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Oil and Gas in the Great State of *Tejas*: Centering Land Tenure Histories of Fracking Geographies within the Texas-Mexico Border Landscape

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Abstract

Oil and Gas in the Great State of *Tejas*: Centering Land Tenure Histories of Fracking Geographies within the Texas-Mexico Border Landscape

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This dissertation examines the Texas-Mexico border oil and gas landscape and the unequitable distributions of impacts and benefits these extractive activities produce. I situate my work within critical, interdisciplinary literature on the relationship between the exploitation of natural resources and wealth distribution, and the explicit problematization of inherent uniqueness of border spaces. I utilized a critical, multi-disciplinary framework drawing from political ecology, planning, and border studies, to critique and inform more nuanced vulnerability assessments and literatures across temporal and spatial scales. I argue consideration of the role of who owns what and how they obtained it in policy and planning, not just land use, is key to understanding the reproduction of oppressive and exclusive political structures and land rights regimes along the border. Using a mixed method approach to examine this exemplary case study, I integrated spatial, quantitative methods with qualitative interviews and archival document analysis to trace the historical land tenure patterns of property ownership in Webb County, as well as conduct

vulnerability and risk assessments. Using governance geographies as a spatial and conceptual lens for analyses, I demonstrate how land tenure and ownership illuminate the important role of the gradations of informality, and by extension the state, is in producing social vulnerabilities in borderlands. The following themes emerged from analysis of my case study: relationship between land wealth and political power and vulnerability; tensions between land control, stewardship, and exploitation; and the value in learning from histories of land tenure and borderlands in reconceptualizing, identifying, and developing policies that aim to address vulnerability. My research suggests the confluence of physical and regulatory remnants of past colonial powers along the border region continue to be visible and influence the balance and power and distribution of public resources. Furthermore, their corresponding land rights regimes, dispossession via subsequent sovereign land grants, and generational wealth accumulation and political power from these activities, are significant in shaping this particular oil and gas producing landscape. As one of the least regulated, pro-property rights and pro-oil-and-gas states in the country, this study serves as an example of what happens when wealth and political power continues to fortify the structural mechanisms that, in the absence of regulatory controls and avenues for redistribution and remediation, effectively rendering moot a government meant to serve and protect everyone else.

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Chapter 1: Introduction

I first did pre-dissertation fieldwork and interviews the fall of 2014. The previous time I had explored the Mines Road area north of Laredo, Texas, and beyond, I had been less than ten years old. This area was the site of active coal mines around 1880-1920[1]. My dad used to take my brother and me to hunt for rocks that looked like chunky shards of obsidian glass. This particular November morning in 2014 was cool and crisp, and I was driving my dad's F150 with my dad serving as my navigator, armed with maps of colonias in northern Webb County, my camera, and a note pad.

The goal was to take pictures and make observations of these colonias. La Moca Ranch was busy with 18-wheeler and other vehicular traffic at the intersection of Highway 83 and I-35 heading toward Carrizo Springs. This intersection serves as the informal gateway into the booming Eagle Ford Shale (EFS) and, in the five years preceding this visit, had become a notoriously dicey intersection with much more traffic than it was designed for. Roughnecks, a nickname for oil field workers, and other workers of ancillary activities related to oil and gas development and production, had numerous opportunities to increase their already enticingly high pay. Much of these opportunities were contingent on many hours per day they could actually clock in. Since truck drivers are paid by how many trips they can make, there are almost no limits to how many hours they can be on the road in one long stretch. This intersection and stretch of about 60 miles of Highway 83 to Carrizo was dangerous and deadly. Being surrounded by so many 18-wheelers with sleep-

[1] From "The Santo Tomas Cannal Coal, Webb County, Texas." By George Ashley in Contributions to Economic Geology, Part II. United States Geological Survey. (1918) Accessed online at https://pubs.usgs.gov/bul/0691i/report.pdf

deprived drivers on roads not designed for them is the reason why I had a reliable navigator and a tank of a truck to get around the area.

We pulled into one of the small roads going into La Moca Ranch that appeared to lead to some manufactured housing, and in the distance behind those structures we could see an oil rig. The small, mostly paved but worn road led to a two-lane county road that was situated between, and in surprisingly close proximity to, the manufactured homes and the rig. There were 18-wheelers blazing by as we sat parked off the side of the road, where not even twenty feet laid between the fence line and the road. The rig was about 100 feet away from the road (and us) where I snapped the pictures below (Figure 1.1.).

Figure 1.1. Well Operated by Lewis Energy in La Moca Ranch, Webb County, 2014.

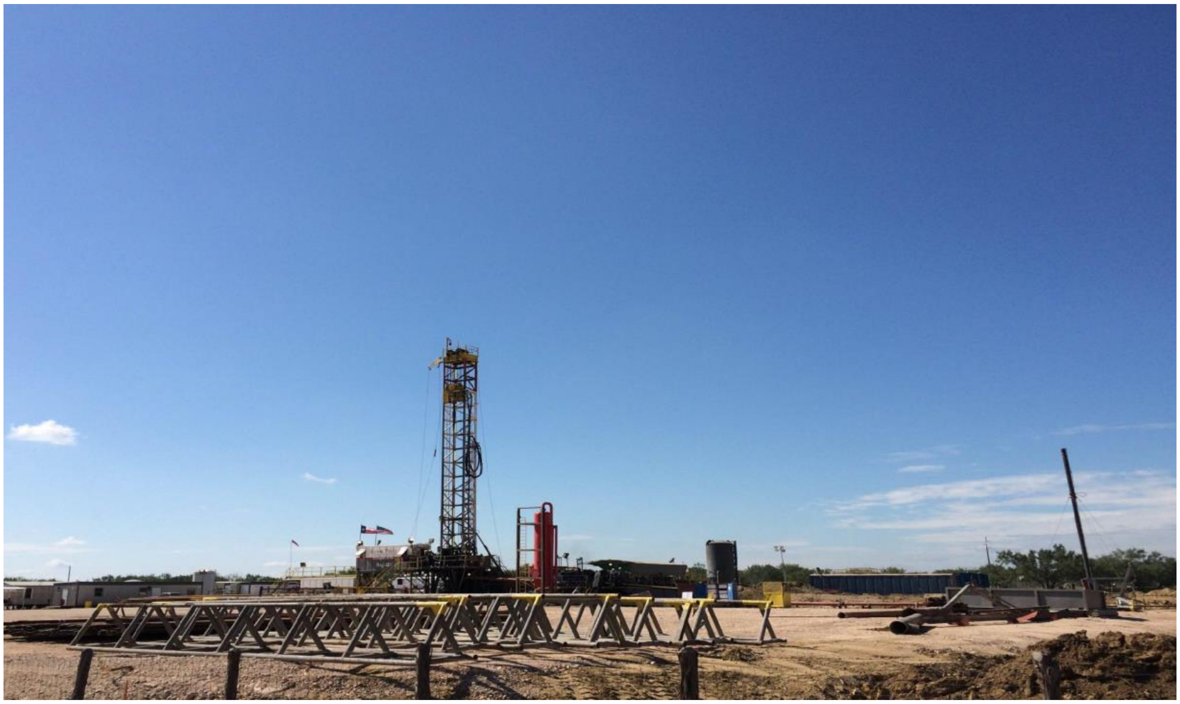

Figure 1.1. Well Operated by Lewis Energy in La Moca Ranch, Webb County, 2014 (continued)

Image Source: Photos taken by author.

Uniformed men were working on the property, and large trucks were coming and going with oil and gas products and machinery used for drilling. This was along the edge of the Eagle Ford Shale, and after looking it up in the Texas Railroad Commission's permitting database we determined that this was a horizontal gas well on what was essentially a heavy industrial site. Across the road were a few rows of manufactured housing with a common outdoor area that included children's playground equipment.

While living in Laredo, I heard many stories about colonias from my mom. She was an administrator, first as an assistant principal, then as a principal, of several large elementary schools where a substantial percentage—at times upward of 90%—of her students lived in colonias. Because of the additional emotional work and professional challenges required of educators in these lower 'performing' schools, many teachers chose not to teach at these schools, and many administrators chose to not work on these campuses, despite the additional stipends the school districts offered to attract educators to these schools. I learned so much about the students' families, many part of a larger migrant community from Mexico and other (mostly Central American) countries, always moving to the available work in the U.S., doing their best to provide better opportunities for their children regardless of the cost to them. Given what I learned growing up, and what I learned from academic literature on colonias as a graduate student, I was appalled. This kind of activity on private land was deemed acceptable, even in its close proximity to a residential area with sensitive populations (children). By 2014, some small local environmental organizations, in informal partnership with social service providers and advocates, had begun to organize and challenge local, county, and state leadership on the conditions in the EFS. Colonia residents, however, were not participating in any of the community meetings or other activities. I was shocked, but not surprised, by the lack of engagement with some of the more vulnerable community residents. We are in Laredo, which is still also Texas.

The questions that bothered me then about how such a site could come into existence informed my dissertation research questions and research design. I was interested in better illuminating the roles of land and institutional bodies responsible for recognizing and also responding to impacts of fracking. As a member of the second generation of Wirschings to live in Laredo, I knew border history and culture were key to understanding how land rights and ownership influences distribution and intensity of benefits and impacts from oil and gas production. And, as someone driven by concerns for social justice and surrounded by family in public service, I also knew that concentrations of power and wealth in border areas are deeply intertwined with how these impacts and benefits are distributed, mitigated and regulated. This is why I designed my dissertation research to empirically test and better understand these phenomena.

1.1.The U.S. Shale 'Boom' and Massive Hydraulic Fracturing and Horizontal Drilling

Although the recent explosion in unconventional oil and gas extraction mostly through hydraulic fracturing ("fracking") has improved U.S. energy security and sufficiency, fracking has also produced uneven, and sometimes severe, environmental and social impacts in communities located in so-called "shale plays." Because of what some scholars call lax environmental controls, fracking has led to soil, air, and groundwater contamination, strains on local infrastructure, and threats to public safety, which are impacting some areas and populations more than others (Apple, 2014; Finewood and Stroup, 2012; Davis, 2011). While communities have received economic development benefits, these are unevenly distributed and contingent on political and economic relations of power, including rights to land, leading to significant economic disparities but also calls to address these inequalities (Apple, 2014; Willow and Wylie, 2014). In particular, residents in shale plays who do not own mineral or surface rights derive fewer benefits from fracking, but are still subject to the social and environmental impacts of the industry. What results is a dynamic landscape of fracking, produced through complex relationships among various institutional actors in ways that are poorly understood but which, nevertheless, significantly shape environmental and social impacts in the country's extractive zones.

In Texas, the oil and gas industry is not just an energy-producing industry. It is deeply embedded in the cultural and historical fabric of Texas. Growth in the industry continues to be magnified as the population of the state increases and urban development continues at a consistently higher pace than much of the country. Improvements in technology, along with a favorable energy market and regulatory environment, contributed to consistently high rates of production throughout the state[2]; consequently, the negative externalities of energy production and extractive practices continue to be substantive. Such strong growth and related pressures from this growth is also evident along the border[3]. As more and more people are migrating to Texas, particularly to urban areas, there are growing concerns about environmental degradation and public health, and also concerns about detrimental changes in land use and segmentation amongst ranch and agricultural lands in the state[4].

Research on fracking has focused on strained water resources, air and water contamination, earthquakes and infrastructure implications, and pressures on local governments to provide adequate public safety, health, and welfare regulations and services (e.g. Abendroth, 2014; Apple, 2014; Davis, 2012; Finewood and Stroup, 2012; Rahm, 2011; Rawlins, 2013). More recently, the falling price of oil has led many to question the longer-term viability of the fracking industry. However, critical, nuanced examinations of the uneven distributions of benefits and risks associated with fracking are lacking.

In my research, I focus on the Texas–Mexico border oil and gas landscape, a unique geography that produces unequitable distributions of impacts and benefits from these

[2] https://www.houstonchronicle.com/local/explainer/article/Texas-population-growth-explained-7865877.php
[3] http://www.madisonvillemeteor.com/stories/new-report-shows-changes-in-texas-borderlands-over-time,31559
[4] http://txlandtrends.org/media/1018/ltchanginglandownerfinal2.pdf

extractive activities. I situate my work within interdisciplinary literature on the relationship between the exploitation of natural resources and wealth distribution while examining the

Figure 1.2. Context state map depicting Austin and Laredo, Texas.

Source: Map created by author.

inherent uniqueness of border spaces and borderlands. I seek to document the historical, institutional, and political relationships that drive control of land and resources and thus produce the characteristic uneven material and social geographies of fracking in the Texas–Mexico borderlands today; and, secondly, investigate how these political institutions work to mitigate the uneven impacts of fracking. My aim is not really to focus on how to improve a process, but more so to challenge and possibly change the way we evaluate and determine designations in a way that is more just and equitable.

In addition to documenting the uneven implications of fracking in the Texas–Mexico borderlands, my dissertation research also seeks to critically assess and improve vulnerability assessment methods so that they recognize the spatial and temporal complexities of border spaces. I conduct this critical assessment from a normative position that just planning practices need to be appropriate for specific local contexts. Planners should use a variety of tools and assessments that better capture the local context and conditions. Performing analyses such as Social Vulnerability Index (SOVI) assessments can be useful if motivated by justice-oriented practice and outcomes as they identify vulnerable areas in relation to others in the study area using socioeconomic and land use data. However, such assessments are not as nuanced, and therefore not as helpful, in areas where granular spatial data is not available. There are a variety of reasons why access to such datasets can be limited, including access to resources to generate this kind of data, but one can argue, which I do here, that such disparities in access to data and resources to conduct such analyses are indicative of deeper and substantial injustices that can be traced to the unique local political, cultural and colonial histories of the border landscape. I argue that a more just approach to identifying vulnerable communities should also include local historical context. This case in particular illuminates the roles of historical patterns of land control and ownership in producing vulnerable spaces. Furthermore, benefits of, and negative impacts from, exploitation of land for oil and gas production are linked to the control of land. Therefore, vulnerability modeling should integrate historical analyses to better understand how the evolution of the built environment impacts the social fabric of these spaces.

With this dissertation, I seek to better understand how political influence and generational accumulation of land wealth has shaped the oil and gas landscape along the Texas–Mexico border, reproducing injustices felt across not just the social fabric but also the built and natural environments. My research suggests the confluence of physical and regulatory remnants of past colonial powers in the border region continue to be visible and influence the balance and power and distribution of public resources. Furthermore, their corresponding land rights regimes, dispossession via subsequent sovereign land grants, and generational wealth accumulation and political power from fracking activities, have been significant in shaping this particular oil- and gas-producing landscape.

It is uncommon to include the history of a place, particularly history related to land rights and tenure, and the role of political power, such as the relationship between land ownership, holding political office, and utilizing the political power these offices afford, as a substantial component of risk and vulnerability analyses. Within the Texas borderlands, the distribution of wealth and political power today is still derived from land ownership, much like it was during colonial Texas (17th–19th centuries). In fact, many critical American border history and sociology scholars argue this continues well into present-day Texas (Montejano, 1987). I therefore believe the focus on tenure, and more broadly land rights, within this unique border context provides an opportunity to trace the connections and contradictions between land and mineral ownership, rights and access, and political power in the Southwestern U.S.—a space where colonial, economic, and political power dynamics and disparities are in many ways still maintained.

Ultimately, government, via rules and regulations, has the ability to mitigate unevenly distributed impacts from development; this role enables the promotion of more socially and environmentally just development. Furthermore, rules and regulations that govern protection from localized harms and the distribution of benefits should aim to curtail the perpetuation of social, economic, and environmental vulnerabilities, ultimately limiting and refocusing political control to change systems that historically have served and benefited a select few.

1. 2. Critical Interdisciplinary Research Design

In my research, I utilized a critical, multi-disciplinary framework drawing from political ecology, planning, and border studies to develop more nuanced vulnerability assessment tools. The scope of my research does not include the development of a comprehensive modeling tool or corresponding datasets for oil and gas hazards, nor is it my intent to perform a detailed impact and risk assessment that involves a broad and detailed understanding of hazard exposure, structural vulnerability, and social vulnerability. Instead, I aim to complement literature in social vulnerability by arguing and demonstrating how an historical analysis can improve our understanding of the complex and nuanced ways in which local context influences social vulnerability. This will also serve as a starting point for future lines of inquiry.

Consideration of the role of who owns what and how they obtained it in policy and planning, instead of focusing on land use (Roy, 2005), is key to understanding the reproduction of oppressive and exclusive political structures and land rights regimes along the border. The spatial and analytical lens I use to unpack these processes centers the spatial and structural ramifications of the governance and formal/informal rule-making institutions along the border. Furthermore, tracing how these spaces change over time highlights the importance of land tenure in reproducing imbalances of political power and cultural currency. Using governance geographies as a spatial and conceptual lens for analyses, I therefore demonstrate how land tenure and property ownership illuminate the important role of the gradations of informality, and by extension the state, in producing social vulnerabilities in borderlands. As one of the least regulated, pro-property rights, and pro–oil-and-gas states in the country, this study serves as an example of what happens when wealth and political power continues to fortify the structural mechanisms that, in the absence of regulatory controls and avenues for redistribution and remediation, effectively render moot a government meant to serve and protect everyone else.

I hypothesize that tenure, specifically ownership of land and minerals, in Texas influences communities' vulnerability to various hazards because of the ways in which surface and mineral rights are separated and regulated. This history of land tenure translates into a generational accumulation of wealth and political influence, which in turn creates the potential for those in power to change rules and regulations in their favor, accumulate even more wealth and power, ultimately reproducing social and environmental injustices. The overarching research question, therefore, is the following: *What is the role of tenure in effecting vulnerable communities' ability to respond to the unique environmental hazards associated with oil and gas activities?*

I organized my research in recognition of the shift in the epistemological approach necessary to fully engage with all aspects of this question. Roy's (2005) epistemology of informality, in particular planning within a state of exception, and focusing on property ownership for more just planning practice, is central to my thesis. That is to say, control of land is relevant to identify populations that are vulnerable and existing in a precarious position relative to those with full access and rights to property. Throughout the course of conducting my research and analyses, three themes emerged: (1) relationship between land ownership, political power and wealth; (2) tensions between land stewardship, resource exploitation, and land control; and (3) importance of borderlands as unique but relevant places.

1.3. CHAPTER ORGANIZATION

This dissertation has been organized into an Introduction (Chapter 1) followed by six chapters and a conclusion (eight chapters in total). Chapter 2: Oil and Gas in South Texas, and Chapter 3: Urbanization, Land Acquisition, and Tenure on the Border, trace historical and cultural aspects of the area in order to provide context for the dissertation. Chapters 4 and 5 provide my Theoretical Framework and Research Design, respectively. Situated within political–ecological approaches to human–environment research, I investigate the ways in which broader, political–economic processes and institutions shape local land-uses and local experiences.

In Chapters 6 and 7, I demonstrate how the two approaches I use in this project allow me to identify social vulnerabilities associated with risk based on land use (housing tenure) *and* ownership (land tenure). Tenure classification schemes, typically found in both planning and international development literatures, vary across formal and non-formal, regulatory and extra-regulatory, cultural, geographical, and religious contexts (Payne, 2004; see also Payne, 2001; Feder and Feeny, 1991). I use a novel, mixed method approach to examine this exemplary case study, integrating these spatial, quantitative methods with interviews and archival document analysis, and adapting Social Vulnerability spatial assessments (Cutter, 2003), commonly used in U.S. hazards planning, to include both tenure and ownership proxies. In Texas, this includes severed surface and mineral estates.

I devised governance geographies using various elements of jurisdictional governance to serve as both a conceptual and spatial lens for my case.

In Chapter 6: Identifying and Understanding Vulnerabilities, I discuss the portion of my research that focused on the assessment methods commonly used to identify vulnerable populations. In Chapter 7: Vulnerability, Precarity, and Land, and Chapter 7: Analysis: The Implications of Land Tenure Histories for Fracking Geographies, I reframe my research by shifting my approach to focus on land tenure and vulnerability. In Global South critical development scholarship, vulnerability and land tenure are usually examined in tandem, often drawing on concepts of stability and precarity in order to inform redistributive practices that counter oppressive labor markets and uneven control over the production of goods. Consideration of all of these elements of vulnerability and land together, however, has the potential to reveal other aspects of the human condition and the spaces they inhabit within the context of an extractive landscape. In these last chapters, therefore, I explore how such an analytical approach better reflects risks and benefits associated with extractivism experienced in rural and semi-rural parts of borderlands. By illuminating the degrees of informality and precarity of position for anyone who does *NOT* own mineral property (Roy, 2005; Roy, 2012), I argue this kind of mode of existence is a feature found in not only the Global South but also border spaces such as the Texas–Mexico border. I then conclude with a discussion about some of the potentials and challenges to conducting studies similar to this dissertation research in other geographic and institutional contexts, while also considering the methodological and theoretical contributions of this study to fields outside of planning and policy.

Chapter 2: Oil and Gas in South Texas

"I believe if you're anti-oil and gas, you're anti-Texas."
State Representative Harvey Hilderbran,
Republican from Central Texas
Texas Tribune Festival panel, 2013[5]

This chapter describes oil and gas exploration in Texas today, tracing its origins and various, layered cultural meanings over time. As with any finite[6] resource, external pressures influence extraction processes, resource uses and access, profits, and impacts on varied populations. I argue that the important roles of historical land development and the accumulation of wealth and political power continue to influence the increasingly disparate distributions of positive and negative impacts from resource extraction in Texas. Such unequal distributions of benefits and harms are more evident along the Texas–Mexico border due to the rich pre- and post-colonial histories of the borderlands, making this an exemplary case and study area. The complex extractive border geographies here thus allow us to reconsider and reimagine conceptualizations of impacts and of the communities they impact.

This chapter traces the evolution of technology and regulation surrounding the oil and gas landscape of Texas. The first section presents the current landscape of fracking in Central Texas and along the border. This includes the Eagle Ford Shale, a region experiencing a major boom over the last decade, which spans more than ten counties from

[5] As quoted in The Center for Public Integrity, Inside Climate News and The Weather Channel's "Bad Oil, Bad Air" report by Jim Morris, Lisa Song, and David Hasemyer (2014). Accessed online at https://eagleford.publicintegrity.org/

[6] This has been debated over the last several decades and is discussed

the South Texas border east into central southeast Texas. I then discuss academic literature from sciences and engineering, social science, planning and policy, and geopolitics on shale development and production in the U.S., setting the stage for unpacking current contexts and our understanding of how we got there. This includes a discussion of the consequences of fracking, technologies and assessments designed to help practitioners address these issues and debates, particularly vulnerabilities produced by localized impacts of oil and gas versus the relatively few and far-removed beneficiaries of the industry. Gaps in literature support my assertion that not only are the various strands of research not covering the South Texas border context, but this research and assessments methods are less helpful in understanding impacts on rural communities of color.

2.1 Geographies of Fracking in Texas

Generally, market forces, technology, and regulatory frameworks drive production and consumption of energy resources[7]. Texas, as a pro-oil and pro-gas state, has benefited from all three, yielding decades of participation in the industry and continuing supportive regulatory frameworks. Hydraulic fracturing has been developed, refined, and utilized for shale resource extraction over the last several decades, but only recently has the technology advanced enough to produce oil and shale gas at such a massive scale. The fracking process is a means through which shale formations are broken or "fractured" enough so that gas trapped within the formations are released. Water, chemicals, and sand (sometimes referred to as "frac sand") are injected into a well, creating fissures throughout the geological formation in the area. The fracked sand flushes out the gas. The remaining sand then keeps the fissure open. Once the gas is released, it flows back up the well to the surface.

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[7] https://www.eia.gov/pressroom/presentations/capuano_01242019.pdf

The Energy Information Administration's Annual Energy Outlook for 2019[8,9] states the U.S. will become a net energy exporter by 2020. This trend will continue through 2050 with increased production and a decrease in overall consumption of energy in the U.S. (2019, U.S. Energy Information Administration). Natural gas continues to have the highest growth in production in the U.S. (2019, U.S. Energy Information Administration). Current estimates from the EIA (2018) state that there are currently 39.2 billion barrels in the U.S.'s crude oil proved reserves (2018). Furthermore, the EIA states that current oil and natural gas reserves in the U.S. have doubled over the last decade[10].

Technologies that made hydraulic fracturing via horizontal wells at a massive scale economically feasible played a large role in the shale oil and gas boom between 2009 and 2014. Exploration and production dramatically increased in this period. Texas has since become a major player as one of the top producers of oil and gas[11]. For reference, Figure 2.1. Lower 48 Shale Plays (2016, U.S. Energy Information Administration) is the most recent map from the EIA containing all shale plays in the U.S. The Wolfcamp/Bone Spring shale play in the Permian Basin (Texas) has passed the Bakken/Three Forks play in the Williston Basin (North and South Dakota, Montana) to become the largest oil-producing play in 2017.

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8 https://www.eia.gov/outlooks/aeo/pdf/aeo2019.pdf
9 https://www.eia.gov/todayinenergy/detail.php?id=38112
10 https://www.eia.gov/naturalgas/crudeoilreserves/pdf/usreserves.pdf
11 https://www.eia.gov/naturalgas/crudeoilreserves/pdf/usreserves.pdf

Figure 2.1. Lower 48 Shale Plays

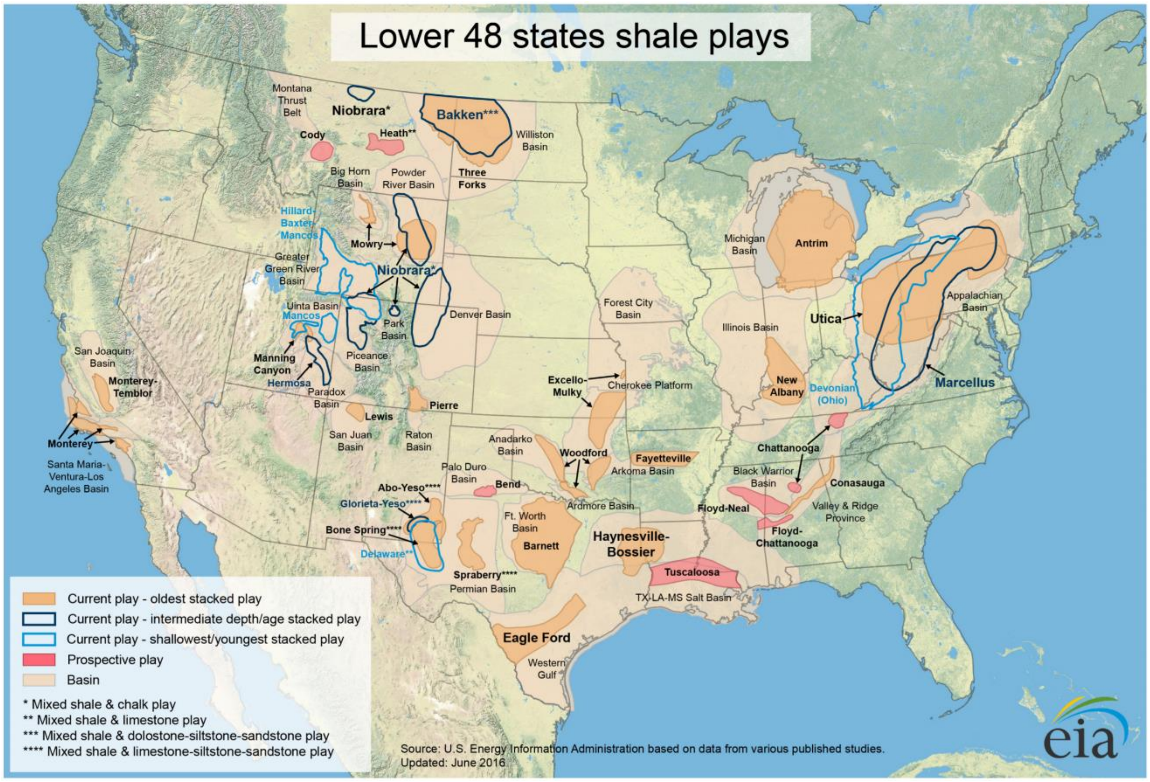


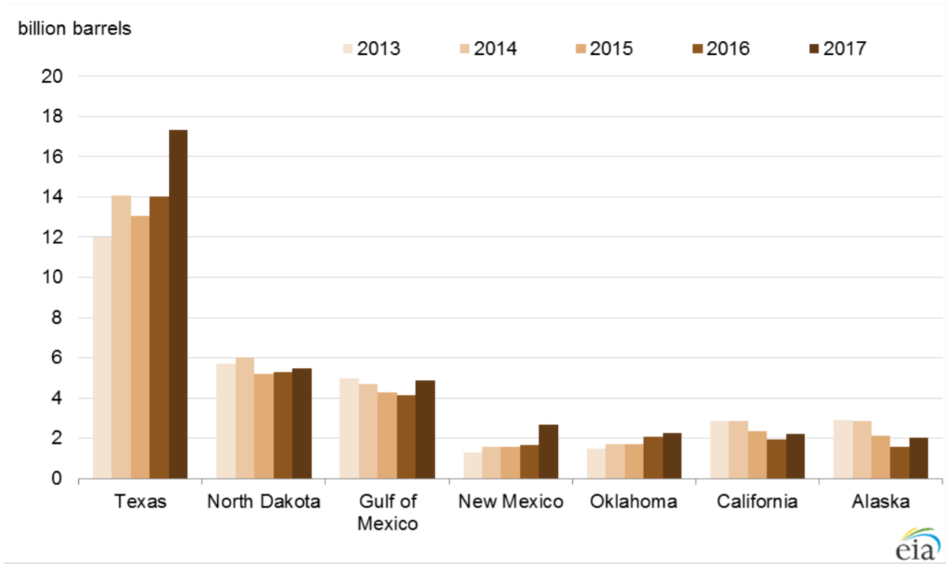
Image Source: 2016, U.S. EIA, 2016

According to the EIA, production in the Eagle Ford Shale, within which a portion of the Texas–Mexico border lies, increased exponentially from 340 barrels per day (bbl/d) to almost 1 million in 2013[12] (2014, U.S. Energy Information Administration). Natural gas production in the area increased at similar rates during this time[13] (Figure 2.2).

12 https://www.eia.gov/todayinenergy/detail.php?id=14951

13 https://www.eia.gov/todayinenergy/detail.php?id=14951

Figure 2.2. Proved Reserves of the top seven U.S. Oil Reserves States, 2013-2017



Notes: Oil reserves include crude oil and lease condensate. Gulf of Mexico represents the federally owned offshore portion of the Gulf of Mexico. Although not a state, it is an important U.S. oil and natural gas production area.

Source: U.S. Energy Information Administration, Form EIA-23L, *Annual Report of Domestic Oil and Gas Reserves*, 2013–17

Image Source: U.S. EIA, 2018.

The changes in the market favoring more production, along with major technological advances and more supportive regulatory frameworks, is best illustrated in the EIA's graph (Figure 2.3.). Most visible are major events such as the 1970s Oil Crisis, the 1980s oil and gas boom, the passage of the 2005 U.S. Energy Policy Act, and the advent of the massive hydraulic fracturing technologies that fueled the Shale Boom from about 2009–2014. These major events have shaped the Texas oil and gas landscape and are elaborated upon in the next section.

Figure 2.3. Total Wells Drilled by Type, 1949-2010

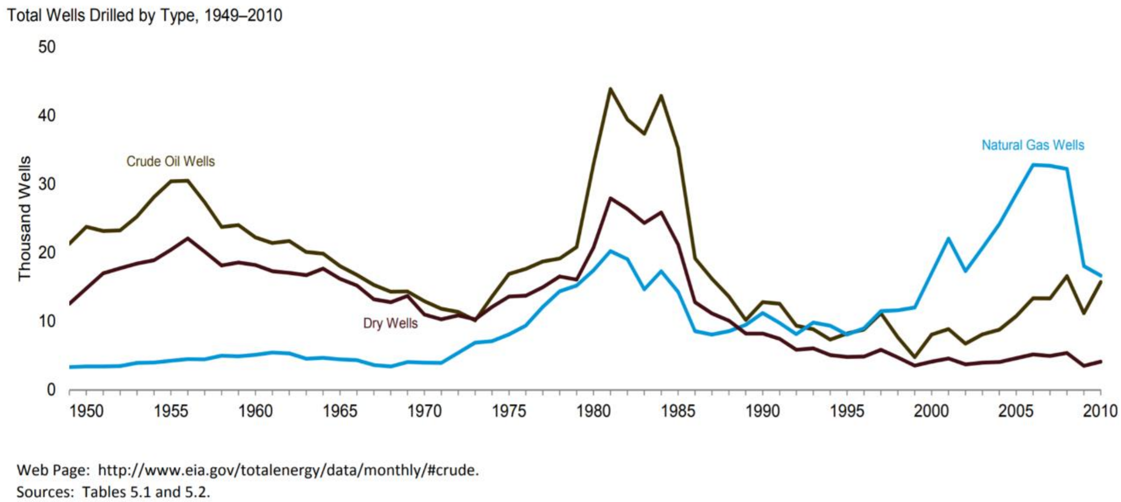


Image Source: U.S. EIA, 2019.

Oil and Gas in Texas, 1850s–1930s

Some of the earliest historical accounts of oil and gas production credit the first producing well drilled to Edwin Drake for what became Seneca Oil in Pennsylvania (King, 2012). However, knowledge of oil and related products can be traced to the De Soto expedition in 1543 and to indigenous knowledge shared with survivors of the resource's medicinal benefits undoubtedly nurtured for generations before then (Warner, 1934/2007; Ramos, 2001). Knowledge of locations of oil seepages, particularly in Nacogdoches and Pecos Counties, was shared by indigenous peoples encountered by Spanish colonizers. We know this through detailed written records of such encounters, according to updated versions of Warner's original *Texas Oil and Gas Since 1543* (1934/2007), although they do not exist within formalized historical canon. However, writings from 1790 associated with Antonio Gil y Barbo detail an oily substance derived from patches by spring in

Melrose, Nacogdoches County, and a similar patch in Pecos County, for medicinal purposes and mechanical maintenance—all of which known and shared by local indigenous peoples (Warner, 1934/2007). Eventually, knowledge of locations of oil springs and seepages in the area grew amongst white settlers, who were attracted to the resources' "beneficial and therapeutic values" (Warner, 1934/2007, p. 3). The Tejas, indigenous to the area of Sour Lake, Hardin County, knew of and similarly were drawn to Sour Lake's steady and reliable supply of its oil spring (Warner, 1934/2007). Before 1860, most known oil seepages were located in East Texas. The lure and legend, however, about this mythical substance and the wide range of properties it possessed, continued to be shared from oral histories to written accounts and literature. In 1857, Frederick Law Olmstead, who was a journalist long before his famous work as a landscape architect and designer, published a novel entitled *A Journey Through Texas*. In it, he described his encounters with oil in his journeys:

> "Near the western limit of Jefferson County is the odd natural phenomenon of a 'fountain of lemonade.' The supply is abundant, and a barrack has been built for summer visitors, who frequent the spring for the relief of every variety of disease—a cure, provided the use of the water be sufficiently reserved in, being guaranteed by the proprietor. There are, certainly, attractions in the cool shade, the gulf-breeze, the agreeable beverage, and the limpid bath, that should draw a throng were there spot made accessible. There are two springs, of cold clear, acid, slightly astringent water, boiling with the outburst of an inflammable gas, having a slight odor of sulphuretted hydrogen. The overflow forms a pond of an acre in extent, which gives to the locality its name of 'Sour Lake.' Upon the banks and bottom is a deposit of Sulphur. The approach to the rude bathing-houses is over a boggy margin, sending up a strong bituminous odor, upon poos in which rises a dense brown, transparent liquid, described as having the properties of the Persian and Italian naphthas." (Olmstead, 1857, p. 375, in *A Journey Through Texas*, as quoted in Warner, 1934/2007, p. 2-3).

In December of 1865, Lynis T. Barrett is credited as being the first to acquire an oil and gas lease and create an oil producing well in Texas, Skillern near Oil Spring in Nacogdoches County. Nacogdoches County also became the site of the first pipeline and the earliest efforts to refine oil (Ramos, 2001). The attention given to East Texas and to other seepages and springs located in north and west Texas was from local and regional individuals and entities as well as oil companies from the northeast (out of Pennsylvania) via a range of oil and gas leases. This included early explorations by Standard Oil Company. According to Warner, at that time leases granted "the right to bore, mine, or dig for Petroleum, Rock or Carbon oil…" or the "exclusive right of boring, mining and excavating for petroleum, coal, rock or carbon oil, gas or other valuable minerals or volatile substances" (Warner, 2007/1934, p. 11). The leases were usually for a term of 17 years, and royalties were usually 1/16 or 1/15, although sometimes 1/10 with all wells and equipment returning to the lessor at the end of the lease (Warner, 2007/1934, p. 11). Many leases today still follow this distribution for royalties, as evident in some of my findings from this research.

Spindletop

> **"It was California's fabled Gold Rush of 50 years earlier repeated on the Texas Gulf coast with rotary drills and derricks instead of pick axes and gold pans."**
> From the "Oil and Texas: A Cultural History" in the Texas Almanac
> by Mary Ramos, editor emerita

The last two decades of the 19th century saw the advent of the railroad, which fueled substantial growth in the Texas oil and gas industry (Ramos, 2001). The Spindletop oil field, located near Beaumont, became a site of national notoriety during an oil boom that attracted hundreds of 'wildcatters', as well as thousands of workers looking for jobs, related service supply and manufacturing firms like refineries, pipelines, and oilfield equipment manufacturers, along with speculators, gamblers and scam artists (Ramos, 2001; Prindle, 1981). Many viewed the discovery of the Spindletop oilfield as the trigger that made Texas an oil and gas giant. Coinciding with the evolution of the railroad and the development of the automobile, Spindletop is a major part of the foundational story of how Texas became *the* oil and gas state. Spindletop is credited as being the event that finally passed Pennsylvania as the top producing state[14]. At its most productive, Spindletop oilfield generated more than 17 million barrels a day, which was 94% of the state's overall production (Ramos, 2001). Oil was found in other parts of the state and, subsequently, generated a glut of oil that lowered oil prices. Eventually, the state began 'prorationing' in order to keep production under control and prices stable. In 1930, the rush to compete for lucrative leases, coupled with no well-spacing regulations or limits to production of the Daisy Bradford #3 well and the area surrounding it in Rusk County, led to severe overproduction (again). This led Texas Governor Ross Sterling to declare martial law and use the National Guard and Railroad Commission of Texas to enforce production restrictions in 1931 (Ramos, 2001).

Establishment of Texas Railroad Commission

The Texas Railroad Commission (TRRC) was first given regulatory and enforcement of railroads, wharves, and terminals when it was established in 1891 (Prindle, 1981; Texas Railroad Commission, 2017). Governor Jim Hogg was elected in 1890 and led an anti-railroad push for more government oversight of powerful railroad interests. These interests conflicted with local farmers who, influenced by a growing populist

14 https://www.rrc.state.tx.us/about-us/history/milestones/

sentiment, saw railroads as detrimental to their overall financial sustainability (Prindle, 1981). To appease both farm and railroad interests, Hogg established a Railroad Commission that would be accountable to the public via elections every six years. Initially the commission's charge was to regulate and enforce laws for rail and related transportation infrastructure, including pipelines. Then *Spindletop* was developed, and by 1920 the oil and gas industry in Texas had surpassed that of Pennsylvania. Anti-integration laws and laws favoring small local companies were repealed in 1917, which meant companies were no longer limited to only producing, transporting, or selling of oil and gas (Prindle, 1981). As part of the compromise to repeal anti-integration laws, the commission was given oversight of the transport of petroleum products. This is how pipelines became the purview of the TRRC, and how the TRRC began to be more directly involved with enforcement of oil and gas operational activities (Prindle, 1981; Texas Railroad Commission, 2017).

The Great Oil and Gas State of Texas, 1930s–1970s

Over time, the TRRC became focused exclusively on oil and gas. Prorationing became a prioritized practice enforced through "yardstick schedules," intended to calculate maximum output allowed per well dependent on proximity to and overall distribution of wells (Prindle, 1981, p. 42). Throughout World War II and up to the 1950s, the TRRC refined their prorationing schedules to better match estimated maximum yields with market demand. A highly political process, allocation and spacing of wells became contentious, pitting large combined producers against small local producers and landowners. Major companies lost favor with some TRRC commissioners since they ultimately spread wealth outside of Texas, contradicting the interests of state and local politics.

Rule 37 is the name of one of the main spacing and allocation rules for the state. Exemptions to these allocation and spacing schedules were more often granted to local, "homegrown" producers and independent companies (Prindle, 1981, p. 48). Royalty interests would leave the state, and the majority of workers at the large major companies were comprised of non-Texans. Large landholders, however, did not benefit so much from these allocation and spacing schedules. Ultimately, by 1946, the Texas Court of Civil Appeals sided with small landowners, explicitly "[stating] that the interests of the small landowner were to be protected, whatever the costs to the major companies and the rest of the country" (Prindle, 1981, p. 54), thus institutionalizing allocation and spacing rules set by the TRRC.

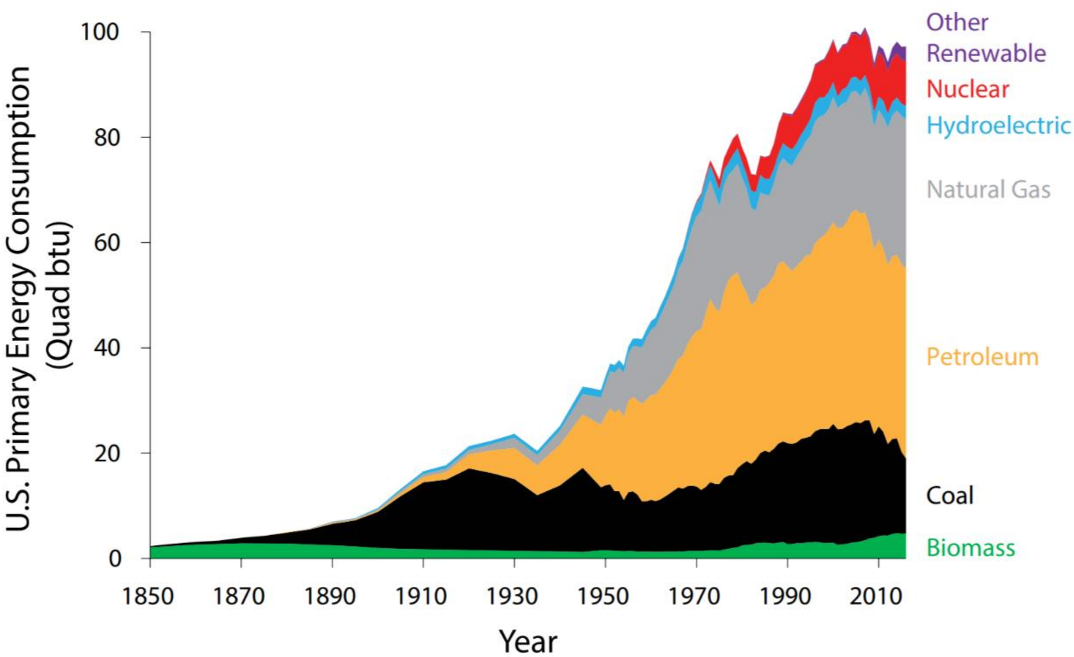
Surviving Decades of Oil Crises to the Shale Boom

The 1950s and 1960s were characterized by steady increases in profitability and overall prosperity in the Texas border region. Part of this was due to increased production of both oil and gas, Texas gaining control of offshore production in 1953, and the ability for intrastate pipelines connect to interstate pipelines as a part of the Natural Gas Act in 1978 (Prindle, 1981; Texas Railroad Commission, 2019). However, a vast majority of reserve surpluses in the state were depleted, which led Texas to lose its position as a top producer in the country. Furthermore, it also exposed problematic estimations of reserves in the gas industry. Nationwide, production peaked around 1960, which led to steady reliance on non-U.S. sources of oil and gas. In 1973, conflict in the Middle East and over-production led to the Organization of the Petroleum Exporting Countries (OPEC) establishing an oil embargo; prices increased dramatically and Texas was no longer able to help sustain national energy needs. This was compounded by the recession in the 1980s, but eventually oil and gas made a comeback with increased domestic consumption of energy resources, well-timed technological innovations, and changes in the regulatory landscape in favor of the industry.

Massive-scaled Hydraulic Fracturing and Horizontal Drilling

Following the recovery from the recession of the 1980s, fuel consumption continued to increase in the U.S. At the same time, awareness of environmental injustices from hazardous, industrial processes became much more mainstream (see Figure 2.4. Sources of Energy Used in the United States, 1850–2016). However, the adoption of the U.S. Energy Act of 2005 facilitated a dramatic increase in opportunities for oil and gas producers to scale up their domestic activities.

Figure 2.4. Sources of Energy Used in the United States, 1850-201615



Sources of energy used in the United States, 1850-2016. "Other Renewable" includes solar, wind, and geothermal energy. Image credit: American Geosciences Institute. Data source: Energy Information Administration.[4,5]

AGI Critical Issues Program: www.americangeosciences.org/critical-issues 1 – 1 Petroleum and the Environment, Part 1/24
Supported by the AAPG Foundation. © 2018 American Geosciences Institute Written by E. Allison and B. Mandler for AGI, 2018

[15] https://www.americangeosciences.org/sites/default/files/AGI_PetroleumEnvironment_web.pdf

One of the goals of the government's shift in approach was to ultimately be energy independent from Middle Eastern energy resources by further developing and producing oil and gas in the U.S. From about 2006 to 2009, technologies vastly improved and were implemented in typically cost-prohibitive shale deposits at a much larger scale than before. The economic recession beginning in 2008 was but a blip on the steady trajectory toward this goal.

The historical context presented above is provided to ground the following section on research, technologies, and the current conditions for oil and gas exploration, production, and transport of the generated products. I argue this is important to better illuminate the complexities of extractivism in the U.S., which vary spatially, temporally, and culturally. Furthermore, this facilitates an epistemological shift and recognition of other aspects of the landscape can contribute to a more nuanced examination and understanding these places.

2.2. CURRENT SHALE OIL AND GAS TECHNOLOGIES AND RESEARCH

This section of the chapter delves into current oil and gas exploration, production, and transport of the oil and natural gas from reservoirs such as those in Texas. More than one-fourth of the nation's top reserves are located in Texas, with Texas's oil production peaking in 2017 at 1.27 billion barrels, the highest since its peak in 1972[16,17]. Between 2009-2014, one of the largest shale oil and gas producers in the U.S. was the Eagle Ford Shale in South Texas. Since then, production in the Permian Basin has been one of the highest-producing natural gas fields in the country. The Permian Basin's high production

16 https://www.eia.gov/state/analysis.php?sid=TX
17 https://www.eia.gov/state/analysis.php?sid=TX#32

levels are credited with tipping the scale toward the goal of making the U.S. a net exporter of petroleum[18].

The first horizontal wells, variations of slanted wells, were built in the 1930s, with fracturing becoming more commonplace after the late 1940s (Prindle, 1981; King, 2012). Non-vertical wells and hydraulic fracturing have been used to access previously inaccessible and cost-prohibitive through conventional means. These processes are, however, more expensive and therefore are only used when it is economically feasible to do so. The cost of oil, or more specifically the cost of one barrel of crude oil, is a gauge through which decisions on balancing costs of drilling and selling versus profits are determined. However, over time these technologies have evolved, with technologies and processes becoming more time and resource efficient. What follows is a quick primer on the various elements of oil and gas exploration, production, processing, refining, transportation, and use. This will be addressed by answering the following questions: (1) What determines the location of a well? (2) How is land used? (3) What are the methods of transport of oil, gas, and refined products?

What determines the location of a well?

Geology, leasing, permitting, technology, economics, and the environment all influence the determination of well locations[19] (Allison and Mandler, 2019). Oil and gas is a product of decaying organic matter, time, sedimentation, pressure, and temperature. Once the injected materials reached a certain depth, anywhere from 5,000 to 30,000 feet, gas and oil separate, where they eventually rise to the surface, become stuck between impermeable rocks, or remain trapped where they formed (i.e. shale deposits)[20]. Such differentiation

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[18] https://www.eia.gov/tools/faqs/faq.php?id=727&t=6
[19] https://www.americangeosciences.org/sites/default/files/AGI_PetroleumEnvironment_web.pdf
[20] https://www.americangeosciences.org/sites/default/files/AGI_PetroleumEnvironment_web.pdf

therefore gives us what we see today: fields of different depths and reservoirs of varying sizes all in geographically diverse places (that were once underwater, or still are under water). Advances in technology in the last couple of decades have enabled operators to locate with more precision and limit the footprint of their well pads.

Once an optimal location is identified, the next task is to obtain permission from the landowner. In states where mineral rights are severed from surface rights, a hierarchy of rules and regulations determined mostly at the state level determine which types of 'estates' (legal term for property; in this case the estate can be split into mineral or surface estates) can be used to do what. If you want to explore and produce oil and gas, but you do not own the mineral rights to it, you must obtain a lease from the owner to do so. Private individual(s), local, state, or federal governments can be owners of minerals and/or surface rights in the area an operator wishes to explore, and these owners will determine where wells will be sited.

In Texas, generally speaking, mineral rights holders have the most power and can overrule a surface rights owner if there is a conflict over the site, or conflict over access to the site or to water. There is a complex hierarchy of property rights that influence rights to use and access of other owner's rights that effect such negotiations, but typically mineral owners will negotiate a percentage of their property's royalties to the surface rights owners. Texas is subject to *Rule of Capture*[21], which essentially means owners of a property can draw as much of the mineral as possible despite the impact on neighboring mineral rights owners' ability to draw from the same deposit. The early days of the Texas Railroad Commission dealt with this problem and eventually instituted a range of rules regarding well spacing and pro-rationing schedules. A more modern strategy used to more equitably

[21] Doctrine of Correlative Rights, stemming from English common law

deal with such conflicts is what is called *pooling* of mineral rights. Such pooling essentially gives a group of neighboring minority owners a larger say in what larger operators can draw from a reservoir (Prindle, 1981). Those pooled interests also share costs and revenues. With the advent of slanted, and, more recently, horizontal drilling, some owners may be forced (*forced pooling*) by another mineral rights holder to access well pads or water necessary for a well, even if a pooled interest holder may not have any producing wells on their property[22]. Forced pooling is evident when reviewing lists of owners of mineral interests or operator interests in efforts to determine who owns what.

The next step in well placement is obtaining a permit from the appropriate government entity. For Texas, this is the Texas Railroad Commission. If the permit is for a well on federal land, then the federal government has to issue and approve a permit. Some municipalities also have the ability to issue permits, but this varies from state to state. Generally, permits give permission to drill the well, or have access to the well pad, assuming requirements are met regarding proximity to sensitive sites, land uses, well spacing, and setbacks[23] (Allison and Mandler, 2019). Some municipalities also require public input before making the decision to issue the permit.

As mentioned previously in this chapter, improved technology increased production across the country, including during the shale boom from 2008–2014. Improvements were made not just on the equipment or tools used, but also in improving processes at every stage of exploration and production, starting with wells.

Wells are the highly complex and well-engineered structures constructed to extract oil and gas and bring it to the surface[24]. A well-designed well should not only withstand

[22] https://www.americangeosciences.org/sites/default/files/AGI_PetroleumEnvironment_web.pdf
[23] https://www.americangeosciences.org/sites/default/files/AGI_PetroleumEnvironment_web.pdf
[24] Per the EIA Energy Monthly Review for June 2019: "Crude Oil and Natural Gas Exploratory and Development Wells. Three well types are considered in the Monthly Energy Review (MER) drilling

and control "any fluid, any reservoir, and any hydraulic pressure, it should last much longer than it will take to produce the oil and gas" (King, 2012, p. 35). Wells are also designed to "protect the surrounding nonhydrocarbon zones, including freshwater aquifers; protect the well from formation problems external to the well, such as corrosive gas or saltwater; and protect the well from the forces of Earth movement" (ibid). Figure 2.5. Typical Well Design illustrates both a generic exploration and production well. The most impactful of innovations was the change from vertical to horizontal over the last 50 years.

statistics: "completed for crude oil," "completed for natural gas," and "dry hole." Wells that productively encounter both crude oil and natural gas are categorized as "completed for crude oil." Both development wells and exploratory wells (new field wildcats, new pool tests, and extension tests) are included in the statistics. All other classes of wells drilled in connection with the search for producible hydrocarbons are excluded" (https://www.eia.gov/totalenergy/data/monthly/pdf/sec5.pdf) for this chapter I follow this as guide when discussing "wells".

Figure 2.5. Typical Well Design

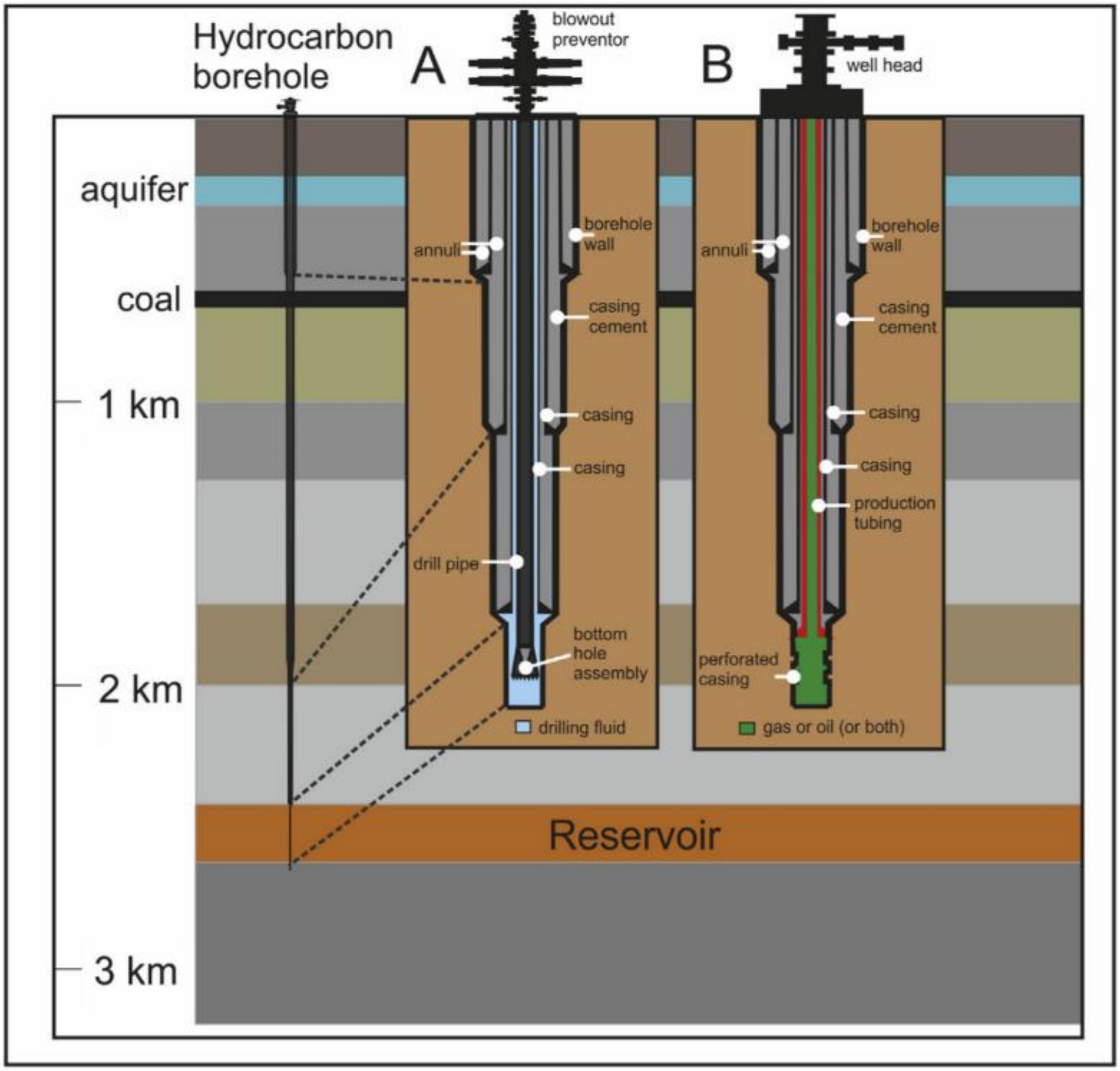

Image source: R.J. Davies et al. (2014) Schematic diagram of typical well design showing (A) structure of an exploration well; and (B) a production well. Depths to which difference casings are vary according to geology and pressure regime of drill site. Well diameter exaggerated to show sections more clearly.

One of the major recent innovations has been the development of non-vertical wells in combination with hydraulic fracturing. This made previously inaccessible shale deposits available for exploration and production, particularly for natural gas.

Improvements in technology used during the drilling and fracking process led to enhanced oil recovery techniques that required disposal in wells far from the original producing well[25]. In hydraulic fracturing, large amounts of water are blasted into fracture rock (shale) to create a space for previously inaccessible oil and gas to flow. Environmental concerns have not only been raised about fracking's use of massive amounts of water, but also about the flaring of excess methane, as well as the storage of produced water in wells farther from the original producing well[26]. This produced water is a point of concern because newer fracked wells use water that has additives that include proprietary, therefore unknown and possibly hazardous, chemical cocktails that are meant to improve the fracking process (Rahm, 2011). The latter is also described as wastewater injection wells. Open air pits are also used for disposal and pose similar risks such as actual harm to flora or fauna that comes into contact with it[27]. There are also concerns with air pollutant and irritant exposure and contamination. Other waste products from the fracking process, such as wastewater and produced frack fluids, also need to be either reinjected or transported to another location for storage and, in some cases, reuse. Regulation of transport and disposal of waste products from fracking and other production processes are discussed later in this chapter.

Shale deposits also yield combination gas and crude, and crude oil. Once the product is out of the ground, it has to be transported to the next step in the production chain. This usually means the product is then transported to a refinery that will process the various derivatives crude oil to make products like ethanol and gasoline. For the U.S., Texas is the

[25] https://www.americangeosciences.org/sites/default/files/AGI_PetroleumEnvironment_web.pdf
[26] https://www.americangeosciences.org/sites/default/files/AGI_PetroleumEnvironment_web.pdf
[27] https://www.americangeosciences.org/sites/default/files/AGI_PetroleumEnvironment_web.pdf

top refiner of crude oil. The Gulf Coast has the highest concentration of refineries, particularly the area around Port Arthur[28].

How is Land Used?

Land is necessary for the well pad, access for transport of personnel and equipment, and disposal of any waste products that can not otherwise be eliminated (like methane flares). For conventional exploration and production, this means that properties directly above the reservoir are going to be needed for extraction. Conflicts arise as ownership of the land deviate from ownership of the mineral estate. Agricultural land uses clash with industrial land uses—which is essentially what a well site is. Industrial land uses are the closest description that planners will recognize, and planners have long known the risks and challenges of such a land use designation. Proximity to residential and other sites where there may be sensitive populations may be directly impacted by oil and gas exploration and production. Horizontal wells have eliminated some of these concerns since well pads do not need to be directly above the reservoir anymore. However, other indirect and also increasingly problematic risks remain. There are still risks from contamination of neighboring water sources along any specific location along the well itself from wells, such as a blown-out well casing. Concerns about the surface risks are still present, and new challenges such as earthquakes are become more frequent, requiring further research.

What are the Methods of Transport of Oil, Gas, and Refined Products?

There are several modes of transport used for oil and gas production: road, rail, water freight, and pipe. More than half of all waterborne freight in the U.S. is comprised

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[28] https://www.eia.gov/state/analysis.php?sid=TX

of coal, petroleum, and petroleum-based products[29]. Around 90% of all crude and refined products, as well as almost all natural gas, are transported via pipeline[30]. The Texas Railroad Commission is in charge of the enforcement of state regulations that govern permitting and reporting. The Railroad Commission also is in charge of monitoring workplace safety for those working with pipelines, as well as enforcement of rules for transporting hazardous materials, including transport of liquefied natural gas (Texas Railroad Commission, 2017)[31]. Safety and rate regulation of intrastate pipelines is enforced by the TRRC. However, generally speaking, pipeline operators do not have to obtain permission to condemn property to build intra- or interstate pipelines via eminent domain. This is a private land rights issue governed by state statute. Permitting for interstate pipelines is administered by the US Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), not the Railroad Commission (Texas Railroad Commission, n.d.)[32].

Empirical Research on Fracking

Studying unconventional shale oil and gas requires empirical data that is wide-ranging in scope, content, and availability. There tends to be, for instance, more data in urban areas than rural areas. Some plays have been researched much more extensively than others, particularly U.S. and Canadian shale plays. There has also been substantial

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[29] http://nationalwaterwaysfoundation.org/documents/Final%20TTI%20Report%202001-2014%20Approved.pdf
[30] https://www.americangeosciences.org/sites/default/files/AGI_PetroleumEnvironment_web.pdf
[31] https://www.rrc.state.tx.us/pipeline-safety/rules/
[32] https://www.rrc.state.tx.us/about-us/resource-center/faqs/pipeline-safety-faqs/faq-pipeline-eminent-domain-and-condemnation/

scholarship over the last ten years on the intersections of technology and policy for unconventional natural resource development.

Practice-oriented shale development research utilizes many methods, but those most commonly used by planning professionals (planners, engineers, policy makers, etc.) are spatial analysis (proximity), life cycle assessments, environmental impact analyses, cumulative impacts, and return on investments. For this chapter, when I discuss practice-oriented research I am generally referring to the actual 'doing' of shale development and policy, planning practices, and interventions in the field.

Issues of concern and debate in the technology and science domains of fracking revolve around cost and time efficiency, safety, and other localized impacts of oil and gas activities. Increased efficiency with fewer time and material costs has driven science and technology for decades. Along with increased efficiencies came more focus on safety of safety for the workers and, more gradually as mandated by law, safety of local communities effected by oil and gas production. Technical aspects, as discussed in science, technology, and engineering scholarship, include improving drilling methods, the developing and refining new extraction processes, and improving methods and tech used in geosciences (Li, Jovanovic, Klimek, and Guo, 2015). Issues like well integrity and well barrier failure are of extreme importance and are the subject of a sizeable amount of engineering literature (Davies et al., 2014; Li, Jovanovic, Klimek, and Guo, 2015). Safety and public health issues are also discussed. Many of these issues stem from failures and leaks from these failures, such as fugitive gases, waste water leaks, possible explosions, and air and contaminate water emissions.

Much of the industry-oriented research on fracking has also focused on measuring and mitigating impacts. Variations of economic costs-and-benefits assessments have long been used to support the viability of oil and gas within a market-oriented context. Private companies, as well as the public entities that research and regulate them, see such assessments as vital to getting a multi-scalar understanding within the geopolitical context. In a broad literature synthesis of such costs and benefits, Mason et al. (2015) argue that positive impacts include lower consumer prices and local and regional effects like increased income from taxes. Positive externalities include lower energy costs for consumers, lower greenhouse gas-related emissions related to burning of fossil fuels (coal, oil) for energy generation, and potential stabilization of vulnerabilities associated with imported energy sources (Mason et al., 2015). Costs include direct market disruptions on other energy sources, and negative externalities include environmental contamination including air and water resources, habitat fragmentation, local boomtown influx of amenities, and public health concerns or property value loss via aggregate measures of such damages (2015).

There are a variety of economic models that aim to predict such impacts, and policy and regulatory development, private market choice, and public perceptions are usually highly influenced by them (Mason, et al., 2015). Specificity and development of more 'accurate' assumptions of these models is something to be desired for many, even as the complexity of the models and input datasets increases (Christopherson and Rightor, 2012). However, these large-scale input/output and economic impact models tend to ignore local realities on the ground (ibid). These models are ultimately a snapshot in time in terms of the data inputs, and creating predictive models from this data can be problematic due to characteristics unique to a specific location and situation (Christopherson and Rightor, 2012). However, perceptions of the value of such economic models continue to influence various officials and other decision makers.

Over the last few years, critical interest in shale development and production has also grown in the planning and the social sciences. Political economies and ecologies of extractive industries, especially their localized contexts and broader relationship to global geopolitical and structural relationships, have been studied in many social science fields. Arguments for and against natural resource extraction such as mining in developing contexts have highlighted how local communities can be negatively impacted but also benefit from extractive industries (Bebbington et al., 2008; see also Bebbington, 2012; Fraser, 2006; Nash, 1979/1993; Auty, 1993; Ross, 2008; Sachs and Warner, 1995; Bridge 2004a, 2004b, 2008, 2009; Wilson, 2004; Graulau, 2008).

Similar scholarship has examined the impacts of U.S. mining and other extractive industries. Early research focused on mineral extraction, while more recent work has examined auxiliary activities related to shale oil and gas hydraulic fracturing processes like the mining of silica products for 'frac' sand, a heavily used sand particle-sized materials in the fracturing process (such as Diller, 2012; Deller et al., 2012; Peaarson, 2013). There is also critical social science scholarship on other aspects of mining such as gender, labor, indigeneity and citizenship, and broader neoliberal geopolitical analyses (for example Smith, 2006, 2010a, 2010b, 2013; Himly, 2010; Kirsch, 2014). Some scholars focusing on oil and gas draw on anthropological methods (see for example Behrends, Reyna and Schlee, 2011); others deploy political–economic perspectives (see for example; Bridge, 2011; Huber, 2013; McNeish and Logan, 2012; Rodgers, 2012; Sawyer, 2004; and Shever, 2012); while others draw on concepts of neoliberal environments from Heynen (2003; see also Heynen et al., 2006). There is a growing body of research that also utilizes political ecological approaches to unconventional shale oil and gas research (see Abendroth, 2014; Apple, 2014; Finewood and Stroup, 2012; Mercer et al., 2014; Perry 2013, 2012a, 2012b; Willow, 2014; Willow and Wylie, 2014; Simonelli, 2014).

Another growing body of literature stems from anthropological studies that utilize qualitative methods like ethnography to better understand community impacts, especially changes to the social fabric and landscape from drilling. Scholars such as de Rijke (2013a, 2013b) and Perry (2013; 2012a; 2012b) use ethnographic methods to blend activist and academic social science research by pursuing collaborative research agendas that further enrich ethnographic data (Willow and Wylie, 2014). Some of these scholars, such as Mercer, de Rijke and Dreeler (2014), and others (Simonelli, 2014; Willow, 2014), view their research as a means of "constructing critical analyses and narratives that question the current state of affairs" (Willow and Wylie, 2014). Others have developed similar tools and strategies that "break down the structural barriers that too often separate not only industry/government and citizens, but also citizens and academics" (Willow and Wylie, 2014; see also Poole and Hudgins 2014; Wylie and Albright 2014).

As a response to the extensive exploitation of shale resources, heavily developed producing areas are utilizing environmental and citizen knowledge to develop responses to shale oil and gas activities. Fortun describes this as "informed environmentalism," in which a multitude of actors come together in what are sometimes called 'bucket brigades.' They create and share data such as online mapping and databases containing useful information like, if available, fracking chemicals (2004 in Willow and Wylie, 2014; see also Fortun, 2011; Wylie, 2011; Martinez-Alier et al., 2014; Penningroth et al., 2013; Steinzor et al., 2013). There is a growing body of literature emerging from the Marcellus Shale in Pennsylvania that considers the role of public knowledge and discourse in educating citizens and empowering them to develop their own responses to the environmental impacts of drilling activities (Willow and Wylie, 2014; see also Kinchy, 2013; Kinchy and Perry, 2012). More recent iterations of this research include explorations of the role of political discourse, framing, and public opinion in relation to fracking policy (see for example Bayer and Ovodenko, 2019).

Consequences of Fracking

Perhaps the most informative summation of risks and potentials of unconventional shale gas hydraulic fracturing is a review of over 100 studies by Benjamin Sovacool (2014). I have listed them in Table 2.1. Reviewing the Costs and Benefits of Shale Gas Fracking below.

Table 2.1. Reviewing the Costs and Benefits of Shale Gas Fracking

Pros	Cons

• Abundance of supply
• Lower natural gas prices
• Cleaner environmental footprint
• Economic development
	• Technological sophistication
	• Environmental degradation
	    ○ Pollution and public health
	    ○ Climate change
	    ○ Displacement and social opposition
	• Earthquakes and seismicity
	• Unclear profitability

(Sovacool, 2014)

This section further parses the potential and actual consequences of unconventional oil and gas production and development, focusing on Texas and its border communities when possible.

When viewed across scales of impact, the failures in various systems meant to distribute negative impacts and externalities associated with fracking become increasingly clear. Generally speaking, an abundance of supply of natural gas translates to lower energy prices associated with natural gas, which then translates to favorable economic development impacts (Sovacool, 2014). Furthermore, recent booms in production, in combination with a more favorable regulatory environment, have allowed the U.S. to become a net producer, which means that we are less reliant on external sources for energy. Many also argue for the 'clean' burning potential of natural gas compared to coal, but this continues to be actively debated within the context of climate change (Sovacool, 2014). However, when examining the entire well development process (see for example air emissions as result of fracking, Table 2.2. Air Pollution According to Each Well Development Stage and Scales), it is apparent that each element, across scales, of these processes have negative consequences in addition to potential positive impacts.

Table 2.2. Air Pollution According to Each Well Development Stage and Scales[33], [34]

	Local							Regional		Global	
	Particulate Matter (PM)		Volatile Organic Compounds (VOCs)							Greenhouse Gases	
Emissions Source	Diesel PM	PM10	BTEX	PAH (incl. Naphthalene, Chlorobenzene, Phenol)	Other (incl. Formaldehyde, Ethylene glycol, Methanol)	H2S	Respirable Silica	VOCs	NOx	CH4	CO2
Well site preparation (landscape clearing, soil movement, pipelines and other infrastructure)	X	X	X	X					X		X
Well drilling, hydraulic fracturing and well completion (drill rig, drilling muds and cuttings, fracturing fluid mixing, water trucks, pumps, generators, flowback	X	X	X	X	X	X	X	X	X	X	X
Well production (produced water, gas flaring/ venting, well maintenance work)	X	X	X	X	X	X		X	X	X	X
Processing and storage (gas venting, glycol dehydrators, separators, condensate tanks, compressors)	X	X	X	X	X						
Transmission (compressors, gas venting, pipelines, tanker trucks	X	X	X	X	X						
Well Abandonment and **Site Rehabilitation**	X	X	X	X					X	X	X

Some of the more apparent negative consequences include faulty or misused technologies to environmental degradation, seismic activity, displacement and social opposition, and variation in costs and expectation of benefits in a market that is inherently influences by internal and external forces (Sovacool, 2014). More of the negative impacts described here

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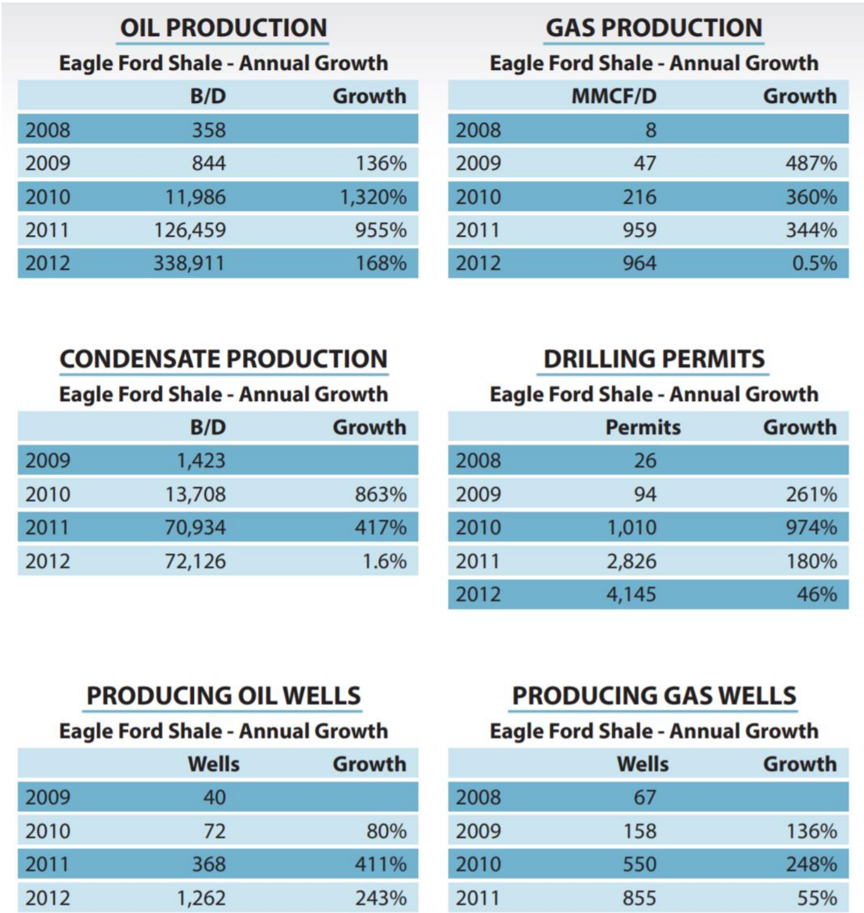
[33]Original Table from *Fracking Fumes: Air Pollution from Hydraulic Fracturing Threatens Public Health and Communities*, p. 9, NRDC Issue Brief; Original Table Sources: Adgate, J., Goldstein, B., and McKenzie, L. 2014. "Potential Public Health Hazards, Exposures and Health Effects from Unconventional Natural Gas Development." Environmental Science & Technology, doi: 10.1021/es404621d. Moore, Christopher W. et al. 2014. "Air Impacts of Increased Natural Gas Acquisition, Processing, and Use: A Critical Review." Environmental Science & Technology, 11. doi:dx.doi.org/10.1021/es4053472.

[34] Table Key: BTEX: benzene, toluene, ethylbenzene, xylene; CH4: methane; CO2: carbon dioxide; diesel PM: diesel particulate matter; H2S: hydrogen sulfide; NOx: nitrogen oxides; O3: ozone; PAH: polycyclic aromatic hydrocarbons; PM10: particulate matter of 10 micrometers or smaller in diameter.

are dependent on proximity, meaning that these impacts are more prominently experienced at the local and regional scales.

In Texas, the Eagle Ford Shale boom (2009 to about 2014) peaked around 2010 (see Figure 2.6. Eagle Ford Shale Annual Growth 2009-2012). The growth during this boom was substantial both in terms of economic infusion from tax revenue leading to significant economic growth, and in terms of rapid changes in the built environment.

Figure 2.6. Eagle Ford Shale Annual Growth 2009-2012[35]



OIL PRODUCTION

Eagle Ford Shale - Annual Growth

	B/D	Growth
2008	358	
2009	844	136%
2010	11,986	1,320%
2011	126,459	955%
2012	338,911	168%

GAS PRODUCTION

Eagle Ford Shale - Annual Growth

	MMCF/D	Growth
2008	8	
2009	47	487%
2010	216	360%
2011	959	344%
2012	964	0.5%

CONDENSATE PRODUCTION

Eagle Ford Shale - Annual Growth

	B/D	Growth
2009	1,423	
2010	13,708	863%
2011	70,934	417%
2012	72,126	1.6%

DRILLING PERMITS

Eagle Ford Shale - Annual Growth

	Permits	Growth
2008	26	
2009	94	261%
2010	1,010	974%
2011	2,826	180%
2012	4,145	46%

PRODUCING OIL WELLS

Eagle Ford Shale - Annual Growth

	Wells	Growth
2009	40	
2010	72	80%
2011	368	411%
2012	1,262	243%

PRODUCING GAS WELLS

Eagle Ford Shale - Annual Growth

	Wells	Growth
2008	67	
2009	158	136%
2010	550	248%
2011	855	55%

Image Source: Texas Railroad Commission, 2013.

[35] The data I used for my spatial analyses are from 2013-2014 (**Chapter 6 and 7**)

Much of the rapid growth necessitated action at the local and county jurisdictional levels in order to develop adequate infrastructure to sustain and support this growth. Many of the subsequent consequences have influenced the evolution of rules and regulation as well as governance approaches unique to oil and gas states like Texas. These are further discussed in the next section.

2.3. FRACKING POLICIES AND GOVERNANCE IN TEXAS

There are different geographies at which various regulatory regimes exist and operate. Federal government institutions involved in some way with the fracking industry are the Department of Energy, Energy Information Administration, Department of the Interior, Environmental Protection Agency, the U.S. Geological Survey, Department of Agriculture, and the Department of Defense. State government institutions in Texas include the Texas Railroad Commission and Texas Commission of Environmental Quality, while local institutions include county governments and local municipally owned utilities. Other stakeholders and actors include the energy industry, finance, auto, aviation, manufacturing industries, labor unions, and environmental and social justice advocacy groups.

Key federal legislation regulating the oil and gas industry include the 2005 Energy Policy Act, which authorized many tax cuts and credits, including $2.8 billion for fossil fuel production. This pivotal and still controversial piece of legislation has been credited with beginning this current shale boom by exempting many fracking practices from federal regulation and even providing subsidies for fossil fuel production (Webber, 2014). See Table 2.3. for Major Legislation of relevance for the fracking industry.

Table. 2.3. Major Federal Legislation

Clean Air Act (1970)
Energy Policy and Conservation Act (1975)
• Extends oil price controls into 1979
• Mandates automobile fuel economy standards,
• Authorizes creation of a strategic petroleum reserve (SPR)
Department of Energy Organization Act (1977)
Power plant and Industrial Fuel Use Act (FUA) (1978)
• Prohibited the use of natural gas in power plants
• Led to the creation of 80 GW of coal plants
Clean Air Act Amendments (CAA1990)
Energy Policy Act of 1992 (EPACT 1992)
Energy Policy Act of 2005 (EPACT 2005)
Energy Independence and Security Act of 2007 (EISA 2007)
Energy Improvement and Extension Act of 2008 (EIEA 2008)
• Creates agencies, authorizes federal expenditures
• Allocation of $$ is better than authorization

(Table Source: Webber, 2014)

However, the Trump administration has made several rule changes that challenge or essentially nullify existing regulations meant to impose restrictions on energy-related policies and projects in order to protect people and the environment. As of June 2019, the *New York Times*, drawing from databases from Columbia Law School and Harvard Law School, has tallied more than 83 environmental rules the administration has severely limited or eliminated[36].

For context, the following table contains all of the laws, rules, and regulations that influence land and resource management and protections, and at what geographic scale these are implemented.

[36] https://www.nytimes.com/interactive/2019/climate/trump-environment-rollbacks.html

Table 2.4. U.S. Land and Environmental Resources and Protection Rules and Regulations Across Geographic Scale

GEOGRAPHY	AGENCY / GOVERNING BODY	GUIDING RULES/REGULATIONS	ACTIONS / POLICE POWERS / RIGHTS HIERARCHY
LAND + ENVIRONMENTAL RESOURCES AND PROTECTION: INFORMS AND SUPERCEEDS STATE LAW			
Federal	Environmental Protection Agency Department of Agriculture Department of the Interior Federal Emergency Management Agency Department of Housing and Development	• Clean Air Act • Clean Water Act • Coastal Zone Management Act • Comprehensive Environmental Response Compensation, and Liability Act (CERCLA) • Rivers and Harbors Act • Endangered Species Act • Federal Land Policy and Management Act • Mineral Policy Act • National Environmental Policy Act • National Forest Management Act • Safe Drinking Water Act • Solid Waste Disposal Act • Water Pollution Control Act	• Rulemaking, Enforcement, Permitting: Depending on which law, state agencies are typically charged with executing them Conflicts related to Rights/Use: These contain various exemptions for oil and gas activities* • Clean Water Act • Clean Air Act • Emergency Planning and Community Right-To-Know Act • Resource Conservations and Recovery Act • National Environmental Policy Act • Safe Drinking Water Act
OIL AND GAS OPERATIONS			
State	Texas Railroad Commission (TRRC) [1]	• Texas Administrative Code (TAC), Statewide Rule 1 (Organization Report; Retention of Records; Notice Requirements) • Texas Administrative Code (TAC), Statewide Rule 14 (Wells - Plugging) • Texas Administrative Code (TAC), Statewide Rule 15 (Inactive Wells and Surface Equipment Requirements) • Texas Administrative Code (TAC), Statewide Rule 78 (Fees, Performance Bonds and Alternate Forms of Financial Security Required To Be Filed) • Texas Administrative Code (TAC), Statewide Rule 58 (Certificate of Compliance and Transportation Authority; Operator Reports)	• Permits: W1 Drilling Permits [2] with broad requirements for well spacing and maximum withdrawals • Complaints/Enforcement: Spills associated with the exploration, development, and production of O&G including suspected contaminated private wells. Generally those in non-compliance may be issued a financial penalty or, in rare cases, criminal prosecution. • Conflicts related to rights/use: Oil and gas estate/rights trumps other property use conflicts • County and general law cities can only affirmatively 'do' what state law explicitly allows the jurisdictions to do; SB 40 (2015) banned Home Rule cities from unilaterally prohibiting oil and gas exploration and production activities at the municipal/local level, even by referendum
ENVIRONMENTAL PROTECTION: AIR			
State	Texas Railroad Commission (TRRC)[3]	• Title 30 Texas Administrative Code (TAC), Chapter 116, Subchapter B Memorandum of Understanding (MOU) between the	• Monitoring, Reporting, Compliance: During drilling, air complaints should be filed with TRRC • Conflicts related to rights/use: Typically applied based on specific criteria based on oil and gas facility type, substances used/produced in site processes, and/or cumulative county thresholds met. Federal statues must

Table 2.4. U.S. Land and Environmental Resources and Protection Rules and Regulations Across Geographic Scale (continued)

GEOGRAPHY	AGENCY / GOVERNING BODY	GUIDING RULES/REGULATIONS	ACTIONS / POLICE POWERS / RIGHTS HIERARCHY
	---	RRC and TCEQ provides explanation of the agencies' jurisdictions over various O&G activities *Title 16 Texas Administrative Code (TAC) §3.30*	be applied (which inform the state requirements, processes, etc.) at the state level and supersede state rules and regulations. ---

	Texas Commission on Environmental Quality (TCEQ)	---
		• Title 30 Texas Administrative Code (TAC), Chapter 116, Subchapter B
		
		Additional Control of Air Pollution[4]:
		• *Visible Emissions and Particulate Matter* (30 TAC Chapter 111)
		• *Sulfur Compounds* (30 TAC Chapter 112)
		  • *Sulfur Compounds* (30 TAC Chapter 112)
		  • *Volatile Organic Compound (VOC) Sources* (30 TAC Chapter 115)
		  • *Nitrogen Compounds* (NO_x).(30 TAC Chapter 117)
		  • Emissions Inventory
		  • National Emission Standards for Hazardous Air Pollutants (40 CFR Part 63 - National Emission Standards for Hazardous Air Pollutants for Source Categories).
		  • *New Source Performance Standards* (40 CFR Part 60 – Standards of Performance for New Stationary Sources).
		  • *Air Operating Permits* (Title V Federal Air Operating Permits / 30 TAC 116, Subchapter B.
			• Air permits: De Minimis, Permits by Rule (PBR), Standard Permit, New Source Review, Title V Operating Permits
			
			• Complaints/Enforcement: Members of the community can register complaints directly with TCEQ, i.e. Make an Environmental Complaint, Report a Smoking Vehicle, Report a Spill, Complaints about an On-Site Sewage Facility, all with access to online or Toll-free Numbers for Reporting Generally those in non-compliance may be issued a financial penalty or, in rare cases, criminal prosecution.
			
			• Conflicts related to rights/use: Typically applied based on specific criteria based on oil and gas facility type, substances used/produced in site processes, and/or cumulative county thresholds met. Federal statues must be applied (which inform the state requirements, processes, etc.) at the state level and supersede state rules and regulations.

ENVIRONMENTAL PROTECTION: WATER			
State	Texas Commission on Environmental Quality (TCEQ)	• Texas Water Code §36.117: The delegation for discharges of produced water, hydrostatic test water, and gas plant effluent into surface water in the state resulting from certain oil and gas activities • Texas Water Code, Chapter 11: Surface water rights Memorandum of Understanding (MOU) between the RRC and TCEQ provides explanation of the agencies' jurisdictions over various O&G activities *Title 16 Texas Administrative Code (TAC) §3.30*	• Permitting: Anyone that withdraws surface waters for mining, construction, and oil or gas activities must obtain a water rights permit from TCEQ. • Compliance and Reporting: Concerns related to public drinking water supply should be reported to TCEQ • Conflicts related to rights/use: Typically applied based on specific criteria based on oil and gas facility type, substances used/produced in site processes, and/or cumulative county thresholds met. Federal statues must be applied (which inform the state requirements, processes, etc.) at the state level and supersede state rules and regulations.
	---	---	---
	Texas Railroad Commission (TRRC)	• §91.101, Texas Natural Resources Code, 16 TAC §3.5, 3.13 and 3.14, Texas Administrative Code: Injection Water Supply Wells that Penetrate the Base of Usable Quality Water	• Permitting: an injection water source well that penetrates the base of usable quality water (and casing, plugging in accordance with RRC regs).

Table 2.4. U.S. Land and Environmental Resources and Protection Rules and Regulations Across Geographic Scale (continued)

GEOGRAPHY	AGENCY / GOVERNING BODY	GUIDING RULES/REGULATIONS	ACTIONS / POLICE POWERS / RIGHTS HIERARCHY
	Texas Department of Licensing and Regulation (TDLR)	• Rig Supply Wells that DO Not Penetrate the Base of Usable Quality Water (§1901.151, 1901.254, 1901.255, and 1901.256, Texas Occupations Code) • Rig Supply Wells that Penetrate the Base of Usable Quality Water (Chapter 28 Texas Water Code, Texas Occupations Code §1901.254) • Injection Water Supply Wells that Do Not Penetrate the Base of Usable Quality Water (§1901.151, 1901.251, 1901.253, 1901.254, 1901.255, and 1901.256, Texas Occupations Code)	• Licensing, monitoring, and compliance of rig supply water wells; plug abandoned wells • Standards for compliance, violation, reporting of wells that harm water, vegetation, land, or other waters • Licensing and reporting, plugging (with GCD power to enforce; TRRC and TCEQ notification) for injection wells
	---	---	---
Regional	Groundwater Conservation District (GCD)[5]	• Rig Supply Wells that DO Not Penetrate the Base of Usable Quality Water (Texas Water Code §36.117) • Injection Water Supply Wells that Do Not Penetrate the Base of Usable Quality Water (Texas Water Code §36.117)	• Permitting: GCD can permit, monitor, enforcement for injection water wells, including water wells used to supply water for activities related to the exploration or production of hydrocarbons or minerals • Spacing of water injection wells from property lines or adjoining wells • Density • Production • Completion (casing according to RRC regulations); and • Plugging (according to RRC regulations) • Permitting, monitoring, compliance for rig water supply wells re installation of casing, pipe, and fittings to prevent the escape of groundwater from a groundwater reservoir to any reservoir not containing groundwater and to prevent the pollution or harmful alteration of the character of the water in any groundwater reservoir
ENVIRONMENTAL PROTECTION: OTHER			
State	Texas Commission on Environmental Quality	• Memorandum of Understanding (MOU) between the RRC and TCEQ provides explanation of the agencies' jurisdictions over various O&G activities *Title 16 Texas Administrative Code (TAC) §3.30* • Environmental complaints and enforcement (water, air, odor and dust) under jurisdiction of TCEQ (2a Texas Water Code Chp. 7)	• Enforcement, Reporting, Compliance: Nuisance odors and dust complaints are reported to and investigated by TCEQ • Conflicts related to rights/use: Typically applied based on specific criteria based on oil and gas facility type, substances used/produced in site processes, and/or cumulative county thresholds met. Federal statues must be applied (which inform the state requirements, processes, etc.) at the state level and supersede state rules and regulations.
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County[6] / Municipality	County / Municipal (Code enforcement)	• Noise complaints go to local (municipal, county) law enforcement (*7 Chapter 217a Texas Local Government Code*, amongst others)	• Enforcement, Reporting, Compliance: Nuisance noise complaints are investigated by local law enforcement
LAND USE CONTROLS / PLANNING			

Table 2.4. U.S. Land and Environmental Resources and Protection Rules and Regulations Across Geographic Scale (continued)

GEOGRAPHY	AGENCY / GOVERNING BODY	GUIDING RULES/REGULATIONS	ACTIONS / POLICE POWERS / RIGHTS HIERARCHY
State	General Land Office / Water Development Board	Floodplain Management	Flood Insurance Maps
County[6]	County Planning Commission or Advisory Board / Code Enforcement	• Commission Rule 16 Texas Administrative Code §3.76, also Texas Local Government Code 232, and similar to Model Subdivisions TWDB 31 TAC Part 10 Chp 364, and Water Code chapter 16 and 17,) which essentially allows for: • Electricity hookups • Transportation ROW buffers • Access to adequate water/waste water infrastructure • Flood Management / Mitigation	• Setbacks: Counties have authority to operate in the same way that General Law / Dillon's Rule cities can in Texas, meaning they can only do what the state expressly grants them to do as codified in the TAC. • Subdivision Review: In large (population) counties, owner/developer can limit spacing of drill sites of at least two acres for every 80 acres in the subdivision; in other counties adjacent to these for counties a developer of the property may obtain Commission approval of subdivision plan with well spacing limits • Some "County Zoning Authority." These zoning powers generally extend 5,000 feet beyond the feature in question, or otherwise cover an area in which potential impacts of development around the feature was sufficient to convince the legislature that enhanced land use control was necessary to protect the feature
---	---	---	---
Municipality		• Zoning and Land Use Planning: *Home rule* municipalities have explicit authority to (7 Texas Administrative Code 211.012) to zoning, comprehensive planning, enforcement, and impose penalties. • Land use controls - setbacks: Texas Municipal Code, Section 253.005(c), setback of 200 feet from a residence**	• Setbacks: For a well within city limits, a city may enact ordinances regarding the proximity to dwellings or other structures. In addition: "A well may not be drilled in the thickly settled part of the municipality or within 200 feet of a private residence."
PIPELINES			
State	Texas Railroad Commission	• Pipelines: U.S. Code of Federal Regulations (CFR), Title 49 "Transportation", Parts 190 - 199. The Office of Pipeline Safety (OPS), in U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA), "has overall regulatory responsibility for hazardous liquid and gas pipelines under its jurisdiction in the United States" [7] • Enforcement and inspections carried out by the TRRC; see for pipeline safety Texas Administrative Code, Title 16, See Chapters 8 & 18	• Inspections and enforcement of pipeline safety regulations for ***intrastate*** gas and hazardous liquid pipeline operators in Texas (*no permits required)* • Pipeline carriers have, generally, right to eminent domain for the construction of intrastate pipelines[8].
WASTE MANAGEMENT			
State	Texas Railroad Commission	• Memorandum of Understanding (MOU) between the	• Permits/Enforcement – Discharge, Reclamation Plant, Commercial Surface Waste Facilities, Disposal of Oil and Gas NORM (Naturally

Table 2.4. U.S. Land and Environmental Resources and Protection Rules and Regulations Across Geographic Scale (continued)

GEOGRAPHY	AGENCY / GOVERNING BODY	GUIDING RULES/REGULATIONS	ACTIONS / POLICE POWERS / RIGHTS HIERARCHY
		RRC and TCEQ provides explanation of the agencies' jurisdictions over various O&G activities *Title 16 Texas Administrative Code (TAC) §3.30* • Waste Disposal associated with oil and gas resources. Texas Adminstrative Code, Section 3.30, and 30 TAC 330.3 (148)(P)/Rule 8.	Occurring Radioactive Materials), Rule 8 minor permits, Waste Separation Facilities • Hazardous and non-hazardous wastes associated with the exploration, development, production, transportation, processing of O&G • Injection wells to dispose of O&G wastes • Naturally Occurring Radioactive Material waste from O&G activities (Oil and Gas NORM) • Wastes from transportation by pipeline and storage of crude oil (including tank bottoms) before it enters a refinery and prior to use in the manufacturing process or residential/industrial use • Wastes such as vacuum truck rinsate and tank rinsate generated at facilities operated by oil and gas waste haulers permitted by the RRC
	---	---	---
	Texas Commission on Environmental Quality	• Waste Disposal associated with oil and gas resources. Texas Adminstrative Code, Section 3.30, and 30 TAC 330.3,148(P)/Rule 8.	• Waste associated with transportation of crude oil and natural gas by railcar, truck, barge, or oil tanker and refined petroleum products by pipeline • Wastes generated at oil field service facilities that provide equipment, materials, or services to the O&G industry • Wastes from O&G activities that are processed, treated, or disposed of at a solid waste management facility authorized by the TCEQ • Residential-like waste generated from the living quarters located on the lease.
---	---	---	---
County	County Commissioners Court	30 Texas Administrative Code Section 330.61 *Chapters 363 and 364 of the Texas Health and Safety Code*	• Some areas may get a designation to form a MSW district if allowed by TCEQ/state (but not Webb County), and can designate what kinds of waste goes where (Webb County does this). The designation of areas where solid waste facilities are not prohibited should not be interpreted as a finding that siting a solid waste facility in such an area is appropriate, recommended or otherwise compatible with surrounding land uses pursuant to 30 Texas Administrative Code Section 330.61.
---	---	---	
Municipality (Home Rule/General Law)	City Solid Waste Services / Planning Commission	• Zoning and Land Use Planning: *Home rule* municipalities have explicit authority to (7 Texas Administrative Code 211.012) to zoning, comprehensive planning, enforcement, and impose penalties (can include hazardous/industrial site location)	

Table 2.4. U.S. Land and Environmental Resources and Protection Rules and Regulations Across Geographic Scale (continued)

NOTES:

[1] Texas Railroad Commission has primary regulatory jurisdiction over the oil and natural gas industry, pipeline transporters, natural gas and hazardous liquid pipeline industry, natural gas utilities, the LP-gas industry, and coal and uranium surface mining operations

[2] The lessee has the right to conduct the activities set out above and otherwise reasonably use the surface without getting permission from the surface owner and without restoring the surface or paying for any non-negligent damages it causes. However, if a lessee's use of the surface is found to be negligent, unreasonable, or excessive, the lessee may be liable to pay damages to the surface owner for the resulting injury (Texas Railroad Commission, n.d.).

[3] State permitting authority for these discharges into water sources will transfer from the RRC to TCEQ upon NPDES delegation (beginning 2020).

[4] Texas Commission on Environmental Quality, *Oil and Gas Facilities: Air Compliance Information Air compliance tools for oil and gas facilities in Texas*, accessed online at https://www.tceq.texas.gov/assistance/industry/oil-and-gas/oilgas_air.html

[5] Jurisdiction of GCD applies to water wells, including water wells used to supply water for activities related to the exploration or production of hydrocarbons or minerals. Jurisdiction does not extend to production or injection wells drilled for oil and gas, or for core tests, or for injection of gas, saltwater, or other fluids, under permits issued by the RRC.

[6] Counties has authority to operate in the same way that General Law / Dillon's Rule cities can in Texas, meaning they can only do what the state expressly grants them to do as codified in the TAC. For more information, CAPCOG has a great article delineating and translating what this means for planning at the county level: https://www.capcog.org/wp-content/uploads/2009/11/2009-10-14-County-Land-Use-Report-final.pdf

[7] Regulatory Fact Sheet: Texas, Pipeline Safety Stakeholder Communications. US Department of Transportation, accessed online at https://primis.phmsa.dot.gov/comm/FactSheets/States/TX_State_PL_Safety_Regulatory_Fact_Sheet.htm?nocache=7368

[8] TRRC FAQs on Pipeline safety and eminent domain and condemnation, accessed online at https://rrc.state.tx.us/about-us/resource-center/faqs/pipeline-safety-faqs/faq-pipeline-eminent-domain-and-condemnation/

* Many of these exemptions were made possible or enforced by the *2005 National Energy Act;*

** Prior to 2015, SB 40, municipalities had the leeway to determine their own setbacks for wells. In Denton, the setback prior to 2014 was over 1000 feet which made it practically impossible for wells to exist within the city limits.

Ultimately, oil and gas politics and policies are influenced by market concerns, political discourse, national security concerns and environmental impacts. Prevention, mitigation, and penalties are designed to dampen or eliminate negative impacts via these environmental rules described above. As Holahan and Arnold state, "policymakers understand the crucial differences between conventional oil and gas plays and [unconventional] shale plays, and the drilling technologies applied to each of them. They should be better equipped to craft fracking regulatory policies that internalize problematic externalities" (2013, p. 127). However, with an uneven regulatory environment for unconventional shale oil and gas across the U.S., in combination with better technological advancements and supportive markets, "boom and busts" have become more prominent across newer shale plays. Predictions of the amount of production from shale oil and gas have traditionally been far off from actual numbers (Boersma and Johnson, 2012). The key difference between the boom-and-bust cycles in newer nonconventional shale plays and other conventional oil and gas plays is that these improved technologies have expanded the potential for expansion (and collapse) of reservoirs and increase in production. The impacts have the potential to far surpass and exponentially reach across larger geographic areas and broader swaths of populations than in previous boom-and-bust cycles. Communities, governments, and private citizens alike, from newer plays are not necessarily equipped to deal with the extreme boom and bust cycles that we have seen more recently.

Many communities have voiced concerns about the environmental impacts of fracking in Texas, including the toxic air emissions from oil production and methane flaring, groundwater contamination, and the massive amounts of water required to produce the oil and gas (e.g. Nicot and Scanlon, 2012; Scanlon, Reedy, and Nicot, 2014; Rawlins, 2013). The current political environment, however, has impeded any regulatory or enforcement measures that can better address some of these concerns. In addition to these impacts, there are concerns about observed and potential land disturbances from drilling pad activities, fumes and noise from additional truck traffic, light pollution from night-time operations, and dust from the sand hoppers which facilitate the addition of frack sand and

Figure 2.7. Central US Earthquakes, 1973-2018, U.S. Geological Survey.

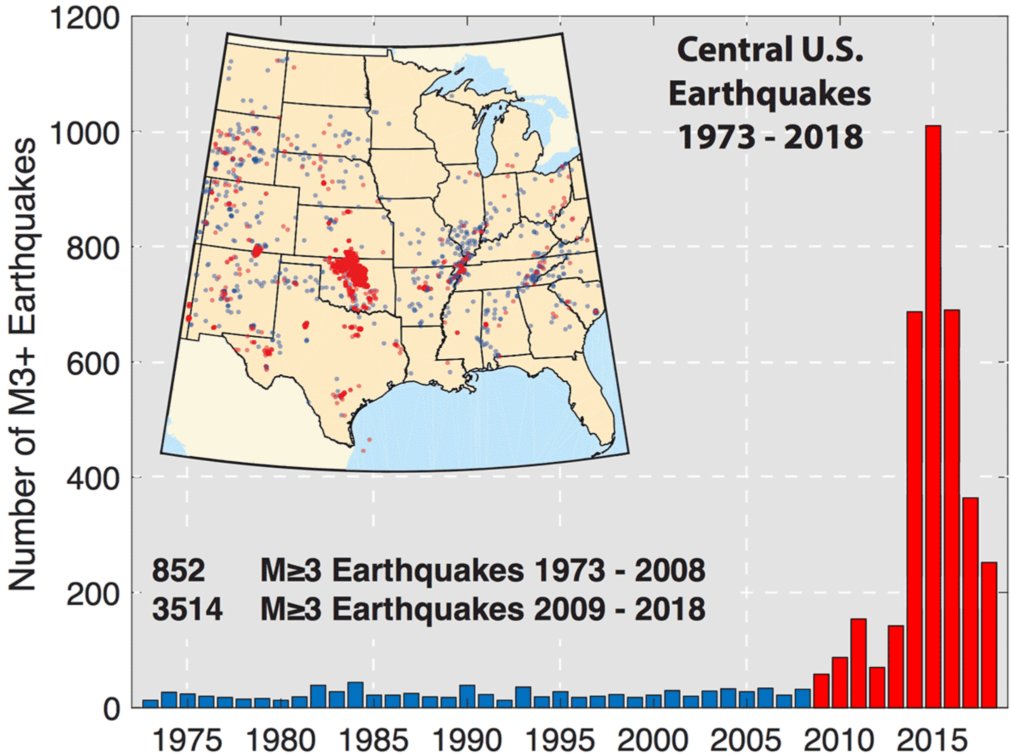

Figure 2.7. Central US Earthquakes, 1973–2018 visually depicts the correlation between place, time and frequency of these quakes to the shale boom beginning around 2009; many studies have since also determined that these activities caused these quakes[37].

fluid additives at the site level into the production and disposal wells38. More recently, engineering studies have found correlations between high producing areas and seismic activity. The U.S. Geological Survey has detected a significant increase in the frequency and intensity of earthquakes in the same geographic areas as the actively producing

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[37] https://earthquake.usgs.gov/research/induced/overview.php

[38] https://www.epa.gov/hw/management-oil-and-gas-exploration-and-production-waste#2019Review

portions of shale plays in the country. In the last few years, more and more empirical research has correlated these earthquakes to fracking activities[39].

In Texas, the state legislature appropriated funds to support research by University of Texas at Austin, Southern Methodist University, and Texas A&M University in 2015[40]. The results of that study, published in 2017, are being used to inform and develop models that can determine seismic causality, generate publicly available data, and a monitoring program. It is important to note that natural gas produces much lower emissions than those from oil and coal: 30%−40% lower for CO2, 80% for NO, and ∼100% for SO2, particulates, and mercury (Nicot and Scanlon, 2012). Perhaps the most significant risk is possible contamination of nearby wells and local groundwater, especially given limited availability and competing demand for water resources in the area (Nicot and Scanlon, 2012; Scanlon, Reedy, and Nicot, 2014). However, newer shale plays such as the Eagle Ford have received less attention from researchers and thus warrant increased scrutiny. The U.S. Environmental Protection Agency (EPA) is currently (2011–present) conducting a large-scale study of the environmental impacts of hydraulic fracturing, which include:

> - Stress on surface water and ground water supplies from the withdrawal of large volumes of water used in drilling and hydraulic fracturing;
> - Contamination of underground sources of drinking water and surface waters resulting from spills, faulty well construction, or by other means;
> - Adverse impacts from discharges into surface waters or from disposal into underground injection wells; and
> - Air pollution resulting from the release of volatile organic compounds, hazardous air pollutants, and greenhouse gases.
>
> (Environmental Protection Agency (EPA), 2013a)

[39] https://www.americangeosciences.org/sites/default/files/AGI_PetroleumEnvironment_web.pdf
[40] http://www.beg.utexas.edu/files/texnet/docs/TexNet-Report-2016.pdf

Impacts on local drinking water fall under the U.S. Safe Drinking Water Act's Underground Injection Control Program (UIC), which governs the regulation of the construction, operation, permitting, and closure of injection wells that place fluids underground for storage or disposal (EPA, 2013b). However, the 2005 Energy Policy Act exempted most hydraulic fracturing from regulatory oversight under the UIC program. Aside from banning outright unconventional shale oil and gas development, some states have also started requiring chemical reporting of fracking fluids and wastewater.

However, many of the hazardous incidents reported could have perhaps been minimized with better regulation of a key source of the problem: human error. As Boersma and Johnson state in their analysis of U.S. fracking regulations, "more broadly speaking, human error, such as bad cementing of wells, chemical spills at the surface, or improper disposal of waste water all can have serious environmental effects" (2012, p. 573). One can argue that better public policies at multiple scales can address many of these issues.

In Texas, management of well leases and related permits and infrastructure fall under the purview of the State of Texas Rail Road Commission. Mineral rights (or "estates") in the state have traditionally been separate from "surface estates" (or rights) (TRRC, n. d.). These estates came to be held by one individual or divided and owned by separate individuals through a legal process known as "severance". Mineral rights have priority over surface rights. This means that an owner of a mineral right can utilize the surface for exploration, development, and production of oil and gas below the surface. The operator, or the company that is 'leasing' the mineral right and operating its exploration, has the right, with few exceptions, to do the following:

- Conduct seismic tests
- Drill wells at locations they select
- Enter and exit well sites and other facilities,

- Build, maintain, and use roads for access to and from the well sites and facilities
- Build and use pipelines to serve wells and facilities on the property
- Use surface and subsurface water on the leased premises for drilling and production operations
- Drill and operate injection wells to enhance lease recovery
- Dispose of lease-produced water

(TRRC, n.d.)

Limitations or exceptions may include specific modifications to requirements for the mineral lease, municipal ordinances, and the requirement of lessees to reasonably accommodate existing surface use (TRRC, n.d.). This means that those who own mineral rights can—and have throughout the Eagle Ford Shale—explore, develop, and produce oil and shale gas with little concern about the implications for the environment on the surface or for the conditions of groundwater reservoirs. However, Texas is still in the position to change the trajectory of its regulatory framework to allow for greater local autonomy in shaping their communities safely.

The exemption of hydraulic fracturing processes to water quality and conservation measures is reflected in relatively lax reporting and permitting processes, including in Texas where well-related water withdrawals are regulated by the State of Texas Commission for Environmental Quality (TCEQ) while the Railroad Commission of Texas is responsible for permitting for ground water wells for active oil and gas exploration (Texas Water Code §36.002, n.d.). In Texas, surface water is deemed a public good, which means TCEQ operates a permitting process for surface water withdrawals for various 'reasonable' uses. These reasonable uses are ranked in order of priority, starting with municipal uses, then agriculture, and then mining processes (Texas Water Code §11.024. Appropriation: Preferences, n.d.). Complicating the intricate political and regulatory framework of water access and use in Texas is the current drought, which has been described as one of the worst on record (Heim, 2013). The impacts of this drought have been felt statewide, affecting both surface and groundwater sources. The Eagle Ford Shale stretches across multiple watersheds and thus can amplify the localized effects of various drilling processes like hydraulic fracturing.

Shale oil production in South Texas increased from 340 barrels/day in January 2009 to 1 million barrels per day in June 2013, with similar growth in natural gas production rates during the same period (E.I.A. 2014 [41]. In South Texas, over 6,000 wells were permitted as of September 2014 in the 26 counties located within the Eagle Ford Shale play, including in colonias in seven border counties.[42] According to an economic development assessment conducted by the University of Texas at San Antonio (UTSA), drilling-related activities in the Eagle Ford Shale had generated more than $87M in output, employed over 150,000, and generated almost $2.5M in local and state revenues (Center for Community and Business Research, 2014). From 2010–2014, the EFS region gained 320 new RV parks / man camps amounting to about 7,600 individual housing units within these worker camps (ibid). However, there is no standard data collection methodology across counties, and not all camps are even reported to county governments (ibid). The UTSA has recently secured grant money from U.S. Housing and Urban Development to comprehensively document these camps via a housing study in three specific counties.[43]

Media has reported numerous incidents stemming from the intense fracking activity in Texas, including failures in transportation infrastructure, water contamination, increased traffic fatalities, toxic air emissions, and other oil and gas production related surface events. Implicit in much of this reporting is the fear that these negative environmental impacts will be ignored by state authorities, which has led to a certain fatalism on the part of residents,

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[41] Energy Information Administration. (2014, February) "Eagle Ford production increasingly targets oil-rich areas", accessed online from http://www.eia.gov/todayinenergy/detail.cfm?id=14951

[42] http://www.rrc.state.tx.us/media/24075/eaglefordshaleplay2014-09-lg.jpg

[43] https://www.utsa.edu/today/2015/04/hudaward.html

as reported in a recent eight-month study conducted by the Center for Public Integrity in collaboration with *InsideClimate News* and *The Weather Channel*.[44] Partly as a result of this skepticism about the possibility of state intervention, residents in this area have been reluctant to voice their concerns to planners and policy-makers. This has resulted in a curious phenomenon, whereby residents who are apparently subject to severe environmental injustice fail to organize in order to press their claims[45]. However, since this 2014 report, there has been a growing focus on the border area of Eagle Ford Shale. The impacts discussed above in Texas shale plays are further amplified in more socioeconomically vulnerable communities along the border within and surround the Eagle Ford Shale.

Much of the Eagle Ford Shale is a rural and semi-rural ranching and agricultural landscape which has undergone dramatic changes over the last 15 years in large part because of unconventional oil and gas development (TAMEST, 2017). To get a sense of the full physical and spatial expanse of the thousands of wells and network of pipelines and transportation routes, and related activities, imagine a well site (or a *well pad* with multiple wells such as the one in Figure 2.8) where in its lifespan there will be multiple fractures over several stages for the well(s), going tens of thousands of feet into the ground vertically, then horizontally (1-2 miles) during the hydraulic fracturing process itself. Some well pads can be as large as 1 to 2 football fields long. Once the well is fully drilled and production begins, the landscape changes as surface is remediated, but what remains are typically wellheads, pumps, a small production facility, storage tanks, and/or pipelines (TAMEST, 2017, p.40-41).

[44] https://insideclimatenews.org/content/fracking-eagle-ford-shale-big-oil-bad-air-texas-praire

[45] https://insideclimatenews.org/content/fracking-eagle-ford-shale-big-oil-bad-air-texas-praire (based off of data on environmental claims/reports made to Texas Commission on Environmental Quality.

Figure 2.8. Yantis Well Pad in the Eagle Ford Shale[46]

Some communities may be more susceptible to the drastic swings of the booms and busts of fracking and associated industries, especially those along the US-Mexico border in the Eagle Ford Shale. In *colonia* communities, where residents earn on average half as much as non-colonia residents in Texas[47], with a median family income of less than $30,000 a year compared to over $50,000 a year, residents benefited from the new jobs, rising income and wealth associated with the rapid oilfield development leading up to the 2015 decline in oil prices (Federal Reserve Bank of Dallas, 2015, p. 12)[48]. And as with other areas that struggle to secure access to basic infrastructure and clear ownership of their property, colonias were impacted by the negative externalities of fracking and the slump in crude prices in 2015. The next chapter, "Urbanization, Land Acquisition, and Tenure

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[46] Image by Yantis Company, n.d., from Texas Academy of Medicine, Engineering and Science of Texas (TAMEST), (2017), *Environmental and Community Impacts of Shale Development in Texas* accessed online on March 2020, https://tamest.org/wp-content/uploads/2017/07/Final-Shale-Task-Force-Report.pdf
[47] Federal Reserve Bank of Dallas, 2015, *Las Colonias in the 21st Century: Progress Along the Texas-Mexico Border*. Accessed online tahttps://www.dallasfed.org/~/media/documents/cd/pubs/lascolonias.pdf
[48] Ibid.

on the Border", as well as my analysis and concluding chapters, will discuss the nuanced context for and implications of disparate impacts in these communities in more detail.

2.4. Conclusion

Texas is an oil and gas state. For more than a century, Texas oil and gas has been central to providing energy to not just the state, but the country and the rest of the world. This chapter aimed to provide historical and political context to some of the technical aspects of oil and gas exploration and production in the state. I first provided an overview of the evolution of conventional hydraulic fracturing and horizontal drilling technologies into a massively scaled industrial efforts in Texas. Technological improvements and favorable policies over time sustained profitability for decades in a state with substantial oil and gas reserves, and infrastructure to process and get these products to the market. Furthermore, a more favorable state and federal regulatory environment and market conditions fueled, at least in part, the latest shale oil and gas "boom" beginning around 2008.

However, this burgeoning oil and gas industry also led to disparate distributions of impacts over time. The extractive landscape of the border only further highlights such the spatial, temporal, and cultural complexities. The private property rights ethos of the state has resulted in a landscape that is similar to other unconventional shale fields in rural and semi-rural communities, but also different because of the historical and spatial complexities of these border communities. And in this particular case, a regulatory framework and planning tools that can mitigate negative harms are not readily available or are non-existent. This further illuminates the subsequent effects of extractivism, politics, and disparities in wealth and power. In order to develop a more nuanced understanding of the uneven impacts of fracking in these border spaces, it is necessary to consider the histories of land and property ownership and tenure in this area.

Chapter 3: Urbanization, Land Acquisition, and Tenure on the Border

The borderlands in South Texas are serving as not just the context to this study, but also as important to fully understanding the complexities of vulnerability. An example of such complexities is the map from 1835 of Texas, Mexico, and the U.S (Figure 3.1.).

Figure 3.1. New Map of Texas: With the Contiguous American & Mexican States, 1835

Map Source: Created by S. Augustus Mitchell, 1835; Library of Congress Geography and Map Division Washington, D.C.; Accessed online: http://hdl.loc.gov/loc.gmd/g4030.ct002350

Aside from being a snapshot in time, this map also details the process by which land was divided and given as grants to certain individuals and not others.

> "LAND GRANTS: The divisions represented on the Map in Texas, and denominated Grants, are tracts of country granted by the Legislature of Cohahuila[49] & Texas, to persons of influence and respectability styled Empresarios or Undertakers, who engage to settle or locate on their Grants within the time specified thereby, the required number of settlers."
>
> (Mitchell, 1835)

Considering the vast acreage of land given to each grantee, these "persons of influence and respectability styled Empresarios" were given substantial power to give away, sell, and/or lease land in any ways they see fit. Today, substantial wealth and power in Texas is derived from the land, whether it be from ranching, farming, and/or the production of oil and gas. What happened back then is just one snapshot into how wealth and power was bestowed, maintained, and accumulated. In this chapter, I trace how land rights, tenure, and ownership have evolved within the uneven class society (Montejano, 1987) in the Southwestern U.S. in order to assess how control over land shapes benefits and risks associated research extraction.

First I'll contextualize the relationship between land and the people who use and inhabit in in the United States. As a reminder, for the purposes of this research, I define land tenure as "the mode by which land is held or owned, or the set of relationships among people concerning land or its product" (Payne, 2001, p. 416). This entails critically conceptualizing land as an active component in crucial social and economic processes. I then delve into how this has changed over time given the layers of approaches to using the

[49] The correct spelling from this time is the same as it is today: Coahuila. This map has it misspelled. Coahuila has also been spelled Coaguila by a Spanish map maker which phonetically is the same in Spanish. See for example "Mapa de la Sierra Gorda y Costa del Seno Mexicano desde la Cuidad de Queretaro" by José de Escandón, c. 1747, Accessed online from the U.S. Library of Congress, http://hdl.loc.gov/loc.gmd/g4410.lh000552.

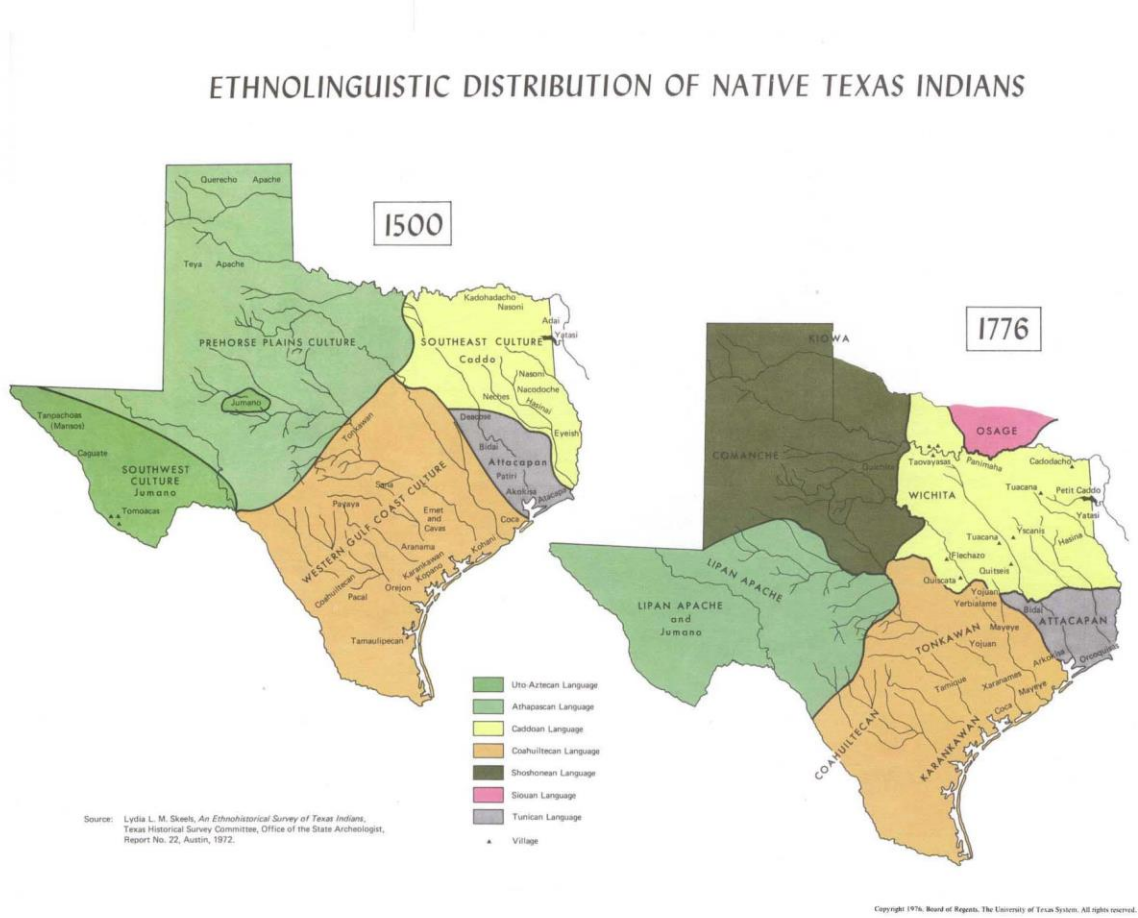
land and land tenure that are visible today along the border. This roughly following a common evolution from the communal lands of various native peoples to sites of economic opportunity and movement, to eventually conquered and colonized spaces of the borderlands. In tracing these changes, I will also highlight how these spaces fit within critical topologies and how they vary, which in part is due to the unique borderland histories that have shaped them.

3.1. LAND TENURE AND RIGHTS: CONTEXTUALIZING RELATIONSHIPS BETWEEN LAND AND PEOPLE IN THE SOUTHWESTERN U.S.

Much of what is now the U.S. Southwest continues to be arid to semi-arid, with proximity to surface or ground water sources. The diverse landscape was home to nomadic, and increasingly more established, leading the way toward some great civilizations in the Western Hemisphere over millennia. Before the European colonization of North America, the approach to land was one of common use and not one of ownership (Krueckeberg, 1995, p.302; see also Udall, 1963, Large, 1973, Cronon, 1983). There were almost 100 million inhabitants when Europeans began arriving in the 1500s to the Americas (Gonzalez, 2009, p.15). The different tribes were as varied as they were populous, ranging from nomadic to semi-nomadic, with communal lands and some version of individual property that differs from colonial Spanish or English precedents (Gonzalez, 2009; Resendez, 1999).

Along what is today the South Texas border, there were Coahuiltecans, closely related to the Karankawas of the Texas Gulf Region, which were divided into several subgroups: Katuhanno, Bobole, Carrizo, Payaya, Aranma, Tamique, Oregon, Pachal, and Kesale-Terkodam (Thompson, 2012). The most notorious bands of nomadic indigenous peoples were the Comanche, who "appear to have been cruel, inhumane, and savage" according to several historians (Thompson, 2012, p. 13), contributing to a myth which proved to be a factor in the characterization of the area as inhospitable during most of the area's colonial history (Gonzalez, 2009; Resendez, 1999).

Figure 3.2. Ethnolinguistic Distribution of Native Texas Indians



Map Source: Perry-Castañeda Library Map Collection, from Historical Maps of Texas From Atlas of Texas. Published by The University of Texas at Austin, Bureau of Business Research, 1976.[50]

[50] https://legacy.lib.utexas.edu/maps/atlas_texas/ethnolinguistic_natives.jpg

For Native Americans, "one used it, one moved on, and use was shared with others" (Krueckeberg, 1995, p.302; see also Hämäläinen, 2009). However, once European colonizers arrived, stewardship of common lands gradually transformed into conflicts of property and dispossession. Many Native American communities were taken advantage of, and their lands were stolen, with a resulting accumulation of power via land control and ownership in the name of the Crown (Kruecheberg, 1995). By 1850, very few of the Carrizos, the band that was situated along the Rio Grande by present-day Laredo and Carrizo Springs in Webb County, remained; others had been "exterminated by way, disease, or both" Thompson, 2012, p. 13).

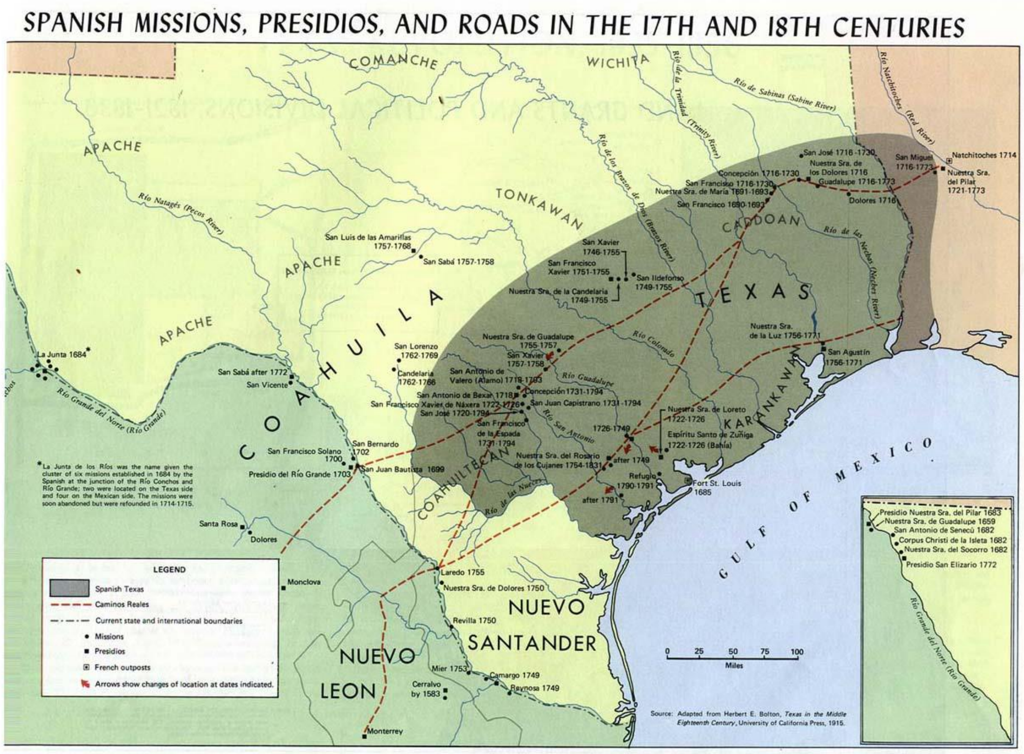
Colonial "New Spain" included Texas, or *Tejas,* which is the name of one of the main Native American bands in the state, up until the early 1800s. Many were encouraged by the Spanish crown to travel north from Mexico into the more sparsely populated areas of the Spanish and later Mexican territories in what is now the American West and Southwest. Anglo Americans headed west to and passed Texas, and eventually surpassed Mexicans in population by 1835. The steady encroachment via "economic penetration" of Spanish settlers, then Mexican and Anglo American frontiersmen, was attributed to the promise of economic success with the lure of cheap to free land (Resendez, 1999, p. 669). Some tribes were more successful at integrating with and, some argue, ruthlessly manipulating, merchant trade activities with the Anglo and Mexican colonial settlers (Resendez, 1999, see also Hämäläinen, 2009). By the early 1800s, diseases that the Europeans had brought with them to the Americas had wiped out significant Native populations. Many also were forcefully assimilated into Spanish culture by renouncing their allegiance to their communities, converting to Catholicism, and intermarrying with

Spanish settlers[51]. However, several bands of indigenous peoples in the South Texas continued to make life difficult for any new settlers via pillaging and sometimes violent raids on the colonizers.

During Spanish colonial Texas from 1590 to 1821, settlements were governed by two major institutions: the Catholic Church and the military. There were numerous settlements that were founded as a mission with clergy and settlers. There were also settlements founded as a *presidio*, which is Spanish for garrison, a military installation (Gonzales, 2009).

[51] Racial mixing of Spanish settlers with Indigenous people yielded what are called Mestizos, which loosely translates to mixed people. I reference Gonzales (2009) for this research but there is a wealth of critical Chicanx studies scholarship that delve into identities, histories, and folklorist literatures on Mestizaje, including the erasure of its more violent origins in race relations, politics, conquering, and colonization.

Figure 3.3. Spanish Missions, Presidios, and Roads in the 17th and 18th Centuries



When Mexico won their War of Independence from Spain in 1821, Texas became *Coahuila y Tejas*, and a new era began, marked by desires and strife to take back control from different nation states. Characteristic of this time, the Mexican government used *empresarios*, or land agents or speculators, to colonize the lands throughout Texas, Arizona, and New Mexico[52]. The 1836 map at the beginning of this chapter (Figure 3.2) reflects these empresario grants, including the Beale-Grants grant that encompassed most of the modern-day South Texas border. John Beale was an English speculator and physician who, at the peak of this time as an empresario, was able to win himself several empresario grants worth over tens of millions of acres of ‘unoccupied’ land which he was

[52] Handbook of Texas Online, "EMPRESARIO," accessed July 31, 2019, http://www.tshaonline.org/handbook/online/articles/pfe01.

able to sell to hundreds of families[53]. The Texas rebellion, however, marked the end of Beale's time as a successful empresario. By 1836, courts failed to recognize much of his titles and claims to lands due to poor record keeping. The remoteness of the state continued to foster the growth and reproduction of the pro-property rights ethos and disdain towards federal, top down governance from afar (first Madrid, then Mexico City) that continues to be a part of the prominent narrative of Texas today – when politically expedient.

There are other aspects of governance specific to land tenure in Texas that has endured Spanish and Mexican rule:[54] remnants of a quasi-feudal political system of *partones* (patron) and peones (peasant) that are visible today (Resendez, 1999). This was reminiscent of "boss rule" and machine politics which was prevalent in major U.S. cities during the second half of the 19th and early 20th centuries (Anders, 2019; Anders, 1981; Resendez, 2009; Montejano, 1987). The Spanish–Mexican version of the estates are *haciendas*; we also saw class and status stratification amongst *peones*, *rancheros*, *vaqueros*[55], and 'landed' Mexican elite sometimes called *compadres* (Montejano, 1987). This created a hierarchy of wealth and access where those who owned of land and who also were Anglo or socially 'elite,' were considered to be the most powerful and, therefore, the most susceptible to corruption, resulting in a socioeconomic stratification based on class and race (Resendez, 1999; Montejano, 1987; Anders, 1981, 2019). "Elite[56]" in this

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53 Handbook of Texas Online, Raymond Estep, "BEALES, JOHN CHARLES," accessed July 31, 2019, http://www.tshaonline.org/handbook/online/articles/fbe03.

54 See for example this piece in Texas Monthly from 2014 on the prevalence of patrones / the patron system still influencing local politics today in Laredo, Webb County seat, Texas. https://www.texasmonthly.com/politics/familia-feud/

55 The Spanish-Mexican version of contemporary U.S. 'cowboy'

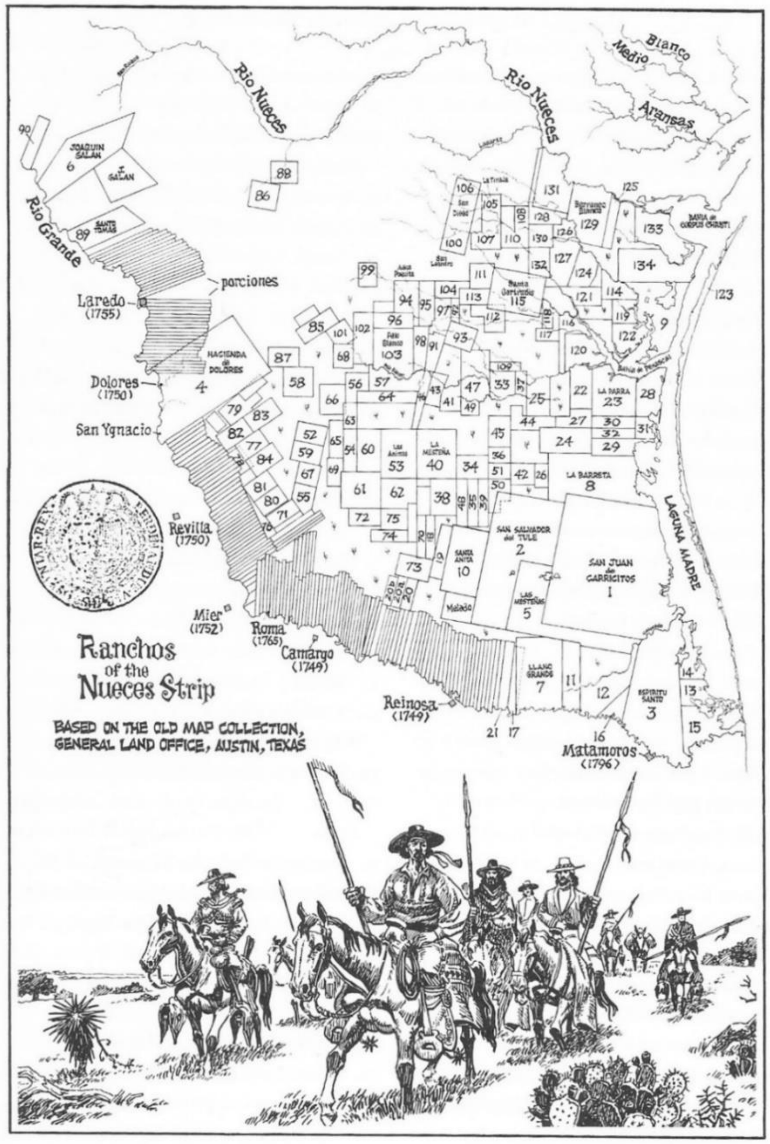
56 Montejano usually speaks of "elite" when talking about non-low income/middle class folks, i.e. Anglo business elite. Elite in sociology and other social sciences tends to describe those who are dominant, hegemonic segments of the population within the larger political (power), class, cultural structures within social institutions (Henslin, 2011, p.161). Mills introduced contemporary conceptualization of the power elite as members of the upper echelons of political, economic, and military realms that, he argues, in turn, influence or make decisions that effect the welfare of everyone else (Henslin, 2011, p.161). Other scholars equate elite with the 'ruling class', which includes rule/law makers and government officials. In the

case, and in this dissertation, refers to those in the upper echelons of social and/or political class institutions that hold power (Montejano, 1987; see also Mills, 1956; Henslin 2011; Bernstein and Byres, 2011).

planning field, Roy in" Praxis in Time of Empire", also "Informality Epistemology of Planning" describes elite as those with wealth and power.

Figure 3.4. South Texas Ranches and Land Grants in 1852 (Originally in Thompson, 1987, p.31-33)

DOLORES



The cattle industry in the United States had its origins in the small ranchos and missions of South Texas and northeastern Mexico. In addition to the small ranches around Reynosa, Camargo, Roma, Revilla, Dolores, and Laredo, which contained thousands of livestock, this map by Jack Jackson shows the location of some 136 land grants in the area south of the Nueces River. *Courtesy Jack Jackson and Texas A&M University Press.*

Consolidation of Power and Influence

Land grants were a powerful tool used by Spain, Mexico, and the Republic of Texas. With land grants, individuals, mostly elite loyal Mexicans, and then Anglo Americans (Montejano, 1987; Resendez, 1999), were given land that was owned and/or occupied by others at that time. Over time, soldiers and veterans were also given an opportunity to receive a land grant. In other instances, elites struggled to maintain landed wealth[57] and then sold their land to large landowners who happened to also be Anglo and viewed the markets and distribution of land[58]. Eventually, this led to a massive dispossession of lands from the Mexican elite to American Anglo settlers by the turn of the century (Montejano, 1987; Resendez, 1999; Gonzalez, 2009). This process was a bit slower in South Texas, mainly because it took the Anglo American settlers and merchants longer to make their way southwest.

There are differing explanations as how this came to be. Early in the transition from Spanish to Mexican to Texan and finally U.S. control (1821–1865), land grants were used to expand and populate swaths of land that previously was unoccupied or not visibly used, and in some cases, land that was previously owned by Mexicans after annexation (Montejano, 1987; Resendez, 1999; Davis, 2016). In describing the resulting conflicting approaches to land tenure and commerce regarding the Lipan Apaches present in mostly Western Texas, J. Martin Davis simply stated,

> "The Lipan Apaches dominated much of Western Texas when the Anglo Americans first appeared. Their economic impact dwindled with the appearance of credit and commercial trade in lieu of the barter system… The Lipan adopted much from the European soldiers, such as weapons, dress and tack. By the end of

[57] wealth derived from land ownership

[58] Such as subdivision amongst heirs for example which were limited by derechos maintained in Mexican law and carried over after Texas was annexed into the U.S, see Montejano, 1987, Chapter 3 "Cattle, Land, and Markets" for more on the influence of land and commerce markets in consolidating estates and eliminating substantial sections of Mexican elite in the process.

> the nineteenth century, Spanish officers were recommending the removal of tribes such as the Lipans. Afterwards, a series of treaties were negotiated, including some by Empresario Stephen F. Austin. Promises of permanent homelands were often included but not honored. The native traditions emphasized temporary possession of land helps in common with use of resources such as water, vegetation, and game. European land traditions were centered on titled ownership and exclusive possession." (pg. 59)[59]

For example, Resendez discusses how much of the communal Pueblo lands of what is now New Mexico became contested by non-Indians particularly toward the end of Mexican period from 1821 to about 1840 (1999, p. 680). This became increasingly common throughout the state, including in the current-day U.S. Texas border area. Dispossession therefore was a powerful colonial tool, and in many instances, a violent one.

Commodification of Land and Her Resources

Indigenous peoples long knew the value of resources the land produced and shared this knowledge with the Spaniards. This fueled in large part the sites of exploration and colonization by both Spanish and American settlers. Stories about gold was one of those resources; oil was another (Prindle, 1981; Montejano, 1987; Resendez, 1999; Chipman, 2017). The coming of the railroad led to increases in property values and generated interest in mining and other industries from investors, aspiring workers, and speculators alike.

With the agglomeration of ranches and farmland into large landholdings owned by Anglo and a few Hispanic elite families came an increased need for cheap labor to continue to produce and transport goods while simultaneously taking advantage of the influx of low wage labor. A confluence of various events and phenomena contributed to a constant influx of Mexican immigrants into the U.S. over the last hundred years. A 'push-pull' process has been used to describe the drive of Mexican immigration to the U.S. (originally by historian

[59] This description accompanied a drawing of a Lipan Warrior, Emory's Boundary Survey, 1857,

Carey McWilliams, as described in Gonzalez, 2009, p. 114). And for the majority of these hundred years, the U.S. government has either encouraged or sought to restrict this immigration. In particular, large-scale farming operations demanded a large, cheap farmworker labor force. During times of heavy socioeconomic strife in the U.S., xenophobic and racist sentiments boiled over and heavily influenced immigration, segregation, and exploitation.[60]

For many of these migrant workers, affordable housing was not available. In time, most especially around the time of the Bracero Program, a migrant labor agreement enacted between the U.S. and Mexico from 1951 to 1964, the landscape was transformed once more along the border with the development of *colonias*. These were informal subdivisions that provided affordable plots of land via 'contract for deed' to migrant families. However, landowners did as little as possible to maintain properties and provide adequate infrastructure for health and safety of the property tenants, and ultimately contribute to complications obtaining a clear title. Not providing adequate services to tenants and targeting the most vulnerable such as migrant worker families with no guaranteed route to citizenship and threats of deportation is not an uncommon occurrence. This mirrors recent shifts in the disconnect between the profits generated from the land going to very few not living on the land, and the localized impacts of resource exploitation such as mining and oil and gas production.

Ultimately, the history of the evolution of land tenure is very important to better understand social vulnerabilities to resource exploitation along the border. These vulnerabilities are diverse, complex, and multilayered, when considering how wealth through land and land tenure have influenced the social and political structures that produce

[60] An example of this is the *Bracero Program* which brought cheap but secure migrant labor from Mexico into the U.S. for almost 20 years in the 1950s and 1960s.

such vulnerabilities. Race and class are clear components to the power dynamics. What becomes clear is a need for a discussion of literatures that more critically examines each of these elements within a border context. The next section therefore presents literature that examines and unpacks these relationships between land and power and pre-, post-colonial spaces like the Texas–Mexico border.

3.2. A *MESTISO* COLONIAL IMAGINARY: SUCCESSION OF RACE AND CLASS, LAND, AND POWER ON THE BORDER

This section examines the production of a Mestizo Colonial Imaginary (Anzaldua, 1987; Montejano, 1987; and Mignolo, 2012) and its implications for vulnerabilities along the Texas–Mexico. I first briefly discuss scholarship that relates land tenure to globalization, as this relationship sets the stage for understanding not just land and ownership but also the complexities of race and class along the border. Given the importance of class and race, I then discuss how these intersect with critical literatures—particularly in border/Chicanx studies—integrating aspects of difference and social stratification into colonial periodization as an organizing heuristic problematizing land tenure in the Texas–Mexico border landscape.

Land as Commodity – Land as Place

In *Roots of Resistance: Land tenure in New Mexico, 1680-1980*, Roxanne Ortiz (1980) traces the evolution of the pre-colonial Pueblo land tenure, beginning with what is now New Mexico along the lower (*Rio Abajo*) and upper (*Rio Arriba*) Rio Grande (1980/2007). The Pueblos had mostly agriculture-focused land use patterns that blended multiple visible and ephemeral aspects of these communal spaces with Pueblo life, including focusing on family, redistribution and fairness, and spirituality. In contradiction to more dominant historical accounts, Pueblos, a peaceful people, allied with Apache and Navajo. This in turn negated Spanish colonial justification for ‘saving’ the Pueblos from the ‘savage’ Apache. The Spanish attempts at ‘saving’ them were ultimately acts of conquest by “annihilation” (p. 24). The Spanish colonists used the relationships among these peoples to eventually take advantage and conquer them. And yet, as an example of their resilience, the 1680 Revolt of the Pueblos against the religious impositions of the Spanish soldiers and Franciscan missionaries reflected long and deliberate planning, several years by many accounts of the Pueblos (p. 37-38). This is contrary to the image the Spanish crafted of the Pueblos as incapable of doing something more enlightened and informed.

Spanish and Mexican militaries used extreme violence, manipulation, and servitude to maintain dominance over the Pueblos, using the capitalization of land tenure and exploitation of her resources to continue this domination. By the 17th century, according to Ortiz, the changing “land tenure patterns and social relations were based on the particular circumstances necessitated by isolation, at least partial Pueblo autonomy, Apache/Navajo resistance, and a subsistence economy” (p. 40). From there she discusses Spanish, Mexican, and then U.S. colonial conquests, through to what is now a capitalist land tenure regime that continued the oppression, marginalization, and domination of native peoples in what are the former Spanish colonies in the U.S. In the midst of this domination and conquest after conquest, Ortiz pointedly states the importance of the cleverly orchestrated organization and planning, dynamic alliances, and deliberate acts of resistance of the Pueblos in the face of colonization and oppression. It is only in ‘free’ Mexico for most of the 18th century that the Pueblos in New Mexico were able to participate more fully in larger political processes as (relatively) equal citizens (p. 63), but that opportunity came to an end with U.S. conquests in the early 19th century.

Ortiz convincingly argues that previous historical accounts, willingly or not, have unfairly delegitimized the autonomy and resilience of the social structures and cultural fabric of the Pueblos. Furthermore, Ortiz argues that much of the woes of the Pueblos and the attendant, changing land tenure regimes is reflective of an evolving and oppressive economic structure and subsequent class struggles between Pueblos, poor Mexicans and Mexican Americans, and their Spanish, and later U.S., colonizers. Ortiz emphasizes the impact of the capitalization of the land and its resources visible in these landscapes today, although I believe this is just one of many means through which vulnerable and oppressed peoples are further marginalized. Ortiz also elaborates on the intricate intersectionality of race, ethnicity, indigeneity, knowledge, and power at play in the changing landscape as reflected in land tenure regimes, ownership, and uses. Each of these aspects of identity and relations of power are ultimately used in an effort to continue to marginalize and oppress others.

In *River of Hope*, Omar Valerio-Jiménez (2013) discusses how communities in the Lower Rio Grande Valley constructed their own identities different from the neighboring nation-states. These identity formation processes were, he argues, a form of resistance to Spanish, Mexican, and American conquests of the borderlands. The daily encounters between Mexicans and Americans, and their experiences with state laws that influenced their ethnicity, gender, and citizenship, "led border residents to construct strategic identities that countered each nation-state's disciplining efforts. Their creative use of the river to resist nation-state control, and their construction of hybrid identities established social and cultural precedents for future generations" (Valerio-Jiménez, 2013, p. 12). He examined municipal archives and church documents in Spain, Mexico, and the U.S. that revealed details on family and social life (p. 13), as well as newspapers, dating back to the vecinos in the Villas del Norte in the early 1800s. In the first section of the book, Valerio-Jiménez provides a border history of pre-Treaty of Guadalupe Hidalgo Villas del Norte, where a unique regional identity was forged via the lack of colonial support, with the exception of benefits enjoyed by 'elite' men, and interactions with the native populations (both antagonist and ally). The second half of the book focuses on the continued marginalization of the newly termed Mexican Americans (or Tejanos) in the area, which reinforced the suppression of cultural expressions of Tejanos by the U.S. and local governments.

Ultimately, the confluence of physical and regulatory remnants of past colonial powers along the border region continue to influence relations of power and distribution of public resources in the area. Scholarship such as this shifts focus from more dominant colonial narratives of decimation and annihilation of weak and inferior native communities to more subversive actions that complicate such narratives. They then challenge ideas of what relationships of land tenure and communities can look like from decolonized perspectives. This also allows for a useful discussion of corresponding land rights regimes, dispossession via subsequent sovereign land grants, and generational wealth accumulation and political power from these activities. These discussions have potential to be significant in critically exploring and unpacking the physical, social, and economic manifestations for vulnerable communities of this particular current border oil and gas producing landscape.

In summary, I argue it is important to understand not just what can be done on the land (land use), but also who owns what, and how they obtained ownership of the property. Given data limitations and previous analyses that poorly represent the Texas–Mexico border, it is necessary to rethink social vulnerability in this context. Injustices of all sorts are embedded in and reproduced by a structural system or set of institutions that, over time, become fully integrated into cultural norms of a space. This can be evident in everyday acts of violence meant to chip away at any resistance while further engraining hegemony into the fabric of this space. Subversive stories and representations of these struggles and their impact on the built environment and social fabric of these spaces should therefore be embraced.

Examining land tenure and its role in shaping negative externalities stemming from resource stewardship and exploitation is a complex but necessary exercise. Many of these complexities stem from the tensions between land as a source of power and rights to the land contingent on formal rights. There is a lack of scholarly work examining the relationship between land tenure, economic development, and social vulnerabilities in pre- and post-colonial Texas. There are spaces of vulnerability within this extractive oil and gas landscape, and the role of varying land tenure regimes in shaping these vulnerabilities should be better documented. However, oral histories of land from indigenous and other marginalized peoples' perspectives have yet to be collected and centered, and data to conduct social vulnerability analyses in the border area is severely limited.

Chapter 4: Theoretical Framework

INTRODUCTION

People's relationships to the land in Texas, whether as owners, users, or temporary occupants, play an important role in influencing various communities' vulnerability to hazards. Rational and environmental planning rely on quantitative, proximity-based models to identify and attempt to quantify unjust impacts from industrial-like processes and activities such as oil and gas production. However, the relationships between people and the exploitation of land and her resources are far more complex. History (colonial past), governance, and ownership regimes are all critical aspects of local context that can further explicate sites and sources of vulnerability of concern to both planning practitioners and academics alike. I draw on work in Chicanx border studies, feminist post-colonial political ecology, and environmental justice to explore and further understand how political influence and generational accumulation of land wealth shape these spaces, reproducing injustices felt across not just the social fabric but also the built and natural environments.

Political–ecological approaches to human–environment research aim to investigate the ways in which broader, political–economic processes and institutions shape local land-uses and local experiences. This multi-scalar perspective can help to analyze and theorize the relationships between institutional actors and local, disparate impacts stemming from shale oil and gas extractivism (see e.g. Apple, 2014; Finewood and Stroup, 2012). In order to better understand the role of land tenure histories and historical patterns of development in shaping the geographies of fracking, in particularly the uneven distributions of economic benefits, I will integrate critical perspectives from Chicanx studies. Research in this field, in particular that of Laura Pulido (1996, 2000), Devon Peña (1998, 2003a, 2003b, 2005, 2010), and Montejano (1987), provides a more nuanced understanding of the particular borderlands histories and experiences that shape relations of power. I also draw on environmental justice and social vulnerability to hazards research to better understand impacts and responses to the fracking industry. The work of Paul Mohai (Mohai, Pellow, and Roberts, 2009; Mohai and Saha 1995, 2006), focusing on disparate impacts of siting industrial land uses by neighborhoods of poor people of color, will inform my own analysis of the impacts of proximity to fracking sites on residents.

Finally, I draw on Ananya Roy's epistemologies of informality (2005) to devise a tenure and ownership rights categorization scheme, influenced by Global South perspectives, to more adequately illustrate the roles of land dispossession, property rights and ownership, and governance in (re)producing conditions that are disproportionately detrimental to historically vulnerable communities along the Texas–Mexico border. Roy's (2005) emphasis on who owns what, instead of how land is used, provides a unique opportunity to trace the connections and contradictions between land and mineral ownership, rights and access, and political power in the Southwestern US.

Table 4.1. Key Theorists and Relevant Concepts

Environmental Justice and Risk

- Social Vulnerability And Risk (Berke, Flanagan, Tate, Cutter)
- Environmental And Participatory Planning – Disparate Impacts, Environmental Racism (Coburn, Pulido)

Political Ecology

- Land Use / Tenure V. Land Ownership And Land Rights (Roy, Finewood & Stroup)
- Unequal Distribution Of Wealth And Power / Distributive Justice (Roy)

Chicanx Border Studies

- Environmental And Economic Racism (Pulido, Peña)
- Borderlands Histories Of Land Rights And Dispassion (Montejano, Anzaldua, De León)
- Patron System

My theoretical framework thus aims to explain the complexities of institutional factors and relations of power that produce the shale oil and gas landscape of South Texas. For exploitative, extractive uses of land, such vulnerabilities are inextricably tied to the ways in which surface and mineral rights are separated and regulated. This relationship translates into a generational accumulation of wealth and overt/covert political influence. This in turn creates the potential for those in power to change rules and regulations in their favor, accumulate even more wealth and power, ultimately reproducing social and environmental injustices.

4.1. PRINCIPLE TENETS, SCHOOLS OF THOUGHT, AND RESEARCH APPROACHES IN ENVIRONMENTAL JUSTICE

The environmental justice movement has been characterized as the confluence of the environmental and civil rights movements. Leading up to the late 19th century, the United States was governed by the “go forth and conquer” mantra regarding environmental resource management and land uses, which came from a biblical justification for stewardship of land and full utilization of nature’s resources (Newton, 2009 p. 19). By the end of the westward migration, people started to question and realize the finiteness of environmental resources. Eventually, two dominant strands of this new environmentalism emerged: conservation and preservation. The traditional environmental movement, therefore, was one that strongly emphasized the connections between humans and nature (Newton, 2009). Early notable champions of the movement were John Muir and President Theodore Roosevelt.

The modern environmental movement is said by many to be epitomized by the ideas in Rachel Carlson’s book *Silent Spring* (1962). Her book called into question how modernity was driving toward better health, comfort, and success, while ignoring the negative consequences of new technologies and scientific achievements like industrialization on our environments (Newton, 2009). Carson and the early environmentalists of her time focused on issues such as air and water pollution, hazardous waste disposal, and incompatible land uses.

A critique levied by early environmental justice activists was that these early organizations were predominantly white, middle, and/or upper middle class. Not only was the membership mostly white and middle class, but the concerns they voiced were mostly driven by the white middle class. Issues faced by urban minorities and the poor were largely ignored, and for many decades purposely so (Newton, 2009). One of the fathers of the environmental justice movement, Robert Bullard, famously critiqued the relationship between mainstream environmentalism and the environmental justice movement:

> "the mainstream environmental movement has proven that it can help enhance the quality of life in this country…. Yet, few of these groups have actively involved themselves in environmental conflicts involving communities of color. Because of this, it's unlikely that we will see a mass influx of people of color into the national environmental groups any time soon. A continuing growth in their own grassroots organizations is more likely" (1993, 38, as quoted in Newton, 2009, p. 22).

The rise of the civil rights movement and environmental racism, however, aimed to address these issues. In Robert Bullard's famous book *Dumping in Dixie* (1990), he argued that communities of color were being "deliberately targeted for the location of society's unwanted waste and that these practices had their origins in both historic and contemporary forms of institutional racism" (Mohai, Pellow, and Roberts, 2009, p. 409). There was also another early watershed moment that propelled environmental justice into national political discourse. In 1982, Warren County, North Carolina, became the site of a new way of thinking about environmental justice, when activists organized to stop the state of North Carolina from dumping 120 million pounds of soil contaminated with polychlorinated biphenyls (PCBs) in the county with the highest proportion of African Americans (Mohai, Pellow, and Roberts, 2009, p. 406). That was when "environmental racism" was coined and defined as:

> "racial discrimination in environmental policy making, the enforcement of regulations and laws, the deliberate targeting of communities of color for toxic waste facilities, the official sanctioning of the life-threatening presence of poisons and pollutants in our communities, and the history of excluding people of color from leadership of the ecology movements." (Mohai, Pellow, and Roberts, 2009, p. 406-407)

Early environmental racism and environmental justice (EJ) scholarship focused on both identifying racist intentions to do harm and disparate impacts on minority and poor populations. Research continues to find that ethnic minorities, indigenous persons, people of color, and low-income communities suffer from a higher burden of environmental exposure to air, water, and soil pollution from industrialization, militarization, and consumer practices (Mohai, Pellow, and Roberts, 2009). Furthermore, scholars of environmental inequalities and injustices are heavily critical of environmentalism for neglecting to acknowledge the multiple meanings of ‘environment’ to different populations, as well as the importance of local knowledge to sustainable environmental resource management (Mohai, Pellow, and Roberts, 2009; see also Peña, 1998, 2003a, 2003b, 2005, 2010; Pulido, 1996, 2000).

According to Mohai, Pellow, and Roberts (2009), environmental justice remains contentious for three main reasons. The first reason is that it asserts that the mainstream environmental movement ignored, and continues to ignore, social justice and equality issues. The second reason is the challenging, complicated, and difficult task of documenting the existence of “disproportionate impact” on people of color or poor populations. And the third reason is the difficulty in deciding how to address documented injustices—addressing environmental injustice with public policy could involve complex and expensive local, national, or perhaps even global interventions (Mohai, Pellow, and Roberts, 2009, p. 407).

Activists, scholars, government agencies and other interested groups have debated the last few decades the definitions of environmental justice and environmental racism. Some suggest that a consensus on these definitions can yield more fruitful and impactful change for the harmed communities via scholarship and activism (Holifield, 2001). Holifield, in his attempt to define and unpack the terminology associated with the environmental justice movement and environmental racism, lays out the genealogies of these terms and their impacts as rhetorical tools and basis for further research (2001). His article "Defining Environmental Justice and Environmental Racism" (Holifield, 2001) serves as a useful frame for defining these terms for this dissertation.

According to the U.S. Environmental Protection Agency (EPA), environmental justice, and an earlier used and since abandoned phrase environmental (in)equity, refers to inequitable distributions of environmental harms. The concept of environmental justice was institutionalized via the Environmental Justice Executive Order issued by President Bill Clinton and defined by the EPA as:

> "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 population, due to policy or economic disempowerment, is forced to bear a disproportionate share of the negative human health or environmental impacts of pollution or environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local and tribal programs and policies". (Mohai, Pellow, and Roberts, 2009, p. 407).

Other conceptualizations stemming from environmental justice include the articulation and distinction of procedural justice and distributive justice (Holifield, 2001). The U.S. Department of Housing and Urban Development (HUD), for example, has been able to institutionalize the concept of distributive justice via the development of programs that aim to redistribute benefits more equitably to historically disadvantaged populations (Holifield, 2001).

Environmental justice is still an elusive concept in terms of concretely defining injustices and thus allows room for other scholarship to further explicate the term's "rhetorical power" (Holifield, 2001, p. 82). In environmental justice scholarship, social constructivists move beyond structural failures that yield such injustices to better understand “how activists have successfully mobilized communities with diverse grievances by using environmental justice conceptual frames, which provide rhetorical links between contemporary environmental activism and historical movements for civil rights and social justice” (as quoted in Holifield, 2001; see Capek, 1993; Cable and Shriver, 1995; Salazar and Moulds,1996; Sandweiss, 1998; McGurty, 2000; Taylor, 2000; Towers, 2000). Urban political philosophers have explored how conceptualizations of justice and environmental discourse can be articulated, embodied and/or contested. This, however, draws attention to the disadvantage of not having such a concrete definition, thus allowing grassroots claims to be contested and subverted by other political interests (Holifield, 2001).

Environmental racism as a term was not assumed by government institutions, but has been utilized by various grassroots in their organizing efforts (Holifiled, 2001). Differences in definitions for this contested phrase is linked to the question of intent. Many, most notably Laura Pulido, have argued that such a definition is very limiting, reducing environmental racism into ‘racial projects’ (Pulido, 1996, 2000; Holifield, 2001). She situates her own work within an anti-racist ‘racial project’ on revealing environmental justices and institutional racism (1996, 2000; Holifield, 2001), challenging disparate impacts as a measure of injustice. Pulido instead calls for using social constructs such as white privilege to identify latent, obscure, and covert injustices that reflect historical, structural, and spatial complexities. A framework for assessing impacts based on a deliberation and intention cannot achieve. Pulido takes racism and connects it to environmental justice head on in her foundational article, “Rethinking environmental racism: White privilege and urban development in Southern California” (2000). Her intent is to draw more nuanced inferences to racism and white privilege, and how these have directly and more subtly (structurally, spatially, and historically) affected minority populations, with a focus on urban minorities in Los Angeles (2000). She argues that the decision processes for siting potentially harmful, hazardous structures must be undertaken within a larger context of various urban processes. Her work has been very significant in terms of critical assessments of incompatible land uses and feminist critiques of the urban growth machine.

There are two main debates within academic circles concerning environmental justice research methodologies. One is the weight of claims based on race or class. The second debate stems from the question of which came first: the discriminatory siting of an unwanted and harmful facility in an already established predominantly minority or poor neighborhood or the presence of such a facility that degraded property values enough to where it is the most affordable to poor and minority populations (Mohai, Pellow, and Roberts, 2009). These debates informed many studies, including influential quantitative proximity analysis studies documenting the siting of environmental hazards within neighborhoods by Paul Mohai and Robin Saha (1995, 2006) and Evan Ringquist (1997, 2005). Further discussions arising from this research substantiated the claim that Locally Unwanted Land Uses (LULUs) became increasingly diverted to politically more vulnerable low-income and people of color communities. This corroborated Bullard & Wright's earlier argument that "Not In My BackYard" (NIMBY) for siting of harmful facilities and other sources of ecological harm, which increasingly became "place in blacks' backyards" (PIBBY) (Bullard and Wright, 1987, as quoted in Mohai, Pellow, and Roberts, 2009, p. 413). In other words, disproportionate siting was a result of NIMBYism, where whites are more likely to be educated, higher income, and have enough political power and presence to fight having such hazards sited near their homes, schools, and businesses.

Mohai, Pellow, and Roberts also discuss various sociopolitical and economic explanations for unjust environmental exposures. They conclude that market forces and class inequalities are never race neutral, revealing what critical race theorists have termed intersectionality, which draws attention to the interrelatedness of race, class, gender, and other social categories, always linked via the experiences of individuals and groups (2009, p. 413). Historical case studies have proved to be quite valuable in uncovering and theorizing the ways intersectionality occurs in actual cases. Critical urban political ecological research has built upon such studies, "collectively…deepening our understanding of the production of environmental inequalities by the forces of global capitalism (Holifield et al., 2009 p. 594; also see Kurtz, 2003, 2005, 2009; Heynen, Perkins, and Roy 2006; Perkins, Heynen and Wilson, 2004; Swyngedouw and Heynen, 2003).

Environmental justice scholarship has had noticeable impacts on land use planning and planning in underserved, poor communities of color. One prominent example is the work of Jason Coburn, whose research interrogates the co-production of knowledge in local contexts of environmental degradation within communities of color (2003; 2005). There are many others who delve into issues related to environmental justice and community participation (e.g. Sletto, 2010, 2012; Burke et al., 2006) and expanding tools for environmental justice and planning research and analyses (e.g. White and Mayo, 2004; Long, 2012; Pezzoli and Howe, 2001; Cutter et al., 2003; Cutter et al., 2006; Anthony and Forkenbrock, 2006). However, new planning-oriented research is required, as suggested by Mohai, Pellow, and Roberts (2009) in their review of the last thirty years of work in the field:

> 1. Research is needed to tie racial disparities in environmental burdens to racial disparities in health. The same is true of economic inequalities.

> 2. Research is needed to examine the promises and pitfalls associated with the globalization of environmental justice struggles.
>
> 3. Research is needed to explore the environmental justice implications of climate change impacts and proposed solutions.
>
> 4. The potential role of green technologies and green businesses in reducing exposures and unequal exposures to risks are unknown.
>
> 5. There is a critical need for understanding the role of efforts to achieve just sustainability—the combination of social justice and sustainability in policy making.
>
> 6. Policy options in response to documented environmental injustice are underdeveloped.
>
> (Mohai, Pellow, and Roberts, 2009, p. 426)

Further illustrating the last two points, Julian Agyeman, who researches sustainability discourse and social justice, observes that sustainability, social justice, and environmental justice in planning are still at odds in practice. Essentially, Agyemen et al. are calling for co-activism and local struggles against environmental injustices and climate change injustices (2003), envisioning a key role for activist planners in these struggles. Others argue that planners should be more deliberate about integrating equity and social justice into their sustainability-oriented plans and practices, because this is lacking (Saha and Paterson, 2008). These concerns are echoed by Devon Peña, who proposes a turn toward activist scholarship by addressing actual, pressing socio-environmental issues impacting Mexican American communities (2010).

Therefore, Mohai, Pellow, and Roberts's six points above have the potential to be actualized through planning. Developing empirically sound methodologies tying racial disparities in environmental burdens to health disparities can have a major impact. Results yielded by such methodologies can guide the standardization of data identification and collection strategies, as well as data processing and analyses. Planning has the potential to better explicate the promises and pitfalls of the globalization of environmental struggles, providing a possible means through which these problems can be mitigated via community plans and policies. Planning can have the same effect on mitigating the local effects of climate change by informing community plans and policies. Research on planning practices can help better identify benefits of green practices, buildings, etc., for all members of the communities planners serve. Taking this a step further and integrating Agyeman's 'just sustainability' through planning practice and research has the potential to bridge social concerns with environmental and economic aspects of a community in meaningful, tangible ways.

Though environmental justice research has made many contributions to planning scholarship in and for communities of color, there are still limitations to an environmental justice approach to planning. As the literature suggests above, some approaches have the potential to turn claims into a 'racial project,' which can limit the true scope and breadth of reach that planning activities, both processes and outcomes, can achieve (Pulido, 1996, 2000; Holifield, 2003). Calling for more activist scholarship also blurs these lines and may yield the same results of whittling valid claims to 'racial projects'. Fuzzy definitions and methodologies derived from qualitative historical data revealing distributive and/or procedural injustices still plague rational planning. Rational, quantitative research presupposes the existence and power in objective information; however, not all injustices are measurable, or even visible, from this seemingly objective perspective. Historical case studies can serve as a useful tool to illuminate patterns and sources of injustices beyond quantitative analyses, but this type of research can be time consuming and is often criticized for embracing subjectivity over objectivity.

4. 2 Political Ecology and Its Contributions to Environmental Justice

Political ecology can contribute to environmental justice in planning in several ways. It can allow for consideration of the social constructed nature of local experiences, which permits insertion of race while not minimizing the claims made for redistributive or procedural justice. This further strengthens the argument for qualitative research methods such as historical analyses or ethnography, which are poorly utilized in environmental justice research and in planning for communities of color. The schism between activism and empirical research can also be mitigated with the introduction of feminist, post-structural political ecological epistemologies and research methods.

Early political ecology literature focused on identifying the political, scalar, and temporal implications of human–environment interaction, conflict and governance (see for example Blaikie and Brookfield, 1987; Bryant and Bailey, 1997; Peet and Watts, 1996). Perhaps the most useful definition of political ecology is from Raymond Bryant:

> "The phrase 'political ecology' combines the concerns of ecology and a broadly defined political economy. Together this encompasses the constantly shifting dialectic between society and land-based resources, and also within classes and groups within society itself."
>
> (Bryant, 1992, p. 13, quoting Blaikie and Brookfield (1987, p.17))

Bryant adds to this definition, emphasizing the importance of broadening the scope to the 'environment' and not just the 'land,' and he also cautions researchers to avoid economic reductionism (Bryant, 1992).

Much of the early work in political ecology fall within three themes: contextual sources of environmental change, conflict over access, and political ramifications of environmental change. Vayda's early work proposed the implementation of a different rationality and methodology to better understand and theorize these complex interactions

(1983). Bryant's work focused on the necessity of understanding political and economic issues when analyzing international development and environmental problems (i.e. Bryant 1992, 1997; Vayda, 1983; Vayda and Walters, 1999; Zimmerer, 2000). Political ecology thus offers a way to analyze and unpack these themes through an examination of the relationships between actors, and examine how power-laden structures contribute to and are products of human–environment interactions (Bryant, 1992, 1997). Tim Forsyth distills the major themes from the principal debates that grew out of various approaches to the study of political ecology: ecology as a subversive science, the domination of nature, social justice and the developing world, and the separation of science from politics (Forsyth, 2003, p. 7).

The first theme, ecology as a subversive science, grew out of the first political ecology studies in the 1960s and 1970s. These first formulations introduced a new philosophical approach of examining the relationship and interactions between humans and our environment, challenging previous scientific methodologies (see Huxley, 1963; also Russett, 1967; Wolf, 1972; Miller, 1978; Cockburn and Ridgeway, 1979; Ward and Dubos, 1972). The second theme, the domination of nature, is a result of discussions around capitalism being the source of environmental degradation (Forsyth, 2003; see also Cockburn and Ridgeway, 1979; Atkinson, 1991; Bryant and Bailey, 1997; Wells and Lynch, 2000). The next theme Forsyth highlights is the importance of social justice, environmental struggles, and resource conflicts. This mirrors debates in the 1980s and 1990s between structural and post-structural political ecologists, with structural-oriented political ecologists contending that the environment itself is commodified under capitalism. Castree argued that the neoliberalization of nature is merely a manifestation of the process of capital accumulation, proposing the 'production of nature' to be characterized as nature as external, nature as internal, nature as the human body, and nature as information (see also (e.g. Watts and McCarthy, 1997; Batterbury and Bebbington, 1999; Peet and Watts, 1996).

More recently, political ecology scholars with a post-structural and feminist orientation have examined the power of discourse, histories, and the socially constructed nature of human–environment interactions. Their research goes beyond the neoliberal state and nature, seeking instead to understand the ways in which environmental issues are experienced, contested, represented, and reproduced (e.g. Rocheleau, 1995; Leach and Mearns, 1996; Escobar, 1995, 1996, 1998). Several of these scholars, especially urban anthropologists such as Arturo Escobar (1995, 1996, 1998) and James Holston (1998, 2009), call for the use of ethnography to uncover local knowledges and lived experiences. That is to say, from the perspective of structuralist political ecology, hegemonic discourse allows for the commodification of nature, making it acceptable to destroy natural and indigenous environments (Heynen, 2003; Heynen et al., 2006; see also Harvey, 1973, 1996, 2005; Mitchell, 1996, 2012). A post-structuralist approach to political ecology foregrounds the social constructions of presumed benefits from resource exploitation such as fracking, while illuminating situated knowledges and experiences that may have previously been ignored (Rocheleau, D. and Thomas-Slayter, B., 2005; Rocheleau, D., Thomas-Slayter, B., and Wangari, E.,1996/2013). Political ecology cannot change technocratic, expert rationalities within planning, but it can provide a different avenue by which injustices can be identified and mitigated through planning research and practices.

4.3 Chicanx Border Studies

Donna Haraway's work, specifically her seminal work entitled "Situated Knowledge: The Science Question in Feminism and the Privilege of Partial Perspective"

(1988) serves as inspiration for my understanding of Chicanx feminist environmentalism. Haraway posits that empirical knowledge privileged in science is inherently not objective. In developing her research methodology, she cites significant challenges one must overcome to truly observe what we actually see from different perspectives. She argues, therefore, that partial perspective promises objective vision (1988). This 'vision,' she proposes, is what she terms 'feminist objectivity,' which is about "limited location and situated knowledge" (1998), emphasizing the spatiality and temporality of knowledges and experiences situated within specific contexts, power structures, and knowledges of, within, and surrounding subjects.

Essentially, feminist objectivity and epistemologies recognize and celebrate multiple, multidimensional subjectivities: "Subjectivity is multidimensional; so, therefore, is vision" (Haraway, 1988, p. 586). A research approach can center such a vision of a multidimensional subjectivity. Therefore, the researcher can draw from and present a privileged image of "feminist epistemologies of scientific knowledge" through methodological and epistemological approaches that recognize situated knowledge (Haraway, 1988, p. 586). This is important because "it allows us to become answerable for what we learn how to see" (1998), bringing to the fore not only an acknowledgement of the inherent power of privileged vision, but also a responsibility to 'see' from multiple perspectives while acknowledging one's own position in meaningful, reflexive ways.

Chicanx feminist environmentalism emerged from the integration of Chicano studies and environmental studies in the 1980s and 1990s by scholars such as Devon Peña and Laura Pulido. They were inspired by the failure of mainstream environmentalism in the U.S. to acknowledge the multiple meanings of environment to different populations, seeking to foreground the importance of local knowledge to sustainable environmental resource management (see Peña, 1998, 2003a, 2003b, 2005, 2010; Pulido, 1996, 2000). Of particular relevance to my research is the more recent "sophisticated conceptualizations of the generation of spaces of environmental inequality" as well as the "ever-increasing scrutiny and analysis of the meanings of environmental justice as a discursive frame for activism, policy, and research" emerging from this literature (Holifield et al., 2009, p. 592).

In particular, Laura Pulido's work in the late 1990s ushered in a more critical and constructivist approach to unpacking the discursive and spatial complexities of environmental justice, focusing especially on the role of race and racism. Pulido sought to use social constructs such as white privilege to identify latent, obscure, and covert injustices that reflect historical, structural, and spatial complexities. In her foundational article, "Rethinking environmental racism: White privilege and urban development in Southern California" (2000), Pulido draws more nuanced inferences about social constructions of racism and white privilege, showing how these have subtly shaped the spatial and environmental injustices effecting minority populations. With a focus on urban minorities in Los Angeles, she argues that environmental injustices must be examined within a broader context of urban processes including racially produced spatialities.

Postmodern scholarship in Chicanx environmentalism focuses on identity politics and spatialized environmental politics. In "Identity, place and communities of resistance" (2003a), Peña utilizes Castells' (1997) juxtaposition of "two types of spatial logics, that of the 'space of flows' and that of the 'space of places' (2003a, p. 147). Castells affirms place-based identity politics and proposes that power and hegemonic identities bestow privilege and transform structural components of a place conveyed on a global scale (2003a). Likewise, local 'places' are spaces where communities can resist by constructing and conveying their own identities and reticular subaltern forms (2003, p.148). He describes the three main types of identities: legitimizing identities, resistance identities, and project identities. Peña takes this a step further and examines these identity formations and sociospatial logic in an environmental justice case study of the acequias of southern Colorado, where water and land rights ecosystem management are contested in a bounded communal property. These two case studies point to more complex, historicized, racialized, and spatialized aspects to the subaltern experience of Mexican Americans in the U.S. southwest.

In her *Environmentalism and Economic Justice: Two Chicano Struggles in the Southwest* (1996), Pulido further expanded her perspective on critical race studies by incorporating Chicanx studies with environmental and subaltern environmental scholarship. Pulido discussed new social movements, identity politics, and subaltern environmentalism in U.S./First world contexts, specifically the pesticide and farm worker struggles in California, and the native Granados grazing conflicts of New Mexico and Colorado. She suggests that first world subaltern struggles have been situated within racial contexts, while third world subaltern struggles have been situated within the context of development and globalism. Reflecting upon and drawing from the work of Escobar and Plotke, she argues instead that we should "move beyond the old and new social movement binary by suggesting the richness and complexity of oppositional forms of collective action" (1996, p.14). Thus Pulido seeks a more nuanced and broader definition of environmental racism that challenges the binary of First and Third World, providing a perspective on subaltern environmentalism which is of particular relevance in borderlands in-between "First" and "Third" worlds such as the Texas–Mexico border.

Other strands of scholarship in Chicanx environmentalism focus on identity politics, expanding on the understanding of human–environment relations developed in post-structural political ecology. Pulido, for one, embraces a more complex notion of identity formation, suggesting that subjectivities are contingent on local histories and contestations surrounding resource conflicts. This resonates with the complex, conflictual and racialized historical experience in South Texas, as explicated in Anzaldua's (1987) Chicanx feminisms. Her highly influential work, *Borderlands*, has become a foundational piece of literature in Chicana/o studies, feminist studies, and queer studies. In the discussion of her own embodiment of intersectionality, she argues for recognition of the existence of a *mestiza* [61] identity that encompasses all of these layers of her existence. For her, her identity includes Chicana, woman, queer, ethnically *mestiza,* and everything in-between, and is embodied in her home on the border, a border very different, layered and historied cultural realities. She is a *Chicanx*. This border space, therefore, is the physical embodiment of this 'in-betweeness.' The essence of her identities celebrates the differences within these spaces in creating a completely new space and set of realities. I therefore am drawing upon this multilayered concept of the borderlands and existence in this space, physically and embodied, along with Anzaldua's Chicanx feminisms, and supporting this with Haraway's feminist epistemologies of scientific knowledge.

However, missing from this scholarship in Chicanx studies and environmental justice, according to Peña (2010) and others, is a stronger connection between ephemeral theoretical discussions and actual experiences with injustices on the ground. Peña proposes a turn toward activist scholarship, which will benefit Chicanx environmental studies by addressing actual, pressing socio-environmental issues impacting Chicanx communities, including "the challenges posed by neoliberal ecological modernization and governmentality; the recovery and restoration of the commons; the emergence and widening scope of the local/slow food and food justice movements; the political ecology and ethnoecology of the post-North American Free Trade Agreement (NAFTA) Mesoamerican diaspora; the politics of risk (and vulnerability) science that is prominent in

[61] Translates to 'mixed' in Spanish, with its various cultural—many negative in hegemonic local, post-colonial discourses—connotations.

positivist environmental and health hazards research; and the study of advanced technologies, including biotechnology (transgenic crops) and nanotechnology and their implications for communities of color" (2010, p.152). Peña thus calls for an epistemological shift toward cross-disciplinary work that bridges environmental and risk sciences with social sciences. I argue that, furthermore, this activist-scholarship project should also include other practice-oriented fields, in particular planning, especially considering the field has been critiqued for being averse to discussions of race and perhaps more explicitly, the Chicanx experience (Diaz, 2005; also for example see Peña, 2010).

Together, these bodies of literature combine to create a new, more refined approach to understanding relationships between histories of land tenure, power and wealth, and the accumulation of these privileges and wealth in border landscapes. Drawing on environmental justice, poststructural political ecology, and Chicanx feminist environmentalism, I seek to develop a nuanced analysis of the complex relationships between vulnerable communities and land tenure with broader narratives surrounding resource extraction, water, and energy security within a very distinct Chicanx border landscape and history. Such a perspective can shed greater light on the power of resource exploitation discourses and practices in a complex politically and ecologically brown Chicanx landscape of extraction, and serve to recalibrate an activist form of scholarship and planning.

Chapter 5: Research Design

Conflict over land ownership, tenure histories, and dispossession are critical aspects of place that traditional vulnerability and risk assessments fail to recognize. In planning, we tend to look at the current conditions of a place, and use observations to predict and plan for future scenarios for planning and development policy recommendations, implementation, and evaluation. It is my intention with this research to push beyond planning research and policy norms and incorporate historical and spatial aspects of land tenure history to present a different approach to land use planning and policy that is explicitly justice oriented.

With this research design, I assert that the study of land and land use in planning requires explicit consideration of who owns what as well as who is doing what on that land. The Texas–Mexico border, specifically Webb County, is a rich study area because of its demographic composition, geographic situation, and location within a low-tax, low-service, very low-regulation governance regime. This area has also been and continues to be impacted by oil and gas production, most recently unconventional shale oil and gas exploration, development, and production in the northern parts of the county. This area has experienced periods of extreme drought, has consistently growing population where more than 95% identify as Hispanic, and has become one of the least regulated places in the U.S. Because of its colonial history with a unique set of legal frameworks and histories of possession and dispossession, this study area, reveals the importance of conceptualizing land tenure as a spectrum that has vulnerabilities and instances of precarity found throughout.

This dissertation is a mixed method revelatory single-case study with embedded units (Yin, 2014). I first conducted a typical social vulnerability assessment and a risk and environmental hazards assessment from oil and gas activities. To better understand the role of land and tenure in contributing to social vulnerability, I first conducted a sensitivity analysis with vulnerability assessment spatial data focusing on housing tenure. I then used qualitative research methods to develop a deeper understanding of the uneven distribution of benefits and harms as they related to *land* tenure, which expands the definition of tenure from housing tenure to land tenure which includes minerals and surface ownership of land. I then was able to highlight the differential access to political power and resources associated with land and mineral wealth, and the generational accumulation of wealth.

The Research Questions informing my research are as follows:

> **Research Question 1:** What areas of Webb County are socially vulnerable to hazard exposure and structural vulnerabilities associated with oil and gas activities?
>
> **Q1A**: What areas are socially vulnerable within extractive areas?
>
> **Q1B**: Where are these areas located geographically in relation to hazard exposure and structural vulnerabilities associated with oil and gas activities?
>
> **Q1C**: What is the role and geographic extent (jurisdiction and powers to mitigate harms) of the government via rules and regulations in identifying and mitigating these vulnerabilities?
>
> **Research Question 2:** How does tenure and ownership of land and minerals influence social vulnerability in these cases?
>
> **Q2A**: What is the spatial relationship between tenure, land ownership, and socially vulnerable areas?
>
> **Q2B**: How does tenure and ownership of land shape political influence in socially vulnerable areas?

Impact assessments are typically conducted in planning as a means by which quantitative and qualitative data are evaluated to determine potential risk to hazards. These assessments are generally required for certain types of infrastructure projects, such as a major natural gas pipeline that crosses state boundaries or federal transportation projects. Conceptual and methodological aspects of vulnerability in planning more recently has focused on hazards related to climate change and community resilience.

Hazards and risk assessments have typically three components: hazard exposure, physical or structural vulnerability, and social vulnerability (Highfield, Peacock, and Van Zandt, 2014; Berke et al., 2015). Risk assessments are used in a variety of hard sciences and engineering, policy, and hazards sciences, and occupational health and safety sciences (for example Han & Weng, 2011; Shan, Liu, & Sun, 2017). Such risk assessments attempt to evaluate and quantify social vulnerabilities associated with risk, but few focus on land tenure and ownership. Land tenure and its classification schemes vary across formal and non-formal, regulatory and extra-regulatory, cultural, geographical, and religious contexts, (Payne, 2004; see also Payne 2001, Feder and Feeny, 1991).

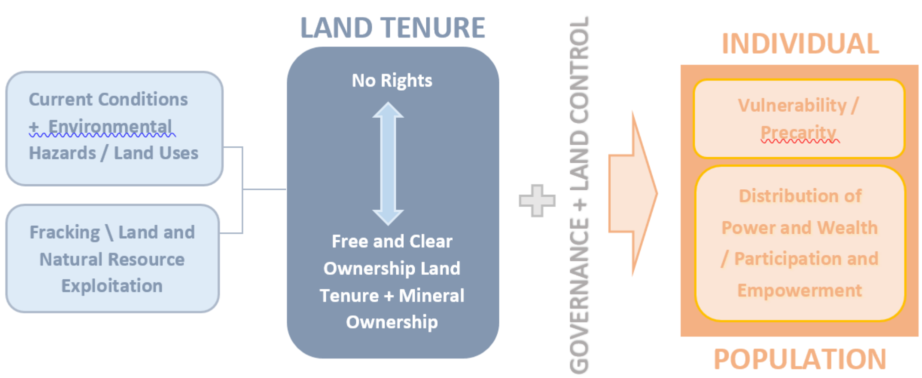
By identifying risk and vulnerability, this body of research draws on methodological tools such as GIS, spatial analysis, and qualitative research to illuminate various aspects of social vulnerability as it relates to other social, physical, spatial, or temporal phenomena (Cutter et al., 2003; Cutter 1996; Cutter and Finch, 2008). This, in turn, informs planning and policy building processes that can generate and sustain supportive systems for those communities (Adger et al., 2005; Blaikie, et al., 2014; Berke et al., 2015; Burton, 2015).

However, although some work has been done to better understand the breadth and scope of local planning government responses to fracking (Loh, C. and Osland, A., 2016), there is no consistent set of metrics or tools for understanding the complex impacts from fracking as well as government responses via land use controls. I will therefore draw on the broad definition by Wisner to guide my research and analyses:

> Generalized vulnerability is a characteristic of the poorest of the poor in every society, especially those who not only suffer income poverty [but] are also politically marginal (no voice in decisions that affect them), spatially marginal (resident in urban squatter settlements or in remote rural locations), ecologically marginal (livelihoods based on access to meager natural resources or living in degraded environments), and economically marginal (poor access to markets) (Wisner, 2013A, p. 258, as quoted in Wisner, 2016, p. 13).

The Figure 5.1 below describes how conceptually these pieces relate to and influence each other:

Figure 5.1. Conceptual Map



In my case, I drew from and adapted Social Vulnerability spatial assessments (Cutter, 2003) to develop tenure and ownership proxies. This approach, I argue, better reflects risks and benefits associated with extractivism experienced in various parts of the Texas–Mexico borderlands by highlighting degrees of informality (Roy, 2005). Informality is a characteristic not only of cities in the Global South but also of border spaces such as the Texas–Mexico border. In my analysis, I draw on Roy's (2005) epistemology of informality to develop and utilize *governance geographies* as both a spatial and analytical lens for this research. As an organizing concept, governance geographies are also useful to help unpack the complexities between land control, ownership, and who determines what one can do and not do with their property. Roy (2005) argues that who owns what (value, ownership, and property rights) is much more important in planning research that what is where (land use). Furthermore, planning analyses should shift away from proximity-based assessments that relies on just land use and socioeconomic data, as this privileges the power associated with wealth and access to resources. For rural and/or small counties in Texas, this is compounded by a lack of resources to generate data such as land use maps at the parcel scale, necessary for more granular vulnerability assessments.

Table 5.1. Theoretical Framework, Perspectives, and Methods

Bodies of Literature	Authors	Analytical Perspectives	Methods
Political Ecology	Michael Finewood Laura Stroup Anaya Roy	Multiple scales Impacts of political-economic processes on land rights and resource uses, distributions, and practices Incorporates both material and constructivist approaches Epistemology of informality Distributive Justice = property ownership, not land uses	(Q2) Planning, historical document (including property/mineral deeds), content analyses (Q1, Q2) GIS Spatial statistical analyses (Sensitivity and Social Vulnerability analyses) (Q1, Q2) Interviews, archival analysis/artifact, content analysis
Environmental Justice and Risk	Barry Flanagan Jason Coburn Philip Berke Susan Cutter Laura Pulido	Disparate impacts on socially vulnerable from hazards or events resulting from resource exploitation Community responses to impacts/injustices Incorporation of actors, institutions, and power	(Q1, Q2) GIS Spatial statistical analyses (Sensitivity and Social Vulnerability analyses) (Q2) Interviews (Q2) Planning, historical document (including property/mineral deeds), content analyses
Chicanx Studies	David Montejano Laura Pulido Gloria Anzaldua	Role of history of land development, tenure, culture and in border landscapes Environmental, economic, institutional racism Grounded, interdisciplinary praxis and activism in Chicanx border landscapes	(Q2) Interviews (Q1, Q2) Planning, historical document (including property/mineral deeds) content analyses (Q1, Q2) GIS Spatial statistical analyses (Sensitivity and Social Vulnerability analyses)

5.2. OVERVIEW OF RESEARCH DESIGN

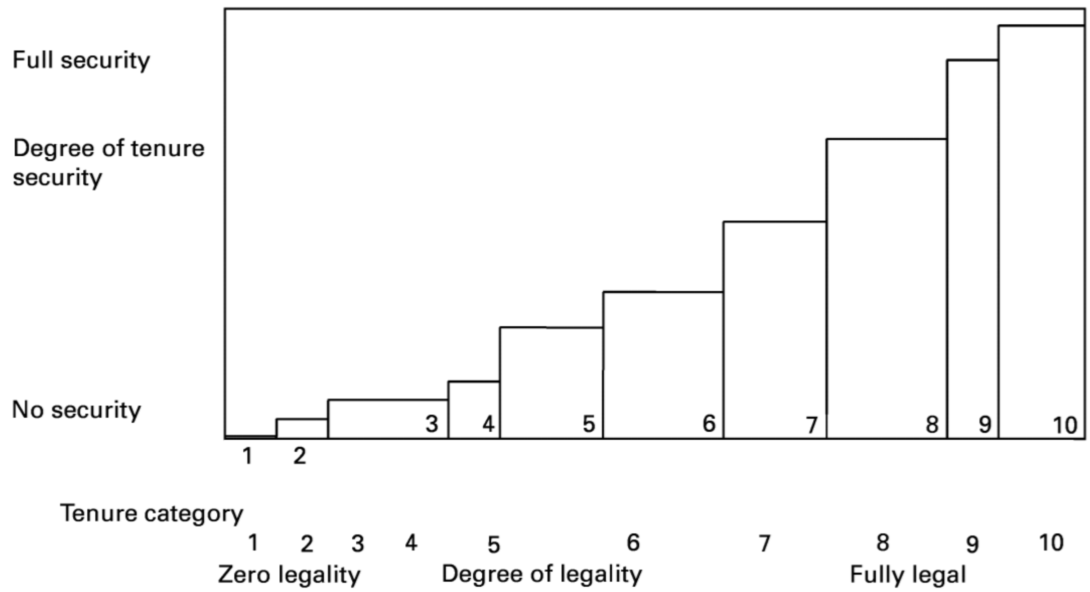
Current conditions and environmental hazards from fracking are all influenced by land tenure and mineral ownership. Who owns what, in combination with governance structures and political will and influence, yields an uneven distribution of power and wealth over time. It can also produce vulnerabilities and precarity, or a lack of stability, amongst those without access to the land wealth and political power derived from free and clear ownership of land and minerals. However, it is also possible to reduce social vulnerabilities via governance, rules, and regulations to mitigate harms from extractivism and redistribute power and wealth. Community participation and empowerment has the potential to directly contribute to the change of governance and political structures to better support the communities themselves. Below I will elaborate on each of these elements.

Land Tenure: From Free and Clear Ownership and Access to No Rights

By "tenure" I refer to a classification based on a range or degree of status in relation to land. More precisely, land tenure will be defined as "the mode by which land is held or owned, or the set of relationships among people concerning land or its product" (Payne, 2001, p. 416). Tenure classification schemes vary across formal and non-formal, regulatory and extra-regulatory, cultural, geographical, and religious contexts, but generally range from 'pavement dweller' to full private owner with legally dictated and recognized private property rights and access (Payne, 2004; see also Payne, 2001; Feder and Feeny, 1991). There are several categories of tenure that can be conceptualized as a spectrum where position along the spectrum is representative of the amount of rights and access an individual has to property. At the lowest end, Payne describes the person with the least secure with fewest rights to property as a pavement dweller. On the other end of the spectrum, an owner as the most secure with the full and clear ownership which provides access and rights to the property in question. Full and clear ownership of property means the owner has the ability to not only use the land as they see fit, but to fully benefit from the land via lease or sale of some aspect of the property (Payne, 2004; see Figure 4.2. below for Payne's classification scheme of tenure security as it relates to degree of legality).

Security of tenure in international development literatures typically refers to attainment and maintenance of particular rights. Furthermore, discussions of tenure security in development literature are inextricably tied to socially vulnerable populations, where the struggle for tenure security and rights is most pronounced and visible amongst poor and ethnic or racial minorities (ibid).

Figure 5.2. Typical Distribution of Urban Tenure Security by Legal Status



Tenure categories found in many cities:

1 Pavement dweller
2 Squatter tenant
3 Squatter 'owner' - un-regularised
4 Tenant in unauthorised subdivision
5 Squatter 'owner' - regularised
6 Owner - unauthorised subdivision
7 Legal owner - unauthorised construction
8 Tenant with contract
9 Lease-holder
10 Free-holder

NB: For simiplicity, this illustration deletes customary and Islamic tenure categories

Fig. 1. Typical distribution of urban tenure categories by legal status.

(Payne, 2001, table from p. 219)

When discussing "tenure" and "ownership" in this research, I am referring to the tenure categorization spectrum I have formulated below in Table 5.2. Tenure and Property Rights: Hierarchy of Rights and Access in Texas. I include mineral rights and ownership as rights assigned to mineral owners. These rights differ from surface rights. Both are aspects of 'property rights' in the state of Texas. In addition to Texas, states where minerals can be separated from the surface estate include Oklahoma, Pennsylvania, Louisiana, Colorado, New Mexico and others where oil and gas has been produced for decades. Mineral rights supersede other property and water rights in Texas.

Table 5.2. Tenure and Property Rights: Hierarchy of Rights and Access in Texas

	Access to Property	Access to Minerals	Access to Water	$ from property leasing	$ from mineral rights leasing	$ from access to water
Mineral Rights	Yes	Yes, Rule of Capture	Yes, Rule of Capture	No	Yes	Possible
Surface Rights	Yes	No	Yes, Rule of Capture	Yes	Yes	Yes
Property Lease Rights	Yes	No	Possible	Possible	No	Possible
Renter-Occupied Dwelling (renters' rights)	Possible	No	Possible	No	No	No

Table Sources: Theriot, 2012; Kulander, 2013.

Governance Geographies: Governance and Land Controls

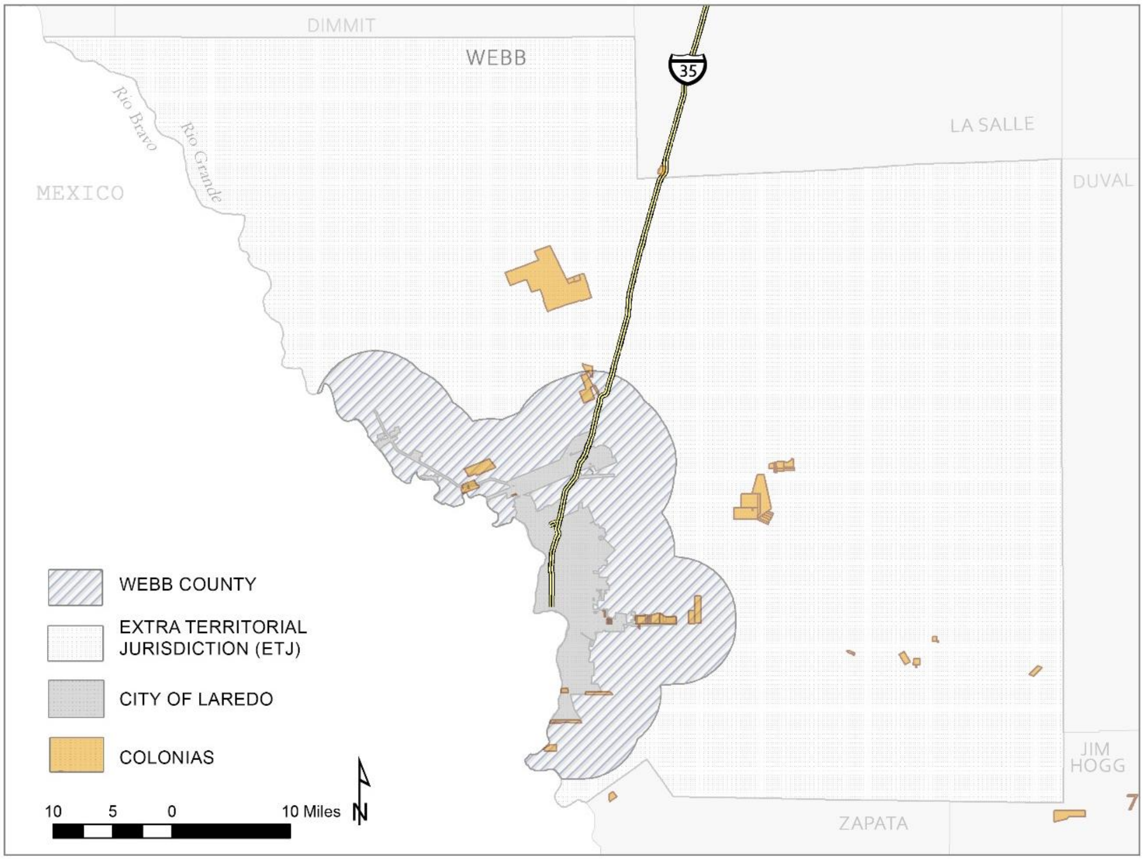
Governance is a critical conceptual and analytical component to my research design. Governance is one method of land control. Land control generally describes the manner through which land is accessed, contested, or taken away. Peluso and Lund define land control as:

> "…practices that fix or consolidate forms of access, claiming, and exclusion for some time. Enclosure, territorialization, and legalization processes, as well as force and violence (or the threat of them), all serve to control land. The mechanisms of land control need not always align, nor proceed in a singular, linear direction. They may be wielded in concert or competition with one another (Peluso and Lund, 2011, p. 668).

There are numerous formal and informal mechanisms to facilitate these processes. Conceptually, the role of land in a variety of structural processes has been an integral part of larger body of critical development and political economy scholarship that examines how "land control, alienation, and dispossession…played classic and contemporary roles in primitive and ongoing forms of accumulation" (Peluso and Lund, 2011, p. 668; see also Mann, 1990; Watts and Goodman, 1997). This Marxist interpretation of land and how its value as property is passed on to future landholders, which more clearly articulates some of the non-formalized mechanisms of the "primitive forms of accumulation" within a pre-modern capitalist society and market such as land dispossession during the transition from colonial to post-colonial society (Peluso and Lund, 2011). Many formalized mechanisms are institutionalized or codified within the context of a modern governance regime similar to Table 4.2. Tenure and Property Rights: Hierarchy of Rights and Access in Texas. Given the complex and, at times, conflicting nature of land as life-sustaining, wealth-generating, and political power-generating, focusing on the role of governance within my methodology provides insights into not only the physical and spatial aspects of vulnerability but also the deeper socio-political and historical drivers of such vulnerabilities.

Who benefits from and who does not benefit from the delineation of rights and access to property reflect the ways rules and regulations produce vulnerabilities. This highlights the power (or lack of power) of actors involved in any aspect of a governance regime that can choose how to prioritize life and wellbeing, wealth creation, and the maintenance of power. With this in mind, I examine the complexities of land tenure via what I call in this dissertation ***governance geographies***, which are essentially typological spatial boundaries as proxies that explicitly affirm certain aspects of governance for land control (as shown in Figure 5.3.1): (1) jurisdictional boundaries and (2) border colonias.

Figure 5.3. Governance Geographies: Jurisdictions and Colonias



Map Created by A. Christina Wirsching. Data Sources: State of Texas, Office of Attorney General, Texas Natural Resources Information Service, Texas Department of Transportation.

Jurisdiction boundaries: County, ETJ, Incorporated/Municipality

In Texas, municipalities like Laredo, Webb County's seat, can make their own laws. As a home rule city, as with most of the municipal jurisdictions in Texas, the City has full power to create its own rules, regulations, and code as deemed by the state constitution[62]. Cities' abilities to make their own rules and enforce them can be restricted or removed in specific instances to not be in conflict with state law. For land control associated with private property, cities' authority to exercise planning powers "for the purpose of promoting the public health, safety, morals, or general welfare and protecting and preserving places and areas of historical, cultural, or architectural importance and significance.[63]" Table 5.3. Texas Zoning Regulatory Power details broad zoning powers in the Texas Local Government Code Section 211.003.

Table 5.3. Texas Zoning Regulatory Power[64]

1. The height, number of stories, and size of buildings and other structures;
2. The percentage of a lot that may be occupied;
3. The size of yards, courts, and other open spaces;
4. Population density;
5. The location and use of buildings, other structures, and land for business, industrial, residential, or other purposes; and
6. The pumping, extraction, and use of groundwater by persons other than retail public utilities, as defined by Section 13.002, Water Code, for the purpose of preventing the use or contact with groundwater that presents an actual or potential threat to human health.

In 2015, however, the Texas Legislature effectively ceased cities' power to ban oil and gas activities ("fracking") as a response to City of Denton's efforts after voter referendum to ban fracking in their city limits[65]. City governments still have the ability to do things like regulate fire and emergency response, traffic, lights, and noise if the rules are

[62] https://www.tml.org/DocumentCenter/View/244/Types-of-Texas-Cities-PDF
[63] American Planning Association, Texas Chapter. *A Guide to Local Planning, 2013*. Accessed online at https://txplanningguide-ojs-utexas.tdl.org/txplanningguide/index.php/tpg/article/viewFile/39/27
[64] American Planning Association, Texas Chapter. *A Guide to Local Planning, 2013*. Accessed online at https://txplanningguide-ojs-utexas.tdl.org/txplanningguide/index.php/tpg/article/viewFile/39/27
[65] Malewitz, Jim. 2015. "Curbing Local Control, Abbott Signs 'Denton Fracking Bill'" in the *Texas Tribune*. Accessed online at https://www.texastribune.org/2015/05/18/abbott-signs-denton-fracking-bill/

"commercially reasonable"[66]. Counties, on the other hand, are only allowed to do what the state says is permissible. So, the county is at the mercy of the state for rules and regulations, as well as funding and support for any enforcement which it also has to coordinate with state and federal agencies (in accordance with their rules and regulations).

Differences in jurisdiction in Texas can mean vast differences in approaches to enforcement and mitigation of any damages effects to people or property resulting from close proximity to hazardous sites like active well pads. The Texas Railroad Commission has jurisdiction over permitting of wells, pipeline oversight, and enforcement of rules related to adhering to state statues that include safety in design and execution of well exploration, production, and cessation (plug the well). Most environmental complaint reporting is under the purview of the Texas Commission on Environmental Quality. By state statue, the county government has to follow state laws and cannot make its own rules and regulations. In Webb County, there is a planning department that works closely with federal and state programs such as FEMA (floodplain management and development permitting), and which can also issue permits related to electricity hookups and minimum setbacks as dictated by the state. However, county governments have the least amount of regulatory and enforcement powers in the state. Given the unique socioeconomic conditions of the border region where Laredo is one of the least diverse cities in the country, with over 95% of its population identifying as Hispanic[67], and one of the most economically segregated communities in the country[68], effects from any negative impacts from oil and gas activities can be disproportionately felt amongst more vulnerable

[66] Malewitz, Jim. 2015. "Curbing Local Control, Abbott Signs 'Denton Fracking Bill'" in the *Texas Tribune*. Accessed online at https://www.texastribune.org/2015/05/18/abbott-signs-denton-fracking-bill/

[67] American Community Survey / US Census Factsheet for Laredo, Texas. Estimates for 2018 Accessed online at https://www.census.gov/quickfacts/fact/table/laredocitytexas/PST045218

[68] Gabriela A. Treviño, "No. 1 ranking: Laredo's wealthy are most segregated", *Laredo Morning Times*, April 20, 2015, pp. 1, 17A

populations in Webb County. Using jurisdictional boundaries ass proxies for variation governance, I am able to then spatially delineate specific drivers (such as sites of high risk) in relation to highly vulnerable populations and the ability of a local or county government to enforce and mitigate (or punish) any negative harms that are a result of oil and gas operations.

Texas Border Colonias

In Texas, the border phenomena known as *colonias* dot the entire span of the U.S.–Mexico border. I use colonia geographies as proxies to indicate informalities and precarities associated with land tenure, use, and governance (including rigid, visible jurisdictions) that exists along the border. Colonias have been described as low-income, informal, self-help housing subdivisions that are located on inexpensive land, have inadequate infrastructure, and are built through self-help dwelling construction (Ward, 1999, p. 1). These are subdivisions that provided affordable plots of land via ‘contract for deed’ for migrant worker families with landowners that did as little as possible to maintain properties, provide adequate infrastructure for health and safety of the property tenants, and ultimately contribute to complications to obtaining a clear title. There are over 2,000 in Texas, with 66 in Webb County (Texas Secretary of State, n.d.).

Spatial Configurations of Vulnerability and Precarity: Inequitable Distributions of Power and Wealth

Understanding the spatial extent of vulnerabilities requires, in part, an understanding of distributions of wealth and power. Many vulnerability assessments use proxies such as home or property ownership, poverty status, and other socio-economic indicators. In this dissertation, I argue that typical assessments of vulnerability do not adequately capture that nuanced and complex ways distributions of power and wealth permeate this border extractive landscape.

Considering the role of land in generating wealth and power throughout the last few hundred years, incorporation of land tenure can better illuminate such distributions of wealth and power as they related to various vulnerabilities. Land is not just a way of life, source of sustenance, power, and wealth. Land controls can therefore be thought of as the modes through which power and wealth are derived, distributed, and in many cases violently taken from politically, socially, and economically marginalized people:

> "New mechanisms of land control and new actors notwithstanding, practices and technologies of governance and control, subtle or violent, are still employed to acquire, secure, and exclude others from land in intense competitions over control. In many cases, the competition for land control has become no less important to its contenders with the passage of time" (Peluso and Lund, 2011, p. 668).

Governance geographies therefore are a useful lens through which comparisons can be made various elements of vulnerable spaces, but also examine these formal land controls via rules and regulations, which ultimately determine who and what gains will be made and at whose and what's expense.

My dissertation methodology is predicated on and builds upon the conceptualization of social vulnerability as a product of a combination of structural and historical aspects of a landscape can be determined by its socioeconomic and geographic characteristics. Outside of planning, there are strands of social science scholarship that examine vulnerabilities as a part of critical political ecology, postcolonial studies, and critical development studies. Most of this research is focused in the Global South (Rigg et al., 2016; see for example Korf, 2004; Wisner et al., 2004; Adger, 2006; Cannon et al., 2003; Bankoff, 2001; Hickey and du Toit, 2007; Ambinakudige, 2009). Upton summarizes debates ranging from the relationship between vulnerability and development, the connections between and dichotomies of the Global North and South, as well as participation and agency as strategic responses to counter vulnerabilities (Upton, 2006).

Precarity is typically defined as instability or insecurity (Waite, 2009, p. 412). In this research, I also draw from literature that defines precarity in relation to vulnerability and risk as this is one of the more common concepts used to describe potential exposure to risk from both hazardous events of varying time and spatial scales (Rigg et al., 2016).

Figure. 5.4. Vulnerability and Precarity (Rigg et al., 2016)

Drawing a line between vulnerability and precarity.

	Character of Exposure	
	Vulnerability (inherited exposure)	Precarity (produced exposure)
Environmental	– Occupation of marginal, hazard prone land – Small landholdings – Steep, poor quality land in the hills which limits agricultural productivity – Absence of irrigation technologies	– Dispossession of (and from) land – Commercial logging and associated soil degradation – Resettlement on marginal lands – Chemicalisation of agriculture – Loss of biodiversity
Economic	– High dependency on agriculture – Lack of access to credit – Lack of access to markets	– Unsustainable levels of debt – Market dependencies – Growing inequalities between rich and poor – Out-migration
Political and socio-cultural	– Caste system and associated marginalisation – Gender divisions in society – Participatory exclusions – Lack of empowerment – Feudalism, lack of land reform	– Erosion of the community covenant (moral economy) – Falling fertility rates, ageing population – Emergence of multi-sited households and crisis of care for elderly – Left-behind children
Poverty	Old poverty	New poverty

Though Riggs et al. distinguishes between inherited and produced exposure, this research highlights the possibility of empirical and conceptual distinctions between precarity and vulnerability. Typical vulnerability assessments like the one I use do not necessarily draw distinctions between vulnerability and precarity. However, when a vulnerability assessment is one piece of a multi, mixed method case study that also incorporates from histories of land tenure, ownership, and governance, the nuance between these concepts as aspects of exposure to risk is more evident. Rigg et al.'s distinction, or categorization scheme, within the context of a mostly homogenous majority-minority population (identifying as Hispanic/Latino), and a land tenure with uniquely Texan governance histories that still imbue its colonial past, a methodology that attempts to elucidate nuance and complexity would be much more appropriate.

Therefore, my research design incorporates a methodological conceptualization of social vulnerability, with a critical theoretical conceptualization of vulnerability that acknowledges the complex relationships between human–environment and socio-political interactions that is multi-scalar and contingent on the historical, local contexts of a place. The following two chapters trace the methodology for answering each of the subquestions as well as the results of the methods used. In Chapter 6: Identifying and Understanding Vulnerabilities, I first detail the methods used for each subquestions 1A and 1B, first described in Table 5. 1. Theoretical Framework, Perspectives, and Methods, as they relate to assessing social vulnerabilities to hazards from oil and gas development. I then discuss the results of each. I do the same for Chapter 7: Vulnerability, Precarity, and Land, where in answering questions 1C, 2A, and 2B, I explicitly incorporate the role of land tenure and governance by expanding my methods and epistemological approach to include qualitative methods that draw attention to the multi-scalar, historical, and distributions of power that produce vulnerabilities and are all derived from the land.

Chapter 6: Using Vulnerability Assessment and Multi-Hazard Suitability Analysis to Assess Impacts of Fracking

The purpose of this chapter is to describe the Vulnerability Assessment and Multi-Hazard Suitability Analysis methods I used to identify vulnerable areas in relation to oil and gas activities. The first section of this chapter delves into the justification for methods used to answer my research question number 1 and its subquestions:

> **Research Question 1:** What areas of Webb County are socially vulnerable to hazard exposure and structural vulnerabilities associated with oil and gas activities?
>
> **Q1A**: What areas are socially vulnerable within extractive areas?
>
> **Q1B**: Where are these areas located geographically in relation to hazard exposure and structural vulnerabilities associated with oil and gas activities?

I then detail my methodology for answering each subquestion, including the data used with justification for it. First, I perform a Vulnerability Assessment (Section 6.1) to identify socially vulnerable areas to answer Question 1A. Next, I conduct a modified[69] Multi-Hazard Suitability Analysis (Section 6.2) to identify socially vulnerable areas with the greatest exposure to risks associated with oil and gas development to answer the second portion of Question 1A, as well as Question 1B. In conclusion, I present the results of the analysis and discuss the limitations of the methods and data used, including which data I do not use and why.

[69] The limitations to getting appropriately scaled data with a large enough population size, and then performing this analysis are discussed further in this chapter and also in Chapter 7.

6.1. VULNERABILITY ASSESSMENT

As mentioned above, I conducted a vulnerability assessment for Webb County to identify socially vulnerable areas. I referred to the work by Berke et al. (2015), as well as Flanigan et al. (2011), in determining which datasets are appropriate for which variables, as well as the methodology for indexing the variables and spatially interpreting and representing them. Below, I first briefly trace the genealogy of vulnerability mapping and data selection for creating indexes and then describe how I developed social vulnerability indexes and models.

Genealogy of Social Vulnerability Mapping

Vulnerability has been defined by risk of exposure to some kind of harm and an inability to adequately respond to such events. Hazards sciences define vulnerability generally as the "to susceptibility or potential for experiencing the harmful impacts of a hazard event" (Cutter 1996; Mitchell 1989; as quoted in Van Zandt, et al 2012). The concept of vulnerability was associated with hazards research and analysis (see for example White, Kates, and Burton 2001) as far back as the 1970's (Blaikie et al., 1994; Van Zandt, et al 2012). The main goal in the last 20-30 years of research has been to incorporate other aspects of communities that are representative of more than just physical elements across scales and time horizons associated with risk from hazardous events.

Hazards researchers wishing to recognize the various systems at play (beyond nature as the source of the harm) began to explore and model these complexities by examining social vulnerability:

> "the 'natural' and the 'human' are so inextricably bound together in almost all disaster situations, especially when viewed in an enlarged time and space framework, that disasters cannot be understood to be 'natural' in any straightforward way" (Blaikie et al. (1994, p. 5).

This aspect of the dynamic relationship between the humans and nature has been to some extent challenged and explored for the last several decades across many fields of study beyond hazards, including political economy and political ecology. It is worth noting here that there are also similar threads of scholarship on the human socio-cultural elements of potential impacts from hazardous events and disasters, notably in environmental justice scholarship (Van Zandt et. al, 2012, p.31; e.g., Bullard 1990; Bryant and Mohai 1992; Pastor et al. 2006). Therefore, drawing from an environmental justice informed framework for this kind of research is both valid and informative.

Developing Social Vulnerability Indexes and Models

Over the last couple of decades, advances have continued in the work to identify and evaluate risk to hazards and vulnerabilities by examining human, built, and natural systems, (Berke, et al, 2018; see Table 6.1). Just as there are many different iterations of social vulnerability indexes and assessments, there are many different approaches to determining indicators to be used in creating these indexes.

Table 6.1. Genealogy of Social Vulnerability Mapping: Sampling of Influential SV Models[70]

Models / Indicators	Scholars/Researchers	Year
Vulnerability and Resilience	e.g. King and MacGregor 2000; Birkmann 2006a	2000's to present
Disaster Risk Index	UNDP, 2004	
Environmental	Esty et al. 2005	
Social Vulnerability Index	Cutter et al., 2010; de Oliveira Mendes 2009; Finch et al. 2010; Holand et al. 2011	
Human Development index	UNDP, 2010	

Of the many assessments of such tools and indicators, Tate has been the most useful in distilling my approach to my research methodology. It should be said that there are many possible variables that can be chosen, informed by place, availability of data, and so on, in addition to the informed decisions made by the researcher. Tate (2012) captures this dilemma between a universally deployed set of variables and data that work for every site and scale and being unique enough to reflect local contexts:

> "there are no established rules for social vulnerability index construction previous studies have helped define a set of potential options for each stage. It is the differences in these choices that distinguish different social vulnerability indices." (p. 327)

[70] Information, though not exhaustive but representative of the breadth of indexes and indicator development related to social vulnerability, compiled for this table are from Berke, et al., 2018; Blaikie, et al 1994, and Van Zandt et al., 2012

Data Organization and Processing for Analyses

The socioeconomic characteristics of these more socially vulnerable populations a generally grouped into categories depending on the model or types of data used. The U.S.'s Centers for Disease Control (CDC), which oversees the U.S. Agency for Toxic Substances and Disease Registry (ATSDR)'s Geospatial Research, Analysis & Services Program (GRASP) program, categorizes data into the following thematic groups: socioeconomic status, household composition and disability, minority status and language, and housing and transportation (2017). Their intent for the dataset and tool they create and publish is "to help emergency response planners and public health officials identify and map communities that will most likely need support before, during, and after a hazardous event"[71]. The variables I used are categorized in a manner similar to Flannigan, which is then useful for interpreting and understanding the relationships between the variables, indexes, and their spatial distributions.

Table 6.2. Categorized Variables for Social Vulnerability Assessment[72]

SOCIOECONOMIC STATUS	Poverty Family Composition Age Educational Attainment
HOUSEHOLD COMPOSITION	Housing Tenure (renter and owner occupied) Parent Status
RACE / ETHNICITY / LANGUAGE	Race and Ethnicity Language
HOUSING/ TRANSPORTATION	Housing Unit Home Structure

71 https://svi.cdc.gov/factsheet.html

72 Adapted from Flanagan et al. (2014) and CDC Agency for Toxic Substances and Disease Registry SOVI 2014 Documentation (2017)

For this research, I referred to the CDC SOVI 2014 Documentation (2017), Eric Tate's comprehensive assessment of social vulnerability indices (2012), and Philip Berke, Galen Newman, Jaekyung Lee, Tabitha Combs, Carl Kolosna, and David Salvesen's "Evaluation of Networks of Plans and Vulnerability to Hazards and Climate Change: A Resilience Scorecard" (Berke et al., 2015). For the Social Vulnerability Analysis, I first downloaded U.S. Census American Community Census 5 year (2009-2013) for block groups in Webb County. I chose this particular dataset since it was the most recent set as of 2017 that was also the most granular in scale for Webb County. Census tracts in Webb Count vary greatly in size and population, so the selection of this dataset needed to account for the census geography's disparities in size and population. I downloaded and used the Webb County 2010 block group shapefile from TNRIS (Texas Natural Resource Information System)[73]. I then cleaned the data and created a spreadsheet to use for my analysis. Since social vulnerability uses socioeconomic data to determine vulnerability, I used the following elements: tenure (renter and owner occupied), poverty, race and ethnicity, educational attainment, language, age, parent status, family composition, housing unit, and home structure. I mapped each of these elements and described them in further detail in the Appendix.

Data Sources and Mapping Social Vulnerability Indexes

There are different approaches and methods to generating vulnerability indices. Generally, vulnerability indices use demographic data to better understand "the effect of

[73] All spatial data is projected or reprojected to Projected Coordinate System—NAD 1983 State Plane South Texas 4205 (US feet), Lambert_Conformal_Conic

social, economic, political, and institutional factors on the spatial distribution of human susceptibility to hazard impacts" (Tate, 2012, p. 326). Over the last 50 years or so, these indices have become much more complex, nuanced, and robust in identifying areas with high risk to various kinds of environmental hazards. The main goal has been to help planners and public health officials better plan for a hazardous event, determine evacuation routes, determine how many may be exposed to an air contaminant, and so on. The literature I mostly refer to for my research methodology is derived from or inspired by Susan Cutter's Social Vulnerability Index (1996). Cutter developed an indexing methodology to determine the vulnerability of certain populations with specific characteristics that ultimately affect their capacity and resources to respond to hazards (Berke et al., 2015, p. 290). Some models utilize dozens of indicators or proxies for indicators. The list of indicators chosen for this project have been tailored to what is available for my study area, Webb County, Texas, given constraints in obtaining datasets that were appropriately scaled with enough of a study sample size (*n*) to be useful. See Table 6.2. Socioeconomic data for vulnerability analyses for all elements of used, including the field name, description, table ID and data source.

Table 6.3. Socioeconomic Data for Vulnerability Analyses[74]

Field Label	Field Name	Description	TableID	Data Source
GEOID	-	Text joining table field	-	ACS 2009-2013, 5 yr
GEOID2	-	Text joining table field	-	ACS 2009-2013, 5 yr
Rentocc	Renter Occupied	Renter Occupied	B25003	ACS 2009-2013, 5 yr
own_occ	Owner Occupied	Owner Occupied	B25003	ACS 2009-2013, 5 yr
pov_total	Total Poverty	Total Poverty	B17017	ACS 2009-2013, 5 yr
pov_incomebelowpov	At or Below the Poverty Rate	At or Below the Poverty Rate	B17017	ACS 2009-2013, 5 yr
totalraceethni	Total Race and Ethnicity	Total Race and Ethnicity	B03002	ACS 2009-2013, 5 yr
Minority	All but non Hispanic white	Minority population = Total pop - whitenonhisp	B03002	ACS 2009-2013, 5 yr
tenure_total	Total Tenure	Total Tenure	B25003	ACS 2009-2013, 5 yr
edattain_total	Total Education Attainment	Total Education Attainment	B15003	ACS 2009-2013, 5 yr
edattain_lessHS	Less than HS Diploma	Sum of all without HS and below	B15003	ACS 2009-2013, 5 yr
age_total	Total Age	Total Age	B01001	ACS 2009-2013, 5 yr
total17under	17 or younger	All 17 years and younger	B01001	ACS 2009-2013, 5 yr
total65older	65 or older	All 65 years and older	B01001	ACS 2009-2013, 5 yr
famWkids_total	Total household members = families and kids	Total household members = families and kids	B09002	ACS 2009-2013, 5 yr
singleparentfam	Single Parent Families with kids under 17	Household members with single parent families with kids	B09002	ACS 2009-2013, 5 yr
total units	Total Units	Total Units	B25032	ACS 2009-2013, 5 yr
mobilehomes	Total Mobile Homes	Total Mobile Homes	B25032	ACS 2009-2013, 5 yr
multiunit	Total with 5 or more units	Pop in mulifamily housing with 5 or more units	B25302	ACS 2009-2013, 5 yr
languageall	All Language (total)	All Language (total)	B16004	ACS 2009-2013, 5 yr
poorenglish	Language	English 'not well' and worse	B16004	ACS 2009-2013, 5 yr
Totpop	Total population	Total population	B03002	ACS 2009-2013, 5 yr

Indices are useful because they identify where features or indicators are located in relation to the rest of its distribution. I am using a deductive model, Social Vulnerability Index (SOVI), to generate these indices (Tate, 2012; Flanagan et al., 2011). There are 10

[74] See APPENDIX: For each indicator I indicate which specific literature supports its selection for this research and briefly detail what is done to prepare each dataset for use. I also mapped each variable for reference and context.

indicators and 141 Census block groups (n) in Webb County. "Totals" were derived from the same table as the indicator (or element) in order to derive rate, average, or percent. All nulls were turned into zero (Flanningan et al., 2011; CDC, 2017). To perform the Social Vulnerability Indicator analysis, I first had to generate a percentile rank to delineate where each feature/indicator was within its full distribution. I did this in Excel using the RANK function and applied the following formula to each indicator (feature, field) from highest to lowest across all census groups:

= Rank (cell, matrix)

I then used **WebbCo_SOVI_blkgrp_2013_v2.shp** for analysis where I was able to join **WebbCo_SOVI_blkgrp_2013_v2.xls** spreadsheet with the ACS data. After ranking each indicator, then applied the formula for the index:

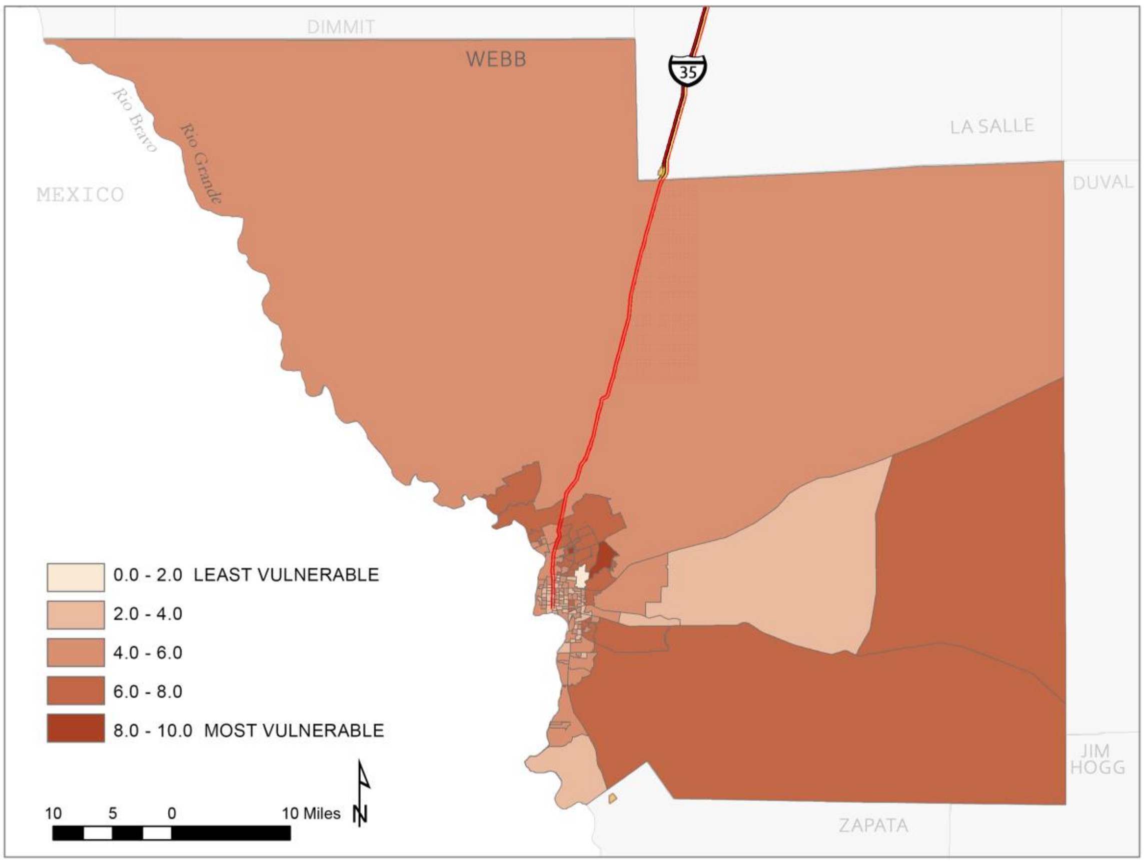
(Rank-1)/(n-1)
n = 141

I then use a ‘flag’ count procedure the CDC uses (Flanagan, 2012), or weights, as a means through which I can draw emphasis to highly vulnerable areas. Following Berke (2015), I took all indicators at the 85th percentile (.8500) and higher and made it a 1. I then calculated the sum of all weighted SOVI’s to produce the Total SOVI. These are all mapped in the Appendix.

Social Vulnerability Indexing and Analysis Results

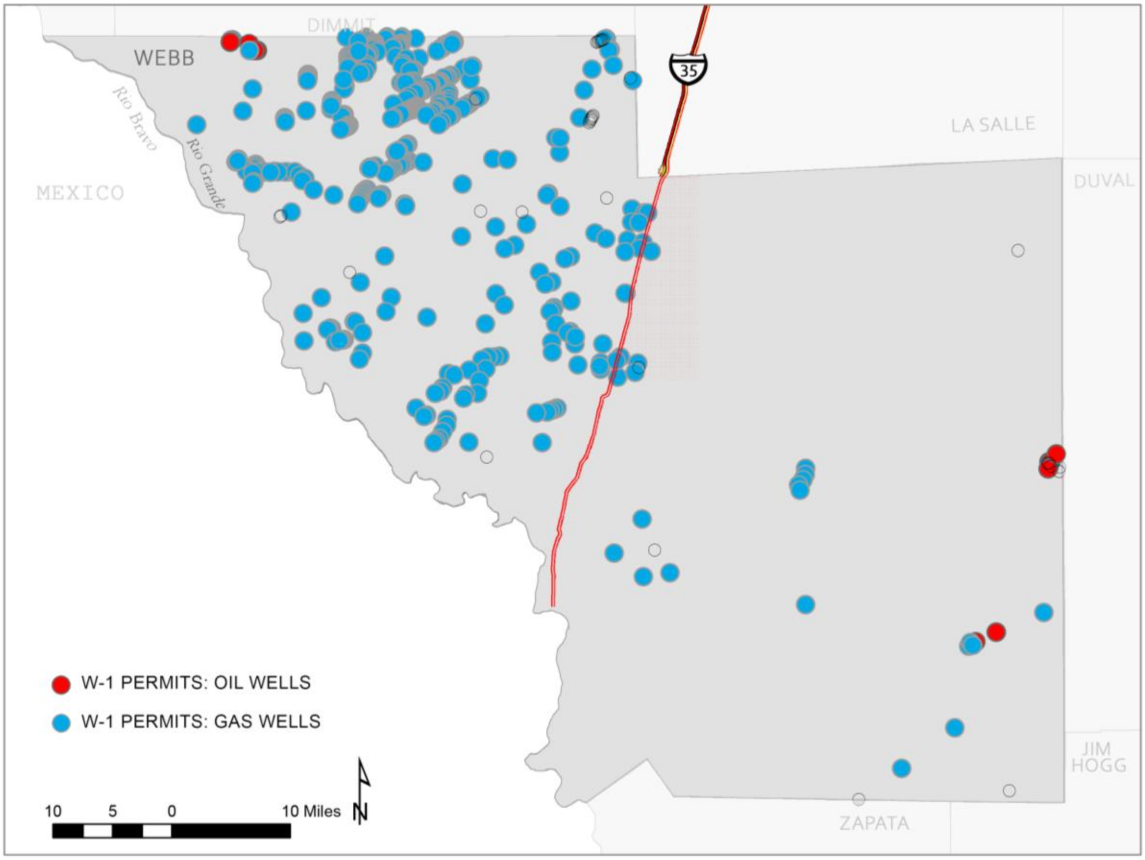
The resulting SOVI map reflects higher poverty, more minority, more renters (versus owner-occupied, tenure), and location in recently annexed ETJ to city (see “Jurisdictions” map in Appendix), County to ETJ, land in outside of the denser downtown (see "Population Density" map in Appendix), southeast along the border, and farther east areas around the city. As a proxy for oil and gas activity in the county, I am comparing the SOVI map to the Oil and Gas Wells (W1 Permits) locations below.

Figure 6.1. Socially Vulnerable Areas (SOVI), 2013[75]



75 Map Sources: American Community Survey 2009-2013 for the Social Vulnerability Index (SOVI) identified areas as vulnerable where the block groups' symbology represents equal interval indexed scores with the Most Vulnerable as the darkest with score closest to 10. The second map is the oil and gas well permits (W-1 permits) from the Texas Railroad Commission for 2013. During this particular year, the shale boom is evident in the density of number and location of gas wells (blue dots) which is along the Eagle Ford Shale in the northern part of Webb County.

Figure 6.2. Oil and Gas Wells, 2013[76]



It is clear that a substantial amount of activity during this snapshot in time is in the northernmost portion of the county. This area, which is dominated by shale gas exploration and production, is also located in the southern portion of the Eagle Ford Shale deposit. This data reflects the period before the 'bust' in 2014–2016 in unconventional shale oil and gas

76 Map Sources: American Community Survey 2009-2013 for the Social Vulnerability Index (SOVI) identified areas as vulnerable where the block groups' symbology represents equal interval indexed scores with the Most Vulnerable as the darkest with score closest to 10. The second map is the oil and gas well permits (W-1 permits) from the Texas Railroad Commission for 2013. During this particular year, the shale boom is evident in the density of number and location of gas wells (blue dots) which is along the Eagle Ford Shale in the northern part of Webb County.

when it was financially most advantageous to extract relatively expensive unconventional products.

SOVI Limitations within this Context

Some limitations are plainly visible on the resulting map. Limitations from the difference in sizes of the block group geographies is the most visible when comparing urban block groups to rural block groups in the outer edges of the country outside of the city limits. This is a result of the vast difference in population density and size as determined by the U.S. Census. Granularity and a high *n* with large spatial datasets are very important in these kinds of assessments, and such disparities in spatial extent of geographies used (block groups) skew the resulting maps. More granular datasets that were available were much older and not as useful given the boom-bust pattern of economic growth and decline in the oil and gas producing portions of the county which also happen to be located within these problematic, rural large block groups in the periphery. Furthermore, another substantial limitation is matching the appropriate timeframe for each dataset. This becomes more evident as I proceed through the rest of the methodological procedures and analysis for the subsequent GIS data in this dissertation.

6.2. Multi-Hazard Suitability Analysis

Suitability Analysis is a simple but powerful method to determine the best areas or sites that fit specific criteria. Suitability analysis, commonly used in planning practice, has more recently also been described as multi-criteria decision analysis (sometimes referred to as MCDA). For this research, I performed a suitability analysis to better understand risk associated with oil and gas production and vulnerable communities. The least desirable areas are those associated with hazards from oil and gas, which are similar to other industrial land uses. In combination with the SOVI areas that are the most socially vulnerable, we can see a more complete picture of the social and environmental aspects of vulnerability within this context.

Table 6.4. Elements of Multi-Hazard Suitability Analysis

SOCIAL VULNERABILITY	
SOVI Total	Reclassified to 0-10, with 10 as most suitable, 0 as most vulnerable
Data Sources	American Community Survey 2009-2013
OIL AND GAS ACTIVITIES	
Wells	500, 1000, 1500 ft buffers, reclassified to 0-10, 10 most suitable, 0 most vulnerable
Pipelines	500, 1000, 1500 ft buffers, reclassified to 0-10, 10 most suitable, 0 most vulnerable
Data Sources	Texas Railroad Commission
ENVIRONMENTAL HAZARDS	
Flood Plain	10 is most 'suitable' area; all zone A's are 0
Major Roads	Buffers at .25, .5, and 1 mile, reclassified to 0-10, 10 most suitable, 0 is least suitable
Data Sources	Texas Commission on Environmental Quality; Texas Department of Transportation

The elements and parameters used in this analysis were chosen using Berke et al. (2015), as well as data availability and appropriateness based on granularity and scale. GIS raster data makes a suitability analysis of a discrete but continuous area a powerful analytical tool. This requires rasterizing data that is in vector format. The majority of environmental hazards data is in vector format, as well as the Total SOVI map(s) I generated and described above. After rasterizing each element, or layer, we can determine the best (or worst areas) for each element. We can also add weights in the calculations to any indicator (similar to a coefficient). These assigned weights and adds importance to that particular indicator in relation to others in the equation[77]. The values for each cell are then added to the same cell values for each layer, yielding a composite map with the least or most desirable areas identified with the lowest or highest values (counts) for each cell. I used the following equation, with equal weights, in Raster Calculator sessions for the Suitability Analyses:

SOVI Most Socially Vulnerable + Proximity to Pipelines + Proximity to Wells + Proximity to Transport (Roads) + Proximity to Flood Prone Areas

I then used the Suitability Analysis results to determine which areas are the most vulnerable. I describe each of these elements in more detail below: SOVI Most Socially Vulnerable, Proximity to Pipelines, Proximity to Wells, Proximity to Transport, and Proximity to Flood Prone Areas. I used the following indicators as proxies for determining risk to vulnerable populations: proximity to pipelines, proximity to wells, proximity to transport (Roads), and proximity to flood prone areas. It is worth noting that I obtained and used TRRC data from 2013[78], 2013 ACS five-year demographic and economic data, as well as transportation data, to stay within the same time period in order to add validity to the dataset. I include at the end of this section a brief discussion on the proxies I used, I did not use, and why.

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[77] I did not add weights as there are several different methods and approaches to determining weights for each type of indicator. It was my intention to stay as true to the available data as possible and not introducing additional variation that can ultimately limit the study's validity in both the ability to compare to similar studies and the ability to reproduce this study.

[78] TRRC Permit Querries: DRILLING PERMIT (W-1) QUERY (yield CSV file), County: WEBB, Approved Date from: 01/01/2013, Approved Date to: 12/31/2013

Most Socially Vulnerable: Social Vulnerability (SOVI)

Since suitability analyses require data to be in raster format, the first task was to rasterize the Social Vulnerability Index analysis (SOVI) map.[79] I then reclassified the rasterized social vulnerability map[80] using five equal intervals. I assigned them the values of 0 as the least suitable, and 10 as most suitable[81.] I then selected and extracted values for Webb County (which is necessary for processing).[82, 83]

Wells Data, Texas Railroad Commission

For the wells data, I requested and downloaded compiled geospatial data set from Texas Railroad Commission[84]. The digital map data included Base Map, Wells, Surveys & Pipelines[85], and I also downloaded permit data by querying the TRRC database in 2013[86]. I am using 2013 ACS 5-year demographic and economic data, as well as transportation data, to stay within the same time period in order to add validity to the dataset. After consulting with the TRRC staff, I chose to look at W-1 drilling permits and join that to the shapefile[87]. I was then able to identify different aspects of well completion from the 2013 wells that were permitted for drilling[88]. Once I identified all of the 2013 wells, I applied

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[79] SOVI_total as the input feature and I designated the raster's resolution as cell size of 10 m.
[80] SOVI_total
[81] 0 as least suitable, 4, 6, 8, and 10 as most suitable
[82] Extracted to Webb County shapefile Extract_SOVItot.
[83] I repeated this same process for the Sensitivity Analysis maps for housing tenure, SOVI Tenure at 1 and SOVI Tenure at 0. These are discussed in the next chapter.
84 Obtained via RRC FTP June 16 2016
[85] This dataset also included API Data as both a ASCII data file and dBase (.dbf) file containing the API number, survey name, well number, lease name, lease ID number, completion date, and plug date.
[86] TRRC Permit Queries: DRILLING PERMIT (W-1) QUERY (yield CSV file), County: WEBB, Approved Date from: 01/01/2013, Approved Date to: 12/31/2013
[87] That required creating different iterations of the well API number as the permits contained different parts of the API number compared to the shapefile which had the full API number sans the state identified (42 is Texas). I did these outside of ArcGIS in Excel using Text to Column.
[88] The types of Completion status from TRRC W-1 app are (1) 1st side of mult/rule10 (none), (2) Cathodic completion, (3) Dry hole, (4) P&A (plug and abandon) exploratory test, (5) Final completion, (6) Unperfed completion.

500-foot interval buffers[89,90] (Berke et al., 2015). Many municipalities and/or states have attempted to regulate oil and gas via setbacks of around 1000 ft[91]. In 2015, the Texas legislature passed legislation that required municipalities defer to state rules and regulations for oil and gas well operations. This means that minimum setbacks in Texas, including for sensitive populations and locations like proximity to a drinking water source, are 200 feet without a variance[92] (Haley et al., 2016). For the most part, however, local municipalities are given leeway in determining their own setback rules for wells since that particular state statute is limited to municipal leases[93].

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[89] 500, 1000, 1500, and 2000 foot buffers

[90] I then rasterized the resulting polygon layer to 10 pixel cell size. I reclassified the raster using the following: 500 feet = 0, 1000 feet = 2, 1500 = 4, No data / everything past 1500 feet = 10. Again, the least desirable, or shortest distance if any, is reclassified as 0. I then Used Extract by Mask with Webb County shapefile to clip boundaries to the county

[91] In California, the Los Angeles County Department of Public Health (2018) recommended distances for oil and gas related facilities for mitigation from poor air quality (600 feet), noise (1,000 feet), odors (1500 feet), fires, explosions, and other emergencies (no value)." A table is posted in the *Appendix* (p. 233) originally from Table ES-1. Review of Key Public Health and Safety Hazards and Setback Distance Guidance. 2018. *Public Health and Safety Risks of Oil and Gas Facilities in Los Angeles County* Los Angeles County Department of Public Health, accessed online at httppublichealth.lacounty.gov/eh/docs/PH_OilGasFacilitiesPHSafetyRisks.pdf

[92] Texas Local Government Code Section 253.005 Accessed online: https://statutes.capitol.texas.gov/Docs/LG/htm/LG.253.htm#253.005

[93] https://agrilife.org/texasaglaw/2015/03/11/questions-from-tiffanys-desk-set-back-rules-for-pipelines-and-oil-rigs/

Proximity to Pipelines

The line pipeline shapefiles[94] represent laterals (branches) as well as the main pipeline. I created a multiple ring buffer using distances of 500, 1000, and 1500 feet. I then rasterized[95] and reclassified[96] the shapefile, and clipped it to the Webb County boundary[97].

Proximity to Transport (Roads)

As a proxy for transportation hazards, I used traffic counts from AADT data for 2013, and was able to identify traffic counts within the 2015 roadways shapefile from the Texas Department of Transportation. I selected Webb County data (n=81) for 2013, rasterized and reclassified to where higher numbers are more suitable. I was then able to add buffers of 0.25, 0.5, and 1 mile since sensitive populations are at higher risk with closer proximity to roads given truck traffic from oil and gas activities (Berke et al., 2015).

Proximity to Flood Prone Areas

For this variable, I used the National Flood Insurance Program map data from U.S. Federal Emergency Management Agency. I used most recent flood insurance maps[98] and

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[94] "The OPERATOR is the physical operator of the pipeline or pipeline system, responsible for the maintenance and safety of the system. The permit is issued to this entity. 2) The OWNER is the entity that owns the pipeline. An "owner only" is not required to have a Form P-5 or report to the RRC. A pipeline system can have more than one owner but only the primary entity needs to be listed. This is for general information only. 3) The ECONOMIC OPERATOR is the responsible entity for the economic operations of the pipeline system. A permit can only have one economic operator, and this entity must have an active Form P-5."

[95] Rasterized using 10 cells.

[96] Reclassify to where higher numbers are more suitable

1. 0 => middle, 1000 feet buffer => 2
2. 1 => outside, 1500 feet buffer => 4
3. 2 => inside, 500 feet buffer => 0
4. No data => 10

[97] Extract by Mask

[98] Downloaded in Summer 2017

identified the most suitable zones for use in my suitability analysis. After the map was rasterized, raster was reclassified to 0 (least suitable) and 10 (suitable) with the most suitable as Zone X, and .2 (500 year flood) Zone, and the least suitable area being Zone A and the other areas (Berke et al., 2015).

Data Not Used and Why

EPA/TCEQ Air Emissions Data. I was unable to use air data for this analysis. There are only three EPA Air Emissions monitoring stations in the study area, and they are centrally located within or close to the City of Laredo. This means the data can't be extrapolated across the county to serve as a reliable representation of air quality variation due to well activity. More specific point and non-point source data could have been used, but required more processing and different methodologies that are beyond the scope of my dissertation research.[99]

EPA/TCEQ Water Monitoring Data. I did not use water quality data for my analysis. EPA water monitoring data can be obtained by viewing surface water quality testing data or wastewater outfalls permitting sites datasets. However, this does not capture all areas (ground water) at risk from an adverse event. This also means that the data can't be extrapolated across the county and be a reliable representation of variation due to well activity.

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99 "These flat files represent emissions for the 2014 NEI version 1. They are formats that can be input to SMOKE for processing for air quality modeling. However, for onroad and nonroad mobile sources, we use more finely resolved data for air quality modeling: monthly for nonroad, and emissions are computed hourly for onroad based on gridded meteorological data and emission factors. So, these files should not be used directly for modeling. For point and nonpoint sources, we typically split these comprehensive files into smaller sectors for emissions modeling." (EPA)

Multi-Hazard Suitability Analysis Results

This analysis is key to answering Q1A and 1B. As a reminder, these questions are:

> **Q1A**: What areas are socially vulnerable within extractive areas?
> **Q1B:** Where are these areas located geographically in relation to hazard exposure and structural vulnerabilities associated with oil and gas activities?

In order to answer these questions, I identified specific hazards and structural vulnerabilities associated with oil and gas production. Heavy activity in the northern part of the county, as indicated by the density of pipelines and well arcs in the maps below, coincides with the larger (and thus less informative) block groups of the county.

Figure 6. 3. Pipelines, 2013

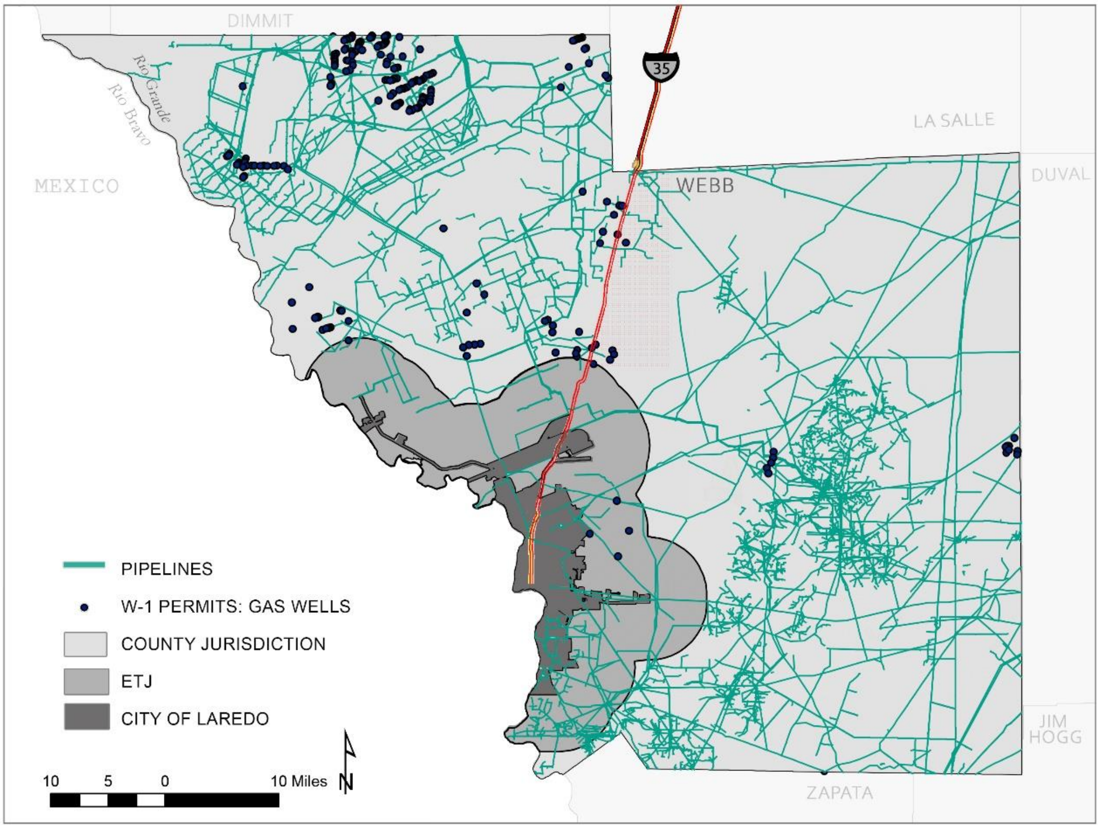
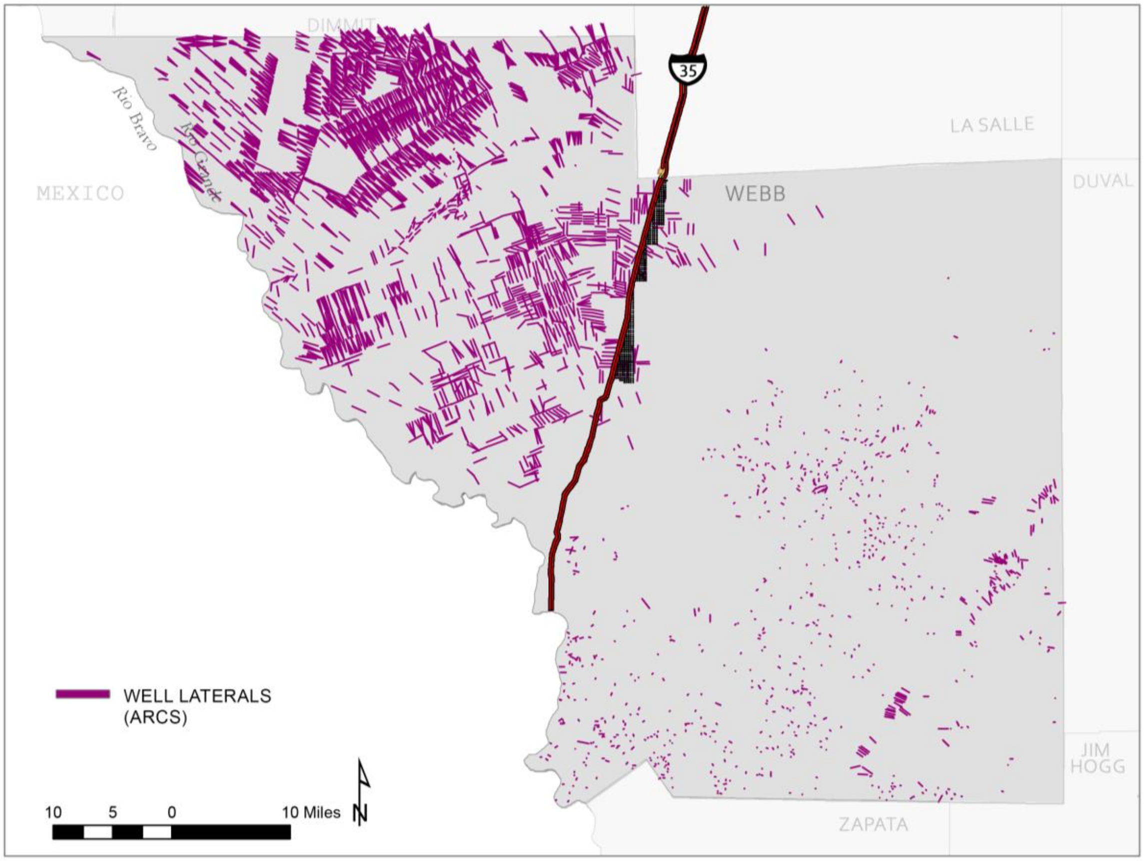


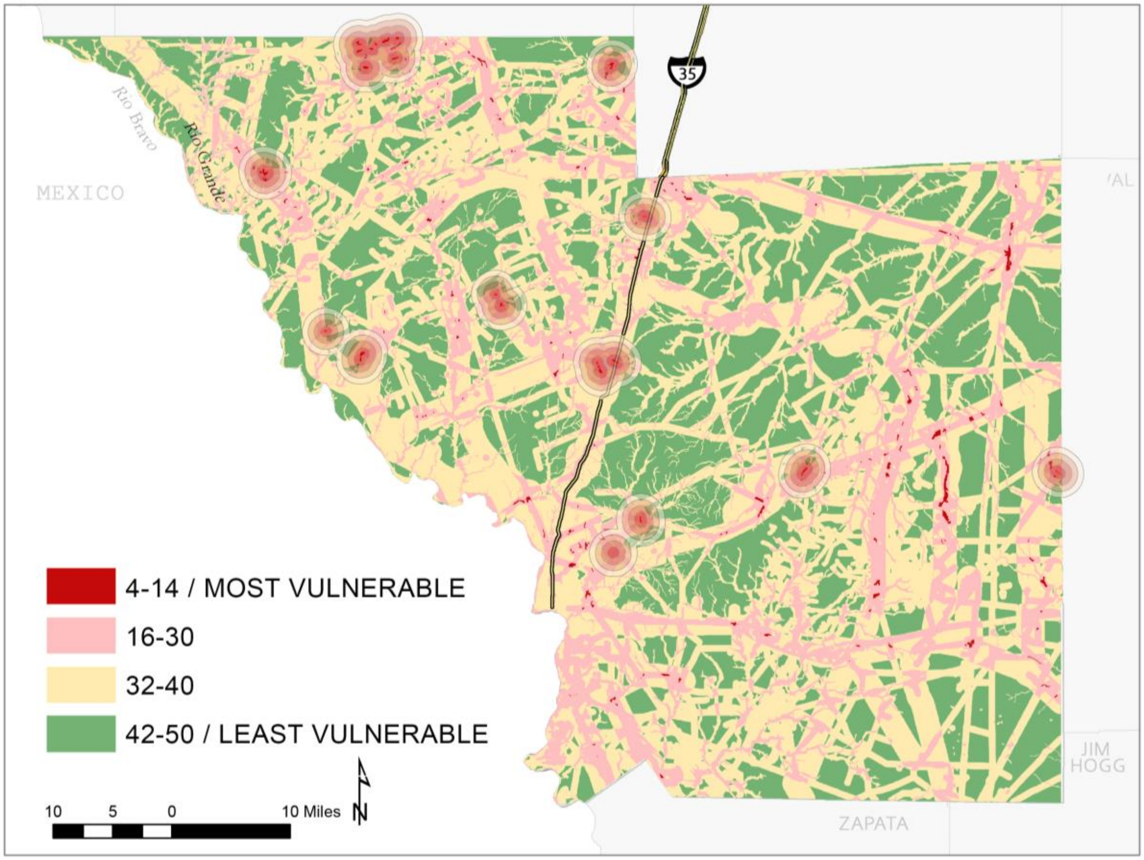
Figure 6.4. Well Laterals (Horizontal Well Arcs), 2013



The results of the suitability analysis indicated that there are several vulnerable sites throughout the county. The large block groups makes the distributions within the selected areas to have a significant finding that is actually useful and actionable. For example, if those large block groups were actually more granular then more variation would be visible and reflected in the vulnerability assessments, making them more precise and therefore more useful. The actual 'most vulnerable' sites are very, very small in area and are therefore scaled up to at least parcel level by adding buffers.

Figure 6.5. Multi-Hazard Suitability Analysis: Original

Figure 6.6. Multi-Hazard Suitability Analysis: Identifying Vulnerable Sites



The most vulnerable areas closely mirror the locations of the most dense and closest proximity to key infrastructure for oil and gas, most of which is within the county jurisdiction. This highlights the importance of resilient hard infrastructure when there is a boom. With Texas being a low taxes low services state, cries for critical improvements of infrastructure related to oil and gas increasing over the shale boom (about a decade now) have however yielded slow responses from the city, county, and state.

I encountered the same data collection and processing limitations in Q1A as I did for Q1B. This is evident if you refer back to the first Social Vulnerability (SOVI) maps earlier in this chapter. In order to perform a vulnerability analysis, the scale of the geographies used are very important. Some data typically used in these analyses were not available for this study. This is similar to issues that arise from a lack of appropriately scaled data created by government or non-profit research entities in rural and semi-rural, poorer parts of the state.

Vulnerability assessments alone, as shown above, are not as insightful. Given the focus on the county jurisdiction of the results from the analyses above, the next chapter discusses Q1C, Q2A, and Q2B to more critically examine similarities and differences between vulnerable areas as they relate to land, focusing on the similarities and differences of ownership, tenure, land controls, and governance.

Chapter 7: Assessing Vulnerability by Incorporating Governance Geographies and Land Tenure History

The previous chapter presented the methodology and results of typical vulnerability and suitability assessments. I identified some areas of highest risk and vulnerability to adverse effects from a hazardous event occurring as a result of oil and gas development, production, and/or ancillary activities. However, there are, I argue, limitations to these kinds of assessments that ultimately inappropriately attribute vulnerabilities in places and with populations that aren't necessarily reflected adequately in the initial, regularly available datasets. In thinking about the particulars of this place and what makes it unique—predominantly Hispanic, highly economically segregated, border communities with deep colonial histories spanning seven sovereignties—the current methodologies and approaches to identifying vulnerable populations is not enough. When these methodologies are also embedded in regulatory mechanisms that are meant to help these communities, perhaps we need to rethink how we approach these problems along the border all together.

Considering the challenges presented, the second set of research questions were derived from not an epistemological framing from where are the most vulnerable situated, but from the perspective of what are the physical, social ramifications of the deeper, structural mechanisms producing inequitable distributions of wealth and power. The remaining research questions therefore are addressed in this chapter:

> **Q1C**: What is the role and geographic extent (jurisdiction and powers to mitigate harms) of the government via rules and regulations in identifying and mitigating these vulnerabilities?
>
> **Research Question 2:** How does tenure and ownership of land and minerals influence social vulnerability in these cases?
>
> **Q2A**: What is the spatial relationship between tenure, land ownership, and socially vulnerable areas?

Q2B: How does tenure and ownership of land shape political influence in socially vulnerable areas?

Research questions 1C, 2A, and 2B aimed to better understand social vulnerability and how focusing on not just land use but who owns the land. I am therefore able to focus on the role of land controls and governance structures in influencing social vulnerabilities represented with this set of research questions: How does tenure and ownership of land and minerals influence social vulnerability in these cases?

In Section 7.1, I identify and discuss the relationship between vulnerability and governance over these highly vulnerable areas to unpack the role and geographic extent of rules and regulations to mitigate these harms, which answers Question 1C. I then detail the methods I used to better understand the relationship between land and vulnerability. To answer Question 2A, I conducted a simple Sensitivity Analysis (Section 7.2) to get a better sense of the effects of housing tenure on social vulnerabilities previously calculated from Question 1A–C. From this, I used governance geographies (Section 7.3), specifically the county, extraterritorial, and city jurisdictions, to serve as a spatial *and* conceptual frame for further qualitative analyses. In essence, using these geographies and vulnerable populations maps, I was able to identify ten discrete sites in the study area (referred to as case study embedded units in the Chapter 5 Research Design) that appear most vulnerable within Webb County to delve into for deeper examination and exploration using historical information. In the third section (Section 7.3), I detail the qualitative methods and triangulation I used to unpack the relationship between land, politics, and vulnerability in the case study area to address Question 2B. For this research, I conducted qualitative semi-structured interviews, reviewed numerous city, county, state planning, and policy documents, along with deeds and other documents that linked property genealogy to specific properties in my study area.

7.1. Governance and Vulnerability

By examining governance geographies, I am able to shift my approach to better integrate local context and histories and therefore addresses my last research questions. To answer Q1C, I reviewed and analyzed via content analysis numerous planning and regulatory documents, including capital improvement plans, recent comprehensive plan, Texas Administrative Code, and city and county code regulations. I focused on those covering issues related to (1) prevention, identification, penalties, and/or required remediation of negative impacts of oil and gas production; (2) who is responsible for any of these actions; and (3) differences in responsibilities by jurisdiction geography. I supplemented this with data[100] from qualitative interviews conducted in 2014[101], 2017, and 2018, which are discussed in further detail in Q2 research later in this chapter

Using governance geographies as an analytical frame, I was able to assign traits gleaned (from coding) from the qualitative and document analyses to the (discrete geographies/polygons) governance geographies, and then used that to further analyze the vulnerable areas identified by SOVI and suitability maps. Certain areas, mainly the county, may be more susceptible to impacts associated with fewer regulations and actions that aim to prevent harms, identify impacts, require remediation, and penalize bad actors (owners, operators, etc.), than others in different jurisdictional types. As a county official once told me, counties have very little power to regulate oil and gas activities, so they do what they can with what they have (Informant #3, 2014). In this case, federal tools such as the proximity to flood plains can be creatively implemented for permit approvals (Informant #3, 2014).

[100] From transcripts, field notes, summaries
[101] Pre-dissertation fieldwork

7.2. SENSITIVITY ANALYSIS

Deploying sensitivity analyses are particularly useful when relationships between variables and outcomes are to be tested. There are Sensitivity Analysis that explore how variation in the output of a model (numerical or otherwise) can be "apportioned, qualitatively or quantitatively, to different sources of variation, and how the model depends on the information fed into it" (Saltelli et al., 2000, as quoted in Chen et al., 2010). There are many different approaches and methods that can be used for a sensitivity analysis, such as differential to well-known Monte Carlo analysis, regression and correlation analysis, or variance-based techniques (Chen et al., 2010, p. 1583). I am using a simplistic version of sensitivity analysis for this study since my goal is to create a baseline for comparison and also complement my qualitative research methods for this mixed methods case study. As Chen describes it, my methodology, which is similar to the most common uses of GIS sensitivity analysis, is based on the variation of the weights of criteria implied in the process to test whether it significantly modifies the results obtained (p. 1583).

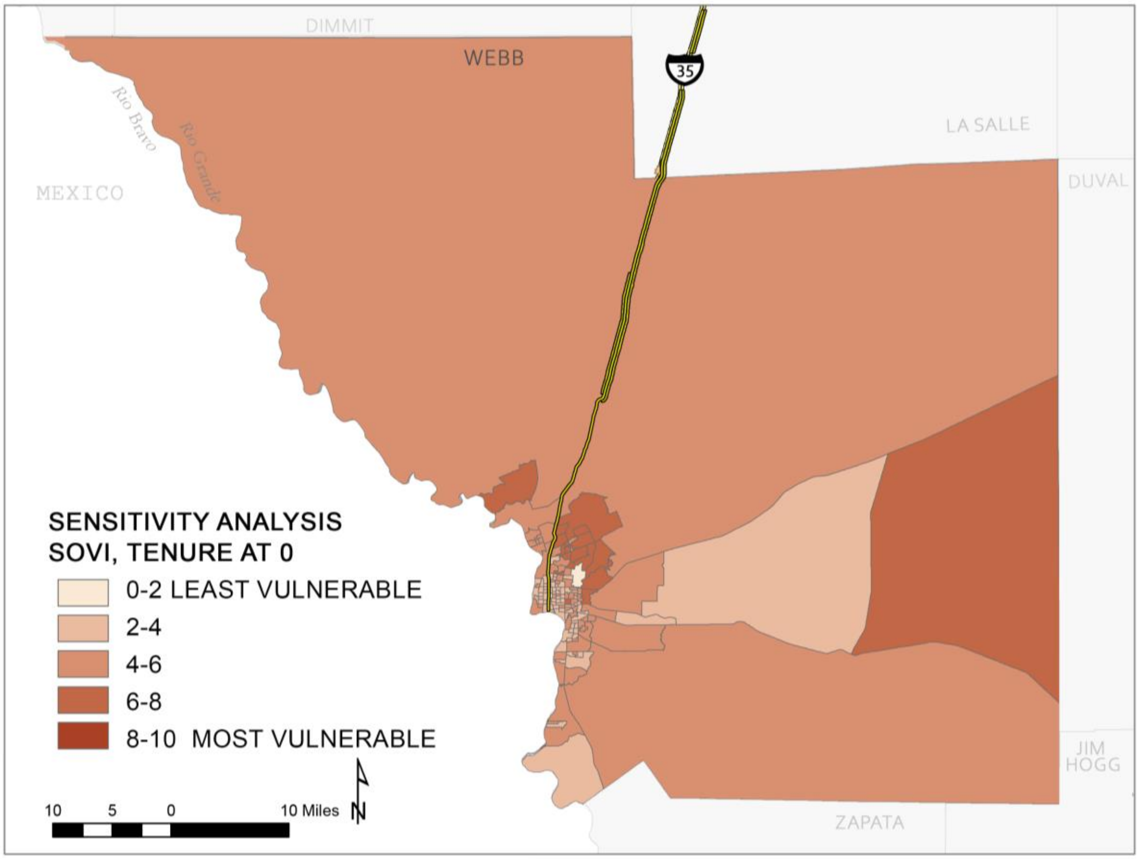
To perform the Sensitivity Analysis on tenure, the indicator Tenure[102] was used. I assigned values of 1 and then of 0[103] for Renter-occupied. After changing the Renter-Occupied indicator to both 0 and 1, I totaled up the Total SOVI scores to assess the impact of the tenure on the rest of the systems that contribute and characterize social vulnerability. I started with the original weighted vulnerability analysis for Tenure / Renter Occupied. I

[102] From the ACS dataset

[103] The distribution of SOVI scores is between 0 and 1, as these are indexed scores. 1 is the highest end and this is the distribution for the change, and 0 is the lowest end. I chose these extremes given that variation between 0 and 1 would not yield anything noticeable enough to be helpful. Typically, a full range of scores are tested in a Sensitivity Analysis, but this is done when several iterations of the variations of possible scores for the indicator is much higher than what we can see with scores between 0 and 1.

then changed the indicator for Renter Occupied to equal 0 as the lower end. I then changed the indicator for Renter Occupied to equal 1 as the higher end and this is the distribution for the change.

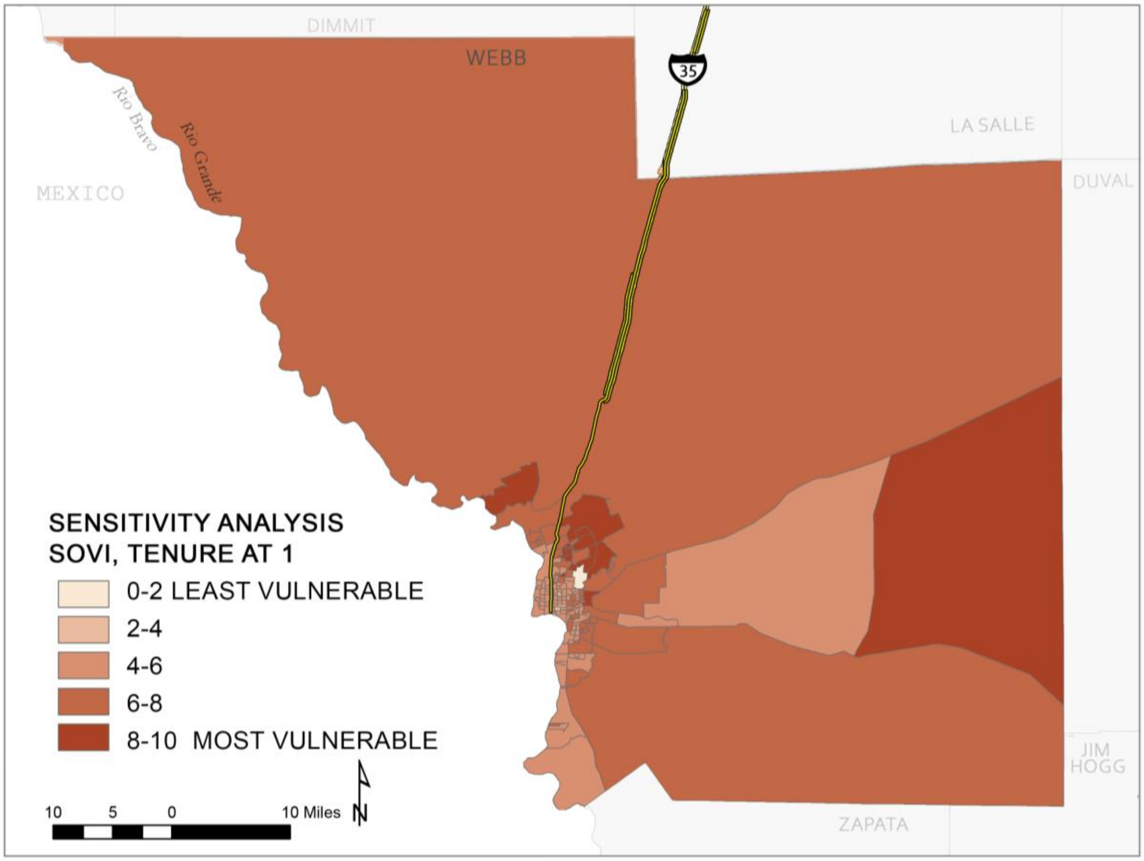
Figure. 7.1. Sensitivity Analysis: Renter-Occupied at 1, using SOVI Scores[104] [105]



[104] See Appendix for distribution tables and larger versions of these maps.

[105] Sensitivity Analysis maps in Figure 6.1 display a tally of all SOVI scores where the highest scores for each element would yield a total of 10.

Figure. 7.2. Sensitivity Analysis: Renter-Occupied at 0, using SOVI Scores[106] [107]



Sensitivity Analysis Results

The lowest numbers in the distribution mapped represent the most vulnerable areas. More than anything, this analysis reinforces that the older parts of the city (as in, when they became a part of the City jurisdiction) which also have the highest population densities. These areas would inherently be more vulnerable because more people can be harmed, have to be moved, or can be displaced if an adverse incident occurred. Some of these vulnerable areas are not as affected by changes in housing tenure, which points to indicators

[106] See Appendix for distribution tables and larger versions of these maps.

[107] Sensitivity Analysis maps in Figure 6.1 display a tally of all SOVI scores where the highest scores for each element would yield a total of 10.

that hint at class status (income, education attainment, language spoken). This to me is indicative of more substantial issues that an indicator like class initially explains in relation to vulnerability. However, in places like this particular border space, identifying as Hispanic is nearly ubiquitous and can obscure some of these other issues related to class and wealth.

However, Sensitivity Analysis suffers from the same limitations as the vulnerability and suitability assessments used to answer Research Question 1. Simple sensitivity analyses are only as good as the data inputs you use. In this case, even though vulnerabilities change when housing tenure is adjusted/tested, the block groups in the county and ETJ jurisdictions are spatially expansive (with substantially different population densities) in comparison to the block groups in the municipality. Colonias, for example, are present in these geographically large block groups in the county, but this analysis presents certain assumptions about the distributions of population densities and locations of them that are much more complex than what I proposed to cover here[108]. They certainly are not useful for making any policy decisions. These limitations will be evident in other rural jurisdictions with highly varied population densities. It is a combination of not enough of a population to draw meaningful conclusions from (a low *n*) and appropriate datasets with spatial units that are statistically significant enough to be useful in producing results that are meaningful. The rural parts of the county are the most adversely effected as such assessments are negatively impacted with the lack of adequate and appropriate datasets.

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[108] For example, there were a handful of studies that attempted to make such adjustments based on locations of population densities in spatially disproportionately larger geographies (block groups)—but they all have to make certain assumptions to complete the complex spatial operations that split the large geographies with their non spatial data that is associated with that polygon.

7.2. SPATIALITY OF TENURE, LAND OWNERSHIP, AND SOCIALLY VULNERABLE AREAS

The first subquestion asks about the spatial relationship between tenure, land ownership, and socially vulnerable areas. To answer this question, I performed a sensitivity analysis, varying the indicator for tenure from the Social Vulnerability Index (SOVI) maps from Q1A and the Suitability Map from Q1B as described above. In this section, I will engage with issues related to land tenure and vulnerability via jurisdictions and regulatory powers by selecting subareas for further study. These are the embedded subunits of my study and allow me to focus my qualitative research into the spatiality of land tenure, ownership, and socially vulnerable areas, which in turn collectively highlight the unique range of the spatial distributions of power and vulnerability along the border.

Governance Geographies

As mentioned in Chapter 6, I proposed to use governance geographies as a spatial and analytical lens. This is because these geographies better reflect a range of informalities and precarities of land tenure, use, and governance regimes that are not fully and adequately acknowledged in planning research.

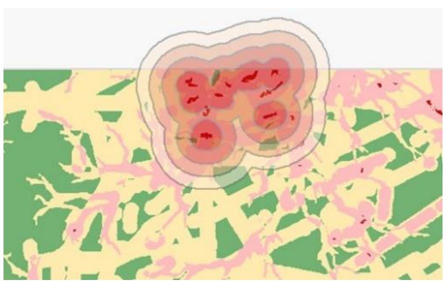
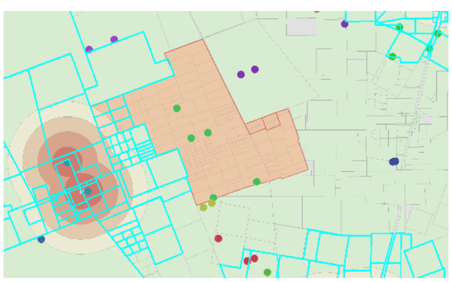
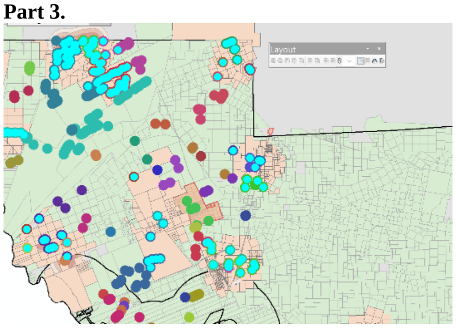
As discussed in Chapter 5, the governance geographies used here include (1) unincorporated, ETJ, incorporated/municipality; (2) traditional fully incorporated neighborhood, colonia (1990 era State of Texas Attorney General's Office), unincorporated, non-neighborhood space. These were then overlaid onto the vulnerable areas highlighted in SOVI maps[109], adding buffers[110] around the vulnerable areas to create more discrete areas that are larger than individual parcels. Both county parcels and also Original Texas State Land Grant polygons were used to create discrete areas that represent

[109] After raster calculator was performed, areas that are most vulnerable and at risk (score of 1-10) were exported (polygons) to a new shapefile (mostvulnerablefromSOVIrastercalc_1_10.shp).

[110] Buffers were added to these polygons in increments of .5 miles (0.5, 1, 1.5, 2 miles) and turned into a new shapefile (suitability_mostvulnerable_1to10_buffers.shp).

the ‘most vulnerable’ as well as varied governance regimes and proxies for informality and precarity (colonias). I chose Original Texas Land Grant parcel data so that it could be easier to determine original land grantees. They happen to closely align with current boundaries, indicating the importance of where/when properties have since been subdivided into their present day form.

Table. 7.1. Spatiality of Tenure, Land Ownership, and Socially Vulnerable Areas[111]

Part 1. 	**Most Socially Vulnerable to Proxies from Oil and Gas Development w/ Buffer**	• SOVIsuitability + Buffers .5 mi increments
Part 2. 	**Parcels from Original Texas Land Grant Survey of Highly Socially Vulnerable areas**	• Parcels from Texas Original Land Grant Survey • Select by Location that are within or touch the Highly Vulnerable + .5 mi increment buffer areas
Part 3. 	**Selected Highly Vulnerable OTLGS Parcels happen to also happen to have well data and located in each type of Governance Geography**	• Highly Vulnerable + .5 mi increment buffers • Original Texas Land Grant Survey Parcels within or touching vulnerable areas • 2013 W-1 well permit data • City / ETJ / County jurisdictions and *colonias*

[111] More detailed processing is described in the Appendix.

The table above, Table 7.1 Spatiality of Tenure, Land Ownership, and Socially Vulnerable Areas summarizes the process I undertook for operationalizing and using governance geographies to hone in on areas that I argue are more revealing than simple vulnerability assessments identify.

As stated previously, I determined highly vulnerable areas, generating a SOVI score for census tracks. Census tracks were the smallest geographies that still corresponded with most recent datasets of the same time-period with enough of the specific demographic information to conduct the SOVI calculations. **Part 1** in Table 7.1 therefore illustrates these areas with a 1.5 mile buffer (shown in .5 mile increments). The basemap shown is the resulting map from the suitability analysis that identified the most socially vulnerable areas (SOVI) at highest risk from oil and gas activities. I used proxies such as distance from pipelines and wells.[112] Since the resulting parcels' size varied in size, some were just too small to conduct any meaningful analysis.[113] I added half-mile increment buffers to better approximate which areas were more vulnerable that also correspond to the Original Texas Land Grant Survey Parcels within or touching these vulnerable areas, which is illustrated in **Part 2** of Table 7.1. The larger areas also made it easier to examine and discuss various properties and property ownership at the time of the original land grant and in the present configuration of mostly contiguous parcels where properties can span thousands of acres. Once these parcels were identified, the resulting map identified Highly Vulnerable Original Texas Land Grant Survey (OTLGS) parcels which also happened to have wells[114], and also happened to be located within (and therefore represent) each type of Governance

[112] 2013 W-1 well permit data

[113] For example, one highly vulnerable sliver of land was 2.2 acres, identified in the maps as red in color, located between Areas 1, 2, 4, and 5.

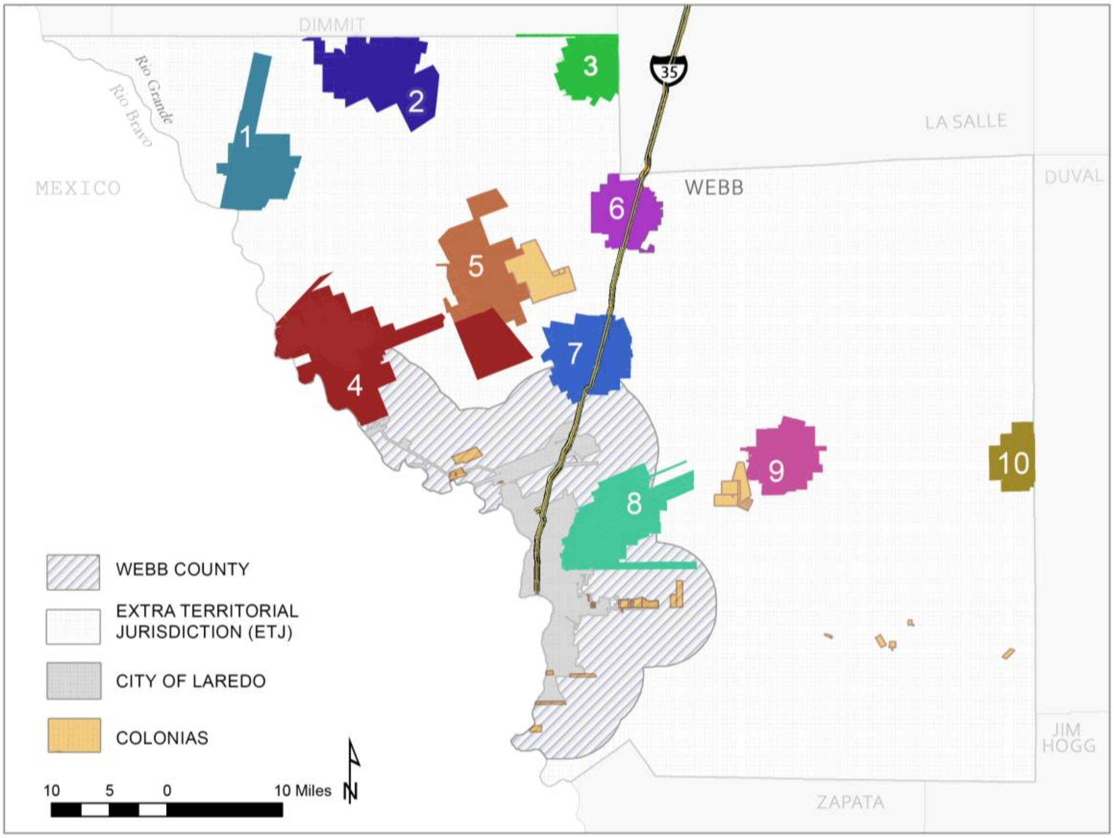
[114] Wells data was useful for then identifying the various mineral estates associated with each W-1 permit for that areas in 2013.

Geography: county jurisdiction with/without colonias, ETJ with/without colonias, and city jurisdiction with/without colonias. These are illustrated in **Part 3** of Table 7.1.

The result is the following map showing ten discrete sites that appear to have the highest level of vulnerability in the study area[115]. There are seven within the Webb County jurisdiction, three in the extra-territorial jurisdiction (ETJ), and one within the jurisdiction of the City of Laredo. Three of these areas also fully or partially contain colonias. In the following section, I will describe these ten most vulnerable areas in greater depth.

[115] This selection was then exported into a shapefile (selected2013wells_W1permit_invulnarea.shp). I used the Vulnrisk1-10_selectedparcels.shp to via Clip look at the Original Texas Land Grants for the selected areas. (OTLAS14_survey_clip_vulnareas), which then became OTLAS14_survey_clip_vulnareas_combined.shp because the parcel shapefile is not as complete as the full OTLS file). I then created a field (Add Field => **parcelclus**) and used Editor to add the attributes for that field which are the 10 groupings from the selected parcels area—10 in total, field is Text format.

Figure 7.3. Ten Discrete Sites of the Study Area that Represent Highly Vulnerable Areas with Highest Risk of Negative Impacts from Oil and Gas Activities



7.3. WHO OWNS WHAT AND HOW THEY OBTAINED IT

This portion of my research focused on developing a deeper and more nuanced understanding of land and power via tracing who owns what and how they obtained it, focusing especially on the ten most vulnerable areas identified in my analysis of governance geographies discussed above. The final subquestion, Q2B, of my second research question is the following: *How does tenure and ownership of land shape political influence in socially vulnerable areas?* I sought to answer this question by piecing together and layering several different kinds of datasets, and complementing this with content analysis of qualitative interviews and numerous planning, deed, and other kinds of ownership documents. I was able to purchase and map mineral ownership data for the same time period as the other datasets I have used for this research, and the socioeconomic data used in the social vulnerability assessments[116]. I processed data for over 4,000 owners of over mineral interests[117] [118]. I also examined Webb County Appraisal District mineral and surface ownership data for the county, which enabled me to extrapolate approximations of mineral and land wealth. This included county records that documented appraisals of ownership of difference property interests. From these records, I also traced oil and gas lease owners, operators of mineral estate owners, as well as family lineages of estate owners, in order to evaluate the political and economic influence of each group/family. Refer to Figure 7.2 Ten Discrete Sites of Study Area that Represent Highly Vulnerable Areas with Highest Risk of Negative Impacts from Oil and Gas Activities for spatial context, and Table 6.4 for more detailed information on the datasets I used.

[116] This was a snap shot at the beginning of Jan 2014 to be close to the ACS 2009-2013 5-year data
[117] Common industry terminology: *estate* and *property* are both synonyms of ‘interests’ here. See Glossary for more.
[118] This includes working, royalty, and overriding interests.

Table 7.2. Data/Document Sources for Qualitative Methods for Ten Sites

Mineral Estates Associated with Wells, Names, and Appraised Values	
Texas Railroad Commission	W-1[119] Drilling Permit Queries[120] for 2013[121]; GIS wells, pipelines, and basemap obtained 2016 w/ Help Manual (2007)
Mineralholders.com	Different owner interests info and appraisals and percentage ownership data downloads with GIS for 2013/2014 active permitted wells (verified with county and TRRC data)
Land Grants	
GLO Original Texas Land Grants	Land Grant lists with names and GIS parcel locations
Compiled Land Grant Resources	Texas Land Grants 1750-1900 A Documentary History, by John Martin Davis (2016); A Wild and Vivid Land, An Illustrated History of the South Texas Border, by Jerry Thompson (1997)
Misc. Archival Materials	Texas General Land Office
Land Appraisals, Current Uses, and Owners	
Webb County Appraisal District	Owner by year, taxes paid/assessed, land use for tax purposes (lists, GIS data)
Misc. Archival Materials	Webb County Clerk's Office
Data Sources	Texas Commission on Environmental Quality; Texas Department of Transportation

I compiled data on ownership and land acquisition for each of the 10 clusters from mineral interests data for 2014 Webb County, Texas General Land Office Land Grant database, as well as from the Webb County tax assessor's and clerk's offices. When necessary, I also supplemented these with local and state newspaper and magazine articles. My qualitative interviews also helped to situate the data and piece some of it together into a more coherent

[119] https://www.rrc.state.tx.us/media/20067/dpmanual.pdf

[120] Notes about the datasets from speaking with TRRC staff and processing: Basically I chose to look at W-1 drilling permits and join that to the shapefile. That required creating different iterations of the well API number as the permits contained different parts of the API number compared to the shapefile which had the full API number sans the state identified (42 is Texas). I did these outside of ArcGIS in Excel using Text to Column.

[121] DRILLING PERMIT (W-1) QUERY (yield CSV file); County: WEBB; Approved Date from: 01/01/2013; Approved Date to: 12/31/2013; 506 results

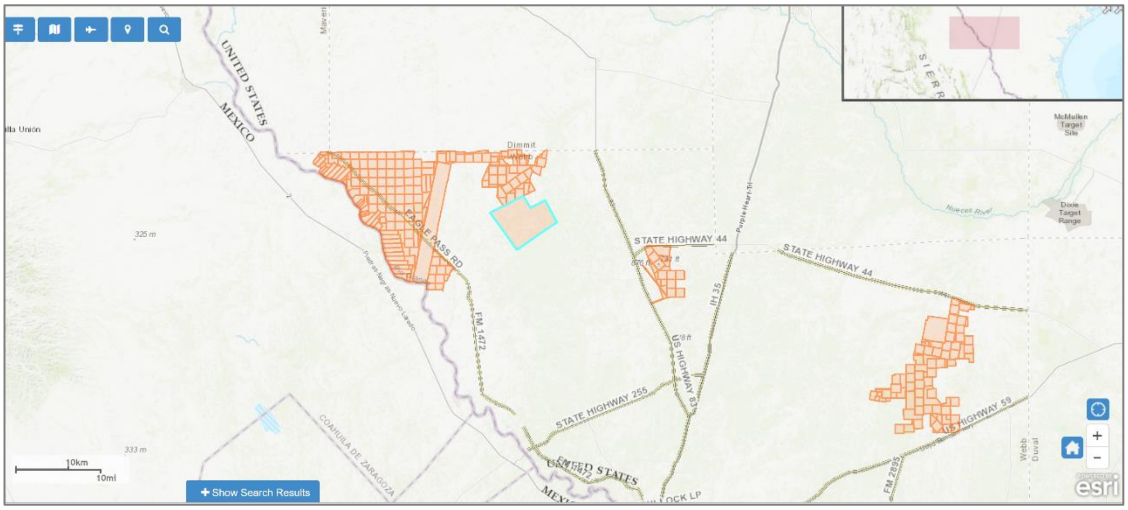
narrative. When I could, I also traced family linages for properties where mineral interests have not been severed and brokered off repeatedly, usually for non-familial investors[122]. These lineages, to varying degrees, enabled me to match local, regional, and state politicians to these families, with some going back to original Texas or Mexican or Spanish land grantee. Findings from the ten sites are detailed below. In some cases, I discussed some individual sites as one combined unit when this more clearly captured and described the nature of the ownership patterns.

Study Area 1: Northwest Webb County

Many of the land grants in this area were made to railroad companies such as I & GN, and TMRR CO (*Original Texas Land Survey*, n.d.). These parcels are a part of the larger Briscoe Ranches and have been for several decades. Originally, Dolph Briscoe, the former governor of Texas, purchased a substantial set of parcels, and instead of eventually subdividing and selling (which is common), the Briscoe family has kept the property intact and has over the last few decades purchased more adjacent and noncontiguous parcels. The following map is only of Webb County, which is around 140,000 acres, but 'Briscoe Ranch' spans over 650,000 acres within several counties in south and southeast Texas (Davies, 1998; Webb County Appraisal District, 2019).

[122] This is visible in the numbers of interests/owners per property

Figure 7.4. All Briscoe Ranches, 2019 (Webb County Appraisal District)

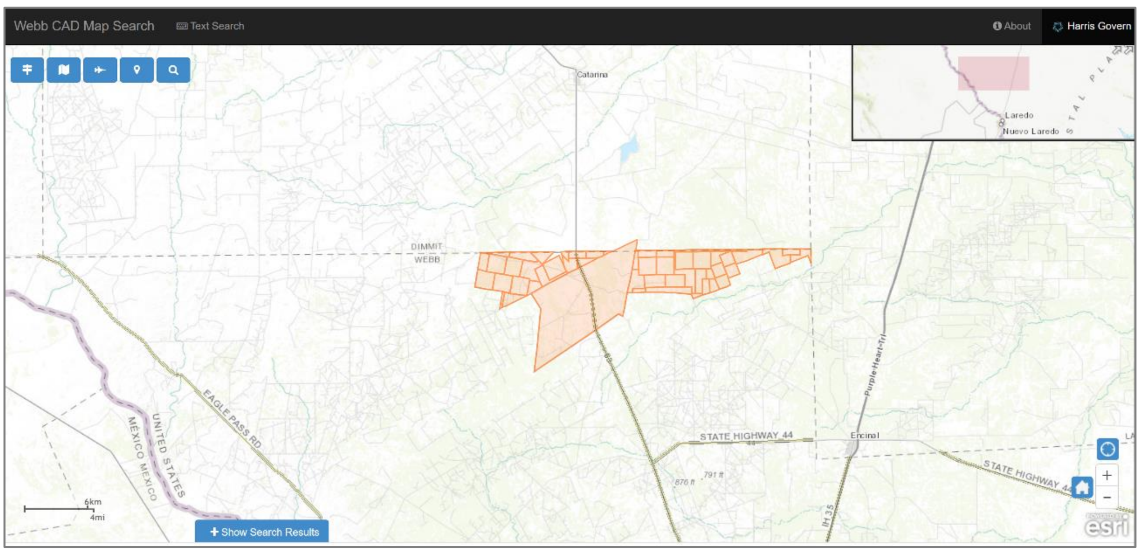


In 2013, the wells in Study Area #1 were all run by the same Operator: SM Energy Company. SM Energy Company, formerly St. Mary Land & Exploration Company, is a petroleum and natural gas exploration company headquartered in Denver, Colorado. Wells in this Study Area, which were all horizontal gas wells, are located within the Briscoe Field of the Eagle Ford Shale. The current uses are agriculture, cattle and other livestock, and oil and gas (Davies, 1998).

Study Area 2 and 3: Northwest Webb County

The majority of the land grants in this area were made to Joaquin Galan, but also other private individuals and railroads (*Original Texas Land Survey*, n.d.). The vast majority of this area is also considered a part of the Briscoe Ranch. Most wells in 2014 are horizontal, and some of these wells are also located in neighboring Gates Ranch, with one in Caterina. The names of the lease owners (business names) are Cotulla, Gates, Piloncillo, Stanley Ranch, and Worthey Ranch. The operators are listed as Lewis Energy, Anedarko, Rosetta, and SN operating LLC (which is essentially Sanchez Oil). Charles Taft at one point owned the Harrison Pilocillo Ranch and built the Taft House[123] which was designed to accommodate his brother, former president William Howard Taft. In the 1980s, Dolph Briscoe Jr. bought a portion of the Harrison Pilocillo Ranch, as well as portions of Caterina Ranch in Dimmit County, just north of Webb County[124]. There is not a homestead currently on these parcels.

Figure 7.5. Piloncillo Ranch, 2019 (Webb County Appraisal District)



Study Area 4

Many of the land grants in this area were made to J. Galan, Billings, G. Alexander, Davis, Perron, P. Revolcara, and C. Vergara (Original Texas Land Survey, n.d.). Prior to Galan, this area was a part of the Beale-Grant empresario grant number 125. According to

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[123] For more background information, see for example "The Taft Ranch" (December 1909) by Geo A. Schreiner in *The Texas Magazine*, Vol. 1, No. 2, p. 35-38.

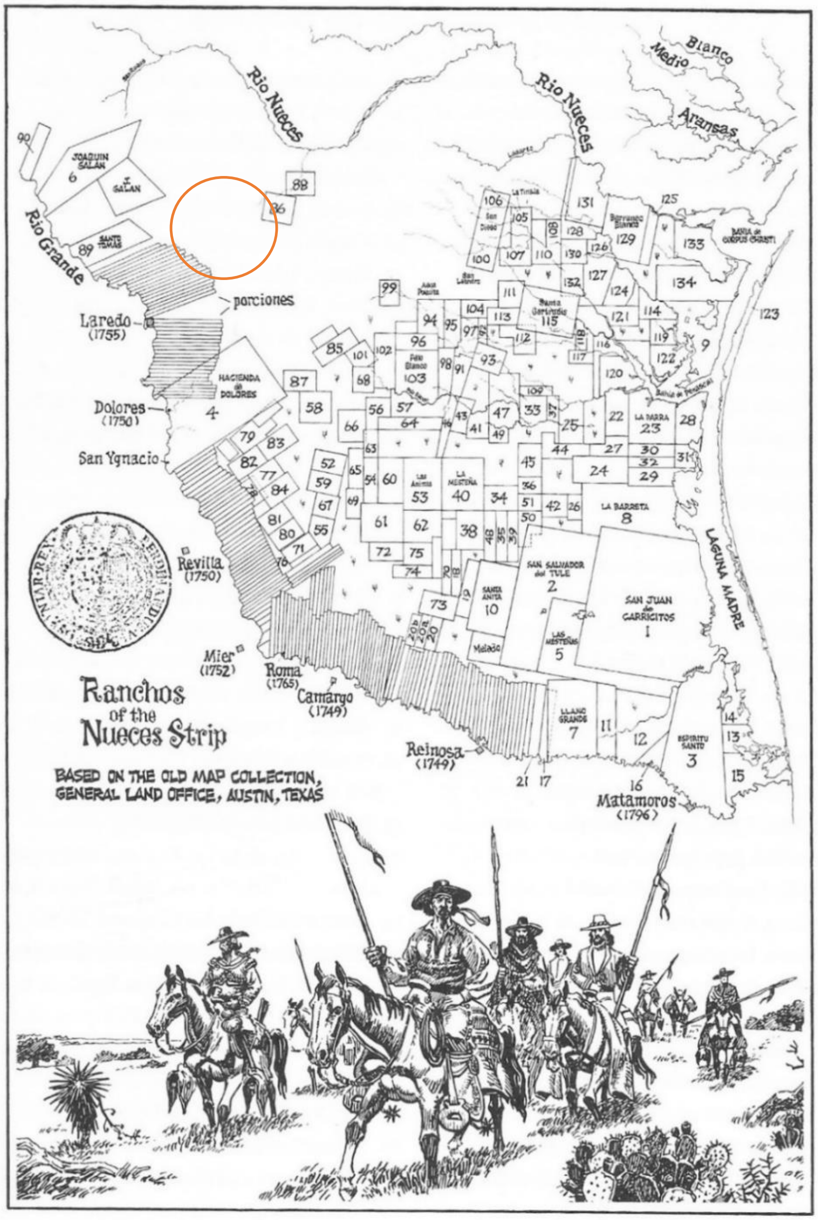
[124] http://www.texasarchive.org/library/index.php/Bruce_Harrison%E2%80%99s_Piloncillo_Ranch,_1965_and_1967

[125] From map created by S. Augustus Mitchell, 1835; Library of Congress Geography and Map Division Washington, D.C.; Accessed online: http://hdl.loc.gov/loc.gmd/g4030.ct002350

historian Jerry Thompson, the Galan property is remnants of the land grants shown in Chapter 3 and in Figure 7.6. below. The Alexanders, related to the Viduaris, have been a prominent family since the founding of Laredo around 1750. The operators in this area are mostly Lewis Energy and Swift.

Figure 7.6. Ranches and Grants in 1852[126]

DOLORES



The cattle industry in the United States had its origins in the small ranchos and missions of South Texas and northeastern Mexico. In addition to the small ranches around Reynosa, Camargo, Roma, Revilla, Dolores, and Laredo, which contained thousands of livestock, this map by Jack Jackson shows the location of some 136 land grants in the area south of the Nueces River. *Courtesy Jack Jackson and Texas A&M University Press.*

126 Image Source: Originally in Jerry Thompson's A Wild and Vivid Land, 1987, p. 31-33.

Study Area 5

Intertwined with Area 4 is Area 5, which has a *colonia* within and just adjacent to parcels in the subdivision known as La Moca Ranch. Members of this community, the colonia and area around it, are not visibly involved in politics but active in local and regional philanthropy today. Lewis is the family that has owned and operated Lewis Energy for several decades now, a prolific Operator seen throughout south Texas and in Mexico[127]. Though they have some mineral lease assets, the majority of their wealth is derived from working interests (as Operator) of Lewis Petro Properties. Lewis Petro has a total working interest value of $938M, or almost 35% of all operator interests' valued in the country, in Webb County in 2014[128]. La Moca Ranch is one of the largest colonias in Webb County[129]. This colonia still does not have 100% coverage of adequate water infrastructure[130]. Leases in 2013 include the families Middleton, Trevino, and Benavides, who are prominent families in the border area. Webb County has little recourse to minimize any negative impacts from primary or ancillary activities from the active production of oil/gas on the manufactured housing in the pictures in Figure 7.7, located across the two lane road from the well pad[131] (see Figure 7.7). With the housing located in such close proximity to the well pad, impacts could range from traffic congestion and noise, possible exposure to toxic fugitive air particles from the well activities or flaring, or the possibility of any kind of hazard from the site resulting in an explosion or damage to the well itself and the people working on the well.

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127 https://www.forbes.com/profile/rodney-lewis/#64384a9a7611

128 See Appendix for full list of Operators and their total working interests in Webb County for 2014, compiled from Webb County Tax Assessor's office, Texas Railroad Commission, and mineralholders.com

129 Largest area for parcels associated with colonias in Webb County; see Appendix for comprehensive Table on colonias' characteristics in the county.

130 Two different interviews I conducted in 2014 and 2015 of different government officials confirmed this information.

131 Two different interviews I conducted in 2014 and 2015 of different government officials confirmed this information.

Figure 7.7. Well Pad in La Moca Ranch (colonia), Northwest Webb County, 2014[132]

132 Images taken by A. C. Wirsching during fieldwork in late 2014

Study Area 6: North Central Webb County

Most of these parcels are located within the San Roman Ranch in north central Webb County. Several mineral interests have been sold and/or pooled with other holdings. The operators here are Lewis Petro, Escondido Resources, and Rosetta Resources. Leases are to San Roman, Gilpin, Lewis, Santa Cruz, and Sanchez. All wells but one are horizontal gas wells in the Owen (Olmos) field. According to the Original Texas Land Survey, several of these parcels were originally railroad land grants. Since the OTLS has many more parcels than the current parcel boundaries, this means over time families slowly continued to build and add to their land and mineral holdings.

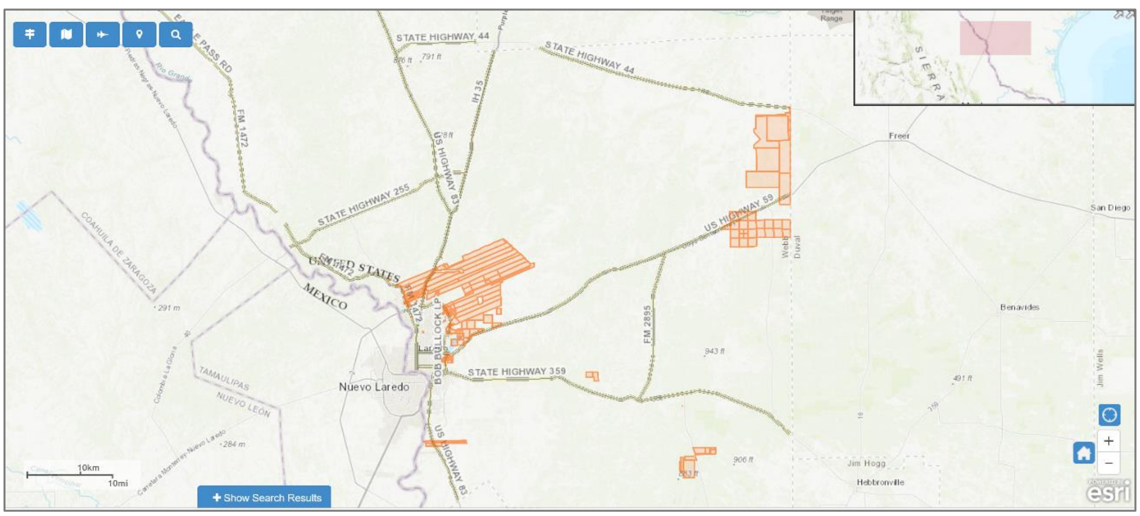
Study Area 7

This study area lies both within the county jurisdiction and the ETJ. A portion of these parcels is within the larger Hachar Ranch, owned by another prominent family with vast land holdings (Webb County Appraisal District, 2019). This particular family is of such social and class status, with matching philanthropic abilities, that buildings and schools named are after them in Laredo. The parcels on the other side of I-35 are zoned as heavy industrial properties. The operators are Lewis Petro, Escondido Resources, and Rosetta Resources. The parcels in this study area are leased to San Roman, Gilpin, Lewis, Santa Cruz, and Sanchez. All but one are horizontal gas wells in the Owen (Olmos) field. The colonias in this study area are Armando Rojias Sur 1593, Avaritt Properties, Bonanza Hills, Los Botines, Four Points. These colonias have the following subdivisions in them: Sunset Acres, J & D Subdiv, Los Veteranos, Murillo Properties, and Riojas, East Webb, Simeon Park Subdivision, and Sunset Acres.

Study Area 8 – East Laredo, Webb County

In this study area, there are mostly regular subdivisions with some commercial, municipal, and educational parcels. The Original Texas Land Survey shows that many of the land grants here were to railroads, including edges of ranch lands annexed within the last 30 years. Families listed as land owners in the Original Texas Land Survey include the Killams, Sanchez, and Callahans. The Killam family, originally from the Midwest, purchased the Villages Ranch in 1927 and eventually bought two other large ranches in Webb and Duval Counties (Texas Monthly, 1998). Their ranches are in total currently appraised at more than $227M. For the most part, the Killams are owner-operators of their ranches through Killam Oil Company, and they also own a large majority of land in north and northeast Laredo.

Figure. 7.8. Killam Ranches in Webb County, 2019 (Webb County Appraisal District)



Study Area 9 – North Central Webb County

Webb County School Board owns the parcels in this study area, and the royalties earned from leases go to schools. This area has both directional and vertical gas wells in

Beccero Creek or Big Cowboy (Lobo) field. The Operator for this group of parcels is White Oak Energy. This area also has colonias: Pueblo East, Las Pilas 1 and 2, East Gate Acres, Hillside Acres 1 and 2, Valle Verde, and Village East.

Study Area 10

The owners of the parcels in this study area are mostly members of the Billings family. The majority of wells in this area are operated by Sanchez Oil; others are operated by Saxum Oil and Gas, Dallas Petroleum, Lopez-Valdez, and Lopez/Heavenly. The wells are all vertical wells, and are located in the Lopez North field. Most of the land grant parcels are for railroads, and were also under the names Lopez, Roscal, Chatham, and Swisher. Sanchez Oil is owned by the Sanchez family and was founded in the early 1970s. Another prominent family in the Laredo area, the Sanchez's have long been involved in politics and banking in addition to oil and gas. One member of the Sanchez family, Antonio "Tony" Sanchez Jr., ran for Texas governor and lost in 2002.

7.4. Governance Geographies and Impact Distributions in the Study Sites

My research design incorporated governance geographies both as a spatial lens and as an analytical lens, in part because rights, access, and protections in Texas vary depending on which jurisdiction you are in. I therefore used jurisdictional boundaries as part of the spatial typologies to represent my 'governance geographies' for purposes of this study. The following table shows which rules and regulations are generally applied to which study site.

Below I present some of the resulting impacts in more detail and how they are distributed throughout the study sites. I describe how rules and regulations are applied, but also refer back to a more comprehensive compilation on **Table 2.4. U.S. Land and Environmental Resources and Protection Across Geographic Scales**. Qualitative descriptions provided by research informants from specific sites have been aggregated to each geography type to preserve their anonymity, and are also further elaborated upon in the next chapter.

Table 7.3. Governance Geographies, Study Areas, and Rules and Regulations

GOVERNANCE GEOGRAPHY / STUDY AREAS	GOVERNANCE TYPE Who decides what can do or not do	RULES AND REGULATIONS: Enforcement, Permitting for Oil & Gas Specific Land Uses, Activities (BEFORE SB 40 / 2015 *)	RULES AND REGULATIONS: Enforcement, Permitting for Oil & Gas Specific Land Uses, Activities (AFTER SB 40 / 2015 *)	RULES AND REGULATIONS: Enforcement, Permitting for Environmental Protection, Waste, Flood Control
City of Laredo Study Sites: 4, 8	LOCAL CONTROL: Home Rule	WELL LOCATIONS / SETBACKS ***City of Laredo*** can determine setbacks in relation to sensitive land uses: • Well ('reasonable') setbacks defined as 200 feet or more OIL AND GAS / DRILLING PERMITS *TRRC* Permitting / Enforcement: • Wells, withdrawal limits and well spacing (prorationing) , waste management for some aspects of well production, intrastate pipelines, emissions from wells (flares)	EXPLICITLY STATED BY ***STATE OF TEXAS*** LAND CONTROLS CANNOT EFFECTIVELY ELIMINATE DRILLING WELL LOCATIONS / SETBACKS *City of Laredo* can determine setbacks in relation to sensitive land uses: • Well ('reasonable') setbacks defined as 200 feet OIL AND GAS / DRILLING PERMITS *TRRC* Permitting / Enforcement: • Wells, withdrawal limits and well spacing (prorationing), waste management for some aspects of well production, intrastate pipelines, emissions from wells (flares)	O/G ACTIVITIES THAT HAVE ENVIRONMENTAL IMPACTS permits and enforcement by TCEQ generally for: • Water, waste management and disposal • Proximity (150 ft) to potential point sources like o/g wells • Surface water rights • Air and water pollution O/G ACTIVITIES THAT HAVE ENVIRONMENTAL IMPACTS permits and enforcement by TRRC generally for: • Waste Management for some aspects of well production, intrastate pipelines, emissions from wells (flares) LOCAL PLANNING responsible for environmentally related land controls and planning (see Note 1): • Local Transportation, Water/Waste Management, Public Works, Environmental Protection, Flood Management
City of Laredo Extraterritorial Jurisdiction / Colonias (Unincorporated Webb County) Study Sites: 4, 7, 8 -- ***Webb County*** Study Sites: 1-10 have a portion or or are completely within the county	STATE CONTROL: General Law (State of Texas)	WELL LOCATIONS / SETBACKS ***Webb County*** can determine setbacks in relation to sensitive land uses: • Well ('reasonable') setbacks defined as 200 feet or more OIL AND GAS / DRILLING PERMITS *TRRC* Permitting / Enforcement: • Wells, withdrawal limits and well spacing (prorationing), waste management for some aspects of well production, intrastate pipelines, emissions from wells (flares)	EXPLICITLY STATED BY ***STATE OF TEXAS*** LAND CONTROLS CANNOT EFFECTIVELY ELIMINATE DRILLING WELL LOCATIONS / SETBACKS *City of Laredo* can determine setbacks in relation to sensitive land uses: • Well ('reasonable') setbacks defined as 200 feet OIL AND GAS / DRILLING PERMITS *TRRC* Permitting / Enforcement: • Wells, withdrawal limits and well spacing (prorationing), waste management for some aspects of well production, intrastate pipelines, emissions from wells (flares)	O/G ACTIVITIES THAT HAVE ENVIRONMENTAL IMPACTS permits and enforcement by TCEQ generally for: • Water, waste management and disposal • Proximity (150 ft) to potential point sources like o/g wells • Surface water rights • Air and water pollution O/G ACTIVITIES THAT HAVE ENVIRONMENTAL IMPACTS permits and enforcement by TRRC generally for: • Waste Management for some aspects of well production, intrastate pipelines, emissions from wells (flares) ***MINIMAL*** COUNTY PLANNING responsible for environmentally related land controls, planning (see Note 1): • Local Transportation, Water/Waste Management, Public Works, Environmental Protection, Flood Management

NOTE 1: County and general law cities can only affirmatively 'do' what state law explicitly allows the jurisdictions to do; SB 40 (2015) banned Home Rule cities from unilaterally prohibiting oil and gas exploration and production activities at the municipal/local level, even by referendum

NOTE 2: Contesting Use/Rights – Usually depends on o/g issue with supremacy rights/access granted to mineral owners. Conflicts about property rights, access and localized impacts thus are ruled by oil and gas since the following (2005) contain various exemptions for oil and gas activities: Clean Water Act, Clean Air Act, Emergency Planning and Community Right-To-Know Act, Resource Conservations and Recovery Act, National Environmental Policy Act, Safe Drinking Water Act

NOTE 3: Refer to ***Table 2.4. U.S. Land and Environmental Resources and Protection Across Geographic Scales*** for a detailed description of the laws, regulations, scales and responsible entities.

In Texas municipalities that are Home Rule[133] cities, like Laredo, land use and other planning tools can be instituted to provide some protections to neighboring communities located around wells and affiliated oil and gas activities. This includes local planning tools like land use planning, zoning, requiring setbacks, and negotiating of right of ways. These are all drawn from and informed by federal law, state law, local ordinances, and comprehensive plans. Municipalities typically are able to use their police powers to create ordinances that shape various aspects of the built environment such as local transportation modes and planning, water and waste water management, public works and infrastructures, and flood management. Locally-impacted infrastructures from oil and related activities like leaks, spills, and odors could potentially be investigated at the local level; however, much of the jurisdictional control of permitting and enforcement of regulations meant to stem impacts from such activities lie at the state level.

Both Sites 4 and 8 are partially within the city limits. This means they have been characterized by growth in terms of population and more recent annexation. The one in the Eagle Ford Shale (#4) has the more recent oil and gas activity visible in these satellite images, one from 2005 and the other from 2015. As expected, the differences in well activity and intensity during the EFS shale boom (2009-2015), as indicated in the red circles, are not seen in other parts of the county outside of the Eagle Ford Shale (such as study site #8). This also reflects shifts in the land uses of large land holdings by some prominent families, especially where families still live on the ranch, as well as the shift in more ‘desirable’ areas within the city limits and the ETJ characterized by higher costs of land and housing. If you continue to focus on the second study site (#8), you will also see

[133] *Home rule* municipalities like the City of Laredo have explicit authority to (7 Texas Administrative Code 211.012) to zoning, comprehensive planning, enforcement, and impose penalties (can include hazardous/industrial site location)

that the suitability and vulnerability analysis also captured the presence of older colonias, thus reflecting a diverse range of uses and property values for this part of the city.

Figure 7.9. Study Site #4 in 2005 and in 2015

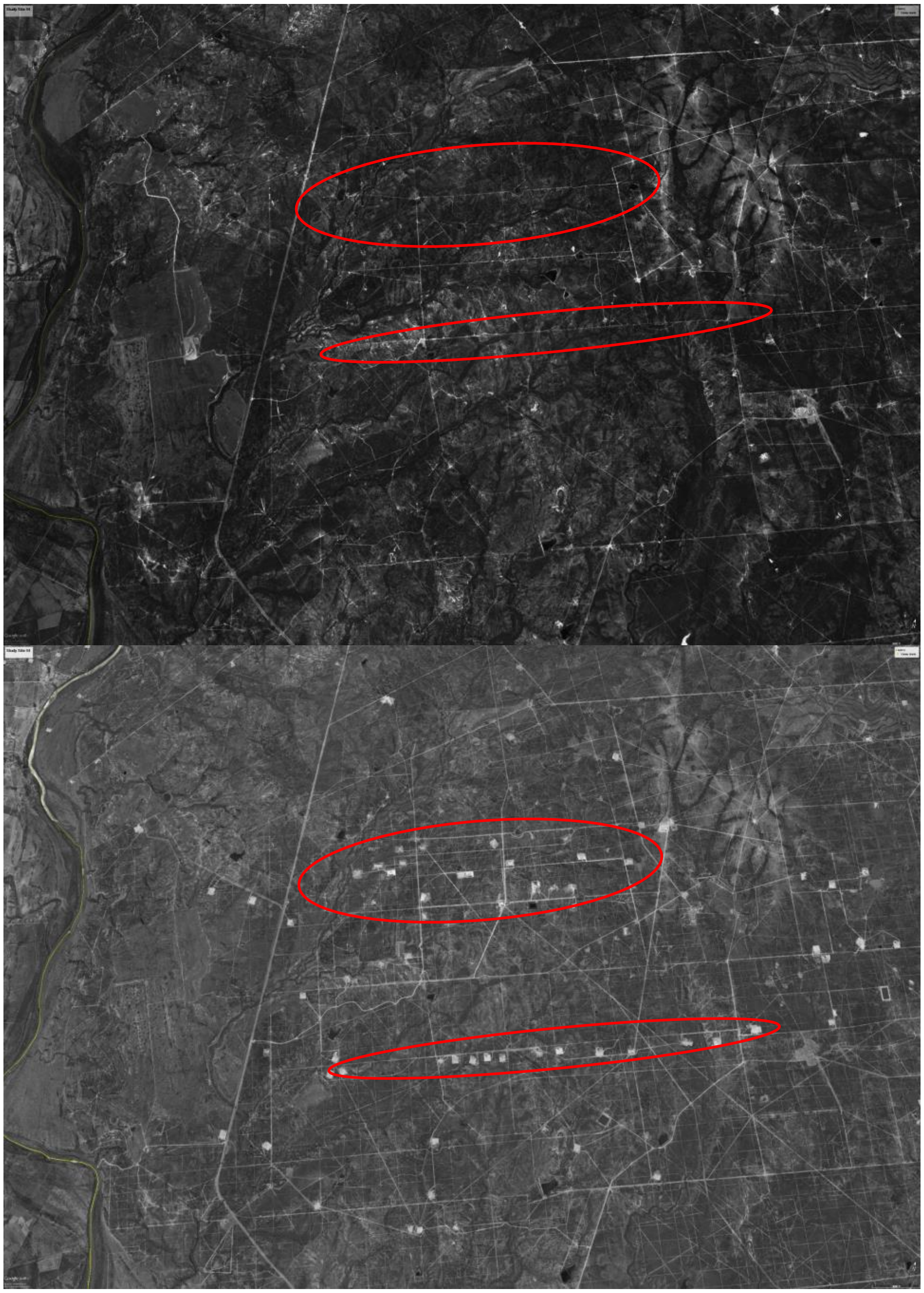
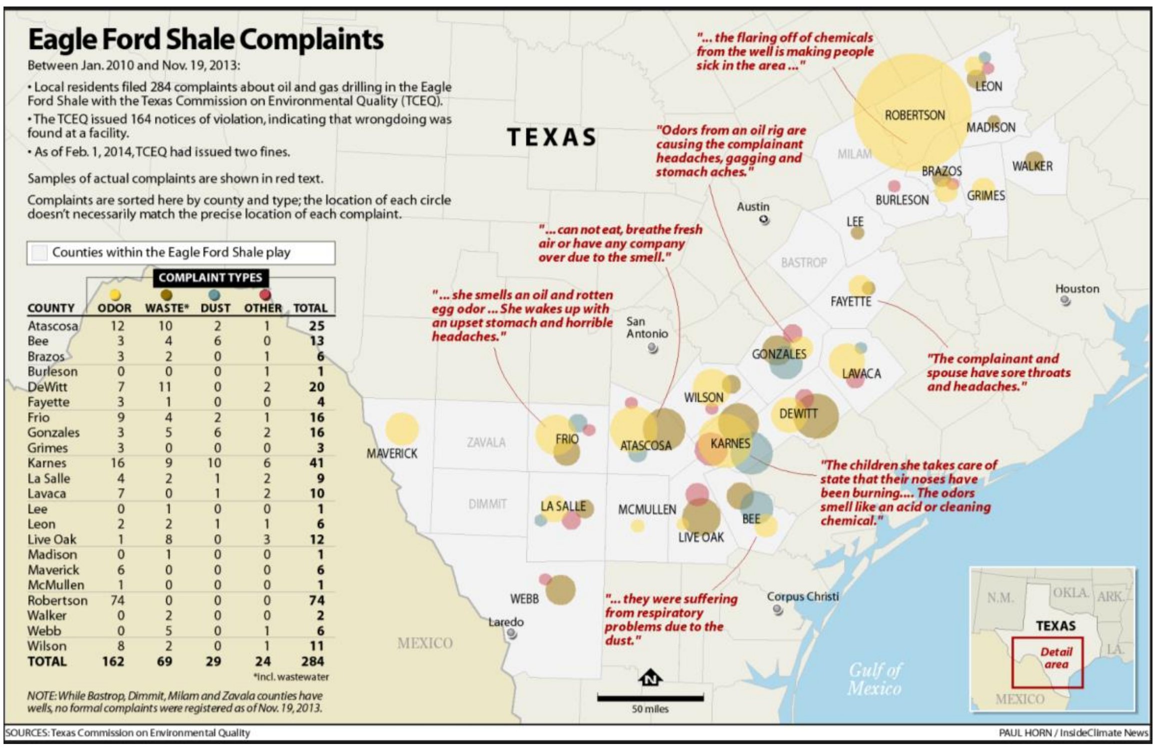


Image Sources: Google Earth, historical imagery for 2005 (top) and 2015 (bottom) of northwestern Webb County by the Rio Grande. Red circles drawn by author for comparison.

These two sites, despite their varying intensities of oil and gas activity, have no documented complaints of groundwater contamination with the TCEQ since 2014 (*TCEQ Active Contamination Complaints* database, accessed 2018, 2019, and 2020). After compiling all records of complaints, including air, water, odor, or spills up to its publication in 2014[134], *Inside Climate* posted only two open case complaints for the entire county. This report was referenced in Chapter 2. In the next chapter, I present interviewee perspectives

Figure 7.10. Eagle Ford Shale Complaints Between January 2010 and November 2013



Map compiled by Paul Horn for Inside Climate News (2014)

who discuss possible reasons for low rates reporting rates in this area.

134 https://insideclimatenews.org/content/fracking-eagle-ford-shale-big-oil-bad-air-texas-praire (based off of data on environmental claims/reports made to Texas Commission on Environmental Quality.

Counties[135] and the Spaces in Between: Unincorporated Areas, Specifically ETJ's and Colonias

As with other parts of Webb County, unincorporated areas including ETJs and colonias have been strongly impacted by Eagle Ford Shale activities over the last decade. Many recognize that when the market is good, and the price of oil is high (up to 2014), they benefit from formal and informal economies related to oil and gas[136]. Colonia residents, along with other not-landed and low-income individuals, are not typically the people who make noise to local, county, or state officials by filing complaints. More prominent 'elite' locals, however, are becoming more visible (and influential) in these efforts, as they happen to be landowners who feel 'these activities harm my land and degrade my property's water source', as one interviewee suggested. To preserve the anonymity of my informants, I aggregated to include more critical comments representative of different experiences I documented for this research. I contextualize and delve into these impacts as told by some residents, property owners, and advocates (on behalf of other residents in addition to most vulnerable) in the next chapter.

7.5. Role of Land Tenure Histories in Representations Vulnerability to Negative Impacts from Oil and Gas

The aim of this chapter was to illustrate the complexities of vulnerability from extractivism by integrating land tenure histories. I used a combination of spatial and

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135 Counties have authority to operate in the same way that *General Law / Dillon's Rule* cities can in Texas, meaning they can only do what the state expressly grants them to do as codified in the TAC. For more information, CAPCOG has a great article delineating and translating what this means for planning at the county level: https://www.capcog.org/wp-content/uploads/2009/11/2009-10-14-County-Land-Use-Report-final.pdf

136 This aligns with this report from the Federal Reserve of Dallas, 2015, *Las Colonias in the 21st Century: Progress Along the Texas-Mexico Border*. Accessed online tahttps://www.dallasfed.org/~/media/documents/cd/pubs/lascolonias.pdf

qualitative methods to answer my research questions 1C, 2A, and 2B, to ultimately better understand social vulnerability and how focusing on not just land use but who owns the land. I focused on the role of land controls and governance structures in influencing social vulnerabilities represented with this research question: How does tenure and ownership of land and minerals influence social vulnerability in these cases? In order to examine the role of land controls and governance structures in influencing social vulnerabilities within this border landscape I incorporated governance geographies into my analysis. Governance geographies highlight the spatial extent of land control mechanisms (land use regulations for example), situating the production of vulnerable spaces within governance structures that to varying degrees can protect both property owners and non-property owners while allowing owners to realize the benefits from the use of their property and its resources.

In this particular study, the deeper examination of the ten discrete vulnerable sites across the different governance geographies for Webb County illuminated the range of types of tenure and degrees of ownership and their relationship to politics and governance. As highlighted by some of my interviews, some aspects of 'vulnerability' not captured by vulnerability assessments include sensitivities to intensity of production, as well as the approach to land use and management. For example, there are some instances of agriculture and ranching as the main source of income and way of life for the property owner. Care and stewardship for the land can conflict in different way with the negative externalities generated by slowing or growing of the oil and gas markets. For context, the timeframe of my study, was 2014 to 2017, during which the non-sustainable energy markets slid into the 'bust' portion of the boom-bust cycle began and eventually bottomed out. This time period was characterized by a slow-down in production due to high costs of development, which was felt by secondary and tertiary activities involved in all aspects of oil and gas production, as well as other users of the land such as farmers and ranchers.

This study therefore illuminates the ways in which the inclusion and critical examination of critical land tenure histories along the Texas-Mexico border landscape affirm the roles of governance and politics, from feudal systems of land ownership and governance to boss rule and corruption, that has continued to be a prominent characteristic of border politics. Physical remnants of changes over time in ownership and types of governance structures, as well as the spatial configurations of iterations of vulnerability from extractive practices, are also evident today. Mexican, Confederate, and American (U.S.) political and cultural figures are memorialized in street and neighborhood names and statues scattered throughout original portions of downtown Laredo closest to the San Agustine Plaza. Parcel and lot lines still echo the original long and narrow *parciones* that touch the river from the early settlement of what eventually became Laredo in the late 1700's. Not memorialized are indigenous communities that were either assimilated (by force) or decimated by colonial New Spain, Mexico, Texas, Confederate South U.S., and then by settler Americans moving west. The muddled histories of land appropriation and dispossession, especially Mexican land stolen and redistributed amongst Anglo and elite Latino families after the Texas Revolution in 1836, and once again after the Republic of Texas was annexed into the Union in 1845. This is memorialized in the Original Texas Land Grant Survey rolls and some deeds dating back to those times.

The legacy of generational accumulations of power and wealth are made visible when examining the histories of land and local politics. In mapping these vulnerabilities, the disparities between being on or close to the most vulnerable pieces of land to oil and gas and not benefiting from royalties from those activities (or influencing politics that can mitigate harm from those activities) are revealed in interesting ways in this study. The next chapter therefore examines implications for such an explicit discussion of vulnerability in relation to histories of land and politics surrounding oil and gas along the border.

Chapter 8: Analysis: The Implications of Land Tenure Histories for Fracking Geographies

Assessments for identifying vulnerable populations are important to planning processes and have been developed and used by both emergency management and land use planners alike. In this dissertation, I have argued that understanding the complexities of vulnerable populations requires more than just spatial, quantitative assessments like Social Vulnerability Index (SOVI) mapping. There has been an increase in the use of such assessments in future land use planning, comprehensive planning, and allocation of programmatic support for housing and disaster aid. This makes a critical assessment and exploration of how to improve such tools (or completely rethink the evaluative processes themselves) both timely and necessary. This is especially true for places like the South Texas border, where pressures from growth and development are necessitating increased resources to conduct such processes to better support the needs of the communities. However, as I have demonstrated in this dissertation, limited data availability can negatively impact the very communities that are in most need of such support.

In particular, data is unreliable or unavailable to fully capture the precarious conditions of colonias because of their informal nature. The Dallas Federal Reserve commented in their 2015 report about a lack of sufficient state-wide and state-produced data on population sizes, homeownership numbers, updated infrastructure lists and *colonia* designation lists, and so on[137]. Many colonias were set up as predatory contract-for-deed opportunities for homeownership for low income, mostly migrant workers, which means they may not get adequate support for infrastructure projects, or political representation.

The second portion of this dissertation therefore aimed to develop a better understanding of these communities by acknowledging and reframing core tenants of vulnerability tied to place: shift in approach that recognizes property ownership and all variations of land tenure in an effort to produce more just, and possibly emancipatory, planning practices and outcomes. This landscape has unique patterns of land use, property ownership, and dispossession and precarity shaped by a deeply complex colonial past. In tracing the historical land tenure patterns of property ownership in Webb County, I was able to discern the following themes and will discuss them further in this chapter: (1) relationship between land wealth and political power and vulnerability, (2) tensions between land control, stewardship, and exploitation, and (3) the value in learning from histories of land tenure and borderlands reconceptualizing, identifying, and developing policies that aim to address vulnerability.

THEME 1: LAND OWNERSHIP YIELDS POLITICAL POWER, WEALTH.

The first and perhaps most overt example of property ownership and political power would be that of the Briscoe Ranch in northwest Webb County (see Study Area #1). Dolph Briscoe was the 41st Governor of Texas in the early 1970s, and then eventually retired and continued pursuing interests in ranching, oil and gas, and philanthropy. He made a substantial donation to his alma mater, The University of Texas at Austin, which then

[137] Barton, Perlmeter, Blum, and Marquez, 2015. "Las Colonias in the 21st Century: Progress Along the Texas-Mexico Border. Accessed at https://www.dallasfed.org/~/media/documents/cd/pubs/lascolonias.pdf

established and named the Briscoe Center for American History after him. The university stated in 2008 in an announcement their rationale was that Briscoe was a "former governor of Texas, landowner, rancher, and noted philanthropist, following gifts totaling $15 million and in recognition of his support for preserving and promoting Texas and U.S. history"[138]. Briscoe was elected in 1972 as governor and stayed through the oil-boom years of the 1970s, during which he "increased spending for highway improvements, signed into law the Texas Open Records Act, and streamlined state agencies."[139] Briscoe was governor during the time of increased national attention on environmental impacts of resource exploitation and development[140]. Many of these laws have either changed very little or become even more titled in support of property rights and autonomy without state intervention. The Briscoe ranch today is a substantially large area in South Texas, which continues to be rural ranchland. The family amassed the property throughout the years and generations, keeping all aspects of the estate, meaning surface and mineral rights, within the family. With increased property values and development along the border, the spatial distribution of non-contiguous parcels in a given property has become more visible compared to similar properties now[141].

Vast disparities in wealth distributions exacerbate distributions of negative effects of oil and gas exploration, development, and production. This is least visible in times of prosperity. On one extreme, when thinking in terms of a proximity-based environmental justice perspective, those that gain the most are furthest removed from the negative consequences of actions taken to generate that wealth:

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138 https://www.cah.utexas.edu/about/briscoe/intro.php
139 https://www.cah.utexas.edu/about/briscoe/intro.php
140 See for example https://www.rrc.state.tx.us/about-us/history/history-1960-1979/
141 http://txlandtrends.org/media/1018/ltchanginglandownerfinal2.pdf

> "A lot of the big landowners you know live in Dallas, or Houston or somewhere else, right. And so they're not experiencing the Health effects. And they're just collecting their checks. They don't plan on living out there, you know, and so the lands [are] destroyed. They're going to get their for money's worth out of it. And you look at, I mean, you drive through you see like dilapidated houses everywhere. Everywhere. And they're like 'oh yeah they're getting all this new tax money' [and therefore not caring about the property itself]."
>
> (Interview with environmental advocate, 2018)

This is evident in the distribution of wealth in the Webb County study areas. There are several sites that may or may not have owner or renter occupied housing on the property, and yet consistently show that the owners of properties directly benefiting from oil and gas royalties are not living on the property. In the meantime, residents near fracking wells are at greater risk of negative health outcomes. As one interviewee indicated, [142, 143, 144]

> "I mean I think there's a lot of people who see both sides. *You know they're grateful for the economic activity but concerned about the health of their families* [emphasis mine]."
>
> (Interview with community advocate and ranch/landowner, 2018)

Both individuals and municipalities struggle with balancing the positive and negative outcomes of any policy or project. This is especially complicated for those who are in precarious economic situations. They are much less likely to, for example, report spills or file complaints because when shale production is 'booming' they are benefiting, even if marginally. One of the community advocates I interviewed explained the impacts of shifts between periods of high prosperity and economic slow-downs associated with boom-and-bust cycles:

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142 Satija, Neena. (2013). "Eagle Ford Shale Region Sees Benefits, Concerns", in Texas Tribune, Accessed at https://www.texastribune.org/2013/09/05/eagle-ford-shale-region-sees-benefits-challenges/

143 Texas Railroad Commission, (2013). "Eagle Ford Shale Task Force Report". Accessed at https://www.rrc.state.tx.us/media/8051/eagle_ford_task_force_report-0313.pdf

144 Morris, Jim. (2014). "Report offers grim predictions for South Texas air quality amid Eagle Ford Oil Boom". The Center for Public Integrity, Accessed online at https://publicintegrity.org/environment/report-offers-grim-predictions-for-south-texas-air-quality-amid-eagle-ford-oil-boom/

> "So all of sudden you've got a job that is paying three times what you've ever made before. … If you live down there also your [rent] just got tripled… And the food prices at the restaurants are [too]. So. Like. How do you benefit? Yeah you're getting paid more [but] your cost of living - I mean some people, if you [own] your house, then OK, you're OK. But if you weren't as economically well-off already you know then your wages went up and so [did] your cost of living."
>
> (Interview with community advocate, 2018)

The advocate is describing the contradictory costs and benefits from the shale boom—more jobs and higher wages are good, but when wages go up, so do other costs. Certain kinds of more 'stable' wealth and security isn't tied to the energy market. Examples of more stable, secure sources of income and employment include having a job in a different industry, having multiple streams of income from property wealth like mineral royalties that are not the primary sources of income, or paying homestead property taxes that are shielded from drastic increases in property values. Variety in sources of income and employment security become increasingly important during less prosperous times. The best example of this kind of period is evident when viewing economic and employment impact data in 2014 for the Eagle Ford shale Region, described as peak 'boom,' compared to 2015. Income and security associated with oil and gas substantially dropped[145]. According to the U.S. Federal Reserve of Dallas, the 15-county area of the Eagle Ford shale yielded an economic impact in 2014 of $98 billion, followed by $59 billion in 2015, and $33 billion in 2016. The trajectory of employment in the area is similar: employment peaked at nearly 130,451 in 2014, but dropped to about 80,000 in 2015 and just over 36,000 jobs in 2016 (Federal Reserve of Dallas, 2017, p. ES / 1). This kind of change is not an inherent part of the vulnerability assessments unless you conduct assessments using longitudinal data or some other data sets that reflect changes over time (like a time series).

[145] https://ccbr.iedtexas.org/wp-content/uploads/2017/06/efs-report-19-june-2017.pdf

Critical analysis of the relationship between property, land tenure histories, and vulnerability along the border is therefore a much more powerful way to understand and ultimately challenge conceptualizations of vulnerability that rely on snapshots in time on land use in relation to risk. The ahistorical nature of assessments of vulnerability to hazardous events fails to recognize the structural implications of precarity amongst populations that are informally understood and represented.

THEME 2: LAND CONTROL, STEWARDSHIP, AND EXPLOITATION.

> "Water knows no boundaries. Air knows no boundaries. We're all connected."
> (Land and minerals owner—ranchland with organic livestock, 2018)

The second theme that emerged from my research is the tensions between stewardship, exploitation, and land control. With over 95% of Texas land privately owned, stewardship of land is important to the maintenance of the public benefits of private lands in Texas[146]. In areas where there is heavy oil and gas production, such as the Eagle Ford Shale or, more recently, the Permian Basin in West Texas, there are numerous ranches and lands used for agriculture that also have active well sites. Interviews with informants, narratives portrayed in policy documents, and news organizations tie back to historical tensions between land conservation and exploitation in the state (some detailed in Chapter 3: Land).

The above quote from a rancher encapsulates this concern for the public use and enjoyment of private land and its resources. This person, along with another ranch owner

[146] https://nri.tamu.edu/programs/stewardship/private-land-stewardship-academies/

I interviewed, voiced the same concerns. Both benefit from mineral royalties but still choose to limit uses and access to their property when possible. One of the ranchers who sells organic livestock has built his business on being able to make those kinds of decisions, but because he is a part of a large estate that the family has owned for over two generations, he has to work with the other mineral interests in the estate. The rancher told me that when they began their organic livestock business, they paid for their own well water and air quality testing and were disturbed by what they found. In his efforts to limit the contamination of his property's precious groundwater and harm this was bringing to the animals and people, he became very politically active and even ran for a regional office. Both ranchers' sentiment was that they couldn't effect change to mitigate harms from oil and gas activities. But, they could participate in the system that manages and enforces the rules meant to curtail negative impacts on their and neighboring properties.

The rancher didn't win his race for office, but he did raise awareness concerning local impacts from fracking on rural agriculture that other similarly-minded landowners were unwilling to voice publicly. Texas is pro-property rights, but it also values mineral rights above other rights[147]. Texas law is still broadly influenced by the Common Law Rule of Capture[148] and mineral rights[149]. And this person fully recognizes the conflict: "When

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[147] With some limits placed by the state on well spacing and "legitimate drainage of a pool" or reservoir. From *Oil & Gas Law—Chapter 1: Rule of Capture* presentation by Prof. Bret Wells. Accessed via https://www.law.uh.edu/faculty/bwells/oilgas2017/Chapter%201.pdf

[148] Rule of capture "provides that a person owns all of the oil and gas produced from a well bottomed on his own land, regardless of the substances' original location—regardless, indeed, of the fact that the well may have been deliberately located at a spot that would cause the maximum drainage of neighboring land." From Prof. Ernest Smith's Texas State Bar presentation "The Basics of Texas Oil and Gas Law: An Overview" (2003) Energy Issues (Oil, Gas and Mineral) session "The Basics of TX Oil & Gas Law: An Overview—PART A" Accessed online at https://utcle.org/ecourses/OC4732/get-asset-file/asset_id/5091

[149] From "each landowner should be afforded the opportunity to produce his fair share of the recoverable oil and gas beneath his land, which is but another way of recognizing the existence of correlative rights between the various landowners over a common reservoir of oil or gas" From *Oil & Gas Law—Chapter 1: Rule of Capture* presentation by Prof. Bret Wells. Accessed via https://www.law.uh.edu/faculty/bwells/oilgas2017/Chapter%201.pdf

everyone is getting rich, it's hard to find a critic" (2018, Interview with landowner). This dilemma is at the forefront of many other property owners minds as well. It is a part of a broader narrative, or counter-narrative, to full exploitation of the land at the cost of others.

Discussing land tenure beyond just simply land use allows for a more nuanced discussion on the subtle differences in rights and who does or does not own them. Mineral rights and more broadly land rights in Texas is quite complex now considering the ability to severe various aspects of your estate. The more complex the law regarding property rights has become, the more difficult it has become for those without absolute mineral rights to do what they want to their property[150]. Negotiating leases becomes that much more contentious and more is at stake when most of the power lies in the mineral estate[151].

Developing mechanisms to monitor, mitigate, and otherwise minimize harm to your property or your ability to use a public benefit from the property (like water) becomes a much more cumbersome and laborious exercise in patience and (usually) disappointment. Formal bodies as dictated by state statute are supposed to perform such enforcement of laws designed to counter and protect the public goods derived from private lands. These formal means of land control should work towards these goals. However, in a state like Texas where property rights reigns supreme, this is increasingly challenging. Take for example my stated complications in performing the vulnerability analyses (see Chapter 6)

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[150] See for example, in an interview with a lawyer: "I noticed was that small landowners in Pennsylvania rapidly figured out that if they get if they might banded together to negotiate they get a lot better deal so in certain geographic areas they would all they would form some kind of a loose association or some kind or another, and they would then negotiate the terms of their leases as a group. But [….]well, you never see that in Texas. I've never seen land owners group together and if you ask your neighbor well I guess we'll see—'well that's none of your business'." (Interview with energy and property lawyer, 2018)

[151] On negotiating leases, see for example from an advocate ""And then there are some who are just upset with the amount of flaring that's going on because the way a lot of the mineral rights. Leases are written and it's written or drawn up such that. Like if you're the land owner and I'm the oil and gas company I don't have to pay you royalties unless I get it the product to market and sell it. So if I drill for oil and I hit natural gas also and I just decide to flare it all off I don't have to pay you for any of that. And so you could be upset that it's all going [that way]." (Interview with advocate, 2018)

with the data and resources typically available to those that area also responsible for enforcement (like a Planning Department). One of these issues is the lack of air quality monitors from Texas Commission on Environmental Quality (TCEQ), the body responsible for monitoring and enforcing federal air quality laws. The lack of data from this resource is problematic not just for me as a researcher, but it is problematic for members of the community, property owners or not, who rely on the state to perform its monitoring and enforcement duties:

> "The one thing we would tell people about them in the eagle ford shale is *there are only two air quality monitors in the [Eagle Ford] Shale*. There are, like 35, I think [in] the Dallas / Barnett Shale. Mostly because it's urban, well because it's urban and because they have more political power."
>
> (Interview with advocate, 2018)

Webb County, more specifically, has only two monitoring stations as of 2017. TCEQ has added two monitoring stations in the Eagle Ford Shale to monitor air quality in known problematic areas (which have the highest amount of production in the EFS)[152]: the Karnes County Ambient Monitoring Station, and the Floresville Hospital Boulevard (Wilson County) Ambient Monitoring Station. This lack of tools for oversight is why the landowner discussed at the beginning of this section paid for their own private tests of water and air on their property. And this is just from the perspective of property owners government officials also voiced their frustrations with the lack of tools for oversight and enforcement. As discussed in Chapter 3, 6, and 7, publicly available data on colonias has not been updated by the State of Texas in years, which has constrained county officials in planning and economic development (Interviews with two county officials and a state official, 2014; Interviews with several advocates, 2018). In one interview, a county official,

[152] https://www.tceq.texas.gov/airquality/eagleford

with overt libertarian preferences for governance and oversight, told me the Texas Administrative Code is 'their best friend' (2014). This is because there are very few rules counties can use for oversight, permitting, and enforcement. In this case, the example used by this official involved creatively using federal FIPS flood plain rules for siting to limit the siting of a temporary water and electricity hookups for a man camp (temporary shelter for oil pad workers). Their goal was to limit sprawled, dense living spaces in problematic or potentially harmful locations.

Ultimately, the tension, exposed by oil and gas activities, between stewardship, exploitation, and land control is visible through the range of property ownership and land use. The ethos of Texas as an oil and gas state, epitomized by Rep. Hilderbran's proclamation that "if you're anti-oil and gas, you're anti-Texas," drives tensions between stewardship, exploitation, and land control. Ultimately, it is clear that local governance and relations of power is very important in understanding the complexities of vulnerability in these border spaces.

THEME 3: THE BORDER IS A UNIQUE PLACE.

The Texas–Mexico border is a complex space that is unlike Texas or Mexico on their own. The border is a confluence of cultures, politics, and the ways those are manifested in today's built environment. The suitability assessment (vulnerability with hazards), with its inherent data challenges, still suggests vulnerabilities associated with close proximity to hard infrastructure need for oil and gas activities. These assessments, however, do not fully represent aspects of the border communities such as its population being majority (95%) minority. Other issues related to class are somewhat more apparent including economic segregation. However, this particular configuration of the built environment is better explained by looking beyond these kinds of assessments. Analysis of my interviews, incorporated with documentation of current and past events and people (primary and secondary sources), and the mapping results, suggest past of this landscape, particularly being under seven flags (seven sovereignties), helps to explain issues of property ownership and its relationship to political power. Specifically, colonial remnant of governance and political power are still very present and visible today. Mechanisms such as economic disparities and education and civic engagement, core features of these border spaces, are slowly changing these complex places.

Much of the Chicanx and border literatures argue that borderlands are inherently different spaces that are composed of remnants of their neighboring spaces and remnants of the previous colonial and pre-colonial political, cultural and spatial configurations visible today (see for example Anzaldua, 1987; Montejano, 1987; others discussed in Chapters 3 and 4). One visible consequence of the numerous changes in sovereignties over the last more than 300 years. Is in the governance regimes in this area. Not only do we have today's system of rules for municipalities, counties, and the state, but the historical and spatial influences of the past are present as well. Mayor J.C. Martin, 1954–1977, is the most notorious example of the Spanish/Mexican boss rule via *patrones* that was also corrupt[153]. In an interview on grassroots efforts in Laredo in the 1970s to expose corruption by Bill Moyers[154], from 1978, Mayor Martin explicitly tells Moyers that he is the *patron* of Laredo. Local media and individuals I interviewed for my research continue to speak of the infamous Mayor Martin and the persistence of the patron system in local governance

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[153] See Mayor Martin's discussion of *patrones* from 1977 at https://youtu.be/5g-HvaL6DiY

[154] Full Interview with Bill Moyers CBS, *You Can Beat City Hall*, is located here: https://vimeo.com/12349293 The 20 minute piece interviewed Mayor Martin and also discussed the local grassroots efforts to bring him down, resulting in eventual federal prosecution of mail fraud Martin

today[155,156]. As Mikaela Rodriguez of the *Texas Observer* stated in 2014, “The days of Martin’s patrón dynasty may be gone, but the vestiges of that political system remain in Laredo.”

My interviews[157] also reveal that this manifests today in the uneven and very visible distributions of wealth and power. They suggest that poverty is a determinant, and hindrance in many cases, to social mobility and political power. One interviewee stated:

> “In a way, though, there’s some things that will never change. I don’t think… the old barriers will never change much. And I’m not being critical. I’m just telling you that that’s poverty. *Poverty is actually a glue that holds a lot of things in place*.”
> (Interview with advocate / local historian, also large ranch owner, 2018)

This statement gets it exactly right from someone who is fully aware of their privilege and tone; along with the way the quote was delivered, it is almost haunting of how true it is down there. There is some consensus that the area lacks a diversity of ideas and people that ultimately yields less political engagement and participation result of less education, openness to new ideas. The following quote captures the slow change to more civic engagement and participation in local politics. Most importantly, engagement and participation that is more inclusive and receptive to different ideas and changing the conversation on local politics and political power.

> “I mean I do think… Laredo is opening and changing. And the mentality is changing slowly. But I do think that [this changing mentality] is because …[when considering the increasing population] it's…a growing community and you have

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155 Mikaela Rodriguez of the Texas Observer stated “The days of Martin’s *patrón* dynasty may be gone, but the vestiges of that political system remain in Laredo,” in UPDATED: With Latest Indictment, Laredo Struggles to Put Corrupt Past Behind It”, (2014) in *Texas Observer*. Accessed online at https://www.texasobserver.org/latest-indictment-laredo-struggles-put-corrupt-past-behind/

156 From two interviews I conducted, for this research, in 2018 with two different advocates

157 From two interviews I conducted, for this research, in 2018 with two different advocates/informal historian

> more and more people getting educated. I mean yes, a lot of people leave but some are staying here and some who were from out of town that are [moving back] home. So, they're bringing in new ideas and new desires. So I think that's helping. I do. And you know….I can speak a bit more…on environmental issues and I think there is a deeper interest now. And I think you have deeper interest in where people who get it here and who want to preserve the environment and get involved with environmental issues. Either for enjoyment of these areas or to minimize… pollution issues or from our quality of life issues or thinking about their future kids. And we've seen that…it's not yet huge numbers but you do have more people and committed people [involved]… But you still have others that are new or maybe a bit more educated. And maybe [they] have been outside of the radar for a while so they have these other [outside] perspectives… And that's starting to happen. You've had a change in city management… Now maybe a bit more a bit more inclusive… I think that's a positive development… It's been slow …but I think…steady progress."
>
> (Interview with advocate, 2018)

The sentiment of recognizing and experiencing a shift in local political perspectives and interests in civic engagement is something I've also seen and heard anecdotal stories about, as a former resident of Laredo with family still there. The sentiment was reflected in other interviews as well which indicates to me that there is slow movement towards different approaches to local participation in politics, environmental stewardship and activism, and deeper appreciation for more complex and diverse ideas on how to improve the quality of life for those directly and indirectly impacted by the environmental and economic impacts of fracking. This is a shift from the more "Texan" cultural approach to property, oil and gas, and local governance discussed in the Land chapter. Furthermore, this also indicates a shift away from the local border *patrones* politics that has been a part of the area's cultural heritage going back to colonial New Spain. This is important because of the histories and politics of who owns what in relation to oil and gas, and also who has political power. Usually those two things are related and have been for generations, with one further cementing wealth and political power in combination with the other, and everyone else having to deal with the negative impacts of oil and gas activities. But as times time change and we have a growing diversity of people moving to the area and staying, along with a growing sense of power in community grassroots organizing for environmental issues, these patterns of ownership and accumulation of wealth and power may also be changing. It would be interesting to investigate this further, how changing demographics can influence and improve civic participation and overall wellbeing of community members across the wealth and status spectrum.

Chapter 9: Discussion

In my Introduction chapter, I wrote about observing an active well pad that was being drilled, full of workers and a steady stream of heavy freight moving precariously on small county roads not designed for even half of that traffic. I was drawn to the contradictions in that space: the children's playground and mobile homes situated in a colonia outrageously close to an active well site, and the broader narrative the was pro-property rights mentality that made such a configuration acceptable, if not even visible. This led me to ask 'what had to happen to where the experiences of the people who lived in those mobile homes and the young children who played in that playground didn't matter enough to prevent such a hazardous and harmful activity from occurring there?'

This dissertation is, in essence, what I did to understand and critically engage with this problem: the visibility of such spaces, the rules and regulations, as well as the social and cultural aspects of this space, are what made this contradiction an exception to what people thought of oil and gas, and what people thought of *colonias*. Focusing on tenure, and more broadly land control and ownership, within this unique historical, border context, provides a unique opportunity to trace the connections and contradictions between land and mineral ownership, rights and access, and political power in the Southwestern U.S.—a space where colonial, economic, and political power dynamics and disparities are in many ways still maintained. My examination of available data from the study areas coupled with my interviews and document analysis, shows that such connections and contradictions do exist. Issues such as class, and race—even in places like the border where the population identifies as +95% Hispanic—are not always evident when using typical tools and data that require lots of resources to compile, process, analyze, and prepare for public consumption. In summary, I sought to critically examine the traditional tools planners use to identify vulnerable communities in places like the South Texas border, where pressures from growth and development are necessitating increased resources to conduct such processes to better support the needs of the communities. Given their prominence in future land use planning, comprehensive planning, and allocation of programmatic support for housing and disaster aid, a critical exploration of how to improve these vulnerability assessments tools is both timely and necessary.

REFRAMING VULNERABILITY IN PLANNING

I approached this study in two phases, guided by different perspectives. Roy's epistemology of informality was instrumental for me in reconceptualizing and reframing core tenets of vulnerability tied to place. One of the main ways to do this, Roy argues, is for planners to value and learn from what does not work ('state of exception'), and the if concerned with distributive justice, should look at value and ownership over land use (who owns what instead of land use/tenure). After demonstrating that a proximity-based assessment using just land use and other socioeconomic data is not the best approach in locales where data is scarce.

Aside from methodologies such as vulnerability assessments, epistemologies of informality is useful in reframing findings and theoretical insights that aim to produce more just, and possibly emancipatory, planning practices and outcomes. Given the complex relationships between people and the border landscape that spans across generations, it becomes imperative to recognize the role of cultural and historical context in influencing patterns of land use, property ownership, and dispossession. A change in epistemological perspective in this case reveals the value of recognizing *precarity of place and of people* in spaces that have undergone several iterations of governance, informed by a deeply complex colonial past still evident in the built environment today.

The second aspect of Roy's epistemologies of informality emphasizes focusing on 'who owns what,' which is explicitly aimed at promoting distributive justice. Roy interprets this within the context of a capitalist, neoliberal sense of production and the role of property and embedded power. The hierarchy of land use supremacy conceals the role of *who owns* property in truly determining what can happen in those spaces. The case of oil and gas on the Texas border captures the essence power and production, and it also reveals who does not have this kind of 'power.' Property law in Texas favors mineral rights above all else, which means that renters suffer the worst negative impacts from being in close proximity to oil and gas activities.

Thinking about land tenure, however, and the spectrum of possibilities expands the possibilities and acknowledges the squatter—it recognizes what may be temporary or explicitly not permanent existence within a space over time. This framing means we can recognize the migrant workers and the temporary man camps that follow workers and the availability of work on the oil field. And since I have been using 'precarity' to emphasize the existence and impermanence of such people and spaces, places like *colonias* can be made visible not by the nature of their existence on the boundaries of what is formal and informal or legal and illegal, but just being another iteration of space that exists within this spectrum of land tenure.

INSTITUTIONAL FACTORS AND RELATIONS OF POWER IN CONFIGURING BORDER SPACES

This research contributes to social and environmentally just literature and practices, political ecology, and Chicanx border studies. In order to understand the social and environmental impacts of fracking in racially produced spaces, existing in an imagined and material borderland, it is necessary to develop an interdisciplinary approach to conceptualizing multiple dimensions of human and environment interactions. I take as my point of departure the work in political ecology, integrating critical perspectives from environmental justice and Chicanx border studies. This novel approach reveals the importance of precarity in complicating conceptualizations of vulnerability, specifically by integrating land tenure histories into discussions about resource exploitation and evolution of land control in the Global North, especially in post-colonial border spaces.

Precarity, or without permanence, does not necessarily have to have the negative connotations associated with the word "vulnerability," from which policy and planning practices are derived and executed. In places where resources are limited and community needs are high, reconsidering how we define vulnerability in relation to an ability to be resilient in communities, whether inherent or produced resilience, is key to better informing processes that fully recognizes the most vulnerable and precarious within these specific, local contexts. This challenges western conceptualizations of property and space where individual ownership is the highest form of attainment of status and citizenship. Thinking this way also adds a whole new layer of complexity to the tensions between exploitation and stewardship and land control by countering what is a very 'Texas' way of thinking about land and property.

Using governance geographies was helpful in identifying how land control was successful and not so successful in enforcement and mitigation. They were also helpful in situating the current spatial configurations of land control mechanisms within specific historical contexts unique to the South Texas border region. Patterns of ownership and the approaches to land exploitation, stewardship, or conservation favor the individual over community in Texas. However, if we think of land as something for sustenance and not purely as something for profit, existing federal control and mitigation mechanisms, which are most stringent and also most easily enforceable, should be represented in every governance geography examined in this dissertation. However, the state's interpretation of the charge to regulate and enforce federal laws, particularly environmental and cultural resource protection laws, especially *after* SB 40 (2015), shifts the balance of conflicting interests towards land owners, i.e. the traditional elite whose power is derived from the land's resources.

PLANNING PRACTICE AND METHODS

Social vulnerability assessments can be helpful, but the caveat is that these assessments need appropriately scaled spatial datasets. If this data is not available, it must then be created by piecing together other datasets and creatively using other datasets, which in turn requires subject-specific knowledge and skillsets that the average staff person in a small planning department in a rural community may not have. For communities experiencing growth that outpaces the government's ability to adapt and increase internal resources to meet new demands, such complications significantly impact other processes. One example of such complications involve the requirement of this kind of data for completing an application for specific grant programs for communities that reach certain thresholds for financial assistance. In this specific case, a lack of enough air monitoring stations along the border is a problem, considering the rate at which the population of urban areas is growing. Fluctuations in demand for more resources for monitoring, compliance, and enforcement can further complicate responses to communities that are significantly impacted by oil and gas production and its ancillary activities. In places with limited support for such activities (like Texas), planners and other government officials have to get creative with the tools at their disposal.

There are tools that landowners and various jurisdictions can use as a means of land control in the absence of formal government oversight and enforcement, such as in Texas). One tool is that of the creation of conservation easements when land is sold or mineral rights are being severed from the rest of the estate. These can be negotiated as a part of the sale of the rights in exchange for controlled access to a well pad or water source. Texas A&M University's Natural Resources Institute[158] has information materials and seminars on how to set up such an agreement within local and state jurisdictional constraints regarding limiting access to minerals as a means of land and resource preservation.

More broadly, one of the lessons learned from completing this research is that planning as a profession needs to more explicitly recognize and embrace the multiple histories of place. This includes centering research and community participatory methods that center and make visible these histories. Communities can therefore prioritize integrating other elements such as property ownership into their calculations and vulnerability models, or use a variety of both quantitative and qualitative methods for collecting data to understand spatial changes over time. Examples may include archival work and collecting oral histories.

BROADER IMPLICATIONS AND CONTRIBUTIONS

Interdisciplinary Theoretical Contributions. This research contributes to a better understanding of border communities and how they are effected by resource

[158] Recommend starting with TAMU Texas Land Trends: A publication of the Texas Natural Resources Institute, January 2019 Accessed at http://txlandtrends.org/media/1030/conservationeasementsintexas.pdf

extractivism and other potentially environmentally unjust practices that can be then mitigated via planning. By adopting an epistemology of informality, we strengthen the power, position and multiplicity of visions and experiences that planning, which typically privileges rational, quantitative research, by amplifying the agency generated from within these community member experiences.

This research contributes to political ecology and environmental justice scholarship by drawing on Chicanx border studies to develop a more nuanced perspective on the complex and often contradictory roles of race, ethnicity and histories in shaping disparate impacts of resource exploitation and the structural forces that influence the distributions of and experiences attributed to these impacts. This research demonstrates how the integration of feminist, post-structural political ecology with Chicanx border studies fosters the recognition and privileging of local, brown knowledge and experiences previously not visible to rational, Global North planning practices. Chicanx border studies shows that acknowledging multiple histories is a significant factor in efforts to decolonize spaces and allow for environmental justice and healing of Mexican American border communities. It presents possible learning opportunities for other similarly oppressed communities, which may have different land development histories and governance structures but which share the goals of transcending oppression and violence through community-driven decolonizing practices.

This research also contributes to more complex and nuanced theorizing of post-colonial border spaces and identity where class and race are all selectively deployed to gain and maintain power. As a concept, *mestizaje* is supposed to reconstitute varying aspects of a specific all-encompassing 'mixed' identity that navigates and responds to local contexts, and more importantly, dynamic socio-cultural landscapes. This mestizo border subjectivity incorporates many aspects of identity as represented by blended, in-between border spaces, and is also as a way to reclaim an identity that is not exactly Mexican, Hispanic, Texan, or indigenous. Mestizaje, however, has also been critiqued as a means by which race and class are separated and ultimately erased to the detriment of those on the margins[159], [160].

Within this context, whiteness can then be deployed as a strategy when convenient and expedient in attaining and maintaining status within certain power hierarchies. In the case of the Sanchez family, part of the mythologized genealogy is how, despite losing his wealth, Sanchez Sr. was redeemed by the financial successes of his children and grandchildren. Other scholars have illuminated cases such as this where, when expedient, whiteness and social class ('elite') can be used for upward mobility[161]. Some of my interviewees suggested that if the Sanchez family had been poor and not a part of the White governing class (pre-Texas), they would not have had the political and social power to recover from poor business decisions. The ability to influence governance and local politics in ways that can further shape the landscape is demonstrated further when examining patterns of land acquisition and ownership through dispossession. This has been documented extensively along the border region up to the San Antonio area, where land belonging to families considered elite Mexicans but not Anglo was stolen by the Texas government and distributed as land grants to prominent white individuals. Once oil and gas were discovered and able to be considered separated estates from the land itself, a

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[159] See for example Lourdes Martinez-Echazabal's "Mestizaje and the Discourse of National/Cultural Identity in Latin America, 1845-1959 (1998) in *Latin American Perspectives* Vol. 25, No. 3, *Race and National Identity in the Americas*;

[160] For a more nuanced application of Heideggerian reconceptualization of mestiza / in-between as fluid identity formation and as social-cultural strategy, see Mariana Ortega's introductory discussions in *In-Between Latina Feminist Phenomonology, Multiplicty, and the Self* (2016); or Antonia Darder's

[161] Victor Valle and Rodolfo Torres capture the dialectical essence of this contradiction in the exercise of power, domination, and selective inclusion or exclusion in their essay "The Idea of Mestizaje and the "Race" Problematic: Racialized Media Discourse in a Post-Fordist Landscape" (1995) in *Cultural and Difference: Critical Perspectives on the Bicultural Experience in the U.S.*, edited by Antonia Darder.

complex governance system reinforced the accumulation of such wealth and political power derived from the land. A larger systematic historical study that traced land ownership from pre-Spanish to Texas as a U.S. state would be able to better capture more examples of this phenomenon.

Applications Beyond Planning. Although the border area of South Texas and this particular landscape is unique, there are many aspects of this research and research design that can be useful within other fracking contexts. For example, such an approach that explicitly focuses on impacts to subpopulations that are most susceptible to harms and least able to adapt to change from fracking hazards by using social vulnerability index (SOVI) methodology and related toolkits is more easily accessible to small municipalities and counties that seek to identify and quantify vulnerability and risk. This methodology and approach can easily be adapted in other locations within and outside of Texas, most especially when there is access to granular and plentiful spatial datasets that help us better understand risk from adverse events or hazards. Furthermore, SOVI has become a commonly used approach in and beyond the hazards, mitigation, and resilience planning domains. As discussed in Chapter 5, SOVI has been repurposed and incorporated into a suite of tools and systematically curated datasets in the *U.S. Climate Resilience Toolkit*[162] with the intension of expanding the bounds of community resilience to hazards associated from human or natural disasters to include those resulting from climate change.

This methodology can also be helpful for systematically identifying enforcement and mitigation mechanisms that are not functioning the way they were intended across spatial and temporal scales. There are noticeable shifts in top-down to bottom-up (local)

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162 See https://toolkit.climate.gov/tool/social-vulnerability-index, as well as the original mapping tool by the US Center for Disease Control's Social Vulnerability Index datasets and mapping tool, .

controls that resulted in significant ramifications evident in spatial allocations of these impacts. The passing of federal environmental and energy legislation have been pivotal in changing the American landscape, including NEPA (National Environmental Policy Act, 1970), RCRA (Resource Conservation and Recovery Act, 1980), and the Energy Policy Act of 2005. Local control mechanisms, epitomized by planning and land use controls, are also important tools that can help to balance mandated controls, resulting impacts, and other localized ramifications of federal law. In some places such as Denton, following state legislation (SB 40, 2015), certain local land use tools were further minimized, leading to visible changes to the urban oil and gas landscapes across the state. However, there probably are other places with incongruent spatial and temporal configurations of distributions of positive and negative impacts from extractive practices, thus necessitating more nuanced and complex interdisciplinary perspectives to better understand why.

In my dissertation I have documented how the relationship between historical patterns of land ownership and political power shapes the fracking landscape in this border landscape. At the local scale, political institutions including the local municipality or county government have limited ability to affect control through simple land-use, regulatory tools such as property setbacks, while state level agencies exert control through regulating rights to water use and establishing standards for mitigation processes. However, land tenure histories and historical patterns of colonia development complicate the political, institutional relationships that produce the fracking landscape. Some extensive surface and mineral rights holdings in the area date back to time of Spanish rule, while colonia residents without such land or mineral rights do not have access to the same economic benefits, resulting in uneven control of land and unequal access to political power (DeLeon, 2010). As a result of this historical, uneven control of land, economic disparities are further exacerbated, complicating the material and social geographies of fracking. Ultimately, because of this disconnect between different domains of the state, it is necessary to develop a more integrated approach to policy-making that considers social, economic and environmental aspects within this border landscape order to address the economic disparities stemming from fracking.

Appendix

I. Social Vulnerability Datasets and Maps

Figure A.1. Socioeconomic Status: Total Poverty / At or Below the Poverty Rate

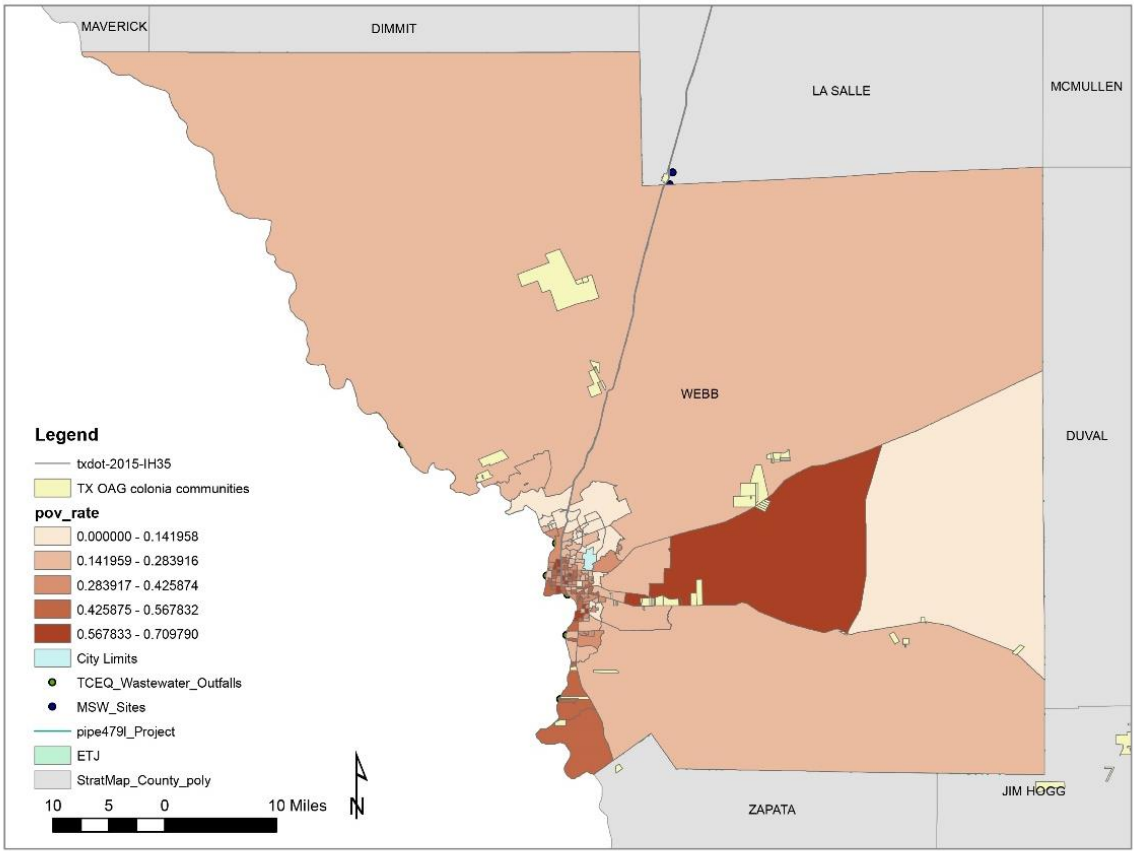


Figure A.2. Household Composition: Total Age 17 or younger

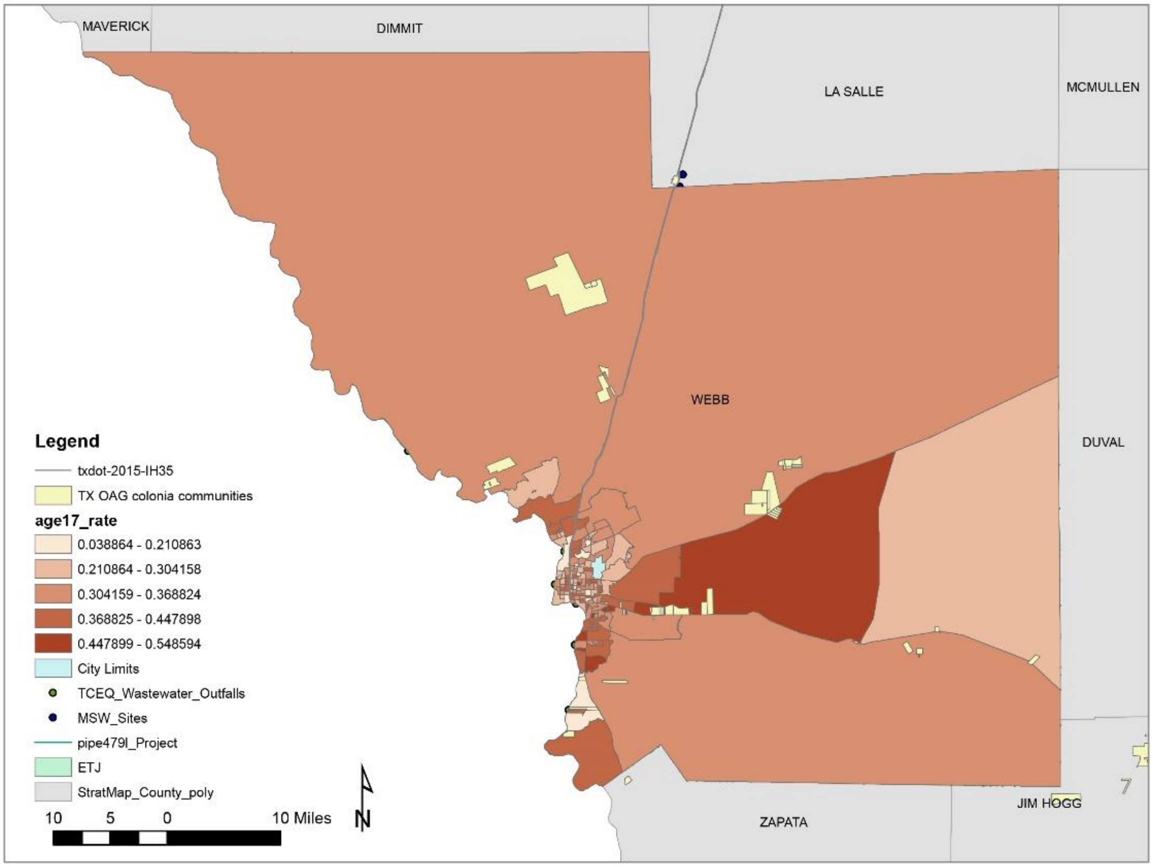


Figure A.3. Household Composition: Age 65 or older

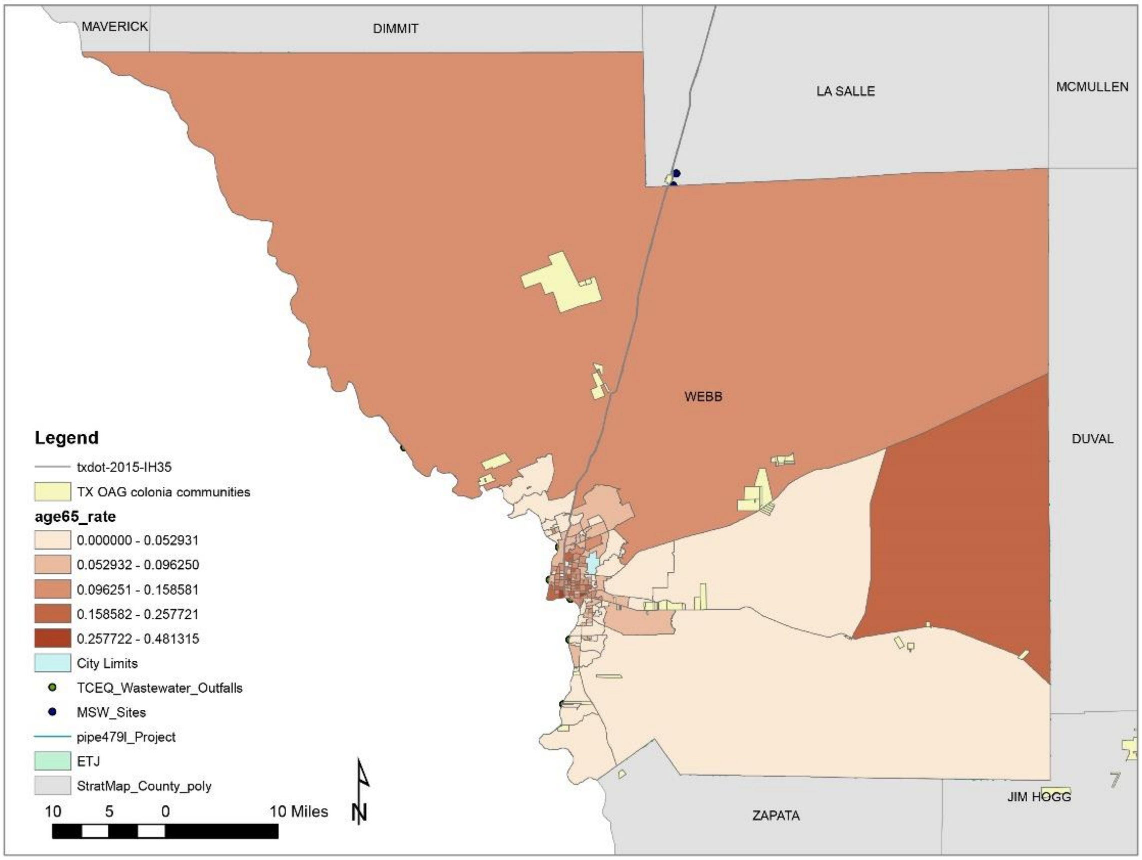


Figure A.4. Household Composition: Total Education Attainment / Less than HS Diploma

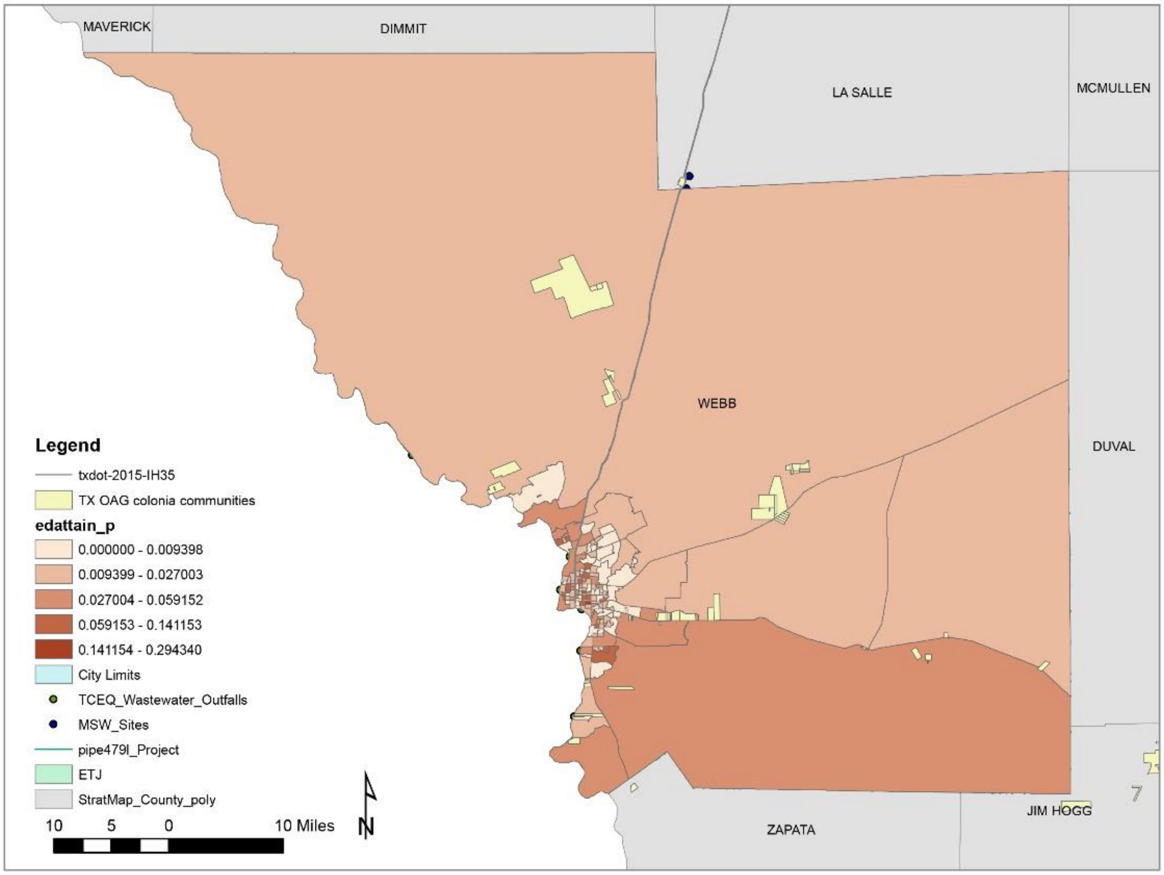


Figure A.5. Household Composition: Single Parent Families with Kids Under 17

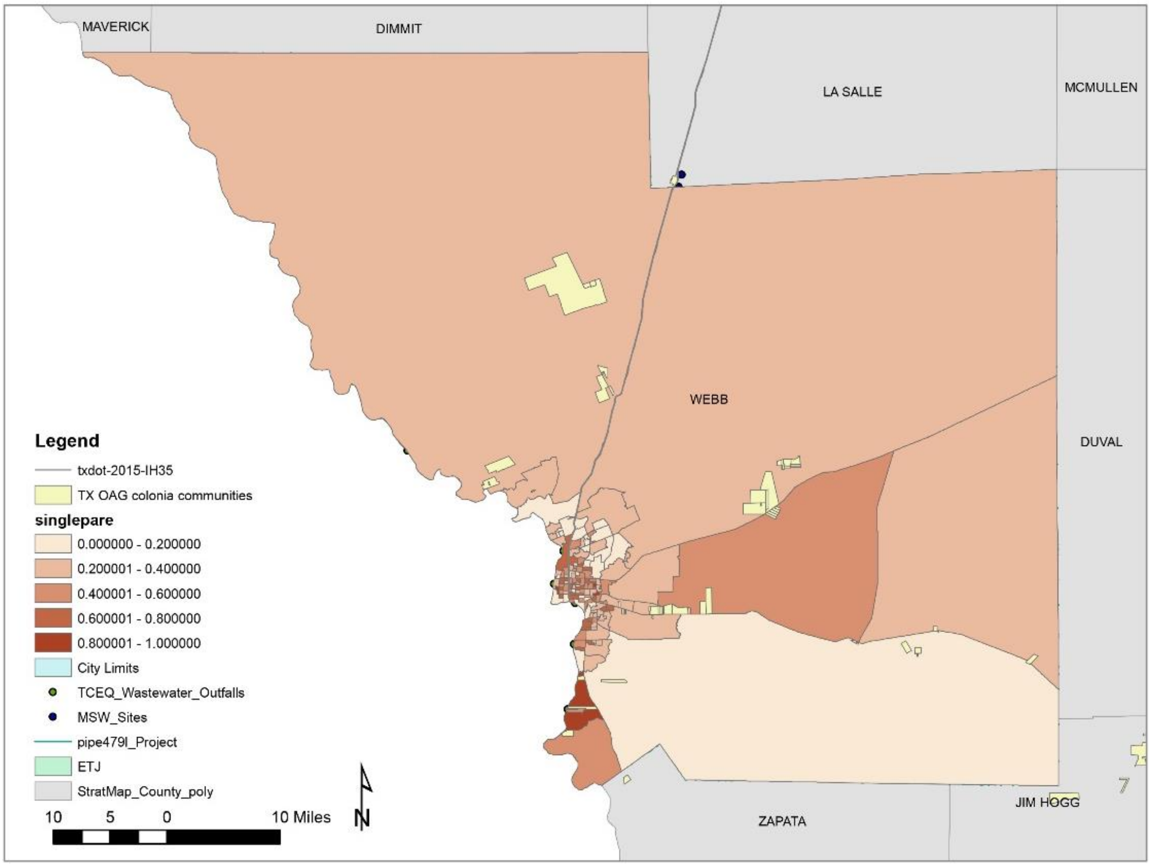


Figure A.6. Minority Status: Total Race and Ethnicity All but Non-Hispanic white

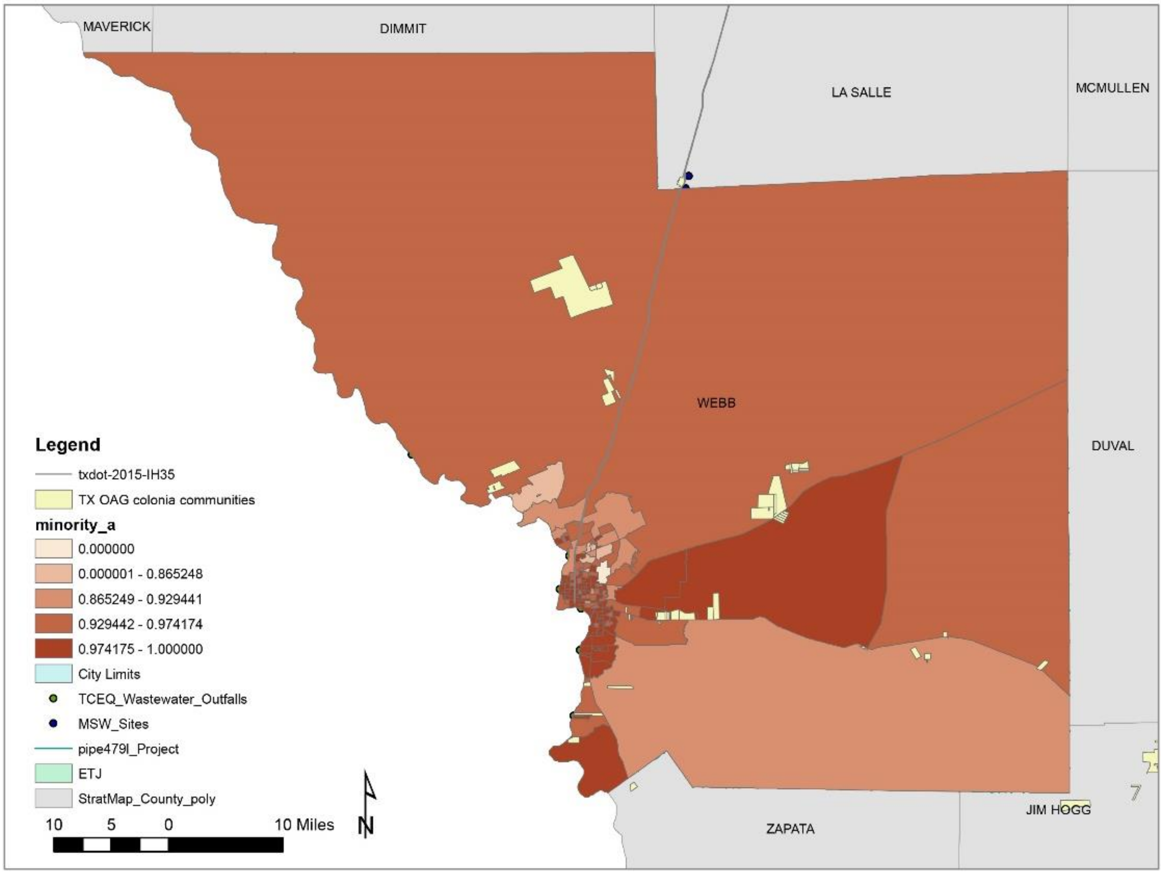


Figure A.7. Housing and Transportation: Total Tenure / Renter Occupied

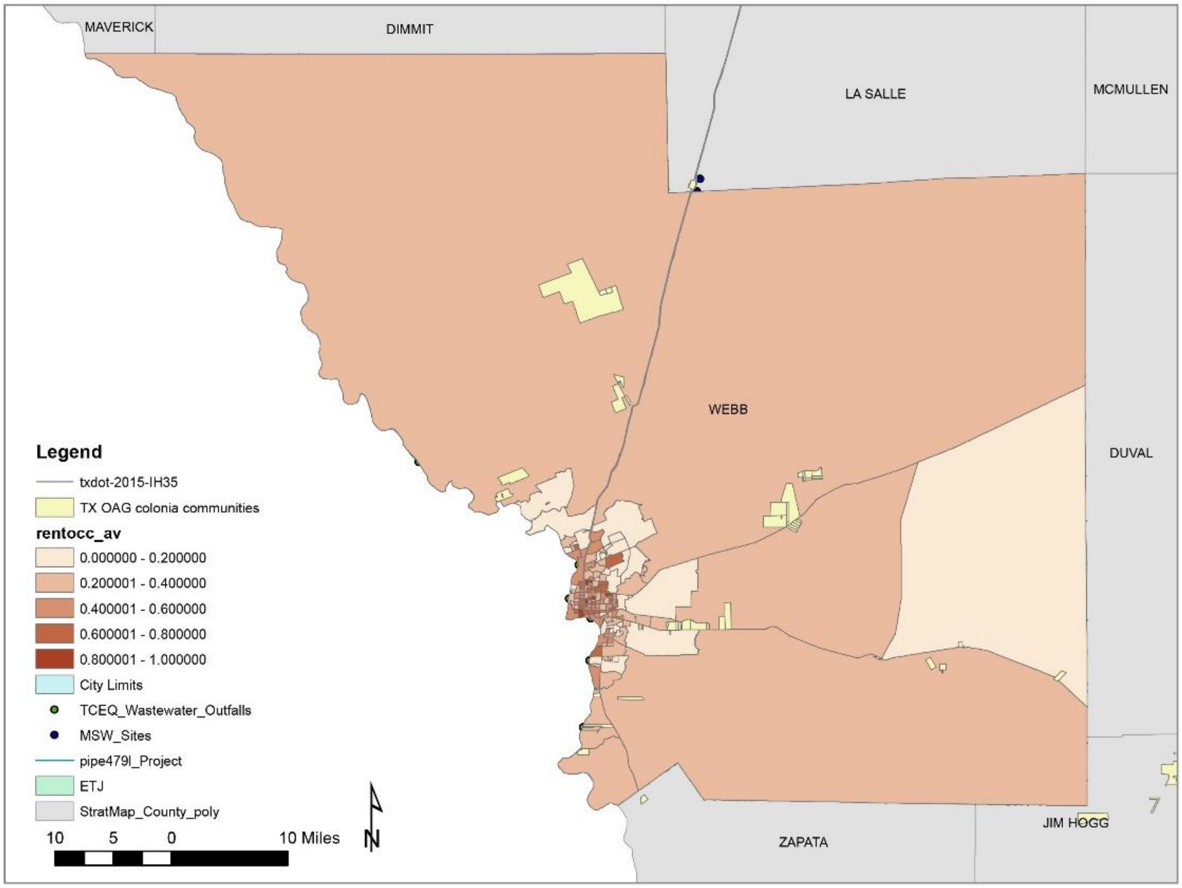


Figure A.8. Housing and Transportation: Total Units / Total with 5 or more units (Multifamily)

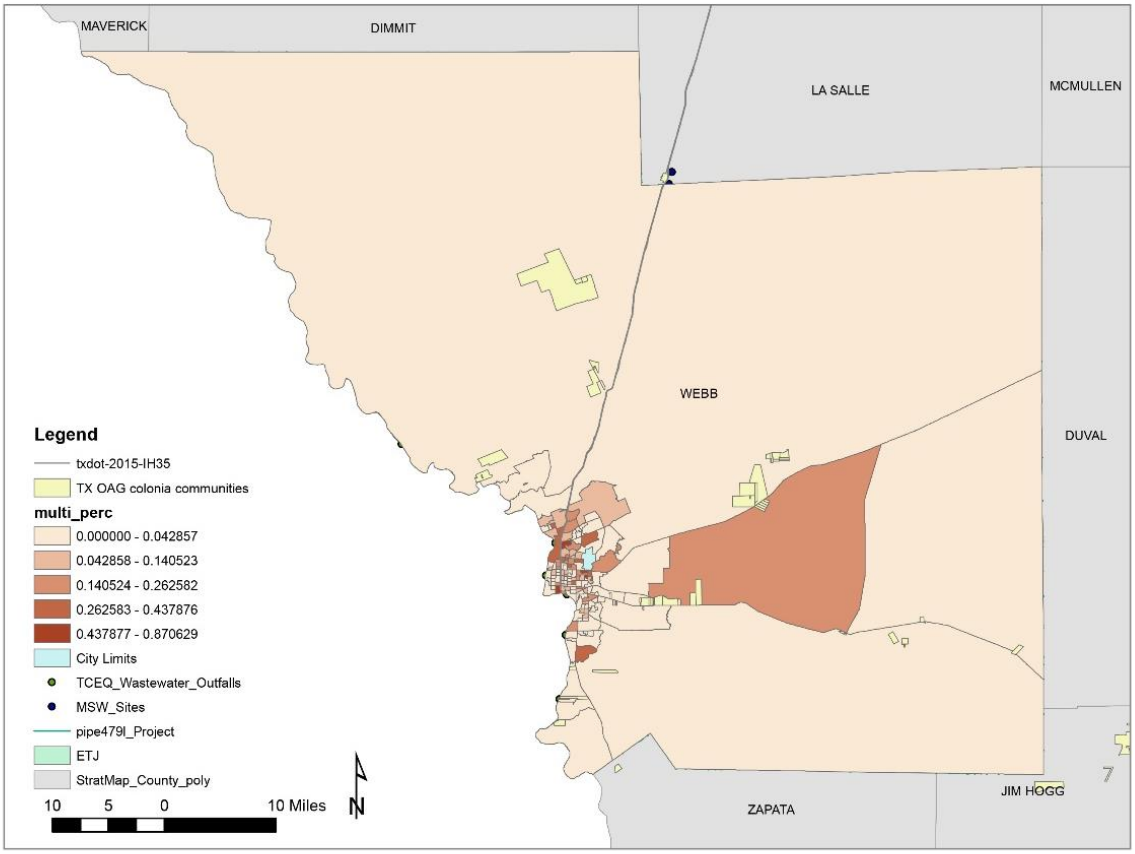


Figure A.9. Language: English ('Poor')

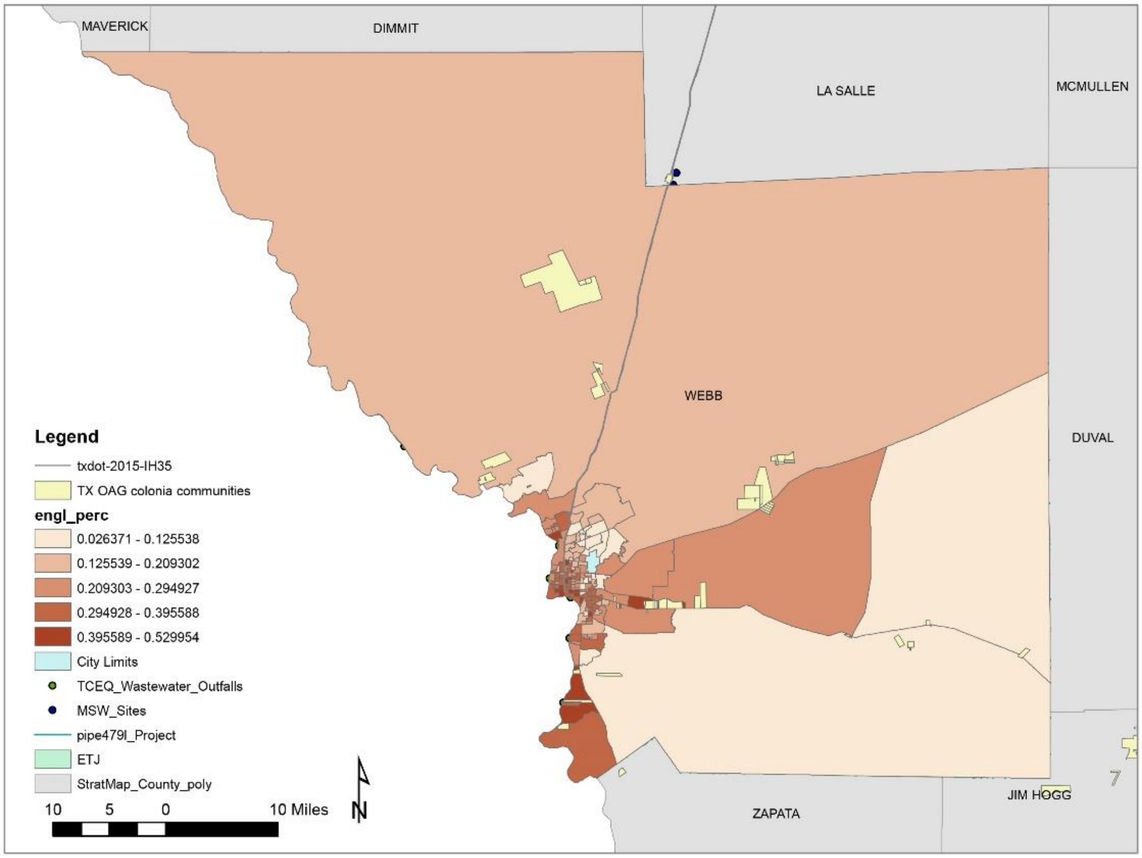
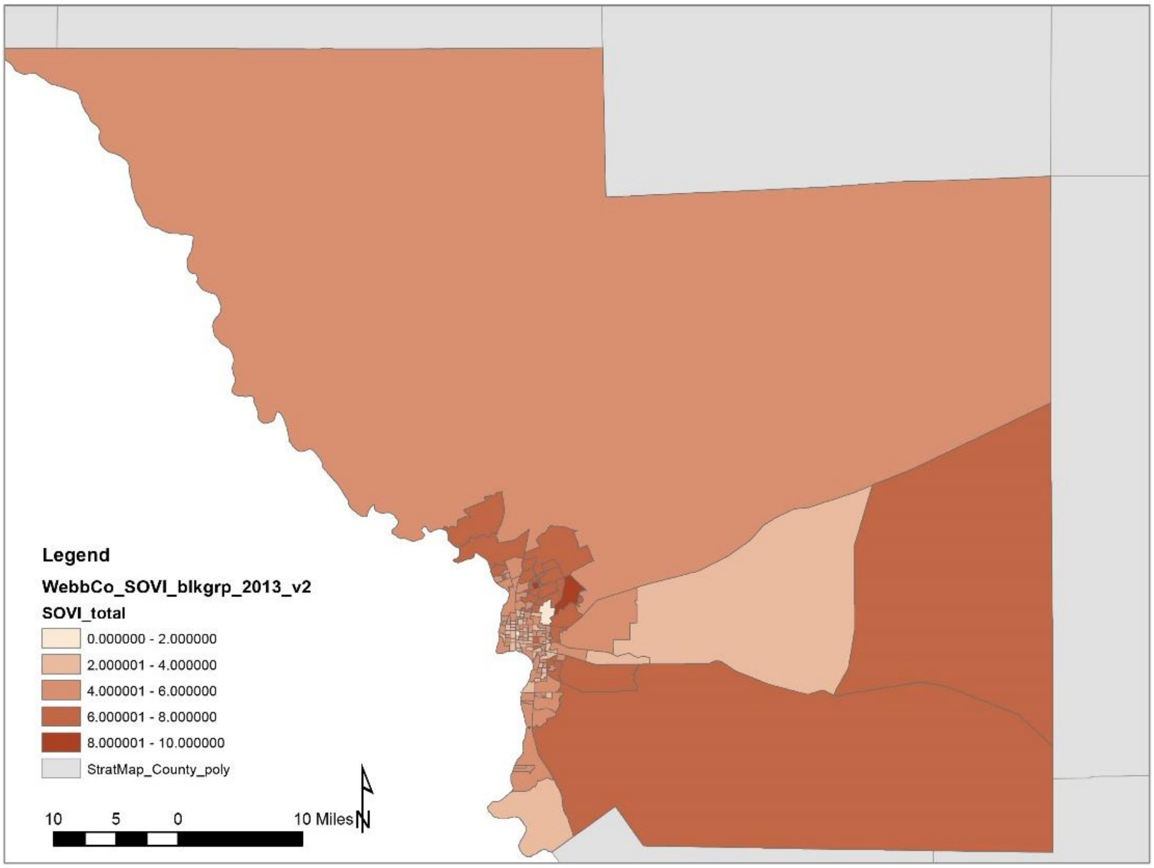


Figure A.10. Total SOVI Scores



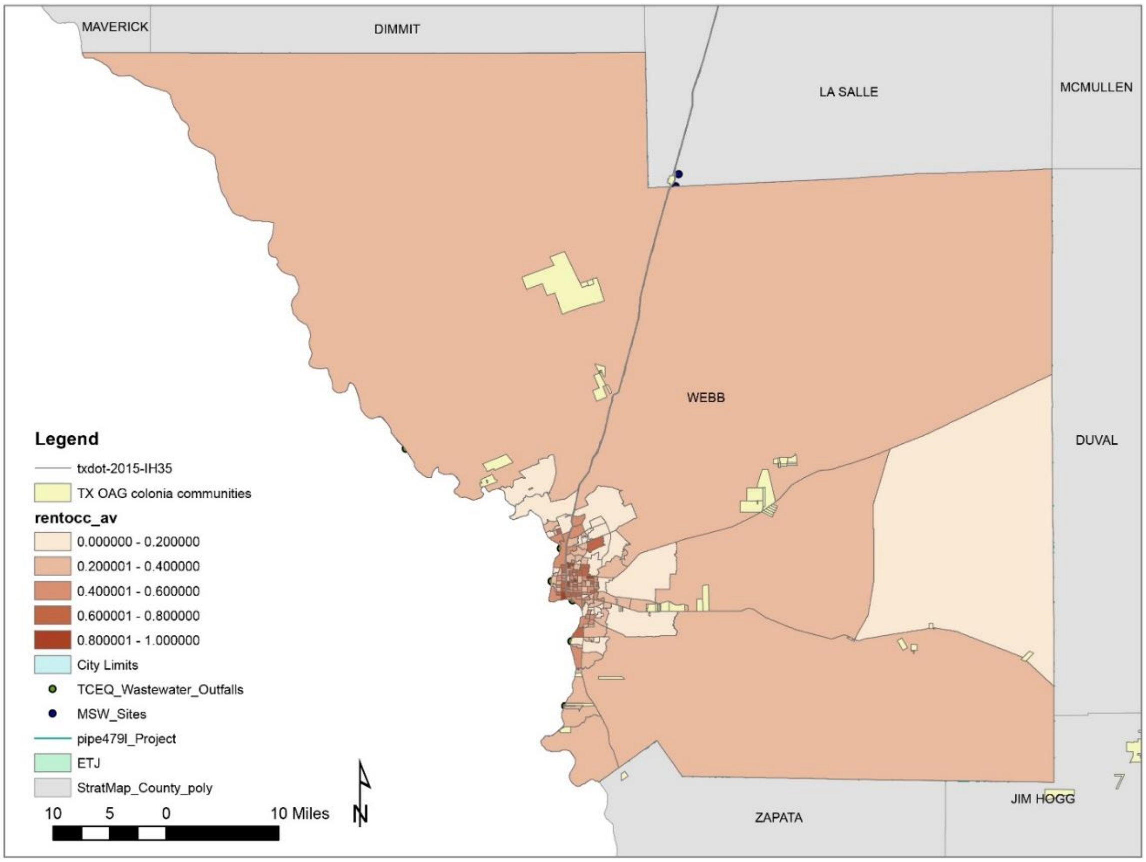
The following is the distribution of scores:

Table A.1. Total SOVI Distribution

Total SOVI Distribution Summary (ArcGIS):	SOVI_total
• Count: 141	
• Minimum: 0	
• Maximum: 8.457143	
• Sum: 675.071429	
• Mean: 4.787741	
• Standard Deviation: 1.424009	
• Nulls: 0	

II. Sensitivity Analysis Datasets and Maps

Figure A.11. Sensitivity Analysis - Renter-Occupied



The distribution is as follows:

Table A.2. Tenure / Renter Occupied Distribution

Renter Occupied per total (tenure)
• Count: 141
• Minimum: 0
• Maximum: 1
• Sum: 55.81041
• Mean: 0.395819
• Standard Deviation: 0.216854
• Nulls: 0

I then changed the indicator for Renter Occupied to equal 0 as the lower end and this is the distribution for the change.

Figure A.12. Sensitivity Analysis - Renter-Occupied, Tenure at 0 SOVI

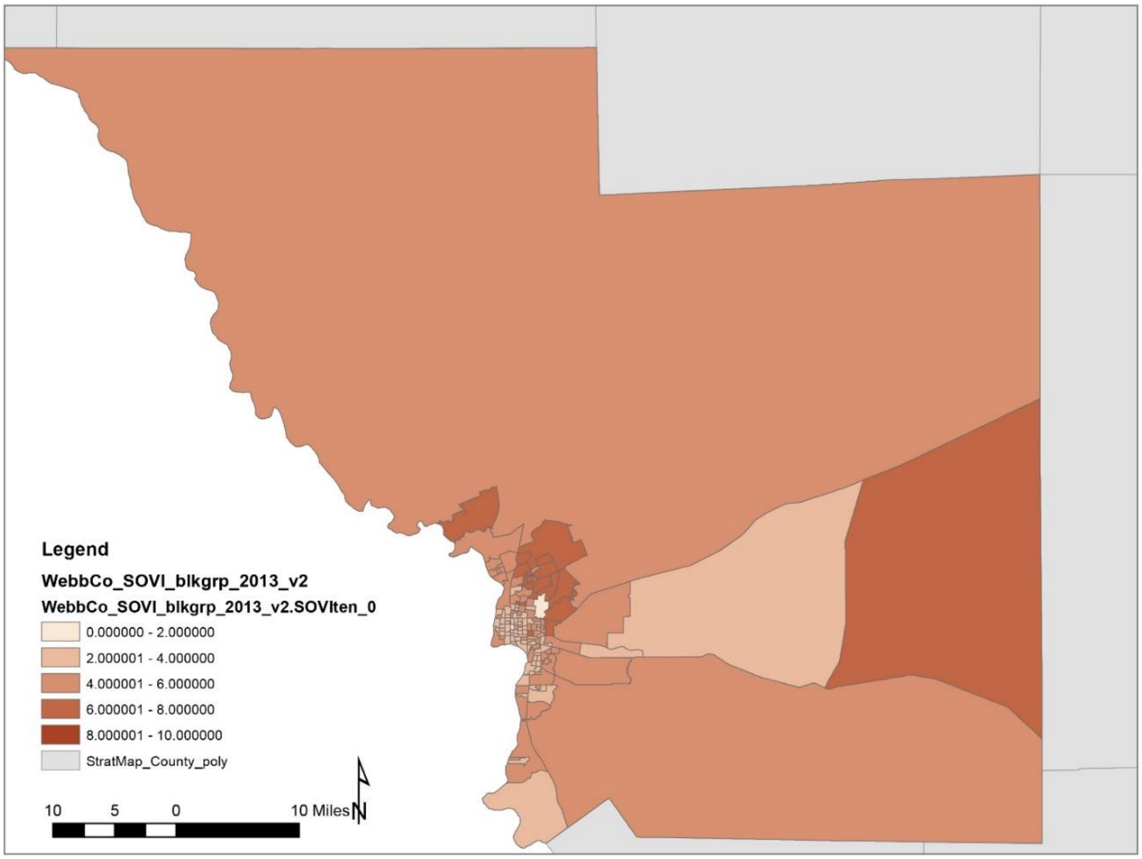


Table A.2. Sensitivity Analysis - Renter-Occupied, Tenure at 0 SOVI Distribution

SOVI with renter occupied => 0	WebbCo_SOVI_blkgrp_2013_v2.SOVIten_0
• Count: 141	
• Minimum: 0	
• Maximum: 7.457143	
• Sum: 603.95	
• Mean: 4.283333	
• Standard Deviation: 1.241538	
• Nulls: 0	

I then changed the indicator for Renter Occupied to equal 1 as the higher end and this is the distribution for the change.

Figure A.13. Sensitivity Analysis - Renter-Occupied, Tenure at 1 SOVI

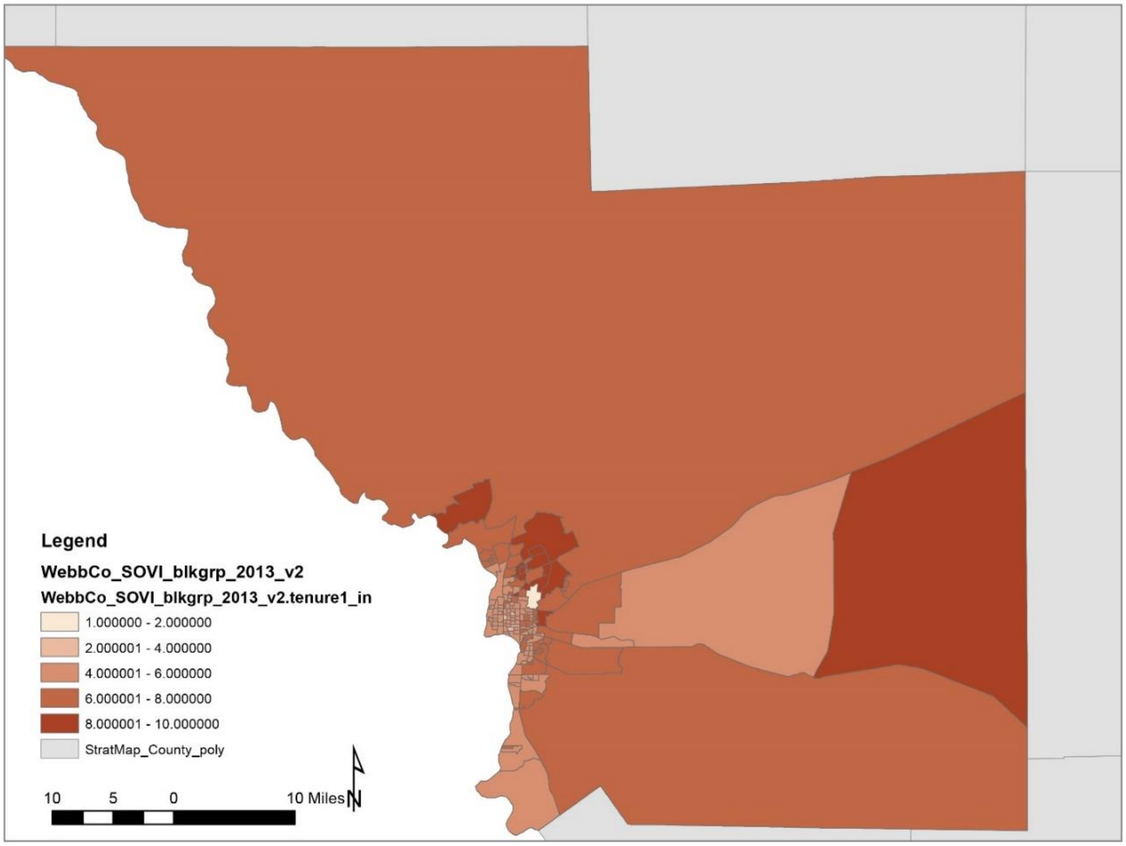


Table A.3. Sensitivity Analysis - Renter-Occupied, Tenure at 1 SOVI Distribution

SOVI with renter occupied => 1	WebbCo_SOVI_blkgrp_2013_v2.tenure1_in
a. Count: 141	
b. Minimum: 1	
c. Maximum: 9.457143	
d. Sum: 816.071429	
e. Mean: 5.787741	
f. Standard Deviation: 1.424009	
Nulls: 0	

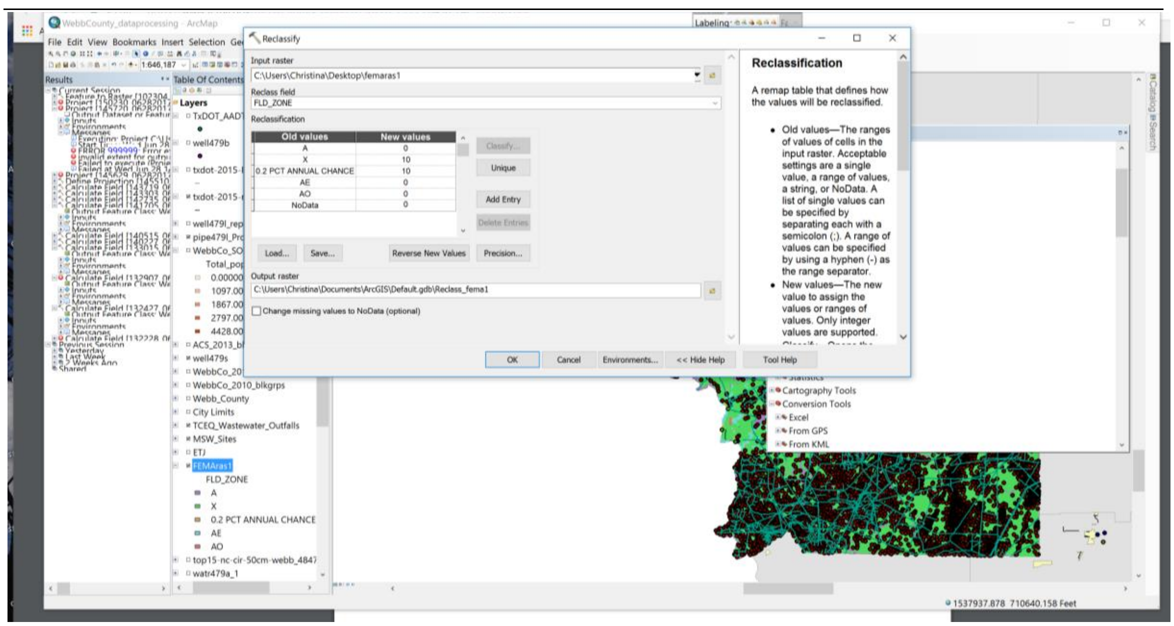
III. MAPS AND PREPARATION FOR SUITABILITY ANALYSIS

A. Social Vulnerability (SOVI)

I used the symbology for displaying the distribution of the vulnerability indicators for the Suitability Analysis. The first task is to **Rasterize** the Social Vulnerability Analysis (SOVI) map. Rasterization allows the used to compile factors of an area using cells. With SOVI_total as the input feature, I designated its resolution as cell size of 10 m. I then **Reclassified** the rasterized SOVI_total map using 5 equal intervals with 0 as least suitable, 4, 6, 8, and 10 as most suitable. I then **Extracted** to Webb County shapefile **Extract_SOVItot**. I repeated this same process for the Sensitivity Analysis maps, SOVI **Tenure at 1** and **SOVI Tenure at 0**.

B. Floodplains, National Flood Insurance Program

Figure. A.14. Reclassification Process for Flood Map



I selected:

1) Rasterize the polygon shapefile for flood zones
2) Reclassify 0 or 10 (where 10 is most ‘suitable’ area; all zone A’s are 0, the rest (x, .2 (500 yr flood)

Rationale: 100 yr flood plane from **Berke et al., 2015** (JAPA article)

1. Flood Zones (2017)

Zone A: The Special Flood Hazard Area (except coastal V Zones) shown on a community's Flood Insurance Rate Map. Unit 3, Section F. There are five types of A Zones: A: SFHA where no base flood elevation is provided. A#: Numbered A Zones (e.g., A7 or A14), SFHA where the FIRM shows a base flood elevation in relation to NGVD. AE: SFHA where base flood elevations are provided. AE Zone delineations are now used on new FIRMs instead of A# Zones. AO: SFHA with sheet flow, ponding, or shallow flooding. Base flood depths (feet above grade) are provided. AH: Shallow flooding SFHA. Base flood elevations in relation to NGVD are provided.

Zone B: Area of moderate flood hazard, usually depicted on Flood Insurance Rate Maps as between the limits of the base and 500-year floods. B Zones are also used to designate base floodplains of little hazard, such as those with average depths of less than 1 foot. Unit 3, Section F.

Zone C: Area of minimal flood hazard, usually depicted on Flood Insurance Rate Maps as above the 500-year flood level. B and C Zones may have flooding that does not meet the criteria to be mapped as a Special Flood Hazard Area, especially ponding and local drainage problems. Unit 3, Section F. Zone D: Area of undetermined but possible flood hazard. Unit 3, Section F.

Zone V: The Special Flood Hazard Area subject to coastal high hazard flooding. There are three types of V Zones: V, V#, and VE, and they correspond to the A Zone designations. Unit 3, Section F.

Zone X: Newer Flood Insurance Rate Maps show Zones B and C (see above) as Zone X. Unit 3, Section F.

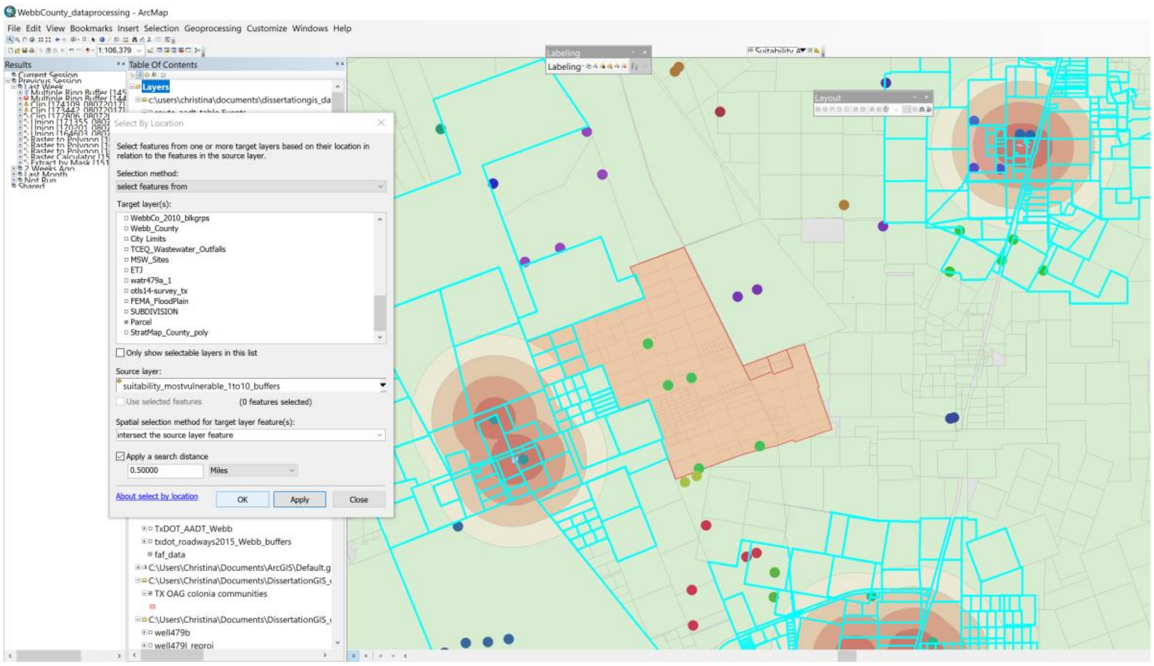
2. Raster Calculator – regular SOVI total

3. Suitability Analysis + Risk = 10 study areas

After raster calculator was performed, areas the most vulnerable and at risk (score of 1-10) were exported (polygons) to a new shapefile (mostvulnerablefromSOVIrastercalc_1_10.shp). Buffers were added to these polygons in increments of .5 miles (.5, 1, 1.5, 2 miles) and turned into a new shapefile. (suitability_mostvulnerable_1to10_buffers.shp). Parcels were selected (***Select by Location***) in relation to these polygons see below

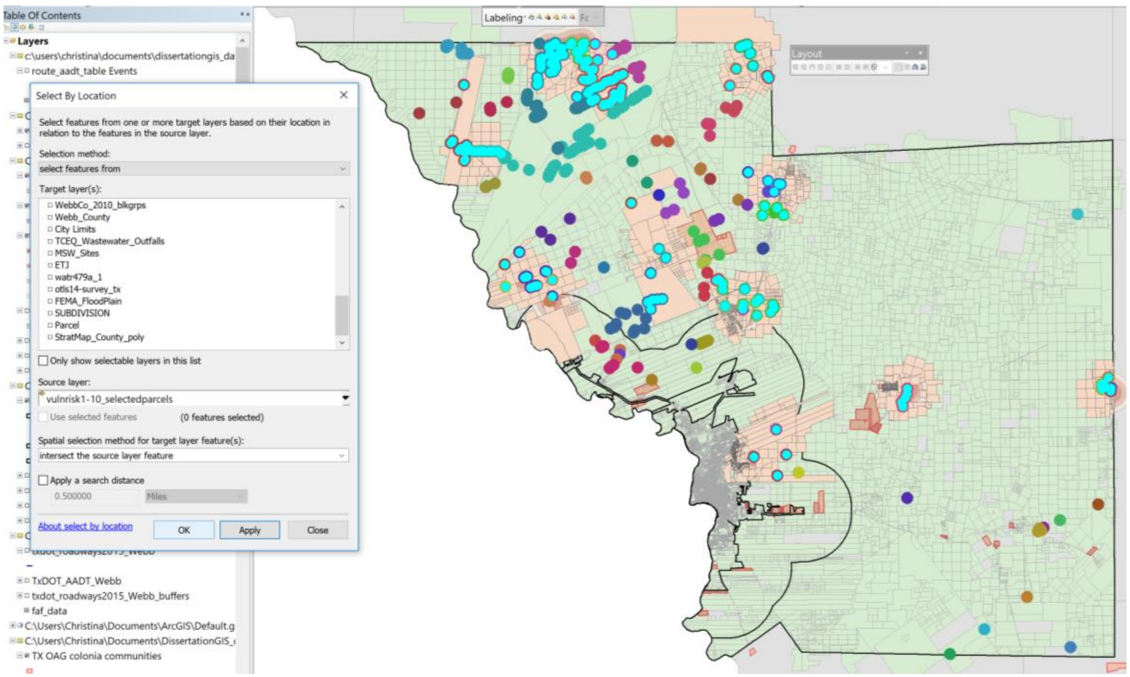
Figure. A.13. Reclassification Process for Flood Map

Figure. A.15. Reclassification Process for Reclassification



4. These parcels were then exported to a new shapefile: (vulnrisk1-10_selectedparcels.shp). To learn more about minerals, surface ownership, I also selected (***Select by Location***) the 2013 permitted wells that were within the new shapefile from above. See below.

Figure. A.16. Reclassification Process for Select by Location / OTLG



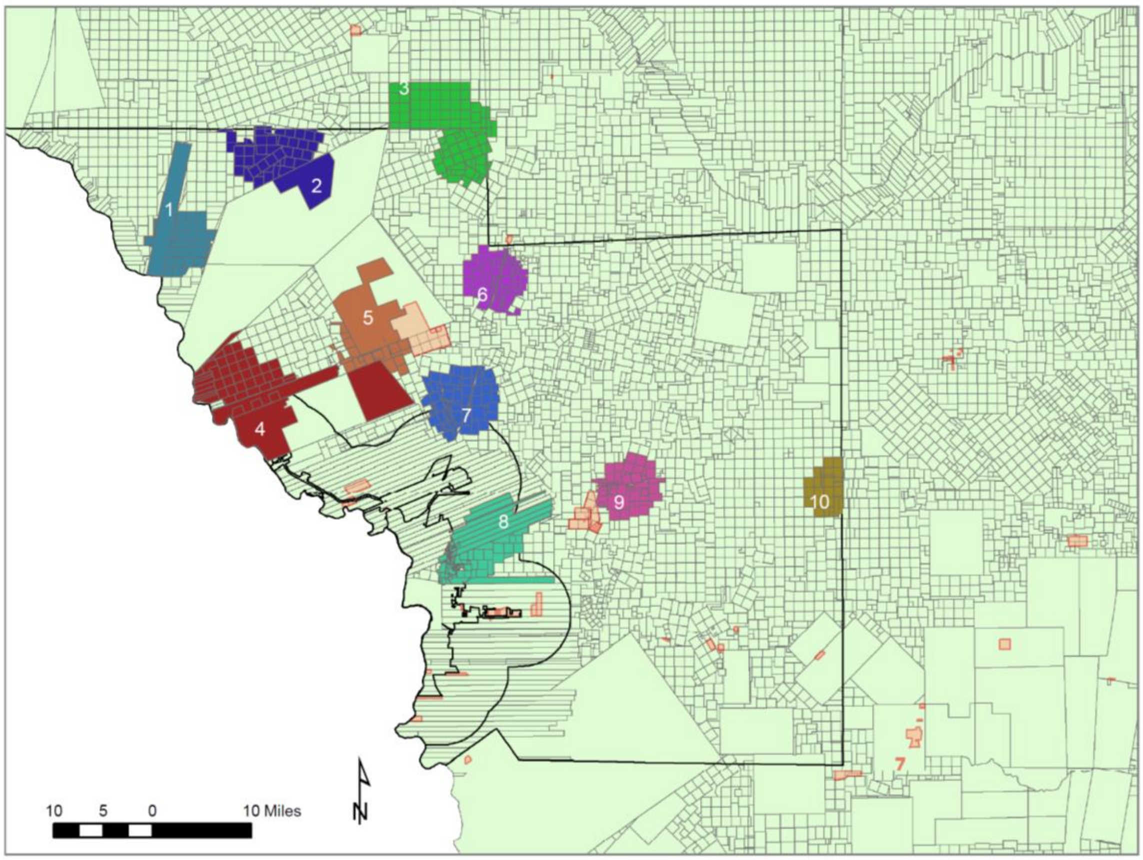
This selection was then exported into a shapefile (selected2013wells_W1permit_invulnarea.shp). I used the Vulnrisk1-10_selectedparcels.shp to via ***Clip*** look at the Original Texas Land Grants for the selected areas. (OTLAS14_survey_clip_vulnareas which then became OTLAS14_survey_clip_vulnareas_combined.shp because the parcel shapefile is not as complete as the full OTLS file). I then created a field (Add Field => **parcelclus**) and used Editor to add the attributes for that field which are the 10 groupings from the selected parcels area – 10 in total, field is Text format.

IV. Original Texas Land Grant Survey + Suitability Analysis + Governance Geographies

Areas with the most vulnerable and at risk were selected. (score of 1-10). Buffers were added to these polygons in increments of .5 miles (.5, 1, 1.5, 2 miles) and converted into a new shapefile. Parcels were selected (Select by Location) in relation to these polygons. These parcels were then exported to a new shapefile. To learn more about minerals, surface ownership, I also selected (Select by Location) the 2013 permitted wells that were within the new shapefile from above. This selection was then exported into a shapefile. Use the

Vulnrisk1-10_selectedparcels.shp to via Clip look at the Original Texas Land Grants for the selected areas. Created a field (Add Field => parcelclus) and used Editor to add the attributes for that field which are the 10 groupings from the selected parcels area – 10 in total, field is Text format.

Figure A.17. Study Areas with OTLGS, Vulnerability and Risk Buffers



V. OIL AND GAS REFERENCES DATASETS, TABLES, AND LISTS

A. Setbacks Reference Table:

"Review of Key Public Health and Safety Hazards and Setback Distance Guidance. 2018. *Public Health and Safety Risks of Oil and Gas Facilities in Los Angeles County"* Los Angeles County Department of Public Health, accessed online at httppublichealth.lacounty.gov/eh/docs/PH_OilGasFacilitiesPHSafetyRisks.pdf

Figure A.18. Review of Key Public Health and Safety Hazards and Setback Distance Guidance

Los Angeles County Department of Public Health
http://publichealth.lacounty.gov

COUNTY OF LOS ANGELES **Public Health**

Table ES-1. Review of Key Public Health and Safety Hazards and Setback Distance Guidance

Setback Distance	*Air Quality*	*Noise*	*Odors*	*Fires, Explosions, and Other Emergencies*	*Additional Mitigation and Assessment Notes*
300 feet					Some health and safety impacts may still be unavoidable regardless of additional mitigation.
600 feet	✓				Additional mitigation and assessment would likely be needed to avoid most impacts. Odors may be unavoidable, regardless of mitigation. Air monitoring is advised.
1,000 feet	✓	✓			Additional mitigation and assessment may be needed to avoid noise impacts during certain operations, e.g. well advancement. Odors may be unavoidable in loss of containment events, regardless of additional mitigation.
1,500 feet	✓	✓	✓		Additional mitigation not likely to be needed. Some uncertainty remains due to gaps in long-term health and exposure data.

This table is based on information compiled from scientific publications,[13,37,51,52] environmental impact assessments,[27-33] other environmental studies,[10,16,20,34,35,36,46] and experiences in other jurisdictions.

✓ Represents the distance at which the impact is likely mitigated

B. OPERATORS AND OPERATING INTERESTS

Table A.4. Operators / Operating Interests in Webb County, 2014

Operator Name	Interest Type	Number of Interests	Total Value	% of Market Total Value (Webb, 2014)
ANADARKO E&P ONSHORE LLC	W	3	$ 270,837,970	10.050%
APACHE CORPORATION	W	34	$ 2,810,060	0.104%
BARRETT BROTHERS OIL & GAS, INC.	W	1	$ 14,360	0.001%
BAY ROCK OPERATING COMPANY.	W	1	$ 11,690	0.000%
BILL H. PEARL PRODUCTION INC.	W	3	$ 336,060	0.012%
BLUE AGAVE RESOURCES, LLC.	W	1	$ 15,340	0.001%
BLUESTONE NATURAL RESOURCES II LLC.	W	57	$ 12,575,920	0.467%
BRASK-DUMONT RANCH, INC..	W	3	$ 59,100	0.002%
BXP OPERATING LLC.	W	6	$ 975,570	0.036%
AWP OPERATING COMPANY.	W	1	$ 1,248,840	0.046%
CHAPARRAL ENERGY, LLC.	W	1	$ 13,500	0.001%
CHEVRON U S A INC.	W	42	$ 28,927,590	1.073%
CHROMA OPERATING INC.	W	22	$ 7,346,630	0.273%
COLUMBUS ENERGY, LLC.	W	203	$ 43,185,050	1.602%
CONOCOPHILLIPS COMPANY.	W	381	$ 276,458,910	10.258%
CONTINENTAL EXPLORATION LLC.	W	2	$ 38,000	0.001%
CORDELE DEVELOPMENT CORPORATION.	W	2	$ 49,170	0.002%
DOUGLAS CRAWFORD.	W	1	$ 67,090	0.002%
DAKOTA OIL COMPANY.	W	2	$ 17,820	0.001%
DEWBRE PETROLEUM CORPORATION.	W	3	$ 218,850	0.008%
MIDDLETON OIL COMPANY.	W	3	$ 158,210	0.006%
EAGLE ENERGY RESOURCES LLC.	W	1	$ 209,120	0.008%
EARTHSTONE ENERGY, INC..	W	20	$ 8,177,090	0.303%
EOG RESOURCES, INC./MIN ACCTS.	W	114	$ 49,246,720	1.827%
EP ENERGY E&P CO LP.	W	1	$ 670,260	0.025%
ESCONDIDO RESOURCES II, LLC.	W	57	$ 159,231,420	5.909%
FASKEN OIL & RANCH, LTD.	W	10	$ 153,321,140	5.689%
VERNON E FAULCONER INC.	W	16	$ 1,287,470	0.048%
KILLAM OIL COMPANY LTD.	W		$ 48,076,190	1.784%
LEWIS PETRO PROPERTIES, INC..	W		$ 938,099,370	34.810%
PETROPOINT ENERGY OPERATING, LLC.	W		$ 56,939,150	2.113%
SHELL WESTERN E&P. (Pilloncillo)	W		$ 189,397,590	7.028%
ROSETTA RESOURCES, INC..	W		$ 444,923,960	16.510%

Figure A.19. List of City of Laredo Mayors, 1755-2018

History of Laredo Mayors

1755 - 1767	Tomas Sanchez
	Captain in charge of civil and military authority
1768 - 1769	Joseph Martinez De Sotomayor
1770 - 1786	Tomas Sanchez
1787 - 1789	Santiago De Jesus Sanchez
1790 - 1791	vacant
	Joseph Gonzalez, Lieutenant Mayor
1792 - 1794	Joseph Gonzalez
1795 - 1800	Jose Jesus De La Garza
1801 - 1802	Juan Jose Treviño
1803 - 1807	Jose Ramon Diaz De Bustamante
1808	Jose De La Fuente
1809 - 1810	Jose Ramon Diaz De Bustamante
1811 - 1813	Jose Gonzalez
1814	Jose Antonio Garcia Davila
1815	Jose Maria Tovar
1816	Jose Andres Farias
1817	Jose Antonio Garcia Davila
1818	Jose Francisco De La Garza
1819	Idelfonso Ramon
1820	Jose Antonio Benavides (February - July)
	Jose Maria Tovar (August - December)
1821 - 1822	Victorino Dovalina
1823	Jose Maria De Tovar
1824	Jose Francisco De La Garza
1825	Jose Lazaro Benavides
1826	Rafael Lopez De Oropeza
1827	Jose Lazaro Benavides
1828	Jose Manuel De Los Santos Coy
1829	Jose Maria Gonzalez
1830	Idelfonso Ramon
1831	Juan Jose Treviño
1832	Jose Lazaro Benavides
1833	Jose Maria Gonzalez
1834	Juan Jose Treviño
1835	Idelfonso Ramon
1836 - 1837	Basilio Benavides
1838	Florencio Villarreal
1839	Gregorio Garcia Davila
1840	Dolores Garcia
1841	Domingo Dovalina
1842	Florencio Villarreal
1843 - 1844	Basilio Benavides
1845	Agustin Dovalina (January - April)
	Jose Maria Ramon (May - December)
1846	Andres Martinez
1847	Florencio Villarreal
1848 - 1850	Basilio Benavides
1851	Jose Maria Gonzalez
1852 - 1854	William Franklin Alexander
1855	Bartolome Garcia
1856	Santos Benavides
1857	Refugio Benavides
1858	Bartolome Garcia
1859	Refugio Benavides
1860	Tomas Treviño
1861	Juan Francisco Farias
1862 - 1864	Bartolome Garcia
1865	Nicolas Sanchez
1866 - 1867	Agustin Salinas
1868	Samuel M. Jarvis
1869 - 1873	Agustin Salinas
1874 - 1876	Hugh James
1877	Atanacio Vidaurri
1878	Rosendo Garcia
1879 - 1880	Julian Garcia
1881 - 1882	Porfirio Benavidez
1883	Dario Sanchez
1884	Porfirio Benavides
1885	Dario Sanchez
1886 - 1890	E. A. Atlee
1891 - 1894	C. A. McLane
1895	Andrew Hans Thaison
1896 - 1898	L. J. Christian
1899 - 1900	A. E. Vidaurri
1901 - 1909	Amador Sanchez
1910 - 1919	Robert McComb
1920 - 1925	L. Villegas
1926 - 1939	Albert Martin
1940 - 1953	Hugh Cluck
1954 - 1977	J. C. Martin, Jr.
1978 - 1990	Aldo Tatangelo
1990 - 1997	Saul Ramirez
1998 - 2006	Elizabeth G. Flores
2006 - 2014	Raul G. Salinas
2014 - 2018	Pete Saenz

Source: City of Laredo, Accessed 2019 at http://www.cityoflaredo.com/History/Mayors_History.pdf

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