World Water Forum College Grant Program
2017-2019 Grant Proposals

College	USC
Faculty	Dr. Meshkati
Project #020	Capturing Rural Residential Rainwater for Consumption & Irrigation

UNIVERSITY OF SOUTHERN CALIFORNIA

Capturing Rural Residential Rainwater for Consumption and Irrigation

Submitted By:
, Faculty Project Manager
Harrison Getter, Student Project Manager, President of USC Engineers Without Borders

Project Strand:
Global (Guatemala)

Submitted December 2017

2. Project Summary

Project Title: Capturing Rural Residential Rainwater for Consumption and Irrigation
Name of College/Department: University of Southern California, Viterbi School of Engineering/ Engineers Without Borders
Faculty Project Manager:
Student Project Manager: Harrison Getter
Project Strand: Global (Guatemala)

Working with the NGO Common Hope, USC Engineers Without Border's Chapter has implemented a water purification system in the Common Hope Family Development Center outside Antigua, Guatemala. However, there remains as of yet an insufficient supply of water for both irrigation and consumption for the 7,000 people living on the campus. Guatemala receives a considerable amount of rainwater for half of the year, and practically no rainwater for the other half. During the dry season, access to water is limited, with reliance on local streams and ponds for drinking water. Our project hopes to implement a rainwater harvesting system that will successfully capture, filter and store rainwater for extended periods of time to aid the campus during the dry season. The water will be consumed and used for irrigation purposes. Two trips to Antigua are planned as part of this project. The first will be an assessment trip in Spring of 2018 to survey the campus, better understand the problems and needs of those living there, and assess how best to implement the project. The second trip will be the implementation trip in Winter of 2018 in which the rainwater harvesting system will be fully implemented.

3. Contact Information

	Name	Address	Telephone	Email
Faculty Project Manager	Najmedin Meshkati	5000 N Parkway Calabasas, Suite 307 Calabasas, California 91302	213-740-8765	meshkati@usc.edu
Student Project Manager	Joshua Neutel and Sabrina Albrecht	3650 McClintock Ave, Los Angeles CA 90089	925-222-0667 925-587-3144	jneutel@usc.edu, salbrech@usc.edu
College	University of Southern California, Viterbi School of Engineering	3650 McClintock Ave, Los Angeles CA 90089	213-740-4530	ewb@usc.edu
Department	Engineers Without Borders, USC Chapter	3650 McClintock Ave, Los Angeles CA 90089	339-225-2004	ewb@usc.edu

Overview/History

The University of Southern California is a private research university established in 1880 in the heart of Los Angeles. The oldest private research university in California, USC was founded with the purpose of furthering the "development of human beings and society as a whole through the cultivation and enrichment of the human mind and spirit." With 19,000 undergraduate students and 24,000 graduate students across 17 schools, USC has consistently been ranked and regarded as one of the premiere universities in the United States.

There are currently five Nobel Laureates, eight Rhodes Scholars, five MacArthur Fellows, and one Turing Award winner on staff at USC. In addition, the university has produced

the most Oscar winners of any other institution in the world by far. The university is highly involved in research with $687 million in sponsored research in 2015. Among the 3,249 full-time faculty, 17 are members of the National Academy of Engineering, 15 members of the National Academy of Sciences, and 17 members of the Institute of Medicine. With two National Science Foundation funded research centers, the Integrated Media Systems Center and the Center for Biomimetic Microelectronic Systems, USC continues to be a world leader in research across all fields.

The Viterbi School of Engineering, named in 2004 after Andrew Viterbi, founder of the Viterbi algorithm and co-founder of Qualcomm Inc., is an innovative and elite engineering school that fosters an environment of advanced learning and change. The main creed of Viterbi is the idea of Engineering+. It is the idea that engineer cannot simply be engineer. In order to make an impact on the world for the better, an engineer must use engineering combined with other subjects. The education at Viterbi is designed to synthesis an engineer's education with that of other subjects that provide context to their work. Electrical engineering is taught alongside astronomy. Computer science is taught alongside psychology. The fusion of these different disciplines allows Viterbi students to become world leaders and innovators through gaining a greater understanding of their work's place in society as a whole. It is this leading philosophy that has led to Viterbi being one of the leaders into tackling the National Academy of Engineer's 14 Global Grand Challenges, fundamental problems that must be addressed for the betterment of all mankind.

Engineers Without Borders is an organization dedicated to building a better world through engineering projects "that empower communities to meet their basic human needs and equip leaders to solve the world's most pressing challenges." The USC chapter of EWB has more than exemplified this mission statement. Last summer, the club implemented a water purification system in the Common Hope campus in Antigua, bringing cleaner water to over 7,000 people. The club has also completed projects designed and built implementing a water collection and storage system in Honduras. Currently, the club is working on a project implementing a rainwater system in Antigua Guatemala, and another one creating a mill in a Kenyan village. Throughout its short existence, the USC chapter of EWB has made a massive impact on communities all around the world.

Make Check Payable To:	Engineers Without Borders USC
Address	3650 McClintock Ave, Los Angeles CA 90089
Phone	(Viterbi USC phone number)
Email	ewb@usc.edu

4. LETTER OF SUPPORT

Los Angeles Department of Water & Power

ERIC GARCETTI
Mayor

Commission
MEL LEVINE, *President*
WILLIAM W. FUNDERBURK JR., *Vice President*
JILL BANKS BARAD
CHRISTINA E. NOONAN
AURA VASQUEZ
BARBARA E. MOSCHOS, *Secretary*

DAVID H. WRIGHT
General Manager

December 4, 2017

Ms. Benita Lynn Horn, Principal Public Affairs Representative
The Metropolitan Water District of Southern California
700 North Alameda Street 10th Floor – Room 322
Los Angeles, CA 90013

Dear Ms. Horn,

The Los Angeles Department of Water and Power is happy to provide this letter of support for the University of Southern California's (USC) Chapter of Engineers Without Borders (EWB) application for the 2015-2017 World Water Forum (WFF) College Grant Program.

The Los Angeles Department of Water and Power is very supportive of the USC EWB's effort to install an innovative rainwater harvesting system for a village in Guatemala. Once completed, the knowledge gathered from the actual implementation of this system will provide valuable insight into the use of similar systems in Los Angeles.

Sincerely,

David Jacot, P.E.
Director of Efficiency Solutions
Los Angeles Department of Water and Power

LADWP's Efficiency Solutions - Helping LA save Water and Energy

Cc:

Amir Tabakh, PE

Dale Thompson, PE

Putting Our Customers First

111 N. Hope Street, Los Angeles, California 90012-2607 *Mailing Address:* Box 51111, Los Angeles, CA 90051-5700
Telephone (213) 367-4211 www.LADWP.com

5. CERTIFICATE OF ATTENDANCE

Certificate of Participation

presented to

SPENCER GILBERT

USC ENGINEERS WITHOUT BORDERS

Thank you for participating in the

Southern California World Water Forum
College Grants Program on Innovative Conservation Technology, Communication and Policy.

October 13, 2017

worldwaterforum

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

SANITATION DISTRICTS OF LOS ANGELES COUNTY
Converting Waste Into Resources

water for people

6. PROJECT DESCRIPTION

1. Our project touches two water related issues. By creating a rainwater collection system for Common Hope's Antigua site, we will both be generating water for their agricultural needs, plus we will be conserving their drinking water as they will not need to use their drinking water in order to perform farming and landscaping. Currently the only water the community has access to is water from a well which goes through a purification system we implemented last summer. By using that system to generate water for agriculture they are limiting the lifetime of their filters, therefore hindering the community's ability to sustainably provide clean water.

2. This is a global project as it will take place in Antigua, Guatemala.

3. As this project involves actual implementation of a rainwater harvesting and storage system, it falls under the technology strand.

4. Our group will travel to Antigua, Guatemala in order to collect data at the Common Hope site. The data will help us in creating a rainwater collection system that best suits the needs of the site. The data will then be brought back to Los Angeles where we will work with our engineering mentor, Peter Kraut, in order to design a rainwater collection system. Our system is divided in three parts: the rainwater collection system, the storage system, and the distribution system. The data we need is summarized below.

   Collection system data:

   a) *Monthly/yearly rainfall* (needed to calculate the amount of water collected on average)*;*
   b) *Current storage systems* (used to design a new storage tank). This includes: How much water can be held? How long can it be held for? Average temperature of stored water Which chemicals can be found in the water as a result of the current systems? What happens during a power outage or when water is low? How much water is used by the community on a daily/weekly basis? Dimensions of current tank, as well as access, inlet and outlet conditions;
   c) *New storage systems* (needed to guide the design of new storage tanks). This includes: The amount of available space (land) for storage tanks; Any possible site constraints present that might limit the location of the storage tank, that is, site constraints that could determine whether storage tank should be either above or below ground; The rock/ground quality at possible sites that an underground storage system can be implemented
   d) *How much water is collected by collection system* (needed to calculate the amount of water being collected and to guide possible modifications). This includes: The flow

rate of the water into the system; The amount of water collected per minute; Current piping composition and state of use

e) *Materials being used* (needed to design a new storage tank). This includes: Prices and durability; Above or below ground; Availability of local vendors that can sell materials to physically implement the tanks
f) *Parameters that will determine the water budget* (needed to determine the water budget). This includes: Square footage for all roof areas in which water will be collected from; Roof conditions - their cleanliness and what material they are made out of; Seasonal factors and how the climate and rainfall varies from month to month; Area of the land that needs to be irrigated, and how much water will be necessary to properly sustain these crops
g) *Identify the anticipated use of the water* (needed to determine the amount of water treatment required). This includes: Whether the harvested rainwater would be used immediately or stored for later use; The type of crop to be irrigated since that determines the amount of water that is needed to be supplied. Especially note if the crops are for consumption.
h) *Filtration needs.* This includes: The type of crops that are planted and what level of water quality is needed to maintain these plants in a healthy way; The vendor options, such as who would be able to supply these filters.

Storage system data:

a) This includes: The number of available storage tanks; Location of collection points; Square footage of each tank/total water storage available; Quality and types of gutters; Layout of campus/see how much space available; Amount of water each gutter can hold (runoff or overflow factor); Square footage of roof/size of the buildings; Location of the peak of the roof; Location of water runoff; Composition of ground underneath the basketball court on campus; Location of downspout; Square feet of garden; Gallons of water needed for the garden (monthly); Type of garden that the citizens want (ex. vegetable garden); Tank capacities and initial tank volume; Average rainfall monthly; Rules for rainwater collection for Antigua; Will sun hit the stored water? If so, what kind of algae problems will develop; How to create below surface piping to prevent ripples from forming in the water

Distribution system data:

a) Create a map of the water usage area by measuring the distance from the storage unit to the area, the square footage of the watered area, and the distance between the areas being watered.
b) Collect data to determine the volume of water needed by the community by recording crops and asking locals about their upkeep.
c) Conduct interviews with people to determine the kind of distribution system and how much works best for them, also what times and how frequently they want to water.

d) Research laws online for Antigua to ensure there is no restriction on rain water usage, ensure legality of using water once touching the ground.
e) Conduct interviews to determine safety standards that are tolerable for the people at Common Hope, EWB, and the community.

5. In the short term, we expect our research to allow us to design the optimal rainwater collection system for Common Hope community. In the longer term, we hope to implement this system either in the summer or the winter of next year.

6. For the 5,321 people directly impacted, that number is composed of 1500+ students, their families, and the many social workers/ volunteers/ and other employees of Common Hope. As for the 8,118 people indirectly affected, this number includes other members of the Antigua community who would benefit from the extended lifetime of the filters as clean water would be more widely available.

7. Our travel team is chosen 4-6 weeks prior to the trip. This is because our club hosts a large number of people, however only a select few are able to come on the trip. The members of the club apply to come on the trip. Those that are the most dedicated and who display the most technical knowledge are invited to come. These students make up the bulk of the travel group. They normally do not have any technical experience or knowledge. However these members mainly act as constructionists and bodies for manual labor, not engineers. Thus verbose technical knowledge is not necessary in order perform well. That being said, some technical knowledge of our system is needed. Because these students were the most dedicated in helping to fill out the necessary paperwork and perform research on the system, they have the most technical knowledge on the project. Plus, before coming on the trip all members are provided with all the information they would need in order to be a useful asset on the trip.

   That being said, there are three members of the travel crew that are already certain. First, there are the two project managers: Joshua Neutel and Sabrina Albrecht. These two students are on the Executive Board of the club and lead the other students in order to fill out all required paperwork. They also facilitate communication between Engineering Without Borders, Common Hope, our engineering mentor, and our club. These two know every detail of the system and help ensure that all tasks are delegated and completed given the small amount of time we have in Guatemala.

   Finally, there is our engineering mentor, Peter Kraut. Peter is a licensed engineer with his own small engineering firm. Peter specializes in plumbing engineering, making him the perfect mentor for our club as we often perform water related projects. Peter and his team design the projects hand in hand with us. They help us learn what it means to be an engineer, but at the end of the day we allow them to design the system because we do not have the expertise to do so. Peter travels with us to Guatemala and is an asset on the field. He has multiple year in construction experience and teaches the newer students the practical skills they need. He also works closely with the project managers to generate a list of tasks, schedule them, and delegate them amongst the group.

8. The projected timeline for the project goes as follows:
   December 16th: Team must submit assessment trip documents to Engineering Without Borders for review. This document summarizes all that will be accomplished on our assessment trip, which is essentially a trip where we collect all necessary data in order to design our system.
   February 16th: Team plans to travel to Guatemala to perform the assessment trip.
   April 13th: Team must submit post assessment trip documents to Engineers Without Borders- USA, summarizing all the data we collected and everything we have learned. We plan on submitting much earlier to leave time to work on our implementation document.
   May 30th: Team must submit Implementation Trip documents to Engineering Without Borders. This is the document that summarizes our design plans and our plan for operations and maintenance of the system.
   August 13th: Team plans to travel to Guatemala in order to implement our system.

7. IDENTIFYING QUANTITATIVE BENEFIT PROJECTIONS

PERFORMANCE MEASURE	**QUANTITATIVE OUTCOME**	**LOCAL/GLOBAL IMPACT**
Makes More Water Available	Acre Feet/ Year	Local/ Global
Reduces Water Treatment Costs	$/ Year	Local
Reduces Per Capita Use	Gallons/ Capita/ Day	Local
Provides Technical Training	# of People	Local/ Global
Provides Water Conservation and/or Hygiene/ Public Health Education	# of People/ Students	Local/ Global
Improves equitable access to fresh drinking water and/or sanitation practices (e.g. by improving water quality)	# of People	Local/ Global
Improves the environment and sustainability benefits for people	5,321 people directly impacted and 8,118 people indirectly impacted	Global
Cost associated with each of the physical quantitative outcomes above	$/person, $/AF/year and Gallons/Capita/Day	Local/ Global

8. FINANCIAL CRITERIA

DESCRIPTION	**AMOUNT**	**NOTES**
GRANT FUNDS REQUESTED	$10,000	
ADDITIONAL SOURCE OF FUNDS (List all, if applicable)	$20,600	DATE ISSUED (if applicable) *see paragraph below
PROJECT TOTAL	$30,600	

*Our funds will come from a variety of fundraising efforts from past years as well a partnership with the NGO Common Hope where, per Engineers Without Borders guidelines, they contribute at least 25% to each project (which in this case would be $7,650). As this percentage has yet to be confirmed and the parts have not been purchased yet, there is currently no “Date Issued” for these funds.

9. BUDGET BREAKDOWN

	COMPUTATION					
BUDGET ITEM DESCRIPTION	**PRICE/RATE**	**UNIT**	**QTY**	**WWF**	**College**	**TOTAL COST**
SALARIES AND WAGES						
SUBTOTAL						0
TRAVEL						
Airfare\ Lodging (not allowed)						
SUBTOTAL						0
SUPPLIES/ MATERIALS						
5000 gallon underground tanks	**$2,500**	**each**	**6**			**$15,000**
submersible irrigation pump	**$400**	**each**	**6**			**$2,400**
controls, filters, appurtenances	**$250**	**each**	**6**			**$1,500**
3" sch 40 PVC pipe and fittings	**$6.00**	**ft**	**800**			**$4,800**
1 1/2" sch 40 PVC pipe and fittings	**$1.50**	**ft**	**400**			**$600**
1 1/4" sch 40 PVC pipe and fittings	**$1.25**	**ft**	**400**			**$500**
1" sch 40 PVC pipe and fittings	**$1.00**	**ft**	**200**			**$200**
drip tubing and emmiters	**$3.00**	**ft**	**1200**			**$3,600**
SUBTOTAL						**$28,600**
CONTRACTUTAL/ CONSTRUCTION						
Electrician	**$2,000**	**estimate**	**1**			**$2,000**
Excavation by Common Hope	**$0**	**volunteer**	**1**			**$0**
Plumbing by EWB	**$0**	**volunteer**	**1**			**$0**
						$0
SUBTOTAL						**$2,000**
TOTAL DIRECT COSTS:						**$30,600**
TOTAL ESTIMATED PROJECT COSTS						**$30,600**

10. SIGNATURE BLOCK (SIGNATURES INCLUDED WITH PHYSICAL VERSIONS)

14. SIGNATURE BLOCK

	NAME / TITLE	SIGNATURE	DATE
Faculty Project Manager			
College Contracts Officer / Administrator			
Student Project Manager			

Local Water Agency / Member Agency Representative
Note: An original signature is not required; refer to the shaded box IN Section 8.
Please send the member agency representative a one-page overview. Do not send the entire grant application, unless the agency representative requests the full document.

Name of Local Water / Member Agency	
Name of Contact Person	Job Title
Signature	Date