



# Rainwater to flush toilets on a volcano

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## Objective:

- Investigate the feasibility of a rainwater collection system to provide for a sustainable source of non-potable or potable water at a potentially isolated solar observatory site (figure 1).

## Introduction:

- The National Center for Atmospheric Research/High Altitude Observatory (NCAR/HAO) proposes to build a solar observatory (Figure 1) comprising a trio of instruments for studying solar coronal magnetism.
- The corona is the source of solar wind with its embedded magnetic field that engulfs the Earth.
- Because changes in solar magnetic fields drive space weather, the ability to measure these changes will help us understand the underlying physical processes and could lead to improved predictions of hazardous effects on Earth related to communications, satellites, space flight, and power transmission.

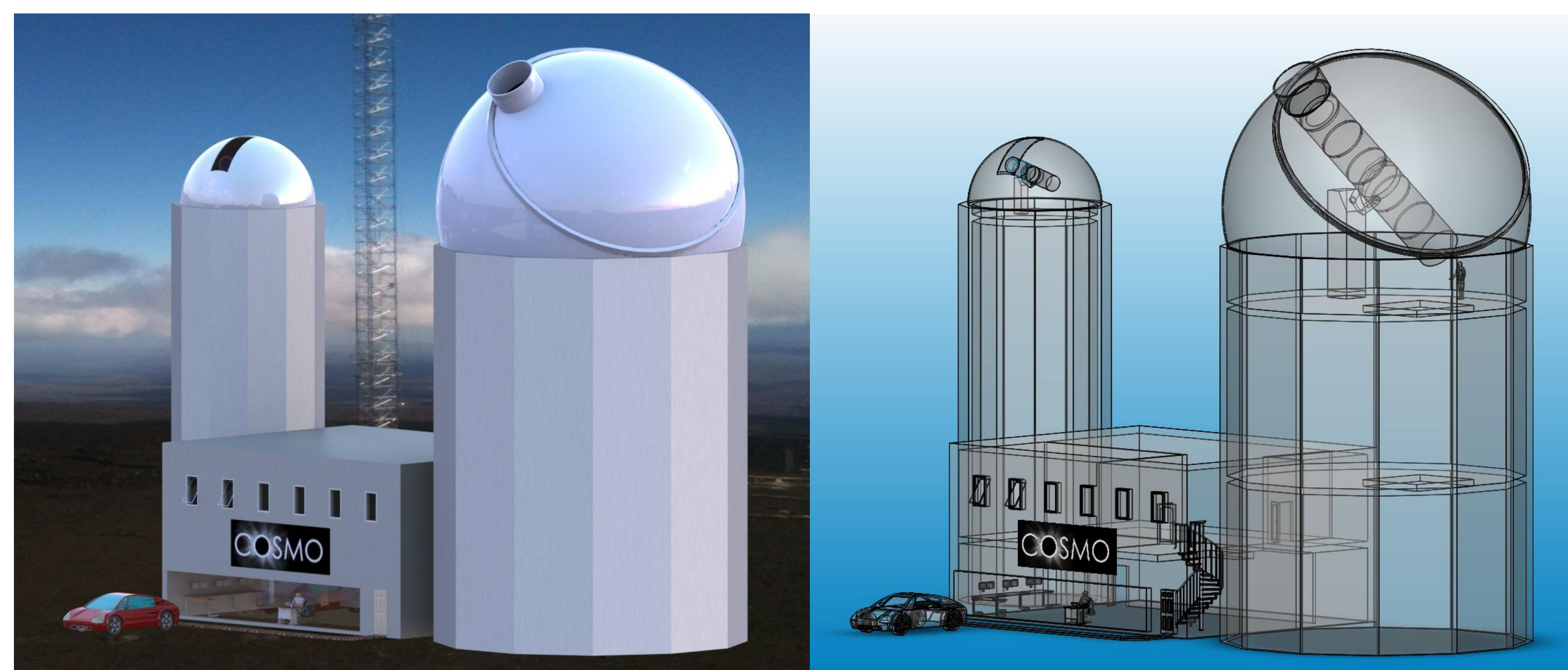


Figure 1: "COSMO" - COronal Solar Magnetism Observatory, a facility for use by the solar physics research community.

- Internal funds from NCAR and the National Science Foundation (NSF) have been awarded to generate a preliminary design for a solar observatory (figure 1) to be built in the state of Hawaii. The effort is cooperative with scientists from the Universities of Hawaii and Michigan as well as the Nanjing Institute of Astronomical Optics and Technology (NIAOT) and the Chinese Academy of Sciences.
- This preliminary design effort studies the feasibility of building COSMO at the existing Mauna Loa Solar Observatory (MLSO) on property owned by the National Oceanic and Atmospheric Administration (NOAA), with the ability to adjust the design to fit other sites in the state of Hawaii or within China.

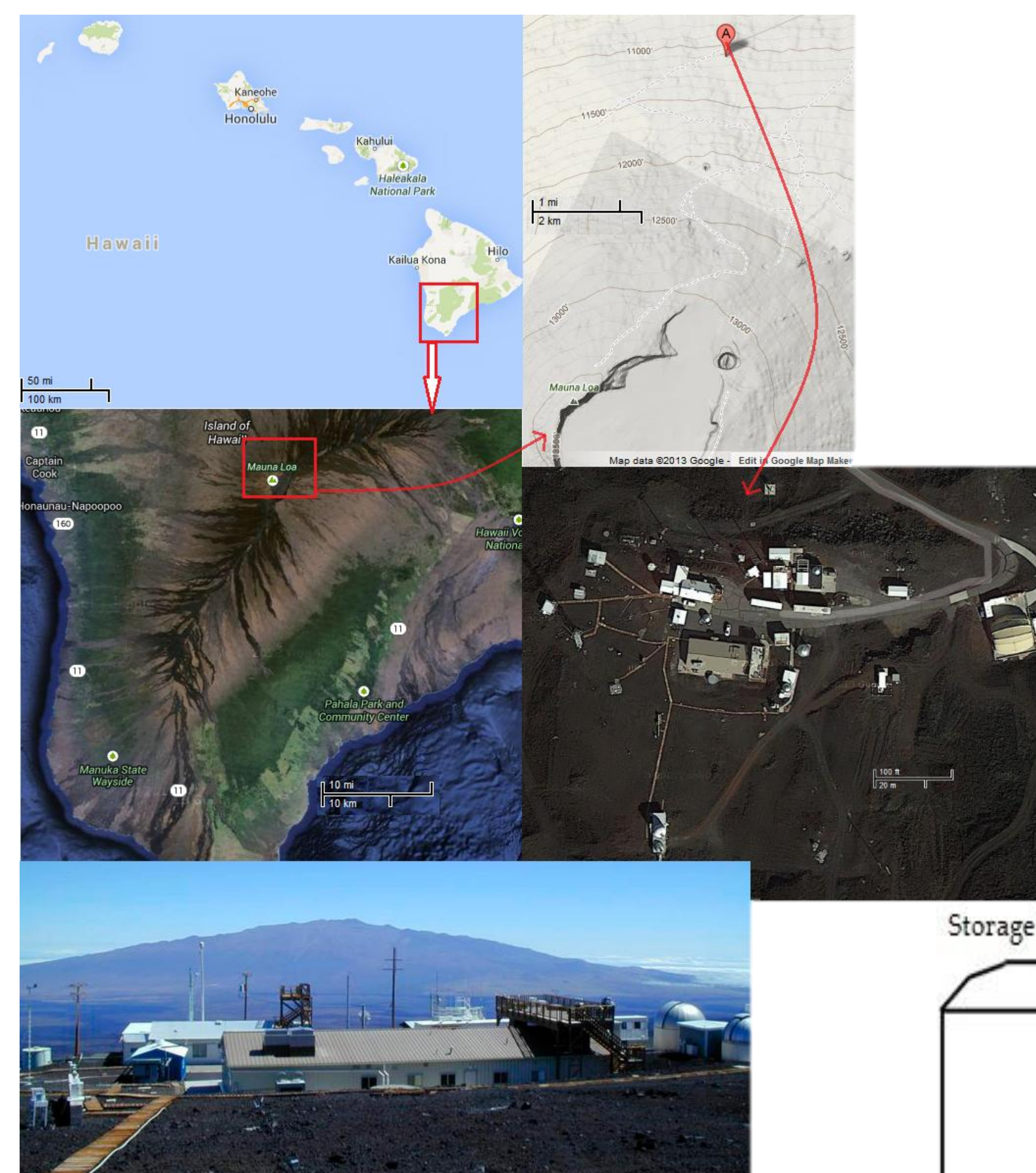


Figure 2: Existing MLSO and NOAA site.

## Design considerations:

- If rainwater is to be collected for potable use food grade materials should be used for collection and storage surfaces. Filtration and disinfection (figure 4) should be included in the system to remove particulate matter (such as volcanic dust at this location) and bacteria from bird, squirrel, or other animal droppings (many locations). Depending on the state or country of the chosen site, potable water may have to meet certain quality standards. Water delivered by truck or municipal source may not be an option at some sites.

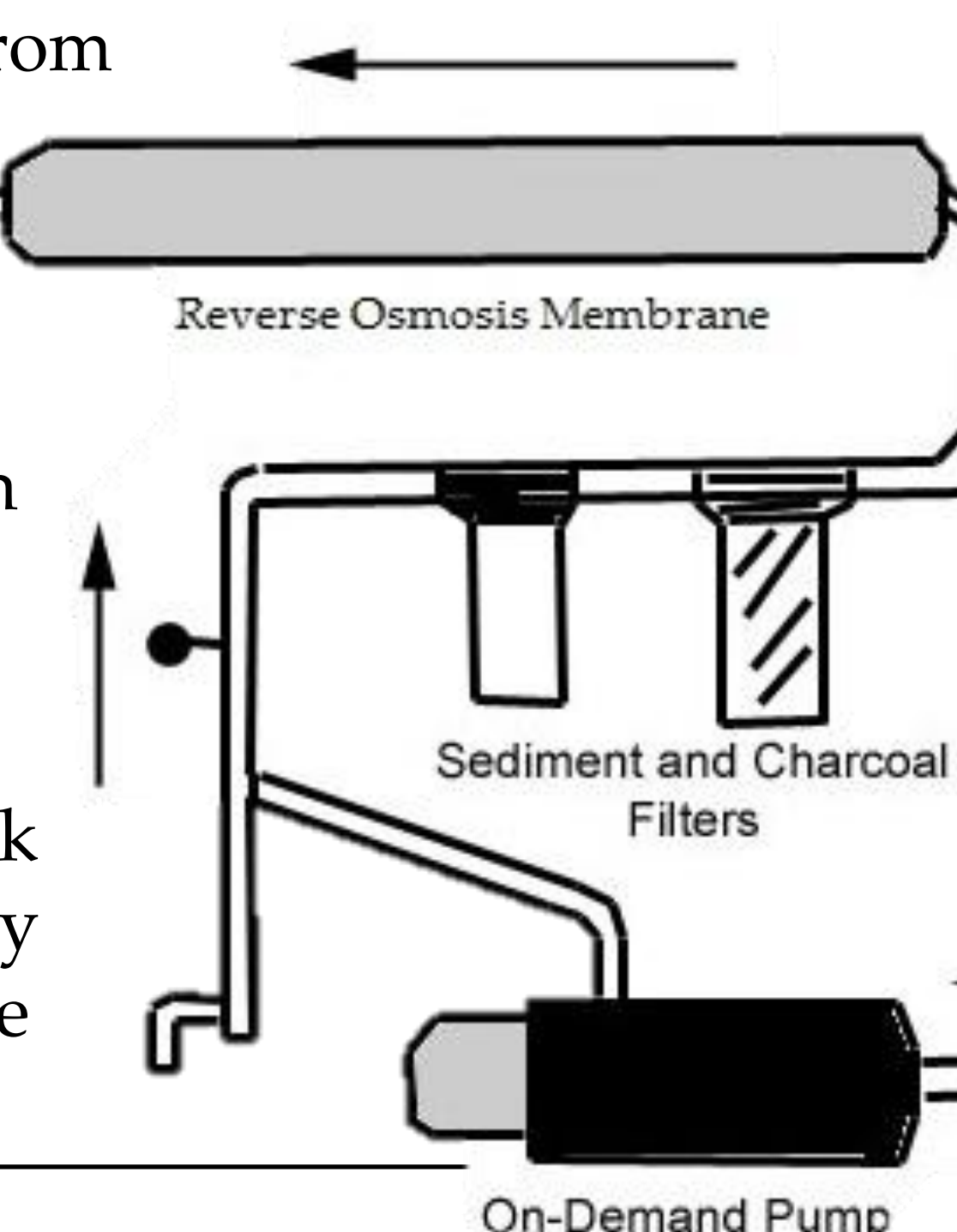


Figure 4: Typical filtration system.

## Water demand and collection estimation:

- Each square foot of collection surface (figure 3) will experience approximately 0.62 gallons of runoff from 1 inch of rainfall ( $12 \text{ in} \times 12 \text{ in} \times 1 \text{ in} = 0.62 \text{ gallons}$ ). Some water will be lost to evaporation, splashing, overflows, and other inefficiencies. Monthly normal rainfall data from 1981-2010 is available from NOAA's Mauna Loa weather station. Demand is estimated based on two observers working on site using water for toilets, sinks, washing instruments, and drinking. Storage (figure 3) is sized to meet water demand through the longest expected interval without rain. Water is collected for storage when rainfall volume exceeds the demand.

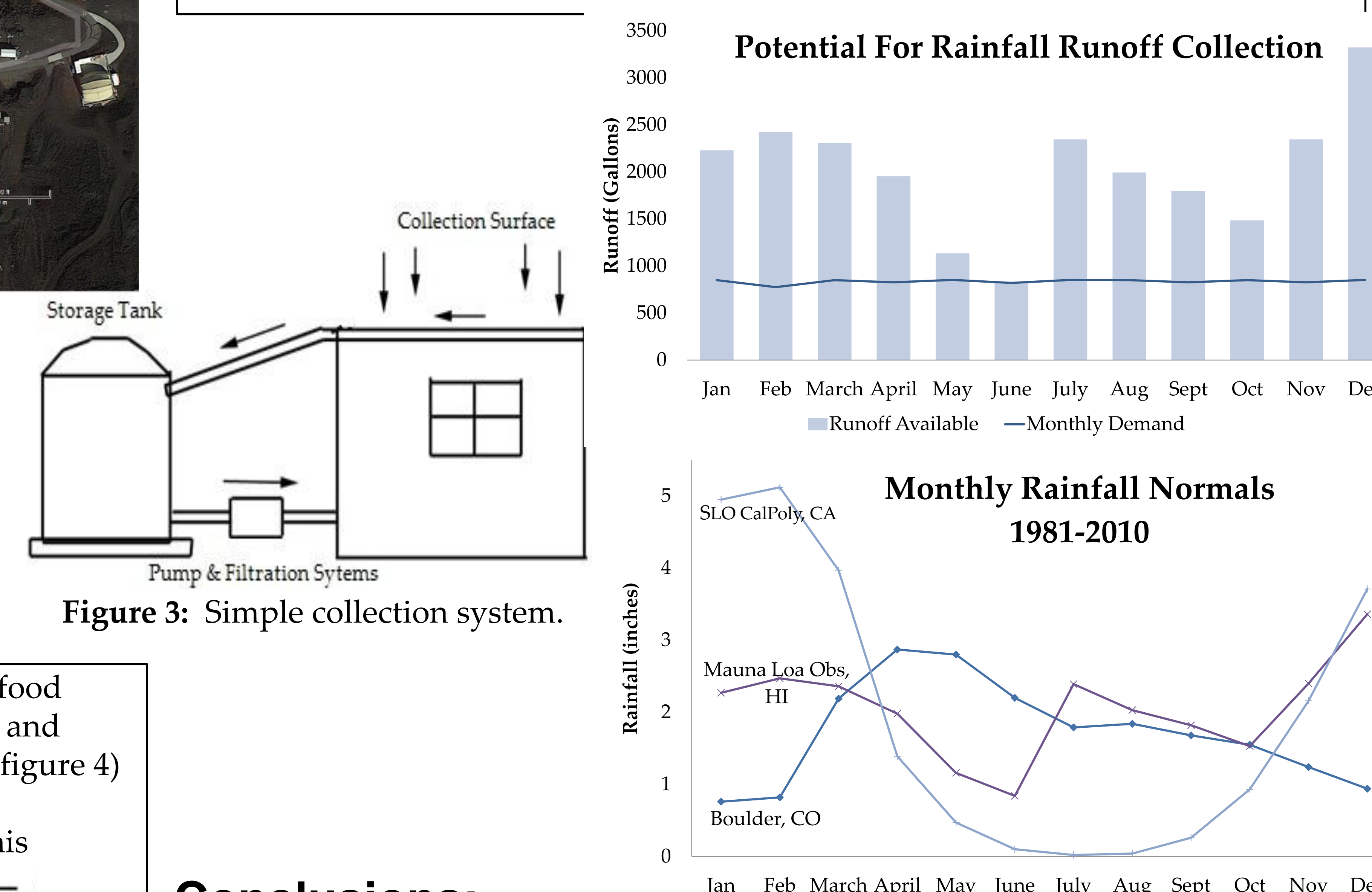


Figure 3: Simple collection system.

## Conclusions:

- The top graph above shows monthly rainfall volumes exceed demand; making collection, storage, and use, feasible at the Mauna Loa COSMO site. A storage tank sized for two months of demand would be reasonable to maintain an adequate water supply during a potential summer drought.

## Acknowledgments:

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This material is based upon work supported by the S.D. Bechtel, Jr. Foundation, National Marine Sanctuary Foundation, Carnegie Corporation of New York, and/or National Science Foundation under Grant Nos. 0952013 and 0833353. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the funders.

The STAR program is administered by the Cal Poly Center for Excellence in Science and Mathematics Education (CESaME) on behalf of the California State University.

