



Document 901*
PROGRAM PLAN AND BASELINE STUDY
CHAPTER: Worcester Polytechnic Institute
COUNTRY: Guatemala
COMMUNITY: Guachtuq

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

July 20, 2014

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

** Since this program has been grandfathered into the PMEL framework, this report contains elements of both the 901 and 901B forms.*

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1.0 INTRODUCTION

1.1 Contact Information and Reporting History

Current	Name	E-mail	Phone
PMEL Lead	Katie Picchione	krpicchione@wpi.edu	518-727-8024
Project Lead	Aaron Pepin	ajpepin@wpi.edu	603-689-3869
President	Thomas Moutinho	tjmoutinho@wpi.edu	207-831-7011
Mentor #1	Pat Austin	Pat.austin@state.ma.us	508-284-4356
Mentor #2	Mike Reiter	Reiter2207@gmail.com	860-748-3445
Faculty Advisor #1	Creighton Peet	cpeet@wpi.edu	
Faculty Advisor #2	Laureen Elgert	lelgert@wpi.edu	508-450-3313
NGO/Community Contact #1	Sucely Ical Lem	exiical@hotmail.com	
NGO/Community Contact #2	Alvaro Caal Lopez	Alvaro.ck@hotmail.es	
Health and Safety Officer	Jessie Ciulla	jmciulla@wpi.edu	207-831-7011

Program Title	Guachtuq Water Supply
Community	Guachtuq
Country	Guatemala
Date of 502 Approval	2009
Date of First Assessment Trip	7/20/2010 - 8/03/2010
# of Months Since Last Site Visit	2
Date of Baseline Study Report (901)	July 20, 2014
Date of This Program Impact Monitoring Report (901B)	July 20, 2014

1.2 Program Summary

The Engineers Without Borders chapter at Worcester Polytechnic Institute aims to provide the community of Guachtuq, Guatemala with a sustainable, year round water supply. Guachtuq is located in the Alta Verapaz region of Guatemala and is home to around 220 people in 36 families. Of the many challenges they face daily, the absence of clean drinking water is the greatest concern. In the Guachtuq Water Supply project, EWB-USA WPI focuses directly on the water problem, and works with the community to learn more about environmental and social issues that affect their health and water security. Future projects may address other issues the

community faces, such as health problems from excessive smoke in the house from open cooking fires.

Currently, EWB-USA WPI maintains excellent contact with El Centro Comunitario Educativo Pokomchi (CeCEP) an NGO that works to preserve and educate the Pokomchi community in the region and improve the quality of life for the needy. Sucely Ical Lem (Sucy) and CeCEP volunteers help coordinate travel and homestay logistics, translators, and monitoring. Alvaro, one of the volunteers, is employed by EWB-USA WPI to visit families in Guachtuq on a monthly basis and collect monitoring data. Through CeCEP, EWB-USA WPI has also made connections with the San Cristobal Municipality, who has supported the project with transportation of materials to Guachtuq and thinks highly of the work the team is doing.

Current PMEL Lead Katie Picchione underwent PMEL training at the 2013 Northeast Regional Conference. She is majoring in the social sciences and has worked closely with Faculty Advisor Laureen Elgert, Ph. D., to learn about research and evaluation methods, indicators, and interviewing practices. Picchione and Elgert spearheaded community interviews in 2014, gathering information to identify indicators of project success.

1.3 Travel History

Dates of Travel	Assessment or Implementation	Description of Trip
7/20/2010 - 8/03/2010	Assessment	This first trip consisted of meetings with the community members and town officials. Conducted health surveys and water quality sampling.
7/23/2011 - 08/07/2011	Assessment	Collected more data on water consumption, existing rainwater harvesting practices, and developed a memorandum of understanding with the community
12/31/2012 - 1/10/2013	Implementation	Pilot implementation of rainwater harvesting systems on two homes, assessment of homes for future implementation, and established a monitoring system
5/2/2013 - 5/15/2013	Assessment	Assessment of pilot implementation, health survey and census of community. Also, home assessments for the next 10 homes and set up for next two implementations.
1/2/2014 - 1/14/2014	Implementation*	This trip was an implementation trip that was funded by an EPA grant. Therefore there are no official EWB reports. Implemented at 2 homes and re-assessed 8 homes for future implementation. Also, further monitored project success.
5/8/2014- 5/22/2014	Implementation	In under ten days, the team and community members built eight rainwater harvesting systems, updated systems of previous beneficiaries, conducted two rounds of water quality testing, interviewed almost every family in the community, met with the mayor of the Municipality, held multiple community meetings, strengthened relationships with local NGO partner CeCEP, and assessed the homes of the remaining twenty-five families.

EWB-USA WPI completed two assessment trips in 2010 and 2011, where the team started to form a relationship with the community members of Guachtuq. The team conducted in-house assessments, held community meetings, and undertook water quality studies. In 2011, the team conducted a community wide survey to determine a water consumption rate for each family. Unfortunately, no trends emerged that related number of family members to water consumption across the community. The team also thoroughly assessed the two homes chosen by the community for pilot implementation. This included measurements of each home as well as in-depth discussions of the needs of each family.

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

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

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

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

Finally, EWB-USA WPI's sixth trip to Guachtuq, the third implementation trip, took place in May 2014. In under ten days, the team and community members built eight rainwater harvesting

systems, updated systems of previous beneficiaries, conducted two rounds of water quality testing, interviewed almost every family in the community, met with the mayor of the Municipality, held multiple community meetings, strengthened relationships with local NGO partner CeCEP, and assessed the homes of the remaining twenty-five families.

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

2.0 PROGRAM PLAN

Planning project work in a way that facilitates effective monitoring of our impact in the community is important to ensure that our efforts in the field are supporting our organizational Theory of Change. Monitoring the project work at the end of the implementation, without any reference to the intended plan, does not provide enough information to study how well we have met the community's goals. By expressly planning the program's activities, the chapter is providing the necessary information to allow future teams to measure how well the chapter met or did not meet the community's goals. This information will be used to learn from our programs and adapt our approach to continually improve our Community Development Program delivery model.

2.1 Community Context

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

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

In most families, the husband is the breadwinner and head of the household. Some women are not allowed to work and rarely leave the house. Many men work as security guards or *campesinos*, tending crops for wealthier land owners. These types of jobs often require men to

be away from home for up to two weeks. Occasionally, men must also leave the community for an extended period of time to find work, leaving the women and children at home to manage for themselves. In some situations, the wife is clearly in control of the household and keeps things running. Some women do have jobs, such as spinning thread, which they do in their free time. Many families own plots of arable land in Guachtuq, or the uphill community of Rexquix, where they grow both subsistence crops and cash crops.

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

2.2 Community Goal Statement

The goal of this project is to achieve water security for every family in Guachtuq. This will be achieved by providing and improving rainwater harvesting systems to ensure that every member of the community has year-round access to sufficient quantity and quality of water to meet basic needs.

2.3 Community-Identified Problems to Address through This Program

Water Poverty: The Finca

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

Quantity

In the mountains of Guatemala, natural water sources exist, but are geographically variable and unreliable. There is only one natural water source available to members of Guachtuq: a concrete water collection basin located downhill of the community. The water that feeds the basin comes from a spring located on a small, nearby farm called *Finca La Primavera*, literally *Spring Farm* (in Spanish, *primavera* means *spring*, as in the season). Colloquially, the basin is referred to as the *finca*. Community members used to have access to the source of the water (the *fuentes* or *nacimiento*, both of which translate to *spring*, as in a natural source of ground water) until the finca basin was built in 2006 through an agreement between the land owner of the Finca La Primavera and the community. The basin is located on public land. Many families rely on the finca water as their primary source of water for drinking and cooking, and nearly every family uses the water for washing clothes and bathing.

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

Quality

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

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

Access

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

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

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

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

2.4 Program Mission

The purpose of this program is to improve water security for the community members of Guachtuq, Guatemala. Through providing infrastructure and support to construct rainwater harvesting systems at each home in the community in Guachtuq, EWB USA-WPI aims to build connections between the community, CeCEP, and the local Municipality to ensure access to water of sufficient quantity and quality to meet needs. As a result, children will have improved access to education, women will have time to pursue other, more fruitful ventures, community members will have improved health, and all will benefit from an elevated quality of life.

2.5 Identified Changes This Program Seeks to Support

EWB-USA Change Element	Through Which Project Type*	Chapter Influence is Direct (D) or Indirect (I)
Change in public health	Water Supply, Sanitation, Energy	I
Change in environmental health	Energy	I
Change in behavior	Water Supply, Energy	D
Change in access to services (water)	Water Supply	D
Change in technical knowledge related to projects	Water Supply	D
Change in community organization	Water Supply	D
Change in community self-advocacy	Water Supply	I

** You may only specify: Water Supply, Sanitation, Civil Works, Structures, Energy, Agriculture or Information Systems. More than one project type can support a single element of change.*

2.6 Community Engagement

Though interactions with Guachtuq began in 2009, most of the development in community engagement occurred in 2013 and 2014. This section details the extent of community engagement at the time the report was prepared.

EWB USA-WPI's relationship with Guachtuq is developing incredibly well, both directly with the community and with the partner NGO CeCEP. From CeCEP, a university student named Alvaro administers monitoring forms that the team has created to evaluate the progress of the project in the community. Because of his continuous and reliable involvement, the community now trusts him and EWB-USA WPI implicitly, which is useful when the forms rely on honest answers.

In Guachtuq, the club has achieved a good level of trust and respect with the community members that has made implementations progressively easier. During a community meeting on the May 2014 Implementation trip, community members expressed this respect was when the announcement was made that the outgoing project lead, Thomas Moutinho, would not be returning and the incoming Project Lead, Aaron Pepin, would be taking over. Multiple community members made small speeches focused on their immense gratitude and respect for Tom as he was leaving and how, because of the legacy he leaves, they are prepared to continue their strong support of the club and the project. All the men of the community brought this commitment to light when they came out in force to support the ambitious eight-home

implementation in May 2014. Even some men whose families were not receiving systems on that trip were present the entire week, working hard to support the project and their neighbors. On two separate days, they also committed to an early trek down from the community to San Cristobal in order to assist with loading materials into a Municipality truck to deliver to the community. With such an incredible outpouring of assistance, the travelers were able to complete everything much sooner than expected.

One community member, Roberto, was of particular value the entire trip. From the beginning of the club's presence in the community he has been a strong advocate for the project and has been a valuable leader in the community. On the May 2014 Implementation trip in particular, he allowed the team to store tools and materials in his house and served as a community leader in the implementations at all 8 homes. Through these examples, it can be seen that the relationship between EWB USA-WPI and Guachtuq is stronger than ever.

2.7 Local Partner Information

Water Committee

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

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

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

It is noteworthy to mention that, as Roberto has taken on increasing leadership within the project and the water committee, he has been confronted by some in the committee (notably Cristobal, president) and accused of 'taking people off of the list'. This has come about, at least in part, because of the differential numbers of tanks granted Guachtuq families. Not all families receive tanks as a part of this project because it uses existing system characteristics and family need (i.e. roof size, family size) to determine how many tanks are granted. This project is about helping families achieve water security, and not about handing out tanks. This model differs from projects that have come before, which often granted tanks based on the advice of the

COCODE alone. Since water tanks are often seen as an asset that is easily liquidated in times of need, and thus valued for purposes beyond rainwater harvesting, the rationale behind 'who gets what' contentious and not well understood. Thus, it remains of the utmost importance that the team takes time to explain the rationale of water security (and how system requirements are calculated), to community members and project beneficiaries.

CeCEP

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

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

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

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

Municipality

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

3.0 PROGRAM BASELINE STUDY

3.1 Methodology for Collecting Baseline Information

To establish a baseline study for Guachtuq, EWB USA-WPI reviewed water quality tests and family interviews conducted on every trip. Because some information is repetitive while some is incomplete or inconsistent, this study was prepared primarily using knowledge gained on the January 2014 and May 2014 Implementation Trips.

EWB-USA WPI relies on water quality tests and interviews as the main sources of recorded information about the community. Water quality tests have been conducted on every trip, but have not been consistent. Chemical tests conducted on the first few trips reveal that, at that time, inorganic contaminants were not a concern in the finca or tanks. In 2014, the team found a field test that works well to assess pathogen contamination in water. The Petrifilm and Coli-ert field tests were used on both the January 2014 and May 2014 Implementation Trips to assess the quality of water from various sources. The travelers tested EWB USA-WPI tanks in the community, government-distributed tanks in the community, the finca, and municipal water in San Cristobal. By running tests in triplicate, the team increases the accuracy and consistency of data. Duplicate testing on subsequent trips will confirm findings and help the team develop best practices for system maintenance and water management. As EWB USA-WPI systems age, the team is also able to monitor if the age of the system affects the water quality.

Interviews have taken place in various ways over the years. While the methodologies used on early trips were not well documented, interviews on the January 2014 and May 2014 Implementation Trips were semi-structured (conversational) and focused on the finca, existing systems and system maintenance, water management practices, boiling, and basic family information. Through observations, the team also gained a sense of family dynamics and social acceptance of the project. Over time, the team will be able to observe how the project affects the lives of individuals throughout the community.

3.2 Baseline Situation Regarding Planned Changes

This table was prepared after reviewing the 521 and 522 forms from the first Assessment trip in August, 2010 and observations from subsequent trips. For this reason, it is written in past tense.

Change Element	Situation at Program Inception
Change in Access to Water	Many families in the community relied solely on the finca for all their water needs during the dry season because they had insufficient systems to store adequate water for drinking and cooking year round. The 2010 assessment team divided the families into four groups based on perceptions of water need. 10 families were identified as "poor," 15 were identified as "fair," and 4 were identified as "excellent." For various reasons, 7 families were ineligible to benefit from the water project. Since that time, families have moved in and out of the community. The May 2014 Implementation team wrote a final list of beneficiary families and divided the families into two groups, again based on need, that will receive systems in May 2015 and May 2016 respectively. Two of the main factors were the family's proximity to the finca and existing storage capacity

	<p>(number of tanks).</p> <p>Another barrier to access is the Finca La Primavera farm and its ownership. Though community members are allowed to freely use the finca water basin, they have been barred from the Finca La Primavera property. The water source, the spring that feeds the finca basin, is located on the Finca property and is inaccessible to community members. Consequently, the water travels a significant distance from source to basin and is contaminated by farm runoff, breeding mosquitos and other insects, and harmful <i>E. coli</i> and coliform bacteria in transit.</p> <p>Through interviews, the EWB-USA WPI team learned that community access to the finca was restricted recently by the owner of the Finca La Primavera. Families were once allowed to travel a shorter distance across a section of the Finca but are now required to walk an additional fifteen to twenty minutes on a public-access road to reach the basin. According to accounts from community members and the Finca manager, Julio, access was restricted because people were abusing the finca. Garbage was left lying around on several occasions, animal remains were also found there once or twice, people were lining up, waiting on line during the dry season, getting angry, arguing. People from other communities were using the water but not helping maintain the finca. Issues, complaints, and disagreements were becoming more common, so the Finca owner's reaction was to close the main gate, supposedly limiting access for all. This is an excellent example of the Tragedy of the Commons, where all suffer reduced access to a common good because of the actions of a few.</p> <p>EWB-USA WPI can expect positive change in access to water with each implementation trip. As families obtain their own systems, they gain more control over the availability, quantity, and quality of their water. Rainwater is naturally cleaner than runoff or stagnant water, and families can adopt conservation practices. Ownership of systems ensures that families will not be barred from a water source simply because of its location and power conflicts.</p>
Change in Technical Knowledge	<p>At the start of the project, some community members had government-provided systems or tanks that they had hooked up to make-shift gutters. Only one or two systems were sufficiently engineered to provide families with adequate water throughout the entire year. By the end of the project, not only will each family have a functioning system that meets their needs, they will know how to construct systems using best-practices and simple principles of engineering. For example, they will know how to cut and install gutter clips, measure the angle of a gutter through which water can flow, attach PVC downspouts and overflows so that the system will function properly, and understand how to reduce contamination through system design. Families will be able to repair, maintain, and improve systems as their homes, families, or circumstances change.</p>
Change in Behavior	<p>There is room for behavioral change through education in the following areas:</p> <ul style="list-style-type: none"> Adequately boiling water – at the time this study was prepared, most families reported that they always boil water until it starts to bubble. Some families report that they let it bubble for about five minutes; some

	<p>simply put the pot on for half an hour or so, not particularly watching it, but take it off after the water bubbles. Two families (32 and 41) reported that they do not always boil water. A few families reported that they always boil tank water, but sometimes drink finca water without boiling. Correspondingly, some families always boil finca water, but sometimes drink tank water straight. The majority of families always boil water and learned to do so from clinics at health centers, schools, hospitals, and community meetings. A few families said it has always been customary to boil water to prevent illness. However, it is important that all families know how to properly boil water to prevent water-related illness.</p> <ul style="list-style-type: none"> • Tank water is better quality than finca water – for various reasons, there are mixed opinions on which water is of higher quality. Some people think finca water is better because they prefer the taste. Most families believe tank water is better, but have varying reasons for why, including: <ul style="list-style-type: none"> ○ Other people wash clothes at the finca ○ Finca water sometimes feels oily when they wash there ○ People leave garbage lying around the finca ○ There are other problems with the finca that make tank water preferable, such as the distance and having to wait on line • Using separate containers for finca water and tank water; having a designated container for boiled water – some families currently have designated containers they put boiled water into that their children know are safe for drinking from. However, no families were aware that using the same containers for finca water and tank water is a source of pathogenic contamination. • Using a first flush to reduce contamination – non-EWB systems do not have first flushes. A few families have makeshift systems or techniques to reduce roof contamination. For example, Roberto (House 26) devised a way to use his overflow as a manual first flush. Graciela and Jose (House 7) move their gutter away from the tank during the first rainstorm of the season. Many families are aware that roof contamination is detrimental to water quality in the tanks, but few take steps to prevent it. • Cleaning systems and scrubbing tanks on a regular basis – most families who own tanks know that systems need to be cleaned, but there are varying methods and perceptions of how this should be done. Most families use diluted chlorine and soap to scrub the inside of the tank with a rag or sponge. Some families only use soap. Families report that they clean tanks anywhere from once a year to four or five times a year. However, they also say that they only clean tanks when the water is low, which happens primarily during the dry season. Monitoring will help EWB-USA WPI better understand the pattern of tank cleaning. Hopefully water quality tests will indicate whether cleanliness improves as tank maintenance becomes more routine. • Chlorinating water sufficiently – when families put chlorine directly into
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	<p>their tanks or tinajas full of water, interview reports show that none use sufficient amounts of chlorine to sterilize water. Families who use chlorine either put a few drops into the tank every few days or put a few drops into a tinaja.</p> <ul style="list-style-type: none"> Amount of water used – Data collected in 2013 was used to calculate a water consumption rate for the community. On average, each person in the community uses about 6.7 L/day. <p>A significant, measurable change in behavior will be the frequency with which family members travel to the finca. As a result of relying less on the finca, women will be able to pursue crafts or jobs, spend more time with the children, and accomplish more tasks around the house. Some will have more time to farm. Children will no longer risk missing school for the sake of gathering water.</p>
Change in Community Organization	Prior to the start of this project, all community development projects were managed by the COCODE, the community government that answers to the San Cristobal Municipality.
Change in Community Self-Advocacy	At the start of the project, the community members relied mainly on projects started by the COCODE and the Municipality to improve their quality of life, since few can afford unsubsidized tanks.
Change in Public Health	Families report that occasionally people get stomach aches from drinking unboiled water. Most families know to always boil the water; they learned to do so in schools, health clinics, local "chats" about health held by the midwife, and word of mouth. Some families report that boiling water is something that has always been done and is customary.

3.3 Update on Change Areas: Impact Assessment

This table was prepared at the same time as the baseline study. Changes are based primarily on interviews and observations from the January and May 2014 trips.

Change Area	Update on Changes from Baseline Study or Last Program Impact Monitoring Report (please read report guidelines on how to complete this section)
Change in Access to Services (Water Security)	<p>As of May, 2014, twelve families have new or improved rainwater harvesting systems. Approximately 33% of families in Guachtuq now have improved water security.</p> <p>Quantity: The EWB-USA WPI team increased quantity of available water by 27,500 L throughout the community on the May 2014 Implementation Trip. To date, twelve families now have systems that meet their quantitative drinking and cooking requirements year round. Monitoring will indicate whether tanks run dry.</p> <p>Quality: Water quality tests have shown that water stored in rainwater</p>

	<p>harvesting systems is significantly less contaminated than water from the finca. Pathogenic bacteria counts are much higher in the finca than in rainwater harvesting systems. Details are explained in the 526.</p> <p>First flush units were built with every rainwater harvesting system to improve quality of water in the tanks. Overflows are strategically designed to flush any sediment out of the tanks when water is plentiful.</p> <p>Access: Beneficiary families have water on-site at their homes. Some no longer need to go to the finca, and are able to avoid issues and limitations to access associated with the finca.</p>
	<p>Significance of change: So far, the implemented systems appear to be functioning properly in providing adequate quantity of water to meet cooking and drinking needs year round. Water quality testing and subsequent system design changes will help the team continue to improve water quality.</p>
	<p>Contributions to the change: Systems were built by community members and the EWB-USA WPI team. The rainwater harvesting systems are the main contributing factor to improved water security.</p>
Change in Technical Knowledge	<p>On the May 2014 Implementation trip, community members took the lead in constructing the systems. At the beginning of the implementation trip, the team demonstrated basic techniques used to assemble a system at one home. The men who volunteered to work then split into two groups to work on separate homes, each paired with either the outgoing project lead Thomas Moutinho or the incoming project lead Aaron Pepin. While the men already had experience with pouring concrete and using PVC, they learned how to use these skills in new ways. They quickly learned to properly slope pipes and gutters to prevent stagnant water from collecting in the system. The first flush was a new element to many, but once it was properly explained, the men quickly and properly assembled them.</p> <p>The gutter clips used for all of the EWB USA-WPI implemented systems were originally innovated by Cristobal Cojoc (House 8). When the team installed a pilot system on his home during the January 2013 Implementation Trip, the travelers left several planks of wood at his house overnight before installing the gutters. The commercially available gutter clips were flimsy and expensive, and the team had started the conversation on how to support the gutters properly. When the team returned the next day, Cristobal had fashioned wooden supports that have since been assessed with statics analysis done by the team, and proven practical through all subsequent implementations.</p> <p>Although a great deal of time was spent designing the piping of the systems before travel, many families decided to change either the structure of their house or their vision for the system. In these moments of quick redesign, community members were often the ones to find the best</p>

	<p>way to reroute the piping. Since they have all built houses themselves, they know where the best supports are and how to prevent the system from being intrusive. This type of redesign happened often enough on the May 2014 trip that clearly, the ideas of the community are often the best.</p>
	<p>Significance of change: If this trend continues, community members will have the knowledge to design and build systems themselves. In the future, they will easily be able to repair or adapt systems. They may also have the skills to help members of other communities build their own systems.</p>
	<p>Contributions to the change: This change came about through patience on the part of the EWB-USA WPI Implementation teams and attentiveness and excitement from community members.</p>
Change in Behavior	<p>For the May 2014 implementation trip, the travel team prepared educational booklets which were distributed to every family in the community. The booklets detail reminders on how to properly boil water, use separate containers, use the first flush, and maintain systems. Booklets and instructions were explained in detail to families who received EWB systems. Monitoring will show how effective the booklets are by whether families use the first flush properly and clean tanks regularly.</p> <p>Changes were observed in the following identified areas:</p> <ul style="list-style-type: none"> • Boiling Water – A water quality test experiment was conducted on the May 2014 implementation trip. As detailed in the 526, water was boiled for different amounts of time and samples were tested. Results indicate that heating water for as little as a minute or two after it reaches a boil is sufficient to kill coliform and harmful <i>E. coli</i> bacteria. Findings will be disseminated among community members as the project continues. <p>In addition, water quality tests were used as an educational tool during interviews and community meetings to explain how to detect harmful bacteria in water and how contaminated water makes you sick. Community members were interested in the tests and generously allowed the team to test their water. Some of the women and children helped prepare the tests in January 2014.</p> <ul style="list-style-type: none"> • Tank water is better quality than finca water – Families who received EWB systems received detailed explanations on this topic. They trust the implementation team and rely on tank water for drinking and cooking. • Using separate containers for finca water and tank water; having a designated container for boiled water – Families who received EWB systems were given designated containers for collecting water from the tanks. They were also given detailed explanations of why it is important to separate containers, citing the water quality tests that showed that finca water is more contaminated than water

	<p>from tested tanks.</p> <ul style="list-style-type: none"> • Using a first flush to reduce contamination – The team used education booklets to explain the first flush in detail to beneficiary families. Families who received first flushes in January 2014 demonstrated that they are aware of how to use the first flush. Water quality tests showed that water in the first flush had higher levels of bacterial contamination than tank water. Monitoring will continue to show whether families use the first flushes appropriately and on a regular basis. • Cleaning systems and scrubbing tanks on a regular basis – The team recommended tanks be cleaned at least twice a year. Monitoring will show whether families follow this instruction. • Chlorinating water sufficiently – No change has been enacted in this area yet because EWB-USA WPI is still doing research to determine viable methods for chlorinating water. • Amount of water used – No new studies were conducted. <p>Some families no longer rely on the finca at all. Mauricia (House 1) reported that during the dry season between January 2014 (when that family received a system) and May 2014, her family only went to the finca on average once a week to do laundry and once every other week to bathe. They did not need to collect water from the finca. This is particularly significant because their system was only half-constructed since they changed the structure of their house during those months. In addition, Roberto and Elidia (House 26) did not need to collect drinking and cooking water from the finca either. Cristobal and Celestina (House 8) report that they hardly ever go to the finca at all.</p>
	<p>Significance of change: These changes indicate that the project is positively affecting beneficiaries' lives. If progress continues, the project will be sustainable, allowing families to take ownership of their own water security and make changes and improvements knowledgably as needed.</p>
	<p>Contributions to the change: The education manuals and explanations were pivotal to some of the behavioral changes. On-site explanations through translators were also essential.</p>
Change in Community Organization	<p>In 2013, the Water Committee formed to maintain communication with EWB-USA WPI and manage the water project. Besides CeCEP, the Water Committee is seen as the main internal authority on the project. Members of the Water Committee have helped the EWB-USA WPI team choose the order in which families should receive systems, though it was determined that it is better for the team to make the final decisions for political reasons within the community.</p>

	<p>Significance of change: The Water Committee is an authority within the community. It shows that community members respect and acknowledge EWB-USA WPI as a partner.</p> <p>It was confided in EWB-USA WPI that the president of the Water Committee, Cristobal Cojoc (House 8), had hoped to benefit additionally from being part of the Committee. This mindset comes from the fact that the COCODE often reaps additional benefits from organizing projects within the community. However, EWB-USA WPI does not condone this sort of corruption. It is possible that leadership will change in the Water Committee soon since Cristobal has become less involved.</p>
	<p>Contributions to the change: The Water Committee was organized independently by community members. Cristobal Cojoc (House 8) volunteered to be the first president, and Roberto Chocoj (House 26) volunteered to be the first vice president. The water committee has not been very active, but Roberto is a key figure in ensuring the success of the rainwater harvesting project.</p>
Change in Community Self-Advocacy	<p>There has not yet been much change in community self-advocacy. On a few occasions, members of the Water Committee--particularly Roberto--spoke with Julio, the manager of the Finca La Primavera, about opening the gate to allow member of Guachtuq more direct access to the finca basin, but conversations were not fruitful.</p>
Change in Public Health	<p>There have not yet been measurable changes in public health. It is possible EWB-USA WPI will not be able to observe this change measurably since it is difficult to relate illness specifically to contaminated water. There are many sources of gastrointestinal illness in Guatemala, as the travel teams have learned, and many are not directly related to contaminated water.</p>

3.4 Potential Barriers to Program Success (up to 3)

1) Availability of Materials: It is essential to be sure to order materials in advance, especially for large-scale implementations. Materials may have to be transported from Coban.

2) Community Involvement: This project requires at least one member from every family who has received a system help with construction of new systems. Though it is part of the MOU, some men are unable to be present for the length of implementation. On past implementation trips, cousins and brothers have provided labor when the man of the house was unavailable. However, some families still took a less active role in other implementations. As many as possible must participate to ensure success in a large-scale implementation.

3) Fundraising: While ordering materials in bulk is less expensive than buying them in small quantities, sufficient funding is required to finance the trips and front capital for systems.

3.5 Potential Facilitators of Program Success (up to 3)

1) CeCEP: CeCEP has been, and will continue to be, and invaluable partner to ensure success of the program. Alvaro visits Guachtuq on a regular basis, confirming our presence there. Suty coordinates homestays and logistics for travel teams. She is also a diplomatic authority in resolving conflicts that arise within the community.

2) Municipality: The San Cristobal Municipality has also been helpful by providing transportation of materials from Coban and to Guachtuq. The mayor has thanked EWB-USA WPI for the work the team does and supports continuation of such projects in the area.

3) Roberto: One of the most valuable members of the in-country team, Roberto keeps track of tools and materials for the team, serves as a translator when needed, and gives freely and lovingly of his time. He is an excellent organizer and a rising expert on rainwater harvesting systems. His knowledge of the systems will be invaluable in assuring long-term success for the project.

3.6 Analysis of Current Results

Analysis Question	Current Results
To what extent is the program achieving and influencing the planned changes or stated community goals?	<p>To date, implementations have successfully improved water security for beneficiary families. The team has helped twelve families so far, about 33% of the community. Three of the four families who received systems prior to May 2014 no longer rely on the finca for drinking and cooking water, even during the dry season (House 27 has extenuating circumstances as described below). All twelve systems will be monitored over the next year.</p> <p>Water quality in EWB tanks tested significantly better than finca water.</p>
Where is the program failing to influence the planned changes or stated community goals, and why?	There are still 25 families planned to receive systems. These implementations are planned to be completed by May, 2016.
Are there any negative and or unexpected changes that have resulted from the program implementation? If so, what are they and why did they happen?	<p>An unexpected negative situation evolved for House 27, the family of Cristobal Coy Max and Herlinda Ixian. The family rents their land and has run into a conflict with their land owner. She has asked them to move from their current location to a different plot of land she owns outside the community. The family was able to make an agreement with the land owner to move to a plot of land owned by her sister that is within the community. Through several conversations with the family, the team learned that the landowner hoped to benefit from our work in the community and claim ownership over the system built at</p>

	<p>House 20 in January 2014. Working with Sucy and Abelino, the EWB-USA WPI team wrote a contract explicitly stating that the system belongs to the family and the tanks belong to CeCEP for ten years per terms of the contract and MOU. The landowner can purchase the system, if she wishes, at the price of the full cost of materials used plus man-labor.</p> <p>Because of the tenuous nature of this situation, no interview was held with the family of House 27, and no monitoring or evaluation of the system took place. They will, however, be included in the ongoing monitoring executed by Alvaro.</p>
Considering all parties involved in the program, how would you describe your chapter's contribution to the planned/unexpected changes? (Very significant, quite significant, not significant)	The EWB-USA WPI chapter's contribution to changes have been very significant. EWB-USA WPI drives most of the progress. CeCEP, Roberto, and the Municipality are invaluable partners, but most activities and changes originate and are driven by the chapter.

3.7 Learning from Current Results

Analysis Question	Current Results
What can your team and EWB-USA Headquarters learn from these findings?	It is difficult to begin structured impact monitoring late in a project. It is also important for the initial assessment teams to carefully record ALL findings and make the information easily accessible to future travel teams. As a result of looking back at old records and buried papers, the 2014 Implementation team realized that much of the work accomplished this year is repeat work from the first few years of the project. However, much of that work was lost or became obsolete because knowledgeable students graduated or left the club without ensuring a strong knowledge base in rising members.
How should the program adapt as a result of the current findings?	<p>The Water Supply project needs to focus more on developing and testing methods for cleaning and chlorinating tanks, filters, and first flushes. Currently, all suggestions are based on existing community practices and have not been tested in a meaningful way.</p> <p>It may also be beneficial to consider ways to improve the quality of water in the finca. Though not explicitly stated in the program goals, improving the finca water would have a larger impact on the community.</p>

4.0 APPENDIX A – PROGRAM LOGICAL FRAMEWORK (Document 905)

Program summary	Objectively verifiable indicators	Means of verification	Assumptions
<p>Overall Goal:</p> <p>Achieve and spread sustainable water security</p>	<p>Measures (direct or indirect) the program's contribution to the goal</p> <p>Number of people or families who rely on the finca</p>	<p>Sources of information and methods used to show your contribution to meeting the goal</p> <p>Interviews</p> <p>Census</p> <p>Surveys</p>	<p>Important events, conditions or decisions beyond the program's control, which are necessary for maintaining progress towards the goal</p> <p>Develop local skills, entrepreneurial spirit, water project/committee leader in the community? Tanks can be purchased or bought inexpensively/subsidized?</p>
<p>Specific Objective: what the team intends to change during the program period (Outcome)</p> <p>Change the way community members use, perceive, and obtain water.</p> <p>Periodic maintenance of tanks, gutters, roofs, first flush, overflow, etc.</p> <p>Community members are willing to maintain the system and help during construction</p>	<p>Measures (direct or indirect) that the intended change has occurred and is sustainable</p> <p>Separation of water containers, boiling water, Identify when to use finca/tanks</p> <p>Are components broken? Is the water/tank cleaner or dirtier?</p> <p>Community members actively seek opportunities to gain knowledge and experience related to the systems</p>	<p>Sources of information and methods used to show that change has occurred</p> <p>Interviews</p> <p>Monitoring surveys</p> <p>Photo documentation</p> <p>Water quality tests</p> <p>Agree to MOU and uphold clauses in the contract, particularly when we are not in-country.</p>	<p>Assumptions about <i>external factors</i> that need to be in place if the program is to contribute to the overall goal</p> <p>Educational materials are effective</p> <p>Each component must be in working order for the system to function properly</p> <p>Families have the financial ability to maintain systems</p> <p>Education is effective,</p> <p>Community member's jobs are stable and not overly time consuming</p> <p>Community values and relies on the technology they receive</p>
<p>Expected Results: the results which should be within the control of the program (Outputs)</p> <p>Increase amount of water available to each family</p> <p>Improve each family's control over water</p>	<p>Measures (direct or indirect) that the expected results of the program have been achieved</p> <p>Amount of water in tanks</p> <p>Number of trips to finca</p> <p>How frequently do they go to finca? Do issues still arise at the finca?</p>	<p>Sources of information and methods used to periodically review results</p> <p>Alvaro's trips to community</p> <p>Interviews</p> <p>Surveys</p>	<p>Assumptions about <i>external factors</i> that might affect whether the specific objective/outcome is achieved</p> <p>The system (first flush, overflow, etc.) effectively improves water quality and quantity as designed.</p> <p>Guatemalan climate can support rainwater harvesting</p> <p>The municipality continues to support transportation of materials,</p>

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improved water quality from tanks, finca	Less pollutants in the water	Water quality tests; Lower frequency of illness	Finca remains open and available to community
reduce reliance on the finca	Fewer trips/amount of finca water used	Monitor finca use and frequency of trips	Families have enough time and financial security to initially implement and maintain the system
<p>Activities: the things which have to be done by the program to produce the outputs</p> <p>Calculate amount of water needed and the required system parameters</p> <p>Build rainwater harvesting systems at each home,</p> <p>Water quality testing</p> <p>produce educational materials to remind families about system maintenance, boiling water, etc.,</p> <p>Transfer money to Guatemala for implementation and monitoring costs</p>	<p>The inputs and resources needed to carry out each task</p> <p>Create the Excel Model- rain data, area of roofs, number of tanks, consumption rate for each family</p> <p>local materials, suppliers, water committee, community labor, municipality transportation, CeCEP's support and communication</p> <p>Identify and order tests</p> <p>Identify rhetorical images and graphics, learn about what images will convey ideas (cultural context), create durable posters</p> <p>Western union is available</p> <p>Sucy maintains bank account and follows up with community members and Alvaro for money distribution</p>	<p>Proof that each activity/task has been completed</p> <p>Excel model and can be used; families do not run out of water</p> <p>Every family has a rainwater harvesting system that provides adequate drinking water year round</p> <p>Results of tests</p> <p>Distribute educational materials with every system we implement, provide CeCEP with electronic copies to produce more if necessary</p> <p>Everyone pays and is paid</p>	<ul style="list-style-type: none"> Assumptions about <i>external factors</i> that might affect activities achieving the expected results Preconditions that need to be fulfilled before the program can start <p>Students have enough knowledge to create a working excel model</p> <p>WPI students can safely travel to Guatemala (political, health, bureaucratic red tape, weather, may pose restrictions)</p> <p>Families can afford systems</p> <p>Students can identify appropriate water quality indicators and to analyze data. Tests are available and financially viable.</p> <p>Rhetorical images exist to communicate ideas, We must assume the community already has an idea about these concepts and is willing to adapt and expand their knowledge base.</p> <p>EWB-WPI has adequate funds to support the project</p> <p>Sucy remains a reliable and trustworthy contact</p>