Live and Learn
EWB-USA Water Project Monitoring in Peru

Master’s Report by Cole Sigmon
Submitted to

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Communication is paramount

- With local partners
- In reporting
- With the community
- During the assessment

Use metrics/indicators that are measureable

The use of inappropriate indicators seems to be very common in EWB projects. The table below lists some examples of this.

Follow up

Community motivations vs EWB/development inspired motivations

Taking lessons forward

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Forword by Cole Sigmon

Something that has become painstakingly clear as I’ve explored different development projects in Peru and read about projects in other parts of the world while simultaneously actively working on the design and implementation of a Peruvian water project is this: It is very easy to criticize a development approach or engineering decision after it has failed; failures and mistakes seem obvious in retrospect. However, things are seldom as clear while design and implementation decisions are being made. The development workers and development engineers with whom I’ve had the opportunity to interact over the past couple of years have all agreed that sustainable community development is really hard! It’s also really hard to expose and share our mistakes and failures and equally as hard to find literature about the failures and mistakes of others.

A shining example of an organization that is working hard to share this valuable information with the rest of the world is EWB Canada, who has published an annual “Failure Report” for the last three years. Bill Gates Sr, the co-chair of the Bill and Melinda Gates Foundation, did a great job of explaining the importance of this kind of sharing in his forward to the most recent report. He wrote, “‘Live and learn’ is a familiar saying, but its importance stems largely from what goes unmentioned: failure. In fact, the primary use of this saying is to acknowledge that everyone makes mistakes and encounters failure. The important thing is to learn and improve from these experiences.” To do just that—to learn and improve from these experiences—it’s absolutely necessary to share our experiences, both successes and failures—to combine our collective wisdom so that we can avoid repeating our mistakes.

With this in mind, I owe a big thanks to Liz Morris of EWB-UNC, Steve Robinson of EWB-UM-CP, Buck Kempner of EWB-CU (circa 2007), Forrest Collins of EWB-CU (circa 2003), and Barbara Hendrick of EWB-PU, who are fellow past EWB project managers who took
time out of their busy lives and mustered up the courage to share project documents, personal experiences, and other information that made this report possible.
**Introduction**

Around the world, well-intentioned water systems lie broken and/or abandoned well before their expected hardware lifetime. Common reasons for failure are lack of community buy-in, lack of education and training, or the use of foreign materials that cannot be replaced with locally available parts. Helping a community obtain clean water for only a short period does not offer the expected health benefits and could even be more harmful if children grow up drinking clean water for a couple years and then are forced to go back to drinking unsafe water without any built-up resistance. In fact, even a few days of interruption in the water system could be enough to eliminate any health benefits that could be gained by clean water provision. Sustainable access to safe water requires more than just system construction. Continued monitoring and evaluation of water projects offer continued support for installed systems as well as information that can help improve future installations. According to Blue Planet Run Foundation, over 50 percent of all water projects fail, less than five percent of projects are visited, and far fewer than one percent have any longer-term monitoring.

This report details experiences and lessons learned during an Engineering for Developing Communities (EDC) project performed in collaboration with several college chapters of Engineers Without Borders-USA (EWB), including the University of Colorado (CU), Princeton University (PU), the University of North Carolina (UNC), and the University of Maryland (UMCP). The objectives of this project were to conduct monitoring activities on six current and past EWB projects in Peru and to use and share these experiences to guide decisions and approaches in the final implementation phases of EWB-CU’s current Peru project, similarly to guide the monitoring and evaluation of EWB-CU past projects, to provide feedback to EWB-USA on their newly-introduced monitoring and evaluation tools and reporting requirements, and to gain a deeper personal understanding of successes and failures in the field. It will also be important to share the findings of this project with other EWB volunteers and the rest of the development engineering community in order to spread these lessons learned and ultimately to prevent the same mistakes from happening in the future.
Section 1: Engineers Without Borders-USA

History of EWB-USA

EWB, which was founded in 2002, has grown to over 12,000 members working on 350 projects in 45 countries around the world\(^3\). The mission of EWB-USA is twofold: “EWB-USA supports community-driven development programs worldwide by collaborating with local partners to design and implement sustainable engineering projects, while creating transformative experiences and responsible leaders.” Over the course of the last decade, project oversight has expanded as much as the organization itself, from chapters working on projects more autonomously to a QA/QC system with substantial reporting requirements and an approval process which includes mandatory approval of the design by a committee of professional engineers called the Technical Advisory Committee (TAC).

The EWB-USA Approach to Monitoring and Evaluation

The most recent addition to the EWB-USA project process, introduced in September 2010, was the incorporation of monitoring into the reporting requirements. The project process consists of a list of guidelines and reports that EWB chapters use to take a project from conception, through community assessment, alternatives analysis, implementation, monitoring and evaluation (since 9-2010), and project closeout. The new monitoring forms are for chapters who plan to visit a previously-implemented project without doing any additional assessment activities (in which case the pre- and post-assessment forms would be used). EWB-USA also introduced a new monitoring section into its pre- and post-assessment, pre- and post-implementation, and closeout reports. These sections follow the same format as the stand-alone forms, although less detail is requested. The monitoring-related sections of the EWB-USA
report instructions can be found in Appendix A and complete forms for EWB-CU filled out since September 2010 are available by contacting the author.

The addition of M & E is a major development in the project process since previously monitoring was only mentioned and not explained. In the absence of clear M&E guidelines or suggested best practice, EWB chapters had little incentive and no guidance designing and implementing an M&E component to their projects. One bullet point in Section 4 of the EWB-USA Community Guidelines under Characteristics of Successful projects does list “an effective monitoring system that measures the project’s progress, identifies problems, and provides a mechanism for necessary changes in the project,” but this “effective monitoring system” is not explained elsewhere in the guidelines. Implementation of a monitoring and evaluation plan is listed also as a tactic in the figure below, from Strategy 1 of the EWB-USA Strategic Plan, published March, 2010.

**Figure 1: EWB-USA’s March, 2010 strategic plan lists M&E as a tactic**

Although much of the work done in the six communities in this report was done prior to the addition of monitoring into the EWB-USA project process, lessons learned while participating in the project process and in the recent monitoring activities provide additional insight into ways to improve EWB-USA chapter reporting and the project process in general. These will be discussed following the community descriptions, EWB involvement, monitoring activities, and lessons learned in Section 6.
Section 2: Community Descriptions

The six projects that were visited in this project can be seen in Figure 2 on the right. Five are bunched together in the province La Libertad and Compone can be seen by itself in Southern Peru. National borders are bright yellow.

Figure 3 is a zoomed-in view of the five monitoring sites in La Libertad

Figure 4 is a zoomed in view of the monitoring sites that are in the District Municipality of Chao
The District Municipality of Chao

The District of Chao, home to four of the six projects in this report (See Figures 2-4 above), was established in Northeastern Peru in January 1994, a little over a decade before EWB-USA’s first project there. The municipal seat shares the name of the district municipality—Chao—and is located along the Panamerican Highway about 1.5 hours South of the city of Trujillo, Peru. The 23 caserios (townships) encompassed by the municipality, including three of the EWB monitoring sites, are governed by a mayor, and the municipality is the level in of Peruvian government that is responsible for providing potable water and sanitation for its citizens. Several caserios in Chao, especially the rural ones far outside the municipal seat, do not enjoy as much monetary support as those which are closer and more accessible, and as a result they lack the electricity, water, and sanitation support that has been given to other villages.

The principal economic driver in this district is agriculture and Chao is known for its corn, peppers, watermelons, beans, and fruits, including papaya and avocado. The only secondary education institution is located in Chao and children commute from the closely surrounding villages to attend. Chao has a piped system for chlorinated groundwater and wastewater collection for the center portion of the town that receives primary treatment in lagoons. Although Chao has a market and several small hardware stores, replacement parts for water systems and other specialized materials have to be purchased in Trujillo.

The three EWB project sites in Chao are in the upper portion of the district, where the residents are primarily recent arrivals, having been relocated from higher up in the Andes during the Peruvian land reform of the 1950s.

The climate is very dry, with rain occurring only in the three- to four-month rainy season. The rest of the year is dry, hot, and sunny, which makes the area incredibly dusty.
Santa Rita—EWB-CU (2002-2004)

Santa Rita is a village of approximately 165 people located approximately 1 hour from Chao in the center of the Chao Valley (See Figures 3 & 4). A school in the village serves 85 children from Santa Rita and the surrounding area. The village is situated between the Río Huamanzaña and the Río Chorobal, which converge with the Río Cerro Blanco downstream, giving rise to the Río Chao. A concrete irrigation canal passes nearby the village to the west, providing means to cultivate crops in an arid environment. Anthropologists from the Metropolitan State College of Denver (MSCD), who were conducting archaeological research near the community after a major El Niño flood in 1998, referred to Santa Rita in their preliminary observations as “a town of considerable poverty” and reported that the flooding event brought considerable damage to the community including to homes, to crops, and to the local school. One of the team, Professor John Kent, brought the needs of the people to the attention of anthropologist Arthur Campa at MSCD. Professor Campa initiated the formation of the Peruvian Eco-Sustainable Research & Understanding (P.E.R.U.) NGO with the goal of starting a micro-enterprise in the village of Santa Rita.

The original spring-source gravity-fed water system in Santa Rita was installed with UNICEF funds in 1996 and pit latrines were installed for each home and four for the school between 1998 and 2002 by the municipality. The municipality has also built and staffed a health post, which serves Santa Rita and the surrounding communities and is “home base” for nurses who staff smaller health posts in surrounding communities.

While Santa Rita did not have electricity during EWB-CU’s involvement there, the electrical grid was extended there in 2010.
San Leon—EWB-CU (2005-2008)

San Leon is a community of approximately 150 people that comprise 36 families. The community is situated in the Chao valley about 1.5 km Southeast of Santa Rita (See Figure 4). Transportation to and from San Leon is on the same route as Santa Rita and operates to and from Chao about every hour.

San Leon, like other villages in the low-lying valley, is served by a concrete irrigation canal which makes life possible in this arid climate. The principal source of income in San Leon is agriculture and they are known for their watermelons, hot peppers, corn, papayas, and avocados. People in San Leon utilize the school and health post in Santa Rita, which are about a 30-minute walk from San Leon.
Huamanzaña—EWB-PU (2005-2010)

Huamanzaña is a village of about 120 people located in the District of Chao about 7.5 kilometers east along the same road as Santa Rita (See Figure 4). A small health post and primary school have been built by and are staffed by the municipality. The only electricity available in Huamanzaña is from an EWB-installed solar panel system, which provides light for the school and health post, as well as power for a cell phone charging station. Transportation between Huamanzaña and Chao is available twice daily both ways.

Few of the townspeople have received post-primary education but during the less intensive farming seasons, most of the young men travel down to Chao or Trujillo to find other jobs.

Two small springs in the area make the land habitable. The smaller of the two feeds reservoirs used for irrigation through open concrete channels, and the larger serves as irrigation for two families in the upper village and as the village source of drinking water since FONCODES, a Peruvian government program, installed it in 1999. The distribution system was installed so that villagers did not have to walk to the spring (up to 2km) and transport their water in buckets. The project placed thirteen public taps throughout the village.

The distribution system includes a 2-meter elevated shallow river bed crossing, two reservoirs (one a dual system), a break pressure tank, and individual tap stands. Household sanitation infrastructure is non-existent in Huamanzaña and the only bathroom, which consists of three toilets, a shower, and two sinks, was constructed by EWB-Princeton in 2005. The community reserves these facilities for children attending primary school and for health post staff. Other than this limited use of the bathroom, the community practices open defecation.
Llacamate—EWB-CU (2008-present)

Llacamate is a village of 135 people in the district of Chao, 20 steep kilometers up the road to the Northeast of Huamanzaña (See Figure 4). Llacamate is a small, agricultural-based community of approximately 35 families currently lacking access to clean water and basic sanitation. Of the 23 Chao caserios, Llacamate is located the farthest from the municipal seat of Chao, which is a major reason why they have not received support from the municipality in the areas of drinking water, secondary education facilities, sewage, and electricity. These services are all available to those who live closer to Chao proper.

The people of Llacamate get their drinking water from a system of irrigation canals that is fed by the nearby Colorado River, which is polluted with agricultural runoff and has tested positive for *E. coli* on numerous occasions. There is a clean, perennially-flowing spring source, located approximately five kilometers away from the village. The spring is partially accessible via the “highway” (dirt road) running through the village, but a kilometer-long access trail must also be traveled to reach the final location of the spring eye.

The irrigation system was installed by a partnership between FONCODES, a Peruvian development organization; APROACH, a Spanish NGO; and the community. The system includes 3 major suspended pipe crossings and is currently being concrete-lined.

Llacamate, like the other Chao communities, has an agriculture-based economy. Their higher altitude (6600ft or 2011m) is well-suited for beans, feed corn, and sweet corn. The market price for beans is 3 soles ($1.10) per kilo and an average sized family may be able to produce 3 or 4 100-kg bags per season, which represents $330.88 - $441.17 and about half of the growing season. Additionally, a “tarea,” or day of work has a monetary value of 15-20 soles ($5.51 - 7.35).
Cuidad de Dios—EWB-UNC (2007-present)

Ciudad de Dios is a community in the La Libertad Province Near Trujillo—about 3 hours North of the previously mentioned District of Chao (See Figure 3). Now recognized by the District Municipality of Laredo in Peru, it began as a squatter village in 1993. Since the villagers had only moved to the area in 1993, there was neither infrastructure nor government recognition. The people of Ciudad de Dios are predominantly indigenous migrants from the mountains to the West, who relocated in search of new economic opportunities. They are day laborers or field hands without agricultural land of their own—poor even by Peruvian standards.

The climate in the Moche Valley is hyper-arid, experiencing 1 inch of rainfall annually. Archaeologist Professor Brian Billman of UNC-CH began excavation at a 1500-year old site in the Moche River Valley in Peru. Excavations were conducted by students enrolled in the UNC-CH Field School in South American Archaeology. Adjacent to this site was the newly founded squatter community, Ciudad de Dios. Professor Billman, concerned about looting of the ruins, partnered with the villagers of Ciudad de Dios to protect the site. In payment, an annual sum of $1,200 for development purposes was offered to the village.

Since 1998, this exchange between Prof. Billman and Ciudad de Dios has resulted in construction of a road connecting the village to the main highway to Trujillo, creation of streets within the village, hiring of a civil engineer to survey the streets and property boundaries, and building of a soccer field and elementary school. Since 1999, looting of the archeological site has stopped completely, and good relations between Professor Billman and the community have prevailed.

In 2002, the district government recognized the community and provided a spring-source gravity-fed water system. However, serious problems existed with the implemented system
resulting in water flows that were sporadic and at times absent. The village then doubled in size, increasing the demand from the water source.

In 2006, Ciudad de Dios decided to use their earned development money to improve their water distribution system, with the goal of regular and adequate water being supplied to the households, public taps, and especially to the school, which will result in further recognition and education support from the Peruvian government.
Compone—EWB-UMCP (2008-present)

Compone is a community of 1500 in the Andean Mountains of southern Peru, 16 miles west of the city of Cuzco (See Figure 2). It is a traditional Peruvian highlands farming community with grain crops, livestock and dairy products as the main sources of livelihood. A local government, elected by the community oversees the water districts and schools in the community. Compone is divided into 5 neighborhoods.

Since Compone is located in the high Andes of Peru, at 11,000 ft (3,350m), the climate can be exceptionally cold at times.

Compone’s drinking water is currently supplied by numerous springs located in the adjacent mountains. Since 1997 a total of five gravity-fed systems have been built to supply water from these springs to the five neighborhoods of Compone. Each of the five independent systems currently provides water, but lacks adequate treatment to prevent the spread of waterborne illness. Each of the systems begins in the mountains, collecting water from a spring by means of a spring box. The spring boxes are connected to a series of underground pipes that take the water down the mountain to small concrete reservoirs. From the reservoirs, the water is piped to individual taps at community buildings and private homes.

Each of the five water supply systems is managed by a water committee but none of them are officially certified by the Peruvian government.
Section 3: Summaries of EWB Involvement

The District Municipality of Chao

Santa Rita—EWB-CU

EWB-CU worked in Santa Rita from 2002 to 2004, repairing their dysfunctional water system and holding a latrine building workshop where they constructed pour-flush latrines for the local school.

Table 1: EWB-University of Colorado travel history for Santa Rita

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<tr>
<th>Dates of Travel</th>
<th>Assessment or Implementation</th>
<th>Description of Trip</th>
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<tr>
<td>June 2002</td>
<td>Assessment</td>
<td>Assessment of water, infrastructure, environmental hazards, sanitation, and energy</td>
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<tr>
<td>June 2003</td>
<td>Implementation and assessment</td>
<td>Created water committee and conducted O&amp;M education; further assessment of sanitation</td>
</tr>
<tr>
<td>June 2004</td>
<td>Implementation</td>
<td>Construction of pour-flush latrines at school</td>
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June 2002:

After initial assessments in Santa Rita, Professor Campa (whose history is provided above) presented his work to the board of EWB-USA. The relationship between EWB-CU and P.E.R.U. began when he, a CU student, and a professional engineer conducted an assessment trip in 2002.

The goals of this trip were to assess structural stability of the buildings in town (in response to flood damage), mudslide and flooding problems, drinking water infrastructure, sanitation, and energy resources. The team discovered that, although mud- and rock-slides were common uphill of the village during the rainy season, none had ever reached the community and
that this was not a concern of the community. The team also discovered that, while the 1998 flood destroyed farmland and the road (both low lying areas to the South of the community), it was not the primary cause of damage to homes and buildings and that gradual degradation of the earthen adobe houses occurred through lack of normal rainwater drainage within the village itself, poor roofing, and shifts in the foundation. These damages occurred to several buildings in the community, including the school and the health post, both of which had to be rebuilt by the municipality.

The team also surveyed the UNICEF-funded water system, including the spring box, a 75-foot elevated ravine crossing the mile-long, the 2” PVC pipe to the concrete 7860L reservoir, the distribution system, and personal taps. The team observed that the system was operating intermittently and was not properly maintained. Valves that had been provided by P.E.R.U. in 2001 to provide a way to isolate different parts of the system in case a pipe were to rupture had not yet been installed a year later. A break in the pipe while the team was present allowed them to observe two additional facts: 1) technical skills to fix breaks in the system only resided in one individual and 2) when the system failed, the community reverted to drinking irrigation water, which tested positive for E. coli. Water testing at the taps revealed 23 total coliforms per 100mL but no fecal coliforms. There was no graywater management system—water was collected in buckets and tossed behind homes. The sanitation assessment revealed an adequate number of ventilated pit latrines with superstructures of wood frames and corrugated steel. Although the only form of electricity in Santa Rita at this time was car batteries charged in nearby Chao, the team learned that the government planned to extend the grid to the community within the coming years.
June 2003:

Six members of each partner organization—EWB-CU and P.E.R.U.—returned to Santa Rita in 2003 to create a water committee, to help the community with system repairs, to provide water system operation and maintenance education, and to conduct a more in-depth sanitation assessment. Infrastructure improvements included repairing leaks in the distribution lines (including the lines to the school and medical center) replacing individual spigots, and installing shutoff valves to isolate different parts of the system for future repairs. In addition, three men and three women were trained by one of P.E.R.U.’s in-country engineers in future operation and maintenance tasks for the water system.

A more in-depth sanitation assessment revealed that some of the homes were affected by foul smells emanating from their pit privies and were plagued by potential disease-carrying flies. Pit privies that were intended to serve the school children were unsanitary and not maintained. They noticed that the unclean conditions encouraged the children to defecate in the area surrounding the pit privies, which was increasing the sanitation problem. Community members noted that they would rather have flushing latrines like the ones they were exposed to in Chao.

June 2004:

Another EWB-CU and P.E.R.U. team returned to the community in 2004 to install pour-flush latrines at the school. The installation was successful and was accompanied by workshops and educational materials for community members to construct personal latrines of the same design. While the principal focus was the pour flush system itself, an important secondary focus was the Quincha-style superstructure. Quincha is a traditional Peruvian type of construction that utilizes local resources of cane (or bamboo) and mud.
**San Leon—EWB-CU**

EWB-CU worked in San Leon from 2005 to 2008, implementing a solar-powered well and distribution system along with providing hygiene education and operation and maintenance education.

*Table 2: EWB University of Colorado travel history for San Leon*

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<tr>
<th>Dates of Travel</th>
<th>Assessment or Implementation</th>
<th>Description of Trip</th>
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<td>March 2005</td>
<td>Assessment</td>
<td>Community assessment</td>
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<tr>
<td>May-June 2006</td>
<td>Implementation</td>
<td>Drilled a well; installed casing, platform and manual pump</td>
</tr>
<tr>
<td>January 2007</td>
<td>Implementation</td>
<td>Manual pump installed, Stands for solar panels, supplier identification</td>
</tr>
<tr>
<td>June 2007</td>
<td>Implementation</td>
<td>Installed solar electric pump and distribution system, including tanks and public tap stands</td>
</tr>
<tr>
<td>June 2008</td>
<td>Implementation/Post imp. assessment</td>
<td>Performed reservoir and pump system modifications, performed hygiene education. Assessed health impact on the community</td>
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EWB-CU’s relationship with San Leon began when community members observing the latrine project at Santa Rita requested to help finish the mortar on the superstructure in exchange for supplies for a community first-aid kit. Through the interaction, EWB-CU learned that San Leon lacked any sort of system for potable water.

2005:

The community assessment for San Leon was completed in July of 2005. The assessment confirmed that San Leon did not have an improved supply of water and the people expressed that parasites were their biggest health concern. Water was obtained through unprotected springs, hand-dug pits, and contaminated surface water. Latrines were observed in
about half of the houses and were typically within 5 meters of the source of drinking water, possibly adding to the contamination of the drinking water. The team also observed high exposure to agricultural chemicals.

After an alternatives comparison, considering the possibility of drilling a well or a spring catchment system, the recommended implementation was to dig a 30-50m well to tap an alluvial aquifer.

May-June 2006:

EWB-CU travelled to San Leon again in May and June of 2006 to try to install the well. EWB-CU’s professional engineering mentor oversaw the design of the well and performed some hydraulic reconnaissance but there were some problems getting the drilling rig out to San Leon. The community hand-dug the upper 11m (down to the water table), which was then cased with a blank conductor pipe and backfilled with gravel, sand, and grout to the surface. A company from Lima drilled the well, which is located in the Northeast corner of the Village, in October 2006. Photos of the well drilling show that sponsor Rotary Club members were present during the drilling. The Peruvian drilling company reported that the well was dug to 40m using a cable tool method and provided an as-build drawing of the casing and screening.

January 2007

From the well design and construction to an implementation trip two years later in 2008, there is very little information available about this project since there was no reporting during this time. However, details of the implementation trips resurfaced through conversations with EWB volunteers and project managers who were involved from August 2006 – June, 2008. In January, 2007, the team imported the submersible pump and the solar panels, which were delayed in customs for approximately 5 months (to be retrieved the following June). Without the
submersible pump and panels, implementation tasks were limited to installation of the solar panel stands and the manual pump. The manual pump was installed by an NGO called Living Water International, which was working in Peru at the time.

June 2007

The next implementation team was able to get the solar panels and submersible pump out of customs and install them successfully at the well. They also installed two HDPE tanks (a 10,000L at ground level and an elevated 1,000L), a PVC distribution system, and several community taps. In addition, the team provided technical training, including removal of the submersible pump for inspection, to a few individuals in the community. A professional engineer did not accompany the team for this implementation trip.

June 2008

A post-assessment trip was conducted in 2008 to evaluate the water system implemented in the summer of 2007. While the system was functioning rather well, the team did note some concerns at the year mark. The team’s primary metric for determining the success of the water system was through water coliform tests performed at the source and various tap stands in households throughout the community. While the water at the source was still deemed to be clear of coliforms, there were some positive results of coliform presence at some taps throughout the community, indicating possible contamination within the system. The team suggested that the primary reason for this contamination was an observed leak near the beginning of the secondary distribution line; however total coliform build-up in a non-chlorinated system is common even without leaks.

Because the team hoped for the community to take ownership and responsibility for their system, no repairs were made during EWB-CU’s 2008 trip. Meetings were held with members
of the water committee in San Leon stressing the importance of repairing leaks and periodic cleanings of their system to eliminate contamination. The community promised that they would work together to identify all leaks and repair them, and then follow that with a cleaning of the system.

In addition to contamination issues, the team worked with the water committee to further facilitate legal recognition of the land where the well is situated and to help them organize household tariffs to support future maintenance and repair expenses. Additionally, hygiene education was carried out with children and other members of the community. Finally, household surveys were taken to gather information on health improvements, water storage practices and overall state of individual taps within the homes.

Despite minor issues such as leaks and management challenges, the system was still functioning well after one year, providing sufficient water to all of the households in San Leon. Community leaders and water committee members expressed interest in proceeding with a more advanced sanitation system, such as flushing latrines.

The EWB-CU travel team reported the presence of total coliforms in the system and concluded that this may have been due to a leak in the secondary distribution. They also reported to have worked with the water committee to further facilitate legal recognition of the land where the well is situated and help them organize household tariffs to support future maintenance and repair expenses.
Huamanzaña—EWB-PU


Table 3: EWB Princeton University travel history for Huamanzaña

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<tr>
<th>Dates of Travel</th>
<th>Assessment or Implementation</th>
<th>Description of Trip</th>
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<tbody>
<tr>
<td>June 2005</td>
<td>Assessment</td>
<td>Preliminary contact and planning for sanitation project</td>
</tr>
<tr>
<td>9 Aug 2005 – 1 Sep 2005</td>
<td>Implementation</td>
<td>Bathrooms, sinks, and storage tank for primary school</td>
</tr>
<tr>
<td>7 Aug 2006 – 30 Aug 2006</td>
<td>Implementation</td>
<td>Solar lighting for school and other buildings; battery charging station</td>
</tr>
<tr>
<td>27 Dec 2006 – 10 Jan 2007</td>
<td>Assessment A</td>
<td>Assessment for cook stoves and future projects</td>
</tr>
<tr>
<td>17 July 2007 – 5 Sep 2007</td>
<td>Assessment B</td>
<td>Prototyping and extensive stove testing</td>
</tr>
<tr>
<td>1 Aug 2008 – 24 Aug 2008</td>
<td>Implementation</td>
<td>Wide-scale implementation of improved cook stoves</td>
</tr>
<tr>
<td>22 Jan 2009 – 31 Jan 2009</td>
<td>Assessment</td>
<td>Assessment of water system and future projects</td>
</tr>
<tr>
<td>5 Aug 2009 – 31 Aug 2009</td>
<td>Implementation</td>
<td>Infrastructure of water system installed</td>
</tr>
<tr>
<td>22 Jan 2010 – 31 Jan 2010</td>
<td>Assessment</td>
<td>Assessment of past projects and education</td>
</tr>
</tbody>
</table>
Records of the initial phases of the EWB-PU Huamanzaña project were not found in the EWB-USA archives nor were they available from the current project manager. This was found to be a typical issue with early EWB-USA projects and is less common today due to increased project oversight.

During the solar electric system implementation in August 2006, community members in Huamanzaña approached EWB-PU about their current rustic stoves, which were causing respiratory and vision problems, in addition to being inefficient. After two assessment trips to research and design an improved wood-burning cook stove, they assisted the community in the installation of improved stoves in August of 2008.

From the EWB-PU 2008 507 report, the metrics that were planned for this project were as follows:

- We will measure the success of this project in two ways. From a functional approach, we will evaluate how well the stove can heat and cook food as compared to their conventional stoves under normal use. Another measure of the success of our project will be its impact on the health of Huamanzanans, especially their respiratory health.
  - We will time how long it takes to boil water and prepare a typical meal on a conventional stove and then do the same type of measurements with an improved stove. We will compare the results.
  - We will conduct testing of lung capacity (or a similar type of test) of the people who have had a stove for a year and compare it to that of people who use a conventional stove. We will also conduct testing of lung capacity of everyone in town this summer and re-test them next summer and compare the results.
- The data needed is related to time and or physical performance. This data will be collected either by timing an event with a stopwatch or performing a test to an individual. In order to perform these tests, we will bring the required instrumentation, namely a stopwatch and a lung capacity meter.”

Of the 14 public taps originally installed by FONCODES, only 7 were in working condition at the time of EWB-PU’s involvement. Several of the working taps were poorly functioning; the valves did not close and water continually poured out when the main valve was opened, producing overflow and wasting water. In addition, since the taps were communal, no
one in the community felt a sense of ownership and the taps went un-maintained. While the original technical design was adequate, no provisions were made for its continued maintenance so the system was falling into disrepair.

After several community meetings held during the January 2009 assessment trip, it was found that the majority of the townspeople felt that repair of the damaged water system was their most pressing need. After obtaining values of pressure and flow rates during the assessment, EWB-PU concluded that it is possible to eliminate the problem of wasted water, by connecting the two, separate ends of the current piping system in town to form a single closed loop regulated by a single control valve, constructing individualized taps inside people’s homes, and connecting into the system one of two proposed facilities at the pressure break, both designed to provide water at a continuous, sustainable rate.

Municipal involvement with EWB-PU projects in Huamanzaña was minimal, limited to replacement of the solar system batteries immediately prior to the election. Huamanzaña does not have a government-recognized water committee, although EWB-PU helped them organize an informal water committee in 2010. Prior to the formation of this committee, EWB-PU observed lackluster maintenance of the common property that resulted from the project—the solar panels, batteries, and water system components. They reported that the community’s difficulty collecting user fees was undermining the goals and continuing operation of the water component of the project. EWB-PU was hopeful that training and provision of an O&M manual and record-keeping materials for new committee members would improve the situation.

EWB-PU also observed a dependency of the community on the chapter to fulfill basic operations and maintenance roles of existing projects, specifically the water system and the solar
electricity system. Although this could have been caused by a number of factors, the red flag here was that the community was not able to maintain the system without the presence of EWB-PU. Repairs would be left for the EWB team instead of being tackled immediately and community members appeared to be unmotivated to learn how to perform basic repairs or to fully take ownership of the infrastructure that was provided.

EWB-PU reported sanitation and electricity as current interests of the community in their final visits but decided not to implement these. Latrine implementation was foregone because of dwindling community interest in EWB projects and an electricity project was deemed inappropriate since the municipality was promising connection to the electrical grid.
Llacamate—EWB-CU

EWB-CU has been working in Llacamate since 2008, building a pilot latrine and constructing a spring source gravity-fed water distribution system in sections.

**Table 4: EWB University of Colorado travel history for Llacamate**

<table>
<thead>
<tr>
<th>Dates of Travel</th>
<th>Assessment or Implementation</th>
<th>Description of Trip</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 2008</td>
<td>Pre-Assessment</td>
<td>Introduction to community</td>
</tr>
<tr>
<td>January 2009</td>
<td>Assessment</td>
<td>Gathering data, community relations</td>
</tr>
<tr>
<td>July 2009</td>
<td>Assessment</td>
<td>Community organization, data collection</td>
</tr>
<tr>
<td>January 2010</td>
<td>Implementation</td>
<td>Spring catchment construction attempted, rain prevented</td>
</tr>
<tr>
<td>May-July 2010</td>
<td>Implementation</td>
<td>Catchment construction, beginning of transmission line</td>
</tr>
<tr>
<td>December 2010-</td>
<td>Implementation</td>
<td>Break pressure tank construction</td>
</tr>
<tr>
<td>January 2011</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2008:

During the summer of August 2008, members from the community of Llacamate approached EWB-CU during a team visit to the previous San Leon Project (located approximately 30 km down valley from Llacamate) asking for assistance with their goals of reducing exposure to contamination through the implementation of a piped water system from the aforementioned spring down to their community. Following meetings with community members, coordination with local government and final approval by EWB-USA as a new project
(September 2008), EWB-CU elected to move forward in a partnership with the community of Llacamate. The goal of the partnership and the project was set out to be to assist the community of Llacamate in the design, implementation and management of a spring-fed gravity based water system providing clean, safe, and a stable, sufficient quantity of water for potable use in the community. In addition to infrastructure improvements, it is the goal of the overall program to work with the community to improve sanitation and hygiene through concurrent education initiatives. The project was deemed necessary because access to clean water and sanitation are basic human rights, and the community members of Llacamate have identified water and sanitation as urgent needs. The provision of access to safe water, combined with hygiene education in coordination with the regional health post, and further sanitation improvements, aims to reduce the vulnerability and risk of the community members to contamination and illnesses.

January 2009:

The January 2009 assessment trip was spent conducting focus groups and community meetings on water and sanitation, hydraulic surveying, water quality analysis of the spring water, and identification of materials and suppliers. EWB-CU also enlisted the help of a Rotary Club lawyer in Trujillo to begin the process of creating a government-recognized water and sanitation committee.

EWB-CU was able to use the information gathered from this assessment trip to secure a $29,900 matching grant from The Rotary Foundation for construction of the Llacamate water system.

July 2009:
EWB-CU’s trip in July 2009 was part assessment, part implementation. The team continued to conduct hydraulic surveying and to advance the design of the system. A memorandum of understanding was also finalized between EWB-CU, the community, and the Chao municipality. EWB-CU agreed to supply the engineering expertise and the majority of construction materials, the community agreed to supply labor and a connection fee, and the municipality agreed to supply sand, gravel and transportation support. A pour-flush latrine workshop was also conducted in July 2009, resulting in a pilot latrine behind a central community building. The sanitation component of the project’s objectives, implementation activities, and monitoring indicators can be seen in Table 6: Logistical Framework 2—Llacamate Sanitation below.

May-July 2010:

The first water system implementation trip occurred in the summer of 2010, when EWB-CU led the community in the construction of a spring catchment, oversaw the installation of 2 km of HDPE pipe, and led the community in the installation 3 of 8 valve boxes. Another major effort in the 2010 implementation trip was monitoring of the concurrent sanitation portion of the project, which was compiled by Jacob Crosby as an EDC master’s report in September, 2010.

A logistical framework for the water system that includes project objectives, implementation activities, and monitoring indicators and techniques appeared in the post-implementation report and can be seen below in Table 5 and Table 5 (continued)—Llacamate Water System Logistical Framework.

December 2010-January 2011
EWB-CU’s following implementation in December and January 2011, included the completion of a break-pressure tank, designed for high pressure management and as a site for potential future chlorination. The team also conducted a tap-stand and soak pit workshop, monitoring and guidance of pipeline installation, and further materials procurement.

Finally, the team assisted the community in defining the rules laid out in the official water committee guidelines. The focus of this was to assist the community in defining monetary contributions, including laying out an itemized list of tap stand components that comprised the individual connection fee, helping the community decide on an appropriate monthly service fee based on operation and maintenance costs, and deciding the fine for not paying the monthly service fee. Figure 5 shows the table that was used to help the committee choose the appropriate monthly service fee.

During the January 2011 implementation, EWB-CU observed three significant changes in the structure of the community relevant to the project, including changes of the town mayor (twice), a community request to the municipality to replace the current school teacher, and the absence of the president of the JASS, who was away due to a major family illness and reportedly may resign his presidency.

The implementation trip also experienced some results of lack of communication between project partners and between the EWB-CU design team and the implementation team. Immediately prior to the EWB-CU implementation trip, the mayor of Chao visited the community and offered to provide the pipe and faucets for indoor taps at every home. This offer effectively undermined the previous agreement between EWB-CU and the community—that each family would pay a S/. 100 (~$35) connection fee for individual taps. The offer also ignored a stipulation in the $29,900 Rotary Club Matching Grant that prohibits installation of taps indoors.
Another area was lacking communication—the Rotary Foundation did not provide a Spanish copy of the Matching Grant’s terms and conditions and EWB-CU did not translate it for our international partners. Rectifying this situation took some major doing and community members still feel as if they were misled by the mayor. Other major communication errors occurred internally between the EWB-CU design team and our translation team. For example, 5 gallons (20 liters) for the soak pit perc test was translated to 20 gallons (80 liters). The printed Spanish version of the soak pit perc test tables and the soak pit instruction manual had to be changed in the field with pens. In addition, laminated maps that were printed were in English, did not contain map keys, and had meaningless or undefined lines.
Table 5: Llacamate Water System Logistical Framework, Updated Feb 2011

<table>
<thead>
<tr>
<th>Development Objective</th>
<th>Narrative Summary</th>
<th>Indicators</th>
<th>Means of Verification</th>
<th>Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>1. Community of Llacamate owns, operates, and maintains a convenient source of water that is a) clean b) sufficient c) reliable 2. Handwashing with soap (HWWS) is practiced by children at school and by families at home</td>
<td>1. % of users who pay user fee of $6.40 per month, amount of JASS savings consistent with O &amp; M plan a. No measurable E. coli at taps or in home storage (if applicable) b. System is able to supply 25 gallons per person per day c. No interruptions in water supply for more than 24 hours 2. Soap available at 100% of home and school piletas, HWWS behavior witnessed by EWB-CU travel team</td>
<td>1. Treasurer register, JASS bank account balance a. Sample of 10 perlitims tests negative for E. coli b. Water use/availability surveys conducted during monitoring trips c. Water use/availability surveys conducted during monitoring trips 2. Photos of soap at home and school, non-staged photos of people practicing HWWS or observations where possible AND/OR HWWS observations described in EWB-CU’s 531 reports</td>
<td>1. JASS treasurer continues to keep good records. JASS is able to open a bank account a. 25 sheets perlitim (25ml) is a sufficient volume to be able to interpret all negative results as clean water b. Community members answer survey questions truthfully and are not influenced in any way to shade the truth 2. It will be possible to observe soap and HWWS behavior in the school and in homes</td>
</tr>
<tr>
<td>Effect</td>
<td>1. Functional clean water system in community of Llacamate 2. Increased capacity in Llacamate to build, operate, and maintain water system components 3. Community-led hygiene workshops</td>
<td>1. Water system is fully functional and is being utilized and maintained by the community 2. JASS operator performs monthly and quarterly visits and maintenance duties and is able to fix the system when there are problems 3. 2 workshops have been conducted by the first monitoring trip (January 2012) that were attended collectively by 80% of the community</td>
<td>1. Water use/availability surveys 2. Operator maintenance records (forms to be provided) pictures of places/waters that have been fixed, replaced, or maintained (included in 531 reports) 3. Workshop attendance records if taken, otherwise word of mouth from 3 different families at separate times (reported in EWB-CU’s 531 reports)</td>
<td>1.3. Community members answer questions truthfully and are not influenced in any way to shade the truth 2. Operator is able to keep good records with supplied forms. Issues worth fixing/placing will happen within the first year of system operation</td>
</tr>
<tr>
<td>Outputs</td>
<td>1. Water system including components, appurtenances, and individual taps and soak pits 2. O &amp; M manual &amp; appropriate trainings/prep for JASS 3. 3 community members trained in operation and maintenance of water system 4. Hygiene education materials distributed to every household in Llacamate 5. Translated and comprehensive technical design documents for engineers in Trujillo and Chaco</td>
<td>1. Existence of system, appurtenances, taps, and soak pits 2. Verbal explanation of O &amp; M elements by at least 3 members of the community &amp; JASS 3. Observed proficiency of 3 community members conducting/explaining operation and maintenance duties 4. Presence of material in households 5. Confirmed understanding of technical system components by partner engineer in Trujillo</td>
<td>1. Photos of system 2. Travel team member sharing feedback on acceptance of O &amp; M manual and feedback on the effectiveness of JASS training/publications 3. Travel team member showing photos of community members showing O &amp; M proficiency and sharing related quotes in 526 and 531 forms 4. Photos of BCC materials in homes 5. Documented correspondence with Trujillo engineer</td>
<td>2.3. Trained community members will retain the knowledge disseminated and will consider it useful. 4. Community members will be interested in receiving BCC pamphlets and other distributed materials and will keep them in their homes. 5. Trujillo engineer will be willing to meet/correspond</td>
</tr>
</tbody>
</table>
Table 5 (continued): Llacamate Water System Logistical Framework (Part 2), Updated Feb 2011

<table>
<thead>
<tr>
<th>Activities</th>
<th>Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Community meeting and planning of water system design</td>
<td>Funding ($40,000 from Rotary/WEU), 50 soles from each family, SI. 4 monthly from each user, labor (from community and EWB volunteers), gravel, sand, and transportation from municipality, materials for O&amp;M manuals and hygiene education</td>
</tr>
<tr>
<td>2. Involvement of community in ensuring legal ownership of spring site and legal recognition of JASS</td>
<td></td>
</tr>
<tr>
<td>3. Collaboration with municipality and community to form project MOU</td>
<td></td>
</tr>
<tr>
<td>4. Construction of Spring catchment, break pressure tank, pipeline, FRBs, reservoir, pilotes, and soak pits</td>
<td></td>
</tr>
<tr>
<td>5. Implementation of hygiene education plan</td>
<td></td>
</tr>
<tr>
<td>6. Provision of O&amp;M manual and appropriate presentation/workshops</td>
<td></td>
</tr>
<tr>
<td>7. Training of at least 4 community members in operation and maintenance activities</td>
<td></td>
</tr>
<tr>
<td>8. Monitoring and evaluation trips conducted 0.5, 1. and 2 years after project completion</td>
<td></td>
</tr>
<tr>
<td>9. Establishing a long term communication web between</td>
<td></td>
</tr>
<tr>
<td>2.3. Copies available of spring site agreement and legal recognition of JASS</td>
<td></td>
</tr>
<tr>
<td>4. Photos of implementation (526)</td>
<td></td>
</tr>
<tr>
<td>5. Copy available of hygiene education plan</td>
<td></td>
</tr>
<tr>
<td>6. Feedback from travel team members on appropriateness and effectiveness of O &amp; M manual and trainings</td>
<td></td>
</tr>
<tr>
<td>7. Copy of training goals and associated travel team feedback with &quot;lessons learned&quot;</td>
<td></td>
</tr>
<tr>
<td>8. 530 and 531 forms turned into EWB-USA before deadlines</td>
<td></td>
</tr>
<tr>
<td>9. Copy of communication web available, information gathered from community to be included in chapter reporting</td>
<td></td>
</tr>
</tbody>
</table>
### Table 6: Logistical Framework 2—Llacamate Sanitation, created Spring, 2009

<table>
<thead>
<tr>
<th>Development Objective</th>
<th>Narrative Summary</th>
<th>Indicators</th>
<th>Means of Verification</th>
<th>Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>1. Intermediate range: Decrease in the # of cases of diarrheal disease. Long range: Decrease in under five mortality and decrease in lost productivity due to diarrheal diseases. 2. Increase in self-efficacy in the community of Llacamate. Elimination of open defecation in the village of Llacamate.</td>
<td>1. Intermediate range: 35% reduction in the # of cases of diarrheal disease. Long Range: 35% decrease in deaths due to diarrheal disease in U5’s. 35% reduction in work-days missed and school absences recorded due to diarrheal diseases. 2. Positive community opinion regarding latrine existence and use. Observable increase in self efficacy of Llacamate. 3. Latrine capacity expanded by village to include 1 latrine per household by 2011. Constructed latrines are used by the community members they serve for every &quot;defecation-related&quot; activity.</td>
<td>1. Data from health post, household surveys, school attendance sheets. 2. Personal interviews, self efficacy scale test in Spanish (administered before and after project). 3. Absence of fecal material around homes. Household surveys, observation, quantity of fecal material in latrine pit / chamber.</td>
<td>1. Data obtained is an accurate representation of decrease in diarrheal diseases. Missed days of school and work are attributable to diarrheal diseases. 2. Individuals respond truthfully in surveys and on tests.</td>
</tr>
<tr>
<td>Effect</td>
<td>1. Operating sanitation system in community of Llacamate. Increased capacity in Llacamate to design, build, and maintain latrines.</td>
<td>1. Installed latrines are fully functional and are being utilized by the community members they serve. 2. 3 additional latrines designed and constructed by community. Maintenance performed on existing latrines by 2011.</td>
<td>1. Household surveys, observation of latrine use and hygiene and sanitation practices, quantity of fecal matter in latrine pit / chamber. Absence of human fecal material around homes. 2. Pictures of new latrines and condition and cleanliness of existing latrines.</td>
<td>1. Entering latrines involves using them for defecation. Villagers are honest in surveys. 2. Community values latrines enough to construct them on their own.</td>
</tr>
<tr>
<td>Outputs</td>
<td>1. 3 functional latrines 5 community members trained in the design, construction, and maintenance of latrines.</td>
<td>1. Existence of 3 latrines. Observed proficiency of 5 community members in latrine design, construction and maintenance. 2. Interviews with trained individuals. Video and pictures depicting individuals engaged in latrine construction.</td>
<td>1. Videos and pictures of latrines. 2. 1-2. Existence of documents. Meeting attendance lists, list of trainees, single latrine design chosen. 3. Pictures of community members constructing latrines and 3 finished products. 4. Existence of documents.</td>
<td>1. Community members will approve of latrine construction. 2. Trained community members will retain the knowledge disseminated and will consider it useful.</td>
</tr>
<tr>
<td>Activities</td>
<td>1. Conduct capacity analysis and produce a list of possible latrine designs (based on assessment performed by EWB). 2. Generate project budgets, materials lists, and schedules. 3. Facilitate community planning meeting 3a. discuss and introduce latrines 3b. allow community to choose a latrine out of the list of latrine technologies. 4. Locate and transport materials (from local municipality). 5. Train community members to install and maintain latrines (while installing latrines). 6. Conduct post-project health and self efficacy survey.</td>
<td>1. Capacity analysis finished by March 2009. Latrine designs developed by April 2009. 2. Budgets, material lists, and schedules completed by April 2009. 3. Community planning meeting conducted by August 2009. Materials located and on site by August 2009. 5. 5 community members trained in construction and ongoing maintenance of latrines and 3 latrines constructed by August 2009. 6. Post-project surveys conducted by August 2010. Surveys repeated by August 2013.</td>
<td>1. Existence of documents. 2. Existence of materials. 3. Pictures of community members constructing latrines and 3 finished products. 4. Presence of materials. 5. Pictures of community members constructing latrines and 3 finished products. 6. Presence of materials.</td>
<td>1. Community desires the installation of latrines (as indicated by 5 community members during the EWB assessment). 2. Design and construction activities will go according to plan. Necessary project supporters will carry out their assigned tasks according to schedule (i.e. community members will provide labor for project). Materials for construction will be available locally or can be shipped to location. 3. Community members will be interested in latrine design, construction, and maintenance training and have time to devote to this pursuit.</td>
</tr>
<tr>
<td>Inputs</td>
<td>Funding, labor (from community and volunteers), volunteers, latrine construction materials.</td>
<td></td>
<td></td>
<td>Community members will be willing to volunteer time to help with latrine construction. Donors will be willing to support the project monetarily. Volunteers outside of the village will be willing to donate their time.</td>
</tr>
</tbody>
</table>
Figure 5: The operations and maintenance cost table used to assist the community in choosing an appropriate monthly service fee considered the annual costs necessary to replace system components at the end of their design life.


ciudad de Dios—EWB-UNC

University of North Carolina Chapel Hill’s Daniel A. Okun Chapter of EWB (EWB-UNC) has been involved in Ciudad de Dios since the fall of 2006, conducting two assessments in March and July of 2007, building a gravity-fed distribution system in 2008, and conducting capacity building in June 2009 and June 2010.

Table 7: EWB University of North Carolina travel history for Ciudad de Dios

<table>
<thead>
<tr>
<th>Dates of Travel</th>
<th>Assessment or Implementation</th>
<th>Description of Trip</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 2007</td>
<td>Assessment</td>
<td>Survey Community</td>
</tr>
<tr>
<td>July 2007</td>
<td>Assessment</td>
<td>Water conservation education, initiation of water committee, map community and pipeline</td>
</tr>
<tr>
<td>July 2008</td>
<td>Implementation</td>
<td>Installation of Gravity-fed water system and in-town water distribution system, water committee elections</td>
</tr>
<tr>
<td>June 2009</td>
<td>Implementation</td>
<td>Training with systems operator, community work days for system maintenance, voting in of formal committee bylaws, financial training for committee treasurer</td>
</tr>
<tr>
<td>June 2010</td>
<td>Implementation</td>
<td>Health surveys, water quality testing, water pressure testing, 10 year cost of maintenance</td>
</tr>
</tbody>
</table>

After learning of the community’s decision to utilize their yearly stipend for the improvement of their water supply, Professor Billman brought EWB-UNC on board to partner with M.O.C.H.E, an NGO that he started to raise money and continue to work towards development projects in the region.
2008:

EWB-UNC was asked by Dr. Brian Billman to design and build a spring-box and gravity-fed water distribution system. Another aim of the project was to plan for and decide upon an institutional model with the locally elected water committee so that the community can maintain and manage the system themselves upon EWB’s departure.

2009:
The purpose of the return 2009 trip was to ensure the sustainability of the equitable provision of reliable water to the community of Ciudad de Dios, by assisting in finalizing the formation of the locally elected water committee who will be responsible for the maintenance and management of the piped water system implemented during a 2008 EWB project.

2010:
The purpose of the 2010 trip was to evaluate the water system, the water committee and their ability to operate and maintain the system, and to complete a health survey in the community. To evaluate the water distribution system, pressure measurements were taken and water was tested for fecal coliforms and *E. coli* at random points from the springbox to the community and at multiple household taps within Ciudad de Dios. EWB-UNC team members met with members of the newly-elected 2010 water committee to assess their progress since the last visit, and to audit the finances and record-keeping of the committee. In these meetings, the committee bylaws were discussed to ensure that the new leaders had read them and were conducting committee business according to the bylaws. Finally a health survey and water pressure readings were conducted at randomly selected homes in the community. These monitoring and evaluation steps
are necessary to ensure the sustainable provision of clean water to the community of Ciudad de Dios.
Compone—EWB-UMCP

The EWB-University of Maryland College Park (UMCP) has worked in Compone since 2008, installing chlorine tablet dosers and a ferrocement tank.

Table 8: EWB University of Maryland College Park travel history for Compone

<table>
<thead>
<tr>
<th>Dates of Travel</th>
<th>Assessment or Implementation</th>
<th>Description of Trip</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 2008</td>
<td>Assessment</td>
<td>A two-week trip to Compone conducted a health assessment, gathered social and technical data, and established open lines of communication.</td>
</tr>
<tr>
<td>May-June 2009</td>
<td>Implementation</td>
<td>A three-week implementation installed chlorine dosing units, baffled reservoirs, and constructed a ferrocement tank as part of a potable water solution in Compone’s five water districts.</td>
</tr>
<tr>
<td>January 2010</td>
<td>Implementation</td>
<td>A two-week implementation constructed a tablet press, pressed chlorine tablets for extended period dosing tests, sealed the ferrocement tank, completed water quality and flow rate testing, and partnered with a new NGO.</td>
</tr>
</tbody>
</table>

In the spring of 2008, a development engineer working with the Association of Conservation of the Amazon Basin (ACCA) approached EWB-UMCP to propose a water sanitation project in Compone. EWB-UMCP’s assessment claimed that the community had two water-related issues: First, annual spring output had declined in recent years, causing daily water shortages in the dry season. Second, the ACCA engineer claimed that the water was not being treated and was thus spreading gastro-intestinal illnesses from waterborne viruses, bacteria and protozoa. EWB-UMCP assumed that the contamination stemmed from animal waste since it is commonplace in an agricultural community such as Compone. That gastro-intestinal illness was caused by animal waste contamination in all five water supplies seems to be a major assumption that was made by the EWB team that did not seem to have been questioned by anyone involved. However, EWB-UMCP went forward with the decision to take on the project with the objective
of increasing access of the community to clean potable water in order to reduce medium and long term intestinal illnesses.

An EWB assessment team comprised of two engineering students and two professional geologists traveled to Peru in August 2008 to assess the extent of the community’s water needs. With the help of in-country contacts, the team conducted interviews with local community members, assessed the current state of the five water systems (one in each neighborhood), and took water samples in various locations to test for contaminates.

During a design process over the fall 2008 and spring 2009 semesters, the EWB-UMCP team reviewed and assessed a variety of water purification methods, including ultraviolet (UV) disinfection, slow and rapid sand filtration, solar pasteurization, clay pottery filtration, and liquid and tablet chlorination for their feasibility in Compone. The team considered effectiveness, reliability, ease of use, environmental and spatial footprint, cost, maintenance, and community preference to select a passive chlorination system as the most feasible treatment option. Since UV disinfection requires electricity to operate and would need components that are not locally available in Compone and since sand filtration would require the construction of large tanks for each spring that would be difficult to place on a mountainous slope, chlorine dosing was ultimately chosen by EWB-UMCP as the best treatment method. Chlorine’s residual protection was also cited as a justification for the choice of chlorine. EWB-CU then performed an alternatives analysis between two chlorine dosing methods: liquid and tablet dosing. Liquid dosing was found to be too problematic since it would require large storage tanks and active or passive liquid addition with variable flow rates, which would be a significant design and operational challenge. Chlorine tablet dosing systems were chosen since they would not require large tanks, they can be simply set for passive dosing even in variable flow situations, and they
met the requirements of the community: a low-maintenance dosing system located close to the springs that could contain a chlorine supply for 1-2 months at a feasible cost for chlorine tablets. In EWB-UMCP’s pre-implementation report, the tablets were also reported to be locally available at a cost of USD $10/4kg.

In addition to the tablet dosers, EWB-UMCP determined that to achieve 1.5 log reduction in giardia, chlorine contact time would need to be maximized. In four out of the five communities of Compone, installing geomembrane baffles was determined to be sufficient. However, a 12,000L tank would be required for Ayotomibamba and so EWB-UMCP planned to construct a ferrocement tank with the primary purpose of increasing the chlorine contact time.

2009:

Implementation of the treatment solution in June 2009 by a dozen students, two professionals, and a faculty member was focused into two objectives: adding chlorine to the distribution systems and ensuring that enough time passed before the chlorinated water reached tap stands. Passive chlorine tablet feeders were installed near the spring boxes in each of the five water districts to provide a continuous supply of chlorine. To ensure adequate reaction time between the chlorine and water, baffles were installed in the reservoirs to slow the progress of water flowing down the mountains. In the case of one water district, Ayotomibamba, a ferrocement tank was constructed to provide additional retention time. While the infrastructure for treatment systems was reported to be successfully installed in Compone, compatibility difficulties between locally available chlorine powder and the chlorine tablet feeders prevented the systems from becoming operational during the June 2009 implementation.

2010:
In an attempt to salvage the infrastructure constructed the previous June, the January 2010 EWB-UMCP trip looked to re-assess the feasibility of a tablet chlorination system. From their post-implementation form, submitted March 2010, “The team was able to successfully construct a tablet press in country with local materials, and pressed chlorine tablets with the machine for use in extended period dosing tests. In addition to testing the performance and accuracy of the tablet chlorination system, the team also sealed and completed the ferrocement tank they had constructed in June. Bringing the tank to operational status has increased the storage capacity of potable water for the community. The team evaluated the health of each of the community’s five water districts by measuring rainy season flow rates and completing water quality testing. Additionally, the team was also able to partner with a local NGO based out of Cusco, who will serve as a local technical contact for the community.”

EWB-UMCP listed several metrics for measuring the success of their project. They planned to measure microbiological water quality and health impacts to verify the success of their project. The water quality goal was to virtually eliminate total coliforms, especially in the two communities where they were previously found. EWB-UMCP planned to use annual health assessments to observe a reduction in the estimated 300 cases of intestinal complaints the doctor treated every year and to observe a reduction in intestinal illnesses in the youth and the elderly of Compone.
Section 4: Monitoring Activities

Over the course of two months, monitoring activities were conducted at each of the five EWB-USA projects communities described above. As described above, three of the projects were ongoing and two were in their very final stages.

The District Municipality of Chao

Santa Rita—EWB-CU

Previous project monitoring

Professor Campa and P.E.R.U. visited the Santa Rita in January, 2005. They learned that at least two families had used the educational materials to build personal latrines and one family had constructed a shower. He also observed that the water system seemed to be well-operational. Professor Campa did not mention anything about the health of the community.

February 2011 Project Monitoring by Cole Sigmon

Monitoring conducted in Santa Rita for this report in February 2011 was very short due to time constraints—limited to two separate one-hour visits. However, monitoring that was conducted revealed several important aspects about the current status of the project. The municipality, in the process of building a new school, destroyed the pour-flush bathrooms built by EWB-CU and installed newer bathrooms with toilets. Professor Campa confirmed hearing about this development and he questions the motivations that led to the decision to destroy the bathrooms.

A new health post had also been constructed by the municipality and along with it an elevated reservoir for potable water storage (See Photo SR2). The water system seemed 100%
functional, pointing to the effectiveness of the O&M education 7 and 8 years prior, although microbiological water quality is unknown since water testing at this location was not successful (the 3M Petrifilms were damaged in a heavy rain). However, the current health post employees (who are reachable by telephone) were in the process of collaborating with a MINSA (Peruvian Ministry of Health) lab in Viru to establish ongoing microbiological monitoring of different points in the water system for total coliforms and fecal coliforms (See Photo SR1).

The water committee is still in place in Santa Rita, although they still lack official government recognition. According to the head nurse, the municipality is going through the process of getting this recognition to the Santa Rita water committee.

Although the treasurer of the water committee was not available at the time of the monitoring trip, the head nurse reported that only 15 out of 50 families in Santa Rita actually pay the monthly fee of 2 soles ($0.75). This means that 70% of families in Santa Rita are not paying the monthly user fee for water. The water committee has no way to enforce the payment system since there are no individual locked shutoff valves.

Further monitoring is needed in Santa Rita to confirm that the water committee is operating in a financially sustainable manner. Indicators for monitoring this could include:

- the percent of people who have paid the monthly user fee for water in the previous month and the previous year,
- the amount of money saved by the water committee for future repairs
- reports of monthly or annual costs borne by operations and maintenance of the system and
- positive evidence of active maintenance on the system, which may be confirmed by receipts saved by the water committee treasurer.
A suggestion of a SMART indicator for financial sustainability, assuming that maintenance is being performed then, would be this question: In the past year, did the water committee collect more money from user fees than they spent on system maintenance? If maintenance is not being performed as needed, a better indicator would be this question: Since the system was refurbished in 2003, has the water committee been able to collect sufficient funds from user fees to cover all needed maintenance and repairs?

**Photo SR1:** MINSA cooler, ice, and sterile sample containers. Asunción, a nurse from the health post in Santa Rita (a 10 minute walk from San Leon), is excited about the possibility of ongoing water quality monitoring by the government.

**Photo SR2:** Elevated tank installed at Santa Rita by the municipality used the same construction method as the 2007 installation in San Leon.
San Leon—EWB-CU

*Previous project monitoring*

Monitoring 1 year after the system (See Photo Group SL1) was installed was conducted by EWB-CU on their 2008 assessment trip and is described above under “Summaries of EWB-CU Involvement.”

In addition, Professor Arthur Campa visits San Leon when he is in country. On his most recent visit, he observed the water committee making pipe repairs (See *Photo Group SL7*).

*January and February 2011 Project Monitoring by Cole Sigmon*

Three monitoring trips were taken to San Leon in January and February of 2011 and it was possible to view and learn about different aspects of the project during each visit.

The first visit was made January 15th, 2011 and upon arrival, the team was greeted with a very good sign: one of the first observations made was a woman retrieving water for cooking from her household tap stand. The monitoring team was able to quickly find the system operator, Jose Lopez, who was proud to give them a tour of system components. He reported that operation and maintenance was on a quarterly schedule and included shock chlorination of the tanks and the distribution system, cleaning of the surface of the solar panels (although they were very dirty at the time of monitoring—See *Photo Group SL2*), and inspection of the pipeline for leaks.

Surprisingly, José had absolutely no paperwork from the project implementation and training. He mentioned that the secretary and treasurer may have some things but that written materials about the system components or about replacement parts or specifications for imported materials were never provided. He expressed interest in having a copy of these for future reference in case the motor, pump, or solar panels, all of which were imported from the United States, were to fail. Although the lack of reporting during this time period made it difficult to dig
up some of this pertinent information, it has been mostly obtained through recent conversations with the project managers at the time and will be included in the San Leon closeout report to be submitted to EWB-USA and provided to EWB-CU in time to deliver copies to San Leon in July 2011.

José demonstrated evidence that he had already replaced some components of the system, including the electric float switch on the upper tank, which was successfully purchased and replaced once by the community at a cost of approximately S/. 45 (See Photo Group SL3). A water sample was taken from a personal tap and 6mL was tested using Petrifilms. The results showed an average of 4pfu/mL total coliforms and no *E. coli*. This is above the MINSA limit of total coliforms of 0pfu/mL and was concerning to the previous implementation team. However, total coliforms are not good indicators for pathogenic contamination in water, according to the WHO Guidelines for Drinking Water Quality (Table 7.7, Note b), which says “Total coliform bacteria are not acceptable indicators of the sanitary quality of water supplies, particularly in tropical areas, where many bacteria of no sanitary significance occur in almost all untreated supplies.” In other words, if the system does not contain residual chlorine, total coliforms can be expected. 4pfu/mL is a sufficiently low concentration not to indicate any infiltration from surface water contamination, as the previous monitoring team suggested.

On the second monitoring trip, the focus was on talking to the members of the water committee to try to locate some original project documents that were missing from EWB-CU and EWB-USA’s archives. The monitoring team was able to meet successfully with the president and treasurer of the JASS (official water committee). The president expressed concern that the official JASS book—the book which essentially contains all of the administrative water system information, including responsibilities of administrators, rules for the community, and
government-granted authority to function as a water committee—was never given back to them after it was taken by the Rotary Club a few years earlier to obtain signatures from a judge in Trujillo. He mentioned that the only paperwork materials that the JASS owned were the books kept by the treasurer.

Rosa Poma has been the treasurer for the past two years and her record-keeping is very organized and complete. She showed that the JASS has saved a little over 1,000 soles (~$370) by collecting the monthly service fee and new connection fees. It was interesting to notice how the number of families in the community who regularly pay the monthly fee has steadily declined since August, 2007, when 100% of the community paid the 2-sol ($0.75) monthly fee. If community members had been paying the monthly fee all along, the JASS would have collected over 3,000 soles ($1,111) at the time of monitoring.

Although the money appears to be kept away for a rainy day, several instances of needed maintenance are evident like putting caulking around small conduit boxes (See Photo Group SL4) and replacing roughly half of the individual shutoff valves (See Photo Group SL5). In addition, the operator of the system does not receive a stipend for maintenance work, which the JASS was in the process of negotiating due to his dwindling interest.

When asked about the procedure for dealing with non-payment of user fees, the JASS said that the intention is to physically cut these users off (with a saw) and not allow them back into the system until they pay the dues that they owe plus the cost of repairing their pipe and paying the operator for his time in repairing the pipe.

The treasurer confirmed what the JASS president had said: Without the book giving them the authority to govern the system, they don’t feel empowered to cut off non-paying users from
the line. Both also agreed that cutting off users could create social tension among the families of the members of the JASS and the rest of the community.

A third visit was made to the community to let them know that Cole Sigmon had found the JASS book in Trujillo and to check up on the system for a third time. Upon arrival, it was discovered that the water system had been down for the entirety of the previous four days. He confirmed that the operator knew what the problem was, where to get replacement parts, and how to install them. The operator was stalling to give incentive to the community to come together for a meeting—something that had been difficult in the past. A meeting was planned for that afternoon, at which the operator would request a stipend for services, the president and treasurer would remind people to pay the monthly fee. In addition, the JASS was to discuss a new idea, which was to divert the entirety of the water to the upper system for part of the day and to the lower system for part of the day in order to supply a more consistent flow. Unfortunately, a choice had to be made between staying to witness this meeting or going to track down the JASS book and potential design documents at the office of a Rotary member in Trujillo and the JASS book got the priority. The meeting went on as planned and the system was repaired two days after the meeting, according to the treasurer of the community.

The JASS book and details of the well drilling were found in the office of Silvia Ibañez, a Rotary member in Trujillo, who did not seem to know that the book belonged in the community. Doctora Ibañez planned to return the book to the community in March, 2011.
*Photo group SL1:* San Leon well site includes two tanks (one elevated), a solar powered pump, and a backup manual pump, all of which are still functional.

*Photo group SL2:* Solar panels are reportedly cleaned 4 times a year but they were fairly dirty at the time of monitoring. The main solar pump control station is protected in a metal box.

*Photo group SL3:* The original float valve was designed out of the system in favor of the electrical float switch (2007), which failed in 2009. The blue electric float switch on the upper tank has since been successfully purchased and replaced once by the community at a cost of approximately S/. 45.
Photo Group SL4: Electric wires and float valve switch boxes are exposed to the environment and need caulking

Photo Group SL5: Several valves and taps were broken. The bucket above is a shutoff valve that is placed in front of houses. The brick casing to the left is the shutoff valve for the school bathrooms that were installed by the municipality. Half of the observed shutoff valves were broken.

Photo group SL6: Several other valves were poorly protected from damaging UV radiation (the lid on the right was present but not utilized.)
Photo Group SL7: Community members fix a broken pipe (Photos taken by professor Campa in July, 2010)

Photo Group SL8: Pressure release valves, installed as a safety against abnormal pressure build-up at the well, were observed to have a persistent drip.

Photo SL9: Moisture was observed around the threads of the manual pumping mechanism
Photo SL10: Although this picture was taken at a different time, the circle and arrow indicate the gasket that was failing on the third implementation trip (16 Feb, 2011) that resulted in the water being unavailable to the community for at least 7 days.
One principal monitoring trip was conducted in Huamanzaña, although the town was visited eight times during the month of January 2011 because of trips back and forth to Llacamate, one of which required renting a donkey in Huamanzaña.

The system operator gave the monitoring team a tour of the system including the spring source, three reservoirs, the break pressure tank, and individual taps. The old spring catchment box (See Photo Group H1) installed by FONCODES in the 80s was destroyed by the farmers in the upper distribution by breaking down a portion of the wing walls with a sledge hammer before EWB-PU was involved. Currently, the spring is captured on the surface of the ground, and besides being surrounded by a lush natural oasis, it is not protected.

One of the two aforementioned farmers at the top of the distribution system took it upon himself to install a ball valve in the distribution main (see Photo H3). The ball valve is left on overnight but is usually turned off during the middle half of the daytime, cutting off the flow to the lower distribution and using the water system water for irrigation in their fields.

Although EWB-PU received word that the wall around the reservoirs was complete, it was still in progress during January and February (See Photo Group H4).

Eight mL of Huamanzaña water was tested using 3M Petrifilms and the results showed an average of 1.6pfu/mL of *E. coli* and 34.5pfu/mL of total coliforms (See Photo H5). This may be due to the fact that the only spring source protection is a natural oasis of dense cane that has surrounds it. Although cattle would have a hard time getting through the brush, it is accessible—and even a nice destination—for dogs, cats, deer, and other smaller animals. Another compounding factor to the water contamination is the lack of disinfectant. Water disinfection is not practiced in Huamanzaña.
The three other EWB-PU Huamanzaña projects besides the water system were working very well. The stoves in the community were still being used and maintained by the community (see Photo Group H6). Also, the school/health post bathrooms were exceptionally well-maintained with nice landscaping and clean toilet seats, which is a rare find in Peru (See Photo Group H7). While cleanliness of bathrooms is not synonymous with their use (and can sometimes indicate the contrary!), the nurse reported that children used the toilets when they were in school and that she and her patients also utilized the facilities. While these bathrooms are well kept, they have not inspired anyone to install personal latrines at home and so children practice open defecation whenever they are not in school, which includes afternoons, evenings, and the summertime. Additionally, the solar charging station and lighting system was functioning well, especially after the Mayor of Chao replaced the batteries a few months earlier in an effort to rally support before the October re-election (See Photo Group H8).

Photo Group H1: The old spring catchment box installed by FONCODES in the 80s (left) was destroyed by the farmers in the upper distribution (by breaking down the wing walls with a sledge hammer) before EWB-PU was involved. Currently, the spring is captured on the surface of the ground and, besides being surrounded by a lush natural oasis, it is not protected.

Photo H2: A Huamanzaña tap stand, or “pileta” being used to wash clothes. Notice how the valve is in the open position and no water is flowing out. The family here is waiting for the farmers in the upper system to turn the water back on.
**Photo H3:** Farmers in the upper distribution system felt entitled to irrigate their crops with the community drinking water so they installed a ball valve, which was kept closed or mostly closed about half the day during the middle of the day.

**Photo Group H4:** Although EWB-PU received word that the wall around the reservoirs was complete, it was still in progress during January and February. The pictures above were taken the 3rd and 13th of February, 2011.

**Photo H5:** 3M petrifilms showed an average of 1.6pfu/mL of E. coli and 34.5pfu/mL of total coliforms, which is a positive indicator that fecal material was present in the drinking water system.
Although this stove on the left was not being used at the time (hence the trash), it was in use a few days later. Although these stoves make the kitchen area sweltering hot, they are regularly used and well-maintained.

Latrines installed by EWB-PU are very well maintained, although they are only used by the school when it is in session and the health post. The nurse at the health post confirmed the observation that this is the only sanitation facility in the village.

The solar battery charging station and light system installed by EWB-PU is still operational. The batteries were recently replaced by the mayor to rally the support of the community before the election in October 2010.
Monitoring in Llacamate can be separated into two categories: water and sanitation.

Water system monitoring and evaluation is incorporated into the logistical framework for the water system that is included in the previous section and entitled *Logistical Framework 1: Llacamate Clean Water.*

A problem that was recognized during the January 2011 implementation trip was that several pieces of printed material were inappropriate and thus proved to be ineffective at accomplishing the goals they were meant for. Maps provided to the community had English language (even though community members can only read Spanish), many distracting and unrelated lines, and no map key or compass rose. Also educational materials for soak pit construction had some important numerical errors based on simple mistakes with unit conversion (i.e. 5 buckets or 80 liters instead of one 5-gallon bucket). These mistakes are discussed below in the “Lessons Learned” section.

Water system monitoring activities during the January 2011 implementation trip included checking water quality and flow, inspecting previously-built structures, and quality control of the pipeline burial.

Water quality sampling was performed with 3M Petrifilms and revealed an an average of 125.6 cfu/mL of total coliforms in the irrigation canal where the community currently gathers water, and an average of 5.7 cfu/mL of total coliforms (based on 13 – 1 mL samples) at the spring catchment overflow, which is 1.34 orders of magnitude less than in the irrigation canal. E. coli, which was found in the canal water in quantities of 5 cfu/mL in June of 2010, was not found in the canal water in January 2011. EWB-CU Peru remains confident in the integrity of the spring water coming from the catchment. Total coliforms in low amounts can be expected in
this system (see reference to WHO Guidelines for Drinking Water Quality reference above in the San Leon monitoring section) and are not of concern.

On January 8\textsuperscript{th}, 2011, spring catchment overflow was measured 3 times using the bucket stopwatch method, with an average of 25.4 gallons per minute. Since this is at the very end of the dry season, which is the driest that the spring should ever get, EWB-CU was happy to see that flow was still well above the design flow of the system (16 gpm). However, it’s interesting to note that flow was reduced significantly from the 45gpm flow measured in January 2009.

During a January visit to the spring catchment box, the monitoring team observed full regrowth of gourd plants in the previously-disturbed area below the box. In addition, moss had already begun to grow on the side of the mountain that had been excavated for the box. In May, 2010, the presence of this erosion-preventing vegetation was a welcome sight (See Photo group L1). However, as seen in Photo group L2, about half of the form ties embedded in the walls of the catchment box had facilitated small leaks. EWB-CU plans to plug these holes with epoxy.

The sanitation monitoring and evaluation plan is embodied in the logistical framework, entitled Logistical Framework 1: Llacamate Sanitation, which was created Spring 2009 and was included in the previous section. Detailed history and monitoring questions were written by Jacob Crosby, were presented in the EWB-CU’s post implementation report from Summer 2010, and served as a major part of Jacob’s EDC project report. These extensive results have not been included here, although the EWB-USA monitoring questions are addressed below.

It is important to note that the health goals that were listed as impacts in 2009 will be difficult to verify using health indicators. Direct health effects of improvements to water supply systems have been proven to be difficult to measure, especially in a rural area like Llacamate. Instead, experience and research show that other indicators such as presence, use and
maintenance of latrines can serve as proxies for health impacts. Therefore, future sanitation monitoring time and resources will be spent on finding out whether or not community members have latrines and whether or not they are actually using them.

The following are responses to the EWB-USA post-implementation monitoring questions that can be found in Appendix A.

- **Functionality – 50%** Although the latrine and blackwater system are still 100% functional, these pilots are not used by the community. Since the latrine was closer to some houses than others, it was decided by the community to keep it locked and to save it for visitors. The latrine was built at a community building, a few meters away from some homes but a 15-minute walk away from others, which was perceived as an inequitable arrangement. See 526 15 Oct 2010 for a description of community adoption of pour-flush latrines.

- **Enhancement –** The community put a lock on the pilot latrine. Future latrines and soak pits were made to be cheaper, and smaller.

- **Duplication –** Has the community duplicated the design on their own in another location? Yes; extensive details were listed in EWB-CU’s 15 Oct 2010 post-implementation report. The most recent community-built pour-flush latrine can be seen in Photo Group L3 below.
**Photo group L1:** Regrowth of erosion-preventing vegetation around the catchment was reassuring.

**Photo group L2:** Water leaks out of the catchment walls in some places where form ties were used.

**Photo Group L3:** The most recent Llacamate-constructed latrine closely follows the EWB-CU pour-flush design from the 2009 workshop.
Ciudad de Dios—EWB-UNC

Ciudad de Dios was visited on the 17th of January, 2011. The monitoring team was welcomed into the community and was glad to demonstrate their model project to members of an EWB team working in another area.

The water committee, although not recognized as an official JASS by the government, was exceptionally organized and the results of the capacity building of the previous two EWB-UNC implementation trips were clear based on the seemingly perfect record-keeping of the treasurer and the operator. Besides the operator, the entire water committee was comprised of women. The system treasurer, pictured below alongside her tap (See Figure Cd1), showed us all of her records and explained aspects of system management.

The treasurer documented families’ monthly payments and the water committee’s monthly expenses and receipts were kept on file. Each user pays 1.50 soles ($0.55) per month within 4 days of the 8th of each month. The new user connection fee in Ciudad de Dios is 100 soles ($36.76), which is the monetary equivalent of 5 workdays or “tareas” plus a 5-sol ($1.84) start-up fee. Similar to other communities that we talked to, the taps of non-paying users would be physically removed from the system and charged a fine of 20 soles ($7.35) to repair this cut in addition to what they owed on the system.

In addition, the operator receives a monthly stipend of 50 soles ($18.38) for monthly duties, which are described in his record book and monthly report forms are submitted in exchange for payment. One duty the operator performs is monthly shock-chlorination of the system. Chlorine is purchased from nearby Trujillo and incurs a monthly cost of 8 soles ($2.94). The operator is also responsible for installing new connections, operating the air-release valves, and fixing breaks in the system of which he reported three to date.
Results of 3M Petrifilm tests on 4mL showed no *E. coli* but showed the average total coliform count to be 40.5pfu/mL—a bit higher than was reported in June 2010. This concentration of coliforms is not enough to prove that the water is contaminated and the absence of *E. coli* supports the conclusion that the system is not contaminated (see WHO Water Quality Guidelines reference in the San Leon section above). However, a larger sample volume should be tested to confirm the absence of *E. coli* since the detection limit of 4 Petrifilm tests is 25pfu/100mL. Having a way to demonstrate the cleanliness of the water is especially important since EWB-UNC reported in August 2010 that 60% of survey respondents in the community perceived the water as being unsafe to drink and the suggestion of the operator was that fecal contamination was likely at the spring.

*Photo Cdl:* The water committee treasurer poses between her household tap and Caroline, a member of the monitoring team
Photo Cd2: Cazimiro, the Cuidad de Dios operator, points down at the buried spring catchment system with his left hand and holds a piece of cow dung in his right hand that was found on the ground nearby, demonstrating the need for further spring source protection.

Photo Cd3: The source is collected in a spring box shown above before the water enters the transmission line.

Photo Group Cd4: Pipe is laid along a sloped rocky area for approximately 3 kilometers from the spring box to the community. Because of the steep, rocky terrain along this slope, the pipe is exposed in sections so it has been covered with plant material to protect from UV damage

Photo Cd5: Professor Billman’s archeological sites are marked with large white pillars so that community members will know not to disturb these areas per their memorandum of understanding
Monitoring activities were conducted in Compone (See Photo CM1) on January 22nd, 2011. One of UMCP’s community partners who is a taxi driver picked up the monitoring team from Cusco and took them to his hometown of Compone. Since the monitoring team was already aware that the chlorine dosers were offline and not functioning through information from Steve Robinson, they focused on Ayotomibamba, where the ferrocement tank was constructed 1.5 years before.

The team was surprised to learn that the tank was also offline because it was leaking through the walls (See Photo Group CM2). When asked why the tank failed, community members had a variety of ideas, including that the hydraulics were designed wrong, that the overflow valve never worked properly, and that this method of construction was just flimsy in the first place. Steve Robinson from EWB-UMCP offered some other suggestions for its failure including poor construction quality and exposure to numerous freeze thaw cycles.

The president of the JASS thought that more than chlorine, the community needed education about water conservation. He suggested installing a few water meters at different houses in the community to demonstrate his theory that some people in the system were using a lot more than their fair share of the water.

Although EWB-UMCP reported that the tablets were locally available, even quoting a price, chlorine tablets did not end up being locally available, which completely undermined the disinfection plan. Tablets were found in Lima a few days after visiting Compone (See Photo Group CM3) but shipping from Lima to Cuzco would be expensive unless a Cuzco hardware store could be convinced to begin carrying these tablets.
**Photo CM1:** Compone is along the highway about 30km outside of Cuzco, Peru.

**Photo Group CM2:** Richard points to a place in the tank where cracking occurred. These places can be easily identified because of the discoloration below them. The tank was empty and non-functional at the time of the monitoring trip.
Photo Group CM3: Chlorine tablets were found in Lima by the monitoring team a few days after visiting Compone. This proves that Chlorine tablets are available in Peru but this does not mean that they are available locally to Compone (in Cuzco).
Microbiological water quality

Microbiological water quality was monitored in this project using 3M Petrifilm *E. coli* and total coliform 1-mL tests. Results were not obtained in Santa Rita due to a heavy rain that soaked the Petrifilms nor were they obtained in Compone, where low temperatures prevented proper incubation. The results of the testing are shown in Table 9 below.

**Table 9: Microbiological water quality results showed total coliforms in all communities but *E. coli* only in Huamanzaña.**

<table>
<thead>
<tr>
<th></th>
<th>Total coliforms (cfu/mL)</th>
<th><em>E. coli</em> (cfu/100mL)</th>
<th>Volume tested (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Leon</td>
<td>4.0</td>
<td>&lt; 16.7</td>
<td>6.0</td>
</tr>
<tr>
<td>Huamanzaña</td>
<td>34.5</td>
<td>162.5</td>
<td>8.0</td>
</tr>
<tr>
<td>C. de Dios</td>
<td>40.5</td>
<td>&lt; 25.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Llacamate</td>
<td>6.2</td>
<td>&lt; 7.7</td>
<td>13.0</td>
</tr>
</tbody>
</table>

While each community water supply tested showed total coliforms in its water, only Huamanzaña also showed *E. coli*, which is significant since the presence of *E. coli* is not permissible according to both the Peruvian microbiological parameters in Table 10 below and the WHO guidelines for the verification of water quality in Table 11 below.

Three different EWB teams suggested using total coliforms for microbiological water quality; however they don’t appear in Peruvian regulations or WHO guidelines as indicator species. In fact, “note C” of the WHO guidelines specifically recommends against the use of total coliforms as an acceptable indicator of the sanitary quality of water supplies. This evidence is enough to recommend strongly against using total coliforms as an appropriate water quality indicator. *E. coli* and thermotolerant coliforms are both recommended as better indicators.
Table 10: Peruvian Maximum Permissible Limits of Microbiological Parameters from MINSA, the Peruvian Ministry of Health

<table>
<thead>
<tr>
<th>Microbiological Parameter</th>
<th>Unit of Measure</th>
<th>Maximum Permissible Limit</th>
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</thead>
<tbody>
<tr>
<td>1. E. Coli or Thermo-tolerant coliform bacteria</td>
<td>CFU/100 mL a 44.5ºC</td>
<td>0 (*)</td>
</tr>
<tr>
<td>2. Heterotrophic bacteria</td>
<td>CFU/mL a 35ºC</td>
<td>500</td>
</tr>
</tbody>
</table>

* When the MPN technique is used with multiple tubes = < 3 /100 ml

Table 11: Guideline values for the verification of microbiological quality, which is Table 7.7 of the WHO’s Guidelines for Drinking Water Quality

<table>
<thead>
<tr>
<th>Organisms</th>
<th>Guideline value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All water directly intended for drinking E. coli or thermotolerant coliform bacteria&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Must not be detectable in any 100-ml sample</td>
</tr>
<tr>
<td>Treated water entering the distribution system E. coli or thermotolerant coliform bacteria&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Must not be detectable in any 100-ml sample</td>
</tr>
<tr>
<td>Treated water in the distribution system E. coli or thermotolerant coliform bacteria&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Must not be detectable in any 100-ml sample</td>
</tr>
</tbody>
</table>

<sup>a</sup> Immediate investigative action must be taken if E. coli are detected.

<sup>b</sup> Although E. coli is the more precise indicator of faecal pollution, the count of thermotolerant coliform bacteria is an acceptable alternative. If necessary, proper confirmatory tests must be carried out. Total coliform bacteria are not acceptable indicators of the sanitary quality of water supplies, particularly in tropical areas, where many bacteria of no sanitary significance occur in almost all untreated supplies.

<sup>c</sup> It is recognized that in the great majority of rural water supplies, especially in developing countries, faecal contamination is widespread. Especially under these conditions, medium-term targets for the progressive improvement of water supplies should be set.
Section 5: Lessons learned

Have a local partner organization

A major strength of the EWB-UNC project in Ciudad de Dios has been their partnership with MOCHE, a non-governmental organization (NGO) which has a local presence and a long-standing relationship with the surrounding communities. Conversely, the projects that had the biggest problems were the ones that did not have a well-established local partner organization. Although this is a requirement of EWB-USA projects, it seems to be loosely enforced. Huamanzaña, San Leon, and Compone all lacked established local partner organizations. While most community level partnerships are formed with NGOs, in some cases, as in Llacamate, the local partner could be the local municipality if they have the political will and resources to allow someone to be actively involved with the project.

Involve the local government

National, regional, and/or municipal and local level agencies are typically responsible for the provision of basic services related to EWB projects including drinking water, sanitation, and health care. Most EWB projects, if at all, engage with municipal level agencies. The type and level engagement of a local government entity can vary from consultation, to technical assistance, to advocacy, to financial support. Sometimes the municipality is not an appropriate local partner, which could happen if resources are limited and the community is at the bottom of a long list of other communities needing service or if the government is simply not doing its job. In Peru, the municipality is usually responsible for providing water and sanitation services, either directly or through its contracted utility providers so they should not be let off easy. Unless the local level government agency is severely stressed, their financial commitment to the project
should be required. By making a financial commitment to the EWB project, the local government signals its view that the project is useful. Financial engagement encourages the municipality to remain involved in order to guard their investment. While the level of government engagement for provision of drinking water is the municipality in Peru, in other settings it may be a different level. The point is to apply the above lessons learned to the government office that is responsible for doing in the first place what the project sets out to do. Government support should be leveraged, where possible, before the project starts, getting local partners to buy in early and in writing.

Another important element of local government involvement is its recognition of the water committee and its establishment of the water committee as a legal entity to empower them to enact the rules that they establish. Although Ciudad de Dios does not have this recognition, they have a lengthy list of rules that were decided upon by all of the users of the system, which serves the same purpose. As the treasurer in San Leon mentioned, it is hard for a committee to enforce rules when they have not officially been given the power to do so.

**Established and agreed-upon rules and regulations are important**

An important part of the process of creating a government-recognized JASS is defining roles, electing people into these roles, and agreeing on basic rules of the system, all of which involve the community in the project process. This process increases the community’s involvement and buy-in to the EWB project. San Leon’s lack of the JASS book and its associated rules and regulations demonstrates the importance of ensuring that the community has a community-approved system of rules and regulations. The problems in San Leon show that that the presence of a person or persons elected by the community to fill defined roles to enforce
rules previously agreed upon by the community can be as serious as any technical aspect of the project.

San Leon, Santa Rita, and Huamanzaña are all examples of projects where the enforcement of rules and regulations could have been considered in the design to account for situations where users did not pay for the service. While Ciudad de Dios shows that a government-recognized committee is not needed to establish a good system of agreed-upon rules and regulations, it is the goal of the Peruvian government to recognize water and sanitation committees in all of the communities that have/need them and the US Peace Corps have followed suit since this is a well-established method of achieving these goals.
Communication is paramount

Many of the failures in project design and implementation described in this report can be attributed to inadequate communication of various types, as summarized in the table below.

Table 12: Summary of communication problems found

<table>
<thead>
<tr>
<th>Community</th>
<th>Communication Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Santa Rita</td>
<td>Latrines replaced by municipality possibly due to lack of original involvement; not financially sustainable</td>
</tr>
<tr>
<td>San Leon</td>
<td>No project documents provided to community; Rotary partners unaware that important documents belonged in the community; lack of reporting in 2007; not financially sustainable</td>
</tr>
<tr>
<td>Huamanzaña</td>
<td>Lack of reporting and communication led to repeated mistakes concerning social tensions in the upper distribution system</td>
</tr>
<tr>
<td>Llacamate</td>
<td>Mayor’s lack of information led to empty promises and hurt feelings</td>
</tr>
<tr>
<td>Ciudad de Dios</td>
<td>Lack of post-monitoring details in reports</td>
</tr>
<tr>
<td>Compone</td>
<td>Community needs may have been misunderstood; chlorine tablets not available; community did not understand purpose of tank</td>
</tr>
</tbody>
</table>

With local partners

Had the municipality been involved (as discussed above) in the EWB-CU latrine project in Santa Rita from the start, they may have been able to anticipate the new footprint of the school and the preferred type and location of the associated bathrooms. Another miscommunication problem concerning the municipality occurred in the Llacamate project, when the mayor’s promise for indoor water faucets had to be retracted due to a limitation on the Rotary matching grant funding of which he was never informed. The disappointment of the community in the mayor and of the mayor in the EWB team could have been prevented if the EWB team had provided the mayor with a Spanish translation of the list of the matching grant limitations. This reinforces the above section on involving the local government but it also shows the importance of thorough communications with local partners. This includes communicating throughout the project process as much as possible: providing them with findings from an assessment, implementation alternatives and decisions, funding opportunities and limitations, engineering
design documents, and O&M and M&E plans. It is also important to be sure to accomplish these communication goals in the local language and a local translator should be hired if no one on the EWB team is fluent in the local dialect.

True community participation is just about impossible in the EWB-USA model unless there is the ability to constantly involve the community in the project process, which is often not feasible. Comparing the EWB-USA model to a project funded by a professional development agency is useful to illustrate EWB-USA’s limitation in this area. In a US-AID funded project, the local partners would be involved in the assessment, problem identification, the decision tree, and the development of the technical design. A field team would visit the community repeatedly over a period of time. In EWB projects, much of this work is performed at universities in the United States with minimal, if any, input from the community. These inherent limitations on community participation and involvement may not be preventable when working on EWB-USA projects but they should be recognized so that they can be addressed at least as much as possible. Establishing regular phone calls with community members, including leaders would be a good start, making sure that the system set up for this communication does not put additional economic burdens on the people with whom you are communicating (in Peru, incoming calls are free).

In reporting

Since the EWB-USA project process depends on reports to institutionalize the assessment and design decisions and to generally embody the thought process of each project, continuous and thorough reporting is key to making a project successful. This is especially true in an organization like EWB-USA where high student turnover rate is unavoidable. When a five-year project goes through 5 or more student project managers, the challenges associated with the lack
of institutionalization of knowledge are exaggerated. These challenges are even more exaggerated when attempting to monitor old projects similar to the monitoring done for EWB-CU projects in this project. Without project documents listing goals, details, and monitoring indicators, monitoring teams are forced to “fly blind” and monitoring becomes more difficult, less effective, and less likely to take place at all.

EWB-PU may have learned more about the tensions placed on the FONCODES water system that was caused by farmers in the upper distribution system feeling entitled to all of the water if the 2010 team had had access to the 2005 reports. Effective communication is extremely important in learning about this kind of socially-sensitive information, since it requires trust to be established between the informant and the party conducting the assessment.

In addition, it is a shame to see a seemingly successful project in the Huamanzaña bathrooms without being able to go back and figure out what was done that made it such a success. EWB-UNC has a model project but the apparent success lacks any real confirmation through monitoring. While appropriate metrics and indicators are set forth in pre-trip reports, the results of these are not contained in post-trip reports. Robust reporting would help fine-tune any deficiencies in the project and would serve as confirmation of the project’s success. In the spirit of improving the work that EWB-USA does, it will be crucial to share successes as well as failures.

**With the community**

San Leon’s complete lack of any shred of paper from the project is an unacceptable communication failure. Providing a community with a list of materials with their specifications, cost, availability (where to find replacements), and expected lifetime in the local language should be a basic requirement for projects. This is especially true when outside or foreign materials are
brought in that are unfamiliar to a community. In addition to EWB-CU taking on the task of locating the resources and providing the information that San Leon needs, care should be taken so that this blunder in communication is not repeated, not only within the EWB-CU chapter, but by all other EWB-USA chapters.

Printed materials present a great opportunity for effective communication with the community but, without care, they can have an undesired effect on the community. The problems that the EWB-CU team had with printed materials in Llacamate can be easily avoided in the future if care is taken when they are produced. These mistakes in Llacamate show that it is important to have all printed project materials reviewed by a few different team members (rather than just one) and finally the professional mentor or faculty advisor if possible before they are approved internally for printing/use in the field. Members of the design team would have easily caught the unit mistakes made during translation and a quick team review of the map would have illuminated errors in the graphics and the use of English.

The project in Llacamate also showed the importance of being able to anticipate and adapt to the changing structure of international partner organizations or governments. It also demonstrates the need to have the project fully owned by the community. EWB-CU’s educational and community capacity-building objectives took a hit when the JASS president, the village mayor, and the school teacher all changed. This is an example of how depending on one person to carry important knowledge forward is like putting all of your eggs in one basket. Various community members should be involved as much as possible during education events and workshops.
During the assessment

Another potential communication mistake lies within the details of the rapid assessment of the community. The problems that were investigated and the conclusions that were reached seemed to be rushed and it doesn’t appear that the community was much at all involved in the process of determining the problem and helping to decide on alternatives to addressing it. The relatively brief discussion with the president of the JASS in Ayotomibamba showed that 1) He did not understand the purpose of the reservoir—and 2) He thought that other problems with the water system were more severe and he had suggestions for using outside help for improving them. Lessons learned here are that 1) it is a mistake to move forward with a project without the involvement and understanding of the community—or at least key community partners like the JASS president and 2) that it is important to make a true effort to involve the community in the project process, including problem identification and decision-making about intervention alternatives. Communication is paramount in this process of true community involvement.

Mis-communication also played a part in the failed chlorine dosers and reservoir in Compone. The source of information for the local availability of chlorine tablets in Compone was unclear in the reports but confirmation of the availability of these from a dependable on-the-ground source would have been ideal. In Peruvian culture, it is common for someone to give the affirmative when they are questioned about something if they know that it is the preferred answer even when they aren’t really sure that it is true. Whether it was hopeful affirmations from a misinformed Peruvian partner or the changing of the situation in the months between confirmation of the local availability of the tablets and actually needing them, more dependable communication may have avoided installing the five chlorine dosers that have never been put on line.
**Use metrics/indicators that are measureable**

The use of inappropriate indicators seems to be very common in EWB projects. The table below lists some examples of this.

**Table 13: Examples of the use of inappropriate indicators by EWB teams**

<table>
<thead>
<tr>
<th>Location</th>
<th>Indicators Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Leon</td>
<td>Total coliforms used for microbiological indicators; reduction of diarrheal disease attempted as an indicator for the success of the water project</td>
</tr>
<tr>
<td>Huamanzaña</td>
<td>Lung capacity proposed as an indicator for success of stove project</td>
</tr>
<tr>
<td>Llacamate</td>
<td>Diarrheal disease proposed to measure the success of the latrine project</td>
</tr>
<tr>
<td>Compone</td>
<td>Reduction in gastrointestinal illness proposed to measure the success of the disinfection system</td>
</tr>
</tbody>
</table>

Health improvements were reported as the impact for all of the water and sanitation projects that were studied. Since EWB teams do not have the capacity or the resources to conduct effective epidemiology studies, available resources should be used instead for ensuring that systems are functioning properly and being used correctly. If systems are functional, well-maintained, and properly used by communities, they will have the intended health effects. Therefore, using indicators related to observed use, reported reliability, and evidence of system maintenance and financial sustainability should be used in place of hard-to-measure health indicators. SMART (or appropriate) indicators are described below in the suggestions to EWB.

**Follow up**

EWB-UNC’s project in Ciudad de Dios is a good example of the usefulness of follow-up (despite the reporting deficiencies listed above). Correctly conducted follow-up monitoring trips that focus on capacity building can be very effective in driving home operation and maintenance and general education objectives, especially in organizations like EWB where project teams are on the ground for very limited amounts of time. Unless education and operation and maintenance and monitoring education are being conducted by a project partner, it is unrealistic...
to assume that all of these things will be accomplished during an implementation trip. Even if an EWB team does put a major effort towards operation and maintenance education and monitoring capacity building during an implementation trip, follow-up will drive home these objectives.

Community motivations vs EWB/development inspired motivations

This “lesson learned” was described very well by EWB-UNC in their post-assessment report from December 2010:

“At the time of the community surveys, most households had yet to construct their own latrine. Many of those interviewed were expecting latrines to be built in the near future, though it was unknown how many were to be built and at which households. It seemed that we, on the project team, saw the health benefits as the strongest advantage to having a household latrine. However, after taking part in over a dozen interviews, it seems that having a latrine is also about equity in the community. People want to feel that they are equally treated and that no household receives special privileges from the water committee or groups providing outside assistance.”

While the EWB team was depending on health improvements to motivate the community to build latrines, they realized that real motivations of community members were completely different. The goal of the assessment should incorporate the community’s opinion about what their needs are and also their motivations for addressing these needs.

Community motivations were also questioned in the Huamanzaña project when EWB-PU observed a relative lack of interest in operation and maintenance of the water system. This situation begs the question of whether the community valued the system in the first place. Although it was unclear whether the operation and maintenance education was inadequate or the
community lacked interest in the project, the take-home message was that the community was not going to be able to maintain the system without the continued support of EWB-PU.

**Taking lessons forward**

As described above, there are limitations within the EWB framework for providing assistance that present obstacles to meeting the challenges presented by sustainable development, like lack of continuity in project team members, lack of understanding of key development principles, the university-break timing of trips, and lack of established relationships with key stakeholders. However, since it is impossible to correct many of the problems inherent in the EWB framework, this section will focus on what can be changed and what adaptations might be made to make up for the limitations above.

The lessons learned in San Leon are applicable to all projects but will be used to guide EWB-CU’s current project in Llacamate. First, it will be important to continue to foster the process of defining rules and regulations. Llacamate is ahead of the game already in this respect since they have an official JASS and they use their JASS book at each meeting and treat it with the utmost respect, logging meeting notes, new rules, and community work logs. It will still be important for individual users to sign the JASS book, acknowledging agreement with all of the rules that are laid out within, including monthly payment and penalties for lack of payment. According to the treasurer in San Leon, this will help the JASS hold families accountable.

Another recommendation from San Leon to be used in Llacamate is to provide the ability for the water committee to lock individual shutoff valves. This empowers the water committee to have more leverage for obtaining user fees and the hope is that this will lead to greater financial sustainability.
The lack of project documents and materials specifications in San Leon will need to be corrected there and will also need to be a focus of the Llacamate project’s operation and maintenance education plan.

The operation and maintenance structure in Cuidad de Dios was so effective that the templates for the monthly maintenance checklist, financial forms, and repair log should be adapted for the Llacamate projects and really for any EWB project where regular administrative duties and operations and maintenance tasks need to get accomplished.

Compone reminds us to use locally available materials and locally proven design and construction methods and to always double check the availability of all parts of a design before implementation is done.
Section 6: Suggestions for Improving the EWB-USA Project Process

The word sustainability is used in EWB-USA’s vision, mission statement, and guiding principles as well as multiple times in the report form instructions. It is most often used to refer to the longevity or long-term functionality of a project and to financial sustainability. As EWB-USA continues to strive toward long-lasting, financially stable projects where the community is able to operate self-sufficiently after a relatively short relationship with a chapter, they will need to further refine their project process to include more specific requirements and additional guidance resources for project monitoring and evaluation. The following suggestions are based on the lessons learned from the monitoring activities in this report:

1) Provide guidance on effective metrics: SMART INDICATORS

In their new reports, EWB-USA recognizes the importance of establishing monitoring indicators by including the following requirement in the assessment and pre-implementation forms:

“List at least three metrics by which you will measure the success of that project. List all data, both quantitative and qualitative, that will be required to develop those metrics. Also provide details on the methods used for data collection.”

What’s missing along with this requirement, however, is the guidance on choosing appropriate metrics or SMART indicators and finding appropriate means of verification. The acronym SMART was promoted by Broughton and Hampshire and others and it stands for Specific, Measurable, Achievable, Relevant, and Time-bound, all of which are characteristics of effective metrics.

While some teams may have individual team members, mentors, or advisors who are familiar with the idea of creating SMART indicators (or a similar set of guidelines for
appropriate metrics), these are not always intuitive. Thus, EWB-USA should provide guidance for and examples of creating effective metrics and indicators.

One thing that all six projects had in common as part of their project objectives was the improvement of community health through the reduction of waterborne illnesses. This is a realistic objective, especially if the project includes a hygiene component (which most did), since the improvement of water quality and handwashing with soap have been proven to reduce diarrheal disease by 17% and 48%, respectively\(^7\). However, even though it can be listed as an appropriate impact or objective, it is not appropriate as an indicator.

2) Require that project objectives be specific and measurable

Taking a step back, defining project objectives, milestones, targets, and benchmarks is a critical part of the design/intervention stage of sustainable community development. To be effective in the long-run and to hold up in project monitoring stages, these have to be defined with the understanding that they will have to be measurable by some metric in the future. While the new EWB-USA report forms have the requirement for metrics, they don’t have a similar requirement for defining specific objectives. A requirement for objectives similar to the one for metrics should be incorporated into the assessment and pre-implementation documents. While the logframe is the development industry standard, the EWB-USA objectives requirement could be a simplified form of this, having the required objectives paired with the required metrics.

3) Require sustainable development committee approval

In addition to TAC approval, projects should also be presented to a sustainable development advisory committee (SDAC) for approval of the non-technical aspects of the project. The problems that were found with EWB projects were mostly non-technical and many aspects of the project process are non-engineering. Since the TAC is comprised of domestic professional
engineers, they lack the international sustainable community development experience that other professionals could offer. This committee would be especially important when this kind of experience is not available in the chapter’s professional mentors and faculty advisors.

4) Require chapters to share materials that have been provided to the community.

This should include specifications, cost, availability, and lifetime of materials used in a project, as well as operation and maintenance educational materials and other educational materials. The O&M section of the 525 is not enough to ensure that a team has communicated these to the community. These should be submitted along with post-trip reports, specifically the 526 report and feedback should be given by the SDAC (from above).

5) Require relevant project documents to be translated into the local language

EWB chapters’ ability to communicate with project partners and the communities where they work is of the utmost importance. If any project stakeholders do not speak English, they should be provided with a copy of relevant project documents in their own language.

6) Recognize EWB-USA’s lack of oversight in early projects and require project updates

EWB-USA projects between 2002 and 2007 seem to be missing details and some don’t have closeout reports or even the information necessary to complete one. A good technique for allowing EWB-USA to have an idea of the longevity of their projects would be to require the chapter, where possible, to visit old projects before approval of a new project. Incentive must be created for visiting old projects if meaningful project monitoring is to be done. EWB-USA’s expectation that monitoring and evaluation are the responsibility of the partner organization are meaningless when the partner organization does not have the necessary information and training to conduct effective project monitoring.

7) Require chapters to report total per capita costs
A valuable and widely used project metric is per capita cost. The project cost table in EWB-USA reports is not useful to establish total per capita costs of a project because most chapters report the costs of the current stage of their project instead of including the entire project cost. This would be a simple addition to this section of EWB-USA reports that would provide a valuable resource for overall project monitoring and evaluation.
References


3. Engineers Without Borders-USA. Home page of website: [www.ewb-usa.org](http://www.ewb-usa.org)


Appendix A: Monitoring-related sections of EWB-USA Reports

The monitoring sections of all of the forms in the project process are included below. Although they are very similar, one can follow the progression of the EWB-USA monitoring approach through the course of the project process. These monitoring sections are followed by complete pre-monitoring form, which illustrates other important and typical sections of EWB-USA reports.

Pre-Assessment (521)

6.0 Monitoring - EWB-USA chapters are required to monitor their project over time to measure the impact their work has had on their partner communities, both positive and negative. Your initial assessment trip schedule should include time to gather data that will be used as a standard against which you can compare the results of your implementation to report on the affect of your work. Develop project specific metrics by which you can measure the success of the project as it relates to functionality and maintenance. Describe at least three metrics for your project that you plan to use to measure the long-term impact of your work in the community. Specifically describe how the data will be gathered before and after implementation of the project. All EWB-USA projects are required to undergo a period of monitoring by the implementing chapter that lasts at least one year after the implementation of the project. Your project schedule must include a return to the site at least one year after implementation to ensure that the project is functional and maintained.

6.1 Monitoring of past-implemented projects: If you will be monitoring past-implemented projects on this trip, include the following additional information related to those efforts. List at least three metrics by which you will measure the success of that project. List all data, both quantitative and qualitative, that will be required to develop those metrics. Also provide details on the methods used for data collection.

Additionally, be prepared to answer the following questions in your post-trip report for each past-implemented project:

- Project Discipline – State the discipline of the past-implemented project you are monitoring. Use only the terms listed in Part 1, Section 6.0 above.
- Date of Completion – What was the date of the completion of the project implementation? (month/day/year)
- Functionality – What percentage of the project implemented is functioning as designed? (0-50%, 50-75%, 75-100%)
- Enhancement – Has the community enhanced the system implemented at all? (Yes or No)
- Duplication – Has the community duplicated the design on their own in another location? (Yes or No)

Post Assessment (522)

6.0 Monitoring— List at least three metrics by which you will measure the success of your project. List all data, both quantitative and qualitative, that will be required to develop those metrics. Also provide details on the methods used for data collection.
6.1 Monitoring of past-implemented projects: If you monitored the status of past-implemented projects on this trip, include all data, both quantitative and qualitative, that were used to measure the success of your project(s). Also provide details on the methods used for data collection. In addition, complete the following information for each project:

Project Discipline , Date of Completion, Functionality, Enhancement, and Duplication

*specifics listed above in pre assessment*

**Pre-implementation (525)**

8.0 Monitoring—List at least three metrics by which you will measure the success of your project. List all data, both quantitative and qualitative, that will be required to develop those metrics. Also provide details on the methods used for data collection. Additionally, be prepared to answer the following questions in your post-trip report for each implemented project:

Project Discipline , Date of Completion, Functionality, Enhancement, and Duplication

*specifics listed above in pre assessment*

8.1 Monitoring of past-implemented projects: If you will be monitoring past-implemented projects on this trip, include the following additional information related to those efforts. List at least three metrics by which you will measure the success of that project. List all data, both quantitative and qualitative, that will be required to develop those metrics. Also provide details on the methods used for data collection. Additionally, be prepared to answer the following questions in your post-trip report for each past-implemented project:

Project Discipline , Date of Completion, Functionality, Enhancement, and Duplication

*specifics listed above in pre assessment*

**Post-implementation (526)**

6.0 Monitoring—Include all data, both quantitative and qualitative, that were used to measure the success of your project(s). Also provide details on the methods used for data collection. In addition, complete the following information for each project.

6.1 Project Monitoring – Include answers to the questions below for each project implemented within the program.

Project Discipline , Date of Completion, Functionality, Enhancement, and Duplication

*specifics listed above in pre assessment*

6.2 Monitoring of past-implemented projects: If you monitored the status of past-implemented projects on this trip, include all data, both quantitative and qualitative, that were used to measure the success of your project(s). Also provide details on the methods used for data collection. In addition, complete the following information for each project.
6.3 Additional Information – If applicable, provide any additional information to clarify why the project is not complete or why the project is not functioning as designed.

**Pre-monitoring (530)**

4.0 Monitoring

4.1 Project Monitoring – State your plan to collect sufficient data to report on all previously identified metrics by which you will measure the success of your project. Include all data, both quantitative and qualitative, that will be used to measure the success of your project(s). Also provide details on the methods used for data collection. Additionally, be prepared to answer the following questions in your post-trip report for each implemented project:

   Project Discipline, Date of Completion, Functionality, Enhancement, and Duplication

   *(specifics listed above in pre assessment)*

4.2 Resolution of technical problems – Provide a description of your approach to identify issues that have arisen since implementation. If significant design changes are required for the project to function as designed, additional data should be gathered to properly assess options for correcting the situation. A redesign must be presented to the TAC for a future implementation trip.

4.3 Capacity and financial assessment – Provide a detail description of how the implemented infrastructure is managed and financially supported by the community. Provide a set of criteria that you will use to evaluate the performance of the managing group, including feedback from the community. Include a detailed description of the trainings that you intend to organize to improve technical and non-technical capacity, or a description of these activities performed by a partnering organization.

**Post-Monitoring (531)**

5.0 Monitoring

5.1 Project Monitoring – Include answers to the questions below for each project implemented within the program.

   Project Discipline, Date of Completion, Functionality, Enhancement, and Duplication

   *(specifics listed above in pre assessment)*

5.2 Resolution of technical problems – Provide a description of any issues identified through communication with the community after construction was completed. Discuss your plans to address the outstanding issues if the community or partnering organization/NGO is not addressing them directly. Include in this discussion your timeline for submitting to the Technical Advisory Committee your design revisions and plans to return to implement the modifications/repairs.

5.3 Capacity and financial assessment – Provide a detail description of how the implemented infrastructure is managed and financially supported by the community. Provide the results
of your evaluation of the performance of the managing group based on your pre-established criteria. Include a detailed description of any changes in the trainings that you developed to improve technical and non-technical capacity.

5.4 Additional information – If applicable, provide any additional information to clarify why the project is not complete or why the project is not functioning as designed.

Project Closeout (527)

5.0 Monitoring—Include all data, both quantitative and qualitative, that were used to measure the success of your project(s). Also provide details on the methods used for data collection. In addition, complete the following information.

5.1 Project Monitoring – Include answers to the questions below for each project implemented within the program.

Project Discipline, Date of Completion, Functionality, Enhancement, and Duplication

(*specifics listed above in pre assessment*)

5.2 Additional Information – If applicable, provide any additional information to clarify why the project is not functioning as designed.
Document 530 – Pre-Monitoring Report—Instructions for Report Preparation

The full instructions for the Pre-Monitoring Report was included here as an example to show what the rest of the report requirements look like. Although the monitoring section deals directly with monitoring, other sections that were left out above are also relevant to establishing the long-term sustainability of the project.

*note: Content of the EWB-USA instructions that is not relevant to this report (administrative information) has been left out

The purpose of a monitoring trip is to gather information to allow the chapter to a) confirm the economic, social, environmental and technical viability of the project, b) confirm project sustainability; the potential for the project to last long-term, c) evaluate the technical and non-technical (management, financial) performance of the implemented project, and d) continue the collection of data for monitoring of the project in the future. The pre-monitoring document is a planning tool for chapters to use to ensure that the pertinent information is gathered during the site monitoring visit. It also allows the EWB-USA National Staff to review the trip and make recommendations that are intended to improve the quality of the project. To allow time for review by EWB-USA National Office staff, this report must be submitted in accordance with the deadlines posted on the EWB-USA website. Your trip will be postponed if your chapter does not meet the posted deadlines.

Note: Use this report if your chapter is only conducting a monitoring trip. The 530 – Pre-Monitoring Report and 531 – Post-Monitoring Report are intended for chapters who are conducting a monitoring trip of past projects and no other project work. If you plan to collect information on past projects while on an assessment or implementation trip for a different project, you should use only the 521 or 525 reports, respectively.

There are two parts to the pre-monitoring report: Part 1 includes the administrative information for the trip and Part 2 includes the technical information.

Part 1 is a fill-in-the-blank exercise that provides the EWB-USA National Office with specific information about chapter and community contacts, travel details, health and safety plans and budget in a specific format. The information should be provided in the exact format requested without deviation. If you have questions about completing Part 1 of the report contact your Chapter Relations Manager (CRM) at the EWB-USA National Office.

Part 2 of the report is not a fill-in-the-blank exercise. This is the portion of the report where your chapter provides all the detailed information about the project and proposed trip. The outline of this portion of the report can be modified by the chapter if necessary to present the project more clearly. It is your chapter’s responsibility to clearly and thoroughly present your project and the proposed monitoring trip. Note that you may need to include additional information that is not listed depending on the specifics of your project. If you have questions about completing Part 2 of the report, contact your project’s assigned Project Manager (PM) at the EWB-USA National Office.

Pre-screening of the Report: Prior to a complete review of this document, it will be screened for compliance with the most basic requirements for a complete submittal. Specifically, the submittal must include a Health and Safety Plan (HASP) and have a qualified Professional Mentor (for student
chapters) or Technical Lead (for professional chapters) on the travel team or it will be rejected and the chapter must re-submit when those items are included. This will likely necessitate postponing travel.

**Part 1: Administrative Information – Instructions**

1.0  Contact Information
2.0  Travel History – Show every trip that your chapter has taken for this program.
3.0  Travel Team – Include information for all the travel team members.
   Travel Team Size - The size of the travel team should be based upon the requirements of the project. The maximum travel team size is eight. Most trips should be smaller.
4.0  Health and Safety – All EWB-USA trips require a site-specific HASP
5.0  Budget – fill in each of the tables in the report template without modifying any of the headings.
   5.1  Cost - This should be your total budget including what team members are paying. Please include in-kind contributions.
   5.2  Donors and Funding - Please include in-kind donations.
6.0  Project Discipline(s) – The headings in bold are project types, the subheadings are project disciplines. Check all project disciplines addressed in this report. Note that each project type needs to be approved by an EWB-USA Project Manager. If this is a new project that has not previously been approved, your chapter may need to submit a 501B – New Project Within Existing Program Application.
7.0  Project Location – Provide the longitude and latitude of the project location so that the project site can be located using Google Earth.
8.0  Project Impact – Provide an estimate of the number of people impacted by the project. Use an exact number, not a phrase like “the whole village”.
9.0  Mentor Resume – Attach the resume for the traveling Professional Mentor/Technical Lead even if you have attached it in a previous report.

**Part 2: Technical Information - Instructions**

6.0  Introduction – Explain the purpose of this document and provide a short description of the proposed trip tasks.
7.0  Program Background – Provide the background of the project including a summary of information contained in previous documents for this project. This is an update of the same section in the most recent document submitted for this project.
8.0  Community Information
   6.2  Description of the Community – Information should include those items that will have a bearing on the sustainability of a project such as population trained, income earned, etc.
   6.3  Community and Partnering Organization/NGO Resources and Constraints – List and describe the community resources and constraints relevant to your project. The sustainability of your project will depend heavily on the resources available to your community and the constraints that the community has. The resources and constraints could include (but are not limited to) items such as financial resources, political organization of the community, administrative capability, language skills, geographic location, distance from vendors of construction materials, educational level and job skills of individuals in the community. Also consider these topics as they relate to the Partnering Organization/NGO, i.e. what resources are they able to bring to the project and conversely what are their constraints.
   6.4  Community Relations – Describe the contacts that you currently have with the community, their relationship with the community and what they are providing you. Include information
about the Partnering Organization/NGO with which you are working. Describe the structure currently in place to interact with your team and locally manage the project, including roles and responsibilities of each member. Include assessment of existing capacity, and areas where capacity development is needed.

9.0 Monitoring

6.5 Project Monitoring – State your plan to collect sufficient data to report on all previously identified metrics by which you will measure the success of your project. Include all data, both quantitative and qualitative, that will be used to measure the success of your project(s). Also provide details on the methods used for data collection. Additionally, be prepared to answer the following questions in your post-trip report for each implemented project:

   Project Discipline – State the discipline of the past-implemented project you monitored. Use only the terms listed in Part 1, Section 6.0 above.
   Date of Completion – What was the date of the completion of the project implementation? (month/day/year)
   Functionality – What percentage of the project implemented is functioning as designed? (0-40%, 40-75%, 75-100%)
   Enhancement – Has the community enhanced the system implemented at all? (Yes or No)
   Duplication – Has the community duplicated the design on their own in another location? (Yes or No)

6.6 Resolution of technical problems – Provide a description of your approach to identify issues that have arisen since implementation. If significant design changes are required for the project to function as designed, additional data should be gathered to properly assess options for correcting the situation. A redesign must be presented to the TAC for a future implementation trip.

6.7 Capacity and financial assessment – Provide a detailed description of how the implemented infrastructure is managed and financially supported by the community. Provide a set of criteria that you will use to evaluate the performance of the managing group, including feedback from the community. Include a detailed description of the trainings that you intend to organize to improve technical and non-technical capacity, or a description of these activities performed by a partnering organization.

10.0 Community Agreement/Contract – Provide an English version of the agreement/contract that your team has developed with the community leadership even if your team has submitted this with previous reports. This agreement/contract should include responsibilities relating to community ownership and funding mechanisms for maintenance into the future. If you have previously submitted this document, please indicate when it was submitted and refer to it in this section. If this is not available, please explain why not.

11.0 Schedule of Tasks – Present all trip tasks within a trip schedule. In order to gather as much information as possible to assess the impact of your project, it is important to organize the tasks that must be accomplished and the schedule of the team members. Different chapters accomplish this in different ways. Some examples of trip/task organization include lists of tasks, daily schedules and decision trees. The trip organization should provide justification for the length of the trip and the number of travel team members.

12.0 Mentor Assessment – The Professional Mentor (for student chapters) or Technical Lead (for professional chapters) should write a short assessment of how the project team prepared this
monitoring trip document. This assessment should include individuals involved, studies and designs carried out, project management tasks preformed and a description of any training that was carried out for the trip. You should discuss the requirement in this section with your Professional Mentor/Technical Lead ahead of time to accommodate their schedule in anticipating the submittal deadline. This section is required for review.

6.8 Professional Mentor/Technical Lead Name – List the name of the Professional Mentor/Technical Lead who wrote the assessment.

6.9 Professional Mentor/Technical Lead Affirmation – The Professional Mentor/Technical Lead should write one sentence here acknowledging their involvement in the development of the monitoring trip plan and their acceptance of responsibility for the course that the project is taking.