Document 522
POST-ASSESSMENT REPORT

CHAPTER: Worcester Polytechnic Institute
COUNTRY: Guatemala
COMMUNITY: Guachthu'uq
PROJECT: Rainwater Harvesting

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

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Post-Assessment Report Part 1 – Administrative Information

1.0 Contact Information

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2.0 Travel History

Dates of Travel	Assessment or Implementation	Description of Trip
7.20.10-8.3.10	Assessment	Initial assessment of community health and water sampling
7.23.11-8.7.11	Assessment	Collection of data to evaluate water consumption rate, assessment of each home in community for water supply situation
12.31.12-1.10.13	Implementation	Pilot implementation in two homes in order to evaluate sociocultural reaction, efficiency of individual rainwater harvesting systems as well as feasibility of construction in the community for large scale implementation
5.3.13-5.15.13	Assessment	Analysis of pilot implementation trip, additional in-country preparations for next large scale implementation trip. Solidification of the role of the Guachthu'uq Water Committee, strengthened relationship with and understanding of community.

3.0 Travel Team

Name	E-mail	Phone	Chapter	Student or Professional
Thomas Moutinho	Tjmoutinho@wpi.edu	207.831.7011	EWB-USA WPI	Student
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4.0 Health and Safety

4.1 Incident Reports

Did any health or safety incidents occur during this trip? _X_Yes __No

During this trip, the one major health and safety incident involved a traveler contracting Giardia Lamblia. The traveler first experienced nausea and disinterest in food on May 9. This did not subside, and the traveler experienced stomach pain and diarrhea for the next two days. On May 11, the traveler was brought to a clinic and was treated for the amoeba. The traveler was treated with AmoebEx, Alusor, Loperacin, and Pedialyte. The traveler's symptoms were alleviated within a day, and the traveler got lab testing once back in the United States and is healthy.

Additionally, a few team members had trouble acclimating to the location, and intermittently experienced traveler's sickness. However, this did not impede these travelers and subsided with bland dieting and Gatorade.

5.0 Monitoring - Current Status of all Past-Implemented Projects in Program

This is the first EWB-USA WPI project.

Project Type	**Project Discipline(s)**	**Date of Completion (m/d/y)**	**Functionality (enter one range per project)***			**Periodic Maintenance* (yes or no)**	**Demonstration of Knowledge Transfer* (yes or no)**
			0-50%	50-75%	75-100%		

***Please read accompanying instructions for information on how to complete these columns.**

6.0 Budget

6.1 Project Budget

Project ID: **6871**
Type of Trip: **A**

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	3900		3888.5
Gas			
Rental Vehicle			
Taxis/Drivers	1000		844.16
Misc.			
Travel Sub-Total	$4900		$4732.66
Travel Logistics			
Exit Fees/ Visas			
Inoculations			
Insurance			
Licenses & Fees			
Medical Exams			
Passport Issuance			
Misc.			
Travel Logistics Sub-Total	$0		$0
Food & Lodging			
Lodging	600		753.25
Food & Beverage (Non-alcoholic)			37.38
Misc.	1000		311.69
Food & Lodging Sub-Total	$1600		$1102.32
Labor			
In-Country logistical support			
Local Skilled labor	500		519.48
Misc.			
Labor Sub-Total	$500		$519.48
EWB-USA			
Program QA/QC	$0		$0
EWB-USA Sub-Total	$0		$0

Project Materials & Equipment (Major Category Summary)			
Rain Gauge	200		227.95
Materials	100		164.07
Water Tests	300		271.32
Project Materials & Equipment Sub-Total	$600		$663.34
Misc. ***(Major Category Summary)***			
Report Preparation			
Advertising & Marketing			
Postage & Delivery			
Misc. Other			
Misc. Sub-Total	$0		$0
TOTAL	$7600		$7017.8

EWB-USA National office use:

Indirect Costs			
EWB-USA			
Program Infrastructure	$500		$500
EWB-USA Sub-Total	$500		$500
TRIP GRAND TOTAL (Does not include Non-Budget Items)	$500		$500

Non-Budget Items:

Additional Contributions to Project Costs			
Community			
Labor			
Materials			
Logistics			
Cash			
Other			
Community Sub-Total	$0		$0
EWB-USA Professional Service In-Kind			
Professional Service Hours			
Hours converted to $ *(1 hour = $100)*	$0		$0
Professional Service In-Kind Sub-Total	$0		$0
TRIP GRAND TOTAL (Includes Non-Budget Items)	$0		$0

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			
Grants - EWB-USA program	$5000		$5000
Other Nonprofits			
Individuals			
Special Events	$600		$600
Misc.	$1500		$1500
EWB-USA Program QA/QC Discount Amount			
EWB-USA Program Infrastructure Discount Amount			
Total	$7100		$7100

6.2 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. Michael Reiter	20	672	4	696

7.0 Project Discipline(s):

Water Supply
____ Source Development
_**X**__ 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

Guachthu'uq is in the outskirts of the San Cristobal municipality in the state Alta Verapaz, Guatemala.
Latitude: 90 29 41.84 W
Longitude: 15 22 22.6 N

Post Assessment Report Part 2 – Technical Information

1.0 EXECUTIVE SUMMARY

This report summarizes the Worcester Polytechnic Institute Chapter of Engineers Without Borders' assessment trip for project number 6871, Rainwater Harvesting. The trip occurred from May 3rd to May 15th, 2013.

The primary goal of the EWB-USA WPI Rainwater Harvesting Project is to ensure that all members of Guachthu'uq, Guatemala have access to potable drinking water. This goal is to be achieved by implementing personalized rainwater harvesting systems for each home in the community. The individual system approach is a result of no communal land as well as several other social rejections.

Guachthu'uq is a rural community located in a northern mountainous region of Guatemala. It is home to over 188 people and 36 families, typically of Mayan descent. The community members speak Pokomchi and some Spanish. One of the community's main problems is access to clean water. EWB-USA WPI seeks to solve this through rainwater harvesting tanks for individual homes. Our main NGO is CeCep, a local cultural museum in San Cristobal. CeCep offers translators, travel logistic assistance and collaboration on social and technical aspects of our project. This has recently changed from the CoCode because we have had great difficulty when trying to communicate only through the CoCode. Additionally, CeCep acts as the liaison between EWB-USA WPI and the community, as it has a positive relationship with the members of Guachthu'uq. CeCep also helped EWB-USA WPI to prepare a memorandum of understanding with the community.

EWB-USA WPI has been working with Guachthu'uq since 2009, and has completed two assessment trips prior to the first pilot implementation trip in January of 2013. On EWB-USA WPI's first two assessment trips, the need for a year round drinking water supply for the community was identified as well the need for sustainable cooking solutions. Rainwater harvesting was selected as the best solution for the community's inadequate water supply issues. The sustainable cook stoves project has been postponed.

On the May 2013 assessment trip, EWB-USA WPI assessed several aspects of existing work done by the chapter as well as worked to further develop the social aspect of our project. The travel team assessed the feasibility of the next large scale implementation trips and assessed the functionality of the pilot implementation project conducted in January 2013. In addition to the technical aspect of the project, the team conducted water quality tests to compare the government tanks, the finca and WPI's recently installed tanks. EWB-USA WPI also held two meetings with the recently formed Guachthu'uq Water Committee in order to facilitate the organization of the group and define their role in the future of the project. Finally, EWB-USA WPI worked with CeCep to create and conduct a community census as well as informal interviews in hopes to better understand the social dynamics surrounding potable water within Guachthu'uq. The team continued to strengthen ties with CeCep, a NGO that will be invaluable in the success of future implementation. With the assistance of Sucy, the head of CeCep, EWB-USA WPI and the Guachthu'uq Water Committee created a finalized and official Memorandum of Understanding.

The data that the team collected through the census and the interviews reveals that Guachthu'uq continues to identify their major concern as water supply. From the census, we have been led to believe that the members of Guachthu'uq are not experiencing severe sickness due to their drinking water. However, further study on the matter will be conducted in the future. The major concern remains that members of the community have limited access to water for a large portion of the year. Water quality tests of the finca, existing tanks, and EWB-USA WPI implemented tanks have revealed that the rainwater stored in the tanks is cleaner than the finca water; however, without a proper cleaning plan the tanks become infected with various bacterial cultures. Although these tests did not provide conclusive detail regarding the types and count of bacteria in the water, they showed that bacteria is a legitimate concern in both the finca and in the government tanks. More extensive bacterial tests will be conducted during future trips.

Future work will consist of several implementation trips. Along with these implementation trips the travel teams will continue to build and develop more effective educational materials to increase the understanding of the necessity for regular cleaning of the systems and standard preparation of water. The chapter will continue to improve system design in order to tailor to the Guachthu'uq home structures as well as maintain a monitoring system that will enable our chapter to assess the success of our project and flaws that may observed as the project progresses.

2.0 INTRODUCTION

This report summarizes the major accomplishments from the May 2013 EWB-USA WPI assessment trip. In addition it will serve as a reference for future work on the project and trips. EWB-USA WPI felt the need for an additional assessment trip in order to assess the success of our first pilot implementation trip. This trip also served as an opportunity for our team to assess the feasibility of conducting a larger implementation in May 2014. Thus, the team thoroughly took measurements of the ten homes that will be implemented on and, using those measurements, made plans and established connections for implementation. The team also mapped the community, took photos of every home in the community, and worked with the water committee to restructure the methods by which families would be picked for implementation. The team held multiple meetings with the recently formed Guachthu'uq Water Committee, an endeavor which proved to be more successful than community wide meetings. These meetings formally detailed the partnership which will ensue between EWB-USA WPI and the Guachthu'uq Water Committee. A Memorandum of Understanding was presented to the committee in a discussion based environment. Additionally, the team conducted water tests at the finca, the community's water source, and from both sets of rainwater harvesting tanks, those implemented in January 2013 by EWB-USA WPI and those installed in 2008 by the Guatemalan government.

3.0 PROGRAM BACKGROUND

The Engineers Without Borders chapter at Worcester Polytechnic Institute aims to provide the community of Guachthu'uq, Guatemala with a sustainable, year round water supply.

The community of Guachthu'uq is located in the Alta Verapaz region of Guatemala and is home to over 188 people of 36 families. Of the many problems they face daily, the absence of clean drinking water is the greatest concern. US Global Health Initiative reports that Guatemala has the highest child mortality rate in Central America due to severely contaminated water. The proposed program, Rainwater Harvesting: Guachthu'uq, will address these concerns using a holistic approach. EWB-USA WPI will focus directly on the water problem, and work with the community to learn more about environmental and social issues that affect their health and access to resources. When completed, this project will improve overall community health and hygiene, and aims to better the quality of life for women and children who have the responsibility of collecting water.

During the dry season, approximately November to May, the community relies on a dam, located on a privately owned piece of land referred to as the Finca, which collects surface runoff water. This dam is located 1 km downhill from the nearest community home and 3 km downhill from the furthest home. Members from Guachthu'uq, Las Arrugas, and La Reforma use this source of water for drinking and washing clothes. In addition to being a contaminated source of water, the finca runs dry during the dry season, According to community members, this can impede water collection for a few days and occurs enough so that it creates a serious problem in the community. It is not fully known how often or for how long the finca water source runs dry; this will be a continued area of research on future trips. In 2009, 25 percent of the families in Guachthu'uq received rainwater harvesting tanks from the municipal government, which have been a beneficial form of additional water storage. However, improper design and implementation of these systems has led to a lack of routine maintenance and cleaning, which resulted in the systems inability to meet the drinking water needs of the Guachthu'uq community.

The first two assessment trips in the summers of 2010 and 2011 introduced our chapter to the members of Guachthu'uq and established a better understanding of their everyday life. Our team conducted in-house assessments, held community meetings, and conducted water quality studies. The trip also built the trust between EWB-USA WPI and the community necessary to helping with future communications and planning. Specifically on the second assessment trip in 2011, we conducted a community wide survey with the goal of determining a general water consumption rate for each family. Unfortunately, we were unable to find any trend that relates number of family members and water consumption across the community. Our team also thoroughly assessed the two homes chosen by the community for the pilot implementation. This included critical measurements of each home as well as in-depth discussions of the needs of each family.

One of the most critical tools developed during the first two assessments trips is our Excel model. This model looks at each home individually, comparing the average rainfall data for the area with the surface area of the roof and the survey data of family water consumption. We are thus able to predict a family's demand for water for an entire year, when their supplies will be depleted the most, and how much storage capacity is necessary to ensure sufficient water supply through the dry season.

Using the information gathered from the first two assessments, our Excel model results, and almost two years of research and design, our chapter constructed two pilot systems during our first implementation trip in January 2013. The aim of a pilot project was to ensure that our Excel model works properly and to provide a basis for future system design. Other benefits of a small scale implementation included setting up procedures for construction, and experimenting

with community members working alongside our team in implementing the rainwater harvesting system. In order to accurately determine if these pilot systems served the families appropriately, a monitoring system was also established during this implementation trip. This monitoring system, which was conducted by a volunteer at our NGO, collected preliminary information on the success of the rainwater harvesting systems and verbal feedback from both families.

Our team completed the third assessment trip in May of 2013. The goal of this trip was to assess the success of the first implementation trip while also preparing for a second implementation. The monitoring system that had been established during the January implementation had evolved over the months 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 were functioning correctly and, most importantly, fit each family's daily needs.

The team laid extensive groundwork with the community to ensure a successful, large scale future implementation. The relationship with the in-country partners was defined and strengthened. Our team spent a great deal of time in Guachthu'uq conducting census surveys, holding formal community meetings and informal "hangout" time in order to gain more community trust and understanding. Our team then reassessed the ten homes selected for the next implementation and met with the families of each home to ask about water use habits and to discuss preferred placement of tanks. Necessary details were also worked out with local hardware stores and water tank vendors to ensure availability of materials. The next step for our chapter and the community of Guachthu'uq is a large-scale implementation of ten rainwater harvesting systems in May 2014.

4.0 PROJECT DESCRIPTION

The community of Guachthu'uq, Guatemala lacks access to clean water year round. The community's current water source is located on privately owned land which, for the time being, is open to multiple communities in the area. Therefore this water source is not a sustainable option for Guachthu'uq. Through our alternatives analysis and community discussions, we have found that individual rainwater harvesting systems are the best solution for providing the families of Guachthu'uq with sustainable drinking water year round. Our goal is to implement a rainwater harvesting system in each home that will tend to the individual family's specific water supply problem. This decision was made based off Guachthu'uq's lack of communal land on which to build a community based water harvesting system. This goal is complicated by the unique water needs and resources available to each family. However, with the assistance of in-country support through CeCep, our NGO partner, and the Guachthu'uq Water Committee, this is a feasible goal.

EWB-USA WPI's rainwater harvesting system design includes gutters that collect water off as much usable roof as needed and directs this water through a first flush and finally into a storage tank. The EWB-USA WPI team uses an Excel model with several variables such as roof area, rainfall data and consumption rate to estimate the volume of harvesting tank that each family needs. Although ruling out the implementation of a communal rainwater harvesting system was a major factor which complicated the design of the project, it is not the only limitation. Another limitation which faces EWB-USA WPI is the location of the community. It's

location on the side of a mountain limits our ability to transport materials. In addition to transportation issues, the local construction stores in San Cristobal do not carry a large enough supply of the necessary materials for the implementation of ten rainwater harvesting systems. A social limitation to our project is the language and cultural barriers that make proper communication with the families difficult. Communicating with families about the importance of routine cleaning and maintenance has proven to be difficult on this assessment trip.

Our team estimates that it will take four more implementation trips to finish all of the homes in the community. This value was reached based off of an approximation regarding time spent implementing at each home and the preliminary goal to implement on ten homes during the May 2014 implementation trip while also assessing the next ten homes during that same trip. Our goal will be made more attainable with the aforementioned in-country support. While we are not in Guatemala, our in-country contacts can help prepare the ten homes to be implemented on, save money for the systems and purchase materials prior to EWB-USA WPI's arrival.

Once the next implementation trip takes place, we will have a better understanding of the quantity of homes which can be implemented on and assessed during one trip. No matter the number, EWB-USA WPI will continue the project until either: all of the homes have been implemented on or the community reaches a point where they can carry out mass implementations without the guidance of EWB-USA WPI.

5.0 TRIP DESCRIPTION

This trip served as an assessment trip for EWB-USA WPI to assess the past pilot implementation trip as well as the feasibility of future larger scale implementation trips. In addition to this assessment, community relations and project partner relations were strengthened considerably on this trip. The team tested water from the tanks implemented in January 2013, assessed the structural integrity of the pilot systems, and improved the pilot systems where necessary to match the needs of the beneficiaries. The team performed water quality tests from both the government issued tanks and the finca, gathered census data from the entire community, and assessed ten homes for future implementation. Following is an itemized list of the main endeavors taken on this trip.

1) Water Committee Meetings

During the trip, there were two official Water Committee meetings and many smaller, more informal meetings. Each of the two Water Committee meetings was extremely beneficial to the success of the trip, laying the foundation for a sustainable project.

Below is a list of the Water Committee members:

Cristobal Laj Cojoc – President, current beneficiary
Roberto Chajoc – Vice President, current beneficiary
Catalina Max Calel – Secretary, future beneficiary
Ricardo Gualim – member
Angelina Quej Cal – member
Elidia Esperanza Xona Yuja – member, current beneficiary, Roberto's wife
Maria Magdelena Jom Yuja – member

The first Water Committee meeting took place on May 6, and was an informational meeting for both the committee and for our travel team. The goal of the meeting was to establish knowledge about how the water committee functions, and the potential that they have to influence future trips. The meeting was directed by Sucely and Alvaro from CeCep, who were best suited for this task as they were familiar with both the members of the Water Committee and the EWB-USA WPI travel team. During the meeting, Edgar, a university student working at CeCep, took notes. One of our travelers asked questions in Spanish, Sucely or Alvaro translated to Pokomchi and then back to Spanish, and then our Spanish speaking travelers would translate back to English. This method of communication was time consuming and the team realized that there would have to be different approach for the next meeting.

The second Water Committee Meeting took place on May 12. This meeting was more structured, as it was our last day in the community and there were many things that needed to be discussed. The setup of this meeting also changed. Sucely was not present, so Alvaro was the main translator from Spanish to Pokomchi. English was not used in this meeting, but notes were being recorded in English so that English speakers could read what was happening. Additionally, the questions which we asked were translated from English to Spanish before the meeting. This allowed for a more efficient conversation and everyone was still aware of the topics being discussed.

2) Census

We performed 31 surveys of the homes in the community during our trip. This allowed us to gain demographic data and build a community census, which added to data that had been collected on previous trips. The surveys were carried out on various days throughout the trip with either Alvaro or Edgar conducting the survey and EWB-USA WPI team members present with the family.

These surveys identified the head of each household, the ages, sex, and family relationships of the members of each household. The culmination of survey data resulted in an approximate size of the community. This data can be used to estimate how much water is being taken from the finca to meet the community's needs on a daily and weekly basis. Additionally, we learned much about water consumption of each individual family and will be able to better determine how much water families will need their rainwater harvesting systems to provide. The surveys also provided insight about the education level, occupation, main priorities, and health of the community members.

3) Water Testing

Testing the water in the implemented tanks, the government implemented tanks, and at the community water source was a critical portion of this trip. The water in the community had been tested during past trips, so these tests augmented the results obtained during past trips. In order to account for a wide range of possible contaminants, we tested the water various times. Each time, our team tested for ammonia, nitrates, nitrites, bacteria, and iron. Members of the travel team performed these tests on three different days, noting the time of the test and weather conditions before and during each test. During each testing period, every test was performed twice per source.

The ammonia, nitrates, nitrites, and iron tests were performed using test strips. These strips were placed in samples of water taken directly from the source being tested and placed into uncontaminated containers. The strips were then submerged in the water and the instructions were followed. These test strips did not provide the travel team with any difficulties.

The bacteria tests were performed using test plates. First, the water testing team gathered a vial of the source being tested and brought it to CeCep. There, the source was properly plated and the time of plating, outdoor temperature, and weather were recorded. These bacteria tests yielded positive results for presence of bacteria, but did not provide conclusive results with respect to type or count of bacteria. Due to the sensitivity of the temperature and time with respect to growth of bacteria, each bacteria test could only be compared to other tests plated at the same time. In the future, more sophisticated bacteria tests will be investigated in order to gain a more comprehensive knowledge of the pathogens in the water. Though concrete results could not be determined, the presence of bacteria showed our team the importance of routine cleaning and maintenance of the tanks.

4) Home Assessments

The travel team photo- and video-documented each of the ten homes that will be implemented on during the May 2014 implementation trip. Additionally, each home and the land immediately surrounding it were mapped and measured, and tank locations were planned with the help of the families. For every home, a comprehensive list was made regarding what supplies would be needed, how many tanks would be best, and where the best location(s) for the tanks would be. We talked with the families at each home with the help of our translator in order to explain our implementation plans and take into account any specific needs that the family had.

5) Materials Assessment

A team spent two afternoons at local hardware stores creating an inventory of available materials and getting quotes on costs to rent a cement mixer. The tank company that we have previously purchased tanks provided a price quote for buying tanks in bulk. We also set up a rain gauge at CeCep, which will be used to determine how often community tanks overflow. This data will give us a better idea about when families should clean their tanks throughout the year and minimize water loss.

6) In-Country Partnership

This trip strengthened our relationship with our in-country project partner, CeCep. Through CeCep, we worked closely with Sucely, Alvaro, and Edgar to properly form Memorandums of Understanding, to plan community meetings, to conduct surveys, and to learn more about the government in the San Cristobal region. As our in country partners, CeCep is our conduit for communicating with the Water Committee and for setting up travel and homestay plans. At the end of this trip, we made it clear that Sucely, Alvaro, and Edgar are as instrumental to the success of this project as we are.

Group Organization

The group was broken up into several different teams throughout the week. In general, the groups were divided as follows:

1) Water Testing Team

- Tested ammonia, nitrate, nitrite, iron, and bacteria levels in the water and documented results
- Photographed changes in EWB-USA WPI implemented tanks since last trip

2) Assessment Team
   - Photographed, measured, and created diagrams of the next ten homes to be implemented on
3) Census Team
   - Conducted surveys with each home in community
   - Interviewed various community members such as the COCODE president and community midwife
   - Photographed each home, with their permission
4) Technical Team
   - Inventoried local hardware stores
   - Acquired price quotes on tools for upcoming trip
   - Designed overflow pipe and first flush system
   - Installed rain gauge
5) Planning Team
   - Detailed daily itinerary
   - Focused group on day to day tasks

Group Translators

One member of our team was a fluent Spanish speaker: Sebastian Vergara. One member of our team was able to assist in most translations: Jessie Ciulla. The rest of the travelers gained a working knowledge of Spanish throughout the trip.

Group Schedule

Below is a brief schedule of the trip:

5/3/2013	Depart from Boston and arrive in San Cristobal around 5 pm. Toured San Cristobal and became acquainted with homestays.
5/4/2013	AM - Worked in CeCep to finalize trip plans and discuss in detail our objectives with Sucy. Worked with Sucy to develop ideas for duties of the water committee. PM – Toured San Cristobal and learned about the government structure with Sucy
5/5/2013	AM - Toured the community. Developed idea of doing a census to gain updated information about the community. PM – Reconvened at CeCep
5/6/2013	AM- Performed water tests on Roberto's government tank and EWB-USA WPI implemented tank. PM – Water Committee meeting, meeting with midwife, evaluated Cristobal and Roberto’s EWB-USA WPI implemented harvesting systems.
5/7/2013	AM- Tom, Mike and Jessie evaluated solutions for Roberto's overflow issue. Bob, Caryn and Sebastian begin work on MOU and contract with homes to receive

	implementation. Bob worked with Sucy and Edgar to prepare census. Began inventories of hardware stores. PM – Meeting with Roberto
5/8/2013	Completed water tests at the finca, Roberto's government tank and Roberto's EWB-USA WPI tank. Completed the census in 9 homes. Observed bacteria test results.
5/9/2013	AM –Observed bacteria test results, assessed homes for upcoming implementation. PM- Planned for 5/10 meeting at CeCep.
5/10/2013	AM – Assessed homes for upcoming implementation. PM – Drafted MOUs for beneficiaries and Water Committee.
5/11/2013	AM-Collected water samples at Roberto's government tank, Roberto's EWB-USA WPI tank and the finca. Planned for final Water Committee meeting. PM- Went over accomplishments and what we had left to accomplish as an entire group.
5/12/2013	AM – Finished survey and completed all home assessments. PM – Final Water Committee meeting.
5/13/2013	Observed bacteria test results, Jessie, Tom and Mike walked through all ten future implementation homes again. Had a concluding meeting with all travelers, Sucy, and Alvaro.
5/14/2013	Departed from San Cristobal and traveled to Antigua
5/15/2013	Departed from Antigua to return to Boston.

6.0 COMMUNITY INFORMATION

6.1 Description of Community

Population Data

As of the first assessment trip in 2010, the population of Guachthu'uq was about 280 people split between 41 homes and 39 different families. During the most recent assessment in May 2013, our census revealed the current population to be 188 people over 36 homes. Five homes were not available to participate in the census, so we estimate the true population to be between 188 and 215 people. Of those 188 people in the census, 61 are below the age of ten. Recently we have begun researching ways to assess the health of the community by looking at the health of the children under the age of ten. The census also revealed that on average families have lived in Guachthu'uq for 13 years. The longest resident family has been in the community for 40 years. How long a family typically remains in Guachthu'uq is important to the scope of our rainwater harvesting project as it will help form guidelines for tank ownership in the case that a family that has received a tank decides to relocate to a new community.

Community Infrastructure

Guachthu'uq is one of five local communities that make up a micro-region. These communities, listed 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 Guachthu'uq residents do not own a vehicle or bicycle, so walking is their primary means of transportation. Though located on a steep hill, the location of Guachthu'uq provides residents with close proximity to the town market. It is about a 40 minute walk by foot, and there is even a van that frequently stops in Guachthu'uq.

Houses in Guachthu'uq are typically built about 50 yards apart; however, some areas do have multiple houses very close due to various generations of one family staying near each other. Most houses in the community are made of wood and have zinc galvanized corrugated roofs. Some homes are made from a combination of wood and concrete. Although there are power lines running though the community, only about half of the homes surveyed in the 2013 census reported having electricity. Most homes in the community have a latrine several yards from the major home structure. Typically these latrines are hidden in the wooded areas up or down the side of the mountain. There are no latrines near the finca and the stream that feeds the finca runs through a wooded area that we were unable to explore.

Work

The average family income is around $500 annually, which is roughly $2-3 a day. The women primarily take care of the home although a few, particularly younger women, work in the town of San Cristóbal as domestics.

The 2013 census revealed that almost everyone in the household was responsible for gathering water. 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. As mentioned in Section 3.0 their main year-round water source is located on a private plot of land called the Finca which is 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 each trip to the finca. 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, which provides eggs and occasionally meet. Many of the families also grow corn for their own use.

Education/Religion

While most women only speak Pokomchi, the local Mayan dialect, many community members speak both Spanish and Pokomchi'. The Guachthu'uq people are a mix of Protestant Evangelicals and Catholics, but are also involved in traditional Mayan spirituality.

The school system in the San Cristobal area runs as follows: Kindergarten (ages 3-4), preparatory (4-5), primary (6-12), basic (13-15), "diversificado" (15-18) and university level

(18+). Most children do not attend school after primary but if they do, then they must travel to San Cristóbal and attend the schools there. About 11 people in the 2013 census reported to have reached the 6th basic level, while about 40 people over the age of 20 years reported to have no education. Children generally attend school when they are not working with their parents. The children from Guachthu'uq/Rehquensal have two primary schools to choose from. One is in the neighboring community of Rexquix (uphill) and the other is in Las Arrugas (downhill). 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.

6.2 Community and Partnering Organization/NGO Resources and Constraints

CeCep:

Our primary NGO in Guatemala is the Centro Comunitario Educativo Pokomchi (CeCep). CeCep is a cultural center and Pokomchi museum located in San Cristobal, several miles from Guachthu'uq. They provide social and educational services to the local Pokomchi communities. Guachthu'uq, being a Pokomchi community, is one of the many communities that interact with CeCep. Our relationship with CeCep has grown stronger over the past two trips. This relationship helps CeCep achieve their objective to assist the Pokomchi people and allows our team to maintain a reliable line of communication with Guachthu'uq. CeCep provides logistical support to EWB-USA WPI including transportation to and from Guatemala City and Antigua, translators, and housing.

Sucely Ical Lem, the head of CeCep, has been a valuable resource for cultural and social custom questions that have arisen while progressing through this project. She understands the scope of our project and has insight on how to work with the sociocultural interactions with the Guachthu'uq people. She also works with a local student to maintain the monitoring systems that we have established and plans to continue providing assistance throughout the implementation phase.

The residents of Guachthu'uq speak Pokomchi, the local Mayan dialect. CeCep provides our team with translators each trip. Often, these translators are the same from year to year. Everyone who works for CeCep is now familiar with our project which helps to make each trip more efficient. Aside from Sucely, there are four main volunteers at CeCep who are heavily involved in translating for our project. Gerson and Abelino, who can translate directly from Pokomchi to English, were very useful in our last implementation and were occasionally available during this trip. Two students, Alvaro and Edgar, have been increasingly involved in the project. Alvaro is our major contact for in country monitoring and Edgar is a new addition to the team as a result of this past trip. Both students have great potential of increasing our ability to maintain a year round presence in the community and can assist our team in making pre-implementation trip preparations.

Guachthu'uq Water Committee:

This past assessment trip we were successful in establishing the formal roles of the Guachthu'uq Water Committee that the Guachthu'uq residents took the initiative to form at the

end of our first implementation trip. One of the major goals in this past assessment trip was to ensure that this committee is going to become an integral part of our project as we progress through the implementation phase. For this coming year our team and the committee agreed that they will start with an educational role revolving around proper boiling of water, clean of existing systems and creation of the mold for the concrete bases.

Political Government:

In the past the EWB-USA WPI chapter has tried to treat the current community government as a mode of communication. The Community Development Council (CoCode) is a small group of community members who are elected by the community to politically represent Guachthu'uq in the overarching government of San Cristobal. The CoCode members do not receive any form of monetary compensation for their positions. This stratified government program is meant to allow communities to more effectively communicate their needs to the larger government officials. Guachthu'uq recognizes that their limited access to water is a major problem within the community. This problem however is not isolated to Guachthu'uq; it affects all citizens living in and around San Cristobal. Our team has found that working with the CoCode as the major line of year round communication is largely ineffective due to limited access to technology and lack of inter-communal distribution of information. CeCep has moved into this role as our major line of communication with the community. Students at CeCep are in contact with members of the Guachthu'uq Water Committee and the committee reports to the people. This mode of communication is a new addition to our project and we are looking forward to the benefits that it will offer to the future of the project.

Financial Resources:

Generating an appropriate payment plan between EWB-USA WPI and the families of Guachthu'uq has been discussed to great extent during and after the past two trips. The total cost of the implemented systems is difficult for the families due to the great cost of the water storage tanks. However, cost of maintenance for the rainwater harvesting systems is minimal since the costs revolve around the cost of cleaning. It is most essential for the community members to understand how the systems work hydrostatically. The cost required for repair work is within the bounds of the families unless it is replacing a tank. The amount that the families must pay for the initial system implementation is 5% of the total cost of their system. This amount represents similar cost requirements to estimated repair costs.

Language:

The residents of Guachthu'uq speak Pokomchi, the local Mayan dialect. We are able to hire translators; however, the number of translators limits the number of groups that the travel team is able to split into. Each additional translator requires additional funds to be allocated away from materials that directly benefit the community. However, with each translator we become friends with we gain an additional member to our team who remains in Guatemala and is able to help our team when needed.

Location:

Guachthu'uq is located on a mountain side, just outside the city of San Cristobal. In this small city we are able to purchase construction materials. The road from San Cristobal to

Guachthu'uq is unpaved and needs repair. Families in Guachthu'uq do not own a motor vehicle; walking is the primary means of transportation as well as a small bus that frequently goes back and forth from Guachthu'uq to San Cristobal. Transportation of materials to the community is feasible, yet the volume of necessary supplies at the construction stores in San Cristobal is insufficient. Our team has established communication with several local construction stores and plans to preorder materials before arrive in country.

Education and Construction Skills:

It has been observed that the members of Guachthu'uq are capable of doing the appropriate construction work required by our project. They also, with some explanation, understand the fundamental concepts of hydrostatics and how gravity water fed systems work. Our team was happy to find that the community members understand that all drinking water needs to be boiled.

6.3 Community Relations

One of the main accomplishments of this trip was immensely strengthening the bond between EWB-USA WPI and the community members of Guachthu'uq. Below is a summary of the major groups and people that were crucial to developing community relations.

CECEP - Centro Comunitario Educativo Pokomchi

- NGO which assists EWB-USA WPI with setting up homestays, travel plans, and transportation arrangements
- Acts as conduit through which EWB-USA WPI contacts community members and sets up meetings in Guachthu'uq
- Allows EWB-USA WPI to use site to hold meetings
- Location of the rain gauge that EWB-USA WPI set up on this trip
- Source of cultural knowledge about Guachthu'uq
- Source of political knowledge surrounding Alta Verapaz region
- Provides basis for official documentation between EWB-USA WPI and community
- Invested in the betterment of the lives of Pokomchi people
- Respected for leadership role in the community

Alvaro Caal Lopez

- Student from San Cristobal, Guatemala who assists EWB-USA WPI while travelers are out of country
- Collects data from rain gauge and relays it to EWB-USA WPI
- Surveys families in community who will be beneficiaries on a biweekly basis
- Aided EWB-USA WPI with Pokomchi to Spanish translations during their trip
- Liaison between Water Committee and EWB-USA WPI

Sucely – Community Contact

- Responsible for arranging transportation, homestays, and meals
- Initiates meetings between EWB-USA WPI and Water Committee
- Helps phrase MOUs between EWB-USA WPI and community
- Provides points of clarification for EWB-USA WPI travelers

Water Committee – Organized group in community

- Goal is to aid us in whatever ways possible so that we can best implement in the entire community
- Inception came about as a result of EWB-USA WPI's January 2013 pilot implementation
- Will perform activities with future beneficiaries in order to better prepare homes for implementation
- Members of Committee:
    - Cristobal Laj Cojoc – President, current beneficiary
    - Roberto Chajoc – Vice President, current beneficiary
    - Catalina Max Calel – Secretary, future beneficiary
    - Ricardo Gualim – member
    - Angelina Quej Cal – member
    - Elidia Esperanza Xona Yuja – member, current beneficiary, Roberto's wife
    - Maria Magdelena Jom Yuja – member

Roberto – community member whose home was implemented on in the January pilot implementation

- Allowed EWB-USA WPI to test the water in both of his tanks
- We implemented and overflow pipe and designs for a first flush on his tank
- Vice President of the Water Committee

Maria Mo – midwife

- Provided information with respect to water usage around newborn babies
- Explained to EWB-USA WPI some repayment customs common in the community
- Uses bleach to clean water before washing clothes, but does not drink this water

Don Domingo – COCODE President

- Allowed EWB-USA WPI to set up meetings and assess homes as frequently as was necessary
- Welcomed EWB-USA WPI to community and answered questions that we had

6.4 Community Priorities

Below are the priorities indicated to EWB-USA WPI during the trip related to general project desires and access to water.

Families

- Increased access to water because travelling to the community water source is time consuming and does not always yield enough water.
- Improved stove designs that would reduce the amount of smoke in homes.
- The families who did not have government or EWB implemented tanks expressed the need for water catchment systems.
- In the interviews conducted with families in the community, every family listed water as their primary concern for their home, over electricity and a bathroom

Water Committee

- The continued implementation of rainwater harvesting systems.
- The order of implementation of rainwater harvesting systems in the community.
    - Should be need based, those families without systems who live further from tanks need to be implemented on sooner than families who have systems or are close to the community water source.
    - After EWB-USA WPI's next implementation, we will abandon the random drafting of houses that was adopted in 2012 in favor of need based evaluations.
- Guidance from EWB-USA WPI because the Water Committee feels as though they would be best served under our direction.
- Consequences of cross family assistance needs to be examined
    - Members of the community cannot afford to lose a day of pay, which pertains to member of the Water Committee as well.
    - How does community account for neighbors helping each other

Refer to Appendix 1 for notes from the meeting between the Water Committee and EWB-USA WPI.

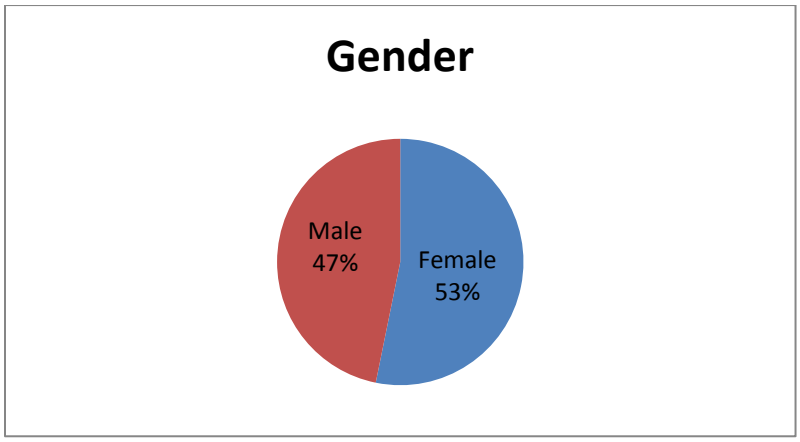
7.0 DATA COLLECTION AND ANALYSIS

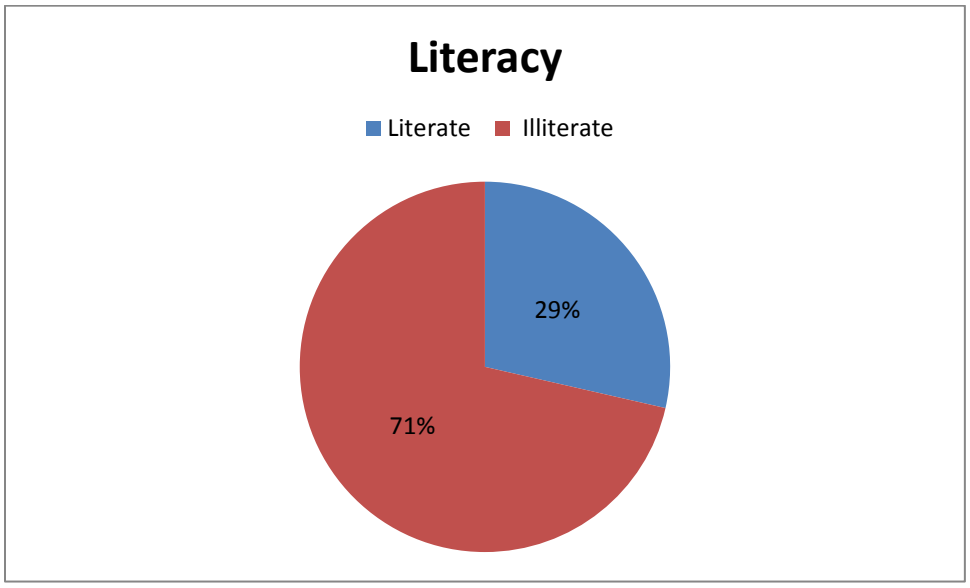
7.1 Summary of Data

Demographics:

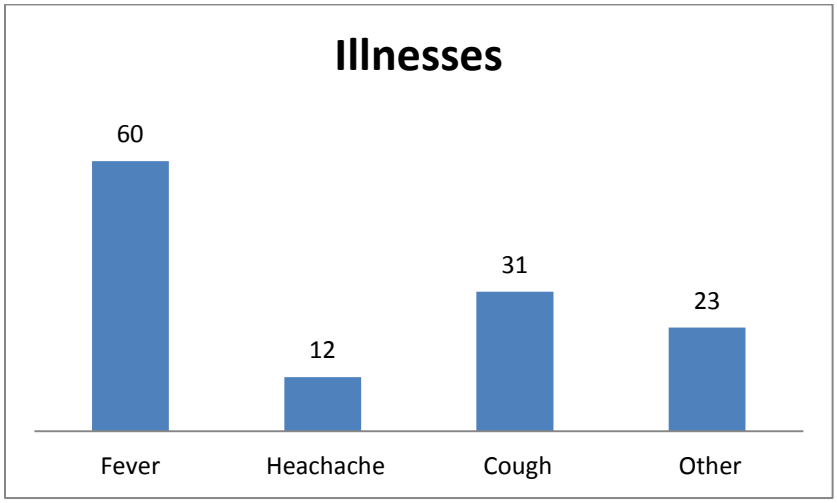
Below are some of the demographics of the community, based on the survey conducted of each home. The complete data from the census can be found in Appendix 2.

NOTE: three homes are not included on survey as they were not present at the time on surveillance.

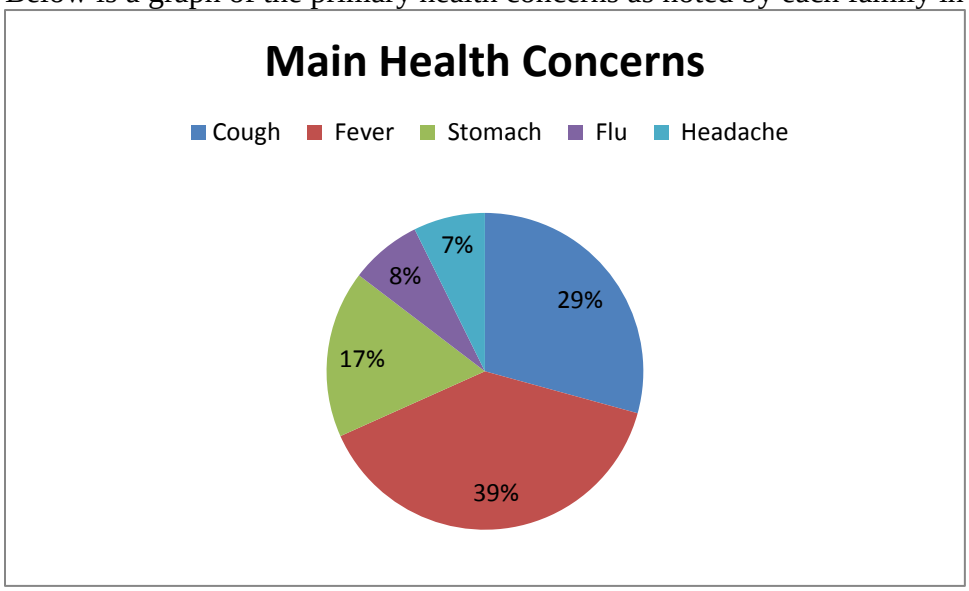




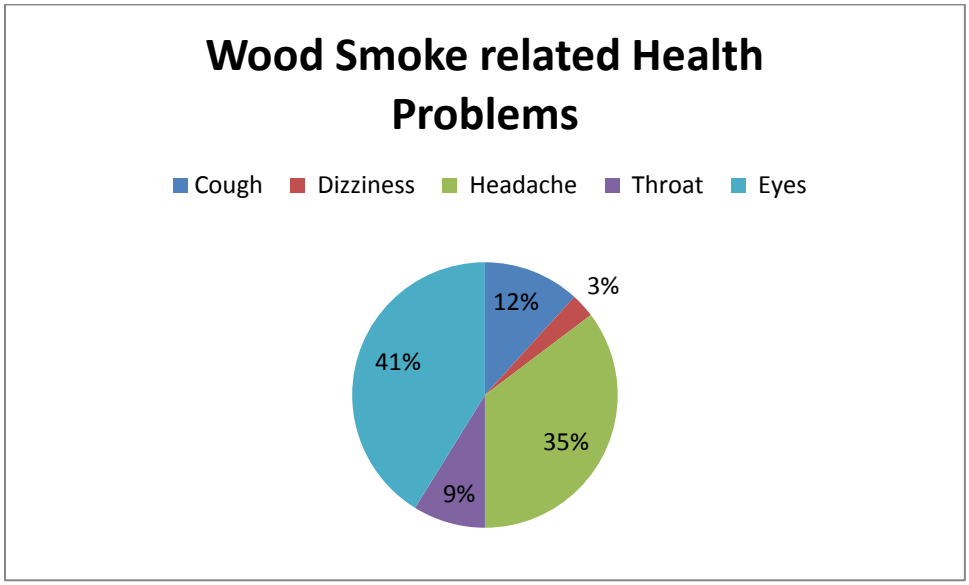
Below is a summary of the accounts of each illness reported in community members during the past year:



Below is a graph of the primary health concerns as noted by each family in the community:



Below is a graph of the health problems occurring as a result of the wood stoves in the homes of the community members:



Water Quality Data:

Table 1: Chemical Water Tests Used

Test	Type	Source	Sensitivity (mg/L)
Iron	Test Strips	Sensafe	0.00-0.30 and 0.0-50
Ammonia	Test Strips	Hach	0.0-6.0
Nitrate	Test Strips	Hach	0.0-50.0
Nitrite	Test Strips	Hach	0.0-3.0

Tables 2 and 3 summarize the findings of the water tests completed on this assessment trip. Water tests were performed on both of the tanks at Roberto's House, which includes a government tank implemented in 2008 and a tank implemented by EWB-USA WPI in January 2013. The intent of these tests was to compare these tanks to the finca, the community water source. The finca water was tested only once, as on the first day of scheduled water testing, the entrance to the finca was blocked and the last day of scheduled water testing the finca had run dry. Therefore, EWB-USA WPI used the remainder of the water tests to conduct a bacteria test in another government-implemented tank in House 31.

Table 2: Chemical Water Test Results

Water Source	Date	Nitrite (0-0.5 mg/L)	Nitrate (0-30 mg/L)	Ammonia (0-2.5 mg/L)	Iron (0-3 mg/L)
Roberto's House-WPI Tank	5/6/2013	0	0	0.25	0.01-0.05
Roberto's House-Government issued tank	5/6/2013	0	0	between 1.0-3.0	0
Robertos House-WPI Tank	5/8/2013	0	0	0.5	0.00-0.005
Roberto's House-Government issued tank	5/8/2013	0	0	1	0
Finca	5/8/13	0	0	0	0

EWB-USA WPI conducted chemical water tests and tested the water sources for nitrate, nitrite, ammonia and iron on both of Roberto's tanks and the finca. It was found that all of the water sources were within the acceptable ranges, based on concentrations that WHO reports to be acceptable. One notable difference in chemical water quality between Roberto's two tanks is the levels of ammonia found. Roberto's government tank observed higher levels of ammonia than the tank issued by WPI. This may be attributed to factors such as higher levels of decaying organic matter surrounding the government tank that may have built up over time. Roberto's government tank is located in closer proximity to trees than the tank WPI implemented which may be a source of this organic matter.

EWB-USA WPI also conducted bacteria tests on both of Roberto's tanks, the finca and House 31. These tests were conducted using Coliscan easygel tests, manufactured by Micrology Labs, which were chosen because they incubate at room temperatures and would serve well for field testing. Therefore, conclusions based on the tests conducted were draw by comparing samples collected on the same day and incubated under the same conditions to ensure conclusions were not skewed by temperature variations throughout the week. This method ensured that comparisons were only being made between identical incubation environments. However, this did not allow for us to quote absolute values of bacteria. The Coliscan Easygel tests show the presence of E. Coli, Other Coliforms, and Teal/Green Colonies. Results are shown in Table 3. Teal/Green colonies were not found, and therefore not shown in the results.

Table 3: Bacteria Test Results (Reported in E.Coli or Fecal Coliform per 100 mL of water)

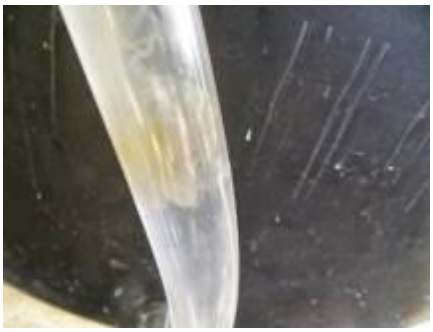
Source	Date of Sample Collection	**Time (hours)**	**"Other Coliforms"**	**"E. coli"**	Time (hours)	"Other coliforms"	"E.Coli"
Roberto's WPI Tank	5/6/2013	**48**	**0**	**0**			
Roberto's WPI Tank	5/8/2013	**48**	**150**	**0**	72	150	0
Roberto's WPI Tank	5/11/2013	**48**	**50**	**0**			
Finca (tap)	5/8/2013	**48**	**200**	**100**	72	450	150
Roberto's Government Tank	5/6/2013	**48**	**700**	**0**			
Roberto's Government Tank	5/8/2013	**48**	**750**	**0**			
Roberto's Government Tank	5/11/2013	**48**	**350**	**0**			
House 31 (Goverment Tank)	5/11/2013	**48**	**TNTC**	**0**			

The major conclusion drawn from these water tests was that the older, government tanks at Roberto's and House 31, showed much higher presence of coliforms than the finca and the newly implemented tank, although the finca showed the presence of E.coli. Assuming the higher level of bacteria in the government tanks can be attributed to age and buildup of contamination over time, this finding is significant as it emphasizes the important of routine cleaning in the tanks to ensure safe drinking water. Robert reported that he cleans his tank only when it runs dry in order to conserve the water. This leads to several problems, community members feel that it is more important to conserve water as long as possible, than to clean their tanks. This becomes an issue because often the tank will be nearly empty but since it still have a small amount to water in it they do not clean it and then when it begins to rain again, the water that once remained contaminated the new clean rainwater. They understand how to properly clean the tanks however they don't see the importance of doing it more often. Over the next year we will work to develop better ways for the community members to conserve as much water as possible while maintaining a regular cleaning routine. The finca also showed the presence of white colonies, which Micrology Labs suggests is the presence of proteus and salmonella. Other Micrology Lab's products specifically test for salmonella which should be considered for testing in future years.

Rainwater Harvesting Systems:
Below is the summary of the data collected from the two tanks implemented on the pilot implementation in January 2013:

Cristobal's Tanks

- Both tanks still present and functioning
- Unknown contaminants in water level pipe

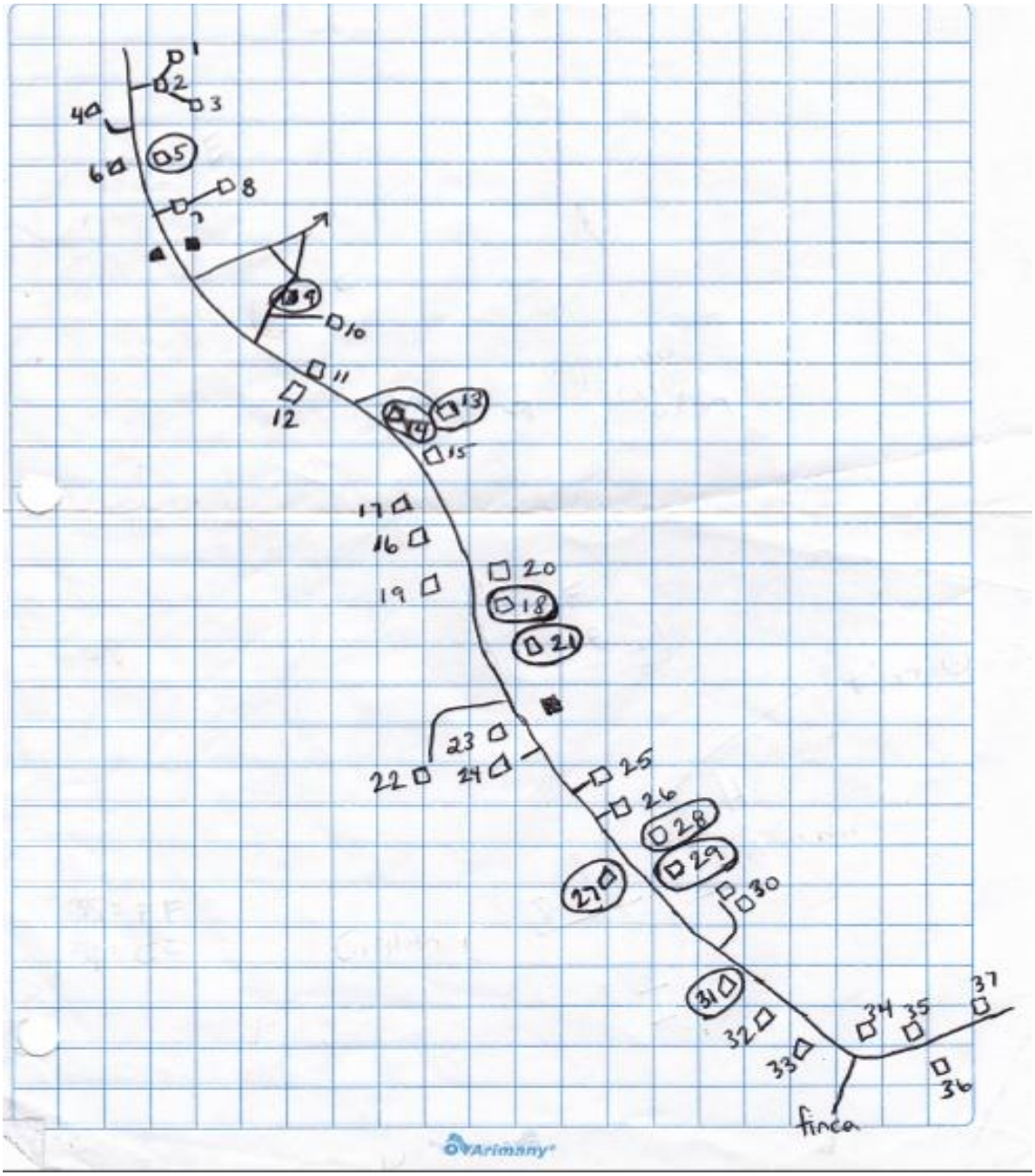


Roberto's Tank

- Overflow pipe installed

7.2 Mapping

While assessing homes and surveying families, the travel team photo-documented the main road of the community, each home, and each family in the community, as well as structural problems with homes and areas that tanks could be placed. These photos will be used to create a visual map of the community and help guide our chapter's progress from the US. This map will replace the one that EWB-USA WPI uses, and will be more spatially accurate. Each home in the map will have the house number, as labeled by EWB-USA WPI on its first assessment trip. Additionally the map will include a picture of the home, a picture of the family, and notes that EWB-USA WPI collected about the home. The team collected GPS points throughout the community, which will be used to better the map of the Guachthu'uq region.



List of Families:

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

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

Implementation Families in Order:

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

Casa 29 – Ricardo Gualim
Casa 21 – Migel Caj Pop
Casa 9 – Cristobal Lem Suran
Casa 27 – Cristobal Coy Max
Casa 5 – Filomena Gualim Caal
Casa 18 – Domingo Caj Pop

Casa 13 – Guillermo Jom Gualim
Casa 28 – Alfozo Xona Jul
Casa 31 – Marcela Cal Moran
Casa 16 – Elvira Cal Chun

8.0 MONITORING

8.1 Monitoring plan for current project

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

Field tests of water quality of both the finca and rainwater catchment tanks is vital in determining the success of our project and ensuring that our design does not cause any unanticipated harm to the community. Water quality tests will allow us to measure the amount of bacteria in the finca and rainwater catchment tank over time. Testing during this assessment trip showed bacteria growth in the government implemented tanks, which were implemented about five years ago. Therefore, it will be important to continue to test the tanks that EWB-USA WPI implements. These tests will strengthen the need for proper sanitation of tanks and preparation of water before consumption. Monitoring water quality will ensure there is no issue and help to ensure that as our project progresses we continue to improve the quality of our aid.

The second metric we will use to measure the impact on the community is to evaluate the structural integrity of the rainwater catchment tanks and concrete bases. Ensuring these aspects are structurally sound will show us that our project is indeed helping the community rather than adding to their problems. Specifically, it is pertinent that each system functions in the manner that it is intended and that there are no portions of the system which detract from the overall effectiveness of rainwater harvesting. We also want to investigate these designs to make sure they do not lead to erosion or indirectly damage the homes of community residents.

The last metric we will use, and perhaps the most important is to continue to conduct community surveys to gather data about the efficiency of our system designs. This will be measured by the amount that a family has to rely on water from the Finca before and after implementation. Our goal is to ensure that all families do not have to resort to the Finca ever during the year. Robert, the owner of one of the home we implemented at, reported to us that with the system we implemented his family does not have to take water from the Finca anymore. This feedback will allow us to further tune our modeling system and allow use to design more appropriate systems as the project proceeds.

8.2 Monitoring of past-implemented projects (refer to listed projects in Part 1 of section 5.0 of this report)

At this time, EWB-USA WPI does not have any past-implemented projects to monitor.

8.2.1 Functionality Status Supporting Information

Project Type	Project Discipline(s)	Date of Completion (m/d/y)	Functionality (enter one range per project)*	Periodic Maintenance* (yes or no)	Demonstration of Knowledge Transfer* (yes or no)
Rainwater Harvesting	Water Usage	N/A	50-75%	Yes	No, we are currently too prematurely through the project

8.2.2 Periodic Maintenance Supporting Information

8.2.3 Demonstration of Knowledge Transfer Supporting Information

9.0 COMMUNITY AGREEMENT/CONTRACT

Beneficiary Agreement MOU

Beginning in 2009, the group Engineers Without Borders began coming to the community of Guachthu'uq, to help to manage and install a rainwater harvesting system. EWB-USA WPI hopes that this will be a long term project and that it will benefit the majority of the families in this community. This project will be executed in a tripartite manner involving the Community Pokomchi Education Center (CeCep), Engineers Without Borders (EWB-USA WPI), and the water committee in the community named for this project. In this fashion, it is hoped that in the upcoming years this project will be completed in a successful manner, and will contribute to an elevated quality of life for the beneficiaries.

Thus, CeCep, represented by Sucely Ical Lem, holder of the personal identification document 2615 127731603; Mr. Cristobal Laj Cojoc, president of the water committee with ID 2200 90777 1603; and Mr. _____ who can be identified with the ID _____ gather to acknowledge this agreement for the implementation of a rainwater harvesting system. In this agreement, the community member selected for implementation is named a beneficiary in this project, and the purpose of this agreement is to ensure that the beneficiary follows the guidelines for use and care of the rainwater harvesting system. The guidelines include:

1. The beneficiary will participate actively and voluntarily in the management, implementation, and monitoring of their rainwater harvesting system.
2. The beneficiary will be solely responsible for the upkeep of their rainwater harvesting system in their home, which indicates that they will be given responsibility of the maintenance of the system (gutters, tanks, cement base, and roof). The objective is that the system remains permanently in good, working conditions.
3. The beneficiary will promise to maintain the rainwater harvesting system in their home for duration of 10 years. If this promise is not upheld, the beneficiary will lose all rights to the value of the rainwater harvesting system, including implementation costs and manual labor during implementation and the tank will be turned over to CECEP.

The beneficiary complies and accepts the aforementioned liabilities and signs in accordance on this date _____.

Cristobal Laj Cojoc.		Sucely Ical Lem
Water Committee President	Beneficiary	CECEP.

Water Committee MOU

Beginning in 2009, the group Engineers Without Borders began coming to the community of Guachthu'uq, to help to manage and install a rainwater harvesting system. EWB-USA WPI hopes that this will be a long term project and that it will benefit the majority of the families in this community. This project will be executed in a tripartite manner involving the Community Pokomchi Education Center (CeCep), Engineers Without Borders (EWB-USA WPI), and the water committee in the community named for this project. In this fashion, it is hoped that in the upcoming years this project will be completed in a successful manner, and will contribute to an elevated quality of life for the beneficiaries.
The purpose of this document is to establish the roll of the Water Committee in this project. The success of this project depends on the active participation of the committee. Engineers Without Borders-WPI hopes that this project will benefit the entire community on a long term scale. With the help of the Water Committee, the project will be more successful. The Water Committee agrees to comply with the guidelines set out as follows:

1. The Water Committee will actively participate annually in three activities with the entire community. These activities include:
    1. Teaching the community members how to clean their tank systems. The Committee will demonstrate how to do this to the rest of the community using the tanks that have already been installed by the government. This will happen once a year.
    2. Explaining to the community that the water from the tanks has the objective of providing clean, potable water to the community. Additionally, the Committee

will teach the community that for drinking water to be most clean, it should be boiled for ten minutes.

3. Teaching the beneficiaries for the upcoming implementation trip how to prepare for a rainwater harvesting system in their home. This will include constructing the wood box for the cement base before EWB-USA WPI comes to Guatemala.

2. The members of the Water Committee will serve on the committee for duration of one year and during this time period will assist with the transition of new members to the committee.
3. The committee will meet once every two months with CeCep to discuss and plan the activities for the project. CeCep will communicate with EWB-USA WPI and the Water Committee, acting as a liaison between the two.
4. The Water Committee will participate in the three listed activities.
5. The Water Committee will learn and document the processes of EWB-USA WPI's implementation so that they can learn more about the technical aspects.

10.0 PHOTO DOCUMENTATION

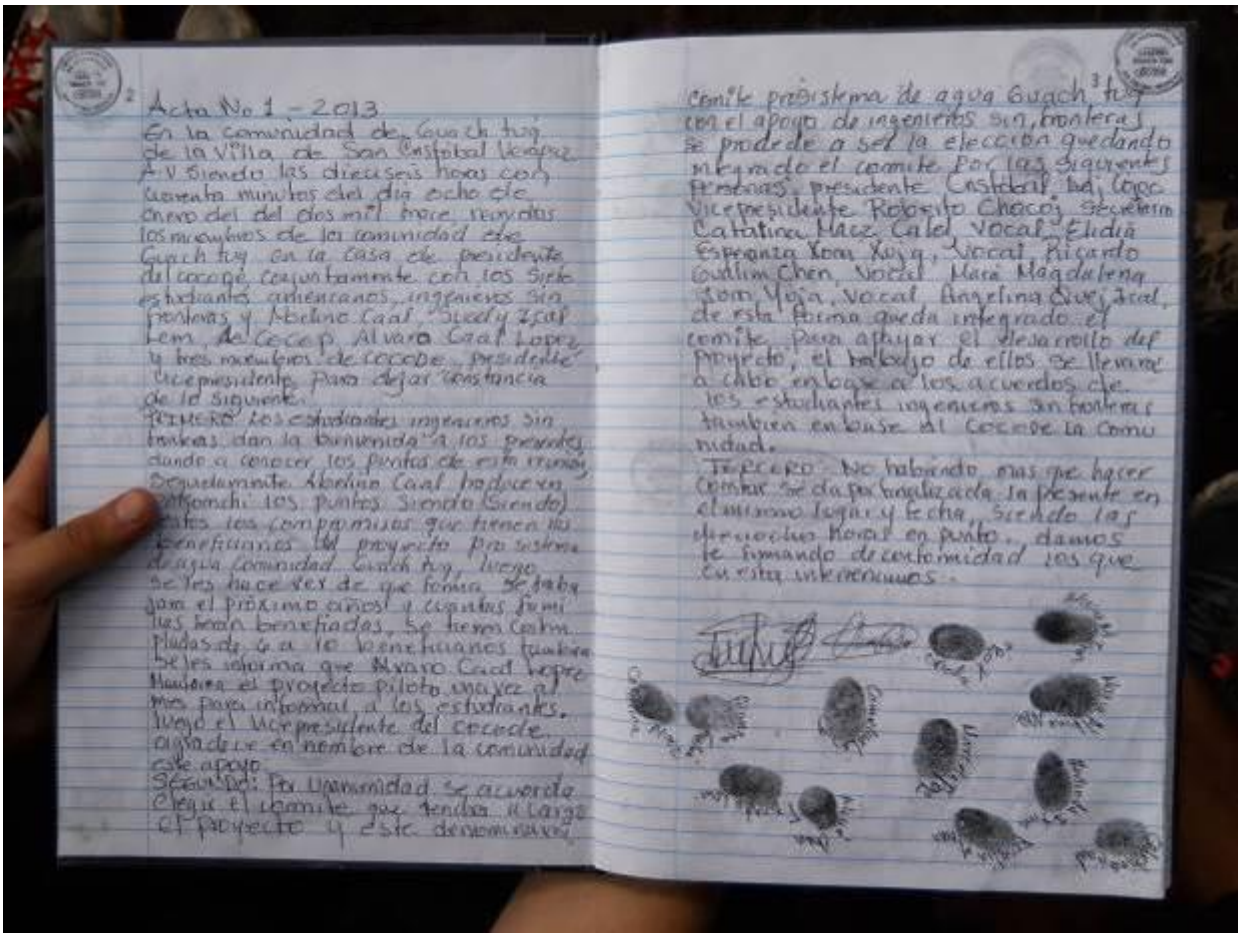


Figure 1 Guachthu'uq Water Committee's notebook, minutes from water committee and community meetings are taken here, followed by the signatures of all that attended the meetings

Figure 2 The stream and finca are dry.

Figure 3 EWB-USA WPI spends some time with the children of Guachthu'uq

Figure 4 Algae build up in older government tanks shows EWB-USA WPI the importance of routine tank cleaning and upkeep

Figure 5 System for overflow in Roberto's tank was designed and implemented on this trip

Figure 6 the team conducting in depth home assessments

Figure 7 Water committee members sign the meeting attendance book

11.0 PROJECT FEASIBILITY

The travel team this year spent a large portion of time assessing the feasibility of implementing in ten homes on the next trip. This assessment has led us to believe that we will be able to successfully implement in all then homes within the two week travel period. This feasibility has been assessed with the use of several parameters. These parameters include: access to materials, transportation of materials, pre-trip preparations, and appropriate pre-trip planning.

Access to Materials and transportation:

San Cristobal has a limited amount of construction materials available. This amount is not sufficient in the construction of ten rainwater harvesting systems within two weeks. Our team has created several relationships with local constructions stores that will order materials for us if we provide a list of the materials that we will need. This will require exact planning; however, we have accounted for such planning as discussed below. The rainwater harvesting tanks are also in limited supply in the San Cristobal area. We were able to confirm with Rotoplas, the tank

company, that they will be able to supply the appropriate amount of tanks and provide transportation of these tanks to San Cristobal.

In San Cristobal it has been confirmed that there are dump trucks as well as concrete mixers for rent that we will have access to in order to transport the concrete materials as well as large amounts of PVC and Gutters.

Pre-trip Preparations:

It was another major goal of this project to increase our understanding of what the Guachthu'uq water committee is able, as well as willing, to do while we are not in country. Our meetings with them revealed that they are capable of helping to maintain a year round educational presence and perform necessary pre-trip preparations. We intend to send plans and locations of tanks to Alvaro and Edgar (students at CeCep) who will communicate these plans with the Guachthu'uq Water committee. The committee along with Alvaro and Edgar will proceed to prepare each home for laying the concrete bases as well as removing any vegetation that infringes on system space. Another pre-trip preparation task is for Alvaro and Edgar to organize the transport of the concrete materials to each home a day or two in advance of our arrival. Alvaro and Edgar will also be able to provide help if we need additional communication with the construction stores that we are pre-ordering the PVC and other materials from.

Pre-trip Planning:

It was discovered from our pilot implementation trip in January 2013 that the data collected from home assessments from the previous trips was not sufficient for planning the systems from the US. We have adapted our methods and on this past trip we established about 90% of the design for each home. The ten homes that will be implemented on have been thoroughly assessed and each home has a rainwater harvesting system designed for it. This will allow our technical committee to focus on the necessary materials for each system as well as the logistical challenges we will encounter from planning this larger scale implementation trip.

Long Term Feasibility of Project Success:

From the water quality tests that we conducted on this trip it is evident that it is very import for there to be regular cleaning of the rainwater harvesting tanks. Tanks that have been in use for several years have a large accumulation of bacterial cultures and infectious agents. We believe that the community members do not practice appropriate cleaning methods on a regular basis. We intend to increase our educational plans in order to emphasize the importance of cleaning the tanks to maintain potable water.

We also implemented a rain gauge at CeCep that will allow us to better estimate with our excel model the amount of rain that is in each tank in the community. This will allow us to better design future rainwater harvesting systems as well as monitor the current systems in place. Our previous rain gauge that we have talked about in past forms was damaged beyond repair and has been not working for the past year.

General Community Feasibility Measures:

The community members have demonstrated to our travel team that they are willing to provide the necessary monetary investments for the rainwater harvesting systems as well as the necessary labor involved. They also have make it clear that they will provide as much in kind

materials as they have available to them i.e. wood, rocks, and tools. Socially we have discovered that for Pokomchi people documentation makes an interaction official. Therefore we have created a document that each family will sign that states that they will pay for 5% of the implemented system and we will provide a personalized system for their home. They are also required to maintain their system as well as allow use to monitor them into the future. We reviewed this document with the Guachthu'uq Water Committee; it was received with agreement and was accepted by all members.

12.0 LESSONS LEARNED

Health and Safety

Each trip we notice multiple travelers feel under the weather. Usually this is from long travel days, followed by long work days and a drastic change in diet. While most of this is just part of the experience, we can't emphasize enough to be extra cautious with tap water around San Cristobal. Many travelers encountered stomach issues on the trip that might have been related to the drinking water. Bringing a spare toothbrush, for when you accidentally run tap water over your usual toothbrush, can help avoid coming in contact with potentially dangerous tap water.

Community Health and Daily Life

Through the community survey and census, our team learned more about certain aspects of the project that we have thought to fully understand due to knowledge passed down from previous years. While it was communicated in previous trips that the major concern for the community is water supply, this does not relate to the most obvious pressing health concerns. It is more common for community members to suffer from complications due to smoke inhalation from cooking over an open fire in a closed room with no ventilation. The community previously communicated that the smoke helps with insects in the home, but our team plans to investigate this cooking method and the reasons behind it on future trips. Our data shows that many community members report smoke related illness more often than illness due to water borne pathogens. However, our data is incomplete due to unknown sources of illness such as the fact that many community members report fever which can often be caused by bacterial gut infections. We also learned that we need more information on how community members boil their drinking water. Most report boiling their water, and in fact do, yet it would be beneficial to know how long they boil it for and if they do it every time. Each family's process slightly differs and a standardized method may be beneficial for many.

When brainstorming ways to keep tank water clean; chlorine is usually brought up as a potential solution. The issue remains that the community members will reject the different taste of the water with chlorine. While speaking with the midwife during this assessment, we learned that she uses chlorine to clean clothes. This means chlorine is already culturally accepted in the community for cleaning purposes, and should be revisited as a potential solution for tank prolonged storage of rainwater.

Project Logistics

Our team took home some valuable lessons about how we should go about dealing with certain trip aspects in the future. Below are the key points.

- Keeping an up-to-date map of the community is very important. Families are always moving in and out of the community and for our planning purposes in future implementations it is vital that we keep track of these moves. Each trip should address updating and verifying the accuracy of the community map.
- When planning the implementation schedule, the team needs to keep in mind that many people work during the week.
- Some of the finca, possibly all of it, is being sold by the current owner. The effect of this transaction on the community is unknown at the moment.
- When planning community meetings, always allow for extra time as they often start later than planned and go later than expected.
- As the project progresses, knowledge retention is more and more crucial to its eventual success. Travelers must make it their personal responsibility to stay involved after the trip to ensure the information gained is effectively passed along to the entire club.

Tips for Travelers

The travelers discussed a few topics that differed from their own outlooks and expectations of the trip. The following are tips for future travelers to keep in mind throughout the project planning and execution process.

- The walk to and from the community can be physically demanding. Be sure to bring high calorie snacks and plenty of drinking water.
- Travelers willingness to be flexible throughout the day-to-day tasks is very important in order to enhance productivity. Don't expect the layout of activities to go as planned, and always be ready and eager to do other tasks.
- Basic knowledge of Spanish can go a very long way in the community and in the homestays in San Cristobal. Each traveler should have the willingness and desire to learn more Spanish before and during the trip.
- While we understand that water is a limited resource in Guachthu'uq, be aware that it is also limited in San Cristobal where the travelers stay. Typically travelers only had running water for half of the day.
- When discussing specific details about the project, the big picture of why we are there can be lost. While most group discussions will focus on project specifics and, make sure to relate the conversation back to the overall goal frequently to not lose sight.

Community Engagement

One focus of this trip included meeting with and understanding the role of the recently formed Water Committee in the community. Our team stands to learn a lot from the water committee about community opinions. While our relationship with the water committee is new, they are a vital resource for the success of the project and in communicating our goals to the community and vice versa. This past trip we learned that water is a source of tension in the community. It isn't our groups place to interfere with that, and we need to use the water committee to help manage this issue. We found that one source of tension stems from the vast differences in how well off each family is. While most, if not all, families don't have the resources to meet all of their drinking water needs, certain families already own multiple rainwater harvesting tanks while others have none or live very far from the finca. The most appropriate solution for this issue is to have the water committee deal with it by continuing to choose the next homes for implementation based on a raffle, but taking into account the need of each family when the final decision is made. When working with the water committee in the future, keep in mind they value paper documents.

Previous Group Involvement

During this assessment, the team learned from our partnering NGO that another volunteer group had been to Guachthu'uq recently and actually built a community center. We are working on trying to figure out which group this was, as their involvement with the community could help or harm our involvement. While sharing resources and experiences with another group dedicated to helping Guachthu'uq, we need to make sure the community does not confuse our efforts with other groups.

13.0 PROJECT STATUS

After successful completion of this assessment trip, the project is now in the design phase with planned ten-home implementation for May 2014.

14.0 PROFESSIONAL MENTOR/TECHNICAL LEAD ASSESSMENT

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

Michael Reiter

14.2 Professional Mentor/Technical Lead Assessment

This document, as with the preparation and travel, came together as a collaborative effort among all the students on the team. I believe that we now have a strong relationship with the staff at CeCEP which will be key to ensuring the needs of the community of Guachthu'uq are met. Because of CeCEP's purpose as a cultural center for communities who speak Pokomchi, they

hold a leadership role in the region. Working through CeCEP confers upon us that same level of respect in Guachthu'uq. The survey we did is the best yet in the community and gives us a lot of data to work with for understanding the needs of the community. Looking at the data, we realized it is very important to re-commit to the stoves project as the smoke may actually be the leading cause of health issues in the community.

Possibly the most important thing we worked on this trip deals with the fact that the chapter has had a change in leadership in the last year and the focus on project goals had been lost. In preparation for this trip we reviewed all of the documentation from previous trips to develop an understanding of what work had been done before and most importantly, what had been discussed and committed to the community. We discussed the importance of documentation for all new chapter members to review and quickly understand project goals. We also agreed that there needs to be continuity between people who do assessments and people who do implementation. I wouldn't recommend having one person plan a renovation on my home and have a different person do the construction and the same concept holds in Guachthu'uq. Two of the students and myself led the assessments and are committed to going back next year.

Not only was there only one student on this trip who had travelled before, but all other chapter members who had travelled previously are now graduated. This trip was very important for establishing the new leadership in the chapter, new approaches to documentation for continuity and set the chapter up for future success.

14.3 Professional Mentor/Technical Lead Affirmation

I was the lead mentor for this trip and I take responsibility for the work presented in this document.

APPENDICES

Appendix 1: Water Committee Meetings

The first Water Committee meeting, which took place on May 6, was informal and greatly helped the travel team. As an icebreaker, each person in the room introduced themselves, giving their name, role in the project, and where they lived. This was translated from the speaker's native language to both English and Pokomchi so that everyone understood. The Water Committee was formed in January 2013 as a result of EWB-USA WPI's project in the community. The proposed role of the Water Committee is to act like teachers for the rest of the community. The committee will relay information from EWB-USA WPI to the community and will assist future beneficiaries. The possibility of having the committee help the next ten families prepare the sites for implementation was also discussed and received favorably. The committee meets every two months, and is willing to partake in the activities that we suggested.

We opened the second Water Committee meeting, on May 12, by saying it was our last visit to the community that trip and we had a few ideas for how the Water Committee could function in our absence during the coming year. We made sure that it was clear we wanted feedback from the Water Committee during the meeting and stated that the success of the project depends on the Water Committee; so it was essential that they agreed with our proposed role and plans for them. Once this was established, we presented the Memorandum of Understanding to the Committee. During the meeting, we learned that the Committee thinks that only beneficiaries should clean their tanks yearly and that members of the community already clean their tanks. However, most of them do not clean their tanks because they do not want to waste the water. They agree that their role should be to teach beneficiaries which water is potable and which should be used for cleaning only, and to prepare future beneficiaries in clearing the area near their house which will be used for implementation. It was decided that members of the Water Committee will serve for at a minimum of a year in order to gain the knowledge to assist the beneficiaries of the following year. It was also established that the entire Water Committee cannot step away from their positions in the same time frame.

Appendix 2: Census Data

Below is the census data from each member of Guachthu'uq

						Work		
House Number	**Name**	**Position in family**	**M/F**	**Age**	**Grade Achieved**	**Profession**	**Location (if not Guachthu'uq)**	**Collects Water?**
1	**Oscar Vicente Laj**	father	M	32	none	farmer		yes
	Mauricia Cal Cal	mother	F	27	none	tends to the house		yes
	Alida Laj Cal	daughter	F	10	4th primary	student		yes

	Sandra Laj Cal	daughter	F	8	1st primary	student		yes
	Oscar Laj Cal	son	M	5	none			no
	Shirley Laj Cal	daughter	F	2	none			no
2	**Isabela Caj**	mother	F	43	none	tends to the house		yes
	Mateo Caal	father	M	53	none	farmer		yes
	Marcial Caal Caj	son	M	16	6th primary	farmer		yes
	Flavio Caal Caj	son	M	13	4th primary	student		yes
	Lidia Isabel Caal Caj	daughter	F	10	4th primary	student		yes
	Luis Everardo Caal Caj	son	M	7	1st primary	student		yes
	Anabela Cal Caj	niece	F	3	none			no
	Romi Rodolfo Caal Caj	son	M	3	none			no
3	**Julio Jalal Latz**	father	M	32	none	farmer		yes
	Cristina Cal Caj	mother	F	25	2nd primary	tends to the house		yes
	Roman Cal Jalal	son	M	8	2nd primary	student		yes
	Amaly Cal Jalal	daughter	F	6	1st primary	student		yes
	Ingrid Cal Jalal	daughter	F	5				no
	Juan Cal Jalal	son	M	1				no
4	**Isabel Xona**	mother	F	51	none	tends to the house		yes
	Estamslao Caal	father	M	38	2nd primary	farmer		yes
	Cristina Caal Xona	daughter	F	16	6th primary	cook		yes
	Vitalina Caal Xona	daughter	F	12	5th primary	student		yes

	Alida Consuela Caal Xona	daughter	F	10	4th primary	student		yes
	Alvaro Leonardo Caal Xona	son	M	8	2nd primary	student		yes
	Elvia Evimiria Caal Xona	daughter	F	6	1st primary	student		yes
5	**Baldeniar Quej Yuja**	father	M	36	1st basic	security guard	Guat City	yes
	Filomena Gualim	mother	F	30	none	tends to the house		yes
	Fabiola Quej	daughter	F	12	1st basic	none		yes
	Fabiana Quej	daughter	F	8	3rd primary	none		yes
	Gladis Azucena	daughter	F	6	1st primary	none		yes
	Gerson Noe	son	M	3	none	none		no
	Yesica Filomena	daughter	F	1	none	none		no
6	Carlos Jom Yuja	father	M	35	none	farmer		yes
	Rosa Gualim	mother	F	34	none	tends to the house		yes
	Denis Jom Gualim	son	M	11	4th primary	student		yes
	Aislian Jom Gualim	son	M	9	3rd primary	student		yes
	Yulisa Jom Gualim	daughter	F	6	preparatory	student		no
	Natali Jom Gualim	daughter	F	4	none	none		no
	Selvin Jom Gualim	son	M	4	none	none		no
	Mararia Lem Yuja	grandmother	F	76	none	none		no
7	**Jose Sis Yuc**	father	M	26	none	security guard	Guatemala City	no

	Graciela Cardona V.	mother	F	24	none	tends to the house		yes
	Wilfredo Sis Cardona	son	M	6	none	none		no
	Katy Sis Cardona	daughter	F	4	none	none		no
	David Sis Cardona	son	M	1	none	none		no
8	**Cristobal laj Cojoe**	Father	M	45	none	farmer		
	Letestina Xoc jol	Mother	F	51	none	tends to the house		
	Cesar Laj Xuc	son	M	21	6th primary	security guard	Guat City	
	Alicia Pop Jom	daughter in law	F	19	3rd basic	tends to the house		
	Maria Laj Xuc	son	M	19	1st basic			
	Romelia Laj Xuc	daughter	F	15	6th primary	student		
	Bairon Laj Xuc	son	M	10	4th primary	student		
	Teni Laj Xuc	daughter	F	4 mos.	none	none		
9	**Cristobal Lem Suram**	father	M	82	none	farmer		yes
	Maria Mo	mother	F	70	none	midwife		no
	Angela Lem Mo	daughter	F	33	none	tends to the house		yes
	Domingo Lem Xoy	Angela's husband	M	34	3rd basic	sawmill	San Cristobal	yes
	Karen Gualim Lem	granddaughter	F	4	none	none		no
	Maria Gualim Lem	granddaughter	F	3	none	none		no
10	**Santiago Lem Mo**	father	M	44	none	farmer		yes
	Margarita Pop Lam	mother	F	40	none	tends to the house		yes
	Maria Lem Pop	daughter	F	21	2nd primary	employee (?)		no

	Reinaldo Lem Pop	son	M	19	6th primary	none		no
	Claudia Lem Pop	daughter	F	16	6th primary	employee (?)		yes
	Juan Lem Pop	son	M	14	1st basic	none		no
	Gladis Lem Pop	daughter	F	12	5th primary	student		yes
	Mario Lem Pop	son	M	10	3rd primary	student		no
	Hector Lem Pop	son	M	8	1st primary	student		no
	Flori Lem Pop	daughter	F	4	none	none		no
	Brandon Lem Pop	son	M	2	none	none		no
12	Alejandrina Yuja Leu	mother	F	17	3rd primary	tends to the house		yes
	Edin Raul Coc	father	M	25	4th primary	farmer		yes
	Ivan Humberto	son	M	3	none	none		no
	Maria Alejandra	daughter	F	3 mos.	none	none		no
15	**Leandro Yuja Lopez**	father	M	53	none	farmer		yes
	Josefina Lem Mo	mother	F	53	none	tends to the house		yes
	Roberto Cae	son-in-law	M	27	2nd basic	farmer		yes
	Elsa Yuja	daughter	F	26	none	cook		yes
	Victor Yuja	son	M	15	1st basic	none		yes
	Alida Yuja	daughter	F	13	6th primary	none		yes
	Glanda Cac Yuja	grand daughter	F	1	none	none		no
16	**Elviva Cal**	Mother	F	50	none	tends to the house		yes
	Elviva Roxana	daughter	F	21				
	Paulina Juya	daughter	F	19				

	Yesema Carolina	daughter	F	16	3rd basic			yes
	Mano Salvador	son	M	14	2nd basic	student		yes
	Alexander Michael	son	M	11	5th primary	student		yes
	Marcos Enrique	son	M	9	2nd primary	student		yes
17	**Edgar Yuja**	father	M	23	3rd basic	manufacturer		yes
	Catarina Macz	mother	F	28	6th primary	none		yes
	Wilian Macz	son	M	12	5th primary	none		yes
	Jorge Macz	son	M	10	2nd primary	none		yes
	Aracely Macz	daughter	F	3	none	none		no
	Frans Yuja	son	M	1	none	none		no
19	Matilda Jor Yuja	Mother	F	20	none	tends to the house		yes
	Victor Caj	Father	M	27	none	farmer		yes
	Berta Dronely	daughter	F	4	none	none		no
	Victor Jose	son	M	11 mos.	none	none		no
20	**Mario Enrique Cul Laj**	father	M	23	none	farmer		yes
	Clara Caj Cul	mother	F	23	2nd primary	tends to the house		yes
	Alexandra Isabel	daughter	F	2	none	none		no
21	**Miguel Caj Pop**	father	M	45	4th primary	farmer		yes
	Rosalia Moran	mother	F	40	none	tends to the house		yes
	Feliza Caj Moran	daughter	F	19	none	none		yes
	Baldomero Caj Moran	son	M	18	2nd basic	none		yes
	Aura Caj Moran	daughter	F	16	5th primary	none		yes

	Juam Caj Moran	son	M	14	6th primary	none		yes
	Florencio Caj Moran	son	M	12	4th primary	none		yes
22	**Terosa Yuja Lopes**	mother	F	43	none	tends to the house		yes
	Celestino Jor Yuja	son	M	17	none	farmer		no
	Nicolas Jor Yuja	son	M	13	2nd primary	farmer		yes
	Blaxinca Estela	daughter	F	9	none	none		yes
	Suri Manela	daughter	F	8	none	none		yes
	Carlos Yuja	son	M	2	none	none		no
23	Adelia Chen Toc	daughter	F	19	none	tends to the house		yes
	Abelino Cal	father	M	67	none	farmer		yes
	Marcela Toc	mother	F	59	none	tends to the house		yes
	Sonia Maribel	daughter	F	14	5th primary	none		yes
	Mario Xim Laj	husband (Adelia)	M	22	6th primary	farmer		yes
24	Alicia Chentat	mother	F	28	none	tends to the house		yes
	Cerapio Chulo	father	M	30	none	farmer		yes
	Ingrid Azucena	daughter	F	8	1st primary	none		yes
	Wilson Leonal	son	M	5	none	none		yes
	Delma C. C.	daughter	F	8 mos.	none	none		no
25	**Emilio Chen Guidin**	father	M	55	none	farmer		yes
	Elvira Chen Len	mother	F	55	none	tends to the house		yes
	Antonio Chen Choc	son	M	21	6th primary		San Cristobal	yes

	Silvestr Chen Guidin	son	M	18	6th primary			yes
	Noima Chen Guidin	daughter	F	16	4th primary	none		yes
	Gricelda Yuja Quej	daughter in law	F	20	none	none		yes
26	Elidia Esperanza Xona Yuja	mother	F	39	none	wash clothes		yes
	Roberto Chojoc	Father	M	44	none	mason		yes
	Ricardo Jor Xona	son	M	21	3rd basic	none		yes
	Elida Candelana	daughter	F	16	6th primary	student		yes
	Romelia	daughter	F	14	1st basic	student		yes
	Maria Rosario	daughter	F	7	2nd primary	student		yes
27	Cristobal Coy Max	Father	M	44	3rd primary	farmer		yes
	Herlunda Ixian	Mother	F	42	none	clothes washer		yes
	Elvia Coy Ixian	duaghter	F	16	4th primary	cook		yes
	Luis Coy Ixian	son	M	11	2nd primary	student		yes
	Romiro Coy Ixian	son	M	10	3rd primary	student		yes
	Angelina Coy Ixian	daughter	F	6	1st primary	student		yes
28	**Alfonso Xona**	father	M	35	6th primary	mason	San Cristobal	no
	Carmelina Laj Yuja	mother	F	29	2nd primary	tends to the house		yes
	Edin Xona Laj	son	M	11	4th primary	student		yes
	Josue Xona Laj	son	M	9	3rd primary	student		yes
	Loida Xona Laj	daughter	F	8	1st primary	student		no

29	Ana Yuja	mother	F	65	none	tends to the house		yes
	Ricardo Gualim	father	M	66	none	farmer		no
	Eliceo Gualim	son	M	21	3rd basic	none		yes
	Carlos Moran	son	M	25	none	farmer		yes
	Maria	daughter-in-law	F	20	none	tends to the house		yes
	Osraldo Yuja	nephew	M	9 mos.	none	none		no
30	Martolo Jom	father	M	41	3rd primary	farmer		
	Herlinda Velasquez	mother	F	49	none	tends to the house		no
	Javier Jom Velasquez	son	M	25	4th primary	none		yes
	Jamrel Jom Velasquez	son	M	22	5th primary			no
	Rumalda Jom Vlasquez	daughter	F	19	none			no
	Irma Jom Velsquez	daughter	F	17	6th primary			yes
	Gloria Jom Velasquez	daughter	F	15	4th primary			yes
	Jose Jom Velasquez	daughter	F	13	4th primary			yes
	Ana Toc Pop	daughter in law	F	16	6th primary	tends to the house		yes
31	Juan Cac	father	M	53	2nd primary	mason	San Cristobal	no
	Marcela Cal	mother	F	52	none	tends to the house		yes
	Fernando Quej	son	M	20	3rd basic	none		no
32	**Emilio Gualim**	father	M	29	3rd basic	sawmill	San Cristobal	no

	Ical							
	Ana Maria Quej	mother	F	29	3rd basic	shoe store	San Cristobal	no
	Kevin Gualim	son	M	8	2nd primary	none		no
	Cristian Gualim	son	M	5	preparatory	none		no
	Janari Gualim	daughter	F	3	preparatory	none		no
33	**Anjelina Quej**	mother	F	25	3rd basic	shoe store	Coban	yes
	Axel Quej	son	M	8	2nd primary	none		yes
	Angelica Quej	daughter	F	6	preparatory	none		yes
	Angela Quej	daughter	F	2	none	none		no
34	**Maria Magdelena**	mother	F	30	2nd primary	tends to the house		yes
	Lerando Gualim	father	M	35	6th primary	?	Guatemala City	yes
	Edgar Gualim	son	M	12	1st basic	none		yes
	Drasely Mar Lem	daughter	F	11	5th primary	student		yes
	Wendy Boxang	daughter	F	9	2nd primary	student		no
	Saion Maribel	daughter	F	8	2nd primary	student		no
	Edwin Yobany	son	M	6	preparatory	student		no
36	Zoila Esperanza Ical	mother	F	25	none	tends to the house		yes
	Jilberto Cojoc	father	M	27	none	security guard	Guat City	no
	Fermin Cojoc	son	M	5	preparatory	none		no
	Leydi Carina	daughter	F	3.5	none	none		no
	Yolanda Noami	daughter	F	5 mos.	none	none		no

Below is the data from each family in Guachthu'uq:

House Number	4. How many years have you lived in Guachthu'uq	5. Where did you live before coming here?	6. Do you own or rent the land?	8. The majority of your water comes from?		9. Who collects water in your home?	10. How many times, daily, is water brought to your home?	11. Which water sources are available to your home?	
				Winter	Summer			Finca	Tanks
1	12	Colindancia in Rax Quix	They bought it from their father	collect it	finca	everyone	4	X	
2	12	Rexquix	Owner	collect it, finca	finca	everyone	2	X	
3	8	Santa Cruz Verapaz	Renter from wive's husband	collect it	finca	everyone	9	X	
4	4	Rexquix	Owner	collect it	finca	everyone	3	X	X
5	1	Rexquix	In the process of buying	Tank	finca	everyone	3	X	X
6	4	Rexquix	Owner	collect it	finca	everyone	2	X	
7	5	Huchuetenango	Owner	collect it	finca	almost everyone	8	X	
8	8	Rax Quix	Owner	collect it	finca	no one	0	X	
9	14	Pamac	Owner	Tank	finca	everyone	3	X	?
10	8	Pamac	Owner	Tank	finca	everyone	4	X	
12	17	Always Guachtuhq	Renter	collect and finca	finca	everyone	2	X	X

15	27	Pamac	Owner	collect it	finca	everyone	6	X	X
16	29	Santa Anna nighborhood of San Cristobal	Owner	collect and finca	finca	everyone	6	X	X
17	4	Santa Anna nighborhood of San Cristobal	Renter	finca	finca	everyone	10 / week	X	
19	20	Always Guachtuhq	Own house, rent land	collect it	finca	parents	4	X	
20	4	Wife - San Cristobal Husband- Venecia	Renter	finca	finca	parents	2	X	
21	25	N/A	Owner	Tank	finca	everyone	8	X	?
22	3	Always Guachtuhq	Owner	finca	finca	everyone	13	X	
23	40	Always Guachtuhq	Owner	collect it and finca	finca	everyone	2	X	X
24	8	Calvario (San Cristobal Verapaz)	Owner	collect it and finca	finca	everyone	4	X	
25	15	Calvario (San Cristobal Verapaz)	Owner	collect it	finca	everyone	4	X	
26	18	Parex Quix	Owner	tinaco and finca	finca	everyone	10		
27	2	Pam Pur	Renter	-	finca	everyone	8	X	
28	5	Pana Neighborhood	Owner	finca	finca	everyone	14	X	

29	19	Rexquix	Owner	collect it	finca	everyone	7	X	
30	25	Chiyuc	Owner	collect it	finca	everyone	16	X	
31	35	Aldea Chisiram	Owner	collect it	finca	-	7	X	
32	6	Rexquix	Owner	collect it	finca	no one	1 tonel/ week	X	
33	24	Always Guachtuhq	Owner	collect it	finca	mother and children	1 tonel/ week	X	
34 (?)	2	Rexquix	Owner	collect it and finca	finca	everyone	2	X	
36	11	Caserio Chivar	Owner	collect it	finca	Mother	10	X	

House Number	12. Are there other water sources available?	13. Which water has the better quality?		14. Where do you keep your water?	15. What do you do to prepare water for drinking?	16. If (15.) was unanswered, would you do something to clean your water?	18. Do you use water during the growing season?	19. Would you pay to better your water system?	19a. How much?
		Finca	Rain						
1	No		X	tambos	Boil for 5 minutes	N/A	-	Yes	What is asked
2	No	Without preference		tambos	Boil	N/A	yes, from the rain	Yes	What is asked
3	No	Without preference		tambos	Boil for a minute then add drops of chorine	N/A	yes, during the summer	Yes	What is asked
4	No		X	tambos	Boil	N/A	-	Yes	What is asked

5	No		X	tanks	Boil	N/A	-	Yes	What is asked
6	No		X	tambos	Boil for 15 minutes	N/A	-	Yes	What is asked
7	No		X	tambos	Boil for 2 minutes	N/A	-	Yes	What is asked
8	No		X	tinajas	Boil	N/A	No	Yes	What is asked
9	No		X	tinacos	Boil for 15 minutes	N/A	Yes, pesticides	Yes	What is asked
10	No	X		buckets	Boil for 10 minutes	N/A	No	Yes	500Q
12	No		X	tambos and tinajas	Boil	N/A	Yes, corn	Yes	What is asked
15	No		X	tambos and tinajas	Boil	N/A	No	Yes	What is asked
16	No		X	tambos and tinajas	Boil	N/A	No	Yes	5% or what is asked
17	No	X		tinajas	Boil	Yes	No	Yes	What is asked
19	No	X		tambos	Boil	N/A	No	Yes	What is asked
20	No	Without preference		tinacos	Boil	Yes	No	Yes	What is asked
21	No	X		toneles and tinacos	Yes	N/A	No	Yes	What is asked
22	No	Without preference		tinajas and laundry	Boil	N/A	No	Yes	What is asked

23	No	Without preference		tonel	Boil	N/A	No	Yes	What is asked
24	No		X	toneles for rain and tinajas to drink	Boil	Yes	No	Yes	What is asked
25	No	X		-	Boil	N/A	No	Yes	What is asked
26			X	tinaco or over the fire	Boil	N/A	No	Yes	What is asked
27	No		X	-	Boil	N/A	No	Yes	What is asked
28	No	Without preference		tinajas	Boil	N/A	No	Yes	What is asked
29	No	Without preference		tambos	Boil	N/A	No	Yes	300Q or what is asked
30	No	Without preference		toneles and tinajas	Boil	N/A	No	Yes	500Q
31	No	X		toneles	Yes	Yes	No	Yes	What is asked
32	No	X		buckets	Boil it or buy purified water	Yes	No	Yes	What is asked
33	No	X		toneles	No	Yes	No	Yes	What is asked
34 (?)	No		X	tambos	Boil	N/A	No	Yes	What is asked
36	No		X	toneles	Boil	Yes	No	Yes	What is asked

House Number	20. Would you help with the construction of a rainwater harvesting system?	21. Would you maintain a rainwater harvesting system?	22. What are the main health concerns for your family?	23. Health problems as a result of wood smoke?

			Cough	Fever	Stomach	Flu	Headache	Cough	Dizzyness	Headache	Throat	Eyes
1	Yes	Yes		X						X		X
2	Yes, manual labor	Yes	X	X								
3	Yes	Yes										X
4	Yes, manual labor	Yes	X	X	X					X		X
5	Yes, manual labor	Yes		X						X		X
6	Yes	Yes	X					X				
7	Yes, manual labor	Yes	X		X	X						X
8	Yes	Yes	X			X				X		X
9	Yes	Yes		X								X
10	Yes	Yes		X				X				
12	Yes, manual labor	Yes										
15	Yes	Yes		X	X					X		X
16	Yes, manual labor	Yes		X			X					X
17	Yes	Yes	X		X			yes				

19	Yes, manual labor	Yes										
20	Yes, manual labor	Yes			X		X			X		
21	Yes	Yes	X	X		X			X			
22	Yes, manual labor	Yes			X		X			X		X
23	Yes	Yes	X							X	X	
24	Yes, could pay someone to help	Yes								X		
25	Yes	Yes										
26	Yes	Yes										
27	Yes	Yes		X						X		X
28	Yes	Yes		X	X			X				
29	Yes, manual labor	Yes		X						X		X
30	Yes	Yes	X	X							X	
31	Yes	Yes										
32	Yes	Yes										
33	Yes	Yes	X	X								
34 (?)	Yes, manual labor	Yes	X	X						X		X
36	Yes	Yes	X	X							X	X

House Number	24. Where do you go to receive healthcare?	25. What does your family grow?	26. If you grow anything, do you sell it at the market?	27. What is your house constructed from?		28. Do you have electricity?		29. How much money do you spend to buy firewood (per load)?	30. How much firewood do you use weekly (loads)?	31. Do you collect your own wood?	32. What type of bathroom do you have?	
				Wood	Cement	Yes	No				Constructed	In the earth
1	Hospital	-	-	X			X	Q45	3	Yes		X
2	Hospital	Corn	Only to eat	X		X		Q50	1	Sometimes	X	
3	Hospital	-	-	X			X	Q66	4	Yes		X
4	Hospital	-	-	X			X	-	2	Yes, all		X
5	Hospital	-	-	X	X	X		Q15	3	Sometimes		X
6	Hospital	Corn, Beans	Only to eat		X	X		Q75	5	Yes		X
7	Hospital	-	-	X		X		Q100	2	No		X
8	Only buy medicine	Corn	Only to eat	X		X		Q400 every 2 mos	7	No		X
9	Hospital	Corn	Only to eat	X		X		Q75	4	Yes	X	
10	Hospital	Corn	Only to eat	X	X	X		Q100	4	Yes		X
12	Hospital	Corn	Only to eat	X			X	Q30	1	Sometimes		X

15	Hospital	Corn, Beans, pacaya, coffee	Pacaya and Coffee	X		X		Q50	1	Yes		X
16	Hospital	-	-	X		X		Q13.5	5	Sometimes	X	
17	Hospital	-	-	X		X		Q30	5	Yes		X
19	Hospital	-	-	X			X	Q15	2	Sometimes		X
20	Clinic or doctor	corn, beans, coffee	Only to eat	X	X		X	Q15	3.5	Sometimes		
21	Only buy medicine	Corn	Only to eat		X	X			8	Yes, all	X	
22	Hospital	-	-	X	X		X		2	Yes, all		
23	Hospital	-	-	X		X		Q15	6			
24	Only buy medicine	-	-	X			X	Q15	7			
25	Never have gone	-	-	X	X	X		Q100	4	Yes		X
26	Hospital	-	-	X		X		Q15	6	Sometimes		
27	Hospital	-	-	X			X	Q100	3	Yes, twice a week		X
28	Hospital	-	-	X			X	Q50	7			X
29	Only natural medicine	-	-	X	X	X		Q15	14	Sometimes	X	
30	Hospital	Corn	Only to eat		X		X	Q10	7	Yes		X
31	Hospital	-	-	X		X		Q30	3	Yes	X	

32	Hospital	-	-		X	X		Q50	5	No	X	
33	Hospital	-	-		X		X	Q30	3	No	X	
34 (?)	Hospital	-	-	X		X		Q15	4	No	X	
36	Hospital	-	-	X			X	Q50	1	No	X	

House Number	33. Where is your bathroom located?	34. Is your family religious?		17. How much water do you use daily to (in tinajes):						
		Catholic	Evangelist	Drink	Eat	Bathe	Clean clothes	Animals	Agriculture	Other
1	Behind the house	X		2	1	2	1 large bucket/week	-	-	-
2	Behind the house	X		4		3/10 days	1 large bucket/ 2 weeks	-	-	-
3	Behind the house	X		2	1	6	8	-	-	-
4	10 - 12 m behind the house	X		3		7	.5 large bucket/week	-	-	-
5	Behind the house	X		1	2	8	1	-	-	-
6	Above the house (land wise)	X		2	2	8	2 large buckets 3 times/ week	1/week	-	-
7	Mother in law's house		X	1	1	3	8, 3 times a week	-	-	-
8	Behind the kitchen		X	4	2	8	1 tonel every 3 days	2 tinajas/ week	1 tinaja/ 4 days	-
9	Behind the house	X		2	1	3	12 tinajas, 3 per week	-	-	-
10	Behind the house		X	1	2	6	1 tonel 3 / week	-	-	-

12	Behind the house	X		1	3	7	6 toneles / week	-	-	-
15	In front of the house	X		2	1	4	4	1	-	-
16	Behind the house	X		2		8	6 toneles /week	-	-	-
17		X		2	5	10	3 toneles/week	-	-	-
19				3		3	2 toneles/week	-	-	-
20		X		2	1	4	6 toneles /week	5	-	-
21	behind to the left of the kitchen	X		2	1	7	1 tonel every 3 days	-	-	-
22		X		1	4	6	4 toneles/week	-	-	-
23			X	6		5	9 toneles / week	-	-	-
24				3		5	9 toneles / week	-	-	-
25	Behind the house		X	1	1	13	4 toneles/week	-	-	-
26		X		1	1	12	6 toneles/week	-	-	-
27	Shared bathroom	X		2	2	7	4.5 toneles/week	-	-	-
28	in front of the kitchen		X	6	2	1 tonel	5 toneles/week	-	-	-
29	about 8m from the kitchen		X	2	1	6	4 toneles/week	0.5	-	-
30	Behind the house		X	3	2	1 tonel	4 toneles/week	1	-	-
31			X	1	1	4	1 tonel / week	1/week	-	-

32			X	1	3	5	2 toneles/week	1/week	-	-
33			X	4	2	4	1 tonel / week	-	-	-
34 (?)	Behind the house		X	2		8	5 toneles / week	-	-	-
36			X	3	1	8	6 toneles/week	-	1	

Appendix 3: Community Interviews

Below are copies of the transcripts of interviews conducted with homes during the trip. These interviews were collected with a member of the travel team and a translator from CeCEP.

House 8:
We came here because where we used to live there were many people who did not like our chickens/hens walking through their houses…if not, they would try to steal them. In this community, we decided to buy a piece of land. Back then, there were only orange and coffee plantations. I used to live here with my family and later, other families began to arrive, 6 years ago. I like this community because it is close to the road and also because it is near the center of the market.

House 29:
I left the other community because where I used to live was far…So I decided to buy a piece of land. When I came here, there were no houses, only woods. The road was in very bad conditions. We came here because we did not want to live in a rented house, along with my husband. We bought a piece of land. The community started to grow 15 years ago and now there are several houses being built. I like to live her because we are close to the market.

Below are copies of the transcripts of interviews conducted by our faculty mentor on May 11, 2013.

Interview 1: Don Domingo
Background: From what we learned from Sucy, Don Domingo, who is the leader of the COCODE, wanted to extract something like a finder's fee of 700Q from the community as compensation for what he claimed to be his work with EWB. He denied this to Sucy, but at a community meeting Don Domingo was challenged by a woman from Guachtu'uq and had to admit that he had asked for the money. So as I thought about what I wanted to learn from Don Domingo----the role of the COCODE, past water initiative by the municipality and other sponsors, etc----I wasn't expecting him to be very forthcoming. He was guarded but cooperative. We conducted this interview as Caryn, Mike, and Sebastian did a site assessment of his property to see where a tank could be sited. I asked questions, Gerson translated to Pokomchi and then relayed Domingo's answer back into English.
Early days in Guachtu'uq He was born in the northern part of Guatemala in /Chi-sah-nee/ and is 49 years old. He came to Guachtu'uq 17 years ago with his wife (children?) in large measure to find refuge from the violence of the civil war. His father was killed in the war and his village was a place "where people were killed". A friend of his father's, Don Gonscalves, advised him to leave and find a safer place where he can buy a small piece of land and build a house. He didn't say why he chose Guachtu'uq, if he had

relatives here, or his wife might have some connection to the place. I asked Gerson to explore this issue but we made little headway. He does remember that when he first arrived, there was a coffee plantation and an orange grove, but that those gave way to houses. On the western side of the road---(the left as you ascend), much of the land is owned by Vincente Moran; the eastern side is characterized by small holders.

COCODE: He and Don Emilio, a neighbor, discussed the need for a COCODE in Guachtu'uq to convey the needs of the community to the administration in San Cristobal. He became president through a vote (I don't know when or how many elections he's won) but clearly he's an important person in the village; his house is bigger than most, is constructed with concrete, has a tile floor although he doesn't have a tank. As president he has the COCODE stamp which might seem trivial but it seems that stamped documents from COCODE and between CODCODE and outside agencies (the city, CECEP) have a power and legitimacy and act as informal/formal contracts. For example, it has been important to separate the new Guachtu'uq Water Committee from the influence of Dom Domingo and the COCODE. To do so, the Water committee made a new stamp to sign the various MOUs we set out. The stamp, in effect, is a means for the Water Committee to carve out a degree of independence from Don Domingo. The COCODE has helped Guachtu'uq make claims on the city for water tanks. He told me that the city provided 27 tanks for the community in 2006 (it appears this initiative took place between December 2007-mid February 2008), which comprised all of the households at that time.

The COCODE meets once a month in his house, according to DD, and most of the village attends. At the meetings they consider what they want from the municipality---tanks, latrines, etc---and draft a document that they then send to the city (Paste in the photos on the white board that describes the politics of these req). DD said the city responded to one of these requests in 2006 (perhaps implementation started a year and half later), but that was about all they managed to extract from the city coffers. The COCODE through an outside agency/foundation also attracted funding from the Spanish Embassy to put in a number of concrete water tanks in 2012. Through Michelle at CECEP, DD pointed out, the COCODE also helped bring EWB to Guachtu'uq; on can understand, perhaps, why Don Domingo felt that is was his connections, his documentation that got the EWB going in the community, and he wanted something to show for it.

But COCODE meetings also help local residents air grievances about water use and the various tensions that arise (laundry, noise, etc). Dom Domingo also wanted me to know that CoCODE is asked to help in the middle of the night sometimes and that he and other members have had to cut down men who hanged themselves from the rafters in their shacks. He seemed to suggest this happened more than once.

Implementing the Tank Scheme: I wanted to explore with Domingo what might be seen as a fair and equitable process to allocate tanks----households without tanks, households with older tanks, households with single mothers who find it hard to collect water from the finca., etc. Domingo didn't want to change what had been decided: luck of the draw from last year, particularly since he was one of the households that was selected from the list. But he did see that for subsequent years a different scheme could be worked out, but he was not willing to say what that scheme could be.

The city grades the road once a year during the rainy season.

Interview 2: Elvira Cal, House 16

Background: She was born in Santa Maria (? I think) in 1962, and then moved to a neighborhood, St Anna, in San Cristobal. Within a year or two, her parents died and, as Gerson told me, "she left without her parents" to Guachtu'uq with her husband who was born there. She arrived in 1985, when there were only four houses in the community---two above, her husband's house, and one below. The road, at that time, was not graveled and was half as wide as it is now. When she arrived, there were no coffee plantations or orange groves, but woods. "They cut down the trees for the coffee". After the coffee, they sold plots of land for houses.

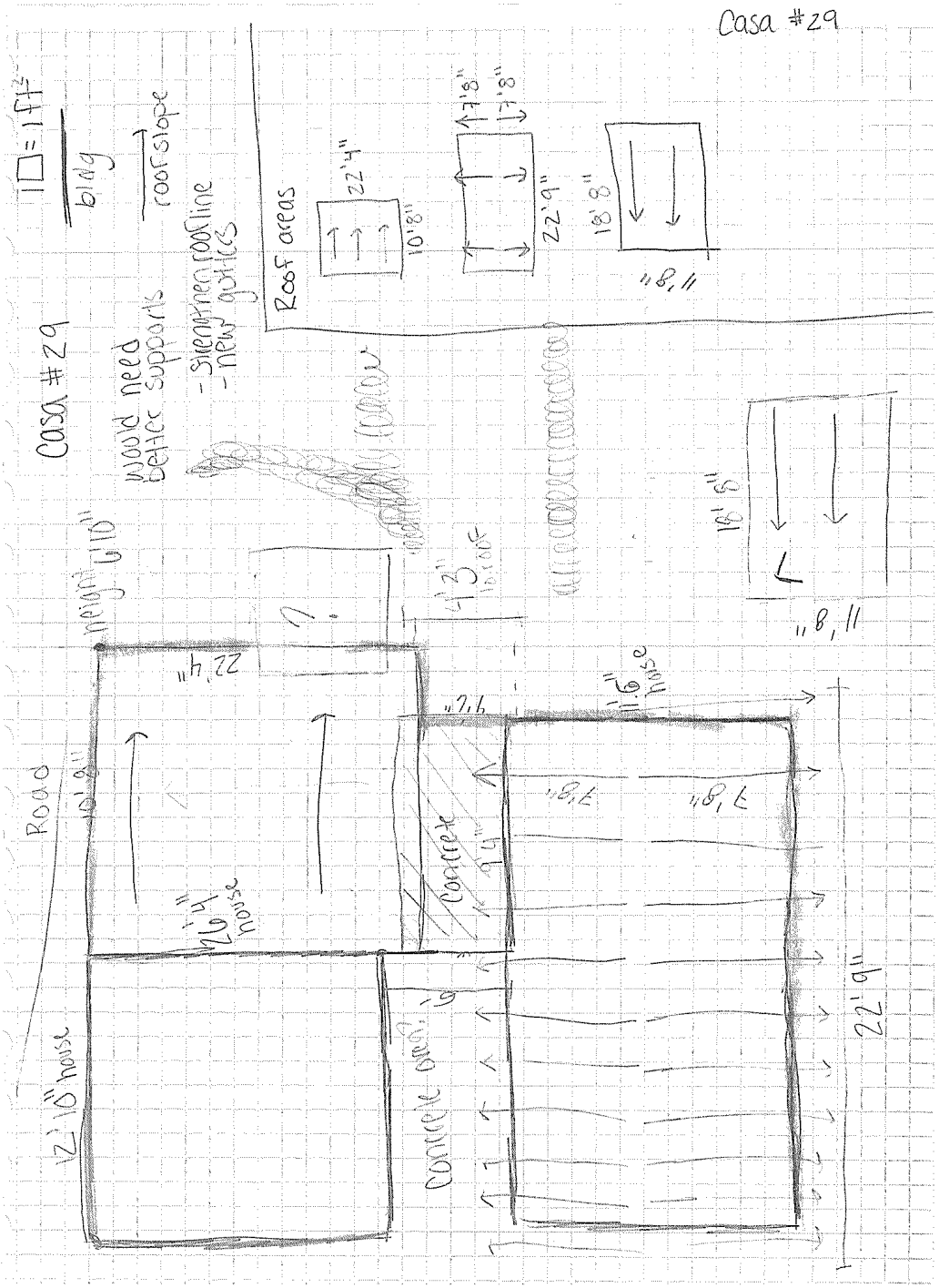
Growing food: In our survey we asked if people grow food. The 19 surveys we got back indicate most people do not grow food. Elviva told us that she and most other families, however, have "cuerdas",

which are plots 21 by 21 meters, where they grow corn and frijollas. She has 8 cuerdas, which are located about 1 hour above the Guachthu'uq. During the dry season, which according to Gerson runs from February to May, her son has to find ways to water the plants. He lives closer to the cuerdas but has to make two three hour round trip, from 3am-6am and in the evening from 5-8pm. He carries to 5 gallon buckets from the spring to the cuerdas twice a day. This food is used for sustenance and supplies a large percentage of the families caloric intake. This is supplemented by food purchased in the market in San Cristobal.
Boiling water: She claims she boils it for 15-20 minutes, not just getting it to the boiling point but have it on a rolling boil. According to Gerson, they keep the water hot because most of the boiled water is used for coffee. Few people drink water neat. Most everyone drinks coffee throughout the day. Even one year olds are given coffee. People also make a corn mash drink, where they cook the corn, take of the kernals and mash it, and add it to water.

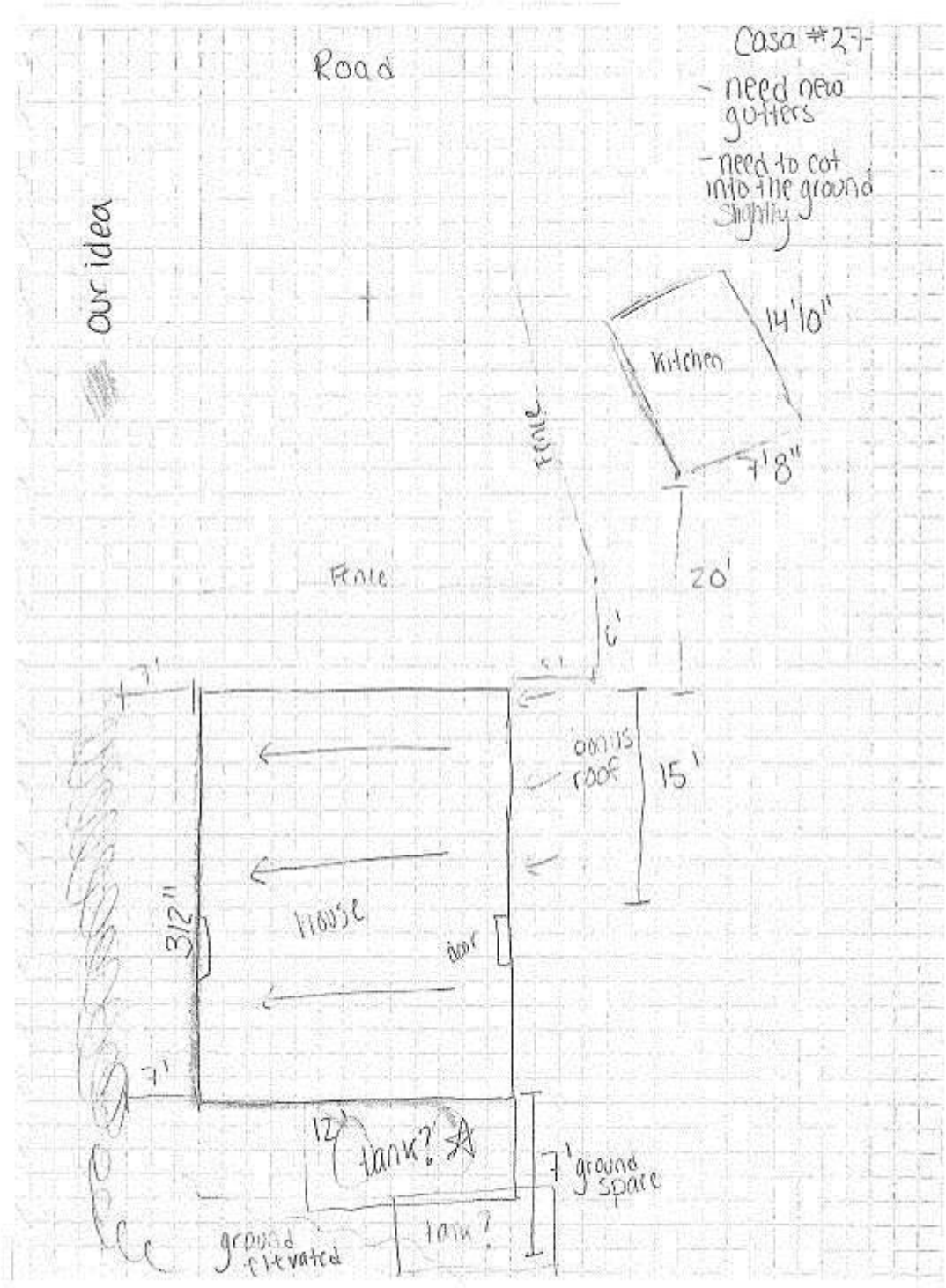
Interview 3: Daughter of Mid-wife
Tensions around water: The municipality provided tanks to some 27 families by the end of February 2008. Since then perhaps ten families or so have moved to Guachthu'uq, some of whom may have received the concrete cisterns from the Spanish embassy. We don't have data on this. It might be that some families with tanks also received these cisterns. We don't know how many families have neither tanks nor a cistern but should have a better sense of this when the surveys our completed.
During the dry season, community tensions can flare up around water. Families without tanks/cisterns must go to the FINCA more often, and to ensure they can obtain water for the day, they have to go at 1 or 2am in the morning since the FINCA tap can run dry later in the day. It seems to have been more of a problem this dry season, which started earlier (November, according to Gerson, not February). People in the community are quite clear about the families that have tanks and those that don't. Earlier this year, the interviewee went to the FINCA to do her laundry. A woman from the village who didn't have a tank was doing her laundry there. They got into a heated argument. The woman without the tank said the interviewee had no right to be there since she had water in her tanks and that the water should be left for people like her, who had little water and who had to make the trip up and down the hill multiple times a day. In the end, the interviewee left without washing her clothes.
Some families will share their water, although she did say that a mother who had water from a tank did not share with her daughter. If people have adequate water they will give a tank-less family a gallon or two, but will not do so if they are short of water. We don't understand reciprocity in the village but the lack of water in the dry season affects families differently and this leads to anxiety, tension, and social unease. She claimed that one important function of the COCODE was to diffuse some of tensions around water provision and to encourage discussion and friendship in the place of arguing, insults, and at times physical fights.
Implementing the Tank Scheme: According to Gerson, the interviewee thought it would be "nice" to give tanks to those who don't have tanks. Perhaps she said "nice", but from the gravity of the conversation and from her demeanor, I felt this view stemmed from a strong moral position, and from her own experience.
Food: They have some 10 cuerdas, plots of land, scattered in the hills about fifteen minutes from their house. They grow maize and beans, and use commercial pesticides and fertilizers. Her father spends most of his time in the fields and sometimes some of the younger children will help. A few families sell in the market, but most supplement their corn and beans with food from the Mercado which takes place on Tues, Thurs, Sat, and Sundays.
Boiling: She uses about one large pot of water a day to make coffee. She uses a wood fire to heat the water for 15 minutes and then lets it boil for 5 minutes. She also makes ATOL (?) and sometime has her children drink purified water from small bags she buys in the shop.

Appendix 4: Homes assessments

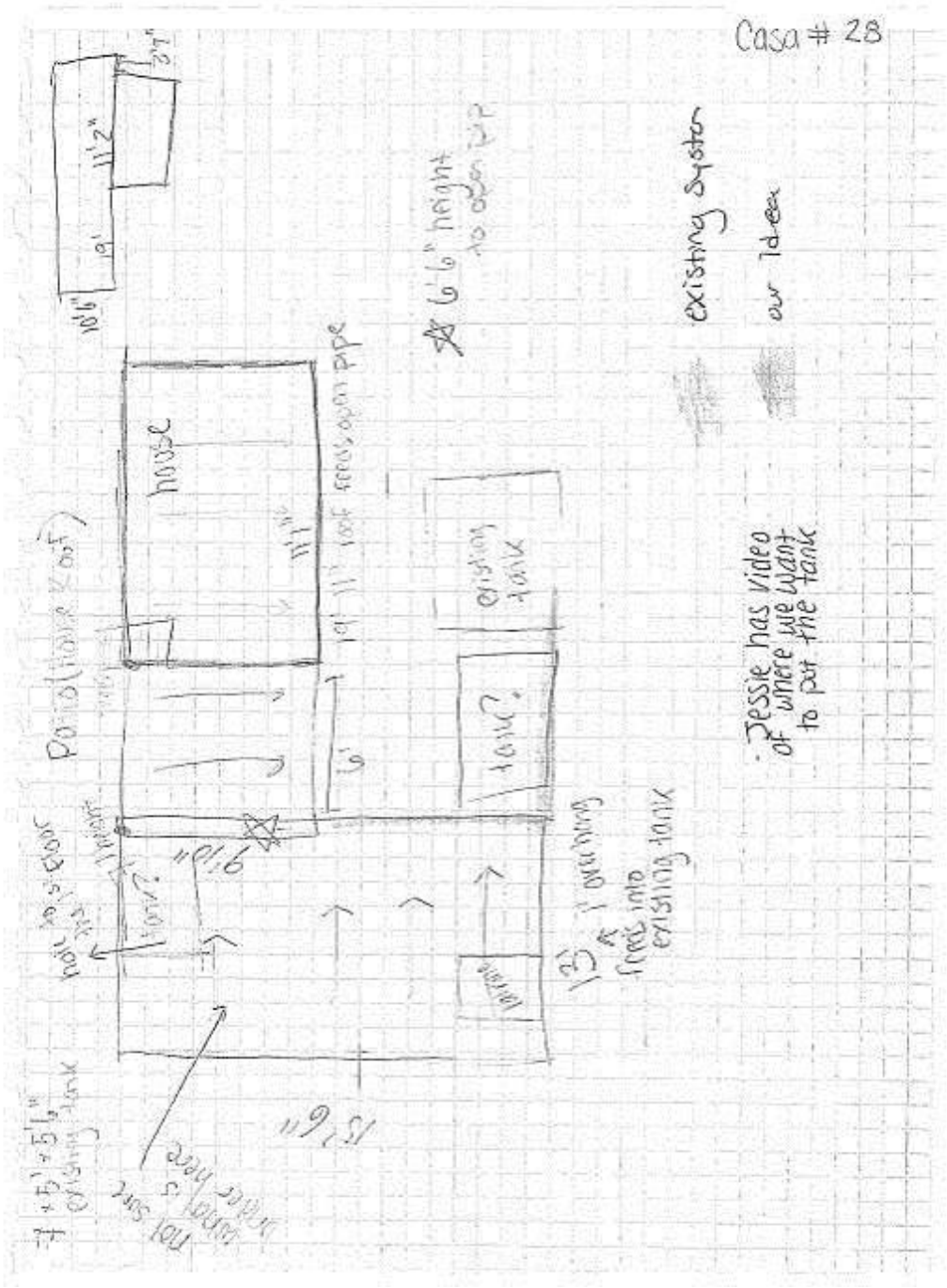
House 29



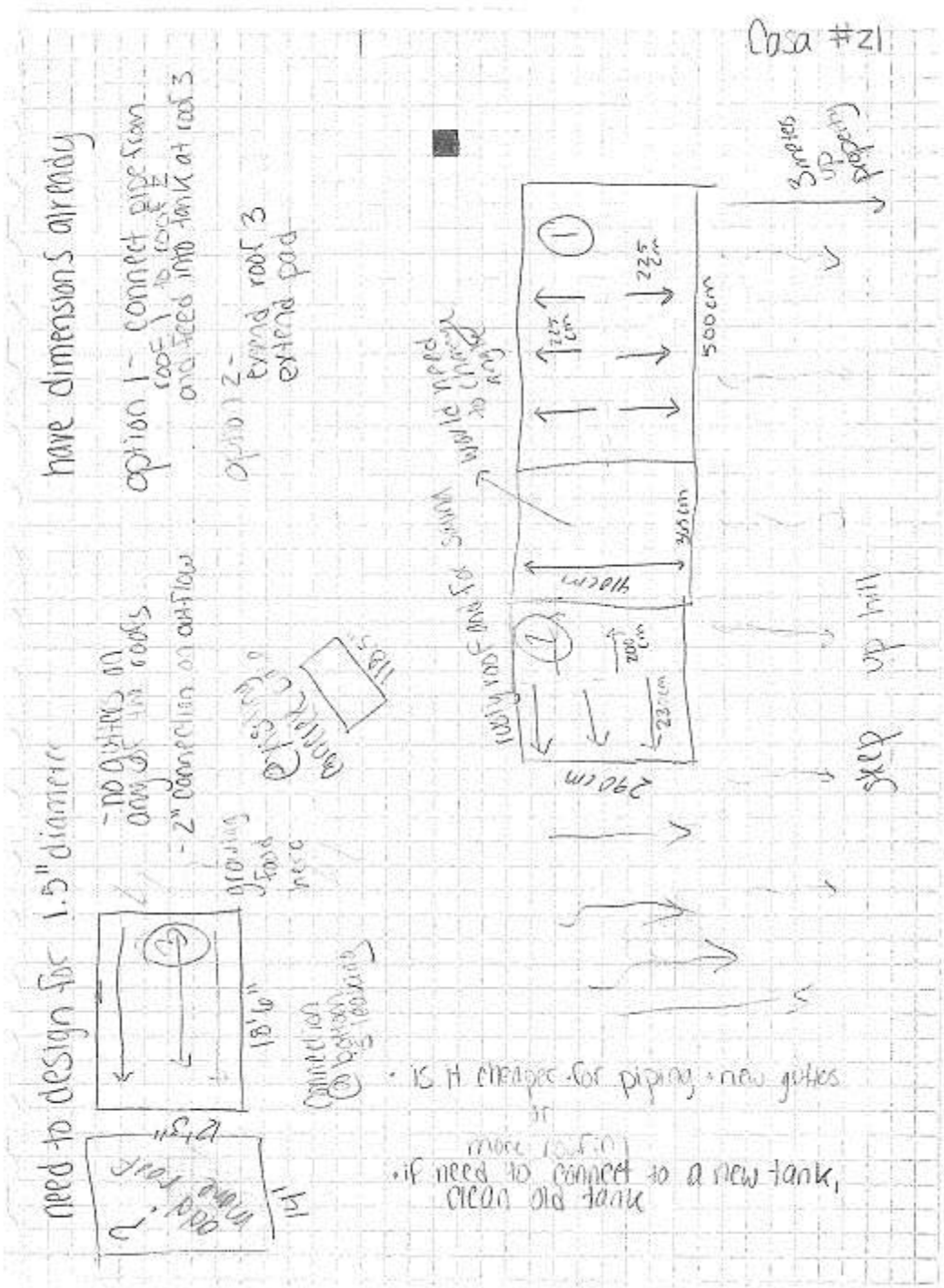
House 27



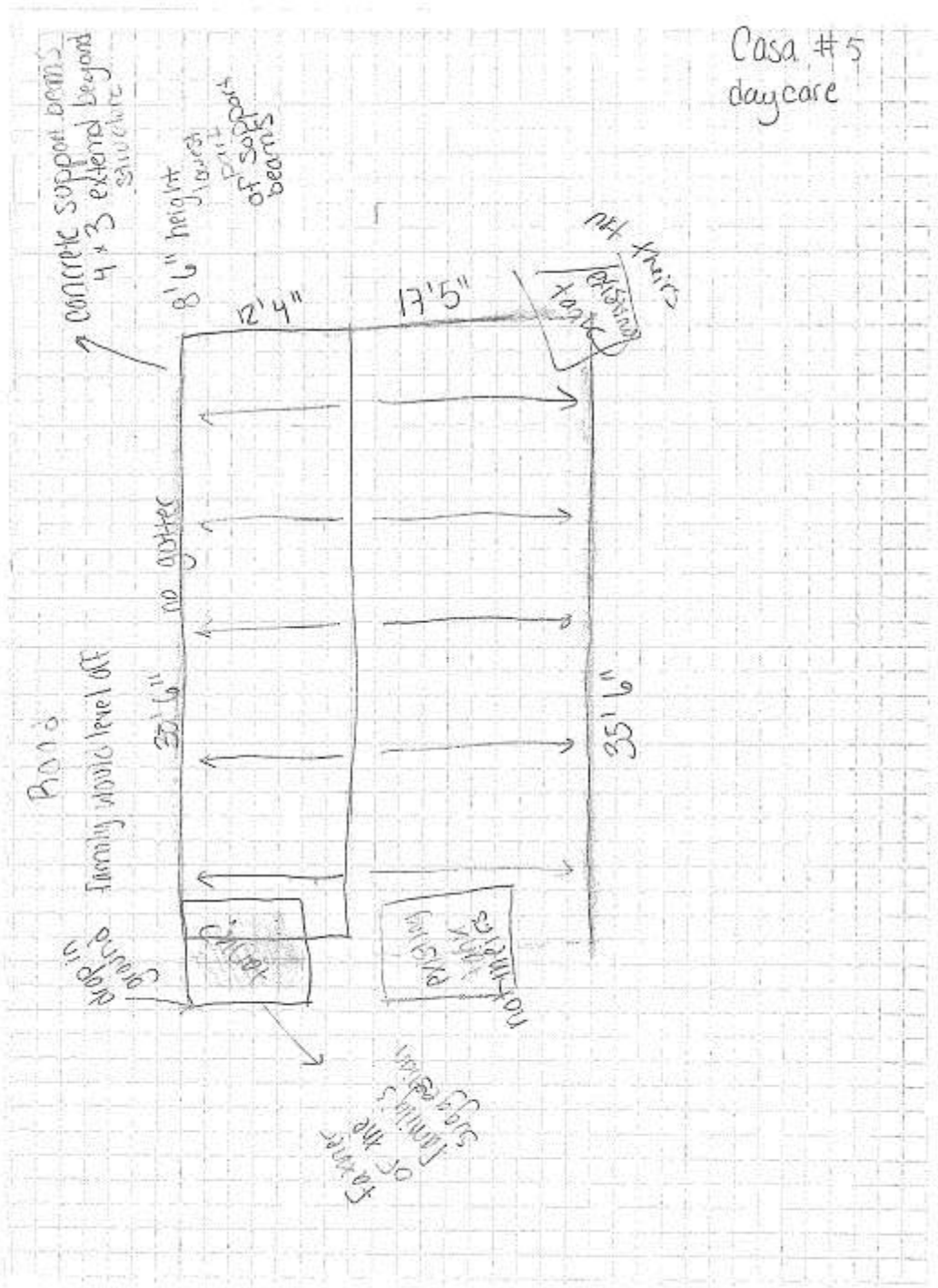
House 28



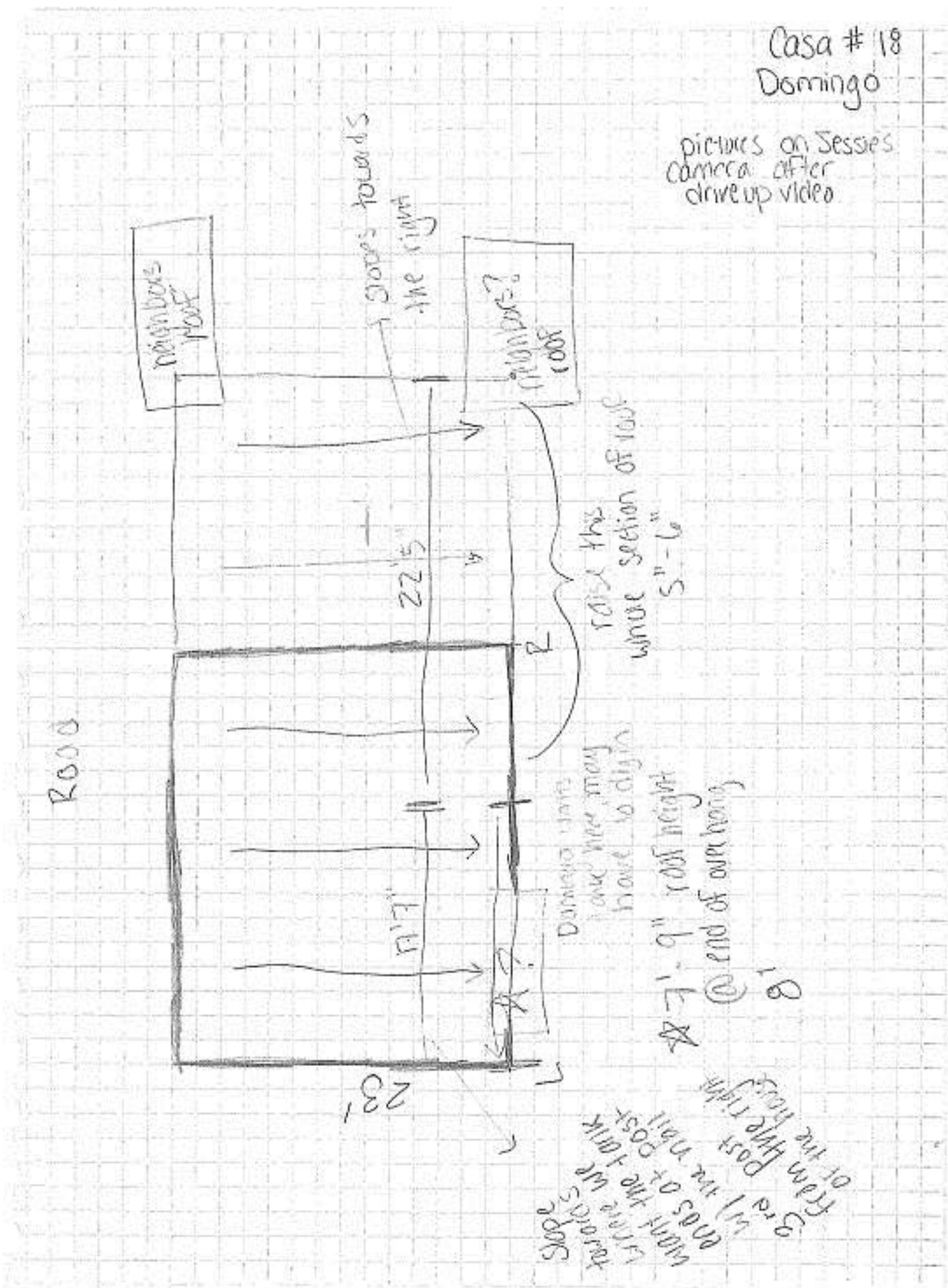
House 21



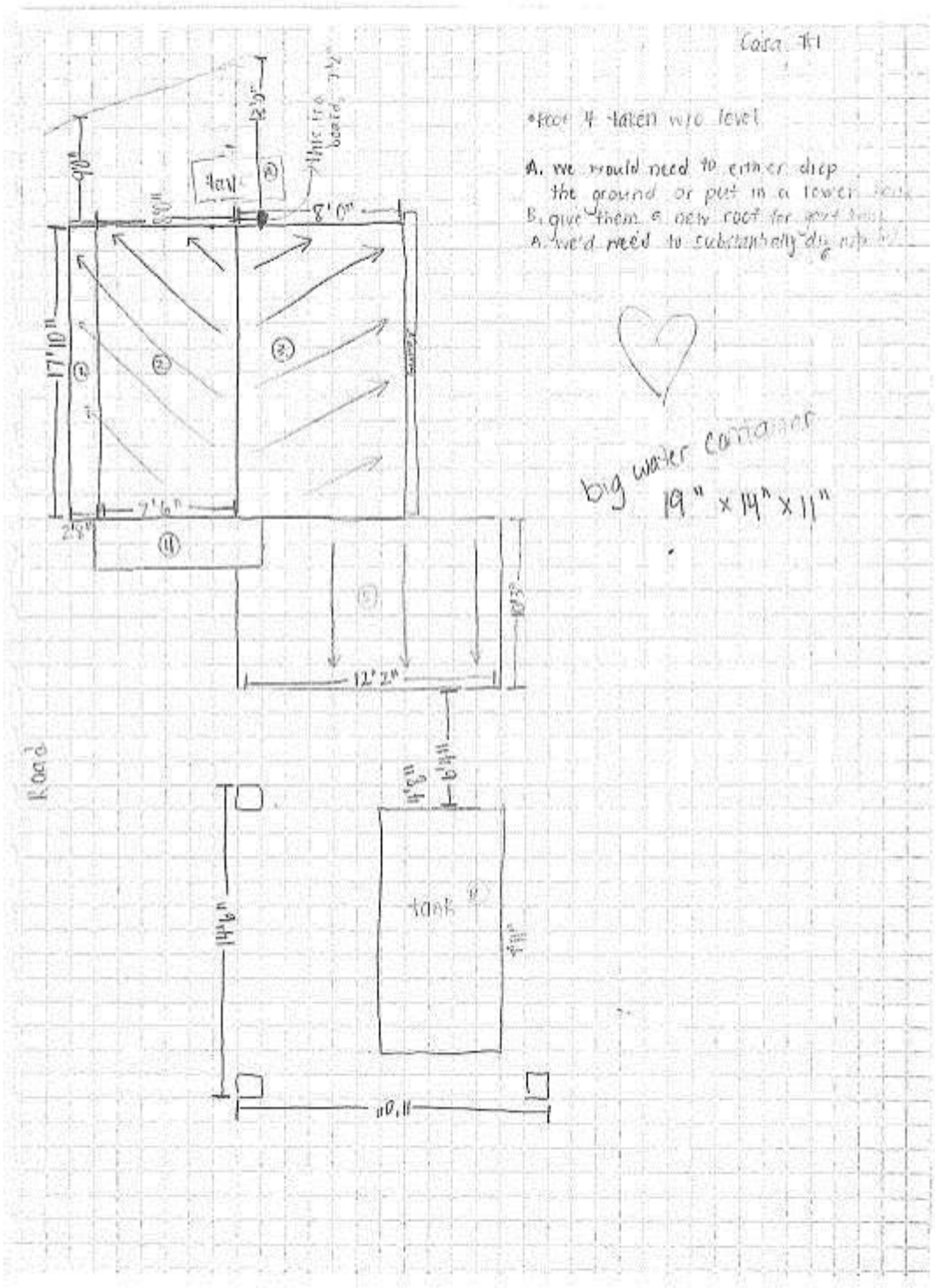
House 5



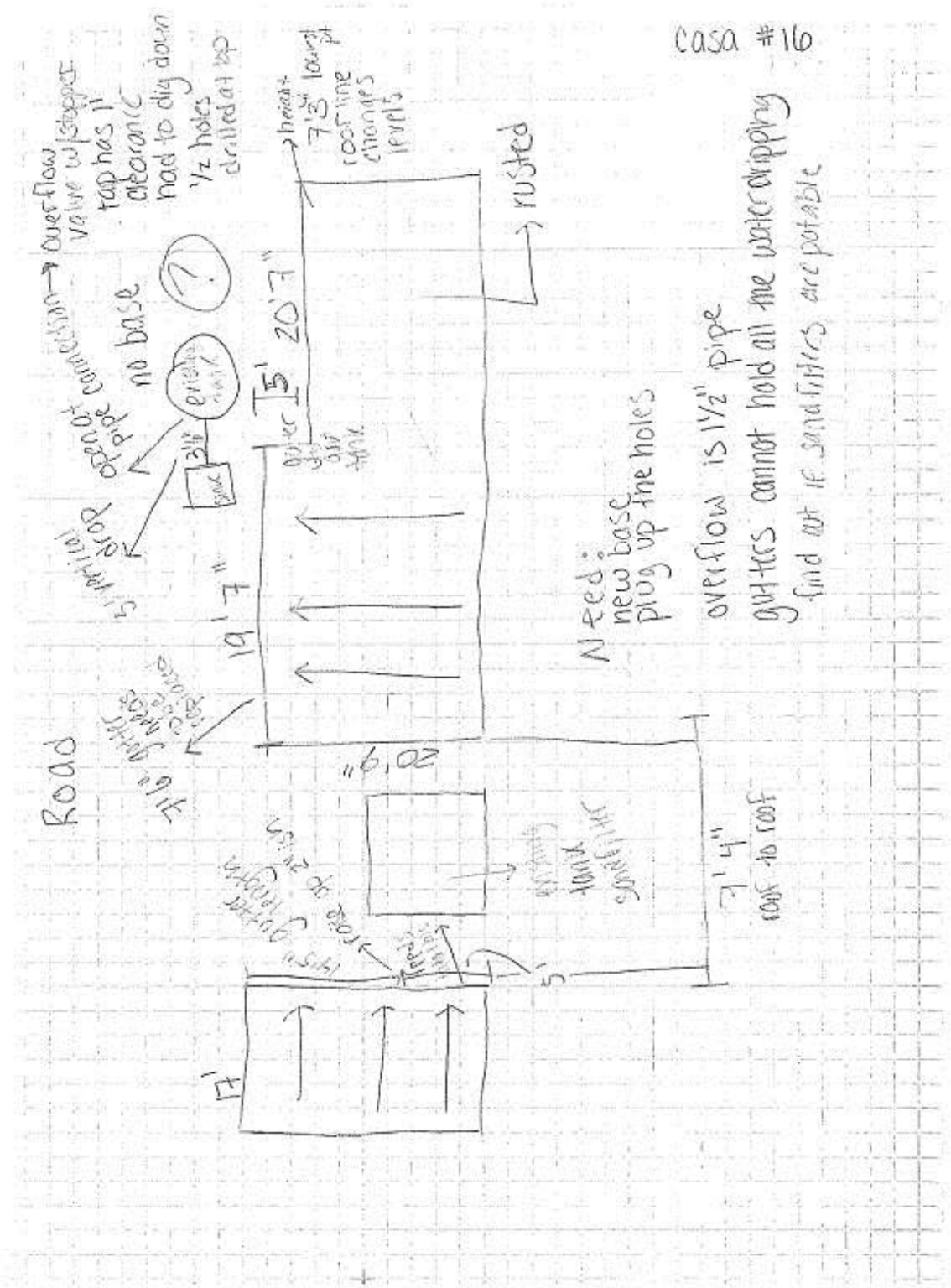
House 18



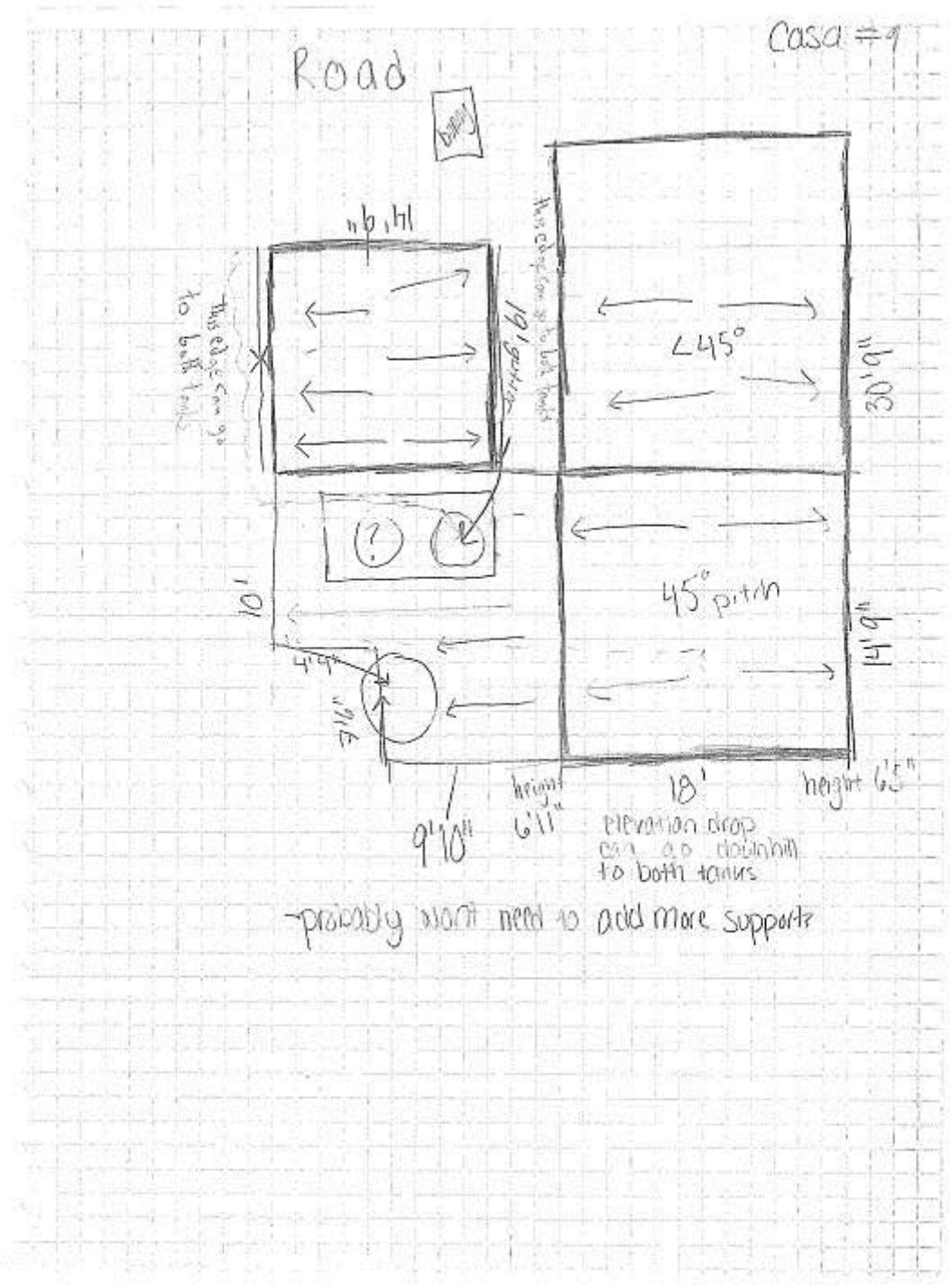
House 1



House 16



House 9



House 30