Final Report

San Mateo Project

Florida State University
Emergency Management and Homeland Security Program
San Mateo, San Pedro, Belize

Summary of Project

San Mateo is a small community on the island of Ambergris Caye in Belize. A community composed primarily of immigrants and other marginalized populations, San Mateo has historically been subjected to limited access to water, electricity, and economic opportunities for its residents. San Pedro, the only true town located on Ambergris Caye, provides water and electricity to residents of San Pedro; however, water is not potable, water pressure is often low, and electricity lines are above-ground and hazardous. The houses in which residents live are highly variable in terms of size, construction type, sewage removal system, and availability of resources. Despite overwhelming odds, most residents are very hopeful for the future of their community and are taking action to make their home a better place to live.

The Disaster Incident Research Team (DIRT), consisting of faculty, staff, and student researchers of the Emergency Management and Homeland Security (EMHS) Program at Florida State University, recently completed field research in San Mateo, gathering information on demographics and resources within the community. The team partnered with the Belize Red Cross, whose members provided vital insight and knowledge about San Mateo and the greater island community. Three student volunteers from Washington and Lee University in Virginia also joined the team to assist with the project. Without these valuable partnerships, DIRT could not have been successful in our project goals.

The project was divided into two parts:

- Teams of EMHS staff and student researchers surveyed San Mateo community members to gather data on the community's vulnerabilities to disaster. Community members were asked primarily about infrastructure, utilities, and bills and taxes paid to the local government.
- Members of EMHS faculty and staff, comprising the UAS flight operations team, flew several missions throughout San Mateo. Employing the use of small Unmanned Aerial Systems (sUAS), the team took photos and recorded video of the community so as to construct orthographic photos and gain a better understanding of the physical aspects of San Mateo.

Project Participants

Compiled by Ryan Gallagher

EMHS Faculty, Staff, and Applied Emergency Management Studio Researchers

The Emergency Management and Homeland Security (EMHS) Program of Florida State University faculty were assisted in this endeavor by six student researchers. These students applied to work for the EMHS program and were carefully selected for their educational backgrounds. One of these was pursuing her Ph.D., three were Masters Students, and the remaining two had plans to begin their Masters degrees in the near future.

The FSU Applied Emergency Management Studio (AEMS) Project is a unique program of the FSU EMHS. AEMS gives students in the EMHS program a unique opportunity to work in the field of emergency management before they graduate from university. Selected students are hired as researchers in the EMHS program for a semester, and work on a unique EM project – typically in a developing community. Student researchers gain valuable work experience and knowledge of emergency management that they cannot learn from textbooks, papers, or course materials.

The following student researchers participated in AEMS 2015:

Joe Crozier: received his Bachelors degree from FSU in Geography and Environmental Studies and was completing his Masters in Urban and Regional Planning specializing in Land Use and Sustainable Development.

Ryan Gallagher: received his Bachelors in Economics from FSU and was pursuing his Masters in Logistics and Supply Chain Management from Embry-Riddle Worldwide.

Laura Hart: received her Bachelor of Arts in International Affairs from FSU in May 2015, and will begin her MPA (Master of Public Administration) in Fall 2015.

Abra Kinch: received her Bachelor's degree in Chinese Language and Culture, her Master's degree in East Asian Studies, and was completing her Doctorate in Public Administration and Policy from Florida State University.

Roger Lemarque: was pursuing his Bachelors in Environmental Studies and is starting to work at the Florida Division of Emergency Management.

Rebecca Rogers: received her Bachelors degree in International Affairs from Florida State University and is finishing her Masters of Public Administration degree.

Partners

This project presented significant cultural and logistical challenges, each of which required the assistance of strong partners in the region. The Emergency Management and Homeland Security Program of Florida State University partnered with the Belize Red Cross Society, the Belize National Emergency Management Organization (NEMO), and the Florida Association for Volunteer Action in the Caribbean and Americas (FAVACA).

Belize Red Cross Society

Evidence of Red Cross activity in the country has been recorded since 1914, and a Branch of the British Red Cross was founded in 1950. After Belize became an independent nation in 1981, the Belize Red Cross Society Act established the Society on 18th August 1983. The following year it was recognized by the International Committee of the Red Cross, and admitted to the International Federation of Red Cross and Red Crescent Societies as a National Society with all the rights and responsibilities therein accorded.

As well as the 1983 Act of Parliament the Belize Red Cross's legal basis includes a Constitution which was revised and approved by the Central Committee in early 2006, and was submitted to the General Assembly and approved on July 1, 2006.

The Belize Red Cross guided by the 7 Fundamental Principles of the Movement serves the people of Belize, especially those most vulnerable, regardless of political affiliation, religious beliefs, race, color, creed, gender or nationality.

The Belize Red Cross has a Headquarters (HQ) in Belize City and 8 Branches throughout the 6 administrative Districts of the country. The highest level is the General Assembly which elects the Central Committee, which in turn coordinates with management. The National Society Self-Assessment 2004 states that there was a total of 1200 volunteers in the Society (900 of them women), and that 330 were also supporting members. For more information visit http://www.caribbeanredcross.org/index.php/national-societies/belize

Belize NEMO

NEMO in cooperation with the respective Emergency Management Committees, and all Public and Private agencies, is established to preserve life and property throughout the country of Belize in the event of an emergency, threatened or real, and to mitigate the impact on the country and its people. For more information visit http://site.nemo.org.bz/

FAVACA

The Florida Association for Volunteer Action in the Caribbean and the Americas, Inc. is a private not for profit organization formed in 1982 by Florida Governor (now former U.S. Senator) Bob Graham. FAVACA's Florida International Volunteer Corps is the only program of

its kind in the country and enjoys statutory authority under Section 288.0251 Florida Statutes. A state appropriation, voted annually since 1986, provides a funding base for an estimated 100 volunteer missions to Latin America and the Caribbean each year.

FAVACA establishes sustainable partnerships between non-governmental organizations, universities, government agencies and businesses in Florida and the Caribbean and Latin America. In response to requests from partner organizations throughout the region, FAVACA has conducted more than 2,500 technical assistance and training volunteer missions reaching approximately 50,000 individuals in 30 countries over the past 25 years- living proof of Florida's commitment to the well-being of the region. These activities also help to mitigate threats to Florida's agriculture, health, and the environment before they reach critical proportions.

FAVACA's extensive experience in Haiti provided invaluable resources for the project, including travel and logistics, translation services, and cultural awareness. For more information, visit http://www.favaca.org/

Community Profile:

Belize, Ambergris Caye, San Pedro, & San Mateo

Compiled by Laura Hart

The Emergency Management and Homeland Security (EMHS) Program (located in Tallahassee, FL) initiated and participated in a community survey project of the San Mateo Community in the town of San Pedro on the island Ambergris Caye. This survey was in tandem with the San Pedro Branch of the Belize Red Cross (SPBRC) and FAVACA (The Florida Association for Volunteer Action in the Caribbean and the Americas) during the summer of 2015. Team members through Florida State University's Center for Disaster Risk Prevention worked in June 2015 to complete a full utilities survey (electricity, water, sewer, structural and social inquiries) delivered door-to-door, providing insight into the types, nature and extent of services available to residents of San Mateo.

Belize is a country in Central America bordered by the Caribbean Sea to its east, Guatemala to its west, and Mexico to its north. The capital, Belmopan, is located on the mainland (Central Intelligence Agency, 2015). The country gained independence from Great Britain in 1981 and was not formally recognized by its neighbor, Guatemala until 1992 (Central Intelligence Agency, 2015). The population is about 350,000 persons, but others remain undocumented (Central Intelligence Agency, 2015). The climate is tropical, with rainy and dry seasons. The largest natural hazards present in the country are floods and hurricanes. The CIA Factbook for Belize reports that current environmental issues include "deforestation, water pollution from sewage, industrial effluents, agricultural runoff; solid and sewage waste disposal" (Central Intelligence Agency, 2015). The last designation is ultimately the influence for this research project: a community survey tailored and specific to utility availability and usage in terms of electricity, water, and sewer in San Mateo, a community on the Belizean island of Ambergris Caye.

The island of Ambergris Caye is the largest island in Belize, and is located just a fifteen-minute airplane ride from Belize City and the accompanying mainland of Belize (Cardona & Cardona, 2009). The island's main source of industry is tourism. Popular activities within the tourism sector include an annual lobster festival and snorkeling, as well as participating in tours of historical and archaeological sites. The island possesses Mayan ruins, as well as caves and other archaeological and natural treasures. Unfortunately, many culturally pivotal areas and monuments on the island lack proper protection and cultivation, while others are difficult to reach or sustain. Undeveloped parts of the island are largely mangrove forests, while the coastlines display beige sand. Ambergris Caye is located off of the Belize Barrier Reef Reserve System, the second largest reef system in the world and a UNESCO World Heritage site (Belize barrier reef, 2013). Although the site has experienced the adverse effects of global warming, the island itself is sustained and protected by the barrier reef system (Cardona & Cardona, 2009). The island and the surrounding waters boast an impressive array of wildlife. The reef contains an astounding breadth of fish, turtles, rays, sharks, crocodiles, and various other creatures. The mainland is also home to iguanas, monkeys, squirrels, birds, snakes, lizards of all types, and other animals. Many residents of San Pedro and San Mateo keep canine and feline pets, for both company and security.

As of 2008, the population of San Pedro was reported to be 11,600 persons (Cardona & Cardona, 2009). The island's official language is English, however, many residents of San Pedro and San Mateo also speak Spanish or a local Belizean variant of Creole, a mixture of Spanish, English, and African languages (Cardona & Cardona, 2009; Central Intelligence Agency, 2015). The community of San Pedro is located on the south side of Ambergris Caye and is the only town on the island (Cardona & Cardona, 2009). The city is quite small but boasts impressive mercantile abilities for such a small island. The narrow streets necessitate the use of golf carts for most transportation, as average cars and trucks would be cumbersome and bulky in the streets of San Pedro, although a small number are now permitted for use.

San Mateo is an impoverished neighborhood next to the city of San Pedro on the island of Ambergris Caye. San Mateo possesses roughly 350 private lots, with many lots possessing multiple households, buildings, and structures. According to the *Revised Master Development Plan for Ambergris Caye* compiled by Malikah Cardona and Kamilah Cardona in 2000, San Pedro continued to experience problems in overcrowding- an issue still present in San Mateo today (Cardona & Cardona, 2009). The population of the community is extremely diverse. Individuals and family units in the community come from several different ancestral backgrounds. Most daytime residents of the community are women. The community of San Mateo hosts a pronounced canine population, a number of which are extremely wary of outsiders or perceived trespassers. Some residents of San Mateo also keep birds such as chickens and turkeys for subsistence. San Mateo is a relatively new community, with only a few residents having lived there for the past quarter of a century. The Belizean government allots a plot of land to each Belizean citizen who elects to apply for one, which brought about the arrival of the San Mateo community. Some plots of land are completely underwater, difficult or unable to be reached by road, or are inundated with trash and refuse. Many residents assert that homes or other structures must be built quickly to assure ownership and involvement in the land, or otherwise the Belizean government may reassign the lot to another citizen candidate. Many lots within San Mateo are unable to receive water, electricity, sewer services, or a combination of all three. As a result, both structural and social surveys were completed lot by lot in San Mateo to ascertain which utilities are available at certain locations within the community.

Works Cited

Belize barrier reef. (2013). Retrieved July 29, 2015, from https://www.travelbelize.org/destinations/belize-barrier-reef

Cardona, K., and Cardona, M. Produced for the Coastal Zone Management Authority & Institute. (2009, December). *Revised master development plan for Ambergris Caye*.

Central Intelligence Agency. Central America and Caribbean: Belize. (2015, July 15). Retrieved July 28, 2015, from https://www.cia.gov/library/publications/the-world-factbook/geos/bh.html

Process

Compiled by Roger Lemarque and Rebecca Rogers

Prior to leaving for Belize, Florida State University's Emergency Management and Homeland Security Program (EMHS), in collaboration with the Belize Red Cross (BRC) and the Florida Association for Volunteer Action in the Caribbean and the Americas (FAVACA), began communicating to establish objectives to be accomplished in the trip to the San Mateo community, San Pedro, Belize. In addition to establishing mission objectives, the three stakeholders prepared the flight information, the period of time in which the researchers will arrive and depart Belize, and a common operating picture. The EMHS Program, Belize Red Cross, and FAVACA determined the purpose of the mission to San Mateo was to survey the utilities and living conditions of the residents within the San Mateo community.

After the mission objectives and the common operating picture were established, the EMHS Program began searching for qualified students to become researchers for the San Mateo expedition. Students from Florida State University were required to submit an application, which included a statement of interest, resume, and transcript. After staff members from the EMHS staff reviewed the applications, a handful of applicants were selected for an interview and were contacted. Applicants were interviewed in late April. During the interview, applicants were asked questions that tested interest in the mission, work ethic, emotional intelligence, critical thinking, team cooperation, and communication skills. These were the skills deemed necessary for the researchers to be successful in San Mateo.

As of May 11th, 2015, the EMHS Program at Florida State University officially hired the six researchers. Once the researchers were selected and notified, the staff members of the EMHS Program conducted weekly meetings to ensure the student researchers received the proper training and understanding of the mission objectives and the common operating picture. During these meetings, the student researchers were assigned different tasks that would aid in the successful operations in Belize. In addition to completing tasks designed to aid in the successful operations, the student researchers were also tasked with submitting a successful human subject testing Institutional Review Board application. The tasks the student researchers and the EMHS Program completed prior to making landfall in San Mateo included: creation of a logistics plan,

which entailed determining what items were needed to ensure a successful operation and what items were needed by the researchers to ensure their safety and comfort in the field; the creation of a survey tool to be used in Belize, to include a social and a physical component; and compiling a list of contacts with whom researchers would communicate in Belize from Belize Red Cross and FAVACA, a communications guide, and a hazards guide.

In preparation for the Belize expedition, the EMHS staff and researchers performed three different exercises through out the month of May. These exercises were conducted to ensure that the researchers were educated on the procedures and tools that would be used in Belize. The first exercise was to test the survey tool, the second exercise was to test the methods in which the researchers would back up their data onto a computer, and the third exercise tested the researchers on the standard operating procedures and guidelines as well as the survey tool.

The first exercise allowed the researchers to test their survey tool. During this exercise, the researchers were tasked with finding a house in the local area in Tallahassee and completing the physical and social survey. The researchers utilized the standard operating procedures and guidelines that were established at the weekly team meetings held by the EMHS staff. After this exercise, the researchers conducted a "hot wash," a forum to review what went well and what could be improved in the exercise. The researchers determined that the survey tool contained vague language, lack of direction on the physical survey, and was too lengthy. The researchers then edited the survey to reduce the length, provided further instructions of the expectations on the physical survey, and made the language on the survey clear and uniform. After the survey was edited, the researchers conducted a second exercise designed to familiarize the researchers with the standard operating procedure for uploading photos taken in the field and backing up data recorded in the field. In this exercise, the researchers were tasked with filling out the improved survey tool and taking pictures of assigned objects. Upon successful completion of these tasks, researchers were required to use the software provided by the EMHS Program to upload the photos taken during the exercise onto a back up computer. The third exercise allowed the researchers to practice the established standard operating procedures and guidelines. In this exercise the researchers went into a neighborhood located in a residential area nearby and completed every aspect of the training. This allowed the researchers to develop strategies to use in the field as well as use the tools that were used in San Mateo, Belize. After this exercise was

completed, another hot wash was done to discuss improvements to be made to the standard operating procedures and guidelines and the survey too. The standard operating procedures, standard operating guidelines, and the survey were edited to accommodate these improvements.

The senior staff of the EMHS Program booked flights to Belize after verifying that all researchers had a valid passport. Once the flights were booked for Belize, an itinerary was produced containing information on days and times the researchers would be working in San Pedro.

On the morning of June 14th, the EMHS staff and the student researchers met at the Tallahassee airport to depart for the first flight to Miami. The next flight was to Belize City and then to the island of San Pedro. Once the EMHS staff and the researchers arrived in Belize, they settled into the hotel and began getting acclimated to the area.

The team followed the provided itinerary unless otherwise instructed. Every morning at 8:00 am, the senior staff and teams met in the lobby of the Sunbreeze hotel in San Pedro for a morning briefing. During this meeting, survey forms for the first part of the day were given to the researchers, researchers stocked up on bottled water for the day, and applied sunscreen and bug spray. At the end of the briefing, the researchers were able to ask questions to senior staff members from the EMHS Program, Belize Red Cross, and FAVACA pertaining to the mission. After the morning briefing, the researchers and any other members going into the field boarded the golf carts going to the San Mateo area. The researchers took four golf carts through San Pedro and across the bridge into the town of San Mateo. The convenience store in the middle of the town was the main rally point. As teams arrived at the rally point, they waited to receive the daily missions from the director of the EMHS Program. Each team then took a golf cart or walked to their respective locations to begin surveying for the day. Surveys began at approximately 8:45 am.

Upon arrival at a lot, if there was a structure present, the team would approach the structure to see if anyone was home. If no one was home, a street survey would be done, leaving out the qualitative aspect of the survey. If someone was home, one team member would do the qualitative survey and also ask permission to take photos and measure the lot. The other team

member would begin taking photos, measuring the lot, measuring any structures on the lot, and filling out the survey form.

The first photo taken at any lot was of the front of the survey with the lot number in the upper right hand corner. The next photos consisted of the structure, structure frame, water pipes/cistern, sewer, electrical box/electrical lines, and the property itself (garbage, standing water, gravel). The teams utilized the Exif Wizard phone application to locate the file numbers of each photos and place them next to their associated part of the survey (water, sewer, electrical, etc.). The last photo taken was a black photo to indicate that all the photos for that lot had been completed. Each lot had to be measured as well as any structures present on the lot. All teams were equipped with both a laser finder and a large measuring tape. All measurements had to be converted from feet to meters.

After a survey was complete, the team would radio the director, who acted as the "Map Master." The researchers then gave the lot number they had completed to the director. The director would radio a confirmation and then mark each completed lot off the master map to keep track of where and how many lots the researchers had completed. At around 11:30 am or 12:00 pm, all teams and staff would break for lunch. The field researchers were given a 15-30 minute warning to finish up their task and then would rally at the convenience store and take the golf carts to a place to eat lunch outside of San Mateo. After eating, the researchers would gather around the director of the EMHS Program for an additional briefing and go over what had already been completed. At this time the researchers then received their next missions for the second part of the day.

Upon returning to San Mateo, teams would disperse to their new locations and begin completing more surveys. At around 4:00 pm, all researchers were given a 15-30 minute warning from the team leader to finish up the survey they were completing and then head back to the rally point. After everyone had finished their respective surveys, the researchers took the golf carts back to the hotel. After unpacking the carts, all teams and staff immediately went to the director's room to upload photos, go over survey forms, update the master map, and assess progress of the Belize expedition. Teams finished editing their surveys, calculated the volume and area of their lots/structures, and began uploading their photos. Photos were to be uploaded into the file with the corresponding lot number that was generated using Exif Wizard in the field.

The first photo of the front of the survey form and the last black photo signaled which photos were to go into which file. This is the same process all teams followed for the duration of the mission.

The EMHS staff and student researchers returned from Belize on the evening of June 22nd, 2015. After returning from Belize, the researchers created a master survey tool to input data from all survey lots in San Mateo. Each team took a portion of the surveys (approximately 40 surveys) to input into the master document. The master survey document included all aspects of the survey including the qualitative survey and all aspects pertaining to the lot. The teams and senior staff continued meeting weekly to work on inputting the data into the master document. After all the surveys had been inputted, the teams were given additional tasks. Team 1 color-coded the survey lot maps to show the total number of residents in a lot, the percentage of garbage on each lot, and the primary language spoken at each residence. Team 2 filled in any gaps in the master survey tool in regards to the qualitative and quantitative aspects of the survey. Team 3 completed a qualitative write up with graphs and charts of the social survey data; they also made the language of the survey more uniform. The teams then finalized the write-up with the process, materials used, expense report, and executive summary of all the research.

SURVEY TOOL

Name:	Date:	Lot Number:
Name:	Group:	File # of first photo taken from street:

On this grid each square = 1 meter

How many structures are on the plot? _____

Source	Area	Volume
Structure A		
Structure B		
Structure C		
Structure D		
Structure E		

1. Structure Type *(Indicate which type with check mark)***:**

Source	Single Family	Duplex	Shed	Animal Shelter/Barn	Apartment	Other	File photo #s associated with lot and category
Structure A							
Structure B							
Structure C							
Structure D							
Structure E							

Comments:

2. Frame/Construction Type *(Indicate which type with check mark)***:**

Source	Wood Frame	Masonry	Metal	Modular/ Mobile	Improvised	Number of stories	Elevated? YES or NO	Elevation type: cement, wood, etc.	Other	File photo #s associated with lot and category
Structure A										
Structure B										
Structure C										
Structure D										
Structure E										

(The "improvised" designation indicates possibly rough materials used to assemble a dwelling including an uncovered domicile or more tent-like structures)

Comments:

3. Sewer:

Source	Waste removal system present? Y/N	Above-ground tank? Y/N	Capacity/ Dimensions	Number of toilets on lot	Year system was installed	Outhouse(s) on lot? (YES/NO)	Type	Description of system (chem toilet, organic, etc)	Other	File photo #s associated with lot and category
Structure A										
Structure B										
Structure C										
Structure D										
Structure E										

Comments:

4. Water

Source	Is consumable water present? YES or NO	Located on mainline? YES OR NO	Shared from mainline? YES or NO	Is a cistern present? YES or NO	Capacity: Please indicate in amount of gallons	Spigot usage for primary water consumption? YES or NO	Other	File photo #s associated with lot and category
Structure A								
Structure B								
Structure C								
Structure D								
Structure E								

Comments:

5. Electricity

Source	Is electricity present? YES or NO	Is electrical box present? YES OR NO	Is a solar charger in use? YES or NO	Split Lines? YES/NO; Indicate severity	Exposed wiring? YES/NO	Other	File photo #s associated with lot and category
Structure A							
Structure B							
Structure C							
Structure D							
Structure E							

Comments:

6. Hazards/Structural Mitigation: **Please estimate total percentage of the lot that each section occupies**

Toxic waste?		Human or animal waste?		Garbage		Organic Waste?		Ground Cover?		Other Type of Waste?		File photo #s associated with lot
Type	%	Type	%	Type	%	Type	%	Type	%	Type	%	

Gravel on lot? Indicate %	Standing water? Indicate %	If standing water, is a bridge necessary? Indicate sidewalk/walkway condition	Distance from coastline (circle one)	File photo #s associated with lot and category
			• On coast • <0.5 miles • >1 mile	

Comments:

NOTES: Utility perception questions

1 What is the primary language spoken in this household?

- ○ English
- ○ Spanish
- ○ Other _____

2 How many adults live here?

3 How many children live here?

4 The septic tank of this household is…

○ Very reliable	○ Sometimes reliable	○ Never Reliable	○ Not sure

comments:

5 Electricity for this household is…

○ Always available	○ Sometimes available	○ Never available	○ Not sure

comments:

6 Clean water is…

○ Always available	○ Sometimes available	○ Never available	○ Not sure

comments:

7 The water is…

○ Very clean	○ OK	○ Contaminated	○ Not sure

comments:

8 We treat our water.

(boiling or using chemicals, etc)

○ Always	○ Sometimes	○ Never	○ Not sure

comments (i.e. only for children):

9 Water pressure in this household is…

○ High or excellent	○ Moderate	○ Poor or low	○ Not present

comments:

10 Bills and taxes paid on water are…

○ Too high	○ OK	○ Too low	○ Don't pay	○ Not sure

comments:

11	Bills and taxes paid on electricity are…	○ Too high	○ OK	○ Too low	○ Don't pay	○ Not sure
	comments:					
12	Living conditions are overall…	○ Good	○ Average	○ Bad	○ Not sure	○ No answer
	comments:					
13	What resources do you share with neighbors?					
	comments (i.e. cistern, sewage system, etc.):					

Additional comments concerning overall survey:

Other materials used in data collection process:

- (6) RINO 650/655t radio communication devices
- (300) Community maps – bird's eye view, distributed to community members
- (25) Maps with lot numbers – used by survey teams
- Pens/Pencils
- (15) Clip boards
- (3) 3DRobotics IRIS+ - sUAS used by flight team


San Mateo, Belize
BELIZE
FAVACA
The Florida Association for
Volunteer Action in the Caribbean
and the Americas
www.favaca.org
em.fsu.edu
FSU
EMERGENCY
MANAGEMENT
& HOMELAND SECURITY PROGRAM
100 meters

Results

Compiled by Abra Kinch and Joe Crozier

Physical Results

Housing Structures on Lots

There were 451 structures on 306 lots that were surveyed. Of those, 27 (~6%) were multi-family, 274 (~61%) were single-family, 36 (~8%) were sheds, and 3 were churches. The remaining structures were animal habitats, outhouses, or businesses. This section will discuss the housing structures on the lots, focusing on the distinction between single-family and multi-family structures. Attention will also be paid to sheds and churches, as these could be indicative to quality of life in the San Mateo community.

Figure 1. Single family residences

Lots that bear **single-family residences** were the most prevalent. Although initial suspicions would have placed multi-family structures above single-family, the preceding image illustrates the contrary. There is no evident pattern to the placement of the lots with single-family structures as compared to others. However, a number of lots maintained multiple single family structures. This may suggest that a portion of these lots contain informal disconnected duplexes or apartment buildings. However, for the purposes of this study, any standalone structure with one family residing in it was considered a single-family residence, regardless of the quantity of those structures.

Of the 274 single-family structures, 267 (97%) were made primarily of wood, and 82 of those included metal in the construction. Others were improvised, entirely metal, or used masonry in construction. Most of these structures, 243 (89%), were one story, and the remaining were two story. Because of the climate, low elevation, and frequency of storms, most of the homes are elevated. There are 250 elevated single-family homes, and 233 of those were elevated with wood construction.

Figure 2. Duplex homes (2 units)

Figure 3. Apartment homes (3+ units)

Multi-family residences, including duplex homes or apartments (figure 2) and single structures with multiple families residing (figure 3), were less common than anticipated. There are far fewer lots with multi-family structures than single family. This indicates that individuals are

building their own homes, upon securing a lot of land. Perhaps the Belizean government, when determining those that would be able to build on the lots designates when and where multi-family structures can be placed. It may also come from the structure owner. Furthermore, some of the multi-family residences were found on the most well-established lots. Those lots that were among the first to be inhabited were predisposed to become shared amongst several generations of a given family.

There were 27 total multi-family homes in the community. Of those, 100% used wood in construction. While a few used metal in roofing or masonry in construction, wood was certainly the preferred medium. A greater portion of multi-family homes were multi-storied. Again these structures capped at two stories, but almost half were that high. Two storied multi-family homes were the least likely to be elevated, with about 25% having no elevation. Of those that were elevated, all used wood.

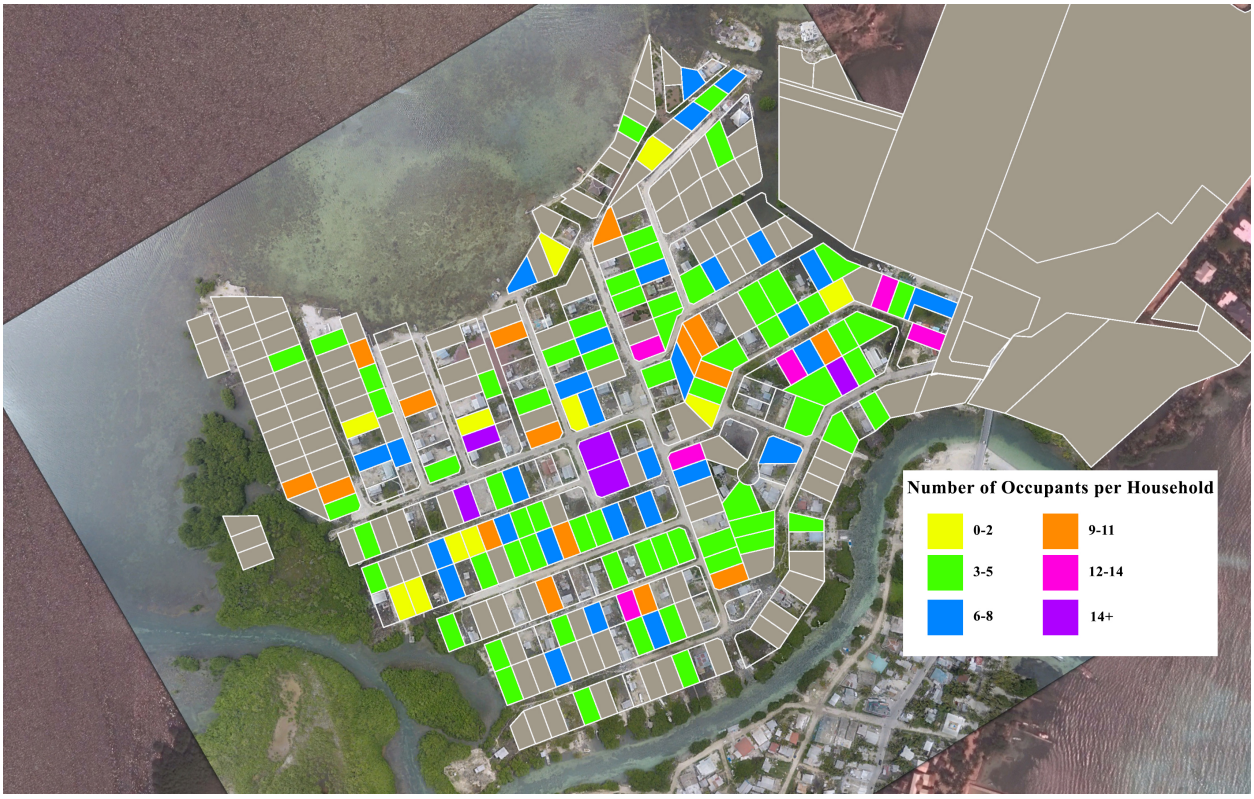


Figure 4. Number of occupants per lot

Because most of the residences were single-family structures, a majority only housed 3-5 individuals. Those lots that had 0-2 were rare and were generally made up of a couple with no children. Homes with 6-8 occupants were either multi-family structures or single-family structures with multiple families residing. Less often, homes with 12 or more occupants were found. Very often, these were larger lots with multiple structures varying in size and occupancy or intention.

Figure 5. Vacant lots contained wither abandoned or no structures

There were many **vacant lots** in this area. These were lots that either contained no structure at all or contained partially-built or abandoned structures. Predominantly, the lots were completely empty and contained only mangroves, water, or other detritus. Despite the absence of a predictable trend of vacant lot orientation, they elucidate the community's origins and future growth trends. The center of San Mateo accommodates the preponderance of the occupied lots, while vacant lots are in greater numbers along the coast or where copious inland water has yet to be displaced. Vacant lots are common along the waterway on the lower constraint of the foregoing image or along the water in the upper right.

The vacant lots found amongst the central component of the landscape have no discernible pattern to either structure fill or location. There are 74 recorded vacant lots, or about a quarter of the community. A few had dilapidated or abandoned structures, while most were completely empty.

Figure 6. Lots with structures used as churches

There were three lots in San Mateo that furnished churches. One is housed in a centralized lot, while the two others lie southwest and southeast of center. Each of the lots had more than the one structure, illustrating that lot owners were using parts of their own lot for religious fellowship with their neighbors. Upon considering the land constraints found in San Mateo, this land use manifests the importance of theological prioritization to the residents.

Figure 7. Lots with structures used as sheds

Many of the lots contained sheds, or improvised structures intended for storage. A profusion of the residents tailor these sheds to accommodate the nature of their work, creating items to sell at markets or preparing fruit or food that will be brought to market. The lots with sheds are sporadically placed throughout the map, signifying that sheds are not necessarily indicative of a particular location, lot size, or lot quality.

Of the 35 sheds in the community, most were constructed with wood, though many others used a combination of wood and metal construction. They averaged about 44.1 cubic feet in volume, though some were substantially larger than others.

Electricity

Figure 8. Lots with structures with electricity

Figure 9. Lots with structures without electricity.

Electricity was present to 236 (52%) structures in San Mateo, yet the sources and integrity varied. The bulk of structures with power (figure 8) had lines originating on the main power line. These were installed approximately five to six months prior to our visit, according to the residents. Some lots had improvised power, whether split lines or a simple extension cord running from a neighbor's house. Those without power (figure 9) did not have power of any kind available in their home. While many of these lots were found on main roads, residents reported that they were responsible for the creation of a "power pole" to house a meter and serve as a

means to split off from the main line. This added cost was the cause for many of the powerless homes to remain in their current state.

Figure 10. Lots where electricity was metered from a box on the property

Those with power from the main power lines were provided electrical boxes outside their homes with meters. These were either placed on the structure, on the pole, or, somewhat commonly, on cement slabs that stood along the road just outside the home. However, as stated, the residents were responsible for housing this electrical meter. Most of the homes with power along the center of San Mateo had electrical boxes, while most of the outer lots with power did not. This indicates that the main line runs through the center of the community.

Of the 236 structures with power, only 146 had an electrical box present, 112 had split lines, and 103 had exposed wiring.

Figure 11. Lots with solar power capabilities

Although Belize is the recipient of year-round direct sunlight, far fewer than expected structures utilize solar power. A meager eight structures, located away from those with reliable electricity maintained these panels. Many of those residents stated the solar panels were only used on occasion. Utilization of solar-derived electricity may be a way for the Belize government to provide reliable electricity to those residents who are not on any power line, or to discourage power sharing in the dangerous methods that have already been used. The size and capabilities of the solar panels found in San Mateo varied immensely. The majority of the few systems present had very low capabilities while a few, well-established, homes maintained systems more extensive capacities.

Water

Figure 12. Lots with water from the main water line

Figure 13. Lots without main line water access

Water for these residents was previously provided by the Government of Belize Office Water and Sewer Authority (WASA), but has since been privatized through the Belize Water Services Ltd. This occurred in 2001, but the residents of San Mateo continually stated that they were on the WASA water lines. Nevertheless, a slight minority of lots fall on the main water lines, 176 structures (39%). Again, there is no evident pattern to which fall on the line (figure 12), but when examining the image of lots without connections to the main water line (figure 13) certain rows

of lots seem to be more susceptible. This may indicate that those lots were planned after the lines were created, and no extensions were put in place before structures were placed. Residents that were connected to main water did not drink the water, but did use it for washing.

Only 64 structures reported that consumable water was present, though the top image indicates a greater number. This would suggest a misunderstanding or miscommunication of the word "consumable" meaning usable or potable. This differentiation could cause confusion even among the researchers. Sharing water from the main line with a neighbor was also present with 116 structures (26%) receiving shared water. There was some overlap in those structures that were on the main line and those that shared from the main line, with 74 (42% of those on the main line) reporting this anomaly.

Figure 14. Lots where cisterns were present in any form or capacity

Cisterns were less popular than originally assumed, with only about a quarter or so of the lots having one on property. There is no evident pattern to the distribution of lots with cisterns, though they do seemingly coincide with lots that are not on the main water line. Some cisterns were used for drinking water, but most were strictly for washing, just as the "WASA" water.

Of the 451 structures, only 84 had at least one cistern, but sizes varied between 100-1100 gallons.

A vast majority, about 99% did not drink anything other than bottled water because of water contamination.

Waste Removal

Figure 15. Lots where waste removal systems are present

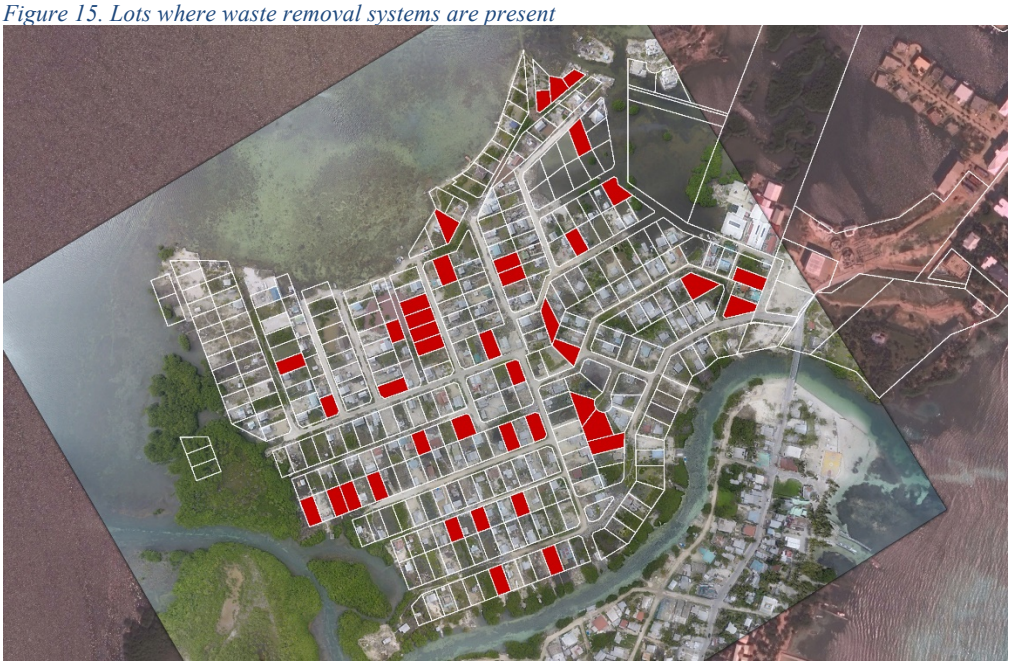


Figure 16. Lots without waste removal

Most lots with structures had some sort of waste removal present (figure 15). Most even had above ground septic tanks made from cement blocks. These septic tanks would be used until they filled, then a new one would be built, leaving the older tank to empty over time. Inhabited lots with no waste removal present (figure 16), tended to be on lots secluded from primary roads or access points, lots that may have been an afterthought between two planned rows of lots.

Waste removal is present in 236 structures (52%). These vary in type from septic tank (162) or outhouse (78). Even fewer have a hole in the ground or a bucket under the house. However, there are 210 structures with a combined 265 toilets in the community.

A San Mateo resident of 15 years reported that a majority of the cement septic tanks had open bottoms, only filled with shells and rocks. This construction facilitates the waste to flow easily back into the ground. She said there had been several attempts by the community residents and government alike to formalize waste removal, but none had been successful. This universal trend amongst the septic tank construction has led to the lush population of mangroves, Sargasso seaweed, and other greenery that thrive in the nutrient-rich environment.

Residents

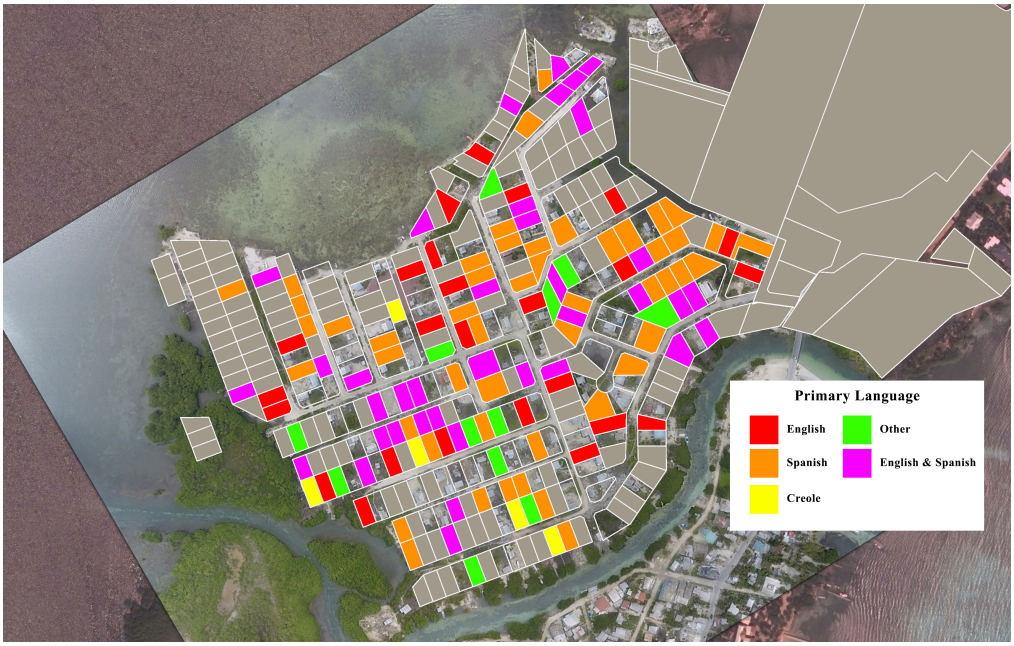
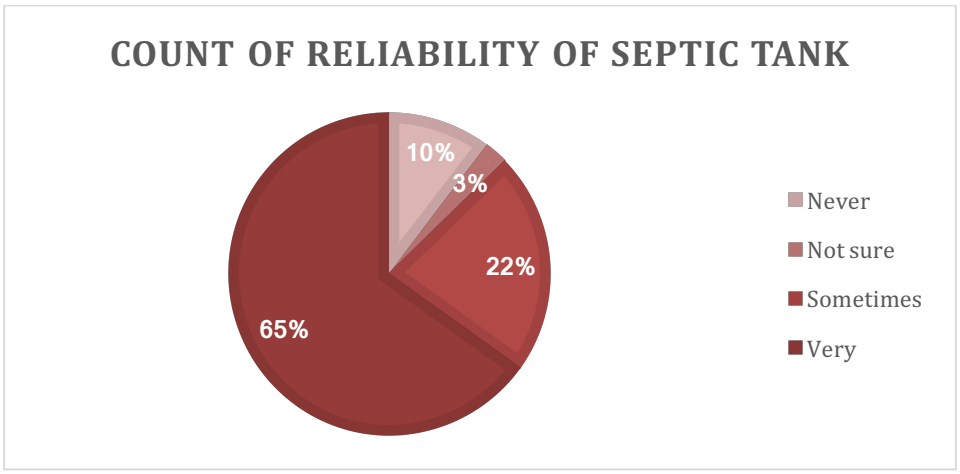


Figure 17. Languages spoken in the residence

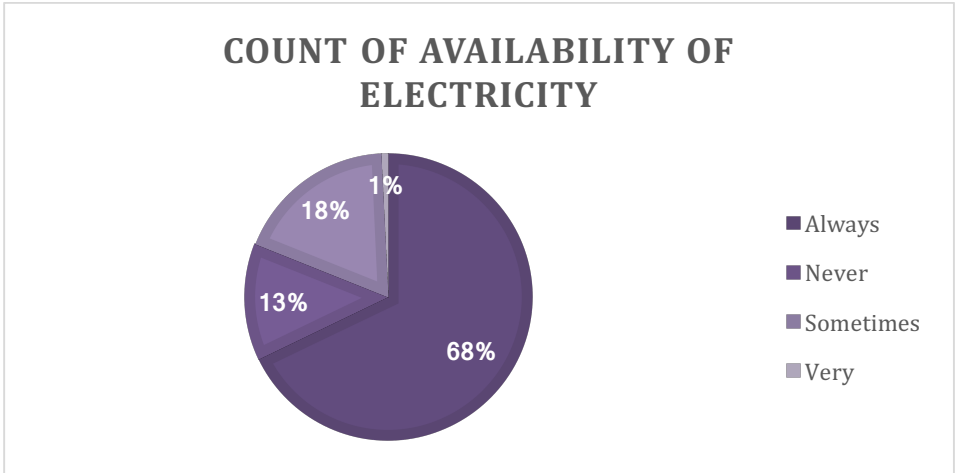
San Mateo residents speak a variety of languages including English, Spanish, and Creole. While most spoke Spanish in the home, most, because of the tourism-driven economy, speak English, and so speak both English and Spanish in the home. Additionally, the schools are taught in English so most of the school-aged children also speak English.

Social Survey Results

Upon consolidation of the data gathered through interviews of the residents of San Mateo, a series of graphical representations of given responses pertaining to infrastructure were compiled. The majority of the graphs depict potential answers limited to always, sometimes, or never, with very an alternative for always in certain instances. The social aspect of the survey completed while in San Mateo was often the most time-consuming aspect of the survey, yet, potentially, the most rewarding. The remainder of this document shows simplified illustrations of the answers provided during these surveys.

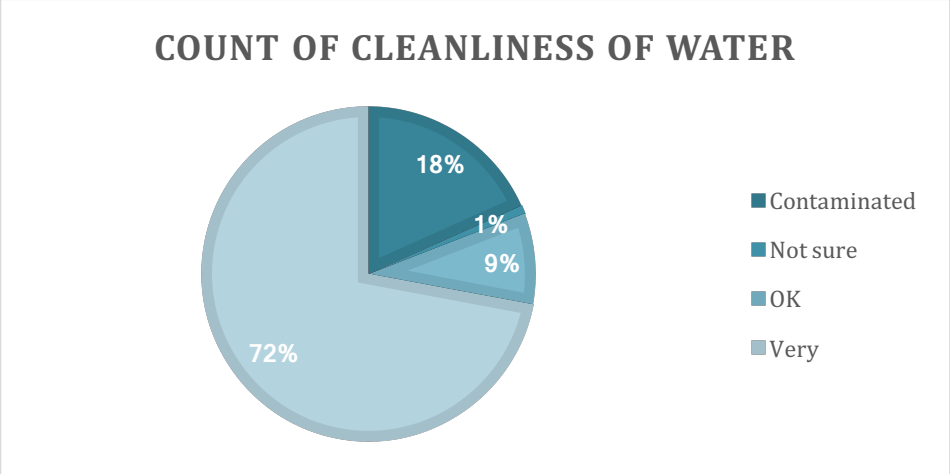


The majority of interviewed residents (65%) found their septic systems to be very reliable. These tanks were vastly comprised of above ground tanks of concrete block and mortar construction. Those that elicited the "not sure" response were often renters or other users of shared resources. Many respondents who replied with "never," meaning their septic was entirely unreliable generally did not have a septic tank or had one that was in disrepair.

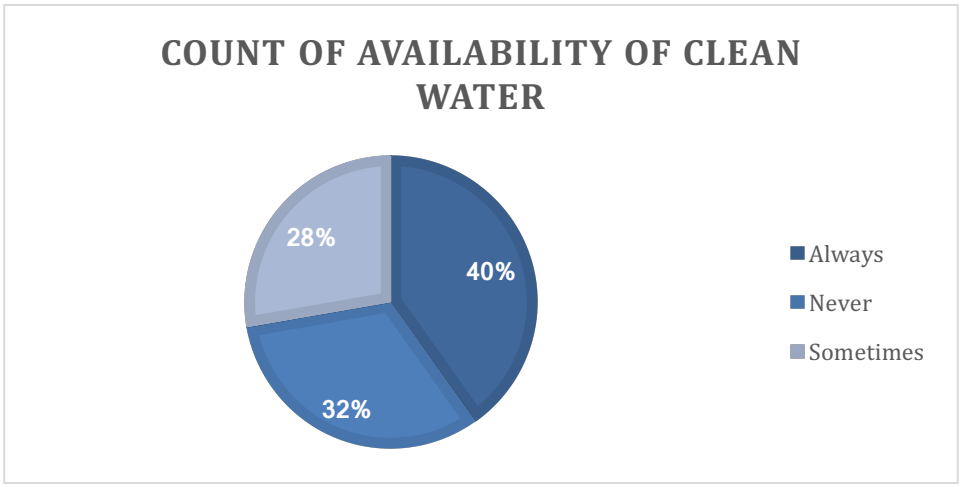


Despite much of the electricity stemming from a shared source, nearly 70% of the interviewed residents claimed to have consistently available electricity. Twenty-five households stated that their electricity was sometimes available, corresponding to the next largest sample at 18%. Many

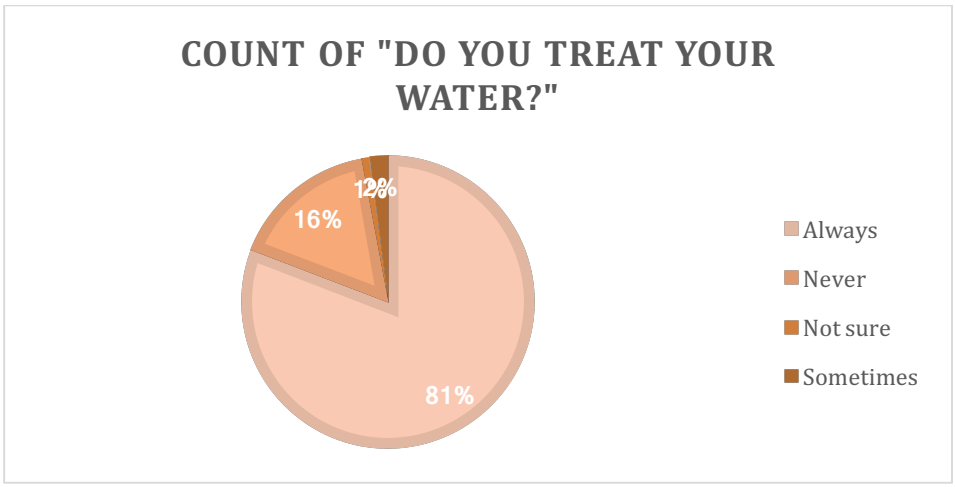
respondents also commented that steady electricity had been provided within five months prior to this survey, and were elated with the change in utility provision.



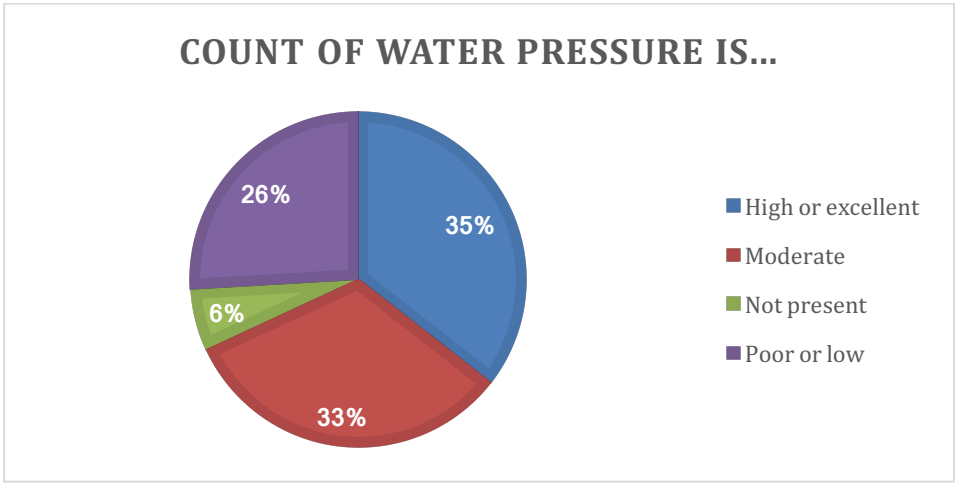
The vast majority of residents (72%) thought their water was "very" clean. One problem with this question comes from the varying definitions of the word "clean." Clean may mean suitable to wash or potable, depending on context and background. Indeed, a misconception in the question was noted on several surveys. The respondents commented that the water was very clean, but also responded that they never drink it, and only purchase bottled water. This may imply a systemic problem with how this question was presented or interpreted implying that "clean" in this case means suitable for washing clothes, dishes, people, etc., but not for drinking. The next largest group (18%) answered "contaminated" implying that either the water was not clean or was not potable.



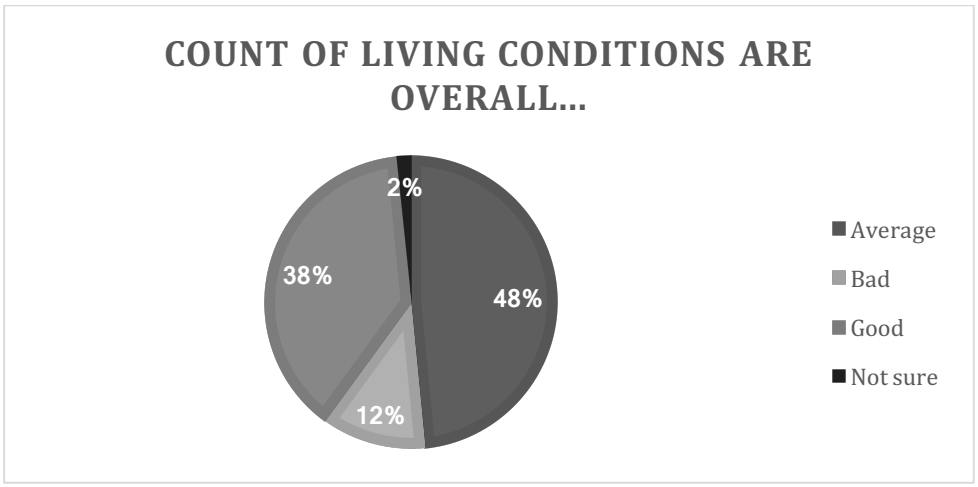
The slight majority of respondents stated that they have clean water available at all times. However, regardless of their response to this question, nearly every person interviewed stated that their drinking water was from bottled water purchased from Crystal Water Co. This wide variation in response may be indicative of the same issues presented above. Those who buy their water always have clean (potable) water present. Again, the concept of the word, "clean" cannot be determined in these cases.



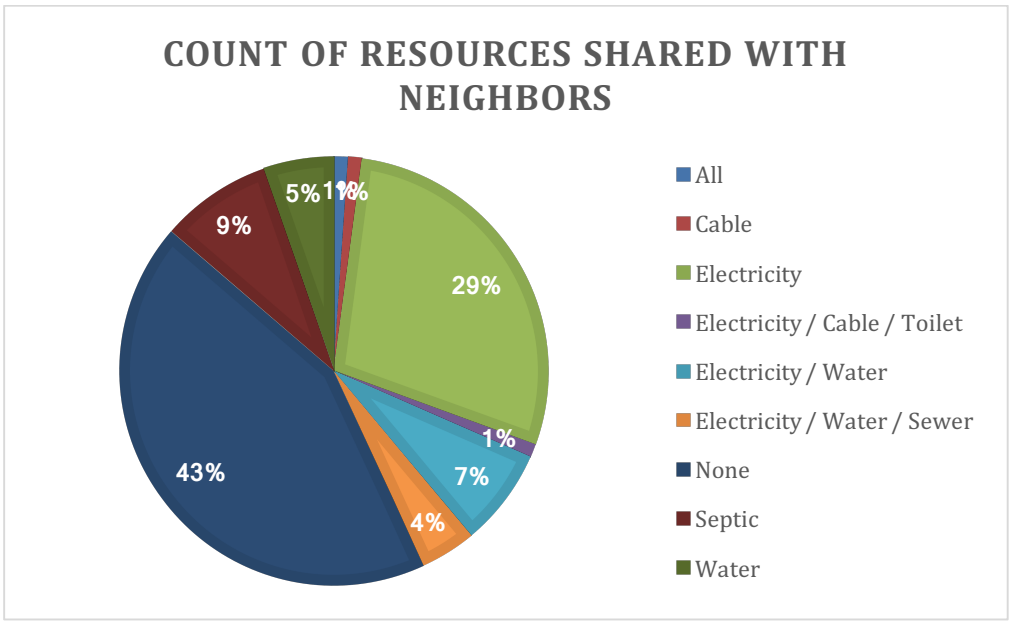
Due to lack of access to clean water from the tap, the residents have found that treating the water is the only alternative to purchasing it by the gallon. Many homes had cisterns on the property to collect rain water but even this water is recommended be treated prior to consumption by the local Red Cross. Surveys indicated that water is treated with bleach, tablets, or boiling as the primary method.



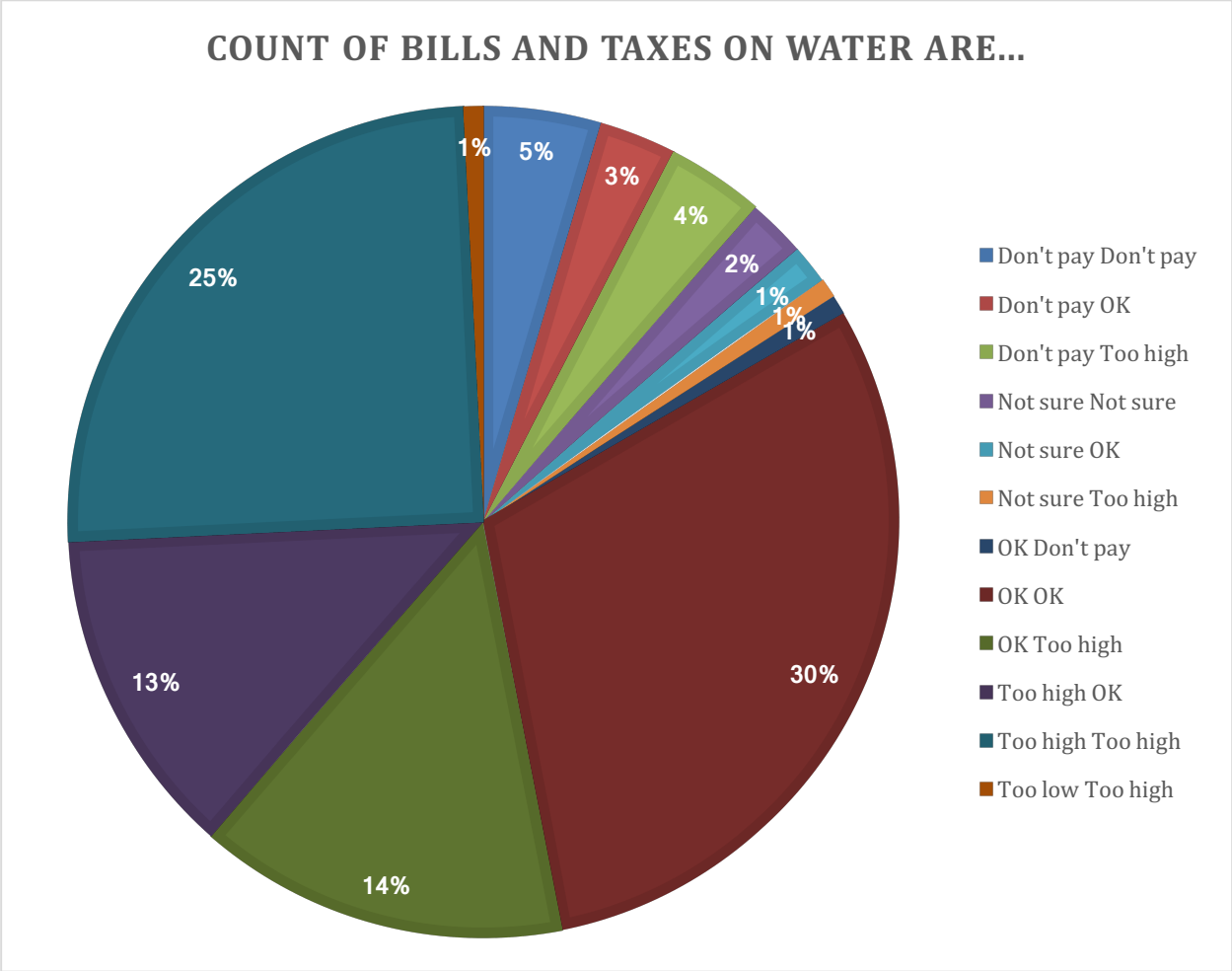
Water pressure varied tremendously from household to household. The overall trend however, was that those farther down the water line had lower and less consistent water pressure. No water pressure in the morning hours was often reported, due to the inability of the current infrastructure to serve peak demand.



This question was the most subjective of the interview. Residents were asked how they considered their overall living conditions. The overwhelming response was that the conditions were good or at least average, in their opinion. A combined 87% of respondents believe their living conditions above poor.



The residents were asked which, if any resources were shared with neighbors. The answers ranged from all to none, and everything in between. That said, the bulk of the respondents stated that they shared no resources with neighbors. However, the next largest block of responses were those that shared only electricity with one or more neighbors.



Another subjective set of questions asked surrounded bills and taxes paid on utilities. This analysis was conducted with the two answers together so that the analysis could look for trends in complimentary responses. The majority of respondents (30%) thought that both bills were "OK," and were amenable to paying what they had been for both. The next highest group believed both bills were "too high." There was an evident correlation between response to bills and taxes collected on water and bills and taxes collected on electricity with 45% of respondents believing both water and electricity were acceptable and 38% believed they were too high. When looking at the responses individually versus combined, the same trend is evident – where over 82% of respondents believe their bills and taxes on water and electricity to be OK or too high.

Acknowledgements

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