# **DEEP SURFACE:** engaging the *terra viscus*

**A Thesis Presented for the**
**Master of Architecture**
**Degree**
**The University of Tennessee, Knoxville**

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# DEDICATION

To my loving mother, Dorothy Lynn Gann, I dedicate this to you.

## ACKNOWLEDGEMENTS

To my friends and family who have been so supportive over the past seven years, thank you! This project/document would not have been possible without the patience of each of you, the long therapeutic phone calls and of course, your unending belief in my abilities kept me going through the tough times. To my boyfriend, Desmond Lovern, you are my rock, my love, and my future. Without you, I don't know how I would have done it. You constantly challenge me and support me in anything I feel compelled to do. You keep me updated on the news when I forget that there is a world outside of the computer lab. To my Mom, your unending love for me has kept me going throughout hard times when I doubted myself, you stood by and showed me that this world is nothing without a little hard work and it takes effort and struggle to make us stronger. To my father, a true role model, you taught me that anything is possible if you put your whole heart and mind into it. Thank you for teaching me to work hard and never give up. To my professor, who I admire greatly, you have taught me more than I could have ever expected about life, passion and the potential of design. You continue to inspire me every day and I hope that I can make you proud. To my peers, THANK YOU for the countless hours of mentorship, coffee breaks, for waking me up when I had to sleep in the building, for late night design sessions, and for inspiring me with your hard work and dedication. Thank you to everyone who stood by me believed in me and helped see the potential in myself over the past few years.

# ABSTRACT

Two hundred and forty-six acres along the eastern edge of downtown Memphis are labeled as “Shaded Zone X” on FEMA flood insurance maps. This is an area “protected by the levees” but subject to flood during large storm events. Unprepared for the potential flood, the people within this area feel safe behind the static levee wall. If storms worsen as predicted and settlement continues to sprawl increasing impervious surfaces of the Mississippi River Basin, the area within Shaded Zone X and the people who occupy it will be in danger.

Historically, storm water In Zone X drained into the Gayoso Bayou, an open-air bayou that snaked through the city and defined its eastern edge. Over the past century, the Bayou has been steadily disappearing from sight, being hidden beneath the concrete *terra firma*. The Bayou represents a temporal ecological landscape that no longer exists within the city of Memphis. Through examination of the DEEP SURFACE – a combination of historical, cultural and ecological layers that comprise the urban landscape, a new paradigm can be established that balances the cultural needs of the landscape with the ecological. This thesis imagines the potential of excavating this area within the urban landscape to transform the *terra firma* -- an unresponsive static surface -- into a *terra viscus* – a semi-liquid landscape that engages with the ebb and flow of seasonal fluctuation. As a development strategy, the project combines seasonally responsive architecture and landscape that embraces the ephemeral qualities of water. The designed infrastructures hybridize infrastructures of the past century with more responsive soft systems to better respond to the dynamic nature of the ever-changing environment and become a more resilient system for urban life.

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**DEEP SURFACE**.engagingtheterraviscus.DESIGN.pdf see attached

## CHAPTER I | INTRODUCTION

Geologists have termed the current geologic time period – the Anthropocene Epoch[1] – which describes the era in which the inhabitation of humans has altered over three-quarters of the earth's ice-free land. For two centuries human inhabitation has become increasingly more stressful to the earth's ecosystems, limiting biodiversity, causing health problems in humans and animals, and decreasing the amount of stable habitat. From the clearing of forests for sprawling development to the binding of waterways through dams, levees, and culverts, the landscape has been altered for human benefit. Impacts of the heavy footprint of human civilization have wreaked havoc on the environment yet we continue to build in ways that we know are detrimental and will eventually fail. Thirty-foot tall static poured-in-place concrete levee walls do not respond to the dynamism inherent in the adjacent water systems; they merely disconnect the inhabitants and habitat from the waterway and create a false sense of comfort to those of whom lie behind its "protection." This thesis posits that the environmental control infrastructures should be re-imagined as a holistic system of responsive micro-infrastructure network that responds to and engages the fluctuation and dynamism of the natural system. As Albert Einstein said, "the measure of intelligence is the ability to change." In order to create more intelligent infrastructures, the design must respond to how the natural system fluctuates.

Considering the ever-increasing dynamism of natural systems and their potential effect on highly populated regions DEEP SURFACE, seeks to examine the role of hybridized urban infrastructures in a "viscous" landscape, referred to Michael and Ursula McClure as the "terra viscus" in their book *TERRA VISCUS: Hybrid Tectonic Nature*[2]. The terra viscus is the state between the solidity of the terra firma and the fluidity of the terra fluxus.[3] In Corner's article, he describes the terra firma as "firm, not changing; fixed or definite" while the terra fluxus is used to describe more fluid processes of change, rapidly adapting systems. The terra viscus lies between these two descriptions and will be used to describe the space that lies on the threshold of the stable urban ground and that of the dynamic hydrological system that moves through and around it. Referring to the viscous nature of the landscape, this term will serve as a descriptor for land that is neither stable nor completely fluid, which presents an interesting conundrum when creating infrastructures in this area. Army Corps of Engineers, over the past century, has made hard designations between the dynamic nature of the water and seemingly static landscape of city. In the Mississippi River especially, the infrastructures have been built to define an edge, a place of separation from the *terra fluxus* and the *terra firma*. DEEP SURFACE examines the role of hybridized built form consisting of infrastructure, architecture and landscape to engage this new category of landscape to develop a more symbiotic relationship between the anthropogenic and natural systems. Since before the industrial revolution, the balance between these systems has been shifting, heavily favoring the anthropogenic. The immediate

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[1] **Crutzen, Paul J. The Anthropocene. Earth System Science in the Anthropocene. Springer Berlin Heidelberg. 2006. 13-18**
**2 McClure, Ursula Emery., and Michael A. McClure. Terra Viscus, Hybrid Tectonic Nature. Lafayette, LA: Emerymcclure Architecture, 2006. Print**
**3 Corner, J. "Terra Fluxus," Landscape Urbanism Reader. Princeton Architectural Press 2006.**

need and desire of humankind preceded any thought for habitat depletion or environmental impact. There is an opportunity now to rethink urban infrastructures to become more sensitive.

James Corner, when discussing infrastructure, claimed "urban infrastructure sows the seeds of future possibility, staging the ground for both uncertainty and promise."[4] This description shows a new way of thinking about urban infrastructure as a catalyst for positive change instead of merely a single solution to a single issue. These "seeds of future possibility" relate to discussion topic on "soft systems" that has begun in response to the failure and decay of the mono-functional infrastructures of the past century. "Soft" is a term used to describe the responsive, indeterminate, flexible and immaterial systems of infrastructural. Neeraj Bhatia in his article "Goes Soft," describes a new type of infrastructure that "acknowledge(es) fluid and indeterminate situations with complex feedback loops that allow for reaction and adaptation." [5] Along the Mississippi River, the testing ground for this investigation, large cities rarely engage with the fluctuation of the Mississippi River, except for in crises of flood as large earthen mounds called levees separate them. In order to decrease the damage of this potentially catastrophic event if the levees were to fail, the ground of the city will need to be prepared. A new "soft" landscape can be designed to respond to the influx of water from flooding but in an incremental way such that it enhances the quality of life of the people and wildlife residing in the city that seek to travel through the city. Over time, a new resilient landscape can grow from the "seeds of future possibility" that were described earlier.

DEEP SURFACE reaches beyond surface-focused planning by integrating a study of the sectional historic layers of ecology. In doing so, one can understand better how our cities' landscapes formed and functioned before settlement began to sprawl, paving over the habitat that once existed within its bounds. Many cities have subdued their natural systems to make it easier and more efficient to move through it. Through examination of flood plains, watersheds, and topography, it can be seen that many cities have hidden layers of hydrology that have been suppressed. Many designers across the globe are exploring the option of daylighting the hidden creek systems as they can contribute greatly to the quality of life, the carbon footprint and the health of the biota that may need this area to survive. DEEP SURFACE seeks to create multi-layered highly integrated systems of infrastructures, both hard and soft, to create a place for wildlife, humans and plants to thrive.

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**[4] Corner, J. "Terra Fluxus," Landscape Urbanism Reader. Princeton Architectural Press 2006.**
**5 Bhatia, Neeraj, and Lola Sheppard. Goes Soft: Bracket 2. Barcelona: Actar, 2012. Print. (p. 8)**

## CHAPTER II | SYSTEMS OF CONTROL

*Infrastructure* is defined by Merriam-Webster dictionary as the underlying foundation or basic framework of a system, particularly described as a system of public works of a country, state or region. Since its introduction into the French language in 1875, Infrastructure has taken on different connotations as the years have progressed. Originating as a term used to describe the "installations that form the basis for any operation or system"[6] in a military sense, infrastructure has most recently been used to describe the basic equipment (such as roads and bridges) that are needed for a country, region, or organization to function properly.

### Grey vs. Green Infrastructure

An emerging type of infrastructure has come into common use in design and described as "green infrastructure". In contrast to the hard engineering (often referred to as "grey infrastructure") of the 20th century, green infrastructure offers a new way of conceiving the systems of the city, introducing flexibility and adaptability. According to Benedict and McMahon, green infrastructure is a "strategically planned and managed network of natural lands, working landscapes, and other open spaces that conserves ecosystem values and functions and provides associated benefits to human populations."[7] Green Infrastructure can provide benefits that grey infrastructure cannot including: carbon reduction, air pollution reduction, water purification, storm water management, social spaces, and energy resources. David Rouse, author of *Green Infrastructure: A Landscape Approach*, states that green infrastructure is about bringing together "natural and built environments" and using the "landscape as infrastructure." [8] He says the benefits of green infrastructure can be described with the following terms: "multi-functionality, connectivity, habitability, resiliency" along with "return on investment." While grey infrastructures serve one function very well, the green infrastructures serve multiple functions and can enhance the quality of life of the people who interact with it. For instance, Central Park integrates storm water management, recreation and multiple types of transportation infrastructure all together. Each of the infrastructures works together to enhance the quality of life of its visitors. Contrasting heavily to its adjacent context, Central Park serves as an example of green infrastructure hybridized with grey infrastructure to produce a balanced system. Over the past century, grey infrastructure has been utilized to combat the dynamism of natural systems, designed for a prediction of capacity that is reaching its limit. Failing infrastructures and stressed systems are common in the United States presently and cities now face an opportunity to transform the ways of thinking about infrastructure as a single solution. Hybridized systems offer new value to the city and the people that live within its bounds.

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6 Harper, Douglas. Online Etymology Dictionary. http://www.etymonline.com/index.php?term=infrastructure Accessed February 14, 2014.
7 http://www.conservationfund.org/our-conservation-strategy/focus-areas/green-infrastructure/#sthash.FsvBYuSu.dpuf
8 Rouse, David. Green Infrastructure: A Landscape Approach. http://www.conservationfund.org/our-conservation-strategy/focus-areas/green-infrastructure/#sthash.FsvBYuSu.dpuf

## Levee System

*"Rivers are the birthplace of civilization and civilization the graveyard for rivers."* [9]

Human settlement has always followed waterways, seeking to occupy the water's edge. When settlement sought to become more permanent, it demanded that the natural elements around it become more static as well. Thus, the city had to separate itself from the dynamic nature of the water bodies that flowed around, through and under it. Rivers, creeks and bayous were incrementally rerouted, encapsulated, hidden underground or barricaded with large concrete walls occasionally crafted in large green mounds.

In Figure 1.0, it shows the levee system on the Lower Mississippi Alluvial Valley. In this depiction, one can see that a majority of the Mississippi Valley is lined with one or more layers of levee systems. The levees constrain the water, reducing the flood plain but create issues such as banks scouring and habitat depletion. The space for the water to move is decreased as the cities along its edge confine the water, lending it to increased speeds, which damage the riparian edges.

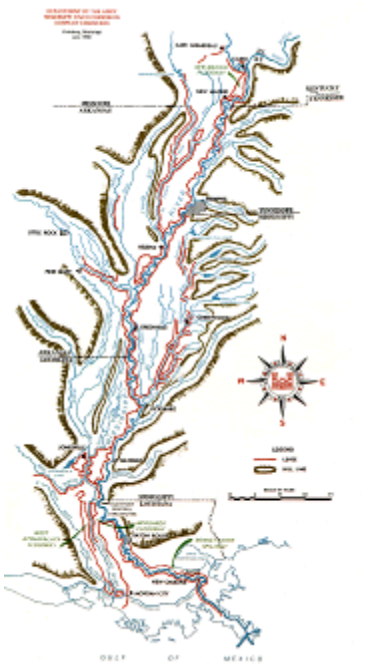


**Figure 1: Levees of the Lower Mississippi River Valley**

[9] **Da Cunha, Dilip. Common saying in India, In the Terrain of Water Conference. http://vimeo.com/27182038#at=0**

In the late 1800s, there were a series of private levees that controlled to river and protected farmland. After the Great Flood of 1927, Congress passed the Flood Control Act in 1928, directing the Corps of Engineers to strengthen and build more of the control structures.

## Ecological Impact

In Figure 2, there is a comparison of two treatments of the waterway. On the left the Fisk map depicts the ever-changing nature of the Mississippi River before the water was altered to serve humankind. The river's edge was a gradient not an edge. The boundary was fluid and the water interacted with the people and fauna that inhabited the adjacent land. With rapid colonization during the last century, it became necessary to control the river, allowing for people to safely live on the land without risk of flood. In the 1800s, a series of dams and levees were built to keep the water out and the cities protected. Without the ability to truly forecast the ecological impacts that would have in future years. Now, with new knowledge of the implications, studies are being done on new modes of interaction with the fluctuating nature of the river. The floodplain, which is important to the survival of the fauna that navigate the river, has nearly disappeared, decreasing areas for pause, procreation and habitat creation.

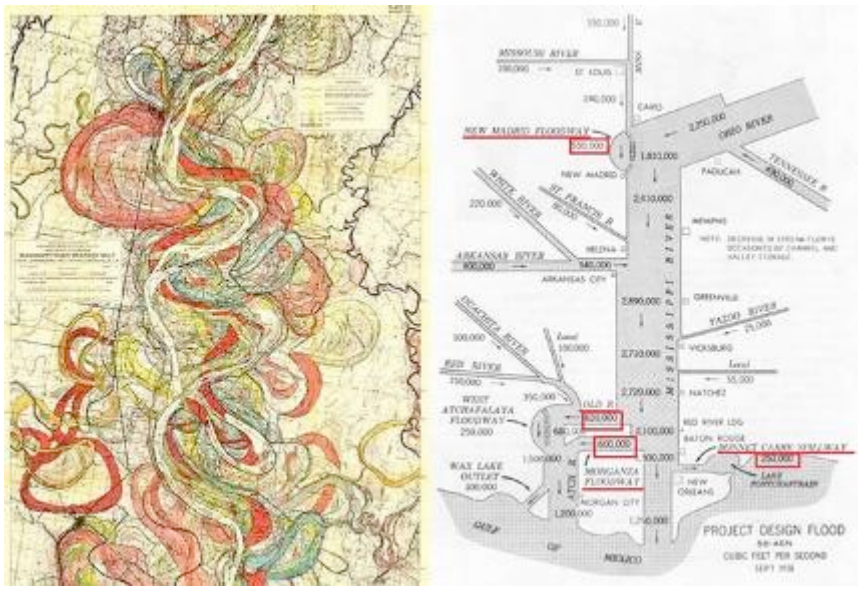



**Figure 2: Two views of the Mississippi River Valley**

Left: the meandering paths of the Mississippi River over time, as published in "Geological Investigation of the Alluvial Valley of the Lower Mississippi River." (Fisk 1944.) Right: The Army Corps of Engineers' view of the Mississippi River peak flow rates during a maximum 500-year flood as described in "Project Flood" (U.S. Army Corp of Engineers, 1958.)

## Soft Systems

As described by Neeraj Bhatia and Lola Sheppard in Bracket: *Goes Soft*, soft systems refer to "a counterpoint to permanent static and hard systems that are no longer viewed as suitable to address contemporary urban complexities and their continual transformations." In this thesis, "soft" will be used as an adjective to describe a responsiveness, malleability, temporality and multi-valiancy of systems of response.[10] "Soft" systems are particularly applicable to the Mississippi river due to its dynamic fluctuation and temporal reassertion of its presence within the culture of the cities that rest alongside of its banks. The relationship with the water drastically changes with the seasonal fluctuation and the climate extremes of weather patterns. Another use of "soft" within the article "Going Soft", references the use of the term to describe systems to "enable individualism, responsiveness, nomadism and anarchy."[11]

In analysis of the cities that populate the edge of the Mighty Mississippi, I noted seasonal shifts in programming, especially of certain areas of public space. The public space, in many cases, especially in Memphis, is seasonally accessible. For five months out of the year, the public River Park is closed to visitors. The only interaction with the dynamism of the fluctuation is through a series of pathways that deliver similar vantage of the shifting horizon. By utilizing a "soft" approach as opposed to the hard systems of levees and dikes, there are opportunities to engage in the potential programmatic shifts of the city.

## Landscape as Infrastructure

Pierre Belanger in his 2009 article "Landscape as Infrastructure,"[12] references the ASCA 2008 article on Infrastructure[13] that states post-war infrastructures – airports, harbors, roads, sewers, bridges, dikes, dams, power corridors, terminals, treatment plants- are now suffering from "major decay from lack of repair and maintenance." In the essay, he "redefines the conventional meaning of modern infrastructure by amplifying the biophysical landscape that has historically suppressed, and to reformulate landscape as a sophisticated, instrumental system of essential resources, services, and agents that generate and support urban economies." Infrastructure and landscape are inherently both systems that respond to a series of inputs and outputs. Through the envisioning of a new infrastructure with landscape as the basis, a realization of the ecological foundation of a city can be discovered and celebrated. The topography, the hydrology, the wind patterns and other climatological concerns can be integrated into the study of the city to make the overall planning strategy more comprehensive and sensitive to the delicate ecosystems that lie beneath the suppressed surface. [See Appendix | Climate for more information on the Memphis climate] Historically, ecology has not been a

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**10 Bhatia, Neeraj, and Lola Sheppard. Goes Soft: Bracket 2. Barcelona: Actar, 2012. Print. 8.**
**11 Ibid. p. 8.**
**12 Belanger, Pierre. Landscape as Infrastructure. Landscape Journal. 2009 12:79-95.**
**13 Infrastructure Canada "2007–2008. Report on plans & priorities. http://www.tbs-sct.gc.ca/rpp/0708/infc-infc/infc-infc-eng.pdf (accessed September 29, 2013).**

driver of discussion in planning circles though with recent movements including Landscape Urbanism and Ecological Urbanism, ecology is becoming a larger part of the conversation. With an estimation of nearly 70 percent of people that will be living in urban areas by 2050[14], more sensitive urban practices must be adopted to accommodate the increase in population. The increase in population will put a strain on the current infrastructures that are designed within the city, making them incapable of functioning properly. With the integration of landscape as a means to a revitalization of the urban environment, a more holistic approach to planning can be integrated in all related fields, from planning to civil engineering. It is imperative that we take action now in our cities before they reach capacity. Incremental changes to underground infrastructures and surface infrastructures such as sidewalks and roads, can drastically transform the quality of urban space.

## Landscape Urbanism

A pertinent theory that has been influential in this research project has been Landscape Urbanism. Charles Waldheim defined landscape Urbanism in the early 1990s in an effort to establish a system by which urban spaces can be a derivative of the landscape instead of landscape being merely used as decoration. By integrating studies of temporality, ecology, biodiversity, water management and human activity[15], a new responsive urbanism could emerge that could engage all of these issues. James Corner in the article *Terra Fluxus* breaks Landscape Urbanism into four themes, which include:

1. Processes over time – "how things work in space and time." [16]
2. The Staging of Surfaces – horizontal surface as "field of action"
3. The operational or Working Method- New modes of representation and techniques for design to be established.
4. The Imaginary – public space as "containers of collective memory and desire" and "places for geographic and social imagination to extend new relationships and sets of possibilities." [17]

In the article Social Formation and Symbolic Landscape by Denis E. Cosgrove, it states that:

> *In pairing landscape with urbanism, landscape urbanism seeks to reintroduce critical connections with natural and hidden systems and proposes the use of such systems as a flexible approach to the current concerns and problems of the urban condition.* [18]

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[14] **Urban Population Growth. WHO. http://www.who.int/gho/urban_health/situation_trends/urban_population_growth_text/en/**
[15] **Note 5: James Corner. "Terra Fluxus" in** *The Landscape Urbanism Reader*, **ed. Charles Waldheim. (New York: Princeton Architectural Press, June 2006) 25.**

[16] **Ibid. 29.**

[17] **Ibid. 32.**

Christopher Gray, in a recent article in Scenario Journal, stated "landscape urbanism tries to understand the massive complexity of the world we live in, to work collaboratively with other disciplines to produce solutions that are respectful to sites and inhabitants, and also create new urban spaces that contribute to the wider natural and cultural territory."[19] Landscape Urbanism as a method of understanding a new way of viewing urbanism embodies a series of thoughts about the ever-changing nature of the urban environment and seeks to respond to it. Unlike many urbanisms from the past year like New Urbanism, Landscape Urbanism does not define itself by an aesthetic of social rule but responds to the city with systematic strategies for thinking and designing. A few years after the discussion of Landscape Urbanism started a new urbanism emerged that related to the goals and issues being addressed by Landscape Urbanism called Ecological Urbanism.

### Ecological Urbanism

Another influential theory in this research was Ecological Urbanism. Founded in response to the latest urban pressures to become more sustainable and respond to issues like climate change, Ecological Urbanism "considers the city with multiple instruments and a worldview that is fluid in scale and disciplinary focus."[20] The unique collaborations that were established to define this urbanism were immense in their ability to comprehensively analyze and engage the needs of the urban realm. Ecological urbanism served as a precedent and supportive urban theory for this thesis. This theory provided a stable foundation upon which to establish a hybridized urban theory that combines some of the thoughts embedded within Landscape Urbanism as well as Ecological Urbanism. In addition to these two urban theories, tactical urbanism was briefly explored as a tool for development of the strategies portion of the thesis project.

### Room for the River

Referencing the movement in the Netherlands called "Room for the River" which examines land use and re-zones parts of the city as areas for water, a new method was explored within this thesis. As sea levels rise, it is inevitable that the Netherlands will not be able to continue to build the walls high enough to keep the water out; therefore, they must engage the water and make room for it. In doing so, they establish a more symbiotic relationship with the hydrological system. Like the Netherlands, to become more resilient, the cities along the Mississippi need to address the ebbs and flows of the river, allowing for them an opportunity to engage with the city. In doing so, the cities would become more resilient to any future large flood event.

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[18] **Denis E. Cosgrove.** *Social Formation and Symbolic Landscape.* **(Kent: Croom Helm, 1984) 13.**
[19] **Gray, Chris. Landscape Urbanism: Definitions and Trajectory. Scenario Journal http://scenariojournal.com/article/christopher-gray/ accessed on April 26th, 2014.**
[20] **Mostafavi, Mohsen. Ecological Urbanism Book Description. http://ecologicalurbanism.gsd.harvard.edu/book.php accessed on May 10th, 2014**

In the "Room for the River Project", designers looked at alternative routes for the riverine systems, strategically carving areas out for the water to pass through without being confined to the high dike system. The project leaders claim that

> *The area available for the rivers has decreased continually during the past centuries. The rivers are confined between high dikes and more people live behind the dikes. At the same time the land behind the dikes has sunk due to the soil subsidence. In addition, since it now rains harder and more frequently, the rivers need to discharge more water to the sea. A flood in the current conditions would put the safety of 4 million people at risk. The continued strengthening of the dikes is an option that would reduce the risk of flooding. However, any flood that occurred would result in even greater damage since more water would flood to the sunken land behind the dikes… The river will be given more room at over 30 locations covered by the 'Room for the River' Program. The main objectives of this program are to complete the flood protection measures by 2015 and to improve the overall environmental quality in the river region.*[21]

A re-routing approach will in fact claim land from people, though it can also save many lives. Through a densification of the urban fabric and an evacuation of other areas where the water can be moved through, the city can become a more resilient system. By integrating the water into the city, the potential for catastrophe decreases exponentially as the water is more manageable. While on a much smaller scale, the daylighting of the Gayoso Bayou, will allow for the water to, not only, be conveyed to the Harbor but also to be cleansed through natural processes and allow for some of the water to contribute to the recharging of the depleting aquifers. The new lush vegetated landscape would increase biodiversity and provide a safe and enjoyable place for humans and urban fauna. The water would no longer be as much of a threat because the city would be more engaged in the dynamism of its flows to better respond through soft systems of infrastructure hybridized with large urban strategies to manage the storm water on many scales from the territory to the rooftop.

[21] **Room for the River Programme. http://www.ruimtevoorderivier.nl/english/room-for-the-river-programme**

Control systems have been implemented on most waterways within the United States. Over ninety percent of all US waterways have been dammed, detoured, drained or otherwise altered by humans. Two-thirds of streamside forests have been leveled for construction, logging, and mining, increasing erosion and runoff into our rivers and streams. [22] Infrastructures, designed over the past century, have transformed the natural ecology for the benefit of humankind. From navigation to settlement protection from seasonal flooding, the edges and surfaces have changed from a place of habitat and balanced ecology to an engineered landscape where economy-driven efficiency is privileged over ecological benefit. In the early 1800s, the Mississippi river was gracious in width and flowed freely as it made its way to the Gulf of Mexico. Since the establishment of the USACE in 1829 by the Army Corps of Engineers who were charged with "providing vital public engineering services in peace and war to strengthen our nation's security, energize the economy and reduce risks from disasters." [23] In 2009, nearly 40,000 barges shipped over 35 million tons of goods up and down the Mississippi river. [24] Thus, the control systems proved necessary to maintain the water level and speed for navigation year round. In the 1950s, congress ordered the U.S Army Corps of Engineers to go to war with the Mississippi. "We are fighting Mother Nature," the Corps stated in a promotional film, "It's a battle we have to fight day by day, year by year, the health of our economy depends on victory. Our opponent could cause the United States to lose nearly all her seaborne commerce, to lose her standing as first among nations." The result was implementation of the river control structures along the lower Mississippi. The Mississippi River and Tributaries Project was intended to "end all floods for ALL TIME from Cairo, Illinois to New Orleans. [25]

## The Mississippi Alluvial Valley

According to the National River Conservation Organization, the Mississippi River is the country's most threatened waterway. After damming and draining for the last century, the river has transformed from a vibrant ecosystem to a lifeless concrete canal. With its high levees and series of other flood management systems, the nearly 100 mammal, 145 reptile and fish species and 60 percent of North America's bird population are impacted from the drying of the wetlands that are no longer fed by runoff. The control systems that are put in place currently play a role in keeping people safe and providing ease of navigation. The reservoirs behind the dams and locks do provide areas for habitat and feeding for migratory birds though in the Lower Mississippi Valley, the control systems are predominantly levees and low revetments. The levees decrease the floodplain, which decreases suitable habitat for migratory birds. Over the past 50 years, the Corps engineers have become much more aware and have made a concerted effort to build with an

22 The State of: The Environment, Food Chain and Animal Protection. http://www.ecovegevents.com/eve/theStateOf.htm
23 River Navigation Today: Locks, Dams and Barges. N.p.: Illinois Department of Natural Resources, n.d. PDF.. http://dnr.state.il.us/education/aquatic/aquaticillinoisrivernavigation.pdf
24 Ibid. page 12
25 Lewis, Tom. "Mississippi Rising: Apocalypse Now?" http://www.dailyimpact.net/2011/04/28/mississippi-rising-apocalypse-now/

environmental conscience, according to Corps spokesperson, Bob Anderson. [26] However, the degradation of wetlands along its path and at the mouth of the river have continued to affect the animal population that need the Valley for survival.

In the book The Control of Nature by John McPhee, when describing the Mississippi River as it pertains to the implementation of the Old River Control structures:

> *As a result of settlement patterns, this reach of the Mississippi had long been known as "the German coast," and now, with B. F. Goodrich, E. I. du Pont, Union Carbide, Reynolds Metals, Shell, Mobil, Texaco, Exxon, Monsanto, Uniroyal, Georgia-Pacific, Hydrocarbon Industries, Vulcan Materials, Nalco Chemical, Freeport Chemical, Dow Chemical, Allied Chemical, Stauffer Chemical, Hooker Chemicals, Rubicon Chemicals, American Petrofina--with an infrastructural concentration equaled in few other places--it was often called "the American Ruhr." The industries were there because of the river. They had come for its navigational convenience and its fresh water. They would not, and could not, linger beside a tidal creek. For nature to take its course was simply unthinkable. The Sixth World War would do less damage to southern Louisiana. Nature, in this place, had become an enemy of the state.*

In this essay he alludes to the inability of the port cities to sustain themselves without protection from the rise and fall of the Mississippi River. The line “for nature to take its course was simply unthinkable” is a testament to much of the thought processes of the early 1900s in engineering. Nature had become an enemy to the cities and they must deny and control it for their own survival. When doing so, they did this to the point where they suppressed the natural dynamism. In this, the infrastructures were calculated to respond to the issues at the time: the flow, the amount of river traffic, the amount of rainfall, etc. Each of these parameters has steadily increased over time necessitating higher walls and larger levees. Since the 1700s in New Orleans alone, the levee walls have risen from three feet to nearly forty in some area of the city. This disconnect has made the potential for failure catastrophic. By building walls, the cities feel safe to sprawl and create even more impervious surfaces, which attribute to the increase in surface water flow. In cities along the Mississippi River, water infrastructure was engineered for efficiency focusing on commerce and not the potential degradation to the environment and public health.

Along the Mississippi Alluvial Valley, there are four major cities that have populations of over 300,000[27] people that include: Minneapolis, Minnesota – St. Louis, Missouri – Memphis, Tennessee – and New Orleans, Louisiana. Each of these cities has a unique relationship with the Mississippi River. In Minneapolis, the water is controlled by a dam and

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**26 Wilkins, Andrew. Environmentalists and the US Corps of Engineers are at odds over the Mississippi River. Memphis Flyer. July 13-19, 2000. Accessed online http://www.memphisflyer.com/backissues/issue595/envir595.asp**
**27 "American FactFinder - ." American FactFinder – Population of New Orleans, Memphis, Minneapolis, and St. Louis. N.p., n.d. Web. 09 May 2014.**

lock system. This allows for the water level to be regulated as it moves through the city. St. Louis, Memphis and New Orleans have similar relationships as large earthen mounds with occasional taller concrete wall structures to keep the water out sever the relationship to the Mississippi River. A large earthen mound to the North protects Memphis and the water within the city is regulated by a series of pumping stations. New Orleans is surrounded by a levee system that consists of a combination of earthen mounds, concrete walls and spillways. Levees, walls and spillways create a barrier from interaction with the seasonal fluctuation of the river. The revetments and levees have controlled the movement of the water over the past century, influencing the formation of new land through deposition, including areas like Mud Island in Memphis, TN. In the Figure 3, it shows a mapping created by Harold Fisk in 1944 of the way that the Mississippi River has moved since 1765.

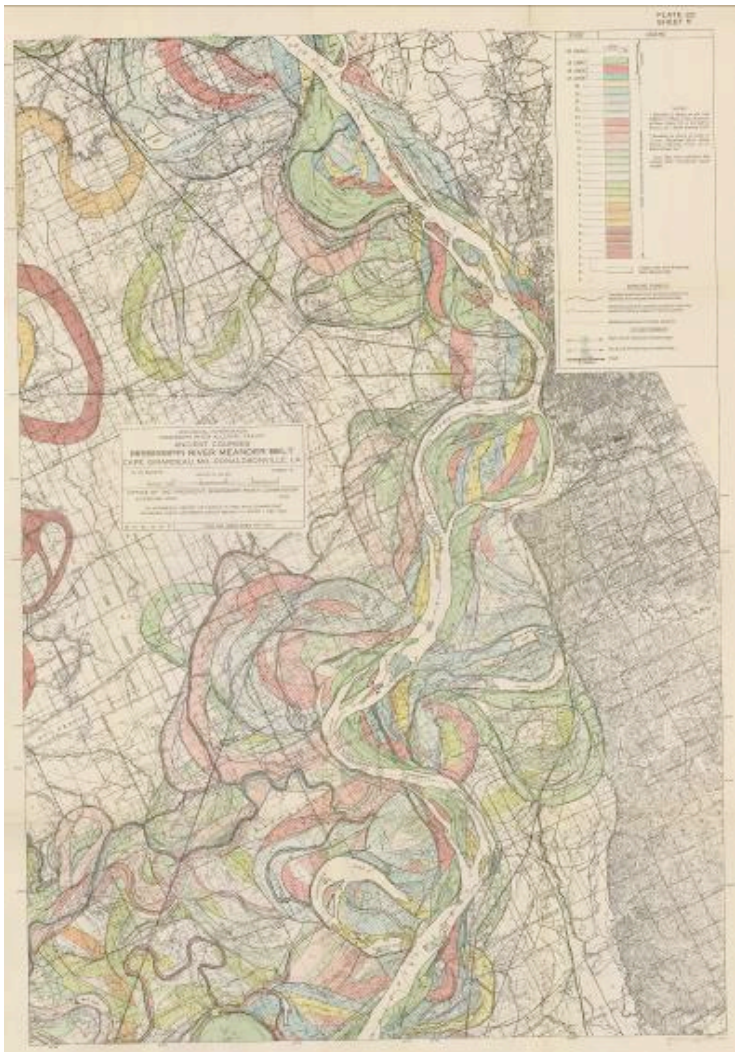


**Figure 3: Fisk Map Number 05**

## Memphis, Tennessee

Of the four cities with the largest populations, Memphis was chosen for the specific area of study for this investigation. Memphis represents a city where the landscape has drastically transformed over time, from the glacial age when the alluvial valley was formed, Memphis rested on the threshold between the muddy waters of the Valley and the bluff system that was created on the edge. The Native Americans and explorers due to its high ground and long vistas to the west chose settlement in the Memphis area. It is said that Hernando de Soto thought that the Mississippi River was the Pacific Ocean because it stretched nearly 35 miles to the west making it nearly impossible to see the other side of land. In the late 1800s, the edge of the city was blurred and the flood plain had a more engaging interaction with the cities inhabitants. The "Cobblestones" mediated between the city and the water, allowing for a gradual transition. See Figure 4 to see how the area related to the Mississippi River. The relationship with the Mississippi has become more disconnected as the years have passed as the edge of the water became more industrialized. After floods continued to creep into the city, walls were built to keep the water out. The control systems had to be put in place.



**Figure 4: Cobblestones in Memphis, TN** [28]

## Memphis and the Mississippi River

In a description of the Riverfront Project by Coleman Coker, he claimed that

> *The riverfront is an edge - a border where change explicitly presents itself. Edges are where things happen; edges are agitated; they make life and encourage difference. Edges promote distinction, but at the same time they cause things to commingle. Just this sort of fusing takes place at this project's location. Wildness and the cultivated meet here; the ephemeral joins the permanent; stability converges with instability; solid becomes transparent; light becomes silhouette. In each, differences meld; a place to begin is given.*[29]

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**28 Cobblestones Images http://media.commercialappeal.com/media/img/photos/2011/05/06/Cotton-Boats_t607.jpg**
**29 Coker, Coleman. Description of the Riverfront 1 Project. Project Description. http://www.buildingstudio.net/ Accessed September 13 2013.**

Memphis has always depended on its waterfront for commerce. As a major exporter of Cotton, the waterfront was a place of exchange and served as an open-air market and storage area for goods. When the cotton industry slowly began to become less and less a driver for the economy, the land use of the waterfront shifted. Since the 1950s, the waterfront has served more as a place of leisure. The Riverside Drive was widened in the late 1950s to become Riverside Boulevard and remains a main access road for the city of Memphis as it connects to the Interstate 40 on its southern end. Since the 1980s, recreation has become a driver of the economy as the city invested in a series of new trails and parks including Tom Lee and Ashburn Park. Mud Island was open to the public in 1982 when access was granted over the dam to the North. Since then, it has had a boom of population and economy.

**Table 1. Historic Crests for the Mississippi River since 1900**

| *Date* | Flood Stage (ft) |
|---|---|
| 02/10/1937 | 48.70 |
| 05/10/2011 | 48.03 |
| 04/23/1927 | 45.80 |
| 02/22/1950 | 40.50 |
| 05/08/1973 | 40.50 |
| 03/07/1975 | 40.32 |
| 05/22/1961 | 40.18 |
| 04/23/1979 | 39.24 |
| 05/15/1983 | 39.20 |
| 04/06/1945 | 39.20 |
| 05/18/1984 | 38.70 |
| 05/24/ 2002 | 38.70 |
| 04/18/2008 | 37.75 |
| 04/23/1994 | 37.33 |
| 03/29/1963 | 36.61 |
| 03/22/2011 | 36.52 |
| 02/07/1974 | 36.36 |
| 01/08/1991 | 36.09 |
| 01/22/2005 | 35.73 |
| 04/02/1955 | 35.45 |
| 05/18/2009 | 34.72 |
| 05/08/1998 | 34.25 |

## Flood Categories [30]

NGVD 29 Gage Height: 183.91 feet

Major Flood Stage: 48 feet

Moderate Flood Stage: 34 feet

Action Stage: 28 feet

This information was used to create a series of diagrams that show the impact of flood if the levees were to crevasse of the pumping station were to malfunction. See Figure 5 for more information on the impact of the inundation.



**Figure 5: Creation of Shaded Zone X, based on topographic study**
**Note: Starting from 212' above sea level to 230' (in increments of 2') showing the potential inundation**

30 Mississippi River at Memphis. Hydrograph Data http://water.weather.gov/ahps2/hydrograph.php?wfo=meg&gage=memt1

The criteria of site selection emerged from an interest in the impacts of water systems as they relate to highly populated urban areas. After comparing the populations and relationships between the top four cities along the Mississippi River, the selection was made to study Memphis, Tennessee. Memphis has a population of over 650,000 people, making it the largest city on the Mississippi River, nearly double the size of the other three cities. The high population makes the city extremely vulnerable to potential failure of the control systems along the river. The population also means that any new infrastructure has the ability of affecting many more people in a positive way as well. In addition to population, there was a study of the impact zones of potential flooding within the cities. Upon the study of the FEMA FIRM map for Memphis, an area delineated as Zone X showed an area which could be under threat from failing infrastructures. Over two hundred and forty-six acres of land just East of Downtown Memphis is currently designated on the FEMA Flood insurance maps as "Shaded Zone X" which is considered "moderately at risk" due to its protection by the levee system. Within this zone, there is over 75 percentage of impervious surfaces. The runoff from this area drains into an underground water conveyance system that consists of culverts, pipes and drains that move the water out into the harbor as fast and most efficiently as possible.

### Opportunity lies within Shaded Zone X

Described on the FEMA flood insurance maps [FIRMs], Shaded Zone X is an area "protected by the levees but subject to failure upon large flood events." Note: Zone X has been substituted for Zone B on the new maps.[31] With sea levels rising, impervious surfaces increasing, and rainfall events predicted to increase exponentially over the next 100 years, the area of Zone X may be described as a minimal risk now, though it may become at high risk within the next 10-15 years. This presents an interesting potential paradigm shift in this area of the city is planned. Active systems of storm water, including rain gardens, constructed wetlands and bio-swales, can be integrated with the current static drainage system to make the city's surfaces more absorbent. If done effectively, the surfaces could absorb the increased amounts of water instead of simply relying on conveyance systems to move it to the Harbor. The area of Shaded Zone X could become a lush, vibrant area for new ecosystems and increase the quality of life of the people in that area. At present, the area is threatened by the potential inundation of a levee failure forcing the residents to pay for flood insurance that will likely not cover the detriment that may be caused if a flood event were to happen. Instead of waiting for the flood to happen, why not prepare the ground now, making the landscape able to absorb and detain the water? If strategies were implemented to engage the hydrological cycle instead of control it, a new symbiosis could be established.

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31 Definitions of FEMA Flood Zones. Moderate to Minimal Risk Areas. Description of Shaded Zone B/X. https://msc.fema.gov/webapp/wcs/stores/servlet/info?storeId=10001&catalogId=10001&langId=-1&content=floodZones&title=FEMA%2520Flood%2520Zone%2520Designations

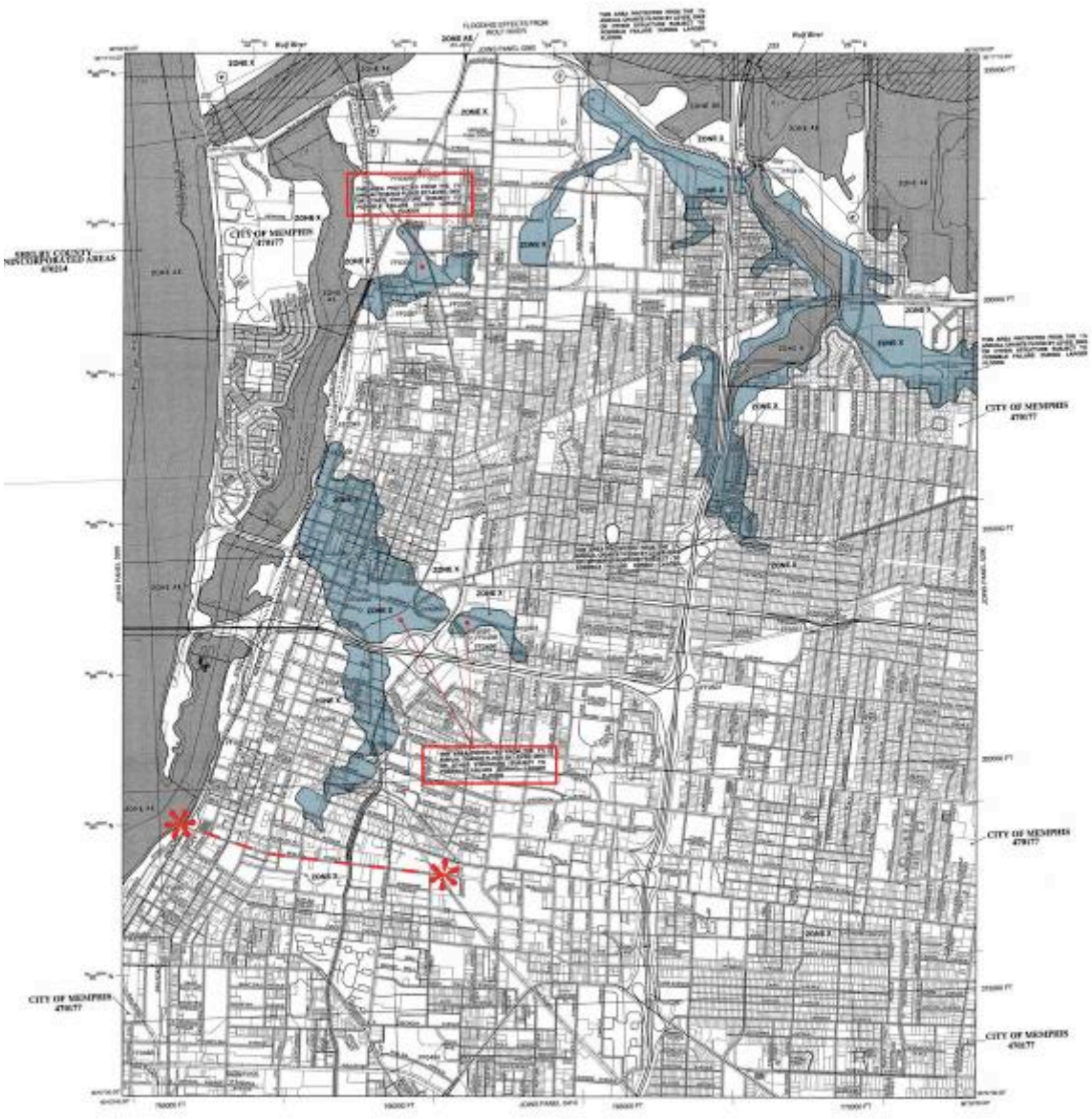



**Figure 6: FEMA Flood Insurance Risk Map for Memphis, TN**

The area shown in blue in Figure 6 would be inundated if one or more of the following occurrences were to happen: the pumping station failed, a severe storm were to create a large volume of storm water beyond the capacity of the storm sewers, the levee were to crevasse allowing water into the city. If any of these instances were to happen, this area would be threatened by a mass of water that could not be absorbed within the surface.

As the threat of the flooding of Zone X seems unlikely, one must consider that according to the 2013 Report Card for America's Infrastructure from the ASCE[32], levees within the Unites States were given a D+ which means that the "infrastructure is in poor to fair condition and mostly below standard, with many elements approaching the end of their service life. A large portion of the system exhibits significant deterioration. Condition and capacity are of significant concern with strong risk of failure." With that in mind, the likelihood of Zone X inundating with water increases with each new impervious surface within the Mississippi Watershed which drains nearly 41 percent of the entire United States. The capacity of the levee wall was designed for the 1000 year flood as predicted in 1941 when the levees in Memphis were constructed as they exist today. During an interview with Nicholas Bidlack and Jason Dickard from the Army Corps of Engineers of Memphis, TN, the levees are surveyed "annually" to "check for crevassing and other malfunctions." When asked if they were assessed for holding capacity during the predicted earthquake of the New Madrid Fault, they were both unable to answer.

This answer led to an exploration of the impacts of the Earthquake on the city of Memphis. After retrieving a map showing the areas of liquefaction (see Figure 7), an area within Zone X overlapped the historic area where the Gayoso Bayou once traveled.

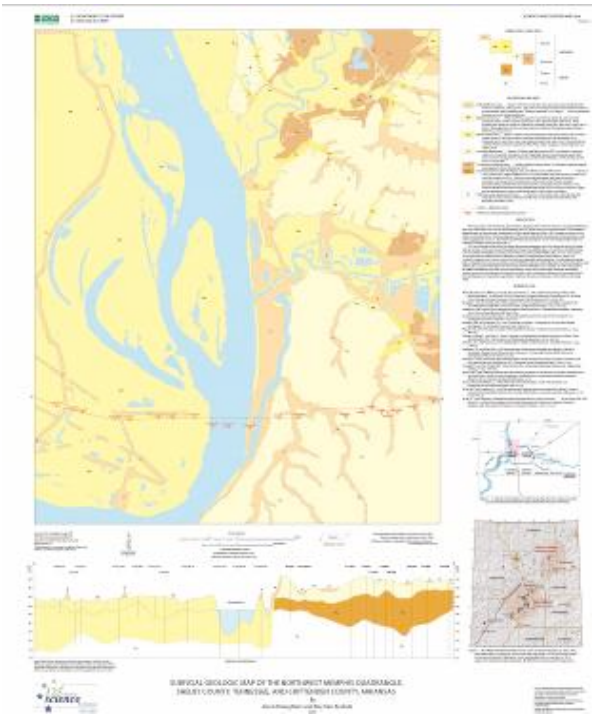


**Figure 7: Liquefaction of Memphis, TN**

32 2013 Report card for America's Infrastructure. Levees. Assessment Methodology. http://www.infrastructurereportcard.org/

## Gayoso Bayou

Through examination of historic and geologic maps of the Memphis area, including early Sanborn maps from the 1800s, the hydrological system consisted of a series of bayous including the Gayoso Bayou. In Figure 8 it shows a comparison of the watershed of the Gayoso Bayou, called catfish bay, and the Gayoso Bayou in 1819. One can see that in the top left corner of the Figure 9, the bayou spills out in to the harbor then out into the Mississippi River. Over the years, since the late 1800s, the bayou has been incrementally paved over and channeled into a series of conveyance tunnels that move invisibly under the feet of the urban dwellers. The ecological system that once absorbed, conveyed but also provided habitat for fauna has been completely transformed into an engineered system that simply moves water out of the city. Through excavation and daylighting of the Bayou, the city would be able to manage and cleanse storm water through natural systems that would also provide habitat for migrating bird population, urban fauna and create a new public realm for people to enjoy. By weaving trails and greenway systems through the city, it will allow for people and animals to move through the city and to the waterfront safely. The Bayou would need to be connected to a larger trail system to be effective as a wildlife corridor but incrementally, it can become an excellent place for people to recreate and enjoy. If its edges are planted, it would increase the biodiversity within the city and reduce carbon, provide oxygen and shade adjacent buildings, reducing energy costs.




Figure 8: Bluff City -- Forts built by Spanish settlers in 1795




Figure 9: Plan of Memphis 1819

According to John Keating, author of *History of Memphis Tennessee: with illustrations and biographical sketches of some of its prominent men and pioneers,*[33] the Gayoso Bayou along with several other bayous filled up during high water on the Mississippi River. Its entire length is noted as nearly five and a half miles draining nearly five thousand acres to the Wolf River harbor. As it is described as a bayou, the slope is extremely low noted at one to one-hundred and eighty in the city limits. The watershed of the Bayou consisted of much of the center of the city and the northern end. In the publication on Municipal Engineering of Memphis, written in 1910, it notes that a majority of the storm water within the city was conveyed through the Gayoso Bayou but that "some of the methods of treating the storm drainage problem at street intersections… are not satisfactory and some storm water sewers will doubtless be constructed before long, particularly for the surface of the long, particularly for the service of the heavily traveled streets on which foot traffic is at times seriously impeded by the rush of water or the gathering of water faster than it can get away." [34] This resulted in a series of culvert systems to convey the water quickly and efficiently, allowing street traffic to flow without imposition made by the water. Figures 10 and 11 depict the implementation of Lauderdale Avenue and how it affected the Gayoso Bayou.



**Figure 10: Gayoso Bayou c. 1900s.**



**Figure 11: Plans for Lauderdale Avenue and Gayoso Bayou Removal**

Since the late 1897, the Gayoso Bayou has been paved over and tunneled through a series of box culverts and caverns. The water that once flowed freely through the city is not highly regulated through an underground system, completely disconnecting the city from its existence. According to a few Memphis natives, many didn't even know that it ran through the city. When the New Deal was passed in the 1930s, infrastructure spending allowed for the system to be completely submerged only to outlet into a system of six open air reservoirs which are depicted in Figure 13 in green.

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**33 Keating, John M. History of Memphis Tennessee: with illustrations and biographical sketches of some of its prominent men and pioneers. (ch: The Site of the City of Memphis) Print. 1888. P. 141.**
**34 Municipal Engineering v39 1910. Google ebook http://books.google.com/books?id=Gg0_AQAAMAAJ&source=gbs_navlinks_s**

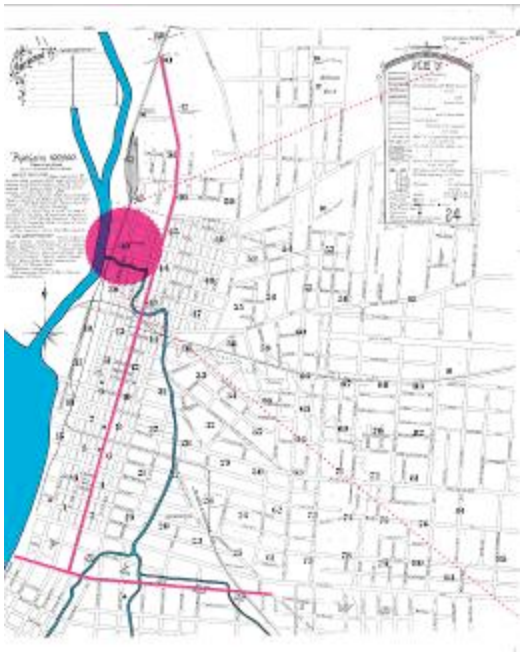


Figure 12: 1897 Sanborn Map with Gayoso Bayou in Blue

Gayoso Bayou



Figure 13: Memphis today with remnants of the

## CHAPTER V | STRATEGIES FOR ENGAGING THE TERRA VISCUS

DEEP SURFACE explores the potential of Memphis to integrate a multifunctional landscape that hybridizes infrastructural systems with urban recreation and dwelling systems. The proposal starts with the resurfacing of much of the watershed of Zone X, planting tree farms in the vacant lots and excavating into some vacant lots surrounding the reservoirs to the north of the site in Uptown. After that phase is complete, the Gayoso Bayou will be incrementally restored to from the Harbor down to Washington Avenue to the South. The excavation will replace the current storm water management system with one that is more engaging to the public and serves multiple functions as an ecological landscape for people and urban fauna.

DEEP SURFACE uncovers the historical layers of Memphis, TN, seeking to re-engage the temporal activities that could be programmed for this area. Along its banks, the restoration could increase the value of the land, necessitating a study of the new urban density that would come out of this restoration project. The new urban edge will be biophilic in its ability to respond to the rising levels of water throughout the year. As a part of an overall public gesture, there will be a soft green edge and a series of accessible pathways that allow for occupation of this landscape during the year. Connecting to the local greenway corridors, existing and proposed, the new public landscape will snake through the city, once again providing a threshold into the city. The scale of the intervention will be a 1.5 mile stretch programmed with a new linear park, a series of public entertainment and recreational nodes as well as new housing and mixed-use development. This influx in urban living will help support the endeavor to revive the bayou corridor. This new public realm will integrate the needs of the people, the urban fauna and the larger ecosystem of the Mississippi Aquifer to continue to recharge it with cleansed urban water.

### Infrastructure as Public Space

Storm water infrastructure of the city was engineered for sanitary issues in the late 1800s. Toxins were being introduced into the water and the city needed to create a municipal treatment system to respond. Green infrastructural technologies allow cities to introduce new cleansing strategies for conveying and purifying water that utilizes the cleansing power of natural elements, like wetland plants and specific biota that consume and digest toxins to purify the water. [See Appendix | Plants for more information on native plants of Memphis] In envisioning a different method for storm water management for Memphis, opportunities arise to integrate public space and thoroughfares throughout. Cities are faced with an opportunity to envision their new infrastructures as multifunctional, vibrant responsive and resilient systems that can become catalysts for the betterment of the urban environment. By integrating soft systems infrastructure into the creation of public space, cities can increase the value of the land, mitigate flooding, create new opportunities for habitat creation and make the urban space more enjoyable for its inhabitants.

To begin to prepare the ground, a series of small-scale but distributed systems of storm water management are proposed. Tree Farms will populate the vacant lots to serve as a new industry for the city of Memphis. The trees that cannot be sold will be transplanted to the edge of the revitalized Gayoso Bayou to serve as bank stabilization and carbon sinks. A series of tests will be done on wetland grasses and field grasses to test their viability in the harsh urban environment. The grasses that do not prove to be resilient will be harvested for biofuel. Specific plants will be selected based on their ability to remediate the hydrocarbons emitted and encapsulated within urban runoff. On the edges of all the roads within Zone X, bioswales and rain gardens will be implemented to detain and treat storm water before it enters the creek system. As the surface is changed, parts of the bayou will be incrementally daylit, allowing for the water to be introduced slowly to not overwhelm the system. As the impervious surfaces have increased within its watershed, the bayou will have to be dug deeper and wider than it was originally in the early 1900s to convey a larger amount of water. A series of terraces will be implemented on its edges utilizing crushed stone and asphalt from the excavation in gabion wall systems to allow for people to occupy the edge condition throughout the year.

### The Bayou Greenway

An overall system of pedestrian and habitat connectivity will be created through a series of greenway systems. Connecting to the plan provided by Greenprint and adding an addition suggestion for a rail-to-trail conversion to the South. The new connected landscape will weave through the urban fabric of Memphis below a large grandeur boardwalk floating above the 232' elevation mark. The boardwalk represents a connected public space. The exact design of the system would need to be further studied as it relates to the new grid system and pedestrian system on the ground. It signifies a separation from the landscape that is being rejuvenated. It hovers above the healing landscape and touches it lightly and unobtrusively. The paths that are laid at the edge of the Bayou are soft and resilient to the influx of flood. See Attachment | Design for further information about the sectional quality of the greenway.

The first phase of the project starts at the mouth of the Gayoso Bayou, where it intersects with the Wolf River Harbor. At present the city is disconnected with the waterfront on the northern end. Upon discussion with Jason from the Army Corps of Engineers, there are plans to open up the levee wall in a few places and provide paths from the Uptown area to the water's edge. Plans for an area called "Uptown West"[35] were completed in collaboration with the Corps, with the help of a local firm called Looney Ricks Kiss who did a master plan and feasibility study of a revitalization of that entire area, including a new extension of the light rail. Paths are planned to bridge across the CSX lines to provide access to the water.

The second phase would continue the creek daylighting into the dense portion of the city, through the Uptown Square neighborhood and culminating near the intersection of Danny Thomas Boulevard and Washington Avenue. Here,

[35] **Uptown West. Looney Ricks Kiss. http://www.lrk.com/projects/uptown-west/**

the creek would become more controlled in a system of aerating water cascades. Detention pools would be implemented along the edges and a deep theatre would be carved into the earth to provide outdoor activity area for performance. This amphitheater would also serve as an overflow system for the storm water. The space could fill up and be stored until the water could be expelled into the water cleansing wetland that transported it to the harbor.

Along the edge of the new pedestrian-friendly public realm, as seen in Figure 14, would be a series of architectural solutions that engage the ephemeral nature of the Bayou. Starting at the northern-most portion, a new public building housing a restaurant, bar, nightclub and café will wrap up from the lot to the North of the Pumping Station and project beyond the levee wall to provide access to the waterfront and gesture toward the horizon. The second, responding to the reservoirs will be an Environmental Education Center and Waterfowl Observatory. The third architectural intervention would be a multi-functional building and landscape that provides temporary office space, living space and performing space for artists of all ages. Each of these programs engage the DEEP SURFACE by relating to not only the sky and the urban horizon but the subsurface as well. The fourth programmatic element is the adaptation of the archetype of the observation well and observation tower.



**Figure 14: Greenway along Gayoso Bayou**

## Edges

In a description of the Riverfront Project by Coleman Coker, he claimed that

> *The riverfront is an edge - a border where change explicitly presents itself. Edges are where things happen; edges are agitated; they make life and encourage difference. Edges promote distinction, but at the same time they cause things to commingle. Just this sort of fusing takes place at this project's location. Wildness and the cultivated meet here; the ephemeral joins the permanent; stability converges with instability; solid becomes transparent; light becomes silhouette. In each, differences meld; a place to begin is given.*[36]

Throughout the project, the edges will be a place of overlap and gradient. They will serve as a blurred threshold for the wildness and cultivated nature of the city. The system of green space will be connected with the overall pedestrian circulation system within the city presently.



**Figure 15: Revealed Gayoso Bayou | Edges**

**36 Coker, Coleman. Description of the Riverfront 1 Project. Project Description. http://www.buildingstudio.net/ Accessed September 13 2013.**

## The Pumping Station

Located at the mouth of the Gayoso Bayou, the Pumping Station has been a highly effective way of controlling water within the city of Memphis. Historically, the pumping station was utilized a few times per year during large storm events to convey water out and to keep the river from inundating the city. It lies on the eastern side of the levee wall, adjacent to a CSX rail line and Front Street. When the water hits the 28' mark, the pumping station begins to work, pumping the water out of the city. If the Pumping Station were to work both ways, the water from the river can become a helpful system to tap into for irrigation for crops, tree farms, and grasslands.



Figure 16: Pumping Station Pier - Aqueduct water wall and deck

**See Attachment | Design for sections and blown-up plans for this area.**

## The Environmental Education Center

Responding to 60 percent of birds and 40 percent of waterfowl that travel along the Mississippi Flyway, a programmatic element of the Environmental Education Center provides people of all ages with an opportunity to learn about the historic ecology of Memphis. Located at the edge of one of the reservoir ponds, the landscape terraces up and ramps to an overlook deck. At the top of the deck rests an observation tower. This tower provides a 180-degree panorama of all of the pools of water. Water would be pumped back into the city through the pumping station during drought times to provide habitat for the waterfowl. Wading areas for certain birds provide areas for safe bird watching. The environmental education center has an underground theater, which responds to the nature of the water as it rises, and falls. Clerestory light in the theater can be closed off or left open to give people a sense as to the level of water being held in the reservoir. The image depicted in Figure 17 shows a path around the southern side of the site where the classrooms and administrative offices are located. A greenway path travels along the wooden decking system one can see in the center of the image. The cascading system will serve as a horizontal marker as to the severity of the flooding fluctuation.



Figure 17: Winter Waterfowl Migration

**See Attachment | Design for sections and blown-up plans for this area.**

## The Performance Arts District

Connecting to the existing fabric of the city, a new district is formed. Programmatically, the site is a combination of storm water systems from hard to soft; the storm water becomes a spectacle within this area. From thirty-foot waterfalls to a series of cascading pools, the area is designed to meet the needs for impromptu public space for both water and people. The water detained can be used for irrigation and cleansed in the municipal system. In Figure 18, one of the performance paces serves as a pool for detaining water. Thin sheets of water fall loudly along the western walls. Three large openings provide secondary access from the park that is adjacent to the new sunken landscape.



Figure 18: Performance Arts District | Cavern + Cascades

**See Attachment | Design for sections and blown-up plans for this area.**

## CHAPTER VI | CONCLUSION

After months of research and design exploration, I learned that there cannot and should not be one solution to the issues embedded within the issue of flooding and hydrology within Memphis or any other city along the Mississippi River. Through territory-scaled thought and implementation of best management practices of water management, flooding potential can decrease though with the increase in water from the melting ice caps and the worsening of storms, the water is exponentially increasing, putting strain on the already overburdened systems. Through careful analysis of the current systems and the potential of new more sustainable systems being integrated, the issue of flooding can be decreased and managed in a softer way. Though, it will be the responsibility of all citizens to contribute to the overall system by managing their runoff onsite and allowing it to recharge the aquifers.

Through daylighting the Bayou, the property value along its edges will likely increase, bringing great economic benefit to the city of Memphis and hopefully delight to the citizens who reside nearby. The creek is designed to be ephemeral which will require more maintenance, though it will decrease the likelihood of catastrophic failure. The engineered systems have been so engrained as a system for quite some time and it will take some efforts to move people beyond their comfort zone. With more analysis, the temporal system will likely outperform any engineered system in the long run and will respond to the biological and ecological needs of the city, unlike the systems of the past century would along.

The architecture on the site must activate the edges of each site along the Bayou, responding to the ebbs and flows of the seasonal shift in water height and suitability for habitat. The architecture is intended to allow people to be closer and experience this phenomenon of fluctuation more frequently than is possible behind the large concrete levee. It can also provide a safe area for people to watch urban fauna as they move through the city along this new safer path. Urban studies of archetypes would be helpful to understand the potential density and scale along the Bayou. New Codes would need to be written that took into consideration the fluctuation of the water and considered no absolutes but made suggestions of responses that the architecture should provide.

This design product is by no means a complete solution to this issue as this issue is too large to solve with one semester of design work. Flooding in Memphis and the area of Zone X is part of a larger system that will need to be managed in addition to any work being done within the bounds of Zone X. Management of water along the entire Alluvial Valley will assist in the ability for this design system to help. This design addresses the issues of inundation and distribution of water and does not provide an emergency relief system, which would need to be worked in to make this proposal feasible.

# REFERENCES

Amidon, Jane. "Two Shifts and Four Threads." *TOPOS* n.d.: 16-24. Print.

Amoroso, Nadia. *The Exposed City: Mapping the Urban Invisibles*. New York: Routledge, 2010. Print.

Berger, Alan, and Dirk Sijmons. *Systemic Design© Can Change the World ; Utopia's Practical Cousin*. Amsterdam: SUN, 2009. Print.

Bhatia, Neeraj, and Lola Sheppard. *Goes Soft: Bracket 2*. Barcelona: Actar, 2012. Print.

Bhatia, Neeraj. *Coupling: Strategies for Infrastructural Opportunism*. New York: Princeton Architectural, 2011. Print.

Corner, James, and Alex S. MacLean. *Taking Measures across the American Landscape*. New Haven: Yale UP, 1996. Print.

Craig, James A., and Matt Ozga-Lawn. *Pamphlet Architecture 32: Resilience*. New York: Princeton Architectural, 2012. Print.

D'hooge. "Monument or Armegeddon." *VOLUME 9* n.d.: 42-122. Print.

D'hooge. *VOLUME 9* n.d.: 42. Web.

Harrison, Ariane Lourie. *Architectural Theories of the Environment: Posthuman Territory*. New York: Routledge, 2013. Print.

Jackowski, Nannette, and Ricardo De. Ostos. *Ambiguous Spaces: NaJa & DeOstos*. New York: Princeton Architectural, 2008. Print.

Jazairy, El Hadi, and Melissa Vaughn. *Scales of the Earth*. Cambridge, MA: Harvard U Graduate School of Design, 2011. Print.

Mathur, Anuradha, and Dilip Da. Cunha. *Mississippi Floods: Designing a Shifting Landscape*. New Haven: Yale UP, 2001. Print.

Mathur, Anuradha, and Dilip Da. Cunha. *Soak: Mumbai in an Estuary*. New Delhi: Rupa, 2009. Print.

Metz, Tracy, and Maartje Van Den. Heuvel. *Sweet & Salt: Water and the Dutch*. Rotterdam [Netherlands: NAi, 2012. Print.

Mostafavi, Mohsen, and Gareth Doherty. *Ecological Urbanism*. Baden, Switzerland: Lars Müller, 2010. Print.

Nijhuis, Steffen, Lammeren Ron. Van, and Frank Van Der Hoeven. *Exploring the Visual Landscape: Advances in Physiognomic Landscape Research in the Netherlands*. Amsterdam, The Netherlands: IOS, 2011. Print.

Nordenson, Guy, Catherine Seavitt, and Adam Yarinsky. *On the Water: Palisade Bay*. Ostifidern: Hatje Cantz, 2010. Print.

Pickard, Jan Sutch. *Salt and Sweet*. Bunessan, Isle of Mull: Oystercatcher Publications, 2007. Print.

Smout, Mark, and Laura Allen. *Augmented Landscapes*. New York: Princeton Architectural, 2007. Print.

Tiberghien, Gilles A., Michel Desvigne, and James Corner. *Intermediate Natures: The Landscapes of Michel Desvigne*. Basel: Birkhäuser, 2009. Print.

Tufte, Edward R. *Envisioning Information*. Cheshire, Conn. (P.O. Box 430, Cheshire 06410): Graphics, 1990. Print.

Waldheim, Charles. *The Landscape Urbanism Reader*. New York: Princeton Architectural, 2006. Print.

Weinstock, Michael. "Emergence and the Forms of Cities." *Architectural Design* Mar. 2010: 118-21. Print.

White, Mason, and Maya Przybylski. *On Farming*. Barcelona: Actar, 2010. Print.

# APPENDICES

## REPRESENTATION

The image below describes a relationship between the tactile nature of the place, the Hoover Dam, and its relationship to the Colorado River. The control system of the dam has created an augmented landscape. This thesis imbues some of the same key relationships to describe what lies beneath the urban surface. The saturated and rich nature of the image on the left seeks to give a sense of scale to the immensity of the infrastructural landscape of the Hoover Dam as it relates to the vast enormity of the desert.

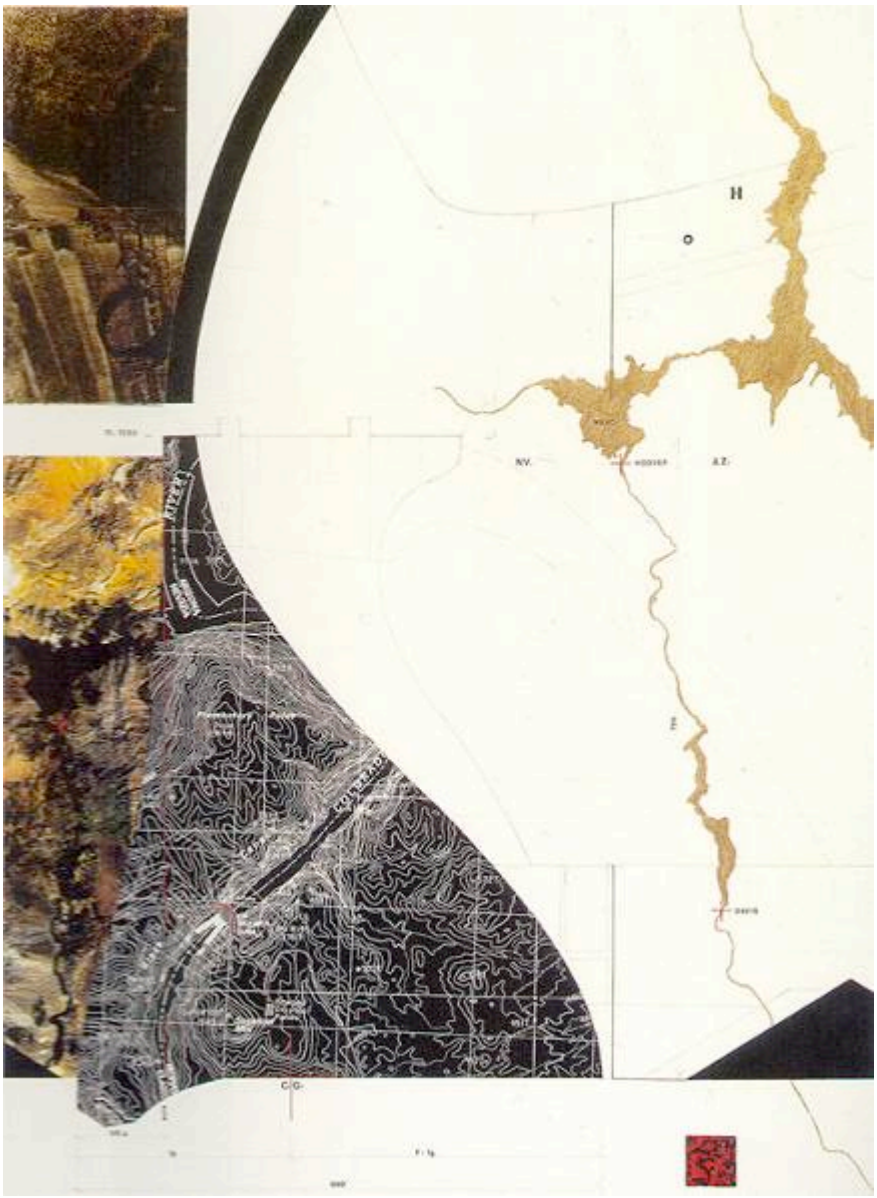



**Figure 19: James Corner, Hoover Dam and the Colorado River, Nevada..** *Taking Measures across the American Landscape,* **1996.**

This image, produced by the authors of Mississippi Floods: Designing in a shifting landscape, depicts a palimpsest of information to describe the way that soil particles are dispersed down the Mississippi River. The nature of the screen print allows for images to be overlaid bringing depth to the representation.




**Figure 20: Depositing Depths in** *Mississippi Floods by* **Anuradha Mathur and Dilip Da Cunha**

## GREEN INFRASTRUCTURE

Brooklyn Bridge Park by Michael Van Valkenburgh Associates, Inc., Brooklyn, NY

High Line Park by Field Operations and Diller, Scofidio Renfro, New York City, NY

Lagoon Park: Living on the Edge of Wilderness by Van Atta Associates, Inc., Santa Barbara, California

Orange County Great Park Comprehensive Master Plan by Ken Smith Workshop West, Irvine, California, Team Lead, and Mia Lehrer + Associates, Los Angeles, California

The Red Ribbon - Tanghe River Park by Turenscape (Beijing Turen Design Institute) and Peking University Graduate School of Landscape Architecture, Beijing, China

The Floyds Fork Greenway Master Plan by Wallace Roberts & Todd, LLC, Philadelphia, PA

Port Lands Estuary: Reinventing the Don River as an Agent of Urbanism by Michael Van Valkenburgh Associates, Inc., Landscape Architects, New York, New York

### Animations:

Leveraging Landscape to Manage Water by Daniel Tal for ASLA

Revitalizing Communities with Parks by Daniel Tal for ASLA

## DAYLIGHTING PROJECTS

Waller Creek by Michael Van Valkenburgh Associates, Inc., Brooklyn, NY

Buffalo Bayou Promenade by SWA Group, Houston, TX

# VITA

Amanda Nicole Gann was born near Nashville, Tennessee and grew up in a small town, Pegram. Her love for architecture and landscape began at a very young age. Growing up in the hills of middle Tennessee, she spent her days exploring the woods, building tree forts and traipsing through creeks and sugarcane fields. On weekends, she would spend time as an assistant to her jack-of-all-trades father with tools in hand and an eagerness to learn. This spirit and dedication to learning new things propelled her to excel in her studies as a teenager, graduating sixth in her class from Harpeth High School and ultimately bringing her to the University of Tennessee in 2007. Wide-eyed and enthusiastic, she plunged into the depths of the pool of design knowledge, hoping to soak up as much as possible. After completing her Bachelor of Architecture degree in 2012, she decided to continue her research in the Master of Architecture program pursuing a post professional degree. With this degree, she hoped to gain a deeper understanding of her own process and how it might engage with multiple aspects of design beyond architecture including landscape architecture, urban design and digital prototyping. After graduation, Amanda plans to head westward to work for the UNLV Downtown Design Center for the summer then move back to Memphis, Tennessee to pursue professional licensure and to hopefully make a positive impact on the landscape of west Tennessee.