SUSTN-100 COURSE

MATC: MILWAUKEE AREA TECHNICAL COLLEGE
T&AS: TECHNICAL AND APPLIED SCIENCES

Sustainable Facilities Operations

SUSTN-100 Sustainable Facilities Operations

National Science Foundation - National Center for Building Technician Education

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SUSTAINABLE FACILITIES OPERATIONS

Course Documentation

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Catalog description

This is an accelerated course that covers the overall aspects of operating a building in an ecologically and economically sustainable fashion in today's complex world. Sustainability as it relates to social and environmental responsibility is discussed. The triple bottom line, LEAN, Six Sigma, CMMS, LEED and overall sustainable operations are covered and are part of a class project. Students are encouraged to use a project from their work or of personal interest to them. Course requires computer skills in word processing, Power Point, and spreadsheet.

Class hours

24 hours of lecture and 24 hours of self-directed research.

Self-directed research is part of each homework assignment, see sample in Appendix C.

Units

3 Credits

Entry skills needed

The following are required for admission to the course:

- A high school diploma or GED
- Demonstration of proficiency in basic skills through a course placement assessment

In addition, the potential for success in the program will be enhanced if students have some work experience and/or a strong interest in sustainability and facilities management. You should also possess conceptual abilities, critical thinking, problem-solving, computer and organizational skills.

Syllabus

See Appendix A for sample syllabus with course schedule and policies.

Student learning outcomes

The exit skills listed in the next section support these three outcomes:

Sustainability Concepts

The student will understand sustainability from local (facility) to a global level.

Business and Budgeting

The student will be able to describe the triple bottom line and some of the various standards that support the concept, such as ISO

Understanding Buildings - Sustainable Management Systems

The student will understand the impact of systems such as LEAN and Six Sigma for driving sustainable efforts in business and manufacturing.

Exit skills

Course content to achieve student learning outcomes:

Sustainability Concepts

- Student can define sustainability both verbally and in a written paragraph as related specifically to the Brundtland Commission Report definition.
- Student will make the case for sustainability based on the triple bottom line.
- Student is able to integrate sustainability concepts into company mission and vision statements
- Student will list upwards of twenty different sustainability measures for any given facility using a LEED checklist.
- Student is able to provide three examples of how a sustainability project can save money.
- Student can describe and provide figures on their own carbon footprint and equivalent number of "planets".

Triple Bottom Line

- Student is able to describe the triple bottom line, People / Profit / Planet and word it in at least one other way.
- Student can give at least three examples of social, economic, and environmental responsibility for a given facility.
- The student can describe the relationship of the three ISO standards, ISO 9000 (financial); 14000 (social); and 26000(environmental) and the triple bottom line.

Sustainable Management Systems

- Student can describe and differentiate between LEAN and Six Sigma.
- Student can describe continuous improvement
- Student can describe the LEED Rating System and its relationship to sustainability.
- Student can describe maintenance management such as Building Operations and Computerized Maintenance Management Systems.
- Student can give examples of energy management in a building.
- Student can follow through with at least one basic concept of LEAN, such as a one-point-lesson.

Sustainability Project

- Student has researched, promoted, and possibly implemented a sustainable project at a facility of their choice.

Course materials

Principal text

Jacobsen, Joseph. Sustainable Business and Industry: Designing and Operating for Social and Environmental Responsibility. Asq Pr, 2011. Print.

Lecture materials and handouts

- Presentations (PowerPoint):

    1. SBI CH01 Introduction, Making the Case for and Defining Sustainability, Social Responsibility, and Environmental Responsibility
    2. SBI CH02 Conveying and Reporting on a Mission and Vision of Environmental and Social Responsibility
    3. SBI CH03 The Local-Global Three Bottom Lines: ISO 9000, 14000, and 26000
    4. SUSTN100 CMMS and Preventative Maintenance
    5. SBI CH04 Social and Environmental Responsibility Measures
    6. SUSTN100 Lean
    7. SBI CH05 Resources, Finance, and Return on Responsible Investment
    8. SUSTN100 Green Cleaning
    9. SBI CH06 Financial, Environmental, and Social Unity Projects
    10. SBI CH07 Sustainable Commercial and Industrial Plant Operations
    11. SBI CH08 Responsible Lean Logistics
    12. SBI CH09 A Sustainable Economy
    13. SUSTN100 Building Operations
    14. SUSTN100 Energy Management

- In Class Exercises

    - Defining Sustainability
    - Generating Ideas for Your Project
    - Outlining Your Project

Other reference materials

LEED Existing Buildings: Operations & Maintenance Project Checklist for HW01

Software required

Access to computer with:

- Microsoft Office Programs (Word, Excel, PowerPoint, etc.).
- Adobe Reader (for pdfs). Price: Free. Source: www.adobe.com.
- Access to computer with internet access. (i.e. Internet Explorer, Google, Mozilla Firefox, Safari, etc.).

Lab setup and materials

None required, lecture only course, although class does walk the building where the course is held to look at various operational aspects.

Equipment & instruments required

None required.

Assessment

Methods

- Class Participation
- Weekly Homework – electronic and/or hard copy
- Quizzes – Online chapter reviews using BlackBoard
- Project and Presentation

Sample quiz questions

For sample questions quiz questions, see Appendix D

Quizzes are given for chapters 1 through 6.

Sample Weekly assignment

WEEK One Homework:
HW#1: Project Facility Selection and Sustainable Items List
See Appendix C

Homework Listing:

1. HW01 Project Site and Sustainability Items Listing
2. HW02 Priority Listing
3. HW03 Footprints
4. HW04 Green Cleaning
5. HW05 One Point Lesson

Project

The project for the class consists of each student implementing a sustainability measure at a facility of their choice. The intent of the project is for the student to search out a project at a place of business, such as where they work, research it, propose the idea and get it implemented.

Since the course is only 8 weeks long, the student does not have to actually implement the project, but it is preferred.

For an example report and scoring rubric see Appendix E.

Here is a listing of previous projects conducted by students:

- Reviewing and Revising Cleaning practices / products at a:
  - Day Care
  - School
  - Home
- Heating System Replacement
  - Residential
  - School
  - Dog "kennel"
- Water Conservation Practices
  - Residential Apartment Complex
  - Residence
  - College
  - School
- HVAC System Modifications - Commercial Facilities
- Compressed Air Refrigeration System Upgrade to non-CFC and more energy efficient
- Transportation - Replacement of personal vehicle (SUV) with high MPG diesel (VW)
- Rain Water Run Off Collection
  - Parking Garage for plant watering and surface cleaning needs
- Multiple Energy Saving Ideas for a local High School
- Night Club Elimination of hand towels to high velocity air dryers (saved money and maintenance)

- Compressed Air Leak Study at a small manufacturing facility
- Lighting - Replacement of CFL cans with LED retrofits at multiple branch offices for a credit union
- Dishwashing Options - Hand vs. automatic dishwasher study
- Energy Audit of a local nature center
- Restaurant - Analysis of "doggy" bags (Styrofoam vs. compostable/recyclable options)

Adaptability to on-line format

This course can be delivered on-line due to its lecture format, with limitations.

Currently the entire course is in BlackBoard online but taught in lecture / discussion format. Test including final exam are online. All homework is available online.

However, due to lecture format, guest speakers from industry present in class, discussing what they do, how it relates to the class, and the potential jobs in their area for the students.

Appendix A – Sample syllabus

MILWAUKEE AREA TECHNICAL COLLEGE
Course Syllabus

Spring, 2014

Course: *Sustainable Facilities Operations*		**Credits:** *3*
Subject Abbreviation: SUSTN	**Course Number:** 100	**Section Number:** 600
Class Meets: *In E114b Wednesdays, 5:45 PM to 8:40 PM in room #E114b: Jan 29th – March 19th, 2013*		
Instructor: *Ted Wilinski*		
Office: *E108*	**Office Hours:** *The hour before class in either E108 or E114b*	
Phone number: *(414) 571-4570*	**E-mail:***wilinskt@matc.edu*	

Course Description*: This is an accelerated course that covers the overall aspects of what it takes to operate a building in a sustainable fashion in today's complex world. A case is made for sustainability, social responsibility and environmental responsibility. The triple bottom line, LEAN, Six Sigma, CMMS, LEED and overall sustainable operations are covered & part of a class project. Students are encouraged to use a project from their work or of personal interest to them. Course requires computer skills in word processing, Power Point, and spreadsheet.*

Prerequisites: *None*

ADA Statement:
If you have a disability that impacts your classroom performance and wish to request an accommodation, contact the Office of Student Accommodations (414)297-6838. They may require documentation regarding your disability to enable them to comply with your request. Admission of a disability is voluntary and will be handled in a confidential manner. MATC does not discriminate against individuals with disabilities and fully complies with the Americans with Disabilities Act.

To ensure your academic success in this program, you are strongly encouraged to provide your instructor with a copy of the Instructor Notification Form from the Office of Student Accommodations. This should be done at the beginning of the semester.

Textbook(s): *Jacobsen, Joseph. Sustainable Business and Industry: Designing and Operating for Social and Environmental Responsibility. Asq Pr, 2011. Print.*
PLEASE NOTE: In the event that the MATC book store does not carry any of the above texts, students may purchase their copies through the online vendors or book stores of their choice.

Supplies: *An Open Mind willing to work hard*

Attendance Policy: Miss first two classes and you are automatically withdrawn from the class!
Attendance will be taken on a daily basis. Students are expected to attend class regularly and to arrive on time. It is the student's responsibility to discuss absences with the instructor and follow up with an email. No email, no consideration for an excused absence. When an absence occurs, the student is responsible for making up the work. Work can be found in Blackboard. As a general rule, no exceptions for not meeting due dates are given for being absent. If there is an exception, it has to be detailed in a response from the instructor to your email explaining the absence. Miss 4 classes and you will be withdrawn from the course .

Tests/Assignments Make-up Policy:
It is the responsibility of the student to keep track of work and grades. In Blackboard, the "MyGrades" tab can be very helpful to check on completed work and view your grades. Ignorance of not knowing an item was due is not an excuse.

Any late work will have 5% taken off for each day it is late. For instance, a chapter review done the morning of class will be considered one day late. Five percent will be taken off the score. So, if a score of 13 points out of 15 is awarded for that chapter review, then 13/15= .867 or 86.7%. Five percent will be taken off, or 87%-5% = 81.7% for a final score.

Any item over two weeks late is not accepted and the student will receive a zero for that grade.

There can be extenuating circumstances but these have to be discussed and agreed upon in writing by both parties at the time the work is due, not after the two week period.

Assessment Activities*:* note: assessment activities are subject to change as the semester progresses.

- **Chapter Reviews:** *These are "tests" taken in Blackboard that are simply going over the reading material for that week and covering items from lectures/class. It is assumed that the student reads the chapter first. Refer to Blackboard for details.*
- **Homework:** *There is homework items that are assigned during the semester to help with understanding of the course*

materials. Refer to Blackboard for details.

- **Class Participation:** *There are activities, such a question answered the first minute of class (and handed in right away) that are part of each class. If you are not in class when that item is submitted, there is no making it up.*
- **Project:** *There is a report required for this course. Make sure you follow the rubric used for scoring reports. Refer to Blackboard for details.*
- **Presentations:** *Each student is required to present their report in class. Use of power point is encouraged but not required. Length of presentation varies depending on the size of the class, but it is typically about 5 minutes with time for questions afterwards. Refer to Blackboard for details.*

Grading Standards: note: grading standards are subject to change as the semester progresses.

- **25% Chapter Reviews:** *Each Chapter Review is weighted the same.*
- **25% Homework:** *Each Homework is weighted typically the same.*
- **15% Class Participation:** *There will be various activities each day in class that require you to submit work in class. If you are not there, late or leave early there is no opportunity to make it up.*
- **30% Project:** *The project will be written up in report format and submitted.*
- **5% Presentations:** *A power point presentation summarizing your project is required.*

Refer to Blackboard for details.

Grading scale is as follows:

A - 4.00	Superior	for grades between 94% and 100%
A- 3.75		for grades between 90% and less than 94%
B+ 3.25	Above Average	for grades between 87% and less than 90%
B - 3.00		for grades between 84% and less than 87%
B- 2.75		for grades between 80% and less than 84%
C+ 2.25	Average	for grades between 77% and less than 80%
C - 2.00		for grades between 74% and less than 77%
C- 1.75		for grades between 70% and less than 74%
D+ 1.25	Below Average	for grades between 67% and less than 70%
D - 1.00		for grades between 64% and less than 67%
D- 0.75		for grades between 60% and less than 64%
U - 0.00	Unsatisfactory/Failing	for grades less than 60%

Instructor Support: Students are encouraged to contact the instructor before or after class, and during office hours, if they have questions or problems related to the class. It is suggested that students contact the instructor immediately in order to avoid falling behind in class. Please do not wait until the end of the semester to discuss issues that should have been resolved much earlier.

Academic Support Services: In addition to obtaining course-related assistance from the instructor, students may obtain assistance from the Academic Support Centers located at the Milwaukee, North, South, and West campuses. These centers are open to all MATC students. Services include, but are not limited to, assistance in computer applications, course assignments, Internet use, math, science, social studies, study skills, and writing. Please call the Academic Support Center at your campus for more information.

Instructor Recommended Withdrawals: You may be dropped for absenteeism when:

1. You are absent three consecutive classes.
2. Your attendance is sporadic (e.g., you miss three class periods), and you are unable to make up the instruction missed.
3. You fail to meet attendance requirements of licensing agencies.
4. You pose a safety hazard to yourself or others because of missed instruction critical to safe class or lab performance.
5. You are unable to make up instruction missed in a lab/shop class.
6. You have not attended class during the first two weeks of the term.

Dropping or Changing Courses: Students who are considering dropping the course should first discuss this with their instructor, counselor, or faculty advisor before dropping. They may be able to recommend an alternative course of action. Please be aware that dropping a course could result in a student being placed on warning or suspension at the end of the semester. Also, please be aware that dropping a course does not mean you will be refunded.

Students who wish to drop a course may voluntarily withdraw from the course up to two weeks before the last day of the semester. Course Change forms are available in the Registration office at the Milwaukee Campus or in Student Services at the regional campuses.

Students who do not report for the final examination (or presentation) and does not formally withdraw nor arrange for an incomplete grade, will be given a U grade for the course.

Incompletes: A grade of Incomplete may be granted, at the discretion of the instructor, in cases where the student has completed at least 75% of the course with a C or better at the time the Incomplete is requested. Students must complete the missing work within one semester or else the Incomplete grade will revert to a U.

Student Complaint Procedure: MATC has established a formal system to assist students in resolving academic problems and course-related issues. In order for a complaint to be valid, the following steps must be followed in order:
Step 1: Meet with the instructor to discuss any questions related to the course (e.g., requirements or assignments) or if you are experiencing academic problems. If the issue is unresolved after meeting with the instructor,
Step 2: Meet with the associate dean of the department. If the issue is unresolved after meeting with the associate dean,

Step 3: Meet with the dean of the department. If the issue is unresolved after meeting with the dean, Step 4: Go to the Office of Student Life for assistance.
Retention Alert: MATC is interested in the success of all of its students. Retention Alert is a tool that instructors, along with the counseling and advising department, use to help improve student success. There are three areas of Retention Alert: financial, personal/confidential, and retention. Retention Alert is designed to identify students who may be at risk of academic difficulty or failure as early as possible. Throughout the semester, an instructor may create Retention Alerts or referrals for some of their students. After a referral is made, the student will be contacted by someone by phone or email to discuss resources or set up an appointment to meet in person. The Retention staff follows up with the student and the student's instructor to facilitate support efforts. Prevention and intervention are key with students so timing and resources are important. With Retention Alert, hopefully students can get the help they need, when they need it.
OTHER IMPORTANT INFORMATION: No cell phones, no texting, no ear buds or other head phone set up, no computers. Please refer to the links in Blackboard under the "Syllabus" tab. Those links are: • Student Code of Conduct • Student Accommodation Services • Student Handbook

WEEK 01 JANUARY 28

- THIS WEEKS TOPICS:
  1. Course Introduction
  2. Discussion On Blackboard & MATC Email
  3. Description of Sustainability:
  4. Chapter 1: Making the Case for and Defining Sustainability, Social Responsibility, and Environmental Responsibility

- DUE NIGHT BEFORE CLASS:
  1. Nothing Due This Week – class did not start

- In Class Participation:
  1. Sign Syllabus Receipt Form and turn into instructor
  2. Discuss Project

WEEK 02 FEBRUARY 4

- THIS WEEKS TOPICS:
  1. Chapter 2: Conveying and Reporting on a Mission and Vision
  2. Chapter 3: The Local-Global Three Bottom Lines: ISO 9000, 14000, and 26000

- DUE TUESDAY NIGHT:
  1. Read Chapter Reviews: 1 2, & 3
  2. Chapter Reviews: 1 & 3
  3. HW01 as discussed in class

- In Class Participation:
  1. Discuss Project
  2. Class Breakout Session on Sustainable Facility Operations

WEEK 03 FEBRUARY 11

- THIS WEEKS TOPICS:
  1. Chapter 4: Social and Environmental Responsibility Measures
  2. CMMS

- DUE TUESDAY NIGHT:
  1. Read Chapter: 4
  2. Chapter Reviews: 4
  3. HW02 Project Priority Listing

- In Class Participation:
  1. Presentation by Industry Person / Guest Speaker
  2. Discuss Project

WEEK 04 **FEBRUARY 18**

- THIS WEEKS TOPICS:
  1. LEAN
- In Class Participation:
  1. Discuss Project
  2. One Point Lesson

- DUE TUESDAY NIGHT:

1. HW03 Footprints

WEEK 05 **FEBRUARY 25**

- THIS WEEKS TOPICS:
  1. Green Cleaning
  2. Chapter 5: Resources, Finance, and Return on Responsible Investment
- In Class Participation:
  1. Discussion of projects

- DUE TUESDAY NIGHT:

1. Read Chapter: 5
2. Chapter Reviews: 5
3. One Point Lesson HW05

WEEK 06 **MARCH 4**

- THIS WEEKS TOPICS:
  1. LEED Rating System
  2. Chapter 6: Financial, Environmental, and Social Unity Projects: New Applications in Research, Statistics, and Continuous Improvement
- In Class Participation:
  1. Discussion of projects

- DUE TUESDAY NIGHT:

1. Read Chapters: 6
2. Chapter Reviews: 6
3. HW04 Green Cleaning

WEEK 07 **MARCH 11**

- THIS WEEKS TOPICS:
  1. Building Operations Overview
  2. Chapter 7: Sustainable Commercial and Industrial Plant Operations
  3. Energy Management Overview
- In Class Participation:
  1. Discussion of projects

- DUE TUESDAY NIGHT:

1. Read Chapter: 7
2. ~~Chapter Reviews: 7~~

WEEK 08 **MARCH 18**

- THIS WEEKS TOPICS:
  1. GUEST SPEAKER, Common Characteristics of Sustainable Publicly Traded Global Companies
  2. Chapter 8: Responsible Lean Logistics
  3. Chapter 9: A Sustainable Economy

- DUE TUESDAY NIGHT:

1. Report

- In Class Participation:
  1. Exam
  2. Discussion of projects

Appendix B – Sample Power Point

Sustainable Facilities Operations

SUSTN-100

Introductions

Your name, where you work (if your working), your background (education and experience) and your reason for being here.

Night One – WHY?

- Depletion
- Pollution
- Earth's Temperature
- CO_2
- Population
- Migration
- Sustainability
- Social Responsibility
- Environmentally Responsibility

Global Temperature Rise

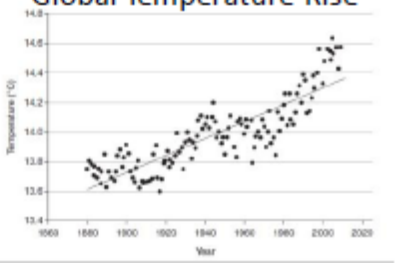
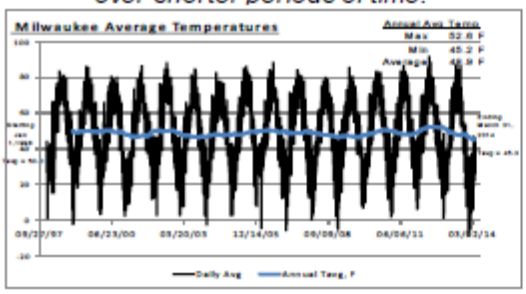


Figure 1.2 Global temperatures over 130 years of industry.

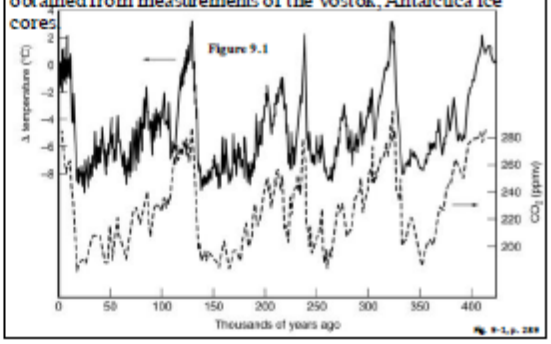
Source: Compiled by the Earth Policy Institute (EPI) from National Aeronautics and Space Administration (NASA), Goddard Institute for Space Studies (GISS), "Global Land-Ocean Temperature Index: in 0.01 Degrees Celsius," http://data.giss.nasa.gov/gistemp/tabledata/GLB.Ts+dSST.txt, updated December 2009; Reto Ruedy (NASA GISS), e-mail to Jerry Hendersling (EPI), January 12, 2010.

Note: The beginning of the Industrial Revolution launched an ongoing upward trajectory in global temperatures.

Not to be confused with local variations over shorter periods of time.



The correlation between carbon dioxide concentrations and the earth's temperature over the past 400,000 years. Data was obtained from measurements of the Vostok, Antarctica ice cores.



CO_2 Emissions over time

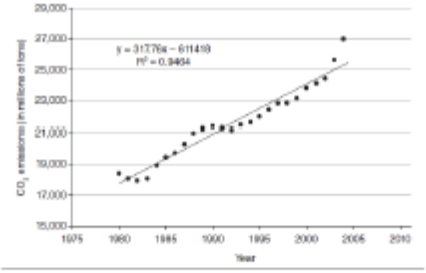


Figure 1.3 CO_2 emissions from 1980 to 2004.
Source: NASA, Goddard Institute, http://www.giss.nasa.gov.
Note: For every year that passes, we find an increase of 317,760,000 tons of CO_2 emitted from economic related activities on Earth.

Temperature / CO_2 relationship

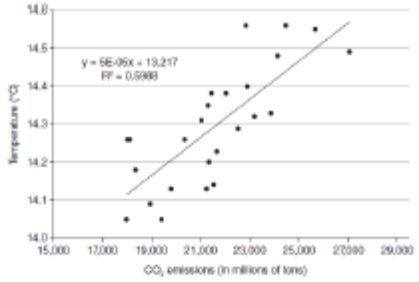


Figure 1.4 Relationship between CO_2 and temperature.
Source: NASA, Goddard Institute, http://www.giss.nasa.gov.
Note: About 60% of the data fits the linear model and there is a 0.00005°C increase in temperature for every 1 million tons of CO_2 emitted.

Its Scientific, Its Math

Table 1.1 Regression analysis: CO_2 emissions (in millions of tons) predict temperature (°C).

Variable	Coefficient	Standard error	t (df = 23)	p-value	Coefficence interval 95% lower	95% upper
Intercept	13.2172	0.1851	71.407	1.65E-28	12.8343	13.6001
CO_2 emissions (million tons)	0.00005000	0.00000853	5.859	5.70E-06	0.00003234	0.00006765
r^2 = 0.599	n = 25	Standard error = 0.101	Dependent variable = temperature			

Source: NASA, Goddard Institute, http://www.giss.nasa.gov.

Note: For every 1 million tons of CO_2 emissions, there is a corresponding 0.00005°C change in temperature. Almost 60% of the relationship between CO_2 and temperature fits the linear model, and the risk of rejecting the null hypothesis (that this relationship does not exist) when it is actually true is 0.0000057, that is, a significant finding. For every 17,543,859,600 tons, we see an increase of 1°C in global temperature. However, there are other greenhouse gases, and CO_2 is only one such gas that contributes to global warming.

Point Is, Climate change is real and it is us burning fossil fuels that is mostly responsible for earths increasing temperatures!

- http://earththeoperatorsmanual.com/segment/6

POPULATION GROWTH

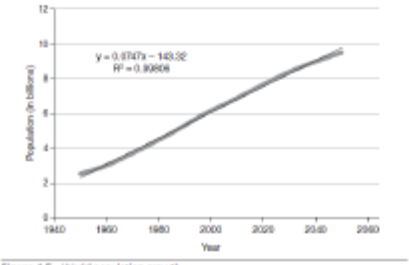


Figure 1.5 World population growth.
Source: US Census Bureau, http://www.census.gov/ipc/www/idb/worldpopinfo.php.
Note: Between 1960 and 2010 the population of the earth grew at an alarming rate, more than doubling in size. Two primary mediators of this phenomenon were an extension of healthcare and the availability of safe drinking water to developing countries.

Rate of Population Growth

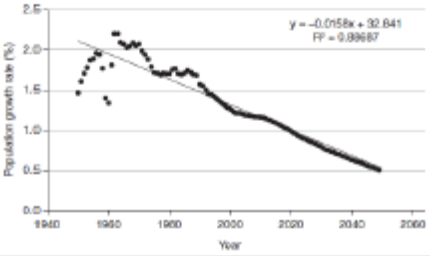


Figure 1.6 Percent of change in world population growth.
Source: United Nations Population Division, "World Population Prospects: The 2008 Revision Population Database," updated March 15, 2009, http://esa.un.org/unpp.

Sustainability - The Dictionary Definition

The dictionary definition of *sustain helps us understand two relative concepts:*

(1) longevity or to keep from falling or sinking below some specified level

(2) to nourish or keep alive, above some specified level.

Sustainability

An environmentally sustainable process is one that contributes to keeping the environment healthy or "alive" by not over-consuming nonrenewable resources or contributing in other ways to the depreciation of the environment.

Sustainability

Nonrenewable resources are Resources that cannot replenish Themselves relative to human timescales.

Sustainability

Depreciation of the environment is in large part the result of two imposing degradations, where one is the result of depletion and the other is from pollution.

Sustainability - Brundtland Report

(1987, "Our Common Future")

- "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Social Responsibility

Individual and organizational variables that social scientists have been investigating for decades:

- values,
- beliefs,
- attitudes,
- subjective norms,
- intentions,
- and behaviors

are all.

Social Responsibility

From a life science point of view, we want congruence among individuals within the organization, thereby setting the stage for the organization's adoption of socially responsible practices.

- *values,*
- *beliefs,*
- *attitudes,*
- *subjective norms,*
- *intentions,*
- *and behaviors*

Social Responsibility

Organization adopts:

- it is cognitively congruent with its members

- but if the organization does not adopt the socially responsible practices, failing to align itself with its members, we will say it is cognitively dissonant

Social Responsibility

The theory of organizational congruence is just as relevant when applied to the organization and the community in which it resides. That is to say, the organization's values, attitudes, subjective norms, intentions, and behavior should be aligned with the community's values, attitudes, subjective norms, intentions, and behavior

It is safe to say, therefore, that social responsibility is a discipline within the social sciences and can be measured as such.

Environmental Responsibility

Environmental responsibility tends to be

- technological,
- physical,
- and biological.

In most instances, sustainability refers to long-term environmental responsibility.

Environmental Responsibility

Not over consuming nonrenewable resources or contributing in other ways to the depreciation of the environment.

Avoiding Depletion

Avoiding Pollution

Natural Capitalism

captures the essence of outcomes relative to the physical transformations of production by introducing the concept of industrial metabolism. Industry production takes in or ingests natural resources such as energy, minerals, water, wood, and Other natural elements.

This system, in turn, excretes liquid and solid waste, just as we do. Additionally, this system breathes in as combustion processes take place to produce heat and electricity while exhaling various gases.

Appendix C – Sample Research & Homework

HW01 – Project Site and Sustainable Items Listing

The intent of this homework is to get the student started thinking about their class project. The student is to determine a facility where they can implement a project. Ideally this is where they work. If there are no options for a particular student they may use the facility that houses the class or their place of residence.

Use a LEED Checklist for assisting with generating ideas.

Students have access to Blackboard which will have examples of the homework from previous classes.

Work is due the night before the next class in BlackBoard.

The research portion is that the student has to determine a site, investigate that site for opportunities, and start the process of generating ideas.

YOUR NAME

HW#1: Project Facility Selection and Sustainable Items List

Selected Facility

NAME OF FACILITY:

LOCATION OF FACILITY:
Street address, city, zip

FACILITY CONTACT INFORMATION:
Should include items such name, title/position, phone, address, email

DESCRIBE FACILITY:
Include items such as time of use (hours), whether seasonal or not, square footages, types of HVAC equipment, building type (brick, old, new etc),

List of Sustainable Items / Projects For Facility:

Cleaning Practices

1. Item
2. Item
3. Item
4. Item

Landscaping or site management

1. Item
2. Item
3. Item
4. Item

Water efficiency

1. Item
2. Item
3. Item
4. Item

Indoor environmental quality

1. Item
2. Item
3. Item
4. Item

Sustainable purchasing and materials/resource management

1. Item
2. Item
3. Item
4. Item

Sustainable transportation

1. Item
2. Item
3. Item
4. Item

Sustainable energy practices / measures

1. Item
2. Item
3. Item
4. Item

Other

1. Item
2. Item
3. Item
4. Item

SCORING (at instructors discretion):	Max Points
NAME OF FACILITY:	5
LOCATION OF FACILITY:	5
FACILITY CONTACT INFORMATION:	5
DESCRIBE FACILITY:	25

Minimum of 20 items. 20 x 3 = 60

One point for overly general phrase
Two points for a specific phrase to your facility
Three points for phrase with short site specific discussion (one sentence)
Will allow for points to be awarded up to a maximum of 110 total

Items must include a mix of the above but is not limited to those items.

Appendix D – Sample Quiz

SUSTN100 SBI CH01

True/False
Indicate whether the statement is true or false.

____ 1. Most population growth is occurring and will continue to be in the developing countries

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 2. During the Great Depression Social Security was developed and signed into law. This act created a social insurance program for retirement. There were other proposals also emerging to improve the quality of life due to evidence that suggested a breakdown of financial, health, and social means at a sustenance level that was threatening the nation. That is happening again today, but there are differences. What is the major differences?
   a. Unemployment
   b. Today the availability of natural resources is an issue.
   c. Decreased consumer demand

____ 3. The book states that our use of natural resources will exhaust many nonrenewable resources. For instance it states that copper will be gone in 61 years, gold 45 years, and indium 13 years, tin in 40 years, silver in 29, and uranium in 59 years. At what rate of depletion is that based?
   a. Today's current consumption rate.
   b. An increasing extraction rate due to increased population and consumption trends.
   c. The rate in the year the resource will be depleted.
   d. Rate at which it can be mined, very similar to modified Hubert curves.

Multiple Response
Identify one or more choices that best complete the statement or answer the question.

____ 4. Select all the items about population that are true.
   a. The rate of population growth in the world is decreasing. This does not mean that population is decreasing.
   b. It is anticipated that in about 2050 the world population will peak at about 9 billion. After that point it is anticipated that world population will start to decrease.
   c. Rural populations are decreasing while urban populations are increasing. This will continue to stress city infrastructures and increase the need for rural farms and resource extraction.

____ 5. Can complete sustainability ever be attained?
   a. yes
   b. no
   c. don't know

Indicate whether you agree with the statement.

____ 6. Do the economic theories based on unlimited growth (which is what our society is based on) hold up today?

____ 7. Is the way we live today sustainable?

Essay

8. How do you describe sustainable?

9. Explain "industrial metabolism"

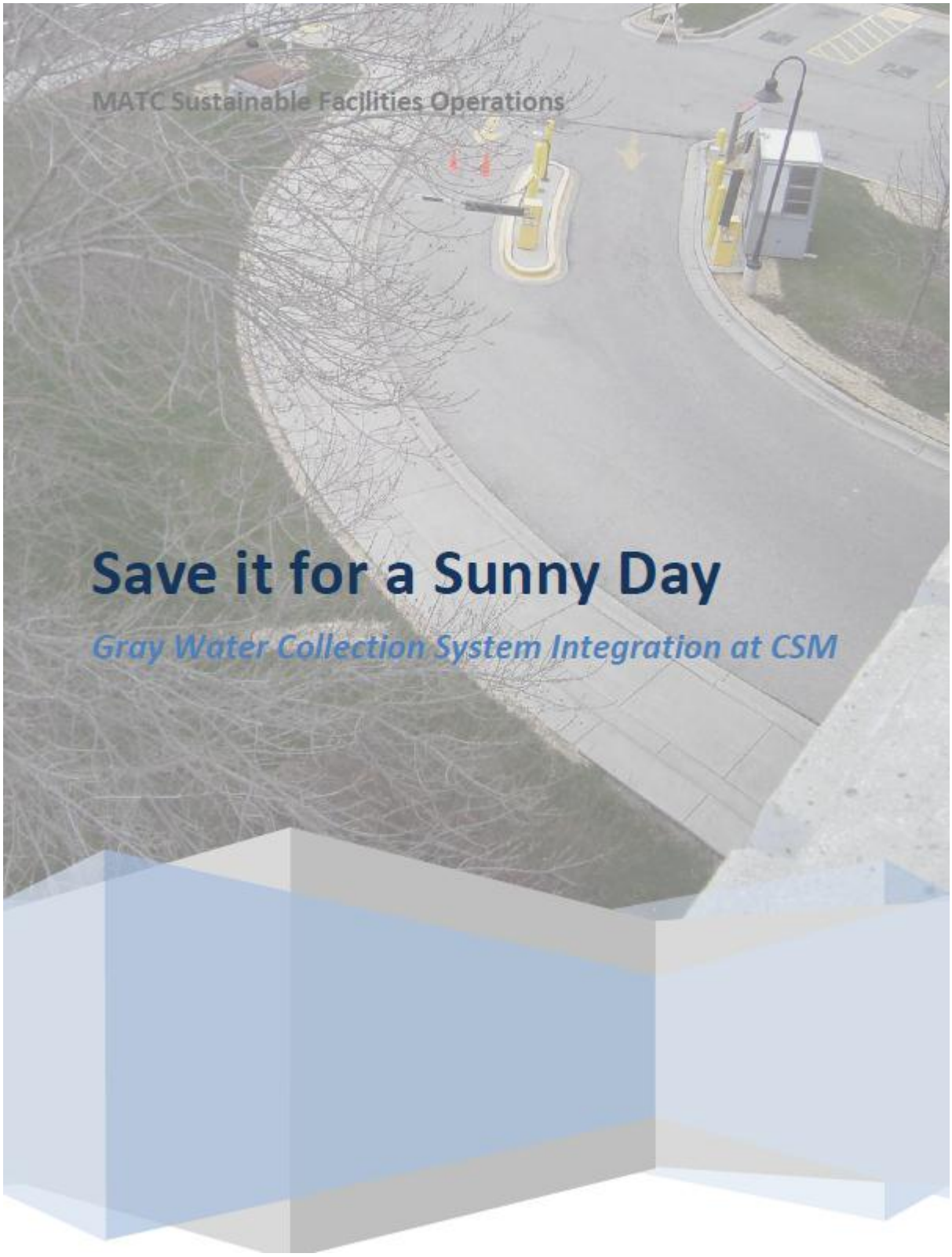
10. Based upon the CO2 trends and time, how many years will it take to increase the temperature of the earth by 1°C?

11. When will the earth have its maximum human population? What will that population be?

12. What are the differences between corporate sustainability and environmental sustainability?

13. In addition to those mentioned in Chapter 1 (pg2, copper, gold, indium, tin, silver, uranium), what other raw materials risk depletion? List at least four that are not mentioned in the book

Appendix E – Sample Report and Rubric


MATC Sustainable Facilities Operations
Save it for a Sunny Day
Gray Water Collection System Integration at CSM

Management Letter

Efficiency in operations is of great concern to any organization. Any opportunity to increase efficiency and save money allows more funds for research, technology, and expansion.

St. Mary's Hospital requires 36,000 gallons of water for pressure washing Parking Structure B (Women's Hospital) and approximately a minimum of another 240 gallons to water the grass. Add that to the rainwater run-off and a minimum of 791,617 gallons of water are washed down the drain per year.

By utilizing collected rain water for pressure washing the structure and watering the grass, operation costs can be greatly reduced. The water reserve would be used twice a year for pressure washing and 10 times throughout late spring to early fall for irrigation. The water would be filtered and collected in two 10,000 gallon tanks and UV filtered before use. The tanks to be used on the site have an estimated life rating of 100 years. At current rates, $7,121.08 in water, sewer and storm water charges can be eliminated per year; leading to a guaranteed return of investment.

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Introduction

In an average year in Wisconsin we will see approximately 35 inches of precipitation. Accumulate this over 35,000 square feet of open space and you have 755,377 gallons of water; or enough water to flush a toilet 472,111 times; or fill 12,086,032 glasses of water. This is how much water just one of the parking structures at St. Mary's Hospital literally flushing down the drain each year.

This project is being conducted to reduce unnecessary use of potable water at Columbia St. Mary's Hospital located at 2323 N Lake Dr. Milwaukee, WI 53211. There are a total of 4 parking structures on the hospital campus; we are concerned with the oldest parking structures, CSM Parking Structure B. The three new parking structures do not have any water reclamation associated with them either.

This report presents reader-awareness to the continuous waste of one of the earth's most precious resources; fresh water; and solutions on how to capture it, filter it and reuse it. It will show that it is not only the environmentally responsible thing to do but will benefit the community, not just in the immediate area, but in far reaching communities by not adding rainwater runoff to the sewer system during a storm. Ultimately financial savings will be achieved through the use of 'free' water instead of paying for potable water.

Methodology

Research for this report came from a variety of primary and secondary sources. Initially, secondary sources were the basis in understanding the situation and evaluating it within reasonable terms, considering we were dealing with an existing structure. We collected information on essentials to consider, systems available, and local precipitation figures. We then developed an idea for a suitable system to integrate into the site. We were able to visit the site in person to collect dimensions and evaluate the condition and possibilities; as well was speak with parties involved in the daily operation of the parking structure. This allowed us to completely comprehend the projects' provisions and limitations. We were fortunate to be able to contact a representative of a local company involved in the commerce of gray water collection systems. We obtained information on systems and services they provide. The CONTECH® gray water collection systems were appropriated to the site, and the infrastructure to join the systems to the existing storm drain system of the structure was to be developed. Using commercial water bills assisted in water savings projections. We took the estimated gallon consumption and converted it to Centrum (Hundred) Cubic-Feet (Ccf) as congruent with water utility charges. Such a figure could be used to determine return of responsible investment and further pushes the projects validity.

Analysis

In an average year in Wisconsin we will see approximately 35 inches of precipitation according to the Midwest Regional Climate Center web site averaging from 1971 through 2000. Accumulate this over 35,000 square feet of open space and you have 755,377 gallons of precipitation. This is how much water just one of the parking structures at St. Mary's Hospital literally flushing down the drain each year.

The first order of operation is the upkeep of the surrounding landscape. The main factor to consider is the sprinkler system. For this figure we will anticipated the hospital to water a minimum of 10 times a season (June-October; twice a month) Throughout the grassy areas of the surrounding, there are 8 known sprinkler heads. Provided that these sprinkler head are rated somewhere between 0.05 gallons per minute and 5.6 gallons per minute (Toro®, 2005) we developed a range of possible water usage for the landscaping.

From:

Equation 1: Low-End sprinkler water usage for entire applicable watering season

$$10_{waterings}\left(8_{sprinklers}\times 60\min_{runtime}\times 0.05gal/\min\right)=240gallons$$

To a possible:

Equation 2: High-End sprinkler water usage for entire applicable watering season

$$10_{waterings}\left(8_{sprinklers}\times 60\min_{runtime}\times 5.6gal/\min\right)=26,880gallons$$

This leads to a range of 240 – 26,880 gallons used annually in irrigations operations. We will concern ourselves with the most conservative value of water spent (240 gallons per year for irrigation.) Using these values we are able to estimate the savings to be noticed in the water bill.

Table 1 – highlighted is the integer used to calculate total precipitation per year.

34.8	Enter the number of inches of annual rainfall received
	Press this button to have the calculation answers shown below
0.4496	Gallons of water received weekly by **one square foot** of soil
1.7985	Gallons of water received monthly by **one square foot** of soil
21.5822	Gallons of water received annually by **one square foot** of soil
945161.1200	Gallons of water received annually by **one square acre** of soil

The Following diagram (fig. 1) is of the surfaces exposed to the annual precipitation. The calculated square footage used to determine the projected precipitation value collected by the structures drainage system.

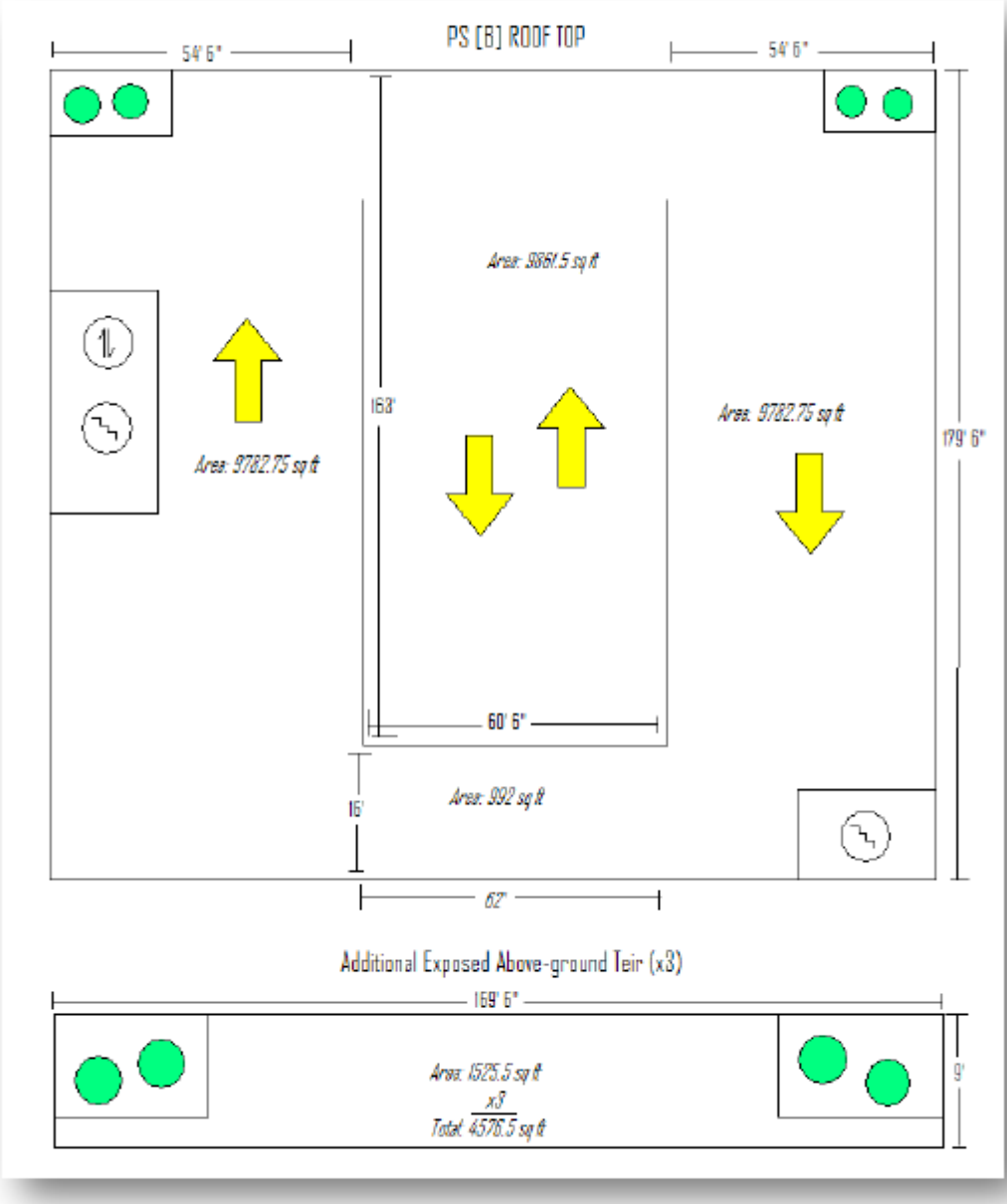


Figure 1: Diagram of Exposed surfaces

Total exposed surface area is 34,995.5 square feet. We are approximating 35,000 square feet for simplicity and possible measuring errors. Taking the structures surface area and multiplying it by the precipitation value per square foot (21.5822 gal/ft^2) resulted in our estimated value of 755,377 gallons of collected water. Equation 3 below entails the verified math.

Equation 3: Perceived annual gray water collected

$$35{,}000\,ft^2 * 21.5822\,gal / ft^2 = 755{,}377\,gallons$$

This collected water is going to be implemented in a variety of operations throughout the year. The structure is pressure washed twice a year. According to Jim, the General Manager of Porta-Wash Services, LLC, the 3 machines used to clean the structure are rated at 5 gallons per minute. He presumes a total of 60 running hours between the three machines. The amount of water used for the pressure washing service is calculated in figure 3.

Equation 4: Water usage per pressure washing

$$5\,gal / \min \times 60\,hrs_{runtime} \times 60\,\min / hr = 18{,}000\,gallons$$

This service is done twice a year. This results in 36,000 gallons of water used on the structure.

Pressure washing water consumption of 36,000 gallons plus minimum sprinkler water consumption of 240 gallons gives us the total water usage of 36,240 used to calculated usage charges. Sewer charges are based solely on water consumption. Stormwater charges are based on square footage and take in account not only the parking lot but also the surrounding land. Amount of 108 ERU was given to us by MMSD; 1 ERU equals 1,610 Square feet.

Table 2 - Usage charges dependent on the water meter pipe size.

WATER AND SEWER CHARGES ACCORDING TO PIPE SIZE											
Pipe Size	Water Service Charge (monthly)	Water Service per year	Water Usage	TOTAL WATER	Sewer Service Charge (quarterly)	Sewer Service per year	Sewer Usage	Sewer Charge Local	TOTAL SEWER	Stormwater Charge	TOTAL SAVINGS
	748.05 gallons = 1 ccf									108 ERU according to MMSD	
	36,240 gallons = 48.45 ccf				Sewer charges based on water usage						
			$1.58 per ccf				$1.44 per ccf	$1.16 per ccf		$56.88 per ERU	
3/4"	6.76	81.12	76.55	157.67	20.48	81.92	69.77	56.20	207.89	6,143.04	6,508.60
1"	14.87	178.44	76.55	254.99	26.96	107.84	69.77	56.20	233.81	6,143.04	6,631.84
1-1/2"	30.70	368.40	76.55	444.95	36.88	147.52	69.77	56.20	273.49	6,143.04	6,861.48
2"	48.80	585.60	76.55	662.15	47.48	189.92	69.77	56.20	315.89	6,143.04	7,121.08
3"	96.00	1,152.00	76.55	1,228.55	81.50	326.00	69.77	56.20	451.97	6,143.04	7,823.56
4"	175.90	2,110.80	76.55	2,187.35	149.00	596.00	69.77	56.20	721.97	6,143.04	9,052.36
6"	319.90	3,838.80	76.55	3,915.35	250.52	1,002.08	69.77	56.20	1,128.05	6,143.04	11,186.44
8"	520.70	6,248.40	76.55	6,324.95	376.34	1,505.36	69.77	56.20	1,631.33	6,143.04	14,099.32
10"	725.80	8,709.60	76.55	8,786.15	550.08	2,200.32	69.77	56.20	2,326.29	6,143.04	17,255.48
12"	1,152.00	13,824.00	76.55	13,900.55	826.16	3,304.64	69.77	56.20	3,430.61	6,143.04	23,474.20

Findings

It is estimated that a minimum of 36,240 gallons of water would be used per year, in combination pressure washing and sprinkler system. The cost savings estimated pertaining to water input (i.e. Water Service and Usage charges) are approximately $662.15 per year.

The cost savings estimated pertaining to water output (i.e. Sewer Service and Usage charges, Local sewerage charge and storm water Management charges) on 791,617 gallons per year (water usage plus rainwater run-off); Total approximately $6,458.93 per year for a total estimated savings of $7,121.08 per year.

It was determined since it takes 18,000 gallons of water to pressure wash the parking structure that storing capacity of 20,000 gallons would be sufficient. To have the lowest impact on the current structure, two 10,000 gallon tanks would be best. The water would be first filtered for oil and debris before entering the holding tanks. Since the final end use of the collected rain water is for power washing and irrigation, we felt the final filtering system should be antimicrobial by means of Ultra-Violet treatment.

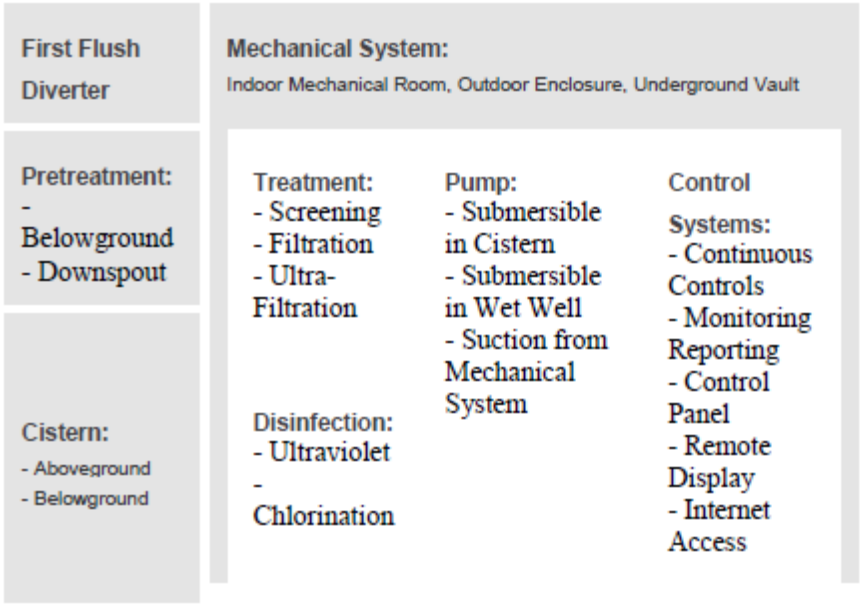


Figure 2 – System Overview

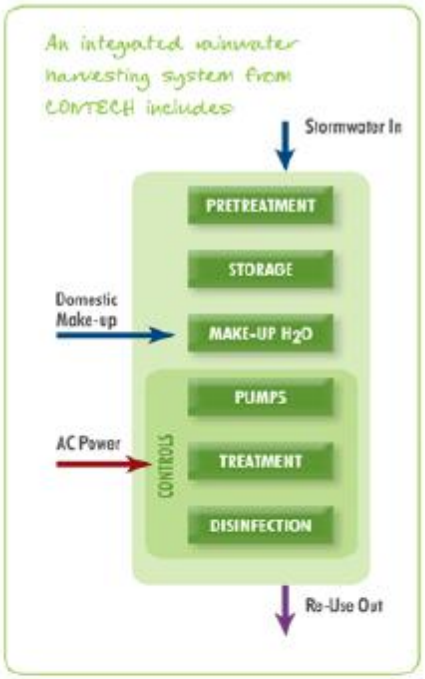


Figure 3 - Filtering process from intake to re-use.

Figure 4 - Location in 1st sub-basement we feel tanks should be placed.

How Triple Bottom Line Addressed

Economics. Employing this water recycling system would reduce the operational costs of the parking facility. Less output of money means the money can be spent on more sustainable projects throughout the hospital campus.

Environment. Anytime there is anything conserved or reused an environmental benefit exists. The collection system would remove thousands of gallons of water that could potentially be a factor a flood. This system also would prevent contaminated run of from entering into water mains with the use of the filtration system.

Community. Removing this site from the sewer grid would benefit the community surrounding the hospital campus in many ways. It is the first step in reducing the amount of water spent into the storm drain system; ultimately to Lake Michigan. If similar projects were conducted on the 3 other parking structures this would have an even greater impact. Milwaukee's East Side is a densely developing neighborhood. With the number of condos and other housing projects developing, the need for water supply and available parking is increasing. We see this parking facility, equipped with a gray water collection system, setting a precedent to meet the needs of the developing community.

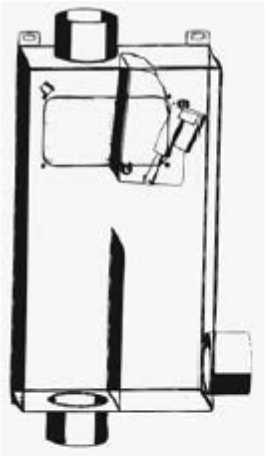
Figure 5 - Photo of water bubbling out of storm sewer on Milwaukee's East side in July 2010.

Discussion with Recommendations

It was determined the best low impact solution would be to install two 10,000 gallon tanks in the second sub-basement that would be connected to the existing parking structure drainage system. There would be a three stage filter system to filter out oil and debris making the water useable for restricted re-use. The first stage would be the grates of the individual drains scattered throughout the parking structure. The second stage would be a pre-treatment system that would include a first flush diverter and filters for oil and debris. The water would then be held in the tanks until needed and an ultra-violate treatment just before use. There should be an overflow system in practice in case of excessive precipitation. To the other extreme, there should be a tap into city provided water in case of a drought.

Pricing for the desired project is undetermined to date. In spite of a rapid response from a local gray water collection systems consultant, the request to obtain further information and pricing has gone unanswered. We can only presume the savings that will be contrived through the reduction of city water usage.

Add-on Component: First Flush Diverter



User Defined first flush

- Based on depth of rainfall and time since last storm

Maximizes collection and runoff reduction

- Diverts only the first flush
- Does not reset during lulls in rainfall

Automatic reset

- Based on time since recent rainfall

Meets building code requirements

- Diverts first flush
- Keeps cistern clean

Figure 6 - First Flush Diverter to be added to system to remove initial debris from parking structure.

Figure 7 - Existing drainage system collecting rainwater from all levels and draining it to local sewer system.

Future Research

Throughout our research and development we have noted possibilities of future research and projects. Some of the approaches pertain to the project on hand, and others entail the other components of the hospital campus. We would like to incorporate a monitoring system in the gray water collection such as a sub meter and an over flow alarm. Sub metering would allow for an exact read of the systems functions. As time goes on we would be able to develop measures of collection and usage. These factors could be implemented to design a schedule for operations based on environmental trends. Based on the effectiveness of this project, similar projects could be applied to the 3 larger parking structures on the campus. This would result in more than 4 times the water collected on site. This water could be used in the operation of the thousands of water closets and urinals within the hospital. Collecting the data from the operation of this project would be the main contributor in influencing a stronger advance to similar projects on the hospital's campus, as well as in the surrounding community.

References

(CONTECH, 2010) – http://www.contech-cpi.com/Products/Stormwater-Mangent

(TORO®, 2005) - http://media.toro.com/CatalogDocuments/Manual/570_ss.pdf

(The Milwaukee Municipal Services Bill, 2011) - http://city.milwaukee.gov/ImageLivrary/Groups/WaterWorks/files/TheMunicipalSvcsBill_110513.pdf

(MMRC, 2011) – http://mcc.sws.uiuc.edu/climate_midwest/mwclimate_events.htm

(McCormack, 2010) – http://www.virtualsecrets.com/annual-rainfall-water-calculator.html

APPENDIX

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A.10 Photos of Site....44-47

Appendices not included to save on space.

SUSTN0100 Report Rubric Overall _____ Bonus Points _____

Student Name: _____ sub1 _____/ 32 Q _____/ 39

sub2 _____/ 29 bonus _____

total _____

32 REPORT TOPIC _____

pts	CATEGORY	
1	**COVER PAGE**	_____ / 4
1	Title	
1	Student Name	
1	Date	
	Table Of Contents	_____ / 5
1	Introduction	
1	Other items	
1	Summary / conclusions	
1	References	
1	Page numbers	
	-1 for error message	
10	**Body of Report 5-10 page**	_____ /10
	_____'total pages in body	
2	**1.5 Spaced or less**	_____ /2
	minus 1x 1.5x plus	
2	**12 point font or less**	_____ /2
	minus 10 12 plus	
3	**Sections labeled in report**	_____ /3
1	**References**	_____ / 6
3	References (5 required)	
2	MLA format followed	
	(http://citationmachine.net/) or use MSWord	
	Author, title, publisher, year, media	
32	*----------sub total1 -*	_____

- Not inteneded to be the titles of various sections of the report
- OK to list more items/sections in the Table of Contents

29

pts	CATEGORY	
1	**Introduction**	_____ / 2
1	one page max	
1	**Summary / Conclusions**	_____ / 9
1	Not same as Exec Summary/intro	
2	Gives quick overview of what was just discussed	
5	Makes conclusion	
	Spelling	_____ / 4
4	No Errors detected	
	many errors 0 1 2 3 4 No errors	
	Triple Bottom Line	_____ / 0
10	People Planet Profit	
	Grammar / writing	_____ / 4
4	No Errors detected	
	many errors 0 1 2 3 4 No errors	
29	*---------- sub total2 -*	_____
	Quality Points Available	_____ / 39
10	Technical 1 2 3 4 5 6 7 8 9 10	
5	Class Topic 1 2 3 4 5	
24	Overall Writing 2 3 4 5 6 7 8 9 10 12 14 15 18 20 22 23 24	

BONUS POINTS

2	***Double Sided***	_____ / 2
1	***Appendices - bonus points +1***	_____ / 4
3	*Nicely / neatly done (up to +3)*	
2	**Pictures/Figures/tables**	_____ / 4
2	*referred to in body of report bonus (up to +2pts)*	
-2	***If in a binder or folder - minus 2 points!***	_____ / -2
-1	***If not uploaded in BB - minus 1 point!***	_____ / -1
	bonus total -	

COMMENTS:

- note: not all errors (for instance spelling & grammar) are noted on the report or here by the instructor
- describe acronyms: The first time it is used the full written out name should prescede the acronym in parenthesis
- a power point is not a report, will not be graded.

NOT ok to write in first person!

___ Run-on sentences?

___ Need to separate paragraphs?

If not five pages, 8 points off. Then 1 extra for each page less.

BEST Center Curricula, Resources & Recordings

Academic Programs
Georgia Piedmont Technical College - Building Automation Systems
Milwaukee Area Technical College - Sustainable Facilities Operations
Laney College - Commercial HVAC Systems
City College San Francisco - Commercial Building Energy Analysis & Audits

Professional Development Materials, Presentations & Videos
National Institutes
Building Automation Systems Instructor Workshops
Webinars (e.g., BEST Talks)

Faculty Profile Videos
Reports & Case Studies
Marketing Resources

BEST
Building Efficiency for a Sustainable Tomorrow

NSF National Science Foundation