



# Document 522

## POST-ASSESSMENT REPORT

CHAPTER: [Worcester Polytechnic Institute](#)  
COUNTRY: [Guatemala](#)  
COMMUNITY: [Guachthu'uq/Rehquensal](#)  
PROJECT: [Water and Stoves for Guachthu'uq](#)

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[September 19, 2010](#)

ENGINEERS WITHOUT BORDERS  
[www.ewb-usa.org](http://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**

<b>Dates of Travel</b>	<b>Assessment or Implementation</b>	<b>Description of Trip</b>
July 20- August 3	Assessment	Fundamental data regarding the community and their resources were collected

## **3.0 TRAVEL TEAM**

<b>Name</b>	<b>E-mail</b>	<b>Phone</b>	<b>Chapter</b>	<b>Student or Professional</b>
Chris Garceau	crgarceau@wpi.edu	774-262-4680	EWB-WPI	Student
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## **4.0 SAFETY**

General precautions were taken when the team was out at night, in groups of large crowds, or in any distrustful setting. There were no injuries, although everyone suffered from bouts of stomach sickness throughout the two weeks. It is advisable for future travel teams to be aware of

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potentially rabid street dogs, poisonous caterpillars, hydration, physical fatigue, and consumption of potentially unsafe local food and water.

## **5.0 BUDGET**

### **5.1 Cost**

<b>Expense</b>	<b>Total Cost</b>
Airfare (6)	3000
Materials	200
Transportation	475
Home stays and Hotels	1000
Communication	300
Customs (hotel costs, taxes, transportation)	1175
Total	<b>6150</b>

The projected cost of the trip was \$5200 but due to unforeseen circumstances in Guatemalan Customs EWB-WPI went over the project's projected budget.

## **6.0 PROJECT LOCATION**

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

**Longitude:** 90° 29' 24.37" W (*Degrees, Minutes, Seconds*)

**Latitude:** 15° 22' 13.04" N (*Degrees, Minutes, Seconds*)

## **Post Assessment Report Part 2 – Technical Information**

### **1.0 INTRODUCTION**

The Engineers Without Borders chapter at Worcester Polytechnic Institute (EWB-WPI) sent four students and two professionals to the community of Guachthu'uq (also called Rehquensal), Guatemala, from July 20 to August 3, 2010. The purposes of this assessment trip were to establish initial rapport with the community of Guachthu'uq and to collect preliminary data on the economic, social, environmental, and technical viability of the project. The EWB-WPI team was particularly attentive to issues concerning the community's cooking methods and water systems. The group worked closely with Michelle Banks from the local Non-Governmental Organization (NGO) called Paat Itz'at. Contact was made with the Geology Department of the University of San Carlos in Cobán, Guatemala, to improve relations and initiate local involvement. During the trip the team observed the community's, as well as other neighboring communities', socio-economic structure, water resources, cooking devices and methods, geology, waste disposal methods, hygiene and sanitation, and general health.

By talking with the community members, witnessing their way-of-life first-hand, and collecting the data mentioned above, EWB-WPI will be able to begin planning a course of action to implement sustainable solutions that will have a significant positive impact on the community members' health and way of life. In the coming months, EWB-WPI will perform an alternative analysis and preliminary design report, followed by a detailed design of the selected alternative(s).

### **2.0 PROGRAM BACKGROUND**

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

Prior to the first assessment trip in the summer of 2010, EWB-WPI participated in several conference calls with Michelle Banks to learn more about the community of Guachthu'uq/Rehquensal and to stay updated on current local events. While the needs of the community are many, the families have identified access to potable water and improved stove design as perhaps their most pressing concerns:

#### Stoves

Families in Guachthu'uq/Rehquensal use three-stone fires for cooking, with wood as their primary source of fuel. As a result, women and children suffer from burns, as well as chronic cough and respiratory infections from spending so much time inhaling smoke. With the construction of cleaner and more efficient wood-burning stoves, the women and children's

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exposure to smoke will decrease, thus improving their health. Their involvement with other aspects of community life will also be greater since the use of more fuel efficient stoves will reduce the amount of time required for the collection of firewood and reduce the amount of money needed to purchase firewood. It will also decrease the risk of fires.

While the government has encouraged the planting of new trees, they have implemented pine trees instead of more appropriate local species, doing little to reforest the region. The supply of wood is reaching unsustainable levels. Many local trees are located on private property, to which the residents have no legal access. In February of 2009, a landslide killed more than 30 people near Guachthu'uq/Rehquensal. While the exact cause of the landslide has yet to be determined, deforestation has been cited as a contributing factor. With the implementation of sustainable stoves, our hope is that less firewood will be used. This will contribute to the restoration of a sustainable ecosystem and create a healthier home environment.

#### Water

During the dry season (February – May) the community relies on a spring water diversion box located approximately one-kilometer downhill from the center of the community. This water source is located on a private estate, which the locals call the “Finca.” The community has had some problems in regard to accessing the Finca source. In 2006, the land owner and the families who live in the communities that access the spring (Guachthu'uq, Las Arrugas, and La Reforma) agreed to restrict access to the actual source and to construct a spring diversion box about 100 meters downstream where families can collect drinking water and wash clothing. This has helped community relations, but the distance between the spring and the community of Guachthu'uq/Rehquensal continues to be a problem since families have to make multiple trips each day. There is also concern about the quality of the spring water. The source does not receive any water treatment, and many people in the community, especially children, suffer from dysentery and parasitic worms.

During the rainy season (June – January), the community gathers water in rainwater collection tanks that were donated by the municipal government in 2009. They have not proved as helpful as the community members wish. The dry season in the region has reportedly become longer and the rainy season is beset by rising temperatures and decreased rainfall. Though these collection tanks have eased some of the community's water problems, not all of the families in the community own a collection tank and many of the collection systems are used inefficiently.

### **3.0 TRIP DESCRIPTION**

The first two days of the trip (July 20-21) were spent traveling to the location of our homestays (San Cristóbal Verapaz) and settling in.

On Day 3 (July 22) the team was escorted and introduced to the community by Michelle Banks from NGO Paat Itz'at. EWB-WPI met the Spanish-to-Pokomchi translator, Humerto Moran, and

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received a tour of the Guachthu'uq/Rehquensal community by community leader, Don Domingo. The tour included a brief look at the community's houses and spring source, as well as a comprehensive discussion on the structure and politics of the local government. EWB-WPI also went to various hardware stores to determine the availability of local construction materials.

On Day 4 (July 23) the team took a trip to the University of San Carlos in Cobán to enhance relations with a local geology instructor, Sergio Moran. Some of the topics discussed were the local geology, EWB-WPI's assessment goals, and project logistics.

On Day 5 (July 24) the team had their first meeting with the Guachthu'uq (Rehquensal) community. The team engaged the community in a map-making exercise and community members answered various questions about water, stoves, and general sanitation. The EWB-WPI team made it imperative that the community understood EWB's role in the 5-year project process. The EWB-WPI team split up into four groups and each group was given a tour of a particular house. The inhabitants of the houses volunteered to show their stove(s), cooking methods, and water collection tank(s) (if they had any).

On Day 6 (July 25) EWB-WPI met with Gilles Brocard, a French graduate student from Université de Lausanne (UNIL) that had been doing seismic and geological studies in the San Cristóbal area. The team learned crucial information about the karst geology of the region and the poor water quality of Lake Chichoj in San Cristóbal Verapaz.

On Day 7 (July 26) the team received an extensive tour of the neighboring communities of Pamac and Rexquix and took pictures and GPS readings of their water sources. The group also collected water samples from the community's only spring source ("The Finca").

On Day 8 (July 27) the group visited the primary school in the Las Arrugas community and collected water samples from the spring diversion box that the Guachthu'uq/Rehquensal community accesses. The team also had a meeting with Peace Corps volunteer Maria and representatives from Ministerio de Ambiente y Recursos Naturales (MARN) pertaining to water quality and potential contaminant sources in San Cristóbal.

On Day 9 (July 28) EWB-WPI split into two groups. Group 1 went to Guatemala City to pick up mentor Matthew Gamache and water testing equipment held in the Guatemalan Customs. Group 2 stayed in San Cristóbal to arrange a meeting with the community of Las Arrugas and to visit hotels in the area to determine if they were a viable alternative to home stays for EWB-WPI members.

On Day 10 (July 29) Group 1 spent another day in Guatemala City trying to acquire testing equipment from Customs but were not successful. They returned to San Cristóbal that night. Meanwhile, Group 2 visited the local hospital to collect health data and visited hardware stores to determine the availability of stove-tops and bricks for stove construction.

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On Day 11 (July 30) the team was reunited and made another visit to the university to meet with geology students and collect rainfall and watershed data.

On Day 12 (July 31) the team made their last visit to Guachthu'uq/Rehquensal. Angel, Don Domingo's son, escorted the team throughout the community. GPS readings were taken for each house and more water samples were collected from the Finca source, the spring diversion box down-stream, and Don Domingo's water catchment tank.

On Day 13 (August 1) the team began organizing and analyzing data and working on the Post-Assessment Report.

On Day 14 (August 2) the team left for Guatemala City in their final attempt to extricate the water-testing equipment from Guatemalan Customs but were unable to retrieve it.

On Day 15 (August 3) EWB-WPI flew back to the United States.

## **4.0 COMMUNITY INFORMATION**

### **4.1 Description of Community**

#### Demographics

Guachthu'uq/Rehquensal is a rural Mayan Poqomchi community of 39 families, 41 houses, and about 280 people, located about three kilometers west of San Cristóbal Verapaz. While many women are monolingual in Poqomchi', many community members speak both Spanish and Poqomchi'. The residents are a mix of Protestant Evangelicals and Catholics and are involved in traditional Mayan spirituality as well.

#### Community Infrastructure

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



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They have dirt floors that often flood in the rainy season.

Work

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

Education

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

## **4.2 Community/NGO Resources and Constraints**

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

The cost of maintenance of the proposed project is a concern as the community's resources are

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limited. An annual maintenance fee would hopefully cover any repairs and also encourage everyone in the community to care for the project's infrastructure.

### **4.3 Community Relations**

Paat Itz'at is an arts education organization based in Washington, DC, that is assisting EWB-WPI with the project. The NGO project coordinator, Michelle Banks, lives in San Cristóbal six months out of the year and brings high school students from the US to volunteer in schools in the San Cristóbal region. Paat Itz'at is helping with logistics and the community education component of the project. They are currently working with children in the community on a documentary project that will serve as both community education and fundraising.

EWB-WPI relied primarily on Humberto Moran, Don Domingo, and Domingo's son, Angel, for Spanish-to-Poqomchi' translation. Michelle Banks of Paat Itz'at and the CeCEP language school provided English-to-Spanish translation when needed.

EWB-WPI also met with Sergio Moran (Humberto Moran's brother). Sergio is an instructor in the Department of Geology at the University of San Carlos campus in Cobán. The team held two meetings with him and his colleagues and students while on the trip. He is eager to help with this project and has provided us with geological maps and data from the watershed. In future trips he may be able to provide the team with water testing equipment.

Sergio introduced EWB-WPI to Gilles Brocard, a French graduate student from Université de Lausanne (UNIL) who had been doing seismic and geological studies in the San Cristóbal area. The group met with Gilles during the trip and collected information regarding the geology of Guachthu'uq and water quality in Lake Chichoj in San Cristóbal.

The group also met with one of Sergio's and Humberto's brothers, Hannibal, who provided us with Spanish-to-Poqomchi translation and access to the community of Las Arrugas, located downhill from Rehquensal.

### **4.4 Community Priorities**

The families have identified access to water and improved stove design as their most pressing concerns but have had trouble prioritizing one over the other. They have stated that any project pertaining to efficient stoves or an improved water system would be greatly appreciated.

## **5.0 DATA COLLECTION AND ANALYSIS**

### **5.1 Summary of Data**

On this assessment trip, EWB-WPI focused on both a community and technical assessment. EWB-WPI had prior knowledge that the community had problems with water quality, quantity, and lack of sustainable stoves. The team focused their data collection efforts on those areas while being open to other potential ways that the community could be assisted. One of EWB-WPI's first opportunities to collect data was at the meeting with the community. During this meeting, the team discussed many topics and received a good base for the rest of the assessment trip.

#### Water Resources Data

Overall, the community's biggest problem was water quantity and quality. During the rainy season, most of the community receives their water from rainwater collection tanks. A majority of the tanks are of the local brand Rotoplas. Out of the 39 households there are 29 tanks with 22 households in possession of them. Some of these households share a tank with their neighbors. These tanks hold 2,500 liters and are supposedly cleaned every six months, along with the corresponding roofs that collect water into the tank. Although current tank usage leaves most families without water during the dry season, preliminary analysis by the team using data collected from the University in Coban (rainfall) and the community members (daily water usage, average roof size, etc.) indicated that the collection systems can most likely be optimized to provide relatively clean drinking water year round through a combination of simple treatment, roof improvements, capacity surveys, and tree trimming.

During the assessment trip, it became evident that all of the water collected by the community of Guachthu'uq/Rehquensal, as well as the neighboring communities, was from springs and rainwater. None of the water collection was from groundwater and none of the communities had wells. Their water systems consisted solely of spring boxes, spring water storage tanks, and rainwater catchment tanks. Houses that do not have rainwater tanks get their water from what is commonly known as the Finca.

The Finca lies on a wealthy person's land. This land is the owner's summer home, and, although unlikely, he could deny the communities access to the water supply. Besides the Finca spring source, there are no other reliable spring sources within the vicinity of Guachthu'uq/Rehquensal.

The dry season occurs between February and May, and during this time, the Finca water source will slow down to a trickle or completely dry up, forcing the community to request access to the water source in Las Arrugas to get their water. Las Arrugas is the community below Guachthu'uq/Rehquensal. This water source seems like it is flowing all year, but the community has to ask permission from the people of Las Arrugas to use it. If the people of Las Arrugas were to say no, then the community would have to buy the water from the town of San Cristóbal,

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which would cause problems because the community does not have the money for this extra expense. Also, other communities that buy water from San Cristóbal suspect that the water comes from Lake Chichoj, which is known to be heavily polluted.

One of the problems that occurs throughout the year is the time it takes to get water. Travel time to the Finca for community members ranges from half an hour to an hour and a half, round trip. Either the whole household makes this trip together, or one member of the family makes multiple trips to the Finca. During the dry season, when the Finca source dries up, the community members must travel to Las Arrugas, which takes between an hour to two and a half hours, round trip, to get water. The containers each person uses to carry water typically hold 5.4 liters. Don Domingo indicated that each household consumes approximately 20 liters per day. While the project team believes this number to be low (especially during the wet season), this number indicates that at least four trips must be made per day to retrieve enough water to meet each household's needs.

The community regards their water quality as poor. Ailments noted by community members include worms, fevers, amoebas, and Hepatitis A. This shows that they are at least a little knowledgeable of the problems associated with dirty water. The community members claim that they boil their water, but strict adherence to this and other human health practices are dubious.

Water Quality

<b>Engineers Without Borders</b> <b>Guatemala Survey – 2010</b> <b>Chemistry Results for Drinking Water Sources</b>				
<b>Parameter</b>	<b>Acceptable Result</b>	<b>Sample 01 – Rain Water Tank</b>	<b>Sample 02 – Wood FINCA</b>	<b>Sample 03 - FINCA</b>
Total Iron (mg/l as Fe)	0.3	<0.05	0.22	0.09
Total Hardness (mg/l as CaCO <sub>3</sub> )	< 500	1.2	230	220
Turbidity (NTU)	< 1.0	0.89	4.0	2.2
Total Alkalinity (mg/l as CaCO <sub>3</sub> )	< 500	4.9	230	220
Conductivity (µS/cm @ 25°C)	1000	<10	430	420
Total Suspended Solids (mg/l)	<5.0	<5.0	<5.0	-
pH	6.0 – 9.0	6.1	7.2	7.3

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(Standard Units)				
Nitrate (mg/l as N)	5.0	<0.10	0.89	0.84
Pesticides (µg/l)				
Delta BHC	-	-	-	<0.024
Lindane	0.0002	-	-	<0.024
Alpha-BHC	-	-	-	<0.024
Beta-BHC	-	-	-	<0.024
Heptachlor	-	-	-	<0.024
Aldrin	-	-	-	<0.024
Heptachlor epoxide	-	-	-	<0.024
Endrin	0.002	-	-	<0.047
Endrin aldehyde	0.002	-	-	<0.047
Endrin ketone	0.002	-	-	<0.047
Dieldrin	-	-	-	<0.047
4,4'-DDE	-	-	-	<0.047
4,4'-DDD	-	-	-	<0.047
4,4'-DDT	-	-	-	<0.047
Endosulfan I	-	-	-	<0.024
Endosulfan II	-	-	-	<0.047
Endosulfan sulfate	-	-	-	<0.047
Methoxychlor	-	-	-	<0.235
Toxaphene	-	-	-	<0.235
Chlordane	0.002	-	-	<0.235
cis-Chloradane	0.002	-	-	<0.024
trans-Chloradane	0.002	-	-	<0.024

While a limited number of samples were obtained during the assessment trip, the results of water testing provide valuable information that can be used to establish a long-term program for providing the people of Guachthu'uq/Rehquensal with potable water for drinking and cooking. Samples were collected during the rainy season. In other words, all results indicate better water quality than normal because of the influence of rainwater. However, the two spring-source samples (Finca and Wood Finca) clearly indicate elevated turbidity values. Turbidity, while a chemical/physical indicator, parallels the total viable bacteria, Total Coliform, and E. coli levels in the water supply. While no bacteria measurements were performed, it is suggested that the Finca sources contain E. coli even during the rainy season. The Finca spring is not a safe source of potable water without extensive treatment, which is impossible with the resources available in the community.

The total hardness, total alkalinity, conductivity, pH and conductivity data for the springs meet acceptable potable water standards. The values are similar to those for ground water supplies in the United States. The nitrate (as nitrogen) and turbidity values for spring water samples are relatively high, supporting the year-round non-potable nature of this water source. The total iron values, while at acceptable potable water levels, are projected to increase with decrease in rainfall. Iron is a concern since it is a nutrient for pathogenic bacteria.

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The chemical sample results for the rainwater tanks are surprising. The water is chemically pure, with a conductivity value  $< 10$  microsiemens/cm or  $< 5$  mg/l dissolved ionic material. For reference, the conductivity is equivalent to that obtained for product water from most high purity water system reverse osmosis units in North America. Unfortunately, the turbidity value of 0.89 NTU indicates that both periodic water collection tank maintenance and treatment by a residual disinfecting agent are required to provide a reliable year-round source of potable water. However, based on review of all data, the rainwater collection systems can provide a viable source of potable water with minimal treatment.

Geology

The karst geology of the surrounding area has much to do with the community's inability to extract groundwater. The quantity and location of groundwater in karst areas is very hard to determine because it may disappear into underground fissures and sinkholes and spring up again in a different location. On top of the karst is a reddish clay/mud that is clearly visible from the surface. While geological and topographical maps from IGN (Instituto Geográfico Nacional) were provided to the project team, their accuracy has been questioned and will likely be taken with a grain of salt moving forward.

Stove Data

All of the households in Guachthu'uq/Rehquensal cook over open fires inside their houses. This is a very inefficient and expensive way of cooking due to the large amounts of firewood that are required. Each household needs three to four bundles of firewood per week and each bundle costs Q15 (\$2.00). Therefore, conserving firewood would allow the community to save money as well. The cost of wood probably discourages families from boiling water, especially during the dry season (February-May) when the wood burns faster because it is hotter and the wood is drier. Because community members do not have a lot of land, they are forced to either get their wood from the nearby woods or from the nearby communities. EWB-WPI suspects that the community members of Guachthu'uq/Rehquensal cut wood on other people's land, but they cannot openly say that in a meeting since it is unlawful.

The open fires they cook over can be either on the floor or on an elevated platform in the house. During the rainy season, the wood is wet and creates a lot of smoke in the homes. As a result, they try to buy wood weeks in advance in an attempt to dry it out. They cook mostly inside, except when cooking meat, which is done outside. It takes two to three hours to cook beans and a half hour to cook tortillas. When asked if they would rather have an open fire or a flat metal surface for a stove, the consensus was that they would rather have the flat metal surface. Also they told us that gas is very expensive. They use cornhusks and plastics to start the fires because they are highly flammable and burn intensely.

Many residents (especially women who do most of the cooking) suffer from headaches and respiratory problems. A stove design should include a chimney to carry the smoke

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outside. Regardless of the designs that EWB-WPI presents, the community members made it clear that they want to be part of the decision making process.

Latrines

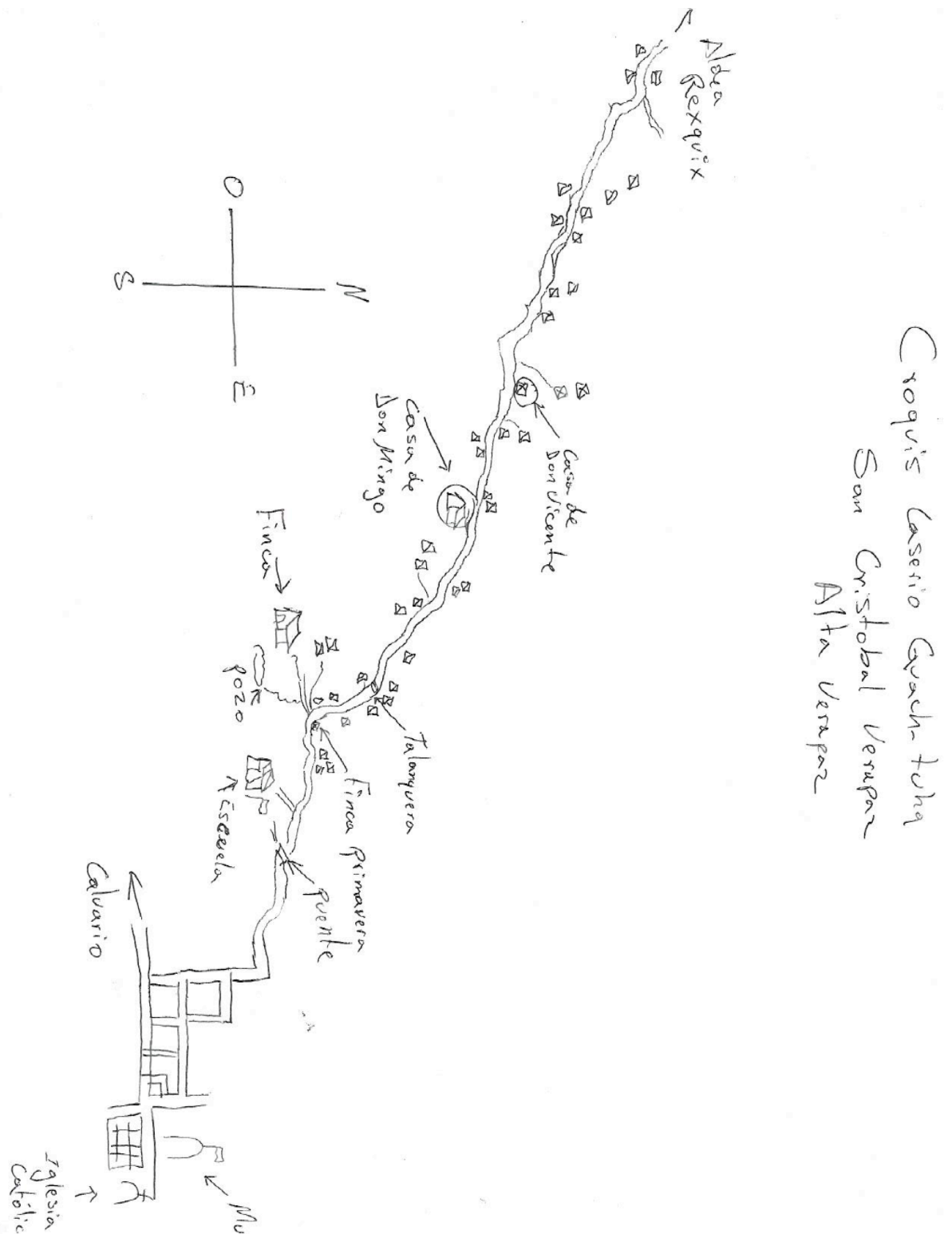
Due to the close proximity of latrines to the homes, many households have problems with odors and flies. The outhouses are simple holes in the ground without proper drainage that are covered with dirt once the hole is filled

## **5.2 Mapping**

Below is a map of Guachthu'uq/Rehquensal and its surrounding area sketched by Angel, Don Domingo's son. The elevation increases as you proceed up the road. At the bottom right of the map is San Cristóbal. The water body labeled "pozo" is the community's Finca water source and the boxes with slashes in them are houses in the Guachthu'uq community.

EWB-WPI intends to create a more detailed map of the community with the GPS data collected on the trip.

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Map of Guachthu'uq/Rehquensal and surrounding area



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**6.0 PHOTO DOCUMENTATION**

“Wood Finca” Water Source



Covered spring source at the private estate (Finca)



A view downstream the spring source

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**“Finca” Water Source**



Spring diversion box located approximately 100m downhill from “Wood Finca”



Clothes-washing area



Drinking tap at the Finca, located to the right of the spring-diversion box.

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Rainwater Catchment Tanks



Typical rainwater catchment setup



2500L Rotoplas catchment tank

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“Stoves”



Heating water over an open flame



Cooking tortillas inside the house



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Playing with Children



Making Playdoh sculptures



Playing "horse"

## **7.0 PROJECT FEASIBILITY**

An essential goal of the assessment trip was to determine whether the community had sufficient infrastructure to support future projects. Prior to the assessment trip, EWB-WPI listed the following criteria to determine the feasibility of future projects:

Adequate:

- community support
- availability of trained/skilled workers
- funding to maintain system, equipment, or technologies involved

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- local availability of materials for initial construction and eventual repair, if necessary
- geological and or geographical features for a new water collection system

Community Support

The community's development council (COCODE) has expressed open appreciation and gratitude toward EWB-WPI's desire to help. The community was very supportive and cooperative throughout the assessment trip. A couple of members from the COCODE sacrificed much time out of their days to help the team. As far as EWB-WPI can tell, there is no disapproval of our intentions.

Labor

The community has openly expressed their willingness to provide any necessary physical labor (skilled and unskilled). Guachthu'uq/Rehquensal is a community of carpenters and builders. The construction of the Finca's spring diversion box is a testament to their skilled labor.

Although some men work away from home for an extended period of time, there are usually enough people in the community year-round to provide the necessary physical labor.

Cost and Maintenance

The cost of maintenance of the proposed project is a concern as the community's resources are limited. An annual maintenance fee, organized by the COCODE, will hopefully cover any repairs and also encourage everyone in the community to care for the project.

Materials

EWB-WPI visited several hardware stores in San Cristóbal and spoke to the owners of the stores to determine the availability of typical construction tools and materials.

Tools such as shovels, hammers, buckets, and saws are readily available in San Cristóbal, as well as some materials like screen, wire, wood, nails, bolts, and screws.

Construction materials such as bricks, metal stove tops, iron corrugated roofs, reinforcing bars, and pipes (PVC or metal) are available in San Cristóbal but are more expensive and in less supply than the tools mentioned above. If large quantities of these materials are desired, it would be more cost-effective to purchase them outside of San Cristóbal and have them transported to the community. EWB-WPI has contacts in Guatemala that would be able to provide the locations of factories and help ship materials from the factories to the community.

Cement, sand, and rock can also be found in San Cristóbal but high quality and quantity must be purchased outside the municipality.

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In the coming months, EWB-WPI will perform an alternative analysis and preliminary design report, followed by a detailed design of the selected alternative(s).

## **8.0 LESSONS LEARNED**

During EWB-WPI's assessment trip the group learned many lessons that are beneficial to the institutional knowledge of the chapter, including:

- Take all information passed through meetings with a grain of salt. In many of the meetings the group learned things that were not necessarily true and were passed by word of mouth.
- There is a huge lack of expertise in our area. Again, many of the group meetings came out fruitless because of the lack of knowledge and technical expertise. For example, Ministerio de Ambiente y Recursos Naturales (MARN) is heading the effort to clean Lake Chichoj but none of the members have technical knowledge pertaining to water resources.
- Having meetings at night to review all data learned and plan for the next day is valuable.
- Homestays should be coordinated so that the team is living in close proximity to each other.
- Having the right clothing is very important. Bringing long sleeves, ponchos and boots proved to be very useful and a necessity for some parts of the trip. Hiking boots were definitely a necessity; raining or not.
- Most necessities are in abundance, such as hygiene products and antibiotics, and can be purchased in San Cristóbal. Consider this when packing your luggage.
- Questions are hardly ever clearly answered, so it is good to ask the question multiple times in different ways to get all the information needed.
- Always have a local person with you when in the community. It is almost like trespassing if you enter the community without permission and without a local contact person.
- Always greet people even if you do not know them, as it is part of the culture.
- Avoid street dogs.
- There is no such thing as a quick meeting. Food or drinks are usually prepared, which you are expected to eat or drink. Also it takes a long time to start the meeting and during the actual meeting there is usually a low sense of urgency. Also there are usually many more topics covered than just the one you want to talk about.

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- Clothes can be cleaned. This should be considered when packing for the trip. Although most people in San Cristóbal do not have washing machines or dryers, clothes can be cleaned by hand.
- Plan for unexpected costs. Between Customs and meetings that took place in far locations, total expenses were greater than expected.
- Cell phones are a cheap and reliable source for short and long distance communication. It will cost less than using your phone from home, and if you need to call long distance it is relatively cheap.
- Try to avoid shipping anything into or out of Guatemala if possible. We were stuck in Customs for multiple days on our trip trying to extract our items. Also, if you do ship, make sure that the person receiving the packages is in the area and reliable. Use a customs clearance agent that has a local office.
- Basic Spanish speaking skills are extremely necessary. Do not underestimate the importance of communication.
- It is important that the traveling team work together prior to departure into Guatemala (to avoid any confusion or logistical errors) and after arrival in the United States (to finish any post-trip documentation)

## **9.0 MENTOR ASSESSMENT**

By Matthew Gamache

Over the course of the two-week assessment trip, the team was able to meet most of the trip's goals. The team excelled (with the help of our NGO contacts) in forming a relationship with the Guachthu'uq/Rehquensal community. Initial meetings with the community leaders were very well received. The team did an excellent job articulating the goals and expectations of our 5-year project to the community leaders. Additionally, it was clear from discussions with the community leaders that the people were cognizant of the most pressing issues affecting their daily lives and health and well being (water supply, water quality, and stoves). Throughout our two weeks the members of the community were always cooperative, getting us access to homes (for surveys) and showing us the water supplies. Building a strong relationship with the people of Guachthu'uq/Rehquensal is paramount to the success of this project. I feel that the students have built a strong foundation with the community and are well positioned to work alongside the residents of Guachthu'uq/Rehquensal on future implementation visits.

The team was also able to work with local experts to obtain the data needed to plan the next trip. In particular, the students built a relationship with professors and students at the local University in Cobán. The rainfall data received from a thesis report housed in the University library



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immediately changed the course of the project, presenting the means to develop a sustainable solution to the community's water supply and quality concerns. This data has already been used to create a proof of concept dynamic analysis tool that relates rainfall quantity to roof and storage tank-related parameters. This tool will continue to be developed and pilot tested throughout the 2010-2011 school year.

Unfortunately, water quality sampling did not proceed according to plan as the sampling material was held up in customs for the duration of the 2-week trip. The students worked diligently to get the materials out of customs and developed a backup plan when it became apparent that the materials would not be reclaimed in time. While this turned out to be an expensive disappointment, it will serve as a lesson learned for future trips. When faced with this adversity the students proved to be resilient, and they were able to address the situation with creative solutions.

Overall the team worked well together. Each team member took ownership of the project and acted in a professional, culturally appropriate manner throughout the two weeks. It should be noted that the work of the team translator (in this case Maria Alexandra Rangel), is a particularly grueling job. The ability to communicate clearly and concisely is a requirement for a successful project. It should be noted that Miss Rangel did an outstanding job in this capacity. It is my recommendation that the students ensure that at least one fluent Spanish speaker attend each trip and, when possible, more translators should be added to the travel team, even if it means additional costs incurred.

## APPENDIX A: RAINFALL DATA

Est	Nombre	Municipio	Lat	Long	Año	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	Annual
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1981	20.1	113.1	24.5	23.1	165.8	327.9	340.7	376.5	210.1	188.2	49.2	58	1877.1
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1982	95	14.6	18.5	61.9		348	269.4	194.1	353.3	121.3	34.5	33.4	1449
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1983	37.1	55.5	11.1	134.4	88.9	189.1	304.4	253.5	194.8	153.6	75.4	74.9	1535.6
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1984	53.4	34.2	82.5	40.9	194.4	360.5	360.3	374	368.6	201	115.4	67.1	2198.9
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1985	32.1	84.6	30.4	84.7	44.8	259	301.6	242.6	236.3	134	41	87.1	1546.1
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1986	50.7	40	46.8	24.9	217.4	335.9	196.4	216.3	266	154.9	88.8	47.5	1634.9
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1987	26.7	15.3	25	31.5	20.5	350.3	422.9	249.9	189.7	77.1	42.3	36.3	1460.8
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1988	44.1	46.8								249.2	100.1		396.1
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1989				77.5				284.5	422.9	161.2	137.2	47.9	1131.2
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1990	50.2	48.9	45.5	52.5	103.7	284.9	198.2	218	289.8	176.7	203	60.7	1431.3
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1991	46.9	25.3	40.1	66.7	85.2	225.4	177.9	78.8	229.1	184.3	39.4	138.7	1290.9
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1992	23.5	12.3	28.6	88.3	130	302.3	281.1	180.9	373.9	143.7	248.5	124.6	1914.2
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1993	43.6	16.4	16.9	102.2	98.6	422.5	163.1	316.5	240.7	177.3	49.6	53.8	1657.6
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1994	85	29	87.7	68.8	84.1	186.1	88.3	196.6	158.2	76.8	45.1	32.3	1073
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1995	34.6	44.1	34.2	186.7	62.7	412.6	278.5	400.2	373.9	264	57	69.9	2183.8
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1996	34.5	35.9	35.8	65.9	187	330.5	293.7	176.2	231	236.5	189.6	39.2	1821.3
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1997	51.8	50.4	36.5	40.1	97.7	113	239.7	184.9	467.6	129.4		57.1	1468.2
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1998	37.7	0.5	41.7	102.6	78.7	343.7	306.5	184.5	301.1	422.2	182.7	42.6	2044.5
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	1999	58	71.9	56.1	87.9	73.5	308.4	244	308.7	366.7	210.7	113.4	25.5	1924.8
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	2000	55.4	25.6	1.8	20.2	372.1	304	148.2	338	283.8	275.1	71.1	60.7	1956
1.8.3	San Cristobal V	San Cristobal	15°21'55"	90°28'33"	2001	25.6	64.2	97.7	50.4	164.7	156.6							559.2

Rainfall data provided by the University of San Carlos in Coban, Guatemala. This graduate thesis report included rainfall data for multiple areas of Guatemala from 1981 to 2001

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**APPENDIX B: CONTACT PAGE**

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People that went to Fundraising Night

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