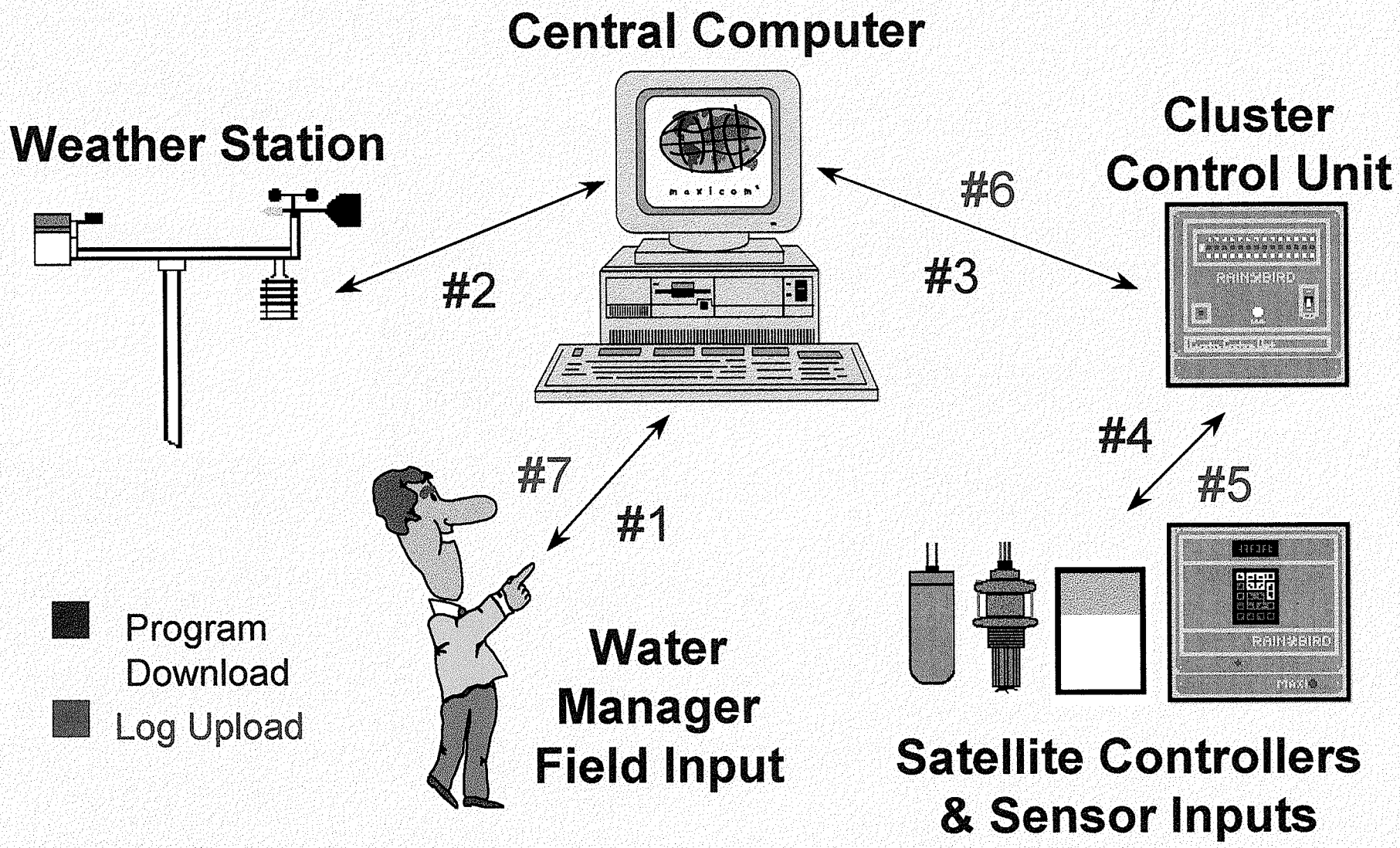
*Based on current cost of SFPUC water of $1,176 per million gallons.
**Present Value is based on 30-year actual costs and benefits.

Appendix E

Schematic information about evapotranspiration controllers, including Maxicom central control system.



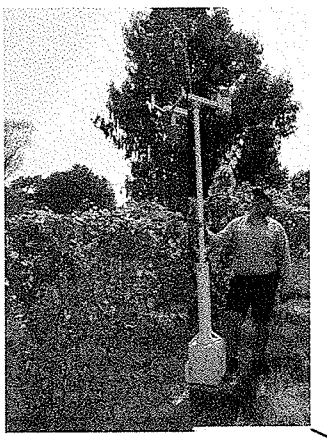
MAXICOM CENTRAL CONTROL SCHEMATIC



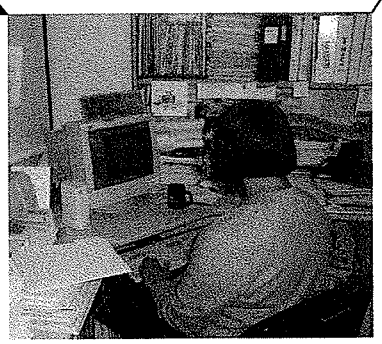
Source: Rainbird

Weather Station Data

Every day, rain or shine, the Grounds Department weather station, located near the Environmental Safety Facility, telephones a weather report to the Grounds Department Office at Bonair Siding. This weather station is a component of the Department's irrigation central control system. The weather data is processed by the central computer, a PC in the Grounds Office, which calculates sprinkler run times based on the daily ET (Evapotranspiration). The central computer then communicates the newly calculated irrigation schedules to the field controllers.



Weather station sends data to PC in Grounds Office daily



PC automatically computes water needs based on daily weather data.

PC sends revised schedules to field controllers and automatically runs the sprinklers.

Evapotranspiration is a measure of water lost both by evaporation from the soil and by transpiration from plant tissues, and provides a good indication of how much water needs to be applied by irrigation when rainfall is insufficient. Measured in inches per day, ET is calculated based on temperature, solar radiation, rainfall, humidity and wind measurements reported from the weather station. The daily reports from the weather station enable daily adjustment of schedules in all the system controllers, something that would not be possible manually. This can result in significant water savings; for example, a 1996 study of the Oval Lawn indicated that use of Maxicom with ET based scheduling resulted in a 27% water savings.

You can see the daily weather station data for the most recent month in the following table.

Source: Stanford University Grounds Dept. Web page.

Current Weather Station Data

Date	Minimum Temp (F)	Maximum Temp (F)	Total Solar Radiation	Total Rainfall	Average Humid-ity	Average Wind Run	Daily Evapo-transpir-ation
4/1/01	40.58	78.55	895.03	0.00	72.82	1.99	0.15
4/2/01	42.78	62.17	669.62	0.00	64.23	4.45	0.12
4/3/01	33.63	57.36	904.08	0.00	61.21	3.10	0.13
4/4/01	34.24	61.25	872.71	0.00	70.45	1.87	0.12
4/5/01	34.84	63.99	886.48	0.00	66.29	2.07	0.14
4/6/01	41.12	61.52	454.66	0.14	88.67	1.59	0.06
4/7/01	41.58	54.59	671.85	0.25	87.18	3.27	0.10
4/8/01	33.94	56.75	665.45	0.00	71.45	3.64	0.11
4/9/01	41.94	58.87	840.41	0.11	80.04	2.20	0.11
4/10/01	37.66	65.07	945.65	0.00	56.39	3.38	0.16
4/11/01	48.76	58.41	380.68	0.00	81.02	3.32	0.08
4/12/01	35.31	65.28	852.17	0.00	72.87	1.70	0.13
4/13/01	38.47	65.21	739.79	0.00	71.81	2.96	0.11
4/14/01	34.31	63.32	876.83	0.00	79.11	1.64	0.12
4/15/01	35.25	63.32	921.76	0.00	79.21	1.76	0.13
4/16/01	39.44	66.06	931.41	0.00	71.62	1.87	0.15
4/17/01	49.64	71.42	913.86	0.00	67.62	1.86	0.16
4/18/01	44.04	70.09	862.85	0.00	70.75	2.03	0.12
4/19/01	45.25	60.44	579.96	0.01	82.27	2.40	0.10
4/20/01	42.31	58.64	311.48	0.79	91.94	1.61	0.06
4/21/01	36.76	64.35	928.94	0.03	82.50	1.87	0.14
4/22/01	40.04	64.98	992.14	0.00	80.79	1.70	0.14
4/23/01	39.56	72.19	969.94	0.00	74.52	1.40	0.16
4/24/01	45.79	82.18	982.50	0.00	70.04	1.61	0.19
4/25/01	47.32	82.58	988.56	0.00	72.17	1.80	0.18
4/26/01	46.90	79.20	889.85	0.00	83.17	1.57	0.15
4/27/01	45.07	67.01	947.48	0.00	83.35	1.94	0.14
4/28/01	46.38	66.88	908.96	0.00	77.92	3.03	0.14
4/29/01	38.60	71.31	1004.47	0.00	61.66	2.88	0.19
4/30/01	44.94	76.06	1001.00	0.00	68.39	1.97	0.19

Components of Central Control Systems

In general, a central control system is made up of many pieces of monitoring and controlling equipment tied together by one or more communication types.

The main pieces of equipment for a central control system include:

- Central control computer and software
- Communications equipment to sites and between site field devices
- On-site processing equipment (Cluster Control Unit)
- Satellite controllers
- Sensors (flow, rain, etc.)
- Weather station

The "Central" in Central Control:

The central control computer is the main piece of equipment that interacts with the irrigation manager to oversee system management. The central computer retains all necessary information about the system. It keeps track of when and how long each device should operate. It calculates runtimes based on data entered by the irrigation manager or automatically gathered from weather stations. By utilizing the power of a personal computer, the central control system can automate many of the tasks required to effectively manage a large irrigation system.

Communications:

Communicating with the site(s) is very important in central control. A communication medium that is fast and error free is vitally important to system integrity. The most efficient communication type is a direct connection to a computer. This is, however, not practical for many systems. Telephone is a very secure and reliable medium, especially since the telephone system providers are responsible for maintaining the communications system. Installing radio communications is easy. However, there are issues (especially in busy urban areas) to be considered before obtaining available radio frequencies, including government regulations and monthly costs. Fiber optics is a very reliable and fast communications medium, but installation cost can be prohibitive.

Field Devices:

On-site processors (CCUs) are the real workhorses of the system. This middle-manager device receives the data and commands from the central computer and processes it for use by satellite controllers and sensing devices. Some systems have this built into satellite controllers but this limits its usefulness to the system as a whole.

Satellite controllers are the key interface in the field. These devices receive commands from the processor and implement them by monitoring sensors and controlling irrigation valves and other electrical switches. Such items as fountains and field lights can be controlled by satellite controllers.

Sensors:

Sensors monitor the system and surrounding areas, watching for problems or out-of-the-ordinary conditions. Flow sensors can monitor the hydraulic operation of the system and report any occurrences or high or low flow conditions. Wind sensors can relay excessive wind conditions and turn off irrigation, fountains and/or other devices when the wind conditions exceed your defined limit.

Weather Sources:

A weather source is one of many possible devices providing data for a database of ET information. Some of the different types of weather sources include weather stations, ET Monitors, Bulletin board systems, rain counters and historical databases. Weather stations monitor key weather functions and use these to calculate an Evapotranspiration (ET) factor. This is used by the system to calculate irrigation runtimes. Substantial water savings can be realized with these important devices.

Related Topics

Appendix F
National Plumbing Efficiency Standards, 1992;Consortium for Energy Efficiency, 2000-02

Energy Conservation Requirements for Plumbing Products

Energy Policy Act of 1992: Section 123

Summary of Standards

Faucets. The maximum water use allowed for any of the following faucets manufactured after January 1, 1994, when measured at a flowing water pressure of 80 pounds per square inch, is as follows:

Faucet Type	Maximum Flow Rate (gallons per minute or per cycle)
Lavoratory faucets	2.5 gpm
Lavoratory replacement aerators	2.5 gpm
Kitchen faucets	2.5 gpm
Kitchen replacement aerators	2.5 gpm
Metering faucets	0.25 gpc

Showerheads. The maximum water use allowed for any showerheads manufactured after January 1, 1994, is 2.5 gallons per minute when measured at a flowing pressure of 80 pounds per square inch.

Water Closets.

(1) The maximum water use allowed in gallons per flush for any of the following water closets manufactured after January 1, 1994, is as follows:

Water Closet Type	Maximum Flush Rate (gallon per flush)
Gravity tank-type toilets	1.6 gpf
Flushometer tank toilets	1.6 gpf
Electromechanical hydraulic toilets	1.6 gpf
Blowout toilets	3.5 gpf

(2) The maximum water use allowed for any gravity tank-type white two-piece toilet which bears an adhesive label conspicuous upon installation of the words "Commercial Use Only" manufactured after January 1, 1994, and before January 1, 1997, is 3.5 gallons per flush.

(3) The maximum water use allowed for flushometer valve toilets, other than blowout toilets, manufactured after January 1, 1997, is 1.6 gallons per flush.

Urinals. The maximum water use allowed for any urinals manufactured after January 1, 1994, is 1.0 gallons per flush.

Appendix F. National Plumbing Efficiency Standards, 1992;Consortium for Energy Efficiency, 2000-02

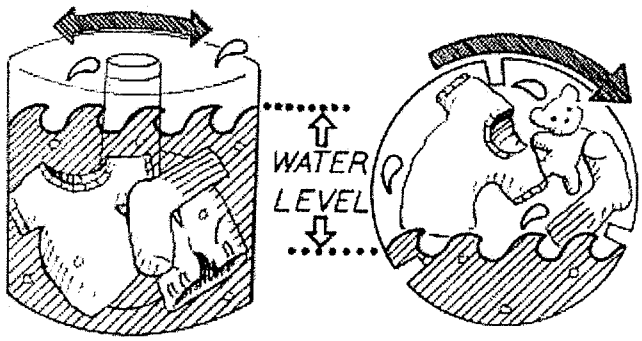
Commercial, Family-Sized Clothes Washer Initiative

How does it work?

About CEE
Residential
Commercial
· A/C & Heat Pumps
· Clothes Washers
· Gas Boilers
· Buildings
· Schools
Industrial
Gas Programs
Multi-Family
Government
Evaluation
Resource Library

Commercial Clothes Washer main page
Residential Clothes Washer main page

Horizontal-axis technology enables washers to save energy and water



Conventional top-loading washers (left) use a large vertical drum. Most high-efficiency washers (right) utilize a horizontal-axis design; loading from the front, they tumble clothes through a much smaller pool of water. There are currently three high-efficiency washing machines on the residential market (Whirlpool, Staber and Fisher-Paykel) that are top-loading.

Horizontal-axis clothes washers save energy because they use less water. Most of the energy needed for clothes washing goes to heating the water.

Conventional washers use a large vertical drum to soak and wash the clothes. Most high-efficiency clothes washers have a horizontal-axis drum, which tumbles the clothes through a pool of water.

Recent technological innovations have resulted in vertical-axis washers that can achieve similar energy-efficiency levels. High-efficiency washers use up to 18 gallons less water per load and remove more moisture from the clothes with a high-speed spin cycle. As a result, energy costs can be reduced as much as 50 percent.

In addition, manufacturers say high-efficiency machines get clothes cleaner and are gentler to fabrics.

Back to top

http://www.cee1.org
One State Street, Suite 1400, Boston MA 02109-3529
617-589-3949 fax 617-589-3948
Send comments about this site to our webmaster.

Original photo courtesy Philip Greenspun

Commercial Programs

Commercial, Family-Sized Clothes Washer Initiative

About CEE

Residential

Commercial
- A/C & Heat Pumps
- Clothes Washers
- Gas Boilers
- Buildings
- Schools

Industrial

Gas Programs

Multi-Family

Government

Evaluation

Resource Library

Fact Sheet · Update · Qualifying products
Efficiency specifications · Initiative Description
Program Summary · Participants
Resources/links · News

On June 1, 2001, ENERGY STAR® established a category for commercial clothes washers. See the CEE press release for further details.

CEE launched the Commercial, Family-Sized Washer Initiative in 1998 as an offshoot of its highly successful Residential Clothes Washer Initiative. The commercial clothes washer initiative encourages the purchase and use of energy- and water-efficient washers for laundromats, multi-family buildings and institutions. These high-efficiency commercial washers are nearly identical to residential models available in retail outlets. The only differences are minor engineering changes, such as a coin box.

Like their residential counterparts, high-efficiency commercial washers save up to 50 percent of energy costs and use about 30 percent less water.

For this program, CEE uses high-efficiency specifications that were originally developed for its Residential Clothes Washer Initiative.

In addition to maintaining an up-to-date list of qualifying washers, CEE serves as an information clearinghouse for initiative news and new products.

Many qualifying washers utilize horizontal-axis technology, which saves energy and water.

In the United States, there are approximately 2-3 million commercial washers, which are replaced at a rate of about 10 percent per year. Approximately 42,000 of those replaced clothes washers are sold to laundromats. It should be noted that, although laundromats represent less than 20 percent of the market, washers in these locations are in use much more frequently on a daily basis.

NEWS

ENERGY STAR now includes commercial washers

On June 1, 2001, the ENERGY STAR® program added commercial washers to the 31 other labeled products. In the past, only residential washers could qualify for the label but ENERGY STAR has decided to develop a separate label for commercial models with volume of 3.5 cubic feet or less. In order to qualify for the label, the washer must meet the minimum Modified Energy Factor (MEF) requirement of 1.26.

For further information, See the CEE press release.

Energy and water benefits demonstrated in PNNL study
In December 2000, Battelle Pacific Northwest National Laboratory (PNNL) released a study on the energy and water use of resource-efficient commercial clothes washers in a real world setting. The study, commissioned by Southern California Edison (SCE), was set in a senior citizens community of 18,000 residents, Leisure World in Laguna Woods, Calif.

The goal of the project was to demonstrate and verify the energy, water and monetary savings of the efficient commercial washers as well as their performance. Specifically, the study focused on whether the savings from reduced water and energy consumption compensated for the higher first cost and whether the community residents liked the machines.

Three laundry buildings, containing four conventional washers each, were metered to determine baseline water and energy use, and then replaced with efficient washers from Maytag, Speed Queen and Whirlpool. Data in the study are based on approximately 350 cycles for each washer.

Water savings ranged from 10.5 gallons/cycle (28 percent) to 22.5 gallons/cycle (59 percent) over the baseline washer. Energy use was reduced by 0.35 kWh/cycle (20 percent) to 1.16 kWh/cycle (67 percent). These water and energy savings produced monetary savings as well. Calculated for electricity and water rates in SCE's service territory, the washers saved from $47-139 annually.

The final report from the Laguna Woods Washer Demonstration is available on-line.

Fort Hood commercial washer study finds big savings
A commercial clothes washer study described in the May 2000 Federal Energy Management Program's *Technology Installation Review* contains interesting and important results for the efficiency community.

The study is the first comprehensive, field-based study of efficient family-sized commercial washers. In the laundry facilities of three nearly identical barracks, metering equipment was installed. Baseline data was gathered from the conventional machines over a two-month time period in 1997, and included 1,050 wash cycles.

After the baseline metering, each laundry room was equipped with high-efficiency machines from a different manufacturer. Maytag, Alliance Laundry Systems, Staber and Whirlpool participated in the study. Metering of the high-efficiency clothes washers took place over 17 months, from February 1998 through July 1999.

Findings include that the four high-efficiency brands saved 0.06 kWh/load (23 percent) on motor and controls electricity use. Annually, the machine energy savings is 140 kWh, and the hot water energy savings is 8.1 million Btu/machine. In addition, the four brands saved an average of 5.6 gallons of hot water (62 percent), 11.0 gallons of cold water (42 percent), and 16.6 gallons of total water (47 percent) per load. Annually, total water savings is 38,780 gallons/machine.

An on-line version of the report is available on the FEMP web site(www.eren.doe.gov/femp).

RESOURCES/LINKS

Multi-Housing Laundry Association

Coin Laundry Association

CONTACT

For more information about CEE's Commercial, Family-Sized Clothes Washer Initiative, contact Rebecca Foster at 617-589-3949, ext. 225, or rfoster@cee1.org.

Back to top

---

http://www.cee1.org
One State Street, Suite 1400, Boston MA 02109-3529
617-589-3949 fax 617-589-3948
Send comments about this site to our webmaster.

Original photo courtesy Philip Greenspun

APPENDIX E: SAMPLE GREEN PURCHASING POLICIES

Campus Purchasing

Long-Term Vision

CU will institute an environmentally responsible purchasing (ERP) program that stimulates the purchase of cost-competitive products and services. Purchases in an institutionalized ERP program would have a reduced effect on human and environmental health compared to competing products or services that serve the same purpose. ERP principals take a number of factors into account when evaluating products, including raw materials acquisition, production, manufacturing, packaging, distribution, reuse options, operation, maintenance, and disposal of product or service.

Individual Goals

1. Educate the campus community about Environmentally Responsible Purchasing (ERP) programs and policies.

2. Train the campus purchasers to apply an environmentally-responsible purchasing framework in purchasing requests and decisions.

3. Recommend and implement standards for top ERP opportunities with the Campus Environmental Council ERP taskforce.

4. Incorporate sustainable food options into UMC Food Services and Housing Dining Services

Backgrounds, Needs and Trends

America's universities spend nearly $200 billion on goods and services annually. With such massive purchasing power, the nation's universities can exert a tremendous amount of influence on the markets for goods and services. As the flagship campus of the University of Colorado system and the state's largest university, CU-Boulder is in a unique position to use its millions of dollars in annual purchases to set an example by supporting the "green purchasing" habits, rather than inadvertently paying for harmful products and services.

Green purchasing is a concept that encourages the use of products that minimize adverse environmental and health impacts while taking both the long- and short-term costs associated with the full life cycle of the product into consideration. The life cycle includes extraction, production, manufacturing, distribution, operation, maintenance, and disposal. Many "green" products are competitively priced with their less environmentally-friendly counterparts, are of comparable quality, and have one or more of the following attributes:

- high post-consumer content
- low embodied energy
- recyclable within CU's existing operation
- non-toxic
- energy efficient
- durable and/or repairable
- produced in an environmentally-sustainable manner

In an effort to help institutions incorporate green purchasing into their daily practices, the Environmental Protection Agency issued five guiding principals of environmentally responsible purchasing. These principals serve as an easy-to-follow baseline for virtually any type of purchasing on any scale:

- Include environmental considerations as part of the normal purchasing process.
- Emphasize pollution prevention early in the purchasing process.
- Examine multiple environmental attributes throughout a product's or service's life cycle.
- Compare relevant environmental impacts when selecting products and services.
- Collect and base purchasing decisions on accurate and meaningful information about environmental performance.

On the CU-Boulder campus, there are a number of targeted areas where ERP would prove to be an effective tool in reducing the university's overall environmental footprint. These targeted areas fall into two subcategories: products and services.

Products applicable to ERP standards:

- Building construction and maintenance
- Electricity
- Furniture
- Landscaping
- Pest management
- Vehicle fleets
- Cafeteria supplies

- Office supplies
- Cleaning products
- Paint
- Computers
- Printing
- Copiers
- Copy paper products
- Custodial paper products

Contracted services applicable to ERP standards:

- Soft drink vending
- Automotive waste disposal
- Campus mailing list purchases
- Food service supplies
- Construction and remodeling
- Concessions

Numerous examples of environmentally responsible purchasing exist around the country. An EPA survey of 90 colleges and universities in 1992, found 44 percent had active procurement programs for recycled products. California's system of higher education for instance, purchases over $5.9 million in recycled products annually.

Middlebury College in Vermont has established a program that includes ERP practices while fostering local economic growth by using locally-grown, sustainably-harvested wood in new buildings and furniture—much of the wood comes from the college's own forests.

Occidental College in California initiated a comprehensive food-purchasing program. Virtually all the produce options at all dining facilities across campus are local and organic. Additionally, many university events, including all administrative functions are catered with all-organic produce. Meanwhile, Yale supports one fully local, organic dining hall on their campus.

Bates College, Ball State University, The University of Massachusetts-Amherst, and the University of Vermont are a few examples of universities that use recycled paper in campus operations. Several of these intuitions also take chlorine use and post-consumer content into account when soliciting bids from paper providers. Here in Colorado, when CU was required to comply with state legislation mandating recycled paper use, we boosted purchasing to the highest levels in the state. Over 60 percent of CU's total annual paper purchases contained recycled fiber. In 1997 however, HB 1140 expired and state agencies like CU were no longer required to buy recycled or report their annual purchases. As a result, there has been a decline in the recycled paper purchased by CU. The campus printing initiative's use of recycled paper has reversed that trend.

There are a number of national and international initiatives advancing ERP. Most notably:

- The 2000 EPA Environmentally Preferable Purchasing Program publication on "State and Local Government Pioneers: How State and Local Governments are Implementing EPP Practices" is an excellent directory of best institutional practices and strategies.
- The Commission for Environmental Cooperation's "Environmental Purchasing Policies 101" compiles policies and programs in existence and documents effective components.
- The North American Green Purchasing Initiative's Eco-S.A.T. is a green purchasing self-assessment tool designed to evaluate organization's ERP initiatives and identify opportunities for improvement.
- Product certification programs, such as GreenSeal, Forest Stewardship Council, Marine Stewardship Council, are prevalent and reliable. www.eco-labels.org is a good source to verify environmental labels.

Another area of activity by America's universities is in food services. The University of Colorado has a great opportunity with our food services using and purchasing sustainable foods to improve health, reduce environmental impacts, and to educate students. The EPA says that agriculture is responsible for 70% of the pollution to the country's rivers and streams caused by chemicals, erosion, and animal waste runoff. Organic farming may be one of the last ways to keep both ecosystems and rural communities healthy and alive.

Sustainable Foods are defined as locally produced, organic grown and/or purchased from fair trade markets. Sustainable food is when food is grown and produced using the most efficient and environmentally sound practices possible to reduce pollution, erosion, emissions, and the use of harmful chemicals. See the attached sustainable food primer for more information.

The 2004 Whole Foods Market® Organic Foods Trend Tracker survey found more than a quarter of Americans (27 percent) are eating more organic products than they did one year ago. Reasons cited for buying organic foods were they are better for the environment (58 percent), better for their health (54 percent), and better for supporting small and local farmers (57 percent). In addition, 32 percent believe organic products taste better, while 42 percent believe organic foods are of better quality.

As national trends continue to favor sustainable, organic and locally-produced foods, it is only natural that colleges and universities—CU included—begin to evaluate the practicality of bringing such options onto campus. By instating a purchasing program that favors local and organic produce, CU can help buttress the local economy, while ensuring that we are responsible for as little pollution from pesticides and fertilizers as possible. Perhaps more importantly, as more Americans change their eating habits, incorporating organic and local food options into campus food service keeps money spent on food by faculty, staff and students on campus. Not only does providing sustainable food on

campus make environmental and social sense, but it can be a wise fiscal choice as well. To fill this need, Piazanos Grab-n-Go dining service in the Cheyenne Arapahoe resident hall, featuring 100% natural products and organic products with many vegetarian and vegan options, opened in Spring 2006. This is a step in the right direction for CU's purchasing habits.

Current Programs and Accomplishments

ERP Taskforce

A subcommittee on environmentally responsible purchasing was re-established in 2004 as part of Campus Environmental Council. The mission of the ERP subcommittee is to identify top green purchasing opportunities and help implement green purchasing strategies. Those product categories are as follow:

- Building maintenance & construction
- Furniture
- Copy paper
- Computers & electronics
- Office supplies
- Custodial paper products
- Cleaning products
- Food service products
- Concessions & vending

Each category will be assessed by the ERP taskforce on the basis of contact timing and campus need. Research into the first of these product categories is well underway and is showing that any recommendations will help to reinforce current standard practices.

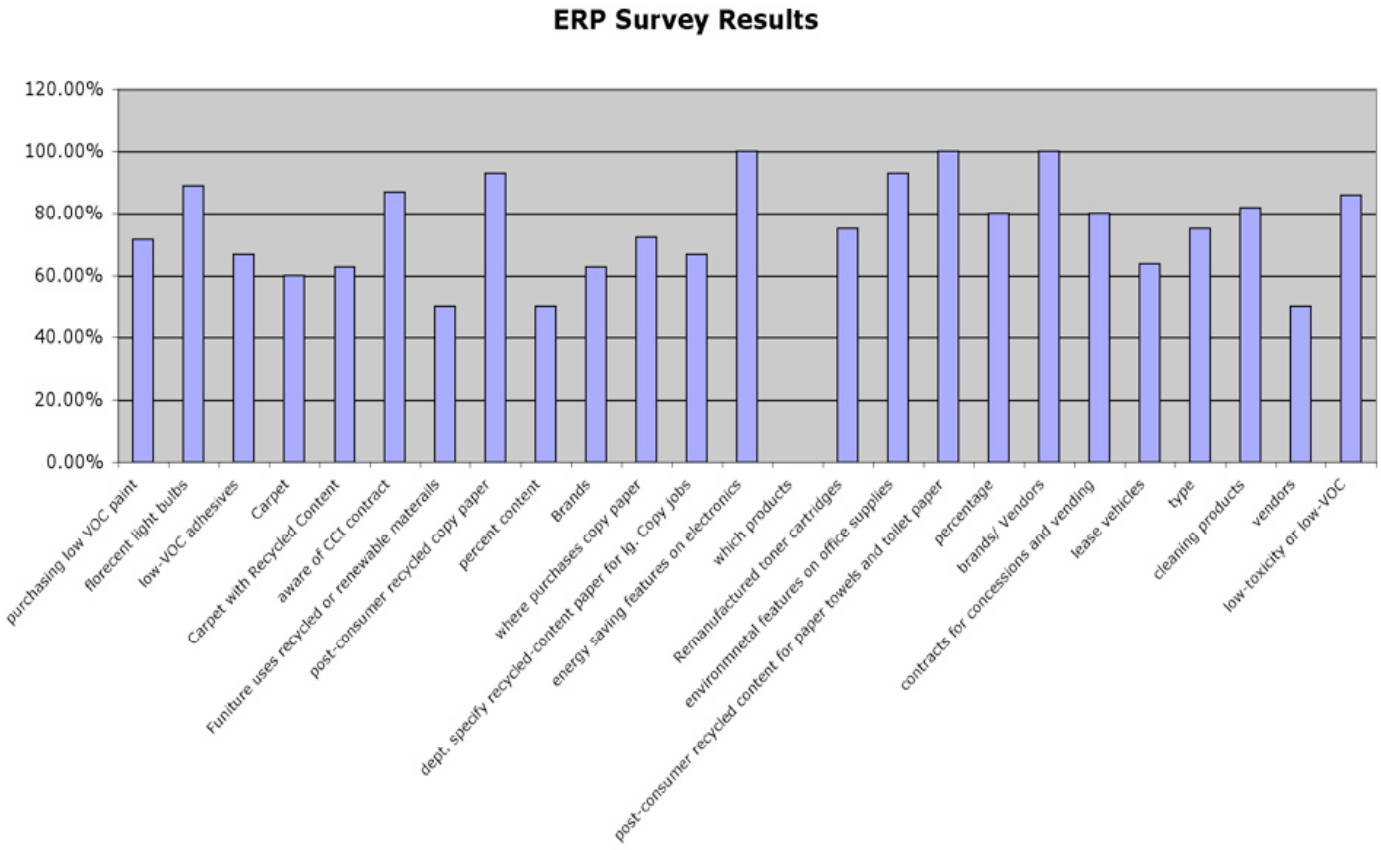
ERP Work by the CU Environmental Center

CU's Green Products Guide is updated regularly, with easy access web link information. The Green Products Guide is produced by the Environmental Center and can be found on the Center's website.

The Environmental Center sponsored an ERP vendor fair in 2005. This was successful in sharing currently available products and services available for institutional purchasers and making links between consumers and industry representatives.

ERP Survey

The fall 2005 survey assessing what ERP products and services departments are currently purchasing and where the gaps are was very successful. Currently, most departments are purchasing post-consumer recycled content custodial and fine paper products. Departments are also regularly purchasing low VOC paint and cleaning supplies, florescent light bulbs, carpet made with recycled content, energy saving features on electronics and remanufactured toner cartridges.



The results of the survey are not comprehensive but provide a representative snapshot of campus procurement activities. The survey results help to reinforce the top ERP opportunities. The majority of departments are following ERP policies within their individual purchasing without a formalized campus-wide policy. With these trends, our goal will be to implement the current ERP practices as a campus-wide initiative. For a look at the fall 2005 survey questionnaire visit http://ecenter.colorado.edu/survey/.

Additional ERP Programs and Departmental Accomplishments:

- Housing is using VOC free paint products, recycled furniture and recycled wood doors

- Campus Printing Initiative uses 100% recycled paper, which has helped to drive the cost down for all departments. The continuation of the pay-as-you-print initiative has reduced copy paper waste
- Campus stationary is 25% post-consumer recycled content
- UMC Food Services offers a fair trade, organic coffee option
- The CU Bookstore offers a variety of recycled products
- UCSU and Housing have prohibited the posting of deep-dyed, "astrobright" papers. This policy has greatly increased the recyclability of paper at CU
- UCSU has passed legislation requiring the use of recycled paper products by all student fee-funded departments
- Facilities Management has conducted a thorough evaluation of all cleaning products in use. Cleaners are approved if they meet established criteria for environmental and health issues
- The Environmental Center has started a sustainable foods campaign geared at educating campus consumers about the impacts of food production and assisting with research needs for dining units

Action Steps CU Can Take to Achieve Goals

The following action steps for ERP are geared toward campus-wide, institutional implementation, which reinforce the individual departmental purchasing activities. Educational efforts will also help to advance comprehensive efforts.

- Continue to research ERP programs of other universities and state agencies, document viable case studies
- Educate the campus community
    - Maintain an in-depth directory of products, services and campus procedures in print and web-based versions of the Green Products Guide
    - Continue to distribute the Green Products Guide to campus departments
    - Educate the campus community via the Department Eco-Advocate program, which will include monthly bulletins, and an office certification program featuring a short ERP presentation/ training for faculty/ staff
    - Produce and distribute product-specific information sheets with current information on price, quality and availability for campus purchasers
    - Hold regular ERP vendor fairs
    - Student education opportunities can include consumer education materials; discounts and incentives for purchasing green products, web resources on commonly purchased products by students (i.e., computers, paper, food, residential living supplies, etc.)

- Train the campus community to apply environmentally-responsible purchasing techniques

    - Include ERP information in employee and student orientation
    - Inform vendors of the importance of environmentally preferable products and the desire of the university to have more selection of these items
    - Formulate an ERP checklist for departmental procurement agents to use with standard procurement requisition processes (i.e., RFI, RFB, Documented Quotes). This checklist can be voluntarily used during a pilot period and then evaluated for potential required use
    - Conduct ERP purchasing trainings for A Card holders and other departmental purchasing agents. This could be in conjunction with the utilization of the ERP checklist

- Target Specific Products

    - Complete the process for making recommendations and establishing procedures for standardizing the procurement of the 10 ERP "best opportunity" categories
    - Research potential usage and current usage of product, its environmental impact, availability, industry trends, price comparison and quality
    - Research which vendor contracts could be revised to include environmentally responsible specifications
    - Establishment in budget for a green products specialist in the Procurement Service Center to focus on screening contracts and potential applications for ERP
    - Institutionalize an environmental metrics system, develop a list of preferred environmental criteria
    - Identify products that meet the criteria
    - Encourage purchasing of products from the list
    - Test products or use pilot programs to evaluate

- Institutionalize a standardized ERP program

    - Research ERP programs of other universities and state agencies, document viable case studies
    - Inform campus suppliers of environmental improvements needed through a request for information (RFI) document.
    - Identify applications for ERP with Procurement Service Center
    - Apply ERP to contract and RFP language
    - Gather administrative support
    - Educate community
    - Adopt reporting requirements and conduct procurement surveys, which allow the campus to track progress and identify areas for improvement for specific product categories
    - Establish measurable goals of program

- Assign responsibilities for upholding program
- Continue outreach to purchasers, vendors and other campus groups

- Incorporate sustainable food options (i.e., local, seasonal, organic, fair trade) into UMC Food Services and Housing Dining Services
  - Identify, prioritize and pilot key products (i.e., bananas, coffee, lettuce/ spinach, meat, dairy) based on cost-competitiveness, environmental impact and availability
  - Target a percentage of all campus food to meet sustainable options
  - Investigate availability of sustainable food products in existing food service contracts and suppliers
  - Hold a Harvest Celebration event on campus with organic, locally grown foods at beginning of Fall semester
  - Research "Farm to Fork" programs at other schools. Put together a feasibility study of a "Farm to Fork" program for CU-Boulder
  - Expand and collaborate with the organic, permaculture garden on campus

Metrics and Assessment

Metrics	Measurement Methods
Educate Campus Community	Green Product Guides and ERP checklist distributed to A-Card holders and purchase requisioners Continue annual survey by product category for assessment of departmental purchasing habits
Train purchasers	Utilization of ERP checklist with purchase requisitions, Hold training sessions;
Institutionalize ERP practices	Documented increase in volume of ERP products purchased; ERP products available through traditional procurement avenues for comparable price; majority of products purchased should conform to ERP standards where applicable
Incorporate sustainable foods	Annual increases in volume of organic and local products purchased

Further Planning and Research Needs

- Research commonly purchased products and services.
- Research which vendor contracts could be revised to include environmentally responsible specifications.
- Research price, quality and availability of environmentally preferable alternatives.
- Create a policy directive, which recommends and/or requires the purchase of ERP products and services.
- Survey the levels to which existing campus suppliers offer products and services with ERP features.
- If an ERP checklist is utilized prior to purchase voluntarily by department purchasers and is successful, what steps would be taken to require purchasers to utilize this tool?
- Research most effective means of introducing "green training" for staff, students, procurement officials and students.

Challenges

- While replacing some purchasing habits with environmentally responsible choices is often cost-competitive (or even money-saving), other shifts in purchasing may incur additional costs. Is it possible to apply savings in one arena to increased expenses in another?
- Another hurdle is overcoming old "norms" regarding a number of products used. For example: the effectiveness of non-toxic cleaning agents or the quality and durability of recycled paper.
- Educating and mobilizing the campus community to systematically change many purchasing habits will require a great deal of organization and outreach.
- The University will need to work closely with outside service entities to ensure the services they provide are in line with our ERP policies (such as making sure vending machines are energy efficient and dispense recyclable packaging). These outside contractors may not be highly receptive to ERP ideals.
- Purchasing procedures such as the Acquisition Card have decentralized purchasing. This shift has caused difficulty in the institution of campus-wide procurement policies for environmentally responsible products and services. However, it has created an enormous level of convenience for campus purchasers.
- Food challenges include:
    - For sustainable food products that would result in a price increase, what level of increase is acceptable if any? The 2003 student survey shows a

willingness to pay for organic options. In Housing, there are set meal equivalencies; prices would need to stay in line with established Housing ME's
- The academic year does not coincide with the regional growing season creating difficulty with reliance on consistent local suppliers
- The cost of organics can be higher, especially given an apparent lack of competition amongst distributors

Social Impacts

Environmentally responsible purchasing reduces waste, energy needs and provides for a healthier campus. Cleaners, in particular, cause direct health effects on students, faculty and staff due to their hazardous toxicity levels. Many departments on campus have been switching to low or no volatile organic compounds (VOCs) and natural cleaning products, which are better for the environment and reduce social health risks. The ERP taskforce currently is working with Facilities Management to test the effectiveness of green cleaning products against current product used, noticing the trend that many departments are switching to green products. Those departments include, but are not limited to: Housing and Dining Services, Facilities Management, the UMC and many UCSU cost centers.

Links to Other Blueprint Topics

Climate: All purchases that use electricity—from light bulbs to computers—have the potential to reduce energy use. Green building will work to integrate sustainably-harvested lumber, non-toxic materials and other green products into new projects and remodels. The university can utilize electric vehicles and alternative fuels to reduce pollution, while ensuring that routine maintenance of these vehicles doesn't produce unnecessary amounts of chemical waste.

Literacy: Increasing environmental literacy will raise awareness and interest in utilizing green products and services whenever possible. Many of the concerted activities in literacy apply to consumer education efforts.

Healthy Campus: The impacts of green purchasing go hand-in-hand with maintaining a healthy campus. Using non-toxic cleaners and paints, applying techniques of integrated pest management and maintaining healthy indoor air quality all relate back to purchasing habits.

Water: By purchasing low-flow faucets, toilets and appliances the university can dramatically cut water usage. Retrofitting laboratories with more efficient water systems will save millions of gallons annually. Additionally, purchasing state-of-the art software and watering devices will lessen demand. Implementing xericscaping methods will further reduce the water requirements of campus grounds.

Waste and Recycling: Obviously, ERP favors products that are easily recyclable over those that are not. Additionally, green products typically come in green packaging, decreasing waste and further increasing recycling potential. Another goal of ERP is to acquire products with a longer useable life, thus decreasing total garbage output.

References

Keniry, J. *Ecodemia*, National Wildlife Federation, 1995.

Eagan, D. and J. Keniry, *Green Investment, Green Return*, National Wildlife Federation, 1998.

Michigan Tech Environmental Sustainability Committee:
http://www.esc.mtu.edu/WhatTheESCDoes/greenPurchasing/Default.htm

National Wildlife Federation, Campus Ecology Division
http://www.nwf.org/campusecology/dspGreeningProjects.cfm?iii=

Western Regional Pollution Prevention Network
http://www.westp2net.org/janitorial/jp4.htm

US EPA http://www.epa/gov/oppt/epp/index.html

European Union EPA http://www.epe.be/workboks/gpurchasing/index.html

http://www.newdream.org/procure/

Duke University

Environmentally Preferable Purchasing (EPP) Guidelines

A. Purpose

Recognizing our impact as a major purchaser of goods and services, Duke University gives preference to environmentally friendly products whose quality, function, and cost are equal or superior to more traditional products. This policy will

- conserve natural resources
- minimize pollution
- reduce the use of water and energy
- eliminate or reduce environmental health hazards to workers and our community
- support strong recycling markets
- reduce materials that are landfilled
- increase the use and availability of environmentally preferable products
- reward vendors who reduce environmental impacts in their production and distribution systems or services
- create a model for successfully purchasing environmentally preferable products that encourages other purchasers in our community to adopt similar goals
- support locally produced goods and services
- educate ourselves, our vendors, and our end users

B. Definitions

Environmentally Preferable Product: A product that has a lesser or reduced negative effect on human health and the environment when compared to competing products that serve the same purpose. This comparison may consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and disposal of the product. This term includes recyclable products, recycled products, and reusable products.

Life Cycle Analysis: The comprehensive examination of a product's environmental and economic effects throughout its lifetime, including new material extraction, transportation, manufacturing, use, and disposal.

Practicable: Satisfactory in performance and available at a fair and reasonable price.

Post-consumer Content: The percentage of materials collected from end-users and recycled into the new product.

Recyclable Product: A product that, after its intended end use, can be demonstrably diverted from the University's solid waste stream for use as a raw material in the manufacture of another product, preferably higher value uses.

Reusable Product: A product, such as a washable food or beverage container or a refillable ballpoint pen, that can be used several times for an intended use before being discarded.

C. Data Collection and Performance Reporting

For purposes of setting goals and evaluating the performance of the University's green purchasing program, vendors may be requested to report the environmental attributes of their products.

Procurement and Supply Chain Management responsibilities:

- Collaborate with vendors to design and implement a data collection system for tracking the environmental attributes of products
- Compile records for the purpose of producing an annual summary of the University's environmentally responsible purchasing actions, and for evaluating the effectiveness of these actions in reducing the environmental impacts of University procurement
- Identify opportunities to educate end users about the impacts of their product choices

D. Priorities

- Ensure the health and safety of workers and citizens.
- Support the Durham economy by purchasing goods and services from local vendors
- Procure goods and services that are environmentally friendly without compromising cost or quality.
- Comply with all local, state, and federal laws that govern our procurement activity.

E. Areas of Focus

1. Source Reduction

Reducing unnecessary waste at the source allows the University to both mitigate the inefficient use of our natural resources and benefit economically from decreased handling and disposal costs.

Procurement activity may include:

- Institute practices that reduce waste, resulting in the purchase of fewer products whenever practicable and cost-effective, but without reducing safety or workplace quality.
- Purchase remanufactured products such as laser toner cartridges, tires, furniture, equipment and automotive parts whenever practicable, but without reducing safety, quality or effectiveness.
- Consider short-term and long-term costs in comparing product alternatives. Include evaluation of total costs expected during the time a product is owned, including, but not limited to, acquisition, extended warranties, operation, supplies, maintenance, disposal costs and expected lifetime compared to other alternatives.
- Purchase products that are durable, long lasting, reusable or refillable.

- Request that vendors eliminate packaging or use the minimum amount necessary for product protection to the greatest extent practicable.

- Request packaging that is reusable, recyclable or compostable when suitable uses and programs exist.

- Reuse pallets and packaging materials.

- Require that all equipment bought after the adoption of this Policy, when practicable, be compatible with products and services that provide source reduction benefits.

2. Recycled Content Products

The University has made significant investments in developing a successful recycling system and recognizes that recycled content products are essential to the continuing viability of that recycling system, and for the foundation of an environmentally sound production system.

Procurement activity may include:

- products for which the United States Environmental Protection Agency (U.S. EPA) has established minimum recycled content standard guidelines – such as printing paper, office paper, janitorial paper, construction, landscaping, transportation, vehicles, and non-paper office products – and which contain the highest post-consumer content practicable, but no less than the minimum recycled content standards established by the U.S. EPA Guidelines.

- Copiers and printers that can be used with recycled content products.

- Re-refined lubricating and industrial oil for use in vehicles and other equipment, as long as the product is certified by the American Petroleum Institute (API) as appropriate for use in such equipment.

- Asphalt concrete, aggregate base or portland cement concrete for road construction projects that contains recycled, reusable or reground materials.

- Recycled content transportation products including signs, cones, parking stops, delineators, and barricades.

3. Energy and Water Savings

Recognizing that the generation of electricity is a major contributor to air pollution and global warming issues, and that clean water is a finite resource, the University values products that minimize the use of these valuable resources.

Procurement activity may include:

- Energy-efficient equipment with the most up-to-date energy efficiency functions, including, but not limited to, high-efficiency heating and cooling systems.

- Efficient lighting with energy-efficient equipment.

- Products for which the U.S. EPA Energy Star certification is available and which meet Energy Star certification, when practicable. When Energy Star labels are not available, choose energy-efficient products that are in the upper 25% of energy efficiency as designated by the Federal Energy Management Program.

- Water-saving products.

4. Landscaping

Supporting low maintenance and environmentally sensitive landscapes minimizes the unnecessary use of fertilizers and water resources, therefore reducing the University's impact on the natural environment.

Procurement activity may include:

- Employ sustainable landscape management techniques for design, construction and maintenance. These techniques include, but are not limited to, integrated pest management, grasscycling, drip irrigation, composting, and procurement and use of mulch and compost that give preference to those produced from regionally generated plant debris and/or food waste programs.

- Minimize waste by selecting plants that are appropriate to the microclimate, species that can grow to their natural size in the space allotted them. Place preference on native and drought-tolerant plants that require no or minimal watering once established.

- Limit amount of impervious surfaces by procuring permeable substitutes such as permeable asphalt or pavers for walkways, patios and driveways.

5. Toxics and Pollution

The use of toxics and the generation of pollution should be minimized to reduce risks to health, safety, and the environment.

Procurement activity may include:

- Refrain from procuring cleaning or disinfecting products (i.e. for janitorial or automotive use) containing carcinogens, mutagens, or teratogens. Chemicals to be avoided are listed by the U.S. EPA or the National Institute for Occupational Safety and Health on the Toxics Release Inventory.

- Phase out chlorofluorocarbon-containing refrigerants, solvents and similar products.

- Procure readily biodegradable surfactants and detergents that do not contain phosphates.

- Maintain buildings and landscapes, manage pest problems through the application of prevention techniques and physical, mechanical and biological controls

- Procure products with the lowest amount of volatile organic compounds (VOCs), highest recycled content, and low or no formaldehyde in materials such as paint, carpeting, adhesives, furniture and casework.

- Reduce or eliminate the use of products that contribute to the formation of dioxins and furans, including, but not limited to:

    - Paper, paper products, and janitorial paper products that are bleached or processed with chlorine or chlorine derivatives

    - Products that use polyvinyl chloride (PVC), including, but not limited to, office binders, furniture, flooring, and medical supplies

- Procure products and equipment with no lead or mercury. For products containing lead or mercury, give preference to those with lower quantities of these metals and to vendors with established lead and mercury recovery programs.

- Consider vehicle procurement alternatives to diesel such as compressed natural gas, biobased fuels, hybrids, electric batteries, and fuel cells, as available.

6. Forest Conservation

The University has made significant investments in sustainable forestry, evident in the preservation of 7,000 acres of Duke Forest. That commitment extends to the purchase of wood products, in recognition of the valuable human and ecological health services provided by forests.

Procurement activity may include:

- Procure wood products such as lumber and paper that originate from forests harvested in an environmentally sustainable manner. Give preference to wood products that are certified to be sustainably harvested by a comprehensive, performance-based certification system. The certification system shall include independent third-party audits, with standards equivalent to, or stricter than, those of the Forest Stewardship Council certification.

- When practicable, procure locally, sustainably harvested wood.

Green Purchasing Policy

Responding to the growing need for environmental stewardship and calls from the University community for the implementation of sustainable practices, Duke University Stores adopted this Green Purchasing Policy. The following policy outlines the purchasing component of Duke Store's plan to "green" its products and services. The other component consists of a marketing strategy to move environmentally preferable products off the shelves.

Hence forth, Duke Stores will give preference to environmentally superior products, where quality, function and cost are equal or superior. Products and packaging materials will contain a prescribed minimum post-consumer recycled content and will be minimized and/or substituted with more environmentally appropriate alternatives whenever possible. All products will be chosen based on efficient use of energy, natural resources, and potential for safe, non-hazardous disposal.

Duke Stores will inform all suppliers / vendors of products and services about the policy and will work with them to meet its criteria.

Where practical and cost effective, products will be ordered in appropriate quantities to avoid having to dispose of obsolete products.

"Whenever practicable,"[1]* products should be purchased which meet the criteria specified in the EPA's Environmentally Preferable Purchasing (EPP) database which is available on the EPA website (www.epa.gov).

When a candidate product meets some of the EPP criterion but not others, preference will be given in the following order:

1) The highest percentage of post-consumer[2] recovered material available in the marketplace; and
2) The highest percentage of pre-consumer recovered material available in the marketplace

[1] "Whenever practicable" means a) the recycled products can perform the function intended at least as well as a product produced from only virgin material, and b) the cost of the recycled product reasonably approximates the cost of the product produced from only virgin materials.

[2] "Post-consumer" materials are those materials that have been used by consumers, collected by recycling programs and then remanufactured into a new product. "Pre-consumer" material consists of the leftover scraps from milling and industrial processes. While both are environmentally preferable to virgin materials, post-consumer recycled material is given priority because it supports local recycling programs by creating demand for the materials collected.

In addition to the recovered material content of a product, the EPP database specifies other important criteria that should be considered in selecting products:

1) The ability of a product and its packaging to be reused, reconditioned for use, or recycled through existing recycling collection programs; and
2) The volume and toxicity of waste and by-products a given product and its packaging generate in their manufacture, use, recycling and disposal.

Equipment purchased or rented by Duke Stores are to be compatible, whenever practicable, with the use of recycled-content products (e.g. photocopy machines).

Product specifications and requisitions for products must conform to the following guidelines:

1) Specifications and requisitions shall not require the exclusive use of products made from virgin materials, nor specifically exclude the use of recycled-content products;
2) Performance standards must be reasonable and related to function, and shall not be designed to exclude the purchase of recycled-content products;
3) To the extent such information is known, Duke Stores staff shall identify in the purchase requisition products available with recycled content and vendors from whom such products are available; and
4) The Purchasing Agent has the authority to specify a minimum recycled-content standard in bid solicitations.

Duke Stores will promote this green purchasing policy on its website, inside its stores and within its marketing materials.

Dukes Stores will promote environmentally preferable products within its stores through green tagging, preferential shelf placement and special displays. Within its catalog, environmentally preferable products will be denoted through a green labeling scheme.

UNIVERSITY OF FLORIDA ENVIRONMENTAL PURCHASING POLICY

Purpose

The purpose of this policy is to support the purchase of products that will minimize any negative environmental impacts of our work. The University of Florida recognizes that the purchasing decisions of our employees can make a difference in favor of environmental quality. We prefer the purchase of environmentally preferable products whenever they perform satisfactorily and are available at a reasonable price.

Definitions

A. "Environmentally Preferable Products" means products that have a lesser impact on human health and the environment when compared with competing products. This comparison may consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, or disposal of the product.
B. "Recycled Products" are products manufactured with waste material that has been recovered or diverted from solid waste. *Recycled material may be derived from post-consumer waste (material that has served its intended end-use and been discarded by a final consumer), industrial scrap, manufacturing waste, or other waste that would otherwise have been wasted.*
C. "Practicable" means sufficient in performance and available at a reasonable cost.

Polices

A. All University of Florida personnel will purchase recycled and environmentally preferable products whenever practicable.
B. All imprinted letterhead paper; envelopes and business cards used by the University of Florida departments should be recycled paper and should bear an imprint identifying the paper as recycled... *Departments should be implementing this policy when ordering new stationery so that the University is using only recycled stationery by* ***July 1, 2004.***
C. University of Florida departments should ensure that the title page of each report printed or copied on recycled papers bears an imprint identifying the recycled content of the paper wherever practicable. *The use of this imprint on every communication will help the University of Florida set an example that will promote the use of recycled products. There is also a significant community relations benefit in this.*
D. Departments should use both sides of paper sheets whenever practicable, have recycle boxes at each desk and Xerox station, and use the back of non-confidential documents for note paper or to print drafts.

E. University of Florida should promote the use of recycled and other environmentally preferable products by publicizing its procurement program. *Materials produced for advertising, conferences, trade fairs, press releases, and other communications with clients and citizens can make reference to the University of Florida's commitment and leadership in the use of environmentally preferable products.*
F. The University of Florida will have an aluminum recycle container available within a reasonable distance of soda machines and in all dining establishments where canned drinks are served.
G. The University Purchasing and Disbursements Department will make every effort to secure contracts with vendors that are environmentally conscientious whenever practicable.

Selected Environmental Products

A. Recycled paper and paper products
B. Remanufactured laser printer toner cartridges
C. Re-refined lubrication and hydraulic oils
D. Recycled plastic Outdoor-wood substitutes
E. Computers, Appliances (Energy Star Rated)
F. Re-crushed cement concrete aggregate and asphalt
G. Cement and asphalt concrete containing glass cullet, recycled fiber, plastic, tire rubber, or fly ash
H. Remanufactured tires and products made from recycled tire rubber
I. Compost
J. Re-manufactured paint
K. Cleaning products with lowered toxicity
L. Energy saving products
M. Waste-reduced products
N. Water-saving products
O. Office Supplies (marked with environmental sign)
P. Re-ripened antifreeze
Q. Desk top organizers
R. Other products designated by the Deans, Directors, and Department Chairpersons

Responsibilities of Departments

A. Develop and maintain information about environmentally preferable products and recycled products containing the maximum practicable amount of recycled materials, to be purchased by agencies whenever possible. The department should use the list composed in this document. They may add or modify this list as needed.
B. Inform employees of their responsibilities under this policy; provide them with information about recycled products and environmental procurement

opportunities. Check the Purchasing and Disbursements Web Page (http://www.purchasing.ufl.edu) for frequent updates on vendor participation with environmental efforts.

C. Establish a yearly review committee to evaluate the efforts the department has made to help protect and preserve the environment and what the future goals are for the up-coming year.
D. Submit new ideas and problems to the Greening Committee at Purchasing and Disbursements (352) 392-1331.

Exemptions

Nothing in this policy should be construed as requiring the purchase of products that do not perform adequately or are not available at a reasonable price.

General Information

A. Brightly colored or neon colored paper cannot be recycled.
B. Envelopes with windows cannot be recycled.
C. Visit the Purchasing and Disbursements Website for updates on environmentally safe products.
D. Consider more then just recycled products when purchasing commodities. Many computers, appliances, and vehicles meet energy-efficient standards defined by the federal government's Energy Star program.
E. Switching to an integrated pest management (IPM) approach is an increasingly popular method of significantly reducing chemical quantities and toxicities.
F. Ronald McDonald house will assist departments with boxes for soda can tops. The tops have more aluminum content then the whole can. The money from the tops is used for patients of the Ronald McDonald house and others with serious illnesses.
G. When replacing used lab equipment and computers consider donating them to a local school or other state agency.
H. Clean out your office supply cabinet and donate over stock or un-used items to schools or other state agencies.
I. Turn out the lights when you leave your office for the evening.
J. Ride to work with a friend, walk, bike, or take the bus if possible.

Environmentally Preferable Purchasing (EPP) Resources

A. Center for a New American Dream's Procurement Strategies (www.newdream.org./procure)
B. EPA's EPP Web Site (www.epa.gov/oppt/epp)
C. EPPNet (www.nerc.org/eppnet.html)
D. Green Seal (www.greenseal.org
E. Office of the Federal Environmental Executive (www.ofee.gov)