Document 521
PRE-ASSESSMENT REPORT

CHAPTER: Greater Austin
COUNTRY: Peru
COMMUNITY: Huasta
PROJECT: Huasta, Peru - Agriculture (Irrigation)
TRAVEL DATES: January 1-13, 2013

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

Pre-Assessment Report Part 1 – Administrative Information

1.0 Contact Information

Project Title	Name	Email	Phone	Chapter Name or Organization Name
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	Rachel Chisolm	rachel.chisolm@gmail.com	(512) 417-0024	Greater Austin
President (student)	Raquel Flinker	raquelflinker@gmail.com	(817) 371-0714	Greater Austin
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NGO/Community Contact	Jorge Recharte	jrecharte@mountain.org	51-719-2570	The Mountain Institute (TMI)

2.0 Travel History

Dates of Travel	Assessment or Implementation	Description of Trip
8/2/2011 – 8/16/2011	**Assessment**	**Commonwealth**
1/1/2012 – 1/14/2012	**Assessment**	**Huasta**
7/12/2012 – 7/13/2012	**Assessment**	**Huasta**

3.0 Travel Team (Should be 8 or fewer):

#	Name	E-mail	Phone	Chapter	Student or Professional
1	Rachel Chisolm	rachel.chisolm@gmail.com	(512) 417-0024	Greater Austin	Student
2	Fernando Salas	fernando.r.salas@gmail.com	(980) 263-4818	Greater Austin	Student
3	Tim Ager	tager@bga.com	(512) 419-0545	Greater Austin	Professional
4	TBD				
5	TBD				

4.0 Health and Safety

The travel team will follow the site-specific Health and Safety Plan (HASP) submitted along with this pre-assessment report.

5.0 Monitoring - Identify Projects to be Monitored on this Trip

Project Type	Project Discipline(s)	Date of Completion (m/d/y)
Sanitation and Technical Training	Black Water System	TBD

6.0 Budget

6.1 Project Budget

Project ID: 009122
Type of Trip: A

Trip type: A= Assessment; **I**= Implementation; **M**= Monitoring & Evaluation	
Trip Expense Category	**Estimated Expenses**
Direct Costs	
Travel	
Airfare	$6,000
Gas	
Rental Vehicle	
Taxis/Drivers	$200
Misc. (i.e. bus, combi etc.)	$600
Travel Sub-Total	$6,800
Travel Logistics	
Exit Fees/ Visas	
Inoculations	
Insurance	$165
Licenses & Fees	
Medical Exams	
Passport Issuance	
Misc.	
Travel Logistics Sub-Total	$165
Food & Lodging	
Lodging	$400
Food & Beverage (Non-alcoholic)	$500
Misc.	
Food & Lodging Sub-Total	$900
Labor	
In-Country logistical support	
Local Skilled labor	
Misc.	
Labor Sub-Total	$0
EWB-USA	
Program QA/QC **(1)** See below	$500

EWB-USA Sub-Total	$500
Project Materials & Equipment (Major Category Summary*)* add rows if needed	
Hand auger	$50
Pocket penetrometer	$100
Education materials	$50
Project Materials & Equipment Sub-Total	$200
Misc. *(Major Category Summary)*	
Report Preparation	
Advertising & Marketing	
Postage & Delivery	
Misc. Other	
Misc. Sub-Total	$0
TOTAL	$8,565
a. (1) Program QA/QC Assessment = $1,500 Implementation = $3,675 Monitoring = $1,125	
EWB-USA National office use:	
Indirect Costs	
EWB-USA	
Program Infrastructure **(2)** See Below	$0
Sub-Total	$0
TRIP GRAND TOTAL (Does not include Non-Budget Items)	$0
a. (2) Program Infrastructure Assessment = $500 Implementation = $1,225 Monitoring = $375	
Non-Budget Items:	
Additional Contributions to Project Costs	
Community	
Labor	
Materials	
Logistics	
Cash	
Other	

Community Sub-Total	$0
EWB-USA Professional Service In-Kind	
Professional Service Hours	
Hours converted to $ *(1 hour = $100)*	$0
Professional Service In-Kind Sub-Total	$0
TRIP GRAND TOTAL (Includes Non-Budget Items)	$0
Chapter Revenue	
Funds Raised for Project by Source	**Actual Raised to Date**
Source and Amount *(Expand as Needed)*	
Engineering Societies	
Corporations	$3,560
University	
Rotary	
Grants – Government	
Grants – Foundation/Trusts	
Grants – EWB-USA program	
Other Nonprofits	
Individuals	$2,000
Special Events	
Misc.	
EWB-USA Program QA/QC Subsidy **(3)** See below	$1,500
EWB-USA Program Infrastructure Discount Amount	
Total	$5,560
Remaining Funds Needed	**$**

a. (3) Program QA/QC & Infrastructure Subsidy:
Assessment = $1500
Implementation = $3,900
Monitoring = $1,000

6.2 Donors and Funding

Donor Name	**Type (**company, foundation, private, in-kind**)**	**Account Kept at EWB-USA?**	**Amount**
Exxon	**Company**	**Yes**	**$1,000**
BP	**Company**	**Yes**	**$2,560**
Travel team	**Private**	**No**	**$2,000**
Total Amount Raised:			**$5,560**

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

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

8.0 Project Location

Latitude: S 10.041267
Longitude: W 77.18789

9.0 Project Impact

Number of Persons directly affected: ~ 600
Number of Persons indirectly affected: ~ 1,800

10.0 Professional Mentor/Technical Lead Resume - Please see document *405 - Mentor Qualifications* for Professional Mentor/Technical Lead requirements related to the project area. This can be found in the Sourcebook Downloads on the member pages of the website.

Pre-Assessment Report Part 2 – Technical Information

1.0 EXECUTIVE SUMMARY

The following pre-assessment report prepared by the Climate Adaptation in Mountain Basins in the Andean Region (CAMBIAR) program within the Greater Austin Chapter of Engineers Without Borders is being submitted to EWB-USA to request approval for the first assessment trip within the second project in Huasta, Peru - Agriculture (Irrigation), project number 009122. This document provides the background and basis for the trip, and outlines the plan and schedule of activities for completing the irrigation project assessment. Concurrently, this report includes a section on details supporting the delayed and now approved implementation of the first project (i.e. sanitation and technical training) in Huasta; please refer to the pre-implementation report submitted to EWB-USA on May 20, 2012 for more details.

The objective of the irrigation project in Huasta is to implement an improved irrigation system that will serve as a pilot project to promote water conservation practices for small-scale agriculture within the region. The scope of the project includes the following: (1) develop spring source(s) to provide sufficient water for the irrigation of a community-owned pasture during the dry season; (2) build/install one (or multiple as needed) water storage tanks; (3) design and install a conveyance system to move water from the spring(s) down to the pasture; (4) install an improved/more efficient irrigation system to water the pasture land; and (5) establish a maintenance and monitoring program for the entire system from the source to the point of use.

This project will be carried out in Huasta, a district located in a tributary of the Pativilca River valley in Ancash, Peru (see Figure 1 in Appendix A). The population of Huasta is approximately 2,400 people, of which roughly 1,800 regularly participate within a community "land-owner" association known as the *Campesina Community of Huasta* herein referred to as the "Campesina Community". The Campesina Community collectively owns and manages land in Huasta and distributes the benefits of that land among the entire Campesina Community. The Campesina Community owns the pasture that is to be irrigated through this project. CAMBIAR has already engaged in conversations concerning this project with the Campesina Community. In August 2012, CAMBIAR drafted a memorandum of understanding (MOU) and presented it to the Campesina Community through its in-country partner, The Mountain Institute (TMI); see Appendix B for a signed copy of the MOU. TMI is a non-governmental organization (NGO) with a local office in Huaraz (approximately two hours from Huasta) that works on community conservation projects in the Ancash region. TMI has invaluable knowledge of local politics and society within the region, since its employees spend much of their time in the field interacting with community leaders to develop sustainable projects.

The CAMBIAR program was initiated in May 2011 with the goal of partnering with several communities located within the Santa, Pativilca, and Fortelaza River basin valleys. In August 2011, CAMBIAR traveled to Ancash, Peru and met with representatives of the Tres Cuencas Commonwealth (Commonwealth), a government recognized entity made up of 25 communities with the sole purpose of mitigating water and climate issues, and signed an MOU in conjunction with TMI. Immediately following the signing of the MOU, CAMBIAR, TMI and the Commonwealth discussed several potential projects in various Commonwealth communities and collectively settled on initiating a project in Huasta. CAMBIAR initially began working on an irrigation project in Huasta and explored the possibility of reusing treated wastewater from an existing wastewater treatment plant (WWTP) upstream of the pasture. However, due to the current state of the WWTP facility, CAMBIAR decided to focus on a maintenance and operation program for the WWTP as a stand-alone project. CAMBIAR has been on two assessment trips to support the WWTP project and will partially implement the maintenance and monitoring program in January 2013.

This assessment trip will focus on technical data collection for the irrigation system, community relations in preparation for implementation of the system, and education and technical training for the WWTP project. CAMBIAR will hold discussions with the Campesina Community about the design and scope of the irrigation system and the responsibilities of the involved parties. CAMBIAR will work with the Campesina Community to plan logistics for implementation, develop an operation and maintenance plan

(including financing plan), and establish a framework for the collaboration between the Campesina Community and CAMBIAR.

CAMBIAR plans to follow this assessment trip with an implementation trip in the summer of 2013. The CAMBIAR team will use the data collected during assessment to work on the design of the entire irrigation system from January to March of 2013. Once the design is completed and documented, CAMBIAR will submit the 524- Preliminary Design Report to EWB-USA on March 11, 2013 and the 525- Pre-Implementation Report on April 15, 2013. Implementation may be divided into multiple trips depending on the schedules of CAMBIAR and the Campesina Community of Huasta.

2.0 INTRODUCTION

The purpose of this document is to provide a complete description of CAMBIAR's anticipated January 2013 assessment trip in Huasta, Peru. This document will provide the background necessary to place the trip in context within the CAMBIAR program and the proposed irrigation project. Details surrounding the schedule of activities will be presented and expounded upon (i.e. planned meetings and goals, data collection tasks and methods etc.) Although the bulk of the material presented in the following sections will focus on the proposed irrigation project, details addressing the existing WWTP project will also be included.

3.0 PROGRAM BACKGROUND

Communities in the mountainous regions of Ancash, Peru, are highly susceptible to the effects of climate change due to their dependence on seasonal snowmelt from Andean glaciers and sensitivity to variations in seasonal rainfall patterns. In recent decades, these sources of fresh water have become less dependable, and many of the rural communities have experienced water shortages during the dry season. The impacts of these shortages have been felt most acutely by farmers and ranchers in the region who have noticed changes in crop yields and struggled to maintain adequate pasture land. Natural heavy metal contamination in several of the region's watersheds compound water availability issues for these communities. The contamination is so concentrated in some areas that stream water is unhealthy for livestock and irrigation use, contributing to the water shortage crisis for these farmers and ranchers.

As a proactive response, several municipal districts have formed the Tres Cuencas Commonwealth (Commonwealth) for the sole purpose of mitigating water issues within the three watersheds (*cuencas*) that feed the region's rivers: the Santa, Fortaleza, and Pativilca (see Figure 1 in Appendix A below for an overview map of the region). In establishing themselves as a nationally recognized entity, the Commonwealth has initiated steps at the local and national levels to address their water concerns. To date, the Commonwealth has gathered leaders from its districts, drafted a document outlining the urgent water needs and goals of the region and held their first meeting as a formal entity. The Ministry of the Economy has approved the Commonwealth's foundational document, ensuring that the Commonwealth is eligible to apply for potential regional public funds. Currently the Commonwealth lacks the financial and technical resources to develop a solution strategy for their community-scale water issues. As such, the priority of the CAMBIAR program is to undertake this challenge and help communities in the Commonwealth adapt to climate change, specifically focusing on water-related challenges, through community driven collaboration and sustainable engineering design solutions.

CAMBIAR has established a partnership with The Mountain Institute[1] (TMI) to provide technical assistance to the Commonwealth and complete small-scale pilot projects that demonstrate successful solutions to their water needs. TMI has worked in Ancash for the last 15 years on USAID funded projects and currently manages a program working with two communities in the Commonwealth focusing on reforestation through education, ecological conservation, and sustainable development. CAMBIAR is

[1] For more information about The Mountain Institute's projects in Peru see: http://www.mountain.org/andes

leveraging TMI's knowledge of the region and existing relationships with members of the Commonwealth to effectively plan, implement and monitor pilot projects.

Within the districts of the Commonwealth, the Commonwealth, TMI and CAMBIAR selected two communities, Huasta and Canrey Chico, as priority areas. Huasta is located about two hours south of Huaraz by car in the Province of Bolognesi in the District of Huasta and is part of the Pativilca River basin. Canrey Chico is located in the Province of Recuay in the District of Recuay and lies in the Santa River basin.

Over the duration of the program, it is expected that CAMBIAR will engage in the following:

- Provide technical assistance needed to help assess and prioritize regional needs
- Design solutions for water projects
- Implement small-scale pilot infrastructure
- Educate citizens on health, sanitation, and conservation.

These goals are oriented to equip Commonwealth residents with the knowledge, means and tools necessary to build resilience to changes in their environment. During the August 2011 program assessment trip, CAMBIAR solidified the aforementioned goals through an umbrella MOU that outlines the responsibilities for each party involved (EWB Greater Austin, TMI and the Commonwealth). After careful consideration in the fall of 2011, CAMBIAR decided to focus its initial efforts on a water reuse project in Huasta. The January 2012 assessment trip was a direct result of this decision.

During the January 2012 assessment trip, the CAMBIAR team evaluated Huasta's WWTP, owned by the Municipality, and performed water quality tests on the influent and effluent to determine the feasibility of using the effluent for irrigating a community-owned pasture; the pasture is owned by the Campesina Community of Huasta representing approximately 600 families. It became apparent during the January assessment trip that the WWTP has not been maintained since it was built in 2006 and is not functioning properly. On the July 2012 follow-up assessment trip, the team met with the newly hired municipal engineer of Huasta, who visited the WWTP and agreed to take responsibility for the plant as part of his duties within the Municipality. CAMBIAR's role will be to work with the engineer on drafting a formal list of technical recommendations for rehabilitating the plant as well as to develop and implement a training program for operations and maintenance workers. CAMBIAR also intends to train workers paid by the Municipality to perform water quality tests on the WWTP effluent so that they can continually monitor the functionality of the plant. The expectation of CAMBIAR and the engineer is to ensure the sustainability of the WWTP through education of paid workers and dedicated community members.

In order to achieve the needs of the Municipality and Campesina Community (i.e. rehabilitating the WWTP and irrigating the community-owned pasture), CAMBIAR submitted a 501b application to EWB-USA on September 16, 2012. This document outlines the goals of a new project in Huasta dedicated solely to building a complete irrigation system; this project is a result of several recently discovered springs in Huasta.

4.0 PROJECT DESCRIPTION

The goal of the project is to provide the Campesina Community with an irrigation system that can be utilized to support cattle during the dry season. The Campesina Community has clearly expressed the need to expand their current cattle grazing area to the pasture indicated in Figure 2, Figure 3, and Figure 4 in Appendix A. This pasture was selected for irrigation by the Campesina Community because of its availability and watering potential from nearby water sources. In discussions with the Campesina Community's board of directors, it has been determined that several springs upstream of the pasture present the best feasible solution to their irrigation needs. As such, CAMBIAR plans to develop one or several of the springs for irrigation. Based on water demand estimates and flow data collected in the summer of 2012, it appears that the Punapuquio spring will provide sufficient water for irrigation; this will need to be confirmed through further data collection and a refined water demand estimate.

CAMBIAR will assess the feasibility of building a spring box or water collection area and then explore the potential conveyance paths down to the pasture. CAMBIAR expects to build a conveyance system out of PVC pipe and recognizes that a break pressure tank or pressure reducing valve might be necessary to meet point of use operating pressures; the approximate elevation difference between the springs and pasture as indicated in Figure 3 in Appendix A is 100 meters. As part of the assessment, CAMBIAR will also explore point of use alternatives for the irrigation system. From past trips, CAMBIAR has learned that the Campesina Community typically utilizes flood irrigation techniques to water their land. However, to CAMBIAR's knowledge there is one avocado farm that currently is equipped with drip irrigation. Due to a limited water supply, CAMBIAR will work with the Campesina Community to build a more efficient irrigation system compared to common flood irrigation practices. A likely alternative would leverage sprinklers as they are easily accessible to the community however several alternatives will be explored throughout the assessment. Finally, CAMBIAR will work with the Campesina Community to develop a maintenance and monitoring program for the system that includes financial stability. Details of the project and assessment plan are presented in the following sections.

5.0 OBJECTIVES OF SITE ASSESSMENT TRIP

This assessment trip has two primary objectives:

(1) Community relations and data collection for the irrigation system in Huasta.
(2) Education and technical training related to the WWTP.

A secondary trip objective is to continue to develop relationships with the Tres Cuencas Commonwealth and TMI and build a framework for expanding the pilot irrigation project.

The training and education program is a continuation of the CAMBIAR program's first project in Huasta working with the Municipality to improve the function and operation of the WWTP. The details of this project are outlined in the 525 Pre-Implementation report submitted on May 20, 2012. The plan for education and technical training is elaborated in Section 8.2.

5.1 COMMUNITY RELATIONS AND DATA COLLECTION

The CAMBIAR team will be working with the Campesina Community to continue assessing the pilot irrigation project in a community-owned pasture to lay the groundwork for a planned implementation of this project in the summer of 2013. The objectives for this trip related to the irrigation project fall into two categories: community relations and data collection.

Continuing to build a trusting relationship with the Campesina Community and working in collaboration with them to plan for implementation will be key to the success of this project. CAMBIAR plans to have a preliminary design prepared by January 2013 so that it can be presented to the Campesina Community during the trip. The purpose of this is to actively engage the Campesina Community in the design process so that they completely understand the project and can provide input and feedback. Through discussion of the preliminary design with members of the Campesina Community, CAMBIAR hopes to identify weak points in the design early and modify them before completion of the final design. These discussions will also include the operation and maintenance of the proposed system to ensure that the Campesina Community is confident in their ability to maintain the infrastructure.

To appropriately design for a field irrigation system, the site assessment trip will provide the opportunity to check and confirm previously collected data, to refine assumptions, and to solidify design considerations. The source, storage, and conveyance system will consist of an existing spring(s), a spring box, storage tank(s), piping, and a pressure break tank if deemed necessary. The point-of-use component of the irrigation system at the field will most likely consist of sprinklers that will either be permanently installed in a fixed location or will be portable so that

they can be removed when the field is being used for grazing. The design of the irrigation system will be determined based on the Campesina Community's preferences and planned use of the field. Field data collection will provide the information needed to determine sizing of system components, system configuration, and the most appropriate materials to use. Specific data collection tasks are outlined in Section 7.2, and CAMBIAR plans to involve community members in the data collection process to encourage their participation in the planning and design of the system.

The objectives for this trip related to the irrigation system are outlined below:

Community Relations

- Discuss use of the irrigation system
    - Type of crop, watering schedule, crop rotation, and grazing schedules
    - Division of labor and use of field among community members
    - Maintenance schedule
    - Hierarchy of responsible parties - potentially establish an irrigation committee that works directly with CAMBIAR and reports directly to the Campesina Community board of directors
- Community contract
    - Refine MOU as project details are developed
    - Verify land rights and obtain permission to build infrastructure
    - Cost/payment structure to cover maintenance costs
- Logistics for implementation
    - Discuss work requirements and implementation schedule
    - Walk through the implementation steps with the Campesina Community to identify potential obstacles
    - Involve community members in investigation of materials for project infrastructure

Data Collection

- Spring box
    - Examine location and terrain of spring (Punapuquio) for suitability and design style of a spring box
    - Collect additional flow data; the Campesina Community has been monitoring flow since August of 2012
- Conveyance pipeline
    - Survey pipe pathline
    - Take specific notes on rocky soil, difficult terrain, gullies and washes, road crossings, etc.
- Storage tank
    - Locate potential tank sites based on estimated footprint of tank(s)
    - Perform soil tests at tank sites for foundation design
- Irrigation

- Perform soil tests at field to be irrigated

Lists of questions to be answered on this trip through discussions with community members and materials to be investigated are elaborated in Appendix C and Appendix D respectively.

5.2 DEVELOP FRAMEWORK WITH TMI AND TRES CUENCAS COMMONWEALTH

CAMBIAR plans to meet with the Commonwealth and TMI to discuss the broader role of the CAMBIAR program within the Commonwealth. It will be beneficial to develop a framework for expansion of the pilot project in Huasta prior to implementation so that the project infrastructure and training for the operation and maintenance program can be designed in a way that is easily reproducible in other communities. Developing a relationship with the Commonwealth will continue after this assessment trip as one of the current project leads, Laura Read, will remain in Peru until August 2013.

6.0 COMMUNITY INFORMATION

6.1 DESCRIPTION OF THE COMMUNITY

Population Data

Based on data from the 2007 National Census (The National Institute of Informational Statistics - Instituto Nacional de Estadísticas a Informática: INEI) and information gathered during field work done by Eloy Neira for TMI, the district of Huasta has 11 territorial units and a government of diverse levels with a differentiated population distribution. The populated areas tend to be located in the lower zones, close to access routes and the Rio Pativilca; whereas the higher zones tend to be less permanently populated (see Figure 2 in Appendix A for overview map of Huasta). According to the 2007 National Census: XI of Population and VI of Homes (INEI, 2008a), the population of the District of Huasta is 2,425 and is mainly urban (66.4%), with 74.9% of the population's economic activity dedicated to agricultural activities, as small producers or laborers. There is a slight male majority (50.7% versus 49.3% women) and the average age is 31.3 years (39.4% of the population is less than 15 years old).

The Campesina Community of Huasta has approximately 650 active Community members and their families, or a total of 1,775 people living in the territory of the Community. According to the 2007 National Census: XI of Population and VI of Homes (INEI, 2008a), 97.4% of the population speaks Spanish (Castellano) as their first language. The people of Huasta, majority mestizo, do not identify with one ethnic group in particular, but rather as Campesinos.

Government Structure

Huasta has two parallel governance structures: the Municipality of Huasta and the Campesina Community. The terms that are used in this report refer to the different governing entities and population centers in Huasta; they are defined below.

- **Municipality**- *refers to the local level of the Peruvian government as well as all of the area that falls under the jurisdiction of the Mayor of Huasta. The position is presently occupied by Arturo Valderrama.*

The Municipality of Huasta is the most local level of the Peruvian government. The land area that falls under the jurisdiction of the municipality can be referred to as the District of Huasta, and it includes the population center of Huasta as well as several surrounding communities and outlying

areas. The governing authorities in the Municipality of Huasta are the mayor and his regents (council). The council members (regidores) assist the mayor in his duties, but the mayor holds executive authority. The current mayor is Arturo Valderrama, and his term of office is 2011-2014.

- **Town**- *refers to the population center, the buildings centered around the plaza, church, and municipal offices of Huasta.*

The town of Huasta is inhabited by approximately 1,000 people and these are the primary users of the wastewater treatment plant pertinent to this project.

- **Campesina Community**- *refers to the Campesina Community of Huasta (Comunidad Campesina de Huasta)*

The Campesina Community of Huasta is a self-governing group of peasant farmers living in and around Huasta. Membership in the Community is voluntary and primarily hereditary. The Community manages its own internal affairs and has a Board of Directors, who will hold elections in December 2012 for a two-year term starting in January 2013. Decisions made by the Campesina Community must be approved by all members in Community-wide assembly meetings held once a month.

The Campesina Community is not part of the Peruvian government but functions in parallel with the municipal government. Members of the Campesina Community of Huasta account for approximately 75% of the total population in the District of Huasta, giving the Community significant influence with the Municipality. Members of the Campesina Community likely form a smaller percentage of the people living in the town of Huasta. The Campesina Community collectively owns the land belonging to its members, and land is most commonly acquired through hereditary passing through generations.

The dual governing bodies in Huasta provide some challenges for CAMBIAR because the collaboration of the municipality and the Campesina Community is necessary for the success of certain projects (i.e. projects related to the WWTP). However, CAMBIAR has benefited from the Campesina Community's influence on the mayor, as his re-election and status are contingent on the satisfaction and support of the Campesina Community.

During the July 2012 assessment trip, the Board of Directors worked directly with the mayor's office to set up meetings and follow through on the mayor's actions. The board's willingness to act on the behalf of the CAMBIAR team and the mayor's willingness to listen to requests from the board shows a promising reinforcement system. Another example of collaboration between the Municipality and Campesina Community is a joint avocado project started in 2011. The Municipality provided the funds to plant the avocado trees, install a drip irrigation system, and to pay someone to care for the trees. The project was installed on Community-owned land, and after a period of 10 years the project will be turned over completely to the Campesina Community. Based on evidence from these recent examples, the team is hopeful that a good working relationship between the Campesina Community and the Municipality of Huasta will continue through the duration of the project.

Education

Huasta has an integrated school for primary and secondary levels where 70.4% of the population of ages 6 to 24 attends the educational system regularly. The attendance data indicate that 92.3% of boys and girls of ages 6-11 attend regularly; that percentage decreases to 87.7% for young people of 12-16 years, and further to 25.9% among young people from 17-24 years. The literacy rate is 94.5% among those older than 15 years, which is higher than the national average (92.9%) and the average in Ancash (88.6%). It should be noted that the level of illiteracy in men (2.5%) is lower than women (8.7%) (INEI, 2006).

Health and Sanitation

Huasta relies on a single basic health center where one doctor and two nurses are available only in the mornings. For help in the afternoon, or for serious situations, people are directed to health centers in other locations, the closest about twenty minutes away by collectivo in Chiquian. 95.3% of the district's population uses wood as the main source of combustion for cooking. According to INEI (2010), 33.5% of the population is living in poverty, with 8.6% in extreme poverty.

Census maps photocopied from the local Catastro (data collection agency) office of the District of Huasta show the number of households connected to the WWTP and those planned for connection to a secondary (septic) system. Those not connected to the plant either use their courtyard as a place for urination and defecation, or have pit toilets (although these are not common).

Ranching and Agriculture

Ranching has been oriented towards breeding dairy cattle in the lower areas of Huasta (for the sale of milk and production of cheese) and breeding sheep or mixed herds of cattle and sheep in the other altitudinal zones in the community. Cattle are sustained throughout the dry season by feeding primarily on natural grassland at the higher elevations. Their nutrition suffers when they only feed on natural grassland, so their diet is occasionally supplemented with cultivated crops such as alfalfa. Milk production increases significantly when the cows are able to feed on cultivated grass and alfalfa. Select pastures are irrigated for cultivating grass and alfalfa during the dry season, but access to irrigation water is limited. The primary irrigation canal for the Campesina Community is shared with other communities, and the Campesina Community only has access to the irrigation canal for a period of 5-6 days during the dry season. The majority of sheep are fed with natural grasses from the high areas. According to information provided by the citizens of Huasta, 50% of agricultural production is for self-consumption, 40% is for the market, and 10% is for seeding (IM: 2009).

Land Ownership

Farming and ranching land in Huasta's district is owned solely by members of the Campesina Community. Becoming a member of the Community is almost exclusively hereditary – that is, land is passed down through families and has been for generations. The Municipality owns land in the town for development but has no control over the agricultural activities in the surrounding district. This system has facilitated the creation of a very organized and collective decision-making process through the Campesina Community Assembly described above. The CAMBIAR team has been working with the Board of Directors to present letters and information at the assembly meetings via TMI and conversations with the president and secretary. One of the most important aspects of the project is to ensure that the land and water sources developed do not belong to specific members of the community and are not private property. Since the Campesina Community is the most familiar with the land and makes all decisions formally (written and stamped), this support is crucial for the progress of the project.

6.2 COMMUNITY AND PARTNERING ORGANIZATION/NGO RESOURCES AND CONSTRAINTS

Huasta

A detailed description of the Huasta community and its governing structure can be found in Section 6.1 of this report.

The Mountain Institute

The Mountain Institute (TMI) is an important player in facilitating contact with the Campesina Community and Municipality to strategize the best way to proceed with the project. TMI is a non-governmental organization with a local office in Huaraz that works on community conservation projects in the Ancash region. They have invaluable knowledge of local politics and society within the Tres Cuencas communities, since employees spend much of their time in the field interacting with community leaders to develop sustainable projects. While the CAMBIAR team was in Huaraz for the July 2012 assessment trip, TMI staff helped translate survey questions and draft an MOU for presentation to the Municipality and Campesina Community. While in Huasta, TMI helped coordinate logistics for the CAMBIAR team and facilitate transportation of equipment to and from the community. An intern and a staff member with TMI traveled with CAMBIAR and attended meetings and visits to the WWTP. The intern, Neil Borland, has been working with TMI's director to apply for local grants in support of rehabilitating the WWTP.

On the July assessment trip, the CAMBIAR team also met with the director of TMI, Jorge Recharte, and confirmed the continuing logistical support and commitment to the project. TMI has recently begun a new project in the Huasta region to grow and preserve medicinal plants, thus they expect to visit the community regularly for the foreseeable future.

Because of funding issues, TMI has had to cut the jobs of some employees, but they anticipate being able to rehire these employees when a new contract with USAID begins around December of 2012. TMI's restricted resources may limit their ability to provide logistical support over the next several months, but they are committed to doing what is within their power to aid CAMBIAR's on-the-ground effort. Since August, Neil, the TMI intern, has regularly made trips to Huasta on behalf of CAMBIAR and facilitated communication between CAMBIAR, the Campesina Community and the Municipality. CAMBIAR plans to apply for the EPA's People, Prosperity and the Planet (P3) grant this fall and hopes to allocate up to 40% of the award to TMI for logistical support. Details of this amended partnership will be addressed in future reports if CAMBIAR is successful in winning the grant. CAMBIAR hopes that this expanded relationship will help TMI take a more active role within the CAMBIAR program. The irrigation project is more closely aligned with the mission of TMI than the previous WWTP project. CAMBIAR plans to discuss with TMI how they can do more of the groundwork in Huasta while the CAMBIAR team is in the US and in preparation for trips so that the time in Huasta can be more productive.

Beginning October of 2012, Neil will no longer be stationed in Peru. As a result CAMBIAR will now communicate with another TMI staff member, Kate Voss, until December of 2012. Beginning January of 2013, CAMBIAR will communicate with current co-project lead Laura Read who will be living in Ancash, Peru until August 2013. Laura will be living close to Huaraz as part of a USAID climber scientist grant. She will be working with TMI and others to document potential project activities in other Commonwealth communities and implement a monitoring program that leverages smart phone technology developed by Positive Innovation for the Next Generation (PING). CAMBIAR has already engaged in conversations with Laura and PING and has signed a general MOU solidifying the relationship.

The Tres Cuencas Commonwealth

The Commonwealth is a nationally recognized entity formed by approximately 25 municipalities to take action on water and climate issues at the local level. The Commonwealth consists of several districts within three watersheds comprising about 50,000 community members, whereby the mayor (or other representative) from each district is expected to meet and report to the Commonwealth with ideas, projects and progress. One of the benefits in working within the

Commonwealth framework is the political influence it exerts as a collective group of district mayors, public figures who are concerned both with pleasing the locals and also keeping a clean public profile for re-election. CAMBIAR expects the Commonwealth representatives to help unite and communicate between the regional government, the municipalities, and the communities. One potential constraint is that the Commonwealth is a newly formed organization and thus the most efficient communication and decision-making infrastructures are not yet in place at this level. As it is a nascent organization, the Commonwealth's capacity for administering potential future funds and their distribution procedure is unclear at this stage.

6.3 COMMUNITY RELATIONS

Through the help of TMI and the CoSeppi Partnership (in-country consultants from August to December 2011), CAMBIAR established a good working relationship with the community of Huasta. Members from the Board of Directors for the Campesina Community served as the principle contacts during both previous assessment trips. The board members are familiar with the inner-workings of the community and manage the day-to-day activities of the Community, but any major decisions regarding the actions of the Campesina Community must be ratified by the entire Community at their assembly meetings that occur on the first Sunday of every month. During the most recent assessment trip, CAMBIAR and TMI drafted a letter for the Community's fiscal, Samuel Jara Rivera, to speak on behalf of the project at the assembly meeting to ask for assistance in collecting spring flow data.

The CAMBIAR team met with the mayor of Huasta several times during the assessment trip regarding the Municipality's role in the WWTP operation and maintenance. The team was able to find the original WWTP operation and maintenance manual in the archives, as well as maps detailing the buildings that are connected to the system. With this information and the support/technical expertise of the municipal engineer, CAMBIAR expects the WWTP to become a higher priority for rehabilitation within the Municipality.

The members of the Campesina Community's board of directors were very helpful during the July 2012 assessment trip, as they provided their building for the team to stay in and dedicated one board member to assisting the team with field visits, workshop activities, and meetings with other Community members. However, the board of directors is very busy managing all of the activities of the Campesina Community (of which the EWB projects are a small part), and so they were not always available – especially in the summer during harvest season. In the future, CAMBIAR hopes to communicate more firmly about travel plans and create a trip schedule that aligns better with the schedules of the Campesina Community and Municipality in order to use the time in Huasta most effectively.

Moving forward, CAMBIAR will continue to work with the Campesina Community to assess and implement the proposed irrigation project. In September 2012, the Campesina Community returned a signed MOU to CAMBIAR establishing their commitment to the project in the coming year (see Appendix B). As more details come to light, the MOU will be revised and signed accordingly.

CAMBIAR has learned that the Campesina Community's board of directors is up for re-election in December 2012. The election of new board members could potentially delay project related activities in January 2013 however with the signed MOU it is expected that the new board will support the project and commitments made to CAMBIAR. It will be important for the CAMBIAR team to immediately meet with the new board upon arrival into Huasta. If possible, CAMBIAR will contact the new board members in December prior to travel.

A complete list of local contacts is provided in Appendix E. The key contacts in Huasta and the local NGO partner TMI are given below:

Contacts in the Municipality of Huasta:

- Municipal Office of Huasta
  Phone: 837126
  Website: munihuasta.gob.pe

- Profesor Arturo Valderrama Atanasio- Mayor of Huasta
  Cell phone: 979228090
  RPM: *051180
  Office phone: 043-837126
  Cell phone 2: 96504-1503
  Address: Jr. Bolognesi No. 125 – Plaza de Armas
  Email: arthur_2507@hotmail.com

- Ingeniero Wilson Novoa Mirande- Municipal Engineer for Huasta
  Cell phone: 952692070
  Email: ingwilson33@hotmail.com

- Raquel Calderon - Municipal Secretary for Huasta
  Email: raquecalderon@hotmail.com

Contacts in the Campesina Community of Huasta:

- Alfredo Velazquez Montes – President of Campesina Community
  Phone: 985067259

- Samuel Jara Rivera- Fiscal of Campesina Community **main contact on the ground
  Cell phone: 964432815
  Address: Colon No 110
  Huasta_Bologneci_Ancash_Peru
  Email: cinachamu_romantico@hotmail.com

TMI Contacts:

- Neil Borland – former TMI intern and Huasta liaison
  Cell phone: 979680071 (EWB-Greater Austin cell phone that was left with Neil)
  E-mail: neil.c.borland@gmail.com

- Kate Voss – TMI staff member in Huaraz
  E-mail: kvoss@mountain.org
- Jorge Recharte – Director of Projects (Peru)
  E-mail: jrecharte@mountain.org

6.4 COMMUNITY PRIORITIES

The Community's first priority is to increase their irrigation capacity during the dry season as irrigation water is the limiting factor for the number of cattle that can graze on Community property, and milk production is the primary source of income for Community members. Currently there is a community-owned pasture that cannot be irrigated because it is at a higher elevation than the irrigation canal; this canal is used to irrigate other pastures. Furthermore, reliable water sources are scarce in the dry season, and the Community has placed great importance on developing new sources of irrigation water. The WWTP was initially presented as an option because it is a source of water currently not being used; however, after the summer assessment trip it became clear that developing springs in the area is a more feasible solution. The board of directors of the Campesina Community and the CAMBIAR travel team collectively sampled three

potential springs that several community members believe are available to pursue as sources for the irrigation project, and the Campesina Community Assembly has approved the use of these springs for irrigation. The Campesina Community views the wastewater treatment plant as a health concern for residents, but does not prioritize it over locating a source for irrigating the community land.

7.0 DATA COLLECTION AND ANALYSIS

7.1 Site Mapping

Previous trips have provided a strong foundation of geographic information about the community. Current maps exist that include the locations of the springs and the field where irrigation is to be implemented as well as a detailed topographic survey of the field to be irrigated (see Figure 4 in Appendix A). The focus on this trip will be possible pipe paths from the sources to the field, locations for storage tanks and break pressure tanks, and positions where sprinklers can be installed. A detailed survey of the pipe pathline will be conducted using a compass and a laser rangefinder to ensure that precise distances and elevation differentials will be available for the hydraulic design of the conveyance pipeline. Waypoints will be taken with a handheld GPS unit at key points along the pipe pathline (e.g. spring location, potential tank sites, community field) to aid in the georeferencing of survey data so that a map and elevation profile of the pipeline can be created.

7.2 Technical Data Collection

Data collected from previous trips are given in Appendix F and include dry season spring flow rates, water quality tests of springs, and evaporation rates. The data to be gathered during this assessment trip will fill in the data gaps and complete the information needed for the design of the irrigation system. In designing this system we will select materials that the community is familiar with and comfortable with using. Options for the storage tank (poured cement vs. prefab) and piping (steel vs. PVC) will be discussed with the community, and availability and pricing of all required materials will be researched at local stores. The data collection tasks are outlined below for each system component.

Spring Box

A single spring, Punapuquio, has been identified as the best of the three springs in the area to use for the irrigation of the cattle-grazing field. Previously collected spring flow data and initial calculations regarding the field water demand indicate that Punapuquio can supply enough flow to meet and even exceed the demand for the field. Design of the spring box should first take into consideration if there is any local knowledge about spring boxes. It should be confirmed whether or not the community has constructed any spring boxes previously and if the design type and materials used would be appropriate in this case. Upon examining the location and terrain of the spring, the best design style and materials can be decided. It is also possible that only a partial spring box will be necessary since the water will be used for an irrigation system and not a drinking water source. It will be important to provide extensive field measurements and photo documentation of the spring to aid in the design process.

Furthermore, it will be necessary to take additional water quality samples from the spring to ensure the quality of water meets the Peruvian water quality standards for irrigation and watering of animals. Peruvian water quality standards can be found in the following thesis in Appendix 5:

http://www.lima-water.de/documents/nwirth_tesis.pdf

It is most likely that water quality tests will be performed at the University of Texas at Austin upon the team's return to the states. Initial water quality tests performed during the July assessment indicate sufficiently clean water for this project.

Tasks:

- *Examine location and terrain of spring (Punapuquio) for suitability and design style of a spring box*

The area around the spring will be dug back to bedrock to locate the "eye" of the spring - where the water emerges from the rock. Care must be taken to determine if there is more than one eye. The terrain around the eye(s) will then be well documented. With this information a spring box can be designed. The capture area must include all eyes and connect with the spring box. The spring box must be located sufficiently below the lowest eye so that when the water is at its highest point (at the overflow pipe level) it is still lower than the lowest eye. In this way water won't rise above the eye and create backpressure, which could cause water to emerge at a different location and outside the capture area, thus rendering the spring box ineffective.

- *Additional flow rate measurements of Punapuquio*

Spring flow rates were measured during the July 2012 assessment trip and are being taken by community members on a regular basis. There should be several months of data to reasonably characterize dry season and wet season flow rates (wet season flow rates are needed to design an effective overflow system). Additional flow rate measurements will be taken on this assessment trip for verification. The bucket method will be employed to determine the spring flow. This method involves recording how much time is required to fill a bucket of known volume and dividing the bucket volume by that time. This should be repeated three times for each measurement.

- *Collect grab samples at each potential spring source*

15 mL samples will be collected in vials and transported back to the US. Samples will be stabilized using 2% HNO_3.

Pipe Pathline

The terrain from the spring to the field will be examined to determine the difficulty of burying the piping and to scout best possible locations for a storage tank(s) and a break pressure tank. Additionally, survey data will be collected along the pipe pathline as outlined in Section 7.1. During the survey of the pipeline, specific notes will be taken on rocky soil, difficult terrain, gullies and washes, road crossings, etc. In order to comply with the ASTM D1785 Standard Specification for Poly (Vinyl Chloride) Plastic Pipe, it is anticipated that schedule 40 PVC pipe will be utilized for the buried conveyance system. The availability of this piping will be confirmed during the assessment trip. However, in case there are sections along the pathline where pipe cannot be buried, CAMBIAR will document the availability of cast iron pipe for above surface runs. Furthermore, although specific national standards referencing buried pipe depth need to be obtained, CAMBIAR will operate under the assumption that schedule 40 PVC pipe will be buried at a minimum depth of one foot.

Storage Tank/Pressure Break Tanks

The sizing of a storage tank is highly dependent on the planned use of the irrigation system (i.e. irrigation technology) and watering schedule. Therefore, the storage tank size will be determined from initial demand calculations and consultations with community members. An additional pressure break tank may be necessary depending on the elevation differentials and the location

of the storage tank. It is possible that pressure reducing valves can be utilized to regulate pressure instead of a break pressure tank. The travel team will document the availability of these valves while in community.

The following structural codes will be pertinent to the design of a storage tank and or break pressure tank. Utilizing these codes as guides, various site parameters will be determined on the assessment trip.

IBC 2009 – International Building Code
ASCE 7-10 – Minimum Design Loads for Buildings and Other Structures (USA)
ACI 318-11 – Building Code Requirements for Structural Concrete and Commentary (USA)
Technical Standard of Building E.030 – Earthquake Resistant Design (Peru)

Tasks:

- *Identify potential tank sites*

The tank should preferably be located on level ground, or near-level ground where minimal adjustments to gradation will be necessary. The site should be easily accessible for transporting materials as well as for maintenance upon its completion. The local landowners will also need to be consulted, and a contract signed stating that CAMBIAR has permission to build/install this tank.

- *Classify soil at tank sites*

This will be conducted using ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes, a document which outlines the use of the Unified Soil Classification System. The testing protocol is outlined in Appendix G. Hand augers will be used to classify the soil to a depth of five to ten feet, or until bedrock is reached. This soil type can then be used to determine the Site Class according to ASCE 7-10. Unless significant data is available to prove otherwise, including shear wave velocity, undrained shear strength, and field standard penetration resistance, the conservative assumption for soil type will be Site Class D, in accordance with ASCE 7-10 Section 11.4.2.

- *Determine bearing capacity of soil*

In order to determine the bearing capacity of the soil, extensive testing would need to be carried out on site, utilizing heavy equipment. Due to the site restrictions, after the determination of the soil type, a conservative estimate for the bearing capacity of the soil will be selected, in consultation with a licensed civil engineer. In order to gather the best possible information to make this estimate, certain field soil tests may be carried out on the proposed tank site. A pocket penetrometer will be used to determine the unconfined compressive strength of the soil and aid in determining the type of soil.

- *Determine moisture content of soil*

The moisture content of the soil will be determined by using the procedures for gravimetric sampling of soil moisture outlined in Appendix G.

- *Topographic survey of tank site*

A detailed topographic survey will be conducted to outline the shape of the land on the tank site. This allows for proper determination of excavation requirements during the design of the tank. The analysis will be carried out using a reference point in one of the corners of the proposed site, at least 15-20 feet away from the proposed edge of the tank. Using a rope and stakes, a grid will

be constructed with grid locations at every 3-5 feet, with the increments spaced regularly. The elevations for the entire site will be taken in relation to the reference point, which will give a good picture of the site topography.

- *Determine runoff locations for overflow*

A suitable solution to control overflow from the storage tank will be discussed with members of the Campesina Community in conjunction with assessment of potential tank sites. Options include digging a ditch to direct runoff and constructing a gravel bed to assist in the infiltration of runoff into the ground.

Irrigation

Assessment of the community pasture for irrigation includes surveying and soil analysis. The site was surveyed on the January 2012 assessment trip to determine the slopes and extent of the area to be irrigated; a contour map of the community field is given in Appendix A. The soil analysis will include measuring the field capacity, soil moisture content, and soil type classification.

According to TMI, community members in Huasta use the following types of grasses: rye, white and red clover, orchard and alfalfa (see Appendix H). During the assessment trip, CAMBIAR will attempt to collect information about the community's farming equipment, techniques and methods (i.e. does the community scatter grass seeds or use special equipment, does the community burn the fields etc.). CAMBIAR will also need to find out how much land is required to graze cattle in the community. This will help the team to design a system with the adequate area to meet the communities' needs.

Tasks:

- *Classify soil at community pasture*

Soil samples will be taken from the community pasture, and the soil will be characterized through a sieve test according to the protocol outlined in Appendix G. The soils in the region are largely leptosols, which is a weakly-developed soil with a shallow profile depth, often containing gravel, and susceptible to erosion. Determining the basic characteristics of the soil will aid the team in determining an appropriate irrigation technique. Locations around the pasture will be hand augured to determine the general soil profile. The soil can be hand-textured to get a general idea of the predominance of sand, silt, and clay. Based on the percentages of sand, silt, and clay in the soil, the soil textural triangle (from Handbook No. 436 U.S. Department of Agriculture, Washington, D.C., 1975) can be used to identify the textural class, which will provide useful information on the type of vegetation that will grow on the soil (see Appendix H for preliminary information on likely grasses growing in this region), and the soil's ability to hold water.

- *Determine field capacity of soil*

The field capacity of the community pasture will determine the maximum amount of time between waterings by indicating how much water the soil can hold. The protocol for measuring field capacity is outlined in Appendix G.

- *Determine moisture content of soil*

The moisture content of the soil will be determined by using the procedures for gravimetric sampling of soil moisture outlined in Appendix G.

8.0 MONITORING

8.1 Monitoring plan for current project

The success of the irrigation project will primarily be evaluated based on the community's ability to increase their grazing capacity for cattle. This can be done informally through discussions and surveys with community members; more concrete evaluation metrics are elaborated below. The potential economic benefit of the project was determined by the number of cows that the community pasture can ideally support if it is properly irrigated (i.e. whether it is evenly irrigated such that enough grass has grown to support the cattle through rotations within the pasture), and if the full economic benefit can be realized, the project will be considered a success.

The project's objective of implementing a pilot project to demonstrate irrigation technology that promotes water conservation can be evaluated based on the volume of water used to irrigate a given area of pasture. Data on current irrigation practices and the quantity of water used in flood irrigation will be needed as a baseline to measure improvement in irrigation efficiency.

Metrics that will be used to evaluate the effectiveness of the irrigation system and the condition of infrastructure:

- *Crop condition*: The direct objective is to provide food for the cattle to graze on. This is a mostly subjective assessment dealing with whether the grass looks like it is healthy and growing.

- *Time to empty tank*: If the tank is emptied on each watering, the time the tank takes to empty gives an accurate measurement of how quickly the water is being administered to the field.

- *Evaluation of even distribution of water*: There is a concern, because of the large elevation drop across the field, that the water distribution may not be even. Rain gauges can be used at various points on the field to determine how evenly water is being distributed.

- *Walk pipeline / Check for leaks*: The pipeline should be walked periodically and any leaks or damage should be noted so that prompt repair can occur. As part of the operation and maintenance plan, a maintenance log will be created so that the community can record any repairs that have been done on the system.

- *Grazing capacity*: The grazing capacity can be measured in terms of the total number of animal-days through the dry season (the number of animals grazing on the field multiplied by the number of days those animals graze).

8.2 Monitoring of past-implemented projects

After learning that the Municipality had hired a civil engineer and discovering an existing operations and maintenance manual for the WWTP, CAMBIAR decided that the Municipality would benefit most if the engineer led the on-the-ground rehabilitation effort and CAMBIAR instead focused on education, technical training and increased awareness. Taking this notion into account, CAMBIAR will now provide the following to the Municipality (these functions are outlined in a draft MOU and can be seen in Appendix I):

1. A list of general recommendations for the rehabilitation, maintenance and monitoring of the WWTP,
2. Technical training of community members assigned to operate and maintain the WWTP,
3. Assessment of the WWTP and its operational status,

4. General workshops to educate and raise awareness in the community about the importance of health and sanitation.

It will be important to monitor the success of this project by measuring both quantitative and qualitative metrics for each goal stated above. CAMBIAR has already drafted a set of general recommendations for the Municipality; they can be found in Appendix J. The recommendations touch on both infrastructure improvements and operation and maintenance of the WWTP.

In order to qualify the success of each recommended infrastructure improvement, the following questions will be asked:

1. *Has the task been completed? If yes, is it serving its function?*

If not,

2. *Have steps been initiated towards completing this task?*
3. *Who is in charge of this task?*
4. *Is there a financial plan for completing this task?*
5. *Have any materials needed to complete this task been acquired?*

As soon as each of the infrastructure improvements has been completed, CAMBIAR will consider this part of the project successful.

The success of the operation and maintenance recommendations and the accompanying technical training will be qualitatively measured as these tasks vary in the manner in which they are executed. In January 2013, CAMBIAR will present those in charge of maintaining the WWTP with a maintenance log in which technicians can record the maintenance tasks they perform, the dates on which they perform each task and other notes and observations. CAMBIAR will rely on both TMI and in-country volunteers to monitor the frequency with which this log is updated. Depending on the maintenance task, CAMBIAR will qualify whether that particular task was executed adequately and in accordance with the recommendations in the existing operation and maintenance manual. Over the course of the upcoming year, CAMBIAR will work closely with the municipal engineer to technically train the community members in charge of the WWTP. It is important that CAMBIAR and the municipal engineer agree on the training plan prior to execution. In the next few months, CAMBIAR will contact the engineer either by phone or e-mail and discuss these topics.

Once the WWTP has been rehabilitated and regular operation and maintenance procedures have been put in place, CAMBIAR will monitor the performance of the plant by repeatedly taking water quality measurements at the effluent of the facility; this data will be compared to the baseline data already collected to provide a quantitative metric for success. Furthermore, CAMBIAR plans to continue monitoring the flow and water quality at the influent to ensure the load on the plant does not exceed its capacity. Finally, educational workshops will continue to be held for the public during future CAMBIAR trips.

Education Plan:

The role of CAMBIAR in regard to the WWTP is an advisory one; CAMBIAR will work alongside the Municipality to train a group of people who will work directly with the operation of the WWTP. The educational/training goals during this trip are twofold:

1. Train the team of Huasta residents that will be maintaining the WWTP
2. Hold capacity-building workshops for the general public (adults and children).

Technical Training

To accomplish the training of the WWTP maintenance team, CAMBIAR will provide a Reference Manual adapted from the existing Operations and Maintenance (O&M) Manual, and maintenance logs to be kept by the maintenance workers; the travel team will also work with members of the maintenance team to explain and demonstrate the tasks necessary for regular maintenance of the WWTP, including keeping work logs.

Note: The existing O&M manual can be downloaded here:

http://ewbgreateraustin.org/wp-content/uploads/2012/09/WWTP_OM_Manual_Huasta.pdf

The adapted Reference Manual will include the content of the O&M Manual in a streamlined presentation that is more accessible and easier to understand, augmented with illustrations and what additional text is deemed necessary to clearly convey proper maintenance procedures and safety practices. The content of the Reference Manual will include:

- Descriptions of each process unit in the treatment train
- Operational procedures for each unit in the treatment train
- Preventative and correctional maintenance procedures for each unit in the treatment train
- Flow and water quality instructions for testing the wastewater effluent
- Supplemental instructions as necessary

Copies of the Reference Manual will be given to all members of the maintenance team at the beginning of the training process, so that they can refer to the content and make their own notes throughout training.

The maintenance logs will be provided for workers to log each maintenance task once it has been completed. This will allow for monitoring of the maintenance program. Maintenance logs will be periodically reviewed and gaps in maintenance can then be addressed.

These documents will be written in English and translated to Spanish, using the technical terms found in the original O&M manual. See Appendix K for a sample of the Reference Manual, and Appendix L for an example of a maintenance log (in English).

Capacity Building

In addition to training the WWTP maintenance workers, CAMBIAR will hold workshops to which all residents of Huasta will be invited. These workshops will build on the workshops held during the July 2012 assessment trip. The primary subjects to be addressed are the functionality of the WWTP and its importance to the community at large, proper disposal of trash and the impact this has on the WWTP, strategies for water conservation, and, for the children in attendance, basic hygiene.

In addition to holding capacity-building workshops, the CAMBIAR team will create and distribute materials to reinforce learning after the workshops are over. These will most likely be posters and calendars that can hang on walls and remind Huasta residents on a regular basis of what was discussed in the workshops.

9.0 COMMUNITY AGREEMENT/CONTRACT

As indicated in previous sections, after the July 2012 assessment trip, CAMBIAR signed an MOU with the Campesina Community of Huasta. This MOU is a preliminary agreement that outlines the scope of the irrigation project and the responsibilities of each party; it will be updated and refined during the January 2013 trip as project details are elaborated. A signed copy of this MOU is presented in Appendix B. Some

things that CAMBIAR plans to discuss with the Campesina Community and incorporate into the next version of the MOU are:

- Forming an irrigation committee
- How the irrigation field will be operated
- Operation and maintenance plan and requirements
- Campesina Community financing of operation and maintenance
- Labor requirements for the Campesina Community
- Land rights and permissions

CAMBIAR also has a working draft of an MOU (Appendix I) with the Municipality of Huasta related to the role of CAMBIAR in education and training for the WWTP. This MOU is currently in the hands of the mayor of Huasta, who is making revisions. CAMBIAR is in email contact with the mayor and the team plans to have a draft of the MOU ready to be signed at the beginning of this assessment trip before beginning any educational or training activities related to the WWTP. The primary responsibilities of CAMBIAR and the Municipality of Huasta outlined in this MOU are:

- *CAMBIAR*
    - Provide technical analysis and give recommendations about the condition of the WWTP (these recommendations were submitted in response to the TAC comments on the August 2012 525- Pre-Implementation Report)
    - Provide education and technical training
    - Submit documents to the Municipality with data and analyses on the WWTP
- *Municipality of Huasta*
    - Provide two contacts from the municipality who are responsible for communication with CAMBIAR
    - Provide the economic resources necessary for the operation and maintenance of the WWTP and contract a permanent person to operate the plant
    - Take charge of the improvement and operation of the WWTP
    - Provide data and information regarding the plant and its history
    - Provide logistical support in organizing a place to stay and other things when EWB teams visit Huasta

10.0 SCHEDULE OF TASKS

A tentative trip schedule is given below:

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
30	31	Jan. 1 **Depart from Austin**	2 Bus from Lima to Huaraz	3 Huaraz- acclimatization, purchase supplies	4 Arrive in Huasta	5 Huasta
6 Huasta CC assembly meeting	7 Huasta	8 Huasta	9 Huasta	10 morning- travel from Huasta to Chiquian Spend night in Chiquian	11 morning- travel to Huaraz meet with TMI night- bus to Lima	12 morning- bus arrives in Lima night- flights depart from Lima
13 **Arrive in Austin**	14					

For the time spent in Huasta, the tasks are outlined below with approximate time allocated for each task. The total time allocated for these tasks is greater than the time to be spent in Huasta, which means that the travel team will need to split into groups to accomplish all of the tasks (e.g. one group can work on data collection while another group is leading the technical training workshops). The team has learned from previous trips that meetings do not always happen as scheduled, so the team must be flexible, and sufficient time must be built in so that the key project members and Spanish speakers will be available for meetings without compromising other trip objectives.

- Source, storage and conveyance
    - Spring box examination ~ ½ day to 1 day
    - Measure flow rate ~ 30 minutes
    - Identify tank locations ~ ½ day
        - Soil tests
        - Survey area
        - Discuss land rights with community
        - Discuss plan for tank overflow
    - Survey pipe pathline ~ 2 days
- Point-of-use
    - Measure field capacity ~ ½ day (start test one day and complete 24 hours later)
    - Soil tests ~ ½ day
        - Sieve tests
        - Bulk density
    - Discussions with Campesina Community about use of irrigation system ~ 1 day
- Education and training
    - WWTP technical training ~ 2 days
    - Community workshops ~ 1 day (or two ½ days)
        - Children
        - Adults
- Community relations
    - Meet with board of directors of Campesina Community ~ 1 day total
        - Discusss MOU
        - Land rights
        - Plan logistics for implementation
    - Assembly meeting for Campesina Community on Sunday, January 6 ~ 1 day
    - Meet with mayor of Huasta and municipal engineer ~ ½ day
    - Meet with irrigation committee (if already formed) ~ 1 day
        - Ideally, if the irrigation committee has been formed, members of the committee will accompany the EWB team for all assessment activities

There are some tasks that will need to be accomplished during time spent in Huaraz and Chiquian. Because of the trip schedule and the New Year holiday, The CAMBIAR team will not be able to count on meeting with people in Huaraz at the beginning of the trip. The trip schedule will be modified based on ongoing discussions with TMI about how the holiday will affect trip plans. During time spent in Huaraz, the team will meet with TMI and investigate the availability of materials.

The administrative offices for the Tres Cuencas Commonwealth are in Chiquian, the larger town that is located approximately 30 minutes from Huasta. The team plans to spend a day in Chiquian to meet with leaders of the Tres Cuencas Commonwealth and investigate the availability of materials at the local hardware stores.

11.0 PROJECT FEASIBILITY

There are two aspects to the question of feasibility that have been considered for this project: engineering design and community relations. CAMBIAR is reasonably confident in the project's feasibility, and the scope of the project has been adjusted to better fit the political structure of Huasta, separating the project into two separate initiatives that each fall under the jurisdiction of the related governing body: WWTP rehabilitation is being done in collaboration with the Municipality of Huasta and the irrigation project is a partnership between CAMBIAR and the Campesina Community of Huasta.

11.1 Feasibility of Engineering Design

During the three previous assessment trips, CAMBIAR and the Campesina Community of Huasta have investigated potential water sources for irrigation and are reasonably confident that all possible sources have been considered. These sources are outlined in Appendix M, which is taken from the 522-Post Assessment Report for the January 2012 trip to Huasta. During the July 2012 trip, the CAMBIAR team was informed that there are three potential spring sources; each of these sources appears to produce enough dry season flow and to be of sufficient water quality for irrigation. The state of the WWTP and the risks of reusing wastewater for irrigation resulted in the decision to separate the WWTP rehabilitation and the irrigation project into two separate projects.

Important things to consider when designing the irrigation system:

- The system must be compatible with cattle grazing on the pasture
- The health of the animals must not be put at risk
- There should be very little risk of reducing the grazing capacity

Because the Community pasture to be used for the irrigation project is not currently being irrigated, the pasture is not being used during the dry season. Therefore, it is very unlikely that the Community's dry season grazing patterns will be negatively impacted by the irrigation project. The water quality tests from all three potential spring sources indicate that the water is clean and should be safe if cows come into contact with it, so there are no anticipated health risks for the cattle.

11.2 Feasibility of Community Relations

Community ownership of the project and co-operation between the Campesina Community and CAMBIAR are the keys to the long-term success of the project. The primary things that CAMBIAR anticipates being potential issues are the operation and maintenance of the infrastructure and how the Campesina Community manages use of the field. The Campesina Community understands that they will be responsible for operation and maintenance, and this will be a focus of the trip to ensure that the project design is compatible with the Community's ability to maintain it. Because the field is owned and operated by the Campesina Community as a whole, there is potential for conflict when it comes to the use of the field. CAMBIAR will discuss this in meetings during the upcoming trip, but ultimately it is the responsibility of the Campesina Community to manage the irrigation and grazing schedule for the pasture.

It is important that the CAMBIAR team not just assume that the Community's interest and involvement in the project remain the same but continue to ask the same questions that influenced the initial decision to work in Huasta:

- Does the Community still desire to partner with CAMBIAR?
- What are the Community expectations of CAMBIAR?
- Are the leadership of both the Campesina Community and TMI engaged?

- Do we have in-community support to organize labor and logistics for implementation trips?
- Is the Community taking ownership of the project?

12.0 PROFESSIONAL MENTOR/TECHNICAL LEAD ASSESSMENT Tim?

12.1 Professional Mentor/Technical Lead Name (who provided the assessment)

Tim Ager

12.2 Professional Mentor/Technical Lead Assessment

The three project leads, with assistance from the subgroup leads, prepared this pre-assessment document. Information was gathered from previous assessment reports, first-hand experiences from traveling to the project community in Peru, as well as from discussions during our weekly CAMBIAR meetings. These weekly meetings have been a forum to discuss this past summer's assessment trip as well as to plan and set goals for the upcoming assessment trip in January.

We are currently focused on our advisory role for the waste water treatment plant rehabilitation, capturing spring water for field irrigation, community training to enhance both technical and health education, and continuing to build relations between our in-country NGO, the community, and our chapter.

Prior to this upcoming assessment trip all of the travelers will be trained on all scheduled tasks. This includes spring box design considerations and construction methods, surveying techniques, soil sampling procedures, and education/training materials. In this way any traveler will have the ability to flex from one task to another during the often-dynamic nature of a project trip. In addition to this task-specific training, cultural and safety considerations will also be discussed with the travel team. There is ample technical, travel, and cultural experience within the Greater Austin chapter of both students and professionals to properly train and prepare these travelers for a safe and successful trip.

12.3 Professional Mentor/Technical Lead Affirmation

I have been directly involved in the development of this assessment trip plan and will continue my involvement throughout the assessment trip, have personally written this Professional Mentor assessment, and accept responsibility for the course that this project is taking.

Appendix A: Maps

Figure 1: Overview map of the Tres Cuencas Commonwealth within Ancash, Peru.

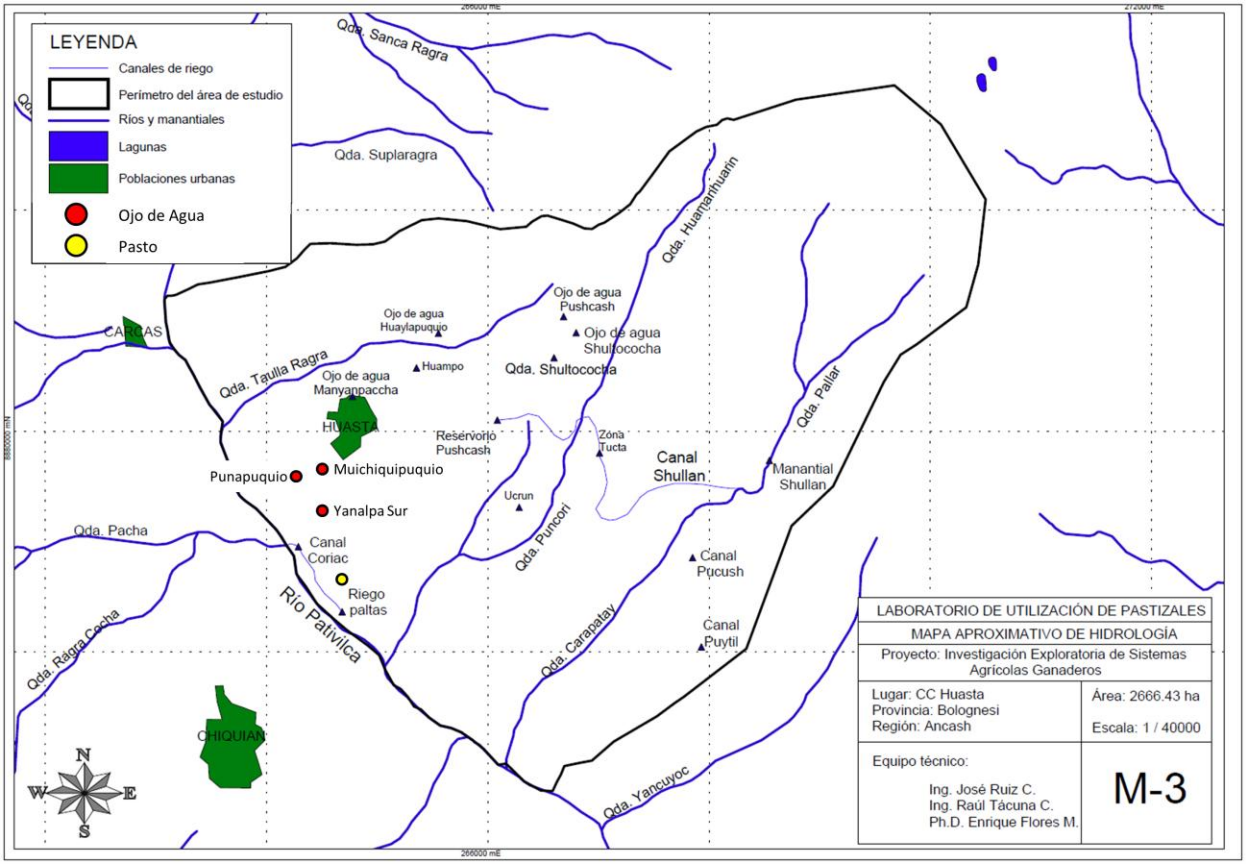


Figure 2: Hydrography in Huasta and pasture and spring locations.

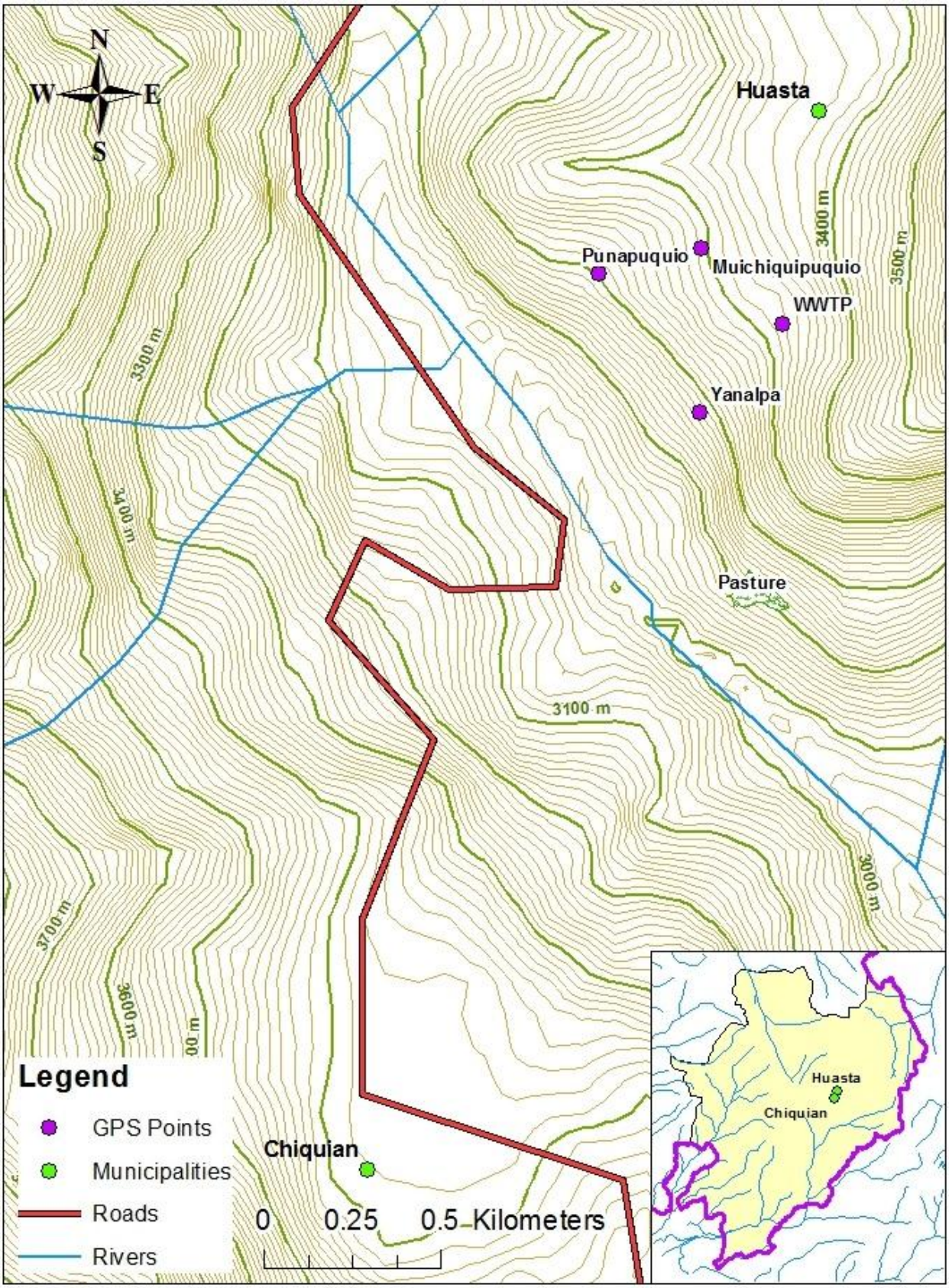


Figure 3: Elevation contours around Huasta.

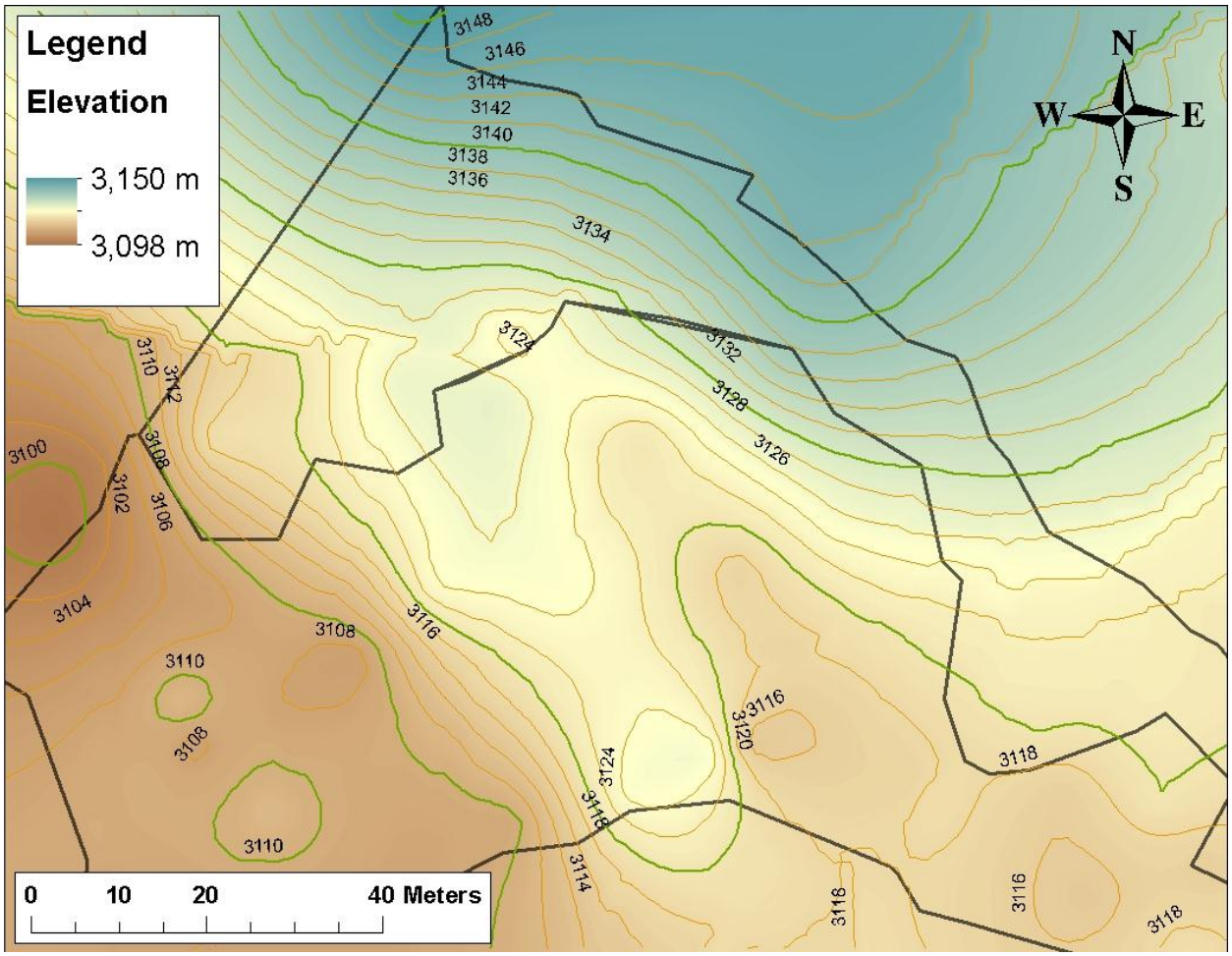


Figure 4: Contour map around pasture derived from survey data collected during January 2012 assessment trip.

Appendix B: Signed MOU with Huasta Campesina Community

Convenio Para el Proyecto de Riego Tecnificado en Huasta, Peru

Este convenio es entre la Comunidad Campesina de Huasta y Ingenieros sin Fronteras de Greater Austin (EWB-AUS) para el proyecto de riego tecnificado ("el proyecto"). Este proyecto es una parte del programa de Climate Adaptations in Mountain Basins In the Andean Region (CAMBIAR) ("el programa"). El propósito de este acuerdo es establecer un marco de colaboración con este proyecto. Acuerdos adicionales se firmarán con cada etapa del proyecto después de confirmar los detalles más específicos en el proceso de desarrollar el proyecto.

CLÁUSULA PRIMERA: DE LAS PARTES

1. Comunidad Campesina de Huasta es ____

2. **Ingenieros Sin Fronteras – E.E.U.U (EWB-USA)** es una organización humanitaria sin fines de lucro establecida para desarrollar programas de apoyo comunitario a nivel mundial a través de asociaciones que diseñan e implementan proyectos de ingeniería sostenible. Los miembros de EWB-USA, que comprenden profesionales y estudiantes de ingeniería y otras disciplinas, trabajan con comunidades y ONG's locales en más de 45 países en vías de desarrollo alrededor del mundo en proyectos de agua, energía renovable, sanitarios, et setera. Los proyectos siempre tienen dos metas (1) cumplir las necesidades de ingeniería de las comunidades con un enfoque de sostenibilidad de largo plazo, y (2) proveer una oportunidad educativa para que los voluntarios ganen una experiencia práctica en ingeniería.

   La sede de Austin e EWB-USA (EWB-AUS) es la combinación de profesionales y estudiantes de EWB-USA que está localizado en Austin, Texas, USA.

CLÁUSULA SEGUNDA: DE LOS FINES DEL PROYECTO

El propósito de este proyecto es para implementar un sistema de riego tecnificado en el campo comunal de la Comunidad Campesina de Huasta Coris. El objetivo de este proyecto es para ser una pilota mostrando como la tecnología pueda ahorrar agua y ayudar a la gente de la región de Ancash a adaptar a los cambios climáticos y el escasez del agua.

CLÁUSULA TERCERA: DEL PROYECTO QUE SE PROPONE

Para el proyecto de riego tecnificado, se propone de captar el agua de una fuente arriba del campo de Coris. Los fuentes que la Comunidad Campesina y Ingenieros sin Fronteras han indicado como posibilidades son: Muichiquipuquio, Punapuquio, y Yanalpa. La Asamblea de la Comunidad Campesina y Ingenieros sin Fronteras tomarán conjuntos la decisión de cuál de los fuentes se usará,

tomando en cuento los derechos del agua, el caudal y calidad del agua, y la necesidad para animales de tomar agua de los fuentes.

El agua se llevará al campo de Coris por medio de un sistema de tubería, y posiblemente será necesario que la tubería cruce debajo de la carretera. La Municipalidad de Huasta va a implementar un proyecto de mejoramiento de la carretera antes de la implementación de este proyecto. Entonces, si la tubería cruzará la carretera, sería necesario poner un tubo debajo de la carretera en los lugares donde la tubería cruzará la carretera antes del inicio del proyecto de mejoramiento de la carretera.

CLÁUSULA CUATRO: DE LAS RESPONSABILIDADES

1.
2.

1. *Obligaciones Conjuntas*

Las obligaciones de ambas partes son:

- Ponerse de acuerdo con la forma de avanzar con el proyecto y el fuente que se va a utilizar por el proyecto
- Estar abierto en la comunicación y compartir información en cada fase del proyecto

2. *Responsabilidades de Ingenieros sin Fronteras (EWB-AUS)*

Las responsabilidades de EWB-AUS son:

a. Ingenieros Sin Fronteras colaborará con el liderazgo de la Comunidad Campesina en tomar todas decisiones en cada fase del proyecto
b. Ingenieros Sin Fronteras proveerá el diseño técnico del sistema según las normas de ingeniería.
c. Ingenieros Sin Fronteras enseñará la Comunidad como mantener la infraestructura implementada y proveerá de manuales (en español) sobre el tema.
d. Ingenieros Sin Fronteras trabajará con la Comunidad para llevar a cabo una evaluación del proyecto seis meses después de la infraestructura se ha completado.

3. *Responsabilidades de la Comunidad Campesina de Huasta*

Las responsabilidades de la Comunidad Campesina son:

a. La Comunidad Campesina proveerá dos contactos quien se responsabilice de la comunicación con EWB-AUS.
b. La Comunidad Campesina contribuirá con el trabajo que pueda ser necesaria para la pre-implantación, posiblemente incluyendo la preparación del sitio, colocando tubería en las cruces de la carretera y la búsqueda de permisos para los residentes de Huasta para localizar la infraestructura de su propiedad, si es necesario.
c. Los miembros de la Comunidad Campesina estarán disponibles para trabajar en la construcción de la infraestructura del proyecto. La Comunidad Campesina ayudará a Ingenieros Sin Fronteras al hacer el plan de trabajo de implementación para asegurar que la gente lo suficientemente estará disponible en los días necesarios.
d. Los miembros de la Comunidad Campesina será responsable de monitorear el caudal de las

fuentes que se propone usar para el riego y la Comunidad Campesina hará que los resultados del monitoreo a disposición de Ingenieros Sin Fronteras para fines de evaluación.

e. La Comunidad Campesina proveerá apoyo logístico para organizar hospedaje y otras cosas cuando los equipos de Ingenieros sin Fronteras visiten a Huasta
f. La Comunidad Campesina entiende que este proyecto forma parte de un programa conjunto entre la Mancomunidad Municipal Tres Cuencas y se compromete a hacer el sitio disponible para otras comunidades en la Mancomunidad que estén interesados en aprender más sobre el proyecto.

CLÁUSULA CINCO: DURACIÓN Y VIGENCIA

El presente Convenio entrará en vigencia a partir de la suscripción del mismo hasta que dure el programa o la infraestructura se ha completado. Al siguiente año, EWB-AUS llevará a cabo una revisión y análisis del proyecto. En ese momento este Memorando de Entendimiento podrá ser modificado con una extensión mayor a que ambas partes lo consideren necesario.

En caso de surgir situaciones no previstas o de incumplimiento de las obligaciones asumidas en el presente Convenio, cualquiera de las partes podrá solicitar su resolución, previa notificación escrita a la otra parte con treinta (30) días de anticipación, dentro del cual se procederá a concluir las actividades y dejar un informe completo de lo avanzado hasta la fecha.

CLÁUSULA SEIS: DE LA MODIFICACION DEL CONVENIO

Cualquier modificación y/o ampliación del presente Convenio se efectuará por acuerdo de las partes mediante adenda respectiva y por periodos similares.

CLÁUSULA SEITE: DE LA SOLUCION DE CONTROVERSIAS

Cualquier asunto no previsto en el presente Convenio o cualquier discrepancia o controversia respecto de su aplicación o interpretación, deberá ser solucionado a través del entendimiento directo entre las partes, sobre la base de las reglas de la buena fe y común intención, designándose para ello representantes por cada una de las partes. Dicha designación deberá ser puesta en conocimiento de la otra parte.

CLÁUSULA OCHO: DE LAS DISPOSICIONES FINALES

Toda controversia sobre la interpretación y aplicación del presente Convenio será solucionada en la ciudad de Huaraz en forma armoniosa por los representantes que designen cada uno de las partes, y en caso contrario se sujetará a lo dispuesto en el Código Civil y demás normas aplicables.

CLAUSULA NUEVE: EJECUCIÓN

Los que abajo subscriben representando a la Municipalidad distrital de Huasta representado por su alcalde y a los Ingenieros sin fronteras de la sede de Austin-USA acuerdan respetar las condiciones descritas arriba.

Firma de miembro de la Junta Directiva de CC Huasta: Benicio Palacios Garcia Vicepresidente

Firma de miembro de Inginerios Sin Fronteras - Greater Austin (ISF-AUS): Neil Borlund

Ingenieros Sin Fronteras- Greater Austin
Engineers Without Borders- Greater Austin

Appendix C: Questions to be Answered

Source, Storage, and Conveyance:

- Do we have permission to use the water from Punapuquio for irrigating the field?
- Do we have permission to bury the piping and locate storage and break pressure tanks along proposed irrigation system route?
- Do we need a “full” spring box for irrigation water?
- Does the community have a spring box “expert”?
- Does the community have a better comfort level between a prefab tank and a poured concrete tank?
- Does the community have a better comfort level between steel and PVC piping?

Irrigation:

- How often are the cattle fed: This includes important logistical information about the feeding habits of the cattle. For instance, are the cattle continuously in this field or do they get moved periodically.
- Are sections of the field unused such that watering is possible: Are the cattle moved between different parts of the field so that the field can be watered when the cattle are not present.

Appendix D: Materials to Investigate (cost and local availability)

- Steel and PVC pipe plus fittings in a range of sizes.
- Valves (manual, automatic air release, ball float shut-off, etc.).
- Prefab storage tanks (various sizes).
- Cement, sand, aggregate, rebar, wire, etc.
- Cement mixer.
- Lumber (2x4's, plywood, etc.) and nails for forms.
- Various hand tools for digging and constructing.

Appendix E: Local Contacts

Contacts in the Municipality of Huasta:

- Municipal Office of Huasta
  Phone: 837126
  Website: munihuasta.gob.pe
- Profesor Arturo Valderrama Atanasio- Mayor of Huasta
  Cell phone: 979228090
  RPM: *051180
  Office phone: 043-837126
  Cell phone 2: 96504-1503
  Address: Jr. Bolognesi No. 125 – Plaza de Armas
  Email: arthur_2507@hotmail.com
- Ingeniero Wilson Novoa Mirande- Municipal Engineer for Huasta
  Cell phone: 952692070
  Email: ingwilson33@hotmail.com
- Alcides M. Valdez Gamarra- Administrator of Municipality of Huasta
  Cell phone: 943610528
  Email: ValdezGamarr4@hotmail.com
- Benito Chavez Jimenez- Director of the primary school, I.E. "Santa Maria"
- Prof. Zambrano- 3rd grade teacher
  Cell phone: 995351703
  Email: mfelix_123@hotmail.com
- Elmer Basallos- Regidor of the Municipality of Huasta (met with EWB-AUS team on 7/6/12)
  Cell phone: 979230999
- Zenón Onorato Ocrospoma Gonzalo- Regidor of the Municipality of Huasta
  Email: gonzalito2_10@hotmail.com

Contacts in the Campesina Community of Huasta:

- Alfredo Velazquez Montes – President of Campesina Community
  Phone: 985067259
- Juvencio Palacios Garcia- Vice President of Campesina Community
- Rosa Elizabet Cano Loos- Secretary of Campesina Community
  Phone: 943986966
- Sinforoso Gaitán Montes- Treasurer of Campesina Community
- Samuel Jara Rivera- Fiscal of Campesina Community **main contact on the ground
  Cell phone: 964432815
  Address: Colon No 110
  Huasta_Bologneci_Ancash_Peru
  Email: cinachamu_romantico@hotmail.com
- Anibel Peña- First Vocal of Campesina Community
- Olivero Monguy Samong- Second Vocal of Campesina Community

TMI Contacts:

- Neil Borland – TMI intern and Huasta liaison
  Cell phone: 979680071 (EWB-AUS cell phone that was left with Neil)
  E-mail: neil.c.borland@gmail.com
- Donato – driver
  Cell phone 1: 944436106
  Cell phone 2: 969746303
- Doris Chavez Osorio- TMI employee, works closely with Canrey Chico community

Cell phone: 943720407
TMI phone: 456739
Email: dchavez@mountain.org

- Cristina- director of Peaks to Coast project
  Cell phone: 996652521
- Jorge Recharte – Director of Projects (Peru)
  E-mail: jrecharte@mountain.org

Contacts in Lima:

- Ray D. Cayo
  MWH Peru
  Environmental Engineer
  Telephone: 511-700-3200
  Direct Telephone: 511-700-3757
  Cell Phone: 511-97558-1958
  Address: Av. Conquistadores 626-638, Piso 4
  San Isidro, Lima, Peru
  E-mail: ray.cayoballarta@mwhglobal.com

- Robin Dufour
  MWH Peru
  Project Hydrogeologist
  Telephone: 511-700-3200
  Direct Telephone: 511-700-3700
  Cell Phone: 511-98577-8033
  Address: Av. Conquistadores 626-638, Piso 4
  San Isidro, Lima, Peru
  E-mail: robin.dufour@mwhglobal.com

- Julie Bolliat
  MWH Peru
  Project Hydrogeologist
  Telephone: 511-700-3229
  Cell Phone: 511-952059382
  Address: Av. Conquistadores 626-638, Piso 4
  San Isidro, Lima, Peru
  E-mail: Julie.Boillat@us.mwhglobal.com

Contacts in Canrey Chico:

- David Cruz Valdiviano- Mayor of Canrey Chico
  Cell phone: 943515906
- Rolando Salvador- Secretary of Campesina Community
  Cell phone: 943330977

Students for International Development- group of Canadian university students working in Chiquian, Huasta, and other communities on health promotion and microfinance

- Email: peru@sidcanada.org
- Gabriella- cell phone: 959683763 (Movistar)
- Alejandro Ramos (Alex)- email: yayomx@gmail.com
- Celine Wadhera- health PM
  email: celinewadhera@hotmail.com

Appendix F: Data Collected on Previous Trips

Evaporation Data:

Table 1: Evaporation rates measured with a pan evaporator

Date Range	Evaporation Rate (mm/day)
7/10/12 - 7/11/12	2.53
7/16/12 - 7/23/12	3.81
Average	**3.17**

A rough calculation of irrigation demand based on the highest evaporation rate measured is 0.39 L/s.

Spring Data:

Table 2: Average dry season flow rates for each spring

Spring	Flow Rate (L/s)
Muichiquipuquio	0.435
Punapuquio	0.665
Yanalpa Total	0.416
Yanalpa Sur	0.175
Yanalpa Norte	0.238

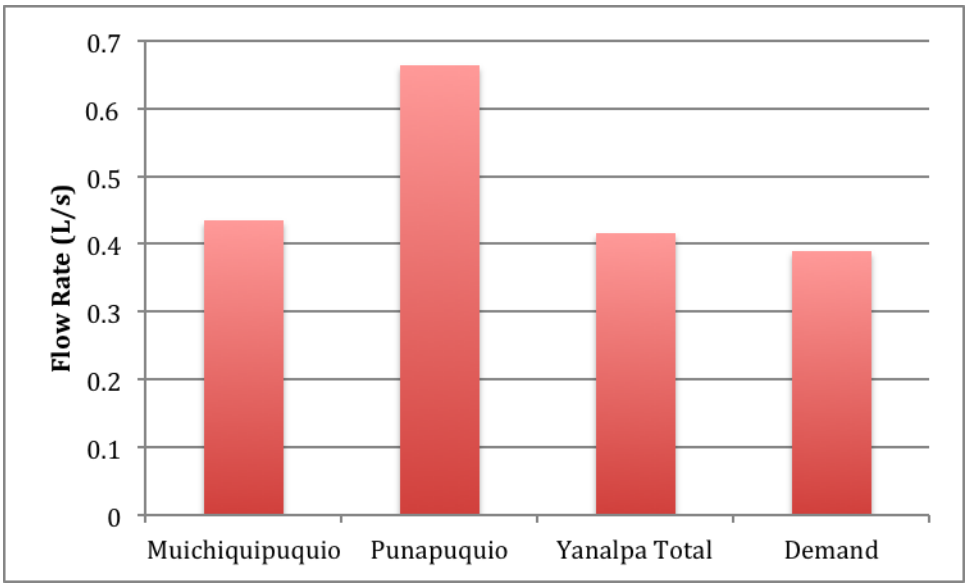


Figure 5: Average dry season flow rates for each spring compared to the preliminary demand calculation.

Table 3: Key water quality parameters for each spring

	Nitrate (ppm)	pH	Total Coliform (count/100 mL)	E. Coli (count/100 mL)
Muichiquipuquio	0.5	6.67	67	0
Punapuquio	0	6.8	150	0
Yanalpa	7.86	7.13	920	400

Soil Data:

Soil testing was conducted in anticipation of the need to 1) characterize infiltration capacity of pasture soil for more detailed assessment of irrigation water needs and 2) determine the unconfined compression strength and classification of the soil.

Bulk density was determined by completing the following protocol in triplicate: 1) fill a static volume with soil from the pasture, 2) weigh only the soil sample on a kitchen scale, 3) empty the static volume and fill with water and 4) weigh the water to estimate total volume based on the density of water. Unconfined compression strength was determined in the field using a pocket penetrometer (ELE international, Model EL29-3729).

Soil classification was determined following ASTM D2487 with No. 4 and No. 200 sieves (Hogentogler & Co, Inc., P/N 1286 and P/N 1310). Sieves conformed to ASTM E-11 and were shaken by hand with masses then weighed utilizing a battery powered kitchen scale. Soil testing results are summarized in Table 4. This standard resulted in the classification of coarse-grained soil, which is likely an acceptable soil for the construction of small break-pressure tanks EWB-AUS is considering along the proposed pipeline path.

Table 4: Summary of soil testing data.

Site	GPS Coordinates	Bulk Density ($g\ mL^{-1}$)	Sieve Test[#]			Unconfined compression strength ($tons\ ft^2$)
			Non-passed (g)	No. 4 (g)	No. 200 (g)	
Pasture	10.13843 S 77.14845 W	1.2	-	-	-	-
Potential Tank Site #1 (0-6")	10.13355 S 77.14821 W	-	28	74	2	2.5
Potential Tank Site #1 (6-12")	10.13355 S 77.14821 W	-	32	80	3	2.5
Potential Tank Site #2 (0-6")	10.13714 S 77.14841 W	-	6	78	8	4.5
Potential Tank Site #3 (0-6")	10.13142 S 77.14777 W	-	79	27	1	-

[#]Sieve tests follow ASTM standard D2487. Initial mass of soil sample for sieve tests was 100 g.

Appendix G: Sampling Protocols

Field Capacity:

Instructions taken from FAO Document Repository:
http://www.fao.org/docrep/T0231E/t0231e05.htm#TopOfPage

Gravimetric sampling of soil moisture

Gravimetric sampling involves collecting a soil sample from each 15-30 cm of the soil profile to a depth at least that of the root penetration. The soil sample of approximately 100-200 grammes is placed in an air tight container of known weight (tare) and then weighed. The sample is then placed in an oven heated to 105° C for 24 hours with the container cover removed. After drying, the soil and container are again weighed and the weight of water determined as the before and after readings.

Field capacity

A field technique for finding field capacity involves irrigating a test plot until the soil profile is saturated to a depth of about one metre. Then the plot is covered to prevent evaporation. The soil moisture is measured each 24 hours until the changes are very small, at which point the soil moisture content is the estimate of field capacity.

$$\theta_{fc} = \gamma_b \mathbf{W}_{fc} / \gamma_w \quad (8)$$

Soil Sampling Protocols:

Note: The procedures summarized in here should be well-known by the person conducting the tests. These protocols simply serve as a reminder for the general procedure of what to do in the field. It is advised to have the ASTM specifications present in the field while conducting the tests and to consult for graphs, tables, and figures. These protocols should not be followed in place of or without thorough knowledge of the exact procedures outlined in the ASTM specifications to ensure the validity of the data gathered.

Classification of Soil Type by USCS System (ASTM D2487)

It is recommended that a soil sample be taken for each foot of soil that is tested, down to the final testing depth, at each test site. The sample size will depend on how easy it is to obtain a good, fairly dry sample, but a preferred sample size will be at least 100 grams of soil.

The chart below outlines the general steps to be taken in the classification of the soil, and certain highlights of the procedure are given below, with comments at the end regarding the acceptable process for the sake of this project.

11. Procedure for Classification of Fine-Grained Soils

(50 % or more by dry weight passing the No. 200 (75-µm) sieve)

11.1 The soil is an inorganic clay if the position of the plasticity index versus liquid limit plot, Fig. 4, falls on or above the “A” line, the plasticity index is greater than 4, and the presence of organic matter does not influence the liquid limit as determined in 11.3.2.

NOTE 7—The plasticity index and liquid limit are determined on the minus No. 40 (425 µm) sieve material.

11.1.1 Classify the soil as a *lean clay,* CL, if the liquid limit is less than 50. See area identified as CL on Fig. 4.

11.1.2 Classify the soil as a *fat clay,* CH, if the liquid limit is 50 or greater. See area identified as CH on Fig. 4.

NOTE 8—In cases where the liquid limit exceeds 110 or the plasticity index exceeds 60, the plasticity chart may be expanded by maintaining the same scale on both axes and extending the "A" line at the indicated slope.

11.1.3 Classify the soil as a *silty clay,* CL-ML, if the position of the plasticity index versus liquid limit plot falls on or above the "A" line and the plasticity index is in the range of 4 to 7. See area identified as CL-ML on Fig. 4.

11.2 The soil is an inorganic silt if the position of the plasticity index versus liquid limit plot, Fig. 4, falls below the "A" line or the plasticity index is less than 4, and presence of organic matter does not influence the liquid limit as determined in 11.3.2.

11.2.1 Classify the soil as a *silt,* ML, if the liquid limit is less than 50. See area identified as ML on Fig. 4.
11.2.2 Classify the soil as an *elastic silt,* MH, if the liquid limit is 50 or greater. See area identified as MH on Fig. 4.

11.3 The soil is an organic silt or clay if organic matter is present in sufficient amounts to influence the liquid limit as determined in 11.3.2.

11.3.1 If the soil has a dark color and an organic odor when moist and warm, a second liquid limit test shall be performed on a test specimen which has been oven dried at 110 6 5°C to a constant weight, typically over night.

11.3.2 The soil is an organic silt or organic clay if the liquid limit after oven drying is less than 75 % of the liquid limit of the original specimen determined before oven drying.

11.3.3 Classify the soil as an *organic silt* or *organic clay,* OL, if the liquid limit (not oven dried) is less than 50 %. Classify the soil as an *organic silt,* OL, if the plasticity index is less than 4, or the position of the plasticity index versus liquid limit plot falls below the "A" line. Classify the soil as an *organic clay,* OL, if the plasticity index is 4 or greater and the position of the plasticity index versus liquid limit plot falls on or above the "A" line. See area identified as OL (or CL-ML) on Fig. 4.

11.3.4 Classify the soil as an *organic clay* or *organic silt,* OH, if the liquid limit (not oven dried) is 50 or greater. Classify the soil as an *organic silt,* OH, if the position of the plasticity index versus liquid limit plot falls below the "A" line. Classify the soil as an *organic clay,* OH, if the position of the plasticity index versus liquid-limit plot falls on or above the "A" line. See area identified as OH on Fig. 4.

11.4 If less than 30 % but 15 % or more of the test specimen is retained on the No. 200 (75-µm) sieve, the words" with sand" or "with gravel" (whichever is predominant) shall be added to the group name. For example, lean clay with sand, CL; silt with gravel, ML. If the percent of sand is equal to the percent of gravel, use "with sand."

11.5 If 30 % or more of the test specimen is retained on the No. 200 (75-µm) sieve, the words "sandy" or" gravelly" shall be added to the group name. Add the word "sandy" if 30 % or more of the test specimen is retained on the No. 200 (75-µm) sieve and the coarse-grained portion is predominantly sand. Add the word "gravelly" if 30 % or more of the test specimen is retained on the No. 200 (75-µm) sieve and the coarse-grained portion is predominantly gravel. For example, sandy lean clay, CL; gravelly fat clay, CH; sandy silt, ML. If the percent of sand is equal to the percent of gravel, use "sandy."

12. Procedure for Classification of Coarse-Grained Soils

(more than 50 % retained on the No. 200 (75-µm) sieve)

12.1 Class the soil as gravel if more than 50 % of the coarse fraction [plus No. 200 (75-µm) sieve] is retained on the No. 4 (4.75-mm) sieve.

12.2 Class the soil as sand if 50 % or more of the coarse fraction [plus No. 200 (75-µm) sieve] passes the No. 4 (4.75-mm) sieve.

12.3 If 12 % or less of the test specimen passes the No. 200 (75-µm) sieve, plot the cumulative particle-size distribution, Fig. 5, and compute the coefficient of uniformity, *Cu*, and coefficient of curvature, *Cc*, as given in Eqs 1 and 2.

$$10 \quad (Equation\ 1)$$

$$60 \quad (Equation\ 2)$$

where:

D10, D30, and D60 = the particle-size diameters corresponding to 10, 30, and 60 %, respectively, passing on the cumulative particle-size distribution curve, Fig. 5.

12.3.1 If less than 5 % of the test specimen passes the No. 200 (75-µm) sieve, classify the soil as a *well-graded gravel,* GW, or *well-graded sand,* SW, if Cu is greater than or equal to 4.0 for gravel or greater than 6.0 for sand, and Cc is at least 1.0 but not more than 3.0.

12.3.2 If less than 5 % of the test specimen passes the No. 200 (75-µm) sieve, classify the soil as *poorly graded gravel,* GP, or *poorly graded sand,* SP, if either the *Cu* or the *Cc* criteria for well-graded soils are not satisfied.

12.4 If more than 12 % of the test specimen passes the No. 200 (75-µm) sieve, the soil shall be considered a coarsegrained soil with fines. The fines are determined to be either clayey or silty based on the plasticity index versus liquid limit plot on Fig. 4. (See 9.8.2.1 if insufficient material available for testing) (see Note 7).

12.4.1 Classify the soil as a *clayey gravel,* GC, or *clayey sand,* SC, if the fines are clayey, that is, the position of the plasticity index versus liquid limit plot, Fig. 4, falls on or above the “A” line and the plasticity index is greater than 7.

12.4.2 Classify the soil as a *silty gravel,* GM, or *silty sand,* SM, if the fines are silty, that is, the position of the plasticity index versus liquid limit plot, Fig. 4, falls below the “A” line or the plasticity index is less than 4.

12.4.3 If the fines plot as a silty clay, CL-ML, classify the soil as a *silty*, *clayey gravel*, GC-GM, if it is a gravel or a *silty*, *clayey sand*, SC-SM, if it is a sand.

12.5 If 5 to 12 % of the test specimen passes the No. 200 (75-µm) sieve, give the soil a dual classification using two group symbols.

12.5.1 The first group symbol shall correspond to that for a gravel or sand having less than 5 % fines (GW, GP, SW, SP), and the second symbol shall correspond to a gravel or sand having more than 12 % fines (GC, GM, SC, SM).

12.5.2 The group name shall correspond to the first group symbol plus “with clay” or “with silt” to indicate the plasticity characteristics of the fines. For example, well-graded gravel with clay, GW-GC; poorly graded sand with silt, SP-SM (See 9.8.2.1 if insufficient material available for testing).

NOTE 10—If the fines plot as a *silty clay,* CL-ML, the second group symbol should be either GC or SC. For example, a poorly graded sand with 10 % fines, a liquid limit of 20, and a plasticity index of 6 would be classified as a poorly graded sand with silty clay, SP-SC.

12.6 If the specimen is predominantly sand or gravel but contains 15 % or more of the other coarse-grained constituent, the words “with gravel” or “with sand” shall be added to the group name. For example, poorly graded gravel with sand, clayey sand with gravel.

12.7 If the field sample contained any cobbles or boulders or both, the words “with cobbles,” or “with cobbles and boulders” shall be added to the group name. For example, silty gravel with cobbles, GM.

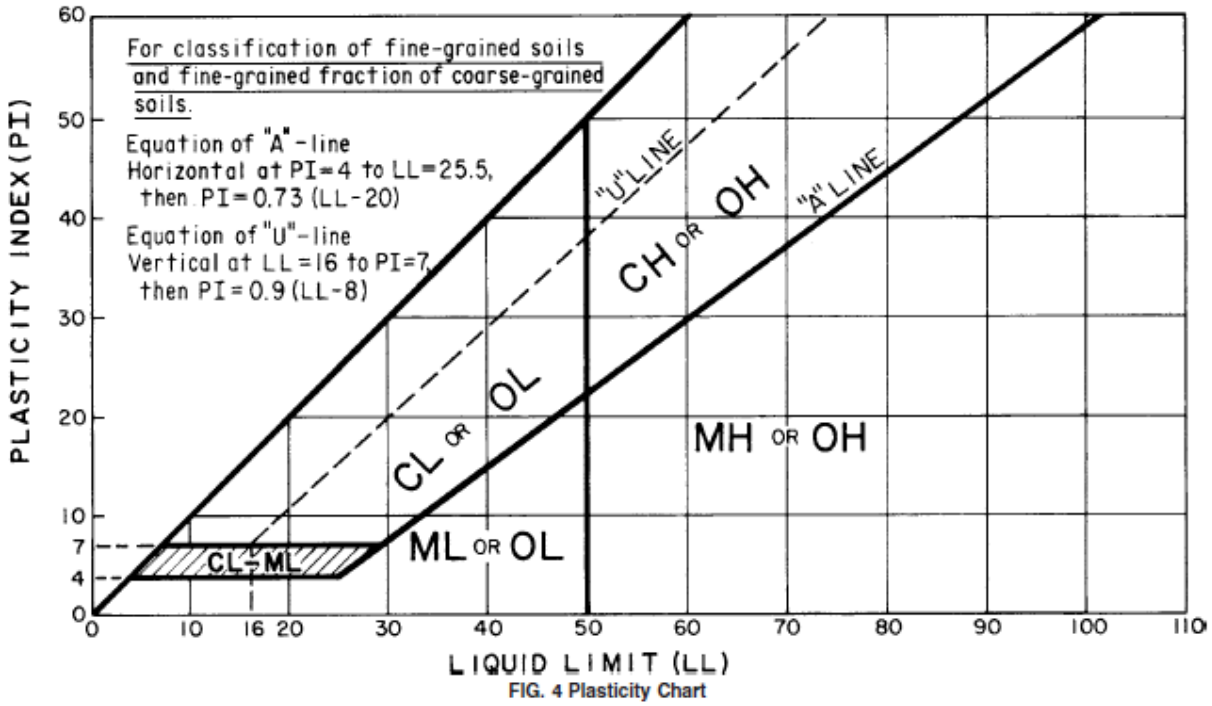


FIG. 4 Plasticity Chart

Summary of pertinent procedure:

1. Take the soil sample and ensure that it is dry and not clumping together.
2. Weigh the initial sample, then shake the sample through the No.200 and No. 4 seives. Use the weights of the soil retained on each of these sieves and the soil that passed through both to determine in which general category the soil should be classified, according to Table 1. This will get the soil classification into the third column of the chart.
3. Based on the distribution of the particles, determine if the soil should be classified as well-graded or poorly-graded. This can be done by observing the sizes of the particles and determining if the approximate distribution of particles of all sizes is uniform (well-graded) or if there percentage of particles of a certain size is much higher (poorly-graded).
4. In the case of fine-grained soils, if the equipment is present to be able to determine the plasticity index(PI) and liquid limit (LL), it is preferable to do so for at least one of the fine-grained samples simply to determine the general characteristic of the fine-grained soils in the area.

If all the samples from all cores are fine-grained, it is necessary to be very detailed in the description of the soil to ensure that it is acceptable for foundation design

Appendix H: Grasses in the Region

Type	Description/misc. notes	Water demand	Nutrients
Rye grasses	Annual ryegrass (*Lolium multiflorum)* or Italian or English Ryegrass; U.S. breeding has improved yield, disease resitance, and cold tolerance.	During the dry season, extensive watering is needed; yield increases with additional irrigation (non-irrigated ryegrass 2-4 tons dry matter/ac); Texas guide: "during hot dry weather apply 1 inch of water in a single application 1 to 2 times per week. During spring and fall, apply 1 inch of water every 7-10 days in absence of rainfall."	U.S. general - 30 - 60 lb N/ac; P and K less than this
White and red clover	*Trifolium pretense* (red) and *Trifolium repens* (white); forage legumes; very persistent legume; rotational grazing recommended	Clovers require constant supply of moisture; white clover can tolerate flooding for short periods while red clover cannot. White clover lawn guide:"To improve your lawn, water the grass thoroughly every week to week and a half to encourage deep roots. Rainfall and irrigation should equal an inch per week. Frequent light watering encourages clover, which is shallow-rooted. Mowing your lawn no shorter than 2½ to 3 inches also encourages deeper grass roots."	Red clover needs less nutrients than most;
Orchard grass	*Dactylis glomerat;* may have less nutritional value than other grasses; rotational grazing recommended; Orchardgrass may be damaged in areas with dry, cold winters and no snow cover (like Peru...)	12 inches or more annual precipitation (IL); 18 inches or more or equiv under irrig. (UT); but its fibrous root system allows for drought tolerance (but not extended periods of drought)	Moderate
Alfalfa	*Meicago sativa,* Perrenial crop (grows several years after planting); considered very good for dairy cows; many varieties of alfalfa - resistant to freezing, diseases etc	Requires high quantities for high yield	Alfalfa adds nitrogen to the soil - good rotation crop (N-fixation)

Growth cycles	Root structure	Soil pH	Soil type
Considered an annual specie, but occasionly behaves as short-term perennial or biennial; Changes with day length changes; flowering varies with variety and latitude; Plant before the rainy season; Some varieties, very resistant to cold, but can also be sensitive to temperature (Near and below freezing temperatures may be a problem- does it get that cold?)	Deeply fibrous root system	Wide range; optimum: 5.6 or higher; 6-7	Has adapted to many soil types
Has adapted to many climatic conditions - usually planted with a cool-season grass; Red clover is biennial (lives for only two years)	White clover has shallow root system	Red clover tolerates more acidic conditions, but 6-6.3 is optimal	Adapted to many soil conditions; clay soils for moisture retention
May have dormancy depending on temperatures and water conditions. Flowers for 5-6 months of year.	short rhizomes and fibrous roots	5.8 -7	Loam or clay loam - moist or slightly dry conditions; well drained, rich or moderately fertilized soils
Planted spring or fall; different varieties can grow diff. lengths of time (ie: AZ can harvest all 12 months of the year)	Roots can grow deeper than 15 feet; most roots within first half foot		

Salinity	Conductivity	Source
		http://edis.ifas.ufl.edu/ag104; http://www.ca.uky.edu/agc/pubs/agr/agr179/agr179.htm; http://www.eastonsod.com/index_rye.html; http://extension.umd.edu/publications/pdfs/fs775.pdf
		http://extension.umd.edu/publications/pdfs/fs775.pdf; http://www.extension.umn.edu/yardandgarden/ygbriefs/h301clover.html; http://edis.ifas.ufl.edu/ds127; http://learningstore.uwex.edu/assets/pdfs/A3492.pdf
		http://www.illinoiswildflowers.info/grasses/plants/orchard_grass.htm; http://www.fs.fed.us/database/feis/plants/graminoid/dacglo/all.html; http://www.plant-materials.nrcs.usda.gov/pubs/wvpmcrb8232.pdf; http://extension.usu.edu/range/Grasses/orchardgrass.htm
		http://forages.oregonstate.edu/php/fact_sheet_print_legume.php?SpecID=1&use=, http://alfalfa.ucdavis.edu/-files/pdf/alfalfaFactSheet.pdf

Appendix I: Draft MOU with the Municipality of Huasta

Convenio Para el Proyecto de Mejoramiento de la Planta de Tratamiento de Aguas Residuales en Huasta, Peru
Memorandum of Understanding for the Improvement Project of the Wastewater Treatment Plant in Huasta, Peru

Este convenio es entre la Municipalidad de Huasta y Ingenieros sin Fronteras de Greater Austin (EWB-AUS) para el proyecto de mejoramiento de la planta de tratamiento de aguas residuales ("el proyecto"). Este proyecto es una parte del programa de Climate Adaptations in Mountain Basins In the Andean Region (CAMBIAR) ("el programa"). El propósito de este acuerdo es establecer un marco de colaboración con este proyecto. Acuerdos adicionales se firmarán con cada etapa del proyecto después de confirmar los detalles más específicos en el proceso de desarrollar el proyecto.

This agreement is between the Municipality of Huasta and Engineers Without Borders-Greater Austin (EWB-AUS) for the project of improving the wastewater treatment plant of Huasta ("the project"). This project is part of the Climate Adaptations in Mountain Basins In the Andean Region (CAMBIAR) program ("the program"). The purpose of this agreement is to establish a framework for collaboration with this project. Additional agreements will be signed with each phase of the project after confirming more specific details in the process of developing the project.

CLÁUSULA PRIMERA: DE LAS PARTES

First Clause: Parties

1.1 Municipalidad de Huasta es ____

1.1 *The Municipality of Huasta comprises about 29,000 hectares and has a population between 800-1,000 people according to the 2007 Peruvian national census. The Peruvian Ministry of Economics reports that Huasta's main industry is mining, which has constituted approximately 70% of the local finances over the past five years. Dairy farming and livestock rearing is another important occupation in the region, where the community owns land specifically designated for cattle grazing in order to sell milk year round. Located in hills with historically many springs, Huasta relies on clean groundwater and rainfall to support its economic activities, as well as its residents' livelihoods. As part of the Tres Cuencas Commonwealth, climate change and water availability are main issues in the district of Huasta and the municipality has taken an active role in pursuing adaptation for the future.*

1.2 **Ingenieros Sin Fronteras – E.E.U.U (EWB-USA)** es una organización humanitaria sin fines de lucro establecida para desarrollar programas de apoyo comunitario a nivel mundial a través de asociaciones que diseñan e implementan proyectos de ingeniería sostenible. Los miembros de EWB-USA, que comprenden profesionales y estudiantes de ingeniería y otras disciplinas, trabajan con comunidades y ONG's locales en más de 45 países en vías de desarrollo alrededor del mundo en proyectos de agua, energía renovable, sanitarios, et setera. Los proyectos siempre tienen dos metas (1) cumplir las necesidades de ingeniería de las comunidades con un enfoque de sostenibilidad de largo plazo, y (2) proveer una oportunidad educativa para que los voluntarios ganen una experiencia práctica en ingeniería.

La sede de Austin e EWB-USA (EWB-AUS) es la combinación de profesionales y estudiantes de EWB-USA que está localizado en Austin, Texas, USA.

1.2 Engineers Without Borders-USA (EWB-USA) *is a nonprofit humanitarian organization established to support community-driven development programs worldwide through partnerships that design and implement sustainable engineering projects. EWB-USA members, comprised of professional and student engineers or other disciplines, work with local communities and NGOs in over 45 developing countries around the world on projects such as water, renewable energy, sanitation and more. The projects always have two objectives (1) to fulfill the engineering needs of the communities with a focus on long-term sustainability, and (2) to provide an educational opportunity so that the volunteers gain practical engineering experience.*

The Greater Austin Chapter of EWB-USA (EWB-AUS) *is a combined professional-student chapter of EWB-USA that is located in Austin, Texas, USA.*

CLÁUSULA SEGUNDA: DE LOS FINES DEL PROYECTO

Clause 2: Objectives of the Project

Según los estudios primeros que ha hecho el equipo de ingenieros sin fronteras, la planta de tratamiento de aguas residuales en Huasta no funciona en la manera adecuada. En las aguas residuales se encontraron niveles de bacteria más alta a la salida que a la entrada de la planta. El objetivo del proyecto es mejorar el funcionamiento de la planta de tratamiento de aguas residuales e implementar un plan de mantenimiento de la planta para mejorar el sistema sanitario y prevenir la contaminación por las aguas residuales. Como ya existe un plan de mantenimiento y operación para la planta de tratamiento de aguas residuales en los archivos de la Municipalidad de Huasta, los pasos necesarios son de arreglar la infraestructura de la planta y capacitar a los trabajadores en la operación de la planta.

According to the initial studies that the EWB-AUS team has made, the wastewater treatment plant (WWTP) in Huasta is not functioning in an adequate manner. Higher levels of bacteria were found in the effluent to the WWTP than in the influent. The objective of the project is to improve the functioning of the WWTP and implement a maintenance plan for the plant to improve the sanitation system and prevent contamination from the wastewater. Because an operation and maintenance manual already exists in the archives of the Municipality of Huasta, the necessary steps to improving the WWTP are to fix the infrastructure problems and train WWTP workers in the operation of the plant.

CLÁUSULA TERCERA: DE LAS RESPONSABILIDADES
Clause 3: Responsabilities

3.2 Obligaciones Conjuntas
Las obligaciones de ambas partes son:

- Ponerse de acuerdo con la forma de mejorar la planta de tratamiento y manejar el mantenimiento
- Estar abierto en la comunicación y compartir información en cada fase del proyecto

3.1 Joint Obligations
The obligations of both parties are:

- *Come to an agreement on the form of improving the WWTP and managing the maintenance*
- *Be open in communication and share information in each phase of the project*

3.3 Responsabilidades de Ingenieros sin Fronteras (EWB-AUS)
Las responsabilidades de EWB-AUS son:

- Proveer un análisis técnico de la planta de tratamiento y dar sus recomendaciones profesionales del estado de la planta
- Proveer educación del funcionamiento y los beneficios de la planta de tratamiento
- Dar capacitación de la operación y el mantenimiento de la planta de tratamiento de aguas residuales
- Proveer documentos elaborados, los pasos del proyecto, recomendaciones profesionales y resultados de los análisis de la calidad de agua de los efluentes
- Colaborar con el liderazgo de la municipalidad y comunidad en tomar todas decisiones en cada fase del proyecto

3.4 Responsabilities of Engineers Without Borders (EWB-AUS)
The responsabilities of EWB-AUS are:

- *Provide a technical analysis of the WWTP and give professional recommendations on the state of the plant*
- *Provide education on the function and benefits of the WWTP*
- *Give training on the operation and maintenance of the WWTP*
- *Provide documents at each phase of the project elaboratins professional recommendations and results of water quality analyses of the WWTP effluent*
- *Collaborate with the leadership of the municipality and Campesina Community when making decisions at each phase of the project*

3.5 Responsabilidades de la Municipalidad de Huasta

Las responsabilidades de la municipalidad son:

- Proveer dos contactos de la municipalidad quien se responsabilice de la comunicación con EWB-AUS
- Proveer los recursos económicos necesarios para operar y mantener la planta de tratamiento de aguas residuales y contratar a una persona permanente para la operación de la planta
- Encargarse del mejoramiento y la operación de la planta
- Proveer datos y conocimientos sobre la planta y su historia
- Proveer apoyo logístico para organizar hospedaje y otras cosas cuando los equipos de ingenieros sin fronteras visiten a Huasta

3.4 Responsabilites of the Municipality of Huasta

The responsabilities of the municipality are:

- *Provide two contacts from the municipality who are responsible for communication with EWB-AUS*
- *Provide the economic resources necessary for the operation and maintenance of the WWTP and contract a permanent person to operate the plant*
- *Take charge of the improvement and operation of the plant*
- *Provide data and information regarding the plant and its history*
- *Provide logistical support in organizing a place to stay and other things when EWB teams visit Huasta*

CLÁUSULA CUATRO: DURACIÓN Y VIGENCIA

Clause 4: Duration and Validity

El presente Convenio entrará en vigencia a partir de la suscripción del mismo hasta que dure el programa o la infraestructura se ha completado. Al siguiente año, EWB-AUS llevará a cabo una revisión y análisis del proyecto. En ese momento este Memorando de Entendimiento podrá ser modificado con una extensión mayor a que ambas partes lo consideren necesario.

En caso de surgir situaciones no previstas o de incumplimiento de las obligaciones asumidas en el presente Convenio, cualquiera de las partes podrá solicitar su resolución, previa notificación escrita a la otra parte con treinta (30) días de anticipación, dentro del cual se procederá a concluir las actividades y dejar un informe completo de lo avanzado hasta la fecha.

This MOU will take effect on its date of execution until the program lasts or the infrastructure of the project is completed. The following year, EWB-AUS will conduct a final review of the project. At that time this MOU may be amended with an extension if the parties deem it necessary.

In the event of unforeseen circumstances or breach of their obligations under this MOU, parties may seek to end the MOU upon written notice to the other parties. With thirty (30) days of written notice of termination parties will conclude their activities and leave a full report on the progress to date.

CLÁUSULA CINCO: DE LA MODIFICACION DEL CONVENIO

Clause 5: Modification of the Agreement

Cualquier modificación y/o ampliación del presente Convenio se efectuará por acuerdo de las partes mediante adenda respectiva y por periodos similares.

Any modification and/or extension of this MOU shall be effected by agreement of the parties through addenda.

CLÁUSULA SEIS: DE LA SOLUCION DE CONTROVERSIAS

Clause 6: Dispute Resolution

Cualquier asunto no previsto en el presente Convenio o cualquier discrepancia o controversia respecto de su aplicación o interpretación, deberá ser solucionado a través del entendimiento directo entre las partes, sobre la base de las reglas de la buena fe y común intención, designándose para ello representantes por cada una de las partes. Dicha designación deberá ser puesta en conocimiento de la otra parte.

Any matter not provided for in this MOU or any dispute or controversy regarding its application or interpretation shall be settled through direct agreement between the parties, based on the rules of good faith and common intention, by designated representatives of each of the parties. Such designation must be made known to the other party.

CLÁUSULA SIETE: DE LAS DISPOSICIONES FINALES

Clause 7: Final Dispensations

Toda controversia sobre la interpretación y aplicación del presente Convenio será solucionada en la ciudad de Huaraz en forma armoniosa por los representantes que designen cada uno de las partes, y en caso contrario se sujetará a lo dispuesto en el Código Civil y demás normas aplicables.

Any dispute concerning the interpretation and application of this MOU shall be settled in the city of Huaraz in a harmonious way by the representatives designated by each of the parties, and otherwise be subject to the provisions of the Civil Code and other applicable rules.

CLAUSULA OCHO: EJECUCIÓN

Clause 8: Execution

Los que abajo subscriben representando a la Municipalidad distrital de Huasta representado por su alcalde y a los Ingenieros sin fronteras de la sede de Austin-USA acuerdan respetar las condiciones descritas arriba.

On behalf of, and acting with the Municipal government of the District of Huasta represented by its mayor and the Greater Austin Chapter of EWB-USA the under-signed agree to abide by the above conditions.

Appendix J: Recommendations for the WWTP

I. Infrastructure

1. The intake gate to the plant should be replaced with small circular bars in order to prevent clogging due to trash and sediment build up.
2. The bypass gate into the bio-sand filter should be fixed, as it is currently stuck in a permanently open position, directing most of the flow from the drying beds and septic tanks past the filter and to the exit of the plant.
3. The bio-sand filter should be completely cleaned out and filled with gravel and a sand layer on top for proper filtration.
4. Fix the fence surrounding the wastewater treatment plant so that the access area is controlled.
5. Construct a roof over the drying beds to prevent rainwater from greatly impacting the levels in the rainy season.

II. Operation

1. Refer to the Operation and Maintenance Manual designed as a guide for this plant.
2. The lids to the septic tank should remain closed at all times to allow for proper decomposition.
3. The septic tanks should be cleaned out only as the sludge accumulates to a certain level in the drying beds, as determined by weekly measurements of sludge levels.
4. The municipality needs to determine a plan for disposing of sludge or following norms to apply it as fertilizer.
5. The operator of the treatment plant should wear appropriate personal protective equipment to minimize their health risks when dealing with human waste.
6. Any solids that have accumulated in the liquid side of the septic tank should be removed via a pump.
7. Flow measurements at the intake and effluent should be recorded on a regular basis to ensure the sludge removal schedule.
8. Construct a roof over the drying beds to reduce impacts of rainfall.
9. Fix the fence surrounding the wastewater treatment plant to ensure safety and security.

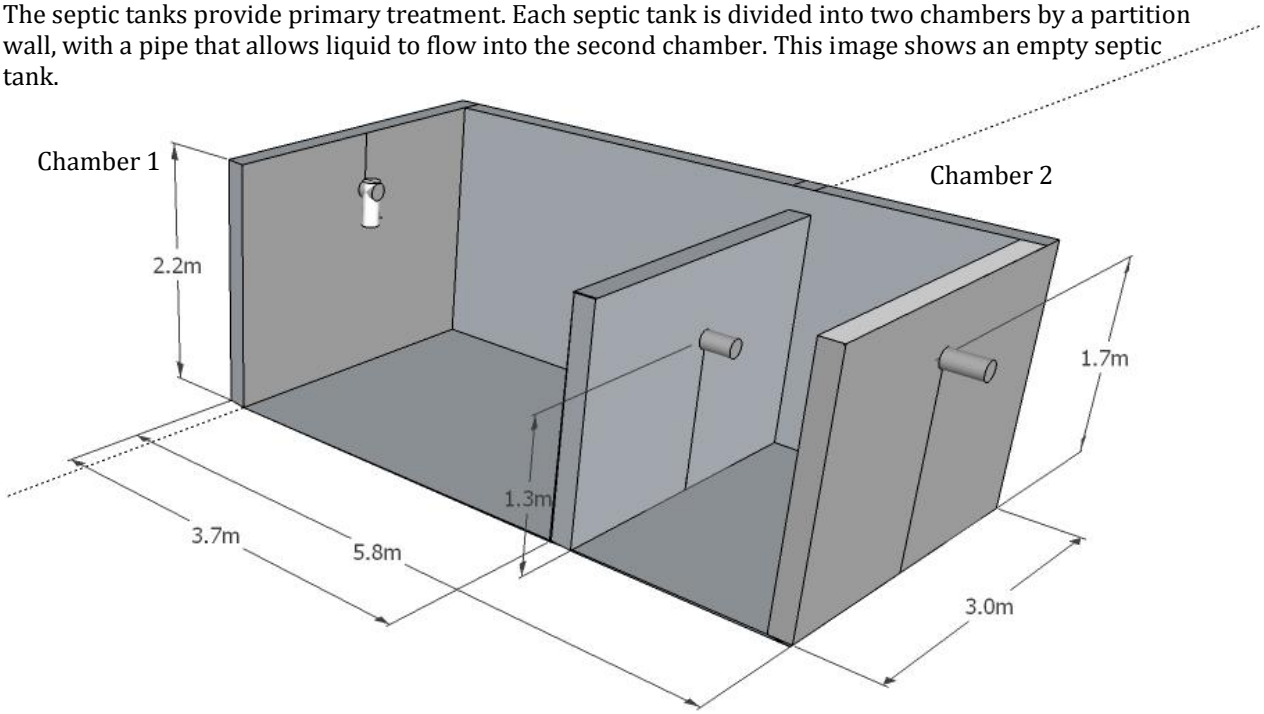
III. Training and Education

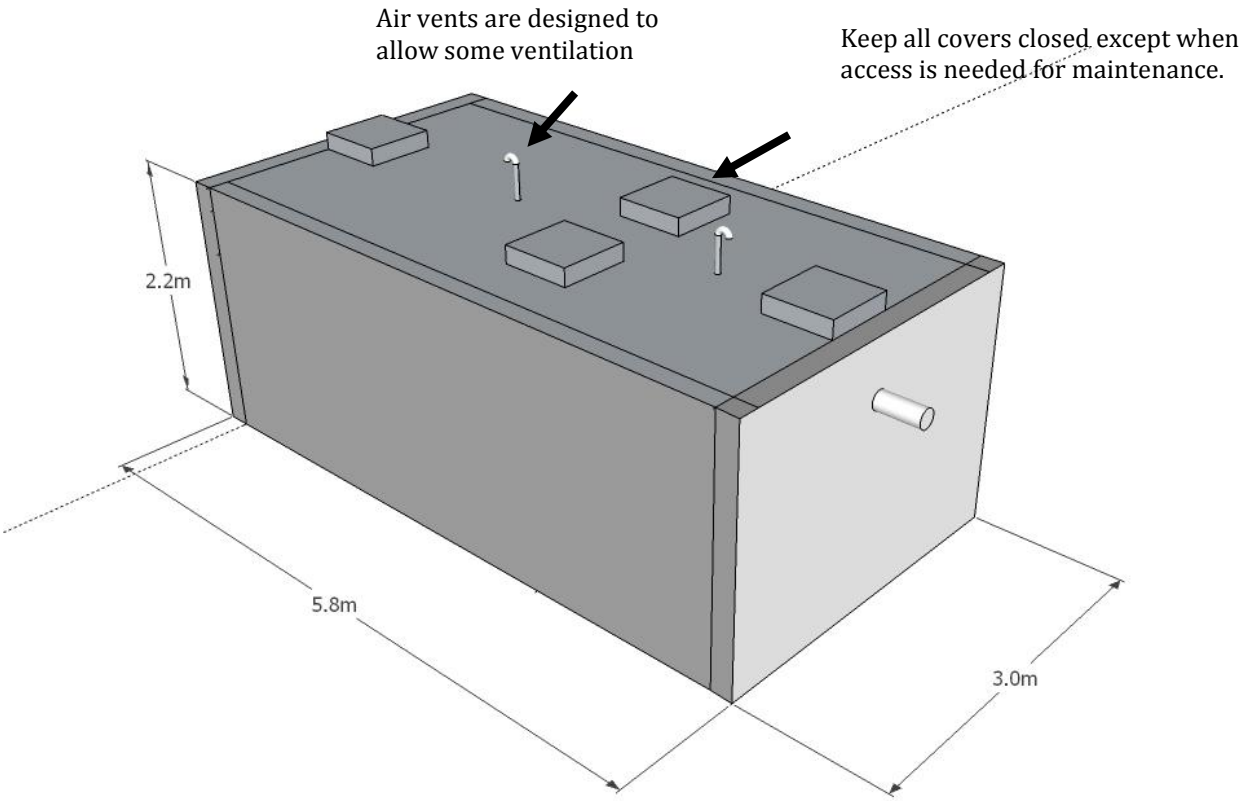
1. A group of community and municipality members should be made aware of the operation and maintenance needs of the treatment plant and its current state.
2. Workshops and community outreach activities should be designed to educate and engage about the plant’s functionality and benefits.
3. A training program for future operators should be developed to transfer knowledge over time.

Appendix K: Sample of Reference Manual for WWTP

Septic Tanks

The septic tanks provide primary treatment. Each septic tank is divided into two chambers by a partition wall, with a pipe that allows liquid to flow into the second chamber. This image shows an empty septic tank.





Septic tanks are designed to provide anaerobic treatment, or treatment in the absence of oxygen and ambient air. Specific microbes grow in this environment, and these microbes readily break down solids, organics, and pathogens in wastewater.

Keeping the tank closed maintains anaerobic conditions, which allow these microbes to provide anaerobic treatment. Such treatment can reduce the volume of solids by half. It is important to give microbial activity enough time to grow, and releasing solids from the tank too often may not encourage sustained growth.

Appendix L: Maintenance Log Template

WWTP Daily Maintenance Log - January 2013

Write your initials in the square for the day that you performed daily maintenance (cleaning the intake grate, visually inspecting for major problems).

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Appendix M: Alternatives Analysis- Irrigation Water Sources (From Section 9.2 of the January 2012 522- Post Assessment Report)

6.1 Alternative Irrigation Sources

Because of the complications involved with rehabilitating the WWTP, the EWB-AUS team investigated other possible water sources for irrigating the proposed community pasture, including pumping water from the canal that runs below the field (9.2.1), pumping water from the River Aynín from a point directly below the field (9.2.2), piping water from the River Aynín from an upstream point that is at a higher elevation than the field (9.2.3), and capturing spring water and piping it to the field (9.2.4). All of these alternatives were ruled out at infeasible for reasons outlined below.

6.1.1 Pumping water from the irrigation canal

The irrigation canal that runs directly below the pasture appears to be the most likely alternative because of its proximity to the field, however, there are problems with the water rights for the canal. The community shares the canal with several other communities, and they only have access to the canal for 6 days out of the dry season. We proposed building a reservoir to store the water during the days that they have access to the water in the canal so that the water can be distributed more efficiently throughout the dry season, but the community anticipates that would cause conflict with downstream users of the canal. A drip irrigation project from a nearby avocado farm project currently takes water from the canal at night during the community's access period and stores it in a reservoir for later use. This has already caused conflict with a community downstream because they believe Huasta is taking more than its share of water, and the Community of Huasta does not wish to incite further conflict. Clearly there is a need for education on water use—there is a lack of understanding that building a reservoir is not using more water but storing it and using it more efficiently—but because it involves another community, this is beyond the scope of our project.

6.1.2 Pumping water from the River Aynín

The River Aynín runs directly below the community pasture, and the elevation drop from the field to the river is approximately 100 m. An elevation change of this magnitude would require significant pumping power, and we believe that the design would be beyond the capabilities of EWB-AUS. In addition, the River Aynín is prone to flooding during the rainy season, so the infrastructure for the uptake of water from the river would need to be sturdy enough to withstand floodwaters, presenting a significant design challenge. Although it seems an unlikely alternative, we have not yet completely ruled it out and will investigate this possibility in the coming months to determine the feasibility of this alternative.

6.1.3 Piping water from the River Aynín

The River Aynín is a substantial water source, and the flow is not significantly diminished in the dry season. The irrigation canal that the community uses for the other community-owned fields originates from the River Aynín, so we investigated what would be required to pipe water directly from the river following a similar path as the canal. The distance from the upstream point of the river to the field to be irrigated is substantial (approximately 5 km), but the prohibitive factor is the pathline that the canal follows. Parts of the path are rocky, which would prevent burying the pipe, and the canal passes underneath the town of Pan Pan for a significant distance. The canal passes underground and is covered with concrete. Because houses and other structures have been built on top of the canal, further access to the canal at that point is impossible. It would also be impossible to lay the pipeline around the town because all of the nearby land is privately owned and the community cannot get the rights to pass the pipeline through privately owned land. Any significant circumvention of the town of Pan Pan would involve scaling an elevation significantly higher than the point of uptake from the river, which would not be feasible with a gravity-fed system.

TIM AGER

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SUMMARY

Fifteen years experience in engineering, manufacturing, and project management. Expertise in mechanical design, 3-D solid modeling and drafting, cost reduction, and small team management. Extensive worldwide travel, both personal and professional. Nonprofit, volunteer, and teaching/mentoring experience with an emphasis on cross-cultural communication. Comprehensive home-construction skills.

SELECTED EXPERIENCE

- **Engineers Without Borders - USA, Greater Austin Chapter** (Austin, TX), 2010 - present
  President, Director of Projects, Professional Mentor, Technical Lead, Health & Safety Officer

  Panama Project: Clean drinking water and health education initiative in remote jungle village of Sieykin. Assessment and implementation trips to construct spring box, pour 5,000-liter concrete water storage tank, bury over a mile of PVC pipe, build bridge pediments for aerial water crossings, and construct slow sand filter.
  Peru Project: Waste water treatment plant rehabilitation and field irrigation projects in the Andean mountain community of Huasta.

- **Applied Materials Inc.** (Austin, TX), 1994 - 2009
  Mechanical Engineer, Manufacturing Engineer

  Global leader in the manufacturing of semiconductor processing equipment. Drove projects from design development through test and implementation. Designed new products, taking into account manufacturability and cost. Managed outsourcing of large assemblies to low-cost regions. Oversaw first-time builds through end-customer installations. Resolved technical and manufacturing issues, clarified dynamic design specifications, and worked within short project timelines. Improved assembly and test processes, fixtures, tooling, quality, cost, reliability, cycle time, and safety. Communicated with cross-functional team members, and acted as liaison between design engineering authority, materials department, and manufacturing floor. Mentored new employees. Created and taught Workmanship Standards class.

- **Robotics Research Group, The University of Texas at Austin**, 1988 - 1992
  Research Assistant

  Basic and applied robotics research lab dedicated to the advancement of open architecture intelligent machine technology. Participated in large-scale robotics projects. Designed robotic components and created accompanying manuals.

- **American YouthWorks, Engineering and Moto Corps Programs** (Austin, TX), 2011 - present
  Volunteer Instructor

  Public charter high school and GED program emphasizing technology with a commitment to preserving the natural environment. Education, green jobs training, and community service opportunities for at-risk youth. Lead hands-on aeronautics and internal combustion engine projects to instill math and physics knowledge, and encourage problem-solving skills.

- **Harvest Classic Motorcycle Rally** (Luckenbach, TX), 2003 - present
  Co-founder, Volunteer Coordinator

  Annual family-friendly European and vintage motorcycle rally to benefit Candlelighters Childhood Cancer Foundation, a human services program of Any Baby Can. Member of team that produces and runs all aspects of the event: registration, merchandise, sponsorships, silent auction, raffle, bike show, food and entertainment. Attracts over 2,500 attendees annually with proceeds of over $300,000 in nine years.

- **Habitat for Humanity** (Tosagua, Ecuador), 2006
  Volunteer

  Nonprofit dedicated to building simple, decent, and affordable houses for low-income families around the world. Intensive construction project including slab pouring, brick-laying, and concrete masonry.

- **MedAid: The U.S. Latin American Medical Aid Foundation** (Havana, Cuba), 2001
  Volunteer

  Traveled to Cuba (under license from the U.S. Department of the Treasury) with Texas-based humanitarian aid group. Hand-delivered donated medical supplies to clinics and hospitals. Toured healthcare facilities throughout Havana, meeting with doctors and nurses to assess future needs.

SKILLS

- **Software:**
  Unigraphics, Inventor, SolidWorks, HP Solid Designer, AutoCAD, Boothroyd-Dewhurst DFMA cost estimator, Microsoft Office Suite.

- **Engineering:**
  Design for manufacturability, geometric dimensioning and tolerancing (GD&T), engineering change orders, supplier problem sheets, workmanship standards, QA standards, cleanroom protocol.

- **Construction**:
  Slab prep: site leveling, digging footings, rebar placement, form construction. Slab pouring and finishing. Masonry: mixing mortar and laying up both CMU and rock veneer walls. Framing, roofing, electrical, plumbing, insulation, flooring, dry wall, painting.

- **Other**:
  Intermediate Spanish speaker, First Aid/CPR certification, travel experience to over 30 countries on 5 continents.

EDUCATION

- **M.S., Mechanical Engineering**, The University of Texas at Austin
  Emphasis in Mechanical Systems and Robotics with Mathematics Minor
- **B.S., Mechanical Engineering**, The University of Texas at Austin