**Executive Summary:**

The University of Washington Botany Greenhouse is a prime candidate for rainwater reclamation. Capturing rainwater that flows through the existing gutter system and re-routing it to storage tanks located within the confines of the greenhouse would save from purchasing city water, increase the quality of water used for irrigation, save energy currently used to warm irrigation water, and dramatically increase the thermal mass of the enclosed greenhouse space which would save on space heating energy demands. We are requesting**$78,944** to fund this project.

The greenhouse demands approximately 350 gallons of water per day (corresponding to 128,000 gallons of water annually). In order to adequately meet this demand there must be a balance between the quantity of rain falling on the roof and the physical storing capacity of the greenhouse. It turns out that the limiting factor is the storing capacity of the greenhouse. To date there is available space underneath six of the tables to store six, 3ft diameter by 32ft long water tanks, allowing for a maximum storing capacity of 7050 gallons at any given time. These tanks would not impose a spatial burden on the greenhouse and could be connected to existing plumbing systems with relative ease. A volume calculation that took into consideration the average monthly rainfall rates in Seattle (in ft) and the available roof area that projects onto the floor of the greenhouse (in ft^2) gave the volume of rainwater supplied equal to 92,800 gallons/year. This accounts for 73% of the total water demanded, or in other words, 265 days of irrigation (assuming the tanks continuously remain filled to supply the greenhouse with at least a days demand of water) . As stated above, physical restrictions within the greenhouse are limiting the number of tanks to six. However, a year or two from now if it is decided that the rainwater reclamation system is effective enough to warrant an increase in storage capacity, it would be very possible to relocate materials currently located underneath the tables to a new location, freeing space for additional tanks. This proposal focuses on six tanks because it utilizes the space that is currently available, and also because inherent in any rainwater collection system is uncertainty in rainfall rates and overall system functionality. At this point in time 73% is a happy medium between available space, adequate irrigation supply, and reducing overflow potential on a high volume rain day. The Department of Biology, more specifically the UW Botany Greenhouse (managed by Doug Ewing), will be involved with this project.

**Student Involvement:**

This project is simple enough to be handled and managed almost entirely by dedicated students who are willing to put the time and effort into seeing each step through to its entirety. It doesn’t require vast technical knowledge on any one subject and it also provides students with real life project management experience under the supervision of professionals. The students already involved with the project have used their experience as a talking point both in their UW engineering school applications and in a professional interview in which the student was subsequently offered a job. Doug Ewing, the greenhouse manager, is highly knowledgeable with everything relating to the greenhouse and what it needs to run properly. Depending on how much freedom we are granted by facility services, there should be ample opportunity for a number of interested students to help with the installation process as well as routine maintenance checks once the system is in place. Doug will oversee all processes carried out by the students.

**Education & Outreach:**

By publishing this project in the UW Daily the concept of rainwater harvesting will spread throughout the campus and remind students of UW’s commitment to green sustainability. It will also help to inspire other motivated members of the community to work on similar, green-minded projects. If implemented, this system is expected to be visibly successful and beneficial to the greenhouse. Energy and water bills will decrease while plant life health will increase. One of the primary goals of this system is to convince the horticultural community that rainwater reclamation in greenhouses is a realistic and practical solution for plant irrigation, and encourage them to implement similar systems of their own. Furthermore, if approved, the Botany Greenhouse website could include a blurb summarizing the project to all those who visit the site. The cost of the above is negligible. Lastly, to capturing the attention of pedestrians walking by and the 27 classes of students that use the botany greenhouse, a colorful, informative, non-technical sign explaining the project could be placed by the north entrance. Perhaps with the heading “Finally! A Reason to Smile when it’s Raining.”

**Environmental Impact:**

* Energy Use
* Living Systems and Biodiversity
* Water

**Project Longevity:**

**Environmental Problem:**

Thousands of gallons of usable rainwater per year are currently being wasted at the University of Washington Botany Greenhouse. The first benefit of this system is the reduction in city water usage. The proposed system is expected to save the university 92,800 gallons of water/year, with the potential for even more savings further down the road. Rainwater is also healthier for the plants than city water because of its lower pH and reduced TDS (Total Dissolved Solids count). A third advantage is the added thermal mass that the six tanks would bring to the greenhouse. Greenhouses are notorious for heating up quickly when the sun is shining and losing heat when the sun is away. This results in the venting of warm air during the day, and the consumption of energy (steam) at night. Right now there is a deficiency of mass capable of storing heat in the greenhouse. By dramatically increasing the thermal mass of the structure (by adding large tanks of water to the interior of the building), we can reduce both the venting of energy by day and the addition of energy at night. Additionally, since the water from the roof will acclimate to room temperature, it will no longer be necessary to add warm water prior to irrigating. One last, but far from trivial benefit would be the reduction of run-off going into the city sewer system. Seattle faces significant challenges to water-treatment facilities by the fact that our storm water is combined with our sewerage.

**Explain how the impacts will be measured:**

One of the main goals of this project is to spread the concept, methods, and benefits of rainwater harvesting. At this writing, similar systems exist in Seattle but are more focused on turning rainwater into a potable source of drinking water. Very few systems, if any, use rainwater for the irrigation of greenhouse plants. The results of this project will serve as a guideline for systems of a similar nature located in a similar climate. Once the system is in place, a continuous stream of data may be collected and interpreted as the seasons progress. Gallons of city water saved, heating energy saved, plant health before/after implementation, consecutive days with/without rainfall, and with/without the use of city water, etc. This data could then be used as a compelling argument to spread the use of similar systems in various regions around the Northwest.

**Total amount requested from the CSF:**$77,365
**This funding request is a:**Grant
If this is a loan, what is the estimated payback period?:

**Budget:**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

| **Item** | **Quantity** | **Cost/Item** | **Total Cost** |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment & Construction |  |  |  |  |  |  |  |  |  |
| New PVC downspout to tank #1 | 14 | 12 | 168 |  |  |  |  |  |  |
| 3" dia rainwater gutternshoe | 1 | 42 | 42 |  |  |  |  |  |  |
| connect 3" dia down spout to sheet metal gutter | 1 | 25 | 25 |  |  |  |  |  |  |
| connect 3" dia down spout to existing down spout | 1 | 25 | 25 |  |  |  |  |  |  |
| tie into copper piping at side of fertilizer container | 1 | 125 | 125 |  |  |  |  |  |  |
| conduit, wire and disconnections | 1 | 500 | 500 |  |  |  |  |  |  |
| remove and disonnect 2 1/2' sheet metal down spout | 6 | 6 | 36 |  |  |  |  |  |  |
| cap off existing gutter at existing down spout | 2 | 35 | 70 |  |  |  |  |  |  |
| 30" dia pipe in 30" lengths w/ polymer wrap | 180 | 61 | 10980 |  |  |  |  |  |  |
| 30" dia water tight end cap | 12 | 520 | 6240 |  |  |  |  |  |  |
| insterta tee at air vent | 1 | 89 | 89 |  |  |  |  |  |  |
| screen at top of insertia tee | 1 | 50 | 50 |  |  |  |  |  |  |
| drain in retention piping | 6 | 125 | 750 |  |  |  |  |  |  |
| 30" dia pump sump 6'0" deep | 6 | 72 | 432 |  |  |  |  |  |  |
| 2" dia drain to plumb tanks together | 70 | 12 | 840 |  |  |  |  |  |  |
| 2" dia tee | 6 | 20 | 120 |  |  |  |  |  |  |
| 2" dia clean out | 1 | 20 | 20 |  |  |  |  |  |  |
| union | 6 | 18 | 108 |  |  |  |  |  |  |
| connect 2" dia pipe w/ tank adapter | 6 | 22 | 132 |  |  |  |  |  |  |
| Gould's model JR55K 1/2 HP jet pump w/ 13.9 gal tank | 1 | 762 | 762 |  |  |  |  |  |  |
| low level float switch w/ 15' cord | 1 | 73.55 | 74 |  |  |  |  |  |  |
| float WT | 1 | 9.05 | 9 |  |  |  |  |  |  |
| pump restart relay | 1 | 64.65 | 65 |  |  |  |  |  |  |
| shipping and handling from seattle pump | 1 | 75 | 75 |  |  |  |  |  |  |
| saw cut existing concrete slab incl. patching | 72 | 12.5 | 900 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| Personnel & Wages |  |  |  |  |  |  |  |  |  |
| General conditions |  | 20% | 4622 |  |  |  |  |  |  |
| Contractors Overhead and Profit |  | 15% | 4160 |  |  |  |  |  |  |
| Performance Bond |  | 1.3 | 415 |  |  |  |  |  |  |
| Contingency for Development of Design |  | 15% | 4784 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| General Supplies & Other |  |  |  |  |  |  |  |  |  |
| Converting construction cost to total project cost |  | 1.85% | 31176.3 |  |  |  |  |  |  |
| Use of professional plumbers |  |  | 11150 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| Total |  |  | 78944 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

**Non-CSF Sources:**

**Project Completion Total:**$78,944

**Timeline:**

|  |  |  |
| --- | --- | --- |

| **Task** | **Timeframe** | **Estimated Completion Date** |
| --- | --- | --- |
|  |  |  |

**Project Approval Forms:**

 [Putting the Green in Greenhouse Budget\_0.pdf](https://csf.uw.edu/sites/default/files/Putting%20the%20Green%20in%20Greenhouse%20Budget_0_0.pdf)

**Are you ready to submit?:**I have reviewed this submission and I am ready to submit this Project Proposal Application to the CSF Committee for review.