EVALUATING WASTEWATER TREATMENT OPTIONS FOR HONDURAS

Group Report

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EXECUTIVE SUMMARY

During the academic year of 2008-2009, three Masters of Engineering students from the Massachusetts Institute of Technology (MIT) conducted a study of wastewater treatment systems in Honduras. The purpose of the study was to assess the state of centralized wastewater treatment facilities, focusing on Imhoff tank and wastewater stabilization pond systems with a cursory look at other forms of treatment implemented in the country. This project included travel to Honduras in January 2009 for a field survey of these systems. This report presents a summary of this investigation including a background on the Honduran national context of the water sector, a description of each facility visited, and trends and recommendations based upon these observations.

A total of ten facilities was visited over the course of the study. These included facilities at the municipalities of Guaimaca, Talanga, Villa Linda Miller, Amarateca, Teupasenti, Las Vegas, Puerto Cortés, Choloma, La Lima, and Tela. An effort was made to select facilities that are typical of wastewater treatment systems in Honduras. The systems visited included wastewater stabilization ponds, Imhoff tanks, constructed wetlands, anaerobic filters, and package activated sludge plants. General field observations were made and, where possible, interviews were carried out with operators or wastewater management staff for information on facility background and maintenance.

Based on observations from the survey, overall systematic trends were developed which were generally related to design, operation and maintenance, and community issues. Specific recommendations were made to address some of these issues.

1.0 INTRODUCTION

1.1 Background

1.1.1 Honduras - General

The Republic of Honduras is the second largest country in Central America. With a population of 7.7 million people, Honduras covers an area of 112,000 square kilometers, roughly the area of the state of Tennessee.

Figure 1: Overview Map of Honduras

Source: Center for Disease Control, 2008

Honduras is a Spanish-speaking nation comprised of 18 departments or political territories, which are further divided into a total of 298 municipalities. The nation is democratic, with universal mandatory voting by all citizens over the age of 18 years (U.S. CIA, 2008). The country's capital of Tegucigalpa is also its largest city, where 12% of the population resides. Overall the country's population is divided into 43% urban dwellers and 57% rural (WHO, 2001).

Honduras has one of the highest levels of poverty in the Central American region, with 65% of the population living on less than two dollars a day (Water for People, 2006) and a nominal per capita GDP of $1,635 (FCO, 2008). Literacy rates in the nation were

reported at 80% on the 2001 census. The median age in the country is 20 years, with a life expectancy at birth of 69 years (U.S. CIA, 2008).

1.1.2 Honduras - Water and Sanitation

Poverty reduction, through the provision of essential services such as adequate water and sanitation, has been a primary development initiative in Honduras (Mikelonis, 2008). However, poverty levels have also been a factor in the historical lack of sewerage fee collection, with current service providers facing cultural and economic challenges in levying rates or tariffs on sanitation services. As a result, sanitation is largely inadequate throughout the country; in urban areas, 41% of all residences lacked sanitation services as of 2001. Rural sanitation connection rates were reportedly below 20% (WHO, 2001). Similar investigative work performed by the organization Water for People five years later (Table 1) found improvement in these number but services are still lacking across both urban and rural populations.

Table 1: Sanitation Coverage

Sanitation Coverage in Honduras 2001 **Groups of Population**	**2001 Population**	**Population with sewerage service**	**Population with latrines**	**Total Population served**	**Coverage %**
Rural	3,113,304	-	1,541,085	1,541,085	49.5
Urban	2,895,776	1,538,440	1,006,947	2,545,387	87.9
Global	6,009,080	1,538,440	2,548,032	4,086,472	68.0

Source: Water for People – Honduras 2006

Inadequate sanitation holds severe consequences for the population of Honduras with regards to water-related diseases. With a high infant mortality rate of 42 out of 1000 births, the leading cause of infant mortality is reported as intestinal infectious diseases. For children under the age of 5, the second leading cause of death is diarrheal diseases. Water-related diseases include waterborne (e.g. bacterial diarrhea, hepatitis A, typhoid fever) as well as vector-borne illnesses (e.g. malaria and dengue fever) whose transmission is exacerbated by unsanitary conditions. Cholera, a waterborne illness

previously eradicated from Honduras, re-emerged with an outbreak in 2001. Proper sanitation is critical to raising the standards of health in the nation (WHO, 2001).

1.1.3 Regulatory Framework of Water and Sanitation

Multiple agencies attempt to work across several layers of government in the oversight, regulation, administration, and promotion of water and sanitation provision within Honduras. Increased coordination and collaboration amongst the agencies in the sector continues to reduce the difficulties in enforcing regulation, obtaining necessary permitting for new projects, and successfully maintaining existing systems. There has been an internal drive within Honduran water and wastewater agencies, as well as external encouragement from aid organizations, to reorganize regulatory responsibilities. This restructuring aims to improve the efficiencies of communication between agencies and to improve the water and sanitation infrastructure of the country. Descriptions of these agencies are provided within this section and are summarized in Table 2.

ERSAPS

Compliance and enforcement in the sanitation sector is handled by the Regulator of Potable Water and Sanitation Sector, or ERSAPS (Herrera, 2006). This agency is charged with the task of acting as a regulatory overseer for municipalities of all sizes with regard to water and sanitation. The agency disseminates knowledge about the laws governing water and sanitation to local authorities through regional workshops and online manuals. The technical manuals are provided through their website which include guidelines for meeting regulatory requirements (Mikelonis, 2008)

SANAA

Historically, the oversight responsibility for sanitation in Honduras fell to the National Autonomous Water and Sanitation Service (SANAA), which was charged with all aspects of sanitation including planning and construction as well as operation of facilities. A legislative change in 1990 created the Law of Municipalities, granting Honduras' 298 municipalities the independent responsibility for sanitation services within their borders. A subsequent legislative change in 2003 created the Framework Law for the Water and

Sanitation Sector of Honduras. This new law detailed the procedure for the implementation of the restructuring guidelines called for in the Law of the Municipalities requiring the decentralization of the water and wastewater services from SANAA to each municipality.

This transference of responsibility from SANAA to the municipalities was set to be completed in 2008. Progress in implementing the change in jurisdiction has been slow, and SANAA's position is that some municipalities are not ready to manage these responsibilities. SANAA still operates roughly half of all urban water sanitation services, despite the mandate to terminate this function by 2008; the remainder of these services is provided by a combination of municipalities and private utility ventures. In the current configuration, SANAA's role is as technical secretary to CONASA, described below (Water for People, 2006).

CONASA

The agency of CONASA was created by the Honduran government to assist in implementing the changes mandated by the Law of the Municipalities, and promoted by the UN Millennium Development Goals and Poverty Reduction Goals set by the national government. As specified in the Framework Law for the Water and Sanitation Sector of Honduras of 2003, the National Water and Sanitation Council (CONASA) was created to set policy for the sector. CONASA seeks to expand sanitation coverage to 95% by the year 2015, (WHO, 2001).

SERNA and CESCCO

Approvals and permitting for wastewater treatment systems are mainly carried out by SERNA, the Department of Natural Resources and the Environment. The agency is specifically involved in the formulation and evaluation of policies pertaining to water resources, renewable energy sources, geothermal and hydropower, and mining. CESCCO, the Center for the Study and Control of Contaminants, is the technical research arm of SERNA. Its responsibilities include the assessment of pollutant impact on human

health and ecosystems, providing laboratory analysis assistance and services to communities, as well as monitoring air pollution in major urban centers (SERNA, 2009).

FHIS

Funding for many water sanitation projects is channeled through the Honduran Social Investment Fund (FHIS), an agency designed to mitigate the economic effect of governmental restructuring on local communities. This agency selects priority projects and transfers funds to municipalities to support those projects with funding from both the Honduran government and international aid agencies. The capital funding provided by FHIS is critical for the implementation of a large portion of Honduras' wastewater facility projects (Water for People, 2006).

RAS-HON

The Honduran Network of Water and Sanitation (RAS-HON) facilitates the efforts of the various entities in the water sanitation sector. This non-governmental organization (NGO) consists of a group of advising environmental engineers and others with technical expertise in the field of sanitation who work with the various agencies listed above in providing technical support and exchange of ideas within this sector (Sistemas de Información, 2007).

Juntas

The provision of services in rural areas falls almost exclusively to the Water Boards or the Juntas Administradoras de Agua (Water for People, 2006). Many of these Juntas are organized into a national association, the Honduran Association of Water Boards, which lobbies for the interests of the rural water boards and allows for pooling of technical knowledge (RAS-HON, 2008).

Table 2: Summary of Agencies Roles

SANAA	Releasing authority as urban service provider, Becoming technical secretary to CONASA
CONASA	Establishment of Policy
FHIS	Channels national and international funds for infrastructure projects
RAS-HON	NGO allows for exchange of ideas and technical support
Juntas	Regional water boards charged with providing rural sanitation services
ERSAPS	Compliance and enforcement in the sanitation sector
SERNA	Approvals and permitting for water resources projects
CESCCO	Technical branch of SERNA providing research and laboratory services

1.2 Purpose of this Study

As discussed previously, the responsibilities of operation and maintenance of wastewater treatment systems are in the process of being passed over from centralized government agency, SANAA, to the respective municipalities. In order to address the political and technical challenges associated with this transition, SANAA and ERSAPS have been collaboratively involved in the government-sponsored PEMAPS program, which refers to the Strategic Plan for Modernization of the Honduran Water and Sanitation Sector. As part of this initiative, SANAA and ERSAPS are conducting a comprehensive review of the current state of centralized wastewater treatment systems in Honduras, including Imhoff tanks, waste stabilization ponds, and activated sludge systems.

The purpose of this project was to contribute to this nationwide study through the assessment of 10 prototypical centralized wastewater treatment systems throughout Honduras. Based on the gathered information, general observed trends are reported and recommendations for improving system performances have been developed.

1.3 Methodology and Approach

In the coordination of this study, two meetings were held in Honduras to gather information about wastewater treatment throughout the country. Representative facilities were selected for visitation in order to assess their design, maintenance, performance, current status, and ongoing issues.

To gain an understanding of the context of wastewater treatment in Honduras, an initial collaborative meeting was held on January 8, 2009 with representatives of SANAA, CESCCO, CONASA, and the MIT research group. This meeting allowed each group to introduce itself, describe its role in the sector, discuss its current concerns, answer questions posed by other groups, and identify opportunities for collaboration. A summary of this meeting is found in Appendix A.

This discussion led to a second meeting with engineers from SANAA and CESCCO to select wastewater treatment plants suited to this research. Ten facilities were selected with the help of Victor Cuevas and Oscar Garcia from SANAA and Dixy Avita from CESCCO, who gathered information on site geography, treatment type, and reported status. An effort was made to select systems representational of those found throughout the country. Thus the ten facilities include Imhoff tanks, waste stabilization ponds, constructed wetlands, anaerobic treatment and aerated package plants. Some have received regular attention with regards to operation and maintenance while others have been abandoned. Other variables represented in the facility roster are urban versus rural, inland versus coastal, newer versus older, and larger versus smaller. In particular, two systems studied were over 15 years old while four were less than 4 years old, and the populations served ranged from 1,700 to 50,000 people. A map showing the location of the facilities studied is depicted in Figure 2, and a listing of these facilities is located in Table 3 below.

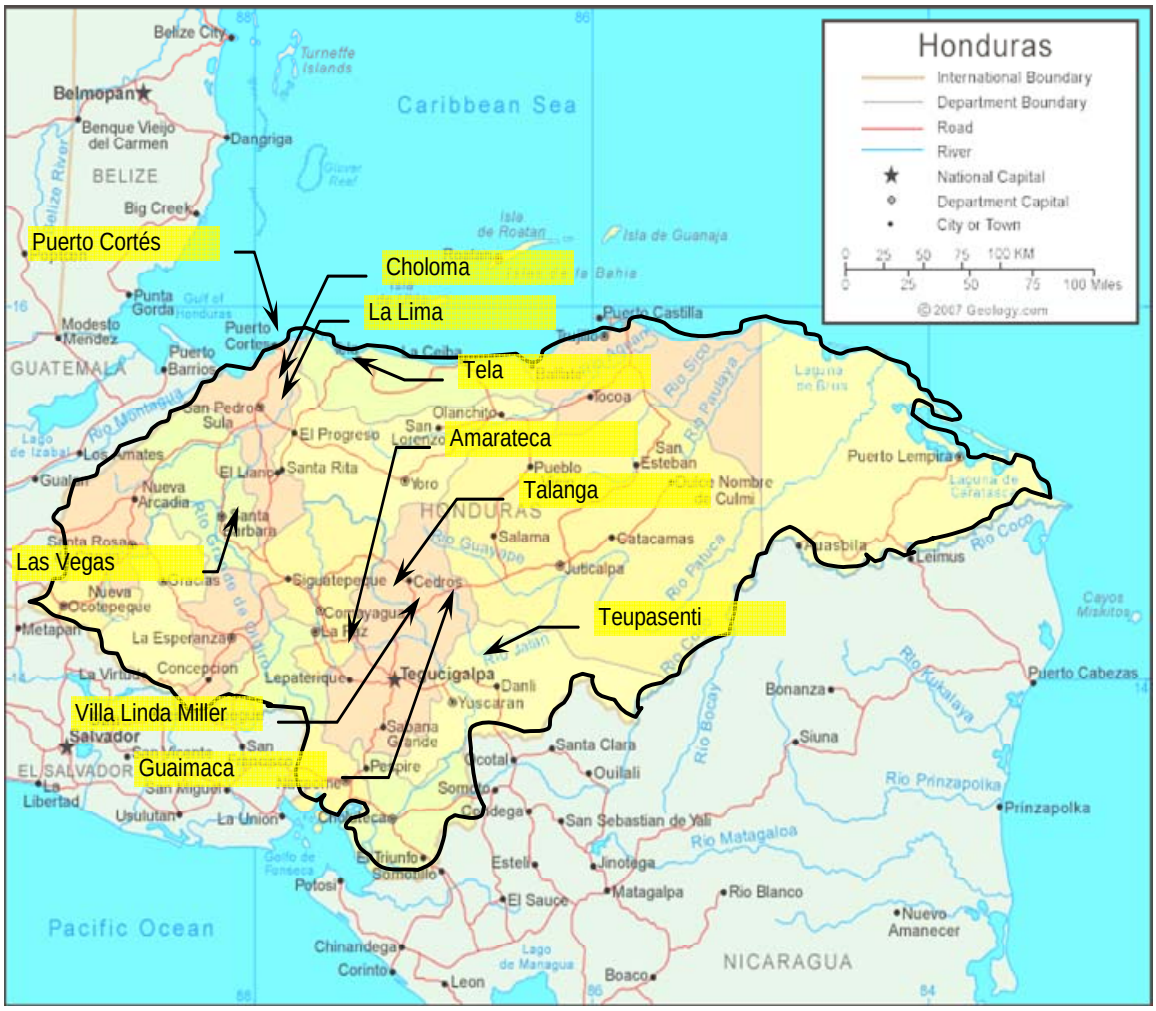

Figure 2: Map Showing Locations of Surveyed Sites (Google, 2009)

Table 3: Survey Sites

Location	Date Visited	Treatment Type
Teupasenti	11-Jan-09	Anaerobic Treatment and Constructed Wetland
Las Vegas	7-Jan-09	Imhoff Tank
Villa Linda Miller	10-Jan-09	Imhoff Tank and Anaerobic Filter
Guaimaca	10-Jan-09	Imhoff Tank and Constructed Wetland
Amarateca	11-Jan-09	Packaged Activated Sludge Plants
Talanga	10-Jan-09	Waste Stabilization Pond
Puerto Cortès	20-Jan-09	Waste Stabilization Pond
Choloma	19-Jan-09	Waste Stabilization Pond
La Lima	17-Jan-09	Waste Stabilization Pond
Tela	18-Jan-09	Waste Stabilization Pond

Despite the efforts to conduct a representational study, it must be noted that the sample group of 10 wastewater facilities visited during our field work is relatively small. Thus it is assumed that this study is not representational of the status of municipal wastewater treatment in Honduras on every measure. However, this study can provide insight into trends as observed at the visited facilities.

To catalogue site information, survey forms were developed which include sections for general information, personnel, plant construction, treatment type, and general description of the facility. These forms were completed through site visits which included interviews as well as observations. The interviewee's role was noted in all cases, with most being facility operators, engineers, or managers. The completed survey forms can be found in Appendix B. The information contained in these survey forms is summarized and discussed in the following sections.

2.0 FIELD SURVEY

2.1 Guaimaca: Imhoff tank and Constructed Wetland

Geographic Region and Location

Guaimaca is located along the eastern side of the department of Francisco Morazán approximately 90 km northeast of Tegucigalpa (Figure 3). This region of Honduras is a high valley about 800 meters above mean sea level (AMSL). Sufficient topographic variation exists to allow for gravity systems to be utilized or systems requiring larger footprints.

Figure 3: Location of Guaimaca, Honduras (courtesy google.com)

Technology – Type of System

The existing wastewater treatment system in Guaimaca consists of a pre-treatment grit chamber with slots for a bar screen, single Imhoff Tank, and downstream constructed anaerobic wetlands. The treatment facility is located within barbed-wire fenced cattle grazing land approximately 250 meters from the adjacent Rio Jalan, the plant's receiving waters. Access to the system can be obtained through an unlocked gate within the fence. The top of the wall for the Imhoff Tank system is presently at grade level on three sides with one wall exposed along the longitudinal direction of flow. The constructed wetlands were explained to be a French drain system that provides a biological leaching field downstream from the Imhoff Tank prior to discharge into Rio Jalan. The system was approximately 3 meters above the river water levels at the time of the visit. During the site tour, conducted by the utility director for the wastewater department of Guaimaca, the team was informed that the system was built in 1996 and presently services approximately 1700 persons. Flow measurements were not available for this location. The dimensions of the tank system are approximately 9 meters long, 4 meters wide, and of unknown depth. The main sedimentation chamber is 2.5 meters wide with adjacent longitudinal scum chambers approximately 0.75 meters each. No information was available for the overall size of the constructed wetlands. See Figure 4 for a schematic of the system.

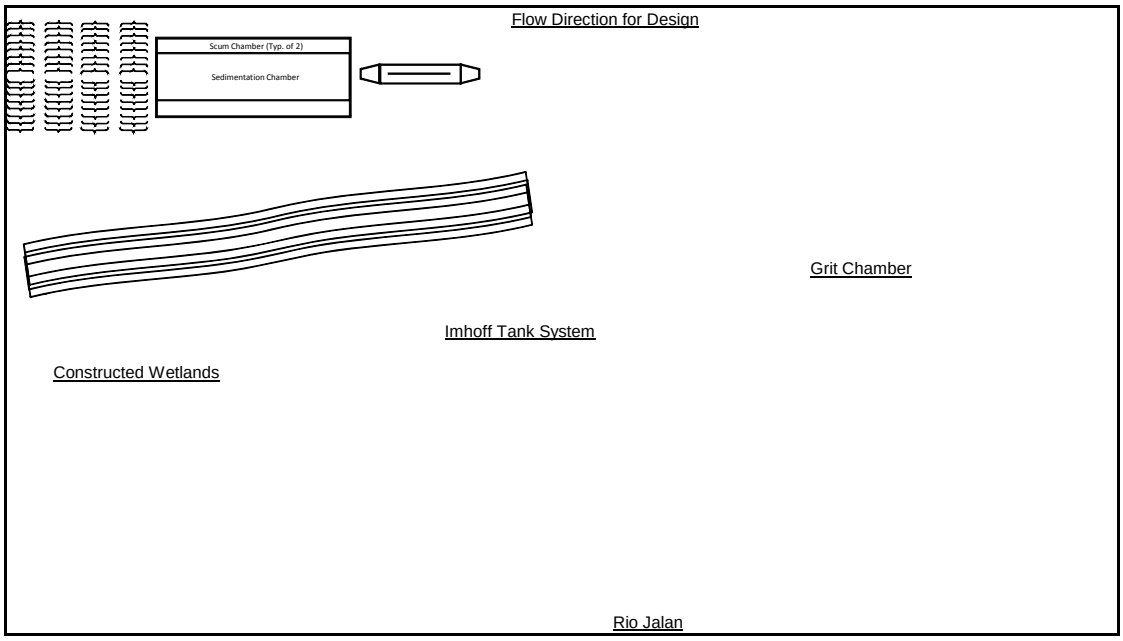

Figure 4: Schematic of Guaimaca Imhoff Tank

General Observations

This system is online; however it is not currently functional. The system provided good treatment when it was functioning according to the utility director, although no record of testing was available. Arriving at the site a clear problem was noted: flow was not proceeding through the plant as designed. Instead it was overflowing the side of the Imhoff Tank closest to Rio Jalan and proceeding untreated to the river. The utility director for Guaimaca explained that this was due to a slope failure of a small adjacent hillside attributed to a heavy rain event 3 years prior, which washed into the Imhoff Tank and clogged the effluent path through the constructed wetlands. The tank has since needed the overflowing wall braced due to scour from cascading wastewater eroding away the supporting soil.

A bypass does exist for this system that can allow for workers to take the facility offline and remove the soil material that has clogged the tank. Making these repairs to the tank was estimated to take three days for a small crew. One option for ensuring that the slope does not erode further into the tank system could be to place a simple concrete surface cap with ties back into the slope face increasing stability.

However, the decision has been made not to proceed with repairs to this system and instead to purchase lands along the river from the site for the purpose of building waste-stabilization ponds. The community hopes to accomplish this through funding from FHIS. However, difficulty was noted in obtaining all of the required land for this new facility. The utility director estimated the time frame for construction to begin on the new system as an additional two years.

The treatment system within Guaimaca was designed to provide primary and secondary treatment. Site and natural conditions resulted in a shortened service period before needing to take the system offline. However, the site can still play a vital role in the treatment of wastewater until such time that the new waste-stabilization ponds are constructed and brought online. Rehabilitation of the existing system in the interim would be better than to continue the discharge of untreated wastewater.

2.2 Talanga: Waste Stabilization Ponds

Geographic Region and Location

The municipality of Talanga is located in the department of Francisco Morazán, approximately 50 km northeast of Tegucigalpa (Figure 5). It is a midsized community with a population of about 14,000.

Figure 5: Geographic Location of Talanga (courtesy google.com)

Technology – Type of System

The municipal wastewater treatment facility is a waste stabilization pond system, consisting of two facultative ponds followed by two maturation ponds. A schematic of the treatment system is shown in Figure 6.

The system came into operation in June of 2006 and serves a population of 3000 people, about 15% of the full design capacity. The facility was designed and partially funded by FHIS with additional support from the United States Agency for International Development (USAID).

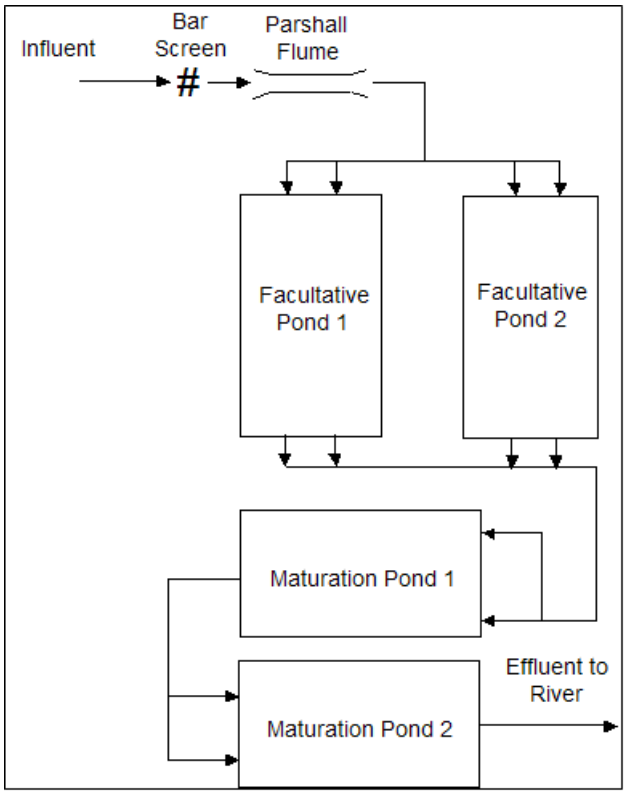

Figure 6: Schematic of Talanga Pond System

General Observations

Wastewater influent is directed through a grit chamber and bar screen followed by a Parshall flume. At the time of the visit, the operator and wastewater management staff were unaware of the function of a Parshall flume and flow measurements had not been made. Downstream of the Parshall flume, flow is directed to one of the facultative ponds through two inlet pipes. The facultative ponds are operated in parallel; when the operating pond needs to be taken offline for desludging, flow can be routed to the parallel pond. During normal operation, a low water level is maintained in the redundant pond in order to keep the clay liner wetted. As flow to the system increases it is expected that both facultative ponds will be operated.

Effluent from the facultative ponds is treated in two maturation ponds in series prior to final discharge. Due to low plant flows, the bulk of the influent to each maturation pond was observed to flow through only one of two inlets. This uneven flow distribution may

cause some recirculation within the ponds. The final treated effluent from the second maturation pond is discharged to Rio Cyanetepe about 50 meters away.

According to the operator, the final effluent quality meets the regulatory criteria for animal water supply. Although the plant has not been desludged yet, the current plan is to offer the dried sludge to neighboring households for reuse.

2.3 Villa Linda Miller: Imhoff Tank and Anaerobic Filter

Geographic Region and Location

Villa Linda Miller is a planned residential community built in 2001 to relocate residents that were displaced by Hurricane Mitch. The community is located within the Department of Francisco Morazán (Figure 7). Site topography is mountainous with the surrounding community located on the adjacent hillsides that slope toward the treatment works. The site's topography requires careful attention to footprint size but offers the advantage of substantial hydraulic head for gravity flow.

Figure 7: Geographic Location of Villa Linda Miller (courtesy google.com)

Technology – Type of System

The treatment system at Villa Linda Miller consists of four concrete structures accomplishing primary and secondary treatment, solids handling, and odor control. Primary treatment is accomplished through the use of two Imhoff Tanks in parallel for

sedimentation and sludge digestion. An up-flow anaerobic biofilter provided secondary treatment, complete with valves for changing flow direction to backwash filters. Solids handling was accomplished with the use of an attached concrete sludge drying basin. For odor control, a pilot system was installed to capture gases from the Imhoff Tank scum chambers beneath a roof and route them through an air scrubber of cedar chips, orange peels, and ashes. The system also contained a v-notch weir for measuring flows, a bypass for diverting flow during maintenance, and a grit chamber for pre-treatment (Figure 8).

This system was designed and built by SANAA in 2001. Of the three Imhoff type systems surveyed within this report this is the newest in construction. The former plant operator (trained by Pedro Ortiz of SANAA) was available for comment and provided us with the explanation for how this system treated the community's wastewater. Information was not available regarding the number of residents connected to this system.

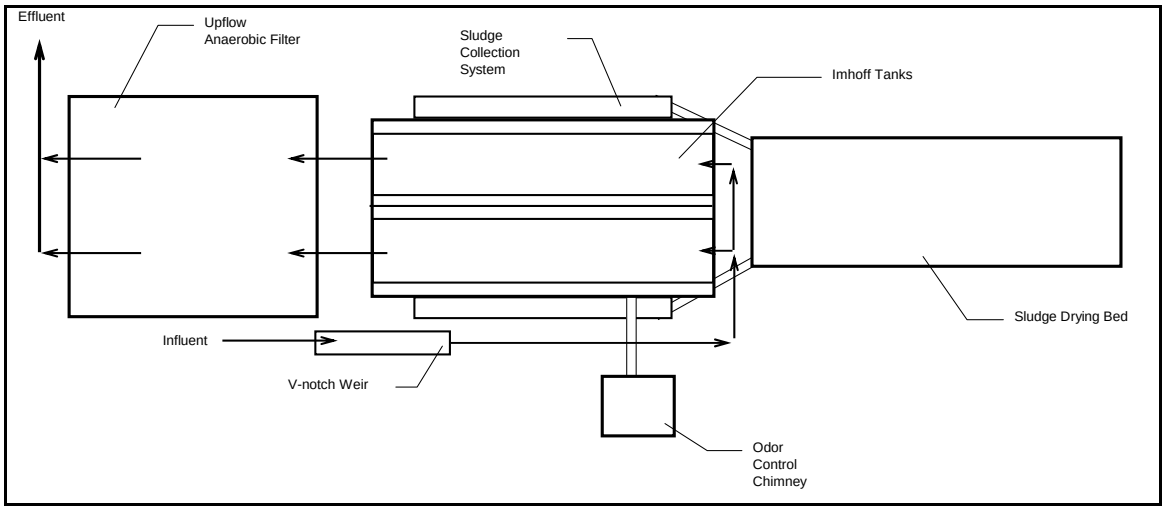

Figure 8: Schematic of Villa Linda Miller System

General Observations

The treatment system at Villa Linda Miller is online and receiving wastewater flows from the community. This system has not been receiving regular operation and maintenance since 2003. The effluent is no longer running through the up-flow filter. Instead it is short circuiting across the bypass after going through the Imhoff tanks, which may not provide the required retention times. This short circuiting could be the result of the filters not being backwashed. Operation and maintenance of this facility ceased when the plant operator was no longer paid for this service.

Visual inspections of the structures themselves reveal that most are in acceptable shape with the exception of the Imhoff tank closest to the odor control chimney. This tank has a vertical crack that is allowing for wastewater and likely sludge to leak out of the unit; this may be corrected with grout or installation of a rubber sealing mending plate. The odor control pipeline from the Imhoff tanks to the air scrubber was broken and the roof not sufficient to capture the off-gassing. A replacement roof and pipeline would allow for the capture and treatment of odorous gases.

This system is a fairly recent capital improvement that was provided through funding from SANAA after Hurricane Mitch. The advanced processes of this system coupled with its simplistic gravity flow make it a sustainable option for the community of Villa Linda Miller. Sludge from this system was cleaned out every six months, dried, and reused in community gardens. It was tested at regular intervals by SANAA until it was handed off to the junta. From the descriptions of the operator the tests showed that this system was achieving the effluent quality standards required by ERSAPS. One idea proposed by the surveying team was that an escrow account may mitigate some of the funding problems associated with these systems. With a modest increase in the initial capital investment, an annuity could provide for the future maintenance of the site.

2.4 Ciudad Divina, Amarateca: 3 Package Plants

Geographic Region and Location

Ciudad Divina is located in the valley of Amarateca about 30 km northwest of Tegucigalpa within the department of Francisco Morazán. The community was built in 2000 as a subsidized housing relocation project after Hurricane Mitch. It currently has a population of approximately 6000 people. The geographic location of Amarateca is shown in Figure 9.

Figure 9: Geographic Location of Amarateca (courtesy google.com)

The vendor and manufacturer for the package plants at Ciudad Divina was Calix International. Three plants in total were installed at this site; only one is currently in operation. The second system was abandoned and the third system was never brought online and has since been utilized for replacement parts.

The NGO Cristo Del Picacho funded the installation of the wastewater treatment package plants for this community. The organization has also been responsible for the plant operational costs, including electricity and operator salary. Recently, there has been an effort to pass the operating costs over to the community; however, due to the expense of

high energy consumption, residents have been reluctant to take ownership of the systems. As a result, the operating plant will be decommissioned and replaced with a biosand filter.

The package plants are single tank systems. As shown in Figure 10, the tank consists of two main zones: aeration and secondary settling. Influent wastewater enters the outer aeration zone where air is supplied through disk diffusers. The aeration system is connected to a 10-hp compressor in an adjacent shed. Effluent from the aeration zone enters the settling chamber for secondary sedimentation.

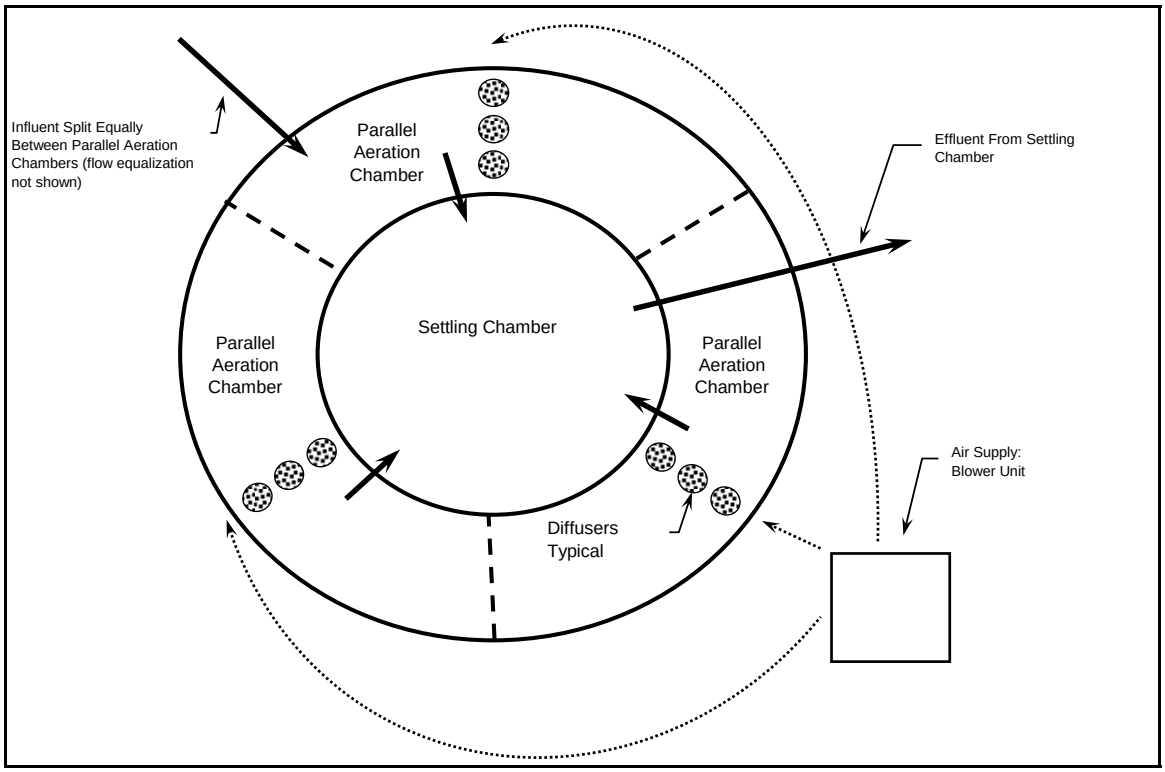

Figure 10: Schematic of Amarateca Packaged Activated Sludge Plant

General Observations

The method of sludge discharge was unclear. There appeared to be a sludge discharge line from the bottom of the tank which was capped; no other outlet pipe was observed. It is speculated that it is either manually removed or discharged together with the final effluent.

The second plant was abandoned about one and a half months prior to the field visit. The tank was heavily corroded and appeared to be in poor overall condition. According to the president of the junta, this plant was abandoned due to excessive operational costs associated with energy consumption. The third system was installed for future expansion of the community, but was never operated. According to the representative from the junta who was interviewed, the reason given at the time was that the plant had been installed at a hydraulically unfavorable location. However, the system was located at a lower elevation than the community and appeared to have a favorable hydraulic gradient.

2.5 Teupasenti: Anaerobic Treatment and Constructed Wetland

Geographic Region and Location

Teupasenti is a small town located approximately 100 km east of Tegucigalpa in the department of El Paraiso. The region is located in a high valley possessing sufficient area for treatment processes with greater land requirements. The map shown in Figure 11 indicates the approximate location of Teupasenti.

Figure 11: Geographic Location of Teupasenti (courtesy google.com)

Technology – Type of System

The wastewater processing system consists of anaerobic treatment followed by a constructed wetland. Background on the system was obtained from the plant operator. The facility was constructed between 1994 and 1998 and reportedly services 90% of the population. It later collapsed due to a heavy rainfall event that blocked the inlet pipes and flooded the wetland. In subsequent years the mayor initiated efforts to restore the site to its current condition. A schematic diagram of the system is shown in Figure 12.

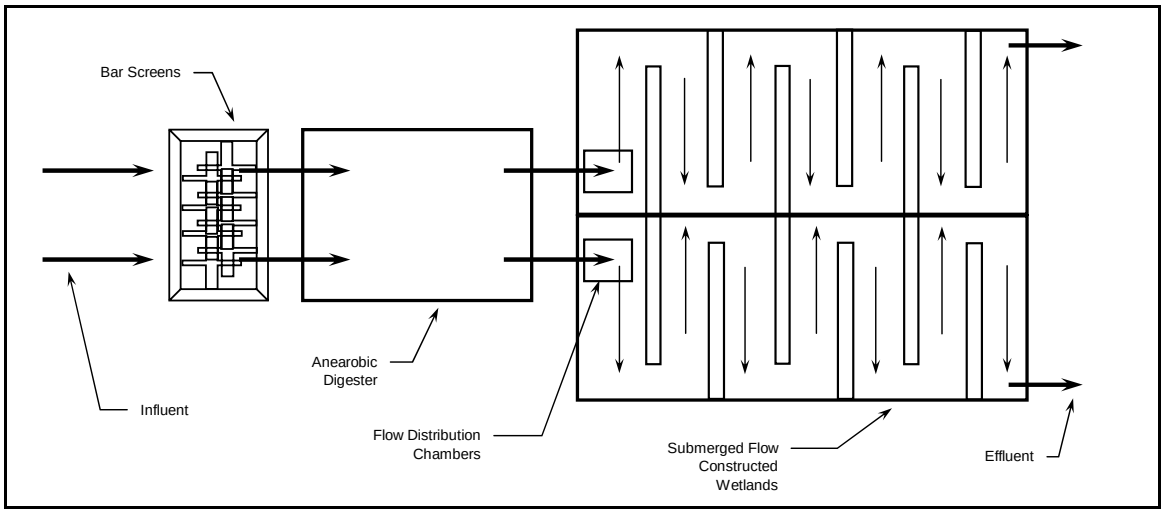

Figure 12: Schematic of Teupasenti System

General Observations

Influent wastewater is filtered through a bar screen and flows to an underground anaerobic treatment tank. Although the specific type of anaerobic treatment was unclear, it is likely either an anaerobic filter or an anaerobic digester. The effluent from the anaerobic tank is directed to the constructed wetland. The wetland did not appear to be in good working condition. The water levels were above the ground surface and some recirculation was observed. Several flow distribution chambers were overflowing, which may indicate the presence of obstructions.

There is an onsite sludge drying bed adjacent to the anaerobic treatment tank, which appeared to have been in disuse for some period of time. According to the operator, sludge had been previously dried and offered to nearby residents. Although initially some interest in sludge reuse as fertilizer had been expressed, nobody came to collect the material.

2.6 Las Vegas: Imhoff Tank

Geographic Region and Location

Las Vegas is located within the Department of Santa Barbara. The city of Las Vegas Central is tucked in a valley approximately 10 km west of Lake Yojoa (Figure 13). The region is inland and mountainous providing ideal hydraulic conditions for gravity systems. Large plots of flat land are not available so consideration must be given to the system footprints within this region to avoid excess earthwork. The township has an overall population of approximately 17,000 dispersed amongst smaller surrounding communities which are collectively governed by the municipality. Built in 1992 by SANAA with funding from FHIS this system provides wastewater treatment for approximately 3600 people, a figure which includes known illegal connections.

Figure 13: Geographic Location of Las Vegas (courtesy google.com)

Technology – Type of System

The treatment system in Las Vegas consists of two Imhoff tanks running in parallel. The system discharges primary treated effluent into the Raices Creek located approximately

50 meters away from the tank. Raices Creek is a tributary to Lake Yojoa located approximately 8 km downstream of the Imhoff tank's discharge point.

As built, the system does not provide any form of pre-treatment. A grit chamber is not present in the design and a bypass does not exist for the system. Secondary treatment processes do not exist for this site. Sufficient favorable land is available adjacent to the site for pre-treatment processes to be installed, and dependent upon technology type secondary processes may also fit within adjacent free land space. This land space adjacent to the tanks is owned by the municipality.

Three separate sludge digestion hoppers are contained beneath each sedimentation chamber. These sludge hoppers are connected by two manifolds that dispose of digested sludge through a PVC pipeline which discharges to Raices Creek. Sufficient land is available to spread sludge out for purposes of drying. However, the present configuration does not contain plumbing to allow for this; retrofitting the pipeline could allow for surface drying.

The site is not fenced in and does not maintain a secure perimeter. The treatment facility is located approximately 75 meters from the nearest residence, which is provided with electricity. The site itself is not connected to the electrical grid.

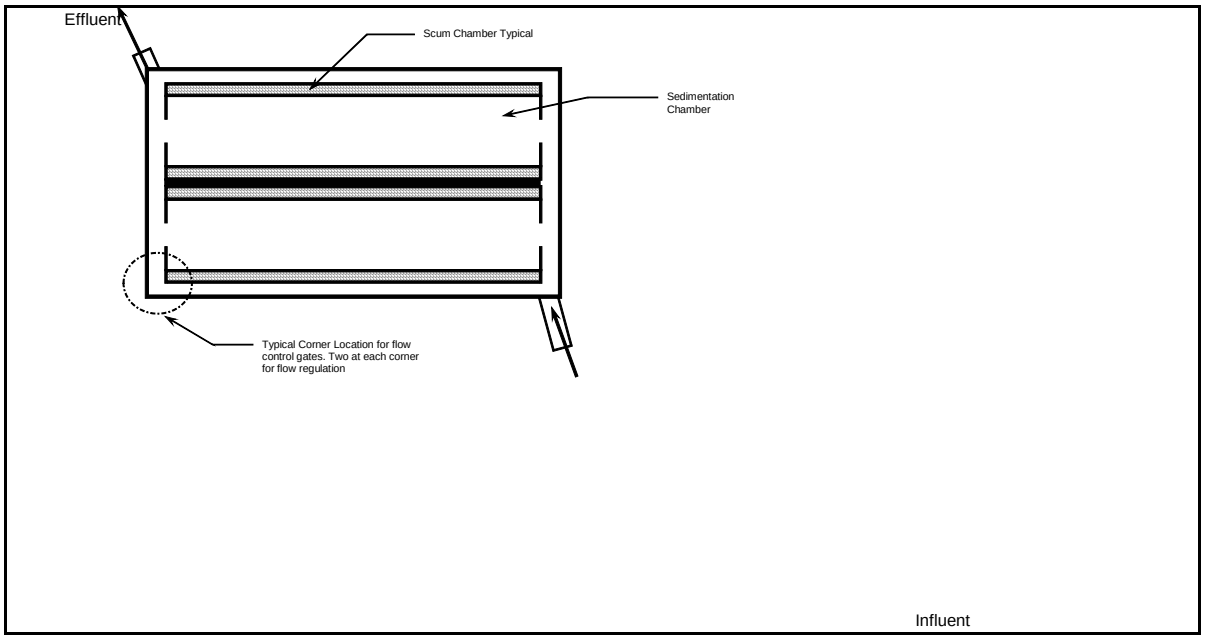

Figure 14: Schematic of Las Vegas Imhoff Tank

General Observations

Observational surveys of the Las Vegas Imhoff tanks have been conducted during short periods (approximately one month) over the span of a few years through the efforts of Mikelonis and Hodge in 2008 while studying at MIT and Herrera in 2006 while studying at University of Texas, Austin (Herrera, 2006; Hodge, 2008; Mikelonis, 2008). Since the first study conducted in 2006, the municipality has expressed an ongoing interest in developing and implementing a strategy for improving its wastewater treatment and infrastructure. The previous research work focused on system optimization through education pertaining to operation and maintenance requirements and through the use of design modifications to improve treatment performance.

The Las Vegas Imhoff Tank system is presently online and functional. The tanks are considered to be structurally sound based upon visual inspection. In the present study flow measurements were obtained for a twenty-four hour period with an average flow of approximately 1050 m^3/day and peak flow of 1250 m^3/day. This value is approximately two-thirds higher than the system was originally designed for based upon tank

dimensions and recommended surface overflow rates. Previous flow measurements were conducted by the MIT students in 2008, the results of which are approximately three times flows observed in 2009. Water conservation measures promoted by Mikelonis and Hodge in 2008 may account for some of this discrepancy. An additional source for this change in observed flow may be attributable to storm runoff after rainfall events; something that the municipality admits is a problem. Major rain events were not reported prior to the site visit.

Upon inspection, the scum chambers were in need of scraping; approximately 3 cm of hard crusted scum existed across the surface. The technical assistant for the municipality stated that the sludge chambers were emptied for the first time in December 2007; it was reported that the tanks have not been emptied since. The time span between sludge removals is beyond the recommended six month interval. The valves for the sludge hopper manifold connections were tested and found to work. Notation was not taken as to whether sludge would flow freely from the system.

The extension beyond the six month sludge removal interval was suspected of causing a decrease in residence times. There is likely sludge within the main sedimentation chamber as bubbling was noted coming from the main chamber which should not occur in regular operation. Flow control gates for this system were not in place. These flow gates are critical to switching the direction of flow and hence evenly distributing sludge. The flow control gates reportedly consisted of wood planks, which are suspected of being stolen for the purposes of firewood. With the control gates missing, a large portion of the incoming flow bypasses treatment.

The municipal technical assistant also took the group to the site of a new sewer trunk collector line that is being constructed. This line, which runs parallel to the Raices Creek, consists of a concrete encased PVC pipe. The current status regarding connection and final distribution of the wastewater that will run through this system was unknown at the time of survey. One option under consideration is to use the existing Imhoff tank for

treatment of this additional wastewater flow. As stated previously, this system is already overloaded regarding flow.

2.7 Puerto Cortés: Waste Stabilization Ponds

Geographic Region and Location

The city of Puerto Cortés is located on the north coast of Honduras in the department of Cortés. In contrast to the largely mountainous terrain of Honduras, Puerto Cortés consists of predominantly flat low-lying plains (Figure 15). The city's economy revolves around an active port which hosts a large volume of international trade.

Figure 15: Geographic Location of Puerto Cortés (courtesy google.com)

Technology – Type of System

The wastewater treatment facility is located on a strip of land between the Alvarado Lagoon and the Caribbean Sea. The total facility occupies 22 hectares. The population served by this facility is approximately 50,000. The headworks of the system consist of a pump house, bar screens and a Parshall flume. As shown in Figure 16 the system then divides into two parallel circuits, each consisting of an anaerobic and a facultative pond in series; both circuits then join and flow into two maturation ponds in series. Additional land is allocated for planned expansion including another battery of anaerobic, facultative and maturation ponds. Land is also available on site for future sludge management. This

plant was built in 2005 by the international consulting firm Hazen & Sawyer, and was substantially funded by loans from the Inter-American Development Bank (IDB).

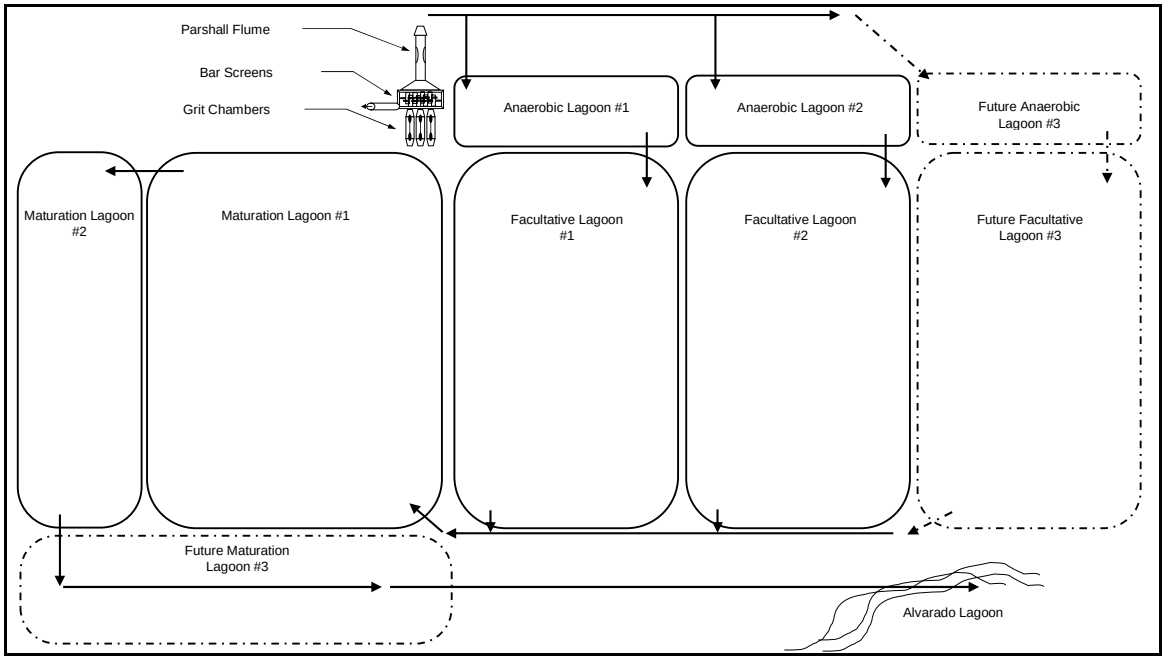

Figure 16: Schematic of Puerto Cortés Waste Stabilization Pond

General Observations

The site is secured by a fence and a guarded gate. Four operators and a supervising engineer maintain the facility. The technical staff conducts the testing of water quality parameters on site twice a week. Detailed water quality records are kept of the raw influent and of effluents from each pond. Flow measurements are also recorded for the system. Once a month samples are sent off site to a commercial laboratory, Jordan Labs, in San Pedro Sula for quality testing. Effluent quality is high, and reportedly exceeds the water quality of the receiving waters on measures such as E. coli count.

This facility has a small multi-purpose building on site. Paperwork and lab work are carried out in the office. An assortment of tools is kept on site in a well stocked store room, and it is in very good condition. A large boat is available for taking sludge

measurements and other maintenance tasks. The facility also includes a washroom with a sink and soap for hand washing.

The system is suffering a critical failure of the geo-liner. The facility is situated on marsh land, with methane generation in the subsurface and a high water table. The bottom of all ponds is at an elevation beneath the water table. Methane generated beneath the ponds is trapped and collected beneath the liner, lifting the geoliner in numerous blisters. Some of these blisters were more than 10 meters in diameter at the water surface at the time of the site visit. The blisters were reported to increase in size during warmer weather due to expansion of gas. The strain of stretching has caused the geoliner to fail in several places. While the phenomenon is most visible in Maturation Pond #1, it is occurring beneath the surface in all four low-lying ponds. The anaerobic ponds appear to be free from this issue with their construction at a higher elevation, and with their greater water depth of four meters.

Several solutions are being considered to address this issue. One alternative is the construction of geodrains, or gravel channels beneath the pond liners. Another alternative under consideration involves replacing the geo-liners with concrete pond liners, which would be designed for a weight and a hydrostatic pressure that will counter the upward pressure from the collecting gas. The municipality is concerned with the funding of this design alternative, as either approach involves draining and reconstructing the ponds. They are also concerned with the success of the project after seeing this failure in the previous facility design.

Desludging has not been undertaken as this is a newer system. Although land provision for solids handling exists, no set sludge management plan has been established. Facility operators have been conducting regular measurements of sludge depth. They anticipate desludging the anaerobic ponds this year, and desludging the facultative ponds on a five year interval. It is unclear where the sludge will be disposed of, but agricultural reuse is one option under consideration.

This facility handles a relatively large flow of wastewater. The system reportedly achieves an effluent quality which is compliant with regulatory standards for water discharges. However, it is experiencing a critical geoliner failure which will worsen over time. The issue of methane gas accumulation beneath the ponds and the subsequent geoliner failure must be corrected soon in order to maintain the integrity of the system.

2.8 Choloma: Waste Stabilization Ponds

Geographic Region and Location

Choloma is located in the department of Cortés, and lies in the Sula Valley about 13 km north of the industrial city of San Pedro Sula, and 30 km south of Puerto Cortés (Figure 17).

The wastewater facility visited is called Lagunas Sector Centro, or the Central Sector Lagoons. Lagunas Sector Norte, or the North Sector Lagoons, is a second municipal treatment system servicing Choloma; reportedly it is in poor condition and was not surveyed as part of this project.

Figure 17: Geographic Location of Choloma (courtesy google.com)

Technology – Type of System

The total population served by Lagunas Sector Centro includes 50,000 people. The system consists of headworks, two facultative lagoons and two maturation lagoons. The headworks consist of bar screens, a grit chamber complete with bypass for cleaning, and

a Parshall flume. The system then divides into two parallel circuits, each consisting of a facultative pond and a maturation pond in series (Figure 18). As reported by the operator, the residence time for the overall system is approximately 3 days. The final effluent is released to the San Augustin Stream. The facility grounds are 30 hectares in size and enclosed by a guarded barbed wire fence. The wastewater system was built in 2005 and came on line in August of that year. The system is currently operated by DIMACH, the Directorate of Municipal Water in Choloma.

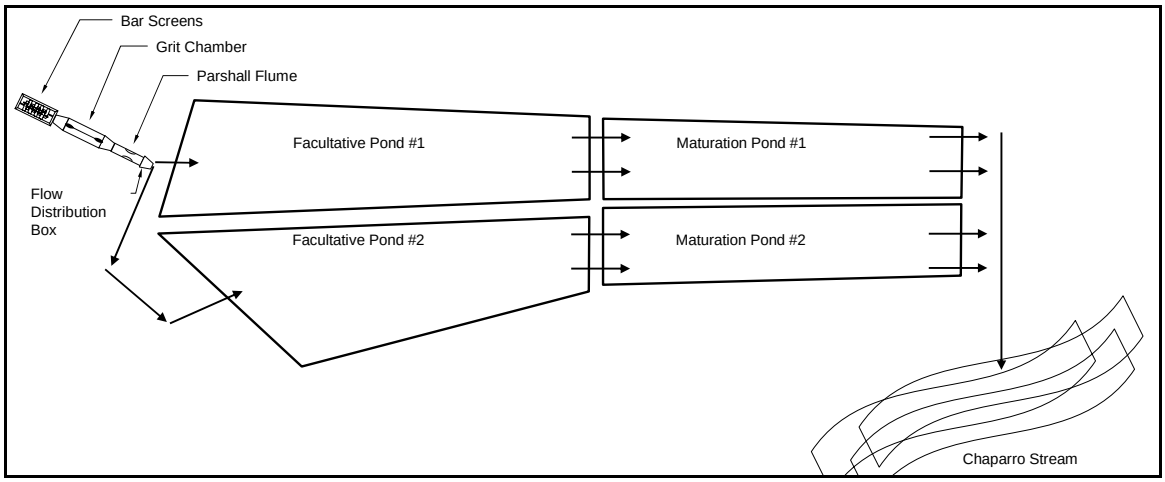

Figure 18: Schematic of Coloma Waste Stabilization Pond

General Observations

The system has been online for 2 years. Currently there is no water quality testing conducted at this facility. DIMACH is in the process of developing testing protocols. The site appears to be well maintained. A variety of maintenance tools are kept on site and are in good condition. Grounds are maintained by mowing around all ponds, which has been cited as important to control mosquitoes and to discourage burrowing wildlife in the vicinity of the ponds. Scum is removed and the bar screens are cleaned daily and screenings are disposed of by burying in an onsite pit.

At the time of the site visit it was observed that one facultative pond was much greener than the other, indicating increased algal activity. Algal growth is encouraged in facultative ponds as it provides oxygen through photosynthesis, which in turn supports

the bacterial breakdown of biodegradable solids in wastewater. However the discrepancy in the two ponds may indicate an inconsistency in pond performance, which warrants further examination.

One concern at the site is the presence of several large crocodiles up to four meters in length. These pose a safety hazard to operators, and have the potential to damage ponds when burrowing and when entering and exiting the ponds.

Due to the relatively short time in operation, sludge levels at this facility have not yet been measured. The facility operators report that their plan involves desludging after five to six years in operation. According to the operator, sludge will be hauled offsite to a drying bed. There may be an interest in sludge reuse for farms and gardens in their community.

2.9 La Lima: Waste Stabilization Ponds

Geographic Region and Location

La Lima is a small city located in northern Honduras in the department of Cortés. The city of La Lima lies in the Sula Valley about 12 km southeast of San Pedro Sula (Figure 19).

Figure 19: Geographic Location of La Lima (courtesy google.com)

Technology – Type of System

The wastewater treatment facility is located in Colonia La Meza. The total population served currently includes 3,500 people, although the facility is designed for a total capacity of 10,000. The system includes headworks, two facultative lagoons and two maturation lagoons. The headworks consist of PVC bar screens, a grit chamber complete with bypass for cleaning, and a Parshall flume. The system then divides into two parallel circuits, each consisting of a facultative pond and a maturation pond in series (Figure 20). According to the operator, residence time for the overall system is seven to ten days. The final effluent is released to Rio Chamelecon, which then drains to the Caribbean Sea. The facility occupies 14 hectares of land enclosed by a gated barbed wire fence secured by a guard. The wastewater treatment facility was built in 2005 and came online in June of that year. The system was financed by USAID and FHIS funding. The international

consultant for the design was Codecon of Puerto Cortés. Currently the system is operated by the municipality of La Lima.

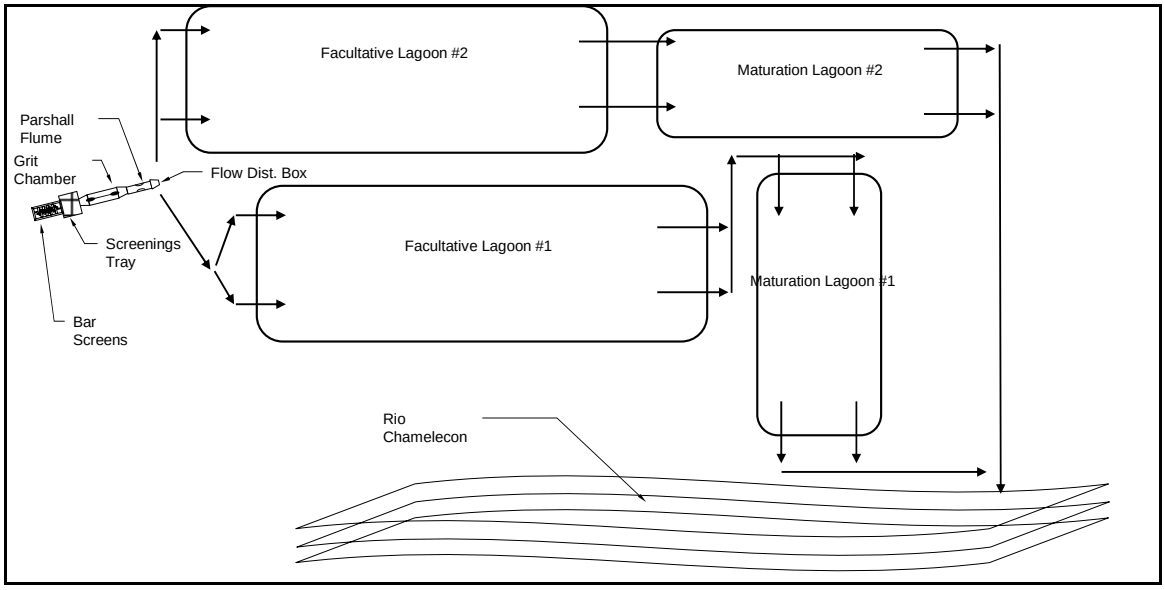

Figure 20: Schematic of La Lima Waste Stabilization Ponds

General Observations

This facility is maintained by three operators and one supervising engineer. Detailed records including sludge depth and flow rates are logged onsite. Routine maintenance includes daily removal of bar screenings and surface scum in addition to general grounds keeping. Screenings and scum are buried in a pit on site. The facility includes a tool shed which is well equipped with an assortment of tools in good condition.

At the time of the visit some dead zones were apparent in the corners of the ponds. There was evidence of recirculation and an accumulation of scum in some corners of the facultative ponds. Desludging has not been carried out yet at this site. The facility reports that desludging is pending, although it is not clear when this will be carried out. A detailed sludge management plan has not been established.

2.10 Tela: Waste Stabilization Ponds

Geographic Region and Location

Tela is a coastal town on the north shore of Honduras in the department of Atlantida. Originally it was a commercial town for the Tela Railroad Company and for a fruit exporting firm. The main economic drivers of modern day Tela are agriculture and tourism. Situated at the junction of the Lancetilla Mountains, the Sula Valley and the Caribbean Sea, the landscape of Tela is predominantly flat terrain (Figure 21).

Municipal wastewater treatment in Tela is carried out using waste stabilization lagoons. The scope of the current investigation included a visit to the Natural Wastewater Stabilization Lagoon System in Tela Vieja, or Old Tela. A second wastewater treatment system exists in Tela Nueva, or New Tela, which was not visited in the course of this project.

Figure 21: Geographic Location of Tela (courtesy google.com)

Technology – Type of System

Old Tela's wastewater treatment services a population of 8,000 people, and consists of headworks and three irregularly shaped ponds in series. A schematic of the system is shown in Figure 22. The headworks include a pump and a precast fiberglass Parshall

flume. Influent wastewater flows to a facultative lagoon and then two maturation lagoons in series, each with a depth of four meters. The final effluent is released to the Rio Hylan, which then drains to the Bay of Tela in the Caribbean Sea. The facility occupies 2 hectares of land and is not enclosed by a fence. The wastewater treatment facility was built in 1993. The construction of the system was financed by USAID funds. Currently the system is operated by the municipality of Tela.

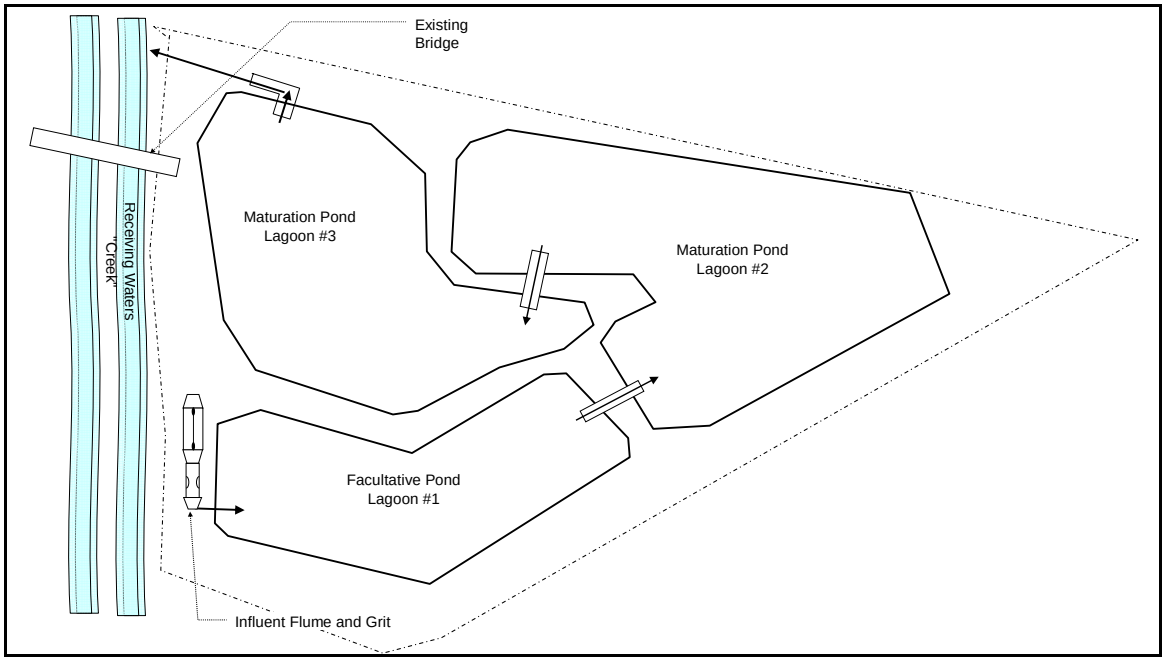

Figure 22: Schematic of Tela Waste Stabilization Ponds

General Observations

The wastewater treatment lagoons in Tela have recently undergone a rehabilitation project, and now appear to be in good working condition. In 2006 the ponds had been in operation for 12 years without being desludged. Guidelines recommend desludging every 5 to 10 years. The system was overdue and sludge was breaking the surface near the inlet to the facultative lagoon. In collaboration between ECOMAC, USAID and an Engineers Without Borders chapter from California State University Chico, a plan was devised to rehabilitate these lagoons.

This project involved construction of a bypass channel to divert flow from the facultative pond in order to isolate it from the system for a year to allow for sludge drying. Sludge was excavated using earth moving equipment, and disposed of largely onsite, saving on handling costs. In total approximately 3,000 cubic meters of sludge were removed. This rehabilitation effort also included a redesign of the Parshall flume. The facility previously had two concrete Parshall flumes, which were not functional due to improper sizing and construction. A precast fiberglass Parshall flume was installed within the existing flume to allow for accurate flow measurements (Engineers Without Borders, 2006). Flow monitoring is necessary for ensuring pond performance and for planning system expansion (Oakley, 2005).

At this time rehabilitations are complete and all ponds are currently on line. The facility is run by a single operator. The system appears to be functional at this time, with effluent reportedly exceeding Honduran national standards for discharge quality. Adjacent to the facility is a luxury housing development which has expressed an interest in the use of effluent from the treatment system for irrigation.

Some minor ongoing issues exist at the site. At the time of visit the effluent pipe from Lagoon 2 to Lagoon 3 was experiencing a constricted flow. It was theorized that this could be due to an obstruction, although none was visible. As a result this pond's level had risen above its banks and had saturated the soil to the north of the pond where the banks were lowest.

As desludging was completed at this pond last year, it is not anticipated that it will be required for four to nine years. Future sludge disposal may also be carried out onsite, although no sludge drying beds are available. It is not known whether drying sludge in Lagoon 1 will be a viable option in the future due to potential impacts on final effluent quality.

The system in Tela was the only waste stabilization pond facility surveyed that had performed desludging. However, it should be noted that the other waste stabilization

pond systems studied are relatively new (ranging from 2-4 years in operation) and generally do not require desludging imminently.

3.0 TRENDS

Over the course of the project a wide variety of sites was visited, representing a sample of the different treatment systems found throughout Honduras. These facilities were found to range greatly on a number of measures such as adequacy of design, financial budgeting, and operation and maintenance. Some facilities observed routine water quality sampling and maintenance protocols while others were found to be less maintained or completely abandoned. The trends discussed below are general in nature and do not necessarily apply to all facilities visited. While this survey presents an informative glimpse into typical wastewater management systems, it may not be fully representative of the wider state of wastewater treatment throughout the country.

3.1 Design

Two main issues were observed with respect to the design of wastewater treatment facilities. These fell under the categories of design oversight and the implementation of inappropriate technologies.

A striking example of design oversight is the case of geoliner failure at the waste stabilization ponds at Puerto Cortés. It was suggested that the site of this facility was poorly chosen as it was previously part of a wetland. Thus this site experiences biological activity leading to methane generation and subsequent entrapment due to a high water table. Additional site investigation may have revealed the site as inappropriate or suggested the need for mitigating measures to address the issue of methane accumulation beneath the geoliners.

The Las Vegas Imhoff tank system also shows instances of design oversights. The facility receives approximately 60% higher flow than the design capacity. This suggests that the original design was undersized or did not account for increases in water consumption, or alternately that planned expansion was never implemented. In addition, this system lacks

standard pretreatment and flow control measures such as bar screens, a grit chamber, a flow bypass channel, and control gates. While there were provisions for flow gates in the original design, these have repeatedly been misplaced leading to significant short-circuiting of flow. This indicates the need for a permanent gate installation.

Whereas the Las Vegas system was undersized, Talanga experienced an oversized system for the flows currently received. Of the ten systems currently on line, only 80% were assumed to be properly sized, as illustrated in Figure 23.

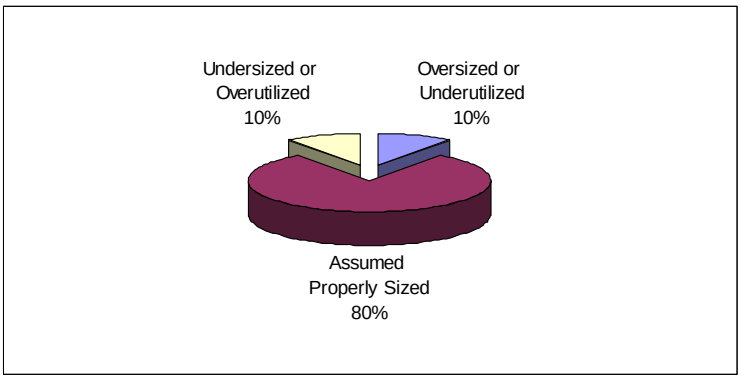

Figure 23: System Sizing Efficiencies

In addition to design oversights, the use of inappropriate technology is a prominent design concern as demonstrated by the activated sludge package plant systems of Amarateca. High energy inputs associated with aeration demands led to excessive operational costs. It was indicated that, in the process of selecting the systems, the community was not made aware of these substantial ongoing expenses or their eventual need to pay for these. According to SANAA, a similar problem was encountered at an activated sludge plant in Tegucigalpa. Due to extremely high operational costs, the plant is shut down during intervals of peak energy demand. This shows that suitability of technologies is not necessarily assessed prior to implementation.

Inappropriate technology has serious consequences regarding system abandonment. Considering all three Amareteca systems, this survey found two out of twelve systems to be completely off line, as illustrated by Figure 24. Others were on line but in a state of

serious neglect, with two slated for decommissioning. This underscores the importance of appropriate technology selection in keeping systems functional.

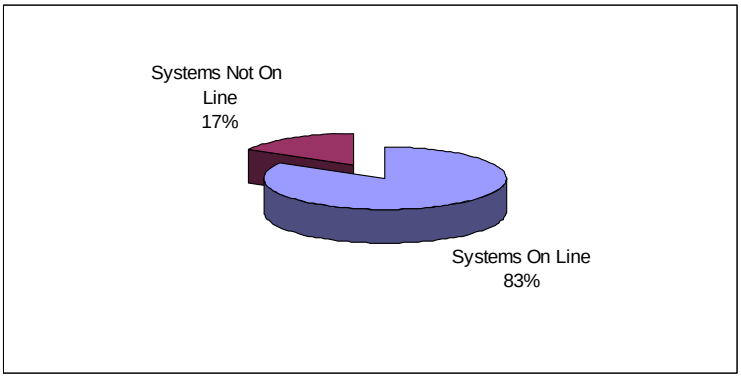

Figure 24: Distribution of Systems by Status, On Line vs. Off Line

Other observations of systems include a lack of bar screens at fully 50% of the on line facilities (Figure 25). Some of these were misplaced, perhaps due to a lack of permanent installation, while others were not a part of the facility design. Bar screens are valuable in keeping large obstructions out of the systems preventing unintended flow patterns or clogs which these can cause.

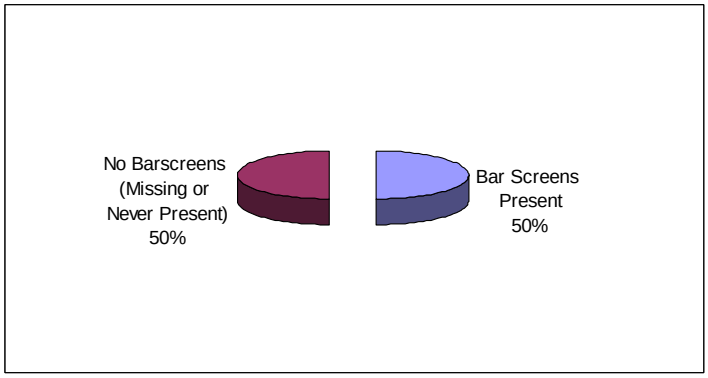

Figure 25: Distribution of Presence of Bar Screens for Systems

A final design observation is that only seven out ten operating facilities were fenced off (Figure 26). While a fence may not have been needed at certain sites, the inclusion of a fence has been noted to minimize complications caused by tampering with systems (Mara, 2005). At least one site mentioned a habit of local children to drop large stones into the treatment works. This can have a number of consequences. Such stones will

increase the overall accumulation of sludge. More importantly, they can obstruct the plumbing which facilitates desludging. For this reason a strategy should be found to secure the site, whether it involves a fence or some other solution.

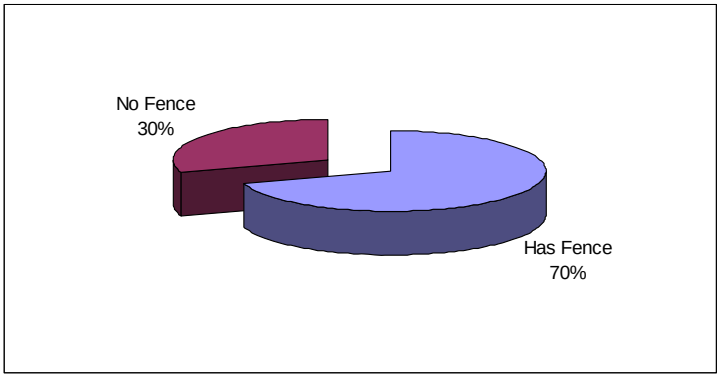

Figure 26: Distribution of Sites With and Without Secure Perimeters

3.2 Operation and Maintenance

Several important aspects of operation and maintenance were identified over the course the study. These are crucial to ongoing system performance and broadly fall under the categories of general maintenance, water quality monitoring, and sludge management. Systems which are currently offline will not be discussed in this section. Emphasis will be on operating systems, while systems which are currently or soon to be abandoned, such as Guaimaca, Villa Linda Miller and Amarateca, will be discussed generally.

3.2.1 General Maintenance

General maintenance activities include routine tasks such as surface scum removal, cleaning of bar screens, clearing flow obstructions, and groundskeeping. Overall 6 out of 12 facilities were maintained to some degree and appeared to be in good operating condition (Figure 27). The extent of general maintenance conducted varied from site to site. At Puerto Cortés, La Lima, Choloma, and Talanga, scum and bar screenings were removed daily and disposed of in onsite pits or in sanitary landfills. The site grounds were well maintained.

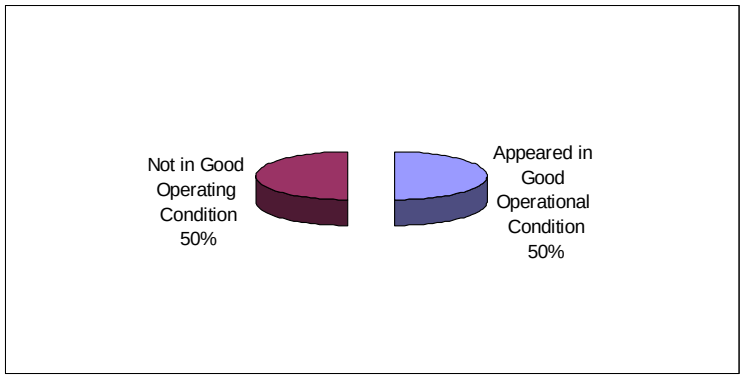

Figure 27: Observed Operating Conditions

By contrast, the Las Vegas facility showed deficiencies in ongoing maintenance. In addition to the lack of flow control due to the missing flow gates, scum chambers were not routinely cleared of debris and flow obstructions were neglected. Flow irregularities were also observed at Teupasenti including flooding and recirculation. Though this is likely due to flow obstructions, not enough is known about this system to identify a definite cause.

3.2.2 Water Quality and Flow Monitoring

Flow monitoring practices were reported at several locations including Puerto Cortés, La Lima, and Tela. Flow measurement devices were present at several other facilities; however, these were not found to be used (Figure 28).

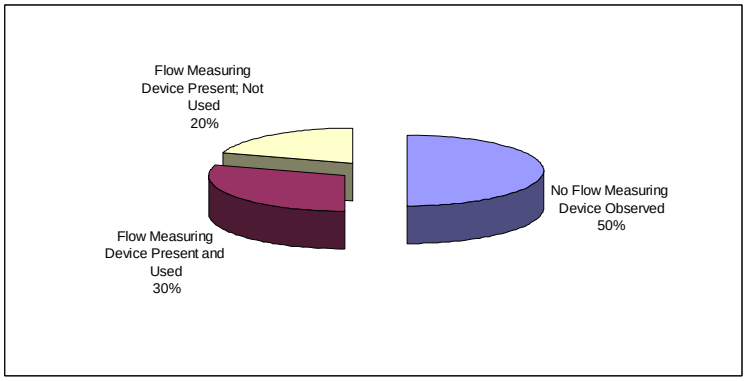

Figure 28: Examination of Flow Measurement Device Distribution and Usage

Routine water quality monitoring was observed at Puerto Cortés and La Lima. The final effluent from these facilities was compliant with regulatory requirements. Among the facilities not performing water quality testing were Choloma, Las Vegas, Amarateca, Villa Linda Miller, and Guaimaca (Figure 29). In the case of Choloma, DIMACH is currently seeking guidance regarding water quality parameters and testing protocols. It is unclear whether any water quality assessments are being carried out at Teupasenti; for the purposes of this overview, it is assumed that no such monitoring is currently being carried out.

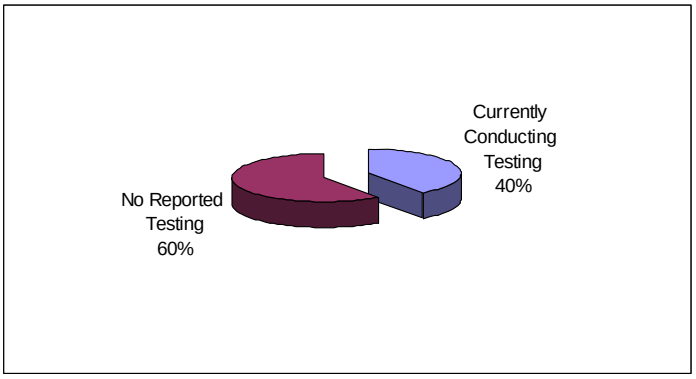

Figure 29: Water Quality Monitoring Distributions

3.2.3 Sludge Management

Of the facilities visited, a number were recently brought into operation and have not yet needed to carry out desludging (Figure 30). Facilities such as La Lima and Puerto Cortés have been monitoring sludge depth and are reportedly in the process of developing a sludge management plan. Puerto Cortés anticipates desludging its anaerobic ponds later this year.

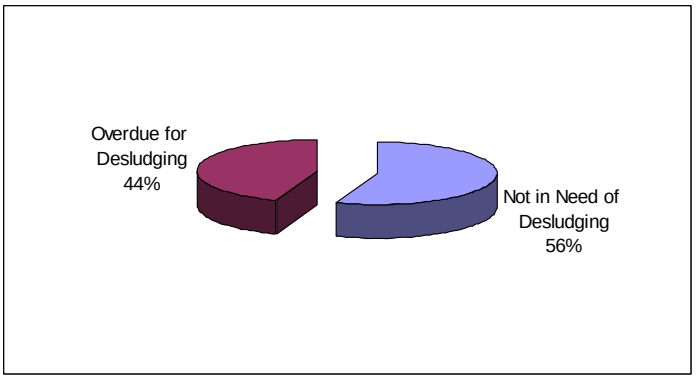

Figure 30: Distribution of System Time Horizons for Desludging

The systems at Tela, Teupasenti, and Las Vegas reportedly have been desludged although not necessarily on a routine basis (Figure 31). Sludge at Tela was dried and buried onsite in 2007. At Las Vegas, sludge was both discharged to Raices Creek and buried onsite. This was also carried out in 2007 and the system shows signs of requiring desludging once again. Drying beds were used for sludge management at Teupasenti. None of the facilities surveyed has been successful in implementing or marketing sludge for beneficial reuse.

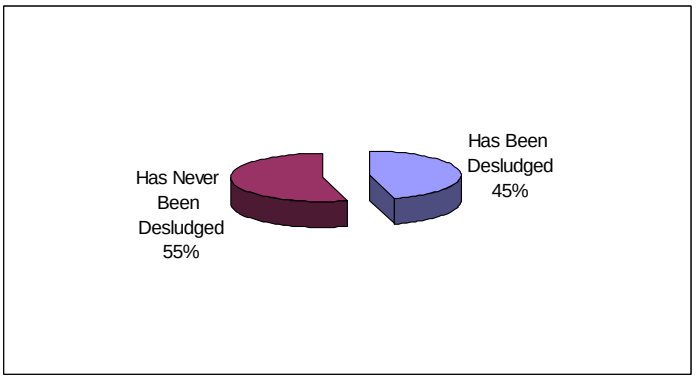

Figure 31: Distribution of Systems Which Have Been Desludged

3.3 Community Issues

Community issues include social and economic aspects that affect plant performance. Two general areas of concern were observed relating to service connections and system financing.

The facility at Talanga received extremely low flows with only 15% of the community connected to the sanitary sewer system. This was attributed to high connection fees. In other locations, illegal connections from storm drains and industrial wastewater sources were of concern. For instance, Puerto Cortés reported high flows during rainfall events due to illegal storm sewer connections.

Both at Villa Linda Miller and Amarateca, financial hurdles resulted in a lack of operation and maintenance of the system, leading to eventual abandonment. The facility at Villa Linda Miller was reportedly well maintained and met effluent discharge requirements while it was managed by SANAA. Upon handover to the junta, funds were not allocated for the system's ongoing maintenance. Subsequently it fell into disrepair due to neglect. Similarly, at Amarateca, when responsibility for the treatment plants was ceded to the community, the junta was unable to fund operational expenses and consequently the facilities are being replaced.

The situations at Villa Linda Miller and Amarateca suggest a disconnection between the communities and their wastewater management systems. In both cases, the treatment works were funded, installed, and initially operated by external agencies with limited community involvement. In the long term, when responsibilities were passed over to the community, it was unprepared to handle the maintenance and financial burden of the system. Ultimately, this led to disrepair or abandonment requiring renewed capital investment. This implies an unsustainable pattern of resource allocation.

4.0 RECOMMENDATIONS

The purpose of this section is to propose recommendations for addressing the observed problematic trends identified during this study. As previously outlined, the trends pertinent to design, operation and maintenance, and community issues have been shown to hinder the performance of wastewater treatment within Honduras. Addressing these concerns has the potential to improve the current infrastructure and to ensure adequate development of new systems.

4.1 Technical Aspects

Many of the issues encountered in this survey pertained to technical aspects which could be precluded by a general increase in accountability. This could be supported by the active involvement of overseeing agencies such as SANAA or through the inclusion of certain provisions in vendor contracts. Some specific examples that address these aspects are:

- Inclusion of technical considerations in the design approval process to ensure that systems are technically sound. These could include examining the appropriateness of facility site location, sizing, and technology employed.
- The inclusion of performance clauses within consulting or vendor contracts to guarantee appropriateness of technologies by creating a system of accountability.
- The provision of proper operations and maintenance procedural manuals, by vendors and consultants, to be kept onsite for facility operator reference at any new facility.

4.2 Operation and Maintenance Aspects

Most of the operation and maintenance issues observed during the site visits could be mitigated through appropriate regulatory and community involvement. In understanding the responsibilities of ERSAPS, the capabilities and function of SERNA, and the new role of SANAA, it is evident that collaborative involvement of these regulatory agencies

in mandating proper water quality monitoring and reporting could serve to enforce effluent compliance. Increased regulatory involvement could include:

- Enforcement of effluent discharge quality requirements to ensure that proper operation and maintenance procedures are followed.
- Provision of guidance in creating procedures where proper water quality monitoring protocols have not been developed.
- Implementation of periodic reporting to regulatory agencies for sustaining plant performance and identifying areas of concern on a regional scale.
- Enforcement of penalties for non-compliance with regulatory requirements.

Honduras' wastewater sector is aware of the necessity for implementing the objectives outlined above and is seeking ways of achieving increased regulatory involvement. At present, technological, financial, and social challenges are putting additional stress upon the sector as it seeks to improve the quality of water and sanitation services within the country. The sector leaders who collaborated in completing this study are aware of these additional hurdles and are working together to find ways of overcoming them.

4.3 Community Involvement Aspects

Successful management of wastewater systems requires adequate involvement by the communities for which they serve. This could be established by:

- The active participation and feedback from community leaders during the selection and approval phase for designs. This could preclude critical issues such as potential odor problems or lack of maintenance funds for certain types of systems.
- Early community involvement to develop a sense of ownership for its wastewater management system. This sense of ownership preemptively tackles future issues such as lack of ongoing maintenance funding.

A number of external measures can also be taken to improve the upkeep of wastewater treatment facilities. These include:

- Establishment of an escrow account at the time of the project capital investment with an annuity to ensure funding for ongoing operation and maintenance activities.
- The presence of a circuit rider for information dissemination thereby helping different facilities resolve their issues based on lessons learned elsewhere.

A circuit rider can provide particular value in building a body of common knowledge amongst municipalities. For instance, uneven flow distribution, which can have significant impact on treatment efficiency, was observed at several waste stabilization ponds. This may be overcome by obtaining insight on possible methods used in other municipalities facing similar issues. The circuit rider could also provide technical guidance where needed. Based on our survey, two locations where such guidance could be useful are Choloma and Talanga. In Talanga, the operator and the director of the municipal water division were not aware that the Parshall flume could be used for flow measurement. No water quality monitoring is currently being carried out in Choloma since the operations staff is unsure which parameters to test for. Both these issues could be resolved through the provision of adequate technical guidance.

Such measures for enhancing community involvement are particularly important at this critical phase of water sector reform to decentralize management responsibilities within Honduras.

5.0 SUMMARY

Honduras is currently reforming its water sector to decentralize operation and management responsibilities to the individual municipalities while maintaining the regulatory and technical advisory roles of central agencies such as SANAA and ERSAPS. This transition presents certain associated technical and social challenges A major technical challenge is the implementation of technologies, such as activated sludge systems, that are inappropriate due to their high power demand and associated operational cost. Increased community involvement and ownership of wastewater treatment facilities is an important social challenge, which must be addressed for ensuring proper maintenance in the long-term. The purpose of this study is to contribute to a nationwide assessment of wastewater treatment systems in order to identify the specific obstacles.

These assessment findings are based upon site visits and surveys performed at 10 varied facilities within Honduras. While a number of facilities visited were in good condition others were found to be inadequate with regard to both design and regular maintenance, resulting in discharge of partially treated effluent to receiving waters. Based upon the findings of this assessment overall observed trends were developed and addressed through proposed recommendations.

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APPENDIX A: INTERVIEW FORMS

Wastewater Treatment Plant Data Sheet
Developed by Ari Herrera and Lisa Kullen

Ficha De Campo de Plantas Depuradoras (Wastewater Treatment Plant Data Sheet)

Informacion General (General Information)

Fecha (Date):	10-Jan-09
Ciudad (City):	Guaimaca
Departamento (State):	Guaimaca
Pais (Country):	Honduras
ID de Proyecto (Project ID):	#1
Nombre del Entrevistador (Interviewer Name):	Lisa Kullen
Coordenadas GPS (GPS Coordinates):	14.53984, -86.83346
Altitud (Elevation), m:	

Resumen del Sitio (Summary of Site):

Site consists of a pair of Imhoff tanks in parallel, followed by constructed wetland (small, underground, french drain in gravel). System is filled with silt due to the adjacent hillside collapsing during a rainstorm, and has been abandoned. Tank is online but is malfunctioning, with effluent spilling over the side of the tank and flowing to the creek. There is frequent bubbling of gasses indicating digestion of sludge despite the condition of the tank. It appears that tank could be rehabilitated with three days' labor from a small crew, draining tank, dredging sludge and silt, and snaking out french drain to the constructed wetland.

Municipality is pursuing construction of alternate treatment, wastewater stabilization lagoons, with funding from FHIS. Half the required land has been purchased. It appears that tank could be rehabilitated to provide treatment in the 1-2 years before construction is completed.

Informacion de Contacto y Personal de Planta (Contact Information and Plant's Personnel)

Nombre del Entrevistado (Name of Person Interviewed):	Bruno Barajon
Posicion del Entrevistado (Interviewee's Position):	Utility Director
Departamento Laboral del Entrevistado (Interviewee's Department):	Wastewater
Nombre de Planta (Name of the Plant):	Guaimaca
Ubicacion de Planta (Plant's Site Location):	Guaimaca
Director de Planta (Plant Director):	Ing. Jose Conrado Gonzalez O.
Operador de Planta (Plant Operator):	Bruno Barajon
Correo Electronico del Director de Planta (Director's e-mail):	conrado442004@yahoo.com
Direccion de la Oficina del Director (Plant's Director's address):	
Numero de Telefono (Telephone Number):	(504) 9818-5325

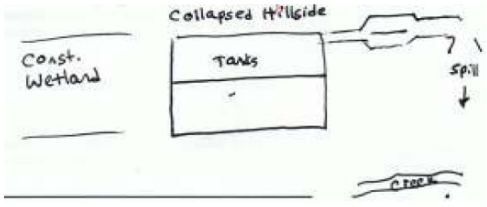
Detalles de Construccion de Planta Depuradora (Construction Details of WWTP's Construction)

Fecha de Construccion (Construction Date):	1996
Poblacion Servida (Population Served):	1,700 People
Capacidad de Planta (Plant's Capacity), m3/dia:	Unknown (9 meters long, 4 meters wide, unknown depth)
Terreno Requerido (Land Required), Hectareas:	Unknown
Consultor Internacional del Proyecto (International Consultant):	Unknown
Consultor Nacional del Proyecto (National Consultant):	Unknown
Costo de Construcion (Construction Cost):	Unknown
Planos Disponibles del Diseno de la Planta (Available Drawings)?:	Unknown
Organismo(s) Financiero (s) (Funding Agency or Agencies):	Unknown

1. Proceso de Tratamiento Existente (Existing WWT Technology - check all that apply):

- [X] Tanques Imhoff (Imhoff Tanks)
- [ ] Lagunas de Oxidacion (Waste Stabilization Ponds)
  - [ ] Anaerobio (Anaerobic)
  - [ ] Facultativa (Facultative)
  - [ ] Maduarcion (Maturation)
- [ ] Lagunas Aereadas (Aerated Lagoons)
- [ ] Aeriacion Mechanizada (Mechanical Aeration)
- [ ] Planta Paquete (Package Plant)
- [ ] Upflow Anaerobic Sludge Blanket (UASB)
- [ ] Aeriacion Mechanizada (Mechanical Aeration)
- [ ] Filtro Percolador (Biofilters)
- [ ] Lodos Activados (Activated Sludge)
- [X] Otro(s) (Others): Constructed Wetland

Tú Dibujas de Configuración del Sitio:
(Sketch Site Configuration):



2. Descripcion General de Instalaciones Fisicas y Pre-Tratamiento (General Description of Physical and Pre-Treatment Facilities)

Epoca (Season): ____ Seca (Dry) X Lluviosa (Rainy)

1) A que distancia se encuentran la planta depuradora de las casas de habitacion mas sercanas?
(How far is the treatment plant form the nearest residence?)
30 meters

2) Se encuentra cercado actualmente las instalaciones de la planta depuradora (cerac, portones, y candados?
(Is the treatment plant site currently enclosed (fences, gates, locks)?
Fence and gate, but no lock

3) Que tipo de cerco presenta? (What type of fence was used)
Barbed wire

4) Como se encontro el cercado al momento de la visita a la planta?
(What was the condition of the site's fence at the time of the visit?)
- ☐ Bueno (good)
- X Regular (regular)
- ☐ Malo (poor)
- ☐ Ninguna (none)

5) Cual es el tiempo de residencia con el cual se diseno el sistema de tratamiento? Actual de tiempo de residencia?
(What is the residence time for which the system was designed? Actual operating residence time?)
Unknown

6) Personal que labora permanentemente en el la planta depuradora?
(Permanent personnel working at the plant?)
- ☐ Vigilante (Guard) #
- X Operador (Operator) # 1 (Site is not currently maintained)
- ☐ Ingeniero supervisor (Supervising Engineer) #

7) Indicar las herramientas de operacion y mantenimiento que son propiedad y utilizadas por el personal de planta?
(Indicate the maintenance and operation tools at the site that belong and are used by plant's personnel?)

☐ Guantes de hule (rubber gloves)	☐ Martillo (hammer)
☐ Botas de hule (rubber boots)	☐ Serrucho (hand saw)
☐ Capotes (rain coats)	☐ Escoba (broom)
☐ Botiquin (first aid kit)	☐ Desnatador (scum remover)
☐ Uniforme de campo (field uniform)	☐ Lancha (boat)
☐ Casco (hard hat)	☐ Manguera (hose)
☐ Rastrillo para rejilla (bar screen rake)	☐ Machete (machete)
☐ Pala (shovel)	☐ Desatornillador (screw driver/drill)
☐ Piocha (pick)	☐ Llave Stilson 12" (12" pipe wrench)
☐ Carreta de mano (wheelbarrow)	☐ Extractor de natas (scum remover)
☐ Podadora de cesped (lawn mower)	X No visto (None seen)

8) Indique la condicion de las herramientas de operacion y mantenimiento de la planta?
(Indicate the condition of the maintenance and operation tools?)
- ☐ Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)
- X No es aplicable (not applicable)

9) Con que instalaciones de limpieza cuentan en la casa de operacion (si existe alguna) en la planta de tratamiento?
(What cleaning facilities exist at the plant's operation room (if any exist)?)
- ☐ Agua potable (potable water)
- ☐ Jabon (soap)
- ☐ Cloro (bleach)
- ☐ Toallas desechables (disposable towels)
- ☐ Bañera (bathroom/shower room)
- ☐ Llave spita simple (simple faucet/spigot)
- ☐ Alcohol (alcohol)
- X Ninguna (none)

10) Con que equipo cuenta el botiquin de primeros auxilios (si existe alguno)?
(List first aid kit equipment (if any exist)

- ☐ Tela adhesive (gauze)
- ☐ Algodon (cotton)
- ☐ Alcohol (alchohol)
- ☐ Mercurio cromo (Chromium mercury)
- ☐ Detergente desinfectante (desinfecting detergent)
- ☐ Tijeras (scissors)
- ☐ Pinzas (tweezers)
- ☐ Repelente (repellent)
- X No cuenta con botiquin (no first aid kit available)

11) Existe una lancha disponible para el matenimiento de la planta? Si la respuesta es no, pasar a la pregunta No. 14).
(Is thera a boat available for the maintenance of the plant? If there is no boat, go to question No. 14).

- ☐ Si (yes)
- ☐ No (no)
- X No es aplicable (not applicable)

12) Si una lancha existe, cual es la condicion de la lancha?
(If a boat exists, what is its condition?)

- ☐ Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)
- X No es aplicable (not applicable)

13) Cuales son las dimensiones de la lancha o la capacidad de esta? (what are the boat's dimensions or capacity?)

Capacidad? (Capacity?)

- ____ Personas (Persons)
- X No es aplicable (not applicable)

Dimensiones (dimensions):

- ____ Length, m
- ____ Width, m
- ____ depth, m

14) Cual es el nombre, ubicacion y condiciciones del cuerpo receptor del agua tratada?
(What is the name, location and condition of the body of water receiving the treated effluent?)

Nombre (name): Rio Jalan

Ubicacion (location): 200 or 300 meters from tanks

Tipo de cuerpo receptor (description of receiving water body):

- ____ Quebrada (Stream)
- X Rio (River)
- ____ Oceano (Ocean)
- ____ Otro (Other): ____

Tributario a que cuerpo mayor (tributary to what major water body): Rio Jalan > Rio Guayape > Rio Patuca > Lago Patuca (?)

Distancia del cuerpo de agua mayor (Distance to major water body): Unknown

15) Existen rejiallas en el sistema? (si la respuesta es no, pasar a la pregunta No. 20)
(Do bar screens exist as part of the treatment system? (if not, go to question No. 20)

- ☐ Si (yes)
- X No (no)

16) Describir el tipo de rejillas. (material, dimensiones, separaciones, ect.)
(Describe the type of bar screens (materila, dimensions, opening size, ect.)
(Slots for bar screens are present, but screens are missing.)

17) Cual es la frequencia de limpieza de estas rejillas?
(How frequent are bar screens cleaned?)

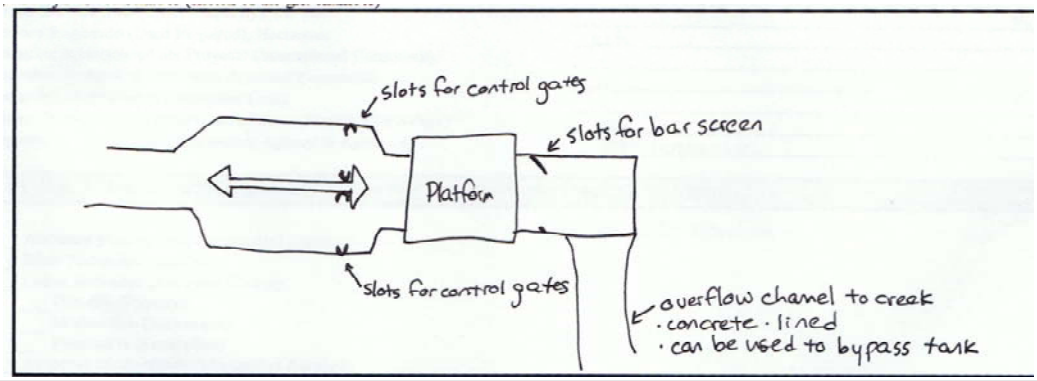
- ☐ A diario (daily)
- ☐ Cada 2 dias (every 2 days)
- ☐ Cada 3 dias (every 3 days)
- ☐ Cada semana (every week)
- ☐ Otro (other) ____

18) Que disposicion se le da la material removido de las rejillas?
(How is the material removed from bar screens disposed off?)
- ☐ En la basaura (in the trash)
- ☐ En la calle (on the street)
- ☐ En el cuerpo receptor (in the recieivng water body)
- ☐ Enterrado (buried)
- ☐ Otro (other) _____

19) En cuanto se estima el costo de la construccion de las rejillas en un lugar cercano a la planta?
(What is the estimated construction cost for the bar screens, if built in a nearby shop?)
Unknown Lempiras (Lps.)

20) Posee desarenador la planta de tratamiento? (si su respuesta es no, pasar a la pregunta No. 25)
(Is there a grit cahmber as part of the treatment plant? If your answer is no, go to question No. 25)
- X Si (yes)
- ☐ No (no)

21) Dibujar el desarenador (sketch of the grit chamber)



20) ¿Qué registros se mantienen y qué pruebas se realiza en la instalación?
(What records are kept and what testing is performed at the facility?)
None

21) ¿Con qué frecuencia se limpia systema?
(How often is the sludge cleaned out?)
Before abandoned, cleaned every 3 months. System was abandoned when filled with silt in storm 3 years ago.

22) ¿Qué se hace con los lodos removidos?
(What do you do with the sludge that is removed?)
Spread on site

23) Se han reutilizado los lodos en granjas o jardines?
(Has there been reuse of sludge for farms or gardens?)
Unknown

24) ¿Existe interes en la utilización de los lodos en las granjas o jardines?
(Do you think anyone in town would be interested in using sludge for farms or gardens?)
Unknown

Ficha De Campo de Plantas Depuradoras (Wastewater Treatment Plant Data Sheet)

Informacion General (General Information)

Fecha (Date):	10-Jan-09
Ciudad (City):	Talanga
Departamento (State):	Talanga
Pais (Country):	Honduras
ID de Proyecto (Project ID):	#2
Nombre del Entrevistador (Interviewer Name):	Lisa Kullen
Coordenadas GPS (GPS Coordinates):	14.43181, -87.08384
Altitud (Elevation), m:	

Resumen del Sitio (Summary of Site):

System has two facultative and 2 maturation ponds. Extremely healthy looking system is well maintained with grass trimmed back from ponds. System is oversized for current flows, so one series of ponds is currently offline and filled with river water to prevent drying out. The current plan is to use one pond until it requires desludging, then to take that pond offline as a drying bed and direct flow to second pond. Community members are charged a large sum for hook-ups, so not many people have chosen to connect to system. Currently 15% of total population is connected. Resources are already in place and system is oversized, so next objective might be to increase connection rates.

Informacion de Contacto y Personal de Planta (Contact Information and Plant's Personnel)

Nombre del Entrevistado (Name of Person Interviewed):	Carlos Eduardo Soza
Posicion del Entrevistado (Interviewee's Position):	Municipal Wastewater Director
Departamento Laboral del Entrevistado (Interviewee's Department):	Water & Wastewater
Nombre de Planta (Name of the Plant):	Talanga
Ubicacion de Planta (Plant's Site Location):	Talanga
Director de Planta (Plant Director):	Carlos Eduardo Soza
Operador de Planta (Plant Operator):	Eduardo Murrillo
Correo Electronico del Director de Planta (Director's e-mail):	
Direccion de la Oficina del Director (Plant's Director's address):	
Numero de Telefono (Telephone Number):	

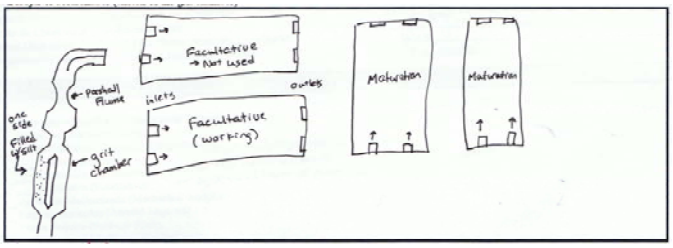
Detalles de Construccion de Planta Depuradora (Construction Details of WWTP's Construction)

Fecha de Construccion (Construction Date):	Began operation in June 2006
Poblacion Servida (Population Served):	3,000 (this is 15% of population)
Capacidad de Planta (Plant's Capacity), m3/dia:	? (Eric paced off ponds - see his notes)
Terreno Requerido (Land Required), Hectareas:	?
Consultor Internacional del Proyecto (International Consultant):	?
Consultor Nacional del Proyecto (National Consultant):	FHIS
Costo de Construcion (Construction Cost):	12,000,000 Limpiras
Planos Disponibles del Diseno de la Planta (Available Drawings)?:	Yes
Organismo(s) Financiero (s) (Funding Agency or Agencies):	FHIS/USAID

1. Proceso de Tratamiento Existente (Existing WWT Technology - check all that apply):

____ Tanques Imhoff (Imhoff Tanks)
X Lagunas de Oxidacion (Waste Stabilization Ponds)
____ Anaerobio (Anaerobic) # ____
X Facultativa (Facultative) # 2
X Maduarcion (Maturation) # 2
____ Lagunas Aereadas (Aerated Lagoons)
____ Aeriacion Mechanizada (Mechanical Aeration)
____ Planta Paquete (Package Plant)
____ Upflow Anaerobic Sludge Blanket (UASB)
____ Aeriacion Mechanizada (Mechanical Aeration)
____ Filtro Percolador (Biofilters)
____ Lodos Activados (Activated Sludge)
____ Otro(s) (Others): _____

Tú Dibujas de Configuración del Sitio:
(Sketch Site Configuration):



2. Descripcion General de Instalaciones Fisicas y Pre-Tratamiento (General Description of Physical and Pre-Treatment Facilities)

Epoca (Season): ____ Seca (Dry) X Lluviosa (Rainy)

1) A que distancia se encuentran la planta depuradora de las casas de habitacion mas sercanas?
(How far is the treatment plant form the nearest residence?)
400 Meters

2) Se encuentra cercado actualmente las instalaciones de la planta depuradora (cerac, portones, y candados?
(Is the treatment plant site currently enclosed (fences, gates, locks)?
Yes, Fence

3) Que tipo de cerco presenta? (What type of fence was used)
Barbed Wire

4) Como se encontro el cercado al momento de la visita a la planta?
(What was the condition of the site's fence at the time of the visit?)
- X Bueno (good)
- ☐ Regular (regular)
- ☐ Malo (poor)
- ☐ Ninguna (none)

5) Cual es el tiempo de residencia con el cual se diseno el sistema de tratamiento? Actual de tiempo de residencia?
(What is the residence time for which the system was designed? Actual operating residence time?)
Unknown

6) Personal que labora permanentemente en el la planta depuradora?
(Permanent personnel working at the plant?)
- ☐ Vigilante (Guard) #
- Operador (Operator) # 1 ?
- ☐ Ingeniero supervisor (Supervising Engineer) #

7) Indicar las herramientas de operacion y mantenimiento que son propiedad y utilizadas por el personal de planta?
(Indicate the maintenance and operation tools at the site that belong and are used by plant's personnel?)

☐	Guantes de hule (rubber gloves)	☐	Martillo (hammer)
☐	Botas de hule (rubber boots)	☐	Serrucho (hand saw)
☐	Capotes (rain coats)	☐	Escoba (broom)
☐	Botiquin (first aid kit)	X	Desnatador (scum remover)
☐	Uniforme de campo (field uniform)	X	Lancha (boat)
☐	Casco (hard hat)	☐	Manguera (hose)
X	Rastrillo para rejilla (bar screen rake)	X	Machete (machete)
X	Pala (shovel)	☐	Desatornillador (screw driver/drill)
X	Piocha (pick)	☐	Llave Stilson 12" (12" pipe wrench)
X	Carreta de mano (wheelbarrow)	X	Extractor de natas (scum remover)
☐	Podadora de cesped (lawn mower)	☐	No visto (None seen)

8) Indique la condicion de las herramientas de operacion y mantenimiento de la planta?
(Indicate the condition of the maintenance and operation tools?)
- X Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)
- ☐ No es aplicable (not applicable)

9) Con que instalaciones de limpieza cuentan en la casa de operacion (si existe alguna) en la planta de tratamiento?
(What cleaning facilities exist at the plant's operation room (if any exist)?)
- X Agua potable (potable water)
- ☐ Jabon (soap)
- ☐ Cloro (bleach)
- ☐ Toallas desechables (disposable towels)
- X Bañera (bathroom/shower room)
- X Llave spita simple (simple faucet/spigot)
- ☐ Alcohol (alcohol)
- ☐ Ninguna (none)

10) Con que equipo cuenta el botiquin de primeros auxilios (si existe alguno)?
(List first aid kit equipment (if any exist)

- ☐ Tela adhesive (gauze)
- ☐ Algodon (cotton)
- ☐ Alcohol (alchohol)
- ☐ Mercurio cromo (Chromium mercury)
- ☐ Detergente desinfectante (desinfecting detergent)
- ☐ Tijeras (scissors)
- ☐ Pinzas (tweezers)
- ☐ Repelente (repellent)
- X No cuenta con botiquin (no first aid kit available)

11) Existe una lancha disponible para el matenimiento de la planta? Si la respuesta es no, pasar a la pregunta No. 14).
(Is thera a boat available for the maintenance of the plant? If there is no boat, go to question No. 14).

- ☐ Si (yes)
- ☐ No (no)
- ☐ No es aplicable (not applicable)

12) Si una lancha existe, cual es la condicion de la lancha?
(If a boat exists, what is its condition?)

- X Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)

13) Cuales son las dimensiones de la lancha o la capacidad de esta? (what are the boat's dimensions or capacity?)

Capacidad? (Capacity?)
? Personas (Persons)
☐ No es aplicable (not applicable)

Dimensiones (dimensions):
_____ Length, m
_____ Width, m
_____ depth, m

14) Cual es el nombre, ubicacion y condiciciones del cuerpo receptor del agua tratada?
(What is the name, location and condition of the body of water receiving the treated effluent?)

Nombre (name): Rio Cuyanetepe
Ubicacion (location): 50 Meters Away
Tipo de cuerpo receptor (description of receiving water body):

- _____ Quebrada (Stream)
- X Rio (River)
- _____ Oceano (Ocean)
- _____ Otro (Other): _____

Tributario a que cuerpo mayor (tributary to what major water body): Unknown
Distancia del cuerpo de agua mayor (Distance to major water body): _____

15) Existen rejiallas en el sistema? (si la respuesta es no, pasar a la pregunta No. 20)
(Do bar screens exist as part of the treatment system? (if not, go to question No. 20)

- X Si (yes)
- ☐ No (no)

16) Describir el tipo de rejillas. (material, dimensiones, separaciones, ect.)
(Describe the type of bar screens (materila, dimensions, opening size, ect.)
Rebar, 5cm square holes

17) Cual es la frequencia de limpieza de estas rejillas?
(How frequent are bar screens cleaned?)

- X A diario (daily)
- ☐ Cada 2 dias (every 2 days)
- ☐ Cada 3 dias (every 3 days)
- ☐ Cada semana (every week)
- ☐ Otro (other) _____

18) Que disposicion se le da la material removido de las rejillas?
(How is the material removed from bar screens disposed off?)

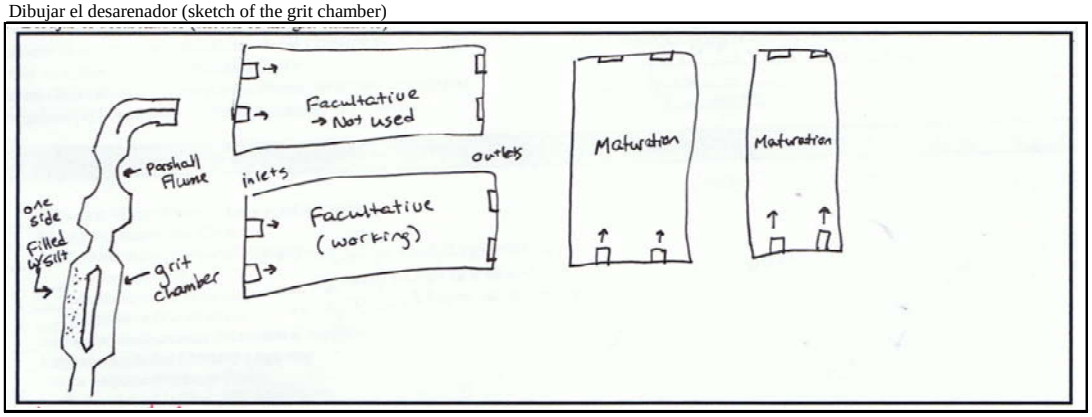
- ☐ En la basaura (in the trash)
- ☐ En la calle (on the street)
- ☐ En el cuerpo receptor (in the recieivng water body)
- ☐ Enterrado (buried)
- X Otro (other) Unknown

19) En cuanto se estima el costo de la construccion de las rejillas en un lugar cercano a la planta?
(What is the estimated construction cost for the bar screens, if built in a nearby shop?)
Unknown Lempiras (Lps.)

20) Posee desarenador la planta de tratamiento? (si su respuesta es no, pasar a la pregunta No. 25)
(Is there a grit cahmber as part of the treatment plant? If your answer is no, go to question No. 25)

- X Si (yes)
- ☐ No (no)

21) Dibujar el desarenador (sketch of the grit chamber)



20) ¿Qué registros se mantienen y qué pruebas se realiza en la instalación?
(What records are kept and what testing is performed at the facility?)
Unknown

21) ¿Con qué frecuencia se limpia systema?
(How often is the sludge cleaned out?)
Brand new system, so never desludged

22) ¿Qué se hace con los lodos removidos?
(What do you do with the sludge that is removed?)
Unknown

23) Se han reutilizado los lodos en granjas o jardines?
(Has there been reuse of sludge for farms or gardens?)
Brand new system, so never desludged

24) ¿Existe interes en la utilización de los lodos en las granjas o jardines?
(Do you think anyone in town would be interested in using sludge for farms or gardens?)
May offer to nearby houses

Ficha De Campo de Plantas Depuradoras (Wastewater Treatment Plant Data Sheet)

Informacion General (General Information)

Fecha (Date):	10-Jan-09
Ciudad (City):	Villa Linda Miller
Departamento (State):	
Pais (Country):	Honduras
ID de Proyecto (Project ID):	#3
Nombre del Entrevistador (Interviewer Name):	Lisa Kullen
Coordenadas GPS (GPS Coordinates):	
Altitud (Elevation), m:	

Resumen del Sitio (Summary of Site):

Villa Linda Miller is a well planned residential community built in 2001 to relocate residents after Hurricane Mitch. System appears to be a very well designed, electricity-free system. Two Imhoff tanks in series are followed by secondary treatment in the form of an anaerobic upflow sand filter. To the other side of tanks is a sludge drying bed, with channels so that sludge flows by gravity when valves are opened. A chimney was built to scrub gas odors with natural methods (by growing a culture on cedar bark, citrus peels and sugar cane), although this may not have ever been used. System came online with development of community in 2001, and with SANAA running initial operation system was well maintained. Sludge was drained every 6 months; sand filter was backwashed through means of a shutoff valve every 20 days. When SANAA handed off control to Junta in 2003, community refused to fund it and so operator quit. Operator had worked for minimum wage when system was running. Now system is in disrepair with effluent spilling out untreated. System could be rehabilitated.

Informacion de Contacto y Personal de Planta (Contact Information and Plant's Personnel)

Nombre del Entrevistado (Name of Person Interviewed):	Unknown
Posicion del Entrevistado (Interviewee's Position):	Former System Operator
Departamento Laboral del Entrevistado (Interviewee's Department):	Unknown
Nombre de Planta (Name of the Plant):	Villa Linda Miller
Ubicacion de Planta (Plant's Site Location):	Residential Development
Director de Planta (Plant Director):	
Operador de Planta (Plant Operator):	Darwing
Correo Electronico del Director de Planta (Director's e-mail):	
Direccion de la Oficina del Director (Plant's Director's address):	
Numero de Telefono (Telephone Number):	

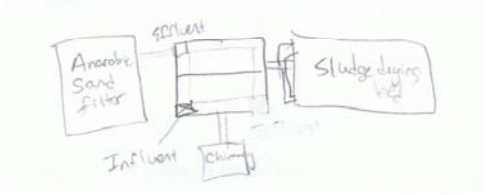
Detalles de Construccion de Planta Depuradora (Construction Details of WWTP's Construction)

Fecha de Construccion (Construction Date):	2001; abandoned in 2003
Poblacion Servida (Population Served):	Unknown
Capacidad de Planta (Plant's Capacity), m3/dia:	8 meters deep, length and width unknown
Terreno Requerido (Land Required), Hectareas:	Unknown
Consultor Internacional del Proyecto (International Consultant):	Unknown
Consultor Nacional del Proyecto (National Consultant):	SANAA
Costo de Construcion (Construction Cost):	Unknown
Planos Disponibles del Diseno de la Planta (Available Drawings)?:	SANAA/Pedro Ortiz
Organismo(s) Financiero (s) (Funding Agency or Agencies):	SANAA

1. Proceso de Tratamiento Existente (Existing WWT Technology - check all that apply):

X Tanques Imhoff (Imhoff Tanks)
___ Lagunas de Oxidacion (Waste Stabilization Ponds)
___ Anaerobio (Anaerobic) # ____
___ Facultativa (Facultative) # ____
___ Maduarcion (Maturation) # ____
___ Lagunas Aereadas (Aerated Lagoons)
___ Aeriacion Mechanizada (Mechanical Aeration)
___ Planta Paquete (Package Plant)
___ Upflow Anaerobic Sludge Blanket (UASB)
___ Aeriacion Mechanizada (Mechanical Aeration)
___ Filtro Percolador (Biofilters)
___ Lodos Activados (Activated Sludge)
X Otro(s) (Others): Anaerobic Sand Filter; Drying Bed; Odor Control Chimney

Tú Dibujas de Configuración del Sitio:
(Sketch Site Configuration):



2. Descripcion General de Instalaciones Fisicas y Pre-Tratamiento (General Description of Physical and Pre-Treatment Facilities)

Epoca (Season): ____ Seca (Dry) X Lluviosa (Rainy)

1) A que distancia se encuentran la planta depuradora de las casas de habitacion mas sercanas?
(How far is the treatment plant form the nearest residence?)
100 Meters

2) Se encuentra cercado actualmente las instalaciones de la planta depuradora (cerac, portones, y candados?
(Is the treatment plant site currently enclosed (fences, gates, locks)?
No

3) Que tipo de cerco presenta? (What type of fence was used)
None

4) Como se encontro el cercado al momento de la visita a la planta?
(What was the condition of the site's fence at the time of the visit?)
- ☐ Bueno (good)
- ☐ Regular (regular)
- ☐ Malo (poor)
- X Ninguna (none)

5) Cual es el tiempo de residencia con el cual se diseno el sistema de tratamiento? Actual de tiempo de residencia?
(What is the residence time for which the system was designed? Actual operating residence time?)
Unknown

6) Personal que labora permanentemente en el la planta depuradora?
(Permanent personnel working at the plant?)
- ☐ Vigilante (Guard) #
- X Operador (Operator) # One (before abandoned)
- ☐ Ingeniero supervisor (Supervising Engineer) #

7) Indicar las herramientas de operacion y mantenimiento que son propiedad y utilizadas por el personal de planta?
(Indicate the maintenance and operation tools at the site that belong and are used by plant's personnel?)

☐	Guantes de hule (rubber gloves)	☐	Martillo (hammer)
☐	Botas de hule (rubber boots)	☐	Serrucho (hand saw)
☐	Capotes (rain coats)	☐	Escoba (broom)
☐	Botiquin (first aid kit)	☐	Desnatador (scum remover)
☐	Uniforme de campo (field uniform)	☐	Lancha (boat)
☐	Casco (hard hat)	☐	Manguera (hose)
☐	Rastrillo para rejilla (bar screen rake)	☐	Machete (machete)
☐	Pala (shovel)	☐	Desatornillador (screw driver/drill)
☐	Piocha (pick)	☐	Llave Stilson 12" (12" pipe wrench)
☐	Carreta de mano (wheelbarrow)	☐	Extractor de natas (scum remover)
☐	Podadora de cesped (lawn mower)	X	No visto (None seen)

8) Indique la condicion de las herramientas de operacion y mantenimiento de la planta?
(Indicate the condition of the maintenance and operation tools?)
- ☐ Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)
- X No es aplicable (not applicable)

9) Con que instalaciones de limpieza cuentan en la casa de operacion (si existe alguna) en la planta de tratamiento?
(What cleaning facilities exist at the plant's operation room (if any exist)?)
- ☐ Agua potable (potable water)
- ☐ Jabon (soap)
- ☐ Cloro (bleach)
- ☐ Toallas desechables (disposable towels)
- ☐ Bañera (bathroom/shower room)
- ☐ Llave spita simple (simple faucet/spigot)
- ☐ Alcohol (alcohol)
- X Ninguna (none)

10) Con que equipo cuenta el botiquin de primeros auxilios (si existe alguno)?
(List first aid kit equipment (if any exist)

- ☐ Tela adhesive (gauze)
- ☐ Algodon (cotton)
- ☐ Alcohol (alchohol)
- ☐ Mercurio cromo (Chromium mercury)
- ☐ Detergente desinfectante (desinfecting detergent)
- ☐ Tijeras (scissors)
- ☐ Pinzas (tweezers)
- ☐ Repelente (repellent)
- X No cuenta con botiquin (no first aid kit available)

11) Existe una lancha disponible para el matenimiento de la planta? Si la respuesta es no, pasar a la pregunta No. 14).
(Is thera a boat available for the maintenance of the plant? If there is no boat, go to question No. 14).

- ☐ Si (yes)
- ☐ No (no)
- X No es aplicable (not applicable)

12) Si una lancha existe, cual es la condicion de la lancha?
(If a boat exists, what is its condition?)

- ☐ Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)

13) Cuales son las dimensiones de la lancha o la capacidad de esta? (what are the boat's dimensions or capacity?)

Capacidad? (Capacity?)

- ____ Personas (Persons)
- X No es aplicable (not applicable)

Dimensiones (dimensions):

- _____ Length, m
- _____ Width, m
- _____ depth, m

14) Cual es el nombre, ubicacion y condiciciones del cuerpo receptor del agua tratada?
(What is the name, location and condition of the body of water receiving the treated effluent?)

Nombre (name): _____

Ubicacion (location): _____

Tipo de cuerpo receptor (description of receiving water body):

- _____ Quebrada (Stream)
- _____ Rio (River)
- _____ Oceano (Ocean)
- _____ Otro (Other): _____

Tributario a que cuerpo mayor (tributary to what major water body): Unknown

Distancia del cuerpo de agua mayor (Distance to major water body): Unknown

15) Existen rejiallas en el sistema? (si la respuesta es no, pasar a la pregunta No. 20)
(Do bar screens exist as part of the treatment system? (if not, go to question No. 20)

- ☐ Si (yes)
- X No (no)

16) Describir el tipo de rejillas. (material, dimensiones, separaciones, ect.)
(Describe the type of bar screens (materila, dimensions, opening size, ect.)

_____

17) Cual es la frequencia de limpieza de estas rejillas?
(How frequent are bar screens cleaned?)

- ☐ A diario (daily)
- ☐ Cada 2 dias (every 2 days)
- ☐ Cada 3 dias (every 3 days)
- ☐ Cada semana (every week)
- ☐ Otro (other) _____

18) Que disposicion se le da la material removido de las rejillas?
(How is the material removed from bar screens disposed off?)

- ☐ En la basaura (in the trash)
- ☐ En la calle (on the street)
- ☐ En el cuerpo receptor (in the recieivng water body)
- ☐ Enterrado (buried)
- ☐ Otro (other) _____

19) En cuanto se estima el costo de la construccion de las rejillas en un lugar cercano a la planta?
(What is the estimated construction cost for the bar screens, if built in a nearby shop?)
_____ Lempiras (Lps.)

20) Posee desarenador la planta de tratamiento? (si su respuesta es no, pasar a la pregunta No. 25)
(Is there a grit cahmber as part of the treatment plant? If your answer is no, go to question No. 25)

- ☐ Si (yes)
- X No (no)

21) Dibujar el desarenador (sketch of the grit chamber)

20) ¿Qué registros se mantienen y qué pruebas se realiza en la instalación?
(What records are kept and what testing is performed at the facility?)
None. SANAA used to perform testing until system was handed off to Juntas. Since then system has been abandoned.

21) ¿Con qué frecuencia se limpia systema?
(How often is the sludge cleaned out?)
Was every 6 months before abandoned

22) ¿Qué se hace con los lodos removidos?
(What do you do with the sludge that is removed?)
Reused in community gardens (every house in development has a small garden)

23) Se han reutilizado los lodos en granjas o jardines?
(Has there been reuse of sludge for farms or gardens?)
Yes

24) ¿Existe interes en la utilización de los lodos en las granjas o jardines?
(Do you think anyone in town would be interested in using sludge for farms or gardens?)
Yes

Ficha De Campo de Plantas Depuradoras (Wastewater Treatment Plant Data Sheet)

Informacion General (General Information)

Fecha (Date):	11-Jan-09
Ciudad (City):	Ciudad Divina
Departamento (State):	Amarateca
Pais (Country):	Honduras
ID de Proyecto (Project ID):	#4
Nombre del Entrevistador (Interviewer Name):	Lisa Kullen
Coordenadas GPS (GPS Coordinates):	14.22397, -87.37368
Altitud (Elevation), m:	

Resumen del Sitio (Summary of Site):

Community was built as a post-Hurricane Mitch relocation project. Energy-intensive treatment system serves roughly 6,000 people, in the form of a package plant sold by Calix International. Three package plants were built on site: one runs part of the day, one has been decommissioned, and one was never brought on line. It was stated that the elevation was too high for this third tank, or that it was built for future expansion, but neither seemed substantiated. This third tank was cannibalized for parts to repair and maintain the other two systems. Residents pay for water but there is a culture of reluctance to pay for sewer services. An NGO pays the electricity and operator salary, but shuts down the plant every night due to extremely high energy costs. Aeration is by a 10 hp compressor motor. Community had not anticipated high energy costs, and before NGO/SANAA hands control of system off to community, the neighborhood has requested that a less energy intensive system is developed. A biosand filter is currently under construction, and the remaining Calix plant will be abandoned.

Informacion de Contacto y Personal de Planta (Contact Information and Plant's Personnel)

Nombre del Entrevistado (Name of Person Interviewed):	Bilma Yolanda Garcia
Posicion del Entrevistado (Interviewee's Position):	Junta Association President
Departamento Laboral del Entrevistado (Interviewee's Department):	Water Board
Nombre de Planta (Name of the Plant):	Ciudad Divina
Ubicacion de Planta (Plant's Site Location):	Ciudad Divina
Director de Planta (Plant Director):	None (Funded by NGO, but being decommissioned)
Operador de Planta (Plant Operator):	
Correo Electronico del Director de Planta (Director's e-mail):	
Direccion de la Oficina del Director (Plant's Director's address):	
Numero de Telefono (Telephone Number):	

Detalles de Construccion de Planta Depuradora (Construction Details of WWTP's Construction)

Fecha de Construccion (Construction Date):	1998
Poblacion Servida (Population Served):	3300 people
Capacidad de Planta (Plant's Capacity), m3/dia:	Unknown
Terreno Requerido (Land Required), Hectareas:	Unknown
Consultor Internacional del Proyecto (International Consultant):	Cristo Del Picacho
Consultor Nacional del Proyecto (National Consultant):	Calix International
Costo de Construcion (Construction Cost):	4,000,000 Limpiras per system
Planos Disponibles del Diseno de la Planta (Available Drawings)?:	Ingeniero Zalaya (Engineer at NGO has drawings)
Organismo(s) Financiero (s) (Funding Agency or Agencies):	Cristo Del Picacho

1. Proceso de Tratamiento Existente (Existing WWT Technology - check all that apply):

____ Tanques Imhoff (Imhoff Tanks)
____ Lagunas de Oxidacion (Waste Stabilization Ponds)
____ Anaerobio (Anaerobic) # ____
____ Facultativa (Facultative) # ____
____ Maduarcion (Maturation) # ____
____ Lagunas Aereadas (Aerated Lagoons)
X Aeriacion Mechanizada (Mechanical Aeration)
X Planta Paquete (Package Plant)
____ Upflow Anaerobic Sludge Blanket (UASB)
____ Aeriacion Mechanizada (Mechanical Aeration)
____ Filtro Percolador (Biofilters)
____ Lodos Activados (Activated Sludge)
____ Otro(s) (Others): _____

Tú Dibujas de Configuración del Sitio:
(Sketch Site Configuration):

2. Descripcion General de Instalaciones Fisicas y Pre-Tratamiento (General Description of Physical and Pre-Treatment Facilities)

Epoca (Season): ____ Seca (Dry) X Lluviosa (Rainy)

1) A que distancia se encuentran la planta depuradora de las casas de habitacion mas sercanas?
(How far is the treatment plant form the nearest residence?)
500 Meters

2) Se encuentra cercado actualmente las instalaciones de la planta depuradora (cerac, portones, y candados?
(Is the treatment plant site currently enclosed (fences, gates, locks)?
Yes - Fence and locked gate

3) Que tipo de cerco presenta? (What type of fence was used)
Chain Link Fence

4) Como se encontro el cercado al momento de la visita a la planta?
(What was the condition of the site's fence at the time of the visit?)
- X Bueno (good)
- ☐ Regular (regular)
- ☐ Malo (poor)
- ☐ Ninguna (none)

5) Cual es el tiempo de residencia con el cual se diseno el sistema de tratamiento? Actual de tiempo de residencia?
(What is the residence time for which the system was designed? Actual operating residence time?)
Unknown

6) Personal que labora permanentemente en el la planta depuradora?
(Permanent personnel working at the plant?)
- ☐ Vigilante (Guard) #
- X Operador (Operator) # 1
- ☐ Ingeniero supervisor (Supervising Engineer) #

7) Indicar las herramientas de operacion y mantenimiento que son propiedad y utilizadas por el personal de planta?
(Indicate the maintenance and operation tools at the site that belong and are used by plant's personnel?)

☐ Guantes de hule (rubber gloves)	☐ Martillo (hammer)
☐ Botas de hule (rubber boots)	☐ Serrucho (hand saw)
☐ Capotes (rain coats)	☐ Escoba (broom)
☐ Botiquin (first aid kit)	☐ Desnatador (scum remover)
☐ Uniforme de campo (field uniform)	☐ Lancha (boat)
☐ Casco (hard hat)	☐ Manguera (hose)
☐ Rastrillo para rejilla (bar screen rake)	☐ Machete (machete)
☐ Pala (shovel)	☐ Desatornillador (screw driver/drill)
☐ Piocha (pick)	☐ Llave Stilson 12" (12" pipe wrench)
☐ Carreta de mano (wheelbarrow)	☐ Extractor de natas (scum remover)
☐ Podadora de cesped (lawn mower)	X No visto (None seen)

8) Indique la condicion de las herramientas de operacion y mantenimiento de la planta?
(Indicate the condition of the maintenance and operation tools?)
- ☐ Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)
- X No es aplicable (not applicable)

9) Con que instalaciones de limpieza cuentan en la casa de operacion (si existe alguna) en la planta de tratamiento?
(What cleaning facilities exist at the plant's operation room (if any exist)?)
- ☐ Agua potable (potable water)
- ☐ Jabon (soap)
- ☐ Cloro (bleach)
- ☐ Toallas desechables (disposable towels)
- ☐ Bañera (bathroom/shower room)
- ☐ Llave spita simple (simple faucet/spigot)
- ☐ Alcohol (alcohol)
- X Ninguna (none)

10) Con que equipo cuenta el botiquin de primeros auxilios (si existe alguno)?
(List first aid kit equipment (if any exist)

- ☐ Tela adhesive (gauze)
- ☐ Algodon (cotton)
- ☐ Alcohol (alchohol)
- ☐ Mercurio cromo (Chromium mercury)
- ☐ Detergente desinfectante (desinfecting detergent)
- ☐ Tijeras (scissors)
- ☐ Pinzas (tweezers)
- ☐ Repelente (repellent)
- X No cuenta con botiquin (no first aid kit available)

11) Existe una lancha disponible para el matenimiento de la planta? Si la respuesta es no, pasar a la pregunta No. 14).
(Is thera a boat available for the maintenance of the plant? If there is no boat, go to question No. 14).

- ☐ Si (yes)
- ☐ No (no)
- X No es aplicable (not applicable)

12) Si una lancha existe, cual es la condicion de la lancha?
(If a boat exists, what is its condition?)

- ☐ Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)

13) Cuales son las dimensiones de la lancha o la capacidad de esta? (what are the boat's dimensions or capacity?)

Capacidad? (Capacity?)
- ___ Personas (Persons)
- X No es aplicable (not applicable)

Dimensiones (dimensions):
- ___ Length, m
- ___ Width, m
- ___ depth, m

14) Cual es el nombre, ubicacion y condiciciones del cuerpo receptor del agua tratada?
(What is the name, location and condition of the body of water receiving the treated effluent?)

Nombre (name): Rio Del Hombre
Ubicacion (location): Amarateca
Tipo de cuerpo receptor (description of receiving water body):

- ___ Quebrada (Stream)
- X Rio (River)
- ___ Oceano (Ocean)
- ___ Otro (Other): ___

Tributario a que cuerpo mayor (tributary to what major water body): Unknown
Distancia del cuerpo de agua mayor (Distance to major water body): Unknown

15) Existen rejiallas en el sistema? (si la respuesta es no, pasar a la pregunta No. 20)
(Do bar screens exist as part of the treatment system? (if not, go to question No. 20)

- ☐ Si (yes)
- X No (no)

16) Describir el tipo de rejillas. (material, dimensiones, separaciones, ect.)
(Describe the type of bar screens (materila, dimensions, opening size, ect.)
None

17) Cual es la frequencia de limpieza de estas rejillas?
(How frequent are bar screens cleaned?)

- ☐ A diario (daily)
- ☐ Cada 2 dias (every 2 days)
- ☐ Cada 3 dias (every 3 days)
- ☐ Cada semana (every week)
- ☐ Otro (other) No Bar Screens

18) Que disposicion se le da la material removido de las rejillas?
(How is the material removed from bar screens disposed off?)

- ☐ En la basaura (in the trash)
- ☐ En la calle (on the street)
- ☐ En el cuerpo receptor (in the recieivng water body)
- ☐ Enterrado (buried)
- ☐ Otro (other) No Bar Screens

19) En cuanto se estima el costo de la construccion de las rejillas en un lugar cercano a la planta?
(What is the estimated construction cost for the bar screens, if built in a nearby shop?)
None Lempiras (Lps.)

20) Posee desarenador la planta de tratamiento? (si su respuesta es no, pasar a la pregunta No. 25)
(Is there a grit cahmber as part of the treatment plant? If your answer is no, go to question No. 25)

- ☐ Si (yes)
- X No (no)

21) Dibujar el desarenador (sketch of the grit chamber)

20) ¿Qué registros se mantienen y qué pruebas se realiza en la instalación?
(What records are kept and what testing is performed at the facility?)
Unknown

21) ¿Con qué frecuencia se limpia systema?
(How often is the sludge cleaned out?)
Should be every 6 months, but it was every 3 years. Accumulation destroyed the bottom of tank.

22) ¿Qué se hace con los lodos removidos?
(What do you do with the sludge that is removed?)
Unknown

23) Se han reutilizado los lodos en granjas o jardines?
(Has there been reuse of sludge for farms or gardens?)
Unknown

24) ¿Existe interes en la utilización de los lodos en las granjas o jardines?
(Do you think anyone in town would be interested in using sludge for farms or gardens?)
Unknown

Ficha De Campo de Plantas Depuradoras (Wastewater Treatment Plant Data Sheet)

Informacion General (General Information)

Fecha (Date):	11-Jan-09
Ciudad (City):	Teupassenti
Departamento (State):	Francisco Morazan
Pais (Country):	Honduras
ID de Proyecto (Project ID):	#5
Nombre del Entrevistador (Interviewer Name):	Lisa Kullen
Coordenadas GPS (GPS Coordinates):	14.221914, -86.715628
Altitud (Elevation), m:	

Resumen del Sitio (Summary of Site):

System is a well develped constructed wetland, following what appears to be an anaerobic filter (a concrete large tank beneath a concrete slab). Performance and history are unknown.

Informacion de Contacto y Personal de Planta (Contact Information and Plant's Personnel)

Nombre del Entrevistado (Name of Person Interviewed):	Operator (Name unknown)
Posicion del Entrevistado (Interviewee's Position):	Facility Operator
Departamento Laboral del Entrevistado (Interviewee's Department):	
Nombre de Planta (Name of the Plant):	Teupassenti
Ubicacion de Planta (Plant's Site Location):	Teupassenti
Director de Planta (Plant Director):	
Operador de Planta (Plant Operator):	
Correo Electronico del Director de Planta (Director's e-mail):	
Direccion de la Oficina del Director (Plant's Director's address):	
Numero de Telefono (Telephone Number):	

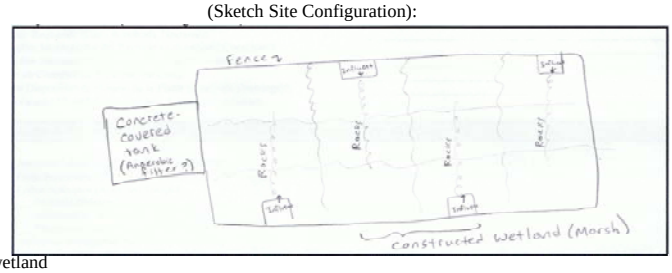
Detalles de Construccion de Planta Depuradora (Construction Details of WWTP's Construction)

Fecha de Construccion (Construction Date):	
Poblacion Servida (Population Served):	
Capacidad de Planta (Plant's Capacity), m3/dia:	
Terreno Requerido (Land Required), Hectareas:	
Consultor Internacional del Proyecto (International Consultant):	
Consultor Nacional del Proyecto (National Consultant):	
Costo de Construcion (Construction Cost):	
Planos Disponibles del Diseno de la Planta (Available Drawings)?:	
Organismo(s) Financiero (s) (Funding Agency or Agencies):	

1. Proceso de Tratamiento Existente (Existing WWT Technology - check all that apply):

____ Tanques Imhoff (Imhoff Tanks)
____ Lagunas de Oxidacion (Waste Stabilization Ponds)
____ Anaerobio (Anaerobic) # ____
____ Facultativa (Facultative) # ____
____ Maduarcion (Maturation) # ____
____ Lagunas Aereadas (Aerated Lagoons)
____ Aeriacion Mechanizada (Mechanical Aeration)
____ Planta Paquete (Package Plant)
____ Upflow Anaerobic Sludge Blanket (UASB)
____ Aeriacion Mechanizada (Mechanical Aeration)
____ Filtro Percolador (Biofilters)
____ Lodos Activados (Activated Sludge)
X Otro(s) (Others): Anaerobic digester; constructed wetland

Tú Dibujas de Configuración del Sitio:
(Sketch Site Configuration):



2. Descripcion General de Instalaciones Fisicas y Pre-Tratamiento (General Description of Physical and Pre-Treatment Facilities)

Epoca (Season): ____ Seca (Dry) X Lluviosa (Rainy)

1) A que distancia se encuentran la planta depuradora de las casas de habitacion mas sercanas?
(How far is the treatment plant form the nearest residence?)
~100 Meters

2) Se encuentra cercado actualmente las instalaciones de la planta depuradora (cerac, portones, y candados?
(Is the treatment plant site currently enclosed (fences, gates, locks)?
Yes: Fence

3) Que tipo de cerco presenta? (What type of fence was used)
Chain Link

4) Como se encontro el cercado al momento de la visita a la planta?
(What was the condition of the site's fence at the time of the visit?)
- ☐ Bueno (good)
- ☐ Regular (regular)
- [X] Malo (poor)
- ☐ Ninguna (none)

5) Cual es el tiempo de residencia con el cual se diseno el sistema de tratamiento? Actual de tiempo de residencia?
(What is the residence time for which the system was designed? Actual operating residence time?)
Unknown

6) Personal que labora permanentemente en el la planta depuradora?
(Permanent personnel working at the plant?) Unknown
- ☐ Vigilante (Guard) #
- ☐ Operador (Operator) #
- ☐ Ingeniero supervisor (Supervising Engineer) #

7) Indicar las herramientas de operacion y mantenimiento que son propiedad y utilizadas por el personal de planta?
(Indicate the maintenance and operation tools at the site that belong and are used by plant's personnel?)

☐ Guantes de hule (rubber gloves)	☐ Martillo (hammer)
☐ Botas de hule (rubber boots)	☐ Serrucho (hand saw)
☐ Capotes (rain coats)	☐ Escoba (broom)
☐ Botiquin (first aid kit)	☐ Desnatador (scum remover)
☐ Uniforme de campo (field uniform)	☐ Lancha (boat)
☐ Casco (hard hat)	☐ Manguera (hose)
☐ Rastrillo para rejilla (bar screen rake)	☐ Machete (machete)
☐ Pala (shovel)	☐ Desatornillador (screw driver/drill)
☐ Piocha (pick)	☐ Llave Stilson 12" (12" pipe wrench)
☐ Carreta de mano (wheelbarrow)	☐ Extractor de natas (scum remover)
☐ Podadora de cesped (lawn mower)	[X] No visto (None seen)

8) Indique la condicion de las herramientas de operacion y mantenimiento de la planta?
(Indicate the condition of the maintenance and operation tools?)
- ☐ Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)
- [X] No es aplicable (not applicable)

9) Con que instalaciones de limpieza cuentan en la casa de operacion (si existe alguna) en la planta de tratamiento?
(What cleaning facilities exist at the plant's operation room (if any exist)?)
- ☐ Agua potable (potable water)
- ☐ Jabon (soap)
- ☐ Cloro (bleach)
- ☐ Toallas desechables (disposable towels)
- ☐ Bañera (bathroom/shower room)
- ☐ Llave spita simple (simple faucet/spigot)
- ☐ Alcohol (alcohol)
- [X] Ninguna (none)

10) Con que equipo cuenta el botiquin de primeros auxilios (si existe alguno)?
(List first aid kit equipment (if any exist)

- ☐ Tela adhesive (gauze)
- ☐ Algodon (cotton)
- ☐ Alcohol (alchohol)
- ☐ Mercurio cromo (Chromium mercury)
- ☐ Detergente desinfectante (desinfecting detergent)
- ☐ Tijeras (scissors)
- ☐ Pinzas (tweezers)
- ☐ Repelente (repellent)
- [X] No cuenta con botiquin (no first aid kit available)

11) Existe una lancha disponible para el matenimiento de la planta? Si la respuesta es no, pasar a la pregunta No. 14).
(Is thera a boat available for the maintenance of the plant? If there is no boat, go to question No. 14).

- ☐ Si (yes)
- ☐ No (no)
- [X] No es aplicable (not applicable)

12) Si una lancha existe, cual es la condicion de la lancha?
(If a boat exists, what is its condition?)

- ☐ Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)

13) Cuales son las dimensiones de la lancha o la capacidad de esta? (what are the boat's dimensions or capacity?)

Capacidad? (Capacity?)
- ____ Personas (Persons)
- [X] No es aplicable (not applicable)

Dimensiones (dimensions):
- _____ Length, m
- _____ Width, m
- _____ depth, m

14) Cual es el nombre, ubicacion y condiciciones del cuerpo receptor del agua tratada?
(What is the name, location and condition of the body of water receiving the treated effluent?)

Nombre (name):
Ubicacion (location): Teupassenti

Tipo de cuerpo receptor (description of receiving water body):

- _____ Quebrada (Stream)
- _____ Rio (River)
- _____ Oceano (Ocean)
- _____ Otro (Other): _____

Tributario a que cuerpo mayor (tributary to what major water body): Unknown
Distancia del cuerpo de agua mayor (Distance to major water body): Unknown

15) Existen rejiallas en el sistema? (si la respuesta es no, pasar a la pregunta No. 20)
(Do bar screens exist as part of the treatment system? (if not, go to question No. 20)

- X Si (yes)
- ☐ No (no)

16) Describir el tipo de rejillas. (material, dimensiones, separaciones, ect.)
(Describe the type of bar screens (materila, dimensions, opening size, ect.)
Rebar with 10 cm squares

17) Cual es la frequencia de limpieza de estas rejillas?
(How frequent are bar screens cleaned?)

- ☐ A diario (daily)
- ☐ Cada 2 dias (every 2 days)
- ☐ Cada 3 dias (every 3 days)
- ☐ Cada semana (every week)
- X Otro (other) Unknown

18) Que disposicion se le da la material removido de las rejillas?
(How is the material removed from bar screens disposed off?)

- ☐ En la basaura (in the trash)
- ☐ En la calle (on the street)
- ☐ En el cuerpo receptor (in the recieivng water body)
- ☐ Enterrado (buried)
- X Otro (other) Unknown

19) En cuanto se estima el costo de la construccion de las rejillas en un lugar cercano a la planta?
(What is the estimated construction cost for the bar screens, if built in a nearby shop?)
Unknown Lempiras (Lps.)

20) Posee desarenador la planta de tratamiento? (si su respuesta es no, pasar a la pregunta No. 25)
(Is there a grit cahmber as part of the treatment plant? If your answer is no, go to question No. 25)

- ☐ Si (yes)
- ☐ No (no) Unknown

21) Dibujar el desarenador (sketch of the grit chamber)

20) ¿Qué registros se mantienen y qué pruebas se realiza en la instalación?
(What records are kept and what testing is performed at the facility?)
Unknown

21) ¿Con qué frecuencia se limpia systema?
(How often is the sludge cleaned out?)
Unknown

22) ¿Qué se hace con los lodos removidos?
(What do you do with the sludge that is removed?)
Unknown

23) Se han reutilizado los lodos en granjas o jardines?
(Has there been reuse of sludge for farms or gardens?)
Unknown

24) ¿Existe interes en la utilización de los lodos en las granjas o jardines?
(Do you think anyone in town would be interested in using sludge for farms or gardens?)
Unknown

Ficha De Campo de Plantas Depuradoras (Wastewater Treatment Plant Data Sheet)

Informacion General (General Information)

Fecha (Date):	7-Jan-09
Ciudad (City):	Las Vegas
Departamento (State):	Santa Barbara
Pais (Country):	Honduras
ID de Proyecto (Project ID):	#6
Nombre del Entrevistador (Interviewer Name):	Lisa Kullen
Coordenadas GPS (GPS Coordinates):	14.871761, -88.068275
Altitud (Elevation), m:	

Resumen del Sitio (Summary of Site):

Well designed Imhoff tanks are in a state of neglect. Flow gates are missing, allowing most wastewater to bypass system and exit untreated. Tanks have been desludged once in 15 years, and this was 14 months ago. No plans exist for the next desludging. Tanks appear to be in need of desludging, with gasses bubbling up into water tanks from sludge compartment below. Flow appears to exceed design flow, leading to less than the intended design residence time. City has low connection rates, and is currently constructing a collector to bring wastewater away from more homes. Most likely this will route wastewater to the river, at least initially, as no additional treatment facility exists for this additional flow.

Informacion de Contacto y Personal de Planta (Contact Information and Plant's Personnel)

Nombre del Entrevistado (Name of Person Interviewed):	Compilation of sources including Marcos Godoy
Posicion del Entrevistado (Interviewee's Position):	Municipal Engineer
Departamento Laboral del Entrevistado (Interviewee's Department):	
Nombre de Planta (Name of the Plant):	Las Vegas Imhoff Tank
Ubicacion de Planta (Plant's Site Location):	Las Vegas
Director de Planta (Plant Director):	Ing. Alexis Rodriguez Murillo
Operador de Planta (Plant Operator):	Marcos Godoy
Correo Electronico del Director de Planta (Director's e-mail):	alerom60@hotmail.com
Direccion de la Oficina del Director (Plant's Director's address):	Barrio el centro, Frente al Parque Central, Las Vegas, Santa Barbara.
Numero de Telefono (Telephone Number):	(504) 659-3275

Detalles de Construccion de Planta Depuradora (Construction Details of WWTP's Construction)

Fecha de Construccion (Construction Date):	1992
Poblacion Servida (Population Served):	3600 People
Capacidad de Planta (Plant's Capacity), m3/dia:	514 cubic meters total volume; 98 cubic meters water volume
Terreno Requerido (Land Required), Hectareas:	Unknown
Consultor Internacional del Proyecto (International Consultant):	N/A
Consultor Nacional del Proyecto (National Consultant):	SANAA, Agua Para el Pueblo
Costo de Construcion (Construction Cost):	
Planos Disponibles del Diseno de la Planta (Available Drawings)?:	Yes
Organismo(s) Financiero (s) (Funding Agency or Agencies):	FHIS and municipality of Las Vegas

1. Proceso de Tratamiento Existente (Existing WWT Technology - check all that apply):

X Tanques Imhoff (Imhoff Tanks)

___ Lagunas de Oxidacion (Waste Stabilization Ponds)

- ___ Anaerobio (Anaerobic) # ____
- ___ Facultativa (Facultative) # ____
- ___ Maduarcion (Maturation) # ____

___ Lagunas Aereadas (Aerated Lagoons)

___ Aeriacion Mechanizada (Mechanical Aeration)

___ Planta Paquete (Package Plant)

___ Upflow Anaerobic Sludge Blanket (UASB)

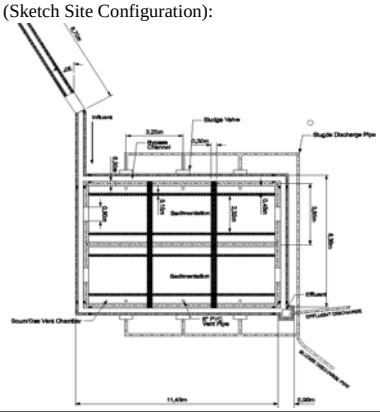
___ Aeriacion Mechanizada (Mechanical Aeration)

___ Filtro Percolador (Biofilters)

___ Lodos Activados (Activated Sludge)

___ Otro(s) (Others): _____

Tú Dibujas de Configuración del Sitio:
(Sketch Site Configuration):



2. Descripcion General de Instalaciones Fisicas y Pre-Tratamiento (General Description of Physical and Pre-Treatment Facilities)

Epoca (Season): ____ Seca (Dry) X Lluviosa (Rainy)

1) A que distancia se encuentran la planta depuradora de las casas de habitacion mas sercanas?
(How far is the treatment plant form the nearest residence?)
50 - 75 meters

2) Se encuentra cercado actualmente las instalaciones de la planta depuradora (cerac, portones, y candados?
(Is the treatment plant site currently enclosed (fences, gates, locks)?
No

3) Que tipo de cerco presenta? (What type of fence was used)
None

4) Como se encontro el cercado al momento de la visita a la planta?
(What was the condition of the site's fence at the time of the visit?)
- ☐ Bueno (good)
- ☐ Regular (regular)
- ☐ Malo (poor)
- X Ninguna (none)

5) Cual es el tiempo de residencia con el cual se diseno el sistema de tratamiento? Actual de tiempo de residencia?
(What is the residence time for which the system was designed? Actual operating residence time?)
Unknown, but designed for 4,000 people with flow of 250 L/person/day, or total flow of 1,000 cubic meters/day

6) Personal que labora permanentemente en el la planta depuradora?
(Permanent personnel working at the plant?)
- ☐ Vigilante (Guard) #
- ☐ Operador (Operator) #
- ☐ Ingeniero supervisor (Supervising Engineer) #

7) Indicar las herramientas de operacion y mantenimiento que son propiedad y utilizadas por el personal de planta?
(Indicate the maintenance and operation tools at the site that belong and are used by plant's personnel?)

☐ Guantes de hule (rubber gloves)	☐ Martillo (hammer)
☐ Botas de hule (rubber boots)	☐ Serrucho (hand saw)
☐ Capotes (rain coats)	☐ Escoba (broom)
☐ Botiquin (first aid kit)	☐ Desnatador (scum remover)
☐ Uniforme de campo (field uniform)	☐ Lancha (boat)
☐ Casco (hard hat)	☐ Manguera (hose)
☐ Rastrillo para rejilla (bar screen rake)	☐ Machete (machete)
☐ Pala (shovel)	☐ Desatornillador (screw driver/drill)
☐ Piocha (pick)	☐ Llave Stilson 12" (12" pipe wrench)
☐ Carreta de mano (wheelbarrow)	☐ Extractor de natas (scum remover)
☐ Podadora de cesped (lawn mower)	X No visto (None seen)

8) Indique la condicion de las herramientas de operacion y mantenimiento de la planta?
(Indicate the condition of the maintenance and operation tools?)
- ☐ Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)
- X No es aplicable (not applicable)

9) Con que instalaciones de limpieza cuentan en la casa de operacion (si existe alguna) en la planta de tratamiento?
(What cleaning facilities exist at the plant's operation room (if any exist)?)
- ☐ Agua potable (potable water)
- ☐ Jabon (soap)
- ☐ Cloro (bleach)
- ☐ Toallas desechables (disposable towels)
- ☐ Bañera (bathroom/shower room)
- ☐ Llave spita simple (simple faucet/spigot)
- ☐ Alcohol (alcohol)
- X Ninguna (none)

10) Con que equipo cuenta el botiquin de primeros auxilios (si existe alguno)?
(List first aid kit equipment (if any exist)

- ☐ Tela adhesive (gauze)
- ☐ Algodon (cotton)
- ☐ Alcohol (alchohol)
- ☐ Mercurio cromo (Chromium mercury)
- ☐ Detergente desinfectante (desinfecting detergent)
- ☐ Tijeras (scissors)
- ☐ Pinzas (tweezers)
- ☐ Repelente (repellent)
- X No cuenta con botiquin (no first aid kit available)

11) Existe una lancha disponible para el matenimiento de la planta? Si la respuesta es no, pasar a la pregunta No. 14).
(Is thera a boat available for the maintenance of the plant? If there is no boat, go to question No. 14).

- ☐ Si (yes)
- ☐ No (no)
- X No es aplicable (not applicable)

12) Si una lancha existe, cual es la condicion de la lancha?
(If a boat exists, what is its condition?)

- ☐ Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)

13) Cuales son las dimensiones de la lancha o la capacidad de esta? (what are the boat's dimensions or capacity?)

Capacidad? (Capacity?)

- ____ Personas (Persons)
- X No es aplicable (not applicable)

Dimensiones (dimensions):

- _____ Length, m
- _____ Width, m
- _____ depth, m

14) Cual es el nombre, ubicacion y condiciciones del cuerpo receptor del agua tratada?
(What is the name, location and condition of the body of water receiving the treated effluent?)

Nombre (name): Quebrada Raices

Ubicacion (location): South of Imhoff Tank

Tipo de cuerpo receptor (description of receiving water body):

- _____ Quebrada (Stream)
- X Rio (River)
- _____ Oceano (Ocean)
- _____ Otro (Other): _____

Tributario a que cuerpo mayor (tributary to what major water body): Lake Joyoa

Distancia del cuerpo de agua mayor (Distance to major water body): 8 km

15) Existen rejiallas en el sistema? (si la respuesta es no, pasar a la pregunta No. 20)
(Do bar screens exist as part of the treatment system? (if not, go to question No. 20)

- ☐ Si (yes)
- X No (no)

16) Describir el tipo de rejillas. (material, dimensiones, separaciones, ect.)
(Describe the type of bar screens (materila, dimensions, opening size, ect.)

None

17) Cual es la frequencia de limpieza de estas rejillas?
(How frequent are bar screens cleaned?)

- ☐ A diario (daily)
- ☐ Cada 2 dias (every 2 days)
- ☐ Cada 3 dias (every 3 days)
- ☐ Cada semana (every week)
- ☐ Otro (other) No Bar Screens

18) Que disposicion se le da la material removido de las rejillas?
(How is the material removed from bar screens disposed off?)

- ☐ En la basaura (in the trash)
- ☐ En la calle (on the street)
- ☐ En el cuerpo receptor (in the recieivng water body)
- ☐ Enterrado (buried)
- ☐ Otro (other) No Bar Screens

19) En cuanto se estima el costo de la construccion de las rejillas en un lugar cercano a la planta?
(What is the estimated construction cost for the bar screens, if built in a nearby shop?)
None Lempiras (Lps.)

20) Posee desarenador la planta de tratamiento? (si su respuesta es no, pasar a la pregunta No. 25)
(Is there a grit cahmber as part of the treatment plant? If your answer is no, go to question No. 25)

- ☐ Si (yes)
- X No (no)

21) Dibujar el desarenador (sketch of the grit chamber)

(none)

20) ¿Qué registros se mantienen y qué pruebas se realiza en la instalación?
(What records are kept and what testing is performed at the facility?)
Unknown

21) ¿Con qué frecuencia se limpia systema?
(How often is the sludge cleaned out?)
Was desludged once in 15 years, in late 2007

22) ¿Qué se hace con los lodos removidos?
(What do you do with the sludge that is removed?)
Some burried on site and some flowed through existing plumbing to river, as there is currently no drying bed on site

23) Se han reutilizado los lodos en granjas o jardines?
(Has there been reuse of sludge for farms or gardens?)
No

24) ¿Existe interes en la utilización de los lodos en las granjas o jardines?
(Do you think anyone in town would be interested in using sludge for farms or gardens?)
Unknown. There are gardens and farms in the immediate vacinity of the tanks

Ficha De Campo de Plantas Depuradoras (Wastewater Treatment Plant Data Sheet)

Informacion General (General Information)

Fecha (Date):	20-Jan-09
Ciudad (City):	Puerto Cortés
Departamento (State):	Cortés
Pais (Country):	Honduras
ID de Proyecto (Project ID):	#7
Nombre del Entrevistador (Interviewer Name):	Lisa Kullen
Coordenadas GPS (GPS Coordinates):	15.85770, -87.92467
Altitud (Elevation), m:	

Resumen del Sitio (Summary of Site):

Puerto Cortés has a sophisticated, well-designed system of lagoons handling large flow volume for a large city. The system has a very good removal efficiency, with effluent quality meeting WHO guidelines for swimming waters (80 CFU). This is a very well managed system.

System is suffering a critical failure of the geoliner. System is built over a marsh with a high water table, and methane generation has strained the geoliner. The facultative and especially the maturation ponds have large bubbles in the membrane, many emerging above the surface of the pond. The liner has broken & failed in several places. The city is searching for solutions and is concerned about funding and about the success of the alternatives considered. Among the options are a geodrain (gravel bed and pipes laid beneath ponds) or concrete liners for ponds. Both solutions involve reconstructing ponds at great expense. Problem will get worse, and must be addressed soon.

Informacion de Contacto y Personal de Planta (Contact Information and Plant's Personnel)

Nombre del Entrevistado (Name of Person Interviewed):	Ing. Sara Canales
Posicion del Entrevistado (Interviewee's Position):	Engineer in charge of facility
Departamento Laboral del Entrevistado (Interviewee's Department):	Wastewater Treatment Plant (Aguas de Puerto Cortes)
Nombre de Planta (Name of the Plant):	Alcantarillado Sanitario
Ubicacion de Planta (Plant's Site Location):	Puerto Cortés
Director de Planta (Plant Director):	Ing. Sara Canales
Operador de Planta (Plant Operator):	Denis Contreras & Enrique Bardales
Correo Electronico del Director de Planta (Director's e-mail):	scanales75@hotmail.com
Direccion de la Oficina del Director (Plant's Director's address):	9 Calle Este, Entre 4 y 6 Calle, Primer Nivel Estadio Excelsior
Numero de Telefono (Telephone Number):	665-6870 or 665-2794

Detalles de Construccion de Planta Depuradora (Construction Details of WWTP's Construction)

Fecha de Construccion (Construction Date):	2005
Poblacion Servida (Population Served):	40,000 to 60,000 people
Capacidad de Planta (Plant's Capacity), m3/dia:	Unknown
Terreno Requerido (Land Required), Hectareas:	22 Hectares
Consultor Internacional del Proyecto (International Consultant):	Hazen & Sawyer
Consultor Nacional del Proyecto (National Consultant):	None
Costo de Construcion (Construction Cost):	$21,500,000
Planos Disponibles del Diseno de la Planta (Available Drawings)?:	Unknown
Organismo(s) Financiero (s) (Funding Agency or Agencies):	Inter-American Development Bank Loan, city will repay

1. Proceso de Tratamiento Existente (Existing WWT Technology - check all that apply):

___ Tanques Imhoff (Imhoff Tanks)

X Lagunas de Oxidacion (Waste Stabilization Ponds)

- ___ Anaerobio (Anaerobic) # 2 (will expand to 3)
- ___ Facultativa (Facultative) # 2 (will expand to 3)
- ___ Maduarcion (Maturation) # 2 (will expand to 3)

___ Lagunas Aereadas (Aerated Lagoons)

___ Aeriacion Mechanizada (Mechanical Aeration)

___ Planta Paquete (Package Plant)

___ Upflow Anaerobic Sludge Blanket (UASB)

___ Aeriacion Mechanizada (Mechanical Aeration)

___ Filtro Percolador (Biofilters)

___ Lodos Activados (Activated Sludge)

___ Otro(s) (Others): Anaerobic digester; constructed wetland

Tú Dibujas de Configuración del Sitio:
(Sketch Site Configuration):

2. Descripcion General de Instalaciones Fisicas y Pre-Tratamiento (General Description of Physical and Pre-Treatment Facilities)

Epoca (Season): ____ Seca (Dry) X Lluviosa (Rainy)

1) A que distancia se encuentran la planta depuradora de las casas de habitacion mas sercanas?
(How far is the treatment plant form the nearest residence?)
50 Meters (residences were relocated by city, but some moved back)

2) Se encuentra cercado actualmente las instalaciones de la planta depuradora (cerac, portones, y candados?
(Is the treatment plant site currently enclosed (fences, gates, locks)?
Yes

3) Que tipo de cerco presenta? (What type of fence was used)
Chain Link Fence & Guard at Gate

4) Como se encontro el cercado al momento de la visita a la planta?
(What was the condition of the site's fence at the time of the visit?)
- X Bueno (good)
- ☐ Regular (regular)
- ☐ Malo (poor)
- ☐ Ninguna (none)

5) Cual es el tiempo de residencia con el cual se diseno el sistema de tratamiento? Actual de tiempo de residencia?
(What is the residence time for which the system was designed? Actual operating residence time?)
9 - 13 days (depending on rain; many illegal storm drain connections exist, so system gets large flows in frequent rain storms)

6) Personal que labora permanentemente en el la planta depuradora?
(Permanent personnel working at the plant?)

X	Vigilante (Guard)	# 1
X	Operador (Operator)	# ~4
X	Ingeniero supervisor (Supervising Engineer)	# 1

7) Indicar las herramientas de operacion y mantenimiento que son propiedad y utilizadas por el personal de planta?
(Indicate the maintenance and operation tools at the site that belong and are used by plant's personnel?)

X	Guantes de hule (rubber gloves)	X	Martillo (hammer)
X	Botas de hule (rubber boots)	X	Serrucho (hand saw)
X	Capotes (rain coats)	X	Escoba (broom)
X	Botiquin (first aid kit)	X	Desnatador (scum remover)
☐	Uniforme de campo (field uniform)	X	Lancha (boat)
☐	Casco (hard hat)	X	Manguera (hose)
X	Rastrillo para rejilla (bar screen rake)	X	Machete (machete)
X	Pala (shovel)	X	Desatornillador (screw driver/drill)
X	Piocha (pick)	X	Llave Stilson 12" (12" pipe wrench)
X	Carreta de mano (wheelbarrow)	X	Extractor de natas (scum remover)
X	Podadora de cesped (lawn mower)	☐	No visto (None seen)

8) Indique la condicion de las herramientas de operacion y mantenimiento de la planta?
(Indicate the condition of the maintenance and operation tools?)
- X Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)
- ☐ No es aplicable (not applicable)

9) Con que instalaciones de limpieza cuentan en la casa de operacion (si existe alguna) en la planta de tratamiento?
(What cleaning facilities exist at the plant's operation room (if any exist)?)
- X Agua potable (potable water)
- X Jabon (soap)
- X Cloro (bleach)
- X Toallas desechables (disposable towels)
- X Bañera (bathroom/shower room)
- X Llave spita simple (simple faucet/spigot)
- X Alcohol (alcohol)
- ☐ Ninguna (none)

10) Con que equipo cuenta el botiquin de primeros auxilios (si existe alguno)?
(List first aid kit equipment (if any exist)

- X Tela adhesive (gauze)
- X Algodon (cotton)
- X Alcohol (alchohol)
- ☐ Mercurio cromo (Chromium mercury)
- X Detergente desinfectante (desinfecting detergent)
- X Tijeras (scissors)
- X Pinzas (tweezers)
- ☐ Repelente (repellent)
- ☐ No cuenta con botiquin (no first aid kit available)

11) Existe una lancha disponible para el matenimiento de la planta? Si la respuesta es no, pasar a la pregunta No. 14).
(Is thera a boat available for the maintenance of the plant? If there is no boat, go to question No. 14).

- X Si (yes)
- ☐ No (no)
- ☐ No es aplicable (not applicable)

12) Si una lancha existe, cual es la condicion de la lancha?
(If a boat exists, what is its condition?)

- X Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)

13) Cuales son las dimensiones de la lancha o la capacidad de esta? (what are the boat's dimensions or capacity?)

Capacidad? (Capacity?)
5 Personas (Persons)
☐ No es aplicable (not applicable)

Dimensiones (dimensions):
_____ Length, m
_____ Width, m
_____ depth, m

14) Cual es el nombre, ubicacion y condiciciones del cuerpo receptor del agua tratada?
(What is the name, location and condition of the body of water receiving the treated effluent?)

Nombre (name): Laguna de Alvarado
Ubicacion (location): Puerto Cortés
Tipo de cuerpo receptor (description of receiving water body):

- _____ Quebrada (Stream)
- _____ Rio (River)
- _____ Oceano (Ocean)
- X _____ Otro (Other): Lagoon

Tributario a que cuerpo mayor (tributary to what major water body): Caribbean Sea
Distancia del cuerpo de agua mayor (Distance to major water body): Immediately adjacent

15) Existen rejiallas en el sistema? (si la respuesta es no, pasar a la pregunta No. 20)
(Do bar screens exist as part of the treatment system? (if not, go to question No. 20)

- X Si (yes)
- ☐ No (no)

16) Describir el tipo de rejillas. (material, dimensiones, separaciones, ect.)
(Describe the type of bar screens (material, dimensions, opening size, ect.)
Metal rails in sophisticated headworks. 1 cm space between rails.

17) Cual es la frequencia de limpieza de estas rejillas?
(How frequent are bar screens cleaned?)

- X A diario (daily)
- ☐ Cada 2 dias (every 2 days)
- ☐ Cada 3 dias (every 3 days)
- ☐ Cada semana (every week)
- ☐ Otro (other) Screens were cleaned mechanically, but system is currently not operating so they are hand cleaned.

18) Que disposicion se le da la material removido de las rejillas?
(How is the material removed from bar screens disposed off?)

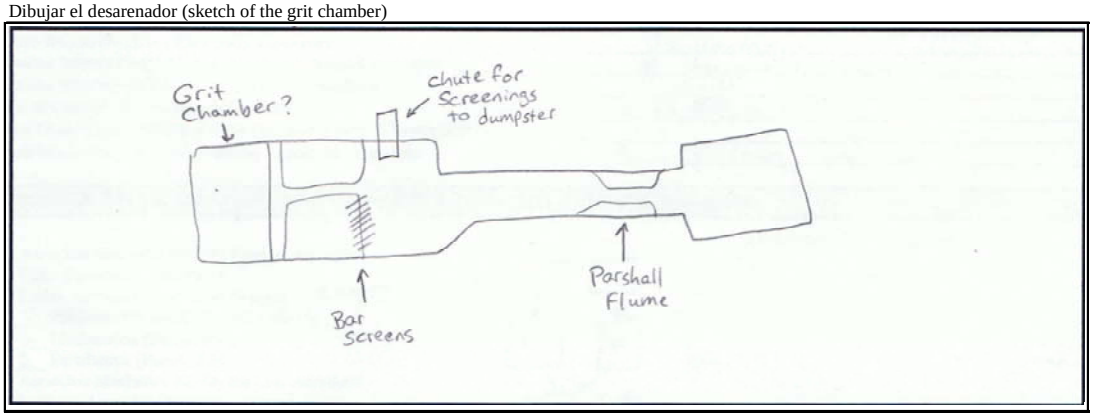
- ☐ En la basaura (in the trash)
- ☐ En la calle (on the street)
- ☐ En el cuerpo receptor (in the recieivng water body)
- ☐ Enterrado (buried)
- X Otro (other) Sanitary Landfill

19) En cuanto se estima el costo de la construccion de las rejillas en un lugar cercano a la planta?
(What is the estimated construction cost for the bar screens, if built in a nearby shop?)
Unknown Lempiras (Lps.)

20) Posee desarenador la planta de tratamiento? (si su respuesta es no, pasar a la pregunta No. 25)
(Is there a grit chamber as part of the treatment plant? If your answer is no, go to question No. 25)

- X Si (yes)
- ☐ No (no)

21) Dibujar el desarenador (sketch of the grit chamber)



20) ¿Qué registros se mantienen y qué pruebas se realiza en la instalación?
(What records are kept and what testing is performed at the facility?)
Very good records, including testing influent and effluent 2x/week. Tests are performed at Jordan Labs every month.

21) ¿Con qué frecuencia se limpia systema?
(How often is the sludge cleaned out?)
Not yet - 3 years in anaerobic, and 5 years in facultative pond.

22) ¿Qué se hace con los lodos removidos?
(What do you do with the sludge that is removed?)
Drying bed will be built on premises. After dry, unsure where sludge will be disposed of.

23) Se han reutilizado los lodos en granjas o jardines?
(Has there been reuse of sludge for farms or gardens?)
Not yet, but under consideration.

24) ¿Existe interes en la utilización de los lodos en las granjas o jardines?
(Do you think anyone in town would be interested in using sludge for farms or gardens?)
Yes.

Ficha De Campo de Plantas Depuradoras (Wastewater Treatment Plant Data Sheet)

Informacion General (General Information)

Fecha (Date):	19-Jan-09
Ciudad (City):	Choloma
Departamento (State):	Cortés
Pais (Country):	Honduras
ID de Proyecto (Project ID):	#8
Nombre del Entrevistador (Interviewer Name):	Lisa Kullen
Coordenadas GPS (GPS Coordinates):	15.593364, -87.925003
Altitud (Elevation), m:	

Resumen del Sitio (Summary of Site):

System has been online 2 years. The director is in process of developing testing protocols, and municipality is interested in recommendations of what to test and to monitor. Facility handles municipal domestic wastewater and some indstrial from machilladoras. Sludge levels have not been measured. Site is well maintained. System does have several large crocodiles (up to 4 meters in length) which pose a safety hazard as well as the potential to damage ponds when burrowing and when entering and exiting over birms. One facultative pond was much greener than the other, indicating dissimilar algael activity between the two ponds. This site is Lagunas Sector Centre; municipal ponds at Lagunas Sector Norte are also online but are reportedly in bad shape.

Informacion de Contacto y Personal de Planta (Contact Information and Plant's Personnel)

Nombre del Entrevistado (Name of Person Interviewed):	Ing. Julio Hernandez & Jose Cecilio Valle
Posicion del Entrevistado (Interviewee's Position):	Julio Hernandez: Technical Assistant
Departamento Laboral del Entrevistado (Interviewee's Department):	Dimach
Nombre de Planta (Name of the Plant):	Lagunas de Oxidacion Sector Centro
Ubicacion de Planta (Plant's Site Location):	Choloma
Director de Planta (Plant Director):	Ing. Julio Hernandez (Technical Assistant) & Fernando Moncada (Technical Director)
Operador de Planta (Plant Operator):	Eduardo Caballero
Correo Electronico del Director de Planta (Director's e-mail):	Hernandez: jicea@yahoo.com; Moncada: fermoncadam@yahoo.es
Direccion de la Oficina del Director (Plant's Director's address):	Bo. El Centro, 2da. Avenida, 2 y 3 Calle, Choloma, Cortés
Numero de Telefono (Telephone Number):	504-669-3223

Detalles de Construccion de Planta Depuradora (Construction Details of WWTP's Construction)

Fecha de Construccion (Construction Date):	Aug-05
Poblacion Servida (Population Served):	50,000 Persons
Capacidad de Planta (Plant's Capacity), m3/dia:	?(2 Facultative: 82*390 meters; 2 Maturation: 75*366 meters)
Terreno Requerido (Land Required), Hectareas:	10 hectares (ponds); 30 hectares (total)
Consultor Internacional del Proyecto (International Consultant):	None
Consultor Nacional del Proyecto (National Consultant):	Unknown
Costo de Construcion (Construction Cost):	Unknown
Planos Disponibles del Diseno de la Planta (Available Drawings)?:	Unknown
Organismo(s) Financiero (s) (Funding Agency or Agencies):	Unknown

1. Proceso de Tratamiento Existente (Existing WWT Technology - check all that apply):

- ____ Tanques Imhoff (Imhoff Tanks)
- X Lagunas de Oxidacion (Waste Stabilization Ponds)
  - ___ Anaerobio (Anaerobic) # ____
  - X Facultativa (Facultative) # 2
  - X Maduarcion (Maturation) # 2
- ____ Lagunas Aereadas (Aerated Lagoons)
- ____ Aeriacion Mechanizada (Mechanical Aeration)
- ____ Planta Paquete (Package Plant)
- ____ Upflow Anaerobic Sludge Blanket (UASB)
- ____ Aeriacion Mechanizada (Mechanical Aeration)
- ____ Filtro Percolador (Biofilters)
- ____ Lodos Activados (Activated Sludge)
- ____ Otro(s) (Others): _____

Tú Dibujas de Configuración del Sitio:
(Sketch Site Configuration):

2. Descripcion General de Instalaciones Fisicas y Pre-Tratamiento (General Description of Physical and Pre-Treatment Facilities)

Epoca (Season): ___ Seca (Dry) X Lluviosa (Rainy)

1) A que distancia se encuentran la planta depuradora de las casas de habitacion mas sercanas?
(How far is the treatment plant form the nearest residence?)
200 Meters

2) Se encuentra cercado actualmente las instalaciones de la planta depuradora (cerac, portones, y candados?
(Is the treatment plant site currently enclosed (fences, gates, locks)?
Yes

3) Que tipo de cerco presenta? (What type of fence was used)
Barbed Wire

4) Como se encontro el cercado al momento de la visita a la planta?
(What was the condition of the site's fence at the time of the visit?)
- X Bueno (good)
- ☐ Regular (regular)
- ☐ Malo (poor)
- ☐ Ninguna (none)

5) Cual es el tiempo de residencia con el cual se diseno el sistema de tratamiento? Actual de tiempo de residencia?
(What is the residence time for which the system was designed? Actual operating residence time?)
Reportedly 72 hours

6) Personal que labora permanentemente en el la planta depuradora?
(Permanent personnel working at the plant?)
- X Vigilante (Guard) # 1
- X Operador (Operator) # 5
- ☐ Ingeniero supervisor (Supervising Engineer) #

7) Indicar las herramientas de operacion y mantenimiento que son propiedad y utilizadas por el personal de planta?
(Indicate the maintenance and operation tools at the site that belong and are used by plant's personnel?)

X	Guantes de hule (rubber gloves)	X	Martillo (hammer)
X	Botas de hule (rubber boots)	X	Serrucho (hand saw)
X	Capotes (rain coats)	☐	Escoba (broom)
X	Botiquin (first aid kit)	X	Desnatador (scum remover)
☐	Uniforme de campo (field uniform)	X	Lancha (boat)
☐	Casco (hard hat)	X	Manguera (hose)
X	Rastrillo para rejilla (bar screen rake)	X	Machete (machete)
X	Pala (shovel)	☐	Desatornillador (screw driver/drill)
X	Piocha (pick)	☐	Llave Stilson 12" (12" pipe wrench)
☐	Carreta de mano (wheelbarrow)	X	Extractor de natas (scum remover)
☐	Podadora de cesped (lawn mower)	☐	No visto (None seen)

8) Indique la condicion de las herramientas de operacion y mantenimiento de la planta?
(Indicate the condition of the maintenance and operation tools?)
- X Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)
- ☐ No es aplicable (not applicable)

9) Con que instalaciones de limpieza cuentan en la casa de operacion (si existe alguna) en la planta de tratamiento?
(What cleaning facilities exist at the plant's operation room (if any exist)?)
- X Agua potable (potable water)
- X Jabon (soap)
- ☐ Cloro (bleach)
- ☐ Toallas desechables (disposable towels)
- X Bañera (bathroom/shower room)
- X Llave spita simple (simple faucet/spigot)
- ☐ Alcohol (alcohol)
- X Ninguna (none)

10) Con que equipo cuenta el botiquin de primeros auxilios (si existe alguno)?
(List first aid kit equipment (if any exist)

X Tela adhesive (gauze)
☐ Algodon (cotton)
X Alcohol (alchohol)
☐ Mercurio cromo (Chromium mercury)
☐ Detergente desinfectante (desinfecting detergent)
☐ Tijeras (scissors)
☐ Pinzas (tweezers)
☐ Repelente (repellent)
☐ No cuenta con botiquin (no first aid kit available)

X Other: Asprin, Alka Seltzer

11) Existe una lancha disponible para el matenimiento de la planta? Si la respuesta es no, pasar a la pregunta No. 14).
(Is thera a boat available for the maintenance of the plant? If there is no boat, go to question No. 14).

X Si (yes) *Boat is missing, but the municipality has a boat which is borrowed when needed
☐ No (no)
☐ No es aplicable (not applicable)

12) Si una lancha existe, cual es la condicion de la lancha?
(If a boat exists, what is its condition?)

X Buena (good)
☐ Regular (regular)
☐ Mala (poor)

13) Cuales son las dimensiones de la lancha o la capacidad de esta? (what are the boat's dimensions or capacity?)

Capacidad? (Capacity?)
? Personas (Persons)
☐ No es aplicable (not applicable)

Dimensiones (dimensions):
_____ Length, m
_____ Width, m
_____ depth, m

14) Cual es el nombre, ubicacion y condiciciones del cuerpo receptor del agua tratada?
(What is the name, location and condition of the body of water receiving the treated effluent?)

Nombre (name): Chaparro Quebrado & Quebrada San Augustin (Agua Prieta)
Ubicacion (location): Choloma
Tipo de cuerpo receptor (description of receiving water body):

X Quebrada (Stream)
_____ Rio (River)
_____ Oceano (Ocean)
_____ Otro (Other): _____

Tributario a que cuerpo mayor (tributary to what major water body): Unknown
Distancia del cuerpo de agua mayor (Distance to major water body): Unknown

15) Existen rejiallas en el sistema? (si la respuesta es no, pasar a la pregunta No. 20)
(Do bar screens exist as part of the treatment system? (if not, go to question No. 20)

X Si (yes)
☐ No (no)

16) Describir el tipo de rejillas. (material, dimensiones, separaciones, ect.)
(Describe the type of bar screens (materila, dimensions, opening size, ect.)
Metal Screen with handles for removal

17) Cual es la frequencia de limpieza de estas rejillas?
(How frequent are bar screens cleaned?)

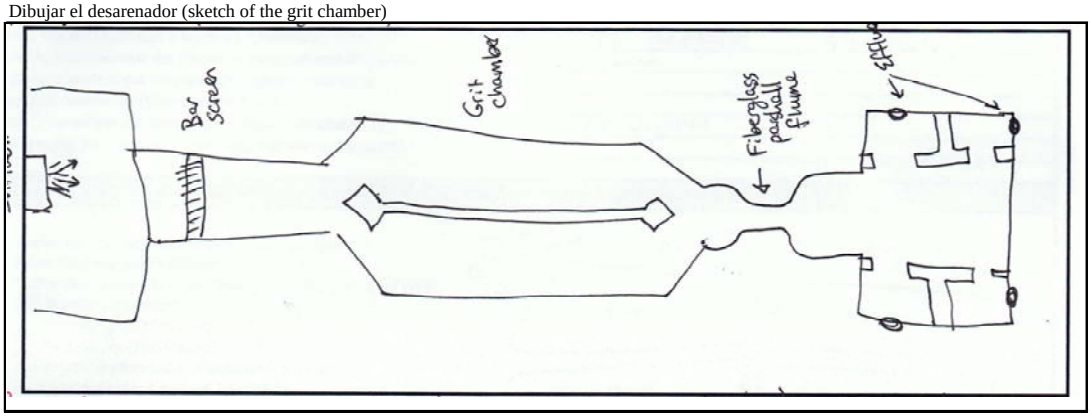
X A diario (daily)
☐ Cada 2 dias (every 2 days)
☐ Cada 3 dias (every 3 days)
☐ Cada semana (every week)
☐ Otro (other) _____

18) Que disposicion se le da la material removido de las rejillas?
(How is the material removed from bar screens disposed off?)
- ☐ En la basaura (in the trash)
- ☐ En la calle (on the street)
- ☐ En el cuerpo receptor (in the recieivng water body)
- X Enterrado (buried)
- ☐ Otro (other) _____

19) En cuanto se estima el costo de la construccion de las rejillas en un lugar cercano a la planta?
(What is the estimated construction cost for the bar screens, if built in a nearby shop?)
Unknown Lempiras (Lps.)

20) Posee desarenador la planta de tratamiento? (si su respuesta es no, pasar a la pregunta No. 25)
(Is there a grit cahmber as part of the treatment plant? If your answer is no, go to question No. 25)
- X Si (yes)
- ☐ No (no) _____

21) Dibujar el desarenador (sketch of the grit chamber)



20) ¿Qué registros se mantienen y qué pruebas se realiza en la instalación?
(What records are kept and what testing is performed at the facility?)
No testing is currently performed. Flow monitoring is done through use of fiberglass Parshall flume in grit chamber.

21) ¿Con qué frecuencia se limpia systema?
(How often is the sludge cleaned out?)
Every 5-6 years (hasn't happened yet)

22) ¿Qué se hace con los lodos removidos?
(What do you do with the sludge that is removed?)
Take off site to a drying bed

23) Se han reutilizado los lodos en granjas o jardines?
(Has there been reuse of sludge for farms or gardens?)
Not yet

24) ¿Existe interes en la utilización de los lodos en las granjas o jardines?
(Do you think anyone in town would be interested in using sludge for farms or gardens?)
Yes, there is interest

Ficha De Campo de Plantas Depuradoras (Wastewater Treatment Plant Data Sheet)

Informacion General (General Information)

Fecha (Date):	17-Jan-09
Ciudad (City):	La Lima
Departamento (State):	Cortés
Pais (Country):	Honduras
ID de Proyecto (Project ID):	#9
Nombre del Entrevistador (Interviewer Name):	Ari Herrera
Coordenadas GPS (GPS Coordinates):	15.453206, -87.919711
Altitud (Elevation), m:	

Resumen del Sitio (Summary of Site):

Well maintained facility keeps very good records. Two facultative ponds and two maturation ponds. Routine maintenance is performed including grounds keeping, scum removal, raking bar screens, documenting flow measurements, and periodically measuring sludge. Some dead zones and were apparent in the corners of ponds. (more?)

Informacion de Contacto y Personal de Planta (Contact Information and Plant's Personnel)

Nombre del Entrevistado (Name of Person Interviewed):	Osmin Aguirre Dubon
Posicion del Entrevistado (Interviewee's Position):	Encaryado de Lagunas (Personnel and Plant Manager)
Departamento Laboral del Entrevistado (Interviewee's Department):	Alcantarillado (Wastewater)
Nombre de Planta (Name of the Plant):	Colonia La Meza / Rodas
Ubicacion de Planta (Plant's Site Location):	Colonia La Meza / Rodas
Director de Planta (Plant Director):	Osmin Aguirre Dubon
Operador de Planta (Plant Operator):	Marcos Ramires, Jose Vaquedano, Jose Luis Martinez
Correo Electronico del Director de Planta (Director's e-mail):	n/a
Direccion de la Oficina del Director (Plant's Director's address):	Municipalidad de La Lima
Numero de Telefono (Telephone Number):	668-2400

Detalles de Construccion de Planta Depuradora (Construction Details of WWTP's Construction)

Fecha de Construccion (Construction Date):	Jun-05
Poblacion Servida (Population Served):	Total capacity 10,000 people, currently serves 3,500 people
Capacidad de Planta (Plant's Capacity), m3/dia:	Unknown
Terreno Requerido (Land Required), Hectareas:	14 Hectares
Consultor Internacional del Proyecto (International Consultant):	Codecon / Puerto Cortés
Consultor Nacional del Proyecto (National Consultant):	N/A
Costo de Construcion (Construction Cost):	18,000,000 Lempiras
Planos Disponibles del Diseno de la Planta (Available Drawings)?:	Yes
Organismo(s) Financiero (s) (Funding Agency or Agencies):	USAID / FHIS

1. Proceso de Tratamiento Existente (Existing WWT Technology - check all that apply):

____ Tanques Imhoff (Imhoff Tanks)
____ Lagunas de Oxidacion (Waste Stabilization Ponds)
___ Anaerobio (Anaerobic) # ____
_X_ Facultativa (Facultative) # 2
_X_ Maduarcion (Maturation) # 2
____ Lagunas Aereadas (Aerated Lagoons)
____ Aeriacion Mechanizada (Mechanical Aeration)
____ Planta Paquete (Package Plant)
____ Upflow Anaerobic Sludge Blanket (UASB)
____ Aeriacion Mechanizada (Mechanical Aeration)
____ Filtro Percolador (Biofilters)
____ Lodos Activados (Activated Sludge)
____ Otro(s) (Others): _____

Tú Dibujas de Configuración del Sitio:
(Sketch Site Configuration):

2. Descripcion General de Instalaciones Fisicas y Pre-Tratamiento (General Description of Physical and Pre-Treatment Facilities)

Epoca (Season): ____ Seca (Dry) X Lluviosa (Rainy)

1) A que distancia se encuentran la planta depuradora de las casas de habitacion mas sercanas?
(How far is the treatment plant form the nearest residence?)
1 Kilometer

2) Se encuentra cercado actualmente las instalaciones de la planta depuradora (cerac, portones, y candados?
(Is the treatment plant site currently enclosed (fences, gates, locks)?
Yes

3) Que tipo de cerco presenta? (What type of fence was used)
Barbed Wire

4) Como se encontro el cercado al momento de la visita a la planta?
(What was the condition of the site's fence at the time of the visit?)
- X Bueno (good)
- ☐ Regular (regular)
- ☐ Malo (poor)
- ☐ Ninguna (none)

5) Cual es el tiempo de residencia con el cual se diseno el sistema de tratamiento? Actual de tiempo de residencia?
(What is the residence time for which the system was designed? Actual operating residence time?)
7-10 days

6) Personal que labora permanentemente en el la planta depuradora?
(Permanent personnel working at the plant?)

X	Vigilante (Guard)	# 1
X	Operador (Operator)	# 3
X	Ingeniero supervisor (Supervising Engineer)	# 1

7) Indicar las herramientas de operacion y mantenimiento que son propiedad y utilizadas por el personal de planta?
(Indicate the maintenance and operation tools at the site that belong and are used by plant's personnel?)

X	Guantes de hule (rubber gloves)	X	Martillo (hammer)
X	Botas de hule (rubber boots)	☐	Serrucho (hand saw)
X	Capotes (rain coats)	X	Escoba (broom)
X	Botiquin (first aid kit)	X	Desnatador (scum remover)
☐	Uniforme de campo (field uniform)	X	Lancha (boat)
☐	Casco (hard hat)	X	Manguera (hose)
X	Rastrillo para rejilla (bar screen rake)	X	Machete (machete)
X	Pala (shovel)	☐	Desatornillador (screw driver/drill)
X	Piocha (pick)	☐	Llave Stilson 12" (12" pipe wrench)
X	Carreta de mano (wheelbarrow)	X	Extractor de natas (scum remover)
X	Podadora de cesped (lawn mower)	☐	No visto (None seen)

8) Indique la condicion de las herramientas de operacion y mantenimiento de la planta?
(Indicate the condition of the maintenance and operation tools?)
- X Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)
- ☐ No es aplicable (not applicable)

9) Con que instalaciones de limpieza cuentan en la casa de operacion (si existe alguna) en la planta de tratamiento?
(What cleaning facilities exist at the plant's operation room (if any exist)?)
- X Agua potable (potable water)
- X Jabon (soap)
- ☐ Cloro (bleach)
- ☐ Toallas desechables (disposable towels)
- X Bañera (bathroom/shower room)
- X Llave spita simple (simple faucet/spigot)
- X Alcohol (alcohol)
- ☐ Ninguna (none)

10) Con que equipo cuenta el botiquin de primeros auxilios (si existe alguno)?
(List first aid kit equipment (if any exist)

- ☐ Tela adhesive (gauze)
- X Algodon (cotton)
- X Alcohol (alchohol)
- ☐ Mercurio cromo (Chromium mercury)
- ☐ Detergente desinfectante (desinfecting detergent)
- X Tijeras (scissors)
- ☐ Pinzas (tweezers)
- ☐ Repelente (repellent)
- ☐ No cuenta con botiquin (no first aid kit available)

11) Existe una lancha disponible para el matenimiento de la planta? Si la respuesta es no, pasar a la pregunta No. 14).
(Is thera a boat available for the maintenance of the plant? If there is no boat, go to question No. 14).

- X Si (yes)
- ☐ No (no)
- ☐ No es aplicable (not applicable)

12) Si una lancha existe, cual es la condicion de la lancha?
(If a boat exists, what is its condition?)

- X Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)

13) Cuales son las dimensiones de la lancha o la capacidad de esta? (what are the boat's dimensions or capacity?)

Capacidad? (Capacity?)
- 2 Personas (Persons)
- ☐ No es aplicable (not applicable)

Dimensiones (dimensions):
- _____ Length, m
- _____ Width, m
- _____ depth, m

14) Cual es el nombre, ubicacion y condiciciones del cuerpo receptor del agua tratada?
(What is the name, location and condition of the body of water receiving the treated effluent?)

Nombre (name): Rio Chamelecon
Ubicacion (location): La Lima
Tipo de cuerpo receptor (description of receiving water body):

- _____ Quebrada (Stream)
- X Rio (River)
- _____ Oceano (Ocean)
- _____ Otro (Other): _____

Tributario a que cuerpo mayor (tributary to what major water body): Carribean Sea
Distancia del cuerpo de agua mayor (Distance to major water body): 50 km

15) Existen rejiallas en el sistema? (si la respuesta es no, pasar a la pregunta No. 20)
(Do bar screens exist as part of the treatment system? (if not, go to question No. 20)

- X Si (yes)
- ☐ No (no)

16) Describir el tipo de rejillas. (material, dimensiones, separaciones, ect.)
(Describe the type of bar screens (materila, dimensions, opening size, ect.)
PVC, 3 cm spacing, 1.5 meters tall, 1/2 meter wide

17) Cual es la frequencia de limpieza de estas rejillas?
(How frequent are bar screens cleaned?)

- X A diario (daily)
- ☐ Cada 2 dias (every 2 days)
- ☐ Cada 3 dias (every 3 days)
- ☐ Cada semana (every week)
- ☐ Otro (other) _____

18) Que disposicion se le da la material removido de las rejillas?
(How is the material removed from bar screens disposed off?)

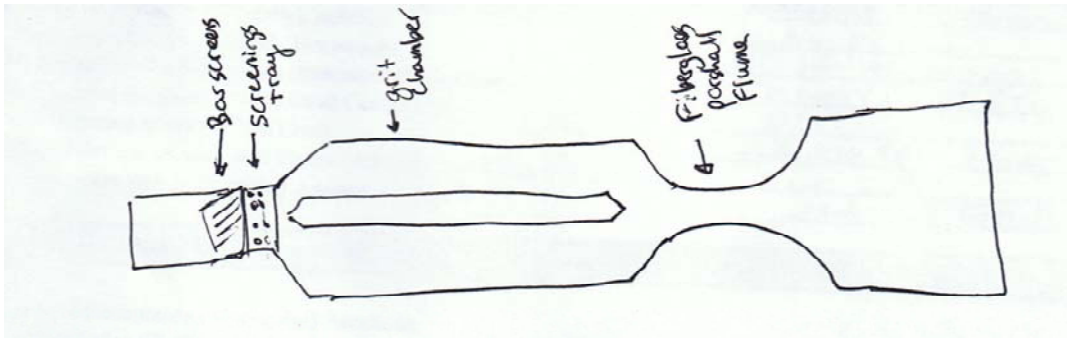
- ☐ En la basaura (in the trash)
- ☐ En la calle (on the street)
- ☐ En el cuerpo receptor (in the recieivng water body)
- X Enterrado (buried)
- ☐ Otro (other) _____

19) En cuanto se estima el costo de la construccion de las rejillas en un lugar cercano a la planta?
(What is the estimated construction cost for the bar screens, if built in a nearby shop?)
100 Lempiras (Lps.) (Made by municipality)

20) Posee desarenador la planta de tratamiento? (si su respuesta es no, pasar a la pregunta No. 25)
(Is there a grit chamber as part of the treatment plant? If your answer is no, go to question No. 25)

- X Si (yes)
- ☐ No (no) _____

21) Dibujar el desarenador (sketch of the grit chamber)



20) ¿Qué registros se mantienen y qué pruebas se realiza en la instalación?
(What records are kept and what testing is performed at the facility?)
Flow monitoring with Parshall flume; sludge depth

21) ¿Con qué frecuencia se limpia systema?
(How often is the sludge cleaned out?)
De-sludging is pending

22) ¿Qué se hace con los lodos removidos?
(What do you do with the sludge that is removed?)
Have not removed sludge yet

23) Se han reutilizado los lodos en granjas o jardines?
(Has there been reuse of sludge for farms or gardens?)
Have not removed sludge yet

24) ¿Existe interes en la utilización de los lodos en las granjas o jardines?
(Do you think anyone in town would be interested in using sludge for farms or gardens?)
Unknown

Ficha De Campo de Plantas Depuradoras (Wastewater Treatment Plant Data Sheet)

Informacion General (General Information)

Fecha (Date):	18-Jan-09
Ciudad (City):	Tela
Departamento (State):	Atlantida
Pais (Country):	Honduras
ID de Proyecto (Project ID):	#10
Nombre del Entrevistador (Interviewer Name):	Lisa Kullen
Coordenadas GPS (GPS Coordinates):	15.786681, -87.440169
Altitud (Elevation), m:	

Resumen del Sitio (Summary of Site):

Three lagoons in series, four meters deep. After 12 years' operation, sludge level had reached pond surface. Pond was rehabilitated in 2007-8 including construction of bypass channels, routing flow around primary pond for a year, drying and dredging sludge to an on-site disposal area. In total 3,000 cubic meters of sludge were removed, and almost all sludge was disposed of onsite. In addition, the project involved rehabilitating the Parshall Flume flow measuring device at the inlet to the treatment facility by inserting a prefabricated fiberglass device into the existing channel.

Informacion de Contacto y Personal de Planta (Contact Information and Plant's Personnel)

Nombre del Entrevistado (Name of Person Interviewed):	Ben Forte & Louise Fox
Posicion del Entrevistado (Interviewee's Position):	Engineers Without Borders Mentor & Student
Departamento Laboral del Entrevistado (Interviewee's Department):	Cal State Chico EWB Water
Nombre de Planta (Name of the Plant):	Natural Wastewater Stabilization Lagoon System Servint Tela
Ubicacion de Planta (Plant's Site Location):	Eastern Tela
Director de Planta (Plant Director):	Ing. Marcos Yánes
Operador de Planta (Plant Operator):	Ing. Marcos Yánes
Correo Electronico del Director de Planta (Director's e-mail):	
Direccion de la Oficina del Director (Plant's Director's address):	Parque Central, Tela, Atlántida
Numero de Telefono (Telephone Number):	(504) 448-0221

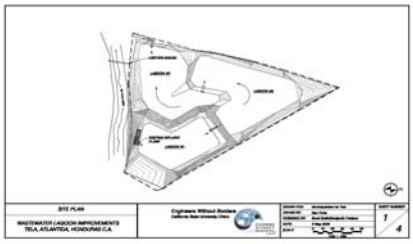
Detalles de Construccion de Planta Depuradora (Construction Details of WWTP's Construction)

Fecha de Construccion (Construction Date):	1993
Poblacion Servida (Population Served):	
Capacidad de Planta (Plant's Capacity), m3/dia:	
Terreno Requerido (Land Required), Hectareas:	2 Hectares
Consultor Internacional del Proyecto (International Consultant):	USAID
Consultor Nacional del Proyecto (National Consultant):	
Costo de Construcion (Construction Cost):	
Planos Disponibles del Diseno de la Planta (Available Drawings)?:	
Organismo(s) Financiero (s) (Funding Agency or Agencies):	USAID

1. Proceso de Tratamiento Existente (Existing WWT Technology - check all that apply):

- ____ Tanques Imhoff (Imhoff Tanks)
- X Lagunas de Oxidacion (Waste Stabilization Ponds)
  - ___ Anaerobio (Anaerobic) # ____
  - X Facultativa (Facultative) # __1__
  - X Maduarcion (Maturation) # __2__
- ____ Lagunas Aereadas (Aerated Lagoons)
- ____ Aeriacion Mechanizada (Mechanical Aeration)
- ____ Planta Paquete (Package Plant)
- ____ Upflow Anaerobic Sludge Blanket (UASB)
- ____ Aeriacion Mechanizada (Mechanical Aeration)
- ____ Filtro Percolador (Biofilters)
- ____ Lodos Activados (Activated Sludge)
- ____ Otro(s) (Others): _____

Tú Dibujas de Configuración del Sitio:
(Sketch Site Configuration):



2. Descripcion General de Instalaciones Fisicas y Pre-Tratamiento (General Description of Physical and Pre-Treatment Facilities)

Epoca (Season): ____ Seca (Dry) X Lluviosa (Rainy)

1) A que distancia se encuentran la planta depuradora de las casas de habitacion mas sercanas?
(How far is the treatment plant form the nearest residence?)
Less than 100 meters

2) Se encuentra cercado actualmente las instalaciones de la planta depuradora (cerac, portones, y candados?
(Is the treatment plant site currently enclosed (fences, gates, locks)?
No

3) Que tipo de cerco presenta? (What type of fence was used)
None

4) Como se encontro el cercado al momento de la visita a la planta?
(What was the condition of the site's fence at the time of the visit?)
- ☐ Bueno (good)
- ☐ Regular (regular)
- ☐ Malo (poor)
- X Ninguna (none)

5) Cual es el tiempo de residencia con el cual se diseno el sistema de tratamiento? Actual de tiempo de residencia?
(What is the residence time for which the system was designed? Actual operating residence time?)

6) Personal que labora permanentemente en el la planta depuradora?
(Permanent personnel working at the plant?)
- ☒ Vigilante (Guard) # 1
- ☒ Operador (Operator) # 1
- ☐ Ingeniero supervisor (Supervising Engineer) #

7) Indicar las herramientas de operacion y mantenimiento que son propiedad y utilizadas por el personal de planta?
(Indicate the maintenance and operation tools at the site that belong and are used by plant's personnel?)

☐ Guantes de hule (rubber gloves)	☐ Martillo (hammer)
☒ Botas de hule (rubber boots)	☐ Serrucho (hand saw)
☒ Capotes (rain coats)	☐ Escoba (broom)
☐ Botiquin (first aid kit)	☒ Desnatador (scum remover)
☐ Uniforme de campo (field uniform)	☐ Lancha (boat)
☐ Casco (hard hat)	☐ Manguera (hose)
☐ Rastrillo para rejilla (bar screen rake)	☒ Machete (machete)
☒ Pala (shovel)	☐ Desatornillador (screw driver/drill)
☐ Piocha (pick)	☐ Llave Stilson 12" (12" pipe wrench)
☒ Carreta de mano (wheelbarrow)	☒ Extractor de natas (scum remover)
☐ Podadora de cesped (lawn mower)	

8) Indique la condicion de las herramientas de operacion y mantenimiento de la planta?
(Indicate the condition of the maintenance and operation tools?)
- ☐ Buena (good)
- ☒ Regular (regular)
- ☐ Mala (poor)
- ☐ No es aplicable (not applicable)

9) Con que instalaciones de limpieza cuentan en la casa de operacion (si existe alguna) en la planta de tratamiento?
(What cleaning facilities exist at the plant's operation room (if any exist)?)
- ☐ Agua potable (potable water)
- ☐ Jabon (soap)
- ☐ Cloro (bleach)
- ☐ Toallas desechables (disposable towels)
- ☐ Bañera (bathroom/shower room)
- ☒ Llave spita simple (simple faucet/spigot)
- ☐ Alcohol (alcohol)
- ☐ Ninguna (none)

10) Con que equipo cuenta el botiquin de primeros auxilios (si existe alguno)?
(List first aid kit equipment (if any exist)

- ☐ Tela adhesive (gauze)
- ☐ Algodon (cotton)
- ☐ Alcohol (alchohol)
- ☐ Mercurio cromo (Chromium mercury)
- ☐ Detergente desinfectante (desinfecting detergent)
- ☐ Tijeras (scissors)
- ☐ Pinzas (tweezers)
- ☐ Repelente (repellent)
- ☒ No cuenta con botiquin (no first aid kit available)

11) Existe una lancha disponible para el matenimiento de la planta? Si la respuesta es no, pasar a la pregunta No. 14).
(Is thera a boat available for the maintenance of the plant? If there is no boat, go to question No. 14).

- ☐ Si (yes)
- ☒ No (no)
- ☐ No es aplicable (not applicable)

12) Si una lancha existe, cual es la condicion de la lancha?
(If a boat exists, what is its condition?)

- ☐ Buena (good)
- ☐ Regular (regular)
- ☐ Mala (poor)
- ☐ No es aplicable (not applicable)

13) Cuales son las dimensiones de la lancha o la capacidad de esta? (what are the boat's dimensions or capacity?)

Capacidad? (Capacity?)

- ____ Personas (Persons)
- ☒ No es aplicable (not applicable)

Dimensiones (dimensions):

- _____ Length, m
- _____ Width, m
- _____ depth, m

14) Cual es el nombre, ubicacion y condiciciones del cuerpo receptor del agua tratada?
(What is the name, location and condition of the body of water receiving the treated effluent?)

Nombre (name): Rio Hylan

Ubicacion (location): Adjacent to treatment system

Tipo de cuerpo receptor (description of receiving water body):

- _____ Quebrada (Stream)
- X Rio (River)
- _____ Oceano (Ocean)
- _____ Otro (Other): _____

Tributario a que cuerpo mayor (tributary to what major water body): Caribbean Ocean, Bay of Tela

Distancia del cuerpo de agua mayor (Distance to major water body): ~1km

15) Existen rejiallas en el sistema? (si la respuesta es no, pasar a la pregunta No. 20)
(Do bar screens exist as part of the treatment system? (if not, go to question No. 20)

- ☐ Si (yes)
- ☒ No (no)

16) Describir el tipo de rejillas. (material, dimensiones, separaciones, ect.)
(Describe the type of bar screens (materila, dimensions, opening size, ect.)

_____

17) Cual es la frequencia de limpieza de estas rejillas?
(How frequent are bar screens cleaned?)

- ☐ A diario (daily)
- ☐ Cada 2 dias (every 2 days)
- ☐ Cada 3 dias (every 3 days)
- ☐ Cada semana (every week)
- ☐ Otro (other) _____

18) Que disposicion se le da la material removido de las rejillas?
(How is the material removed from bar screens disposed off?)

- ☐ En la basaura (in the trash)
- ☐ En la calle (on the street)
- ☐ En el cuerpo receptor (in the recieivng water body)
- ☐ Enterrado (buried)
- ☐ Otro (other) _____

19) En cuanto se estima el costo de la construccion de las rejillas en un lugar cercano a la planta?
(What is the estimated construction cost for the bar screens, if built in a nearby shop?)
_____ Lempiras (Lps.)

20) Posee desarenador la planta de tratamiento? (si su respuesta es no, pasar a la pregunta No. 25)
(Is there a grit cahmber as part of the treatment plant? If your answer is no, go to question No. 25)

- ☐ Si (yes)
- ☒ No (no)

21) Dibujar el desarenador (sketch of the grit chamber)

(No Grit Chamber)

20) ¿Qué registros se mantienen y qué pruebas se realiza en la instalación?
(What records are kept and what testing is performed at the facility?)

21) ¿Con qué frecuencia se limpia systema?
(How often is the sludge cleaned out?)
Has been cleaned once in 15 years

22) ¿Qué se hace con los lodos removidos?
(What do you do with the sludge that is removed?)
Store onsite

23) Se han reutilizado los lodos en granjas o jardines?
(Has there been reuse of sludge for farms or gardens?)
No

24) ¿Existe interes en la utilización de los lodos en las granjas o jardines?
(Do you think anyone in town would be interested in using sludge for farms or gardens?)
Yes

APPENDIX B: MEETING NOTES

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Honduras Coordination Meeting Summary

Project: 2009 Honduras Research Project
Consultant: MIT Research Group "Sustainable Treatment Solutions"
Time: Thursday, January 8, 2009
3:00 PM – 5:00 PM
Location: RAS-HON Offices

Attendees:

Pedro Ortiz, SANAA
Dixy Avita, CESCCO
Mirtha Ferrari, CESCCO
Oscar Garcia, SANAA
Luis Romero, CONASA
Victor Cuevas, SANAA
Robert McLean, MIT
Lisa Kullen, MIT
Ari Herrera, MIT/Malcolm Pirnie
Mahua Bhattacharya, MIT
Eric Adams, MIT

The following is a summary of discussion at the collaboration meeting between the MIT Honduras Research Group and representatives of CESCCO, SANAA and CONASA. If you have any comments on this meeting summary, please contact Ari Herrera at (512) 370-3873 or at aherrera@pirnie.com otherwise, please accept this copy as your record copy.

1. Introductions:
   - Mirtha discussed CESCCO's initiative assessing air quality, water, etc. This involvement was not because this was their jurisdiction, but was due to their unique position and ability to assess these issues. Working with a Swiss student group, they have just completed development of metrics and indicators and performed an assessment of Lake Yojoa contamination. (Note: MIT students would love to see this study if possible.)
   - Pedro expressed interest in hearing what the MIT student group is doing. He stated that, though SANAA has worked on development and implementation of wastewater systems, they haven't always gone back and assessed the success, efficiency, maintenance, and monitoring programs after installation of these systems. Of particular interest is how well a system's performance matches the performance it was designed for.
   - Pedro stated that he sees Honduras as having a strong professional environmental engineering community but it has a need for more research. Many Honduran engineers study outside the country and bring back engineering plans which may be well suited elsewhere, but may not have been evaluated for use in Honduras. Certain assumptions and certain coefficients are used in design, but they have been developed at different latitudes. He would like to see systems assessed for how well they perform locally, and how well they match the equations and the predicted behavior.
   - He would also like to see a broader base of technical training in Honduras, so that there is as stronger foundation of common knowledge and training for collaboration throughout the country.

- Pedro recommends MIT visits previous installations, to see if work has been appropriate, evaluate and modify, and then move on to improving the operation of these systems.
- Pedro feels simple technologies may be very well suited: septic systems, stabilization ponds, Imhoff tanks, etc. But if they're not maintained, the systems will fail.
- Eric introduced the MIT group. He discussed MIT's role as a technical university in Massachusetts, USA. MIT's current project in Honduras is an extension of previous work. In 2006 a student research group studied pollution in Lake Yojoa, identifying likely causes of pollution and determining who the stakeholders were in cleaning up this pollution. Then in 2008 two students investigated treatment in Las Vegas, Santa Barbara, including analysis of chemically enhanced primary treatment in the Imhoff tank, and also looking at the state of treatment and evaluating options for expanded sewerage and treatment throughout Las Vegas. This year's group will be studying Imhoff tanks, waste stabilization ponds, and sludge handling in both systems.
- Robert explained his plan to investigate chemically enhanced primary treatment in order to improve settling of solids in Imhoff tank systems, and to explore simple secondary treatment systems that could be installed downstream from the Imhoff tank.
- Lisa discussed her plan to analyze performance in waste stabilization ponds, comparing observed performance to ideal behavior predicted by the formulas which apply to these systems.
- Mahua described her plan to examine sludge handling in both systems. She will assess the current state of sludge removal and explore handling methods including sludge drying beds, and will also examine the potential agricultural reuse of sludge to maximize the resource value of this material.

2. Mirtha discussed current concerns:
   - CESCCO has just completed an inventory of water and wastewater treatment systems in southern Honduras, in the Choloteca watershed. One issue is the numerous "ghost systems" which are not registered. Many systems are not working, abandoned or not registered. So far their inventory has identified 67 facilities in that one watershed.
   - Their goal behind this study is to provide an overall picture of the condition of the systems, to set the stage for a second stage. Following assessment, they can identify ways to improve the efficiency of these systems.
   - Dixy is a technician who is out in the field and is very familiar with these systems, and has many tools at his disposal including lab, GPS units, etc. He is available to assist the MIT student group with equipment, lab facilities, and technical support.

3. Pedro discussed current concerns:
   - Pedro discussed current work while showing images from a recent presentation.
   - SANAA has looked at Imhoff tanks, and found many have been abandoned due to challenge of construction of the deep-wall system. Many are not designed right,

and have not been structurally sound. There's been a tendency to use a "canned" design, which could pose challenges when the tank is built, as well as during ongoing operation and maintenance.

- Most existing Imhoff tanks are plugged up with sludge. Communities face the problem of rehabilitating tanks, and therefore many abandon the systems. Many communities stopped building altogether and let discharge go to the nearest creek.
- Then in 1979 USAID started to promote pond systems as a way to address the high death statistics in Honduras, often associated with sanitation. The primary focus in wastewater treatment has always been pathogen removal. Early ponds included anaerobic and facultative ponds in series, whereas later the anaerobic ponds were eliminated due to odor concerns, and because these systems are harder to desludge. The current scheme is just systems of facultative and maturation ponds utilizing plug flow to meet removal requirements. Also under consideration is the inclusion of aeration lagoons.
- For Honduras, shorter retention systems such as activated sludge are challenging because they must be followed by disinfection.
- Current concerns with lagoons include their large footprint and their discharge to water bodies. Regulations require 5 log removal of pathogens. One challenge is desludging these systems. While they are initially attractive as resilient and forgiving systems, this leads to waiting up to a decade to desludge. While the pond may still function like this, this poses the problem of requiring an enormous area for a sludge drying bed. Now Pedro feels it's much better to desludge every three to five years, for pond function and to make desludging manageable.
- After Hurricane Mitch, wastewater in Honduras became an open market. Suddenly things changed with the influx of international funds and private sector interests. Honduras had tried to keep things simple, but with outside influences they're considering systems much too complicated for Honduras such as activated sludge. They are marketed as the most modern, effortless, up-to-date systems which don't need skilled technicians because the computer does it all. But it becomes clear that systems do indeed need university-trained personnel to be properly operated and maintained. Pedro states that even many of the highly skilled experts at the table today are not trained in methanogenic systems.
- Problems in advanced technologies include high energy consumption and high sludge production, neither of which is addressed when plants are purchased. Biological maintenance is complicated.
- One idea is to use secondary treatment, and pair Imhoff tanks with constructed wetlands. Tegucigalpa had two such systems which have failed, but Pedro encourages MIT to visit to assess why and consider the possibility of reviving these systems.

4. Panel Discussion:
   - Pedro: Certain systems are being pushed on Honduras, not always for the best.
   - Eric: Also important is the failing state of existing systems.
   - Pedro: Country has 5-10% treatment currently, so to get to 50% sounds like a nice goal. But it may not be wise to strive for 50% of advanced treatment which you

never reach, when you could have success with 60% of the country receiving at least primary treatment in simpler systems.
   - Ari: That's the concern we've also been discussing. In Las Vegas we saw fancy and extravagant systems under consideration, while the Imhoff tank is suffering a lack of maintenance. There was skepticism that the advanced system would be better maintained.
   - Mahua: Has there been any instance of sludge reuse in Honduras?
   - Mirtha: There's no regulation or benchmarking to set standards.
   - Eric: What is the sludge handling in a healthy system?
   - Pedro: When it's done right, you just open the valves, flow to a drying bed, and then bury it or spread it onsite. This is not reuse, but just disposal. Now there may be an interest in assessing quality and looking at potential guidelines for reuse.
   - Mirtha: A new vision includes working with the US EPA to develop a model for sludge reuse.
   - Ari: There is a list of EPA collaborators available to us, which Ari will share with the group.
   - Pedro: The first wastewater treatment pipes were concrete and infiltration was a real problem. New installations use PVC pipe which suffers less infiltration, but there is still a big problem with cross connects, or combined sewers. This can double or triple the wastewater flow during a rainstorm.

5. Luis discussed current concerns:
   - The timing for this partnership is perfect. The sector entities are becoming coordinated. Honduras has not just the institutions to do the job, but also regulations to enforce that job. RAS-HON is the core of all these sectors, and is interested in bringing government, NGOs, and civil organizations together on the issue.
   - Last year was the national year of sanitation in Honduras. A national sanitation plan was developed, which Victor and Oscar implement now. Last December they held a conference. The presentation in the background this afternoon was from that conference.
   - There is a desire to assess wastewater treatment not by region but by watersheds. Step one is to work with all the stakeholders, to get buy-in and to share ideas. San Pedro Sula is the second largest city in Honduras, and yet has no wastewater treatment, and relies on the aquifer as its water source.
   - The biggest accomplishment is that we've all found it's time to question our previous strategies. The other biggest accomplishment is that this all has been carried out by technically educated people and not politicians.

6. Handouts:
   - Luis distributed materials from the December conference. A printout of the PowerPoint presentation from the conference was included in the folder. There was also a magazine by RAS-HON included. This is named for the Myan rain god Chac, and we were given last year's special edition on sanitation.

7. Action Items:
    - Ari will share a list of EPA collaborators with the group.
    - Luis will forward copies of the December PowerPoint presentation to the group.
    - Victor and Oscar will work with Ari to develop a list of treatment facilities to visit.
    - If possible, can Mirtha and CESCCO provide their recent Lake Yojoa study to the MIT students?

8. Summary:

    It is historic to have all these stakeholders and interested parties meeting at this table today. Everyone is excited to collaborate, communicate, and share their work to advance the cause of improved sanitation and wastewater treatment in Honduras.