



Document 521 PRE-ASSESSMENT REPORT

CHAPTER: Worcester Polytechnic Institute

COUNTRY: Guatemala

COMMUNITY: Guachthu'uq

PROJECT: Rainwater Harvesting

TRAVEL DATES: May 2nd - May 15th

PREPARED BY
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March 10, 2013

ENGINEERS WITHOUT BORDERS-USA
www.ewb-usa.org

Pre-Assessment Report Part 1 – Administrative Information

1 Contact Information

Project Title	Name	Email	Phone	Chapter Name or Organization Name
Project Leads	Thomas Moutinho	Tjmoutinho@wpi.edu	207-831-7011	EWB-WPI
President	Alexandra Vresilovic	Avresilovic@wpi.edu	518-265-8234	EWB-WPI
Mentor #1	Michael Reiter	Michael.Reiter@pw.utc.com	860-748-3445	EWB-HPC
Mentor #2	Matthew Gamache	GamacheM@cdm.com	857-389-2170	EWB-WPI
Faculty Advisor (if applicable)	Laureen Elgert	Lelgert@wpi.edu	508-450-3313	EWB-WPI
Health and Safety Officer	Jessie Ciulla	Jmciulla@wpi.edu	781-987-4139	EWB-WPI
Assistant Health and Safety Officer	Thomas Moutinho	tjmoutinho@wpi.edu	207-813-7011	EWB-WPI
Education Lead	Sebastian Vergara	Severgara@wpi.edu	401-256-7926	EWB-WPI
NGO/Community Contact	Sucy Ical Lem	Cecep@inteln.net.gt	502-7950-4039	CeCep

2 Travel History

Dates of Travel	Assessment or Implementation	Description of Trip
7.20.10 - 8.3.10	Assessment	First trip for health surveys, water sampling and meetings with community members and town officials

7.23.11 - 8.7.11	Assessment	Collected more data on water consumption, existing rainwater harvesting practices, and developed a memorandum of understanding with the community
12.31.12 - 1.10.12	Implementation	Implemented pilot rainwater systems in two homes, began the setup for monitoring and worked to revise the MOU

3 Travel Team (Should be 8 or fewer):

#	Name	E-mail	Phone	Chapter	Student or Professional
1	Caryn MacDonald	cemacdonald@wpi.edu	781-413-7700	EWB-WPI	Student
2	Jessie Ciulla	jmciulla@wpi.edu	781-987-4139	EWB-WPI	Student
3	Thomas Moutinho	tjmoutinho@wpi.edu	207-831-7011	EWB-WPI	Student
4	Sebastian Vergara	severgara@wpi.edu	401-256-7926	EWB-WPI	Student
5	Michael Reiter	Michael.Reiter@pw.utc.com	860-748-3445	EWB-HPC	Tech Mentor
6	Laureen Elgert	Lelgert@wpi.edu	508-450-3313	EWB-WPI	Faculty Mentor

4 Health and Safety

The EWB-WPI travel team will follow the site-specific HASP that we have prepared for this project site. The 600 - HASP form has been sent with this form.

5 Monitoring - Identify Projects to be Monitored on this Trip

Project Type	Project Discipline(s)	Date of Completion
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		(m/d/y)
Rainwater Harvesting	Individual rainwater harvesting systems	Not yet completed

6 Budget

1 Project Budget

Project ID: 6871

Type of Trip: A

Trip type: A= Assessment; I= Implementation; M= Monitoring & Evaluation

Trip Expense Category	Estimated Expenses	
Direct Costs		
Travel		
	Airfare	4200
	Gas	0
	Rental Vehicle	0
	Taxis/Drivers	1000
	Misc.	0
	Travel Sub-Total	\$5,200
Travel Logistics		
	Exit Fees/ Visas	0
	Inoculations	0
	Insurance	0
	Licenses & Fees	0
	Medical Exams	0
	Passport Issuance	0
	Misc.	0
	Travel Logistics Sub-Total	\$0
Food & Lodging		
	Lodging	550

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TOTAL	\$9,400
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1 Program QA/QC
Assessment = \$1,500
Implementation = \$3,675
Monitoring = \$1,125

EWB-USA National office use:

Indirect Costs

EWB-USA

Program Infrastructure (2) See Below \$500

Sub-Total \$500

TRIP GRAND TOTAL (Does not include Non-Budget Items) \$9,900

2 Program Infrastructure
Assessment = \$500
Implementation = \$1,225
Monitoring = \$375

Non-Budget Items:

Additional Contributions to Project Costs

Community

Labor 0

Materials 0

Logistics 0

Cash 0

Other 0

Community Sub-Total \$0

EWB-USA Professional Service In-Kind

Professional Service Hours 0

Hours converted to \$ (1 hour = \$100) \$0

Professional Service In-Kind Sub-Total \$0

TRIP GRAND TOTAL (Includes Non-Budget Items) \$0

Chapter Revenue

<i>Funds Raised for Project by Source</i>	Actual Raised to Date
Source and Amount (Expand as Needed)	
Engineering Societies	
Corporations	1500
University	
Rotary	
Grants - Government	
Grants - Foundation/Trusts	
Grants - EWB-USA program	8000
Other Nonprofits	
Individuals	800
Special Events	
Misc.	
EWB-USA Program QA/QC Subsidy (3) See below	1,500
EWB-USA Program Infrastructure Discount Amount	
Total	\$10,300

Remaining Funds Needed	\$0
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3 Program QA/QC & Infrastructure Subsidy:
Assessment = \$1500
Implementation = \$3,900
Monitoring = \$1,000

2 Donors and Funding

Donor Name	Type (company, foundation, private, in-kind)	Account Kept at EWB-USA?	Amount
Pratt and Whitney	Grant	yes	8,000

Total Amount Raised:			8,000

7 Project Discipline(s): Check the specific project discipline(s) addressed in this report.
Check all that apply.

<p>Water Supply <input type="checkbox"/> Source Development <input checked="" type="checkbox"/> Water Storage <input type="checkbox"/> Water Distribution <input type="checkbox"/> Water Treatment <input type="checkbox"/> Water Pump</p> <p>Sanitation <input type="checkbox"/> Latrine <input type="checkbox"/> Gray Water System <input type="checkbox"/> Black Water System</p> <p>Structures <input type="checkbox"/> Bridge <input type="checkbox"/> Building</p>	<p>Civil Works <input type="checkbox"/> Roads <input type="checkbox"/> Drainage <input type="checkbox"/> Dams</p> <p>Energy <input type="checkbox"/> Fuel <input type="checkbox"/> Electricity</p> <p>Agriculture <input type="checkbox"/> Irrigation Pump <input type="checkbox"/> Irrigation Line <input type="checkbox"/> Water Storage <input type="checkbox"/> Soil Improvement <input type="checkbox"/> Fish Farm <input type="checkbox"/> Crop Processing Equipment</p> <p>Information Systems <input type="checkbox"/> Computer Service</p> <p>Community Organization <input checked="" type="checkbox"/> Community Committee and MOU Development</p>
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8 Project Location
Guachthu'uq is on the outskirts of the municipality of San Cristobal which is in the state of Alta Verapaz.
Latitude: 90° 29' 41.84'' W
Longitude: 15° 22' 22.6'' N

9 Project Impact
Number of Persons directly affected: 280 people, 37 families
Number of Persons indirectly affected: 80 Families (neighboring communities of Rexquix and Pamoc)

10 Professional Mentor/Technical Lead Resume - Please see document 405 - *Mentor Qualifications* for Professional Mentor/Technical Lead requirements related to the project area. This can be found in the Sourcebook Downloads on the member pages of the website.

Michael Reiter
264 Mile Creek Rd, Old Lyme, CT 06371
Reiter2207@Gmail.com (860) 748-3445

Education

Carnegie Mellon University – Tepper School of Business

Master of Business Administration, December 2004

Worcester Polytechnic Institute

Bachelor of Science in Mechanical Engineering, Focus in Aerospace, May 2000

Professional Experience

Currently maintain a Secret Clearance with JSF Program Access

Progressing towards Six Sigma Black Belt Certification

Pratt and Whitney, United Technologies Corporation East Hartford, CT

October 2008-Present, Advanced Manufacturing Technology Program Deputy

- Leading Pratt & Whitney through the process of advancing all additive manufacturing technologies from concept, advancement through all Technology Readiness Level activities and into production. Responsible for development, documentation and training of Project Engineering discipline on using new technologies which are not fully characterized in rigs and development engines.

November 2007-November 2010, Ceramic Matrix Composite (CMC) Technology Manager

- Led multi-disciplinary team of engineers to advance the manufacturing process for CMC hardware. Responsibilities included management level reporting, creating technology development strategies, coordinating between Pratt & Whitney and vendor for development planning, delivering hardware and monitoring at engine test.

August 2005 – November 2007, Integrated Product Team (IPT) Leader

- Organized and led a group of designers, manufacturers, drafters and structural and aero/thermal analysts through the design, analysis, manufacturing and delivery activities of F135 hardware. Provided problem solving and technical support during engine testing, implementing fixes and providing short-term mitigation solutions. Led team through multiple issues at engine test, requiring fixes to be implemented in as short term as week, Applying lessons learned into a leading a more robust redesign effort.

June 2003 – August 2005, Senior Structural Engineer

- Created structural analysis techniques for composite design and analysis and acoustic analysis. Techniques were incorporated in to Pratt and Whitney standard work for all engineers to use.
- Managed outsourcing for design and analysis of the JSF airframe nozzle seals and external flaps for both the Conventional Takeoff and Landing (CTOL) and Short Takeoff and Vertical Landing (STOVL) variants.
- Developed and executed subelement and full part test plans required to validate Ceramic Matrix and Polymer Composite components for flight, with plans being incorporated in to Pratt and Whitney standard work for all engineers.

June 2000 – June 2003, Structural Engineer

- Assisted multiple Integrated Product Teams, performed structural analysis using ANSYS, organized subelement and full part testing and consulted on material characterization efforts for various components of the JSF nozzle. Parts were manufactured from various metals, Ceramic Matrix and Polymer Composites.
- Member of Pratt and Whitney integration team, helping the Lockheed Martin Corporation design aircraft parts that interact with engine components and find solutions acceptable for both companies.

Computer Skills

SAP, ANSYS, Unigraphics, Microsoft Office, Matlab, Windows OS, SUN OS, Minitab, TeamCenter

Pre-Assessment Report Part 2 – Technical Information

1 EXECUTIVE SUMMARY

The Worcester Polytechnic Institute chapter of EWB (EWB-WPI) is proposing an assessment trip for project number 6871, Rainwater Harvesting from May 2nd to May 15th, 2013.

The goal of this trip is to continue strengthening EWB-WPI's bond with the community of Guachthu'uq, Guatemala and formalize the Memorandum of Understanding with the community. Furthermore, EWB-WPI will assess the success of the Rainwater harvesting implementation EWB-WPI completed in January 2013, through both community feedback and technical assessment. This will be EWB-WPI's fourth trip to the community and vital for the project's success.

Guachthu'uq is a rural, community located in a northern, mountainous region of Guatemala. It is home to over 280 people and 37 families, typically of Mayan descent. The community member's speak Pokomchi and some Spanish. One of the community's main problems is access to clean water. EWB-WPI seeks to solve this through Rainwater Harvesting. Our main NGO is Michelle Banks, who originally contacted EWB to get the project started.

This project was brought to EWB-WPI at 2009. From the first two assessment trips, it was established that bringing a sustainable water supply to the community in Guachthu'uq was the main project focus. From assessment, EWB-WPI learned that Guachthu'uq lacked a clean, year round water source. During the dry season, the community relies on a community water collection system located approximately 1 km downhill from the community. This distance, in combination with the hill's steep slope, makes accessing water a long and difficult task for many residents. Some homes do have rainwater catchment systems, although they are often inefficient or used improperly. To create a feasible and successful project, EWB-WPI chose to focus on rainwater harvesting in its first implementation trip, which occurred in January 2013. The team implemented on two homes and further established a relationship with the community.

On this trip, EWB-WPI will evaluate the feasibility of continuing at an increased rate of implementation. We hope to find the best method to implement in as many homes as possible in each trip that still allows us to create a positive relationship with our community. We will also assess the success of the previously implemented designs to assure structural integrity and functionality. This will be accomplished through community feedback gained through community questionnaires, explained in more detail in our monitoring section. This monitoring system will allow community residents a way to express concerns over their rainwater harvesting systems and EWB-WPI hopes to formalize this monitoring system. Furthermore, EWB-WPI will conduct water quality tests on the rainwater catchment systems, and community water collection system.

Results from assessing the success of the implemented rainwater harvesting system through both community surveys and visual inspection, will determine whether EWB-WPI needs to redesign

or improve the implemented rainwater catchment systems. Using the water quality testing results EWB-WPI will look into which water treatment options are necessary, appropriate, and feasible for the rainwater harvesting project, when they return to WPI in the fall. Treatment options will be researched with the aid of WPI's Environmental Engineering department. With this data, EWB-WPI hopes to implement the remaining rainwater harvesting systems in the community with a higher level of structural integrity.

2 INTRODUCTION

This pre-assessment report indicates the preparedness of EWB-WPI for its third assessment trip to Guachthu'uq, Guatemala. Through the preparation of this document, EWB-WPI has fully assessed and noted the various objectives and purposes of this trip. The main priority of this trip is to strengthen the previously formed bonds with the community. This will be done through numerous methods. Our team's goal is to design a system so that we can implement on as many homes as possible in the future while still maintaining a high quality finished project, so that our community maintains faith in the projects and cooperates with us on maintaining a monitoring system. Already, our team has worked to implement a monitoring system in the community, so another main goal is to assess its utilitarian and cultural functionality in the community. Secondary goals that our team will uphold are to test the water quality in the community and determine the feasibility of implementations with respect to soil erosion. Finally, the tertiary goals which our team has established are to provide communities with the education and materials to implement without our presence and to implement a rain gauge at a nearby Pokomchi cultural center.

3 PROGRAM BACKGROUND

On our first assessment trip we learned that while the needs of Guachthu'uq are many, the families have identified access to water as their most pressing concern. The proposed program, Rainwater Harvesting: Guachthu'uq, will address these concerns using a holistic approach that includes both addressing the problems directly and working with the community to learn more about environmental issues that affect their health and access to resources. The projects will improve overall community health and hygiene, particularly the quality of life for women and children, who are charged with collecting water.

During the dry season (November 15th – May 15th) the community relies on a dam that collects ground runoff water from a small stream. This dam is located on private property 1 km downhill from the nearest community home and 3 km downhill from the furthest home. Members from Guachthu'uq, Las Arrugas, and La Reforma use this source of water for drinking water and washing clothes. In 2009 some families in Guachthu'uq received rainwater harvesting tanks from the municipal government; however, these systems do not have high efficiency due to improper design of the systems.

On our second assessment trip we took a complete assessment of each home in the community and took a thorough assessment of the two homes that our community chose for our pilot project.

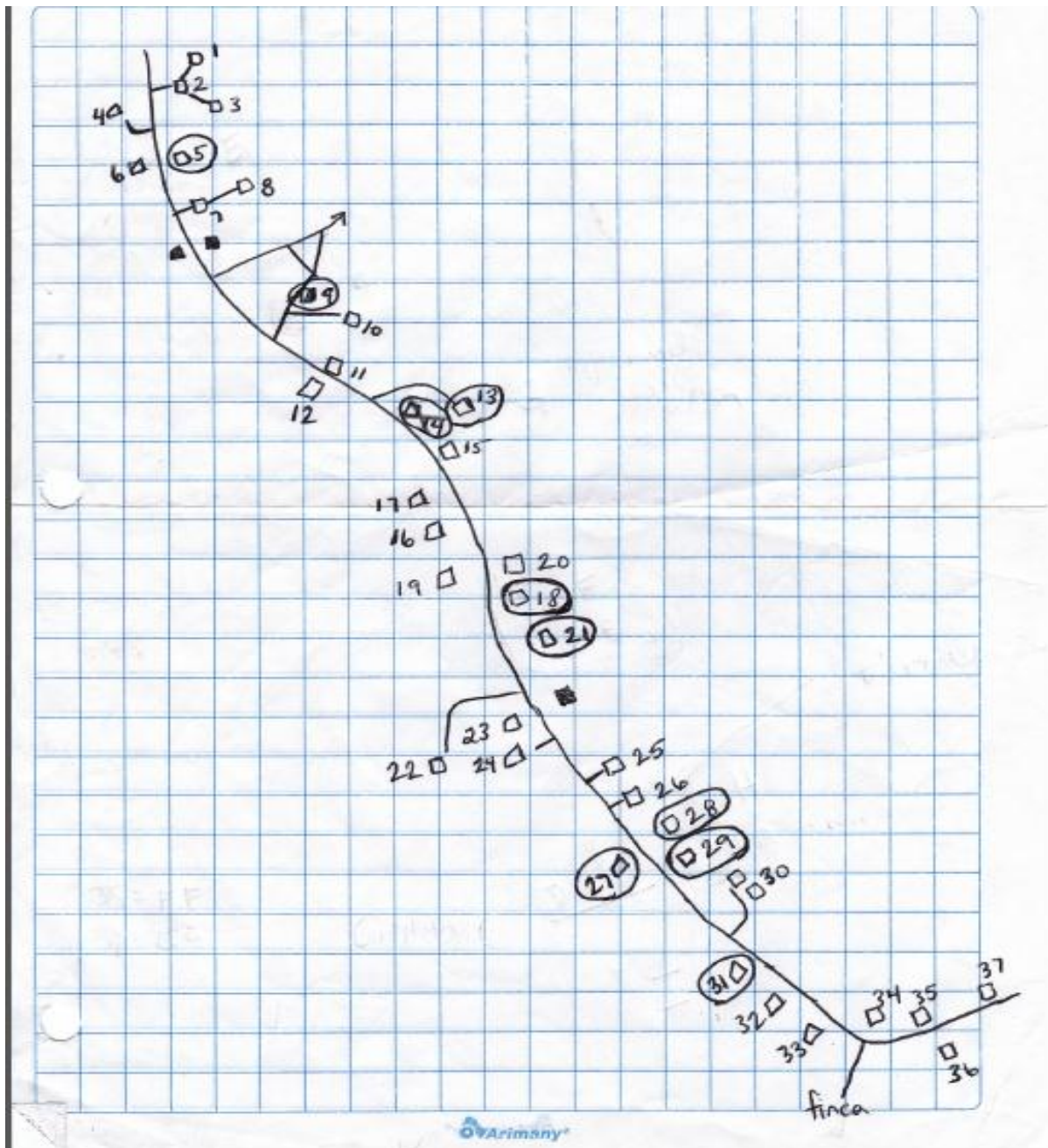
From the community assessment our goal was to find an appropriate water consumption rate for the families in the community. Unfortunately, we were unable to find any trend that relates number of family members and water consumption across the community. After this trip we created an excel computer model that estimates the amount of water in a storage tank based on average rainfall data, roof area, water consumption, and storage volume.

On our last trip, EWB-WPI's first implementation trip, our team implemented rainwater harvesting systems in two homes as a pilot project. The aim of a pilot project was to ensure that our computer rainwater harvesting calculator works properly. For our team to see if our system works and to see how the community really feels about individual rainwater harvesting systems we must reassess our community and ensure that we are able to effectively establish an appropriate monitoring system.

4 PROJECT DESCRIPTION

The community of Guachthu'uq, Guatemala lacks access to clean water year round. We have found thus far that individual rainwater harvesting systems is the best solution to providing the families of Guachthu'uq with drinking water year round. Our goal is to implement a rainwater harvesting system in each home that will tend to the individual family's specific water supply problem. Our team estimates that at the current rate of implementation it will take 6 more implementation trips to finish all of the homes in the community. Our team, as well as the people of Guachthu'uq would like to increase the amount of homes that we can construct each trip and evaluate the best work that can be done why our team is not in country.

This upcoming trip will be both a continuation of the project and an opportunity for EWB-WPI to move the project to a higher level. We hope to solidify the monitoring system that was started last trip, meet with the community about three times, and talk to the families in the homes that we plan to implement in on our next implementation trip. Through these meetings, EWB-WPI will establish a deeper understanding about the community and their capabilities. Additionally, this trip will be used to assess the quality of water the new systems will provide compared to the existing sources of water. Finally, we will educate the community about how to clean a tank and gutter system and provide the community with a design which will allow families to see the exact amount of water in the tank. These are to ensure that the community members that are waiting to construct their system will be included in our project.



List of Families

1. Oscar Vicente Laj
2. Mateo Caal Cal
3. Julio Jalal Latz
4. Estanislado Caal Nio
5. Filomena Gualim Caal

6. Carlos Jan Yuja
7. Jose Emiliano Sis Xuc
8. Cristobal Laj Cujoc
9. Cristobal Lem Suran
10. Santiago Lem Moo
11. Sergio's Fathers House
12. Raul Coc Chub
13. Yermo Jom Gualim
14. Juan Chah Laj
15. Leandro Yuja Lopez
16. Elvira Cal Chun
17. Edgar Etrain Yuja
18. Domingo Caj Pop
19. Victor Caij Cu
20. Mario Enrice Chul
21. Migel Caj Pop
22. Terease Yuja
23. Abelino Caal Cal
24. Cerapio Chub
25. Emilio Che Gualim
26. Roberto Chacoj
27. Cristobal Coy Max
28. Alfozo Xona Jul
29. Ricardo Gualim
30. Erlinda Velazque
31. Marcela Cal Moran
32. Emilio Cualim Ical
33. Ajelina Quej Cal
34. Abelina Gualim Pop
35. Gonzalo Vinoch
36. Luis Jilberto Cojoc Yuja
37. Valeriano Cualim Sis

Implementation Families in Order

On our last implementation trip we had the community decide what the next 9 homes would be that go implemented at. They decided on the following 9 homes by picking the names from a bowl.

Casa 29 – Ricardo Gualim
Casa 21 – Migel Caj Pop
Casa 9 – Cristobal Lem Suran
Casa 27 – Cristobal Coy Max
Casa 5 – Filomena Gualim Caal
Casa 18 – Domingo Caj Pop
Casa 13 – Guillermo Jom Gualim
Casa 28 – Alfozo Xona Jul
Casa 31 – Marcela Cal Moran
Casa 16 – Elvira Cal Chun

5 OBJECTIVES OF SITE ASSESSMENT TRIP

Objective 1:

Establish the framework for future Implementation Trips. We hope to continue to develop a stronger relationship with the people of Guachthu'uq. To accomplish this task we will hold community meetings, meet with the CoCode, talk with the members of the new water committee, revise the MOUs, and create a better payment plan for the community members. This will also include maintaining a relationship with the construction store that supplied the rainwater harvesting tanks previously and trying to create a connection with the companies that make rainwater harvesting tanks in hopes of buying the tanks at wholesale value. We also plan to check up on the families that we plan to implement for next trip and if needed evaluate more homes. This objective will help to make our chapter more efficient in the construction of the systems and allow us to implement in more homes each trip.

Objective 2:

Collect sufficient data to analyze the implemented rainwater harvesting designs, thus preparing EWB-WPI for future implementations and confirming that our rainwater model is accurate. This will include evaluating the security of the concrete bases below the rainwater tanks and ensuring the tank systems are working properly. Also, we aim to determine the water quality of both the community water dam (the finca) and rainwater catchment systems. This will be achieved through water quality field testing and assessing the area surrounding the community water source.

Objective 3:

Improve and evaluate the year-round monitoring system of the rainwater harvesting tanks. This monitoring system will provide our team with important water conservation data about the families that we have implemented water systems for, as well as the families that we plan on implementing on during the next trip. We hope that this data will help us to better understand how our systems are affecting the families in addition to monitoring the lifespan and degradation of our systems over time.

Objective 4:

Develop a better relationship with the midwife in the community. She is responsible for overseeing new mothers and their infants for the first three months after the mothers give birth. From this relationship, EWB-WPI would like to gain a better understanding of the health of newborns in the community. This way, our team would be able to decide whether water quality and infant health could be correlated in any way.

Objective 5:

Implement a community wide educational day about how to effectively clean rainwater harvesting system and to implement a design which will allow community members to gauge exactly how much water is in their tanks. This may serve as a means of see the increase in involvement from the community after our last implementation trip.

6 COMMUNITY INFORMATION

1 Description of Community

The community of Guachthu'uq is located in a northern, mountainous region of Guatemala west of San Cristobal Alta Verapaz and is home to over 280 people in 37 families. Our EWB-USA student chapter at Worcester Polytechnic Institute is working with this community to help them gain access to clean water. The current water supply for all families is several kilometers downhill and is not sufficient for the entirety of the community. Some families also have rainwater harvesting systems on their property. Both water supplies however run dry for several months each year during the dry season. While many women are monolingual in Pokomchi', the male community members speak both Spanish and Pokomchi. The residents are a mix of Protestant Evangelicals and Catholics and are involved in traditional Mayan spirituality as well.

Community Infrastructure:

There are five local communities that make up one micro-region, all connected by one road. These communities, in order from the top of the mountain to the bottom, are Pamac, Rexquix, Guachthu'uq, Rehquensal, and Las Arrugas. There is one mostly unpaved road that goes through the area starting at San Cristóbal and ending at the highest community of the micro-region (Pamac). Most families in Guachthu'uq do not own a transportation vehicle or bicycle, so walking is their primary means of transportation. There are power lines running up the road but only a couple of community members can afford or have access to electricity in their homes. The houses are spread throughout the community with most houses located approximately 50 yards from the next one, though some areas have two or three houses within close proximity. This typically occurs because one of the family members got married and built a house next door to their parents. Most houses in the community are made of wood and have iron corrugated roofs. They have dirt floors that often flood in the rainy season.

Work:

The women primarily take care of the home although a few (particularly younger women and some girls as young as eleven years old) work in the town of San Cristóbal as domestics. The

women and children gather water every day and tend to the house, while the men gather wood for fuel. Some men might travel to work at a large farm for weeks at a time. Their main year-round water source is located at a private “finca,” or dam, on an estate at the bottom of the community. There, the women do laundry and gather drinking water with their children. Depending on where the family lives, it takes anywhere from a half-hour to an hour and a half to bring water to their homes. Most of the families do not own much land, if any at all, so they usually buy their food and wood from others who own land. There is almost no livestock in the community. The average family may own one or two chickens at most, which provide eggs and meat occasionally.

Education:

Children attend school when they are not working with their parents. The children from Guachthu'uq have two primary schools to choose from. One is in the neighboring community of Rexquix (uphill) and the other is in Las Arrugas (downhill). The schools terminate at sixth grade and boys are more likely than girls to reach the higher grades (4th- 6th). Most children do not attend school after the 6th grade, but if they do, then they must travel to San Cristóbal and attend the schools there. Some children drop out for a year or more to provide assistance to their families. For this reason, ages of students in each grade are not consistent. Information on health and hygiene are rarely covered in the schools. The children's education revolves primarily around basic math, and reading and writing Spanish.

2 Community and Partnering Organization/NGO Resources and Constraints

Political Government:

The current COCODE (Community Development Council) meets regularly with the entire community (both men and women) to generate and discuss solutions for issues that affect them. In general, the EWB-WPI project team found the COCODE to be very organized. The president of Guachthu'uq's COCODE is Don Domingo. He is also the Vice President of the COCODE for the micro-region. The community recognizes that their limited access to water is also an environmental issue, and they are committed to the creation of a program that is both sustainable and has a positive impact on their environment and health. They are aware of deforestation in the region and the contamination of natural resources. Meetings with the COCODE have enabled us to organize community contributions in terms of labor, tools and some materials (e.g., clay and wood) to the EWB-WPI project. Overall, the COCODE enables our project team to communicate effectively with community members.

CeCEP:

CeCEP is a local museum located in San Cristobal that provides logistical support to our travel team. Our main contact from CeCEP is Sucely, who is able to set up a van for us, translators and homestays. Sucely is also a great resource for any cultural questions that we may have.

The constraints described below limit the design of our rainwater catchment project. Taking these constraints into account help to ensure that our designs are practical and culturally appropriate in Guachthu'uq.

Financial Resources:

Coming up with an agreed payment plan between EWB-WPI and the community of Guachthu'uq is a concern. The cost of maintenance of the proposed project is a concern as the community's resources are limited. An agreement on a payment plan for rainwater harvesting systems would hopefully cover any repairs and also encourage everyone in the community to care for the project's infrastructure.

Language:

Most residents of Guachthu'uq speak Pokomchi (a Mayan language). While one or more of travel team members speaks Spanish, we have been connected with two translators, Gerson and Abelino, who can translate from Pokomchi to English. This ensures that a language barrier does not prohibit us from completing our project.

Location:

Guachthu'uq is located on a hill, isolated from San Cristobal, the small city where we are able to purchase construction materials. The road from San Cristobal to Guachthu'uq is unpaved and needs repair. Most families in Guachthu'uq do not own a transportation vehicle or bicycle, so walking is their primary means of transportation. Therefore, transportation of materials and investigating what materials are locally available is a consideration that must be taken into account when designing the systems.

3 Community Relations

Michelle Banks:

She is our official NGO, she is married to one of the community members and brought this project to us.

Sucely Ical Lem:

She is the head of a local Museum and Pokomchi cultural center. Her role in our project is a significant one. On our last trip we greatly increase our relationship with her and we hope to make her our main NGO in the future. At her museum, she works to help pokomchi people (our community). She has many connections in the country and she is able to help us with logistical aspects of travel and cultural questions that we may have.

Alvaro Caal Lopez:

He is a new member of our team that we met on our last trip. He speaks both Pokomchi and Spanish. We have chosen to employ him to do all of the monitoring of our systems that we talk about later in this form. He is interested in our project and is a good match to work with our community.

Don Domingo:

He is the leader of the COCODE in Guachthu'uq and he has had a major role in our communication with the community as a whole. Also, we have been in contact with his son Angel.

4 Community Priorities

In Guachthu'uq, Guatemala the community members lack both quantity and quality in their water supply. The community continues to prioritize access to clean water by means of rainwater harvesting. Our goal is to get clean water to the members of our community for year round use.

7 DATA COLLECTION AND ANALYSIS

7.1 Site Mapping

As of now, there is an up to date map of the community. This map was drawn and labeled during EWB-WPI's most recent implementation trip, which took place in January 2013. This map shows the main road of the community and labels the 37 homes in the community as well as the location of the small community reservoir in conjunction to the community. This way, EWB-WPI and EWB Nationals has knowledge about the location of all of the homes in the community, thus knowing the locations of the homes which have been implemented on and the homes which will be implemented on in upcoming implementation trips. During this trip, the team will gain a more qualitative knowledge about the community.

GPS Mapping of the community:

EWB-WPI plans to use a GPS to map the community road, the individual homes, and the location of the finca. This will enable us to gain a more comprehensive and accurate knowledge of the layout and terrain of the community.

Source of the community water source:

EWB-WPI will locate the source of the stream that feeds the Finca (dam) that the community currently uses as a communal water source. Currently, our team only knows that it collects water from an uphill stream and that it is polluted from agricultural runoff, but does not know from where the stream originates.

Homes to be implemented on:

EWB-WPI will photograph all important infrastructures from these six homes so that detailed measurements and calculations can be made before the next implementation trip. The team will measure the roofs and also the area around the home.

Feasibility of a first flush system:

The team will photograph the terrain and concrete bases around the existing rainwater catchment tanks to assess the possibility of implementing first flush systems at the tanks.

7.2 Technical Data Collection

The technical data which will be collected on this trip will serve to determine the structures of the next six homes to be implemented on, the quality of the water in the community versus in the

community water source, and the feasibility of first flush systems in the designs of the rainwater catchment system.

Structures of homes for next implementation:

Our team will collect metrics for the subsequent six homes that will be implemented on in the community. This will include measurements of the roofs and photographs of the outsides of the homes so that they can be diagramed and the locations of the tanks can be determined.

Water Quality:

Our previous trips have focused on assessing the water sources available to Guachthu'uq. Our next step is to conduct water quality tests on both the rainwater harvesting tanks and the community water source and to look more deeply into the water quality issues in Guachthu'uq. This will help us to ensure that rainwater catchment is an appropriate solution.

Through water testing, EWB-WPI will be able to determine the different contaminants in the tanks and community source and determine which source provides the cleanest water. Our team will measure the water quality of the source water and collected rainwater in two ways:

Qualitative Observation:

EWB-WPI will keep detailed descriptions of the water in both the community water source and in the rainwater catchment tanks. Team members will record daily, systematic observations.

Field analysis of water samples:

Water quality tests will be taken three times throughout the trip, ensuring accurate and meaningful results. Time of test, weather, and location will be recorded. These tests will allow us to assess the most prominent contaminants in both water sources and to propose proper treatment solutions for Guachthu'uq. Plans for seasonal water quality tests will be established with the community for further data collection in the team's absence from the project site.

The table below lists the tests we will be conducting as well as the collection method we will use to complete the tests.

Test	Type	Source
Turbidity	Meter	Hach
Total Iron	Test Strips	Hach- Iron Test Strips (Total Dissolved Iron), 0-5 mg/L
Nitrate and Nitrite	Test Strips	Hach
Ammonia	Test Strips	Hach- Ammonia (Nitrogen) Test Strips, 0-6.0 mg/L

Phosphate	Test Strips	Phosphorus, Orthophosphate (Reactive) Color Cube Test Kit
Total coliform bacteria	Chemical	Simpltek
E. coli	Chemical	Simpltek

First flush system:

EWB-WPI will also be assessing the potential for erosion around the previously implemented rainwater catchment systems. If there is a high likelihood of erosion as a result of an automatically dispensing first flush system, our team will reconsider designs for first flushes as well as possible structural amendments that could be made to the areas to decrease erosion.

8 MONITORING

Monitoring is an essential part of our project since it measures the impact of the work we have done in the community. Part of this assessment trip includes strengthening the monitoring system and ensuring its effectiveness. We plan on implementing a monitoring system which will efficiently measure how the water catchment system is affecting and will continue to affect the community. As a result, we hope to receive both qualitative and quantitative data that will provide us with useful information on the performance of the water harvesting system. Our approach consists of including community members in the monitoring system by having them take part in the process of collecting data.

Members of the community will work closely with a local student from Guatemala in the collection of data. The student, Alvaro Caal Lopez, will serve as a liaison between the community of Guachthu'uq and our chapter to ensure that the data is recorded appropriately and reported back to us routinely. He will visit the community twice a month with the purpose of collecting important information pertinent to the condition of the rainwater catchment system. Both Alvaro and community members will have a survey to fill out with questions that cover the maintenance of the system, observations, quality of water, and amount of water consumed. Questions include: have any repairs been done to the system? Do you prefer the flavor of the water from the tank or the finca? How much water has been consumed for drinking? See below:

MAINTENANCE OF THE SYSTEM	
Has a part of the system been damaged? Yes? No? Describe/Explain:	

<p>How severe was the damage? Does it work? Repairable? Non repairable? Describe/Explain:</p>	
<p>What caused the damage? Weather? Vandalism? Normal Use? Bad Use? Animals? Other? Describe/Explain:</p>	
<p>Have any repairs been done to the system? Gutter PVC Valve Screen Base Tank Who made the repairs? Describe/Explain:</p>	
<p>How much did the repairs cost ? _____ Quetzales _____ Hours Details about the cost:</p>	
<p>Has the tank been cleaned? Yes? No? How many times? Routinely or by necessity? Who? Details about the cleaning (How, why, etc.):</p>	
<p>Have the gutters been cleaned? Yes? No? How many times? Routinely or by necessity? Who? Details about the cleaning (How, why, etc.):</p>	

PHOTOS/IMAGES	
Photo #	Description

OBSERVATIONS				
	Leaves	Branches/Twigs	Fungus	Other
Gutters				
Tanks				
Roof				
Clear tube on the tank Clean? Change in color? Fungus? Soil/Sand? Other? _____				
Comments:				

QUALITY OF THE WATER
How is the quality of the water of the tank ?
Do you prefer the flavor of the water from the tank or the finca? Which is cleaner? Explain.
Has anybody gotten sick? Do you think it has to do with the quality of the water? Explain.
<i>Other problems or questions/Suggestions?</i>

AMOUNT OF WATER CONSUMED (By week, per barrel)				
	From Tank	From Finca	Cost*	Comments:
Drinking				
Cooking				
Laundry				
Cleaning (house)				
Bathing				
Agriculture				
Other uses?				
Total amount				

* What has been paid for transportation or how many hours it took for the transportation , how many people

1 Monitoring plan for current project

To measure the long-term impacts of our project work EWB-WPI will perform water quality field tests, evaluate the structural integrity of catchment systems and conduct community surveys as part of our monitoring system.

Field tests of water quality of both the finca and rainwater catchment tanks is vital in determining the success of our project and ensuring that our design does not cause any unanticipated harm to the community. Water quality tests will allow us to measure the amount of bacteria in the finca and rainwater catchment tank over time. Since the rainwater catchment tanks act as a storage tank for water which is intended to last for extended periods of time in the dry seasons, there is the risk that bacteria may grow and multiply in this environment. Water testing and eventual water treatment will ensure that we are truly helping out community and not creating a health hazard. Similarly, since the rainwater is collected from metal roofs, the run off from corrosion

poses a threat to the quality of the water. Monitoring water quality will ensure there is no issue and help to ensure that as our project progresses we continue to improve the quality of our aid.

Furthermore, frequent field testing that compares finca water to the water in the rainwater catchment tanks will help EWB-WPI ensure that rainwater catchment is indeed the best solution for the people of Guachthu'uq.

The second metric we will use to measure the impact on the community is to evaluate the structural integrity of the rainwater catchment tanks and concrete bases. Ensuring these aspects are structurally sound will show us that our project is indeed helping the community rather than adding to their problems. We also want to investigate these designs to make sure they do not lead to erosion or indirectly damage the homes of community residents.

The last metric will use, and perhaps the most important is to conduct community surveys to gather data about community perception of our designs and the design's usability. This will ensure that the community approves of our design and it using it as intended. Furthermore, community feedback will help EWB-WPI make sure they are maintaining positive working relationships with the community.

9 COMMUNITY AGREEMENT/CONTRACT

We have created 3 MOUs for our project. One is for our involvement in the community. The second is for the community members and what they are asked to uphold. The last is for the members of the water committee that our community created for our project. The MOUs can be seen below. These documents have been reviewed by the respected groups and all agree on the parameters that have been established.

COCODE and Committee of Water Systems Guachthu'uq with support from Engineers Without Borders Agreement

We agree, as members of the governing body of Guachthu'uq, to work with the Engineers Without Borders student chapter from Worcester Polytechnic Institute (EWB-WPI) to the best of our abilities. This agreement to work with EWB-WPI centers on providing general organization of the community. We understand that the implementation of any type of water system in the community will need to be monitored. The responsibility of watching the development of the community of Guachthu'uq around the project lies with the Cocode and Water Systems Committee. Assistance with communication between individual households, the general community, and EWB-WPI is crucial for the success of the project. We agree to relay information, concerns, questions, and suggestions between the Guachthu'uq community and EWB-WPI. This is a community based project, and the inputs of the community are extremely valued. The Cocode and Water Systems Committee is responsible for passing on the opinions of the community. As leaders of the community, we understand that we will also have to pass on project updates received from EWB-WPI. These updates will be received through monthly phone calls or emails with EWB-WPI and through monthly monitoring.

We also understand that labor and monetary support of the project will be contributed to some degree. Funding the project, including the pilots, will require saving and fundraising by the individuals. We understand that communication with the local municipality of San Cristobal, Alta Verapaz, including application for government funds, will be directed and completed by the members of Guachthu,uq and the Cocode without the direct involvement of EWB-WPI. As decided by the community at the meeting on January 5, 2013, individuals receiving a water system will be responsible for 5% of material costs as well as provide construction labor. This is a strict number set by Engineers Without Borders Nationals.

We understand that this pilot project is a test and it may not be successful when EWB-WPI first implements it. It will take time and communication from all parties, the community of Guachthu'uq, the Water Systems Committee, the Cocode, and EWB-WPI, in order to make adjustments so the designs can be perfected. Support of the pilot project will be demonstrated by the Cocode. If there are changes in attitudes toward the project, by individuals, the Cocode, or the entire community, they will be communicated to EWB-WPI either directly or through Cecep and Alvaro.

Community Project Agreement Form

We plan to work with the Engineers Without Borders student chapter from Worcester Polytechnic Institute (EWB-WPI) to the best of our ability. We will provide labor and monetary support towards the completion of the projects. Each family receiving project implementation will provide 5% of materials cost associated with the project as of January 5, 2013. It is required that the community organizes labor on all implementation trips.

We understand that we have to be dedicated to the project by conveying any concerns, questions, or suggestions about how to make the project more applicable to our community to EWB-WPI or the Water Systems Committee. This is a community based project, and the inputs of the community are extremely valued and necessary to the success of the project. We understand that communication with the local municipality of San Cristobal, Alta Verapaz, including application for government funds, will be directed and completed by the members of Guachthu,uq and the Cocode without the direct involvement of EWB-WPI.

We understand that a drawing will select the future homes for the rain water catchment systems. We understand that the families who are not selected are not forgotten. These few pilot homes will be actively working to ensure that the designs meet the individual's needs. Once the EWB-WPI group and the community have decided that the designs are satisfactory, we will start working with other families to implement the rain water catchment systems. We will choose homes for the next set of implementation, each time EWB-WPI travels to Guatemala until the project has finished.

We understand that these pilot programs are a test, and they may not be entirely successful when EWB-WPI first implements them. It will take time and full communication from both parties, both the community of Guachthu'uq and EWB-WPI, in order to make adjustments so the designs

can be perfected. We will address any suggestions or concerns with the project directly to EWB-WPI or through Cecep and Alvaro. Also, the Cocode will be responsible for passing on these suggestions and concerns to us.

We understand that the projects EWB-WPI has proposed will require a long process over a number of years. This is because EWB-WPI intends to ensure that the designs are effective and will work with each family to train them in how to use the designs properly. This will ensure that if something happens, either if something breaks or requires standard maintenance, we will be able to fix the systems and understand proper upkeep and maintenance. We understand that each family who owns the rainwater catchment system will be responsible for maintenance and repair of said system. We understand that if we choose to sell our tank, we will be required to pay EWB-WPI for the whole cost of the tank. The Project Committee and Alvaro will enforce the above statement for the entirety of the EWB-WPI Water Project.

Engineers Without Borders student chapter from Worcester Polytechnic Institute Agreement Form

We agree, as members of the Engineers Without Borders student chapter from Worcester Polytechnic Institute, to work with the Community of Guachthu'uq, Alta Verapaz, to the best of our abilities. Each year we accept the drawing of the project homes within a meeting where both the Cocode and EWB-WPI is present.

We agree to update the community with any changes in the project, whether it is in regards to designs or costs. This may require very frequent communication, which we are prepared to conduct. We will do our best to make the designs fit the needs of the community and take into consideration all of the input the community has given us thus far. This includes keeping the project as low in cost as possible without sacrificing the correct functioning of the designs and their long term maintenance.

EWB-WPI is going to ensure that the designs are effective, and we will work with each family to train them how to use the systems properly. This will ensure that if something happens, either if it breaks or needs simple maintenance, the families of Guachthu'uq, will be able to fix the systems. We will continue to work on the project until all systems have been completed to the community members' satisfaction.

EWB-WPI will assist in labor towards the completion of the projects. EWB-WPI will purchase all materials in full at the start of the implementations as of January 5, 2013. Each family receiving ownership of the materials will contribute 5% of the material cost. This will be collected by EWB-WPI at the completion of the project or brought to Cecep on the first of the month for the maximum length of five months with a minimum of 20% required each month.

10 SCHEDULE OF TASKS (3.2.13)

Trip Objectives

Establish framework for future Implementation Trips:

- Establish a stronger, more formal relationship with CeCEP
- Community meetings (3 at least, beginning, middle and end of trip)
 - Meet with CoCode on the first day- Explain our trip to the community
 - Solidify Memorandum of Understanding
 - End with “playing with the children day” establish community bonds
 - Solidify payment plan for implementation of rainwater catchment systems
- Establish relationship with Rotoplas (tank company)
 - Can we buy in bulk
 - Discuss buying tanks in advance with local construction stores
- Establish implementation payment plan with community
- Meet with homes that we plan to implement in 2014
 - Propose tentative design to each family
- Monitoring
 - Rain gauge: set up in CeCEP
 - Evaluate the cultural impact of the monitoring forms
 - Establish success of the monitoring forms
 - Meet with the community based Water Committee
 - Learn about their objectives and approach

Technical Assessment

- Complete evaluation of Finca (community dam/water supply)
 - Evaluate possible improvement of the structure and quality of water
 - Find source of the stream
- Give community members the design for tubing that will allow them to see exact level of water in their tank
- Further establish feasibility for implementation of first-flush
- Evaluate condition of concrete bases that support the implemented harvesting tanks
 - Ensure structural integrity is sufficient
- Figure out roof compositions

Water quality

- Perform water tests a total of three times per source over the course of the trip
- Set water quality standards that we will uphold moving forward
- Identify the crops farmed in the area
- Assess the feasibility of educating the community members to clean their tanks routinely
 - Look into locally available equipment for cleaning the tanks

Itinerary

May 2 Thursday

PM:

- Leave from Logan Airport
- Layover in Miami

May 3 Friday

AM:

- Arrive in Guatemala City Airport
- Leave for San Cristobal by 12PM

PM:

- Arrive at homestays

May 4 Saturday

AM:

- Meet with Sucely at CeCEP
 - Catch-up/ talk about creating a connection with the tank companies
- Get Alvaro
 - Take a look at his Monitoring set up
- Travel to Community of Guachthu'uq
 - First Community Meeting
 - COCODE
 - Water Committee
 - Community: Talk about clear tube implementation

PM:

- Reconvene at CeCEP
- Get back to home stays, spend some time with them

May 5 Sunday

AM:

- Get Alvaro
- Stop at Finca to get water test quickly
- Go to Cristobal's and Roberto's Homes
 - Do water tests as we go
 - Assess Cristobal's concrete base
- Begin meetings with homes which will be implemented on in 2014
 - Tour community

PM:

- Reconvene at CeCEP
- Talk with Sucy about payment plan

May 6 Monday

AM:

- Meet with Midwife
 - Work on her house
- Finish meetings with homes (Group 2)
- Get samples of the roof materials

PM:

- Go to construction stores to find the different kinds of roofing materials

- Reconvene at CeCEP

May 7 Tuesday

AM:

- Second community Meeting
 - MOU
 - Gutter Design
 - Clean your tanks
- Discuss the clean tube implementation

PM:

- Figure out crops in the area
- Reconvene at CeCEP

May 8 Wednesday

AM:

- Clear tube implementation
- Cleaning initiative
- Work with Cristobal's base
- Water tests on Finca and tanks

PM:

- Rain Gauge at CeCEP
 - Figure it out with Alvaro

May 9 Thursday

AM:

- First Flush
- Find location of Community Water Source
- Pictures and better structural understanding of the Finca

May 10 Friday

AM:

- Time to complete clear tube designs
- Complete other unfinished business
- Complete unexpected complications

PM:

- Meet with Sucy about cultural aspect of the prolonged implementation

May 11 Saturday

AM:

- Water tests on Finca and tanks
- Finish any other unfinished business

PM:

- Play with the kids
- Spend time with home stays

May 12 Sunday

- Travel to Antigua

May 13 Monday

- Depart from Antigua to Guatemala City
- Depart from Guatemala City Airport

May 14 Tuesday

- Arrive at Logan Airport

11 PROJECT FEASIBILITY

In our project we have verified the feasibility of implementing rainwater harvesting systems through the following measures:

- Adequate monetary investment from the community members
- Access to necessary building materials
- Access to skilled labor in the community
- Adequate funding to maintain the systems
- Cultural acceptance of the implemented harvesting systems

On this trip we hope to continue to evaluate the feasibility of the project from the software side. We would like to further understand the cultural effects of the nature of implementation in individual homes over the course of several years. Also, we feel that it is very important that our community members fully understand the importance of cleaning and maintaining their systems moving forward.

Feasibility of Construction

Our team also hopes to assess the feasibility of constructing a greater number of homes than 6 per trip. A few measures to verify the feasibility of this are as followed:

- Community's willingness to attend meetings
- Contact made with Rotoplas tank company
- Ability of Water Committee to provide in country support
- Community has enough available people for necessary physical labor

With these measures we will get a better sense of how many homes we will be able to implement in for the trips to come.

12 PROFESSIONAL MENTOR/TECHNICAL LEAD ASSESSMENT

1 Professional Mentor/Technical Lead Name (who provided the assessment)

Michael Reiter

12.2 Professional Mentor/Technical Lead Assessment

I am very impressed with the work these students have done to bring this report together. In

January, EWB-WPI traveled for their first Implementation Trip and improved the rainwater harvesting system for two houses in the community. These installations were successful, the families directly benefiting have more water availability and were beginning to understand the importance of preserving clean water for drinking. However after returning from this trip, the chapter felt like although the implementation went well they weren't able to spend enough time continuing to develop their relationship with the Water Committee and community. A significant measure of success for this overall project will be the sustainability of the systems installed in the distant future, long after EWB-WPI has finished their formal implementation efforts, moved into monitoring phase and finally completed the project all together. The students reached out to me for help as the professional mentor on this Assessment Trip because of my experience developing committees, establishing criteria for relationships and empowering others to succeed.

The project itself is at a very important stage, implementation in January was successful and this trip is all about reinforcing that success. A unique aspect of this project is that the end goal is for all houses in the community to have personal rainwater harvesting systems. Now that members in the community have seen EWB-WPI manage installation on two houses, the Chapter needs to reinforce that over time the management of installation will shift from the students to the community and the individual homeowner. They need to establish criteria the community must meet to proceed through each stage of the project. And finally, the student chapter will reinforce the overall vision for their relationship with the community, which has already started with the first two Assessment trips and one Implementation Trip and will end with the community building and managing these rainwater harvesting systems as their own.

3 Professional Mentor/Technical Lead Affirmation

I confirm that I have been involved in the development of this document and accept responsibility for the course of this project.