Rainwater Harvesting System Design

The basic design principles of rainwater harvesting systems are:

1. Gravity flow – grades facilitate a smooth transfer of stormwater passively through the water harvesting system to minimize energy input.
2. Simple and low maintenance – easily accessible cleaning at early filtering points in the system to mitigate detritus and silt buildup.

The objective of the rainwater harvesting system is to supply clean, uncontaminated rainwater of low salinity to the plant watering system. The objective of the large storage capacity is to have a three-month buffer against drought. The facility is projected to utilize 89% of the harvested rainwater for the watering requirements of the plant collection and aquatic system, providing a margin for annual rainfall variability.

System Components

The system components are precisely sloped **pipes** connecting **inlets**, **basket filters**, to a **settling tank**, **pump room**, and an array of six 43,000-gallon fiberglass **storage tanks**.

The **pipes** are 8’ diameter high-density polyethylene (HDPE) at 1% slope, except in the latter half of the Q1-Q2-Q3 line, which enlarges to 10” and section F using 4” diameter sloped 2%.

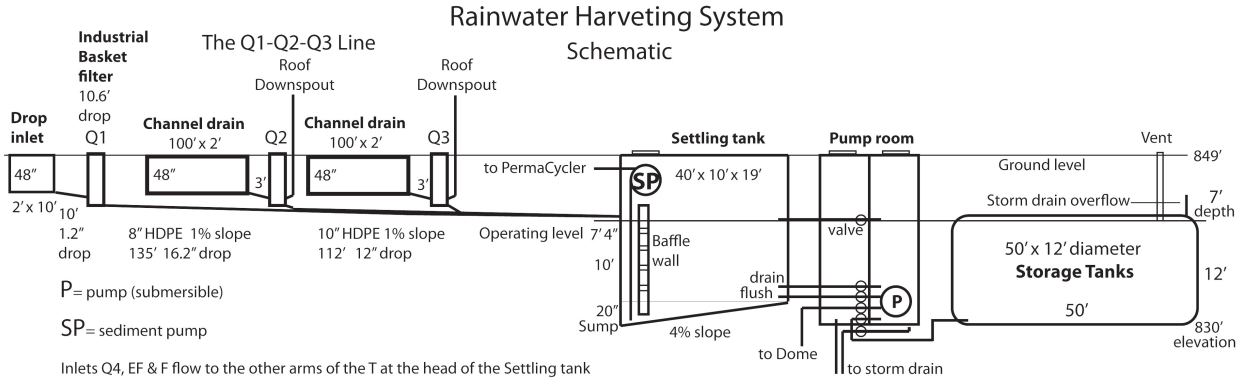
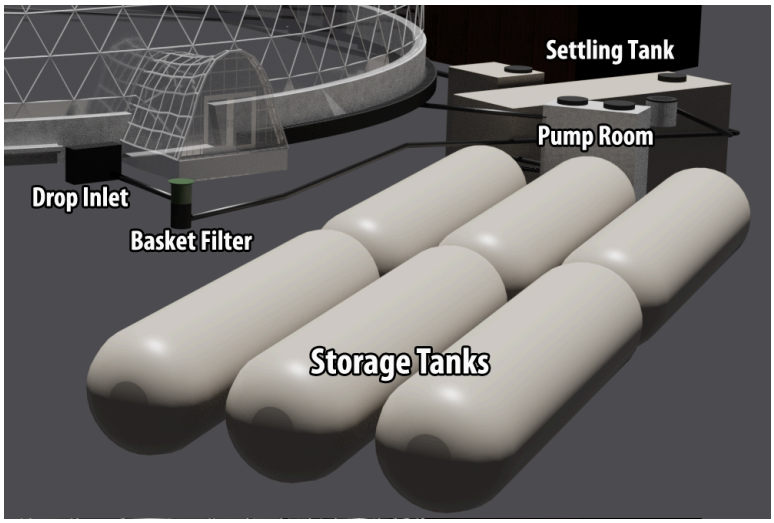


Figure 3 Rainwater harvesting system schematic

The drop **inlets** in Q1 & 4 receive the southern half of the dome’s stormwater from 2’ wide valley gutters, which descend at 4% slope for a 100’ length in each quadrant. The northern half of the dome is encircled by a long 100’ channel drain, 2’wide and bar-grated at the top in each quadrant. Both inlet types have 1% sloped floors and depths at the outlet 6” below the frost line. This allows subsoil temperatures and dome foundation heat loss to melt accumulated snow and ice in the inlet for all-season water harvesting. It is significant for spring thaw flooding that the inlets and channel drains (Q2 & Q3) are pre-melted and ready to receive sudden surges during the first warming spring days.

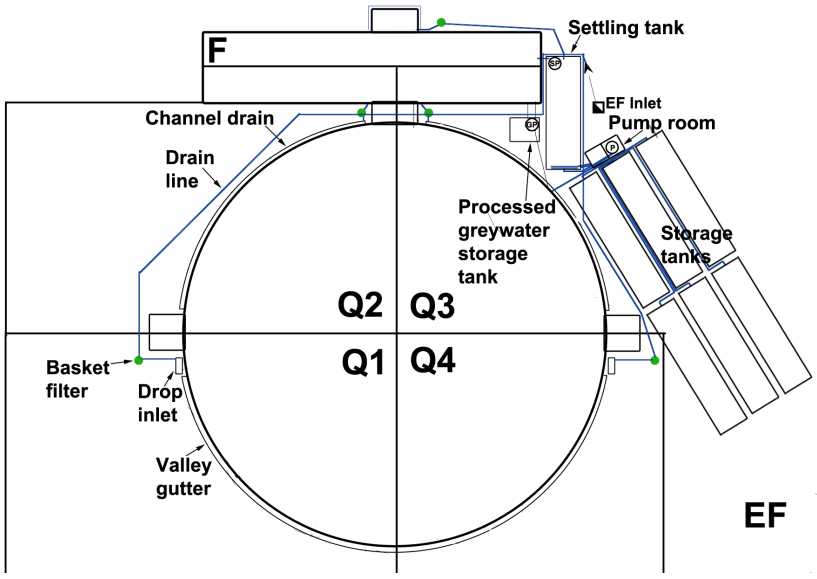
Closely positioned to the inlets are commercial Graf **basket filters**, Industrial-Vehicle loading type, designed for 100% catch with a deep internal screen basket and a loop handle to pull up for regular cleaning. Basket filters in Q2 & Q3 also receive roof rainwater collected from the backside of the north entry building.



The **settling tank** will be 40’ long, 10’ wide, and from 17.3’ to 19’ deep. The flow sedimentation zone volume is 40’ x 10’ x 10’, 29,290 gallons, with a 10’ depth of water above the 20” deep sediment sump. The floor of the tank has a 4% grade down toward the inlet end and sludge pump intake, with overhead manhole access for servicing. The accumulated sediments will be pumped to the Permacycler during flush cycles. The sludge pump will not be submersible.

The **pump room** is a two-compartment, double manhole covered concrete structure going down to a 19-foot depth. The valve room side has the shut-off valves for controlling flow through the system, while the other side is a water chamber containing the submersible pump, which directs water to the dome and/or to flush the settling tank.

The six fiberglass **storage tanks** are 12’ diameter, 50’ long, and 43,000 gallons each.



Graywater Processing

The effluent of the 9 sinks, 2 water fountains, and the janitor station are a lightly contaminated waste stream categorized as graywater. Graywater processing is

bioremediation that uses bacterial and fungal communities to digest biological molecules, to oxidize, precipitate, and sequester heavy metals, to produce an outflow stream from the process that meets hazardous material standards for release into the environment. Occasional flushing of the rainwater harvesting system's settling tank sediments will also be directed into the Permacycler, a welcome enhancer of biological substrates and community members to make the biota more robust. The Permacycler is near the majority of graywater sources, set in the basement below the control room in the north entry building's east end, where it can be gravity fed by the drain lines.

The main component of the graywater processing system is the Permacycler, a tank holding what constitutes a concentrated, biologically active, three-chambered wetland. The EcoIsland LLC MK412 permacycler unit is a 10.5' x 5.5' x 4.5', thermo-welded HDPE flow chamber. It contains coir - coconut hull fiber - as a bio scaffolding and base nutrient matrix for the internal processing microbial biocommunity. It has a 1,200-gallon capacity and operates aerobically at 5 to 95 gpm flow rates. The system is designed to recirculate post-treatment water to maintain a minimum flow through the Permacycler to aid in aeration. If nutrient load were high without recirculation, absorbed oxygen in the water would decrease and the biological community could switch over to anaerobic digestion, with off-gassing of sulfurous vapors or methane. Normally digestion releases CO_2, so the area is actively vented. Once the graywater has been purified, it flows to the 6,000-gallon storage cistern buried outside the building. There, a submersible pump, accessed by a manhole, sends water to the dome and recirculates to the Permacycler.