UCSB Recreation Center

ENV S 187: Green Building Case Study
By: Chris Gomez

Overview Facts

Location: 516 Ocean Rd, Santa Barbara, CA 93106

Function: Space for physical activity

Size: 68,450 ft^2

Construction Year: 1994

UCSB's Recreation Center

UC Santa Barbara's Recreation Center, located on campus in sunny Santa Barbara serves as a space for physical activity and exercise for students, faculty, staff, and the broader community. The Rec Cen is also a hub that offers a range of programs, including group fitness classes, personal training, aquatics, and the beloved Adventure Program.

The Rec Cen, opened on campus in 1995 and serves an average of 3,000 visitors and an estimated 200 employees daily.[1] The site includes two main buildings. The main building consists of two weight rooms, two locker rooms, the main gymnasium, five racquetball courts, and a long rectangular two story East wing which holds offices and educational spaces. The second building is a large gymnasium with basketball and volleyball courts. This site also includes a courtyard dividing the office wing and main gymnasium, two outdoor pools, an outdoor weight lifting zone, an artificial turf area, a grass area, and a storage container for the Adventure Program's equipment.

1. UC Santa Barbara Department of Recreation, https://recreation.ucsb.edu/about/general-information

Case Study Snapshot: UCSB Recreation Center

Case Study Overview

The objective of this case study is to analyze the key performance areas commonly addressed in LEED and other green building rating systems, while investigating sustainable features and identifying any potential opportunities for improvement.

Performance areas consist of:

- Location & Transportation
- Sustainable Sites
- Water
- Energy & Atmosphere
- Materials & Resources
- Indoor Environmental Quality

These key performances were investigated with my own eyes with the use of LEEDs v4 indoor water use reduction calculator and ENERGY STAR Portfolio Manager to analyze water and energy efficiency. The indoor water reduction calculations contained data from indoor water flush and flow fixtures such as toilets, urinals, lavatory sinks, and showers. Flush and flow rates were recorded for each fixture along with estimated uses per day. The calculator then compared the Recreation Centers flow volume and water consumption to a baseline to show percent in water use reduction and consumption. I do not show outdoor water use calculations in this case study as I chose to only focus on indoor water use. The ENERGY STAR Portfolio Manager used utility data from a 12 month period recorded by electricity and gas meters from 2021 to 2022. The data was compiled into graphs and charts visualizing energy use by calendar month in kBtu and comparing the Recreation Center to buildings of similar types.

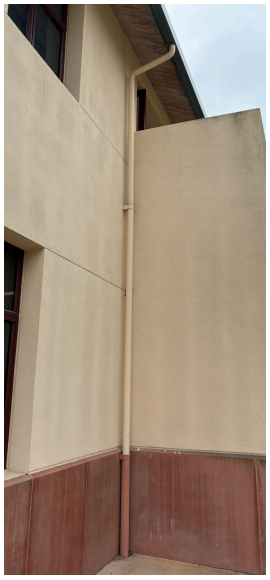
Pre-Existing Building Conditions

Location & Transportation

Slanted permeable concrete tiles.

UCSB's Recreation Center was constructed on a brownfield site that was formerly part of the Marine Corps Air Station Santa Barbara. There are numerous bike racks located right outside the building's main entrance, access to bus stops, and green vehicle infrastructure such as EV charging stations in the parking facilities across Ocean Road. There are also a series of bike paths nearby leading to the building in addition to sidewalks around the building. Lastly, the building is within walking distance of numerous basic services including a bank, convenience store, fire station, laundry mat, library, medical center with a dental office, parks, post office, restaurants, school, theater, and community center.

Sustainable Sites



Roof gutter with a downspout built into the ground

The Recreation Center's site has evidence of numerous sustainable practices such as planting native vegetation including a Coastal Live Oak, and a Greenspot Nightshade. There is also evidence of bioswales located on the outside of the building along the office wing. Additionally, a portion of the outdoor section uses permeable concrete tiles that are slightly sloped, directing water toward the nearest storm drain. Similarly, the courtyard between the office wing and the main gymnasium is angled to facilitate drainage. Furthermore, rainwater from the roof is collected through gutters and directed via downspouts into an underground drainage system. To reduce the heat island effect, the Recreation Center uses light-colored pavements and roofing materials that reflect sunlight. The Rec Cen also mitigates light pollution by using LED outdoor light fixtures that are either pointed down at the ground or are built with a shield on top to angle light downward. However, despite these efforts, the site includes more non-native than native plant species, and a large artificial turf area located between the second gymnasium and the main gymnasium.

Irrigation with reclaimed water

Water

The Recreation Center exclusively uses dual-flush toilets and non-water urinals to conserve water. The dual-flush toilets offer two options: a full flush at 1.6 gallons per flush and a reduced flush at 1.1 gallons. In the locker rooms, showers have a flow rate of 2.5 GPM, while the faucets have an exceptionally low flow rate of 0.25 GPM. Additional fixtures throughout the building include three faucets with a 2.2 GPM flow rate, three with 0.5 GPM, and two with 1.5 GPM. Lastly, there is evidence that the facility irrigates its outdoor landscaping with reclaimed water.

Energy & Atmosphere

The Recreation Center uses window films to maintain indoor temperature efficiency. The pool is equipped with an aforementioned aquatic pump which circulates water according to the time of day, based on the occupancy in the pool for that time, rather than simply pumping full-blast at all hours of the day.[1] Overnight covers are kept on the pools to keep temperatures from dropping too low in order to save energy and reduce daytime heating. Lastly, all indoor lights are LEDs and most fixtures are equipped with time-of-day settings to take advantage of natural daylight in areas with ample window coverage. However, some inefficiencies remain as lights in the office wing remain on at night even when unoccupied, and both weight rooms have all lights on during the day despite having sufficient natural light from windows.

Time of day setting on lights and sufficient sunlight.

Materials & Resources

The Recreation Center has implemented a recycling program, with clearly labeled trash and recycling bins distributed throughout the building. To reduce paper waste, all paper towels have been removed from restrooms and replaced with Dyson Airblade hand dryers. Additionally, all staff are provided with thermos-style reusable containers for hot and cold beverages, helping to minimize the use of disposable cups.[1] The office wing features carpet tiles in all rooms and hallways, contributing to more sustainable flooring practices. Additionally, multiple water bottle refill stations are available, encouraging the use of reusable bottles, helping to reduce plastic waste.

Water refill station with data on plastic water bottles save.

Use of carpet tiles, time of day sensors on lights, and windows in office wing room.

Indoor Environmental Quality

Walk-off mats are placed at every entrance, including those leading to the gymnasiums and weight rooms, aiding in reducing the amount of dirt and dust brought indoors. The Recreation Center features large windows throughout the facility, along with skylights in the main hallway, which maximize daylight harvesting. Each office in the East Wing includes a window, enhancing access to natural light. To promote ventilation, doors to the main gymnasium are typically kept open, and windows in the office wing hallway remain open as well. However, during the summer months, the weight rooms tend to feel stuffy due to high temperatures and poor air circulation, though conditions are generally comfortable the rest of the year.

1. UC Santa Barbara Department of Recreation, https://recreation.ucsb.edu/about

Technical Assessments

LEEDs v4 indoor water use reduction calculator

Recreation Center occupants per day: 2,000 visitors | 200 employees
50% males & 50% females

Days of operation per year: 335 days
Dual-flush toilet average flush rate: 1.35 GPM
Non-water urinal flow rate: 0 GPM
Total daily uses: 1,000 toilets, 600 male urinals

Showerhead flow rate: 2.5 GPM
Public lavatory faucet: 0.25 GPM
Public lavatory faucet: 0.5 GPM
Public lavatory faucet: 1.5 GPM
Public lavatory faucet: 2.2 GPM
Total daily uses: 100 showers, 300 0.25 GPM, 200 0.5 GPM, 800 1.5 GPM, 800 2.2 GPM

Summary

I kept the default values for daily uses of the toilets and urinals because I thought these were accurate. I changed the daily uses for each faucet due to some faucets being placed in higher traffic areas compared to others. The Recreation Center saves about 106, 250 gallons of water per year thanks to the dual-flush toilets. However, due to the highest flow rate faucets being located in the busiest areas the Rec Cen uses about 260,625 gallons of water more than the baseline annual flow volume. This leads to the Rec Cen having a negative percent water use reduction when using the construction rating system. This value is likely more since I was unable to add drinking fountains and water refill stations to my calculations which I presume use an immense amount of water.

Summary for Design and Construction Rating Systems

Note: All information on this tab is READ-ONLY. To edit, see the previous tab(s).

Refresh Groups

Group Name	Baseline Case (gallons/year)			Design Case (gallons/year)		
	Annual Flush Volume	Annual Flow Volume	Annual Consumption	Annual Flush Volume	Annual Flow Volume	Annual Consumption
Group 1	275,000.00	443,750.00	718,750.00	168,750.00	704,375.00	873,125.00

Annual baseline water consumption (gallons/year)	718,750.00
Annual design water consumption (gallons/year)	873,125.00
Percent water use reduction (%)	**-21.48%**

Summary for Operations and Maintenance Rating Systems

Note: Baseline and design volumes are READ-ONLY. To edit, see the previous tab(s).

Unrenovated percentage of fixtures installed before 1995 (%)	0.00%
Renovated percentage of fixtures installed in 1995 or later (%)	100.00%

Refresh Groups

Group Name	Baseline Case (gallons/year)			Design Case (gallons/year)		
	Annual Flush Volume	Annual Flow Volume	Annual Consumption	Annual Flush Volume	Annual Flow Volume	Annual Consumption
Group 1	275,000.00	443,750.00	718,750.00	168,750.00	704,375.00	873,125.00

Annual baseline water consumption (gallons/year)	718,750.00
Annual design water consumption (gallons/year)	873,125.00
Baseline multiplier (%)	120.00%
Water consumption maximum (gallons/year)	862,500.00
Percentage below water consumption maximum (%)	**-1.23%**

ENERGY STAR Portfolio Manager

I entered utility data into ENERGY STAR Portfolio Manager from a 12 month period between 2021 and 2022, all recorded by electricity and gas meters installed on the Rec Cen. At first glance the building uses an immense amount of natural gas during the fall and winter months which tapers off during the spring and summer months. I have concluded this is largely due to the amount of energy it takes to heat the building, pools, and hot tub during the winter months since water has a high heat capacity.

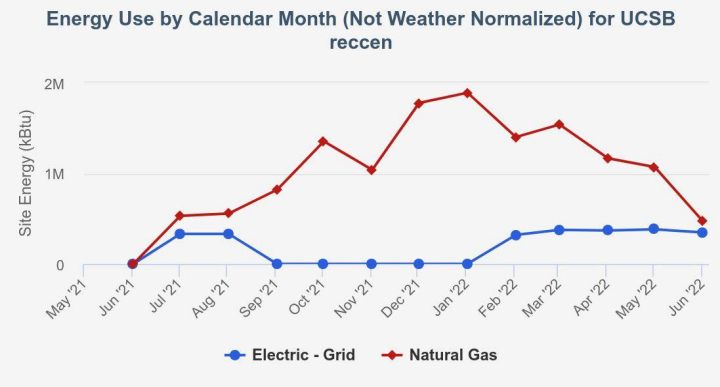


Figure 1. Energy utility data for a 12 month period of the Rec Cen

Comparing the Rec Cen to buildings of similar types it has the same source EUI as other buildings, but it does have a slightly higher site EUI compared to other fitness centers. The source EUI is a measure of a building's energy consumption that considers the entire energy cycle, from the raw fuel source to the end-use. The figure below depicting source EUI makes sense from the Rec Cen's perspective because there are no signs of renewable energy being produced on site which would significantly reduce the source EUI value. However, the site EUI statistics are surprising since UCSB's Rec Cen show's evidence of sustainable practices relating to energy. From my research I believe the reason for the site EUI of the Rec Cen to be slightly higher than similar buildings is due once again to the large pools and hot tub as well as the fact there are no sources of renewable energy on site.

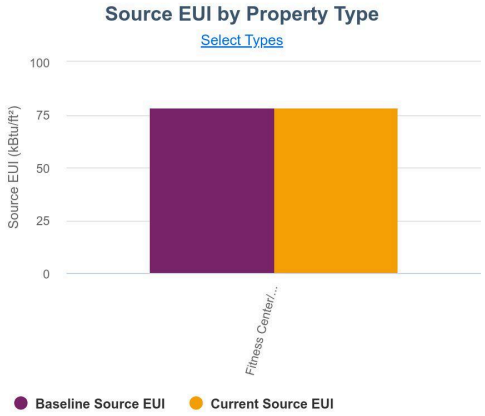


Figure 2. Total energy footprint including raw fuel associated with generation and transmission compared to similar building types

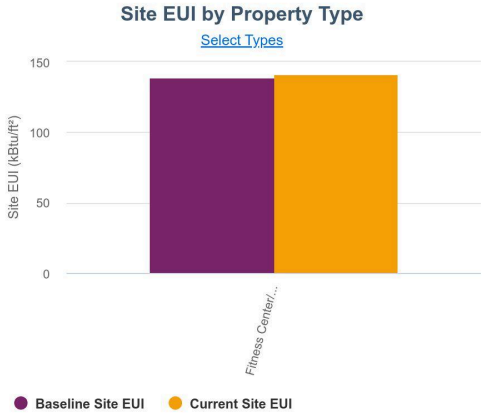


Figure 3. Total site energy reported by utility bills compared to similar building types.

Opportunities for Improvement

Sustainable Sites

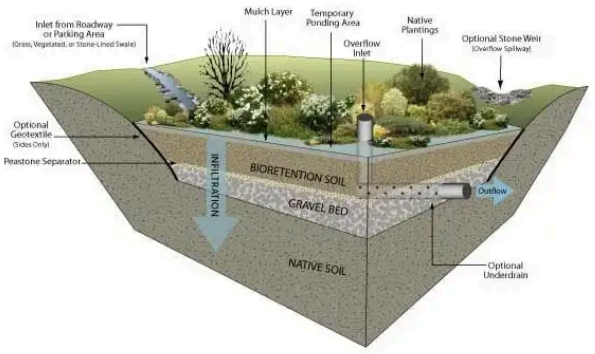


Figure 4. Diagram showing how a bioswale works

The greatest opportunities for improvement relating to sustainable sites include replacing non-native vegetation with native vegetation, replacing the turf area with natural grass, replacing all outdoor pavements with permeable pavements, and adding more bioswales with native vegetation. Replacing non-native vegetation with native vegetation would be a huge outdoor water saving opportunity since native plants are less water intensive than non-native plants.[1] The artificial turf area is a contributing factor to the heat island effect because it retains more heat than natural vegetation, leading to higher surface temperatures. Replacing turf with natural grass will reduce the heat island effect due to evapotranspiration cooling the air as water evaporates from the grass. Adding permeable pavements in place of regular pavement will also combat the heat island effect as well as runoff since water will be able to infiltrate into the ground easier. Lastly, adding more bioswales with native vegetation around the site will aid in reducing runoff and the need to water the vegetation around the storm drain, it also adds an aesthetically pleasing aspect to the building.

Water

To me the water efficiency of the Rec Cen is the most important opportunity of improvement. By doing my technical assessment of indoor water consumption I found that updating all public lavatory faucets to be motion sensored with a 0.25 GPM flow rate is *urgent* in order to have a positive water use reduction percentage. The Recreation Center has already proved it has the ability to install motion sensored faucets with a 0.25 GPM flow rate as they are already in the locker rooms. However that is not good enough as those faucets are not the most used in the building. I recommend updating the 2.2 GPM faucet and 1.5 GPM faucet immediately in order to see positive water saving results as those are the most used and most wasteful in the building.

Energy & Atmosphere

My last important opportunity of improvement relates to the energy and atmosphere sector. The Rec Cen's roof is flat with a large square footage so why not install solar panels to produce renewable energy on site. This would perhaps be the most impactful improvement since it directly affects utility energy usage. Although, this improvement is the most costly and will take time to implement. I believe it is worth the upfront investment since it has been proven to pay off in the long run.[2]

1. UC Agriculture and Resources, https://ucanr.edu/blog/real-dirt/article/native-vs-non-native-plants
2. U.S Department of Energy, https://www.energy.gov/energysaver/articles/5-benefits-residential-solar

Lessons Learned

Conducting this case study awarded me valuable insight into what it truly means for a building to be considered sustainable. It highlighted how the various components outlined in LEED and other green building rating systems work together to create a sustainable site. One of the most unexpected discoveries I encountered in this study was when I used the LEED v4 indoor water use reduction calculator because I did not realize how important faucet flow rates are in terms of reducing water usage. I came across this realization when I compared the striking difference in water volume of a 0.25 GPM flow rate faucet to a 2.2 GPM flow rate faucet. This study has encouraged me to pay closer attention to faucet fixture flow rates when aiming to reduce a building's overall water consumption. Additionally, this study introduced me to new concepts such as bioswales and emphasized the importance of indoor environmental quality. I am grateful for the opportunity to engage in such meaningful research and I look forward to using my newfound knowledge in my future endeavors.