



Document 526

POST IMPLEMENTATION REPORT

CHAPTER: Worcester Polytechnic Institute

COUNTRY: Guatemala

COMMUNITY: Guachtuq*

PROJECT: Water Supply

Prepared By
Jessie Ciulla
Camden Knoff
Rita Newman
Aaron Pepin
Katie Picchione
Thomas Moutinho

July 20th 2014

*The spelling of the name of the community has been updated and will be spelled 'Guachtuq' from this point forward. The May 2014 travel team learned that this is the proper spelling of the community name, as seen on official documents and stamps.

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

Table of Contents

TABLE OF FIGURES	4
POST IMPLEMENTATION REPORT PART 1 – ADMINISTRATIVE INFORMATION	7
1.0 CONTACT INFORMATION	7
2.0 TRAVEL HISTORY	7
3.0 TRAVEL TEAM	8
4.0 HEALTH AND SAFETY	8
4.1 Incident Reports	8
5.0 PLANNING, MONITORING, EVALUATION AND LEARNING	8
5.1 Canceled/Non-functioning Projects	9
5.2 Updated 901B	9
6.0 BUDGET	9
6.1 Project Budget	9
6.2 Professional Mentor Team Hours	12
7.0 PROJECT DISCIPLINE(S)	12
8.0 PROJECT LOCATION	12
POST IMPLEMENTATION REPORT PART 2 – TECHNICAL INFORMATION	13
1.0 EXECUTIVE SUMMARY	13
2.0 INTRODUCTION	14
3.0 PROGRAM BACKGROUND	14
4.0 TRIP DESCRIPTION	16
4.1 Implementations	16
4.2 System Improvements	17
4.3 Education	17
4.4 Water Quality Testing	17
4.5 Family Interviews	17
4.6 Meetings with Beneficiaries	18
4.7 Community Meetings	18
4.8 Water Committee Meetings	18
4.9 Home Assessments	19
5.0 COMMUNITY INFORMATION:	19
5.1 Description of Community	19
5.2 Community Relations	22
6.0 PROJECT SUMMARY	25
6.1 Project Description	25
6.2 Summary	25
6.3 Difference Between Planned and Actual Implementation	26
6.4 Drawings	27
6.5 Operation, Maintenance and Education	28
7.0 FINAL IMPLEMENTATION AGREEMENT	39
8.0 PHOTO DOCUMENTATION	42
9.0 LESSONS LEARNED	46

9.1 Health and Safety:.....	46
9.2 Community Engagement:	46
9.3 Teamwork:.....	46
9.4 Travel:.....	47
10.0 PROJECT STATUS.....	47
11.0 COMPLETED PROJECT MONITORING:	48
11.1 Completed Project Status Table	48
11.2 Project Functionality Indicators.....	48
11.3 Periodic Maintenance Indicators.....	49
11.4 Demonstration of Knowledge Transfer Indicators	50
11.5 Additional Information	51
12.0 NEXT PHASE OF THE PROGRAM.....	52
13.0 PROFESSIONAL MENTOR ASSESSMENT	52
13.1 Professional Mentor Name and Role.....	52
13.2 Professional Mentor Assessment	52
13.3 Professional Mentor Affirmation.....	53
APPENDICES.....	54
Appendix A.....	54
Appendix B.....	91
Appendix C.....	92
Appendix D.....	101
Appendix E.....	104

Table of Figures

Figure 1: This drawing details the basics of the systems that EWB-USA WPI is implementing. In it you can see the basic elements of the gutters, PVC pipes, first flush, and storage tank equipped with an overflow.	27
Figure 2: Drawing of House 1. The first flushes are marked in red, all other elements of the system remained the same.....	28
Figure 3: Bar chart depicting water quality data.....	32
Figure 4: This education manual was distributed to every family in the community, regardless of their status as a system owner. The diagrams used in each page were further explained on a house-to-house basis.	35
Figure 5: The first page in the manual depicts the most important message: boil water. Until the team can guarantee that tank water is potable, boiling water is an excellent precaution to prevent illness. Thankfully, this message is something that has been reinforced culturally for years. Based on information gathered through community interviews, nearly every family knew to boil their water before the EWB-USA WPI team first arrived. The reason this message is still included in the booklet is due to its importance.	35
Figure 6: The next two pages encourage the practice of separation of containers. It is important to use separate containers to collect water from the tanks (cleaner), the first flush (less clean), and the finca (dirty) to reduce cross-contamination. Each water source also has its specific uses (diagramed on the bottom page). To encourage this practice, each family was supplied with a bright orange bucket in which tank water should be collected. Buckets were distributed with a thorough explanation of their purpose and a quick demonstration of good separation of containers practice. These buckets are also labeled with an EWB-USA WPI sticker as a reminder of their intended use.	36
Figure 7: In order for the first flush to effectively serve as the initial catchment for dirty water, the system must be maintained regularly with the weather. These pages emphasize the importance of taking action to maintain the first flush as weather dictates. Much like the education system used for communicating separation of containers, description and demonstration were used to further explain this process.	37
Figure 8: In order for the first flush to effectively serve as the initial catchment for dirty water, the system must be maintained regularly with the weather. These pages emphasize the importance of taking action to maintain the first flush as weather dictates. Much like the education system used for communicating separation of containers, description and demonstration were used to further explain this process.	37
Figure 9: The tanks themselves must also be regularly cleaned. Ideally, at the start of the rainy season, every family will chlorinate their tank water as pictured above. The reason for this timing is that the increased rainfall will be able to flush out the chlorine through the overflow more quickly, thereby removing the chlorine flavor from the water faster. Overall, this concept is a difficult one for community members to agree with as water is such a precious resource, sacrificing any amount of it for cleaning purposes sounds unreasonable. To make the process seem less painful and more familiar, the team cleaned a few of the older tanks with various families throughout the community by completely emptying the tanks and scrubbing the interiors.	37
Figure 10: Maintaining the sediment filter is simple, but something easy to neglect. This diagram encourages regular cleaning of this filter, as seen in the miniature calendar. Families who received systems in prior years have already become acquainted with the idea of cleaning this filter and do so regularly. Hopefully, the trend will continue.	38

Figure 11: The tanks themselves must also be regularly cleaned. Ideally, at the start of the rainy season, every family will chlorinate their tank water as pictured above. The reason for this timing is that the increased rainfall will be able to flush out the chlorine through the overflow more quickly, thereby removing the chlorine flavor from the water faster. Overall, this concept is a difficult one for community members to agree with as water is such a precious resource, sacrificing any amount of it for cleaning purposes sounds unreasonable. To make the process seem less painful and more familiar, the team cleaned a few of the older tanks with various families throughout the community by completely emptying the tanks and scrubbing the interiors.	38
Figure 12: This is the first MOU that the family must sign to be part of the project.....	39
Figure 13: This is the second MOU that the family must sign after the assessment of their home and the establishment of the construction plan.	40
Figure 14: This is the final MOU that the families sign when their system is complete. It discusses the payment plan.	41
Figure 15: Here, materials for constructing the base are being dropped off at Filomena's house.	42
Figure 16: The children were very enthusiastic to help move rocks at Elvira's house.	42
Figure 17: Traveler, Rita Newman, helping Rigoberto and Alfonso mix concrete for the base...43	43
Figure 18: Various community members tie down rebar at the midwife's house.	43
Figure 19: Filomena and her children proudly standing next to their recently completed system.	44
Figure 20: Aaron Pepin, Thomas Moutinho, Mike Reiter, Katie Picchione, Camden Knoff, Melissa Rivera, Jessie Ciulla, and Rita Newman take a photo with community children shortly after the materials were delivered.	44
Figure 21: Camden Knoff prepares and wears water quality tests.....	45
Figure 22: The team (left to right: Camden Knoff, Aaron Pepin, Melissa Rivera, Jessie Ciulla, Katie Picchione, Thomas Moutinho, Rita Newman, Mike Reiter) meet with the mayor of the San Cristobal Municipality (center).	45
Figure 23: List of Materials at Roberto's House.....	91
Figure 24: Drawing of House 5. The First Flushes are marked in red, all other elements of the system remained the same.....	92
Figure 25: Drawing of House 9. The First Flushes are marked in red, all other elements of the system remained the same.....	93
Figure 26: Drawing of House 16. The first flush and the changed elements of the planned implementation are drawn in red.....	94
Figure 27: Drawing of House 18. The first flushes are marked in red, all other elements of the system remained the same.....	95
Figure 28: Drawing of House 21. The first flushes are marked in red, all other elements of the system remained the same.....	96
Figure 29: Drawing of House 27. The first flushes are marked in red, all other elements of the system remained the same.....	97
Figure 30: Drawing of House 28. The first flush and the changed elements of the planned implementation are drawn in red.....	98
Figure 31: Drawing of House 29. The first flushes are marked in red, all other elements of the system remained the same.....	99
Figure 32: Drawing of House 31. The first flushes are marked in red, all other elements of the system remained the same.....	100
Figure 33: This is the MOU signed by Filomena Gualim acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at her home.....	104

Figure 34: This is the MOU signed by Cristobal Lem Suram acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at his home.	105
Figure 35: This is the MOU signed by Elvira acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at her home.	106
Figure 36: This is the MOU signed by Domingo acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at his home.....	107
Figure 37: This is the MOU signed by Miguel Caj Pop acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at his home.	108
Figure 38: This is the MOU signed by Alfonso acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at his home.....	109
Figure 39: This is the MOU signed by Ricardo acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at his home.....	110
Figure 40: This is the MOU signed by Marcela acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at her home.	111

Post Implementation Report Part 1 – Administrative Information

1.0 Contact Information

	Name	Email	Phone	Chapter Name or Organization Name
Project Leads	Thomas Moutinho (outgoing)	tjmoutinho@wpi.edu	207.831.7011	EWB-USA WPI
	Aaron Pepin (incoming)	ajpepin@wpi.edu	603.689.3869	EWB-USA WPI
President	Thomas Moutinho	tjmoutinho@wpi.edu	207.831.7011	EWB-USA WPI
Responsible Engineer in Charge	Michael Reiter	michael.reiter@pw.utc.com	860.748.3445	EWB-USA HPC
Traveling Mentor	Laureen Elgert	lclgert@wpi.edu	508.450.3313	EWB-USA WPI
Additional Mentor	Patricia Austin	pat.austin@state.ma.us	508.792.7423 x204	EWB-USA WPI
Faculty Advisor (if applicable)	Creighton Peet	cpeet@wpi.edu		EWB-USA WPI
Health and Safety Officer	Jessie Ciulla	jmciulla@wpi.edu	781.987.4139	EWB-USA WPI
Assistant Health and Safety Officer	Aaron Pepin	ajpepin@wpi.edu	603.689.3869	EWB-USA WPI
Education Lead	Rita Newman	rpnewman@wpi.edu	203.962.1357	EWB-USA WPI
Planning, Monitoring, Evaluation and Learning (PMEL) Lead	Katie Picchione	krpicchione@wpi.edu	518.727.8024	EWB-USA WPI
NGO/Community Contact	Sucely Ical Lem	exiical@wpi.edu	502.7950.4039	CeCep

2.0 Travel History

Dates of Travel	Assessment or Implementation	Description of Trip
7/20/2010 - 8/03/2010	Assessment	This first trip consisted of meetings with the community members and town officials. Conducted health surveys and water quality sampling.

7/23/2011 - 08/07/2011	Assessment	Collected more data on water consumption, existing rainwater harvesting practices, and developed a memorandum of understanding with the community
12/31/2012 - 1/10/2013	Implementation	Pilot implementation of rainwater harvesting systems on two homes, assessment of homes for future implementation, and established a monitoring system
5/2/2013 - 5/15/2013	Assessment	Assessment of pilot implementation, health survey and census of community. Also, home assessments for the next 10 homes and set up for next two implementations.
1/2/2014 - 1/14/2014	Implementation*	This trip was an implementation trip that was funded by an EPA grant. Therefore there are no official EWB reports. Implemented at 2 homes and re-assessed 8 homes for future implementation. Also, further monitored project success.

*Unofficial EWB-USA Implementation trip. EWB was notified of travel.

3.0 Travel Team

#	Name	E-mail	Phone	Chapter	Student or Professional
1	Michael Reiter	michael.reiter@pw.utc.com	860.748.3445	EWB-USA HPC	Professional
2	Laureen Elgert	lelgert@wpi.edu	508.450.3313	EWB-USA WPI	Professional
3	Thomas Moutinho	tjmoutinho@wpi.edu	207.831.7011	EWB-USA WPI	Student
4	Jessie Ciulla	jmciulla@wpi.edu	781.987.4139	EWB-USA WPI	Student
5	Camden Knoff	cmknoff@wpi.edu	651.269.7023	EWB-USA WPI	Student
6	Rita Newman	rpnewman@wpi.edu	203.962.1387	EWB-USA WPI	Student
7	Aaron Pepin	ajpepin@wpi.edu	603.689.3869	EWB-USA WPI	Student
8	Katie Picchione	krpicchione@wpi.edu	518.727.8024	EWB-USA WPI	Student

4.0 Health and Safety

4.1 Incident Reports

Did any health or safety incidents occur during this trip? ☒ Yes ☐ No

5.0 Planning, Monitoring, Evaluation and Learning

5.1 Canceled/Non-functioning Projects

Has the status of any of this program's past-implemented projects changed to Canceled or Non-functioning? ___Yes ___X_No

5.2 Updated 901B

Is the updated version of the 901B – Program Impact Monitoring Report included with this report? _x_Yes ___No

*Since this project has been grandfathered into the formal PMEL process, a 901 – Program Plan and Baseline Study has been submitted concurrently.

6.0 Budget

6.1 Project Budget

Project ID: 6871

Type of Trip: I

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

Trip Expense Category	Estimated Expenses (Fill in from Pre-trip Report)	Actual Expenses
Direct Costs		
Travel		
Airfare	5200	--
Airfare, Insurance, and USA Van	--	5544
Gas	0	0
Rental Vehicle	0	0
Taxis/Drivers	1350	1000
Misc.	320	0
Travel Sub-Total	\$6870	\$6544
Travel Logistics		
Exit Fees/ Visas	0	0
Inoculations	0	0
Insurance	320	222
Licenses & Fees	220	180
Medical Exams	0	115
Passport Issuance	0	0
Misc.	400	0
Travel Logistics Sub-Total	\$940	\$517
Food & Lodging		
Lodging	1890	1187
Lodging (Antigua)	--	200

Food & Beverage (Non-alcoholic)	0	100
Misc.	350	0
Food & Lodging Sub-Total	\$2240	\$1487
Labor		
In-Country logistical support	0	0
Local Skilled labor (Translators)	1000	1200
Misc.	0	0
Labor Sub-Total	\$1000	\$1200
EWB-USA		
Program QA/QC (1) See below	\$3700	\$3700
EWB-USA Sub-Total	\$3700	\$3700
Project Materials & Equipment (Major Category Summary)		
Construction Materials	9500	
Sent before trip and spent		5000
Sent during trip and spent		2000
Other withdrawals		265
Sent after trip for items on credit		596
Water Quality Tests	325	400
Monitoring	2000	1008
Project Materials & Equipment Sub-Total	\$11,825	\$9269
Misc. (Major Category Summary)		
Report Preparation	0	0
Advertising & Marketing	0	0
Postage & Delivery	0	0
Misc. Other	0	0
Misc. Sub-Total	\$0	\$0
TOTAL	\$0	\$0

- (1) Program QA/QC (EWB-
USA Headquarters Project
Managers and Chapter
Relations Managers)
Assessment = \$1,500
Implementation = \$3,700
Monitoring = \$1,150

EWB-USA Headquarters use:

Indirect Costs		
-----------------------	--	--

EWB-USA		
Program Infrastructure (2) See Below	\$1200	\$1200
EWB-USA Sub-Total	\$1200	\$1200
TRIP GRAND TOTAL (Does not include Non-Budget Items)	\$27,775	\$23,917

- (2) Program Infrastructure
(EWB-USA Headquarters
accounting, administration
and fundraising)
Assessment = \$500
Implementation = \$1,200
Monitoring = \$350

Non-Budget Items:

Additional Contributions to Project Costs		
Community		
Labor	600	1120
Materials	0	100
Logistics	500	200
Cash	475	400
Other	0	0
Community Sub-Total	\$1575	\$1820
EWB-USA Professional Service In-Kind		
Professional Service Hours	224	224
Hours converted to \$ (1 hour = \$100)	\$22400	\$22400
Professional Service In-Kind Sub-Total	\$22400	\$22400
TRIP GRAND TOTAL (Includes Non-Budget Items)	\$51,750	\$48,137

Chapter Revenue

Funds Raised for Project by Source	Raised Before Trip	Actual Raised by end of Trip
Source and Amount (Expand as Needed)		
Engineering Societies		
Corporations		

University		
Rotary		
Grants - Government		
Grants - Foundation/Trusts	3100	3100
Grants - EWB-USA program	8000	8000
Other Nonprofits		
Individuals	2000	2000
Special Events	5000	5000
Misc.	1200	1200
EWB-USA Program QA/QC Subsidy (3) See below	3800	3800
Total	\$23100	\$23100

(3) Program QA/QC & Infrastructure Subsidy:
Assessment = \$1450
Implementation = \$3,800
Monitoring = \$950

6.2 Professional Mentor Team Hours

Name(s) of Professional Mentor(s)	Pre-trip hours	During trip hours	Post-trip hours	Total Hours
1. Laureen Elgert	5	100	5	110
2. Michael Reiter	64	104	4	172

7.0 Project Disciplines

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

Water Supply

- ☐ Source Development
☒ Water Storage
☒ Water Distribution
☒ Water Treatment
☐ Water Pump

Sanitation

- ☐ Latrine
☐ Gray Water System
☐ Black Water System

Structures

- ☐ Bridge
☐ Building

Civil Works

- ☐ Roads
☐ Drainage
☐ Dams

Energy

- ☐ Fuel
☐ Electricity

Agriculture

- ☐ Irrigation Pump
☐ Irrigation Line
☐ Water Storage
☐ Soil Improvement
☐ Fish Farm
☐ Crop Processing Equipment

Information Systems

- ☐ Computer Service

8.0 Project Location

Latitude: -90.494921 W

Longitude: 15.372468 N

Post Implementation Report Part 2 – Technical Information

1.0 EXECUTIVE SUMMARY

The EWB-USA Worcester Polytechnic Institute Chapter has completed the second phase of the Water Supply project (6871) in Guachtuq, Guatemala, May 8th – 21st 2014.

Over the course of this project EWB-USA WPI will assist the people of Guachtuq with gaining access to a potable, adequate supply of year-round drinking water by means of rainwater harvesting.

Guachtuq is in central Guatemala and home to 220 Pokomchi (Mayan descent) people (36 homes). The community has limited access to obtainable water at the bottom of the hill that the community located one. The local NGO EWB-USA WPI is in contact with is a Pokomchi Cultural Center called CeCEP. Their aims are to aid local Pokomchi people and align well with the aims of the WPI project. The Implementation Agreement is active and functioning as intended.

The program began in 2009 and the water supply project is the first in the program. There have been three assessment trips and three implementation trips thus far. The first two assessment trips initiated the program and started the project. The first implementation trip was a pilot implementation of two systems. The third assessment trip was taken in order to assess the pilot systems. The last two trips were implementation trips. The implementation phase of this project has been spread among many trips for two reasons: to ensure the rainwater harvesting systems are having a positive impact and because the systems are home specific, individual systems that are designed and build to service the family's need living each home.

The team and the community implemented 8 rainwater harvesting systems, directly impacting 49 people living in Guachtuq. The collaboration and work the community provided was a factor in the success of the implementation. A system includes the following components: concrete base, water storage capacity (tanks), gutters, first flush units, and PVC piping. Each family that was implemented on now has a complete system composed of these components.

The majority of the systems were built as designed with minor deviations such as the fittings used for the PVC piping and the location of the first flush units. A more detailed description of the minor changes is located in section 6.3 below.

The project is 33% completed and will be 100% complete by May 2016. When the project is complete each home in Guachtuq will have access to an adequate supply of potable water. The systems that have already been implemented are fully operational. If there are and design changes for future systems, all previously implemented systems will have the opportunity to implement these changes at their home with the help of EWB-USA WPI. The necessary information required for the remaining 66% of the implementation was gathered on this trip.

The team also conducted extensive interviews with each family in the community as an integral part of understanding the social dynamic in the community around water poverty and the impact of the EWB-USA WPI water supply project.

2.0 INTRODUCTION

This report summarizes the major accomplishments achieved during the May 2014 EWB-USA WPI implementation trip. Additionally, this document will serve as a reference for future EWB-USA WPI implementation trips. This trip marks the second implementation trip that EWB-USA WPI has completed through EWB Nationals. However, with an independently-funded trip in January 2014 (funded through the EPA's P3 program), this was the third implementation that EWB-USA WPI has completed in Guachtuq. There are a total of twelve beneficiary homes in the community with complete systems thus far, eight of which were completed on this trip.

During this trip, the team successfully implemented rainwater harvesting systems in eight homes, modified a January 2013 pilot system, and completed final stages of implementation on a January 2014 beneficiary's home (House 1). This process included allocating appropriate materials to each home and instructing community members about appropriate implementation techniques. The team also spent considerable time educating families about proper methods of cleaning and maintaining their systems. The travelers ensured that every beneficiary family was equipped with proper education materials to aid them when EWB-USA WPI is not in the community.

In addition to implementing systems, the team continued to monitor water quality in the community. Tests were conducted at the community water source and various rainwater harvesting systems, including those with EWB tanks and non-EWB tanks. These data are discussed in more detail under section 6.5.1.

The team spent extensive time strengthening relationships with the community and preparing for future implementations. During this trip, nearly every family in the community was interviewed to gain a deeper understanding of the culture and people's perceptions of water issues within the community. Finally, the team assessed the remaining twenty-five homes in the community that will be implemented on by May 2016.

3.0 PROGRAM BACKGROUND

The Engineers Without Borders USA chapter at Worcester Polytechnic Institute (EWB-USA WPI) aims to provide the community of Guachtuq, Guatemala, with a sustainable, secure, year-round water source. The community of Guachtuq is located in the Alta Verapaz region of Guatemala and is home to about 220 Pokomchi (people of Mayan descent) among 36 families. Of the many problems they face daily, unreliable access to clean drinking water was identified as their greatest concern. Water security can be described as having adequate quantity, quality, and access to water to meet a home's basic needs. Currently, many families rely on a water source called the *finca* a polluted, spring-fed water basin located a half-hour walk downhill from most families in the community. During the dry season, which lasts from February to May, the *finca* often dries up, leaving families to find other, more distant sources of water.

EWB-USA WPI completed two assessment trips in 2010 and 2011, where the team started to form a relationship with the community members of Guachtuq. The team conducted in-house assessments, held community meetings, and undertook water quality studies. In 2011, the team

conducted a community wide survey to determine a water consumption rate for each family. Unfortunately, no trends emerged that related number of family members to water consumption across the community. The team also thoroughly assessed the two homes chosen by the community for pilot implementation. This included measurements of each home as well as in-depth discussions of the needs of each family.

Throughout the project, one of the most important tools the team has developed is an Excel model that, uses a variety of parameters, discussed in Section 6.1, that helps the team design systems to fit the specific needs of each family. Considering average regional daily rainfall, roof area of a home, number of family members, and water consumption rate, this model can be used to determine how many additional tanks each family needs to ensure sufficient water for drinking and cooking throughout the dry season.

Using information gathered from the first two assessment trips, Excel model results, and nearly two years of research and design, the team constructed two pilot systems during the first implementation trip in January 2013. The goal of the pilot project was to ensure that the Excel model worked properly and to provide a basis for future system design. Other benefits of a small-scale implementation included developing methods for construction and beginning to establish a knowledge base about constructing rainwater harvesting systems within the community. In order to accurately determine if these pilot systems served the families appropriately, a monitoring system was also established during this implementation trip. A volunteer at CeCEP, EWB-USA WPI's partner NGO, visited the community while the team was out of the country, collected preliminary information on the efficacy of the rainwater harvesting systems, and received verbal feedback from both families.

The team completed a third assessment trip in May 2013. The goal of this trip was to evaluate the success of the pilot systems and assess homes for the second implementation. In addition, a thorough census was conducted to gather information about every family and to learn general information about the community. Water quality tests were also administered. The monitoring system established during the January 2013 trip evolved into a bi-weekly survey that asked residents about their water consumption habits. Follow-ups were conducted with the two pilot homes to ensure the systems functioned properly and, most importantly, satisfied each family's daily needs.

The second implementation trip, EWB-USA WPI's fifth trip to Guachtuq, took place in January, 2014. Though not an official EWB trip since it was funded by a grant through the EPA P3 program, this trip was essential to the progress of the project. The team constructed two rainwater harvesting systems, conducted water quality tests, held in-depth, semi-structured interviews, established a connection with the mayor of the Municipality of San Cristobal, developed stronger relationships with CeCEP and community members, and further assessed the eight homes scheduled to receive systems during the May 2014 implementation trip. Necessary details were also discussed with local hardware stores, water tank vendors, and the Municipality to arrange availability of materials and plan for transportation.

Finally, EWB-USA WPI's sixth trip to Guachtuq, the third implementation trip, took place in May 2014. In under ten days, the team and community members built eight rainwater harvesting systems, updated systems of previous beneficiaries, conducted two rounds of water quality testing, interviewed almost every family in the community, met with the mayor of the

Municipality, held multiple community meetings, strengthened relationships with local NGO partner CeCEP, and assessed the homes of the remaining twenty-five families.

Furthermore, the team strengthened ties with the community to ensure success in future, large-scale implementations. The team spent time getting to know community members in order to build trust and understanding. The next step for EWB-USA WPI and the community of Guachtuq is to complete implementation of the remaining 25 rainwater harvesting systems by May 2016.

4.0 TRIP DESCRIPTION

During the May 2014 EWB-USA WPI Implementation Trip, the EWB-WPI USA team worked with the community members of Guachtuq to complete the largest and most successful implementation thus far. A total of eight rainwater harvesting systems were constructed, directly impacting 49 people in the community. One system, originally started in January 2014, was completed after the family finished modifying the structure of their home. One of the pilot systems, built in January 2013, was updated to better match the needs of the beneficiary. Additionally, the team tested water quality at the finca and tanks from the January 2013 and January 2014 implementations, conducted extensive interviews with nearly every family in the community, held community meetings in Guachtuq, met with the Alcalde (the mayor) of San Cristobal, and assessed the remaining 25 homes in the community. This section details each accomplishment of the trip.

4.1 Implementations

On this trip, the team and community built new rainwater harvesting systems for eight homes. Before the trip, the team did extensive work designing systems specific to each home. This was achieved by using the Excel model that the club has created and designing systems based on these data. Each system had a unique bill of materials which was prepared before the trip. Once in country, the team assembled kits for each home based on the specifications listed in the bill of materials. These kits included the appropriate number of tanks, gutters, lengths of PVC, and PVC connectors. The delivery of the materials to the community was a semi-organized orchestra of different forms of materials transportation. Some of the materials were purchased from Macsams with transportation included. The tanks were transported from Guatemala City all the way to the community. The rest of the materials were transported by use of the municipality borrowed trucks. This collaboration with the San Cristobal municipality was facilitated through Sucy, the head of our NGO. Once all of the materials were delivered to each home, the team and community members worked in phases to complete the systems.

First, the frame for the concrete base was assembled. Next, concrete was poured and allowed to set overnight. Once dry, cinderblocks were placed on top of each concrete slab for additional height. Gutters were then attached to each home, tanks were connected by PVC piping, and first flushes and overflows were constructed. As discussed further in this report in sections 6.1 and 6.3, the implementation phase of the trip ran smoothly because of consistent and dedicated assistance from the beneficiary families. Each family had at least one representative who assisted with the implementations every day, and the community members worked in teams to implement at each home, rather than implementing solely at their own home. This teamwork was quintessential to the success of this implementation. After the implementations were

completed, the EWB-USA WPI team re-evaluated each home to record what materials were actually used for each home and to make note of discrepancies between that list and the original bill of materials.

4.2 System Improvements

The May 2014 EWB-USA WPI implementation team also worked with community members to improve two previously constructed systems. Modifications made to the system of Oscar Vincente Laj Lem, House 1, were a continuation of the January 2014 implementation. In January, Oscar and Mauricia expressed their desire to make significant changes to the structure of their home, which would result in a more efficient construction process and high quality system than had been previously planned. Thus, EWB-USA WPI built a temporary, functioning system in January and finished installation of the first flush and PVC connections in May. The second system improvement was to the pilot beneficiary home of Cristobal Laj Cojoc, House 8. The team added two first flush units to the system and redirected the overflow pipe to empty into a better location for the family.

4.3 Education

In order to ensure that the systems continue to function after EWB-USA WPI's presence in the community fades, this trip focused on providing in-depth education materials as part of the PMEL for the project. Each family in the community was given a manual with the education materials prepared before the trip. These were distributed and explained at a community meeting. Additionally, the manuals were explained thoroughly in Pokomchi through translators to the beneficiary families after their homes had been implemented on. Visual aids and demonstrations were used where appropriate. The content of the education materials is further discussed in section 6.5.2.

4.4 Water Quality Testing

In order to continue evaluating the success of the project, EWB-USA WPI conducted various water quality tests during this trip. Two rounds of tests were administered on samples of water collected from the finca and from various tanks in the community. The results of these tests are discussed in further detail in section 6.5.1.

4.5 Family Interviews

Semi-structured (conversational) interviews were held with almost every family in the community. Facilitated by faculty advisor Laureen Elgert, the interviews were conducted using social science research methods. Initial questions prompted discussion about

- a. The finca and general access to water resources
- b. Water consumption and tank maintenance (where applicable)
- c. Water boiling and health
- d. Family background information

Interviews took place with three groups of families: past beneficiaries who received EWB systems in January 2013 and January 2014, those who received systems on the May 2014 implementation trip, and those who will receive systems on future trips. It was not possible to conduct interviews with every family, and there is inconsistency in the data collected due to the

informal nature of the interviews. Overall, the interviews were essential to learning about how the community members view water and limitations to water security. Translators Abelino Cal and Edgar Gua were invaluable to completing the interviews since most of the community members, especially many women and the elderly, prefer to or are only able to converse in Pokomchi. The main takeaways from the interviews are summarized in section 11.5.

4.6 Meetings with Beneficiaries

Throughout the trip, EWB-USA WPI held meetings with the May 2014 beneficiary families. These served as instructional reminders and guidelines for the families. Topics discussed include:

- a. Participation in implementation
- b. Commitment to the future of the project
- c. Implications of being a beneficiary
- d. Contractual agreements with EWB-USA WPI and CeCEP

Through these meetings, it was conveyed to the beneficiary families that they would be expected to participate in the implementations for the 2014 trip as well as implementations in future trips. Over the time that EWB-USA WPI has spent with the community, a strong relationship has been built such that there is trust and accountability between both parties. Therefore, this discussion did not yield dissent; rather, it was more of a reminder to each of the families and was well received. Additionally, conversations included the monetary contributions expected of each family and how they would pay CeCEP 5% of the monetary cost for their system. Sucy the head of CeCEP then puts this money into a bank account designated for these payments and ultimately this money will be used to pay Alvaro to continue monitoring the homes.

4.7 Community Meetings

In addition to meetings with the beneficiary families, EWB-USA WPI felt that it was important to hold two community-wide meetings. These meetings, timed at the beginning and end of the trip, served to keep the community informed about progress on the project. It is EWB-USA WPI's goal to develop a strong, lasting relationship with the community. The team desires complete transparency surrounding work done with the community, and these meetings serve as a medium to achieve such a relationship. The team spoke with the community about plans for the remainder of the project, presented education materials, and introduced the incoming Project Lead, Aaron Pepin, to the community. The team answered all questions that the community had, and cross-checked to ensure that anyone in the community who believed that they should be on the beneficiary list was included and actually belonged there. EWB-USA WPI also announced that any family who did not permanently reside in the community as of the start of the May 2014 trip was ineligible to receive a system. This step was taken by the team to establish the final scope of the project.

4.8 Water Committee Meetings

EWB-USA WPI and the Guachtuq Water Committee held one official meeting during the trip, although individual members frequently helped with implementations and community relations. The main goal of the meeting was to reassess the way beneficiaries are chosen. The first pilot implementation homes were chosen through a need-based system that selected one family

from each of three socioeconomic strata constructed by the 2011 EWB-USA WPI travel team. These strata divided the community into groups based on wealth and status. However, only two of the three homes were implemented on because the family chosen from the lowest bracket moved out of the community. The two homes implemented on in January 2014 were chosen based on need, in a decision made by the EWB team. The eight homes implemented on during the May 2014 implementation trip were chosen in a lottery.

The system of choosing homes was amended on this trip in order to prioritize need more highly than was done in the past. In May 2013, the travel team and the Water Committee discussed the potential for need-based selection. Over the past year, EWB-USA WPI prepared a census of the community that details the number and age of family members and current water storage capacity for each home. This was sent to the Water Committee to encourage them to begin considering which families would most benefit from a system. However, the Water Committee did not feel comfortable making a final decision independent of EWB-USA WPI. The meeting determined that, in order to avoid potential resentment and political conflicts among community members, it was more logical for the EWB-USA WPI team to select the order in which homes would receive systems. The team decided to prioritize families that had no tanks. Families living furthest from the finca were granted next preference.

4.9 Home Assessments

In preparation for the future implementation trips, the team conducted two-stage assessments at each of the 25 remaining homes. It was decided during the trip that all 25 homes should be assessed because it may be possible to complete the implementation of all of the remaining systems during the May 2015 Implementation Trip with sufficient fundraising. The first-stage assessments were primarily to discuss the terms of agreement and MOUs with future beneficiary families. The census that was developed in May 2013 was updated to verify the names and ages of family members and current water storage capacity of each house. Dimensions of the house were recorded as well. These parameters were used to calculate system requirements before the second-stage assessments. During the second stage, the EWB team discussed system layout options with each family as well as necessary components of the system to be completed prior to the implementation. Once the system was explained and the layout was agreed upon by EWB-USA WPI and the families, the MOUs were signed.

5.0 COMMUNITY INFORMATION:

5.1 Description of Community

General Information

Guachtuq is a small community located near the town of San Cristobal in the mountainous Alta Verapaz region of Guatemala. EWB-USA WPI has been working with 36 homes in the community, about 220 people, since 2009. The community is a somewhat informal settlement of Pokomchi (Mayan) people. Homes are dispersed over a 1.5 km long, dirt-rock road that winds up a mountain located approximately 6 km from San Cristobal. Guachtuq is the third of five communities along this road. Throughout the region, there are many similar satellite

communities that branch away from San Cristobal. Members of Guachtuq and other communities in the area primarily speak Pokomchi, a Mayan language. Some community members have secondary knowledge of Spanish.

Families frequently move into and out of Guachtuq or relocate their homes within the community. The oldest families have lived in the community for 30 years, while others have recently begun to build homes. Some families rent the land they live on, but the majority owns their land or lives on land owned by relatives. Houses are primarily constructed from wood planks and have roofs made of corrugated zinc-galvanized steel or plastic. Based on census data collected in Guachtuq, the average family has 4 children living at home. The birthrate is difficult for EWB-USA WPI to calculate based on our data and is likely higher since many older children have moved away and started families of their own. Most community members have parents, siblings, or extended relatives living in the community. It is not uncommon for a son or daughter to marry and build a home on their parents' land.

In most families, the husband is the breadwinner and head of the household. Some women are not allowed to work and rarely leave the house. Many men work as security guards or *campesinos*, tending crops for wealthier land owners. These types of jobs often require men to be away from home for up to two weeks. Occasionally, men must also leave the community for an extended period of time to find work, leaving the women and children at home to manage for themselves. In some situations, the wife is clearly in control of the household and keeps things running. Some women do have jobs, such as spinning thread, which they do in their free time. Many families own plots of arable land in Guachtuq, or the uphill community of Rexquix, where they grow both subsistence crops and cash crops.

Children go to school either uphill in Rexquix or downhill in the community of Las Arrugas. Some children, particularly those of less-poor families, go to school in San Cristobal. Most children attend through 4th grade. Some stay on for an additional two to three years of secondary school, which they can attend in San Cristobal. Some of the children the team met aspire to attend university as well.

An updated census of the community is located in Appendix A.

Water Poverty: The Finca

The community members of Guachtuq have identified *water poverty* as their greatest problem. Water poverty, the antithesis of *water security*, is characterized by a lack of accessible, potable water. EWB-USA WPI defines water security as having adequate quantity, quality, and access to water to meet human needs. Guachtuq lacks this in all three dimensions.

Quantity

In the mountains of Guatemala, natural water sources exist, but are geographically variable and unreliable. There is only one natural water source available to members of Guachtuq: a concrete water collection basin located downhill of the community. The water that feeds the basin comes from a spring located on a small, nearby farm called *Finca La Primavera*, literally *Spring Farm* (in Spanish, *primavera* means *spring*, as in the season). Colloquially, the basin is referred to as the *finca*. Community members used to have access to the source of the water

(the *fuelle* or *nacimiento*, both of which translate to *spring*, as in a natural source of ground water) until the finca basin was built in 2006 through an agreement between the land owner of the Finca La Primavera and the community. The basin is located on public land. Many families rely on the finca water as their primary source of water for drinking and cooking, and nearly every family uses the water for washing clothes and bathing.

Guatemala is a subtropical country, and receives rain throughout much of the year. The heaviest rain falls between June and August. The dry season extends from February through the beginning of May, and is said to have intensified in recent years. During the dry season, water shortage is a serious issue. Families in Guachtuq struggle to get enough quantity of water to meet basic needs. The finca basin often runs dry, leaving some families with few options to obtain drinking water. At these times, families must either purchase water from San Cristobal or hike to other communities to collect water.

Quality

Even with water available, it is imperative that water is of adequate quality to meet needs. While runoff water may be sufficient for washing clothes, potable water is more difficult to obtain. The water that feeds the finca basin travels about 100 meters from the source to the basin, and becomes highly contaminated in the process. Even at the source, water quality tests from January 2014 detected pathogens. The karst soil formations in this area allow pollutants to easily seep down to the aquifer that feeds the spring. Water quality tests have shown that levels of harmful *E. coli* and fecal coliform bacteria in the finca basin are well above acceptable standards for potable water. Tests from 2010 reported the existence of pesticides and high turbidity in the finca as well. These early tests also report that water hardness, iron, alkalinity, and pH are within acceptable limits.

The water in the finca is not suitable for drinking unless boiled first to kill bacteria. Testing has shown that boiling the water for even a few minutes kills *E. coli*. Testing has also shown that water collected in rainwater harvesting systems has lower levels of *E. coli* than finca water. Through ongoing improvements to system design, EWB-USA WPI aims to create systems that provide safe drinking water.

Access

The third dimension of water security, access, is the ability to obtain adequate quantity and quality of water to meet needs. So far, EWB-USA WPI has helped twelve families improve access to potable water for drinking and cooking year round.

Physical barriers to access exist. The finca basin is located about a half-hour's walk, on average, from homes in the community. Women and children, who are primarily responsible for collecting water, often get up at 3:00 or 4:00 in the morning to go to the finca before school. Water is carried in containers called tinajas, which hold about 2.5 gallons of water. Women and children carry tinajas and other vessels on their heads, placing a cloth underneath to provide additional support and comfort. Carrying 2.5 gallons of water uphill is hard work, and many families make this trek three or four times each day.

Through interviews, the team has learned about a variety of social barriers to access that exist as well. Since the source of the finca lies on private land and the relationship between the community and the land owner is tenuous, there is an ongoing concern that access to the finca water will be restricted. Already, community members have been barred from the La Finca Primavera property and must walk an additional fifteen minutes through a roundabout public-access path to get to the water. Trash has frequently been found at the finca, and people from other communities regularly come there to collect water. According to several sources in Guachtuq, people from other communities are the ones responsible for garbage and abuse of the finca's water. During the dry season, more people than usual use the water, even though other communities have alternate water sources.

Around 2008, 25% of the families in Guachtuq received rainwater harvesting tanks from a program through the municipal government, which provided additional water storage. However, improper design and implementation of these systems, compounded by a lack of routine maintenance and cleaning, has rendered the systems unable to meet drinking water needs of the families. In addition, corruption is rampant among government-sponsored projects, and many families feel they are repeatedly excluded for political reasons.

5.2 Community Relations

COCODE

The COCODE is the governing body of Guachtuq. Currently, Domingo Caj Pop, a wealthier member of the community, is the president. He has been president of the COCODE for as long as EWB-USA WPI has been partnered with the community. The COCODE represents Guachtuq to the San Cristobal Municipality and petitions the Municipality to aid in community development projects. It is through the COCODE that Guachtuq has been a part of government tank programs. However, EWB-USA WPI is uncertain about the functions and proceedings of the COCODE. To date, the team does not have a list of the members nor does it have an idea about the frequency or content of COCODE meetings.

Over the course of the project, EWB-USA WPI has largely removed the Guachtuq COCODE as a stakeholder in this project. This action is due to the ambiguity of the COCODE's daily functions in the community. Additionally, there have been multiple reports of corruption in the COCODE, leaving EWB-USA WPI wary of viewing the COCODE as a reliable partner. During EWB-USA WPI's time in Guachtuq, it has surfaced that Domingo tried to get financial benefits at the expense of the community from the EWB-USA WPI project, just as he did during the 2008 government tank project. Community members have reported that and the team witnesses, on multiple occasions, the COCODE tried to collect money from community members in order to keep them on the list for such projects. Though the team has not investigated many of the allegations, unjust actions will not be tolerated by EWB-USA WPI. For this reason, the team has decided to avoid consulting the COCODE as a major partner in the project. Individual cocode members, however, are still included as project beneficiaries.

Water Committee

The Water Committee was established by community members in 2013 as a group to manage the EWB-USA WPI Guachtuq Water Supply project. The Water Committee replaces the COCODE as the authority on the project. The current President of the Water Committee is Cristobal Laj Cojoc (House 8) and the Vice President is Roberto Chocoj. The complete list of Water Committee members is:

Cristobal Laj Cojoc (House 8, January 2013) – President
Roberto Chocoj (House 26, January 2013) – Vice President
Catalina Macs Calel (House 16, May 2015/16) – Secretary
Ricardo Gualim (House 29, May 2014) – member
Angelina Quej Ical (House 33, May 2015/16) – member
Elidia Esperanza Xona Yuja (House 26, January 2013 [Roberto's wife]) – member
Maria Magdalena Jom Yuja (House 34, May 2015/16) – member

The Water Committee is voluntary, and members are allowed to participate and resign as they choose, as long as members do not leave concurrently. On the May 2014 Implementation Trip, Roberto proved to be the most valuable member in the community, giving freely of his time, resources, and dedication. He is incredibly trustworthy and committed. Roberto also keeps equipment that EWB-USA WPI bought during implementations and plans to use again in the future. In the meantime, community members may "check out" any tools that belong to EWB-USA WPI and return them. Both Roberto and the team have copies of a complete list of these materials and equipment, as seen in Appendix B.

It is noteworthy to mention that, as Roberto has taken on increasing leadership within the project and the water committee, he has been confronted by some in the committee (notably Cristobal, president) and accused of 'taking people off of the list'. This has come about, at least in part, because of the differential numbers of tanks granted Guachtuq families. Not all families receive tanks as a part of this project because it uses existing system characteristics and family need (i.e. roof size, family size) to determine how many tanks are granted. This project is about helping families achieve water security, and not about handing out tanks. This model differs from projects that have come before, which often granted tanks based on the advice of the COCODE alone. Since water tanks are often seen as an asset that is easily liquidated in times of need, and thus valued for purposes beyond rainwater harvesting, the rationale behind 'who gets what' is contentious and not well understood. Thus, it remains of the utmost importance that the team takes time to explain the rationale of water security (and how system requirements are calculated), to community members and project beneficiaries.

Roberto is crucial to the success of the project. He is not only a hard worker with a good heart, he is a friend to EWB-USA WPI. Throughout the entire project, Roberto has given freely of his time, taking the equivalent of several weeks off of work over the past four trips. He is also seen as an authority on rainwater harvesting and system maintenance. Several other community members told the team that they turn to Roberto when they have problems or questions about the system. Herlinda Ixian (House 27) specifically said she asked him about using chlorine to clean the tanks. Similarly, Roberto has been crucial to maintaining relations with Julio, the manager of the Finca La Primavera property. He has spoken to Julio several times about access to the finca basin, and in January, he compromised with Julio to allow vehicles to use the road that runs through the Finca property.

CeCEP

EWB-USA WPI has established a strong relationship with CeCEP (Centro Comunitario Educativo Pokomchi), an NGO that supports the local Pokomchi communities through social and educational services. CeCEP is located in San Cristobal, a 40 minute walk from Guachtuq. CeCEP provides logistical support to EWB-USA WPI including transportation, translators, and housing. Sucely Ical Lem (Sucy) is the head of CeCEP and has been a reliable resource for cultural questions that arise. EWB-USA WPI's project aligns with the values of CeCEP; both parties aim to help the Pokomchi people. Members of Guachtuq visit CeCEP frequently for various educational, cultural, and administrative reasons.

CeCEP is an invaluable contact, and integral to the success of the project. Sucy is a respected authority both in Guachtuq and in San Cristobal. Whenever the team has run into conflicts or had difficulty making decisions, Sucy's resourcefulness and advice has been highly valued. CeCEP also generously allows the team to use an upstairs classroom as an office during trips. Many evenings have been spent at CeCEP debriefing and preparing for the days ahead.

CeCEP also plays an important role in monitoring and in-country administration of this project. Sucy manages a local EWB-USA WPI bank account and keeps track of payments families make. She also connected us with Alvaro, a CeCEP volunteer and friend who regularly goes to the community to collect data for the monitoring program. Monitoring has changed over the past few years, but Alvaro is a continual symbol of the team's presence in the community and dedication to the project. The data he has collected has been essential to determining the community's water consumption rate, and the trust he has built with the community members has also been incredibly valuable. In the future, he will help track the functionality of systems and evaluate the success of the project.

Staff at CeCEP have been actively involved with preparations that catalyze our implementation trips and make them run more smoothly. Alvaro and Sucy have taken charge of purchasing materials before our arrival and have also arranged for their delivery to Guachtuq.

Municipality

The Municipal Government of San Cristobal is an important partner in the Guachtuq Water Supply project. The mayor of San Cristobal met with members of the EWB-USA WPI team during both the January 2014 implementation trip and the May 2014 implementation trip. He is outwardly supportive of the work the team does and has said on numerous occasions that it is important to work with the poor and help those in need. In line with his words, the mayor granted EWB-USA WPI the use of municipal trucks and workers on both implementation trips to facilitate transporting materials to the community. The Municipality workers also helped deliver materials from Coban, the capital of Alta Verapaz, prior to the team's arrival in-country. The Municipality's support will be essential to the success of future implementation trips and subsequent work the team may choose to pursue in the area.

6.0 PROJECT SUMMARY

6.1 Project Description

This implementation trip was the latest step in EWB-USA WPI's mission to provide water security to the community of Guachtuq, Guatemala. On this trip the team worked with community members to implement complete rainwater harvesting systems for eight homes. Each system included the basic elements of: a concrete base, gutters, pipes, a first flush, and storage tanks. Systems were specifically designed for each home using the club's Excel model and measurements taken in the January 2014 implementation trip. The Excel model considers the roof area, existing tank storage, and number of family members in each home. It then utilizes average water consumption rate, many years of daily rainfall data, and current daily rainfall data that EWB-USA WPI has been collecting since the beginning of the project, to predict how full the tanks will be at any given point in the year. This allows the team to determine the system requirements that need to be implemented at each home to ensure that they will not run out of water for drinking and cooking. The January 2014 travelers worked with each family to determine the best place to put the system, and then the club developed a plan for piping and location of first flush units. Preparatory work allowed the team to predict and purchase the appropriate materials for construction. On this trip, the community worked alongside EWB-USA WPI to implement these systems in order to create a sense of ownership, and these community members are now extremely efficient workers.

6.2 Summary

As stated in the Project Description, each system was designed for the specific family that received it. Each system included a concrete/cinderblock base, gutters, PVC pipes, a first flush, mosquito netting and storage tanks. The team bought all materials from local suppliers and hardware stores.

Colonial style gutters and corresponding gutter unions and downspouts are purchased, but the clips that they used to hold them in place are cut out of wood based on a design created by a community member on the pilot implementation trip in January 2013 (Cristobal Laj Cojoc, House 8).

The first flush is a vertical PVC pipe that separates the first volume of water in a storm that rinses dust, dirt, and other debris off the roof, reducing roof-sourced contamination of the drinking water in the tanks. There is an empty water bottle inside the tube that floats as the first flush fills with water. A reducer at the top of the tube catches the water bottle when the tube fills up, creating a seal that prevents dirty water from mixing with the cleaner rainwater that follows. First flushes are designed with a ball valve at the bottom so that they can be emptied after it rains, and the water in it can be used. The length of each first flush is based on the roof area from which it receives rain. Most of the first flushes that the travelers implemented were made out of 4" PVC tube, but a couple were small enough that 3" PVC piping was used instead.

The piping for the rest of the system was all planned out before travel, and so it only needed to be cut to length and brought up to the community. All connectors were accounted for in the bill of materials that was brought with the travelers, and the kits that were created with them were brought to each home before implementations began.

The storage tanks were the same 2500L Rotoplas HDPE plastic tanks used in previous implementations.

6.3 Difference Between Planned and Actual Implementation

Due to extensive pre-trip planning, the travel team was fortunate to not encounter any major setbacks during the implementations. However, there were a few minor discrepancies between what was planned and what actually occurred. Among these was the duration of the implementation process. The original itinerary predicted the systems being completed on Monday, May 19. But due to a variety of factors including beneficial weather and phenomenal participation from members of the community, the implementations were completed by Friday, May 16. The time saved proved to be very valuable as the travel team was able to focus on finishing interviews and assessing all of the remaining homes for future implementations.

Another minor difference between planned and actual implementation occurred with materials distribution. Prior to the trip, the travel team created a drawing of every house to be implemented on that outlined the placement of the gutter and pipe system leading to the tank. From this diagram the lengths of gutters and PVC pipes could be determined as well as the quantity of other necessary materials including PVC elbows, unions, and tank bulkheads. Once these parts were itemized, they were ordered and delivered to CeCEP. From there, the team sorted and distributed the materials to their respective houses in the community. Once all the materials were delivered, the men of Guachtuq took the lead in construction with minimal guidance from the EWB-USA WPI travel team. The men were extremely efficient at completing the systems since they had existing construction skills and the knowledge base established on past implementation trips. However, because of this, the blueprints that the travel team created were not always followed as planned, which led to a surplus or shortage of some of the materials. Though confusing at times, this was only a minor setback. Parts were redistributed as necessary or bought at a hardware store the following day. Often times the community members actually saved resources and invented a more logical and less costly waterway than the travel team had originally designed.

Another unexpected yet beneficial surprise occurred when Sucy informed the travel team of a public relations opportunity she set up for them. She asked a contact of hers at *La Prensa Libre*, a nationally circulated Guatemalan newspaper, to travel to San Cristobal to interview the travel team. On the morning of Saturday, May 17th, a reporter and cameraman arrived at CeCEP to record an interview with members of the travel team that aired on the Guatemalan news channel *Guatvision*. The interview questions focused on water inequality issues in the region and how much of the population has an adequate supply of water, while many others, including those in Guachtuq, struggle to meet their basic needs. The news segment included video of the community members and EWB-USA WPI team working together to unload materials and raise gutters. This opportunity was an excellent chance to showcase the benefits of the EWB project on a national scale. It raised good publicity for the project and Engineers Without Borders as a whole. The travel team had left Guatemala before the interview was televised or the article was published, but the news segment can be viewed online (See minute 2:36, <https://www.youtube.com/watch?v=XAQavpHmSGc&feature=share>).

6.4 Drawings

This section contains a drawing of the system components in a general form and one example of the technical drawing for planning a house-specific system. The drawings for the remaining 8 homes with details showing system design changes are located in Appendix C.

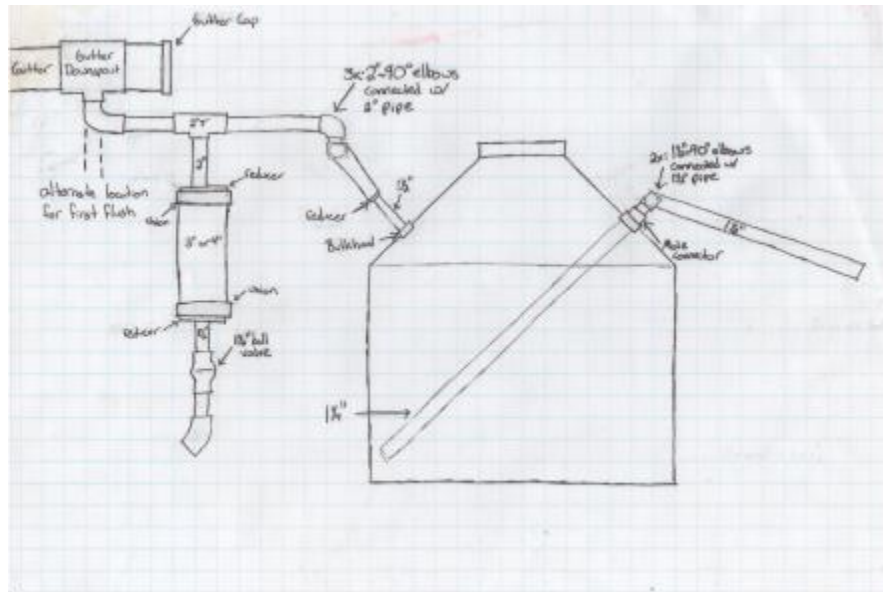


Figure 1: This drawing details the basics of the systems that EWB-USA WPI is implementing. In it you can see the basic elements of the gutters, PVC pipes, first flush, and storage tank equipped with an overflow. It is important to note that the location of the ports into the tank vary depending on roof area. This drawing does not show an accurate representation of the typical inflow and overflow locations.

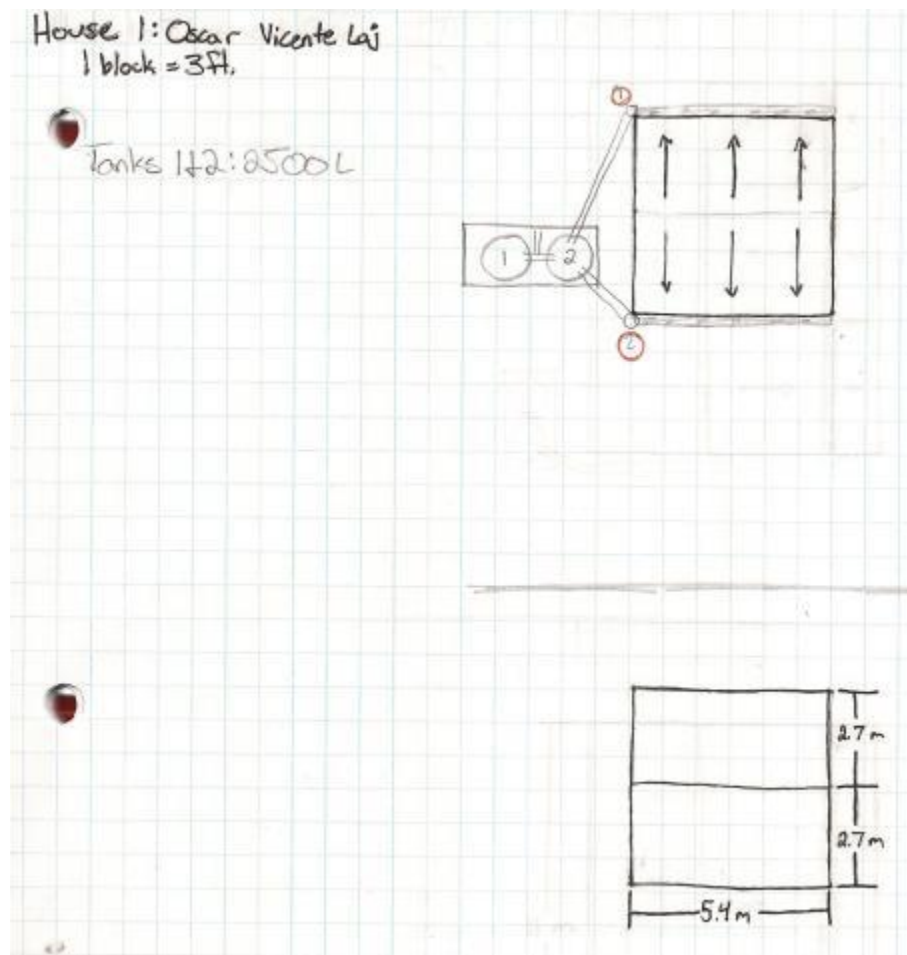


Figure 2: Drawing of House 1. The first flushes are marked in red, all other elements of the system remained the same.

6.5 Operation, Maintenance and Education

Operation and Maintenance

In-Country Monitoring

In order to effectively assess the success of the Guachtuq Rainwater Harvesting project, EWB-USA WPI works closely with Alvaro, a volunteer at CeCEP who the club pays in order to maintain consistent monitoring while there are no travelers in country. The Monitoring forms are located in Appendix D. Alvaro distributes monitoring forms written by EWB-USA WPI and works closely with both the club and the community members. He is in charge of monitoring each of the twelve beneficiary homes monthly. Starting in May 2014, he will be paid 750 Quetzals (~\$100.00) each month to meet with every home. Additionally, he is responsible for ensuring that future beneficiary families prepare their homes according to EWB-USA WPI instructions prior to the travel team's arrival in country. This expedites implementations and ensures that families are adequately invested in and prepared for the project.

Water Quality Testing

While supplying water to families is crucial, water security is also dependent upon the quality of available water. Ideally, water collected by the rainwater harvesting systems should be ready to drink, or at least of better quality than that which can be collected from the finca. To analyze current water quality, bacterial tests have been conducted during each trip since January 2014 and will be collected on future trips to indicate where improvements to water quality must be made and to monitor water quality over time.

Colilert and Petrifilm tests are used since they are simple field tests that yield reliable results. Each test requires a small sample of water. Ten milliliters are added to clear glass Colilert tubes, which are pre-filled with a chemical powder. For the Petrifilms, one milliliter is dropped onto a flat, circular test paper that has a small amount of agar and resembles a Petri dish. Once assembled, both types of tests are incubated on the body for about 22 hours. To make the time more comfortable, the team designed shirts with pockets that accommodated the dimensions of the two tests.

The Colilert tubes will turn yellow with the presence of bacteria and will fluoresce under a black light with the presence of harmful *E. coli*. If the fluid in Colliert tests remains clear, the water is potable. The Petrifilm tests offer a better sense of how much bacteria is in each water sample. Red and blue colonies, general bacteria and *E. coli* respectively, can be counted per unit area on the flat test surface. The results of these tests can be seen in the following tables.

A colony count was conducted for only four of the Petrifilm squares to increase speed of test result interpretation. This count data can be multiplied by 5 to estimate the count for the full plate.

Day 1: May 11: Post Heavy Rain: 20 Hour Incubation				
Location	Colilert Test		Petrifilm Test	
	Yellow	Flourescent	Red Colonies	Blue Colonies
Finca Basin	Yes	Yes	56	11
	Yes	Yes	60	38
	Yes	Yes	16	17
	Yes	Yes	26	5
	Yes	Yes	64	15
Finca Tap	Yes	Yes	49	14
	Yes	Yes	21	16
	Yes	Yes	45	8
	Yes	Yes	64	11
House # 21: Miguel Government Tank	No	No	(14 total sheet)	0
	No	No	(10 total sheet)	0
	No	No	(11 total sheet)	0
House #31 Government Tank	Yes	Yes	Too many to count	0

	Yes	Yes	Too many to count	1
	Yes	No	Too many to count	0
House #26: Roberto Government Tank	Yes	Yes	Too many to count	4
	Yes	Yes	Too many to count	1
	Yes	No	Too many to count	1
House #26: Roberto EWB Tank, No Filter	Yes	No	11	0
	Yes	No	15	0
	Yes	No	7	0
House #26: Roberto EWB Tank With Filter	Yes	No	(2 total sheet)	0
	Yes	No	(3 total sheet)	0
	Yes	No	(4 total sheet)	0
House #27 EWB Tank No Filter	Yes	Yes	13	0
	No	No	10	0
	No	No	11	0

Day 2: May 14: Post 3 Days Without Rain: 20-21 Hour Incubation				
Location	Colilert Test		Petrifilm Test	
	Yellow	Flourescent	Red Colonies	Blue Colonies
Finca Basin	Yes	Yes	27	2
	Yes	Yes	47	5
	Yes	Yes	40	5
Finca Tap	Yes	Yes	18	3
	Yes	Yes	23	2
	Yes	Yes	21	11
House #8: Cristobal EWB Tank Water, Boiled to First Bubble at Midwife's (18 Minutes)	No	No	0	0
	No	No	0	0
	No	No	0	0
House #8: Cristobal EWB Tank Water, Boiled Two Minutes After First Bubble	No	No	0	0
	No	No	0	0
	No	No	0	0
House #8: Cristobal EWB Tank Water, Boiled Four Minutes After First Bubble	No	No	0	0
	No	No	0	0
	No	No	0	0
House #8: Finca Water, Boiled to First Bubble (5 Minutes, 30	Yes	No	0	0
	Yes	No	0	0

Seconds)	No	No	0	0
House #8: Finca Water, Boiled 7 Minutes, 30 Seconds	No	No	0	0
	No	No	0	0
	No	No	0	0
House #8: Finca Water, Boiled 9 Minutes, 30 Seconds	No	No	(3 total sheet)	0
	No	No	0	0
	No	No	0	0
Alfonso Concrete Tank	No	No	0	0

Results:

Each water sample collected was tested in a minimum of three Colilert tubes and on three Petrifilm tests to generate replicate data points and observe consistency of results. Water quality tests were conducted on two days during this trip. The following conclusions can be drawn about water quality in Guachtuq as a whole as a result of the May 2014 tests:

1. Tests confirmed that, despite the altitude, boiling water for as little as four minutes after the first bubble appears to be enough to kill all bacteria and E. Coli present in the water (however, it may take as long as 20 minutes to reach boiling from the moment the water is placed over a fire). Since water boils at a lower temperature at higher altitudes, concerns were raised about the efficacy of boiling. Further research is necessary.
2. The E. Coli count in the finca basin and finca tap water increased substantially after a period of rain, but no correlation to weather was observed with the general bacteria count. It is possible that bacteria collects and is washed into the finca during the rain, but does not have enough nutrients, sunlight, or other vital to survive for long. Again, further testing may confirm that *E. coli* presence increase with rainfall.
3. One concrete, government implemented tank was tested and the water was the cleanest of all samples taken. Further research into concrete tank design will take place during this coming academic year. However, since only one un-replicated tests was conducted, this data is inconclusive. Future travel teams will test other concrete tanks, especially since different families use and maintain them in different ways.
4. Some families who previously received systems are still having trouble maintaining their first flushes properly (water collected in these components was found to be extremely discolored with much debris), so education must continue to be emphasized on future trips.

Important data on bacteria data is summarized in this chart:

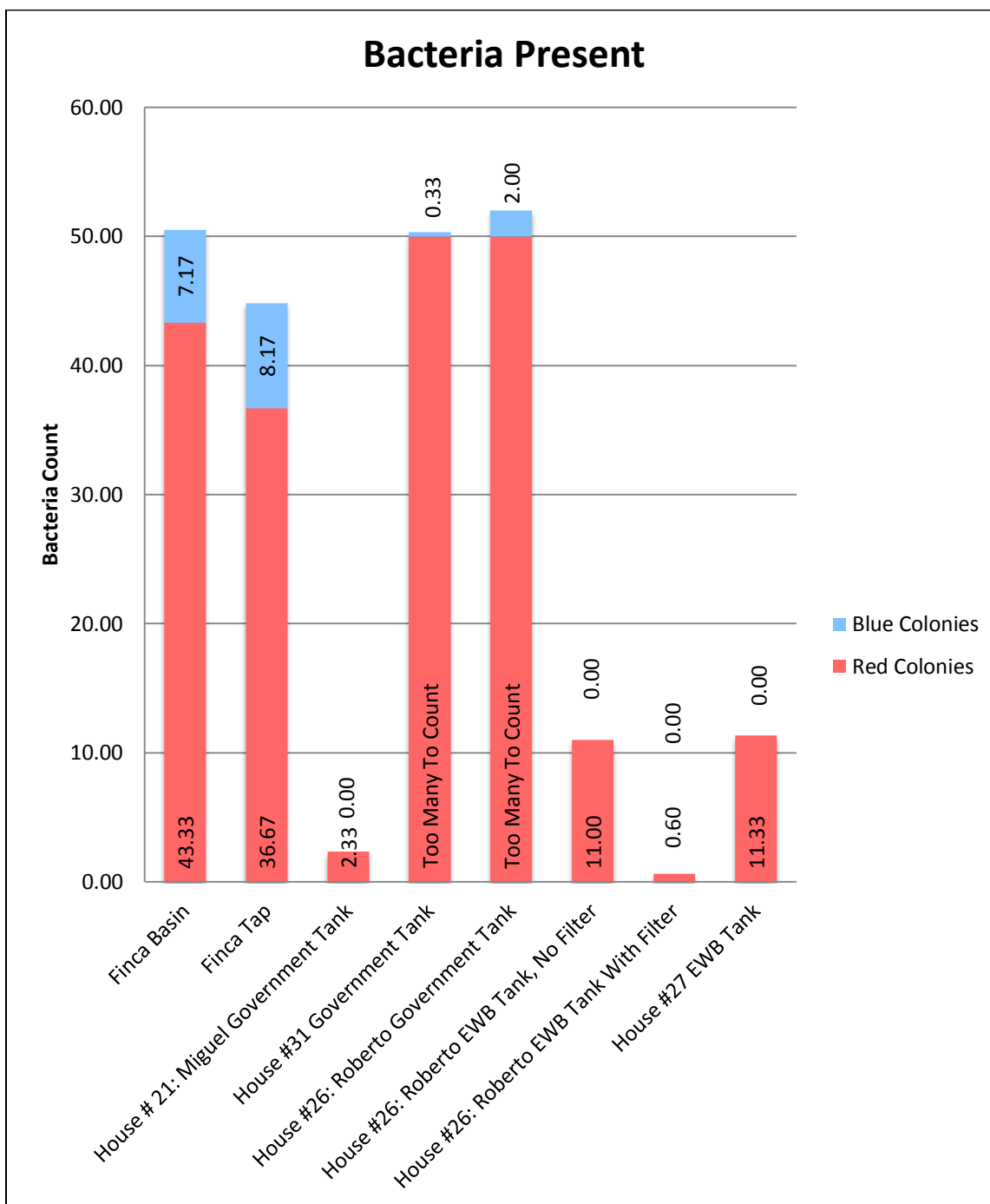


Figure 3: Bar chart depicting water quality data.

The finca and two of the government tanks have far more bacteria than the other water sources. Interestingly, the government tank at house 21 had levels of regular bacteria lower even than the EWB tanks implemented in January. At this time, it is uncertain why one government tank had much lower levels of bacteria and no harmful *E. coli*, while the other two had levels of regular bacteria higher than the finca. In interviews, the family reported that their tank-cleaning

regiment is similar to that of the other families. It is noteworthy that, when the tank water from House 21 was tested in January, 2014, similar results were obtained. Future travel teams will continue to investigate possible reasons for this occurrence.

The following table displays the level of hazard presented by each water source as indicated by the Colliert tests. Red cells indicate that harmful *E. coli* are present and drinking the water unboiled may lead to illness. Yellow indicates that the water presents a mild threat if consumed since some bacteria are present, but not harmful *E. coli*

Colliert tests for tanks:

	Yellow?	Flourescent?
Finca Basin	Yes	Yes
Finca Tap	Yes	Yes
House # 21	No	No
House #31	Yes	Inconclusie
House #26:	Yes	Inconclusive
House #26:	Yes	No
House #26:	Yes	No
House #27	Inconclusibe	Inconclusive

Colliert tests for boiled water

	Yellow?	Floursece?
House #8: Cristobal EWB Tank Water, Boiled to First Bubble at Midwife's (18 Minutes)	No	No
House #8: Cristobal EWB Tank Water, Boiled Two Minutes After First Bubble	No	No
House #8: Cristobal EWB Tank Water, Boiled Four Minutes After First Bubble	No	No
House #8: Finca Water, Boiled to First Bubble (5 Minutes, 30 Seconds)	Yes/no	No
House #8: Finca Water, Boiled 7 Minutes, 30 Seconds	No	No
House #8: Finca Water, Boiled 9 Minutes, 30 Seconds	No	No

The levels of harmful *E. coli* are much higher in the finca than in any of the tanks tested. This is likely because the finca collects runoff from the Finca La Primavera farm and is an open cistern, while the tanks collect only rainwater and are covered.

Boiling water for as little as two minutes after the first bubble appears is enough to kill all bacteria. Boiling water until the first bubble appears is enough to kill harmful *E. coli*. Boiling water for as little as two minutes more after the first bubble appears kills the rest of the bacteria

tested for as well. Based on these results, it is possible that the longer it takes to boil, the more likely these other bacteria are to be killed before the first bubble is seen. Again, duplicating experiments on future trips will further support this hypothesis.

Some observations were made on site that could not be supported reliable data (either Colilert results were lost or Petrifilm counts swapped). However, some things are still clearly remembered: the first flush water tested at Roberto's house (House 26) was dark brown in color. All first flush water tested with the Petrifilms seemed to have presence of bacteria, but since their corresponding Colilert results were lost, these tests were not discounted. However, the color of the water and bacteria presence in the Petrifilms were shocking enough for the team to remember and make note of.

Education

Education is essential to continuous maintenance and proper system operation. Tanks must be regularly cleaned, the first flush units emptied, and the sediment filters washed with chlorine. Maintenance can be difficult to enforce, as water is a precious resource in the community. Emptying tank water for cleaning purposes and discarding first flush water are practices easily forgotten or disregarded. To prevent systems from becoming poorly maintained, illustrated instructional handbooks were distributed to every family at the second community meeting. The handbooks serve as a simple reminder of proper maintenance practices. The specifics depicted in the handbooks were also explained further at each home that received systems. These explanations included the process of emptying the first flush and cleaning the tanks. Each home received these explanations positively as they were communicated clearly through CeCEP's translators. Families were checked on their comprehension throughout this process and were asked to demonstrate proper practice of emptying the first flush and to explain proper maintenance practices from what they understood. This additional reinforcement will hopefully encourage the use of all system maintenance practices. Handbooks are a great reminder and an ongoing, ever-present resource for RHS users. However, they can also be somewhat abstract and difficult to understand without thorough and repeated hands-on training. Thus, it is essential that we continue to reinforce the messages found in the handbooks through ongoing and repeated face-to-face demonstration with each RWH user. In future, it will be interesting to see how many families found the handbooks useful and still have them at easy access. It may also be worthwhile to present the full explanation of these procedures to more members of each family. Typically, only the older women in each household were given more thorough explanations. Having children of a reasonable age present as well, and even trying to pull husbands from their system construction work for the brief review, could help make maintenance more of a joint familial responsibility. The pages of the distributed handbook are shown below. It is important to note that the cleaning protocols for both the filters and the tanks are not in place to make the water from the tanks potable, they are simply in place to ensure that the community members are cleaning their systems and not allowing anything to become a source of serious contamination.



Figure 4: This education manual was distributed to every family in the community, regardless of their status as a system owner. The diagrams used in each page were further explained on a house-to-house basis.



Figure 5: The first page in the manual depicts the most important message: boil water. Until the team can guarantee that tank water is potable, boiling water is an excellent precaution to prevent illness. Thankfully, this message is something that has been reinforced culturally for years. Based on information gathered through community interviews, nearly every family knew to boil their water before the EWB-USA WPI team first arrived. The reason this message is still included in the booklet is due to its importance.

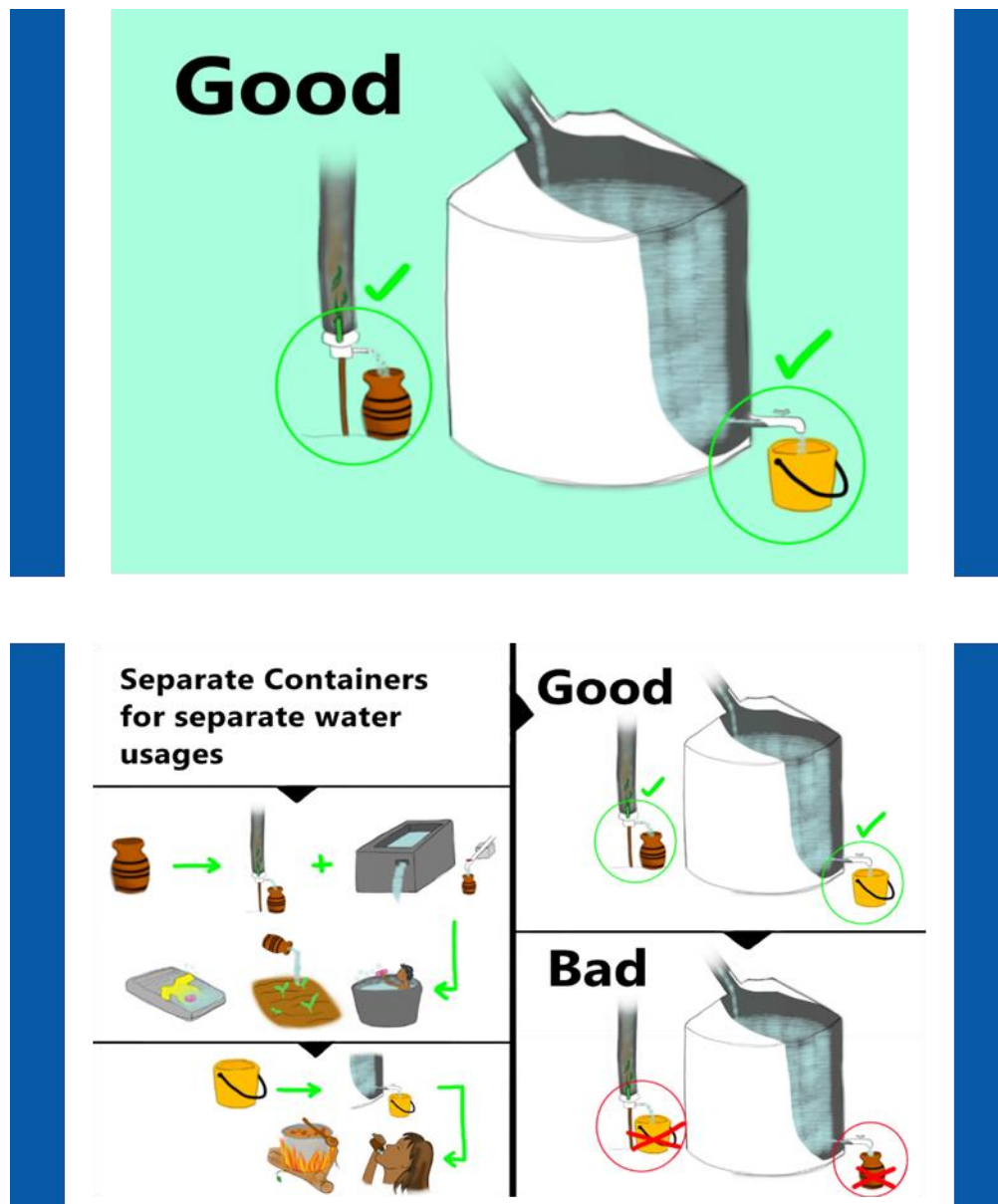


Figure 6: The next two pages encourage the practice of separation of containers. It is important to use separate containers to collect water from the tanks (cleaner), the first flush (less clean), and the finca (dirty) to reduce cross-contamination. Each water source also has its specific uses (diagramed on the bottom page). To encourage this practice, each family was supplied with a bright orange bucket in which tank water should be collected. Buckets were distributed with a thorough explanation of their purpose and a quick demonstration of good separation of containers practice. These buckets are also labeled with an EWB-USA WPI sticker as a reminder of their intended use.

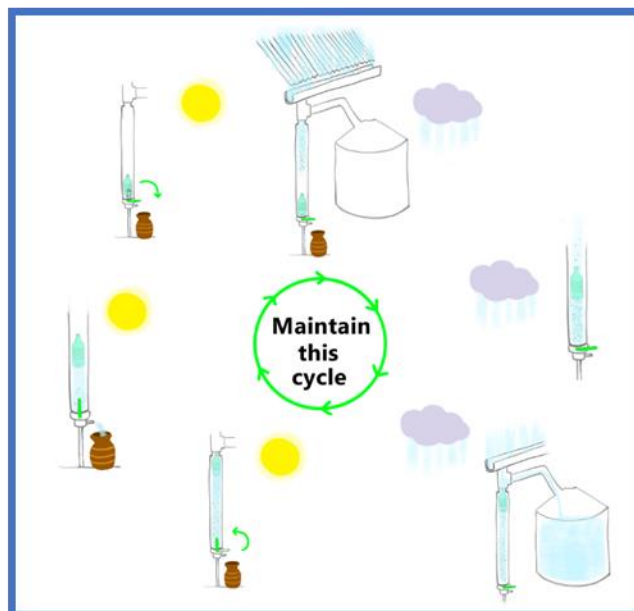


Figure 7: In order for the first flush to effectively serve as the initial catchment for dirty water, the system must be maintained regularly with the weather. These pages emphasize the importance of taking action to maintain the first flush as weather dictates. Much like the education system used for communicating separation of containers, description and demonstration were used to further explain this process.

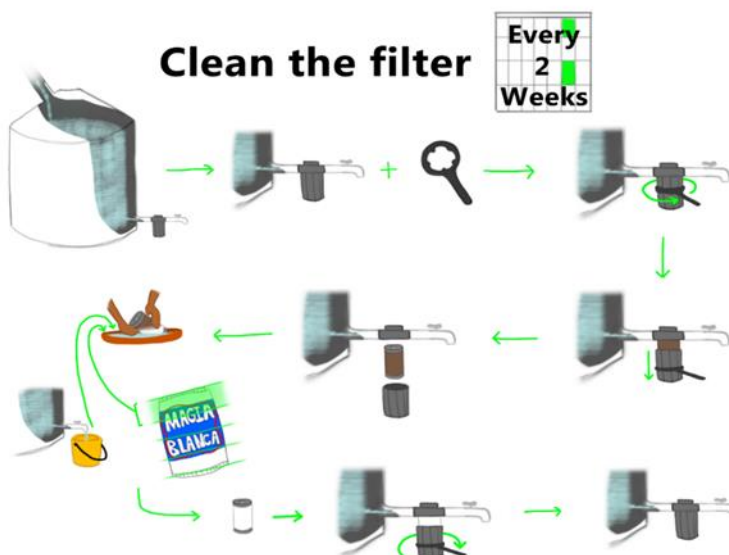



Figure 10: Maintaining the sediment filter is simple, but something easy to neglect. This diagram encourages regular cleaning of this filter, as seen in the miniature calendar. Families who received systems in prior years have already become acquainted with the idea of cleaning this filter and do so regularly. Hopefully, the trend will continue.



Figure 11: The tanks themselves must also be regularly cleaned. Ideally, at the start of the rainy season, every family will chlorinate their tank water as pictured above. The reason for this timing is that the increased rainfall will be able to flush out the chlorine through the overflow more quickly, thereby removing the chlorine flavor from the water faster. Overall, this concept is a difficult one for community members to agree with as water is such a precious resource, sacrificing any amount of it for cleaning purposes sounds unreasonable. To make the process seem less painful and more familiar, the team cleaned a few of the older tanks with various families throughout the community by completely emptying the tanks and scrubbing the interiors.

7.0 FINAL IMPLEMENTATION AGREEMENT

Shown here are the Spanish translations of the Memorandums of Understanding that the travelers signed with the community to solidify their preparation work and EWB-USA WPI's dedication to implement on their home. The final page is filled out and signed after implementation, in order to document that the team did implement what was promised and that they are satisfied with the result. The MOUs of the 8 houses that the travelers implemented on during this trip are in Appendix E.



Museo Katinamit
San Cristóbal Verapaz
Tel. (502) 7950-4896
cecep@intelnet.net.gt

The group of students 'Engineers Without Borders' has worked with the community of Guachtuq since 2009. They have helped providing the necessary resources and have helped install a system of phuvial water, in order for the beneficiaries to count on a reliable resource of water. The students of Engineers Without Borders hope that they are able to carry out this project so that the majority of the families from the community are benefitted. This Project will be executed along with el Centro comunitario Educativo Pokomchi (CECEP), the water committee of this Project and the students 'Engineers Without Borders'. It is expected that in the following years the project will be successfully finalized. In this way, it will be possible to improve the life quality of the beneficiaries.

It is in this way that the following people get together on today's date to celebrate the present agreement of the Project of Water Collection: Sucely Ical Lem, who represents the CECEP (her number of identification is 2615 127731603); Cristóbal Laj Cojoc, the president of the water committee (whose identification number is 2200 90777 1603) and Mr. _____, whose identification number is _____.

In this agreement the beneficiary will be denoted as the person that receives the direct benefits of the Project. The purpose of this agreement is to have the beneficiary comply to the guidelines of usage and care of the system of collection of rain. These guidelines will be the following:

1. The beneficiary will participate in a voluntary and active basis in the arrangement and implementation of the Project. The beneficiary will collaborate in the same way monitoring the system.
2. The beneficiary will be the only one responsible for the system of collection of water. This means that there will be continuous maintenance of the system. The system includes: a roof, cement, canals and tank. The objective of the maintenance is that the system remains in good conditions.
3. The beneficiary is compromised to have the system of water in his house for a lapse of ten years. If not, the beneficiary will have to pay the total value of the system (in accordance to the bill and hand labor). The cancellation will be done by the Centro Comunitario Educativo Pokomchi (CECEP).

The beneficiary agrees to the set conditions, he compromises to follow these guidelines and assumes the responsibility of them in the date of _____.

Cristobal Laj Cojoc
President of the Water Committee

Beneficiary

Sucely Ical Lem
CECEP




Figure 12: This is the first MOU that the family must sign to be part of the project.



Museo Katinamit

San Cristóbal Verapaz
Tel. (502) 7950-4896
cecep@intelnet.net.gt

Engineers Without Borders, USA Worcester Polytechnic Institute

Implementation, May of 2014

The objective of Engineers Without Borders is to implement a rainwater harvesting system at each home in Guachtu'uq. This system will be designed based on home conditions and number of inhabitants, to supply a sufficient quantity of water for drinking and cooking. Our objective is to promote better quality of water.

In order to allow for complete implementation of an Engineers Without Borders (EWB) rainwater harvesting system, the homeowner is required to prepare his plot of land before implementation.

Upon the completion of these preparations EWB commits to implement adequate rainwater harvesting system.

The home owner will complete the following before May 2014:

I _____ will prepare my plot of land with the above items before the arrival of EWB in May of 2014 for implementation of a rainwater harvesting system.

Cristobal Laj Cojoc
President of the Water Committee

Beneficiary

Sucely Ical Lem
CECEP



Figure 13: This is the second MOU that the family must sign after the assessment of their home and the establishment of the construction plan.



Museo Katinamit

San Cristóbal Verapaz
Tel. (502) 7950-4896
cecep@intelnet.net.gt

Este contrato representa un acuerdo entre: el beneficiario de la comunidad de Guachtu'Uq, Ingenieros sin Fronteras y CECEP.

Se instaló un sistema de agua, de valor total de _____, el (fecha) _____. La siguiente lista muestra un desglose del valor total del sistema:

Base _____
Rebalse _____
Primera lluvia _____
Tinacos _____
Misceláneo _____

Este contrato implica 3 compromisos más allá que los que están indicados en el acta:

1. Yo pagaré un 5% de este costo, que es de _____. Lo pagaré: en un plazo o en 12 cuotas mensuales de _____ que entregaré a CECEP, a Susy Ical Lem el primero de cada mes.
2. Yo me comprometo a apoyar las instalaciones futuras que hacen Ingenieros sin Fronteras en otras casas de la comunidad de Guachtu'Uq.
3. Yo me comprometo a no vender el tinaco por el mínimo establecido de 10 años. Si decido venderlo o si salgo de la comunidad, tendré que comprar el tanque de CECEP a un monto que disminuye cada año. La siguiente tabla incluye el precio del tinaco en el periodo de diez años.

Años después de la instalación	Precio del tinaco (quetzales)
0	2400
1	2160
2	1920
3	1680
4	1440
5	1200
6	960
7	720
8	480
9	240
10	0

Este contrato es firmado por los siguientes colaboradores:

Cristobal Laj Cojoc
Presidente Comité de Agua

Beneficiario

Sucely Ical Lem
CECEP



Figure 14: This is the final MOU that the families sign when their system is complete. It discusses the payment plan.

8.0 PHOTO DOCUMENTATION



Figure 15: Here, materials for constructing the base are being dropped off at Filomena's house.



Figure 16: The children were very enthusiastic to help move rocks at Elvira's house.



Figure 17: Traveler, Rita Newman, helping Rigoberto and Alfonso mix concrete for the base.



Figure 18: Various community members tie down rebar at the midwife's house.



Figure 19: Filomena and her children proudly standing next to their recently completed system.



Figure 20: Aaron Pepin, Thomas Moutinho, Mike Reiter, Katie Picchione, Camden Knoff, Melissa Rivera, Jessie Ciulla, and Rita Newman take a photo with community children shortly after the materials were delivered.



Figure 21: Camden Knoff prepares and wears water quality tests.



Figure 22: The team (left to right: Camden Knoff, Aaron Pepin, Melissa Rivera, Jessie Ciulla, Katie Picchione, Thomas Moutinho, Rita Newman, Mike Reiter) meet with the mayor of the San Cristobal Municipality (center).

9.0 LESSONS LEARNED

9.1 Health and Safety:

Do not eat food in the community.

Unfortunately this implementation trip had a high occurrence of illnesses among the team members that required minor medical attention i.e. medications. Some team members had colds or allergies. Others were likely unavoidable due to different bacteria naturally found in the food and water of Guatemala that the team is not accustomed to. Although it is difficult to decipher exactly what was the cause of each illness, one likely cause is the consumption of food given to the travel team by community members. During implementations it was common for a member of the respective household to feed the workers with a glass of soda, homemade corn drink, or bread. The travel team often accepted this food as not to offend the family. The danger that arises with this is that even if the food was recently purchased at a store, it is still served in dishes that have likely not been cleaned sufficiently with soap. There is also no way of knowing if the hands of the person serving it are clean. For this reason it is a good idea to be cautious when accepting food served in the community.

9.2 Community Engagement:

Do not expect services to be punctual.

The travel team was pleasantly surprised by the punctuality of the men from the community who worked on implementations every morning. It is important to know that the community members are ready to begin work at 7am. Unfortunately the same cannot be said for the services utilized in San Cristobal. Much time was spent waiting around for the trucks to arrive at Macsams, one local hardware store, to transport rocks up to the community early on in the trip. Similarly, the trucks from the municipality used to transport the PVC and other materials were quite late. Even the meeting with the mayor was significantly delayed for unknown reasons. Nothing can really be done to combat this issue as it is cultural. Instead, the travel team must accept and be prepared for the fact that Guatemalans are not as strict about time as Americans. It is a good idea to have alternative tasks planned that can be dealt with if there is extra time. Striking up conversation with the local people is always interesting.

9.3 Teamwork:

Work to keep morale high.

The tasks required of the travel team are very mentally and physically challenging. In addition to the pre-trip planning, the travelers are faced with little sleep, physical exertion, late nights, and tough decision-making while in country. It is enough stress to cause disgruntlement among the travelers as has happened during trips in the past. This trip the travel team worked very hard to try to prevent this issue from arising. Before the trip many activities were planned for the team to build camaraderie. Examples included eating breakfast together and taking personality tests to determine individual and group strengths and weaknesses. While in Guatemala the team took further measures to increase cooperation and productivity. Music was played in the evenings while the team was working in CeCEP, and everybody agreed this increased productivity and made everybody feel less tired. During the days the team would occasionally stop for a quick

treat at a local store. It was occasions like these that brightened spirits and lowered stress levels. All of these measures taken proved to be extremely beneficial to the team dynamic. Everybody got along well and not a single traveler got "burned out". Returning travelers agreed that this team was possibly the best yet, and it can likely be attributed to the efforts to keep morale high.

9.4 Travel:

Dress for the weather.

May marks the beginning of the rainy season in Guatemala, but the weather does vary from year to year. The May 2013 travelers reported that it only rained on occasion during their trip and solely for short bursts. This trip turned out to be much different. Rain occurred on an almost daily basis, going through the afternoon, sometimes without stop. For this reason it is important to have a durable rain jacket at all times in case you are stranded outside during a sudden shower. In addition to rain, the temperature is also important to monitor on the trip. In the Alta Verapaz highlands, the days can be very hot and humid, but the mornings and evenings can be surprisingly cool. It is important to expect this change in temperature and wear layers as well as durable shoes.

The May climate is also very different from January. January travelers experienced cooler weather and primarily packed long pants and long-sleeved layers. In January, jeans or cargo pants, boots, and layers of light sweaters or polar fleece with a t-shirt underneath are the best clothes to wear to accommodate for warm days (mid 70s) and cool nights (around 50°F in the evenings, sometimes as low as 40°F). May travelers should dress for warmer temperatures, up to high 80s and 90s in the day, low 60s at night.

10.0 PROJECT STATUS

Project Type	Implementation Continues	Monitoring & Evaluation	Complete
Water Supply	x	x	

Ongoing implementation and the individualized nature of the Guachtuq Water Supply project render it in both the Implementation Continues and Monitoring & Evaluation phases. Future implementation will include building systems with the remaining 25 homes in the community as well as providing previous beneficiaries with design modifications (like the first flush and modified overflow) as desired. Monitoring & Evaluation begins for each system after its initial completion.

Since the Guachtuq Water Supply project has been grandfathered into the PMEL structure, Monitoring & Evaluation criteria were established in July, 2014; the 901 Program Plan and Baseline Study, and 905 Project Logical Framework were submitted concurrently with this document (May 2014 526 Post Implementation Form). Requirements of the 902 Project Partnership Agreement and 903 Implementation Agreement are fulfilled by existing MOUs and contracts signed with each family prior to and following system implementation at their home.

11.0 COMPLETED PROJECT MONITORING:

11.1 Completed Project Status Table

Project Type	Project Discipline	Date of Completion (mm/dd/yy)	Functionality (enter one range per project)			Periodic Maintenance (yes or no)	Demonstration of Knowledge Transfer (yes or no)
			0-50%	50-75%	75-100%		
Water Supply	Rainwater Harvesting	Ongoing	33%			Yes	Yes

11.2 Project Functionality Indicators

Project Type	Project Functionality Indicator (list indicators identified in the 522 for each project)	Monitoring Result
Water Supply	Times Tanks Run Dry (Quantity)	House 1: Tank ran empty a few times during the dry season. System implementation occurred just before the dry season (January '14), so there was not enough time for it to fill.
	Water Quality Tests (Quality)	Water quality tests indicated that the Finca was much more polluted than any of the rainwater harvesting system tanks tested. Government tanks were, generally, more polluted than the EWB tanks. They are also older, so this metric will be more valuable as time goes on.
	Time Spent Going to Finca (Access)	House 8: This family almost never goes to the finca. They only went a few times during the dry season,

		<p>primarily for washing.</p> <p>House 26: Did not need to go to the finca at all during the 2014 dry season.</p> <p>House 27: Data unavailable</p>
--	--	---

11.3 Periodic Maintenance Indicators

Project Type	Periodic Maintenance Indicator (list indicators identified in the 522 for each project)	Monitoring Result
Water Supply	Empty First Flush	Hard data was not collected on this trip. Alvaro will collect this data through ongoing monitoring.
	Clean Tank	Hard data was not collected on this trip. Alvaro will collect this data through ongoing monitoring. Through interviews, many families reported that they clean tanks regularly, at least once or twice a year. Tanks are generally scrubbed with chlorine and soap, though the EWB-USA WPI team questions whether the amount of chlorine used is enough to sanitize.
	Clean Filter	Hard data was not collected on this trip. Alvaro will collect this data through ongoing monitoring. Families with filters reported cleaning them regularly. Filter cleaning will be measurable on the implementations from this trip.

11.4 Demonstration of Knowledge Transfer Indicators

Project Type	Transferred Knowledge Indicator (list indicators identified in the 522 for each project)	Monitoring Result
Water Supply	Repair Systems	<p>House 1: Modified system slightly since the house was rebuilt between the January '14 and May '14 trips. The family was able to rebuild the system to meet needs, but needed assistance fully assembling the first flush and downspout.</p> <p>House 8: Requested parts for a first flush in January '14, but did not seem to make any progress by May. However, Cristobal Cojoc has repaired the system in the past.</p> <p>House 26: No known incidents</p> <p>House 27: No known incidents</p>
	Assist With Future Implementations	<p>House 1: Oscar was present at many May '14 implementations</p> <p>House 8: Cristobal was not present for most of the May '14 implementations</p> <p>House 26: Roberto not only helped with every May '14 home, but served as a temporary translator and spoke passionately about helping his neighbors.</p> <p>House 27: Not present at any May '14 implementations</p>

11.5 Additional Information

While the team strove to interview every family of the community on this trip, it was not possible given the length of trip. Interviews lasted about two hours each, and some families were not present when team members arrived for an interview. Additionally, the team had a time conflict with translators, where Edgar was available to translate interviews in the morning and Abelino was available in the afternoon. However, time was wasted in the middle of the day in the interval when neither was available. Some interviews were not "formal" and data was inferred from other conversations and meetings held.

Complications with Constructed Systems

While a family's ability to repair and maintain systems is an important metric, these data are not available for families with extenuating circumstances. The family of Cristobal Coy Max, House 27, rents their land and has run into a conflict with their land owner. She has asked them to move from their current location to a different plot of land she owns outside the community. The family was able to make an agreement with the land owner to move to a plot of land owned by her sister that is within the community. Through several conversations with the family, the team learned that the landowner hoped to benefit from our work in the community and claim ownership over the system built at House 20 in January 2014. Working with Sucy and Abelino, the EWB-USA WPI team wrote a contract explicitly stating that the system belongs to the family and the tanks belong to CeCEP for ten years per terms of the contract and MOU. The landowner can purchase the system, if she wishes, at the price of the full cost of materials used plus man-labor.

Because of the tenuous nature of this situation, no interview was held with the family of House 27, and no monitoring or evaluation of the system took place. They will, however, be included in the ongoing monitoring executed by Alvaro.

Complications with Contracts

After the assessments for future implementations were complete and contracts were signed, the team heard many rumors that the family of House 34, Maria Magdalena and Leandro Gualim, is not actually the house the family lives in. According to several sources, the family has another house in a different community and owns several Rotoplas tanks. There is a small tienda in the house, but apparently nobody lives there permanently. However, Maria Magdalena answered interview questions as if the tienda was her primary residence. Edgar and Sucy are looking into the matter further.

No contract or MOU was signed with Teresa Yuja, the owner of House 22. She was not available for an interview and was not present on the day we planned to complete the second-stage assessment.

12.0 NEXT PHASE OF THE PROGRAM

EWB-USA WPI has come to realize that there are two more phases in this rainwater harvesting project. The first and immediate phase is to implement at the remaining 25 homes in Guachtuq. This implementation is believed to be possible during the May 2015 trip with proper preparation during a January 2015 trip and adequate funding. After all families have received systems, monitoring and evaluation will continue throughout the following year and for the duration of the Guachtuq Program.

A further reaching "Phase II" involves designing inexpensive rainwater harvesting systems that local families are able to purchase independently. Though possibly out of the scope of an EWB project, Phase II will establish the social framework for educating people throughout the region about best-practices in rainwater harvesting, complete demonstration systems in various communities and build relationships between the San Cristobal Municipality, local hardware stores, CeCEP, and the communities. The EWB-USA WPI chapter is currently looking into alternative funding that will allow for such expansion of this project.

Beyond the rainwater harvesting system project in Guachtuq, EWB-USA WPI will soon be looking to, either begin another project in Guachtuq, or apply for another project in a new community.

13.0 PROFESSIONAL MENTOR ASSESSMENT

13.1 Professional Mentor Name and Role

This section is written by Michael Reiter, I was the REIC for this implementation trip.

13.2 Professional Mentor Assessment

This report was written as a collaborative effort by all six students who travelled in May and assembled by the Tech Lead. At this moment we are in the middle of the implementation phase but so far I consider this project a success. The support from the community during our building days was overwhelming! They showed up early, they worked hard and they worked efficient. On the day when we were building the form for the concrete bases, once they saw how we wanted them build the community finished the work the next morning before we even made it to the community. It was the community's idea to create two work teams as a way of moving faster through the construction phase. I was also extremely impressed with the efficiency of the students managing logistics of material delivery. For these eight homes, four dump truck sized trucks were needed to move materials into Guachtuq and be delivered to the individual homes. The students managed this activity flawlessly and without any confusion. After looking at the overall success we had in May, I really believe the approach the students took is scalable to allow for more homes to be implemented on the next implementation trip.

One thing that made this so successful is the rapport between the students and community members. They give the students complete respect when it comes to their designs and

construction approach. They never worked ahead without asking a student to confirm a plan and when they did alter a design it was always for the better, which confirms they are learning how to design systems for themselves.

The key to success in the next phase of the project will be fundraising, but this is a technical report so I'll keep my focus in that area. Twenty-five homes is a 3X increase from the eight, but it can be done with proper planning which the students have piloted on the trip they just completed. I do believe an assessment trip in January is warranted to ensure the individual homeowners understand the preparations they have to make for implementation. It will also allow for a better materials list, considering the systems we just installed were designed in Worcester, MA based on measurements taken a few months prior. We had to make a few design modifications on the fly so it will be very beneficial to review the final designs on site before ordering materials.

It has been a pleasure to work with the students from WPI over the past two years as the REIC. They work hard, they work smart and they are totally dedicated to this community and this project. I look forward to continuing my relationship with them in the future.

13.3 Professional Mentor Affirmation

I acknowledge my involvement in the implementation phase of this project and take responsibility for the course this project is taking.

APPENDICES

Appendix A

Guachtuq, Guatemala

Censo de 2014

Ingenieros Sin Fronteras – USA Worcester Polytechnic Institute



Casa 1

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Oscar Vicente Laj Lem	padre (odd jobs around)	M	1981
Mauricia Cal Caj	madre	F	1986
Alida Patricia Laj Cal	hija	F	2003
Sandra Estela Laj Cal	hija	F	2005
Oscar Anibal Laj Cal	hijo	M	2008
Shirley Paola Magali Laj Cal	hija	F	2011
Nelson Giovani Laj Cal	hijo	M	2013
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	2
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	5000 [L]

Apuntes:

Mauricia was Vice President of the Comité de Mujeres from 2012-2014. She is the daughter of Isabela and Mateo (house 2) and Oscar bought their land from Mateo at a nominal price.

Casa 2

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Isabela Caj Pop	madre	F	1970
Mateo Cal Cal	padre (farmer)	M	1960
Marcial Cal Caj	hijo	M	1998
Claudia Esperanza Cal Caj	hijo	F	2000
Lidia Isabel Cal Caj	hija	F	2003
Luis Everardo Cal Caj	hijo	M	2006
Anabela Cal Caj	nieta	F	2010
Roni Rodolfo Cal Caj	hijo	M	2010

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	2
Tanque de Concreto (5000L):	1
Volumen Total:	8400 [L]

Apuntes:

Isabela and Mateo have ten children. Six are young and live with them. Celestina is the oldest and lives next door in house 3 with her family. Mauricio lives just up the hill in house 1 with Oscar and their family. Esteban lives just below in house 41 with Elvia and their son. These three bought their land at a nominal price from Mateo and Isabela, who originally owned the entire plot. Their other daughter, Matilda, currently lives elsewhere (currently unknown) with her husband. Anabela is her daughter. Anabela is currently (May 14) living with Isabela, her grandmother, but Mauricio may take her back in the near future. One 1700L is said to be

cracked. The concrete tank apparently is in estebans name. There is confusion and disagreement over the ownership and usership of this tank.

Casa 3

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Julio Caal Jalal	padre (wood cutter)	M	1981
Celestina Cal Caj	madre	F	1983
Julio Roman Cal Jalal	hijo	M	2005
Amalia Cal Jalal	hija	F	2007
Ingrid Guadalupe Cal Jalal	hija	F	2010
Juan Edin Cal Jalal	hijo	M	2012
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	1
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	2500 [L]

Apuntes:

This house is going to be moved about 4m uphill. It should have the same roof area and be exactly the same, but in a slightly different location.

Casa 4

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Isabel Xona Suc	madre	F	1964
Estanislao Caal Mo	padre	M	1979
Cristina Caal Xona	hija	F	1997
Vitalino Caal Xona	hija	F	2003
Alida Consuela Caal Xona	hija	F	2005
Alvaro Leonardo Caal Xona	hijo	M	2005
Elvia Herminia Caal Xona	hija	F	2007

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	2
Tanque de Concreto (5000L):	0
Volumen Total:	3400 [L]

Apuntes:

One tank was cracked at the bottom. They have a temporary fix but want to repair it further. The children are ADORABLE!

Casa 5

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Waldemar Quej Yuja	padre (security in guatemala)	M	1977
Filomena Gualim Cal	madre	F	1983
Fabiola Elizabeth Quej Gualim	hija	F	2001
Jacqueline Fabiana Quej Gualim	hija	F	2005
Gladis Azucena Quej Gualim	hija	F	2007
Gerson Noe Quej Gualim	hijo	M	2010
Yesica Filomena Quej Gualim	hija	F	2012

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	2
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	5000[L]

Apuntes:

Filomena works on a farm up the hill to grow crops for the fsmily and to sell. Waldemar does not earn enough to fully support the family. Their home is on land partially owned by them. They are shared owners with Filomena's brother.

Casa 6

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Carlos Jom Yuja	padre	M	1978
Rosa Gualim Cal	madre	F	1979
Denis Eduardo Jom Gualim	hijo	M	2002
Christian Raul Jom Gualim	hijo	M	2004
Yulisa Mariela Jom Gualim	hija	F	2007
Natali Maribel Jom Gualim	hija	F	2009
Selvin Rudolfo Jom Gualim	hijo	M	2009
Macaria Yuja Lem	abuela	F	1937

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	1
Tanque Gubernamental (1700L):	2
Tanque de Concreto (5000L):	1
Volumen Total:	10900 [L]

Apuntes:

Speak primarily pokomchi. They never go to the finca.

Casa 7

Persona en Familia Nacimiento	Posición de la familia	Género	Fecha de
Jose Sis Xuc	padre (security in Guatemala)	M	1987
Graciela Cardona Valezquez	madre	F	1989
Wilfredo Sis Cardona	hijo	M	2007
Katy Sis Cardona	hija	F	2009
David Sis Cardona	hijo	M	2012

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	1
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	2500 [L]

Apuntes:

Jose is the owner of this tank. It was originally at house 8 but was moved after the Jan '13 implementation at 8. This system will be modified with the systems of houses 8 and 42. Celestina, the matriarch of house 8, is the owner of the land of all three plots.

Casa 8

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Cristobal Laj Cojoc	padre	M	1967
Celestina Xuc Jul	madre	F	1964
Mario Ruben Laj Xuc	hijo	M	1994
Natividad Cal	nuera	F	1990
Romelia Laj Xuc	hija	F	1998
Bayron Moises Laj Xuc	hijo	M	2003

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	1
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	2
Tanque de Concreto (5000L):	0
Volumen Total:	5900 [L]

Apuntes:

This house is located right next to house 42. César of house 42 is Cristobal and celestina's son. Jose of house 7 is Celestina's son, but Cristobal's step son. Natividad is married to Mario and she is from a different community.

Casa 9

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Cristobal Lem Suram	padre	M	1931
Maria Albina Mo	madre	F	1943
Angela Alejandrina Lem Mo	hija	F	1980
Domingo Lem Xoy	El marido de Angela	M	1979
Karen Yamira Fabiola Gualim Lem	nieta	F	2009
Maria Magdalena Gualim Lem	nieta	F	2012
Bebe Gualim Lem	nieto	F	2014

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	2
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	2
Tanque de Concreto (5000L):	0
Volumen Total:	8400 [L]

Apuntes:

Received two EWB tanks and a system in May 2014. Maria is the midwife (la comadrona) in the community. She also weaves nets for extra money.

Casa 10

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Santiago Lem Mo	padre (farmer in Guachthq)	M	1969
Margarita Pop Jom	madre	F	1973
Maria Lem Pop	hija	F	1992
Reinaldo Lem Pop	hijo	M	1994
Claudia Lem Pop	hija	F	1997
Juan Lem Pop	hijo	M	1999
Gladis Lem Pop	hija	F	2001
Mario Lem Pop	hijo	M	2003
Hector Lem Pop	hijo	M	2005
Flori Graciela Lem Pop	hija	F	2009
Brandon Lem Pop	hijo	M	2011

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	2
Tanque de Concreto (5000L):	0
Volumen Total:	3400 [L]

Apuntes:

One tank has a hole; the faucet was broken off. Santiago put a metal patch over the hole, but it needs to be repaired properly. It does temporarily hold water. The other tank has a sac as a filter.

Casa 12

Persona en Familia Nacimiento	Posición de la familia	Género	Fecha de
Alejandrina Yuja Lem	madre	F	1996
Edin Raul Coc Chub	padre	M	1988
Juan Humberto Coc Yuja	hijo	M	2010
Maria Alejandra Coc Yuja	hija	F	2013
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	1
Volumen Total:	5000 [L]

Apuntes:

Edin does odd jobs. There are no problems with their concrete tank. Alejandrina is a daughter of Josephina Lem and Leandro Yuja (house 25).

Casa 15

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Leandro Yuja Lopez	padre	M	1960
Josefina Lem Mo	madre	F	1960
Victor René Yuja Lem	hijo	M	1998
Alida Rosenda Yuja Lem	hija	F	2000
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	1
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	1
Volumen Total:	7500 [L]

Apuntes:

This family is very well off. The tanks technically belong to the children, who MAY come and take them at some point in time. They all use the water.

Casa 16

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Elvira Cal Chun	madre	F	1962
Elvira Roxana Yuja Cal	hija	F	1992
Paulina Veronica Yuja Cal	hija	F	1994
Iseña Carolina Yuja Cal	hija	F	1997
Mario Salvador Yuja Cal	hijo	M	1999
Michael Alexander Yuja Cal	hijo	M	2002
Marcos Enrique Yuja Cal	hijo	M	2004

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	1
Tanque Gubernamental (2500L):	1
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	5000 [L]

Apuntes:

Elvira is a widow. She does not have relatives except her husband's family. Her other children are Luis Yuja (lives in Rixqix), Edgar Yuja (house 17), and Rubidia Yuja (Rixqix). She shares water with Cati in house 17.

Casa 17

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Edgar Efrain Yuja Cal	padre (packing plant in Guatemala)	M	1990
Catarina Macz Calel	madre	F	1985
Wilian Armando Yuja Macz	hijo	M	2001
Jorge Oswaldo Yuja Macz	hijo	M	2003
Jennifer Aracely Yuja Macz	hija	F	2010
Eduar Frans Yuja Macz	hijo	M	2012
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	1
Volumen Total:	5000 [L]

Apuntes:

The pump is broken, but the tank does not leak. This family is related to 16.

Casa 18

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Domingo Caj Pop	Padre	M	1961
Isabel Cu Sis	Madre	F	1964
Anjel Caj Cu	hijo	M	1984
Mario Antonio Caj Cu	hijo	M	2000
Domingo Caj Cu	hijo	M	2002
Damaris Micaela Caj Cu	hija	F	2004

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	2
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	5000 [L]

Apuntes:

Domingo's daughter Clara (house 20) has a government 2500L tank. They share water.

Domingo is the current president of the COCODE.

Domingo is a florist.

And an ass.

Casa 19

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Matilde Jor Yuja	madre	F	1993
Victor Caj Cu	padre (farmer in Guachtuq)	M	1986
Berta Aracely Caj Jor	hija	F	2009
Victor Jose Pablo Caj Jor	hijo	M	2012
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	0 [L]

Apuntes:

They rent their land, but if they have to move, they will buy land in the community. Victor is the nephew of Isabela and mateo in house 2.

Casa 20

Persona en Familia Nacimiento	Posición de la familia	Género	Fecha de
Mario Enrique Chul Laj	padre	M	1990
Clara Caj Cu	madre	F	1992
Alexandra Isabel	hija	F	2011
Marleni Anabell Chul Cal	hija	F	2013
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	1
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	2500 [L]

Apuntes:

Clara is Domingo's daughter (house 18), and their house is right next door. They may move their house in the near future.

Casa 21

Persona en Familia Nacimiento	Posición de la familia	Género	Fecha de
Miguel Caj Pop	padre	M	1970
Rosalía Moran Lem	madre	F	1971
Felisa Caj Moran	hija	F	1992
Baldomero Caj Moran	hijo	M	1995
Aura Caj Moran	hija	F	1997
Juan Caj Moran	hijo	M	1998
Florencio Caj Moran	hijo	M	2001
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	1
Tanque Gubernamental (2500L):	1
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	5000 [L]

Apuntes:

Need Pokomchi. Received an EWB tank in May 2014. They have another daughter, Carmela, who was born in 1990 and lives elsewhere when she married. Rosalia, Felisa, and Aura are beautiful.

Casa 22

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Teresa Yuja Lopez	madre	F	1971
Celestino Jor	Padre	DECEASED	
Celestino Jor Yuja	hijo	M	1996
Nicolas Jor Yuja	hijo	M	2000
Blaca Estela Jor Yuja	hija	F	2004
Suri Amariela Jor Yuja	hija	F	2005
Carlos Yuja Lopez	hijo	M	2011

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	0 [L]

Apuntes:

Teresa's husband died many years ago. The land she lives on was given to her by a priest. She makes money by doing laundry and other jobs around as needed. She does not think she will be able to pay for a system.

Casa 23

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Abelino Cal (a)	padre	M	1946
Marcela Toc (a)	madre	F	1954
Adelia Chen Toc (b)	hija	F	1994
Sonia Maribel (a)	hija	F	1999
Mario Xim Laj (b)	El marido de Adelia	M	1991
Hijo de Adelia y Mario (b)			2013

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	1
Tanque Gubernamental (1700L):	5
Tanque de Concreto (5000L):	0
Volumen Total:	11000 [L]

Apuntes:

Jessie has updated data on names for 23 (b). A and b were separated because the families each have their own home and their own wáter requirements. Though they currently share, Adelia and Mario are independent.

Casa 24

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Alicia Chen Toc	madre	F	1985
Cerapio Chulb Caal	padre (farmer in Guachtuq)	M	1983
Ingrid Azucena Chulb Chen	hija	F	2005
Wilson Leonel Chulb Chen	hijo	M	2008
Floridalm Chulb Chen	hija	F	2012

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	1
Volumen Total:	5000 [L]

Apuntes:

There was a problem with their concrete tank leaking, but they fixed it. The PVC pump is complicated, but they make it work. The land belongs to her stepfather, but she owns the patch of land with the kitchen and tank.

Casa 25

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Emilio Chen Gualim	padre	M	1958
Elvira Choc Lem	madre	F	1957
Antonio Chen Choc	hijo	M	1992
Silvestre Chen Choc	hijo	M	1995
Norma Chen Choc	hija	F	1997
Judith Yuja	nuera	F	1993
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	1
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	1
Volumen Total:	7500 [L]

Apuntes:

Emilio is the twin of Ricardo Gualim (house 29).

Casa 26

Persona en Familia Nacimiento	Posición de la familia	Género	Fecha de
Elidia Esperanza Xona Yuja	madre	F	1974
Roberto Chocoj	padre	M	1969
Ricardo Jor Xona	hijo	M	1992
Elida Candelania Chocoj Xona	hija	F	1997
Romelia Chocoj Xona	hija	F	1999
Maria Rosario Chocoj Xona	hija	F	2006

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	1
Tanque Gubernamental (2500L):	1
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	5000 [L]

Apuntes:

Roberto is the best

Casa 27

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Cristobal Coy Max	padre	M	1969
Herlinda Ixian	madre	F	1971
Luis Coy Ixian	hijo	M	2002
Romiro Coy Ixian	hijo	M	2003
Angelina Coy Ixian	hija	F	2007
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	2
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	5000 [L]

Apuntes:

This family has had issues with the landlord. They will be moving to a different location within Guachtuq hopefully.

Casa 28

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Alfonso Xona Jul	padre	M	1978
Carmelina Laj Yuja	madre	F	1984
Edin Xona Laj	hijo	M	2002
Josue Daniel Xona Laj	hijo	M	2004
Loida Rutilia Xona Laj	hija	F	2005
SadracAlfonso Xona Laj	hiho	M	2013 (9m in May 14)
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	1
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	1
Volumen Total:	7500 [L]

Apuntes:

Elidia (house 26) is the aunt of Carmalina's mother, Adelina Yuja Lem. Leandro Yuja Lem (15) and Ana Yuja Lem (29) are Adelina's aunt and uncle.

Casa 29

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Ana Yuja	madre	F	1948
Ricardo Gualim	padre	M	1947
Eliceo Gualim	hijo	M	1992
Carlos Moran	hijo	M	1988
Maria	nuera	F	1993
Osraldo Yuja	sobrino	M	2012
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	1
Tanque Gubernamental (2500L):	1
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	5000 [L]

Apuntes:

Census data could not be updated for this family

Casa 30

Persona en Familia Nacimiento	Posición de la familia	Género	Fecha de
Bartolo Jom Velasques	padre	M	1969
Herlinda Velasques Xona	madre	F	1964
Javier Jom Velasques	hijo	M	1988
Samuela Jom Velasquez	hija	F	1991
Romalda Jom Vlasquez	hija	F	1993
Irma Lois Jom Velsquez	hija	F	1996
Gloria Carolina Jom Velasquez	hija	F	1998
Bartolo Jom Velasquez	hijo	M	2000
Ana Toc Pop	nuera	F	1997

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	1
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	1
Volumen Total:	7500 [L]

Apuntes:

It is uncertain whether Ana Toc Pop is still living with them. They claim the concrete tank has problems. Apparently the tinaco used to belong to someone else, or still does, but the family uses it and it does not seem to be in danger of being taken away.

Casa 31

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Juan Quej Pop (construction)	padre	M	1960
Marcela Ical Moran	madre	F	1961
Fernando Leonisel Quej Ical	hijo	M	1993
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	1
Tanque Gubernamental (2500L):	1
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	5000 [L]

Apuntes:

Received an EWB tank in May 2014

Casa 32

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Emilio Gualim Cal	padre	M	1983
Ana Maria Quej Cal	madre	F	1984
Kevin Yosiel Gualim Quej	hijo	M	2005
Cristian Emanuel Gualim Quej	hijo	M	2008
Hanali francesca Gualim Quej	hija	F	2009

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	2
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	5000 [L]

Apuntes:

Casa 33

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Anjelina Quej	madre	F	1988
Axel Quej	hijo	M	2005
Angelica Quej	hija	F	2007
Angela Quej	hija	F	2011

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	0 [L]

Apuntes:

Casa 34

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Maria Magdalena Jom Yuja	madre	F	1981
Leandro Gualim Cal	padre (Security in Guatemala)	M	1978
Edgar René Gualim Jom	hijo	M	2001
Aracely Marleny Gualim Jom	hija	F	2002
Heidi Roxana Gualim Jom	hija	F	2004
Saida Maribel Gualim Jom	hija	F	2005
Edwin Yobany Gualim Jom	hijo	M	2007

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	0 [L]

Apuntes:

THERE IS A CONCRETE TANK NEXT TO THEIR PROPERTY THAT DOES NOT BELONG TO THEM. Leandro is one of three brothers. Emilio of house 32 is probably one pf them. The other is Victor Gualim, and he no longer lives in the community. However, he does not allow them to use the water from the tank.

Casa 36

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Zoila Esperanza Ical Cojoc	madre	F	1988
Luis Gilberto Cojoc Yuja	padre (farmer -works 15 days at a time)	M	1986
Fermin Antonio Cojoc Ical	hijo	M	2008
Leydi Carina Cojoc Ical	hija	F	2009.5
Yolanda Noemi Cojoc Ical	hija	F	2012

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	0 [L]

Apuntes:

Moved to their current location near the finca two years ago. They used to live with Luis's parents at an unidentified home in the community. It seems there is tension and/or they are for some reason outcasts.

Casa 40

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Secundino Lem Mo	padre	M	1964
Lucia Cal Suram	madre	F	1966
Cesar Damian Lem Cal	hijo	M	1989
Angela Lem Cal	hija	F	1994
Ignacio Lem Cal	hijo	M	1992
Maria Magdalena Lem Cal	hija	F	1998
Ingrid Gabriela Garcia Calmo	Nuera	F	1998
Vinicio Lem Cal	hijo	M	2000
Elvia Leticia Lem Cal	hija	F	1998
Naney Fabiola Lem Garcia	Nieta	F	2013?
Dani Joel Moran lem	Nieto	M	2013

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	2
Tanque de Concreto (5000L):	0
Volumen Total:	3400 [L]

Apuntes:

One tank was cracked, but they repaired it.

Casa 41

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Esteban Cal Caj	padre	M	1995
Elvia Coy Ixian	madre	F	1997
Ezaquel Cal Coy	hijo	M	2013
_____	_____	_____	_____

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	0 [L]

Apuntes:

Confusion over ownership of concrete tank at house 2.

Casa 42

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Cesar Rolando Laj Xuc	padre	M	1992
Alicia Pop Jom	madre	F	1994
Yenni Laj Pop	hija	F	2012

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	00 [L]

Apuntes:

Cesar is the son of Crkstobal Cojoc (house 8) and they share tanks.

Casa 43

Persona en Familia	Posición de la familia	Género	Fecha de Nacimiento
Rigoberto Cac Caal	padre	M	1985
Elsa Marta Yuja Lem	madre	F	1987
Glanda Marisol Cac Yuja	hija	F	2012

Capacidad de Almacenamiento Existente (2013)

Tipo de Tanque	Cantidad
Tanque de EWB USA WPI (2500L):	0
Tanque Gubernamental (2500L):	0
Tanque Gubernamental (1700L):	0
Tanque de Concreto (5000L):	0
Volumen Total:	0

Apuntes:

Appendix B

	Item	Amount	Measurement
2" PVC	PVC de 2 pulgadas	9	6 m
		1	.22 m
		1	4 m
		1	3.6 m
1.5" PVC	PVC de 1.5 pulgadas	1	3.5 m
		3	6 m
		1	4 m
1.25" PVC	PVC de 1.25 pulgadas	1	.282 m
		1	6 m
		1	5.5 m
3" PVC	PVC de 3 pulgadas	1	2.6 m
4" PVC	PVC de 4 pulgadas	1	.26 m
Rebar	Hierro	11	6 m
PVC glue	Pegamento PVC	3	all open
Concrete Tool	Herramienta Concreto	7	
Wire Clipper	Cortadores	2	
Pliers	Alicates	3	
Coarse Thread Drywall Screw Box	Tornillo Rosca Ancha para Panel de yeso	1	box
Silicon Tube	Tubo de Silicon	1	
Can of Spray Paint	Pintura en Spray	1	
Pedazos de Lija	Sandpaper	2	
Teflon Tape	Teflon	2	
Saw	Serrucho	3	
Hammers	Martillos	2	
Hand Saw	Serrucho (de mano)	4	
Brushes	Cepillos	1	
Wheel Barrow	Carretilla	4	
Levels	Niveles	4	
Bulk Heads	Roscas por Rotoplas 1.25"	2	
Male Adaptor (2")	Adaptadores Macho de 2 pulgadas	1	
Male Adaptor (1.5")	Adaptadores Macho de 1.5 pulgadas	14	
Female Adaptors	Adaptadores Hembra	7	
2" Elbows	Codo de 2 pulgadas	33	
1.5" Elbows	Codo de 1.5 pulgadas	15	
4" Elbow	Codo 4"	1	
3" Elbow	Codo 3"	1	
1.5" Cap	Tapon Macho 1.5" con Roscas	4	
2" PVC Union	Union 2"	9	
1.5" PVC Union	Union 1.5"	10	
2" PVC Union	Union 2"	9	
3" PVC Union	Union 3"	6	
2" Tee	Tee PVC 2"	6	
1.5" Tee	Tee PVC 1.5"	2	
2 - 1.5 Reducer	Reductor 2" x 1.5"	2	
3 - 1.5 Reducer	Reductor 3" x 1.5"	2	
1.5" 45 elbow	Codo PVC 1.5" x 45 deg	7	
2" 45 elbow	Codo PVC 2" x 45 deg	1	
1.25 45 elbow	Codo PVC 1.25" x 45 deg	2	
Gutter Unions	Tapaderas PVC Para Canal Colonial	4	
Downspouts	Canal Debajada 2"	2	
Gutter Clips	Clips	3	pair

Figure 23: List of Materials at Roberto's House

House 5: Filomena Gualim Coal
1 block 3 ft

Building 2 tank base for 1+2
Tanks 1+2: 2350 L

Road

3.3m 5.3m

10.8m

9.1m

© 2014 Engineers Without Borders USA. All Rights Reserved

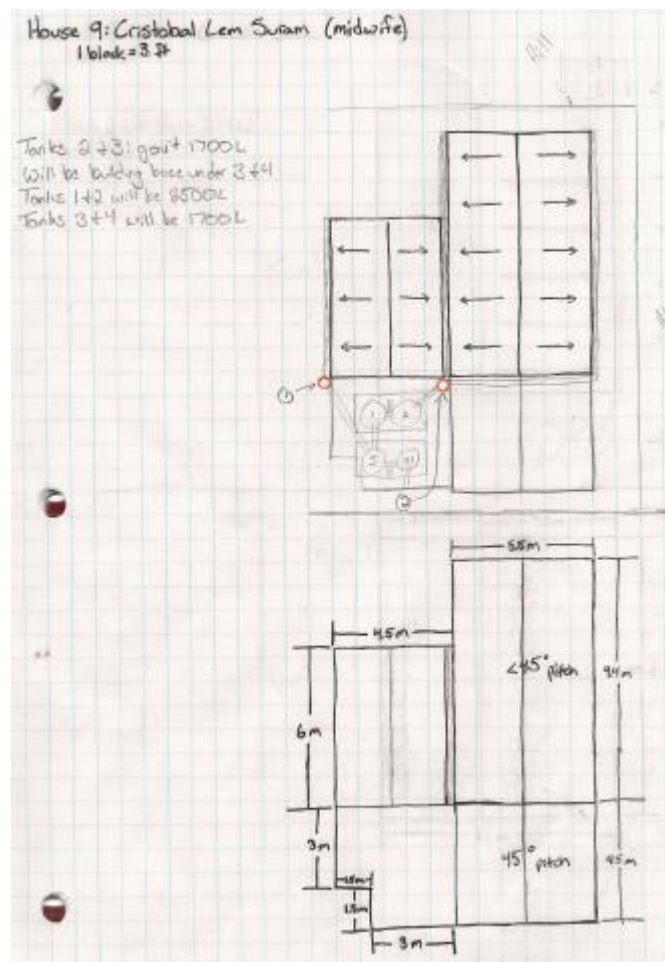


Figure 25: Drawing of House 9. The First Flushes are marked in red, all other elements of the system remained the same.

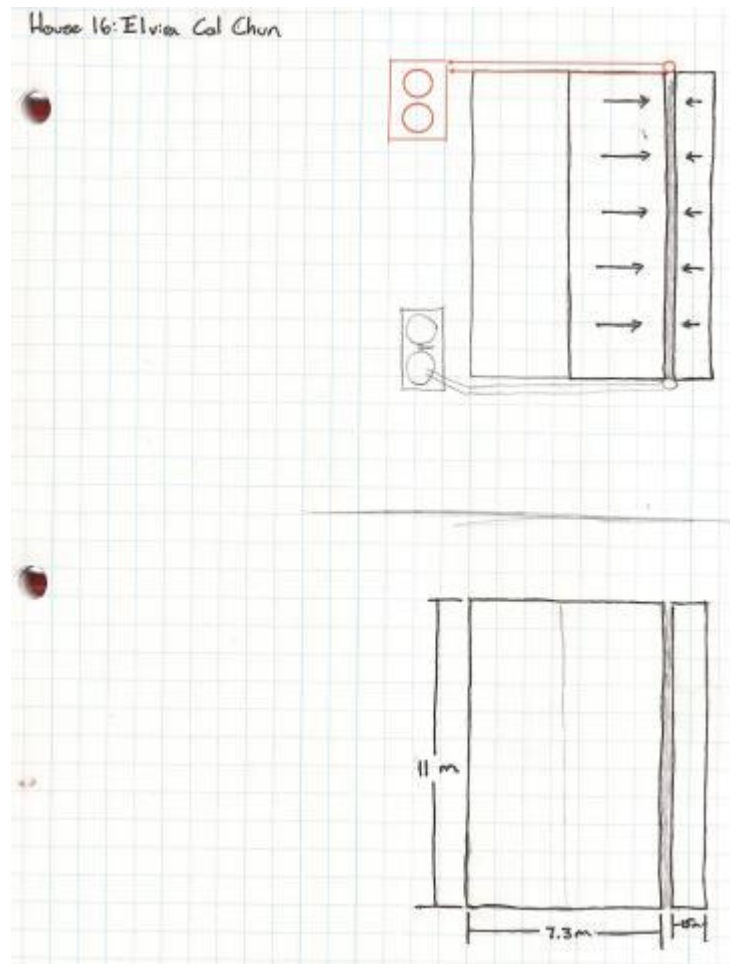


Figure 26: Drawing of House 16. The first flush and the changed elements of the planned implementation are drawn in red.

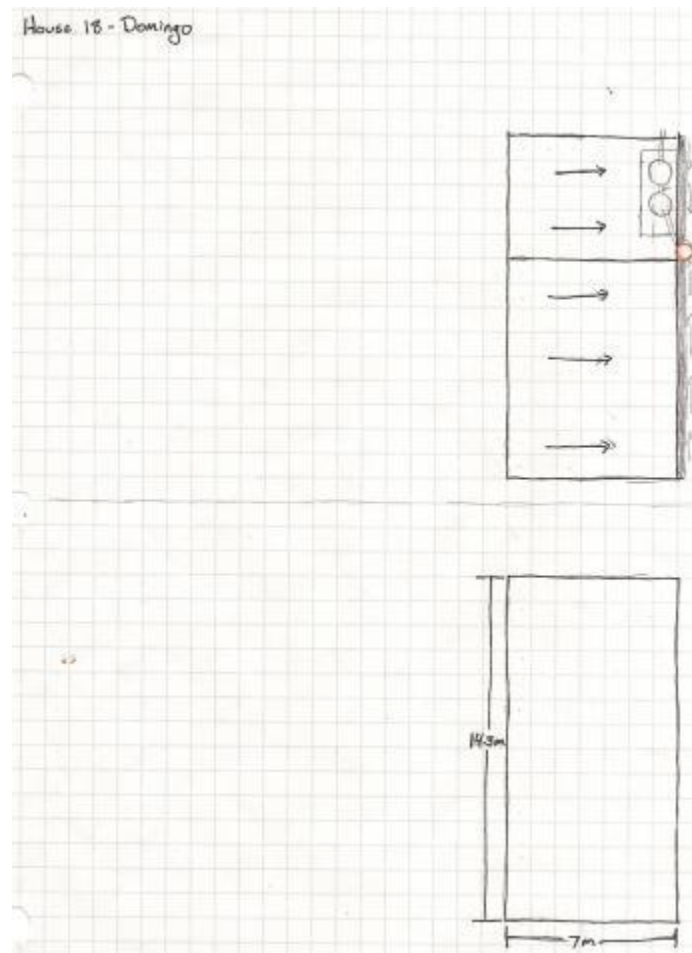


Figure 27: Drawing of House 18. The first flushes are marked in red, all other elements of the system remained the same.

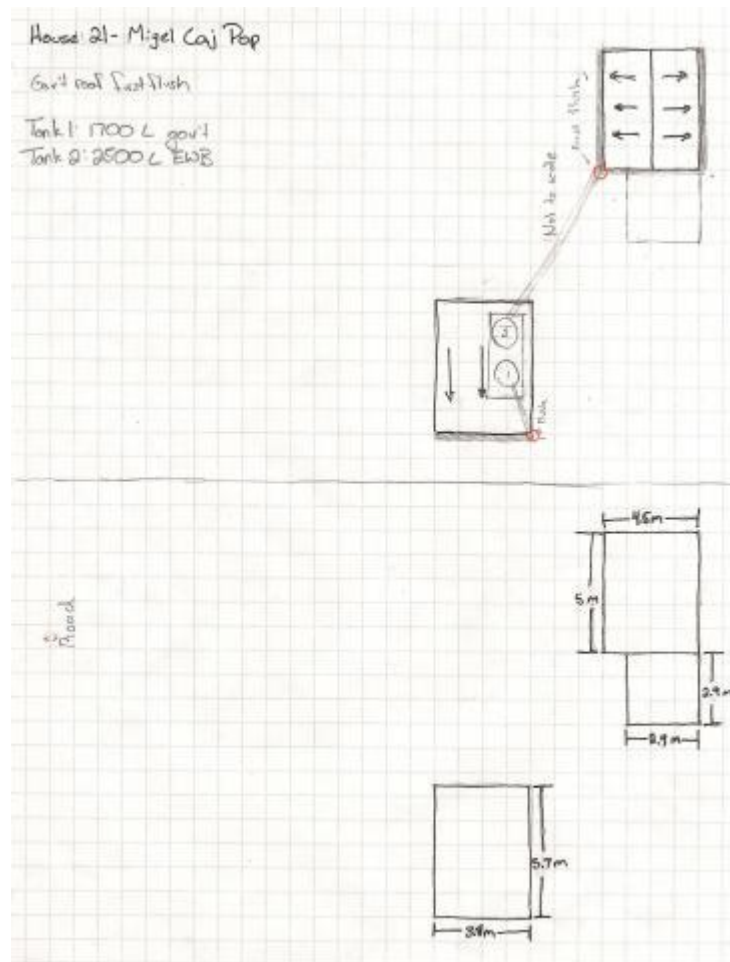


Figure 28: Drawing of House 21. The first flushes are marked in red, all other elements of the system remained the same.

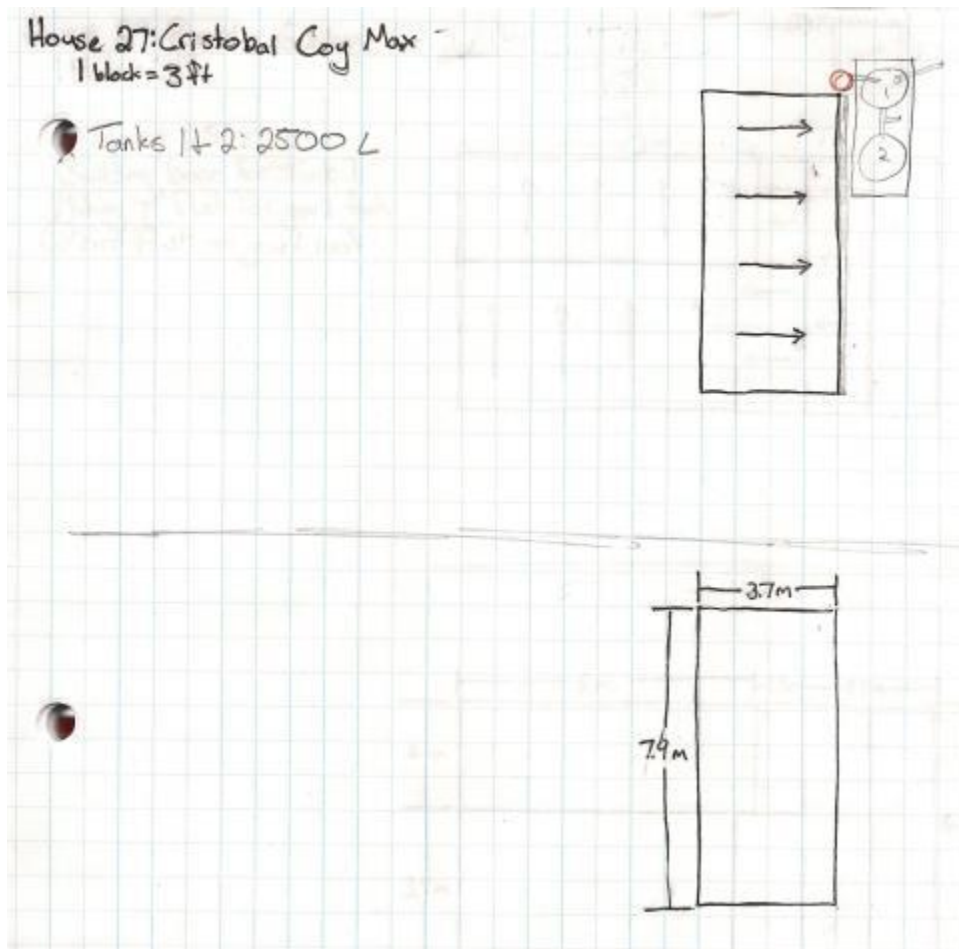


Figure 29: Drawing of House 27. The first flushes are marked in red, all other elements of the system remained the same.

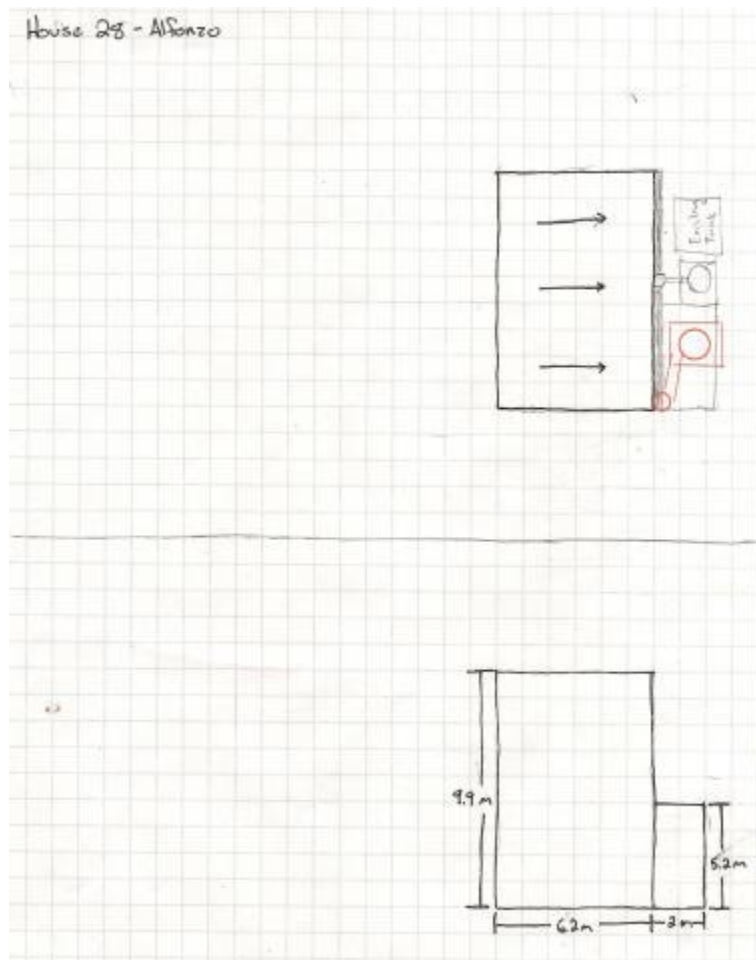


Figure 30: Drawing of House 28. The first flush and the changed elements of the planned implementation are drawn in red.

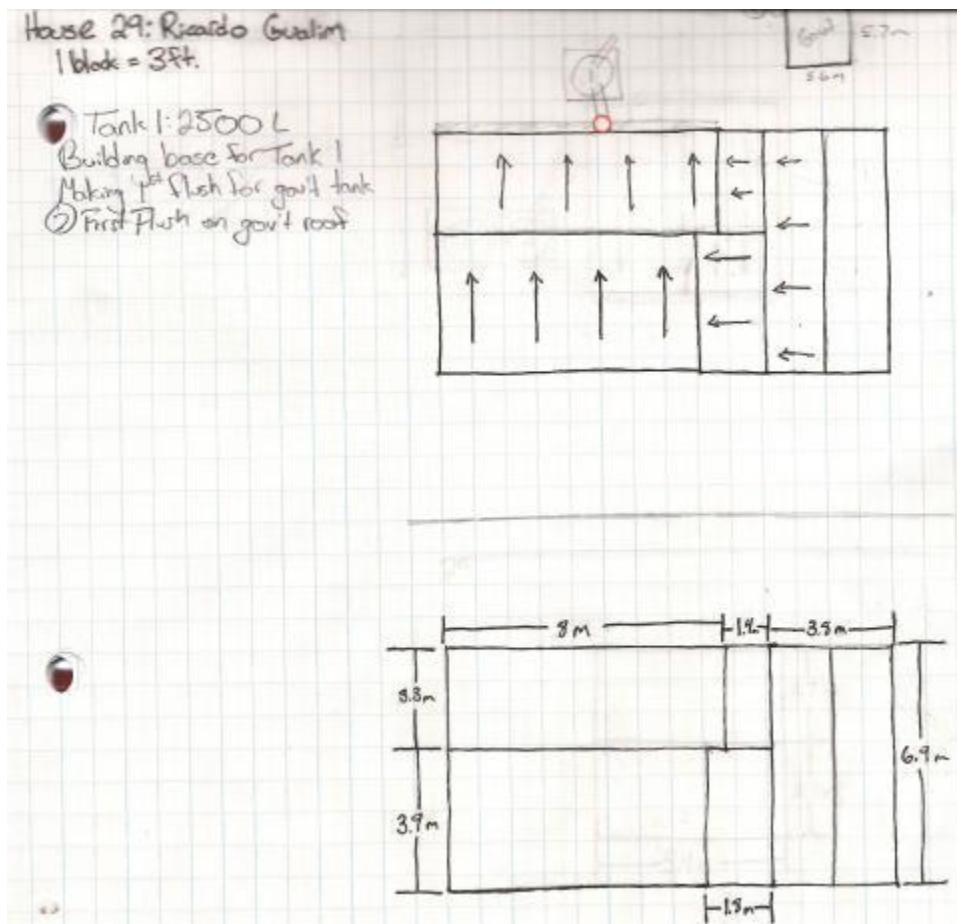


Figure 31: Drawing of House 29. The first flushes are marked in red, all other elements of the system remained the same.

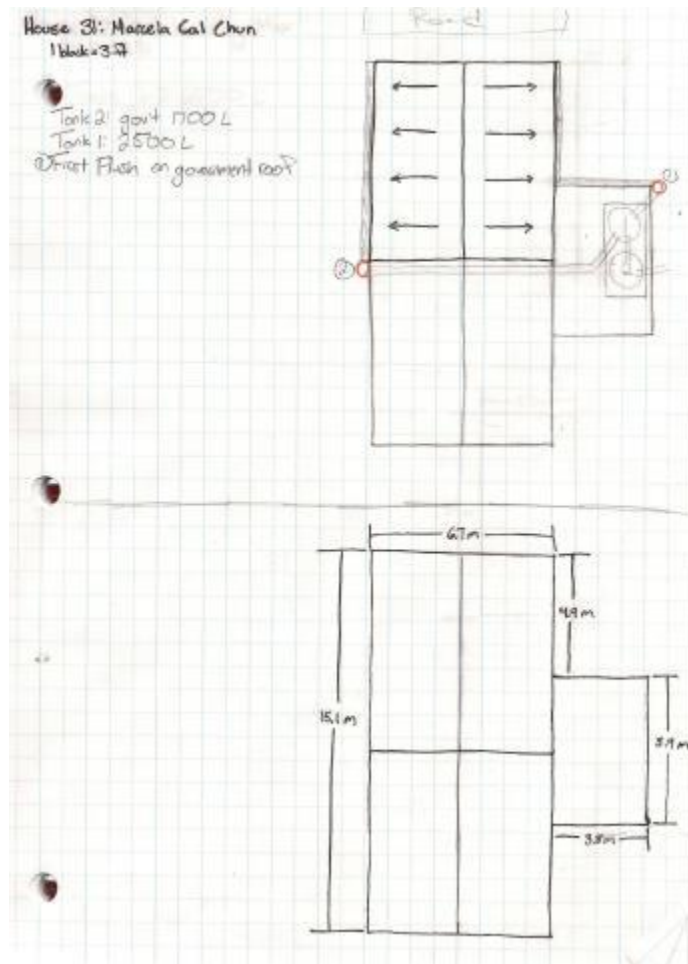


Figure 32: Drawing of House 31. The first flushes are marked in red, all other elements of the system remained the same.

Appendix D

Form 1 Master Monitoring Sheet

Month/Year_____

Through the surveys, try to get a feel on the following three topics. These are not questions that are specific to a home, but observations about the community.

Did you hear any news about the Finca?

What's the feel on the EWB implemented systems?

Anything new we should know about in the community?

House 1

Surveyed ☐

Unavailable ☐

House 5

Surveyed ☐

Unavailable ☐

House 8

Surveyed ☐

Unavailable ☐

House 9

Surveyed ☐

Unavailable ☐

House 16

Surveyed ☐

Unavailable ☐

House 18

Surveyed ☐

Unavailable ☐

House 21

Surveyed ☐

Unavailable ☐

House 26

Surveyed ☐

Unavailable ☐

House 27

Surveyed ☐

Unavailable ☐

House 28

Surveyed ☐

Unavailable ☐

House 29

Surveyed ☐

Unavailable ☐

House 31

Surveyed ☐

Unavailable ☐

Form 2

Previously Implemented Homes

House #

General Water Usage Questions

For the past two weeks, has this EWB implemented system provide sufficient drinking water for your family?

Have there been any water problems which EWB should be notified about?

System Questions

Have you made changes to your EWB implemented system? Why and what were they?

Are there any problems with the system?

How are you using your first flush? (Alvaro: ask family to show how much it is filled) (Do you allow it to fill up during each rainstorm and empty it afterwards?)

When was the last time that you emptied the first flush?

When was the last time that you cleared debris off of your roof?

Do you collect and use the water from your First Flush? How do you use that water?

How else do you maintain the system?

Are you content with the system?

Alvaro Checklist

Check to see if there is water in the first flush.


Check to see if the gutter is clogged/dirty.

Check to see if there is debris in the gutter/on the roof.

Are there any puddles of water collecting near the system?

Is there anything out of the ordinary with the system?

Appendix E



CECEP
MUSEO
KATINAMIT

Museo Katinamit
San Cristóbal Verapaz
Tel. (502) 7950-4896
cecep@inteln.net.gt

Este contrato representa un acuerdo entre: el beneficiario de la comunidad de Guachtu'Uq, Ingenieros sin Fronteras y CECEP.

Se instaló un sistema de agua, de valor total de 7489,39 Q, el (fecha) 17 de Mayo 2014. La siguiente lista muestra un desglose del valor total del sistema:

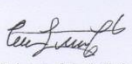
Base	<u>1811 Q</u>
Rebalse	<u>97,17 Q</u>
Primera lluvia	<u>261,13 Q</u>
Tinacos	<u>4488 Q</u>
Misceláneo	<u>832,09 Q</u>

Este contrato implica 3 compromisos más allá que los que están indicados en el acta:


1. Yo pagaré un 5% de este costo, que es de 374,45 Q. Lo pagaré: en un plazo o en 12 cuotas mensuales de 31,20 Q que entregaré a CECEP, a Susy Ical Lem el primero de cada mes.
2. Yo me comprometo a apoyar las instalaciones futuras que hacen Ingenieros sin Fronteras en otras casas de la comunidad de Guachtu'Uq.
3. Yo me comprometo a no vender el tinaco por el mínimo establecido de 10 años. Si decido venderlo o si salgo de la comunidad, tendré que comprar el tanque de CECEP a un monto que disminuye cada año. La siguiente tabla incluye el precio el tinaco en el periodo de diez años.

Años después de la instalación	Precio del tinaco (quetzales)
0	2400
1	2160
2	1920
3	1680
4	1440
5	1200
6	960
7	720
8	480
9	240
10	0

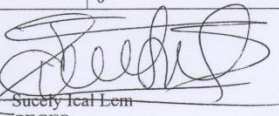
Este contrato es firmado por los siguientes colaboradores:



Cristobal Laj Cojoc
Presidente Comité de Agua



Filomena Gualim
Beneficiario



Susy Ical Lem
CECEP






Figure 33: This is the MOU signed by Filomena Gualim acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at her home.



CECEP
MUSEO
KATINAMIT

Museo Katinamit
San Cristóbal Verapaz
Tel. (502) 7950-4896
cecep@intelnet.net.gt

Este contrato representa un acuerdo entre: el beneficiario de la comunidad de Guatchthu'Uq, Ingenieros sin Fronteras y CECEP.

Se instaló un sistema de agua, de valor total de 8716,46 Q, el (fecha) 17 de Mayo 2014. La siguiente lista muestra un desglose del valor total del sistema:

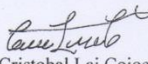
Base	<u>1811 Q</u>
Rebalse	<u>99,67 Q</u>
Primera lluvia	<u>527,09 Q</u>
Tinacos	<u>4488,00 Q</u>
Misceláneo	<u>1791,10 Q</u>


Este contrato implica 3 compromisos más allá que los que están indicados en el acta:

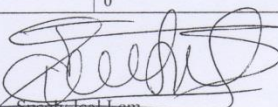
- Yo pagaré un 5% de este costo, que es de 435,84 Q. Lo pagaré: en un plazo o en 12 cuotas mensuales de 36,32 Q que entregaré a CECEP, a Susy Ical Lem el primero de cada mes.
- Yo me comprometo a apoyar las instalaciones futuras que hacen Ingenieros sin Fronteras en otras casas de la comunidad de Guatchthu'Uq.
- Yo me comprometo a no vender el tinaco por el mínimo establecido de 10 años. Si decido venderlo o si salgo de la comunidad, tendré que comprar el tanque de CECEP a un monto que disminuye cada año. La siguiente tabla incluye el precio el tinaco en el periodo de diez años.

Años después de la instalación	Precio del tinaco (quetzales)
0	2400
1	2160
2	1920
3	1680
4	1440
5	1200
6	960
7	720
8	480
9	240
10	0

Este contrato es firmado por los siguientes colaboradores:


Cristobal Laj Cojoc
Presidente Comité de Agua


Cristobal Lem Suram
Beneficiario


Susy Ical Lem
CECEP





Figure 34: This is the MOU signed by Cristobal Lem Suram acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at his home.



CECEP
MUSEO
KATINAMIT

Museo Katinamit
San Cristóbal Verapaz
Tel. (502) 7950-4896
cecep@intelnat.net.gt

Este contrato representa un acuerdo entre: el beneficiario de la comunidad de Guatchthu'Uq, Ingenieros sin Fronteras y CECEP.

Se instaló un sistema de agua, de valor total de 5079,59 Q, el (fecha) 17 de Mayo 2014. La siguiente lista muestra un desglose del valor total del sistema:

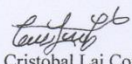
Base	<u>1811 Q</u>
Rebalse	<u>3811 Q</u> <u>89,63 Q</u>
Primera lluvia	<u>276,65 Q</u>
Tinacos	<u>2244 Q</u>
Misceláneo	<u>658,31</u>

Este contrato implica 3 compromisos más allá que los que están indicados en el acta:


- Yo pagaré un 5% de este costo, que es de 253,97 Q. Lo pagaré: en un plazo o en 12 cuotas mensuales de 36,67 Q que entregará a CECEP, a Susy Ical Lem el primero de cada mes. 21,16 Q
- Yo me comprometo a apoyar las instalaciones futuras que hacen Ingenieros sin Fronteras en otras casas de la comunidad de Guatchthu'Uq.
- Yo me comprometo a no vender el tinaco por el mínimo establecido de 10 años. Si decido venderlo o si salgo de la comunidad, tendré que comprar el tanque de CECEP a un monto que disminuye cada año. La siguiente tabla incluye el precio el tinaco en el periodo de diez años.

Años después de la instalación	Precio del tinaco (quetzales)
0	2400
1	2160
2	1920
3	1680
4	1440
5	1200
6	960
7	720
8	480
9	240
10	0

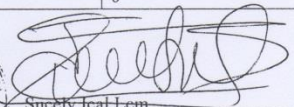
Este contrato es firmado por los siguientes colaboradores:



Cristobal Laj Cojoc
Presidente Comité de Agua



Elvira
Beneficiario



Susy Ical Lem
CECEP





Figure 35: This is the MOU signed by Elvira acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at her home.



Museo Katinamit
San Cristóbal Verapaz
Tel. (502) 7950-4896
cecep@intelnet.net.gt

Este contrato representa un acuerdo entre: el beneficiario de la comunidad de Guachtu'Uq, Ingenieros sin Fronteras y CECEP.

Se instaló un sistema de agua, de valor total de 7,481.32, el (fecha) 17 de Mayo 2014. La siguiente lista muestra un desglose del valor total del sistema:

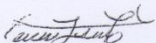
Base	<u>1,811 Q</u>
Rebalse	<u>10,425 Q</u>
Primera lluvia	<u>288,65 Q</u>
Tinacos	<u>4,488 Q</u>
Misceláneo	<u>792.42 Q</u>


Este contrato implica 3 compromisos más allá que los que están indicados en el acta:

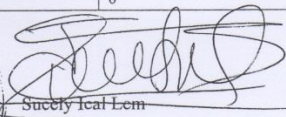
1. Yo pagaré un 5% de este costo, que es de 374.07 Q. Lo pagaré: en un plazo o en 12 cuotas mensuales de 31.17 Q que entregaré a CECEP, a Susy Ical Lem el primero de cada mes.
2. Yo me comprometo a apoyar las instalaciones futuras que hacen Ingenieros sin Fronteras en otras casas de la comunidad de Guachtu'Uq.
3. Yo me comprometo a no vender el tinaco por el mínimo establecido de 10 años. Si decido venderlo o si salgo de la comunidad, tendré que comprar el tanque de CECEP a un monto que disminuye cada año. La siguiente tabla incluye el precio el tinaco en el periodo de diez años.

Años después de la instalación	Precio del tinaco (quetzales)
0	2400
1	2160
2	1920
3	1680
4	1440
5	1200
6	960
7	720
8	480
9	240
10	0

Este contrato es firmado por los siguientes colaboradores:


Cristóbal Laj Cojoc
Presidente Comité de Agua


Domingo
Beneficiario


Susy Ical Lem
CECEP





Figure 36: This is the MOU signed by Domingo acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at his home.



CECEP
MUSEO
KATINAMIT

Museo Katinamit
San Cristóbal Verapaz
Tel. (502) 7950-4896
cecep@intelnet.net.gt

Este contrato representa un acuerdo entre: el beneficiario de la comunidad de Guachtu'Uq, Ingenieros sin Fronteras y CECEP.

Se instaló un sistema de agua, de valor total de 4,005.17 Q, el (fecha) 17 de Mayo 2014. La siguiente lista muestra un desglose del valor total del sistema:

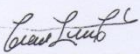
Base	<u>0 Q</u>
Rebalse	<u>83.67 Q</u>
Primera lluvia	<u>551.63 Q</u>
Tinacos	<u>2244 Q</u>
Misceláneo	<u>1.125,87 Q</u>

Este contrato implica 3 compromisos más allá que los que están indicados en el acta:


- Yo pagaré un 5% de este costo, que es de 200.26 Q. Lo pagaré: en un plazo o en 12 cuotas mensuales de 16.69 Q que entregará a CECEP, a Susy Ical Lem el primero de cada mes.
- Yo me comprometo a apoyar las instalaciones futuras que hacen Ingenieros sin Fronteras en otras casas de la comunidad de Guachtu'Uq.
- Yo me comprometo a no vender el tinaco por el mínimo establecido de 10 años. Si decido venderlo o si salgo de la comunidad, tendré que comprar el tanque de CECEP a un monto que disminuye cada año. La siguiente tabla incluye el precio el tinaco en el periodo de diez años.

Años después de la instalación	Precio del tinaco (quetzales)
0	2400
1	2160
2	1920
3	1680
4	1440
5	1200
6	960
7	720
8	480
9	240
10	0

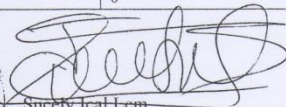
Este contrato es firmado por los siguientes colaboradores:



Cristobal Laj Cojoc
Presidente Comité de Agua



Miguel Caj Pop
Beneficiario



Susy Ical Lem
CECEP





Figure 37: This is the MOU signed by Miguel Caj Pop acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at his home.



Centro Comunitario Educativo Politécnico
CECEP
MUSEO KATINAMIT

Museo Katinamit
San Cristóbal Verapaz
Tel. (502) 7950-4896
cecep@intelnet.net.gt

Este contrato representa un acuerdo entre: el beneficiario de la comunidad de Guachtu'Uq, Ingenieros sin Fronteras y CECEP.

Se instaló un sistema de agua, de valor total de 42,559.61 Q, el (fecha) 17 de Mayo. La siguiente lista muestra un desglose del valor total del sistema:

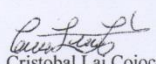
Base	<u>995.5 Q</u>
Rebalse	<u>120.5 Q</u>
Primera lluvia	<u>270,28 Q</u>
Tinacos	<u>224.1</u>
Misceláneo	<u>625.68</u>

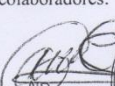
Este contrato implica 3 compromisos más allá que los que están indicados en el acta:

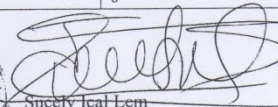
- Yo pagaré un 5% de este costo, que es de 212,80 Q. Lo pagaré: en un plazo o en 12 cuotas mensuales de 17,73 Q que entregaré a CECEP, a Susy Ical Lem el primero de cada mes.
- Yo me comprometo a apoyar las instalaciones futuras que hacen Ingenieros sin Fronteras en otras casas de la comunidad de Guachtu'Uq.
- Yo me comprometo a no vender el tinaco por el mínimo establecido de 10 años. Si decido venderlo o si salgo de la comunidad, tendré que comprar el tanque de CECEP a un monto que disminuye cada año. La siguiente tabla incluye el precio el tinaco en el periodo de diez años.

Años después de la instalación	Precio del tinaco (quetzales)
0	2400
1	2160
2	1920
3	1680
4	1440
5	1200
6	960
7	720
8	480
9	240
10	0

Este contrato es firmado por los siguientes colaboradores:


Cristobal Laj Cojoc
Presidente Comité de Agua


Alfonso
Beneficiario


Susy Ical Lem
CECEP





Figure 38: This is the MOU signed by Alfonso acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at his home.



CECEP
MUSEO
KATINAMIT

Museo Katinamit
San Cristóbal Verapaz
Tel. (502) 7950-4896
cecep@intelnet.net.gt

Este contrato representa un acuerdo entre: el beneficiario de la comunidad de Guachtu'u'Uq, Ingenieros sin Fronteras y CECEP.

Se instaló un sistema de agua, de valor total de 4,353,61 Q, el (fecha) 17 de Mayo 2014. La siguiente lista muestra un desglose del valor total del sistema:

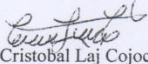
Base	<u>995,5 Q</u>
Rebalse	<u>7675 Q</u>
Primera lluvia	<u>564,45 Q</u>
Tinacos	<u>2,241 Q</u>
Misceláneo	<u>472,91 Q</u>

Este contrato implica 3 compromisos más allá que los que están indicados en el acta:


- Yo pagaré un 5% de este costo, que es de 217,68, Lo pagaré: en un plazo o en 12 cuotas mensuales de 18,14 Q que entregaré a CECEP, a Susy Ical Lem el primero de cada mes.
- Yo me comprometo a apoyar las instalaciones futuras que hacen Ingenieros sin Fronteras en otras casas de la comunidad de Guachtu'u'Uq.
- Yo me comprometo a no vender el tinaco por el mínimo establecido de 10 años. Si decido venderlo o si salgo de la comunidad, tendré que comprar el tanque de CECEP a un monto que disminuye cada año. La siguiente tabla incluye el precio el tinaco en el periodo de diez años.

Años después de la instalación	Precio del tinaco (quetzales)
0	2400
1	2160
2	1920
3	1680
4	1440
5	1200
6	960
7	720
8	480
9	240
10	0

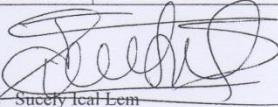
Este contrato es firmado por los siguientes colaboradores:



Cristóbal Laj Cojoc
Presidente Comité de Agua



Ricardo
Beneficiario



Susy Ical Lem
CECEP





Figure 39: This is the MOU signed by Ricardo acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at his home.

81



CECEP
MUSEO
KATINAMIT

Museo Katinamit
San Cristóbal Verapaz
Tel. (502) 7950-4896
cecep@inteln.net.gt

Este contrato representa un acuerdo entre: el beneficiario de la comunidad de Guatchthu'Uq, Ingenieros sin Fronteras y CECEP.

Se instaló un sistema de agua, de valor total de 4,562,59 Q, el (fecha) 17 de Mayo 2014. La siguiente lista muestra un desglose del valor total del sistema:

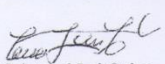
Base	<u>0 Q</u>
Rebalse	<u>148,42 Q</u>
Primera lluvia	<u>543,68 Q</u>
Tinacos	<u>2.244 Q</u>
Misceláneo	<u>1.626,49</u>

Este contrato implica 3 compromisos más allá que los que están indicados en el acta:

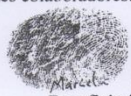
- Yo pagaré un 5% de este costo, que es de 228,130. Lo pagaré: en un plazo o en 12 cuotas mensuales de 19,01 Q que entregaré a CECEP, a Susy Ical Lem el primero de cada mes.
- Yo me comprometo a apoyar las instalaciones futuras que hacen Ingenieros sin Fronteras en otras casas de la comunidad de Guatchthu'Uq.
- Yo me comprometo a no vender el tinaco por el mínimo establecido de 10 años. Si decido venderlo o si salgo de la comunidad, tendré que comprar el tanque de CECEP a un monto que disminuye cada año. La siguiente tabla incluye el precio el tinaco en el periodo de diez años.

Años después de la instalación	Precio del tinaco (quetzales)
0	2400
1	2160
2	1920
3	1680
4	1440
5	1200
6	960
7	720
8	480
9	240
10	0


Este contrato es firmado por los siguientes colaboradores:



Cristobal Laj Cojoc
Presidente Comité de Agua



Beneficiario



Susy Ical Lem
CECEP

Figure 40: This is the MOU signed by Marcela acknowledging the completion of the EWB USA-WPI Rainwater Harvesting System at her home.