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Lacking A Connection To A Community Water System: Water Quality And Human Health Impacts In El Paso Colonias

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Dedication

I dedicate this thesis to my parents, Alma and José McDonald. My parents opened their home and their hearts to Ozzi, Harriet, Cole, and I so that I could return to college. This thesis would not have been possible without their support, love, and encouragement.

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LACKING A CONNECTION TO A COMMNITY WATER SYSTEM: WATER QUALITY AND HUMAN HEALTH IMPACTS IN EL PASO *COLONIAS*

by

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Abstract

Water-borne disease and its symptoms, such as stomach cramps and diarrhea, are a serious concern in areas that are not connected to a public water system. To investigate the impacts of not being connected to a community water system, I surveyed households in El Paso County *colonias* that were not connected to a community water system (household n = 75, individual n= 293) and households that were connected to a community water system (household n = 75, individual n= 320). I conducted 150 door-to-door surveys and tested water samples from each household for free residual chlorine level, turbidity level, presence of total coliforms and *E.coli* during November 19, 2011 through January 27, 2012. Using this data, I applied an environmental and economic injustice approach to analyze the relationship between socio-demographics, water costs, water quality, water storage practices, sanitation, and health outcomes using descriptive statistics, independent samples differences of means *t*-test, *z*-tests for two proportions, bivariate correlations, and logistic regression. I found that all households connected to a community water system met overall EPA standards for water quality, while only 66% of households not connected to a community water system met this standard. The data on water costs affirmed the economic injustice that those without community water systems are burdened with. The logistic regression results illustrated that sub-standard water quality was a significant predictor of gastrointestinal symptoms, apart from socio-demographics.

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Chapter 1: Introduction and Literature Review

1.1 Introduction

This study examines the relationship between socio-demographics, water costs, water quality, water storage practices, sanitation, and health outcomes for *colonias* in El Paso County. *Colonias* are unplanned semi-rural subdivisions, primarily located along the US-Mexico border, which are home to socially marginalized residents. These unincorporated settlements have high poverty rates, lack adequate access to health care, and residents lack basic infrastructural services, such as public water and sanitation (Ward, 1999; Parcher & Humberson, 2009). In El Paso County, Texas, 78,000 residents live in 302 communities defined as *colonias*. Of these *colonias*, 60 (representing 4,500 residents) are not connected to a community water system ("The *Colonia* Initiatives Program", 2010). While previous studies have examined water quality and water-borne diseases, I was not able to find a study that linked socio-demographics, water costs, water supply, and water storage practices to water quality and health in a comparative framework. This study utilizes the *colonias* classification developed by the 2005 State of Texas Senate Bill 827, which grouped *colonias* into three categories based upon the level of infrastructure and potential health risk to residents in terms of the availability of adequate public resources, such as not being connected to a community water system and not being connected to a public sanitation system (Parcher and Humberson, 2009) (See Table 1.1).

Table 1.1: *Colonias* Classification

Degree of health risk	Classification level	Criteria
High health risk	Red	At least one of the following factors applies: 1) Either all or some of the lots have inadequate wastewater disposal, such as cesspools. 2) All lots do not have a potable water supply 3) Not platted
Medium health risk	Yellow	Platted *colonias* with a potable water supply and adequate wastewater disposal, and at least one of the following factors: 1) Either all or some of the lots lack solid waste disposal, i.e. trash collection 2) Not all roads are paved 3) Not all roads are passable in all weather conditions 4) It floods during a precipitation event
Low health risk	Green	All of the following factors apply to all of the lots: 1) Platted 2) Have a potable water supply 3) Have adequate wastewater disposal 4) Have solid waste disposal 5) All roads are paved 6) All roads are passable in all weather conditions 7) Lot does not flood during precipitation event

Residents in red *colonias* face particular health risks due to inadequate drinking water and lack of wastewater disposal, such as water-borne diseases, which are typically gastrointestinal illnesses (Rose et al., 2001). These illnesses have symptoms that include diarrhea, stomach cramps, and a bloated stomach (Weniger et al., 1983). Because of the health vulnerability of residents in *red* colonias, I have selected only red *colonias* for inclusion in this study. However, some red *colonias* have piped water indoors from a community water system (CWS), and some do not. A community water system (CWS) is a type of public water system that provides potable water to the same people year-round via pipes or other established distribution systems (EPA Public Drinking Water Facts and Figures, 2010). I divided the *colonias* into two types based on that distinction. For that reason, the first type are *colonias* that lack piped indoor water from a CWS (henceforth called CLW, *colonias* lacking water*)*, and the second type are *colonias* that have access to piped indoor water from a CWS (henceforth called CWW, *colonias* with

water); both types lack public sanitation. To structure the comparison between the two types of *colonias*, I collected water samples to test water quality and conducted a detailed health survey, including questions on water costs, water practices, sanitation, and socio-demographics. In addition, I determined the extent of the economic injustices faced by the residents in the CLW and the CWW by comparing their socio-demographics and water costs to non-colonia residents living in the same side of the county, specifically residents serviced by the Lower Valley Water District (LVWD, a community water system).

1.2 Literature Review

This literature review begins by examining population groups not connected to a community water system on a worldwide level and how this burden is predominantly borne by the socially marginalized through policies and practices that have created environmental and economic injustices. Then, I review how the environmental injustice framework has been used in previous quantitative studies and how it can be applied to those not connected to a community water system. I also review the economic injustices faced by populations not connected to a community water system. I explored the cost of water for everyday household use, such as showering, and the costs to purchase potable water. Then, I examine the procedural injustices in El Paso County that have contributed to the development of *colonias*, and the legislative history of how the State of Texas has attempted to deal with existing *colonias* and halt the development of more. Lastly, I review the additional burdens populations face due to not being connected to a community water system, i.e., the risk of contamination from water delivery suppliers and health risks associated with inadequate potable water, including sensitive subpopulations at risk to water-borne diseases.

1.2.1 LACKING A CONNECTION TO A COMMUNITY WATER SYSTEM: A WORLDWIDE PROBLEM

Worldwide, 1.1 billion people lack access to potable water (World Water Council, 2010). The global water and sanitation crisis is not driven by the lack of availability of water, but is instead due to poverty, unequal power, and inequality, which shapes unequal access to water (UNDP Environment and Energy, 2010). In 2000, the international community acknowledged that access to water and sanitation is more directly connected to human development than is spending on healthcare, education, and the availability of energy services (UNDP Millennium Goals, 2010). The United Nations (UN) member nations formalized a commitment to address these concerns through the creation of the UN Millennium Development Goals (MDG) in 2000, which addressed lack of access to potable water and basic sanitation facilities via MDG Target 7c. The United Nations Development Programme (UNDP) achieved its 2015 goal of halving the proportion of the population that lacks access to clean water three years ahead of schedule and is working towards the 2015 deadline of halving the basic sanitation deficiency (UNDP Millennium Development Goals, 2012). Despite the UNDP achieving the potable water goal this year (in 2012), many communities still do not have access to a community water system.

On a global level and within the US, those most likely to lack access to clean piped water in their homes (which imparts a health risk) are the socially marginalized (Birkenholtz, 2010; Ghaderpoori, Dehghani, Fazlzadeh, & Zarei, 2009). For example, in Mexico, Stevens, Dias, & Ezzati (2008) found that the people most disproportionately exposed to unsafe water and lacking sanitation were the indigenous located in Chiapas, Guerrero, Oaxaca, and Puebla. Lacking water has health effects for these marginalized populations. As compared to other hazards, unsafe water and sanitation had a greater impact on mortality than indoor air pollution and ambient particulate matter in Mexico's 50 most-environmentally at-risk *municipios* (i.e., counties) (Stevens et al., 2008). Lack of access to piped indoor drinking water is also the key contributor to child dysentery in the Limpopo Valley (rural South Africa

and Zimbabwe), not transportation of water or poor sanitation and water practices (Gundry et al., 2009). In the US, those who are not connected to a community water system are the populations that typically suffer from environmental injustices: homeless populations, those living in absolute poverty who may have shelter but are vulnerable to having their water shut-off for non-payment, poor rural residents, including migrant farmworkers, Native Americans living on remote reservations, and residents in *colonias* (Westcoat, Headington, & Theobald, 2007).

1.2.2 LACKING A CONNECTION TO A COMMUNITY WATER SYSTEM: AN ENVIRONMENTAL INJUSTICE

The definition the US Environmental Protection Agency (EPA) uses for environmental justice (the opposite of environmental injustice) is:

> The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socio-economic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies (as cited in Bullard, 2005, p. 4).

Brulle and Pellow (2006) further clarified the concept environmental injustice by defining it as when a particular social group is disproportionately impacted by environmental hazards or risks, which is the definition used in this thesis. Quantitative environmental justice (EJ) researchers have primarily focused on the disproportionate exposure experienced by racial minorities and groups of lower socioeconomic status to hazardous waste, industrial facilities, and health risks from air toxics (Chakraborty & Armstrong, 1997; Brulle & Pellow, 2006; Mohai, Pellow, & Roberts 2009; Chakraborty 2009; Grineski & Collins 2010; Gilbert & Chakraborty 2011), as opposed to focusing on areas that are not connected to a community water system (see McDonald & Grineski, 2011 for an exception).

Lacking a connection to a CWS is an environmental injustice because on a global level and within the US, the socially marginalized are those most likely not to have access to potable water, a vital environmental resource (McDonald & Grineski, 2011). Despite global awareness that the lack of access to potable water that is piped into the home is a major health risk, and the United Nations' recognition that lacking piped potable water represents a human rights violation (United Nations General Assembly, 2010), there are households in the US that are not connected to a CWS. Therefore, while the US is a member nation of the UN, it does not does not enforce the human right for all of its citizens to have access to piped potable water in the home via a CWS. At the same time, anti-poverty programs in the US have not adequately addressed disparate water policies and the problematic water issues faced by the poor (Westcoat, Theobald, & Headington, 2008) contributing to the economic injustice related to the high cost of purchasing water from private water suppliers and bottled water.

1.2.3 LACKING A CONNECTION TO A COMMUNITY WATER SYSTEM: AN ECONOMIC INJUSTICE

Residents not connected to community water systems (CWS) pay more for water provided by private water suppliers, which is usually delivered by a water hauler and stored on- site in a storage tank. In El Paso County, *Colonia* Revolucion residents that purchase water from a water hauler, pay 5.5 times more per unit than El Pasoans who receive water from El Paso Water Utilities, the largest CWS in the area (Korc, 2010). This disparity is due in part to Texas regulating rates for municipal water systems but not for private water suppliers, which supply 77% of the water used in *colonias* (Olmstead, 2004). In addition, residents in *colonias* purchase bottled and/or water from machines for drinking because they do not trust the quality of water delivered by water haulers. A study in 2010 found that 70% of residents El Paso County and Hudspeth County *colonias* that are not connected to a CWS purchased bottled

and/or water from machines for drinking (Texas Department of State Health Services and the Pan American Health Organization, 2010).

1.2.4 LACKING A CONNECTION TO A COMMUNITY WATER SYSTEM: A PROCEDURAL ENVIRONMENTAL INJUSTICE

In an examination of procedural environmental injustice, researchers concluded that in the *colonias* in El Paso County, the lack of piped drinking water was due to historical racism towards Hispanics, and the high cost of building water and sewage infrastructure (Bath, Tanski, and Villarreal, 1998). Bath et al. (1998) contended that while poor ethnic minority groups face lack of home ownership opportunities across the United States, in the case of El Paso, the challenges faced by Hispanics were worsened by a history of institutional racism directly leading to an environmental injustice in the lack of access to public works, which is manifested in lack of public utility infrastructure in *colonias*.

As the population in *colonias* continued to increase in the 1980's so did media and non-governmental organizations (NGOs) awareness that people in the United States were living in unsanitary conditions due to not being connected to a community water system, which was viewed as a public health threat (Carter & Ortolano, 2004). Therefore, Texas took legislative steps toward addressing the procedural environmental injustices that kept *colonia* residents from accessing basic infrastructure like plumbing. Specifically, the 71st Texas Legislature responded through the establishment of the 1989 Economically Distressed Areas Program (EDAP), in conjunction with the Texas Water Development Board (TWDB), which was designated to oversee water and waste water system implementation projects in EDAP identified areas that would be subsidized by the state (Carter & Ortolano, 2004).

Many *colonias* met the requirements of the EDAP, which consisted of lacking and/or having inadequate water and wastewater services and being located in an economically distressed area (Texas Water Development Board, 2010). In theory, this was a major step for residents in *colonias* because it

opened dialogue that had not existed between the TWDB and *colonias*, and the state passed a series of bills to regulate development in economically distressed areas, such as *colonias*. However, due to lax enforcement that allowed developers to not meet Model Subdivision Regulations (Ward, 1999) and *colonia* residents' lack of experience working with governmental agencies and administrative bureaucracies (Carter & Ortolano, 2004), *colonias* not only continued to lack piped water, but also continued to increase in number along the US-Mexico border.

After almost a decade, EDAP started to make progress in household connection rates, however, *colonias* without piped water still exist (Carter & Ortolano, 2004). Meanwhile the State passed three significant Senate Bills between 1999 and 2007: Senate Bill 1421 (1999), Senate Bill 827 (2005), and Senate Bill 99 (2007) that focused on addressing inadequate water and wastewater systems in *colonias.* The culmination of these bills was the creation of the *Colonia* Initiative Program of the Office of the Secretary of State, the *colonia* classification by infrastructure status and corresponding public health risks (See Table 1), and the monitoring of the process of infrastructure investment by the State ("The *Colonia* Initiatives Program", 2006).

As of December 2010, per a report update for Senate Bill 99, there are still approximately 45,000 residents in 353 Texas *colonias* classified as 'red' and approximately 4,500 residents in 62 Texas *colonias* whereby information on services is unknown ("The *Colonia* Initiatives Program", 2010). In El Paso County, per the 2006-2010 American Community Survey (ACS) there are 3,993 households lacking complete indoor plumbing, which is 925 more households than in the 2000 census. However, both figures represent approximately 2% of the occupied housing units in El Paso County. The 2006-2010 ACS increase may be attributed to procedures that the US Census Bureau implemented to overcome the barriers with the enumeration process that one encounters in *colonias*, such as irregular housing and addressing (TLCEF, 2011). Therefore, while the State has dedicated some resources to the

problem, more than 20 years after the media and non-governmental organizations first raised awareness that residents in *colonias* were not connected to a CWS, the procedural injustice persists.

1.2.5 Additional Burdens Due to Lacking a Connection to a Community Water System

Lacking a connection to a community water system places additional burdens on residents that heighten the economic and environmental injustices they experience and these include: (1) the risk of contamination from water delivery suppliers and water storage containers and (2) health risks associated with inadequate potable water.

1.2.5a The Risk of Contamination from Water Delivery Suppliers

Households that are not on a CWS in El Paso (and elsewhere) are at increased risk for being sold contaminated water, and their water practices (e.g., not cleaning their tanks) can put them at risk for water contamination (Hinojosa, 2011). Related to practices, eighteen percent (18%) of residents in two *colonia* communities in El Paso and Hudspeth counties infrequently or never cleaned their water storage tanks (Korc, Orozco, Corona, & Murtaza-Rossini, 2011), increasing their likelihood of having contaminated water. A study in El Paso County of four adjacent *colonias* found that water delivered by a water truck to the household and then placed in a storage unit had a 30 percent contamination rate of total coliforms, meaning the water quality did not meet the Recommended Water Quality Standards issued per the World Health Organization (total coliforms standards discussed in 2.5) (Graham & VanDerslice, 2007). Researchers found that the chlorination levels of stored water were insufficient, thereby allowing for the presence of coliforms, which can cause diarrhea. While Texas water haulers are required to maintain a safe level of chlorine in the water to protect it from bacterial infestation, the level of chlorine does not remain steady in tanks, and it drops over time especially as outdoor

temperatures increase (Graham & VanDerslice, 2007; Reynolds, Mena, & Gerba, 2008). On July 21, 2011, D&D Water Trucks, a water hauler that sells water to residents in the CLW surveyed as part of this thesis was cited by the Texas Commission on Environmental Quality Investigation for using expired free chlorine reagent packets (expiration date of 5/2003). While D&D has purchased new reagents, it can be concluded that the company may have not been adequately monitoring the free residual chlorine level in their water tanks. Therefore, because of the risk of contamination and because the chlorine levels drop through time, regular testing and maintenance of chlorine levels in water storage tanks are necessary, which underscores the additional burden on the household to manage their storage tanks to prevent bacterial growth (Graham & VanDerslice 2007).

Additionally, Reynolds et al. (2008) acknowledged that while residents connected to CWS are at risk for water-borne diseases, these systems are regulated, which should reduce their risks. However, an internal 2002 audit revealed that the EPA had incorrectly reported achieving its drinking water goal under the Government Performance Results Act for drinking water quality. The goal was for 91% of the population served by CWS to meet all health-based standards. While the EPA was unable to provide the actual percentage achieved, it noted that the inaccuracy in reporting was not cause for a public health concern (USEPA, 2004). While regulation of US drinking water supply may have problems from time to time, there are guidelines, monitoring protocols, and reporting which ensures oversight of the public water supply. For households that store water in tanks, such as *colonias* residents that lack piped indoor water from a CWS, there is no governmental monitoring entity testing their water, putting this population at greater risk for water-borne diseases.

1.2.5B HEALTH RISKS ASSOCIATED WITH INADEQUATE POTABLE WATER

The lack of access to piped potable water in a community based setting is ideal for the spread of water-borne diseases, typically gastrointestinal illnesses, such as diarrhea (Reynolds et al., 2008; Rose et al., 2001). Drinking water that does not meet EPA guidelines (EPA guidelines discussed in 2.5) for free residual chlorine level and/or turbidity has been linked to diarrhea, stomach cramps, stomach pain, and a bloated stomach, which are all symptoms of gastrointestinal illnesses (Rose et al., 2001; Mac Kenzie et al., 1994; Payment et al., 1991; Weiniger et al., 1983). Teschke et al. (2010) found in a study of a mixed rural and urban community that had varied levels of public water and sanitation services in Vancouver, Canada that the proper level of chlorination in the water supply was linked with decreased visits to the doctor.

The world-wide impact of unsafe water and sanitation is an estimated 3.4% of the global burden of disease (Stevens et al., 2008). In order to sustain human life, water must not only be available, it must also be free of contaminants in order to prevent water-borne diseases. Specifically, lacking piped indoor water causes health risks because storage tanks are susceptible to health-damaging contamination. Chlorine levels can drop quickly, which accelerates bacteria growth, and if water tanks are not sealed properly, they can become contaminated from birds, animals, wind, and algae (Reynolds et al., 2008). Therefore, a lack of piped indoor drinking of water is directly related to a potential public health crisis.

There is a growing body of literature on epidemiologic studies that have measured the occurrence of water-borne diseases in the U.S. population, which are primarily focused on specific episodes related to water quality in the CWS being compromised, such as the breakout of cryptosporidium infection in Milwaukee in 1993 (Mac Kenzie et al., 1994). At a non-specific incident level, Messner et al. (2006) conducted a comprehensive epidemiologic study to develop a national estimate model of water-borne disease in the US for residents on community water systems. Messner et

al. (2006) used only the population served by CWS because of the limited data available to conduct a risk based epidemiologic study of communities not connected to a CWS. Furthermore, Messner et al. (2006) acknowledged that more research is needed in both CWS and non-CWS populations to better estimate rates of water-borne diseases and gastrointestinal illnesses in the US population related to drinking water.

More specific to my study area, in Texas *colonias*, the rates for shigellosis and Hepatitis A (both associated with contaminated water) were at least double than other parts of the U.S. (Ward, 1999). Parcher and Humberson's (2009) study of the border revealed that, during the 1980's, a population boom in the *colonias* was coupled with increases in water-borne diseases, such as dysentery and hepatitis. Along the US-Mexico border, there is a higher than average prevalence rate of intestinal parasite infections but there is a lack of data to explain this phenomenon (Escobedo et al., 2003). However, I searched the Texas inpatient hospitalization data for 2000 – 2005 and found zero cases of water-borne diseases. The lack of cases may be driven by people seeking treatment at clinics or with over the counter medications, or relate to the lack of awareness of the incidence of water-related parasitic diseases on the US side of the border by health professionals, resulting in under-diagnosis and/or misdiagnosis (Escobedo et al., 2003).

1.2.5C SENSITIVE SUBPOPULATIONS AT-RISK FOR WATER-BORNE DISEASES

Children under 5 years of age, being 65 years of age or older, being diabetic, and being pregnant have been identified as sensitive subpopulations at-risk to water-borne diseases (Reynolds et al., 2008; Rose et al., 2001). Children have been a focus in the EJ literature more generally due to their increased vulnerability to environmental toxins (Szyszkowicz, 2008). Ninety percent of the world-wide disease burden related to unsafe water and sanitation is borne by infants and young children who live in low and

middle income countries (Stevens et al., 2008; Buttenheim, 2008), including Mexico. Furthermore, 15% of all the deaths in children under 5 years of age, in these aforementioned countries, were linked to diarrheal disease (see Buttenheim 2008). A 1996 – 1997 study of East Texas *colonias* (Leach, Koo, Kuhls, Hilseneck, & Jenson. 2000) focused on *Cryptosporidium parvum*, herein called Crypto. Crypto is a protozoan parasite found in water, which can cause cryptosporidiosis, a diarrheal disease (Minnesota Department of Health, 2010). The study discovered that *colonia* children had a comparable rate of infection to those in developing countries (89%) (Leach et al., 2000). Leach et al., (2000) concluded that these infections in *colonias* should be studied to identify risk factors for other water-borne diseases.

In addition to children, the elderly are also sensitive to water-borne diseases. For example, in Philadelphia hospital admissions for gastrointestinal illness for children and the elderly increased after higher levels of turbidity were recorded in the city's drinking water (Mann, Tam, Higgins, and Rodrigues, 2007). Turbidity is a measure of suspended matter or impurities in the water, i.e. an indicator of the clarity of water. The less clear the water is, the higher the turbidity level, and the greater the potential for the presence of pathogens capable of causing water-borne diseases (EPA Guidance Manual Turbidity Provisions, 1999). Moreover, people with diabetes are also at increased risk for water-borne diseases (Reynolds et al., 2008; Rose et al., 2001). Persons with diabetes are at an increased risk for gastrointestinal illness and its symptoms, such as stomach pain and diarrhea. The mechanism that puts a person with diabetes at risk for gastrointestinal illness is one's glycemic level not being properly maintained (Bytzer et al., 2001). Therefore, if a person with diabetes drinks contaminated water and their glycemic level is too high or too low, it could put them at an increased risk of gastrointestinal illness compared to a person without diabetes. Diabetes is a concern among Mexican-Americans, which is the predominant ethnic group in my study area. In a study of Mexican Americans in *colonias*, researchers found a slightly higher prevalence of diabetes among Mexican Americans compared to the US average (Mier et al., 2008). While the difference is small, not being connected to a CWS and the

potential of water-borne diseases exacerbate negative health outcomes for residents with diabetes, factors that those with potable water and diabetes are not burdened with.

1.3 Specific Aims

The overall aim of this study is to examine water quality and its potential impact on water-borne diseases, as well as the symptomatic health conditions associated with these diseases, through the testing of water quality at the point of where water is accessed for household use and a health survey to address the following specific aims:

Specific Aim 1: Determine the extent of the economic injustices faced by the residents in the CLW and the CWW by comparing their socio-demographics and water costs to non-colonia residents, specifically residents serviced by the Lower Valley Water District (LVWD, a community water system).

Specific Aim 2**:** Analyze if the water quality differs between the CLW and the CWW based upon bacteriological, chemical, and physical indicators.

Specific Aim 3: Understand the relationship between socio-demographics, water storage practices, and sanitation with water quality and health conditions within the CLW.

Specific Aim 4: Analyze if health conditions differ between CLW and the CWW.

Specific Aim 5: Determine the impact of quality of water on health using the following control variables: age (over 65 years of age and under 5 years of age), health insurance status, household size, total household income, and tap water drinking habits, and free residual chlorine or turbidity for all household members in the CLW.

1.4 Chapter Conclusion

While there has been previous research on water access and water quality (Graham & VanDerslice, 2007), and health studies in *colonias* in the state of Texas (Escobedo et al., 2003), to the best of my knowledge, there has not been a study that examines the impact of not being connected to a community water system on water quality and the health status of *colonia* residents in regard to water-borne diseases and related symptoms. Additionally, this study will contribute research to counter the myth identified by Westcoat, Headington, and Theobald (2007) that 100% of people living in the US have access to water and wastewater systems. Additionally this thesis addresses the recommendation that more research is needed to understand water-borne diseases in US, as well as in *colonias* along the US-Mexico border. Furthermore, this study builds upon existing research, such as Graham and VanDerslice's (2007) examination of water quality after intervention efforts to increase water storage capacity in CLW. The next chapter I will explain how I will explore and analyze data to address the five specific aims of this thesis.

Chapter 2: Methods

2.1 Study Areas and Sample Size

To begin, I utilized the El Paso County *Colonias* database to identify a study area to survey the CLW and the CWW households for a total household sample size of 150 (n = 75 in the CLW and n = 75 in the CWW). This household sample of 150 yielded data on 613 individuals for the health and socio-demographic domains (n=293 in the CLW and n=320 in the CWW). The following *colonias* are the CLWs communities surveyed: Ascension, Cochran Trailer Park, College Park, Dairyland, Hillcrest Estates, Hueco Tanks, Las Colonias, and Sunset Ranches, and CWW *colonias* were represented by Agua Dulce, Montana Vista, and Panorama Village (Table 2.1).

Table 2.1: Participating household counts and individual resident counts by *colonia* type

	Households		Individuals	
CLW[1]	Frequency	Percent	Frequency	Percent
Ascenscion	13	17.3	42	14.3
Cochran Trailer Park	4	5.3	22	7.5
College Park	11	14.7	43	14.7
Dairyland	11	14.7	48	16.4
El Conquistador	9	12.0	34	11.6
Hillcrest	6	8.0	31	10.6
Hueco Tanks	12	16.0	46	15.7
Las Colonias	5	6.7	19	6.5
Sunset Ranches	4	5.3	8	2.7
Total	75	100	293	100

[1] *Colonias* lacking water

	Households		Individuals	
CWW[2]	Frequency	Percent	Frequency	Percent
Agua Dulce	45	60.0	185	57.8
Montana Vista	23	30.7	98	30.6
Panorama Village	7	9.3	37	11.6
Total	75	100	320	100

[2] *Colonias* with water

The CLW and the CWW included in this study are both classified as red *colonias* (See Table 1.1). The residents in both communities are poor (average household income is $16,250) and of Hispanic ethnicity. In terms of education, insurance status (being insured as opposed to being uninsured), length of residence at current address, country of birth (Mexico or the US), diabetes status, language most often spoken at home (increase in Spanish as opposed to English), and total household income the CWW residents are similar to those living in the CLWs (See Table 2.2). In terms of

education, for persons under 25 years old, I assigned the highest level attained by parent(s). While there are significant differences between some attributes, such as the percentage of people who are 65 years of age and older, percentage under 5 years of age, household size, and housing tenure (renter occupied housing is more common in CLW), these differences do not create dramatically different socio-demographic profiles for the residents in the CWW or the CLW. For example, the average resident in both communities lives in a bilingual household and 40% of residents were born in Mexico. However, while neither community is hooked up to a public sanitation system, the critical difference is that the CWW are connected to a community water system.

Table 2.2: Differences in socio-demographics between the CLW and CWW independent samples t-test: metrics and results

Variable (individual level)	Metric	*Colonia*	N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
65 years age and older	0 = No, 1 = Yes	CLW[1]	293	.10	.30	.02	.020*
		CWW[2]	320	.05	.22	.01	
Under 5 years of age	0 = No, 1 = Yes	CLW[1]	293	.06	.23	.01	.023*
		CWW[2]	320	.11	.31	.02	
Education Highest Level	1 = Less than high school, 2 = High school graduate/GED, 3 = Some college, 04 = Associate's degree or specialized training, 5 = B.A. degree, 6 = M.A. degree or more	CLW[1]	293	1.87	1.12	.07	.165
		CWW[2]	320	2.00	1.13	.06	
Insurance status	0 = Insured, 1 = Uninsured	CLW[1]	293	.46	.50	.03	.080
		CWW[2]	320	.39	.49	.03	
Household size	Range: 1 - 9 household members	CLW[1]	293	4.88	1.90	.11	.018*
	Range: 1 - 8 household members	CWW[2]	320	5.26	2.05	.11	
Length of residence at current address	Range: < one year to 32 years	CLW[1]	293	9.76	7.41	.43	.490
	Range: < one year to 27 years	CWW[2]	320	9.33	7.97	.45	
Country of Birth	0 = All Other, 1 = Mexico	CLW[1]	293	.44	.50	.03	.539
		CWW[2]	320	.42	.49	.03	
Diabetes status	0 = No, 1 = Yes	CLW[1]	293	.12	.33	.02	.783
		CWW[2]	320	.12	.32	.02	
Language most often spoken at home	1 = English only, 2 English more than Spanish, 3 = English and Spanish about the same, 4 = Spanish more than English, 5 = Spanish only	CLW[1]	293	3.66	.88	.05	.159
		CWW[2]	320	3.74	.66	.04	
Total household income	1 = Less than $1,999/yr - 15 = $55,000+/yr	CLW[1]	287	7.52	3.48	.21	.937
		CWW[2]	320	7.54	3.33	.19	
Housing tenure	0 = Own, 1 = Rent	CLW[1]	293	.19	.39	.02	.006*
		CWW[2]	320	.11	.31	.02	

*. Signficant at the 0.05 level (2-tailed).

**. Signficant at the 0.01 level (2-tailed).

[1]*Colonias* Lacking Water

[2]*Colonias* With Water

The CWW receive water from two CWS: Horizon Regional Municipal Utility District (HRMUD) and El Paso Desert Meadows County Water Program (EPDMC). The CWWs that are serviced by the HRMUD were connected 15+ years ago and those served by the EPDMC were connected in the past five to 10 years. The CWWs have a varied mix of housing, ranging from brick homes (See Figure 2.1) to those that were constructed using available materials. In the figure below, an unused water storage tank is still on the property (see black tank behind home) despite this community being hooked up to HRMUD almost 20 years ago.

Figure 2.1: *Colonia* Agua Dulce, a CWW

When conducting surveys, I was surprised to see numerous CWW homes that looked like they could be located in a comfortable neighborhood in El Paso County (See Figure 2.2). However, a ubiquitous feature in the CWW, that differentiates it from other comfortable El Paso neighborhoods, is the barren landscape. CWW tend to be devoid of grassy lawns and are spotted with very few shrubs and trees.

Figure 2.2: *Colonia* Agua Dulce, a CWW

Despite the CWW having a connection to a community water system, 79% of residents surveyed still purchased bottled water and/or water from a machine for drinking (See Figure 2.3). This particular water machine is located in the center of Agua Dulce (the main street of the community) and the residents in the CWW and the CLW purchase water from this location.

Figure 2.3: Water machine located in the *Colonia* of Agua Dulce, a CWW

In the CLW, residents, in addition to buying bottled water and/or water from machines for drinking (92%), purchase water from water haulers, i.e. water delivery truck (See Figure 2.4).

Figure 2.4: A water hauler, i.e. water delivery truck in *Las Colonias*, a CLW

The water is primarily stored in large 1,500 to 2,500 gallon plastic storage tanks (See Figure 2.5 and Figure 2.6).

Figure 2.5: Water storage tank in Dairyland, a CLW

Figure 2.6: Water storage tank in Cochran Trailer Park, a CLW

The majority of homes in the CLW were in some phase of construction. A common practice in CLWs is to purchase a lot and put a mobile home on the property as the primary residence. And then, as money and time allows, the family will build a permanent structure which is connected to the mobile home (as depicted in Figure 2.7). This type of building construction can last for decades creating a perpetual state of construction.

Figure 2.7: A home in Dairyland, a CLW

2.2 Sample Methodology

The survey was conducted using a skip pattern of contacting one out of three households (i.e. go door-to-door selecting every third house) to obtain 75 households per type of *colonia*. We contacted 181households in the CLW and 107 people answered the door. Of those 107 households, the participation rate was 70%. While the CWW had a similar response rate (69%), there were more "no answers", requiring us to knock on 33% (n=59) more doors than in the CLW. I went door-to-door conducting the surveys with a Vicenta Plascenia, a *promotora*, i.e., a community-based bilingual health worker. A *promotora* is ideal to assist with conducting health surveys and asking permission to obtain water samples door-to-door because of her ability to establish rapport and gain support within the study areas (Hernández and Grineski, 2010, Balcazar et al., 2006). I worked with Project Vida to help me identify the *promotora* based upon the *colonias* selected and the scope of the hours and the days of the week. The door-to-door surveys were collected by Vicenta and me between November 19, 2011 and January 27, 2012. We followed a varied schedule to conduct our interviews, including weekdays and weekends. After a couple of Sundays, we found the day to be unproductive unless we used it to schedule

"come back" requests made earlier during the week, so that became our strategy. During the week and on Saturday we followed a 9:15 a.m. start (knocking on our first door) and worked until early evening.

2.3 Survey Procedure

To explore the relationships between socio-demographics, overall cost of water, water storage practices, water consumption habits, sanitation facilities and related expenses, health, health insurance status, and where and how one seeks medical treatment, a health survey was utilized. The door-to-door survey was offered in English and Spanish (See Appendix A1- English and Appendix A2 - Spanish) and captured five domains: (1) health, (2) water storage practices (only for the CLW), (3) sanitation, (4) socio-demographics, and (5) water supply. The survey and consent form (See Appendix B1- English and Appendix B2 - Spanish) were professionally translated from English to Spanish by Victoria García, Director of the Translation Service Office in the Department of Language & Linguistics at The University of Texas at El Paso. The Spanish language version of the survey was used 75% of the time in the CLW and 89% in the CWW.

The survey was piloted in Spanish and English among four *colonia* residents. The Spanish and the English version were used for the two residents in the CLW (conducted an interview in each language) and the Spanish version for the two residents in the CWW. The pilot process enabled me to field test the language and terms contained in the survey from a respondent viewpoint. Based upon feedback on the Spanish, as well as the English instrument, Question #20 (about the size of septic tank) was modified to include numbers of bedrooms (as this is relevant to estimating the size of tank needed for each household), in addition to capacity in gallons. In addition, it was identified that Question #28 (about seeking medical treatment) required interviewer to be very careful in distinguishing that the question was for medical treatment specifically for diarrhea, and then for general illness. Additionally,

the pilot ensured that the survey was operable and flowed in an effective manner for the interviewer and the respondent.

2.4 Survey Domains

The survey instrument was created by culling questions related to water access, water quality, health questions, and socio-demographics from the following sources: Texas Department of State Health Services (TDSHS) and the Pan American Health Organization (PAHO) community-based survey in border *colonias* of west Texas (2010); Graham and VanDerslice's *colonias*-based research water container intervention study (2007); National Health Interview Survey (2004); *Agua Para Beber* (2005); Homedale Neighborhood Survey (Grineski, 2003); and the WHO Survey (2002). During the Fall of 2010, The *Colonias* Initiatives Program (ICIP) successfully piloted an exploratory survey, which contained questions related to water storage practices, sanitation, and water supply in El Paso and Hudspeth Counties. The survey developed for this thesis built upon the 2010 ICIP survey, as well as incorporated additional questions to explore the relationship between water and health.

All domains were asked for the head of household, and he/she also answered a sub-set of questions about all household members. This subset of questions included: the person's relationship to respondent, age, sex, ethnicity, country of birth, education, employment status, marital status, length of residence at current address, diabetes status, pregnancy status, insurance status, health conditions, and where medical treatment is sought. In the event that other household members were present and were over 18 years old, the interviewer directly asked the member health related questions. The interviews, on average, were one hour in length. Therefore, at the completion of the survey, as a gesture of reciprocity, all participants were compensate with $10 cash (Rabinow, 2007), along with a list of community clinics

(name, address, and phone number) located in El Paso County (See Appendix C1- English and Appendix C2 - Spanish).

2.4.1 HEALTH

I used questions from the following surveys: *Agua Para Beber* (2005), National Health Interview Survey (2004), Homedale Neighborhood Survey (Grineski, 2003), and the WHO Survey (2002) to develop the questions focusing on health. I asked questions about general health, followed by an in-depth series of questions related to diarrhea and its symptoms, and occurrence of water-borne diseases and gastrointestinal illnesses. To measure whether the household members had access to preventive health-care measures, the survey included a health insurance status variable. In addition, I collected data for how and where medical treatment was sought, which will be used for future research to explore the health dimension of whether residents in *colonias* seek treatment in El Paso, Ciudad Juárez, or both cities. The data obtained from this domain represents a contribution to the knowledge base related to health and/or health treatment practices in El Paso *colonias* because the 2010 ICIP survey (a pilot for this project) did not include any health questions.

2.4.2 WATER STORAGE PRACTICES

This battery of questions was developed using the TDSHS and PAHO community-based survey in border *colonias* of west Texas (2010) and *Agua Para Beber* (2005), and were only asked of residents in the CLWs, since they were not applicable in the CWW. The data collected were used to construct variables for overall cost related to water storage, the frequency of water delivery, type of storage, and water storage cleaning practices. Additionally, modeled after the 2010 ICIP survey, my survey instrument included questions about water storage practices based upon seasonality (i.e. spring/summer

versus fall/winter) due to possible changes in water usage between seasons and potential differences in tank cleaning practices during summer months, which will be used for future research.

2.4.3 SANITATION

I built upon the sanitation questions contained in the 2010 ICIP survey to gather additional data on septic tank maintenance and expense. The 2010 ICIP demonstrated that resident knowledge about septic systems was poor. If respondents answered yes to having a septic tank, only 12% knew the name of the company that certified their system (Korc et al., 2011), which is relevant because this information should be known since septic certification is paramount to ensuring the system is properly working, i.e. that is sewage is not leaking. While my thesis focuses primarily on the impacts of not being connected to a community water system, there are also health impacts associated with not being hooked up to a public sanitation system, such as increased incidence of diarrheal disease (Graham, Corella-Barud, Avita-Diaz, & Gurian, 2005). Therefore, in addition to questions about type of sanitation facility used, if septic tank is certified, and frequency of septic tank being pumped, I added two questions that will be used in future research. The first question will allow me to determine if the septic tank is being pumped on the recommended frequency based upon total number of members in the household by asking the size of the septic tank. And, the second is related to annual septic maintenance expenses so that I can explore if there is greater financial burden experienced by *colonia* residents because they are not connected to a public sewer system.

2.4.4 SOCIO-DEMOGRAPHICS

The WHO Survey (2002) household roster and the 2010 ICIP instrument were utilized as baseline instruments to capture socio-demographic data to characterize the population of residents in the

colonias. These instruments included data points relevant to environmental justice research, such as ethnicity, class, age, and gender measures (Collins et al., 2010; Downey and Hawkins, 2008 ; Grineski et al., 2007; Mohai and Saha, 2006). The survey respondents were predominantly Hispanic (99.7%), which reflects El Paso's 'majority minority' city profile of 83% of the residents being Hispanic (U.S. Department of Commerce, Bureau of the Census, 2012). In addition, contextually relevant environmental justice variables were analyzed in this study. Contextually relevant variables include preferred language spoken at home, country of birth, and length of residence at current address in the *colonia* (Collins et al., 2010). And, socio-demographic variables of relevance in health studies, such as being pregnant, having diabetes, insurance status, and age (65 years and over, and under 5 years of age), were included in this domain (Reynolds et al., 2008; Rose et al., 2001).

2.4.5 WATER SUPPLY

The basis for the water supply questions are the 2010 ICIP instrument and *Agua Para Beber* (2005), with additional questions on water purchasing habits, location of water storage (inside or outside of home), and the size of the containers. In addition, I expanded the water treatment questions from the 2010 ICIP instrument to include water practices from the *Agua Para Beber* (2005) survey to measure if *colonia* residents employed water treatment customs more common in Mexico, such as using iodine tablets and/or drops.

2.5 Water Sample Methodology

To determine water quality, I collected three 250 ml water samples at the point of where water was accessed for household use to test whether the samples met EPA drinking water standards for (1) free residual chlorine, (2) total coliforms, and (3) turbidity (Ghaderpoori et al., 2009). In the event that

water samples were damaged or spilled during transport, the consent form included a request to return for additional samples; however, no samples were damaged during transport. The final protocol for water sample collection and testing was reviewed and approved by Dr. Shane Walker, an Assistant Professor at The University of Texas at El Paso (UTEP) in the Civil Engineering Department, and Dr. Kristina Mena, an Associate Professor and Program Head of the Program in Environmental and Occupational Health Sciences at The University of Texas Houston School of Public Health. I contracted an undergraduate Research Assistant (RA), Nereida (Neddie) Cora to assist with the collection and testing of the water samples. Neddie is a senior level civil engineering (major) and environmental science (minor) student at UTEP. I compared the results to EPA standards and Graham and VanDerslice's (2007) findings and entered data into the door-to-door survey results SPSS database.

The water sample testing was piloted by using three water samples: (1) from the kitchen tap at Old Main (at UTEP), (2) from a home in a *colonia*, and (3) from a control sample of distilled water poured in the lab to ensure there were no problems with field execution of the water sampling protocol. Water collection occurred in conjunction with the door-to-door surveys (November 19, 2011 through January 27, 2012). Notification of water quality results was based upon whether participate selected to receive results in the consent form and all participants opted to receive the results (See Appendix D1 – English and Appendix D2 – Spanish for water quality results letter).

For the first water sample, I measured and recorded free residual chlorine level, which should be at least 0.2 mg/l for stored water to be considered potable (Chlorine Residual Testing Fact Sheet, n.d.; Graham and VanDerslice, 2007). Chlorine is commonly used to disinfect water supplies. Free residual chlorine is a product that remains after chlorine is added to water. Chlorine reacts with organic materials, metals, and nitrates to transform chlorine to free residual chlorine (see Figure 2.8). It is the residual free chlorine that inactivates disease causing organisms (note, chlorine is not effective against all disease, such as giardiasis) (Chlorine Residual Testing Fact Sheet, n.d.).

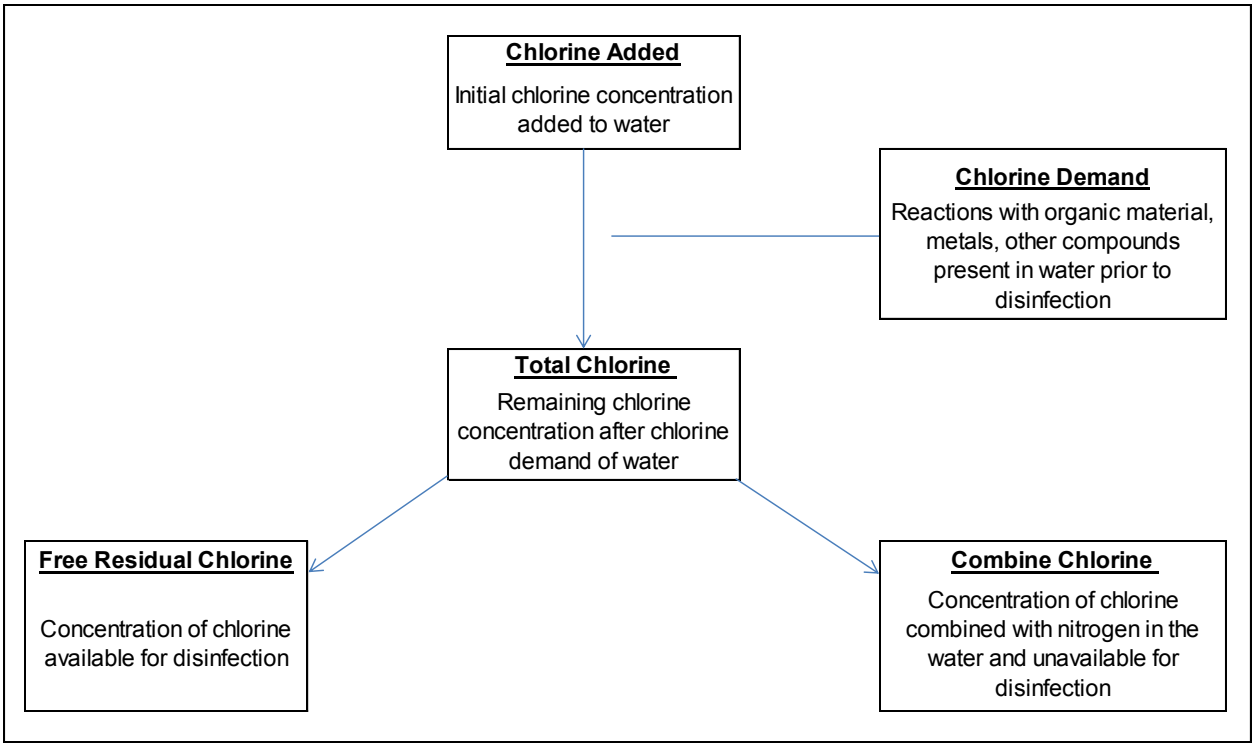

Figure 2.8: Chlorine Addition Flow Chart

Source: CDC SWS Project, n.d.

While I conducted and recorded the free residual chlorine test at the home-site, the results were reported to residents when all tests were completed. I used a HACH pocket colorimeter to test free residual chlorine level. The colorimeter and reagents were provided by Elizabeth DeMoultrie (Sample Specialist, Laboratory Services, El Paso Water Utilities Public Service Board).

The second sample was analyzed for bacteriological factors, i.e. total coliforms and *E. coli* at the University of Texas Houston School of Public Health (Dr. Di Giovanni's) on-site lab at the UTEP campus. I utilized the Colilert system and Quanti-Tray to test for the presence of and most probable number of bacteria density of total coliforms and *E. coli* (Gundry et al., 2009).While the testing equipment is the same for both bacteriological analyses, the standards are different and so total coliforms and *E. coli* will be discussed in turn.

Coliforms are naturally present in the environment and not necessarily a health threat if present in drinking water. However, the presence may indicate other harmful bacteria, such as *E. coli* (EPA Drinking Water Contaminants, 2010). I compared the water sample findings to the EPA National Primary Drinking Water Regulations for microorganisms contaminants threshold for total coliforms, which indicates that there can be no presence of total coliforms (zero) based upon my study size. Additionally, I compared total coliforms to Graham and Vanderslice's (2007) study, which used the World Health Organization Recommended Water Quality Standards, which calls for less than 10 total coliforms per 100 ml of water, as the baseline category. The study had three total coliforms levels, which are %: < 10 CFU/100 ml; 11-100 CFU/100 ml; and >100 CFU/100 ml.

I also tested for *E. coli*. The presence of this bacteria is an indication that the water maybe contaminated with human or animal feces (EPA Drinking Water Contaminants, 2010), which is a public health concern linked with water-borne diseases that cause symptoms such as diarrhea, stomach cramps, and a bloated stomach. I was not able to conduct a direct comparison to EPA guidelines for *E. coli* because under the EPA's 1989 Total Coliform Rule (TCR), *E. coli* testing is only conducted after two consecutive positives for total coliforms and only if one of the samples also tests positive for *E. coli* (EPA Drinking Water Contaminants, 2010). My protocol called for testing every sample, regardless if it tested positive for total coliforms. I had contextually relevant *E.coli* results to compare my findings with as Graham and VanDerslice (2007) tested every sample for *E.coli*. The Graham and VanDerslice's (2007) study reported an 8.6% presence of *E. coli* prior to intervention and 2.9% post intervention. In addition, currently, the EPA is reviewing a proposed revision to the aforementioned 1989 Total Coliform Rule, which calls for the elimination of the Maximum Contaminant Level Goal (MCLG) and the Maximum Contaminant Level (MCL) for total coliforms, and replacing it with a MCLG and a MCL of zero for *E. coli*. The revision would include ongoing monitoring of total coliforms with protocols in place to address a specified frequency of the presence of total coliform in the public water systems so as

to require and monitor corrective steps as needed (Fact Sheet: Announcement of Proposed Revisions to Total Coliform Rule, 2010). Therefore, my research design reflects the proposed EPA rule change of testing every drinking water sample for *E. coli*.

The third water sample was tested for turbidity using a HACH 2100p turbidimeter at UTEP's Civil Engineering lab (Dr. Walker's). The higher the nephelolometric turbidity unit (NTU), which indicates suspended matter or impurities in the water (i.e., water is cloudy), the higher the likelihood of the existence of disease-causing microorganisms (Mann et al., 2007; Mac Kenzie et al., 1994). The EPA's guideline for turbidity is that the sample cannot exceed one NTU (EPA Drinking Water Contaminants, 2010), which is also the standard that Graham and VanDerslice (2007) used. After testing the water in the laboratory, Neddie recorded the total coliforms, *E. coli*, and turbidity results at the household level in an Excel spreadsheet.

2.6 Analysis Strategy

The data gathered through the surveys and water sample results were entered into a SPSS database. The database was transformed into two databases. The first is an individual level database, which was used to analyze specific aims 1, 3, 4, and 5. This dataset includes all household members (n=613). The second is a household level database, which was used to analyze specific aim 2, and includes only variables at the household level (N=150). All continuous variables were tested for skewness and kurtosis and were within the acceptable +/- 2.0 range (SPSS Inc., 2009); therefore it was not necessary to use the natural log transformation process.

2.6.1 SPECIFIC AIM 1

Specific Aim 1: Determine the extent of the economic injustices faced by the residents in the CLW and the CWW by comparing their socio-demographics and water costs to non-colonia residents, specifically residents serviced by the Lower Valley Water District (LVWD, a community water system).

SA1 Analysis

The individual level survey database was used to characterize the CLW and the CWW, and the 2010 US Census and the 2006-2010 American Community Survey were used for the LVWD, in order to compare socio-demographics between the communities. The socio-demographic variables for this analysis by community type are illustrated in Table 2.3. I selected the LVWD as the non-*colonia* comparison group because it is the largest CWS that is closest in proximity to the CLWs and the CWWs that participated in this study. In addition, the socio-demographics of the residents serviced by the LVWD are more similar to CLW and CWW residents as compared to the more affluent residents serviced by El Paso Water Utilities (the largest CWS in the county). To compare household water costs (exclusive of bottled water and any water purchased from machines) between the CLW, the CWW, and the LVWD, I used CWS published rates for the LVWD and the CWW, and the household database for the CLW. To compare bottled and machine water costs, I used the US annual average to represent an estimate for the LVWD and the individual level database for the CLW and the CWW.

Table 2.3: Analysis variables: Socio-demographics of the population serviced by Lower Valley Water District (LVWD), a community water system, and the population in CLW and CWW

Variable	Source	Specific Aim
Socio-demographics		
%_65 years and older	LWVD[1] = Census, CLW[2] & CWW[3] = Individual database	1.0
%_Under 5 years of age	LWVD[1] = Census, CLW[2] & CWW[3] = Individual database	1.0
%_Hispanic	LWVD[1] = Census, CLW[2] & CWW = Individual database	1.0
%_Uninsured	LVWD[1] = PUDF database[4], CLW[2] & CWW = Individual database	1.0
%_Below Poverty	LVWD = ACS[5], CLW[2] & CWW[3] = Individual database	1.0
%_Rent	LVWD = ACS[5], CLW[2] & CWW[3] = Individual database	1.0

[1]Lower Valley Water District
[2]*Colonias* Lacking Water
[3]*Colonias* With Water
[4]Texas Hospital Inpatient Discharge Public Use Data File
[5]American Community Survey (2006 - 2010)

To begin, I obtained the Texas Commission of Environmental Quality (TCEQ) ArcGIS shapefile of Texas water districts from Dr. Aldouri, at UTEP's Geospatial Service Center. Then, I selected (using the "select by location tool") all block groups (BGs) that fell completely within the Lower Valley Water District (LVWD). This resulted in 22 block groups serviced by the LVWD; these block groups do not contain any of the CLW households. 2010 socio-demographic data for these 22 BGs were assembled using multiple data sources. Census 2010 data at the census block group (BG) level were used to construct percentage of population: 65 years of age and older, under 5 years of age, Hispanic, and renter variables. American Community Survey (ACS) 5-year estimates (2006 -2010) at the BG-level were used to construct the percentage of the population below poverty variable. The Texas Hospital Inpatient Discharge Public Use Data File (PUDF) prepared by the Texas Health Care Information Council (THCIC) in Austin, Texas for 2006 – 2010) was used to construct the percentage of the population uninsured variable following Grineski and McDonald (2010) at the BG-level.

I used the individual level database to create a percent of: 65 years and older, under 5 years of age, Hispanic, uninsured, below poverty, and renters for CLW and CWW. A below poverty variable was also created for the CLW and the CWW as a proxy for socio-economic status (using income data

contained in the individual level database). The variable was constructed by taking the total number of members in the household and using the midpoint of the total household income variable to determine if the income size of family unit was above or below the preliminary estimate of weighted average poverty thresholds for 2011 (U.S. Department of Commerce, Bureau of the Census, 2012).

To calculate non-bottled and water purchased from machines water costs, I used the cost per gallon for the Lower Valley Water District ($0.0048). This rate is based upon the applying a 15% increase on the published El Paso Water Utilities (EPWU) rate per gallon of $0.00417 (National Wildlife Federation and the Lone Star Chapter of the Sierra Club, 2010). This is because the LVWD purchases water from EPWU and adds 15% to the rate that EPWU customers pay (S. Trejo, personal correspondence, July 5, 2010). To calculate the cost per gallon for water by community type, I used the cost per delivery for a tank of water ($45.00 for 2,300 gallons) to the CLW reported through the survey ($45/2,300 gallons = $0.0196 per gallon). For the CWW, I applied the cost per gallon for the predominant water supplier (60% of surveyed CWW residents) to these communities, Horizon Regional Municipal Utility District ($0.0067 per gallon). I used the Horizon Regional Municipal Utility District minimum residential rate per gallon of water published on their website as of February 2012 (Horizon Regional Municipal Utility District, 2012).

I could not find a local rate for the per capita cost of bottled and/or water from machines for residents in the LVWD. For that reason, I used a range of estimates based on US averages for bottled water consumption. For the low end of the range, I used the US annual average bottle water consumption per gallons based on the assumptions that the average American purchases one's water in cases, and drinks 30 gallons of bottled water a year (NPR, War on Tap, 2010). I then applied a per case rate of $4.00 to calculate annual costs. One case of water equals 384 ounces of water, which is equivalent to 24 bottles of 16 oz. water or three gallons. I calculated a per gallon rate of $1.33 and then multiplied that rate by 30 (gallons) to arrive at an annual rate of $40.00 per person for bottled water.

The middle range estimate, also based on 30 gallons of water per person per year, is $139.95, which I based upon a consumer purchasing 15 gallons at the case rate of $4.00 and 15 gallons at a rate of $1.00 per 16 oz. bottle of water. The high end range is $240.00 per year, which is based upon a person purchasing 30 gallons of water at a rate of $1.00 per 16 oz. bottle of water. To calculate the total cost at the individual level for the CLW and the CWW residents per year, I used the total dollars spent for bottled and/or water from machines contained in the individual database.

2.6.2 SPECIFIC AIM 2

Specific Aim 2: Analyze if the water quality differs between the CLW and the CWW based upon bacteriological, chemical, and physical indicators.

SA2.1 Analysis

The household level database was used to analyze if water quality differs between the CLW and the CWW. Specifically, the independent samples difference of means *t*-test was used to determine the significance of difference of means between the communities for chemical (i.e. free residual chlorine), physical (i.e. turbidity), and overall water quality, i.e. does not meet one or more of the following EPA standards for free residual chlorine, turbidity, and there is a presence of total coliforms and/or *E. coli* (See Table 2.4).

Table 2.4: Analysis variables for differences between the CLW and the CWW independent samples *t*-tests: metrics and descriptive statisitics

Variable (household level - CLW[1])	Metric	Min	Max	Mean	SD	Range	Specific Aim
Does not meet EPA standard for turbidity	0 = Safe, 1 = Unsafe	0	1	.16	.37	1	2.1
Does not meet EPA standard for free residual chlorine	0 = Safe, 1 = Unsafe	0	1	.35	.48	1	2.1
Does not meet EPA standard for overall water quality	0 = Safe, 1 = Unsafe	0	1	.44	.50	1	2.1
All CWW[2] were safe so all statistics are 0							

[1] *Colonias* Lacking Water
[2] *Colonias* With Water

SA2.2 Analysis

Next, I used the household level data to run *z*-tests for two proportions using a *z*-tests calculator (Stangroom, 2012) to compare the number of household cases that did not meet the WHO Recommended Water Quality Standards for the CLW and the cases in the previous El Paso County *colonias* water quality study, i.e. Graham and VanDerslice (2007) (See Table 2.5).

Table 2.5: Water quality variables based upon cases per household

Variable (cases at household level)	CLW[1] (n = 75)	G&V[2] (n = 34)	Specific Aim
Total coliforms <10 CFU/100ml	69	10	2.2
Total coliforms 11-100 CFU/100ml	2	13	2.2
Total coliforms >100 CFU/100ml	4	11	2.2
E. coli	1	1	2.2
Turbidity >1.0 NTU	12	2	2.2
Free Residual Chlorine >0.2 mg/l	26	33	2.2

[1]*Colonias* lacking water

[2]Graham and VanDerslice study

Since the CWW had zero violations for total coliforms, *E.coli*, free residual chlorine, and turbidity, it was in essence a proxy for EPA water standards. Therefore, no comparison was conducted for the CLW and the EPA standards because the analysis would be the same as the CLW versus the CWW.

2.6.3 SPECIFIC AIM 3

Specific Aim 3: Understand the relationship between socio-demographics, water storage practices, and sanitation with water quality and health conditions within the CLW.

SA3.1 Analysis

To understand the relationship between socio-demographics, water storage practices, sanitation with water quality within the CLW the individual level database was used and the variables are detailed Table 2.6.

Table 2.6: Analysis variables for bivariate correlations between socio-demographics, water storage practices, sanitation, water quality, health conditions and binary logistic regression models to predict diarrhea, stomach cramps, stomach pain, and bloated stomach within the last 12 and three months: metrics and descriptive statisitics within the CLW

Variable (individual level)	Metric	Min	Max	Mean	SD	Range	Specific Aim
Socio-demographics							
65 years age and older	0 = No, 1 = Yes	0	1	.10	.30	1	3.1, 3.2, 4
Under 5 years of age	0 = No, 1 = Yes	0	1	.06	.23	1	3.1, 3.2, 4
Education	1 = Less than high school, 2 = High school graduate/GED, 3 = Some college, 04 = Associate's degree or specialized training, 5 = B.A. degree, 6 = M.A. degree or more	1	6	1.87	1.12	5	3.1, 3.2
Insurance status	0 = Insured, 1 = Uninsured	0	1	.46	.50	1	3.1, 3.2, 4
Household size	Range: 1 - 9 household members	1	10	4.88	1.90	9	3.1, 3.2, 4
Length of residence at current address	Range: < one year to 32 years	.10	32	9.76	7.41	31.90	3.1, 3.2
Country of Birth	0 = All Other, 1 = Mexico	0	1	.44	.50	1	3.1, 3.2, 4
Diabetes status	0 = No, 1 = Yes	0	1	.12	.33	1	3.1, 3.2
Language most often spoken at home	1 = English only, 2 English more than Spanish, 3 = English and Spanish about the same, 4 = Spanish more than English, 5 = Spanish only	1	5	3.66	.88	4	3.1, 3.2
Total household income	1 = Less than $1,999/yr - 15 = $55,000+/yr	1	15	7.52	3.48	14	3.1, 3.2, 4
Housing tenure	0 = Own, 1 = Rent	0	1	.19	.39	1	3.1, 3.2, 4
Water Storage Practices							
Water storage tank ever cleaned	0 = No, 1 = Yes	0	1	.64	.48	1	3.1, 3.2
Sanitation							
Septic tank system ever pumped	0 = No, 1 = Yes	0	1	.51	.50	1	3.1, 3.2
Water Quality							
Does not meet free residual chlorine EPA std.	0 = Safe, 1 = Unsafe	0	1	.16	.36	1	3.1, 3.2, 4
Does not meet turbidity EPA std.	0 = Safe, 1 = Unsafe	0	1	.31	.46	1	3.1, 3.2, 4
Does not meet overall EPA std.	0 = Safe, 1 = Unsafe	0	1	.42	.49	1	3.1, 3.2
Drink tap water	0 = No, 1 = Yes	0	1	.20	.40	1	4
Self-Reported Health							
Diarrhea within last 12 months	0 = No, 1 = Yes	0	1	.54	.50	1	3.2, 4, 5
Diarrhea within last 3 months	0 = No, 1 = Yes	0	1	.27	.44	1	3.2, 4, 5
Stomach cramps within last 12 months	0 = No, 1 = Yes	0	1	.40	.49	1	3.2, 4, 5
Stomach cramps within last 3 months	0 = No, 1 = Yes	0	1	.26	.44	1	3.2, 4, 5
Stomach pain within last 12 months	0 = No, 1 = Yes	0	1	.43	.50	1	3.2, 4, 5
Stomach pain within last 3 months	0 = No, 1 = Yes	0	1	.30	.46	1	3.2, 4, 5
Bloated stomach within last 12 months	0 = No, 1 = Yes	0	1	.34	.47	1	3.2, 4, 5
Bloated stomach within last 3 months	0 = No, 1 = Yes	0	1	.28	.45	1	3.2, 4, 5

I used bivariate correlations to test for significance and strength of relationships of between socio-demographics (65 years of age and older, under 5 years of age, education, insurance status, household size, length of residence at current residence, country of birth, diabetes status, pregnancy status, language most often spoken at home, total household income, and housing tenure), water storage practices (is water tank ever cleaned), sanitation (is septic tank ever pumped), and water quality (does

not meet free residual chlorine EPA standard, does not meet turbidity EPA standard, and does not meet overall EPA standard). While collected for each household, the total coliforms and *E.coli* water quality variables were not included in the analysis due to low case numbers, 24 individuals in six households and eight individuals in two households respectively). Additionally, I did not use 'pregnancy status' in the bivariate correlation analyses because there were only four cases of an individual being pregnant or Hispanic because 99% of CLW identified themselves as Hispanic.

SA3.2 Analysis

In addition, correlations were used to test for significance and strength of relationships between socio-demographics, water storage practices, sanitation, water quality, and health conditions using the individual level household database. The criteria utilized to select health variables for analysis was based upon using the same parameters that were used in the logistic regression analysis (as discussed in 2.6.5), which required a minimum threshold of 70 cases per condition (See Table 2.6). Therefore, the following eight conditions were utilized: diarrhea, stomach cramps, stomach pain, and a bloated stomach experienced within the last 12 months and the same set of conditions experienced within the last three months.

2.6.4 SPECIFIC AIM 4

Specific Aim 4: Analyze if health conditions differ between the CLW and the CWW.

The individual level database was used to analyze if health conditions (diarrhea, stomach cramps, stomach pain, and a bloated stomach) within the last 12 months and three months differ between the CLW and the CWW. I used the independent samples differences of means *t*-test to determine the significance of difference between the communities for the aforementioned health conditions within the last 12 months and the same set of conditions within the last three months.

2.6.5 SPECIFIC AIM 5

Specific Aim 5: Determine the impact of quality of water on health using the following control variables: age (over 65 years of age and under 5 years of age), health insurance status, household size, total household income, and tap water drinking habits, and free residual chlorine or turbidity for all household members in the CLW.

SA5 Analysis:

To determine the impacts of not being connected to a community water system on poor water quality and health in the CLW, 16 binary logistic regression models were run (i.e., one set of models for "last 12 months" and another set for "last three months" for each of the four health conditions; these models were run twice, once with each of the water quality variables (free residual chlorine and turbidity) on all household members' data (See Table 2.6). I identified seven independent variables for the logistic regression analysis, which included contextually relevant environmental justice variables, a drinking water consumption practice variable, and a water quality variable (does not meet EPA standard for residual free chlorine and turbidity, separately). Since logistic regression requires a minimum of 10 cases or greater per independent variable to eliminate bias in negative and positive direction for regression coefficients (Peduzzi, Concato, Kemper, Holford, & Feinstein, 1996), I selected health conditions that had a minimum of 70 cases per condition. The following seven independent variables were used: 65 years of age and older, under 5 years of age, insurance status, household size, total household income, does the resident drink tap water, and water quality (does water meet EPA standard for free residual chlorine or turbidity, separately).

2.7 Chapter Conclusion

In this chapter, I reviewed the data sources (2010 US Census, 2006-2010 American Community Survey, published water costs, and the individual and household database) and the statistical methods (descriptive statistics, independent samples differences of means *t*-test, *z*-tests for two proportions, bivariate correlations, and logistic regression), which will be used to analyze the five specific aim of this thesis. In the next chapter, I will present the results from the analyses.

Chapter 3: Results and Analysis

The results are organized by specific aim, each of which will be discussed in turn. I used independent samples differences of means *t*-test, *z*-tests for two proportions, bivariate correlations, and binary logistic regression to analyze data.

3.1 Specific Aim 1

Specific Aim 1: Determine the extent of the economic injustices faced by the residents in the CLW and the CWW by comparing their socio-demographics and water costs to non-colonia residents, specifically residents serviced by the Lower Valley Water District (LVWD, a community water system).

In this section, I address SA1 by comparing socio-demographic variables and water costs (see Table 4) aggregated at the level of the CLW, the CWW, and the Lower Valley Water District (LVWD). See Table 8 for results. For 65 years and older, the CLW had the largest percentage (10%), followed by the LVWD at 8%, and then the CWW at 5%. Conversely, the CWW had the largest percentage of under 5 years of age (11%), while the CLW had the lowest (6%), and the LVWD had 9%. All three areas were above 98% Hispanic. The percentage of people uninsured was highest in the CLW at 46%, followed by 39% in the CWW, and 22% in the LVWD. In terms of people below poverty, the CWW (83%) and the CLW (72%) had a substantially larger percent of persons in this category compared to the LVWD (33%). The LVWD had the highest percentage of renters (22%) compared to 19% for the CLW, and the CWW at the lower end (11%).

To review, the water cost per gallon figures were based upon cost provided by participants in CLW, the published rate for Horizon Regional Municipal Utility District (serves the CWW), and the Lower Valley Water District (LVWD). The water cost per gallon ranged from a low of $0.0048 per

gallon for LVWD residents to a high of $0.0196 per gallon for residents who purchase water from a water hauler in the CLW (See Table 3.1). This means that the average resident in the CLW pays 308% more per gallon for water than water utility customers in the Lower Valley District. The cost does not include water purchased for drinking, such as bottled water and/or water from machines, which this thesis demonstrated was nearly ubiquitous among the CLW residents. In terms of costs in the CLW versus the CWW, the CLW residents pay 194% more per gallon for water than the CWW residents. Additionally, the CWW residents, who are serviced by Horizon Regional Municipal Utility District, pay 39% more per gallon per water than the LVWD customers, despite both communities being served by community water systems.

Table 3.1: Results of comparison of socio-demographics and water cost per gallon between the LVWD, the CLW, and the CWW

Variable (individual level)	LVWD[2] (n = 36,619)	CLW[3] (n = 293)	CWW[4] (n = 320)
%_65 years and older	8%	10%	5%
%_Under 5 years of age	9%	6%	11%
%_Hispanic	98%	99%	100%
%_Uninsured	22%	46%	39%
%_Below Poverty[1]	32%	72%	83%
%_Rent	22%	19%	11%

[1]Below Poverty for the *Colonias* Lacking Water (n = 287)
[2]Lower Valley Water District
[3]*Colonias* Lacking Water
[4]*Colonias* With Water

While I did not have an annual dollar amount spent on bottled water and/or water purchased from machines for residents in the LVWD, I estimated the annual per person dollar range (low, middle, and high). The low end was $40.00, the middle was $139.95, and the high was approximately $240.00 as per the methods described in the previous chapter. Based on survey data, the CLW annual per person expense was $239.76 and for the CWW it was $105.00.

3.2 Specific Aim 2

Specific Aim 2: Analyze if the water quality differs between the CLW and the CWW based upon bacteriological, chemical, and physical indicators.

The following results address SA2.1, which focuses on the differences in water quality between the CLW and the CWW at the household level. The CLW had significantly higher percentages of households with water not meeting EPA standards than the CWW. In the CLW, 35% of the households did not have the proper level of free residual chlorine in their water, 16% had a turbidity level greater than 1 NTU, and 44% did not meet one or all the EPA standards. As a point of comparison, all CWW households met all of the EPA standards (See Table 3.2).

Table 3.2: Results of difference of means *t*-tests for water quality between the CLW and the CWW

Variable (household level)	*Colonia*	N	Mean	SD	Std. Error Mean	Sig. (2-tailed)
Does not meet free residual chlorine EPA std.	CLW[1]	75	.35	.48	.06	.000**
	CWW[2]	75	.00	.00	.00	
Does not meet turbidty EPA std.	CLW[1]	75	.16	.37	.04	.000**
	CWW[2]	75	.00	.00	.00	
Does not meet overall EPA std.	CLW[1]	75	.44	.50	.06	.000**
	CWW[2]	75	.00	.00	.00	

*. Signficant at the 0.05 level (2-tailed).
**. Signficant at the 0.01 level (2-tailed).
[1]*Colonias* Lacking Water
[2]*Colonias* With Water

Then, I used *z*-tests for two proportions to address SA2.2 (See Table 3.3). I compared water quality findings (total coliforms, *E. coli*, turbidity, and free residual chlorine) at the CLW household level using the actual number of cases so as to have a like comparison to the previous El Paso County colonias water quality results study (Graham & VanDerslice, 2007). The Graham and VanDerslice (2007) study evaluated total coliforms at three levels rather than solely using the EPA 1989 Total Coliform Rule metric of presence or absence of total coliform. In the CLW households, there were

significantly ($p < 0.01$) lower levels of total coliforms and fewer water samples that did not meet standards for free residual chlorine compared to the households in the Graham and VanDerslice study. This means that the water samples tested in the Graham and VanDerslice (2007) were significantly worse in regard to these water quality indicators than were the CLW water samples. While *E. coli* and turbidity were found in both studies, there was no statistically significant difference between the measures.

Table 3.3: Results of *z*-tests for two proportions of water quality between CLW and G&V (2007)

Water quality by cases	CLW[2] (n = 75)	G&V[3] (n = 34)	*z*-test[1]	*p*	
Total coliforms <10 CFU/100ml	69	10	-2.926	0.000	**
Total coliforms 11-100 CFU/100ml	2	13	-4.994	0.000	**
Total coliforms >100 CFU/100ml	4	11	-3.794	0.000	**
E. coli	1	1	-0.579	0.562	
Turbidity >1.0 NTU	12	2	1.463	0.144	
Free Residual Chlorine >0.2 mg/l	26	33	-6.056	0.000	**

*. Signficant at the 0.05 level (2-tailed).
**. Signficant at the 0.01 level (2-tailed).
[1] *z*-test run at significance level of 0.05
[2] *Colonias* lacking water
[3] Graham and VanDerslice study

3.3 Specific Aim 3

Specific Aim 3: Understand the relationship between socio-demographics, water storage practices, and sanitation with water quality and health conditions within the CLW.

In this section, I used the individual level database to run bivariate correlations to analyze the relationship between variables found in Table 2.6 to address SA.3.1 and SA.3.2 (See 3.4 and Table 3.5).

3.3.1 Relationships between Socio-demographics and Water Storage

Living longer at the current residence and renting (as opposed to owning) were significantly associated with the household reporting their water storage tank had never been cleaned ($p < 0.05$) (See Table 3.4).

3.3.2 Relationships between Socio-demographics and Sanitation

Household size (number of members living in the household) and being a renter were positively correlated (significant at $p < 0.05$) with the septic tank ever being pumped, i.e. cleaned. This means that as the number of persons within a household increases and if the home is renter occupied (as opposed to owner occupied), there is an increased occurrence that the septic tank has been pumped. Being 65 years of age and older (as opposed to 0-64) and an increase in the use of Spanish in the home (as compared to English) were negatively and significantly correlated ($p < 0.01$) with septic tank ever being pumped. This means that there is a decreased occurrence that the household's septic tank has been pumped if the resident is 0-64 years of age and increase in frequency of used of Spanish in the home was associated with a decrease in occurrence of septic tank ever being pumped (See Table 3.4).

3.3.3 Relationships between Socio-demographics and Water Not Meeting Turbidity EPA Standard

Total household income was positively correlated and significant at $p < 0.01$ with water exceeding the EPA turbidity level. This means that as income increases so does the occurrence that the water quality will not meet the EPA standard that the sample cannot exceed one nephelolometric turbidity unit (NTU). Being a renter was negatively correlated and significantly related ($p < 0.01$) with

water quality not meeting turbidity EPA standard. This means that home owners have an increased occurrence for turbidity above 1 NTU (See Table 3.4).

3.3.4 Relationships between Socio-demographics and Water Not Meeting Free Residual Chlorine EPA Standard

An increase in the use of Spanish in the home (as opposed to English), an increase in total household income (increase reflects an additional $2,499 per year), and being a renter were significantly associated with the household water supply not containing at least 0.2mg/l of free residual chlorine, i.e. not meeting EPA standard (See Table 3.4).

3.3.5 Relationships between Socio-demographics and Water that Does not Meet EPA Water Quality Standards

Total household income was positively correlated and significant at $p < 0.01$ with overall poor water quality, i.e. the water did not meet the EPA standard for at least one of the following tests: turbidity, free residual chlorine, total coliforms, or *E.coli*. This means that the occurrence that water quality will not meet one of the aforementioned EPA standards increases, as there is an increase in income level. As household size increases so does the occurrence of better overall water quality ($p < 0.01$) (See Table 3.4).

Table 3.4: Results of correlations between socio-demographics, water storage practices, sanitation, and water quality within the CLW

Variable		Water Storage Tank Ever Cleaned	Septic Tank Ever Pumped	Does Not Meet EPA Turbidty Std.	Does Not Meet EPA Free Residual Chlorine Std.	Does Not Meet EPA Overall Standard.
65 years age and older	*corr.*	.016	-.164**	.045	.000	-.025
	Sig.	.796	.007	.438	.998	.671
	N	264	271	293	293	293
Under 5 years of age	*corr.*	.066	-.038	.094	.023	.057
	Sig.	.284	.536	.110	.699	.332
	N	264	271	293	293	293
Years of education	*corr.*	-.014	-.065	.015	-.023	.027
	Sig.	.820	.283	.796	.693	.642
	N	264	271	293	293	293
Insurance Status	*corr.*	.006	-.023	-.038	.006	.017
	Sig.	.924	.706	.513	.923	.775
	N	264	271	293	293	293
Household size	*corr.*	-.066	.221**	-.091	-.081	-.157**
	Sig.	.289	.000	.122	.168	.007
	N	264	271	293	293	293
Length of residence at current address	*corr.*	-.175**	.069	-.083	.046	.041
	Sig.	.004	.257	.156	.434	.488
	N	264	271	293	293	293
Being born in Mexico (as opposed to being born in another country)	*corr.*	.040	-.098	-.024	.103	.102
	Sig.	.513	.109	.687	.078	.082
	N	264	271	293	293	293
Diabetes status	*corr.*	.067	-.065	.010	.041	.021
	Sig.	.279	.286	.865	.486	.716
	N	264	271	293	293	293
Language most often spoken at home	*corr.*	-.056	-.048	-.005	.229**	.177**
	Sig.	.366	.428	.936	.000	.002
	N	264	271	293	293	293
Total household income	*corr.*	.073	.033	.179**	.183**	.238**
	Sig.	.239	.594	.002	.002	.000
	N	258	265	287	287	287
Housing Tenure	*corr.*	-.123*	.143*	-.159**	.131*	.055
	Sig.	.045	.019	.006	.025	.349
	N	264	271	293	293	293

*. Correlation is signficant at the 0.05 level (2-tailed).

**. Correlation is signficant at the 0.01 level (2-tailed).

3.3.6 Relationships between Socio-demographics, Water Storage practices, Sanitation, Water Quality, and Diarrhea

In terms of statistically significant correlations with having diarrhea within the last 12 months, an increase in total household income, being a renter (as opposed to an owner), and water that does not meet free residual chlorine EPA standard were positively related and significant at $p < 0.05$ (See Table 3.5).

3.3.7 Relationships between Socio-demographics, Water Storage practices, Sanitation, Water Quality, and Stomach Cramps

Being born in Mexico (country of birth), an increase in the use of Spanish in the home (as opposed to English), total household income, and water that does not meet the EPA standard for turbidity, free residual chlorine, and overall poor water quality were positively correlated and significantly related ($p < 0.05$) with having stomach cramps within the last 12 and three months. An increase in household size decreases the occurrence of having diarrhea within the last three months (See Table 3.5).

3.3.8 Relationships between Socio-demographics, Water Storage practices, Sanitation, Water Quality, and Stomach Pain

In terms of correlations with having stomach pain within the last 12 and three months, being a renter was positively correlated and significant at $p < 0.05$. In addition, water quality that does not meet free residual chlorine and overall EPA standards were positively correlated and significantly related ($p < 0.05$) with having stomach pain within the last three months. Years of education was negatively correlated and significant at $p < 0.05$ with having stomach pain within the last three months. This means as one's years of education increase, there is decreased occurrence of having stomach pain within the last 3 months (See Table 3.5).

3.3.9 Relationships between Socio-demographics, Water Storage practices, Sanitation, Water Quality, and Bloated Stomach

Being 65 years of age and older, being uninsured (as opposed to insured), being born in Mexico, having diabetes, an increase in the use of Spanish at home (as opposed to English), and having water that does not meet turbidity EPA standard were positively correlated and significantly related ($p < 0.05$) with having a bloated stomach within the last 12 months. Being under 5 years of age, an increase in one's years of education, and the larger the household size decreases the occurrence of having a bloated stomach within the last 12 months. In terms of correlations with having a bloated stomach within the last three months, being uninsured (as opposed to being insured), being born in Mexico, having diabetes, a decrease in the use of English at home (as opposed to Spanish), and having water that does not meet turbidity and free residual chlorine EPA standards were positively correlated and significant at $p < 0.05$. As one's years of education increase and as household size increases, there is decreased occurrence of having a bloated stomach within the last 3 months (See Table 3.5).

Table 3.5: Results of correlations between socio-demographics, water storage practices, sanitation, water quality, and eight health variables (for having condition within the last 12 and three months separately) within the CLW

Variable		Diarrhea within last 12 months	Diarrhea within last 3 months	Stomach cramps within last 12 months	Stomach cramps within last 3 months	Stomach pain within last 12 months	Stomach pain within last 3 months	Bloated stomach within last 12 months	Bloated stomach within last 3 months
65 years age and older	*corr.*	-.037	.005	.059	-.014	-.036	.007	.151**	.101
	Sig.	.532	.930	.315	.816	.537	.902	.010	.087
	N	290	290	293	293	293	293	291	291
Under 5 years of age	*corr.*	-.034	.113	-.052	.020	-.070	-.003	-.115*	-.089
	Sig.	.568	.054	.378	.737	.234	.954	.049	.128
	N	290	290	293	293	293	293	291	291
Years of education	*corr.*	-.020	-.066	-.033	-.100	-.049	-.146*	-.151**	-.154**
	Sig.	.740	.259	.569	.087	.403	.013	.010	.008
	N	290	290	293	293	293	293	291	291
Insurance Status	*corr.*	-.014	-.070	.097	.035	.109	.026	.134	.138*
	Sig.	.813	.233	.096	.550	.061	.655	.022	.018
	N	290	290	293	293	293	293	291	291
Household size	*corr.*	.004	-.010	-.139*	-.040	-.059	-.063	-.150*	-.142*
	Sig.	.952	.862	.018	.500	.311	.279	.011	.015
	N	290	290	293	293	293	293	291	291
Length of residence at current address	*corr.*	.059	-.063	.063	-.031	-.004	-.088	.075	.035
	Sig.	.313	.285	.279	.599	.948	.135	.204	.557
	N	290	290	293	293	293	293	291	291
Being born in Mexico (as opposed to being born in another country)	*corr.*	.010	-.050	.210**	.165**	.057	.019	.311**	.335**
	Sig.	.872	.401	.000	.005	.334	.748	.000	.000
	N	290	290	293	293	293	293	291	291
Diabetes status	*corr.*	.015	.069	.037	.039	.029	.072	.117*	.124*
	Sig.	.796	.241	.526	.501	.618	.217	.047	.035
	N	290	290	293	293	293	293	291	291
Language most often spoken at home	*corr.*	.085	.092	.159**	.117*	.092	.105	.202**	.171**
	Sig.	.151	.118	.006	.045	.115	.074	.001	.003
	N	290	290	293	293	293	293	291	291
Total household income	*corr.*	.122*	.110	.150*	.124*	-.015	.002	.038	.034
	Sig.	.040	.063	.011	.035	.799	.967	.518	.571
	N	284	284	287	287	287	287	285	285
Housing Tenure	*corr.*	.148*	.083	.076	.114	.144*	.181**	.009	-.006
	Sig.	.011	.156	.197	.051	.014	.002	.880	.918
	N	290	290	293	293	293	293	291	291
Water Storage Tank Ever Cleaned	*corr.*	-.044	.036	.031	.027	-.024	-.058	.026	.034
	Sig.	.475	.563	.616	.667	.702	.350	.680	.581
	N	261	261	264	264	264	264	262	262
Septic Tank Ever Pumped	*corr.*	.036	-.030	-.005	.019	.096	.063	-.008	-.004
	Sig.	.557	.621	.932	.754	.113	.299	.896	.948
	N	268	268	271	271	271	271	269	269
Does Not Meet EPA Turbidty Std.	*corr.*	.015	.105	.130*	.130*	.039	.045	.150*	.151**
	Sig.	.797	.074	.026	.026	.506	.446	.011	.010
	N	290	290	293	293	293	293	291	291
Does Not Meet EPA Free Residual Chlorine Std.	*corr.*	.150*	.093	.150**	.175**	.112	.172**	.074	.132*
	Sig.	.011	.116	.010	.003	.054	.003	.209	.024
	N	290	290	293	293	293	293	291	291
Does Not Meet EPA Overall Std.	*corr.*	.069	.086	.151**	.179**	.085	.141*	.077	.114
	Sig.	.242	.144	.009	.002	.144	.015	.188	.052
	N	290	290	293	293	293	293	291	291

*. Correlation is signficant at the 0.05 level (2-tailed).

**. Correlation is signficant at the 0.01 level (2-tailed).

3.4 Specific Aim 4

Specific Aim 4: Analyze if health conditions differ between the CLW and the CWW.

The following results address SA4. Independent samples differences of means *t*-test were used to address the differences in the four health conditions within the last 12 months and three months between the CLW and the CWW using the individual database level. There were no significant differences between the CLW and the CWW for any of the health conditions (diarrhea, stomach cramps, stomach pain, or bloated stomach) for either time interval (See Table 3.6).

Table 3.6: Results of difference of means *t*-tests for health conditions between the CLW and the CWW

Variable (individual level)	*Colonia*	N	Mean	SD	Std. Error Mean	Sig. (2-tailed)
Diarrhea within last 12 months	CLW[1]	290	.54	.499	.029	.296
	CWW[2]	309	.50	.501	.028	
Diarrhea within last 3 months	CLW[1]	290	.27	.444	.026	.315
	CWW[2]	317	.31	.462	.026	
Stomach cramps within last 12 months	CLW[1]	293	.40	.490	.029	.559
	CWW[2]	310	.42	.494	.028	
Stomach cramps within last 3 months	CLW[1]	293	.26	.439	.026	.212
	CWW[2]	318	.31	.461	.026	
Stomach pain within last 12 months	CLW[1]	293	.43	.496	.029	.215
	CWW[2]	310	.48	.501	.028	
Stomach pain within last 3 months	CLW[1]	293	.30	.459	.027	.382
	CWW[2]	318	.33	.472	.026	
Bloated stomach within last 12 months	CLW[1]	291	.34	.473	.028	.276
	CWW[2]	311	.38	.486	.028	
Bloated stomach within last 3 months	CLW[1]	291	.28	.449	.026	.850
	CWW[2]	319	.29	.452	.025	

*. Correlation is signficant at the 0.05 level (2-tailed).

**. Correlation is signficant at the 0.01 level (2-tailed).

[1]*Colonias* Lacking Water

[2]*Colonias* With Water

3.5 Specific Aim 5

Specific Aim 5: Determine the impacts of quality of water on health using the following control variables: age (over 65 years of age and under 5 years of age), health insurance status, household size, total household income, and tap water drinking habits, and free residual chlorine or turbidity for all household members in the CLW.

The following results address SA5. As stated in the methods chapter, I used 16 binary logistic regression models (i.e., one set of models for "last 12 months" and another set for "last three months" for diarrhea (See 3.7), stomach cramps (See Table 3.8), stomach pain (See Table 3.9), and bloated stomach (See Table 3.10), which were run twice, once with each of the water quality variables (free residual chlorine and turbidity) using the individual level database. I utilized the following independent variables: 65 years of age and older, under 5 years of age, insurance status, household size, total household income, does the resident drink tap water, and water does not meet residual chlorine EPA standard or water does not meet turbidity EPA standard.

3.5.1 Logistic Regression Models for Diarrhea – Free Residual Chlorine Model

In the model predicting diarrhea within the last 12 months (see Table 3.7), the Negelkerke R Square (R^2) was .080. Total household income and water that does not meet the free residual chlorine EPA standard were significant ($p < 0.05$) and positive in direction. An increase in one category of total household income (one category in income represents an additional $2,499 per year) predicts an 8.3% increase in the odds of having diarrhea. Having unsafe levels of free residual chlorine, as opposed to safe levels of chlorine, predicts a 95.9% increase in the odds of having diarrhea. The finding for if the resident drinks tap water was almost significant at $p = 0.06$ and was positive in direction, suggesting

increased risk of diarrhea for those drinking tap water. The other variables did not approach significance.

The independent variables explain 6% ($R^2 = .060$) of the variance in the model for predicting diarrhea within the last three months (See Table 3.7). Total household income was significant and positive in direction. An increase in one category of total household income predicts a 7.9% increase in the odds of having diarrhea. Being under 5 years of age (as opposed to between 6 and 64) was associated with increased odds (almost significant at $p = 0.06$) of diarrhea. The other variables were not significant.

3.5.2 Logistic Regression Models for Diarrhea – Turbidity Model

There was only one significant predictor in the diarrhea models including turbidity (See Table 3.7). An increase in one category of total household income predicts a significant increase ($p < 0.05$) in the odds of having diarrhea within the last 12 (10%) and three months (8.6%). The model fit was almost 6% for both time periods.

Table 3.7: Logistic regression models for having diarrhea within the past 12 and three months

	12 Mos.- Diarrhea (n = 272)				3 Mos.- Diarrhea (n = 285)			
Variable (Free Residual Chlorine Model)	B	S.E.	Sig.	Exp (B)	B	S.E.	Sig.	Exp (B)
65 years of age and older	-.234	.453	.606	.792	.033	.494	.946	1.034
Under 5 years of age	-.338	.553	.541	.713	1.016	.547	.063	2.761
Insurance Status	-.119	.266	.655	.888	-.251	.293	.392	.778
Household size	.013	.071	.853	1.013	-.028	.082	.735	.973
Total household income	.080	.037	.031*	1.083	.076	.039	.048*	1.079
Drink tap water	.645	.338	.057	1.905	.234	.346	.500	1.263
Does Not Meet Free Residual Chlorine EPA Std.	.672	.287	.019*	1.959	.364	.303	.229	1.440
Nagelkerke R Square	.080				.060			
	12 Mos.- Diarrhea (n = 272)				3 Mos.- Diarrhea (n = 285)			
Variable (Turbidty Model)	B	S.E.	Sig.	Exp (B)	B	S.E.	Sig.	Exp (B)
65 years of age and older	-.212	.451	.638	.809	.016	.496	.975	1.016
Under 5 years of age	-.288	.554	.603	.750	.951	.553	.085	2.587
Insurance Status	-.103	.262	.695	.902	-.252	.293	.391	.777
Household size	-.003	.070	.968	.997	-.027	.083	.748	.974
Total household income	.097	.036	.007**	1.102	.083	.038	.029*	1.086
Drink tap water	.455	.326	.163	1.576	.158	.338	.641	1.171
Does Not Meet Turbidity EPA Std.	.013	.345	.969	1.013	.443	.354	.211	1.558
Nagelkerke R Square	.054				.060			

*. Signficant at the 0.05 level (2-tailed).

**. Signficant at the 0.01 level (2-tailed).

3.5.3 LOGISTIC REGRESSION MODELS FOR STOMACH CRAMPS – FREE RESIDUAL CHLORINE MODEL

The R^2 was .099 for the model predicting stomach cramps within the last 12 months (See Table 3.8). Total household income and water does not meet free residual chlorine EPA standard were significant and positive in direction. An increase in one category of total household income predicts a 9.4% increase in the odds of having stomach cramps. Having poor water quality in terms of unsafe levels of free residual chlorine predicts a 79.4% increase in odds of having stomach cramps. Being uninsured (as opposed to being insured) was almost significant at $p = 0.08$ and was positively related to the odds of having stomach cramps.

In the model predicting stomach cramps within the last three months, the R^2 was .083 (See Table 3.8). Water that does not meet the free residual chlorine predicts a 164.3% increase in odds of having stomach cramps and had a significance level of $p < 0.01$. No other variable were significant.

3.5.4 LOGISTIC REGRESSION MODELS FOR STOMACH CRAMPS – TURBIDITY MODEL

The R^2 for the 12 month model was 10% and for the three month time frame was 5% for predicting stomach cramps (See Table 3.8). An increase in one category of total household income predicts a 9.5% increase in the odds of having stomach cramps within the last 12 months and an 8.4% increase in the odds of having stomach cramps with the last three months. In addition, both models were significant at $p < 0.05$.

Table 3.8: Logistic regression models for having stomach cramps within the past 12 and three months

	12 Mos.- Stomach Cramps (n = 269)				3 Mos.- Stomach Cramps (n = 282)			
Variable (Free Residual Chlorine Model)	B	S.E.	Sig.	Exp (B)	B	S.E.	Sig.	Exp (B)
65 years of age and older	.514	.463	.267	1.672	.111	.522	.832	1.118
Under 5 years of age	.089	.592	.881	1.093	.381	.600	.526	1.464
Insurance Status	.488	.276	.077	1.630	.152	.301	.614	1.164
Household size	-.100	.077	.194	.905	-.003	.084	.973	.997
Total household income	.089	.038	.020*	1.094	.073	.040	.071	1.076
Drink tap water	.379	.357	.289	1.460	.420	.380	.269	1.522
Does Not Meet Free Residual Chlorine EPA Std.	.585	.296	.048*	1.794	.972	.313	.002**	2.643
Nagelkerke R Square	.099				.083			
	12 Mos.- Stomach Cramps (n = 269)				3 Mos.- Stomach Cramps (n = 282)			
Variable (Turbidty Model)	B	S.E.	Sig.	Exp (B)	B	S.E.	Sig.	Exp (B)
65 years of age and older	.500	.462	.279	1.649	.054	.520	.917	1.056
Under 5 years of age	-.008	.603	.990	.992	.310	.599	.604	1.364
Insurance Status	.521	.275	.058	1.683	.194	.297	.514	1.214
Household size	-.105	.077	.173	.900	-.028	.084	.742	.973
Total household income	.091	.038	.017*	1.095	.081	.041	.048*	1.084
Drink tap water	.142	.342	.679	1.152	.066	.359	.854	1.068
Does Not Meet Turbidity EPA Std.	.640	.348	.066	1.897	.633	.352	.072	1.884
Nagelkerke R Square	.096				.050			

*. Signficant at the 0.05 level (2-tailed).

**. Signficant at the 0.01 level (2-tailed).

3.5.5 LOGISTIC REGRESSION MODELS FOR STOMACH PAIN – FREE RESIDUAL CHLORINE MODEL

The R^2 was .062 for the model predicting stomach pain within the last 12 months (See Table 3.9). Drinking water from the tap and water not meeting the free residual chlorine EPA standard were the only significant findings ($p < 0.05$). If the resident ever drinks tap water, this predicts a 107.8% increase in the odds of having stomach pain in the last year. Having poor water quality, in terms of free residual chlorine, predicts a 93.1% increase in the odds of having stomach pain in the last year.

The independent variables explain almost 7% ($R^2 = .066$) of the variance in the model for predicting stomach pain within the last three months (See Table 3.9). Water not meeting the free residual EPA standard predicts a 173.3% increase in the odds of having stomach pain and had a significance level of $p < 0.01$. No other variable were significant.

3.5.6 LOGISTIC REGRESSION MODELS FOR STOMACH PAIN – TURBIDITY MODEL

The models for predicting stomach pain within the last 12 months and three months did not have variables that were significant (See Table 3.9).

Table 3.9: Logistic regression models for having stomach pain within the past 12 and three months

	12 Mos.- Stomach Pain (n = 269)				3 Mos.- Stomach Pain (n = 282)			
Variable (Free Residual Chlorine Model)	B	S.E.	Sig.	Exp (B)	B	S.E.	Sig.	Exp (B)
65 years of age and older	-.322	.469	.492	.724	-.056	.489	.909	.946
Under 5 years of age	-.252	.590	.670	.777	.121	.597	.840	1.128
Insurance Status	.410	.266	.124	1.507	.017	.283	.954	1.017
Household size	-.053	.072	.466	.949	-.047	.078	.547	.954
Total household income	-.040	.037	.288	.961	-.011	.039	.766	.989
Drink tap water	.732	.348	.036*	2.078	.641	.350	.067	1.899
Does Not Meet Free Residual Chlorine EPA Std.	.658	.292	.024*	1.931	1.006	.302	.001**	2.733
Nagelkerke R Square	.062				.066			
	12 Mos.- Stomach Pain (n = 269)				3 Mos.- Stomach Pain (n = 282)			
Variable (Turbidty Model)	B	S.E.	Sig.	Exp (B)	B	S.E.	Sig.	Exp (B)
65 years of age and older	-.308	.464	.507	.735	-.078	.480	.870	.925
Under 5 years of age	-.232	.587	.692	.793	.152	.585	.795	1.164
Insurance Status	.432	.264	.102	1.541	.051	.278	.855	1.052
Household size	-.067	.072	.351	.935	-.080	.077	.301	.924
Total household income	-.029	.037	.439	.972	.006	.038	.885	1.006
Drink tap water	.491	.331	.138	1.634	.296	.327	.365	1.345
Does Not Meet Turbidity EPA Std.	.235	.341	.491	1.265	.231	.352	.512	1.260
Nagelkerke R Square	.039				.014			

*. Signficant at the 0.05 level (2-tailed).

**. Signficant at the 0.01 level (2-tailed).

3.5.7 LOGISTIC REGRESSION MODELS FOR BLOATED STOMACH – FREE RESIDUAL CHLORINE MODEL

The model for predicting bloated stomach within the last 12 months the R^2 was .107 (See Table 3.10). Being 65 years of age and older and insurance status significantly ($p < 0.05$) predicted increased odds of the having the health condition. Specifically, being 65 years of age and older (as opposed to being between 6-64) predicts a 166.1% increase in the odds of having a bloated stomach. Being uninsured, as opposed to having health insurance, predicts a 104.6% increase in odds of having a bloated

stomach. Drinking water from the tap was also positively related to bloating and almost significant (p = 0.07).

The independent variables explain almost 11% (R^2 = .109) of the variance in the model for predicting a bloated stomach within the last three months (See Table 3.10). Insurance status and water not meeting free residual chlorine EPA standard were statistically significant and positively associated with stomach bloating. Not being insured (as opposed to being insured) predicts a 108.2% increase in odds of having a bloated stomach and was significant at $p < 0.05$. Having water that does not meet free residual chlorine EPA standard predicts a 120.4.0% increase in the odds of having a bloated stomach and had a significance level of $p < 0.01$. Drinking water from the tap was almost significant at $p = 0.074$ and positively related to bloated stomach.

3.5.8 Logistic Regression Models for Bloated Stomach – Turbidity Model

The model for predicting bloated stomach within the last 12 months had a R^2 of 13% (See Table 3.10). Being 65 years of age and older, being uninsured, and having water quality that did not meet turbidity EPA standard were significant and positive predictors in this model. Being 65 years of age and older (as opposed to being between 6-64) predicts a 169.7% increase in the odds of having a bloated stomach. Being uninsured (as opposed to being insured) predicts a 107.6% increase in odds of having a bloated stomach. Having poor water quality in terms of an unsafe level of turbidity, as opposed to having a safe level of turbidity, predicts a 148.8% increase in odds of having a bloated stomach.

The R^2 was .108 for the model predicting a bloated stomach within the last three months (See Table 3.10). This model had two significant findings. Insurance status (being uninsured, as opposed to being insured) predicts a 109.6% increase in odds of having a bloated stomach and this finding was significant at $p < 0.05$. Having poor water quality for turbidity (i.e., having turbidity levels greater than 1

NTU, which does not meet EPA standard) predicts a 147.3% increase in the odds of having a bloated stomach and had a significance level of $p < 0.05$.

Table 3.10: Logistic regression models for having a bloated stomach within the past 12 and three months

	12 Mos.- Bloated Stomach (n = 273)				3 Mos.- Bloated Stomach (n = 286)			
Variable (Free Residual Chlorine Model)	B	S.E.	sig.	Exp (B)	B	S.E.	Sig.	Exp (B)
65 years of age and older	.979	.462	.034*	2.661	.662	.471	.159	1.939
Under 5 years of age	-.681	.795	.391	.506	-.443	.804	.582	.642
Insurance Status	.716	.283	.011*	2.046	.733	.295	.013*	2.082
Household size	-.085	.079	.280	.918	-.111	.083	.180	.895
Total household income	.015	.038	.690	1.015	-.002	.038	.948	.998
Drink tap water	.619	.340	.069	1.858	.602	.337	.074	1.826
Does Not Meet Free Residual Chlorine EPA Std.	.366	.301	.225	1.441	.790	.307	.010**	2.204
Nagelkerke R Square	0.107				.109			
	12 Mos.- Bloated Stomach (n = 273)				3 Mos.- Bloated Stomach (n = 286)			
Variable (Turbidty Model)	B	S.E.	Sig.	Exp (B)	B	S.E.	Sig.	Exp (B)
65 years of age and older	.992	.466	.033*	2.697	.640	.471	.174	1.896
Under 5 years of age	-.899	.809	.266	.407	-.623	.810	.442	.536
Insurance Status	.731	.286	.011*	2.076	.740	.295	.012*	2.096
Household size	-.072	.080	.367	.930	-.113	.084	.178	.893
Total household income	.014	.037	.715	1.014	.006	.038	.878	1.006
Drink tap water	.518	.334	.121	1.678	.396	.327	.227	1.485
Does Not Meet Turbidity EPA Std.	.911	.357	.011*	2.488	.905	.356	.011*	2.473
Nagelkerke R Square	.131				.108			

*. Signficant at the 0.05 level (2-tailed).

**. Signficant at the 0.01 level (2-tailed).

3.6 Chapter Conclusion

In this chapter I have utilized descriptive statistics, independent samples differences of means *t*-test, *z*-tests for two proportions, bivariate correlations, and binary logistic regression to analyze and present findings from the data I collected through a health survey and water samples. I was able to identify several statistically significant results related to socio-demographics, water quality, and health that will be discussed in the next chapter.

Chapter 4: Discussion

My study design allowed me to gather and analyze data at the household and individual level using an environmental and economic justice framework. In what follows, I will highlight important findings related to each specific aim and discuss their relevance in light of previous literature.

4.1 Specific Aim 1

Specific Aim 1: Determine the extent of the economic injustices faced by the residents in the CLW and the CWW by comparing their socio-demographics and water costs to non-colonia residents, specifically residents serviced by the Lower Valley Water District (LVWD, a community water system).

4.1.1 SOCIO-DEMOGRAPHICS

The comparison between the CLW, CWW, and the LVWD demonstrated that the residents in the CLW and CWW face greater economic injustice than those in the LVWD. For example, residents in the CLW and the CWW have a higher percentage of residents living below poverty and lacking insurance in comparison to the LVWD. The CLW and the CWW had higher percentages of residents than the LVWD who were 65 years of age and over and under 5 years of age, which are sensitive subpopulations identified by the literature that are at risk to water-borne disease and its symptoms (Reynolds et al., 2008; Rose et al., 2001). In terms of housing tenure (renter occupied as opposed to owner occupied), the LVWD had the largest percent of renters. This finding may be unexpected because renting is typically a characteristic associated with social marginality (Grineski et al., 2007). In the case of *colonias* in El Paso County, homes are predominantly owner occupied because *colonias* provide an affordable housing option for people to own their own home. However, home ownership in many colonias comes at the price of not being connected to a community water system and public sanitation, supporting Bath et al.'s

(1998) institutional racism paradigm. One common socio-demographic variable between all three communities is the percentage of residents who are of Hispanic ethnicity (the range was 98% to 100%).

While the CLW and the CWW are both socially marginalized communities there are differences between these communities. For example, the percent of uninsured in the CLW is 17% higher than the CWW. While the incorporation of health insurance data into environmental justice research has been done (Linder, Marko, & Sexton, 2008), it is still relatively unexplored. This study illustrated that CLW, the community which is at most risk to water-borne disease and its symptoms due to poor water quality (44% of households did not meet overall EPA water standards) had the lowest percentage of persons with access to health care compared to the CWW and the LVWD (both communities met all EPA water standards). Moreover, the literature has found that those who are uninsured are less likely to seek out healthcare (O'Neil and O'Neil, 2009). The CLW are the most marginalized, followed by the CWW, and finally the LVWD.

4.1.2 WATER COSTS

While residents in CLW and CWW pay a higher water cost per gallon, CLW pay 194 percent more per gallon for water than CWW, and 308 percent more per gallon than LVWD, clearly illustrating a case of economic injustice between the communities. Water haulers and private water suppliers, in the state of Texas, are allowed to set their own rates, unlike municipal water suppliers, which contributes to this disparity (Olmstead, 2004). Water tankers are common in the less developed countries and similar to Olmstead's (2004) findings for Texas, they are generally unregulated. For example, lack of regulation in Jaipur, India has resulted in a 152% rate increase between 2007 and 2009 in the cost per delivery to fill a water tank (Birkenholtz, 2010). Apart from water haulers, this study found there to be pricing disparities between municipal water suppliers, i.e. community water systems. The residents in the CWW

pay 39 times more per gallon for water than residents serviced by the LVWD. While one would assume that the rate per gallon would be uniform in the same County, it is not. The varied rates are due to several factors, such as municipal water suppliers costs for maintaining wells differs per supplier, and smaller water suppliers, such as the Horizon Regional Municipal Utility District, purchase water from other larger water suppliers and then pass along an increased rate on this water to their customers. When the differences in poverty levels between the communities are considered, the disparity in water costs as a proportion of household income is only exacerbated, further compounding the economic injustice.

In addition to the economic injustice related to water costs, a resident in the CLW uses 314% fewer gallons of water per month than the El Paso Gallons Per Capita Per Day (GPCD) statistic. The El Paso GPCD is 133 gallons (unfortunately, this statistics is not available for the average LVWD customer), which translates to 4,045 gallons per person per month, which is right on target for recommended water use per the state of Texas Water Conservation Implementation Task Force recommendation (National Wildlife Federation and the Lone Star Chapter of the Sierra Club, 2010). This is water used for activities such as showering, flushing toilets, and washing dishes. An average CLW resident uses 976 gallons per person per month (based upon my data analyzed at household and individual level databases). Residents in CLW told us they conserve water through practices such as reusing grey water to flush toilets and washing dirty dishes, pots, and pan once a day, i.e. that is piling up soiled dishes in the kitchen sink and on the kitchen counter and cleaning them at the end of the day. Furthermore, as shown in Figures 2.5 and 2.7, residents do not use water on lawns or trees (because water is expensive), resulting in no escape from the heat and sand of the desert environment. While the grey water use can be commended as water saving technique, the dirty dishes create an unsanitary environment. It is challenging for residents to maintain a hygienic environment when preparing food for the next meal due to the clutter in the sink and on the kitchen counter. The stove may also have dirty pots, and flies and other bugs are attracted to the dirty dishes.

The economic injustice is further compounded by households in the CLW and the CWW purchasing bottled and/or water from machines (which is much more expensive than municipal tap water) as a protective health measure, with 92% and 79% respectively doing this. Residents purchase drinking water because of the perceived poor water quality from either the water tank delivery company or in the case of the CWW, the residents do not trust the water from their community water system (water quality to be discussed below), the Horizon Regional Municipal Utility District. As a point of comparison to the LVWD proxy for the low, middle and high expense range for bottled and/or machine water costs, the CLW households spent more for each expense category. In the CWW, residents spent more than the LVWD proxy for the low expense range. While the dollar amount does not appear to be large, this is a significant amount because the population in the *colonias* does not reflect the average U.S. resident in terms of economic status. Therefore, in the case of the CLW, there is an economic injustice due to persons trying to protect their family's health due to poor quality of drinking water. In the case of the CWW, the residents' perception of poor water quality from the CWS is an expensive misconception.

4.2 Specific Aim 2

Specific Aim 2: Analyze if the water quality differs between the CLW and the CWW based upon bacteriological, chemical, and physical indicators.

In the first water quality comparison, CLW performed poorly against CWW in terms of water quality; CWW water met all tested EPA standards. However, in the second set of analysis, CLW compared favorably to the previous Graham and VanDerslice study (2007). In terms of the first comparison, the water in the CLW had excessive turbidity and low levels of free residual chlorine compared to the CWW and the findings were significant at $p < .001$. The free residual chlorine finding is not an artifact of it being difficult to regulate the level of chlorine during the summer months because of dissipation due to heat (samples obtained November 19, 2011 through January 27, 2012). Therefore,

these findings support the concerns of the CLW residents that there is possibility that their household water supply is contaminated and that the purchasing of bottled water is a protective health measure behavior. In the event that a household's water quality did not meet standards, I included information (with their results) on how to treat water properly because many residents stated that while they did not drink the water, they did brush their teeth with it. The CWW water met all tested EPA water standards, thereby it was used a proxy for EPA standard for water quality comparison to CLW. Information about the good CWW water results will hopefully enable residents to redirect dollars from purchasing bottled and/or water from machines to other household expenses. During the survey, I explained to residents in CWW that the EPA monitors their water to ensure its safety. In addition, I stressed how important it is for them to read the materials provided by their municipal water supplier that are contained in the bill, so that they are knowledgeable of the quality of their drinking water. The water quality comparison findings between the two communities supports that residents in the CLW endure an environmental injustice because 44% of households had at least one violation of EPA water standards compared to 0% for the CWW.

The second comparison demonstrated how the water quality for the CLW has likely improved since 34 water samples were tested during September 1998 through December 1999 as reported in the Graham and VanDerslice (2007) study. To review, the water in the Graham and VanDerslice (2007) study was of worse quality than the samples tested in my study. However, while the water quality tests were the same, the Graham and VanDerslice (2007) study was from a smaller sample size (34 households versus my thesis of 75 CLW households) and the they used a convenience sample, i.e. a group that had been selected by a program to receive 2,500 gallon water storage tanks for free, which could have resulted in a bias of selecting residents that already had poor water storage practices. Nevertheless, it should be acknowledged that several residents recalled the researchers from the Graham and VanDerslice (2007) study and commended them for raising their awareness of how to treat their

water with chlorine. From the data I collected (from the point of use, not directly from the truck), it is impossible to determine if the apparent improvement in water quality is because residents are better managing their personal water supplies and/or if water from the haulers has improved in quality over the last 15 years. While total coliforms were less than the previous study, there were still eight households that tested positive for total coliforms, which is a public health concern. Even more disconcerting, one household tested positive for *E. coli*. The resident whose water tested positive for *E. coli* was immediately contacted, even though during the interview the respondent told us that they 'never' drink from the tap.

4.3 Specific Aim 3

Specific Aim 3: Understand the relationship between socio-demographics, water storage practices, and sanitation with water quality and health conditions within the CLW.

An increase in the use of Spanish at home (as opposed to English), country of birth (being born in Mexico as opposed to the US), total household income, and household size were the most closely related to having diarrhea, stomach cramps, and a bloated stomach. An increase in the use of Spanish at home, a contextually relevant environmental justice variable in El Paso (Collins et al., 2010), was positively correlated and significant with two of the health conditions (stomach cramps and a bloated stomach) within the last 12 and three months. This link between an increase in the use of Spanish at home and higher illness rates could be connected to an almost significant correlation between an increase in the use of Spanish at home and being uninsured ($r = .103$, $p = 0.079$). Being uninsured has been demonstrated to be of key relevance to an individual not seeking out traditional medical treatment (O'Neil and O'Neil, 2009).

It was counterintuitive that I found total household income positively and significantly correlated with diarrhea within the past three months, stomach cramps within the last 12 and three months, water quality not meeting EPA standard for turbidity, free residual chlorine, and overall water quality. While

the correlation was positive, the mean income for the CLW is $16,250 per year and an increase in one income category represents an additional $2,499 per year. Therefore, even though there was variation in income levels the residents in the CLW and CWW are both very poor. Nevertheless, one hypothesis for this finding may be that as one's income increases so does the frequency of water delivery, thereby resulting in fewer opportunities for the water storage tank to be cleaned thus contributing to water not meeting free residual chlorine and/or turbidity EPA standards.

An unexpected finding, which was supported by the logistic regression models (to be discussion under Aim 5) was the negative and significant correlation between household size and stomach cramps within the last 12 months, bloated stomach within the last 12 and three months, and overall poor water quality. The range in household size (See Table 2.6) is 1 to 10 members per household with a mean of 4.88. I expected to find that an increase in household members would result in higher incidences of illnesses (due to close living quarters) but found the reverse. While I did not take specific measurements of square footage of homes, I did observe what appeared to be overcrowded conditions of the sort that typically result in decreased health outcomes (Bashir, 2002; Gove, Hughes, & Galle, 1979). However, household size had a positive and significant relationship with if the septic tank was ever cleaned. Therefore, there may be an increased awareness in homes with more members that sanitation is critical when the household is sharing tight living quarters.

My findings for the sensitive subpopulations (being 65 years and older, being under 5 years of age, and being a diabetic) were incongruous with the literature because the only significant health correlation was with a bloated stomach. However, an explanation for the lack of findings for these groups may be attributed to the sensitive subpopulations' general access to public insurance, which would serve as a protective health measure. All of the groups are negatively correlated with being uninsured (being 65 years of age and older, $r = -.212$, $p < .001$, being under 5 years of age $r = -.199$, $p < .001$, and having diabetes, $r = -.114$, $p = .051$). Therefore, my thesis found little evidence that sensitive

subpopulations were at risk for poor quality of water and at minimal risk for symptoms related to water-borne diseases. However, this could be due to these groups having better access to healthcare (through public programs like Medicare and the State Children's Health Insurance Program), which could improve their resiliency due to better access to preventive healthcare and routine check-ups , thereby making them less susceptible to water-borne disease and its symptoms.

In terms of correlations between water quality and health, all three poor water quality variables were positively and significantly correlated with health conditions. In particular, water that did not have at least 0.2mg/l of free residual chlorine (EPA standard) was associated with diarrhea, stomach cramps, stomach pain, and a bloated stomach. Moreover, stomach cramps within the last 12 and three months were linked with water that did not have the aforementioned level of free residual chlorine, had turbidity in excess of the EPA standard of over 1 NTU, and water that did not meet overall EPA standard. These findings support that water that does not meet EPA has a negative impact on health outcomes (Ghanderpoori et al., 2009; Rose et al., 2001; Mac Kenzie et al., 1994; Payment et al., 1991; Weiniger et al., 1983).

4.4 Specific Aim 4

Specific Aim 4: Analyze if health conditions differ between the CLW and the CWW.

There were no significant findings for this aim. This finding is counterintuitive because water quality is significantly poorer in the CLW in comparison to the CWW (44% of water does not meet overall EPA standard versus 0% for the CWW). Furthermore, despite 21% of the CLW residents reporting they drink water from the tap, the majority (92%) also purchase bottled and/or machine water as a protective health measure. In addition, it is the similarities in socio-demographics (See Table 2.2), such as lacking health insurance and a total household income of approximately $16,250 (amount applies for both communities), as well as the everyday hardships of living in a *colonia,* which likely contributes to illness beyond the quality of the water. Moreover, in terms of poverty, a larger percent of

residents in the CWW live below the poverty line (83%) as compared to the residents in the CLW (72%). This underscores the idea that being connected to a community water system is not a panacea to alleviating the extreme socio-environmental marginality that colonia residents are burdened with.

4.5 Specific Aim 5

Specific Aim 5: Determine the impacts of quality of water on health using the following control variables: age (over 65 years of age and under 5 years of age), health insurance status, household size, total household income, and tap water drinking habits, and free residual chlorine or turbidity for all household members in the CLW.

The two poor water quality variables (free residual chlorine and turbidity) were the most numerous in significance in predicting an increase in odds of having one of the health conditions. In particular, water that did not meet the free residual chlorine EPA standard was a significant predictor for the increase in odds for all four health conditions, i.e. diarrhea (within 12 months), stomach cramps (within 12 months and three months), stomach pain (within three months), and a bloated stomach (within three months). Water that had excessive turbidity (did not meet EPA standard) predicted in increase for stomach cramps and a bloated stomach within the last 12 and three months. These findings are expected given that water that does not meet free residual chlorine and/or turbidity standards has been linked to one or more of the following conditions in previous studies: diarrhea, stomach cramps, stomach pain, and bloated stomach (Rose et al., 2001; Mac Kenzie et al., 1994; Payment et al., 1991; Weiniger et al., 1983).

Lacking insurance was associated with an increased risk of suffering from a bloated stomach within the last 12 and three months, in the models controlling for free residual chlorine and turbidity (separately). The increase in stomach problems amongst the uninsured is not unexpected given that being uninsured reduces the likelihood that one will access healthcare treatment (O'Neil and O'Neil, 2009). Being 65 years of age and older was associated with an increased risk of suffering from a

bloated stomach within the last 12 and three months, in the model controlling for free residual chlorine and turbidity (separately). Previous studies have demonstrated that persons 65 years of age and older are at greater risk for water-borne diseases (Reynolds et al., 2008; Rose et al., 2001) and related symptoms, which I found here as well.

Total household income (even though the dollar variance per category is relatively small) was significant for diarrhea and stomach cramps. Understanding these logistic regression findings for diarrhea and stomach cramps, and the like socio-demographic bivariate correlation results, requires future research to better understand the relationship between income, health, and water quality in CLW.

4.6 Chapter Conclusion

Overall, this study demonstrated that there are economic injustices that residents in the CLW and CWW are burdened with. In addition, living in the CLW is also a contributing factor to environmental injustices because of the significant relationships between poor water quality and an increase in the odds of having health conditions that are related to symptoms of water-borne diseases and gastrointestinal illnesses. The bivariate correlations and logistic regression models illustrated that inadequate levels of free residual chlorine and high levels of turbidity are significantly related to the occurrence of diarrhea, stomach cramps, stomach pain, and a bloated stomach controlling for age, insurance status, household size, drinking tap water, and water quality. Moreover, the logistic regression models demonstrate an environmental injustice, i.e. how poor water quality has negative health ramifications on a socially marginalized community lacking access to a CWS (the CLW). The following chapter will summarize the thesis, provide directions for future research, address limitations of this thesis, and discuss practical implications.

Chapter 5: Conclusion

5.1 Summary

There are three key findings in my thesis. First, the residents in the CLW and the CWW are both poor and socially marginalized in comparison to residents in the LVWD, who are typical Lower Valley (El Paso) residents. However, the residents in the CLW are burdened with the economic injustice of having to pay 308% more per gallon for water compared to residents in the LVWD. In addition, the residents in the CWW have to pay 39% more for water from their community water system compared to the LVWD rates. Moreover, residents in the CWW and the LVWD do not have to purchase safe drinking water in bottles or from water mills as it flows readily from their tap. Due to the potential for poor water quality from tank-delivered water in the CLW, the residents spend an additional $218 more per person per year (than the average American) to purchase drinking water as a preventive health measure separate from the tank water they rely on for household uses.

This leads to the second key finding: the water quality at the point of use in the CLW is significantly worse than that of the CWW. Finally, the third key finding is that water quality, in particular water that does not meet the free residual chlorine EPA standard, predicts an increase in the odds for diarrhea, stomach cramps, stomach pain, and a bloated stomach within the last 12 and three months, controlling for age, insurance status and drinking tap water.

5.2 Directions for Future Research and Limitations

I believe there needs to be more comprehensive studies completed to understand the relationships between water quality and health. Future community-level efforts could improve on my work in several specific ways. Future work should identify at what point water quality diminishes. This means that future research in settings like CLW should include testing water directly from the point of

origin of the water source (e.g., hauling truck in CLW), the spout from the water storage tank, and the point- of- use location. My study was limited by collecting water only from the point-of-use location. In addition, sampling should be done when the water storage tank is filled, at its mid-point, and when there is less than 10% of water left as water quality changes throughout time. In this study, I did not account for the level of water in the tank at the time the sample was collected. In addition to a health survey, feces should be collected on every occasion that water is collected. This would enable the researcher to test specifically for the presence of organisms that cause water-borne illnesses (which may be misdiagnosed or undiagnosed) in the feces, as opposed to relying of reports of health symptoms and water quality proxies (total coliforms and *E.coli*) as I did here. Additionally, feces sampling would allow the researcher to determine if one's diarrhea was a symptom of a water-borne disease because the pathogen would be present in the stool sample.

A longitudinal, as opposed to cross-sectional, design would also be advantageous to determine exactly how getting access to a CWS impacts health and quality of life. Of the households that participated in the study, 18 are now connected to a community water system and 22 more will be connected within the next six months. A follow-up study, with the households that participated in my thesis, could be conducted in the *colonias* that received CWS water no later than one year after connection to the CWS, using the same methods in this study to determine changes in water quality, water practices, and health. Adding a qualitative component to the follow-up study would allow the researcher to capture how having access to a CWS financially, emotionally, and physically changed or did not changed the lives of these residents.

In addition to those already mentioned, there are other limitations of this study that include the fact that gastro-intestinal health can be influenced by other factors beyond where the participant drinks water. Additionally, the water samples were collected for one point in time and water quality varies over

time, especially in CLW where water is stored on-site in tanks. Lastly, I did not interview each member of household and instead relied on the head-of-household's assessment of the other residents' health.

5.3 Practical Implications

The findings in this thesis support that lacking a connection to a community water system is associated with the occurrence of illness. This lack of a connection also creates economic injustices which burden residents in the CLW due to the high costs of hauling water. However, the incidence of gastrointestinal health problems was comparable between those in the CWW and those in the CLW. Therefore, even though being connected to a community water system will improve water quality in the CLW and reduce costs, it is not the 'cure-all' solution to remedying health inequalities in *colonias*. *Colonia* residents, including those connected and those not connected to a community water system, experience socio-environmental marginality, which has been shown to shape health inequalities. Therefore, until the broader socio-environmental conditions of marginality, such as poverty and lack of access to health care, are addressed in a more holistic manner, residents in *colonias* will likely continue to suffer disproportionately due to socially and environmentally related health problems.

This thesis can be used as a resource document for the *Colonias* Initiatives Program to illustrate the public health threat faced by residents in the CLW related to poor water quality, as well as contribute to the dialogue that being connected to a community water system is not a panacea to public health disparities issues in the *colonias*. In advance of completing this document, I have shared with the following entities my five specific aims and have agreed to share my findings with representatives from their organizations: the Texas Department of State Health Services Border Health and Public Health divisions, the Texas Secretary of State local ombudsperson, the Pan American Health Organization regional office, the Texas Commission on Environmental Quality, and the local Industrial Areas

Foundation, an organization that works directly with Border Interfaith, an advocacy group for *colonias.* The findings in this thesis can add to the ongoing dialogue at the local, state, and national level in regard to funding for water infrastructure projects.

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Appendix A1

COMMUNITY WATER, SANITATION, AND HEALTH SURVEY

Thank you for taking the time to participate in this survey. The information you provide us will be kept confidential and will be used as part of a larger project to better understand issues related to water, sanitation, and health and to raise awareness about these issues.

Household water overview

I would like to ask you questions about the water you use in your home. Specifically, please tell me about the water you use in your home.

Q1. What is your household's main source of water for the kitchen, bathroom, and laundry?

☐Municipal water from a water district, e.g. local public water company
☐Water hauled/delivered by others, like a water/pipe truck
☐Water hauled by self
☐Well
☐Other: _____
(specify)

Q2. Does this water come from a faucet?

☐Yes
☐No

Q3. Is this your household's main source of drinking water?

☐Yes
☐No ⟶ **If no, what is your main source of drinking water? _____**
and SKIP to Q7

Q4. Do you treat this water in any way before drinking it?

☐Yes
☐No ⟶ ***If no, SKIP to Q7***

Q5. If yes, how do you treat your drinking water? *(check all that apply)*

☐Boil the water
☐Chlorine tablets or drops
☐Iodine tablets or drops
☐Pitcher filter, such as Brita
☐Filter at kitchen tap/faucet
☐Sun (containers in the sun)
☐Other: _____
(specify)

Q6.To which household members do you provide **the** treated water for drinking?
(check all that apply)

- ☐All members
- ☐None of the members
- ☐Children under 5 years of age
- ☐Members over 65 years of age
- ☐Pregnant members
- ☐Members with diabetes
- ☐Only if family member are sick

Q7. Does your household purchase drinking water from another source, other than the water bought for your tank or from the local public water company, such as from the grocery store?

- ☐Yes
- ☐No ⟶ ***If no, SKIP to Q11***

Q8. If yes, where do you purchase the drinking water for your household?

- ☐Bottled water from the store
- ☐Water from machines, such as watermills
- ☐Other: _____ (specify)

Q9.To which household members do you provide **the** bottled and/or water from machines for drinking?*(check all that apply)*

- ☐All members
- ☐None of the members
- ☐Children under 5 years of age
- ☐Members over 65 years of age
- ☐Pregnant members
- ☐Members with diabetes
- ☐Only if family member are sick

Q10. If you store drinking water, where do you store it? *(check all that apply)*?

☐5 gallon container, such as from watermill	☐In the bottle it came in from the store, such a 8 oz. or 16 oz. bottle
_____ inside the home	_____ inside the home
_____ outside the home	_____ outside the home

☐Containers smaller than 5 gallons, such as jars, milk jugs

_____ inside the home	_____ covered or sealed	_____ uncovered or unsealed
_____ outside the home	_____ covered or sealed	_____ uncovered or unsealed

☐Containers larger than 5 gallons, such as drums

_____ inside the home	_____ covered or sealed	_____ uncovered or unsealed
_____ outside the home	_____ covered or sealed	_____ uncovered or unsealed

☐Other: _____ (specify)

Household water storage practices *(To be completed if respondent answered yes to Q1. – that the main source of water for the kitchen, bathroom, and laundry is water hauled/delivered by others, like a water/pipe truck or water hauled by self).* ⟶ *Q.11 – Q.15. otherwise* ***SKIP TO Q16****.)*

Next, I am going to ask you questions about your water storage practices. Each question will have two parts related to different times of the year. **The first period** is spring and summer, which is the beginning of April through the end of September and **the second period**, is fall/winter, which is the beginning of October through the end of March.

Q11. What size is the large container you use to store your water, what material is it made of, and where is it located?

In the spring/summer (April – September)

☐Size: _____
(specify)

☐Type/Material it is made of: _____
(specify)

☐Location: _____
(Inside or outside)

In the fall/winter (October – March)

☐Size: _____
(specify)

☐Type/Material it is made of:_____
(specify)

☐Location: _____
(Inside or outside)

Q12. How frequently is your water delivered in your tank, either by a water truck or yourself?

In the spring/summer (April – September)

☐More than once a week
☐Once a week
☐Once every two weeks
☐Once every three weeks
☐Once a month
☐Other:_____
(specify in number of weeks)

In the fall/winter (October – March)

☐More than once a week
☐Once a week
☐Once every two weeks
☐Once every three weeks
☐Once a month
☐Other:_____
(specify in number of weeks)

Q13. How often do you clean your water tank?

In the spring/summer (April – September)

☐More than once a month
☐Once a month
☐Once every 2 months
☐Once every 3 months
☐Once every 4 to 6 months
☐Once every 7 to 11 months
☐Once a year
☐Less than once a year
☐Never

In the fall/winter (October – March)

☐More than once a month
☐Once a month
☐Once every 2 months
☐Once every 3 months
☐Once every 4 to 6 months
☐Once every 7 to 11 months
☐Once a year
☐Less than once a year
☐Never

Q14. How long does it take to clean your tank?

In the spring/summer (April – September)

☐Less than 1 hour
☐A couple of hours
☐Half a day
☐All day
☐More than one day

In the fall/winter (October – March)

☐Less than 1 hour
☐A couple of hours
☐Half a day
☐All day
☐More than one day

Q15. What do you use to clean your tank?

In the spring/summer (April – September)
☐Bleach
☐Chlorine
☐Detergent
☐Other:_____
(specify product)

In the fall/winter (October – March)
☐Bleach
☐Chlorine
☐Detergent
☐Other:_____
(specify product)

Q16. If you don't purchase drinking water in bottles or water machines, do you ever get bottled water and/or water from a tap for free or do you trade or barter for it?

In the spring/summer (April – September)
☐Yes
☐No

In the fall/winter (October – March)
☐Yes
☐No

Household water expenses overview *(Ask all households)*

Now I would like to ask you questions about how much you spend on water. I'd like you to think about all the expenses you might pay related to water, such as purchasing bottled water, water from machines, treating it, transporting it, cleaning water tanks, etc…

Like the previous set of questions, each question will have two parts, the parts consists of different times of the year. **The first part** is spring and summer, which is the beginning of April through the end of September and **the second part,** is fall/winter, which is the beginning of October through the end of March. I am asking information about these different time periods because how much you spend on water might vary between seasons.

Q17. How much do you **pay per month or week** for all the water you use? Please include **ALL COSTS** for household water usage, such as for drinking, cooking, bathing, laundry, garden, etc… Let's walk through these items together.

Interviewer, read each possible expense listed below and enter dollar amount AND ask if this if on a monthly basis or weekly basis. After each item, ask if expenses include costs to treat water, clean tank, buy the water, and the gasoline if you haul it yourself, but not the cost of the tank, and any other costs related to water usage.

If the following expense applies, please let me know how much you spend in the spring/summer and repeat for fall/winter, please let me know if you are giving me monthly or weekly costs.

In the spring/summer
(beginning of April – end of September)

_____Municipal (all expenses)
Circle if monthly or weekly

_____Water Hauled (all expenses)
Circle if monthly or weekly

_____Bottled/machine (all expenses)
Circle if monthly or weekly

In the fall/winter
(beginning of October – end of March)

_____Municipal (all expenses)
Circle if monthly or weekly

_____Water Hauled (all expenses)
Circle if monthly or weekly

_____Bottled/machine(all expenses)
Circle if monthly or weekly

Household sanitation systems overview *(Ask all households)*

Now I would like to ask you questions about your sanitation systems, what type of sewage and wastewater systems do you use?

Q18. What type of toilet facilities does your household use? *(check all that apply)*

- ☐ Flush to piped sewage system
- ☐ Flush to septic tank system
- ☐ Pit latrine
- ☐ Cesspool
- ☐ No facility
- ☐ Other: _____ (specify)

(If answered YES to having a septic tank system, ask Q.19 – Q.22, otherwise ⟶ ***SKIP TO Household Roster, Q23**.)*

Q19. Is your septic tank system certified?

- ☐ Yes
- ☐ No
- ☐ Don't know

Q20. How large is your septic tank?

- ☐ 500 - 749 gallons
- ☐ 750 - 999 gallons
- ☐ 1,000 – 1,250 gallons
- ☐ 1,251 – 1,750 gallons
- ☐ 1,751 – 2,250 gallons
- ☐ 2,251+ gallons

Q21. How frequently is your septic system pumped, that is, emptied out?

- ☐ Once a year or less
- ☐ Every 2 years or less
- ☐ Every 3 years or less
- ☐ Every 4 years or less
- ☐ Every 5 years or less
- ☐ Every 6 years or less
- ☐ Never

Q22. How much is the annual maintenance cost (per year) of your septic system?

- ☐ Less than $100
- ☐ $100 to $200
- ☐ $201 or more
- ☐ Don't know

HOUSEHOLD ROSTER *(Ask all households)*

Q23. Next, I am going to ask you questions about the people in your household to understand your family make-up. Any information you provide to me is strictly confidential. I would like to know the first name, relation to you, age, ethnicity, country of birth, education level, employment status, marital status, length of residence in home, and insurance status of each resident. Let's start with the males in your home from oldest to youngest and then we will cover the females, oldest to youngest.

HOUSEHOLD ROSTER *(Ask all households)*

			A[1]	B	C[2]	D[3]	E[4]	F[5]	G[6]	H[7]	I[8]	J[9]	K[10]
		First Name	Household member's relationship to informant	Age	Ethnicity	Country of Birth	Education	Employment Status	Martial Status	Length of Residence at Current Address	Diabetes	Pregnant	Insurance Status
M	001												
A	002												
L	003												
E	004												
S	005												
	006												
	007												
	008												
F	001												
E	002												
M	003												
A	004												
L	005												
E	006												
S	007												
	008												

Codes for A[1]	01 = himself/herself	02 = wife or husband	03 = son or daughter	04 = son or daughter-in-law
	05 = parent	06 = parent-in-law	07 = grandchild	08 = grandparent
	09 = brother or sister	10 = other relative	11 = not related	
Codes for C[2]	01 = Hispanic, Latino/a, or Mexican-American		02 = White, non-Hispanic	03 = Black, non-Hispanic
	04 = American Indian		05 = Other	
Codes for D[3]	01 = United States	02 = Mexico	03 = Other	
Codes for E[4]	**ONLY ASK FOR PERSONS AGE 17 AND OVER**			
	01 = Less than high school	02 = High school graduate/GED		03 = Some college
	04 = Associate's degree (2-year) or specialized technical training			05 = Bachelor's degree
	06 = Master's degree or more			
Codes for F[5]	**ONLY ASK FOR PERSONS AGE 17 AND OVER**			
	01 = Yes, full-time	02 = Yes, part-time (less than 40 hours)	03 = No	04 = On Disability
	05 = Social Security			
Codes for G[6]	**ONLY ASK FOR PERSONS AGE 17 AND OVER**			
	01 = Single	02 = Married	03 = Living with partner	04 = Separated
	05 = Divorced	06 = Widowed		
Codes for H[7]	Note years and months			
Codes for I[8]	00= No	01 = Yes		
Codes for J[9]	00= No	01 = Yes		
Codes for K[10]	01 = Private Insurance	02 = Medicare	03 = Medicaid	04 = CHIPS
	05 = No Insurance	06 = Other public, such as CHAMPUS, VA and Workers Compensation Health Claim		

Household Health overview

Q24. Now I am going to ask you about (1) the percent of water you drink from the faucet in your kitchen, the kitchen tap, and then the percent of water that **each member** of your household drinks from the faucet in your kitchen, the kitchen tap.

***Interviewer**, refer to the household roster (Q. 23). Start with the household respondent **AND** then the males in the household by order, e.g. all males M001 – M008 and then move to females, e.g. females F001 – F008.*

	% drinking water from tap
Household Respondent/Member (e.g. M001): _____	
Member (e.g. M001): _____	
Member (e.g. M001): _____	
Member (e.g. M001): _____	
Member (e.g. M001): _____	
Member (e.g. M001): _____	
Member (e.g. M001): _____	
Member (e.g. M001): _____	
Member (e.g. M001): _____	
Member (e.g. M001): _____	
Member (e.g. M001): _____	
Member (e.g. M001): _____	
Member (e.g. M001): _____	
Member (e.g. M001): _____	
Member (e.g. M001): _____	

Q25. *If the household respondent drinks less than 100% from the home kitchen faucet and if any other household member drinks less than 100%, ask Q25. Otherwise. **SKIP to Q. 26***

At which of the following locations do (1) you drink water or 2) other household members drink water.

Interviewer**, refer to the household roster (Q. 23). Start with the household respondent **AND** then the males in the household by order, e.g. all males M001 – M008 and then move to females, e.g. females F001 – F008 that answered less than 100% drinking water from tap: **"N" = No, "Y" = Yes, "DK" = Don't Know, "Ref" = Refused, if selects Other, write in response

Location where consume water	School	Work	Church	Family member's home	Community Center	Other: specify
Household Respondent/Member (e.g. M001): _____						
Member (e.g. M001): _____						
Member (e.g. M001): _____						
Member (e.g. M001): _____						
Member (e.g. M001): _____						
Member (e.g. M001): _____						
Member (e.g. M001): _____						
Member (e.g. M001): _____						
Member (e.g. M001): _____						
Member (e.g. M001): _____						
Member (e.g. M001): _____						
Member (e.g. M001): _____						
Member (e.g. M001): _____						
Member (e.g. M001): _____						
Member (e.g. M001): _____						

Q26. Now, I'm going to read a list of medical conditions and illnesses. Please tell me (1) if you have had these conditions/illnesses or any other member in your home has had these conditions/illnesses. We will start with you, then move to the other members in your home. *If the respondent answers YES to "Ever," then ask other time periods. If the respondent answers "NO," go on to the next condition. Repeat for each child and adult.*

Interviewer**, refer to the household roster (Q. 23). Start with the household respondent **AND** then the males in the household by order, e.g. all males M001 – M008 and then move to females, e.g. females F001 – F008: **"N" = No, "Y" = Yes, "DK" = Don't Know, "Ref" = Refused, if selects Other, write in response

If household member has experienced diarrhea within the last 3 months, go directly to Q27. (detailed diarrhea questions), then go back to list of conditions and illnesses in Q26.

	Household Respondent/Member (e.g. M001) _____					Member (e.g. M001)_____:				
CONDITION	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**	**Ever**	**Last 12 mos.**	**Last 3 mos.**	**Last 2 wks .**	**Now**
Diarrhea										
Nausea										
Vomiting										
Stomach cramps										
Stomach pain										
Bloated stomach										
Blood in stools										
Dehydration										
Amebiasis/Amoebas										
Giardiasis/Giardia										
HepatitisA										
Salmonella										
Shigellosis/Shigella										
Skin rashes										
West Nile Virus										
Other water-borne illness: Specify _____										
Other gastrointestinal illness: Specify _____										

	Member (e.g. M001) _____:					Member (e.g. M001) _____:				
CONDITION	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**
Diarrhea										
Nausea										
Vomiting										
Stomach cramps										
Stomach pain										
Bloated stomach										
Blood in stools										
Dehydration										
Amebiasis/Amoebas										
Giardiasis/Giardia										
HepatitisA										
Salmonella										
Shigellosis/Shigella										
Skin rashes										
West Nile Virus										
Other water-borne illness: Specify _____										
Other gastrointestinal illness: Specify _____										

	Member (e.g. M001) _____:					Member (e.g. M001) _____:				
CONDITION	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**
Diarrhea										
Nausea										
Vomiting										
Stomach cramps										
Stomach pain										
Bloated stomach										
Blood in stools										
Dehydration										
Amebiasis/Amoebas										
Giardiasis/Giardia										
HepatitisA										
Salmonella										
Shigellosis/Shigella										
Skin rashes										
West Nile Virus										
Other water-borne illness: Specify _____										
Other gastrointestinal illness: Specify _____										

	Member (e.g. M001) _____:					Member (e.g. M001) _____:				
CONDITION	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**
Diarrhea										
Nausea										
Vomiting										
Stomach cramps										
Stomach pain										
Bloated stomach										
Blood in stools										
Dehydration										
Amebiasis/Amoebas										
Giardiasis/Giardia										
HepatitisA										
Salmonella										
Shigellosis/Shigella										
Skin rashes										
West Nile Virus										
Other water-borne illness: Specify _____										
Other gastrointestinal illness: Specify _____										

	Member (e.g. M001) _____:					Member (e.g. M001) _____:				
CONDITION	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**
Diarrhea										
Nausea										
Vomiting										
Stomach cramps										
Stomach pain										
Bloated stomach										
Blood in stools										
Dehydration										
Amebiasis/Amoebas										
Giardiasis/Giardia										
HepatitisA										
Salmonella										
Shigellosis/Shigella										
Skin rashes										
West Nile Virus										
Other water-borne illness: Specify _____										
Other gastrointestinal illness: Specify _____										

	Member (e.g. M001) _____:					Member (e.g. M001) _____:				
CONDITION	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**
Diarrhea										
Nausea										
Vomiting										
Stomach cramps										
Stomach pain										
Bloated stomach										
Blood in stools										
Dehydration										
Amebiasis/Amoebas										
Giardiasis/Giardia										
HepatitisA										
Salmonella										
Shigellosis/Shigella										
Skin rashes										
West Nile Virus										
Other water-borne illness: Specify _____										
Other gastrointestinal illness: Specify _____										

	Member (e.g. M001) _____:					Member (e.g. M001) _____:				
CONDITION	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**
Diarrhea										
Nausea										
Vomiting										
Stomach cramps										
Stomach pain										
Bloated stomach										
Blood in stools										
Dehydration										
Amebiasis/Amoebas										
Giardiasis/Giardia										
HepatitisA										
Salmonella										
Shigellosis/Shigella										
Skin rashes										
West Nile Virus										
Other water-borne illness: Specify _____										
Other gastrointestinal illness: Specify _____										

	Member (e.g. M001) _____:					Member (e.g. M001) _____:				
CONDITION	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**	**Ever**	**Within Last 12 mos.**	**Within Last 3 mos.**	**Within Last 2 wks .**	**Now**
Diarrhea										
Nausea										
Vomiting										
Stomach cramps										
Stomach pain										
Bloated stomach										
Blood in stools										
Dehydration										
Amebiasis/Amoebas										
Giardiasis/Giardia										
HepatitisA										
Salmonella										
Shigellosis/Shigella										
Skin rashes										
West Nile Virus										
Other water-borne illness: Specify _____										
Other gastrointestinal illness: Specify _____										

Q 27. I'd like to go into more detail about *(use the name of the household member)* your/their most recent bout with diarrhea, how long it lasted (number of weeks), the frequency of disruptions (times per day), and the treatment options, such as medicines, that were used to relieve the symptoms. ***Check all that apply for Treatment Options.***

Diarrhea History	**Member ___________:**					**Treatment Options**				
	1 - 3 days	**4 - 6 days**	**1 wk**	**2 - 3 wks**	**4+wks**	**None**	**Over the Counter**	**Perscription Drugs**	**Herbal /Folk**	**Other**
Diarrhea (# of wks it lasted?)										
Diarrhea (# of times per day?)										
	Member ___________:					**Treatment Options**				
	1 - 3 days	**4 - 6 days**	**1 wk**	**2 - 3 wks**	**4+wks**	**None**	**Over the Counter**	**Perscription Drugs**	**Herbal /Folk**	**Other**
Diarrhea (# of wks it lasted?)										
Diarrhea (# of times per day?)										
	Member ___________:					**Treatment Options**				
	1 - 3 days	**4 - 6 days**	**1 wk**	**2 - 3 wks**	**4+wks**	**None**	**Over the Counter**	**Perscription Drugs**	**Herbal /Folk**	**Other**
Diarrhea (# of wks it lasted?)										
Diarrhea (# of times per day?)										
	Member ____________:					**Treatment Options**				
	1 - 3 days	**4 - 6 days**	**1 wk**	**2 - 3 wks**	**4+wks**	**None**	**Over the Counter**	**Perscription Drugs**	**Herbal /Folk**	**Other**
Diarrhea (# of wks it lasted?)										
Diarrhea (# of times per day?)										
	Member ____________:					**Treatment Options**				
	1 - 3 days	**4 - 6 days**	**1 wk**	**2 - 3 wks**	**4+wks**	**None**	**Over the Counter**	**Perscription Drugs**	**Herbal /Folk**	**Other**
Diarrhea (# of wks it lasted?)										
Diarrhea (# of times per day?)										
	Member ____________:					**Treatment Options**				
	1 - 3 days	**4 - 6 days**	**1 wk**	**2 - 3 wks**	**4+wks**	**None**	**Over the Counter**	**Perscription Drugs**	**Herbal /Folk**	**Other**
Diarrhea (# of wks it lasted?)										
Diarrhea (# of times per day?)										
	Member ____________:					**Treatment Options**				
	1 - 3 days	**4 - 6 days**	**1 wk**	**2 - 3 wks**	**4+wks**	**None**	**Over the Counter**	**Perscription Drugs**	**Herbal /Folk**	**Other**
Diarrhea (# of wks it lasted?)										
Diarrhea (# of times per day?)										
	Member ____________:					**Treatment Options**				
	1 - 3 days	**4 - 6 days**	**1 wk**	**2 - 3 wks**	**4+wks**	**None**	**Over the Counter**	**Perscription Drugs**	**Herbal /Folk**	**Other**
Diarrhea (# of wks it lasted?)										
Diarrhea (# of times per day?)										

Q28. Now, I'm going to read a list of medical treatment locations and I would like to know where AND in which city, El Paso or Juárez, you most often seek treatment for diarrhea AND when you get sick in general for (1) you and the other members in your home. Please let me know where you go for treatment **when you only have diarrhea** and where you go when you have another **illness other than diarrhea.**

***Interviewer**, refer to the household roster (Q. 23). Start with the household respondent **AND** then the males in the household by order, e.g. all males M001 – M008 and then move to females, e.g. females F001 – F008:**"N" = No, "Y" = Yes, "DK" = Don't Know, "Ref" = Refused.** Can select one or both cities.*

	Household Respondent Member (eg. M001)		**Member (eg. M001)**		**Member (eg. M001)**		**Member (eg. M001)**	
	Diarrhea	Sick	Diarrhea	Sick	Diarrhea	Sick	Diarrhea	Sick
Botánica - EP								
Botánica - CJ								
Consult Pharmacists - EP								
Consult Pharmacists - CJ								
School Nurse - EP								
School Nurse - CJ								
Senior Center Nurse - EP								
Senior Center Nurse - CJ								
Free Clinic, such as La Fe, EP								
Free Clinic, such as La Fe, CJ								
Doctor's Office - EP								
Doctor's Office - CJ								
Urgent Care - EP								
Urgent Care - CJ								
Hospital - EP								
Hospital - CJ								

	Member (eg. M001)		Member (eg. M001)		Member (eg. M001)		Member (eg. M001)	
	Diarrhea	Sick	Diarrhea	Sick	Diarrhea	Sick	Diarrhea	Sick
Botánica - EP								
Botánica - CJ								
Consult Pharmacists - EP								
Consult Pharmacists - CJ								
School Nurse - EP								
School Nurse - CJ								
Senior Center Nurse - EP								
Senior Center Nurse - CJ								
Free Clinic, such as La Fe, EP								
Free Clinic, such as La Fe, CJ								
Doctor's Office - EP								
Doctor's Office - CJ								
Urgent Care - EP								
Urgent Care - CJ								
Hospital - EP								
Hospital - CJ								

	Member (eg. M001)		Member (eg. M001)		Member (eg. M001)		Member (eg. M001)	
	Diarrhea	Sick	Diarrhea	Sick	Diarrhea	Sick	Diarrhea	Sick
Botánica - EP								
Botánica - CJ								
Consult Pharmacists - EP								
Consult Pharmacists - CJ								
School Nurse - EP								
School Nurse - CJ								
Senior Center Nurse - EP								
Senior Center Nurse - CJ								
Free Clinic, such as La Fe, EP								
Free Clinic, such as La Fe, CJ								
Doctor's Office - EP								
Doctor's Office - CJ								
Urgent Care - EP								
Urgent Care - CJ								
Hospital - EP								
Hospital - CJ								

	Member (eg. M001)		Member (eg. M001)		Member (eg. M001)		Member (eg. M001)	
	Diarrhea	Sick	Diarrhea	Sick	Diarrhea	Sick	Diarrhea	Sick
Botánica - EP								
Botánica - CJ								
Consult Pharmacists - EP								
Consult Pharmacists - CJ								
School Nurse - EP								
School Nurse - CJ								
Senior Center Nurse - EP								
Senior Center Nurse - CJ								
Free Clinic, such as La Fe, EP								
Free Clinic, such as La Fe, CJ								
Doctor's Office - EP								
Doctor's Office - CJ								
Urgent Care - EP								
Urgent Care - CJ								
Hospital - EP								
Hospital - CJ								

Household Demographic Overview

Q29. What language do your household members most often speak at home?

- ☐ English only
- ☐ English more than Spanish
- ☐ English and Spanish about the same
- ☐ Spanish more than English
- ☐ Spanish only
- ☐ Other

Q30. Which of the following best describes your **total household income** before taxes? Please include your income and income from anyone else in your household from jobs, investments, public assistance, unemployment insurance, social security, disability/pension funds, and all other sources. **Your estimate is fine**.

- ☐ Less than $1,999/yr (Less than $166/month)
- ☐ $2,000-$4,999/yr ($167-$416/month)
- ☐ $5,000-$7,499/yr ($417-$625/month)
- ☐ $7,500-$9,999/yr ($626-$833/month)
- ☐ $10,000-$12,499/yr ($834-$1,041/month)
- ☐ $12,500-$14,999/yr ($1,042-$1,249/month)
- ☐ $15,000-$17,499/yr ($1,250-$1,457/month)
- ☐ $17,500 - $19,999/yr ($1,458 - $1,666/month)
- ☐ $20,000-$22,499/yr ($1,667-$1,874/month)
- ☐ $22,500-$24,499/yr ($1,875-$2,083/month)
- ☐ $25,000-$29,999/yr ($2,084-$2,500/month)
- ☐ $30,000-$39,999/yr ($2,501-$3,333/month)
- ☐ $40,000-$49,999/yr ($3,334-$4,166/month)
- ☐ $50,000-$54,999/yr ($4,167-$4,582/month)
- ☐ $55,000 or more/yr ($4,583 or more/month)

Q31. Do you own or rent your home?

☐Own
If own, do you own the land your home is built on?
☐Yes
☐No
☐Rent

Q32. Since moving into this home, have you been connected to the municipal water company, meaning your home did not have piped water from the municipal water company **BUT** it does now?

☐Yes
If yes, how many years ago? _____
☐No

Q33. Are there are any additional comments you would like to share about water, sanitation, and/or health in your community or family?

Read to Respondent: We appreciate you taking the time to participate in this survey. Please remember that your responses will be kept strictly confidential. We hope that the information collected today will contribute to better serving your community needs. As a token of our appreciation, please sign the log to receive your $10.00 cash for taking the time to participate in the survey.

Appendix A2

ENCUESTA SOBRE LAS CONDICIONES DE SALUD, SANITARIAS Y DE HIGIENE DE LA COMUNIDAD

Gracias por tomarse el tiempo para participar en esta encuesta. La información que nos proporcione se manejará en forma confidencial y se utilizará como parte de un proyecto más amplio para comprender mejor los temas relacionados con las condiciones del agua, sanitarias y de salud, y para crear conciencia sobre estos temas.

Descripción general del agua en el hogar

Quisiera preguntarle sobre el agua que usted utiliza en su hogar. Específicamente, dígame sobre el agua que utiliza en su hogar.

P1. ¿Quién le suministra principalmente el agua que utiliza en su hogar para la cocina, el baño y para lavar la ropa?

☐Agua municipal de un distrito hidráulico, por ejemplo, la compañía local de agua pública
☐Agua transportada/ distribuida por otros como una pipa de agua/ camión cisterna
☐Agua que usted mismo acarrea
☐Pozo
☐Otro: _____
(Especifique)

P2. ¿Viene esta agua de una llave?

☐Sí
☐No

P3. ¿Es éste el principal suministro de <u>agua potable</u> en su hogar?

☐Sí
☐No ⟶ **Si la respuesta es no, ¿Cuál es su principal suministro de agua potable?**

_____
y PASE a P7

P4. Antes de tomarla ¿le da algún tipo de tratamiento a esta agua?

☐Sí
☐No ⟶ ***Si su respuesta es no, PASE a P7***

P5. De ser así, ¿Qué tipo de tratamiento le da al agua potable?
<u>marque todas las que apliquen</u>

☐Hierve el agua
☐Tabletas o gotas de cloro
☐Tabletas o gotas de yodo
☐Jarra con filtro, como el de la marca Brita
☐Filtro en la llave de la cocina
☐Sol (contenedores en el sol)
☐Otro: _____
(Especifique)

P6. ¿A cuáles miembros de su familia les da de tomar agua tratada? *(Marque todos los que apliquen)*

- ☐ A todos los integrantes
- ☐ A ninguno de los integrantes
- ☐ Niños menores de 5 años
- ☐ Integrantes de más de 65 años
- ☐ Embarazadas
- ☐ Integrantes con diabetes
- ☐ Solamente si ese integrante se encuentra enfermo/a

P7. ¿Compran en su casa agua para tomar de otro lado como el supermercado?

- ☐ Sí
- ☐ No → ***si su respuesta es no, PASE a P11***

P8. De ser así, ¿Dónde compran en su casa el agua para tomar?

- ☐ Agua embotellada del supermercado
- ☐ Agua de máquinas, como molinos de agua
- ☐ Otro: _____ (Especifique)

P9. ¿A cuáles miembros de su familia les da de tomar **el** agua embotellada y/o de las máquinas?*(marque todas las que apliquen)*

- ☐ A todos los integrantes
- ☐ Ninguno de los integrantes
- ☐ Niños menores de 5 años
- ☐ Integrantes mayores de 65 años
- ☐ Embarazadas
- ☐ Integrantes con diabetes
- ☐ Solo si ese integrante se encuentra enfermo/a

P10. Si guarda el agua para tomar, ¿Dónde la almacena? *(marque todas las que apliquen)*

☐ Contenedor de 5 galones, como el de las máquinas de agua	☐ En la botella en la que vino de supermercado como las botellas de 8 oz. o 16 oz.
_____ dentro de la casa	_____ dentro de la casa
_____ fuera de la casa	_____ fuera de la casa

☐ Contenedores de menos de 5 galones, como frascos o contenedores de leche

_____ dentro de la casa	_____ cubierto o sellado	_____ sin cubrir o sin sellar
_____ fuera de la casa	_____ cubierto o sellado	_____ sin cubrir o sin sellar

☐ Contenedores de más de 5 galones, como un bidón o bote

_____ dentro de la casa	_____ cubierto o sellado	_____ sin cubrir o sin sellar
_____ fuera de la casa	_____ cubierto o sellado	_____ sin cubrir o sin sellar

☐ Otro: _____ (Especifique)

Almacenamiento del agua en el hogar *(Debe llenarse si la persona contestó sí a la P1- el suministro principal de agua para la cocina, el baño y para lavar la ropa es transportado/distribuido por otros, como un camión cisterna o por él/ ella mismo/a).* ⟶ *(P.11 – P.15. de lo contrario* ***PASE a la P16****.)*

A continuación, le voy a hacer preguntas sobre la forma en que almacena el agua. Cada pregunta tendrá dos partes relacionadas con las diferentes estaciones del año. **La primera parte** es primavera y verano, que viene siendo a principios de abril hasta finales de septiembre y **la segunda parte** es el otoño/invierno, que viene siendo a principios de octubre hasta finales de marzo.

P11. ¿De qué tamaño es el contenedor que utiliza para almacenar el agua, de qué material está hecho y dónde está ubicado?

En la primavera/verano (abril- septiembre)
☐Tamaño: _____
(Especifique)

☐Tipo/ Material del que está hecho: _____
(Especifique)

☐Ubicación: _____
(Adentro o afuera)

En el otoño/invierno (octubre- marzo)
☐Tamaño: _____
(Especifique)

☐Tipo/ Material del que está hecho: _____
(Especifique)

☐Ubicación: _____
(Adentro o afuera)

P12. ¿Con qué frecuencia surte de agua su depósito, ya sea por camión cisterna o por usted mismo/a?

En la primavera/verano (abril- septiembre)
☐Más de una vez por semana
☐Una vez a la semana
☐Una vez cada dos semanas
☐Una vez cada tres semanas
☐Una vez al mes
☐Otro:_____
(Especifique en número de semanas)

En el otoño/invierno (octubre- marzo)
☐Más de una vez por semana
☐Una vez a la semana
☐Una vez cada dos semanas
☐Una vez cada tres semanas
☐Una vez al mes
☐Otro:_____
(Especifique en número de semanas)

P13. ¿Con qué frecuencia limpia su depósito de agua?

En la primavera/verano (abril- septiembre)
☐Más de una vez al mes
☐Una vez al mes
☐Una vez cada dos meses
☐Una vez cada tres meses
☐Una vez cada cuatro a seis meses
☐Una vez cada siete a once meses
☐Una vez al año
☐Menos de una vez al año
☐Nunca

En el otoño/invierno (octubre- marzo)
☐ Más de una vez al mes
☐ Una vez al mes
☐ Una vez cada dos meses
☐ Una vez cada tres meses
☐ Una vez cada cuatro a seis meses
☐ Una vez cada siete a once meses
☐ Una vez al año
☐ Menos de una vez al año
☐ Nunca

P14. ¿Cuánto tiempo le lleva limpiar su depósito de agua?

En la primavera/verano (abril- septiembre)
☐Menos de una hora
☐Un par de horas
☐Medio día
☐Todo el día
☐Más de un día

En el otoño/invierno (octubre- marzo)
☐Menos de una hora
☐Un par de horas
☐Medio día
☐Todo el día
☐Más de un día

P15. ¿Que utiliza para limpiar su depósito?

En la primavera/verano (abril – septiembre)
☐Blanqueador
☐Cloro
☐Detergente
☐Otro:_____
(Especifique el producto)

En el otoño/invierno (octubre - marzo)
☐Blanqueador
☐Cloro
☐Detergente
☐Otro:_____
(Especifique el producto)

P16. Si no compra agua embotellada o de las máquinas expendedoras de agua para tomar, ¿Alguna vez ha obtenido gratis agua embotellada y/o de la llave, o a cambio o intercambio?

En la primavera/verano (abril – septiembre)
☐Sí
☐No

En el otoño/invierno (octubre –marzo)
☐Sí
☐No

Descripción de los gastos de agua en el hogar *(Preguntar en todas las casas)*

Ahora quisiera preguntarle cuánto gasta en agua. Me gustaría que pensara en todos los gastos relacionados con el agua que pueda pagar, tales como comprar agua embotellada, agua de máquinas, tratamiento de agua, transportarla, lavar depósitos, etc.

Al igual que en las preguntas anteriores, cada pregunta tendrá dos partes, que incluyen las diferentes estaciones del año. **La primera parte** es de primavera y verano, que viene siendo desde principios de abril hasta finales de septiembre y **la segunda parte,** otoño/invierno, desde principios de octubre hasta finales de marzo. Estoy pidiendo información sobre estas diferentes estaciones porque la cantidad que gasta en agua puede variar entre una y otra.

P17. ¿Cuánto **paga por mes o por semana** por el agua que utiliza? Favor de incluir **TODOS LOS COSTOS** para el uso del agua del hogar, tal como el agua para tomar, cocinar, bañarse, lavar ropa, jardín, etc. Vamos a repasar juntos estos puntos.

Entrevistador, lea cada gasto en la lista a continuación y anote usted la cantidad de dinero, luego pregunte si esta cantidad es por mes o por semana. Después de cada punto, pregunte si la cantidad incluye el costo por tratar el agua, limpiar el depósito, comprar el agua y la gasolina en caso de que la misma persona la acarree, pero no incluya el costo del depósito ni los demás gastos relacionados con el uso del agua.

Si los siguientes gastos corresponden, dígame cuánto gasta en la primavera/ verano y haga lo mismo para el otoño/ invierno, dígame si me está proporcionando los costos mensuales o semanales.

Durante la primavera/ verano
(principios de abril- finales de septiembre)

_____Municipales (todos los gastos)
Encierre en un círculo si es mensual o semanal

_____Agua transportada (todos los gastos)
Encierre en un círculo si es mensual o semanal

_____Embotellada/ de máquina (todos los gastos)
Encierre en un círculo si es mensual o semanal

En el otoño/ invierno
(principios de octubre- finales de marzo)

_____Municipales (todos los gastos)
Encierre en un círculo si es mensual o semanal

_____Agua transportada (todos los gastos)
Encierre en un círculo si es mensual o semanal

_____ Embotellada/ de máquina (todos los gastos)
Encierre en un círculo si es mensual o semanal

Descripción de los sistemas sanitarios en el hogar *(Preguntar en todas las casas)*

Ahora quisiera preguntarle sobre su sistema sanitario. ¿Qué sistemas de drenaje y de aguas residuales utiliza?

P18. ¿Qué instalaciones sanitarias existen en su hogar? *(Marque todas las que apliquen)*

- ☐ Sistema de tuberías a alcantarillas
- ☐ Sistema de desagüe a una fosa séptica
- ☐ Letrina de pozo
- ☐ Fosa séptica
- ☐ No existen instalaciones
- ☐ Otro: _____ (Especifique)

(Si contestó SÍ a la pregunta sobre contar con un sistema de fosa séptica, haga las preguntas P.19- P.22, de lo contrario, ⟶ ***PASE A Lista de Integrantes del Hogar**, P23.)*

P19. ¿Está certificado su sistema de tanque séptico?

- ☐ Sí
- ☐ No
- ☐ No estoy seguro/a

P20. ¿Qué capacidad tiene su tanque séptico?

- ☐ 500 - 749 galones
- ☐ 750 - 999 galones
- ☐ 1,000 – 1,250 galones
- ☐ 1,251 – 1,750 galones
- ☐ 1,751 – 2,250 galones
- ☐ 2,251+ galones

P21. ¿Con qué frecuencia se bombea, es decir, se vacía su sistema séptico?

- ☐ Una vez al año o menos
- ☐ Cada 2 años o menos
- ☐ Cada 3 años o menos
- ☐ Cada 4 años o menos
- ☐ Cada 5 años o menos
- ☐ Cada 6 años o menos
- ☐ Nunca

P22. ¿Cuál es el costo de mantenimiento anual (por año) de su sistema séptico?

- ☐ Menos de $100
- ☐ $100 a $200
- ☐ $201 o más
- ☐ No estoy seguro/a

LISTA DE INTEGRANTES DEL HOGAR *(Pregunte en todas las casas)*

P23. Ahora voy a hacerle preguntas sobre las personas en su casa para entender cómo se estructura su familia. Cualquier información que usted me proporcione es estrictamente confidencial. Quisiera saber su nombre, la relación que tiene con usted, edad, origen étnico, país de origen, nivel de escolaridad, estatus de empleo, estado civil, tiempo de residir en la casa y el estatus del seguro médico de cada persona que vive aquí. Empecemos con los hombres de la familia del mayor al menor y después con las mujeres, de la mayor a la menor.

ORMACION SOBRE EL HOGAR (Pregunte en todas las casas)

		A[1]	B	C[2]	D[3]	E[4]	F[5]	G[6]	H[7]	I[8]	J[9]	K[10]
	Nombre	Relación del miembro de la familia con la persona que brinda la información	Edad	Orígen Etnico	País de origen	Educación	Estatus de empleo	Estado Civil	Tiempo de residir en el domicilio actual	Diabetes	Embarazada	Estatus de seguro médico
001												
002												
003												
004												
005												
006												
007												
008												
001												
002												
003												
004												
005												
006												
007												
008												

s para A[1]	01 = el mismo/ella misma	02 = esposo/a	03 = hijo/a	04 = yerno o nuera
	05 = padre/madre	06 = suegro/a	07 = nieto/a	08 = abuelo/a
	09 = hermano/a	10 = otro familiar	11 = no se relaciona	
s para C[2]	01 = hispano/a latino/a o mexicoamericano/a		02 = Anglo, no hispano	03 = Afro, no hispano
	04 = Indígena americano		05 = Otro	
s para D[3]	01 = Estados Unidos	02 = México	03 = Otro	
s para E[4]	**PREGUNTAR SOLO A PERSONAS DE 17 AÑOS O MAS**			
	01 = Estudios inferiores de pre	02 = Gruadado de Preparatoria o equivalente (GED)		03 = Algunos semestres de universidad
	04 = Carrera de dos años o carrera técnica especializada			05 = Licenciatura
	06 =Título de maestría o superior			
s para F[5]	**PREGUNTAR SOLO A PERSONAS DE 17 AÑOS O MAS**			
	01 = Sí, tiempo completo	02 = Sí, tiempo parcial (menos de 40 horas)	03 = No	04 = Bajo incapacidad
	05 = Seguro Social			
s para G[6]	**PREGUNTAR SOLO A PERSONAS DE 17 AÑOS O MAS**			
	01 = Soltero/a	02 = Casado/a	03 = Viviendo con una pareja	04 = Separado/a
	05 = Divorciado/a	06 = Viudo/a		
s para H[7]	Anote años y meses			
s para I[8]	00= No	01 = Sí		
s para J[9]	00= No	01 = Sí		
s para K[10]	01 = Seguro médico privado	02 = Medicare	03 = Medicaid	04 = CHIPS
	05 = Sin seguro médico	06 = Otro tipo de seguro público como CHAMPUS, VA y Reclamos de salud por accidentes laborales		

Descripción general de la salud en el hogar

P24. Ahora le haré preguntas sobre (1) el porcentaje de agua que toma de la llave de su cocina, del grifo de la cocina y luego el porcentaje de agua que **cada miembro de la casa** toma de la llave de su cocina.

***Entrevistador**, vea la lista de los miembros de la familia (P. 23). Empiece con la persona encuestada de la casa Y luego con los hombres de la familia en orden, por ejemplo, todos los hombres M001 – M008 y luego pase a las mujeres, por ejemplo, F001 – F008.*

	% de agua de la llave que usted toma
Miembro de la familia encuestado (Por ej. M001): _____	
Miembro (Por ej. M001): _____	
Miembro (Por ej. M001): _____	
Miembro (Por ej. M001): _____	
Miembro (Por ej. M001): _____	
Miembro (Por ej. M001): _____	
Miembro (Por ej. M001): _____	
Miembro (Por ej. M001): _____	
Miembro (Por ej. M001): _____	
Miembro (Por ej. M001): _____	
Miembro (Por ej. M001): _____	
Miembro (Por ej. M001): _____	
Miembro (Por ej. M001): _____	
Miembro (Por ej. M001): _____	
Miembro (Por ej. M001): _____	

P25. *Si la persona encuestada toma menos del 100% de agua de la llave de la cocina y si cualquier otro integrante de la familia toma menos del 100%, haga la P25. De no ser así, **PASE A LA P26**.*

En cuáles de los siguientes lugares (1) usted u (2) otros integrantes de su familia toman agua.

Entrevistador**, vea la lista de los integrantes de la familia (P. 23). Empiece con la persona encuestada Y luego con los hombres de la familia por orden, por ejemplo todos los hombre M001 – M008 y luego pase a las mujeres F001 – F008 que contestaron que tomaban menos del 100% de agua de la llave: **"N" = No, "S" = Si, "NS" = No sé, "Neg" = se negó, si selecciona Otro, anote su respuesta.

Lugar donde toma agua:	Escuela	Trabajo	Iglesia	Hogar del miembro de la familia	Centro Comunitario	Otro: Especifíque
Miembro de la familia encuestado (Por ej. M001): _____						
Member (Por e.j. M001): _____						
Member (Por e.j. M001): _____						
Member (Por e.j. M001): _____						
Member (Por e.j. M001): _____						
Member (Por e.j. M001): _____						
Member (Por e.j. M001): _____						
Member (Por e.j. M001): _____						
Member (Por e.j. M001): _____						
Member (Por e.j. M001): _____						
Member (Por e.j. M001): _____						
Member (Por e.j. M001): _____						
Member (Por e.j. M001): _____						
Member (Por e.j. M001): _____						
Miembro (Por ej. M001): _____						

P26. Ahora voy a leerle una lista de condiciones médicas y enfermedades. Dígame si (1) usted ha tenido alguna de estas condiciones/enfermedades o si cualquier otro integrante de su hogar ha tenido estas condiciones/ enfermedades. Empezaremos con usted, y luego con los demás integrantes de su familia. Si la persona encuestada contesta "SI" a "Alguna vez", pregunte en que otras ocasiones. Si la persona encuestada contesta "NO", pase a la siguiente condición. Repita estos pasos para cada niño y adulto.

Entrevistador**, vea la lista de integrantes del hogar (P. 23). Empiece con la persona encuestada de la casa Y luego los hombres que integran la familia, por orden, por ejemplo, todos los hombres M001 – M008 y luego pase a las mujeres, por ejemplo, mujeres F001 – F008: **"N" = No, "S" = Si, "NS" = No sé, "Neg" = Se negó, si selecciona Otro, anote su respuesta.

Si el integrante de la casa ha tenido diarrea en los últimos 3 meses, pase directamente a la pregunta P27. (Preguntas detalladas sobre la diarrea), luego regrese a la lista de condiciones y enfermedades en la P26.

	Miembro de la familia encuestado (Por ej. M001) _____					Miembro (Por ej. M001)				
CONDICION	**Siempre**	**útimos 12 meses**	**últimos 3 meses**	**últimas 2 semanas**	**Actual-mente**	**Siempre**	**útimos 12 meses**	**últimos 3 meses**	**últimas 2 semanas**	**Actual-mente**
Diarrea										
Náuseas										
Vómito										
Retortijones										
Dolor estomacal										
Estomago inflamado										
Sangre en el excremento										
Desidratación										
Amibiasis/Amibas										
Giardiasis/Giardia										
HepatitisA										
Salmonela										
Shigellosis/Shigella										
Erupción en la piel										
Virus del Nilo										
Otras enfermedades que se transmiten a través del agua: Especifique _____										
Otras enfermedades gastrointestinales: Especifique _____										

	Miembro (Por ej. M001) _____:					Miembro (Por ej. M001) _____:				
CONDICION	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**últimas 2 semanas**	**Actual-mente**	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**En las últimas 2 semanas**	**Actual-mente**
Diarrea										
Náuseas										
Vómito										
Retortijones										
Dolor estomacal										
Estomago inflamado										
Sangre en el excremento										
Desidratación										
Amibiasis/Amibas										
Giardiasis/Giardia										
HepatitisA										
Salmonela										
Shigellosis/Shigella										
Erupción en la piel										
Virus del Nilo										
Otras enfermedades que se transmiten a través del agua: Especifique _____										
Otras enfermedades gastrointestinales: Especifique _____										

	Miembro (Por ej. M001) _____:					Miembro (Por ej. M001) _____:				
CONDICION	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**últimas 2 semanas**	**Actual-mente**	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**En las últimas 2 semanas**	**Actual-mente**
Diarrea										
Náuseas										
Vómito										
Retortijones										
Dolor estomacal										
Estomago inflamado										
Sangre en el excremento										
Desidratación										
Amibiasis/Amibas										
Giardiasis/Giardia										
HepatitisA										
Salmonela										
Shigellosis/Shigella										
Erupción en la piel										
Virus del Nilo										
Otras enfermedades que se transmiten a través del agua: Especifique _____										
Otras enfermedades gastrointestinales: Especifique _____										

	Miembro (Por ej. M001) _____:					Miembro (Por ej. M001) _____:				
CONDICION	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**últimas 2 semanas**	**Actual-mente**	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**En las últimas 2 semanas**	**Actual-mente**
Diarrea										
Náuseas										
Vómito										
Retortijones										
Dolor estomacal										
Estomago inflamado										
Sangre en el excremento										
Desidratación										
Amibiasis/Amibas										
Giardiasis/Giardia										
HepatitisA										
Salmonela										
Shigellosis/Shigella										
Erupción en la piel										
Virus del Nilo										
Otras enfermedades que se transmiten a través del agua: Especifique _____										
Otras enfermedades gastrointestinales: Especifique _____										

	Miembro (Por ej. M001) _____:					Miembro (Por ej. M001) _____:				
CONDICION	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**últimas 2 semanas**	**Actual-mente**	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**En las últimas 2 semanas**	**Actual-mente**
Diarrea										
Náuseas										
Vómito										
Retortijones										
Dolor estomacal										
Estomago inflamado										
Sangre en el excremento										
Desidratación										
Amibiasis/Amibas										
Giardiasis/Giardia										
HepatitisA										
Salmonela										
Shigellosis/Shigella										
Erupción en la piel										
Virus del Nilo										
Otras enfermedades que se transmiten a través del agua: Especifique _____										
Otras enfermedades gastrointestinales: Especifique _____										

	Miembro (Por ej. M001) _____:					Miembro (Por ej. M001) _____:				
CONDICION	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**últimas 2 semanas**	**Actual-mente**	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**En las últimas 2 semanas**	**Actual-mente**
Diarrea										
Náuseas										
Vómito										
Retortijones										
Dolor estomacal										
Estomago inflamado										
Sangre en el excremento										
Desidratación										
Amibiasis/Amibas										
Giardiasis/Giardia										
HepatitisA										
Salmonela										
Shigellosis/Shigella										
Erupción en la piel										
Virus del Nilo										
Otras enfermedades que se transmiten a través del agua: Especifique _____										
Otras enfermedades gastrointestinales: Especifique _____										

	Miembro (Por ej. M001) _____:					Miembro (Por ej. M001) _____:				
CONDICION	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**últimas 2 semanas**	**Actual-mente**	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**En las últimas 2 semanas**	**Actual-mente**
Diarrea										
Náuseas										
Vómito										
Retortijones										
Dolor estomacal										
Estomago inflamado										
Sangre en el excremento										
Desidratación										
Amibiasis/Amibas										
Giardiasis/Giardia										
HepatitisA										
Salmonela										
Shigellosis/Shigella										
Erupción en la piel										
Virus del Nilo										
Otras enfermedades que se transmiten a través del agua: Especifique _____										
Otras enfermedades gastrointestinales: Especifique _____										

	Miembro (Por ej. M001) _____:					Miembro (Por ej. M001) _____:				
CONDICION	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**últimas 2 semanas**	**Actual-mente**	**Siempre**	**En los útimos 12 meses**	**En los últimos 3 meses**	**En las últimas 2 semanas**	**Actual-mente**
Diarrea										
Náuseas										
Vómito										
Retortijones										
Dolor estomacal										
Estomago inflamado										
Sangre en el excremento										
Desidratación										
Amibiasis/Amibas										
Giardiasis/Giardia										
HepatitisA										
Salmonela										
Shigellosis/Shigella										
Erupción en la piel										
Virus del Nilo										
Otras enfermedades que se transmiten a través del agua: Especifique _____										
Otras enfermedades gastrointestinales: Especifique _____										

P 27. Quisiera entrar más en detalle sobre el episodio de diarrea más reciente que haya tenido (u*tilice el nombre del integrante de la familia*), cuánto tiempo duró (número de semanas), con qué frecuencia ocurren estos episodios (veces al día) y las opciones de tratamiento, tales como medicinas que se utilizaron para aliviar los síntomas. *Marque todo/as las que apliquen para Opciones de Tratamiento.*

Historial de la enfermedad: Diarrea	Miembro __________:					Opciones de tratamiento				
	Días 1-3	Días 4-6	Semana 1	Semanas 2-3	Semana 4 y mas	Ninguno	Medicina no prescrita	Medicina prescrita	hierbas/ remedios	Otros
Diarrea (# de semanas que duró)										
Diarrea (# de veces al día)										
	Miembro __________:					Opciones de tratamiento				
	Días 1-3	Días 4-6	Semana 1	Semanas 2-3	Semana 4 y mas	Ninguno	Medicina no prescrita	Medicina prescrita	hierbas/ remedios	Otros
Diarrea (# de semanas que duró)										
Diarrea (# de veces al día)										
	Miembro __________:					Opciones de tratamiento				
	Días 1-3	Días 4-6	Semana 1	Semanas 2-3	Semana 4 y mas	Ninguno	Medicina no prescrita	Medicina prescrita	hierbas/ remedios	Otros
Diarrea (# de semanas que duró)										
Diarrea (# de veces al día)										
	Miembro __________:					Opciones de tratamiento				
	Días 1-3	Días 4-6	Semana 1	Semanas 2-3	Semana 4 y mas	Ninguno	Medicina no prescrita	Medicina prescrita	hierbas/ remedios	Otros
Diarrea (# de semanas que duró)										
Diarrea (# de veces al día)										
	Miembro __________:					Opciones de tratamiento				
	Días 1-3	Días 4-6	Semana 1	Semanas 2-3	Semana 4 y mas	Ninguno	Medicina no prescrita	Medicina prescrita	hierbas/ remedios	Otros
Diarrea (# de semanas que duró)										
Diarrea (# de veces al día)										
	Miembro __________:					Opciones de tratamiento				
	Días 1-3	Días 4-6	Semana 1	Semanas 2-3	Semana 4 y mas	Ninguno	Medicina no prescrita	Medicina prescrita	hierbas/ remedios	Otros
Diarrea (# de semanas que duró)										
Diarrea (# de veces al día)										
	Miembro __________:					Opciones de tratamiento				
	Días 1-3	Días 4-6	Semana 1	Semanas 2-3	Semana 4 y mas	Ninguno	Medicina no prescrita	Medicina prescrita	hierbas/ remedios	Otros
Diarrea (# de semanas que duró)										
Diarrea (# de veces al día)										
	Miembro __________:					Opciones de tratamiento				
	Días 1-3	Días 4-6	Semana 1	Semanas 2-3	Semana 4 y mas	Ninguno	Medicina no prescrita	Medicina prescrita	hierbas/ remedios	Otros
Diarrea (# de semanas que duró)										
Diarrea (# de veces al día)										

P28. Ahora, voy a leerle una lista de ubicaciones para recibir tratamiento médico y quisiera saber dónde Y en qué ciudad, El Paso o Juárez, usted busca comúnmente tratamiento para la diarrea Y en general para cuando se enferma(n) (1) usted y los otros miembros de su familia. Dígame a dónde va para tratamiento **cuando solamente tiene diarrea** y a dónde va cuando tiene **otra enfermedad aparte de diarrea.**

***Entrevistador**, vea la lista de integrantes del hogar (P. 23). Empiece con la persona encuestada **Y** luego los hombres de la familia por orden, por ejemplo, todos los hombres M001 – M008 y luego pase a todas las mujeres, por ejemplo, mujeres F001 – F008:**"N" = No, "S" = Si, "NS" = No sé, "Neg" = Se negó.** Puede elegir una o ambas ciudades.*

	Miembro de la familia encuestado (Por ej. M001) _____		**Miembro (Por ej. M001) _____**		**Miembro (Por ej. M001) _____**		**Miembro (Por ej. M001) _____**	
	Diarrea	Vómito	Diarrea	Vómito	Diarrea	Vómito	Diarrea	Vómito
Botánica - EP								
Botánica - CJ								
Consulta de Farmacólogo-EP								
Consulta de Farmacólogo-CJ								
Enfermera de la Escuela-EP								
Enfermera de la Escuela-CJ								
Enfermera en el Centro para Adultos Mayores -EP								
Enfermera en el Centro para Adultos Mayores -CJ								
Clínica gratuita como La Fe-EP								
Clínica gratuita como La Fe-CJ								
Consultorio médico-EP								
Consultorio médico-CJ								
Servicio de Emergencia -EP								
Servicio de Emergencia -CJ								
Hospital - EP								
Hospital - CJ								

	Miembro (Por ej. M001) _____		Miembro (Por ej. M001) _____		Miembro (Por ej. M001) _____		Miembro (Por ej. M001) _____	
	Diarrea	Vómito	Diarrea	Vómito	Diarrea	Vómito	Diarrea	Vómito
Botánica - EP								
Botánica - CJ								
Consulta de Farmacólogo-EP								
Consulta de Farmacólogo-CJ								
Enfermera de la Escuela-EP								
Enfermera de la Escuela-CJ								
Enfermera en el Centro para Adultos Mayores -EP								
Enfermera en el Centro para Adultos Mayores -CJ								
Clínica gratuita como La Fe-EP								
Clínica gratuita como La Fe-CJ								
Consultorio médico-EP								
Consultorio médico-CJ								
Servicio de Emergencia -EP								
Servicio de Emergencia -CJ								
Hospital - EP								
Hospital - CJ								

	Miembro (Por ej. M001) _____		Miembro (Por ej. M001) _____		Miembro (Por ej. M001) _____		Miembro (Por ej. M001) _____	
	Diarrea	Vómito	Diarrea	Vómito	Diarrea	Vómito	Diarrea	Vómito
Botánica - EP								
Botánica - CJ								
Consulta de Farmacólogo-EP								
Consulta de Farmacólogo-CJ								
Enfermera de la Escuela-EP								
Enfermera de la Escuela-CJ								
Enfermera en el Centro para Adultos Mayores -EP								
Enfermera en el Centro para Adultos Mayores -CJ								
Clínica gratuita como La Fe-EP								
Clínica gratuita como La Fe-CJ								
Consultorio médico-EP								
Consultorio médico-CJ								
Servicio de Emergencia -EP								
Servicio de Emergencia -CJ								
Hospital - EP								
Hospital - CJ								

	Miembro (Por ej. M001) _____		Miembro (Por ej. M001) _____		Miembro (Por ej. M001) _____		Miembro (Por ej. M001) _____	
	Diarrea	Vómito	Diarrea	Vómito	Diarrea	Vómito	Diarrea	Vómito
Botánica - EP								
Botánica - CJ								
Consulta de Farmacólogo-EP								
Consulta de Farmacólogo-CJ								
Enfermera de la Escuela-EP								
Enfermera de la Escuela-CJ								
Enfermera en el Centro para Adultos Mayores -EP								
Enfermera en el Centro para Adultos Mayores -CJ								
Clínica gratuita como La Fe-EP								
Clínica gratuita como La Fe-CJ								
Consultorio médico-EP								
Consultorio médico-CJ								
Servicio de Emergencia -EP								
Servicio de Emergencia -CJ								
Hospital - EP								
Hospital - CJ								

Descripción demográfica del hogar

P29. ¿Qué idioma hablan con más frecuencia los integrantes de su familia?

- ☐ Únicamente inglés
- ☐ Inglés más que español
- ☐ Inglés y español más o menos igual
- ☐ Español más que inglés
- ☐ Español únicamente
- ☐ Otro

P30. Entre las siguientes cantidades, ¿Cuál describe de mejor manera el **ingreso total de su familia** antes de deducir los impuestos? Incluya sus ingresos y los ingresos de cualquier otra persona en su hogar que provenga de empleo/s, inversiones, asistencia pública, seguro de desempleo, seguro social, discapacidad/ pensiones y otras fuentes. **Una cantidad aproximada está bien.**

- ☐ Menos de $1,999/año (menos de $166/mes)
- ☐ $2,000-$4,999/año ($167-$416/mes)
- ☐ $5,000-$7,499/año ($417-$625/mes)
- ☐ $7,500-$9,999/año ($626-$833/mes)
- ☐ $10,000-$12,499/año ($834-$1,041/mes)
- ☐ $12,500-$14,999/año ($1,042-$1,249/mes)
- ☐ $15,000-$17,499/año ($1,250-$1,457/mes)
- ☐ $17,500 - $19,999/año ($1,458 - $1,666/mes)
- ☐ $20,000-$22,499/año ($1,667-$1,874/mes)
- ☐ $22,500-$24,499/año ($1,875-$2,083/mes)
- ☐ $25,000-$29,999/año ($2,084-$2,500/mes)
- ☐ $30,000-$39,999/año ($2,501-$3,333/mes)
- ☐ $40,000-$49,999/año ($3,334-$4,166/mes)
- ☐ $50,000-$54,999/año ($4,167-$4,582/mes)
- ☐ $55,000 o más/año ($4,583 o más/mes)

P31. ¿Es usted dueño de su casa? ¿o la renta?

☐Dueño
Si usted es el dueño, ¿es usted también dueño de la propiedad en la que está construida su casa?
☐Sí
☐No
☐Rento

P32. Desde que vive en esta casa, ¿ha tenido usted servicio de la compañía municipal de agua? es decir, su hogar no contaba con agua entubada de la compañía de agua municipal **PERO** ya cuenta con ella.

☐Sí
Si su respuesta es sí, ¿Desde hace cuantos años? _____
☐No

P33. ¿Tiene algún comentario adicional que quisiera compartir sobre el agua, servicios sanitarios y/o la salud en su comunidad o en su familia?

Lea esto a la persona encuestada: Apreciamos que se haya tomado el tiempo para participar en este estudio. Recuerde que sus respuestas se manejarán en forma confidencial. Esperamos que la información que hoy se recopiló contribuya a servir de mejor manera las necesidades de su comunidad. Como muestra de nuestro agradecimiento, le pedimos que firme esta hoja para recibir $10.00 en efectivo por tomarse el tiempo para participar en esta encuesta.

Appendix B1

University of Texas at El Paso (UTEP) Institutional Review Board

Informed Consent Form for Research Involving Human Subjects

Protocol Title: The Impacts of Lack of Indoor Plumbing on Water Quality and Self-Reported Health in El Paso Colonias

Principal Investigator: Yolanda McDonald

UTEP: Anthropology and Sociology

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1. Introduction

You are being asked to take part voluntarily in the research project described below. Are you at least 18 years of age or older? If so, we would like to invite you to participate. If not, is there someone else available that we can speak with? Before agreeing to take part in this research study, it is important that you understand the consent form that describes the study. Please take your time making a decision and feel free to discuss it with your friends and family. Please ask me if to explain any words or information that you do not clearly understand.

2. Why is this study being done?

You have been asked to take part in a research study on community water and health. Approximately, 150 people will be taking part in this study in *colonias* in El Paso County.

You are being asked to be in the study because you are at least 18 years of age and live in a *colonia*. If you decide to enroll in this study, your involvement will last about 40 to 60 minutes.

3. What is involved in the study?

If you agree to take part in this study, we will begin by asking you questions about water and health in the form of a survey. Then, we will take one 290 mL and one 250 mL water samples from the tap of your kitchen sink or where you access water for household use (to test for drinking water quality). The water samples will be tested at labs on the University of Texas at El Paso campus and will be compared to the EPA National Primary Drinking Water Regulations, World Health Organization (WHO) Guidelines, and results from a previous study conducted in El Paso County *colonias*. Below, we have listed the tests and what the guidelines are:

Test	**EPA/WHO/Previous Study**
Total Coliforms	No more than 10 total coliforms per 100 ml of water
E. coli	Not to exceed 8.6% presence in 100 ml of water
Residual Chlorine	To be at least 0.2 mg/l for stored water
Turbidity (how clear water is)	Not to exceed one nephelolometric turbidity unit for sample

4. What are the risks and discomforts of the study?

There are no known risks associated with this research.

5. What will happen if I am injured in this study?

The University of Texas at El Paso and its affiliates do not offer to pay for or cover the cost of medical treatment for research related illness or injury or any costs related to improving your water supply. No funds have been set aside to pay or reimburse you for medical care. You will not give up any of your legal rights by signing this consent form. You should report any such injury to Yolanda McDonald, 915-747-6508 and to the UTEP Institutional Review Board (IRB) at (915-747-8841) or irb.orsp@utep.edu.

6. Are there benefits to taking part in this study?

There will be no direct benefits to you for taking part in this study. This research may help us to understand issues related to water and health in *colonias* and to raise awareness about these issues among community advocates, researchers, and non-governmental agencies.

7. What other options are there?

You have the option not to take part in this study. There will be no penalties involved if you choose not to take part in this study.

8. Who is paying for this study?

Yolanda McDonald is receiving funding from the Hispanic Health Disparities Research Center at UTEP to conduct this study.

9. What are my costs?

There are no direct costs.

10. Will I be paid to participate in this study?

You will be offered $10 to thank-you for your time. If you quit the study without finishing it, you will not be offered the $10.

11. What if I want to withdraw, or am asked to withdraw from this study?

Taking part in this study is voluntary. You have the right to choose not to take part in this study. If you do not take part in the study, there will be no penalty. If you choose to take part, you have the right to stop at any time.

12. Who do I call if I have questions or problems?

You may ask any questions you have now. If you have questions later, you may call Yolanda McDonald at 915-747-6508 (office phone number), cell phone number (915-615-9088), and/or email address: wshresearch@yahoo.com.

If you have questions or concerns about your participation as a research subject, please contact the UTEP Institutional Review Board (IRB) at (915-747-8841) or irb.orsp@utep.edu.

13. What about confidentiality?

Your part in this study is confidential. None of the information will identify you by name. We, Yolanda McDonald and [promotora name], will assign an ID number to your information (whether you provide your name or not). There is no way to link your responses to your name, the names of the members of your household, or your home address, unless you choose to provide them so that you can be considered for participation in a possible follow-up project. The results of this research study may be presented at meetings or in publications; however, your identity will not be disclosed in those presentations. Data will be presented in summary form and will not contain any confidential or identifying information, such as a name or address.

14. Mandatory reporting

If information is revealed about child abuse or neglect, or potentially dangerous future behavior to others, the law requires that this information be reported to the proper authorities.

15. Authorization Statement

In the event that a water sample is damaged during transport from your home to our lab, may we come back to your home to take another sample?

☐Yes ☐No

Would you like to be contacted for future studies?

☐Yes ☐No

If yes, how would you like to be contacted?

_____

Phone Number

_____

Email

I have read each page of this paper about the study (or it was read to me). I know that being in this study is voluntary and I choose to be in this study. I know I can stop being in this study without penalty. I will get a copy of this consent form now and can get information on results of the study later if I wish.

Participant Name: _____ Date: _____

Participant Signature: _____ Time: _____

Consent form explained/witnessed by:

_____

Signature

Printed name:

_____

Date: _____ Time: _____

Appendix B2

Comité de Revisión Institucional de la Universidad de Texas en El Paso (UTEP)

Forma de Consentimiento Informado para una Investigación que involucra sujetos humanos

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Título del protocolo: El impacto de la falta de agua corriente en la calidad del agua y en los auto-reportes de salud en las *colonia*s de El Paso

Investigadora principal: Yolanda McDonald

UTEP: Antropología y Sociología

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1. Introducción

Se le ha pedido que participe de manera voluntaria en el proyecto de investigación que se describe a continuación. ¿Tiene por lo menos 18 años de edad o más? De ser así, deseamos invitarle a que participe. De no ser así, ¿hay alguien más en casa que esté disponible y con quien podamos hablar? Antes de que acepte participar en este estudio, es importante que entienda la forma de consentimiento que describe la investigación. Le pedimos que se tome el tiempo suficiente para tomar una decisión y se sienta en libertad de discutirlo con sus familiares y amigos. Pida que se le explique cualquier palabra o información que no entienda del todo.

2. ¿Por qué se realiza este estudio?

Se le ha pedido que participe en un estudio de investigación sobre el agua y la salud comunitaria. Participarán aproximadamente 150 personas en las *colonia*s del Condado de El Paso.

Se le ha pedido que tome parte en el estudio porque tiene por lo menos 18 años de edad y vive en una *colonia*.

Si decide inscribirse en este estudio, su participación durará aproximadamente de 40 a 60 minutos.

3. ¿Qué involucra el estudio?

Si usted acepta participar en este estudio, empezaremos haciéndole algunas preguntas sobre el agua y la salud, a manera de encuesta. Luego, tomaremos una muestra de 290 mL y una muestra de 250 mL de agua del

fregadero de su cocina o donde el acceso del agua para la casa (para analizar la calidad del agua potable). Las muestras de agua serán analizadas en los laboratorios del campus de La Universidad de Texas en El Paso y serán comparadas con las normas que rigen el agua de consumo humano establecidas por la Agencia Para la Protección del Medio Ambiente (EPA, por sus siglas en inglés), los lineamientos de la Organización Mundial de la Salud (WHO, por sus siglas en inglés) y los resultados de un estudio previo llevado a cabo en las *colonia*s en el condado de El Paso. A continuación se presenta una lista de las pruebas y cuáles son los lineamientos:

Prueba	**Estudio previo de la EPA/WHO**
Coliformes totales	no más de 10 coliformes totales por cada 100 ml de agua
E. Coli	Su presencia no debe exceder el 8.6% en 100 ml de agua
Cloro residual	Debe ser por lo menos 0.2 mg/l para el agua almacenada
Turbiedad (que tan clara es el agua)	No debe exceder una unidad nefelometría de turbulencia por muestra

4. ¿Cuáles son los riesgos y molestias del estudio?

Se desconoce algún riesgo relacionado con este estudio.

5. ¿Qué sucederá si resulto lesionado/a en este estudio?

La Universidad de Texas en El Paso y sus afiliadas no ofrecen pagar por o cubrir el costo de tratamiento médico por enfermedades o lesiones relacionadas con la investigación, ni ningún costo que se relacione con el mejoramiento del suministro de agua. No se ha establecido ningún fondo para pagarle o reembolsarle por cuidados médicos. Al firmar esta forma de consentimiento, no está renunciando a ninguno de sus derechos legales. Deberá reportar cualquier lesión a Yolanda McDonald (915-747-6508) y al Comité de Revisión Institucional (IRB, por sus siglas en inglés) en UTEP al teléfono (915) 747-8841 o al correo electrónico irb.orsp@utep.edu.

6. ¿Existen beneficios por participar en este estudio?

No habrá ningún beneficio directo para usted por participar en este estudio. Esta investigación puede ayudarnos a entender los temas relacionados con el agua y la salud en las *colonia*s y a concientizar sobre estos temas entre los defensores comunitarios, investigadores y agencias no gubernamentales.

7. ¿Qué otras opciones existen?

Usted tiene la opción de no participar en este estudio. No involucrará ninguna sanción si usted decide no participar en este estudio.

8. ¿Quién patrocina este estudio?

Yolanda McDonald recibe fondos del Centro de Investigación de Disparidades de la Salud Hispana en UTEP para realizar este estudio.

9. ¿Cuáles son mis gastos?

No existen costos directos.

10. ¿Recibiré algún pago por participar en este estudio?

Se le pagarán $10 como agradecimiento por su tiempo. Si se retira del estudio sin haberlo terminado, no se le darán los $10.

11. ¿Qué sucede si deseo retirarme o se me pide que me retire del estudio?

Su participación en este estudio es voluntaria. Usted tiene derecho a decidir no participar en este estudio. No habrá ninguna sanción si decide no participar en el estudio. Si decide participar, tiene derecho a retirarse en cualquier momento.

12. ¿Con quién puedo comunicarme en caso de que tuviera alguna pregunta o problemas?

En este momento puede hacer cualquier pregunta que tenga. Si posteriormente tuviera alguna pregunta, puede comunicarse con Yolanda McDonald al teléfono 915-747-6508 (número de oficina), al número celular 915-615-9088 y/o al correo electrónico: wshresearch@yahoo.com.

Si tiene preguntas o dudas sobre su participación como sujeto de investigación, favor de comunicarse con el Comité de Revisión Institucional (IRB, por sus siglas en inglés) al (915-747-8841) o irb.orsp@utep.edu.

13. ¿Cómo se maneja la confidencialidad?

Su participación en este estudio es confidencial. Usted no será identificado/a por su nombre en ningún tipo de información. Yo, Yolanda McDonald y [nombre del/la promotor/a] le asignaremos un número de identificación a su información (sin importar si proporciona su nombre o no). No hay manera de relacionar sus respuestas con su nombre, con los nombres de los integrantes de su hogar o con su domicilio, a menos que usted decida proporcionarlos para que poder ser considerado/a para participar en un posible proyecto de seguimiento. Los resultados de esta investigación pueden ser presentados en reuniones o en publicaciones, sin embargo, no se divulgará su identidad en esas presentaciones. Los datos serán presentados a manera de resumen y no incluirán información confidencial o que lo identifique, como su nombre o domicilio.

14. Informes obligatorios

La ley exige que si se divulgara información sobre abuso o negligencia infantil o un posible comportamiento peligroso a futuro, se reporte esta información a las autoridades pertinentes.

15. Declaración de Autorización

¿En el evento en el que una de las muestras de agua se dañe durante el transporte desde su casa a nuestro laboratorio, podemos regresar a su casa para tomar otra muestra?

☐Sí ☐No

¿Desea ser contactado/a para participar en estudios a futuro?

☐Sí ☐No

¿Si su respuesta es sí, como desea que se le contacte?

_____

Número de teléfono

_____

Correo electrónico

He leído (o me fue leída) cada hoja de este informe sobre la investigación. Entiendo que mi participación en este estudio es voluntaria y yo elijo tomar parte en el mismo. Entiendo que puedo retirarme de este estudio en cualquier momento sin recibir ninguna sanción. En este momento se me dará una copia de esta Forma de Consentimiento y si lo deseo, puedo obtener posteriormente información sobre los resultados del estudio.

Nombre del Participante: _____ Fecha: _____

Firma del Participante: _____ Hora: _____

Forma de consentimiento explicada / atestiguada por:

_____

Firma

Nombre en letra impresa: _____

Fecha: Hora:

_____ _____

Appendix C1

Non-profit clinics where you can receive free or reduced price care.

Clinic Name	Address	Phone Number
La Fe Montana Vista Community & Satellite Resource Resource Center	14618 Greg Dr., El Paso, TX 79938	(915) 857-1567
La Fe Central Clinic	700 S. Ochoa St., El Paso, TX 79901	(915) 545-4550
La Fe Lisbon Clinic	200 Lisbon St., El Paso, TX 79905	(915) 545-6140
La Fe Jose Pediatric Clinic	815 E. Yandell Dr., El Paso, TX 79902	(915) 534-7979
La Fe Yandell Adult Clinic	832 E. Yandell Dr., El Paso, TX 79902	(915) 545-7205
La Fe San Elizario Clinic	1313 San Antonio, San Elizario, TX 79849	(915) 851-5519
La Fe Care Clinic	1505 Mescalero, El Paso, TX 79925	(915) 772-3366
La Fe Westway Clinic	1713 Banker Rd., Canutillo, TX 79835	(915) 231-4370
Centro San Vicente Alameda Clinic	8061 Alameda Ave., El Paso, TX 79915	(915) 859-7545
Centro San Vicente San Elizario Clinic	13017 Perico Rd., San Elizario 79849	(915) 851-0999

Appendix C2

Clínicas, como La Fe y Centro San Vicente, usted puede recibir servicios médicos gratuitos o a un precio reducido.

Nombre de Clínica	Dirrecćion	Número Telefónico
La Fe Montana Vista Community & Satellite Resource Resource Center	14618 Greg Dr., El Paso, TX 79938	(915) 857-1567
La Fe Central Clinic	700 S. Ochoa St., El Paso, TX 79901	(915) 545-4550
La Fe Lisbon Clinic	200 Lisbon St., El Paso, TX 79905	(915) 545-6140
La Fe Jose Pediatric Clinic	815 E. Yandell Dr., El Paso, TX 79902	(915) 534-7979
La Fe Yandell Adult Clinic	832 E. Yandell Dr., El Paso, TX 79902	(915) 545-7205
La Fe San Elizario Clinic	1313 San Antonio, San Elizario, TX 79849	(915) 851-5519
La Fe Care Clinic	1505 Mescalero, El Paso, TX 79925	(915) 772-3366
La Fe Westway Clinic	1713 Banker Rd., Canutillo, TX 79835	(915) 231-4370
Centro San Vicente Alameda Clinic	8061 Alameda Ave., El Paso, TX 79915	(915) 859-7545
Centro San Vicente San Elizario Clinic	13017 Perico Rd., San Elizario 79849	(915) 851-0999

Appendix D1

Dear Participant,

I would like to thank you again for participating in the research study, *The Impacts of Lack of Indoor Plumbing on Water Quality and Self-Reported Health in El Paso Colonias*. Below please find the results of your water that was tested. The results are noted if within or not within the guidelines.

Test	**EPA/WHO/Previous Study**	**Within Guidelines**	**Not Within Guidelines**
Total Coliforms	No more than 10 total coliforms per 100 ml of water	X	
E. coli	Not to exceed 8.6% presence in 100 ml of water	X	
Residual Chlorine	To be at least 0.2 mg/l for stored water	X	
Turbidity (how clear water is)	Not to exceed one nephelolometric turbidity unit for sample	X	

If your water does not meet the above standards for total coliforms, *E. coli*, or turbidity, you will need to boil it for at least one minute before you drink it, wash dishes with it, cook with it, or brush your teeth with it. The water is safe for bathing but make sure not to brush your teeth while you are in the bath/shower or gargle the water in the bath/shower. Also, if you have small children, as a precaution, do not use a wash cloth to rub soap and water in their skin while you are bathing them.

Again, thank you for participating in the survey. If you have any questions, please call me at 915-615-9088 or email me at wshresearch@yahoo.com.

Sincerely,

Yolanda McDonald

Appendix D2

Estimado participante,

Me gustaría darle las gracias otra vez por participar en el estudio de investigación, *El impacto de falta de agua corriente en la calidad del agua y en auto-reportes de salud en las colonias de El Paso.* A continuación encontrará los resultados de las pruebas de su agua. Los resultados muestran si el agua está o no está dentro de las guías.

Prueba	**EPA/WHO/o Estudio previo guías**	**Está dentro de las guías**	**No está dentro de las guías**
Coliformes totales	no más de 10 coliformes totales por cada 100 ml de agua	X	
E. coli	Su presencia no debe exceder el 8.6% en 100 ml de agua	X	
Cloro residual	Debe ser por lo menos 0.2 mg/l para el agua almacenada	X	
Turbiedad (que tan clara es el agua)	No debe exceder una unidad nefelometría de turbulencia por muestra		X

Si el agua no cumple con las normas anteriores con respecto a coliformes, E. coli, o turbiedad, necesitara hervirla por lo menos un minuto antes de beberla, lavar los platos con ella, cocinar con ella, o cepillarse los dientes con ella. El agua es segura para bañarse con ella, pero asegúrese de no cepillarse los dientes o hacer gárgaras con el agua de la bañera / ducha mientras se está bañando. Además, si usted tiene niños pequeños, como medida de precaución, no utilice esponjas o paños para frotar el jabón y el agua en su piel mientras los baña.

Si el agua no cumple con la norma mencionada arriba para el cloro residual, por favor revise el folleto que la promotora le dio al final de la encuesta. También se adjunto un resume sobre cómo tratar el agua con cloro correctamente.

Una vez más, gracias por participar en la encuesta. Si usted tiene alguna pregunta, por favor llamé a 915-615-9088 o por correo electrónico en wshresearch@yahoo.com.

Sinceramente,

Yolanda McDonald

Vita

Yolanda McDonald was born in Irapuato, Guanajuato, Mexico. She received a B.A. in Multidisciplinary Studies from the University of Texas at El Paso in 2009. For the past two years, she has been a teaching assistant and research assistant at the University of Texas at El Paso. Her research interests include social and environmental justice, political ecology, human dimensions of environmental change, water governance and injustices, and the role of race, ethnicity, and socioeconomics on exposure to environmental hazards and health disparities. Her publications include:

- McDonald, YJ and Grineski, SE. (2012). Disparities in access to residential plumbing: A bi-national comparison of environmental injustice in El Paso and Ciudad Juárez. *Population and Environment*

- Grineski, SE, J Chakraborty, T Collins, T and YJ McDonald. *In Press*. Environmental Health Injustice: Exposure to Air Toxics and Children's Respiratory Hospital Admissions. *The Professional Geographer*

- Collins, T, SE Grineski, J Chakraborty, and YJ McDonald. 2011. Understanding environmental health inequalities through comparative intracategorical analysis: Racial/ethnic disparities in cancer risks from air toxics in El Paso County, Texas. *Health and Place*

- Grineski, SE and YJ McDonald. 2011. Mapping the Uninsured Using Secondary data: An Environmental Justice Application in Dallas. *Population and Environment*.

Ms. McDonald will be joining the Human-Environment Research Group at Texas A&M University Fall 2012 to start a Geography doctorate program in the College of Geosciences.

Permanent address: 7880 Trimona Way

El Paso, Texas 79915

This thesis was typed by Yolanda McDonald.