Document 521
PRE-ASSESSMENT REPORT

CHAPTER: Worcester Polytechnic Institute
COUNTRY: Guatemala
COMMUNITY: Guachtuq
PROJECT: Rainwater Harvesting
TRAVEL DATES: January 2nd – 12th, 2015

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

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Pre-Assessment Report Part 1 – Administrative Information

1.0 Contact Information

Project Title	Name	Email	Phone	Chapter Name or Organization Name
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President	Thomas Moutinho	tjmoutinho@wpi.edu	(207)831-7011	EWB-USA WPI
Responsible Engineer in Charge	Michael Reiter	michael.reiter@wpi.edu	(860)748-3445	EWB-USA HPC
Traveling Mentor	Rodney Rookey	rodrookey@gmail.com	(860)982-6567	Centurion Waterproofing, Inc.
Additional Mentor	Patricia Austin	pat.austin@state.ma.us	(508)792-7423x204	Worcester DPW
Faculty Advisor (if applicable)	Patricia Stapleton	pastapleton@wpi.edu	508-831-4832	EWB-USA WPI
Health and Safety Officer	Jessie Ciulla	jmciulla@wpi.edu	(781)987-4139	EWB-USA WPI
Assistant Health and Safety Officer	Nikos Kalaitzidis	nakalaitzidis@wpi.edu	(413)374-1502	EWB-USA WPI
Education Lead	Amanda Gatz	amgatz@wpi.edu	(631)445-8418	EWB-USA WPI
Planning, Monitoring, Evaluation and Learning (PMEL) Lead	Katie Picchione	krpicchione@wpi.edu	(518)727-8024	EWB-USA WPI
NGO/Community Contact	Sucely Ical Lem	cecep@intelnet.gyt	(502)7950-4039	CeCep

2.0 Travel History

Dates of Travel	Assessment or Implementation	Description of Trip
7/20/2010 - 8/03/2010	Assessment	This first trip consisted of meetings with the community members and town officials. Health surveys and water quality samplings were conducted.
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 – 5/25/2014	Implementation	Implemented on 8 homes in the community, conducted water quality tests, conducted family interviews and assessed the remaining homes for implementation.

3.0 Travel Team

#	Name	E-mail	Phone	Chapter	Student or Professional
1	Aaron Pepin	ajpepin@wpi.edu	(603)689-3869	EWB-USA WPI	Student
2	Jessie Ciulla	jmciulla@wpi.edu	(781)987-4139	EWB-USA WPI	Student
3	Amanda Gatz	amgatz@wpi.edu	(631)445-8418	EWB-USA WPI	Student
4	Katie Picchione	krpicchinone@wpi.edu	(518)727-8024	EWB-USA WPI	Student
5	Daniel Singer	dtsinger@wpi.edu	(443)974-0814	EWB-USA WPI	Student
6	Nikos Kalaitzidis	nakalaitzidis@wpi.edu	(413)374-1502	EWB-USA WPI	Student
7	Rodney Rookey	rodrookey@gmail.com	(860)982-6567	EWB-USA WPI	Professional
8	Patricia Stapleton	pastapleton@wpi.edu	508-831-4832	EWB-USA WPI	Professional

4.0 Health and Safety

The EWB-USA WPI travel team will follow the site-specific Health and Safety Plan that has been prepared for this trip. The Health and Safety Plan is submitted as a separate document.

5.0 Planning, Monitoring, Evaluation and Learning

5.1 If this will be the first assessment trip for the program, is the Draft 901 – Program Plan and Baseline Study included with this report? ___Yes ___No _X_Not the First Assessment trip

5.2 This is <u>not</u> the first assessment trip and the travel team has reviewed the 901B – Program Impact Monitoring Report template and has assigned travel team members to complete this report during the upcoming trip. We acknowledge that the completed 901B is required with the eventual submittal of the 522 – Post-Assessment Trip Report. _X_Yes ___No

6.0 Budget

6.1 Project Budget

Project ID: ___6871_____
Type of Trip: _A_____

Trip type: A= Assessment; **I=** Implementation; **M=** Monitoring & Evaluation	
Trip Expense Category	**Estimated Expenses**
Direct Costs	
Number of Travelers	
Travel	8
Airfare (Per Capita)	750
Gas	0
Rental Vehicle	0
Taxis/Drivers	1000
Misc.	0
Travel Sub-Total	$7,000
Travel Logistics	
Insurance (Flight)	40
Licenses & Fees	0
Medical Exams	0
Passport Issuance	0

Misc.	0
Travel Logistics Sub-Total	$320
Food & Lodging	
Lodging	1200
Food & Beverage (Non-alcoholic)	100
Misc.	0
Food & Lodging Sub-Total	$1,300
Labor	
In-Country logistical support	0
Local Skilled labor	1200
Misc.	0
Labor Sub-Total	$1,200
EWB-USA	
Program QA/QC **(1)** See below	$1,500
EWB-USA Sub-Total	$1,500
Project Materials & Equipment *(Major Category Summary)* add rows if needed	
Printing	0
Project Materials & Equipment Sub-Total	$0
Misc. *(Major Category Summary)*	
Report Preparation	0
Advertising & Marketing	0
Postage & Delivery	0
Misc. Other	0
Misc. Sub-Total	$0
TOTAL	$11,320
(1) Program QA/QC (EWB-USA Headquarters Project Managers and Chapter Relations Managers) Assessment = $1,500 Implementation = $3,700 Monitoring = $1,150	
EWB-USA Headquarters use:	
Indirect Costs	
EWB-USA	

Program Infrastructure **(2)** See Below	$500
Sub-Total	$500
TRIP GRAND TOTAL (Does not include Non-Budget Items)	$11,820

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

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

Water Supply ___ Source Development _X_ Water Storage _X__ Water Distribution ___ Water Treatment ___ Water Pump **Sanitation** _____ Latrine _____ Gray Water System _____ Black Water System **Structures** _____ Bridge _____ Building	**Civil Works** _____ Roads _____ Drainage _____ Dams **Energy** _____ Fuel _____ Electricity **Agriculture** _____ Irrigation Pump _____ Irrigation Line _____ Water Storage _____ Soil Improvement _____ Fish Farm _____ Crop Processing Equipment **Information Systems** _____ Computer Service

8.0 Project Location

Latitude: -90.494921 W
Longitude: 15.372468 N

9.0 Project Impact

Number of Persons directly affected: 220
Number of Persons indirectly affected: 220

10.0 Professional Mentor Resume(s) - Please see document *405 - Mentor Qualifications* for the requirements for the Responsible Engineer in Charge (REIC) and overall Professional Mentor Team. This can be found in the Sourcebook Downloads on the member pages of the website.

Rodney's professional experiences make him well suited for this type of project for many reasons. Rodney has 5 years working as an employee for a Construction Company that

primarily installed concrete driveways, sidewalks, stairs, patios, pool surrounds, foundations. His duties included all aspects of the installation process from digging the hole, to forming, installing and compacting the subgrade material, installing the rebar and/or mesh, pouring and finishing the concrete.

Rodney then obtained an Associate Civil Engineering degree and upon graduation opened Northeast Industrial Floorings, Inc. (NIF) in 1984. NIF is a premier epoxy flooring contractor in the Northeast US. Not only do they install state of the art resinous floor systems and concrete repair, they also polish concrete.

Fifteen years ago, Rodney opened Centurion Waterproofing, Inc. (CW). CW installs a methyl methacrylate base spray applied waterproofing system. Primarily used under the ballast on railroad bridges as well as underneath asphalt on road bridges. Some projects completed by CW are waterproofing both tubes of the Queens Midtown Tunnel, the Triboro Bridge, center tube of the Lincoln Tunnel, various ports of the Manhattan, Williamsburg and Queensboro bridges, the Calvin Cooledge Bridge in Northampton, MA to name a few.

Rodney's duties at both companies, included blueprint reading, cost estimating, contract negotiations, union negotations, material estimating, material procurement, project scheduling, all aspects of project management, equipment repair, punch list review and final project closeout.

Rodney's personal experiences also make him well suited for this type of project.

Rodney has been involved in racing of many types since an early age. He obtained his first motorcycle at the age of 9 and began racing motorcycles at 14. He eventually purchased a Porsche and raced that for many years. In 1995 Rodney's son Ralle began racing go karts then atv motocross, now cars. During this time Rodney has maintained many different race vehicles as well as a wide array of construction equipment.

Rodney has completely remodeled 2 multi-family homes, renovations are down to studs, new electrical and plumbing (copper and pvc), roofing, and siding.

Rodney was a General Contractor for his 6,500 SF office/warehouse facility which included all site work and the design of a 5,000 SF radiant heating system.

Rodney helped design and install water collection systems at both brothers homes. This included shooting grades, installing pvc piping, installing a systern.

This explains why Rodney is a great technical mentor for the January assessment trip to Guachtuq. A General Contractor is a good technical mentor, and his experience with construction management makes him ideal for this assessment trip. Rod has lots of experience doing General Contractor, project management and people skills specifically valuable to the implementation.

Included below is Rod's Resume:

RODNEY A. ROOKEY
278 East Street North
Suffield, CT 06078
(203) 668-6093

Experience:

1982 to Present	**NORTHEAST INDUSTRIAL FLOORINGS, INC.** Vice President, Co-Owner. Duties include: Equipment operator, driver, project management, material procurement and estimating.
1992 – Present	**CENTURION WATERPROOFING, INC.** Vice President, Co-Owner. Duties include: All administrative duties, laborer, driver.
1980 to 1982	**BOUTIN CONST. ASPHALT PAVING COMPANY** Laborer.
1975 to 1980	**AYOTTE BROS. CONCRETE CONSTRUCTION** Laborer, Driver.
1973 to 1977	**NICHOLSON FUNERAL HOME** Facilities, Maintenance.

Education:

Springfield Technical Community College
Associate's Degree - 1984
Major: Civil Engineering

Other:

Appointed to Who's Who of Community Colleges.
Math Tutor for Math Department.
Dale Carnegie Sales Course.
Dur-A-Flex University
Elite Crete Applicator Training

Hobbies:

Motorcycling, Auto Racing.

Figure 1: The resume of Rodney Rookey

Pre-Assessment Report Part 2 – Technical Information

1.0 EXECUTIVE SUMMARY

The Worcester Polytechnic Institute chapter of Engineers Without Borders (EWB-USA WPI) is requesting that project #6871, Rainwater Harvesting, be approved for an assessment trip this January 2nd to January 12th of 2015. The purpose of this trip is to re-assess community infrastructure and make preparations for a large-scale implementation trip in May, 2015.

The goal of this project is to achieve water security for each of the families in Guachtuq, Guatemala. This goal is being accomplished through the implementation of individualized rainwater harvesting systems; thus, the scope of this project encompasses the 37 families living in the community as of May 2014. Each home receives its own individual system due to the lack of a central community location. Systems are designed with enough storage capacity to ensure families will have adequate amounts of water to meet cooking and drinking needs year round.

Guachtuq, a rural community of about 220 people, is located in the Alta Verapaz region of Guatemala, a mountainous region in the northern half of the country. Many community members exclusively speak Pokomchi, an indigenous Mayan dialect, although some are also able to speak Spanish. As has been established through assessment trips, the community has identified lack of water security as their most pressing problem. EWB-USA WPI has been working in conjunction with the community to solve this problem through individualized rainwater harvesting systems. EWB-USA WPI emphasizes that these are system implementations, and not just an implementation of additional tanks for the community. The 37 families are dispersed over about a 1km road that leads up a mountain just outside of the San Cristobal municipality. The chapter's in-country contact NGO is CeCEP (El Centro Comunitario Educativo Pokomchi), which aids the travel teams with cultural information, translators, a work space, and communication with the community when the team is not in Guatemala.

EWB-USA WPI partnered with Guachtuq in 2009 when the community first identified its main concerns to EWB-USA. From the first two assessment trips, it was established that bringing water security to the community in Guachtuq should be the focus of the project. During the dry season, the community relies on a single communal water source located approximately 1 km downhill from the top of the community. This distance, in combination with the mountain's steep slope, makes accessing water a long and difficult task for many of the community members. Some homes have existing rainwater harvesting systems, however, they do not always meet the water needs of the families. This problem mainly manifests itself in that they are often not built as closed systems, leading to insect infestations in the tanks and contamination of the water. Following the success of the first two assessment trips, EWB-USA WPI traveled on its first implementation trip in January of 2013 and implemented 2 pilot individualized rainwater harvesting systems. This trip was followed up with another assessment trip in May 2013 to ensure the functionality of the pilot systems. The team received positive feedback regarding the first two systems and returned in January 2014 to gather information and to implement an additional 2 systems. The team also made some system improvements, including the first flush system. With 4 successful systems implemented, EWB-USA WPI returned in May 2014 to construct systems with 8 more families. On this trip, community families were heavily involved in

the implementation, showing their complete commitment to the project. This brings the chapter to the January assessment trip.

During the requested assessment trip, the EWB-USA WPI team plans to accomplish several major objectives. These objectives include:

1. Clarifying construction techniques, materials management, and water quality testing.
2. Setting up meetings with the community, CeCEP, and the municipality.
3. Arranging logistics to finish the project with a 25 home implementation trip in May 2015.

Construction techniques will be discussed with community members in order to establish a standard, intuitive method for displaying construction plans. A new store for purchasing materials will be located, and transport will be secured to get the materials from the city of Coban, where the suggested store is located, to the community. Should the materials need to be stored anywhere before the team arrives in country, a secure location will also be found that can fit the needed quantity of materials. Water quality testing will continue as it has been done on previous trips to ensure that the quality of water being supplied by the systems is still sufficient, and more specifically to quantify the efficacy of the first flushes. Meetings held with the chapter's in-country partners will ensure that everyone is still satisfied with the progress of the project and agrees on the current project trajectory. Through all of these tasks, the team will evaluate the feasibility of completing the implementation phase of this project in May 2015. The 25-home implementation will achieve the project's goal of providing water security to every family living in the community of Guachtuq.

Upon returning from Guachtuq this January, EWB-USA WPI will evaluate the feasibility of finishing the implementation in May 2015 based on the indicators discussed in this report. With the successful completion of each of them, the chapter will be able to make the proper arrangements to ensure that all 25 remaining homes in the community can receive complete rainwater harvesting systems by May 2015. EWB-USA WPI does believe that due to increased community involvement, this larger scale implementation trip is possible; this will be confirmed by the assessment trip in January.

2.0 PROGRAM BACKGROUND

The Engineers Without Borders-USA chapter at Worcester Polytechnic Institute (EWB-USA WPI) aims to provide the community of Guachtuq, Guatemala with water security. The community of Guachtuq is located in the Alta Verapaz region of Guatemala and is home to about 220 Pokomchi (people of Mayan descent) among 37 families. Of the many problems they face daily, unreliable access to clean drinking water was identified as their greatest concern. Water security can be described as having adequate quantity, quality, and access to water to meet a home's basic needs. Currently, many families rely on a water source called the *finca,* a polluted, spring-fed water basin located a half-hour walk downhill from most families in the community. During the dry season, which lasts from February to May, the finca often dries up, forcing families to find other, more distant sources of water.

EWB-USA WPI completed two assessment trips in 2010 and 2011, where the team started to form a relationship with the community members of Guachtuq. The team conducted in-house assessments, held community meetings, and undertook water quality studies. In 2011, the team conducted a community wide survey to determine a water consumption rate for each family. Unfortunately, no trends emerged that related the number of family members to water consumption across the community, so the team temporarily used WHO standards for

determining water consumption rates. 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 that the team has developed is an Excel model to assist the team when creating the metrics for each system. Using a variety of parameters, the model 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. The model has a built-in safety factor for water consumption rate to ensure that systems will have adequate storage to provide families with sufficient drinking and cooking water year round.

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 demographic information about every family and to learn general information about the community. Water quality tests were also collected at various water sources throughout the community. The monitoring system established during the January 2013 trip evolved into a bi-weekly survey that asked residents about their water consumption habits. This data was compiled and analyzed to deduce that the average community consumption rate before implementation was approximately 6.7 liters per person per day for cooking and drinking. This confirmed that the Excel model incorporates a safety factor of two for water consumption rate. 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 all but one 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. This resulted in an immense transfer of knowledge such that many of the community men are now more knowledgeable and experienced in assembling rainwater harvesting systems. The next step for EWB-USA WPI and the community of Guachtuq is to complete implementation of the remaining 25 rainwater harvesting systems in May 2015.

3.0 PROJECT DESCRIPTION

The project in Guachtuq is focused on providing individual rainwater harvesting systems to each home in the community. A map of the community is attached below in this section. The focus of the project is to implement systems, not just to distribute tanks. This is in contrast to other rainwater harvesting projects that the community has had experience with in the past. Using the Excel model, described in section 2.0 Program Background, the team can determine the amount of tanks each home needs, if any. If a home does not need additional tanks, the team will improve the existing system (e.g. ensure that the system is completely closed and that no insects can infiltrate it). The basic components of the rainwater harvesting systems include the roof of the home, gutters, piping, a first flush, tanks and then a concrete base for the tanks. The gutters are attached to the side of the house using gutter clips made in the community from 1" x 8" rough cut pine and installed at an angle that makes sure that there won't be any stagnant water stuck in them. The PVC piping coming out of the gutters then leads to a first flush in order to take off the first volume of water coming off the roof, effectively rinsing the roof. The rest of the clean water then flows into the 2500L HDPE Rotoplas tank(s). These tank(s) rest on top of a concrete base, which is a thin poured slab of concrete with cinderblocks placed on top to elevate the tanks to a height that makes the spigot at the bottom of the tanks accessible.

The purpose of this assessment trip is to ensure that the community of Guachtuq is prepared for the implementation trip in May 2015. During the trip the team will make sure all of the families of the remaining homes are fully prepared for the time commitment and are informed of all preparations they must complete for the implementation in May 2015. The team will hold learning sessions with community children to reinforce concepts of water security throughout the community. One indicator that the community members have already learned from past implementations is that one family has already taken apart and successfully reconstructed their system at a new location independent of EWB-USA WPI. This indicates that the community members are knowledgeable about the systems and how to maintain them. Once all members of the community have been trained in how to implement the systems, the team will guide the Water Committee to create construction teams for the May 2015 trip. These teams will consist of one family member from each of the twenty-five intended implementation homes as well as help from community members whose homes have already been implemented on. With at least one member from all thirty-seven homes, the team is confident that the teams will be able to complete the 25-home implementation in May 2015. Once the team ensures the community members are prepared, they will confirm that CeCEP, the Municipality, and the suppliers in Coban are all prepared to support the 25-home implementation trip in May 2015.

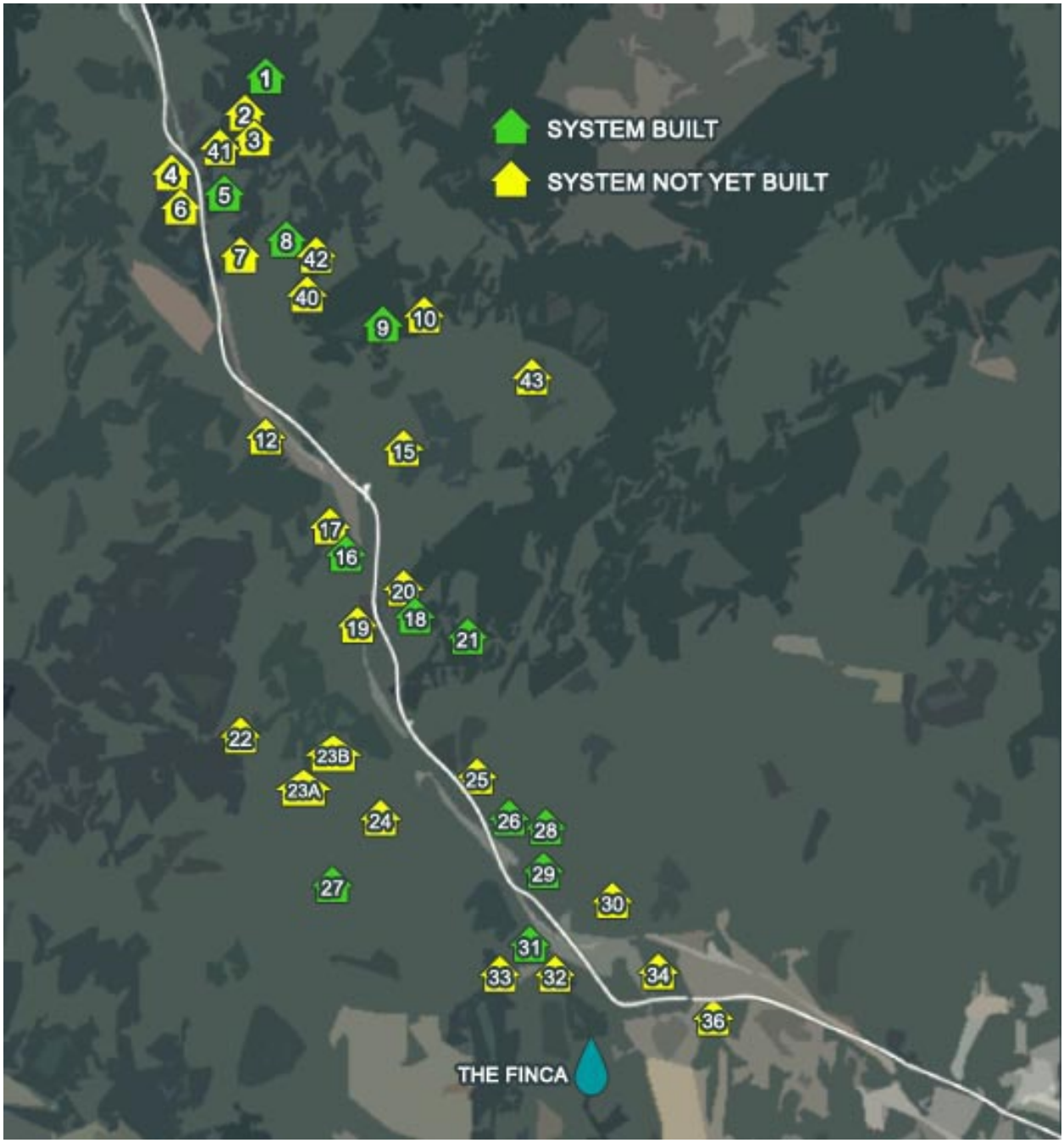

Figure 2: Map of Guachtuq

4.0 OBJECTIVES OF SITE ASSESSMENT TRIP

The January assessment trip aims to gather needed information to prepare a successful implementation trip for the final 25 homes in the community in May 2015. With this purpose, the travel team will conduct meetings with the Water Committee to create construction teams and will collect information from families of the intended implementation homes. By doing this the team will ensure that there will be enough man-power to run an efficient implementation in May 2015. During the trip the travelers will ensure all community members are confident in their ability and knowledge on how to build the systems. To continue the preparations the travel team

will confirm the store in Coban will be able to supply all the materials for the implementation in May 2015. Once the supply of materials is established, the travel team will meet with the San Cristobal Municipality to ensure transportation from the store in Coban to Guachtuq. While confirming the plans for the May 2015 implementation trip, the travel team will also test the previous 12 systems to ensure that the implementation of the systems was effective.

4.1 Materials Acquisition for 25 homes

The team will look into purchasing materials from a larger construction store in Coban, named Construfacil, that has the capacity to provide materials for the 25 systems that will be constructed during the May 2015 implementation trip. This is a store that was recommended to the team by Alvaro, a volunteer at CeCEP and the chapter's in country contact. For the concrete materials, the team will be checking with the concrete supply store (Macsams) in San Cristobal to ensure it can handle the order size. The travelers will also be checking with the lumber supply store to be sure it can handle the order quantity as well. If either store cannot meet the order size, these materials will be sourced out to Coban as well. Based on initial designs developed last trip, and agreed upon by the community, the travel team will contact Rotoplas to discuss ordering and transportation of 30 tanks from Guatemala City to Guachtuq.

4.2 Meeting with the Municipality

The travel team will have a meeting on January 5th to meet with the Municipality. During this meeting, the team will discuss materials transportation logistics. Due to the large quantity of materials required on the May 2015 implementation trip, there may be a need for more trucks or a phased implementation. The travel team will also ask if the Municipality can transport materials from Construfacil to Guachtuq.

4.3 Materials Management

Transporting materials in "home kits" to the community requires a more durable method of transport than the team used in the previous implementation trip. The travelers found that plastic bags were flimsy and disorganized, and therefore will be exploring other locally available options. The January travel team will also find a secure place to store materials in the event that Construfacil needs to deliver them before the May 2015 implementation trip. The team will ask the executive director of CeCEP if the materials can be stored at her house. If she is unable to store the materials, the travel team will ask the Municipality if materials can be stored in the Central Municipality Building. If neither option is viable, then the team will work with CeCEP to find another location, and determine the price of the new option, if applicable. The team will also inventory previously purchased tools that were left in country. The estimated list of materials needed for the proposed May 2015 implementation trip are included in appendix C. This list will be perfected and reviewed with the community on the January 2015 trip.

4.4 Implementation Plan

The community and EWB-USA WPI had originally agreed that the implementation of the final systems would be completed by 2016. However, the team has determined that it is possible to complete all of the homes in one final implementation trip in May 2015. During the assessment

in January, the team will empower the Water Committee to organize construction teams of community volunteers and working representatives from each family who will provide in-kind labor during the May 2015 implementation trip. The travel team will advise the Water Committee to be conscious of each community member's experience so that construction teams have an even distribution of skill sets during the May 2015 implementation. The travel team will discuss with the Water Committee what would be the best way to communicate the construction plan to the May 2015 construction teams. The travelers will also meet with the Water Committee specifically to discuss the changes made to the project timeline.

4.5 Family Meetings and Home Assessments

During the assessment trip, the travel team will visit each home in the community. The team will check old systems to ensure maintenance has been continued and all the systems are meeting each family's needs. The team will talk to all future beneficiaries about the status of the agreed upon preparations for the May 2015 implementation such as: fixing roofs, modifying houses, leveling the ground for the concrete base, collecting rocks for the concrete base, and cleaning existing tanks. The travelers will also check that each home still has the education booklets that were distributed on the May 2014 implementation trip.

4.6 Water Quality Testing

The team is going to be testing the water quality of each system at two points: the outflow of the first flush and the tank. This will be valuable information in determining whether the first flush impacts water quality. Public water sources will also be tested, including the finca.

4.7 Community Learning Sessions

The team wants to ensure that all members of the community understand the importance of water security and how to operate and maintain the systems. To accomplish this, the team will hold learning sessions with the children of the community to teach them about the systems. Parents will be encouraged to attend as well.

4.8 Meetings with Community

The travelers will be having two community meetings during the January trip. These meetings will orient the community to what will be expected from them during the May 2015 implementations in order to ensure the success of the project. In addition, there will be a focus group conducted with the women's committee in order to gather feedback on the maintenance and operation of the systems.

5.0 DATA COLLECTION AND ANALYSIS

5.1 Community Map

EWB-USA WPI has a map of the homes in the community that has been updated with data collected during the May 2014 implementation trip. It has been labeled with relevant locations, such as the primary water source, the Finca, the town of San Cristobal, and the houses of the community. The houses that have been implemented on and the houses that will be implemented on this January have been labeled as well. The map will be updated if any buildings have been constructed or removed since May 2014. This map will be helpful to EWB-USA WPI in tracking which homes have been or will be implemented on and where they are in the community. A copy of the current map is in Section 3.0.

5.2 Water Quality Data Collection

To ensure that systems are functioning as designed, the travel team will conduct water quality tests on the tanks and first flush of each of the 12 EWB-USA WPI systems. The team will also ask the users of each system if they have experienced any issues. Based on previous water quality tests conducted on EWB-USA WPI trips, bacteria presence has been identified as a primary concern. During this assessment trip, the team will continue using the Colilert Protocol tube tests and Petrifilm Protocol tests used previously in May 2014. The Colilert test will indicate the presence of bacteria based on color change and presence of E. coli based on fluorescence under a black light. The Petrifilm test will indicate presence of bacteria (red colonies) and the presence of harmful E. coli specifically (blue colonies). Each sample source will be subjected to three trial tests of each type and results will be documented on the “Water Quality Data Sheet” forms in appendix A. As can be seen in the appendix, the team will be testing each of the 12 EWB-USA WPI implemented systems at the outflow of the tank and the outflow of the first flush. The procedure for this can be found in appendix B. Along with testing for coliform presence, various tests will be carried out with regards to possible inorganic contaminants. The team will be testing two of each of the following: free chlorine, total chlorine, chlorine, pH, total alkalinity, total hardness, nitrates/nitrites, iron, sulfates, copper, lead and pesticides. One set of each of these tests will be taken at the finca and the other will be taken at House 9. Although there is not expected to be any hazardous inorganics in the systems, the team wants to have quantitative evidence of this and to be able to compare the systems with the contamination of the finca.

5.3 Material Cost Information

The team will travel to Coban to visit Construfacil, a materials supplier that can provide the quantities of materials needed for the upcoming implementation, which smaller suppliers in San Cristobal cannot support. The plan is to order all of the materials from this store in May 2015 and transport them to Guachtuq. While at this materials supplier, all the materials needed for the systems will be assessed for cost. This data will allow the team to have a more accurate cost estimate for the May 2015 trip rather than using the material costs from the other stores in San Cristobal. The team will also arrange for the materials to be transported to the community in May 2015, whether it is by the municipality or by the supplier.

5.4 Community Preparation Assessment

During this trip the team will ensure the community and the community members will be ready for the implementation of 25 systems in May 2015. The team will once again, similar to the May 2014 trip, meet with each of the families who will be participating in the implementation. These meetings with the families will ensure that they are clear on the preparations, which they agreed to during their home assessments in the past May 2014 trip. Also, the team will again communicate with each family that they are required to provide at least one working family member to help with the system implementations. In addition, it will be reiterated that the families of the previous implementations are aware that they are obligated to participate. This will ensure that there is adequate manpower available for a successful implementation. The names of each man will be recorded and the list will be given to the Water Committee who will be responsible for organizing them into five construction groups that the travel team will work with during the May implementation. The community members' knowledge of the design of the systems will be checked and reinforced with a community learning session geared towards engaging the children of the community. The travelers will also work with the community to ensure that the house and the surrounding land of each implementation site will be prepared by May 2015.

6.0 SCHEDULE OF TASKS

Friday January 2nd

1. Flight, Boston to Guatemala City (Arrive 14:00 - 15:00)
2. Van ride from Guatemala City to San Cristobal (Arrive 19:00 - 20:00)

Saturday January 3rd

1. Orient the team to the community and San Cristobal
2. Visit local schools and clinics in order to see if the implementation has made a difference
    a. Increased School Attendance
    b. Decreased clinic visits that would be caused by contaminated water sources

Sunday January 4th

1. 09:00: Team meeting at CeCEP with Sucy and Alvaro
    a. Communicate plans for the May trip
    b. Discuss the Rotary funding for the May 2015 trip
2. 15:00: Community Meeting
    a. Discuss 25 system implementation in May
    b. Discuss the objectives for the week
3. 17:00: Split into two groups: one to House 1 and House 9 for Learning Sessions with the children and parents
    a. The sessions will cover maintenance of the systems and small details of system construction

Monday January 5th

1. 10:00 - Municipality Meeting to discuss:
    a. Materials transport, in case the team needs to arrange something with store in Coban
    a. Water Transport
    b. Tank or materials storage in the municipality building
2. 12:00 - Talk to Macsams and Wood store about order quantity
    a. Need to ensure they can handle it and can store it before talking to store in Coban

3. 15:00 - Talk with all 12 previously implemented homes
    a. Check on Education Materials
    b. Check Tank cleanliness and First Flush
4. 17:00 Materials Inventory at Roberto's

Tuesday January 6th

1. 08:00 - Talk with each original 2015 Family
    a. Confirm design and preparations
        i. leave something printed with design
2. 12:00 - Check on education materials
3. 13:30 - 1630 Water Quality Tests

Wednesday January 7th

1. 10:00: Meeting with each family that was originally to receive implementation in 2016
    c. Confirm design and preparations
        i. Create a printed design with the families for their personal reference
    d. Ensure each home still has an education booklet
2. 14:00: Water Quality Tests

Thursday January 8th

1. 09:00 - Community Meeting
    a. Discuss May 2015 plan and stress that community involvement is needed to make the May 2015 successful
    b. Introduce Rotary travelers and briefly explain the idea of Phase II
2. 12:00 - Water Quality Testing
3. 16:00 - Talk to any families that weren't available earlier in the week
    a. Make sure preparations for their homes will be completed by May 2015

Friday January 9th

1. 08:00 - Trip to Coban
    a. Materials Store
    b. Quantity and specific items
2. 10:00 - Rotary Club of Coban Visit*

Saturday January 10th

1. 08:00 - Show Rotary to:*
    a. The Community
    b. San Cristobal
    c. CeCEP
2. 11:00 - Water Quality
3. 15:00 - Talk with remaining families who were not home during the week

Sunday January 11th

1. Travel to Antigua

Monday January 12th

1. Van ride from Antigua to Guatemala City (Arrive 19:00 -20:00)
2. Flight, Guatemala City to Boston

*These action items are required to secure the $35,000 grant that is funding the May 2015 implementation trip.

7.0 GO/NO-GO DECISION

Criteria that the team will use to assess the feasibility of moving forward with the 25 home implementation in May 2015 include:

1. Successful organization of May 2015 work force and division into construction teams.
2. Construfacil, or another construction store in Coban is able to handle the order quantity, and the prices are comparable to the San Cristobal store prices.
3. Each family acknowledges and understands the preparations they must have completed when the implementation team returns in May 2015.
4. The men of the community have approved a way for the team to draw house designs that they understand and that can be easily communicated to the work groups.
5. The team has established a plan for transporting the materials from Coban to the community, and how much it will cost, if applicable.
6. Water Quality tests continue to show that the water that the systems implemented by EWB-USA WPI do not contain any hazardous materials or pathogenic E. coli.

When these criteria are met, the team will be sure that the 25 system implementation in May 2015 is possible. As can be seen by the criteria above, the focus of this trip is to guarantee that there will be adequate community involvement to support the construction of all 25 remaining systems. In the past trip there were groups of 8 men, that allowed the travelers to work on 2 homes at once. With these same numbers, it would be possible to be working on 6 homes at once. While EWB-USA WPI fully believe that there is already sufficient community involvement, using these indicators, the team will be able to confirm this in a concrete and tangible manner.

8.0 PROFESSIONAL MENTOR ASSESSMENT

8.1 Proffesional Mentor Name and Role

Rodney Rookey will be the Professional Mentor who will be traveling on this assessment trip in January.

8.2 Professional Mentor Assessment

To date, the students have implemented Rainwater Harvesting Systems in a total of 12 homes. Two homes were completed in January 2013. This allowed 5 months for in field testing of completed systems. An assessment of these homes was conducted in May 2013 and the system was performing at or above expectations. (Two more homes were implemented in January 2014 by the WPI team and these were assessed in May 2014.) Again the performance was satisfactory so eight more homes were implemented in May 2014. These eight homes will be assessed in January 2015. I have read the 526 report and am confident the WPI team and mentors are accurate in all protocols and assessments. I am looking forward to working with the WPI team in January 2015 to procure the required materials and arrange for delivery of same to a safe secure location until the team returns in May 2015 to implement the final 25 homes. As owner of two contracting firms, I have been involved with many groups of engineers, architects, project managers, etc. and I would rank this group of students and mentors among the best of all the “professionals” I have been involved with. The entire project plan is well thought out and complete. I would be grateful to have this team in my employ.

8.3 Professional Mentor Affirmation

I am part of the WPI-EWB USA Rainwater Harvesting Team as a professional mentor. I am involved in the development of the aforementioned trip plan and I will be going to the community to finish implementation of the original design.

Appendices:

Appendix A: Water Quality Test Forms

Water Quality Data Sheet

Source: Boiled: Tester:

Date/Time: Incubation Length:

Colilert (Tube)	YES	NO	Petrifilm
Yellow? (Bacteria present)	☐	☐	Blue Colonies (*e. coli*):
Fluorescent? (*e. coli* present)	☐	☐	Red Colonies (other):

Colilert (Tube)	YES	NO	Petrifilm
Yellow? (Bacteria present)	☐	☐	Blue Colonies (*e. coli*):
Fluorescent? (*e. coli* present)	☐	☐	Red Colonies (other):

Colilert (Tube)	YES	NO	Petrifilm
Yellow? (Bacteria present)	☐	☐	Blue Colonies (*e. coli*):
Fluorescent? (*e. coli* present)	☐	☐	Red Colonies (other):

Notes:

Source: Boiled: Tester:

Date/Time: Incubation Length:

Colilert (Tube)	YES	NO	Petrifilm
Yellow? (Bacteria present)	☐	☐	Blue Colonies (*e. coli*):
Fluorescent? (*e. coli* present)	☐	☐	Red Colonies (other):

Colilert (Tube)	YES	NO	Petrifilm
Yellow? (Bacteria present)	☐	☐	Blue Colonies (*e. coli*):
Fluorescent? (*e. coli* present)	☐	☐	Red Colonies (other):

Colilert (Tube)	YES	NO	Petrifilm
Yellow? (Bacteria present)	☐	☐	Blue Colonies (*e. coli*):
Fluorescent? (*e. coli* present)	☐	☐	Red Colonies (other):

Notes:

Figure 3: Water Quality testing sheets, where data from each Colilert and Petrifilm test is recorded.

Inorganic Contaminant Data

Parameter	Sample - House 9	Sample - Finca
Total Chlorine (mg/L)		
Free Chlorine (mg/L)		
Chlorine (mg/L)		
pH (standard units)		
Total Alkalinity (mg/L)		
Total Hardness (mg/L)		
Nitrates/Nitrites (mg/L)		
Iron (mg/L)		
Sulfates (mg/L)		
Copper (mg/L)		
Lead (mg/L)		
Pestacides (mg/L)		

Figure 4: The chart with which the results of the inorganic tests are recorded

Appendix B: Procedures for Water Quality Testing

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

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

The inorganic test results are immediate. The color of the tabs, after being dipped in water, determines the presence and quantity of the respective contaminant.

Appendix C: Materials List For each Home: Divided up by each section of the system

Materials	House 3	House 4	House 6	House 7	House 10	House 12	House 15	House 17	House 19
2" Downspout	2	2		2	3	2	2	1	2
Gutter Caps [Pair]	2	12		1	3	1	2	1	2
Gutter Unions	0	2		2	3	2	2	0	2
Gutter Clips	8	16		8	30	8	8	3	6

Figure 8: Gutter Materials, Houses 2-24

House 22	House 23A	House 23B	House 24	House 25	House 30	House 32	House 36	House 40	House 41	House 42	House 43
	2	1	1	2	5	2	2		2	3	1
	2	1	1	2	5	2	2		2	3	1
	2	1	1	2	4	0	0		0	1	1
	12	6	6	12	20	6	6		8	18	9
	4	1.5	1.5	3*	7	2	2		2	3	1.5

Figure 7: Gutter Materials Houses 22-43

Materials	House 3	House 4	House 6	House 7	House 10	House 12	House 15	House 17	House 19
2" PVC Elbow		2	2	2	3	2	2	1*	2
2" PVC Tee		1	1	2	1	1	2	1	2
2" PVC Tube (cm)		300	200	900		1000	700	300	800
2" x 1.5" Reducer		1	1	1	1	1	1	1	1
1.5" PVC Tube (cm)		40	40	40	20	40	40	60	60
Rotoplas Tank Inlet		1	1	1	1	1	1	? (4/2)	1
1.5 Male Adaptor		1	1	1	1	1	1	1	1
Mosquito Netting	bulk	bulk	bulk	bulk	bulk	bulk	bulk	bulk	bulk
2" PVC Coupling		0	0	0	0	0	0	0	0
1.5" Elbow	0	1	1	1	1	1	1	1	1
1.5" Tee	0	0	0	0	0	0	0	0	0
45 deg 1.5" elbow		1	1	1	1	1	1	1	1
45 deg 2" elbow		0	0	0	0	0	0	0	0

Figure 5: Path To Tank Materials Houses 1-23b

House 22	House 23A	House 23B	House 24	House 25	House 30	House 32	House 36	House 40	House 41	House 42	House 43
	2	1	1	0	3	3	2		0	4	1
	1	1	1	2	2	2	2		2	4	1
	1800*	200	1500	700	1500	400	1000		500	500	100
	1	1	1	2	1	1	2		1	1	1
	60	60	60	60	60	60	60		60	60	60
	1	1	1	1	1	1	2		1	1	1
	1	1	1	2	1	1	2		1	1	1
	bulk	bulk	bulk	bulk	bulk	bulk	bulk		bulk	bulk	bulk
	0	0	0	0	0	0	0		0	0	0
	1	1	1	2	1	1	2		0	1	1
	0	0	0	0	0	0	0		0	0	0
	1	1	1	2	1	1	2		1	1	1
	0	0	0	0	0	0	0		2	0	0

Figure 6: Path to Tank Materials Houses 24-43

Materials	House 2	House 3	House 4	House 6	House 7	House 10	House 12	House 15	House 17	House 19
2" PVC Tube (cm)		10	10	10	10	10	10	10	10	10
1.5" PVC Tube (cm)		10	10	10	10	10	10	10	10	10
3" x 2" Reducer		0	0	0	0	0	0	0	0	0
4" x 2" Reducer		1	1	1	1	1	1	1	1	1
3" x 1.5" Reducer		0	0	0	0	0	0	0	0	1
4" x 1.5" Reducer		1	1	1	1	1	1	1	1	0
3" PVC Tube (cm)		0	0	0	0	0	0	0	0	100
4" PVC Tube (cm)		140	215	210	210	370	115	180	170	0
1.5 Male Adaptor		2	2	2	2	2	2	2	2	2
1.5" Italy Valve (metal)		1	1	1	1	1	1	1	1	1
1.5" x 90 deg elbow		1	1	1	1	1	1	1	1	1
3" union (coupling)		0	0	0	0	0	0	0	0	2
4" union (coupling)		2	2	2	2	2	2	2	2	0
Water Bottle		1	1	1	1	1	1	1	1	1
Stick		1	1	1	1	1	1	1	1	1

Figure 9: First Flush Materials Houses 2-19

House 22	23A	23B	House 24	House 25	House 30	House 32	House 36	House 40	House 41	House 42	House 43
	10	10	10	20	10	10	20		10	20	10
	10	10	10	20	10	10	20		10	20	10
	0	0	0	0	0	0	0		0	0	0
	1	1	1	2	1	1	2		1	2	1
	1	1	1	2	1	1	2		1	2	1
	0	0	0	0	0	0	0		0	0	0
	0	175	0	0	0	0	0		0	0	150
	100	0	120	200	134	140	80		75	270	0
	2	2	2	4	2	2	4		2	4	2
	1	1	1	2	1	1	2		1	2	1
	1	1	1	2	1	1	2		1	2	1
	0	2	0	0	0	0	0		0	0	2
	2	0	2	4	2	2	4		0	4	0
	1	1	1	1	1	1	2		1	2	1
	1	1	1	1	1	1	2		1	2	1

Figure 10: First Flush Materials Homes 22-43

Materials	House 2	House 3	House 4	House 6	House 7	House 10	House 12	House 15	House 17	House 19
Rotoplas Tank Inlet		3	3	1	1	5	0	1	1	3
1.5" PVC Tube (cm)		300	300	200	200	400	0	200	200	300
1.5 Male Adaptor		3	3	1	1	5	0	1	1	3
1.5" PVC Elbow		1	1	1	1	1	0	1	1	1
1.25" PVC Tube (cm)		400	400	400	400	400	0	400	400	400
Mosquito Netting		-	-	-	-	-	0	-	-	-
1.5" PVC 45 Elbow		1	1	1	1	1	0	1	1	1

Figure 11: Tank Connections Materials Houses 2-19

House 22	House 23A	House 23B	House 24	House 25	House 30	House 32	House 36	House 40	House 41	House 42	House 43
	3	1	1	3	3	3	2		1	5	1
	300	200	200	300	300	300	200		200	400	200
	3	1	1	3	3	3	2		1	5	1
	1	1	1	1	1	1	2		1	1	1
	400	400	400	400	400	400	400		400	400	400
	-	-	-	-	-	-	-		-	-	-
	1	1	1	1	1	1	2		1	1	1

Figure 12: Tank Connections Materials Houses 22-43

Materials	House 2	House 3	House 4	House 6	House 7	House 10	House 12	House 15	House 17	House 19
Rotoplas Tank Inlet		3	3	1	1	5	0	1	1	3
1.5" PVC Tube (cm)		300	300	200	200	400	0	200	200	300
1.5 Male Adaptor		3	3	1	1	5	0	1	1	3
1.5" PVC Elbow		1	1	1	1	1	0	1	1	1
1.25" PVC Tube (cm)		400	400	400	400	400	0	400	400	400
Mosquito Netting		-	-	-	-	-	0	-	-	-
1.5" PVC 45 Elbow		1	1	1	1	1	0	1	1	1

Figure 13: Overflow Materials Houses 2-19

House 22	House 23A	House 23B	House 24	House 25	House 30	House 32	House 36	House 40	House 41	House 42	House 43
	3	1	1	3	3	3	2		1	5	1
	300	200	200	300	300	300	200		200	400	200
	3	1	1	3	3	3	2		1	5	1
	1	1	1	1	1	1	2		1	1	1
	400	400	400	400	400	400	400		400	400	400
	-	-	-	-	-	-	-		-	-	-
	1	1	1	1	1	1	2		1	1	1

Figure 14: Overflow Materials Houses 22-43

Materials	House 2	House 3	House 4	House 6	House 7	House 10	House 12	House 15	House 17	House 19
lastic Covering for Concrete (72")	10	10	10	10	10	6	0	6	10	10
Tie Wire [ft]	3	3	3	3	3	3	0	3	3	3
Cinder Blocks	50	50	50	50	50	25	0	25	50	50
Ready Mix Concrete 50kg	28	28	28	28	28	14	0	14	28	28
2"x4"x12' wood	2	2	2	2	2	0	0	0	2	2
2"x4"x5' wood	2	2	2	2	2	4	0	4	2	2
Rocks [m3]	0.5	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5
2 L Bottles	4	4	4	4	4	4	0	4	4	4
1/4" Rebar	8	8	8	8	8	3	0	3	8	8
3/4" Crushed Stone [m^3]	0.5	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5
Water [L]	150	150	150	150	150	75	0	75	150	150

Figure 15: Concrete Base Materials 22-43

House 22	House 23a	House 23B	House 24	House 25	House 30	House 32	House 36	House 40	House 41	House 42	House 43
	10	6	6	10	10	10	10		10	6	10
	3	3	3	3	3	3	3		3	3	3
	50	25	25	50	50	50	50		50	25	50
	28	14	14	28	28	28	28		28	14	28
	2	0	0	2	2	2	2		2	0	2
	2	4	4	2	2	2	2		2	4	2
	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
	4	4	4	4	4	4	4		4	4	4
	8	3	3	8	8	8	8		8	3	8
	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
	150	75	75	150	150	150	150		150	75	150

Figure 16: Concrete Base Materials Houses 2-19