Document 522
POST-ASSESSMENT REPORT

CHAPTER: Worcester Polytechnic Institute
COUNTRY: Guatemala
COMMUNITY:Guachthu`uq, San CristóbalVerapaz
PROJECT:Water/Stoves for Guachthuúq

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

Post-Assessment Report Part 1 – Administrative Information

1.0 Contact Information

	Name	Email	Phone	Chapter Name or Organization Name
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Travel History

Dates of Travel	Assessment or Implementation	Description of Trip
07/20/2010-08/03/2010	**Assessment**	**1st Assessment Trip**
07/23/2011-08/07/2011	**Assessment**	**2nd Assessment Trip**

2.0 Travel Team

Name	E-mail	Phone	Chapter	Student or Professional
Julie Bliss	blissj2012@wpi.edu	774-551- 6213	EWB-WPI	Student
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3.0 Health and Safety

3.1 Incident Reports

Did any safety incidents occur during this trip? ___Yes _X__No

If "Yes," please submit your completed Incident Report as a separate attachment with this report. If your HSO has not yet filled out the Incident Report, a blank form can be found on the EWB-USA website – Member Pages – Project Process – Health and Safety Program.

4.0 Budget

4.1 Projected Cost

Expense	Total Cost
Airfare(8)	$4,400
On Ground(transportation, homestays)	$3,300
Translators	$800
Total	$8,500

Actual Cost

Expense	Total Cost
Airfare	$4100
On Ground	$2900
Materials	$100
Other (Rain Guage, Customs)	$1000
Total	$8,100

1.1 Professional Mentor/Technical Lead Hours

Name(s) of Professional Mentor(s) (student chapters) Technical Lead(s) (professional chapters)	Pre-trip hours	During trip hours	Post-trip hours	Total Hours
1. Matthew Gamache (Prof. Mentor)	40	60	16	116
2.Professor Peet (Faculty Advisor and Prof. Mentor)	40	120	10	170

2.0 Project Location

Guachthu'uq is on the outskirts of the municipality of San Cristóbal Verapaz in the state of Alta Verapaz. is located very close to Guachthu'uq, and as a result the two community names are used interchangeably to describe the general area of the community.

Longitude: 90º 29' 24.37" W *(Degrees, Minutes, Seconds)*
Latitude: 15º 22' 13.04" N *(Degrees, Minutes, Seconds)*

Post Assessment Report Part 2 – Technical Information

1.0 INTRODUCTION

The Engineers Without Borders chapter at Worcester Polytechnic Institute (EWB-WPI) sent six students and two professionals to the community of Guachthu'uq, Guatemala, from July 23rd to August 7th 2011. The purposes of this second assessment trip were to further build on the existing relationship with the community of Guachthu'uq and to collect in depth data on each homes structure, household tendencies with respect to cooking and water use, and rainwater catchment potential.

The local NGO contact continued to be Michelle Banks, Michelle Banks, from the local Non-Governmental Organization (NGO) called PaatItz´at with whom the team worked closely throughout the trip. The team also continued to collaborate with the Geology Department of the University of San Carlos in Cobán, Guatemala. This relationship is essential to obtain new, quality controlled meteorological data in the community. During the trip the team further observed the community's socio-economic structure, water resources, cooking devices and methods, geology, waste disposal methods, hygiene and sanitation, and general health.

Through holding in-depth conversations with the community members, witnessing their way of life first-hand, and collecting data, EWB-WPI will be able to begin implementation of sustainable solutions that will have a significantly positive impact on the community members' health and way of life. In the coming months, EWB-WPI will perform an alternative analysis and preliminary design report, followed by a detailed design of the selected alternative(s).

2.0 PROGRAM BACKGROUND

EWB-WPI has a five-year commitment to the community to ensure the sustainability of any implemented project(s).

While the needs of the community are many, based on the first and second assessment trip, the families have identified year-round access to potable water and the addition of cooking stoves into their homes as their most pressing concerns.

Stoves

Most amilies in Guachthu'uq use three-stone fires for cooking with wood as their primary source of fuel. As a result, women and children suffer from burns, as well as chronic cough and respiratory infections from inhaling smoke. Respiratory conditions are the highest sources of death in the area. With the construction of clean and efficient word-burning stoves, the women's and children's exposure to smoke will decrease, thus improving their health. Their involvement with other aspects of community life will increase since the use of more fuel efficient stoves will reduce the amount of time required for the collection of firewood. It will also reduce the amount of money needed to purchase firewood and decrease the risk of destructive fires.

While the government has encouraged the planting of new trees, most of what has been planted has been pine trees, instead of planting a more appropriate local species, that would burn better and longer, thus doing little to reforest the region. In addition many local trees are located on private property, to which the residents have no legal access. In February of 2009, a landslide killed more than 30 people near Guachthu'uq . While the exact cause of the landslide has yet to be determined, deforestation has been cited as a contributing factor. With the implementation of sustainable stoves, our hope is that less firewood will be used. This will contribute to the restoration of a sustainable ecosystem and create a healthier home environment.

Water

During the dry season (February – May) the community relies on a spring water diversion box located approximately one kilometer downhill from the center of the community. This water source is located on a private estate, which the locals call the "Finca." The community has had problems accessing the Finca source. In 2006, the land owner and the families who live in the communities that access the spring (Guachthu'uq, Las Arrugas, and La Reforma) agreed to restrict access to the actual source. They agreed to construct a spring diversion box about 100 meters downstream where families can collect drinking water and wash clothing. This has helped community relations. However, the distance between the spring and the

community of Guachthu'uq continues to be a problem since families have to make multiple trips each day. There is also concern about the quality of the spring water. The source does not receive any water treatment, and many people in the community, especially children, suffer from dysentery and parasitic worms.

During the rainy season (June – January), most families in the community gather water in rainwater collection tanks that were donated by the municipal government in 2009. However, these tanks have not proved to be as effective as predicted. The dry season in the region has reportedly become longer and the rainy season is beset by rising temperatures and decreased rainfall. Though these collection tanks have eased some of the community's water problems, many families in the community do not own a collection tank, and many of the collection systems are used inefficiently or is ineffective in serving the household's water demands.

3.0 TRIP DESCRIPTION

The following activities were performed on each day of the assessment trip:

- Day 1, July 23: The team spent the entire day en-route to San Cristóbal, Verapaz.

- Day 2, July 24: The team spent the day getting acquainted with their surroundings and prepping for a week of field work.

- Day 3, July 25: Team members traveled to Cobán to meet with Sergio Moran, the local geology professor, at the University of San Carlos where collaboration on data collection plans were discussed. The team also met with Sucely Ical Lem, who runs CeCep (Community Center for Pokomchì Education), she introduced us to the English-Spanish-Pokomchì translator, Gerson. We then briefed Gerson so that he understood the project objectives and methodologies for the upcoming field work. At this time Sucely offered us the keys to CeCep so that we could have a large meeting space with internet and three pronged plugs. Then we travelled to the community of Guachtuúq to meet with the local government, the COCODE. The point of this meeting was to update the COCODE and to inform them of our plans for the trip. At the meeting we introduced ourselves, updated the COCODE, explained the goals of our

Assessment Trip, explained why we chose rain water catchment, and our projected schedule of events over the next couple of years. We then participated in a general discussion to receive their feedback on our ideas.

- Day 4, July 26: The team started the day off by doing 5 home assessments and then had a community meeting. At this community meeting we talked about the project objectives and the cooperation that would be needed to achieve our trip goals. After the meeting the team collected water samples from 3 tanks in use and the Finca.

- Day 5, July 27: The entire day was spent conducting the home assessments.

- Day 6, July 28: The entire day was once again spent conducting home assessments. We then analyzed the water samples.

- Day 7, July 29: The team divided into two groups, with one group working on data entry and analysis and the other group wrapping up the final home assessments.

- Day 8, July 30: The team completed more data entry and worked on the rough draft of the Memorandum of Understanding. In the afternoon half of the team conducted a materials inventory for the rainwater and stove projects, while the other half of the team worked on more data entry.

- Day 9, July 31: The team took Sunday off and enjoyed local tourist attractions.

- Day 10, August 1: The team met at CECEP in the morning to prepare for a meeting with a lawyer (INFO) who specialized in land transactions. At the meeting we talked about the process of transferring the private land of one of the community members to the community for the use as a potential community water tank. At a meeting with Michelle Banks later in the day, we talked about how we were going to explain all of the data we took during the home assessments and the next steps of the project process to the COCODE. In the afternoon the team did more data entry.

- Day 11, August 2: The team continued with data entry, worked on the Post Assessment Trip Report and conducted a meeting with the COCODE in preparation for the community meeting to be held the next day.

- Day 12, August 3: The team traveled to Cobán to visit local construction stores specifically for stove tops and bricks. In the evening, we had a large community meeting to discuss topics like the pilot projects, funding, and cooperation of the community with EWB-WPI . This was accomplished by the signing of a Memorandum of Understanding by both parties.

- Day 13, August 4: The team visited the community to further assess the pilot project homes by retaking measurements to assure accuracy.

- Day 14, August 5: The team traveled to the University of San Carlos to work with Sergio in purchasing the rain gauge which is crucial to our project.

- Day 15, August 6: The team traveled to Guatemala City to work on getting price quotes on stove tops and then stayed in Antigua to have close access to the airport ensuring we make our flight.

- Day 16, August 7: The team flew back to the United States.

4.0 COMMUNITY INFORMATION

4.1 Description of Community

Demographics

Guachthu'uq is a rural Mayan Poqomchi community of 39 families, 41 houses, and about 280 people, located about three kilometers west of San Cristóbal,Alta Verapaz. While most women are monolingual in Poqomchi', many community members speak both Spanish and Poqomchi'. The residents are a mix of Protestant

Evangelicals and Catholics and are involved in traditional Mayan spirituality as well.

Community Infrastructure

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

Work

The average family income is around $500 annually (roughly $2-3 a day). The women primarily take care of household work although a few (particularly younger women and some girls as young as eleven years old) work in the town of San Cristóbal as domestics. The women and children gather water every day and tend to the house, while the men gather wood for fuel. Some men might travel to work at a large farm for weeks at a time. Their main year-round water source is located at a private "finca" or estate, at the bottom of the community. There, the women do laundry and gather drinking water with their children. Depending on where the family lives, it takes anywhere from a half-hour to an hour and a half to bring water to their homes. Most of the families do not own much land, if any at all, so they usually buy their food and wood from others who own land. There is almost no livestock in the community. The average family may own one or two chickens at most, which provides eggs and meat occasionally.

Education

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

4.2 Community and Partnering Organization/NGO Resources and Constraints

The current COCODE (Community Development Council) meets regularly with the entire community (both men and women) to generate and discuss solutions for issues that affect them. In general, EWB-WPI found the COCODE to be very organized. The president of Guachthu'uq 's COCODE is now Angel, Don Domingo's son. The community recognizes that their limited access to water and fuel consumption for cooking are also environmental issues, and they are committed to the creation of a program that is both sustainable and has a positive impact on their environment and health. They are aware of deforestation in the region and the continuous loss of natural resources. The community will contribute labor and tools in addition to monetary contributions for materials needed in the EWB-WPI project.

The community as a whole decided to work together to fund the materials necessary for the project. EWB-WPI has committed to funding about 75 percent of the project costs. This is mainly because the cost of the materials is much more than previously anticipated. Members of the COCODE will work with the community to come up with fundraising ideas such as raffles and reaching out to other NGO's.

4.3 Community Relations

Beyond the community of Guachthuúq, EWB-WPI worked in the town of San Cristóbal and created strong relations with many people and organizations in the surrounding areas.

PaatItz'at is an arts education organization based in Washington, DC, that is assisting EWB-WPI with the project. The NGO project coordinator, Michelle Banks, lives in San Cristóbal six months out of the year and brings high school students from the US to volunteer in schools in the San Cristóbal region. Michelle Banks is helping with logistics and community education components of the project.

Centro Communitario Educativo Poqomonchi (CeCEP) is a local cultural museum centered in San Cristobal. It highlights the Mayan cultures in the region, covering religious tradition and way of life. The center provides classes in language (English, Spanish and Poqomchi) as well as in culture. CeCEP was very gracious throughout the trip in Guatemala, providing resources of information, work space and cultural education.

EWB-WPI worked with Gerson, as suggested to us by CeCEP for English-to-Poqomchi' translation. When Gerson was not available our team member Alberto translated from Englilsh-to-Spanish while the director of CeCEP, SucelyIcaiLem, translated from Spanish-to-Poqomchi. Most people in the community of Guachthuúq do not speak Spanish fluently, so the translation to Poqomchi´ is imperative for communication.

EWB-WPI also met with Sergio Moran (Humberto Moran's brother). Sergio is an instructor in the Department of Geology at the University of San Carlos campus in Cobán. EWB-WPI continued collaboration with the university by planning to station a rain gauge in Guachthuúq. This instrument will provide reliable and accurate data about the rain quantity and climate in the community. The University of San Carlos is working with EWB-WPI by agreeing to install the instrument and train a local monitor. This will be a crucial partnership for the chapter.

4.4 Community Priorities

The EWB-WPI chapter is working with the homes of Guachthu'uq to implement improved water collection systems and stoves for individual houses. The community has conveyed that both projects are crucial. As a whole, the community members have not designated one project over the other. They have said that water is very important to them but some women communicated that new stoves are of more interest to them. The chapter is planning to work simultaneously on both projects considering the interest levels in Guachthu'uq.

5.0 DATA COLLECTION AND ANALYSIS

5.1 Summary of Data

The team's primary objectives for this assessment trip were to conduct house assessments and qualitatively assess the quality of the community's drinking water.

Water Resources Data

The main objective of the home assessments was to obtain all the necessary data to create a catalogue of all the information pertaining to each house in the community that wished to participate in the project. This was accomplished by splitting up the travelers' team into three groups; one group took measurements of the external structures of the house, one group took measurements of the internal features of the house, specifically focusing on the kitchen area, and the final group sat with a translator to interview the women of the home. The external measurements focused on all of the roofs, gutters, tanks and general structure of the existing water catchment system. The internal measurements focused on obtaining the dimensions of the room where the cooking area was, including if there were any obstructions such as mid-level extensions for storage, windows, and distance between walls, as well as the size and quality of the actual cooking area. The questionnaire was an array of questions with the main goals of achieving information about water consumption, wood consumption, house demographics, cooking times for staple foods, and the amount the number of months during the year that the tank did not have water in it. The data had some trends including the cooking times for the staple foods, the amount of time the tank did not have water in it, and the increase in wood used during November and December. However, the most extreme difference between the various homes was the estimate of water consumption per day. The women of the home either did not share the correct information or did not effectively convey the actual amount of water consumption. All of the information gathered from these surveys was valuable, especially when being applied to the rainwater catchment model and calculating the average consumption rate per day. The data sheets can be further reviewed in the Appendix.

The analysis of the home assessment data offered new points of view for the team to assess. First, the consumption rate given on the previous assessment trip was very inaccurate. The data collected from the home assessments while wide ranging, offered the opportunity to chart a graph and base the consumption rate for each home on the trend line of that graph. This allows the team to effectively exclude outliers. The exact number of months the homes go without water can be used in the model to define the percent effectiveness of the roof for each home. The more accurate percent efficiency will allow for a more accurate assessment of measures needed to optimize the existing rainwater catchment systems for the pilot projects. This will also provide a metric to evaluate the rainwater catchment pilot projects with. The home assessments also offered new information with regards to the cooking mechanisms already in place. The team will be able to calculate an average weekly wood consumption per household which will provide a metric for analysis of the pilot stove projects. Additional metrics include the improvement on the average cooking times for staple food items, and the weekly cost of wood.

After the completion of the home assessments, we divided all of the homes into three groups twice. The purpose of these divisions was to ensure that when the pilot projects are conducted, the information that is gathered will be pertinent and helpful to assessing our designs. We divided the homes into three groups for the rainwater catchment systems based on the status of their existing systems; poor, fair and excellent. These categories were subjective and the houses were grouped by the members of the team that focused on collecting data pertaining to the water collection systems during the home assessments. We noticed that the majority of the houses were in the fair and poor categories. The logic behind this categorization was to ensure that the group had experience optimizing all stages of rainwater catchment systems. The team agrees that there will be different challenges faced when implementing designs for each condition.

For the stove project, we regrouped the houses into three groups based on if they had a large kitchen, small kitchen, or if their kitchen was detached from the rest of the house. These categories were much less subjective than the water ones and could easily be divided by the entire team. The reason for grouping the homes this way was to ensure that our design will work effectively in both small and large kitchens.

From this point the team originally planned on presenting these groups to the community and having them choose one house from each group so that there would be six different houses receiving the pilot projects, three for rainwater catchment, and three for stoves. However, Don Domingo had already picked out houses based on their location on the mountain (two from the top, two from the middle, and two from the bottom). We cross referenced these houses with our groupings and found that they fit perfectly so we moved forward with the houses that Don Domingo chose. The houses that will be receiving the rainwater catchment pilot systems are House A, L/M and W the houses that will be receiving stove pilot projects are House T_1, V and F.

5.2 Mapping

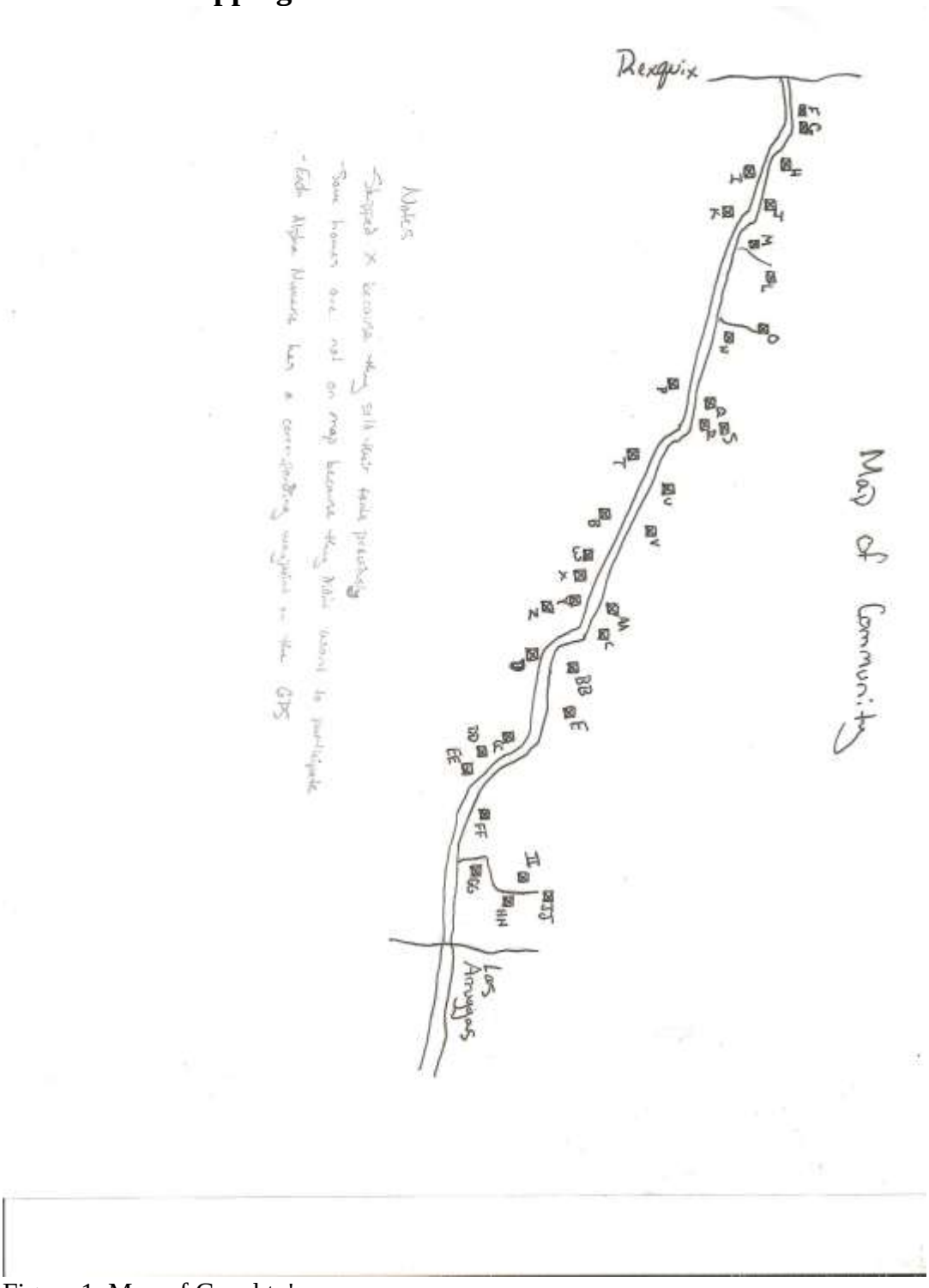


Figure 1. Map of Guachtu'uq

6.0 PROJECT FEASIBILITY

The EWB-WPI team has worked to evaluate the projects in Guachthu'uq before progressing farther with the project. Determining the adequacy of resources of the community and the preparedness of the community were crucial elements to evolve our project feasibility.

Community Support

The essence of the entire community is created by the individual members and families of Guachthu'uq. It is obvious from time spent in the community that each family has different opinions of the EWB-WPI chapter. Being integrated and accepted into the community is essential for our chapter. We began our communication with the members of Guachthu'uq through the Cocode. They have introduced us to the households of Guachthu'uq who are willing to participate with the projects we are proposing. Most of the homes of the community are supportive of our group. They demonstrate this by attending community meetings with us and by being actively involved when we visit at the homes. The majority of the interactions we have had with the individuals are very optimistic. They are grateful for our work and are willing to participate with us on many levels.

Labor

One of the many points of support of the people of Guachthu'uq is their agreement to construction work. The manual labor of construction for and by the community is an especially important point for our chapter. Because the current plan is to implement the projects by households, the knowledge of construction for a stove or water system will be a key element to creating a sustainable solution for the future of Guachthu'uq. In our Memorandum of Understanding that was signed by the participating families of Guachthu'uq the families agreed to assisting and performing the main building of the project. There are some families, approximately six, that are not supportive of EWB-WPI. They are not participating in this project at the discretion of the Cocode. The EWB-WPI team has had no contact with these families because an introduction was not initiated by the Cocode.

Cost

The cost of the project is a main concern of the EWB-WPI chapter especially because of the community's limited funds. Project costs will need to be delegated between the EWB-WPI chapter, Guachthu'uqCocode and the individual families. We are currently working with the community to develop fundraising tasks for the community to collaborate on and determining savings goals for payment of materials.

Maintenance and Materials

EWB-WPI visited several hardware stores in San Cristóbal and spoke to the owners of the stores to determine the availability of typical construction tools and materials. Tools such as shovels, hammers, buckets, and saws are readily available in San Cristóbal, as well as some materials like screen, wire, wood, nails, bolts, and screws. Construction materials such as bricks, metal stove tops, iron corrugated roofs, reinforcing bars, and pipes (PVC or metal) are available in San Cristóbal but are more expensive and in less supply than the tools mentioned above. If large quantities of these materials are desired, it would be more cost-effective to purchase them outside of San Cristóbal and have them transported to the community. EWB-WPI has contacts in Guatemala that would be able to provide the locations of factories and help ship materials from the factories to the community. Cement, sand, and rock can also be found in San Cristóbal but high quality and quantity must be purchased outside the municipality.

7.0 LESSONS LEARNED

During EWB-WPI's second assessment trip the students, along with the mentors learned many lessons that will be beneficial for knowledge of the chapter, including:

- Nightly meetings within the travelers were extremely useful. During the first week, when house assessments were being completed, the meetings were beneficial to have every night after dinner to make sure we were all on

the same page. However, other nights it would have been more beneficial to have a quick meeting before dinner so the group would have time to rest.

- Do not get involved in issues that do not concern the chapter. For example, the group learned about some alleged corruption within the COCODE. Some members of the COCODE supposedly would start raising money for community projects and then would keep it for themselves. EWB-WPI was extremely concerned when we first learned about this but decided it was an area not to get involved in since we did not know if it was true and we are not giving any members of the community money. We had made it clear that this project was only going to be implemented if the community invested monetarily as well as contributed with labor.
- The group would benefit with multiple fluent Spanish speakers. Although, every traveler should know some basic Spanish. The group would be able to get more accomplished if there were fewer issues with communication.
- Ask questions multiple times, most of the times you will get different answers. This could because of translation issues or people are not being completely honest.
- Repeat yourself a lot, especially when communicating with the community. This will ensure that nothing gets lost in translation as well as ensuring that the community understands what our intentions are.
- The next trip should be closer to the end of the school year. This will make it so the travelers can meet more frequently before the trip, since no one has gone home for the summer. Also, many summer internships start in the beginning of June. If the trip is before then it will give the opportunity for chapter members to go that would not have been able to otherwise.
- Do not be shy on public transportation; it will most likely be very crowded.
- Be careful speaking English in front of not English speakers. Can be very rude, especially if the group starts laughing, because they do not know what they group is laughing at.
- Have good body language. This is a good way of nonverbal communication.
- Make sure the group has all supplies, which are needed for the day, before heading out. This includes making sure all phones, cameras, etc. are charged as well as have enough memory on them.
- Leave extra funds in your budget. You never know what the group may need to buy spur of the moment.

8.0 MENTOR ASSESSMENT

I accompanied the travelers for the second consecutive year to San Cristobal. During our time in-country, the team worked very well together and was able to complete the trip objectives earlier than expected. In comparison to the first assessment trip, the team was more organized, communicated better, and dealt with adversity better. I was encouraged, in particular, to see the two returning travelers (Chris Garceau and Julie Bliss) become effective team leaders and make the necessary adjustments in ensure the project objectives were made. It is heartening, as a mentor, to see this growth.

Chris Garceau and Alexandra Vresilovic effectively communicated with the community members during our multiple meetings. This was most likely the most sensitive and challenging task of the trip.

As stated in the Lessons Learned section of this report, nightly meetings helped keep the team focused and prepared for the following day. It also gave the students a forum to communicate their feelings about the trip and this in turn allowed for better communication when in the field.

In 2011/2012 the students should focus on effectively transitioning from the current leadership (who are seniors) to the next wave of students. The underclass travelers will hopefully play a significant role in the upcoming implementation trip(s) as they will bring valuable perspective and experience to future travel teams.

I would challenge the EWB-WPI chapter to double its focus on technical work and maintaining project schedule milestones this year. To do this, work needs to be effectively delegated throughout the year and outlines technical objectives and how they can be achieved. The EWB-WPI chapter is small relative to other, larger schools/universities, which puts more pressure on the students to work efficiently. To date they have done a very good job and I'm proud to have assisted them to this point in the project.

9.0 Appendix A

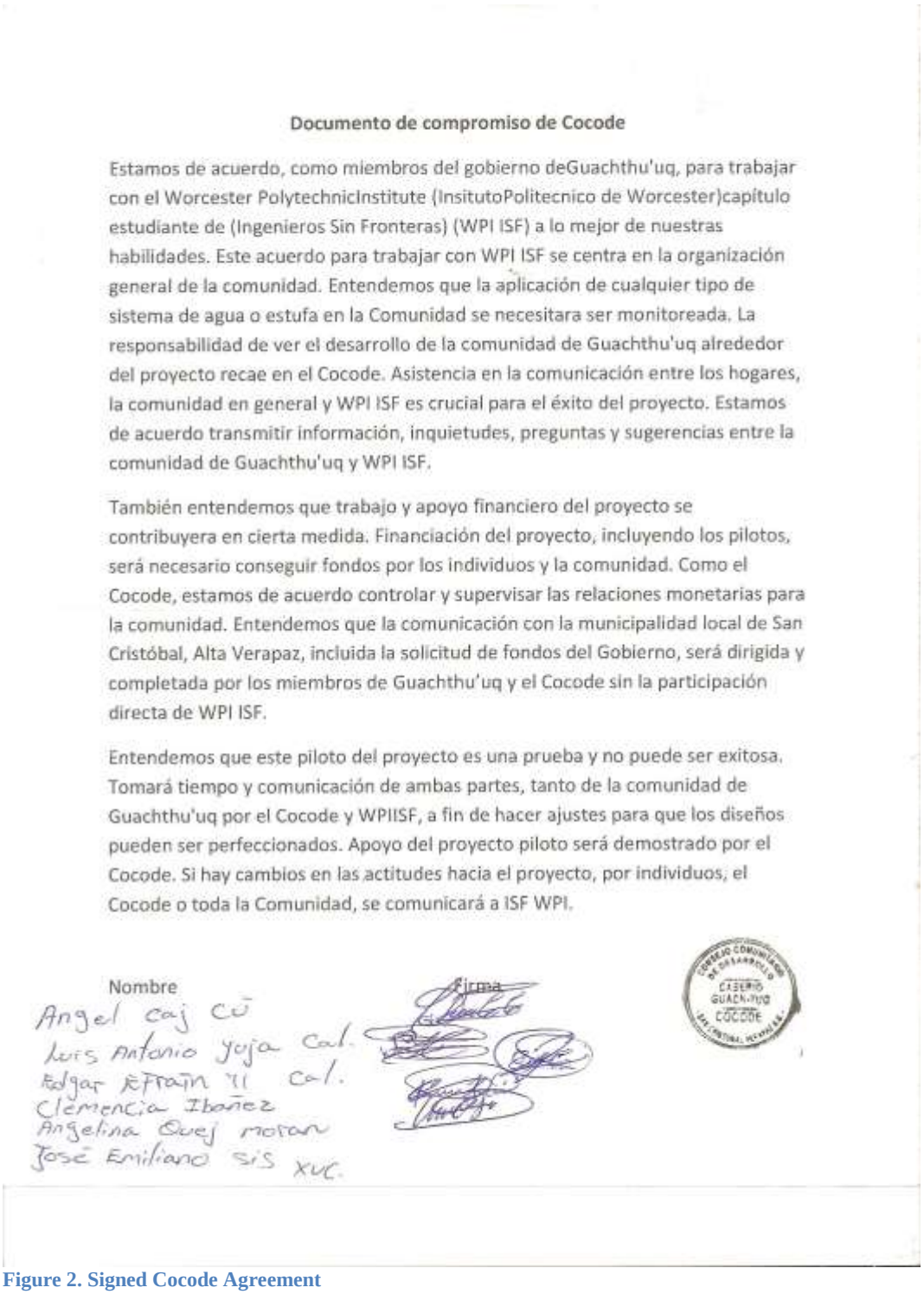
COMMUNITY AGREEMENT/CONTRACT

Cocode Agreement Form

We agree, as members of the governing body of Guachthu'uq, to work with the Worcester Polytechnic Institute Student Chapter of Engineers Without Borders (WPI-EWB) to the best of our abilities. This agreement to work with WPI-EWB centers on general organization of the community. We understand that the implementation of any type of water or stove system in the community will need to be monitored. The responsibility of watching the development of the community of Guachthu'uq around the project lies with the Cocode. Assistance with communication between individual households, the general community and WPI-EWB is crucial for the success of the project. We agree to relay information, concerns, questions and suggestions between the Guachthu'uq community and WPI-EWB.

We also understand that labor and monetary support of the project will be contributed to some degree. Funding the project, including the pilots, will require saving and fundraising by the individuals and by the community. As the Cocode, we agree to control and oversee monetary dealings for the community as a whole. We understand that communication with the local municipality of San Cristobal, Alta Verapaz, including application for government funds, will be directed and completed by the members of Guachthu,uq and the Cocode without the direct involvement of WPI-EWB.

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



Documento de compromiso de Cocode

Estamos de acuerdo, como miembros del gobierno deGuachthu'uq, para trabajar con el Worcester PolytechnicInstitute (InsitutoPolitecnico de Worcester)capítulo estudiante de (Ingenieros Sin Fronteras) (WPI ISF) a lo mejor de nuestras habilidades. Este acuerdo para trabajar con WPI ISF se centra en la organización general de la comunidad. Entendemos que la aplicación de cualquier tipo de sistema de agua o estufa en la Comunidad se necesitara ser monitoreada. La responsabilidad de ver el desarrollo de la comunidad de Guachthu'uq alrededor del proyecto recae en el Cocode. Asistencia en la comunicación entre los hogares, la comunidad en general y WPI ISF es crucial para el éxito del proyecto. Estamos de acuerdo transmitir información, inquietudes, preguntas y sugerencias entre la comunidad de Guachthu'uq y WPI ISF.

También entendemos que trabajo y apoyo financiero del proyecto se contribuyera en cierta medida. Financiación del proyecto, incluyendo los pilotos, será necesario conseguir fondos por los individuos y la comunidad. Como el Cocode, estamos de acuerdo controlar y supervisar las relaciones monetarias para la comunidad. Entendemos que la comunicación con la municipalidad local de San Cristóbal, Alta Verapaz, incluida la solicitud de fondos del Gobierno, será dirigida y completada por los miembros de Guachthu'uq y el Cocode sin la participación directa de WPI ISF.

Entendemos que este piloto del proyecto es una prueba y no puede ser exitosa. Tomará tiempo y comunicación de ambas partes, tanto de la comunidad de Guachthu'uq por el Cocode y WPIISF, a fin de hacer ajustes para que los diseños pueden ser perfeccionados. Apoyo del proyecto piloto será demostrado por el Cocode. Si hay cambios en las actitudes hacia el proyecto, por individuos, el Cocode o toda la Comunidad, se comunicará a ISF WPI.

Nombre Firma

Angel Caj Cú
Luis Antonio Yoja Cal.
Edgar Efraín Yi Cal.
Clemencia Ibañez
Angelina Ouej Morán
José Emiliano Sis Xuc.

CONSEJO COMUNITARIO DE DESARROLLO CASERIO GUACHTHU COCODE

Figure 2. Signed Cocode Agreement

Community Project Agreement Form

We plan to work with the Worcester Polytechnic Institute Student Chapter of Engineers Without Borders (WPI-EWB) to the best of our ability. We will provide labor and monetary support towards the completion of the projects. We understand that we have to be dedicated to the project by conveying any concerns, questions or suggestions about how to make the project more applicable to our community to EWB-WPI.

We understand that we are to select the three homes for the rain water catchment system pilot program and three homes for the improved stove pilot program. We understand that the families who are not selected are not forgotten. These few pilot homes will be actively working to ensure that the designs meet the community's needs. Once the EWB-WPI group and the community have decided that the designs are satisfactory, we will start working with other families to implement the rain water catchment systems and improved stoves.

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

We understand that these projects that EWB-WPI has proposed will require a long process over a number of years. This is because EWB-WPI intends to ensure that the designs are effective and will work with each family to train them in how to use the designs properly. This will ensure that if something happens, either if something breaks or requires standard maintenance, we, the families of Guachthu'uq, will be able to fix the systems after all systems have been implemented, and each family understands the proper upkeep and maintenance.

We understand that it is our responsibility to communicate with the municipality or other appropriate government agencies in order to request funding for these projects. We also understand that we might have to fundraise in other ways in order to raise money for these projects.

Formulario de acuerdo de proyecto comunitario

CASERIO GUACH-TUQ COCODE

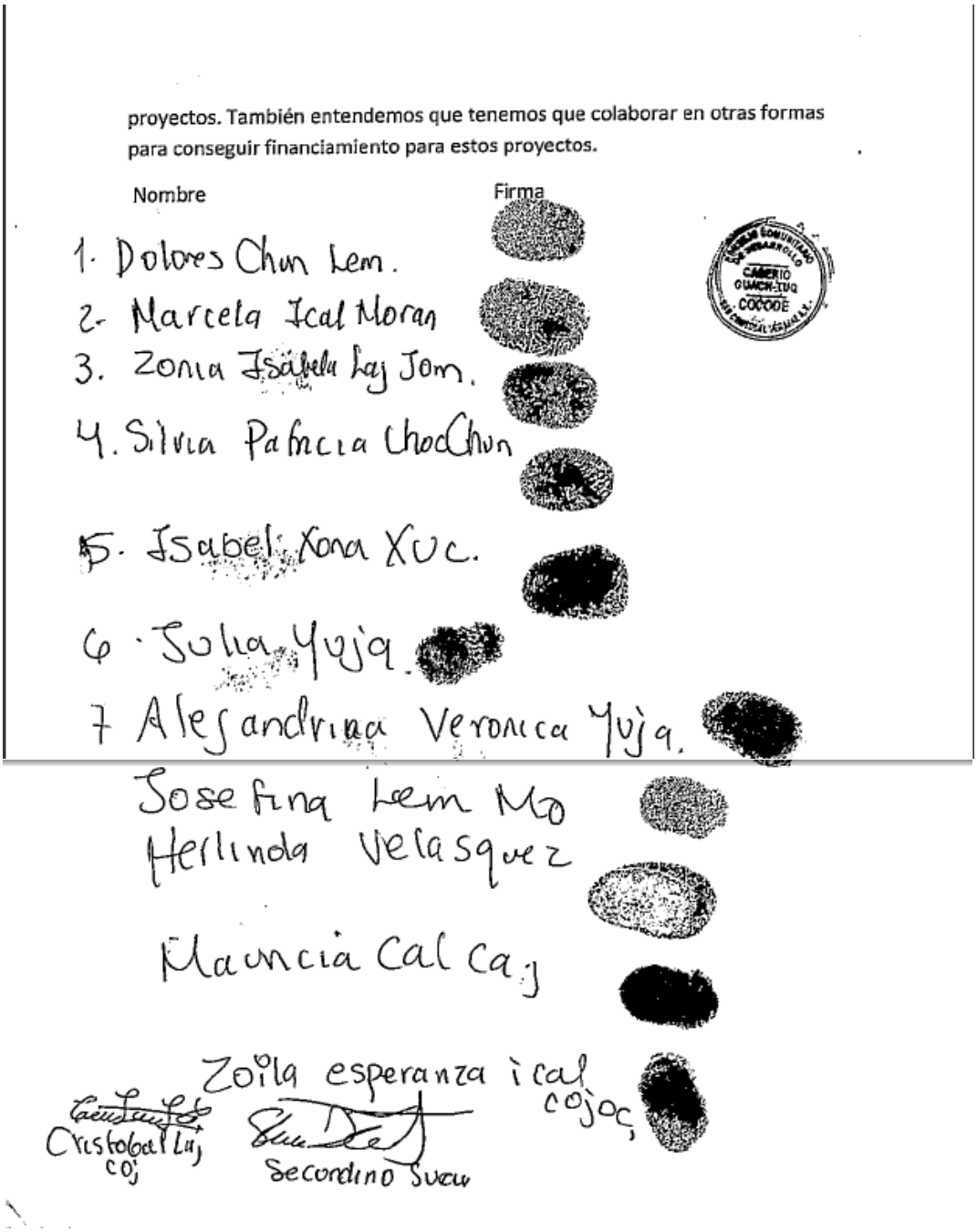
Queremos trabajar con el Worcester Polytechnic Instituto estudiante capítulo de Ingenieros Sin Fronteras (WPI-ISF) a lo mejor de nuestra capacidad. Ofrecemos trabajo y apoyo financiero para la ejecución de los proyectos. Entendemos que tenemos que ser dedicados al proyecto transmitiendo inquietudes, preguntas o sugerencias acerca de cómo hacer el proyecto más aplicable a nuestra comunidad a ISF-WPI.

Entendemos que tenemos que seleccionar las tres casas para el programa piloto del sistema de captación de lluvia y tres casas en el programa piloto de la estufa mejorada. Entendemos que las familias que no fueron seleccionadas no serán olvidadas. Estas pocas casas pilotos trabajaran activamente para asegurar que los diseños satisfagan las necesidades de la comunidad. cuando el grupo de ISF-WPI y la comunidad han decidido que los diseños son satisfactorios, comenzaremos a trabajar con otras familias para aplicar los sistemas de captación de agua de lluvia y estufas mejoradas.

Entendemos que estos programas pilotos son una prueba, y no pueden ser totalmente exitosos cuando WPI ISF los implementa primero. Tomará tiempo y comunicación de ambas partes, tanto de la comunidad de Guachthu'uq y ISF-WPI, para poder hacer ajustes para que los diseños puedan ser perfeccionados.

Entendemos que estos proyectos que ha propuesto la ISF-WPI requerirá un largo proceso durante varios años. Esto es porque ISF-WPI tiene la intención de asegurarse de que los diseños son eficaces y que trabajarán con cada familia para entrenarlos en cómo utilizar correctamente los diseños. Esto asegurará que si pasa algo, ya sea si algo se rompe o requiere mantenimiento, nosotros, los familiares de Guachthu'uq, seríamos capaz de arreglar los sistemas después de que todos los sistemas se han aplicado, y cada familia entiende que es el mantenimiento adecuado.

Entendemos que es nuestra responsabilidad de comunicar con la municipalidad u otras agencias gubernamentales apropiadas para solicitar la financiación de estos



proyectos. También entendemos que tenemos que colaborar en otras formas para conseguir financiamiento para estos proyectos.

Nombre Firma

1. Dolores Chun Lem.
2. Marcela Ical Moran
3. Zonia Isabela Laj Jom.
4. Silvia Patricia ChocChun
5. Isabel Xona Xuc.
6. Julia Yuja.
7. Alejandrina Veronica Yuja.

Josefina Lem Mo

Herlinda Velasquez

Mauricia Cal Caj

Zoila esperanza ical cojoc,

Cristobal Laj Coj

Secondino Suc

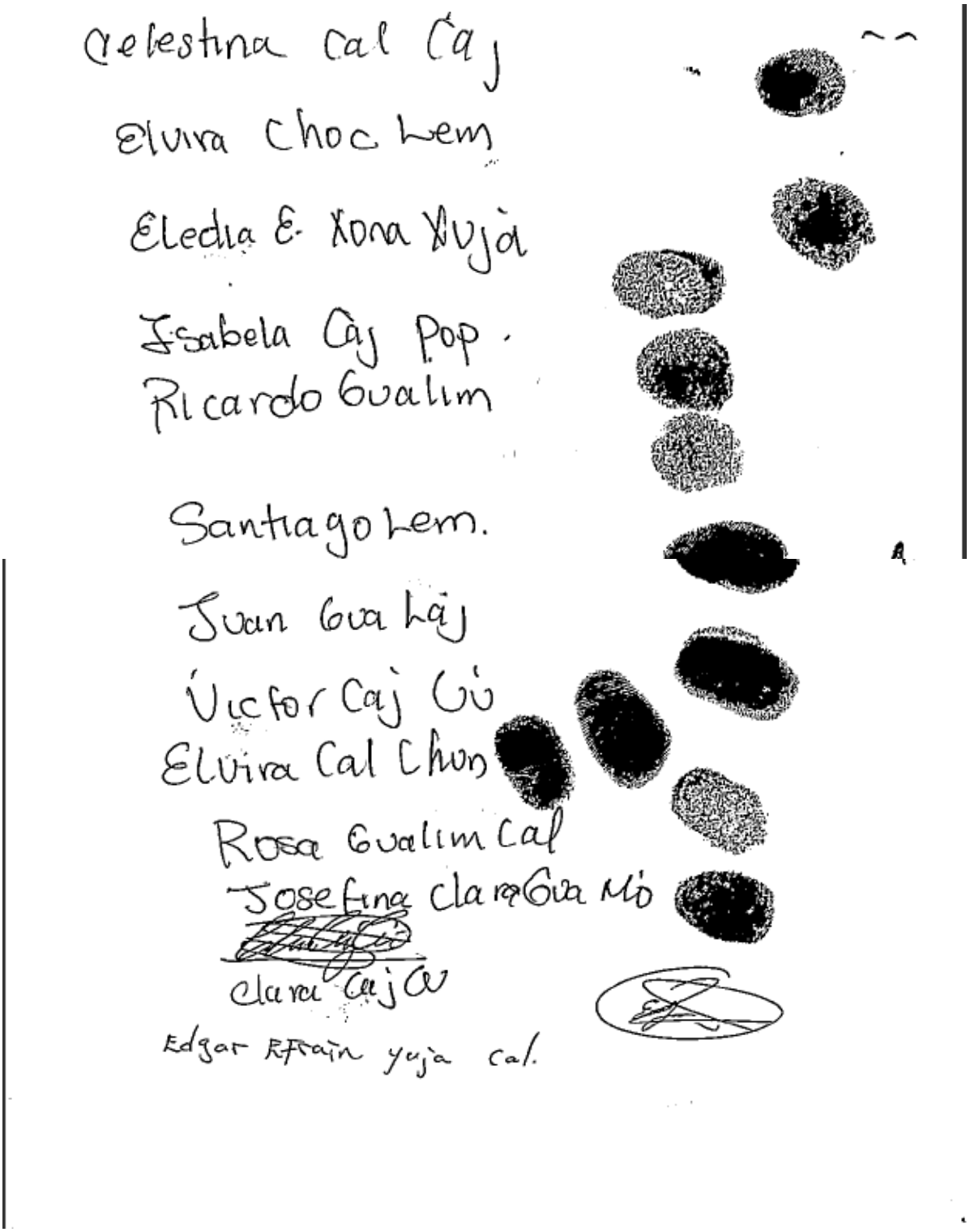


Figure 3. Signed Community Agreement

Engineers Without Borders Agreement Form

We agree, as members of the Worcester Polytechnic Student Chapter of Engineers Without Borders, to work with the Community of Guachtu´uq, Alta Verapaz, to the best of our abilities.

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

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

Ingenieros sin fronteras formade acuerdo

Estamos de acuerdo, como miembros del Worcester Polytechniccapítulo estudiante de Ingenieros Sin Fronteras, para trabajar con la comunidad de Guachtu'uq, Alta Verapaz, a lo mejor de nuestras habilidades.

Estamos de acuerdo en actualizar la comunidad con los cambios en el proyecto, ya sea en cuanto a diseños o los costos. Esto puede requerir comunicación muy frecuente, que estamos dispuestos a realizar. Haremos nuestro mejor esfuerzo para hacer que los diseños satisfagan las necesidades de la comunidad y tener en consideración todas las sugerencias que la comunidad nos ha dado hasta ahora. Esto incluye mantener el proyecto conlos costos más bajos posible sin sacrificar el correcto funcionamiento de los diseños y su mantenimiento.

ISF-WPI va a garantizar que los diseños son eficaces, y vamos a trabajar con cada familia para entrenarlos cómo utilizar correctamente los diseños. Esto asegurará que si pasa algo, ya sea si rompe o necesita mantenimiento simple, las familias de Guachthu'uq, serán capaz de arreglar los sistemas después de la implementación de todos los sistemas. Seguiremos trabajando en el proyecto hasta que se ha completado todos los sistemas a la satisfacción de la comunidad.

Nombre	Firma
Alberto Phillips	
Kali Manning	
Lexa Vresilovic	
Creighton Peet	
Julie Bliss	
Chris Goscau	
Emily McWilliam	

Figure 4. Signed EWB-WPI Agreement

Appendix B Photo Documentation

Guatemalan home used as pilot house for rainwater harvesting

Ceiling of pilot house for rainwater harvesting

Roof of Guatemalan home to be measured for rainwater harvesting system

Junction of roof and gutter system

One of the best looking gutter systems in the village

Rainwater collection tanks set up by Guatemalan family

Government issued tanks for rainwater collection


Travelers Julie, Lexa and Chris taking measurements of pilot house for rainwater harvesting

Tanks from government issued water collection system

Pipe and gutter junction from preexisting rainwater collection system built by Guatemalan government

Stoves Project

Poor quality ceiling inside kitchen of Guatemalan home

Traveler Lexa meets with Guatemalan family to take measurements of their kitchen


Soot collected on walls, ceiling, and furnishings from open flame cooking inside this home


Soot collection from open flame cooking built up over the years


Soot collected on the ceiling and rafters of the house from cooking with an open flame inside the home


Travelers Emily and Lexa taking measurements inside a kitchen


Open flame heat source for cooking inside

Kitchen of Guatemalan home. Soot from indoor smoke collected on all furnishings and

Traveler Lexa meets with Guatemalan family to take measurements of their kitchen

Guatemalan family inside their home

Soot from indoor smoke collected on ceiling and walls over the years

Travelers Emily and Lexa taking measurements of kitchen

Kitchen and dinning area cover in soot from open flame cooking over the years