

Water Accessibility and Potability Project: Las Mercedes & El Naranjito El Salvador 2008

Ann Campana Judge Foundation Project Report

Engineers Without Borders – Oregon State University

Project Director: Kelly Kibler, Engineers Without Borders 103 Memorial Union #262 Corvallis, OR 97331

<http://groups.engr.orst.edu/ewb/>

Project Overview:

Engineers Without Borders is a non-profit humanitarian organization established to partner with developing communities world wide in order to improve their quality of life. This partnership involves the implementation of sustainable engineering projects, while involving and training internationally responsible engineers and engineering students. The Oregon State Chapter of Engineers Without Borders (EWB-OSU) has been working in the communities of El Naranjito and Las Mercedes for over four years. The El Salvador Ministry of Health has designated this region as an area of grave concern due to the prevalence of undernourished children. In 2004 EWB-USA was contacted by a Peace Corps volunteer stationed in the area and subsequently EWB-OSU adopted the project. The main issue the group is addressing is one of water availability, and potability. Before receiving the Ann Campana Judge Foundation Grant, EWB-OSU had traveled to the community five times to gather information and to implement point of use filtration systems, and a rainwater catchment system at El Naranjito School. With support of ACJF, EWB-OSU was able to complete two more implementations. The first of these was in June of 2008, and consisted of sending 5 students and one professional to the community of Las Mercedes to construct a gravity fed water delivery system. Finally, the grant also served to make the implementation of 3 rainwater catchment systems in rural sub-community of Cerro Caballo possible. Complete engineering reports of this project are available at

http://groups.engr.orst.edu/ewb/projects/el_salvador_project

Project Accomplishments:

Between June 2008 and December 2008, EWB-OSU worked with community members from Las Mercedes and El Naranjito, El Salvador, and a Peace Corps volunteer, to construct two water systems that now serve two different locations in the communities. In June 2008, a team of five student members of EWB-OSU and one Professional Mentor traveled to Las Mercedes to build a gravity-fed water delivery system. The system consisted nominally of a buried PVC well topped by a sand and gravel filter (referred to as an infiltration gallery), 1036 m of PVC piping, 132 m of galvanized steel piping, two concrete storage tanks, and two laundry stations. The infiltration gallery was comprised of 3 meter-long PVC screens placed below the perennial water table. The screens were topped by 0.15 m of pea gravel, followed by 0.80 m of medium sand, 0.10 m of angular gravel, and finally capped with an armor layer of large cobbles and small boulders. A PVC and galvanized steel pipeline carried the water by gravity to pre-determined tank sites that were central to multiple households. The tanks were constructed of cement blocks, rebar, and mortar sited on gravel, concrete, and rebar foundations. Each lidded tank was sized to provide approximately 12 hours of storage. Float valves were placed on the

tank inlets to stop the flow of water when tanks were full, and overflow mechanisms redirected flows in the case of failed valves. Concrete laundry stations were constructed next to each tank, to provide a convenient place to wash clothes. Heavy loads of bleach and detergents are discharged to the local aquatic ecosystems as many women in Las Mercedes and El Naranjito wash their clothes directly in streams. Promoting use of wash stations situated far from natural hydrologic systems may prevent considerable pollution of water resources in this area.

In December 2008, a team of six student members of EWB-OSU and one Professional Mentor traveled to El Naranjito to build rainwater catchment systems for families in the isolated community of Cerro Caballo (a sub-community of El Naranjito). Three households are located in the ridgetop community of Cerro Caballo, approximately one mile from El Naranjito proper. Of all the homes surveyed by EWB-OSU, families in Cerro Caballo walk the farthest for their water. As no sources of gravity-fed water were available to serve Cerro Caballo, EWB-OSU chose to construct rainwater catchment systems, consisting of rooftop collection, gutters to transport the water, temporary rain barrels to serve water needs during the rainy season, and long-term storage tanks to store water for the dry season. EWB-OSU also constructed concrete laundry stations near each storage tank. To preserve quality of the stored water, each tank was equipped with a lid, and each system also included a first-flush mechanism that prevented the first 1 mm of runoff from entering drinking water storage. This 1 mm was stored separately where it could be used for non-consumptive uses.



View of the rainwater catchment tank as the roof is being constructed.

Prior data collected in El Naranjito and Las Mercedes indicated that on average, people spend over two hours daily collecting water. In Cerro Caballo, people averaged three hours of water collection during the dry season. These two projects eliminated the need for approximately 50 men, women and children to spend this time on water collection. We hope that in addition to the improved quality of life engendered by these projects, this extra time will also generate considerable economic, educational, and social returns as community members now have more time to devote to earning a living, education, or improving their community.

Overcoming Obstacles: Problem-solving in the field:

Of the two implementation trips that the ACJF grant helped fund, the June 2008 trip was the more challenging. However, lessons learned during the June trip have improved the planning for future trips.

Technical Obstacles

A major obstacle that the June 2008 team faced was construction of the pipeline. The galvanized steel pipe proved frustratingly difficult to install, mainly due to the pipe's rigidity, its weak threaded joints, and the steep terrain. Its installation consumed much more time than anticipated, putting pressure on the rest of the construction schedule.



Galvanized pipe along the steep, forested hillside.



An EWB-OSU member works with beneficiaries to mix cement by the "volcano method."

During construction, the pipeline was routinely tested for water flow to the unfinished end. After over 50% of the pipeline had been laid, the flow stopped. Team members determined the problem was due to air pockets being trapped in the pipeline at local maximum heights, and also mud clogging the pipeline. To solve the air problem, two team members made an unplanned two-day trip to the nearest large city, Ahuachapán, to search for a remedy. They brought back and installed fittings, dubbed "burp valves."

The major obstacle with tank construction was quantity and location of materials. For both trips, the amounts of sand and gravel delivered seemed to be less than pre-ordered, and thus additional money had to be spent ordering more materials. Although there were multiple construction sites, many of the materials were delivered by truck to one location in the community. Therefore, team and community members labored to manually transport materials from one site to another. When this herculean effort proved impossible for certain items, a truck was hired to transport them.

The sheer size of the rainwater catchments tanks constructed on the December 2008 trip was a difficulty in itself, and the time-sensitive pouring of the foundation was a particular concern. The team rented a gasoline-powered cement mixer to solve this problem, rather than hand-mixing the cement in the traditional fashion. They also hired an additional mason to help finish the tank walls within the scheduled time.

Environmental Obstacles

In El Salvador, June is the middle of the rainy season. During the trip it rained hard anywhere from three to 20 hours per day. At one point, although nobody knew it at the time, the team worked through a tropical storm. The travelers were prepared personally for such weather, but it conflicted with the construction schedule and safety of the workers due to potential landslides. Major components of the construction, such as the PVC joints and the tank, required dry weather. Team members made liberal use of plastic tarps in an attempt to keep the work dry, but the weather still caused major delays.



Two EWB-OSU team members sift sand during a downpour.

Wildlife was also a factor in construction, particularly the construction of the pipeline. Biting ants' nests were common and minor setbacks. However, when a large wasp's nest directly in the pipeline path was identified by the wary locals, construction was postponed for an entire day. A heroic EWB member donned as much protective gear as possible and installed the sections of pipe nearest the nest.

How the ACJF funds were expended

The ACJF foundation awarded EWB-OSU \$12,000 for these two implementation projects. Additional funding from the OSU student foundation, Isa Mundo One World Foundation, individual donations, and

EWB-OSU fundraising also helped to fund these projects, however the ACJF grant was by far the largest single donation towards the work. These projects would not have been possible without it.

Categorized Expenditures	Cost
<i>June 2008 Trip</i>	
Airfare	\$ 3,600.00
Construction Materials	\$ 5,360.00
Travel expenses (food, transportation etc.)	\$ 753.16
Pre-trip Expenses	\$ 294.45
Total	\$10,001.61
<i>December 2008 Trip</i>	
Airfare	\$ 5,246.80
Materials	\$ 8,880.00
Travel expenses (food, travel etc.)	\$ 1,483.23
Pre-trip Expenses	\$ 247.67
Total	\$15,797.70
Grand Total	\$25,805.31



Pouring the foundation at the sub-community of Cerro Cabollo on the December 2008 Trip.



The team rests for a few minutes and celebrates Christmas after the completion of the rainwater catchments.