The Report Committee for Anna Christine Boggs
Certifies that this is the approved version of the following report:

Controlling Boggy: A Historical Study of Creek Channelization in Austin, Texas

APPROVED BY
SUPERVISING COMMITTEE:

Supervisor: Jacob A. Wegmann

Co-Supervisor: Bjørn Sletto

Controlling Boggy: A Historical Study of Creek Channelization in Austin, Texas

by

Anna Christine Boggs, BS

Report

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Master of Science in Community and Regional Planning

The University of Texas at Austin

August 2016

Acknowledgements

This project is indebted to everyone who provided insight on Boggy Creek, particularly the City of Austin Watershed Protection Department. Thank you to the Austin History Center for helping me find so many valuable research materials, and to my readers, Jake Wegmann and Bjørn Sletto, for being so helpful throughout the writing process. Finally, thank you to my family and friends for their support, and thank you to Boggy Creek for being such an interesting research subject.

Abstract

Controlling Boggy: A Historical Study of Creek Channelization in Austin, Texas

Anna Christine Boggs, M.S.C.R.P.
The University of Texas at Austin, 2016

Supervisor: Jacob A. Wegmann
Co-Supervisor: Bjørn Sletto

Boggy Creek in East Austin, Texas, was channelized by the U.S. Army Corps of Engineers in the 1980s due to frequent and severe flooding throughout the 1960s and '70s. This paper delves into the history of the creek and the community around it leading up to the channelization, situating the story in context to Austin's regulatory, social, and environmental history, as well as the broader history of federal flood control and ecological planning in the U.S. Ultimately, the channelization led to negative environmental affects for the creek that persist today, and this paper aims to begin a discussion on how the creek can be improved and possibly restored in the future while recognizing the many obstacles that exist.

Table of Contents

List of Figures

Chapter 1: Introduction

Austinites have long held the dream of protecting and preserving numerous creeks.

Austin Creeks, 1976

Legend has it that the president of the Republic of Texas, Mirabeau Lamar, was so enthralled with the beauty of Shoal Creek that he suggested it as an option for the new state capital in 1838 (Black et al., 1976). Like many cities, Austin was founded due to its plentiful water sources, and today the Colorado River and its tributaries continue to be cherished natural features of the landscape. Yet while traveling through parts of East Austin, you would be hard-pressed to find any clear streams; like many urban areas, its creeks have experienced the stress of urbanization and no longer serve as aesthetically pleasing, ecological functioning parts of the environment. Boggy Creek in particular has been affected by humans in a dramatic way: Severe flooding led to U.S. Army Corps of Engineers involvement in the 1970s, and by 1991 nearly three miles of the creek was channelized, its channel dramatically straightened and deepened. It has also been lined with concrete for a large portion of the channelization, which further increases flood capacity.

Boggy Creek is not unique in the history of the United States, but I believe it is unique in the history of Austin. No other local creek has been so altered from its natural state, in spite of the City of Austin's long-stated goal to preserve the natural character of creeks. Though other creeks have been similarly channelized with concrete, including Tannehill Branch, one of Boggy's tributaries, Boggy Creek's channel is wider and deeper than other examples in the city. Further, at the time of Boggy Creek's flood-control planning, channelization had already reached its zenith at the national level and was beginning to be questioned by some federal officials as environmentally irresponsible.

Today, it is striking as a relic of our past that would never be built today, as there are now proven flood mitigation techniques that are more environmentally responsible, or at the very least more aesthetically appealing. The channelization of Boggy Creek led to negative impacts for the creek in terms of water quality, riparian habitat, and erosion. Overall, the old methods of channelization, diversion, and damming, conducted in order to reduce flooding and increase development potential, have been acknowledged to destroy stream beds and habitats, as well as reduce stream flow (City of Austin, 2015a). These methods also inherently restrict access to creeks, and today cities such as Austin are redefining creeks and other water bodies as amenities to enjoy, rather than as merely drainage for stormwater. The channelized portion of Boggy is fenced for most of its extent as it snakes through neighborhoods in East Austin, restricting residents from interacting with the creek. It is devoid of any trails with the exception of the recently completed Southern Walnut Creek Trail, which will hopefully help to increase access and awareness of the creek.

The story of Boggy Creek becomes more complex when put in context of Austin's regulatory, social, and environmental history. People of color formed communities in lower-elevated, flat areas on the East side that were more vulnerable to flooding due to the low cost of land as well as a long history of restrictive real estate practices. The Govalle neighborhood within the Boggy Creek floodplain developed in the mid-20th century in an area susceptible to regular and severe flooding. The community displayed strong resilience throughout its push for aid from the city and the federal government. Thus, an outdated method of flood control is also understood as symbol of community resilience. Today, that community is not susceptible to flooding due to the protection that channelization provided, which allowed nearly 1,600 structures to be removed from the floodplain.

This paper will explore the history of Boggy Creek's channelization and briefly discuss challenges and opportunities for its restoration. The research methods utilized in this paper largely drew from personal interviews, local newspaper archives, City of Austin city council agenda archives, U.S. Army Corps of Engineers documents, and planning documents from the City of Austin's Watershed Protection department. Interviews were conducted with residents of Boggy's historic floodplain, community organizations in the area (including a creek restoration organization, a neighborhood creek organization, and an urban farm), and staff members of the City's Watershed Protection department.

Overall, through interviews with residents and city staff, I tell the story of Boggy Creek, and through studying literature and case studies, I explore alternatives for it in the future. Although the channelization of the creek was heavily covered in the newspaper at the time it occurred, and is well documented in government records, there is no full historical account or update on the outcome of the channelization; that is what this paper aims to do. In the second chapter, I present a literature review of topics relating to Boggy Creek, including flood control, planning history, and resilience. The third chapter shows the historical significance of the creek, and the fourth chapter shows the history of the flooding and channelization that occurred. The fifth chapter shows the creek's conditions post-channelization, and the final chapter discusses possibilities and challenges for the future.

Figure 1: Boggy Creek before channelization (U.S. Army, 1980).

Figure 2: Boggy Creek today (Annie Boggs).

Figure 3: The channelized creek during the annual U.S. Army Corps of Engineers inspection in 2015; workers inside the channel help demonstrate the scale of its width and depth (City of Austin, 2015)

Chapter 2: Literature Review

The story of Boggy Creek presented in this paper draws from the history of governmental flood control, the history of ecological planning, and contemporary ecological perspectives. Discussion of these topics demonstrate why Boggy was channelized, in terms of the role of the federal government and the lack of importance nature held in cities for most of the past century. Literature from contemporary ecology scholars helps show why Boggy was (and is) a degraded urban stream. Drawing into the regulatory, social, and environmental history in Austin helps put the community around Boggy Creek in context, a resilient neighborhood that worked hard to save the community it had cultivated.

The History of Federal Flood Control

Floods are an unavoidable part of the hydrologic cycle and were traditionally seen as "blessings" as they sustained ecosystems and river-dependent economies (Tarlock 2012, p. 151). Flooding only became a problem when people began to settle in floodplains, as it caused damage to human settlements and agriculture (ibid). Because creeks and rivers are naturally low-lying, they have been particularly vulnerable to the effects of urban development, which has the impact of turning what was once an active ecosystem into little more than a gutter for carrying water downstream (Bernhardt & Palmer, 2007). With that background, it is almost understandable that Boggy was referred to as a floodway by the U.S. Army Corps of Engineers (Quarles, 1995) as opposed to a functioning ecosystem. It had lost most of its natural function many years prior to Army Corps involvement, as Austin's landscape became increasingly urbanized.

Thus, concerns over flooding, and subsequent attempts to control flooding, can be traced to a lack of awareness for how waterways function, and to a lack of attention paid

to the environment when developing land. Recent decades have seen a change in recognition that flooding can never be fully prevented or avoided, only managed (Tarlock, 2012). This is demonstrated through the City of Austin Watershed Protection Department's shift of terminology from "flood control," as it used in its 2001 Master Plan, to "flood mitigation" (City of Austin, 2015a). The Texas Water Development Board expressed this very sentiment in response to the U.S. Army Corps of Engineers in regards to its report for Boggy Creek, stating that "structural engineering works" are not complete solutions to flooding problems and should not be likened to flood control, as there is always a chance that a flood could occur which is bigger than the structure can accommodate (U.S. Army, 1979). The board warned against overreliance on such structures (ibid).

Channelization, which entails straightening, widening, deepening, lining or clearing stream channels, is a method that has historically been used by engineers to control flooding and erosion, as well as improve drainage (Carter, 2005). It makes use of simple and dependable physical processes: by increasing the amount the stream can carry, the water elevation can be reduced, and thus, flooding from the creek can be mitigated (Loomis & Moore, Inc., 1998). While communities have been channelizing rivers and streams for the last two centuries in the U.S., the federal government began using the method more extensively in the mid-20th century (Wohl, 2004). This can be partly attributed to the growth of the U.S. Army Corps of Engineers. Although originally a military agency focused on navigation improvement, the scope of the Army Corps' duties expanded in the 19th century to also include public works projects. From the mid-1800s through World War I, the agency grew considerably (Paehike, 1995). Following the Civil War, Congress gave the Army Corps responsibility for flood protection along the Mississippi River, although it was not until the 1927 Mississippi River Flood that the agency took on flood control as a core mission. Congress reacted to the devastating Mississippi flood by

implementing the Flood Control Act of 1928, which made flood control an equal, if not more important mission than the Army Corps' primary goal of navigation, while also establishing a flood management style of structural protection through dams and levees. The Flood Control Act of 1936 explicitly gave the federal government responsibility for flood control of rivers and their tributaries (Tarlock, 2012).

The 1940s through the 1970s marks what geomorphologist Ann Riley termed the "golden age of channelization," when 1,630 projects that encompassed plans for 34,140 miles of waterways were completed by the Army Corps and the Soil Conservation Service, another federal agency given flood control authority (Riley, 1998). But by the 1970s when the City of Austin was establishing its first watershed protection ordinance, local and national attitudes were beginning to change regarding the merits of creek channelization and other structural solutions. The City's 1974 Waterway Ordinance aimed to maintain the "natural and traditional character" of creeks (City of Austin, 2015a, p. 23). Another document on Austin's creeks in honor of the country's bicentennial suggested that other cities who eliminated natural areas through channeling or piping "gave Austinites a glimpse of their own potential future, if natural areas are not saved" (Sinclair et al., 1976, p. 8).

The federal government, too, was beginning to acknowledge the negative impacts of channelization. In 1973, a congressional report found that there was "considerable evidence that little was known" about the adverse effects of channelization, and additionally, "little was done to ascertain them" (Wohl, 2004, p. 186). As environmental consciousness increased, state and federal government programs were introduced to restore rivers and retain some of their lost environmental value (Calder, 1999). A 1986 act authorized the Army Corps to modify previously completed projects in order to improve their environmental quality, motivated by the harmful effects of the straightening of the

Kissimmee River in Central Florida. In 1990, another act included a directive that the Army Corps adopt environmental protection as one of its primary missions (Riley, 1998). The agency continued to draw wide-scale criticism for its lack of environmental awareness through the 2000s. Almost two-thirds of the rivers listed in the advocacy organization American Rivers' "most-endangered" list in 2002 were found to have been affected by Army Corps projects, and the *New York Times* described the agency as "untouchable" to change (2002).

Though it seems obvious today, individual flood projects should not be studied in isolation without regard to what might occur downstream or in the environment around them. The Army Corps' simplistic philosophy of cost-efficient flood reduction failed to take into consideration the natural functions of creeks, and that, for example, engineering the creek to flow quickly eliminates the natural storage function of the floodplain, leading to increased flooding downstream (Calder, 1999). Additionally, the cost-benefit analysis employed in the Army Corps' analysis has been criticized as an overly simplistic rationalization of complex political problems (Byrne, 1987).

Though at the time channelization was referred to as channel "improvement," documented negative impacts of channelization are plentiful and include the elimination of natural riparian areas, the destruction of plant and animal habitat, the loss of aesthetic attraction, and the creation of more flooding problems downstream (Loomis & Moore, Inc., 1998). Increasing the velocity of water moving through the channel can also lead to erosion and degraded water quality (Carter & Burgess, Inc., 1994). Yet, as with Boggy Creek, channelization has also often been the only option for built-up communities experiencing flooding, in which detention or property buy-outs are not possible or too cost-prohibitive (Loomis & Moore, Inc., 1998).

The Army Corps' project on Boggy Creek did not officially start construction until 1987, well-past the "golden age" of channelization, showing the slow rate of change in the organization even after years of pressure toward greater environmental awareness. Planning for the project started 12 years prior in 1975, however, at a time when channelization was only beginning to be understood as potentially damaging to the environment. While the Army Corps' Environmental Impact Statement for Boggy, published in 1980, mentioned environmental quality and the effect of the project on the environment, these effects were more focused on the human environment than the natural one. When discussing the implications of replacing 11,000 feet of riparian and aquatic habitat with a concrete channel, the agency only stated that it would try to preserve trees by the creek, and that fish and other animals downstream would not be affected. It also performed what it called a "Habitat Evaluation Procedure" to develop a plan for mitigating adverse impacts, proposing that 32 acres of natural area along lower Boggy be acquired to mitigate the negative effects to wildlife habitat from the project. While 54 acres of natural habitat was initially recommended by the Fish and Wildlife Service, the Corps proposed that 32 would be used for habitat, and the remaining 22 for recreational trails (U.S. Army, 1980). The rationalization that preserving this small piece of land would mitigate the loss to wildlife habitat caused by the entire channelization project is absurd, showing how outmoded the Army Corps was in their environmental policies (U.S. Army, 1980).

Ecological Planning Perspectives

The discipline of ecology is important to bring into this literature review, as a central tenet of ecology is the study of interrelated systems. Steiner describes an ecosystem as an "organized set of connected relationships" (2004, p. 181). Using this definition, one could argue that the Army Corps of Engineers' study of Boggy Creek was completely

devoid of any ecological analysis; the organization failed to see that it was looking at a system with many interrelated parts. While the discipline of ecology largely ignored cities for most of the 20th century, recently ecologists have started to work with other disciplines in order to more fully understand the ecosystems in our cities. This shift gave way to the rise of urban ecology, which merges natural and social sciences in order to analyze urban ecosystems (Grimm et al., 2008). Alberti et al. describe urban ecology as focusing on the "emergent phenomena" of city-scale, dynamic relationships among both socioeconomic and biophysical components (2003, p. 1169). They note that urban areas differ from other ecosystems in that humans have a dominant impact (ibid).

The impetus for the focus toward urban areas is clear: Grimm et al. note that urban areas throughout the 20th century experienced significant growth. While only 10 percent of the world's population lived in urban areas in 1900, that percentage is now up to more than half and is expected to grow even higher in the next 50 years (2008). Along with that growth has come the growing recognition of the services that functional ecosystems provide. "Ecosystem services" refers to the societal benefits that ecosystems provide, which includes direct services such as food and water, and indirect services like flood regulation (Everard & Moggridge 2011). This framework helps to quantify ecological benefits, allowing them to be better integrated into urban planning efforts (ibid).

Perhaps the most notable and advanced representative of modern-day ecological planning has been Ian McHarg's *Design with Nature*, which shed light on how humans can work in line with nature when planning to develop land. McHarg was one of the first planners and designers to use ecology as the foundation for his decision-making (Yang, Li, Li, 2013). McHarg believed that urban design should conform to the region's underlying geology, soils, and vegetation. He advanced ecology as the theoretical basis for planning and design, and was a proponent of ecological determinism — that we're determined by

our interactions with each other and the environment. McHarg declared that "nature is the arena of life," a simple statement that he pointed out was not even followed by professions like engineering whose survival depends upon the knowledge of nature (1969, p. 7). He called out engineering, where "dependence on rigid construction has assumed the aspect of a creed" (ibid). He took issue with the practice of filling in sites prone to flooding so that they could be developed, believing that some areas weren't meant for development and human habitation. In his suitability maps, he mapped out areas that were suitable and unsuitable for urbanization, using natural features such as floodplains, aquifers, and slopes as a foundation (1969).

Landscape architect (and co-worker of McHarg) Anne Whiston Spirn also focused on the significance of nature in the design of cities. In her book *Granite Garden*, she noted that urban residents have always been interested in nature, but today that interest has reached new heights due to increasing environmental consciousness. In her eyes, 1985, the year her book was published, marked the time to expand what had traditionally been a "romantic attachment" to nature into a philosophy of transforming the city in line with the "workings of nature" (1985, p. 37). Spirn made the point that planners and designers had commonly treated nature as a separate entity from the city, rather than an important part of urban areas. She drew inspiration from the founder of modern landscape architecture, Frederick Law Olmsted, who she believed helped "transform urban landscapes polluted by waste into habitats that enhanced human health, safety, and welfare" in the mid to late-19th century (1995, p. 92). She noted that a portion of Boston's Emerald Necklace park system was specifically designed by Olmsted to mitigate flooding and pollution in the city's Back Bay area, not simply as a recreational amenity as it is perceived today. Olmstead's strategy was unique, in that many other parks of this era were planned to showcase artificial representations of nature instead of harnessing their natural processes (Spirn, 1985).

Thus, the historic divide between humans and nature in the city can be further understood as the divide between the human ideal of nature in the city, versus the knowledge of how the hydrological cycle operates. Many contemporary ecology scholars have reflected on the modern-day construction of nature in cities. Kaika discusses binaries implicit in our cities: private vs. public, good vs. bad, pure vs. contaminated, and inside vs. outside (2004). According to her, the wide-scale practice of purifying water in the 19th and early 20th centuries helped lead to the dichotomy of "good" water vs. "bad" water: good water was controlled and commodified, and bad water was anything that was not modified by humans (2004, p. 267). Good water was used for human activities like drinking, swimming, and bathing, and bad water was the kind found in urban water bodies and sewers. She makes the point that with the rise of easily available "good" water for drinking, natural water bodies began to disappear from urban areas through, for example, being covered by pavement. Naturally occurring water in cityscapes was perceived as a threat, as something to be controlled due to the risk of epidemics and the lack of developable space available within cities (Kaika, 2004).

Kaika provides great insight into why urban dwellers have historically turned their backs on many of their water bodies, and she notes positively that revealing the natural processes within urban areas has the potential to be a "source of knowledge and emancipation" (2004, p. 280). Similarly, Michael Hough is a landscape architect who makes the point that the concept of visibility is crucial to an environmentally responsible community. He notes that "Water is drained off streets, parking lots, pavements, plazas, school yards, front and back gardens and parks, and disappears from human consciousness, perpetuating environmentally destructive practices" (1995, p. 48). Flooding, erosion, and degraded water quality are all the costs of well-drained urban spaces, and he describes this as a serious disconnect in the perception of cities and the natural processes within them,

which has not been fully grasped by conventional urban design and planning. Hough correctly notes that much of our daily life is spent in environments designed to hide the natural processes that sustain life (ibid). He echoes Kaika's point that revealing the natural processes in our cities can be educative and help create a more environmentally aware community.

The dire condition of many of our urban waterways is widely acknowledged by ecology scholars today. "Urban Stream Syndrome," is a term coined by Walsh et. al to describe the declining ecological health of urban streams that many researchers have consistently witnessed. Common symptoms include a "flashier" hydrograph, meaning that rainwater rapidly collects in the stream to produce flash flood conditions, higher amounts of nutrients and contaminants, and an altered channel shape (Walsh et al., 2005). High peak flows and limited baseflow (the groundwater in the stream that is not supplied by runoff) is perhaps the most reliable indicator of the effects of urbanization on creek hydrology (Bernhardt & Palmer, 2007). Due to increasing urbanization around the globe, research on ecology in urban areas has grown in the last two decades, yet Bernhardt and Palmer note that research on the effects of urbanization on urban streams is relatively recent compared to the decades of research on stream hydrology and morphology (ibid).

The Regulatory, Social, and Environmental History of Austin

The channelization of Boggy Creek also touches on issues of environmental justice. Schweitzer and Stephenson note that the study of environmental justice has affected environmental scholarship, in that the notion of what we refer to as "the environment" has expanded from only considering pristine, untouched spaces to including the expression of nature in urban areas as well (2007). This shift has also contributed to the growth of environmental research on the health of people who live in cities, a group that had been

traditionally left out of environmental scholarship (ibid). Boone et al. notes that environmental justice emerged as a reaction to the concentration of dumps and other hazardous facilities that were located in close proximity to people of color. They note that the majority of environmental justice literature treats people of color as "magnets" for toxic industries, ignoring the privilege of white people who have more power to oust these unattractive land uses from their neighborhoods (2009, p. 768).

This is relevant to the history of Austin, as the East side has historically been made up of low-income people of color, and has historically been less protected by zoning and other regulations. The differences between East and West Austin, in terms of social and environmental characteristics, is important in understanding the history of Boggy Creek. The City of Austin's now infamous 1928 plan institutionalized segregation by recommending that all African Americans relocate to the East side, which would be a "negro district" home to all African American facilities and institutions (Gregor, 2010). The racial divide between East and West Austin was strengthened when Interstate Highway 35 was constructed on the boundary of the East side alongside downtown Austin in the 1950s (ibid). Further, many of the zoning uses in East Austin were marked unrestricted, which had the effect of allowing residential neighborhoods to be closely located to industrial sites (Moore & Wilson, 2013).

Within Austin, the difference in topographical characteristics between the western and eastern parts are important to discuss, as they have broader social and environmental connotations. While western Austin is characterized by hilly terrain and marks the beginning of the Texas Hill Country, East Austin is flatter and is ecologically defined by the Blackland Prairie region (Lee & Jung, 2014). Creeks in the eastern part of the city generate more floodplain land than those in the west due to these terrain differences (ibid). East Austin in particular has been likened to the city's "hydrological drain," as it is located

downstream from downtown Austin and at the bottom of multiple watersheds (Karvonen, 2011, p. 157). Because of this, the area's population has been exposed to greater flood risk than residents in West Austin (Lee & Jung, 2014).

Tretter and Adams writes how regular flooding in Austin significantly affected what he terms the racial geographies of the city (2014). While Hispanics, African-Americans and poor white people all historically resided in flood-prone areas of Austin, Hispanics in particular had the most substantial exposure to flooding. They moved from the flood-prone western part of downtown to the flood-prone East side, as they were restricted from other parts of Austin (Tretter & Adams, 2014). While Hispanics were not cited in the 1928 Plan that created a "negro district" in East Austin, they had limited housing opportunities due to the cost of real estate, as well as racial covenants which prohibited sales to non-white people (ibid). This is particularly relevant to Boggy Creek, as the neighborhoods surrounding the Boggy floodplain were predominantly Hispanic.

On the other side of town, West Austin's steep slopes, thin soil, and the location of the Edwards Aquifer, which provides the region's primary water supply, have made it a higher priority for environmental protection than East Austin (City of Austin, 2015a). This area is also home to the beloved Barton Springs pool and the endangered Barton Springs salamander (Moore & Wilson, 2013). Thus, the city has valid and important reasons to protect this area of town.

Since the 1980s, Austin has been home to a strong environmental movement. The natural landscape during the 1980s and '90s was attractive to labor and capital, assisted by an expanding parks and greenbelt system and a lack of pollution that many other cities were experiencing during this era (Long, 2014). The city came close to tripling in population between 1950 and 1980, and out of this population increase came concerns that Austin was growing too quickly (ibid). A movement was formed which focused on

managing growth, protecting the environment, and overall of preserving a distinctive "Austin" identity. This movement brought with it political battles that were commonly referred to as "developers vs. environment" in the 1980s and '90s (ibid).

While the environmentally sensitive western region of Austin was sparsely developed up until the 1990s, Tretter and Adams note that it was also increasingly appreciated for its scenic beauty and had less problems with flooding than East Austin, opening it up to development interests (2013). Most notably, the passage of the Save Our Springs Ordinance in 1992 marked the beginning of a city-wide growth strategy that aimed to shelter West Austin from development by placing limits on impervious cover in order to protect water quality in the southwestern part of the city (Moore & Wilson, 2013).

Due to a historically low minority voter turnout rate, however, the environmental movement in Austin has been led by a predominantly white voice, which has had the effect of overshadowing concerns of environmental racism (Long, 2014). Around the same time as the passage of the Save Our Springs ordinance in the early 1990s, the organization PODER (People Organized in Defense of the Earth and her Resources) was founded to combat polluting industries located on the East side. PODER successfully closed down a Tank Farm that was home to bulk fuel storage tanks, which was located next to neighborhoods. The organization also forced the Austin City Council to close the Holly Power Plant, similarly located in close proximity to neighborhoods (PODER, n.d.). Yet the founder of PODER has expressed that bettering the environmental quality of East Austin has also led to higher property taxes and new amenities only attractive to affluent residents (Long, 2014).

Increasing real estate values in East Austin were amplified by Smart Growth policies in the 1990s, which aimed to find a balance between the push for economic growth from the development community and the push for protection of West Austin advocated

by environmental activists (Karvonen, 2011). It aimed to create a denser urban core, decrease sprawl and protect environmentally sensitive areas. The "Desired Development Zone" was implemented in Central and East Austin at this time, which incentivized growth in those areas and away from West Austin (ibid). For urban watersheds like Boggy, this means impervious cover is not regulated by watershed but by zoning. While commercial zoning is limited to 40 percent impervious cover at most in the watersheds located in the Drinking Water Protection Zone (and further regulated in more sensitive areas of that zone), commercial zoning in the Boggy Creek watershed allows up to 95 percent impervious cover in the most permissive zoning category, General Commercial Services (City of Austin, June 2014).

Today, the area continues to experience gentrification, the outcome of intensified development in the area since the 1990s (Moore & Wilson, 2013). Neighborhoods like those surrounding Boggy Creek have since seen their property taxes increase rapidly. The census tract that includes the Govalle neighborhood saw a 90 percent increase in median home value from 2000 to 2010 (Governing, 2016). This has led to the displacement of people of color who formed established communities in East Austin. The African-American community in Austin experienced a population decline of 5.4 percent from 2000 to 2010, making Austin the only growing major city in the U.S. to experience such a decline (Tang & Ren, 2014).

Long notes that Austin's brand of sustainability, as is common with urban sustainability across the U.S., has focused more on the two pillars of economy and environment than on the social equity pillar (2014). The sustainability narrative that Austin projects, he writes, has overlooked the concerns of the most vulnerable. This notion is reflected with Dooling's concept of ecological gentrification (2009). Ecological gentrification refers to the contradiction between environmental planning agendas that

represent an environmental ethics, and the injustices — displacement and exclusion —that occur as a result which impact the city's most vulnerable. Dooling writes: "The privileging of nature and natural processes, implemented through a city's environmental agenda, produces spatial, political and economic impacts for a group of people who, because of society's common perception that they have willingly rejected the formal economic system, carry the symbolism and reality of being cast as outlaws, outcasts, dangerous criminals or pitiful (and disdained) victims" (2009).

Social vulnerability refers to the exposure of people to stress as an outcome of the effects of environmental change, stress meaning disruption to peoples' livelihoods and "forced adaptation" to their changing environments (Adger, 2000, p. 348). It is defined at the community level, and is associated with the social capital of communities. Resilience refers to the increased capacity for communities to manage stress. Importantly, the resilience of social systems has been found to relate to the resilience of ecological systems on which the social system depends (ibid). The community around Boggy Creek lacked social capital, and the decision to settle in the floodplain was likely the result of a long history of restrictive real estate practices in Austin for people of color. The community was focused on surviving, forming the Govalle Association for Survival (Breaux, 1991), and fighting for their basic rights in front of City Council for 20 years. I believe the community displayed resilience throughout the flooding, continuing to push for a solution through the local government, and when that path did not bring results, pushing for a dramatic flooding solution through the federal government. Ultimately, through their efforts they succeeded in solving the flooding problem in their community to a large extent.

The story of Boggy Creek, in some ways, is not unique and draws from a long history of disinvestment in urban streams. It draws from the lack of emphasis on ecological planning in many cities throughout the 20th century, and more broadly, the exclusion of

urban areas from ecological research entirely. It also draws from the prevalence of structural flooding solutions that were implemented throughout the 20th century. The widespread acceptance of these structural solutions, at a root cause, is related to landscape architect Michael Hough's point that urban environments are designed to hide the natural processes that sustain life (1995). In the future, it is my hope that the growing focus on revealing the natural processes within cities will help to transform Boggy Creek to be an ecologically functioning, accessible creek.

Chapter 3: Introduction to Boggy Creek

Boggy Creek's headwaters begin just east of Interstate Highway 35 near Airport Boulevard (Figure 4). It travels about eight miles before discharging to the Colorado River, east of U.S. Highway 183. The creek has two major tributaries, Tannehill Branch and Fort Branch, which meet Boggy Creek shortly before its confluence with the Colorado River. Boggy Creek and its branches have a drainage area of about 14 square miles, and contain 24 miles of streams (City of Austin, 2011).

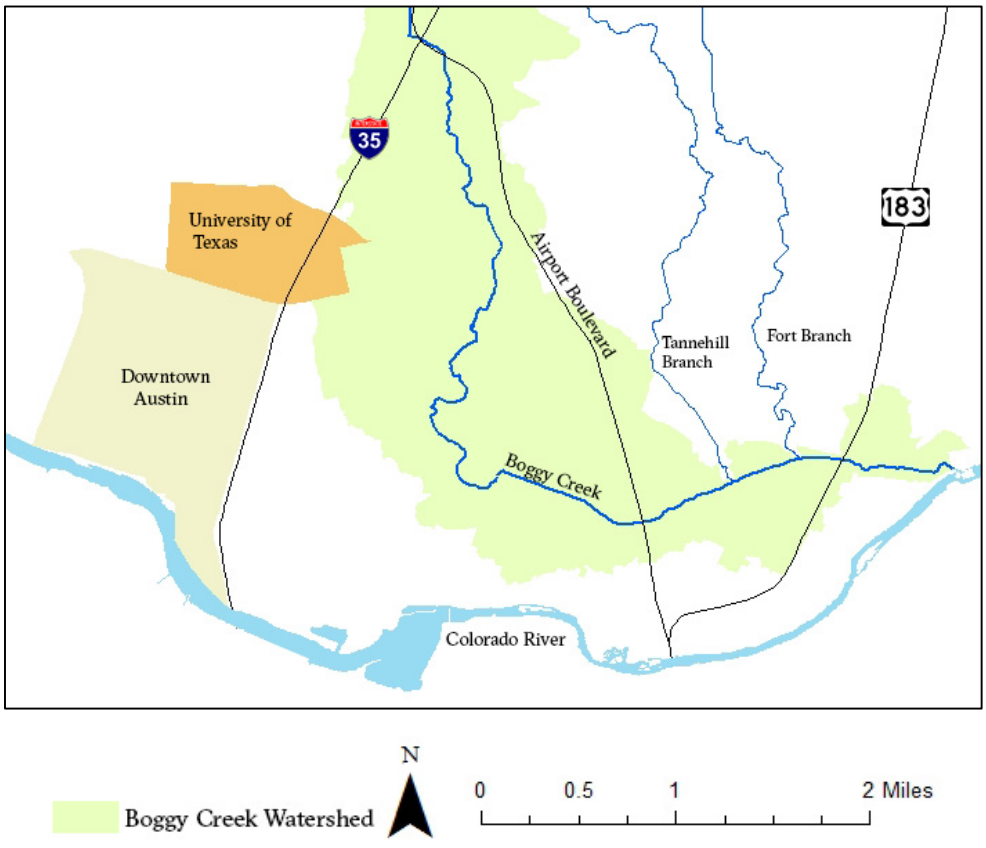

Figure 4: Boggy Creek Watershed in Austin, Texas (Annie Boggs, City of Austin GIS Data)

The creek is one of 65 watersheds in the City of Austin's boundaries, and it covers about 5.9 square miles in East Austin (City of Austin, 2015a). The City defines a watershed as an area of land that drains to one of Austin's larger creeks (City of Austin, n.d.).

The creek is marked by a history of severe flooding, a characteristic not uncommon in Austin. The city is part of what is known as "Flash Flood Alley," a region in Central Texas that has a higher risk of flash flooding than most places in the U.S. due to its high rainfall rates, steep topography, and shallow soil (Lower Colorado River Authority, 2016). Boggy Creek's topography also helps explain its history of flooding: While at its headwaters it has an elevation of 740 feet above sea level, it drops to 410 feet at its intersection with the Colorado River (U.S. Army, 1989). Additionally, the creek experiences a drop of 200 feet through a 3.6-mile span as it travels southeast from its headwaters to its intersection at Webberville Road, where the land becomes much more flat (Isom H. Hale & Associates, 1966). The lower-elevated, flat area beginning at Webberville Road had a history of the most intense flooding.

Urbanization has played a large part in the watershed's history of flooding. Boggy is classified as an urban watershed and is one of Austin's earliest-developed watersheds, in addition to Shoal and Waller creeks. These watersheds in the urban core have some of the most severe erosion and flooding in Austin, exacerbated by the fact that much of the development took place prior to the City's first watershed regulations in 1974. Today, the Boggy Creek watershed's impervious cover is estimated at 43 percent (City of Austin, 2013b). Unrestricted development, and thus increased impervious cover, have had long term effects on the creek's hydrology, leading to increases in stormwater runoff and peak discharges (City of Austin, 2015a). Rapid development surrounding the most flood-prone part of the Boggy Creek watershed began to occur in the 1950s, prior to the advent of any regulations restricting building on floodplain land (Haworth, Nov. 24, 1975). This

combination of urban development and topography, in addition to a prevalence of severe storms, created a situation in which neighborhoods around Boggy Creek experienced flooding two to three times a year throughout the 1960s and '70s (Austin American Statesman, 1975).

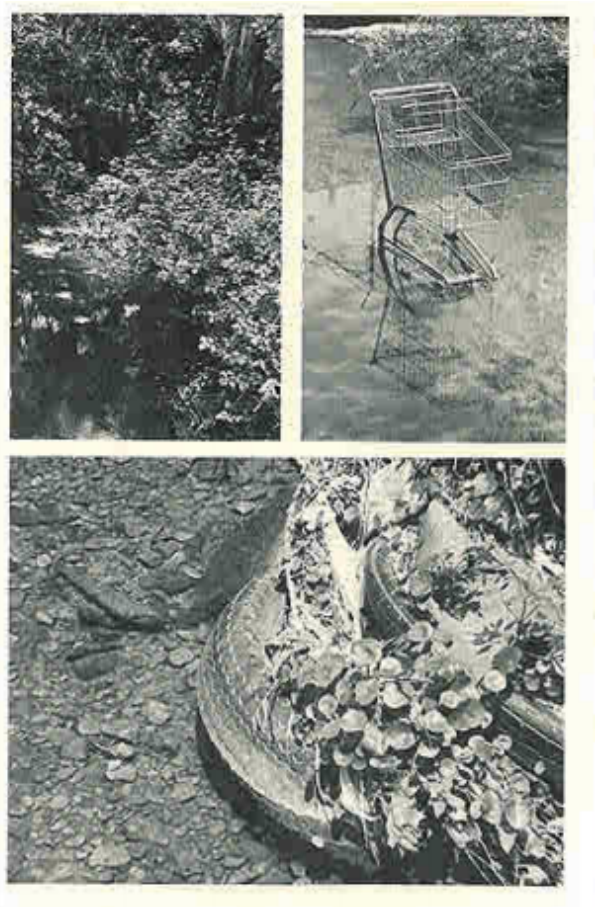

Figure 5: Photos representing creeks in East Austin (Sinclair et al., 1976)

Perhaps aided by its less-than-appealing name, Boggy Creek's history is not a glamorous one. Multiple sources note that Boggy Creek was used as a dump site up to the mid-20th century (G. Rivera & J. Rivera, 2012; McCormick & Alderson, 1983). A group in East Austin called the City Council to clean up Boggy in 1961, describing it as a "health menace and a public dumping ground" (Austin Statesman, 1961). Neighbors complained that a city-owned garbage truck cleaning facility was polluting the creek as late as the 1990s (Wright, 1993). Unlike Barton and Shoal Creeks in West Austin, cherished for their aesthetic qualities, Boggy was never valued for its natural beauty — at least in any written documentation. A document on Austin's creeks in honor of the United States' Bicentennial devotes multiple pages to Shoal Creek, while Boggy receives barely a sentence in the document (Black et al., 1976).

On a photo and map page dedicated to creeks in East Austin — Walnut Creek, Little Walnut Creek, and Boggy Creek and its branches — half of the photographs show trash in the water bodies (Figure 5). Boggy's plight, however, is not unique, as many urban streams today have lost much of their ecological function and aesthetic value. As mentioned in the previous chapter, the ecological degradation of urban creeks has even been termed the "urban stream syndrome" by researchers (Walsh et al., 2005).

Yet, as the main source of water in East Austin, Boggy has no doubt been important to plants, animals, and humans throughout its history. A report documenting an archaeological investigation of a site on the creek, one of the only documents I found that alludes to the creek's ecological value, notes that the area has been "consistently attractive for human inhabitants" due to the "considerable variety" of plants and animals (Alderson & McCormick, 1983, p. 15). Archaeologists discovered a rock-lined hearth and other lithic remains near the creek site, representing encampments by humans during the late prehistoric era, likely during the Austin phase, 650-1350 AD (ibid, p. 34). Additionally, agricultural activity that occurred in East Austin by early European settlers in the mid-19th century was no doubt assisted by the presence of Boggy Creek (ibid, p. 7). The founders of Boggy Creek Farm, an urban farm on one of the only remaining farm properties in Austin from the 19th century, discovered Boggy Creek inscribed on a well on their property, showing that at least one farm made direct use of Boggy for its agricultural production (C. Sayle, Interview, June 20, 2016).

Overall, most of the literature I found describing the perception of Boggy Creek before its channelization was derived from government documents and newspaper articles in anticipation of the flood control project by the U.S. Army Corps of Engineers. The Environmental Impact Statement for the channelization project states that the area around the creek is an "extensively urbanized human habitat with little potential for fish and

wildlife support" (U.S. Army, 1980, para. 1). The aquatic habitat of the creek is described as "marginal" and "generally unproductive" (p. 15). A 1966 article in the *Austin American-Statesman* describes Boggy as "little more than an insect-infested, shallow depression in the earth" (Castlebury, 1966). These documents present a somewhat grim picture of the creek leading up to its channelization.

Chapter 4: Background to the Channelization of Boggy Creek

History of Flooding

This chapter will focus on the portion of the creek that experienced the most intense flooding and was later channelized: a three-mile section which runs from Webberville Road to U.S. Highway 183, just south of the Rosewood neighborhood and through the center of the Govalle neighborhood in East Austin. Flooding events in Boggy Creek were recorded back to the late 19th century by the *Austin Daily Statesman*, where the creek was often referred to as "Little" Boggy Creek. An 1886 article described how two men "cheat the angry waters of Boggy Creek" in order to rescue "two young ladies from the jaws of death." A 1935 article refers to a "roaring, swirling" creek that flooded the "city lowlands," with water 10 to 12 feet deep (Austin Statesman). This article refers only to areas in Rosewood, as residential development in Govalle had not yet occurred. An aerial photograph from 1940 shows farmland as the dominant land use in much of this area (Figure 6).

Flooding concerns increased starting in the mid-20th century as residential and commercial development grew in the area with no limitations on building in the floodplain (Haworth, Nov. 24, 1975). Structures were often built on small lots set very close to the creek edge (Karvonen, 2011). The flood in October of 1960 demonstrates the severity of the floods the neighborhoods experienced: more than nine inches of rain fell within a 12-hour period, with 200 residents evacuated and 12 homes washed away (Dept. of the Army, June 18, 1979). A 1960 article in the *Austin Statesman* describes cars on Rosewood Avenue in the neighborhood as "being pushed around like floating beer cans," with damage in Govalle much greater than the previous historic flood that occurred in 1936. Between 1960 and 1965, the creek flooded an estimated 12 times (Isom H. Hale & Associates, 1966). The *Austin American Statesman* noted that though the creek did not receive rainfall on the scale

of a 100-year flood, shorter periods of rain in much smaller proportions caused the creek to swell over its banks (Haworth, 24 November 1975). Annual flood damages for Boggy Creek at the time it was studied in 1978 were estimated at $1.15 million (over $3.9 million in today's dollars), 81 percent of which affected residential properties (Dept. of the Army, June 18, 1979).

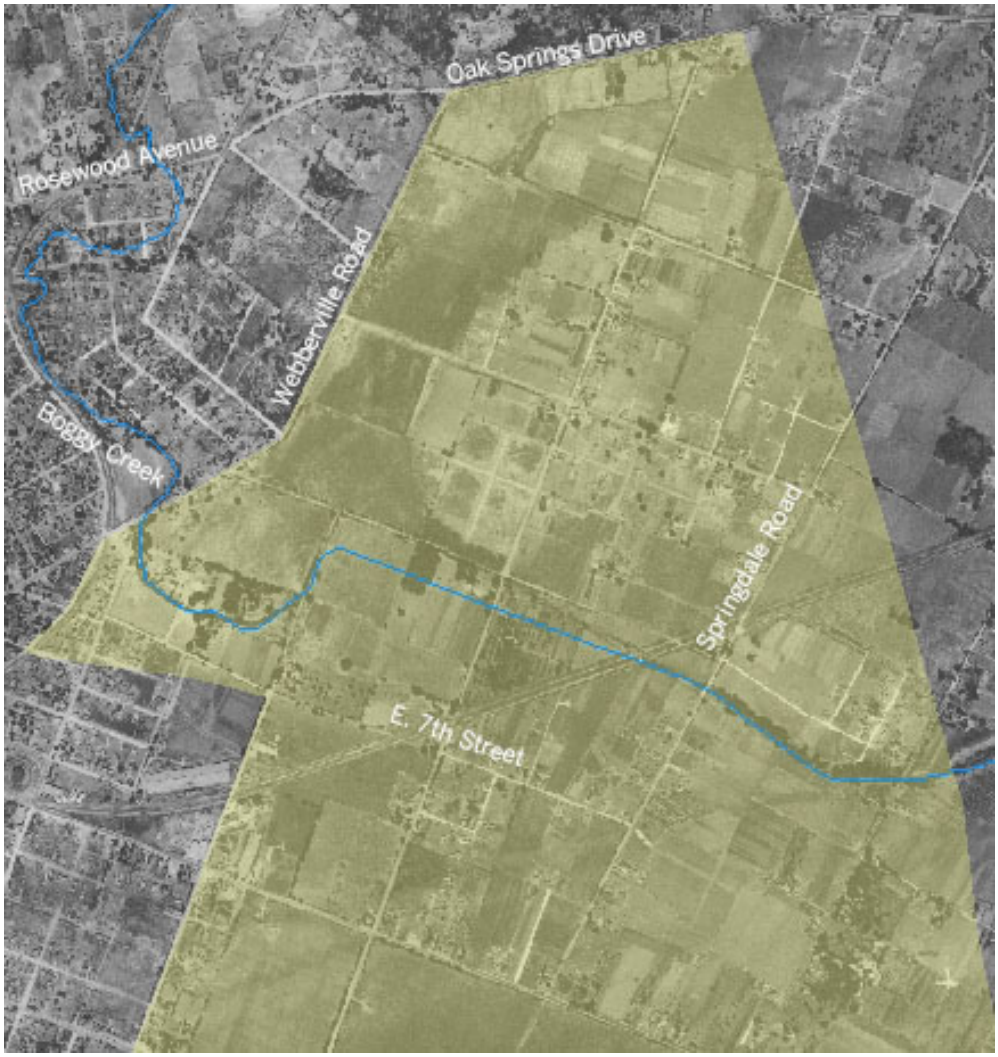

Figure 6: Aerial imagery of the Govalle neighborhood in 1940, with the current neighborhood boundaries as defined by the City of Austin shown in yellow (Annie Boggs, City of Austin aerial imagery)

Figure 7: The Govalle neighborhood today in its developed state (Annie Boggs, City of Austin aerial imagery)

The City's Response

From the neighborhood's perspective, there seemed to be a general consensus that the City was not doing enough to control the flooding, and that it did not have a definite plan (City of Austin, 1960; Haworth, November 25, 1975). It is clear, however, that there was no easy fix, and as it was such a flat area, that there was simply no place for the water

to go. As early as 1947, it was reported that rainwater along Boggy had no drainage outlet, and a 4,000-foot drainage ditch was being constructed to help draw water from the creek (Austin Statesman). As described by a City Council member in 1961, the City was dealing with two drainage problems in the area: the drainage problems from the flood waters around Boggy Creek, as well as the presence of several low areas that simply did not drain and had standing water (City of Austin, Aug. 10, 1961).

City Council agenda documents from this era show that the City was trying to find solutions for the area, though the solutions were never significant enough to solve the flooding and drainage problems of Govalle. In 1960, a representative from a group in the Govalle area stated they were "entitled to some rights and relief," and in response the director of public works stated that $63,000 ($293,000 in today's dollars) had been spent on drainage work in the area during the previous three to four years, with $150,000 planned in the bond fund (City of Austin, 1960). In March of 1961, the Council received a petition asking for drainage work to prevent the flooding of homes along Boggy Creek, and it discussed the problem "at length" (City of Austin, March 16, 1961). The issue was that it would cost several hundred thousand dollars just to help the situation for a few people, much less provide adequate drainage for the entire Govalle area. Though the Council expressed that drainage work for the whole neighborhood was not economically feasible, they also expressed that it would spend the money it could out of its budget to help relieve the flooding (ibid).

The root problem was that the City at this time had no way to limit building in the floodplain. One council member inquired at the March 1961 meeting if there was a way to prevent this, and another responded that the City could zone all of the flood areas and mark the type of structure that would be allowed there, a recommendation that he stated had been made to the Council 15 years ago. Ultimately, limitations on development in the floodplain

did not begin until 1974 with the City's Waterway Development Ordinance that limited development in the 25-year floodplain (City of Austin, May 2014). In a 1975 article in the *Austin American Statesman* discussing development that had already occurred in floodplains throughout Austin, the Boggy Creek floodplain was described as the worst such area by the City's engineer, and one of his biggest priorities (Cox, 1975).

By 1975, the 100-year floodplain for Boggy Creek was estimated to include 1,600 homes and 100 businesses, in addition to schools and city property (Haworth, Nov. 24, 1975). Many residents were relocating to drier land, and according to one prominent neighborhood resident who later led the charge for flood assistance, Jorge Guerra, the city was considering turning the Govalle neighborhood into a lake (Breaux, 1991). The flooding almost exclusively affected low-income, minority residents (Austin American Statesman, 1975), a fact that was heavily reported in newspaper articles written about the flooding and, later, the channelization. African Americans, Hispanics, and other people of color made up about 50 percent of the community living in the flood-prone area of the creek. The area particularly impacted by the flooding of Boggy Creek was referred to as "the fishbowl" by City engineers, which ran from Webberville Road to Airport Boulevard (U.S. Army, 1980). As stated previously in this paper, this area was the flattest area near the creek, causing water to rapidly pool during heavy rainfall. The water would often rise more than five feet (Breaux, 1991).

Govalle also lacked basic amenities; its streets were unpaved and it did not have curbs or gutters, which further contributed to the flooding problem (Haworth, Nov. 24, 1975). The City of Austin's efforts to control the flooding was described as short-term and disjointed, and Boggy Creek was called a "bureaucratic hot potato" by the *Austin American Statesman* (ibid). The City estimated that significant flood control would entail a

multimillion dollar project that it could not afford. They planned to call the U.S. Army Corps of Engineers for assistance (ibid).

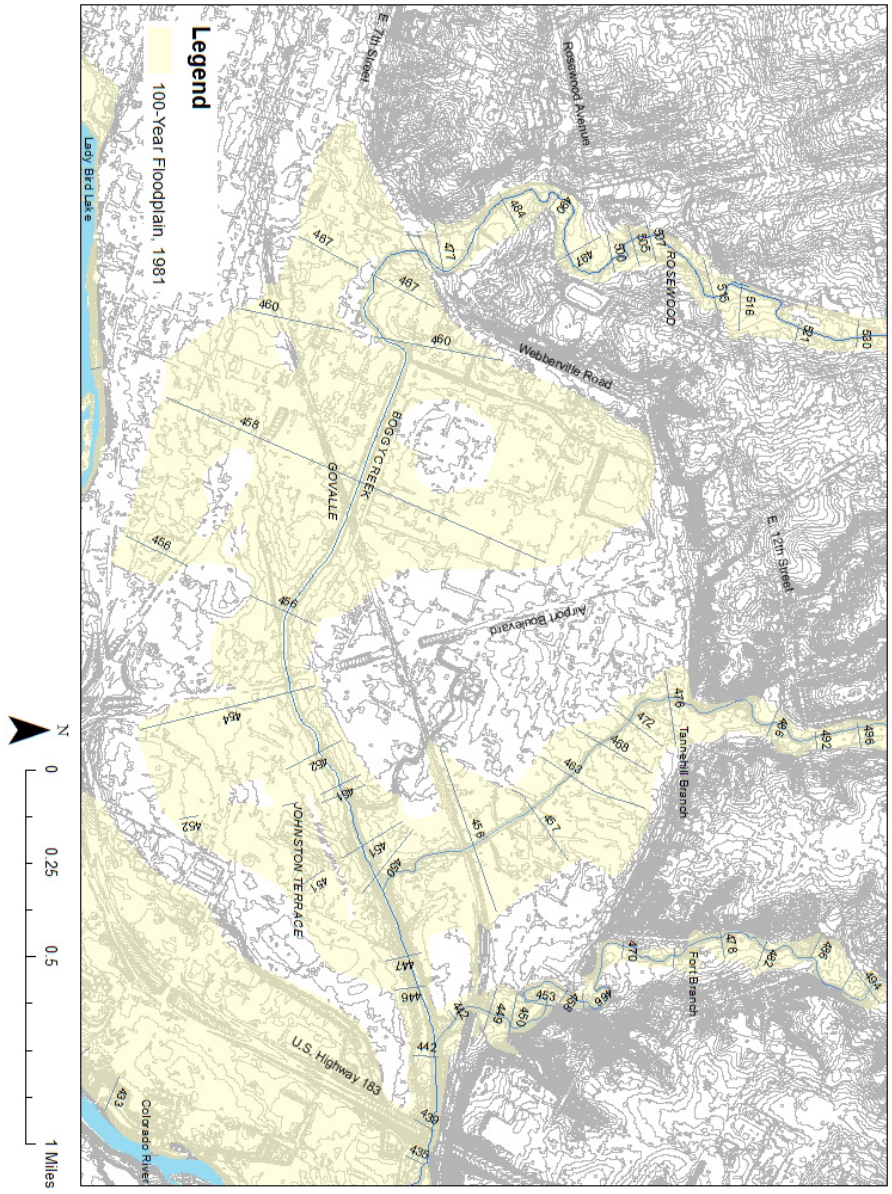

Figure 8: Boggy Creek's 100-year floodplain is shown in yellow with topographic elevation shown in grey. The map demonstrates the floodplain's lower elevation compared to the land surrounding it. Corresponding elevation numbers are shown along the creeks. (Annie Boggs, City of Austin GIS Data).

In the decade prior to Army Corps intervention, however, the City turned to the newly formed Urban Renewal Agency as a possible answer to the flooding of Boggy Creek in the Rosewood neighborhood. In the mid-1960s, the agency hired an engineering and planning firm to study ways to decrease flooding along the creek, which marked the first time Boggy was officially studied. In its report, the firm concluded that the creek had contributed to the current state of substandard housing along the channel (Isom H. Hale & Associates, 1966). As the homes were regularly subjected to floods, "a minimum of expenditures" had been used to develop housing, which then had deteriorated to "blight" (p. 7). The report echoed the City's point that flood protection was costly, and pointed out that the costs to provide flood protection for the area was more than the total property values which would be protected. Nonetheless, the recommended solution was to deepen, widen, and straighten the creek channel (Isom H. Hale & Associates, 1966).

A neighborhood along the creek called Glen Oaks was the second in Austin to be selected as an urban renewal district due to its deteriorating condition from frequent flooding. A plan completed by the Urban Renewal Agency surveyed the neighborhood and found that 72 percent of buildings were dilapidated, fifty percent of the streets were unpaved, and that the area had inadequate drainage facilities, fire protection, and commercial facilities (1966). "Dilapidated" amounted to the most severe classification of housing by the Urban Renewal Agency, meaning that the housing was not livable and would therefore be cleared (Busch, 2013).

After the city had not invested in the area with even the most basic infrastructure improvements, all private and semi-public structures in Boggy Creek's 50-year floodplain were marked to be cleared, along with other structures perceived to be substandard (Urban Renewal Agency, 1966). From the city's perspective, the neighborhood was overcrowded and lacked standard land division and street layout patterns. It was believed that these

factors added to neighborhood decay, in addition to the regular flooding the residents experienced (Hill, 2011). Overall, the agency displaced 360 families and 20 businesses, many of whom did not wish to move. According to residents, the money offered for their properties was also less than sufficient to allow them to relocate (G. Rivera & J. Rivera, 2012). A greenbelt bordering the floodplain was created where homes once stood, and the land out of the floodplain was re-subdivided with new single-family residences, an apartment complex, and a shopping center (Castlebury, 1966). Pleasant Valley Road was constructed, which passed through the center of the Glen Oaks neighborhood (See Figure 9). The new residents benefitted from an improved sanitary and storm sewer system, as well as paved streets and sidewalks (City of Austin, 1968).

The Urban Renewal Agency's efforts, however, were not sufficient to address the entire area's flooding concerns. Two-hundred neighbors petitioned city officials during the late 1960s to request solutions for the flooding, and they were told that by 1969 the problem would be addressed by urban renewal efforts. But the flooding continued (Haworth, Nov. 26, 1975). Additionally, the city would not grant permits for residents of the Govalle neighborhood to improve their flood-damaged properties (City of Austin, 2003; Smith, 1968). According to one community newspaper, because the Govalle neighborhood had been tentatively declared an urban renewal area, the city denied the neighborhood street paving or sewer line extensions (Smith, 1968).

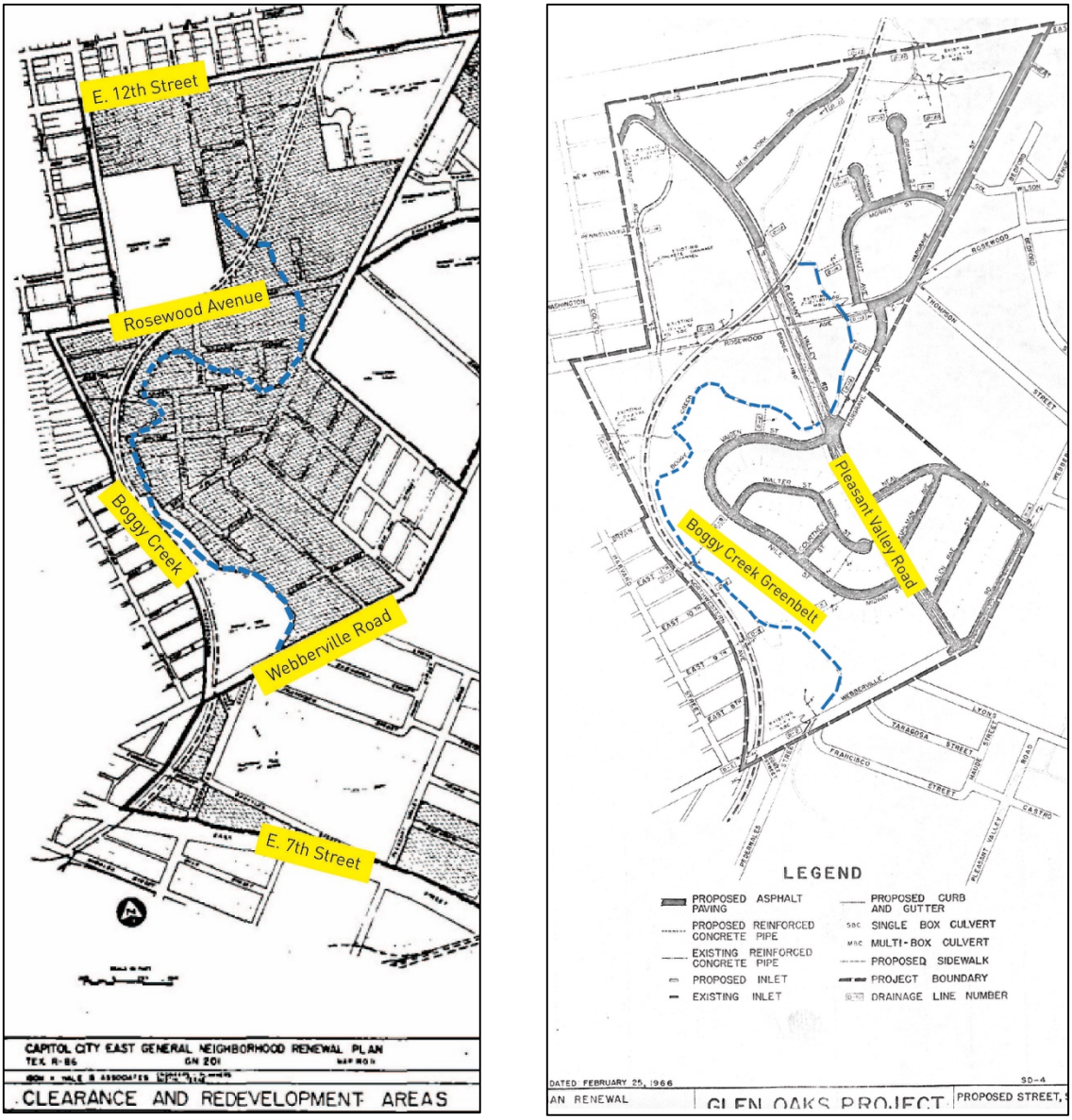

Figure 9: At left, the Glen Oaks neighborhood before the urban renewal project. The image on the right shows the project's proposed street layout and improvements, with the Boggy Creek Greenbelt and Pleasant Valley Road as new additions.

Entrance of the Army Corps of Engineers

The effort to involve the U.S. Army Corps of Engineers appeared to be a long and somewhat arduous process, involving ongoing pressure from the community and City of

Austin officials to prove that the project was justified and worth being funded by the federal government. Jorge Guerra was a leader of the Govalle community's push for flood control relief. He lived across from a Catholic church in the neighborhood, and requested the help of the local priest, Father Joe Znotas, who had a reputation for his community activism and had even been witnessed directing traffic outside the church during heavy rains and flooding (Breaux, 1991). Znotas managed to contact Representative J.J. Pickle and arrange a meeting (ibid).

In February 1974, Representative Pickle met with City of Austin officials and representatives from the Fort Worth District of the U.S. Army Corps, where it was decided that the Corps would prepare a preliminary feasibility study of the creek (U.S. Army, 1979). More than a year later, however, in June 1975, the Corps stated they were not continuing with a report as the cost-benefit ratio they had derived was not high enough to justify a project at that time. Representatives stated the agency would continue to investigate the flooding problem during a larger study it was undertaking for the entire Colorado River basin. A month later, however, City of Austin officials met with the Army Corps to review the data used in the preliminary study, and through this meeting the Corps was able to obtain additional information. They reassessed and found that the updated benefit cost ratio made the project feasible after all (ibid).

The Boggy Creek Ad Hoc Steering Committee was formed, a group made up of residents, school officials, city officials, conservation group representatives, and congressional representatives, and chaired by Jorge Guerra. The group was a liaison between the Army Corps and the community (U.S. Army, 1980), and Guerra was adamant that the city was not doing enough for the neighborhood most affected by Boggy Creek. He was quoted in an *Austin American Statesman* article saying that after unsuccessfully petitioning the city, he decided to investigate the flooding himself. He found that the

railroad tracks, which align closely with Boggy near its intersection at Webberville Road, were "acting as a dam," clogging the creek with trees, lumber, and trash (Breaux, 1991). The impact of the railroad trestle on the creek's flooding was also noted by the Army Corps in its Environmental Impact Statement, which stated that debris at railroad bridges contributed "significantly" to the flooding (U.S. Army, 1980, p. 17).

In the fall of 1975, after it was determined that the project would be feasible based on a preliminary review, more than 600 residents met with representatives of the U.S. Army Corps of Engineers to request help for flooding in the form of a three-year flood study (Haworth, Nov. 26, 1975). Though that request was granted, by 1977 the Fort Worth District of the Army Corps did not have enough resources to continue its work (U.S. Army, 1979). Due to the immense public interest the project had garnered, however, the District outsourced the services of a private engineering form to continue the study. When completed, the study showed that the project was indeed feasible, and alternatives for the flooding situation were discussed with the community (ibid). The Army Corps evaluated using levees and detention structures, diverting the flow of water around flood-prone areas, flood-proofing existing structures, and evacuating portions of the floodplain (U.S. Army, 1980). However, the study results showed that only channel improvements and evacuation of the 100-year floodplain were sufficient solutions to solve the problem (Dept. of the Army, June 18, 1979).

The residents accepted all the alternatives presented with the exception of evacuation. A public meeting summary from the Corps Fort Worth District states clearly that "the people were so opposed to evacuation that city officials, State officials, and Congressman Pickle asked that the Corps that in their studies they place more emphasis on people than the environment" (U.S. Army, 1979). The Corps noted that during its public meetings with the community, the agency witnessed a "strong sense of community

cohesion" from the residents in the flood plain, who exhibited "strong ethnic and religious affiliations" and who expressed opposition to being relocated throughout the public participation process (U.S. Army, 1979, E-11). The regular flooding the neighborhoods experienced no doubt made their community more close-knit, and they were particularly organized in opposition to the issue of evacuating the floodplain. These residents did not want to leave their homes, and stated they would rather endure flooding there than to relocate (ibid).

The Plan for Boggy Creek

In 1979, an Army Corps district engineer presented the tentative plan to a public meeting of about 150 residents (Dept. of the Army, Oct. 29, 1979). The plan was to target the creek at its 100-year floodplain with a 2.1-mile trapezoidal concrete-lined channel and a 0.8-mile grass-lined channel from Webberville Road to U.S. Highway 183 (ibid), though this was later adjusted to 1.1 miles of grass lined channel, and 1.7 miles of paved channel (City of Austin, 1986). The channel required an estimated 60 acres of land, and the plan recommended that an additional 54 acres be acquired to compensate for habitat losses resulting from the channelization (Dept. of the Army, June 18, 1979). The recommendation was described as having the "optimum balance" of engineering, environmental, and economic problem-solving (U.S. Army, 1980, p. 11).

A hike-and-bike trail along the channelized creek was also included in the plan, but several residents expressed privacy concerns so this trail was eliminated in reaches where it traveled near homes and backyards. Some residents were opposed to the concrete lining of the channel, as well as the need for it to have capacity for a 100-year flood (U.S. Army, 1979). Meeting attendees were also concerned about the destruction of trees and the acquisition of residential and commercial property that would be required for the

channelization. Thirty-nine people signed a petition in opposition to the plan, and the district engineer invited further statements to be sent to his office (Dept. of the Army, Oct. 29, 1979).

Two days following the meeting, eight families were evacuated yet again due to more flooding in the area, the product of a somewhat minor storm (Dept. of the Army, Oct. 29, 1979). A week following the initial public meeting, residents organized a second meeting at the local Catholic church with representatives from the Army Corps (U.S. Army, 1979). Residents said that they felt the critical attitudes expressed at the earlier meeting was not representative of the feelings of most flood plain resident (ibid), and that the residents most directly impacted by the floods were not sufficiently represented at the public meeting (Dept. of the Army, Oct. 29, 1979). Thirty-three neighbors signed in support of the Army Corps plan, and the engineer also received letters of support from the Boggy Creek Ad Hoc Committee, the City of Austin, and other neighborhood and religious groups. No letters in opposition were sent (ibid). The Ad Hoc Committee acknowledged that some residents had expressed opposition to the concrete lining, but reminded the Corps that if concrete were not to be used, a larger channel would be required thus resulting in the forced relocation of families (U.S. Army, 1979). Another neighborhood group, the Rosewood Advisory Group, sent a letter suggesting that the channel be grass-lined in as much area as possible. The Corps responded that the concrete-channel was recommended along Boggy due to cost-efficiency and reduced erosion, as well as decreasing the amount of people that would need to be relocated (ibid).

With nearly everyone's blessing, the engineer thus recommended the plan with the exception of the planned hike-and-bike trail that neighbors expressed discomfort with. He would submit it to the Army Corps division engineer in Dallas, and following that, to the Board of Engineers for Rivers and Harbors in Washington, D.C. (Dept. of the Army, Oct.

29, 1979). Shortly after that submission, Representative Pickle expressed to a colleague at the University of Texas that the project had been fast-tracked in a U.S. Senate subcommittee (Pickle, 1979).

While waiting for federal funding to be allocated to the project, the neighbors continued to push. They formed the Govalle Association for Survival to advance the Boggy Creek project and express their demands to the city (Breaux, 1991). Representative Pickle, too, continued to push for the funding, and was supposedly even nicknamed "Old Boggy Creek" by his colleagues in Washington. By the mid-1980s, federal funding finally arrived. In June of 1986, City officials signed a $26 million contract with the Army Corps; the City's share would be just over $10 million (ibid). Construction kicked off in the spring of 1987 and by 1991 the channel was complete, signaling the culmination of a nearly 20-year community-driven struggle for flood control. Community members and city officials gathered where the creek travels through Zaragoza Park to christen the new channel in the spring of 1991. Coincidentally, a rainstorm swept through the area during the event, but the attendees celebrated: They were no longer subject to yearly devastating floods (Gamino, 1991).

The impact of the channelization was significant; while there were 1,615 structures located in Boggy's 100-year floodplain (U.S. Army, 1980), an estimated 1,593 of those were no longer flood-prone (Gamino, 1991). One thousand of these were residential structures. The 100-year floodplain was reduced by 86 percent, from 811 acres to 110 acres, and the channelization affected an estimated 5,500 residents in the area (Houston, 1994). The results of the channelization were dramatic, both in the aesthetic transformation of the creek and the mitigation of flooding. The public response and news coverage of the completed project was overwhelmingly positive; Representative Pickle even went as far as

to say that the channelization was the “beginning of the end of the neglect of East Austin” (Gamino, 1991).

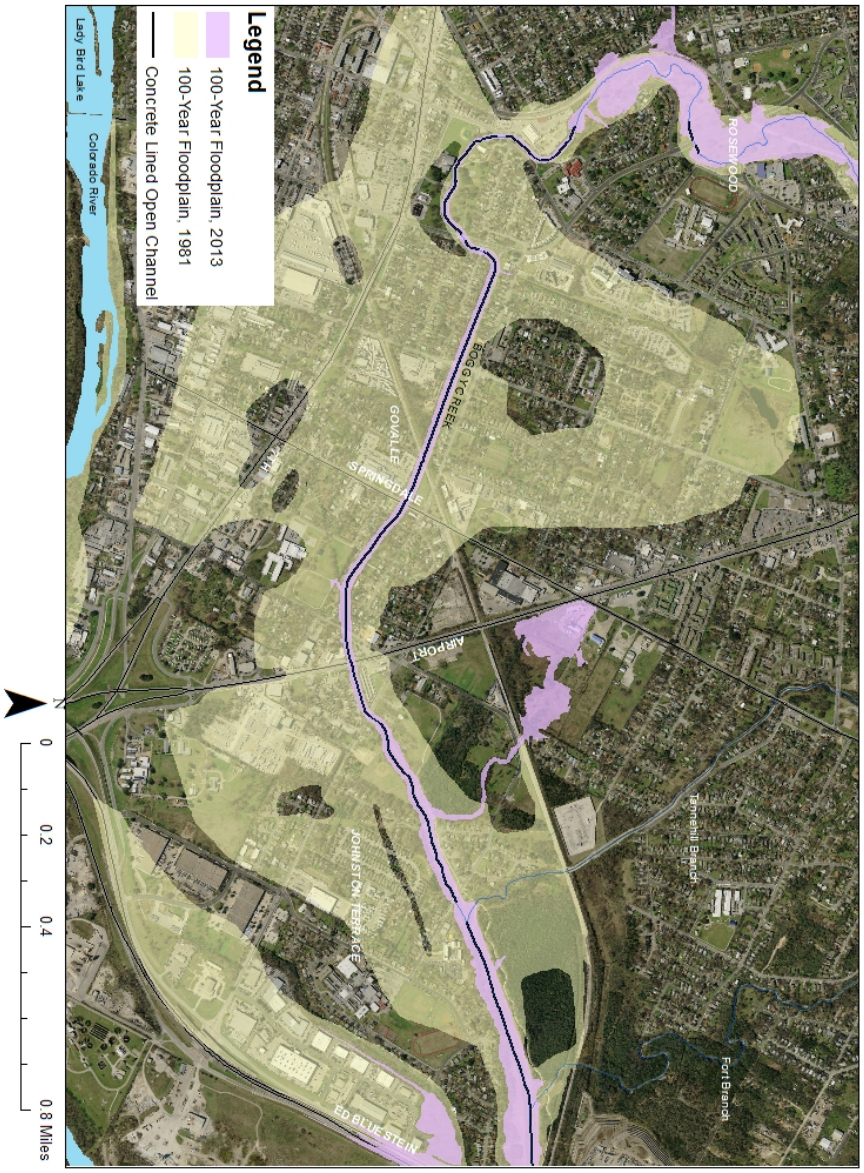

Figure 10: The 100-year floodplain, pre-channelization, is shown in light yellow, and the floodplain, post-channelization, is shown in light purple. The channelized portion of Boggy Creek is marked in black. Nearly 1,600 structures were removed from the floodplain as a result of channelization (Annie Boggs, City of Austin GIS Data)

Figure 11: Boggy Creek in 1940, and under it, Boggy Creek today. The channelization removed many trees along the creek, as well as a meander that existed in the upper right portion of the top photograph (City of Austin aerial imagery)

Chapter 5: Boggy Creek Post-Channelization

Impacts of the Channelized Creek

It should not be understated that the channelization provided important benefits to the community, primarily by removing nearly 1,600 homes and commercial structures from the floodplain (Houston, 1994). The Army Corps saw high level flood protection as a way to raise property values and trigger housing and economic improvements in the area (U.S. Army, 1980). According to interviews with City of Austin staff, the channelization facilitated economic and community development that would not have occurred without the project: a branch of Austin Community College, a substation of the Austin Police Department, an HEB grocery store, and the headquarters for Capital Metro (the public transit authority for the city) are all located in former floodplain land and were constructed following the channelization (J. Guerrero, Interview, July 11, 2016).

However, City staff also strongly believe that channelization brought negative environmental impacts. For one, the 86 percent reduction in Boggy's floodplain made possible by channelization is today understand as a negative outcome, not a positive as it was represented by the Army Corps. It is widely acknowledged that reducing a creek's floodplain has environmentally devastating consequences (M. Byars, Interview, July 26, 2016), as rivers and their floodplains act as one unit (Sprin, 1985, p. 131). The perception of the creek today is generally negative. A 2006 article in the *Austin American Statesman* quotes an engineer from the Watershed Protection Department as saying, "It's dangerous. It's nasty. It's polluted. The creek is just unraveling." It was estimated that Boggy had grown three times deeper and wider than it had been before the watershed was urbanized (Alexander, 2006).

Today, erosion is among the most severe problems for Boggy Creek. While streams on the eastern side of the city are naturally more vulnerable to erosion as they wind through

deep clay soil rather than bedrock (City of Austin, 2015b), increased erosion has been widely documented as an outcome of channelization, as the channelized stream becomes increasingly unstable. Straightening a channel leads to steeper slopes and greater water carrying capacity, leading to increased soil loss, erosion, and flooding downstream (Leete, 2013). The Army Corps left a short section of creek downstream from the channelization in its natural state (shortly before it flows into the Colorado River), and this segment currently experiences flooding and erosion (Interview, M. Byars, July 26, 2016).

Figure 12: The photo on the left shows erosion of the banks at Boggy Creek downstream of the channelization. On the right, a bridge that is threatened by the erosion conditions (City of Austin, 2016)

A Watershed Protection engineer likened the water coming out of the channel into the short segment of natural creek to a "fire hose," and stated that a large section of the natural bank blew out during a recent flood (Interview, J. Middleton, July 26, 2016). Particularly, Delwau Lane, which intersects the creek right before it flows into the Colorado River, experiences severe erosion and is a top flooding problem for the city (City of Austin, 2015a). The City of Austin's Capital Improvements Program five-year plan

states that this portion of the creek is slated for an engineering study, as the erosion of the channel threatens an existing bridge and street in the area, as well as the Southern Walnut Creek Trail, the railroad right-of-way, a gas line, and several residences (City of Austin, 2016).

Using the Watershed Protection Department's Environmental Integrity Index, which monitors local creeks and streams every two years, Boggy scores "fair" in the categories of water chemistry, aesthetics, and aquatic life, and "marginal" in the categories of recreation and habitat (City of Austin, 2013b). Additionally, the widened channel eliminated established riparian areas downstream (Loomis & Moore, Inc., 1998). Riparian vegetation is beneficial as it can both lessen erosion and the velocity of water flowing through the creek, as well as provide habitat for wildlife. Channelization and lining the creek with gabions (rock-filled baskets), on the other hand, has enabled water to flow quickly. In addition to erosion, increased flooding downstream, and reduced riparian habitat, channelization also has negative repercussions for water quality as it speeds the scouring, or scrubbing, of the stream bed downstream (Carter & Burgess, Inc., 1994).

Wetland degradation is also a common outcome of channelization projects. A natural wetland known by some as the Oak Springs Marsh, located in the floodplain of Boggy Creek, was described by the Army Corps during its study as the sole marsh in Austin owned by the City (U.S. Army, 1980). Opinions differed at the time over the importance of preserving the marsh. The Army Corps noted that nature conservation organizations had expressed reservations over the marsh being affected by channelization, while neighboring residents believed the area to be a dumping site and a breeding site for mosquitoes (ibid). According to Govalle residents, who described the marsh in their neighborhood plan as "the single most important wildlife area in East Austin," the marsh was eradicated by the channelization of Boggy Creek (City of Austin, 2003, p. 76). In the past decade, however,

the City has worked to restore some of the ecological function of the former wetland site by constructing a two-acre water quality pond that provides wildlife habitat and removes stormwater pollutants from runoff headed to Boggy Creek (City of Austin, 2005).

Comparing Boggy and Shoal

Following the completion of the Boggy Creek project, the *Austin American Statesman* called out disparities between the City's treatment of watersheds in East and West Austin. While the city had invested over $19 million in Shoal Creek to help mitigate its flooding and erosion problems, the newspaper pointed out in an editorial that the city only contributed money toward Boggy Creek after Representative Pickle had worked for a decade to get $16 million in federal funds for the flooding problem (1993). "To a growing number of East Austinites," another article pointed out, "Shoal Creek and Boggy Creek have become symbols of environmental racism" (Banta, 1993). East Austin environmentalists expressed that they were not opposed to the work done at Shoal Creek due to the destructive 1981 Memorial Day flood that impacted the creek. But they believed the slower and less dramatic erosion of creeks like Boggy on the East side of the city should also be equally addressed (ibid).

Interestingly, Shoal Creek was also studied for flood control by the Army Corps following the 1981 Memorial Day Flood. A report completed in 1991 assessed various plans for the creek, including complete channelization. The Army Corps recommended constructing two tunnels and channelizing two portions of the creek, but the City chose to implement only part of their recommended plan (U.S. Army, 1991). The language in the report shows the beloved nature of the creek; goals aimed to preserve existing environmental areas and maintain habitat along the creek. The report noted that complete channelization would negatively impact the "valued habitats" along the stream (1991, p. 2-

7). Shoal is described as an "important ecological resource" (p. 2-8) that "provides a natural and recreational setting to an urbanized area" (p. 2-13). In contrast, Boggy is described as having "marginal" aquatic habitat and "some good" riparian habitat, with no language alluding to its importance as a natural system (U.S. Army, 1980).

Overall, the extent and nature of the channelization completed is vastly different between Boggy and Shoal: while only 3,200 feet of Shoal was channelized (U.S. Army, 1991), Boggy was channelized for 2.8 miles (of which 1.7 miles was lined with concrete). With Boggy, the City and the community readily accepted the Army Corps' full recommendation. Boggy and Shoal Creek have vastly different histories and ecological components, so in some ways it is difficult to compare the two water ways in this manner. Still, reviewing the Army Corps assessment of Shoal Creek presents a compelling example of what occurred when a creek with recognized recreational and environmental value was proposed to be channelized.

Natural Function and Riparian Restoration

Today, the City's Watershed Protection Department values the natural function of streams in its projects. The department no longer lists channelization as a solution for flood control in urban watersheds like Boggy, as it did in its 2001 Master Plan. Instead, the 2015 plan states that channelization degrades streams and aquatic habitats, and emphasizes sustainable design, such as "rock boulders and vegetative armoring" for any channel modification that does occur, as these materials have a lower environmental impact than concrete channelization (City of Austin, 2015a, p. 260).

The sustainable techniques mentioned above have recently been incorporated in riparian restoration projects on non-channelized reaches of Boggy Creek. Following a study of the Boggy Creek watershed, the segment of the creek within the Boggy Creek

Greenbelt near Rosewood Park was identified as a higher priority area for restoration due to erosion, flooding, and storm water issues (City of Austin, 2012). This area of the creek was found to have intense bank erosion and polluted stormwater runoff, as well as visible wastewater infrastructure (ibid). Prior to the restoration project, the creek was little more than a drainage channel, with vegetation along the creek mowed and erosion apparent. There were wastewater lines through the creek, as well as pieces of concrete (Interview, D. Nuffer, June 24, 2016).

This part of the creek made use of two primary strategies for creek restoration used by the Department: A low-tech and low-cost method described as "passive" restoration, which entailed volunteers planting trees and the city not mowing up to the creek edge in order to restore riparian vegetation, and a more expensive "active" method that required construction work, in which the creek was engineered for channel stability and its wastewater lines removed. The latter method, like channelization, still involves disturbance to the creek, though today care is taken that the creek retains its natural aesthetics and ecological function (ibid). The eroded banks of the creek were established with grading and re-vegetation, and concrete channel-lining was removed from a small section (City of Austin, 2015c). Two meandering swales were also constructed and vegetated in order to treat runoff (ibid). A publication from the Department on riparian restoration notes that the passive restoration technique should be used when the environmental disturbance is not extreme; thus, in the case of channelized Boggy, active techniques would likely be necessary for restoration (Duncan, 2012).

Figure 13: A portion of Boggy Creek near Rosewood Park that follows the City's restoration effort (Annie Boggs)

Differences in Creek Perspectives

Today, the organization Friends of Boggy Creek focuses on neighborhood involvement through creek cleanups, tree plantings, and neighborhood picnics. A leader of the organization noted the historic differences in perception between the residents that lived in the neighborhood prior to the channelization, and those that moved there more recently. For the former group, the channelization was a "godsend" (J. Wilson, Interview, June 28, 2016). This was echoed by a family who lived through the flooding, who felt that the Army Corps did an excellent job and made the creek safe. Family members expressed that they would rather sacrifice the nostalgia of the natural creek for the safety that the channelized version brings (L. Limon, Interview, June 25, 2016).

Alternatively, everyone to whom I spoke that did not directly experience the flooding, which includes Watershed Protection Department employees and newer residents, viewed the project more critically for its detrimental effects on the ecological and aesthetic qualities of the creek. The previously mentioned restoration project at Rosewood Park, too, elicits different responses depending on who you speak to. While some residents view the "grow zone" — the Watershed Protection Department's effort to stop mowing along streams to allow more riparian vegetation — as beautiful, others view it as messy and dangerous, and fear that it will attract such dangers as transients, the risk of fire, rodents, and ragweed (J. Wilson, Interview, June 28, 2016). Overall, aesthetic preferences concerning nature will have to be considered in any future restoration effort of Boggy, as different people have different levels of comfort for untended nature located alongside the creek.

Chapter 6: Possibilities and Limitations for the Restoration of Boggy Creek

Any future restoration of Boggy Creek holds serious social, political, and economic risks that will not be adequately assessed in this paper. In light of this limitation, this chapter is only the start of a discussion of the future research needs required for a restoration effort, as well as a demonstration of other restoration efforts that Boggy might be able to draw from. Overall, the movement to restore the channelized reaches of Boggy seems far off. There does not seem to be high neighborhood interest in the prospect, and the obstacles from the perspective of the City of Austin in terms of the lack of funding and the existence of other higher priority projects present a timeline for restoration that, if it ever occurs, is many years away.

Today, river restoration is an "increasingly popular management strategy" for improving both the physical and ecological state of streams (Bernhardt & Palmer, 2007, p. 738). Broadly, urban ecological restoration could be defined as the act of repairing human damage in cities, which is where the most intense human impact has occurred. Common strategies, as listed in the introduction of this paper, include riparian replanting, bank stabilization, channel reconfiguration, and daylighting. The movement toward ecological restoration in cities can be understood as a solution to declining biodiversity in urban areas, as well as a solution to the decreased access urban dwellers have to nature (Standish, Hobbs, & Miller, 2012). The Westside Creeks in San Antonio, Texas, and the Los Angeles River in Los Angeles, California, will be discussed in this chapter as examples for restoration. Both water bodies were chosen because, like Boggy, they were channelized and lined with concrete decades ago by the U.S. Army Corps of Engineers. Why and how they were restored will be analyzed so that insight can be provided for future restoration attempts of Boggy Creek.

The Westside Creeks

The Westside Creeks in San Antonio, just south of Austin, include Alazan, Martinez, Apache, and San Pedro Creeks, all tributaries of the San Antonio River that have a similar story to Boggy Creek: portions were channelized for the purpose of flood control by the Army Corps in the 1960s and '70s (U.S. Army & San Antonio River Authority, 2014). Before channelization, the creeks were home to swimming and fishing, and served as a space for the community to come together. A report on the restoration effort states that through public meetings, it was found that the degraded condition of the channelized creeks caused the community to feel both physically and psychologically disconnected from other neighborhoods and amenities, as well as from the creeks themselves (ibid). It notes that although the channelization project successfully managed flood risk, it also had "severe ecological consequences" along the 35 miles of the project, which were not thought of during the time of the project's conception (p. 1).

The San Antonio River Authority asked the Army Corps to reassess the Westside Creeks to study ecosystem restoration and recreation potential. The restoration plan devised by the Army Corps included about 220 acres of native aquatic and riparian vegetation, a 6.5-mile natural channel design, and eight miles of recreational components. Importantly, the recommended plan was required to not increase flood damage to the area (ibid). Goals of the project included both environmental enhancement and flood control enhancement, as well as aquatic and riparian restoration and recreational use (San Antonio River Authority, 2011).

Figure 14: Channelization of Alazan Creek (San Antonio River Authority, 2011)

The neighborhoods surrounding the creek share many similarities to those surrounding the channelized portion of Boggy Creek. When the proposal for the Westside Creeks restoration was presented to the community, residents who experienced the flooding expressed that they were grateful for the flood protection that the channelization offered (U.S. Army & San Antonio River Authority, 2014), which is similar to the feedback offered by some long-time residents of Boggy Creek. Yet, it is important to note that San Antonio residents were still open to and interested in the restoration of the creek. The degraded conditions of the Westside Creeks from straightening the channel and removing riparian vegetation include increased erosion downstream and degraded aquatic and riparian life (ibid), very similar to the degraded conditions of Boggy Creek.

The project was initiated by the San Antonio River Authority in 2008 and was particularly championed by its director, Roberto Rodiguez, who was also a lifelong resident of the community by the creek and experienced the flooding and resulting channelization

(U.S. Army & San Antonio River Authority, 2014). The planning included a lengthy public process and the restoration process received $10.7 million of funding from a city bond (Olivo, 2012). Overall, the restoration received support at the neighborhood, city, and federal level, which contributed to its success. And, there was a still-living memory and nostalgia for the creek as it once was.

The LA River

The Los Angeles River in California is perhaps the most well-known example in restoration of urban waterways. In reaction to severe floods, the LA River was one of the first to be channelized following the 1936 Flood Control Act which gave the Army Corps authorization to execute flood control projects (Riley, 1998). The LA River is a massive project, and for that reason is not as applicable to Boggy Creek as the San Antonio creeks case study. It demonstrates a long-term creek restoration effort — the master plan for the river's revitalization lays out an ambitious 25 to 50-year "blueprint" for executing various improvements to the river, with the aim of transforming a forgotten river into a true urban amenity (City of Los Angeles, 2007, p. 2). Long-term goals include bringing back riparian habitat within the channel and removing concrete walls where possible. The plan also notes the difficulties of restoring the river to a more natural condition while also attaining flood control and maintaining the current state of dense urban development along the creek (ibid).

Similar to the Westside Creeks in San Antonio, the effort required multiple levels of support — the Army Corps, which is involved in restoration studies for a portion of the creek ecosystem, various neighborhood groups and nonprofits, state agencies, and of course the City and County of Los Angeles (City of Los Angeles, 2007). It has had many champions, most recently Mayor Eric Garcetti, who made the restoration effort a focus of

his administration. After pressure from Garcetti and river advocacy groups, the Army Corps approved the most expensive and ambitious of four restoration proposals, costing $1.3 billion to restore 11 miles of the river. This proposal entails tearing down about six miles of concrete, which will be replaced with green terraces and wetlands (Rosner, 2014). The concrete removal will require congressional authorization (ibid), and the restoration start-date is still years away; it is pending congressional appropriations as the city will share the cost with the federal government (Kreitner, 2016). The Army Corps found through their study of the channelized river that it was not able to remove all the concrete due to the flood risk of the river. It also found that buying out the entire floodplain of the area in order to restore the river back to pre-channelized conditions would cost an astronomical, but not all that surprising, $7.6 billion (U.S. Army, 2013).

Figure 15: The channelized LA River (City of Los Angeles)

The restoration of the LA River also brings up risks of ecological gentrification, as discussed in this paper's literature review. The project has been described as more of an example of urban renewal than nature restoration (Rosner, 2014). An article headline in *The Nation* asks pointedly, "Will the Los Angeles River Become a Playground for the Rich?" The article notes that the river's revitalization went from a "social-justice crusade" to a "money-soaked land grab" (Kreitner, 2016). In anticipation of the restoration, real estate speculation has run rampant. Rents have increased significantly and sale prices of riverfront properties have more than doubled in some areas of Los Angeles. One community organizer advocated for prioritizing the money brought in from the redevelopment along the river — estimated to be more than $5 billion — for affordable housing, workforce investment, and other strategies for mitigating the risk of displacement (ibid). It remains to be seen how the City will respond, but it's certain that the public sector will have to directly address this issue as the restoration process continues; all eyes are on the LA River.

Possible Strategies for Restoring Boggy

The U.S. Army Corps report for the Boggy flood control project seems to anticipate a future restoration effort by noting that "While it would be possible to remove the concrete channel to retrieve the channel for natural habitat, in the future, the cost for such action would probably be excessive" and that in doing this, there would be resources that could not be recovered, including the labor of planning, design, and construction for the channel, as well as the capital invested in the project (U.S. Army, 1979). It is true that any future restoration project would undo the flood control effort that the community worked hard to accomplish, as well as the large amount of money both the federal government and local government invested in the project—money invested less than thirty years ago. That being

said, interviews with staff members in the City of Austin revealed a genuine interest in the restoration of the channelized portion of Boggy Creek, yet an acknowledgement that the project would have many hurdles.

Primarily, the Watershed Protection Department has many higher priority problems in terms of creek and local flooding, and investing limited resources in a restoration project might engender a critical response from the public. Even with all of the acknowledged problems in water quality, erosion, and loss of habitat that Boggy has caused, the channel is still doing its job in terms of flood protection. One staff member mentioned optimistically that the almost completed Waller Creek Tunnel was conceived of two decades ago, expressing that big ideas such as the de-channelization of Boggy Creek would take time — and that at least the idea is floating around (Interview, J. Middleton, July 26, 2016).

What would happen if the project were completed today? An engineer stated that a floodway channel could still be constructed, but that it would likely look much more natural (Interview, M. Byars, July 26, 2016). The Department practices natural channel design for its projects and is a proponent of natural stabilization techniques for both flooding and erosion. From an engineering standpoint, the Army Corps requires the City to maintain the channel in its original condition. Any new change, such as wanting to bring out more of the natural character, would require a new operational plan where the City would have to redefine the performance of the project (ibid).

Importantly, the channel would be held to the same standard of flood control no matter what benefits the changes bring. This presents constraints to restoring riparian function, as bringing back natural elements to the creek, such as plants at the creek bottom, would add "roughness," an engineering term which basically represents resistance. Increasing the roughness would slow the water down, causing the water level to rise and affecting the conveyance capacity of the creek, and would have to be compensated by

adding area to one side of the creek or the other (Interview, M. Byars, July 26, 2016). This presents a challenge because many properties are tightly backed up to the bank of the creek, possibly necessitating property buyouts — a costly and political process. In contrast, the Westside Creeks in San Antonio had a much larger channel so there was more space for the restoration of the creek (Interview, M. Scoggins, July 27, 2016). The lack of space is a definite constraint, however by using modeling, Boggy's channel could also be re-evaluated to assess if it is perhaps more wide than it needs to be, and to see how changing different "roughness factors" —for example, changing the creek bottom to plain grass — would affect the capacity of the channel (Interview, J. Middleton, July 26, 2016).

Suggestions for Boggy from those I spoke with included filling it to some degree with natural materials, re-vegetating, and armoring the channel with rock riffles as opposed to concrete, which would give it a more natural look. Overall, the belief of the Watershed Protection Department is that harder solutions like concrete have a shorter life, and they have to be replaced in perpetuity. The Department's philosophy is to let nature do the work, that river systems provide their own stability if you set up the framework for them (Interview, M. Byars, July 26, 2016). Today, resilient nature is found amidst the concrete of Boggy. For a period of time, the channel was not maintained and the creek went through a "recovery" process (Interview, M. Scoggins, July 27, 2016). Wetland plants and other vegetation were found growing in the gabions on the edge of the channel (ibid).

Figure 16: Vegetation growing in a channelized portion of Boggy (Annie Boggs)

Of course, the City should not completely abandon the maintenance of the channel, and regular inspections of the channel have picked back up in recent years. One potential path, however, would be to incrementally naturalize the channel as maintenance is needed, to slowly stop fighting nature by not clearing out vegetation and even actively planting in the channel. However, this method of "re-naturalization", though it seems to take the path of least resistance, would likely not be supported by the Army Corps. City staff members noted that the agency views any naturalization of the channel as threatening to the flood control purpose of their project. Though the Corps has the ability to disavow itself from the project, which would certainly give the City more flexibility, the agency would likely be a helpful partner in any future restoration effort. As shown with both the Westside

Creeks and the LA River examples, the agency provided funding and research support as official partners in the restoration efforts.

Overall, there are possibilities that exist between this incremental approach and a full-fledged, multi-million-dollar restoration effort. I envision, above all, a community-driven restoration effort for Boggy Creek. The restoration would be most similar to that of the Westside Creeks in San Antonio, where the creek restoration provided a natural and recreational amenity for neighborhoods along the creek. Admittedly, the potential for restoration has not been thoroughly vetted in this paper in terms of what local neighborhoods envision for the future of Boggy Creek, which is arguably the most significant component of the restoration. Yet, already positive signs exist; the restoration of Poquito Creek, a small tributary of Boggy, was recently led by a community group called Creek People (Interview, J. Stewart, June 13, 2016). Funded by a grant, these efforts created a pocket park in the neighborhood by the creek. The recently completed Southern Walnut Creek Trail passes alongside a portion of the channelized creek, opening up more Austin residents to the prospect of discovering the creek and getting involved in its vision for the future.

This brings up the possibility of Boggy acting as a connector through East Austin. The existing Walnut Creek trail and Boggy Creek Greenbelt could be expanded in the future into a system of trails and greenbelts along Boggy. This could be a driver for interest in Boggy Creek moving forward, which actually builds on the original plan for the creek's channelization. The intent of the project was to have a hike-and-bike trail alongside the channel, which the Army Corps described as a "channel corridor" that "will help to provide an extensive area for active and passive recreational activities for use by the urban population of the area" (U.S. Army, 1979, p. 8), though this idea was largely eliminated

Figure 17: Southern Walnut Creek Trail (Annie Boggs)

from the plan. The channelized portion of Boggy has been largely devoid of trails for most of its history. Increasing access to the channelized creek would be one way to increase what landscape architect Michael Hough called "visibility," in order to increase environmental consciousness of water resources, drainage, and the history of what occurred at Boggy Creek. Currently, the creek does not look or act like an amenity, and functions only as a place to get rid of water. Thus, it may take a perspective shift, or a long period of time, to envision what Boggy could be.

Overall, this chapter presents only very preliminary ideas for Boggy. Due to the limitations in my research methods, which primarily focused on the history of creek channelization, any future restoration effort is purely speculative. Nonetheless, I believe it is still productive to wonder *what could be* for the creek. An extensive and expensive restoration approach, an intentional "re-naturalization" of the creek, and providing access to the creek through expanding existing trails and greenbelts are all potential beginnings to that conversation. Overall, Austin is a very different place than 30 years ago when the channelization of the creek occurred. The community around Boggy Creek in coming years

may envision another future for Boggy Creek. In that case, I hope this paper will be a productive start to that conversation.

Chapter 7: Conclusion

The historical analysis of the channelization of Boggy Creek presents a clear picture of a flooded community four decades ago that was desperate for solutions. The story is an intersection of federal flood control policy, the local environmental conditions of Austin, and the environmental and social history of Austin. Literature on ecology, particularly the growing field of urban ecology, helped to illuminate issues implicit in the story of Boggy Creek.

It is tempting to simplify the history of Boggy Creek and say that this severe type of channelization was only able to occur on the East side of Austin due to the demographics of the community, due to the lack of power that poor people of color held in Austin — a dynamic that continues to persist today. But I believe that conclusion diminishes the voice of the residents, who pushed hard for many years for a solution to near-constant flooding in their community. It diminishes the power of community residents who united together during floods, traveling in rowboats through the neighborhood to ensure their neighbors were safe, doing so with little resources. To me, the channelization is also representative of the resilience of East Austin neighborhoods, which created vibrant communities in the face of seemingly unending discrimination and displacement.

Yet, from an environmental standpoint, Boggy is degraded in many aspects: water quality, erosion, and riparian and aquatic habitat, among others. It is not a pleasant stream to look at, and almost everyone I spoke with regarding the topic of this paper had also entertained thoughts of restoring the creek to a more natural state. This was also a viewpoint espoused by those that were not present during the floods of the 1960s and ‘70s, when the flow of the creek was something to be feared. I wish to be sensitive to that history; still, the restoration of the Westside Creeks in San Antonio demonstrates that residents can both

view channelization as protective for their communities (and want the same level of flood protection to continue) while also being open to restoring the creek to its natural function. Any restoration of the channelized reaches of Boggy Creek is a long way away, but I hope this paper has succeeded in clearly laying out the history of the creek and providing a basis for restoration in the future.

Bibliography

Adger, N.W. (2000). Social and ecological resilience: are they related? *Progress in Human Geography*. *24*(3), 347-364.

Alberti, et al. (2003). Integrating Humans into Ecology: Opportunities and Challenges for Studying Urban Ecosystems. *BioScience*. *53*(12), 1169-1179.

Alderson, L.E., & McCormick, O.F. (1983). *Archaeological Investigations at Site 41 TV 383, Lower Boggy Creek, Colorado River Drainage, Travis County, Texas*. Fort Worth, Texas: Coastal Ecosystems Management, Inc.

Austin American Statesman (1976: Jan. 19). Boggy Creek due flood project aid.

Austin American Statesman (1975: July 17). Boggy Creek flood study on horizon.

Austin American Statesman (1993: July 15). Editorial: Environment exists east of Interstate 35.

Austin Daily Statesman (1886: Sep. 14). Heroic Conduct.

Austin Statesman (1935: June 1). 15 Saved From Flood Here: Boggy Creek Floods City Lowlands.

Austin Statesman (1947: June 8). New Drainage Ditch Okehed.

Austin Statesman (1960: Oct. 29). City Property Losses Put at $2.5 Million.

Austin Statesman (1961: June 16). Boggy Creek Cleanup Asked.

Black, S. et al. (1976). Austin Creeks. Best Printing Co. Retrieved from: https://brykerwoodsaustin.files.wordpress.com/2013/09/austincreeks.pdf

Banta, B. (1993: July 11). Eroding Confidence: East Austin residents are skeptical of the city's promises to fix problems along Boggy Creek. *The Austin American-Statesman*.

Bernhardt, E.S. & Palmer, M.A. (2007). Restoring streams in an urbanizing world. *Freshwater Biology*. *52*, 738-751.

Boone et al. (2009). Parks and People: An Environmental Justice Inquiry in Baltimore, Maryland. Annals of the Association of American Geographers. *99*(4), 767-787.

Breaux, Brenda J. (1991: April 27). Out of the fishbowl: Boggy Creek flood-control project is done. *The Austin American-Statesman*.

Busch, A. (2013). Building "A City of Upper-Middle-Class Citizens": Labor Markets, Segregation, and Growth in Austin, Texas, 1950-1973. *Journal of Urban History. 39(5) 975-996*. Retrieved from: http://juh.sagepub.com.ezproxy.lib.utexas.edu/content/39/5/975.full.pdf+html

Byrne, J. (1987). Policy science and the administrative state: the political economy of cost benefit analysis. *Confronting Values in Policy Analysis: The Politics of Criteria*.

Calder, I. (1999). *Blue Revolution: Integrated Land and Water Resources Management*. London: Earthscan.

Carter & Burgess, Inc., (1994: Aug. 15). Fort Branch Watershed Water Quality Retrofit Master Plan. Retrieved from: http://www.austintexas.gov/watershed_protection/publications/document.cfm?id=206593

Carter, C. (2005). Environmental Case Study: A Suburban Creek Resists Channelization. The McGraw-Hill Companies. Retrieved from http://www.mhhe.com/Enviro-Sci/CaseStudyLibrary/Regional/Southeast/CaseStudy_ASuburbanCreekResists.pdf

Castlebury, G. (1966: Sep. 18). "Boggy Creek: City Council Will Consider Project to Tame it. *The Austin American-Statesman*.

City of Austin (n.d.). Watershed Protection Department FAQ. Retrieved from: http://www.austintexas.gov/department/watershed-protection/faq

City of Austin. (1961: March 16). Minutes of the City Council. Regular meeting.

City of Austin. (1961: Aug. 10). Minutes of the City Council. Regular meeting.

City of Austin. (1968: March 28). Minutes of the City Council. Regular meeting.

City of Austin (1976: Jan. 29). Minutes of the City Council. Regular meeting.

City of Austin. (1979: August 23). Minutes of the City Council. Special Called Council Meeting.

City of Austin (2001). Watershed Protection Master Plan.

City of Austin. (2003). *Govalle/Johnston Terrace Combined Neighborhood Plan*. Retrieved from: ftp://ftp.ci.austin.tx.us/npzd/Austingo/gjt-np.pdf

City of Austin (2005: Sep. 29). Recommendation for Council Action. Retrieved from http://www.austintexas.gov/edims/document.cfm?id=77895

City of Austin (2011). Floodplain Study: Boggy Creek. Retrieved from: https://austintexas.gov/sites/default/files/files/Watershed/flood/fl_study_boggy.pdf

City of Austin (2012: Aug. 23). CIP Expense Detail. Boggy Creek Greenbelt Reach B8.

City of Austin (2013a). An Index of Riparian Integrity for the Austin area. Retrieved from http://www.austintexas.gov/watershed_protection/publications/document.cfm?id=206342

City of Austin (2013b). Boggy Creek Watershed Summary Sheet. Retrieved from http://www.austintexas.gov/sites/default/files/files/Watershed/eii/BoggyNorth_EII_ph1_2013.pdf

City of Austin (May 2014). Resolution No. 20140515-064. Retrieved from http://www.austintexas.gov/edims/document.cfm?id=254396

City of Austin. (June 2014). Guide to Zoning. Retrieved from https://www.austintexas.gov/sites/default/files/files/Planning/zoning_guide.pdf

City of Austin (2015a). Watershed Protection Master Plan. Retrieved from: http://www.austintexas.gov/watershed_protection/publications/document.cfm?id=240265

City of Austin (2015b). Watershed Protection City Profile. Retrieved from: http://www.austintexas.gov/sites/default/files/files/Watershed/Citywide_Profile.pdf

City of Austin (2015c). Boggy Creek Reach B8 Restoration at Rosewood Park. Retrieved from: http://www.austintexas.gov//sites/default/files/files/Watershed/projects/project-summary/Website_Summary_Boggy_Creek_Restoration_At_Rosewood_Park.pdf

City of Austin (2016). Capital Improvements Program Five Year Plan. Retrieved from https://assets.austintexas.gov/budget/16-17/downloads/fy_17_5_year_cip_plan_final.pdf

City of Los Angeles (2007). Los Angeles River Revitalization Master Plan.

Cox, M. (1975: May 4). Floodproofing: Safer Future Seen for City. *Austin American Statesman*.

Cronon, W. (1995). The Trouble with Wilderness; or, Getting Back to the Wrong Nature. In W. Cronon (Ed.), *Uncommon Ground: Rethinking the Human Place in Nature*. p. 69-90. New York: W.W. Norton & Company, Inc.

Daniels, T.L. (2009). A Trail Across Time: American Environmental Planning from City Beautiful to Sustainability. *Journal of the American Planning Association*. *75*:2, 178-192.

Department of the Army. Forth Worth District. Corps of Engineers (1979: June 18). "Public Meeting Announcement."

Department of the Army. Forth Worth District. Corps of Engineers (1979: Oct. 29). "Notice of Study Conclusions and Plan Selection."

Dooling, S. (2009). Ecological Gentrification: A Research Agenda Exploring Justice in the City. *International Journal of Urban and Regional Research*. *33*(3), 621-639.

Duncan, A. (2012). *A Functional Approach to Riparian Restoration in Austin, Texas*. City of Austin Watershed Protection Department. Retrieved from: http://www.austintexas.gov/watershed_protection/publications/document.cfm?id=196455

Everard, M. & Moggridge, H.L. (2011). Rediscovering the value of urban rivers. *Urban Ecosystems*. *15*(2), 293-314.

Gamino, D. (1991: April 29). Flood-control channel for Govalle dedicated. *The Austin American-Statesman*.

Gregor, K. (2010: Feb. 5). Austin Comp Planning: A Brief History. *The Austin Chronicle*.

Grimm, N.B., et al. (2008). Global Change and the Ecology of Cities. *Science*. *319*, 756-760.

Governing (2016). Austin Gentrification Map: 2000 Census – Present. Retrieved from http://www.governing.com/gov-data/austin-gentrification-maps-demographic-data.html

Haworth, K. (1975: Nov. 24) Boggy Creek hearing 1st step to flood control. *The Austin-American Statesman*.

Haworth, K. (1975: Nov. 26). Boggy Creek hearing draws crowd: Over 600 E. Austinites voice flooding woes. *The Austin American Statesman*.

Hill, S. (2011). The Empty Stairs: The Lost History of East Austin. "Intersections: New Perspectives on Texas Public History."

Hough, M. (1995). *Cities and Natural Process*. London and New York: Routledge.

Houston, F.C. (1994: June 21). Memorandum to Bill Stockton.

Isom H. Hale & Associates. (1966). Capitol City East General Neighborhood Renewal Plan.

Kaika, Maria. (2004). Interrogating the Geographies of the Familiar: Domesticating Nature and Constructing the Autonomy of the Modern Home. *International Journal of Urban and Regional Research*. *28*(2), 265-286.

Karvonen, A. (2011). *Politics of Urban Runoff: Nature, Technology, and the Sustainable City*. Boston, MA: MIT Press.

Kreitner, R. (2016). Will the Los Angeles River Become a Playground for the Rich? *The Nation*. Retrieved here https://www.thenation.com/article/will-the-los-angeles-river-become-a-playground-for-the-rich/

Leete, N.S. (2013). The influence of hydropological and riparian factors on stream channel stability in a central Iowa stream. Iowa State University.

Long, J. (2014). Constructing the narrative of the sustainability fix: Sustainability, social justice and representation in Austin, TX. *Urban Studies Journal*. *1*(24).

Loomis & Moore, Inc. (1998: June 8). Integrated Solutions Development: Capital Solutions Interim Report Volume I. Retrieved from http://www.austintexas.gov/watershed_protection/publications/document.cfm?id=186143

Lower Colorado River Authority (2016). Managing floods in Flash Flood Alley. Retrieved from LCRA website: http://www.lcra.org/water/floods/pages/default.aspx

McHarg, I.L. (1969). *Design with Nature*. Garden City, NY: Doubleday & Company, Inc.

Moore, S.A. & Wilson, B.B. (2014). *Questioning Architectural Judgment: The Problem of Codes in the United States*. New York: Routledge.

New York Times. (2002: Aug. 19) Taming the Untouchable Corps. Retrieved from http://www.nytimes.com/2002/08/19/opinion/taming-the-untouchable-corps.html

Olivo, Benjamin. (2012: June 8). Attention, and funding, starting to flow San Pedro Creek's way. *San Antonio-Express News*. Retrieved from: http://www.mysanantonio.com/news/local_news/article/Attention-and-funding-starting-to-flow-San-3620555.php

Pickle, J.J. (1979: Nov. 14). Letter to Peter O. Coltman.

PODER: People Organized in the Defense of Earth and her Resources (n.d.). Victories/Accomplishments. Retrieved from http://www.poder-texas.org/victories.html

Quarles, D.L. (1995: May 17) Letter to Franklin C. Houston.

Riley, A.L. (1998). *Restoring Streams in Cities: A Guide for Planners, Policymakers, and Citizens*. Washington, D.C.: Island Press.

Rivera, G.C., & Rivera, J.H. (2012). *Austin's Rosewood Neighborhood*. Charleston, SC: Arcadia Publishing.

Rosner, H. (2014: July 18). Los Angeles River: From Concrete Ditch to Urban Oasis. *National Geographic*. Retrieved from: http://news.nationalgeographic.com/news/2014/07/140719-los-angeles-river-restoration-kayaking-greenway/

San Antonio River Authority (2011). Westside Creeks Restoration Project Conceptual Plan. Retrieved here http://www.westsidecreeks.com/wp-content/uploads/2014/09/WSC_Concept_Plan_-_Report-sm1.pdf

Schweitzer, L. & Stephenson, JR. (2007). Right Answers, Wrong Questions: Environmental Justice as Urban Research. *Urban Studies*. *44*(2), 319-337.

Smith, Judy. (1968: Oct. 14). Urban Renewal: The Home You Save May Be Your Own. *The Rag*. Retrieved from
http://demo.revealdigital.com/cgi-bin/independentvoices?a=d&d=BFIGCEE19681014.1.3&e=-------en-20--1--txt-txIN----------1#

Spirn, A.W. (1985). *The Granite Garden: Urban Nature and Human Design*. New York: Basic Books, Inc., Publishers.

Spirn, A.W. (1995). Constructing Nature: The Legacy of Frederick Law Olmsted. In W. Cronon (Ed.), *Uncommon Ground: Rethinking the Human Place in Nature*. p. 98-113. New York: W.W. Norton & Company, Inc.

Standish, R.L., Hobbs, R.J., & Miller, J.R. (2012). Improving city life: options for ecological restoration in urban landscapes and how these might influence interactions between people and nature. *Landscape Ecology*. *28*, 1213-1221.

Steiner, F. (2004). Urban human ecology. *Urban Ecosystems*. *7*, 179-197.

Tang, E. & Ren, C. (2014). Outlier: The Case of Austin's Declining African-American Population. The Institute for Urban Policy Research & Analysis at the University of Texas at Austin. Retrieved from http://liberalarts.utexas.edu/iupra/_files/pdf/Austin%20AA%20pop%20policy%20brief_FINAL.pdf

Tarlock, D. (2012). United States Flood Control Policy: The Incomplete Transition from the Illusion of Total Protection to Risk Management. *Duke Environmental Law & Policy Forum*. *23*:151, 151-183. Retrieved from http://scholarship.kentlaw.iit.edu/cgi/viewcontent.cgi?article=1772&context=fac_schol

Tretter, E.M. & Adams, M. (2012). The Privilege of Staying Dry: The Impact of Flooding and Racism on the Emergency of the "Mexican" Ghetto in Austin's Low-Eastside, 1880-1935. In S. Dooling & Simon, G (Ed.) *Cities, Nature, and Development: The Politics and Production of Urban Vulnerabilities*. p. 187-205. Burlington, VT: Ashgate Publishing Company.

Urban Renewal Agency (1966). *Austin, Texas Glen Oaks TEX R-70 Final Project Report: Part I of Application for Loan and Grant.*

U.S. Army Engineer District. (1980). Draft Environmental Impact Statement.

U.S. Army Engineer District. (June 1979). Boggy Creek Interim Report. Appendices.

U.S. Army Corps of Engineers. (1989). Boggy Creek North Hydrology.

U.S. Army Corps of Engineers. (1991). Shoal Creek Interim Report and Environmental Assessment.

U.S. Army & San Antonio River Authority. (2014). San Antonio Channel Improvement Project, General Re-evaluation Report and Environmental Assessment. Retrieved

here http://www.westsidecreeks.com/wp-content/uploads/2014/09/Final-Report.pdf

Walsh, C.J., Roy, A.H., Feminella, J.W., Cottingham, P.D., Groffman, P.M., & Morgan, R.P. (2005). The urban stream syndrome: current knowledge and the search for a cure. *The North American Benthological Society, 24*(3), 706-723. Retrieved from ftp://ftp.ci.austin.tx.us/WPDRHHM/Waller_Design_Competition/Ecology_and_Infrastructure/Restoration_riparianzones/walsh%20et%20al_urban%20stream%20syndrome_2005.pdf

Wescoat, J.L. & White, G.F. (2003). Water for Life: Water Management and Environmental Policy. Cambridge, UK: Cambridge University Press.

Wohl, E. (2004). *Disconnected Rivers: Linking Rivers to Landscapes*. New Haven, CT: Yale University Press.

Wright, Scott W. (1993: March 25). Residents want site closed, Garbage truck facility unwanted in East Austin, opponents say. *The Austin American Statesman*.

Yang, B., Li, M., & Li, S. (2013). Design-with-Nature for Multifunctional Landscapes: Environmental Benefits and Social Barriers in Community Development. *International Journal of Environmental Research and Public Health*. *10*(11), 5433-5458.