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MATTHEW MILLMAN PHOTOGRAPHY

WATER PETAL CASE STUDY

HAWAII PREPARATORY ACADEMY ENERGY LAB

LOCATION
KAMUELA, HI

TYPE
EDUCATIONAL BUILDING

SIZE
5,092 SQUARE FEET

DAILY OCCUPANTS
25 FULL-TIME, 10 VISITORS

RAINWATER HARVESTED/YEAR
6,593 GALLONS

WATER USE INTENSITY (WUI)
0.84 GALLONS/SF/YEAR

AVERAGE WUI*
11.9 GALLONS/SF/YEAR

CLIMATE
TROPICAL RAINFOREST
23 inches of rain/year
179 days of precipitation/year

**Average WUI by building type according to Seattle 2030 District data*

Water independence and resiliency take on a whole new significance at the Hawaii Preparatory Academy (HPA) Energy Lab. Residents of Hawai'i's Big Island, where the Energy Lab is located, are acutely aware of their dependence on imported fossil fuel for not just electricity, but water pumping and purification as well. Bill Wiecking, the Director of the Energy Lab, wanted to develop a self-sufficient educational facility that encouraged the community to think outside of the box – in regards to water security and beyond. Ken Melrose, the project manager and father to an alumnus of HPA, was the perfect trusted advocate to work with local officials. From a regulatory perspective, there were both benefits and obstacles to working with code officials on the predominately rural island: though many self-sufficient residential developments on the island established some precedent for projects of this type, regulators were reticent to change existing code to accommodate a project intended to serve only a small number of people. Ultimately, however, the project succeeded in permitting a catchment facility for their rainwater and a three-part septic facility to process their grey and blackwater.

SYSTEMS

RAINWATER HARVESTING

The Energy Lab has 6,100 square feet of roof area, used in its entirety to harvest both rain water and condensation. A series of gutters directs the harvested water to a 10,000-gallon cistern located below the west veranda for storage prior to treatment.

STORMWATER MANAGEMENT

Rainwater from the roof is directed into a cistern. The team also added seepage wells to mitigate the increased runoff and decreased infiltration potential resulting from the introduction of impervious roofs and hardscape on site. Site runoff follows the predevelopment drainage pattern, sloping from the north to the southeast.

WATER SYSTEM DIAGRAM

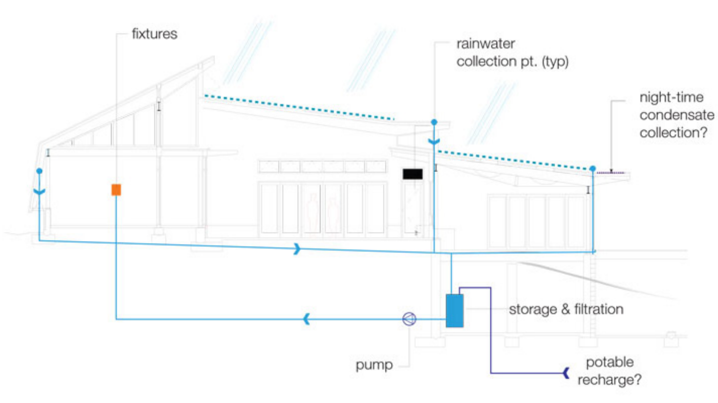

DIAGRAM COURTESY FLANSBURGH ARCHITECTS

WATER PETAL CASE STUDY
POLICY SOLUTIONS

RAINWATER HARVESTING

The Big Island's Board of Water Supply is guided by both geography and topography in its approach to providing safe drinking water to its citizens. Many residents live far away from an organized water supply, so there is more regulatory flexibility around decentralized water sources. However, there are also two active volcanos on Hawai'i, one of which has been erupting continuously since 1983. These active volcanos produce vog, a form of air pollution that results from the combination of sharp volcanic gas and sulphuric acid aerosol. Vog pulls zinc and cadmium out of poorly galvanized steel roofs and lead out of the solder – both materials commonly used in large rainwater catchment systems. In order to address this, local regulations specify that buildings must provide bottled water for occupants if there are more than 80 people using the building.

Even though the Energy Lab intentionally specified materials that are unaffected by vog for their entire catchment system, they were unable to convince local authorities to let them use rainwater as a primary source of potable water. Instead, the catchment system is used as potable water redundancy in the event that the mandated bottled water isn't available. It has since become an emblem of resiliency: their 10,000 gallon cistern can provide water for their students for a year, which may prove crucial for an area that is vulnerable to earthquakes, tsunamis, and hurricanes.

GREYWATER REUSE

The story of greywater in the HPA Energy Lab begins with the aggressive efficiency of water use in the building. Despite the two hundred different students and teachers passing through their space every day, collective demand reaches only eleven gallons of water per day. The project team proposed to use the very small amount of resultant greywater for irrigation and to deal with exterior dust. However, they were precluded from doing so by county regulations that do not allow greywater reuse. In the 1970s, when this regulation was instituted, detergents contained phosphates high in naturally-occurring heavy metals. Greywater infiltration subsequently transferred this toxic burden to food crops, resulting in cases of heavy metal poisoning.

Although these detergents have since been phased out, local regulators were unwilling to revisit this law for such a small project that would impact so few people. Instead, the project team had to add this small amount of greywater to the three-part septic system they were already using for their blackwater.

BLACKWATER TREATMENT

The three-part septic system provides treatment for domestic wastewater and on-site infiltration. The final step is a leach field infiltration system, which disperses the treated wastewater over a larger area. This facilitates an additional degree of treatment from soil biota and filtration as the wastewater percolates through deeper soils prior to recharging the ground water below.

LESSONS LEARNED

The HPA Energy Lab project team learned that regulation is heavily dependent upon local history and context, and that barriers to altering code or attaining variances often result from the inherent conservatism of authorities charged with maintaining high standards of public health and safety. Though the project team was unsuccessful in their pursuit of greywater reuse, they were nonetheless able to find a code-compliant pathway to manage both greywater and blackwater on site. Their effective rainwater catchment strategy and aggressive water efficiency measures ensure that the building is capable of meeting both potable and non-potable demand year-round, without reliance on municipal infrastructure.