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DEPARTMENT OF LANDSCAPE ARCHITECTURE

NEWPORT ON THE LEVEE 2.0

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ABSTRACT

Realizing the beauty of nature, analyzing the history of human civilization and celebrating the future sustainable urban development, this thesis is a research-based landscape design project inspired by, and design for nature. The approach is to use flooding pattern, urban ecology, and varying spatial experience as frameworks to picture a new riverfront for Newport, KY, revitalization. Proposing methodologies by which progressive landscape urbanism uses a simulated pattern to unify a city and its riverfront, this design project demonstrates those research topics and implements design ideas through a series site-specific study areas in Newport. The redesign of Newport riverfront includes a combination of natural, educational, and recreational nodes to give an identity to the community in order to increase the ecological and economic value of the area. It considers three locations, each with unique character and function, to integrate human landscapes with ecological importance, to create visual landscapes that change as water level changes, and to spark possibilities for other places to create more meaningful waterfront.

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Acknowledge

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CHAPTER 1

Introduction

Riverfronts, where the land and city meet the river, are unique, finite landscapes representing early locations of human settlement and potential localities for community enhancement. New riverfront development has been seen as an important opportunity for cities to improve their socioeconomic conditions and become sustainable locations for development (Watson et.al., 2011).

With the increasing rate of extreme weather events caused by climate change, many inland cities that are situated along river are constantly been challenged. Places such as Cincinnati, OH, and Newport, KY, increasingly face serious impacts from annual flooding of the Ohio River following strong seasonal precipitation and snow melts (National Weather Service, 2016, Web). Additionally, due to the industrial uses along much of the river, the level of contamination of the Ohio River is very high (EPA, 2012); the high level of water contamination in the Ohio River further raises concerns about the wellbeing of human and riparian wildlife along its banks.

Levees are not the only solutions for minimizing the damage, nor methods that cut the river-city connection. Recognizing the value and potential of floodplains, this research-based design project brings a new resilient and permeable perimeter to the city riverfront through reclaiming land for riparian ecosystem, increasing pervious surfaces for natural discharge and reconstructing visual and physical access from the inland. Those changes are feasible for implementation, valuable for natural habitats, convenient for post-disaster maintenance, and meaningful for residents in this area.

The development and revitalization of the Newport riverfront represent a multidisciplinary and multitask challenge. Generating a new urban form and integrating a living infrastructure to make cities more vital and communicative, the resulting form emerges as a network of functions and osmotic interface that can be cultural, educational, ecological, productive, and public.

CHAPTER 2

The Ohio River

The Ohio River is a 981-mile-long river and one of the most important tributaries to the Mississippi River. Starting at the confluence of the Allegheny and the Monongahela Rivers in Pittsburgh, PA, and ending in Cairo, IL, the Ohio River flows westward into the Mississippi River (Figure 2.1). The river flows through or borders six states: Pennsylvania, West Virginia, Ohio, Kentucky, Indiana, and Illinois. Moreover, more than 3 million people rely on the Ohio River as their source of drinking water. Over 25 million people, about 10% of the US population, living in the Ohio River Basin (Ohio River Foundation, 2017).

2.1 History

The Ohio River had great significance in the evolution of human civilizations. In the past, Native Americans used the river as a major trading route for transportation. Settlements and communities depended on its waters for living and sustaining themselves. During the westward expansion of the early US, the river was a primary transportation route for pioneers. In addition, during the 19th century, the river was the border between free and slave territories (Bright, 2011). The Ohio River has been important to American history in the region and continues to serve future development.

The development of cities, such as Chicago, Pittsburgh, Baltimore, and Cincinnati, all relied on significant relationships to rivers and other local bodies of water. Though those former powerful industrial cities started to shrink during the late 20th and 21st centuries, with the rising awareness and investment toward city revitalization and inner-city development, there has been increasing development of urban infrastructures and amenities in many of the inner cities in the

Figure 2.1. Ohio River and Its Major Cities in the U.S.

US (Alder et al., 2012). In those cases, floodplains and coastal communities witness both historic and modern urbanization. These are the "new frontiers" of development and the places full of potential to become green space and recreational amenities for city recovery (Watson et al., 2011).

2.2 Industrialization of Major Cities Along the Ohio River

Over the past 200 years, the aquatic ecosystems in the US have been abused by "human activates through dam construction, stream channelization, discharging wastewater and clearing riparian vegetation" (Hupp et al., 2009, 33) (Figure 2.2.1). The Ohio River is a naturally calm and shallow river. The natural depth of the river varies from about 3 to 20 feet. From the river origin to Cincinnati, the average depth is approximately 15 feet. However, it was artificially deepened by a series of dams and straightened by modifying banks through construction of levees and channels (Ohio River Foundation, 2018). The dams cause the water level raising and, in many cases, lead river to change its floodway to into a series of reservoirs. Manmade structures eliminate shallow stretches and allow for commercial navigation. Consequently, the alteration of river flow, coupled with urban development, caused a series of environmental impacts on water quality, aquatic life, and the riparian ecosystem.

Nowadays, the Ohio River "remains a working river that cuts through the heart of American industry" (Bruggers, 2015, 7). The water quality of the river has been improved significantly compared to what it was 50 years ago, like many other water bodies along the industrial cities, the Ohio River was used as the dump (Bruggers, 2015). However, according to the U.S. Environmental Protection Agency's (EPA's) Toxic Release Inventory 2015, the Ohio River topped the nation's waterways for pollution discharges from industry. The amount of

HYDROLOGICAL ANALYSIS
River Problem Caused by Urban Development

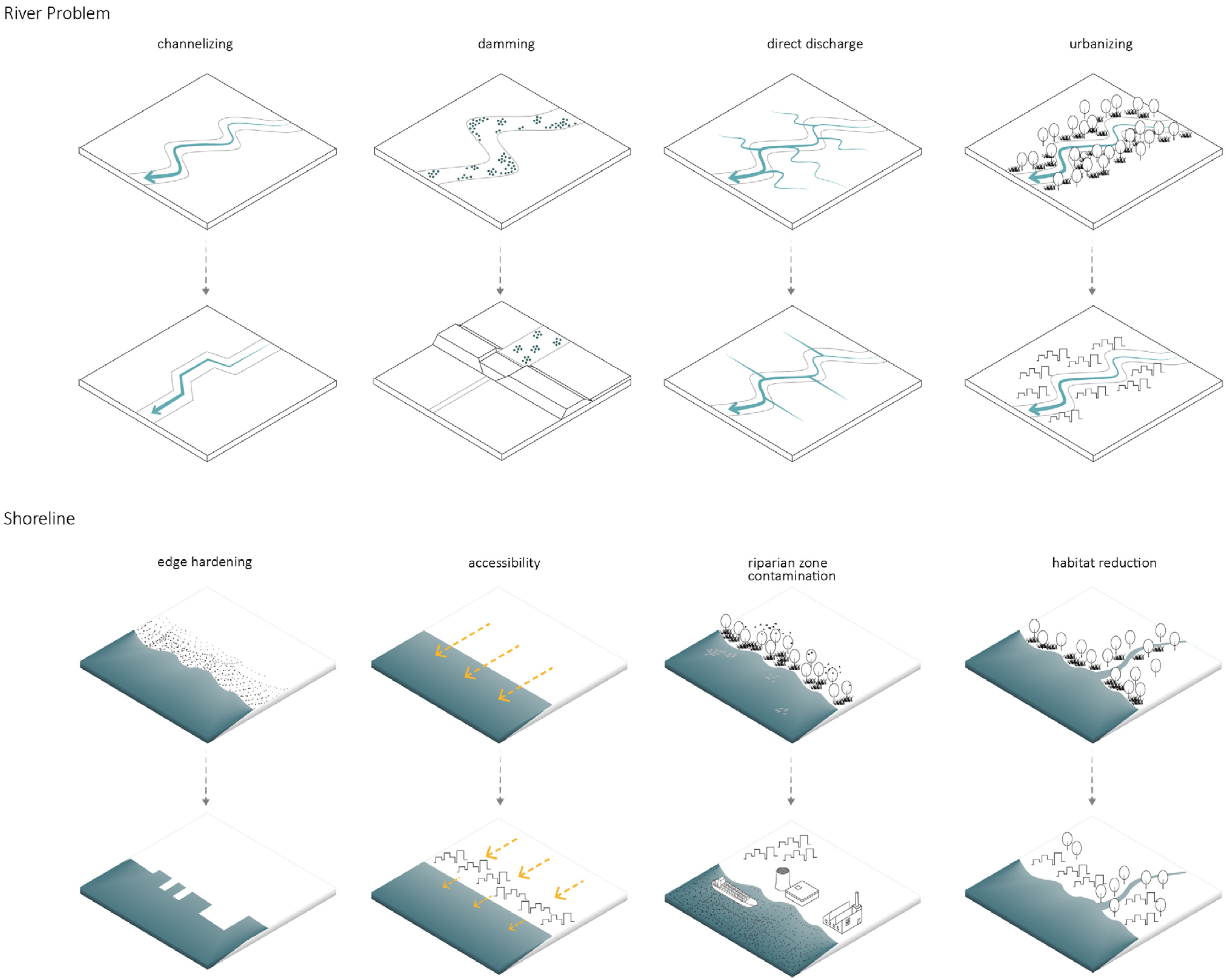


Figure 2.2.1. Hydrological Analysis

discharges is more than twice of what industries pour into the Mississippi River, which ranked second in toxic discharges. The Ohio River has been ranked as the most polluted body of water in the U.S. since 2001 (EPA, 2012).

Industrial sites along the Ohio River are the major point sources of water contamination. From the early industrial era to the present, acid mine drainage (AMD), with a large amount of sulfur and high concentrations of metals, has become a major source of water quality problems for the Upper Ohio River and its tributaries (EPA, 2012). A wide array of contaminants, including heavy metals, organic compounds, petroleum products and radioactive material, constantly discharge into the Ohio River from industrial sites from its banks. With the declining of industry in the region, some underused industrial sites and improperly managed brownfields become a continuous source of concerns to the environment (Ohio River Foundation, 2018) (Figure 2.2.2).

Furthermore, non-point-source pollution discharged from urban runoff and agricultural activities along the Ohio River contributes significant amounts of contaminants to the river. Urban runoff seems to be a minor component; however, it actually causes a tremendous impact on water quality (EPA, 2003). As runoff is deposited and accumulates in the river, it can be harmful to aquatic life. In urban and suburban areas, the land surface is covered by large areas of impermeable pavements, which means that rain and snowmelt often is unable to infiltrate into the ground. Aside from blocking water to be naturally discharged into groundwater, such broad presence of impermeable surfaces leads to storm water carrying pollutants left from vehicles into nearby river and streams. In addition, because agricultural lands tend to contain excessive amounts of fertilizers and pesticides, major rainfalls flush chemicals and minerals from farm fields into water bodies, which affect the nutrient balance in surface water and in excessive

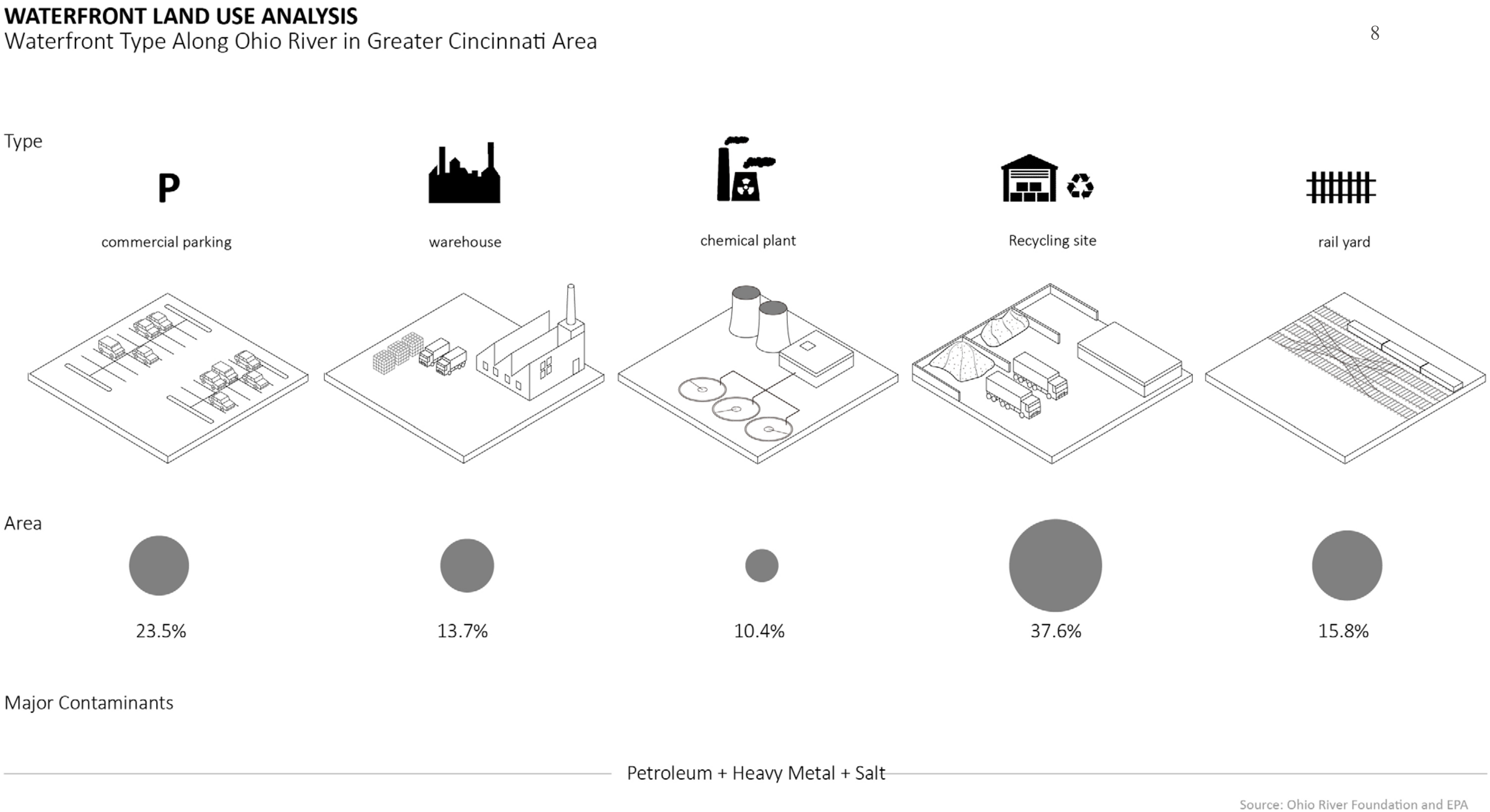


Figure 2.2.2. Major Types of Insutrial Land Use

instances lead to water eutrophication (EPA, 2011).

Even if the water of the Ohio River is not ideal for recreation, there still are considerable amounts of activities that take place in major cities along the Ohio River, including fishing, boating, swimming competitions and so on (ORSANCO, 2009). From an urban planning and design perspective, better development and management practices should be implemented to help reduce sewage overflow and storm water runoff, as well as maintain a safe and healthy environment for aesthetic and recreational purposes.

CHAPTER 3

Cincinnati, OH and Newport, KY

Situated at the confluence of the Ohio River and the Licking rivers, Cincinnati was settled in 1788, and Newport was founded shortly thereafter, in 1791. Thanks to their locations, city size and their population experienced rapid growth during the industrial era. The success of Newport is closely associated with the City of Cincinnati (Figure 3.1). Today, Newport is considered as a satellite city of Cincinnati and an important part of its Metropolitan Area. From 1900, Newport has been the third largest city in the state of Kentucky. By the end of the 19th century, railroads took over the role of steamboats for freight shipping. As transport modes changed, so did the trade patterns and city landscape (Condit, 1977). Even now, large tracts of land in these cities are used for rail yards or isolated for rail tracks.

In terms of recent waterfront development on the Cincinnati side, two city arenas, Paul Brown Stadium and Great American Ball Park, play major roles on the waterfront, attracting thousands of fans during the sports seasons. Opened in 2012, the Cincinnati Smale Riverfront Park was lead-designed by two firms, Sasaki Associates and KZF. It is intended to reconnect downtown to the river and to link the existing riverfront parks along the river (Cincinnati Parks, 2013). As a good example and reference for other riverfront space in the region, Smale Park has not only become a lively place for community gathering with great views, but it also accommodates seasonal flooding along the river edge through a series of terraces.

Newport, KY, is an important source of entertainment for the Cincinnati area and one of the fastest growing communities in northern Kentucky, with a current population of 15,000 (City of Newport, 2015). The Newport riverfront is a vibrant place for people’s daily leisure activities as well as diverse community events. Developed in the 2000s, “Newport on the Levee”

TIME LINE

Historical Events of Newport, KY, Parallel to Cincinnati

Cincinnati Founded
named "Lousantiville", meaning, the opposite side of Licking River
1788

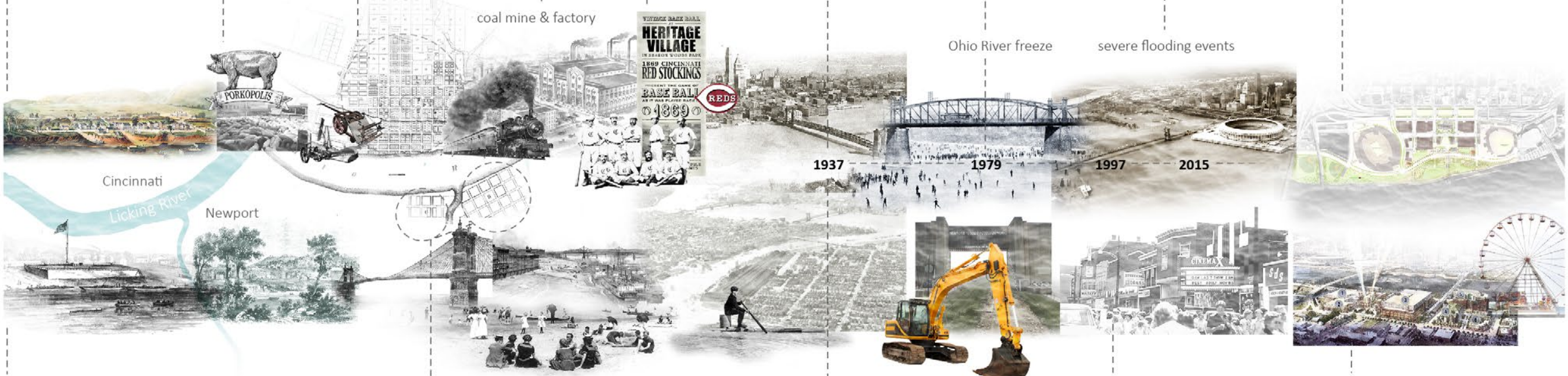
meat packaging and agriculture core in central US.
1800S

1819 First City Plan

Cincinnati Reds Founded
world first professional baseball team
1867

1937 flood, the worst nature disaster in history

Cincinnati Riverfront Smale Park
city major waterfront park with 2 arenas
2012



1789
Fort Washington built to protect settlements

1791
Newport Settled

Newport & Covington were included in city plan

By 1900
Newport became the 3rd largest city of KY

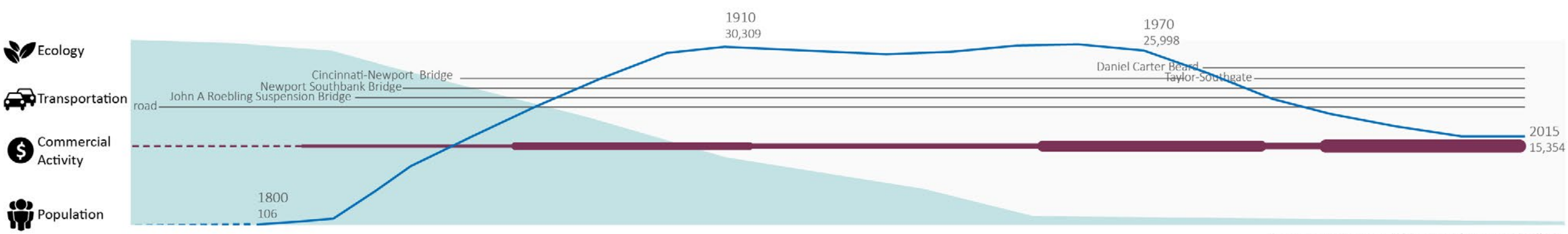
Worst nature disaster

1948
Completed Flood wall

1940-1980
Newport became a gambling hull

1999
"Newport on the Levee", commercial center open

Sources: Ohio River Foundation & City of Cincinnati



Source: US. Census, Ohio Foundation and Zillow

CURRENT

Figure 3.1. Cincinnati and Newport History Time Line

is a major riverfront commercial center in the Greater Cincinnati area. The center consists of a complex of an aquarium and an entertainment center, supplemented with shops and restaurants. A $13 million sky wheel project has been proposed and at Newport on the Levee since early 2017. And it aims to be open in late 2018 (WLWT, 2017). It is believed that the wheel will bring more people to this space and further promote Newport on the Levee as a regional entertainment center. Below the wheel, the riverfront terraces include two levels. The upper level is often used for events, activities, pedestrian and parking, while the lower level that is closer to the water body is primarily purposed for parking. Several river boat floating restaurants draw crowds to the riverfront. At the confluence of the Ohio and Licking rivers, General James Taylor Park, a small park built on the site of an historic fort, overlooks the two rivers and Cincinnati skyline. On the other side of the levee, a large open grassy area provides a ready-to-build site and a prime location for future development. Newport government has announced a $800 million investment for this area as a mixed-use development. FC Cincinnati, a United Soccer League club, is also eyeing for this land as its potential future home (Williams and Wartmen, 2017).

3.1 City and Flooding

Extreme weather events, geographic harshness, and poor urban development all challenge to future urban design. Urban flooding is a major concern for localities along rivers (Figure 3.1.1). The tragic weather events caused by Hurricane Harvey in Houston in 2017, Hurricane Sandy in Atlantic Coast in 2012, and in many localities in heavily developed Asian cities in recent years, bring people's attentions to the consequences of water-related impacts on poor urban development, and question the future urban planning strategies.

Flooding is a natural process. It may occur as an overflow of water from water bodies

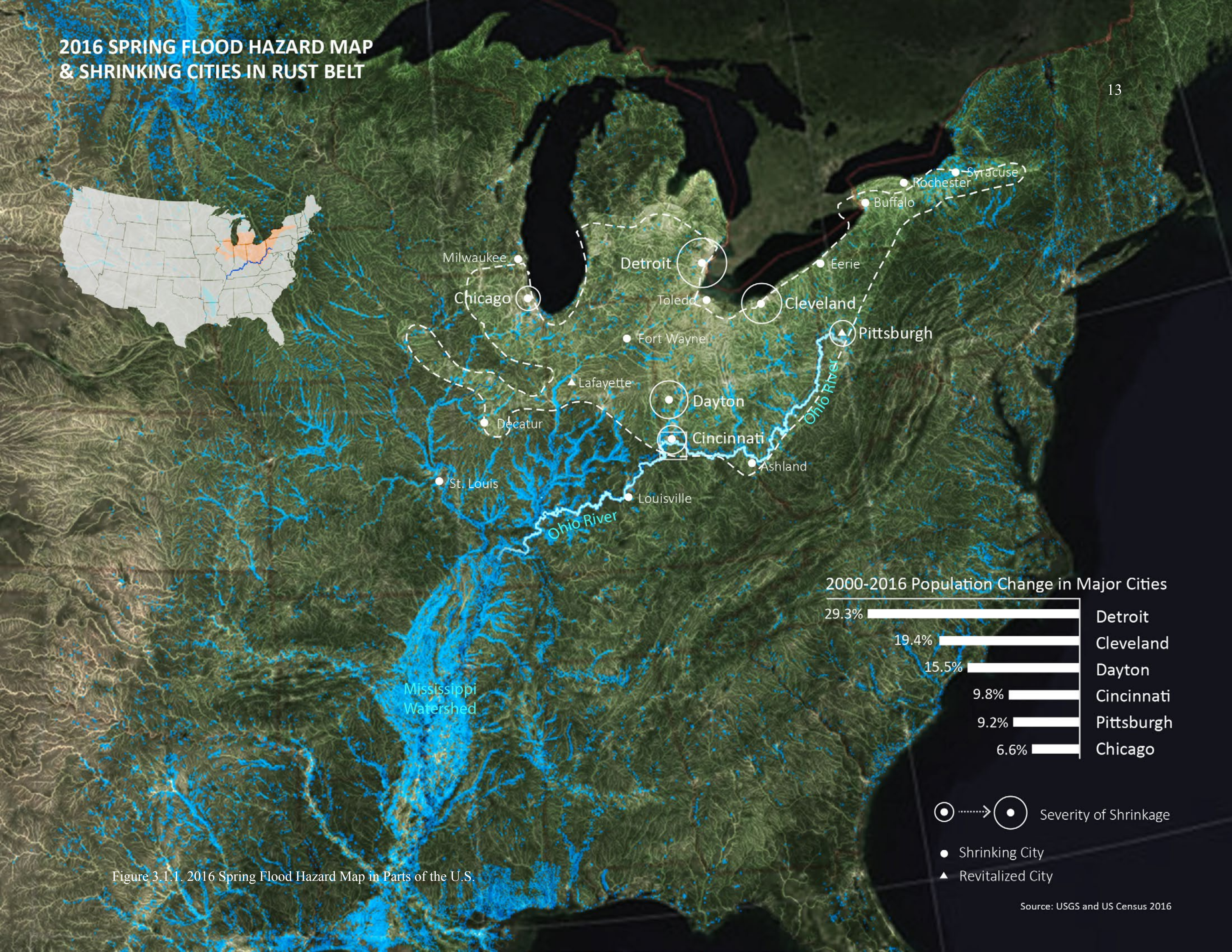


Figure 3.1.1. 2016 Spring Flood Hazard Map in Parts of the U.S.

due to the flow rate exceeding the capacity of its original containing feature, including rivers, lakes, or wetlands, in which case water to escape from its usual boundaries. Flooding may also happen due to an accumulation of rainwater on saturated ground, following heavy storms. In the current world, climate change and questionable urban development strategies accelerate the rate and impact of flooding, in many cases leading to extreme consequences. Flooding not only causes economic losses to developments, but can also introduce long-term health issues. For example, during particularly heavy rainstorms, raw sewage can be discharged directly into a river at hundreds of points along its length; exposed brownfields also become sources of varies types of pollutants (Bates et al. 2008). Unfortunately, near the confluence of the Ohio and Licking rivers – in Cincinnati City Center and Newport areas – several large exposed point sources can be identified easily (Figure 3.1.2).

Unless flooding affects important properties, such events often are not considered significant. However, waterfront areas respond to natural changes in water volume in different ways. Climate change is projected to increase the magnitude and frequency of intense precipitation events in the near future (Bates et al., 2008; IPCC, 2013). In addition to infrastructure, these changes will also greatly impact the interaction between rivers or streams and their riparian zones, affecting vegetation dynamics as well as soil formation and re-nutrification processes.

As a typical inland river, the size of the Ohio River changes constantly with seasonal changes in precipitation and snow melt (Figure 3.1.3). Historically, Greater Cincinnati suffered its worst natural disaster in 1937, when a flood covered a great part of both the waterfront and the inland settlements in this location. A levee system was constructed in Newport in 1948, and remains a significant part of Newport’s landscape (Havern, 2011); City of Newport, 2015).

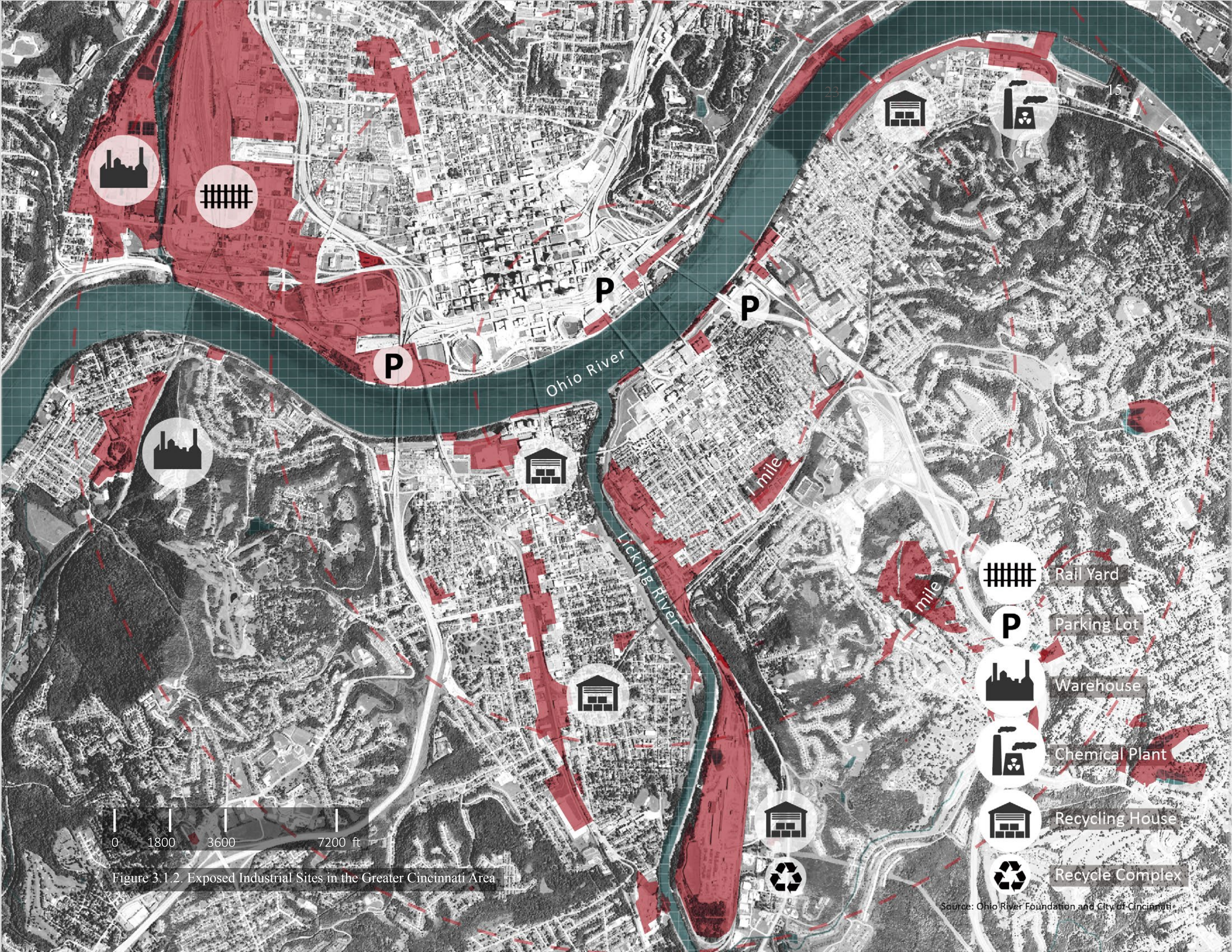


Figure 3.1.2. Exposed Industrial Sites in the Greater Cincinnati Area

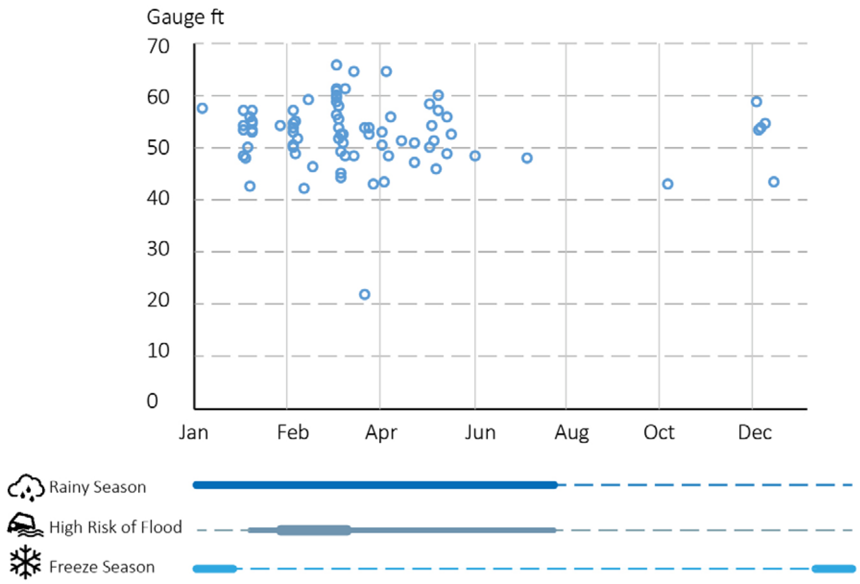


Figure 3.1.3. Recorded Past 70 Years Ohio River Flood Events in the Greater Cincinnati Area

Though the levee protects the Newport from flooding with its 60 feet of height, in a very real sense it separates the city from its riverfront. Based on the U.S. Federal Emergency Management Agency (FEMA) 100-year floodplain, which demonstrates identified flood hazard areas for floodplain management, a large area of the Newport waterfront is threatened by river flooding. In some of the most flooded area, the distance from the original river boundary extends more than 1350 feet into the inland (Figure 3.1.4).

The proposed design project, Newport on the Levee 2.0, recognizes the changing in water level as a benefit to riparian zone restoration, an opportunity for educational demonstration, and a design feature for the Newport riverfront. Considering the level of contamination in the Ohio River, it is not wise to place people in direct contact with the water. As a result, the goal for this project is to use the levee as a platform for people to observe the seasonal changes of the water, to understand the impact of flooding, to embrace the moderate and controlled natural events, and more importantly, to create something that is meaningful to nature and to people.

Figure 3.1.4. FEMA 100 Year Flood Plan, Source: FEMA, City of Cincinnati

3.2 Ecology Struggles

With the high impact of water contamination of the Ohio River, aquatic life and riparian ecosystems have gradually deteriorated. The increased frequency and magnitude of seasonal flooding events have accelerated this process. Approximately 164 species of fish and 80 species of mussels once lived in the Ohio River. However, due to heavy contamination of the water and the drastic alteration of river habitats by dams, only 50 mussel species still occur and five of those are in danger of extinction (Ohio River Foundation, 2012). What's more, there are warnings against fish consumption for the entire river. The State of Ohio and the City of Cincinnati specifically posted that the primary fish to avoid is catfish (a bottom feeder), which should not be eaten at all, and many other types all advised under limitations and advisories (EPA, 2012; Ohio River Foundation, 2012).

Aside from the ecological struggles of the Ohio River, the levee system also alienated the city and its waterfront relations. Since the 1989 release of the updated Newport Comprehensive Plan 2015, "no development had occurred within the floodplains of the Ohio and Licking Rivers except roads, bridges and floodwalls" (City of Newport, 2015, 3). From an ecological perspective, the city has not designated natural habitat area. Development has eliminated natural habitat for vegetation and wildlife. Luckily, numbers of typical wildlife species, including birds, fishes, and amphibians, have been spotted in the confluence of the Ohio and Licking rivers, which indicates the potential for improvement (Figure 3.2.1). The less developed areas, including hillsides, river banks and floodplains, provide a natural space for a greater variety of plants and animals (City of Newport, 2015).

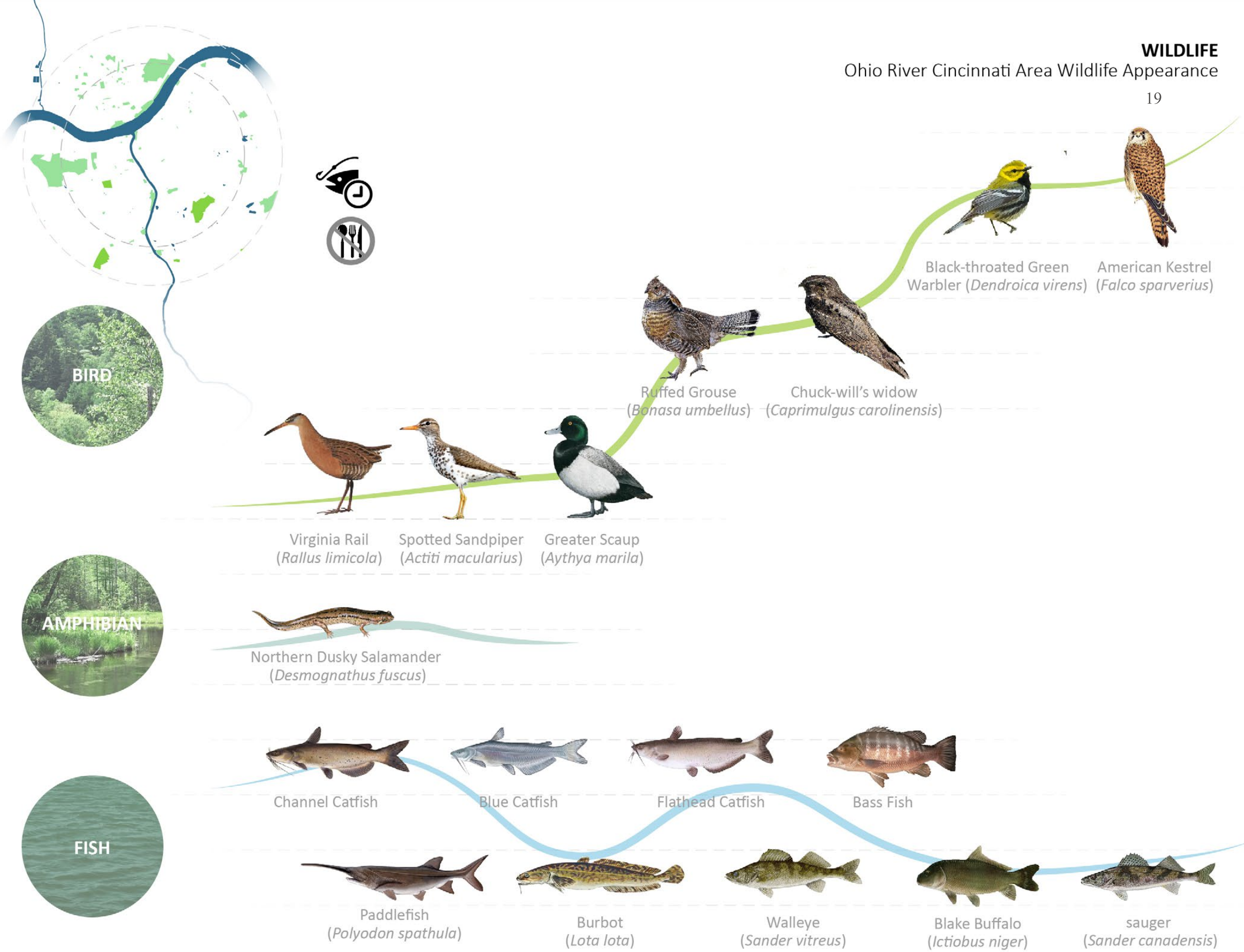


Figure 3.2.1. Wildlifes That Have Been Found in the Area

Source: Ohio River Foundation

CHAPTER 4

Case Studies

Current cities have been designed, in part, in response to problems that happened before. With the rising population, climate change, and economic challenges, the general public has come to realize that we cannot afford to rebuild after all extreme events or overlook aging infrastructures and pollution that are affecting our quality of life. In addition, designs should be adaptable to the ever-changing environment, now and into the future.

"Rebuild by Design," which is a partnership of governments, communities, designers and planners, uses collective power to reimagine ways for communities to deal with the challenges that tomorrow brings (RebuildByDesign.org, 2015). Through intensive research, collaborative design and community outreach, several large-scale, complex projects have been proposed after Hurricane Sandy devastated New York coast in 2013. "Living Breakwaters" and "Oyster-tecture," proposed by SCAPE Studio, a landscape architecture firm based in New York, aim to reduce wave intensity and clean water by using small architectural intervention and borrowing nature's hand (SCAPE, 2014). The approaches proposed include adding subtle levee systems in the sea as wave reducer and oyster reef. "BIG U," in turn, is a project for lower Manhattan waterfront led by BIG Architects. The goal is to generate a future city waterfront that is adaptable for different uses and weather conditions. Though some of these proposals have not yet been implemented, they provide designers and communities with a better understanding of what is possible in future city planning, explicitly recognizing the city-nature relationship as well as the power of process that leads to a better outcome (Rebuild by Design, 2015).

4.1 Case Study 1: New York "Big U"

Proposed by Bjarke Ingles Group, et al.;

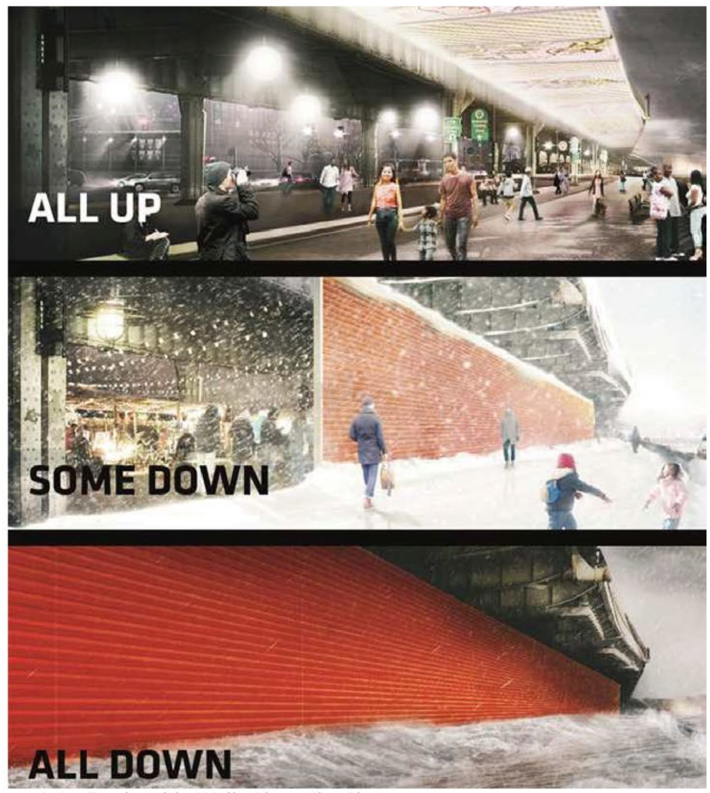
Current Status: On-Going and partially Implemented

"Big U" is a city-scale research based resiliency planning proposal for future lower Manhattan waterfront, which is threatened by climate change. After Hurricane Sandy in 2013, New York City decided to enhance the flood-proofing of its shores. Proposed by planners and designers in partnership with the city and communities, the plan reflects "landscape architecture as public realm, design as policy, and urban planning on an architectural level," (BIG, 2016). A 3.5-mile-long linear protective system, the "U," encircles the Manhattan shore, responding to needs from diverse communities (Figure 4.1 a.). Among planning efforts and research studies, some design ideas are worth noticing as inspirations. For instance, on the Lower East Side, a bridging berm system provides vertical protection for the inland from storms and the rising sea. Routes, activity spaces, and parks lie as integrated compartments in the berm, providing a resilient urban habitat (Figure 4.1 b.). Moreover, between the Manhattan Bridge and Montgomery Street, deployable walls attached to the existing infrastructure have been proposed, providing protection which can be flipped down to prepare for floods. The panels, decorated by locals and featuring lighting on the ceiling, transforming this currently menacing area into a safe destination (Figure 4.1 c.). Additionally, the plan also envisions new environmental education facilities that not only protect the financial district from flooding, but also functions as a tidal observation center (Figure 4.1 c.) (City of New York, 2018, Web).

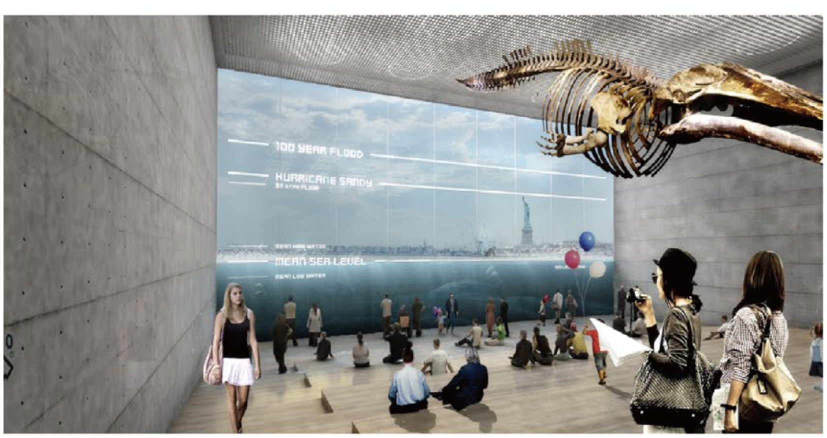
Empowered by collative design and planning efforts, the project explores ways to prepare for the future based on existing conditions. One cannot propose a site design only for its own sake; it is essential to take different perspectives into design consideration, and narrow attention down from larger into smaller design scale issues to address particular challenges.

4.1 a.Big U Manhattan Plan

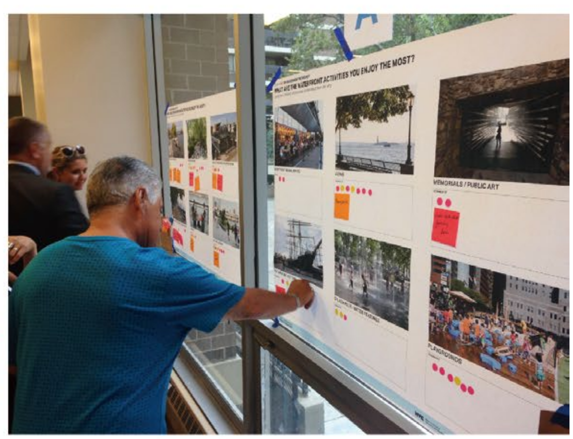
4.1 b."Berms", Waterfront Park System



4.1 c.Deployable Walls Along the Shore



4.1 d.Tidal Observation Building



4.1 e.Community Involvement

Source: All Photo Credit to BIG

Figure 4.2. "BIG U" Manhattan Waterfront Planning Proposal

4.2 Case Study 2: Yanweizhou Park Jinhua City, Zhejiang, China

Designed by Turenscape; Current Status: Completed

Yanweizhou is a wetland situated on the confluence of two rivers in Zhejiang Province, China (Figure 4.2). The cultural facilities are constructed among fragmented riparian wetlands and sand quarries, where a great number native animal and plant species had started to use the land as habitat. The landscape design team recognized the value of water-city and human-nature relationships, and connect riparian landscape to strengthen the ecology, community and cultural identity of the city. One of the adaptive strategy was to develop designs following the natural flooding pattern and mix newly designed landscape into existing riparian topography and sand quarries, with minimum intervention to help preserve and increase biodiversity of the site (Landezine, 2015, Web).

The water resilient terrain and planting design along the riverbanks and riparian flood plains are inspiring to other designs for flooding, especially for the Newport redevelopment project pursued in this thesis. A series of walls and permeable planting areas serve as the intimate connection between the human and natural landscape. At the same time, they ultimately reduce the destructive force of the annual floods. This is a landscape that reveals and celebrates flooding.

4.2 a.Yanweizhou, full site ariel photo when dry

4.2 b.Yanweizhou, full site ariel photo when flooded

4.2 c.riparian terraces

4.2 d.flood resistant bridge

Source: All Photo Credit to Turenscape

Figure 4.2. Yanweizhou Ecological Park

CHAPTER 5

Design Proposal

Grounded on the research about the Ohio River, Newport city history, development pattern, ecological condition, and future potential analysis, and combined with knowledge of landscape system and design theories, this design project aims to create a hypothetical landscape system that accommodates both nature and human usage for Newport waterfront. The goal is to become a meaningful landscape for locals and educational about regional ecology. It is also designed to become a reference of flooding resilient landscape design for other places along the Ohio River.

5.1 Newport Study Areas

In the case of Newport waterfront, what is needed is a place that adapts to a shifting water volumes and changing demographics of the community over time. At the same time, it must reconnect the city and its waterfront to stimulate economic growth and bring its own identity other than a place shaded by Cincinnati. In order to increase investment, the space should be able to conform to evolving ways people use public space differently in different times. It is also important to be sustainable to strengthen the investment over the long-term.

The downtown Newport waterfront parallels the Cincinnati waterfront, starting from under Daniel Carter Beard Bridge to the confluence of Licking River, near 4th Street Bridge connecting with Covington County (Figure 5.1.1). The 1.3-mile waterfront is separated from inland areas by a continuous levee. This short and narrow stretch of land formed by the levee features different landscape characteristics and uses. This study focuses on incorporating three study areas (shown on Figure 5.1.1) into the overall design as prototypes, each of which will

Figure 5.1.1. Newport Site Context

bring different functions, and design elements to the overall site.

Study Area 1 is located near the central portion of the Newport waterfront, extending down from the commercial center, Newport on the Levee (Figure 5.1.2). The commercial buildings and city aquarium are incorporated as parts of levee's top level, which is the center plaza of this commercial hub with great views of the Cincinnati skyline. As one of the most vibrant places in the greater Cincinnati area, this locality has been a welcoming space for families, residence, businesses, holiday gatherings and social events. Below the architecture are two lower levels of terraces connected by grass slopes to the water. The mid-level terrace often is used as a gathering space for events, including seasonal celebrations, small concerts, etc.

The focus of the Study Area 1 redesign is to enhance the user experience by providing a more pleasant and organized mid-level events space. The lower level terrace will be transformed into a natural walk distinguished from the mid-level in its function and user experience.

Study Area 2 is located where the waterfront connects to a floating restaurant (see Figure 5.1.2). The human footprint here is relatively small compared to Study Area 1. People use this space mainly to park cars, gain access to the restaurant, or for passing through. Considering that this terrace is primarily used for parking with the short distance to the river, there is a high potential of water contamination caused by parking lot runoff (see Chapter 3). Similar land use can be found in other places along the Newport waterfront and across the river below the Cincinnati sports arenas.

The proposed design for Study Area 2 aims to increase the awareness of storm water management and inspire better design practice near the water body. In order to create an environmental friendly parking lot and pleasant dining experience, the strategies include reducing parking spaces, incorporating them into the landscape, and managing parking lot runoff in a visually appealing manner. The levee should become a medium for residents to connect with the river and use for activities. Additionally, on the other side of the levee, an apartment complex and an open field waiting for development bring a residential component to the overall site.

Study area 3 is near the Licking River (Figure 5.1.2). It is a quiet setting, with an unmanaged and naturalistic riparian condition. Due to small human and structure footprint and low usage of the space, the waterfront can be left for nature to thrive. Therefore, it is designated as a unique space to showcase riparian ecology.

5.2 Design Concept

According to Christopher Alexander, an influential architect and design theorist, "determining shapes is essential in order to create positive outdoor spaces" (1977, 23). Defining a pattern language provides basic design templates that synthesize rhythm and coherence of a space. When creating a landscape for both human and ecosystem, right forms not only give boundaries to each program area and activity zones, but also allows to achice a balanced situation (Alexander, 1977).

How should one generate a pattern that is suitable to land and water as well as built landscapes, uniting stillness and motion, harsh and tender? Generally, natural systems work in small clusters - in an interconnected, free-form manner, responding to their own rhythm, cycle, and sequence. Water is shapeless. The surface of a flowing river often seems calm and peaceful, but it conceals changing velocity and containments within. These characteristics are powerful enough to erode land; on the other hand, they generate new life along the way. When the force of free form river, encounters linear, point-to-point trajectory of human activity as well as vehicular-driven city pattern, what happens in between fuses the mutual relationship of the two (Figure 5.2.1).

The exploration of form for Newport waterfront begins with inputting a basic city grid pattern. Lattices start to stretch when the source of two forces - the Ohio River and Licking River - are introduced. Some are compressed into smaller and denser pieces near the confluence, representing a higher intensity of flow and rapid sediment exchange when rivers intersect.
The Ohio River flows more calmly but with a higher rate of runoff due to its straight and wide waterway. Accordingly, Study Area 1 has larger and more uniform cells in its associated lattice, compared to Study Area 3 near the Licking River, where the total runoff is significantly lower

Figure 5.2.1. Concept Plan and Reconceptualization Diagram

but the current is more rapid. Therefore, this methodology of pattern simulation and its graphic representation becomes the pattern languages for this waterfront design.

The design is also inspired by the mechanical concept of tooth wheels transferring motion and changing speed in industry use. A tooth wheel is a mechanical invention that looks very simple and works easily, but has anchored many machines' key operations. It is "a wheel with periphery projections at an equal distance apart, with corresponding indentations or spaces into which the teeth of the corresponding teeth can fit with ease" (Scientific American, 2018, Web). By including wheels at different angles, the motion is able to be transferred from the motor and cause movements.

The lattice form sets the geometric outline for the waterfront, yet the concept of tooth wheel conveys the core idea of connecting the riparian area to the city in relationship to the river. The relationship of river and city can also be translated and represented by this connection (Figure 5.2.1 Diagrams). If a river is seen as one tooth wheel and city as the second, in order for two to work the best together, the periphery has to fit and respond to each other. Therefore, a resilient riparian zone is the key in this relationship. In many senses, the condition of a riparian zone determines whether people percept the river as a city's backbone, natural refugee, or leisure area. In contrary, an unpleasant environment may also alien the public from the water. For the purpose of this project, it is to helps to shape the relation of people and river by enhancing and recreating an attractive riparian environment for people and nature.

Bringing a conceptual pattern to the resilient ecological waterfront and applying to three focused areas, a set of prototypes for Newport waterfront are generated.

CHAPTER 6

Design Implementation

6.1 Study Area 1

The first design prototype in Study Area 1 is situated along the Ohio River with most circulation and activities. Based on the conceptual plan, the lattices pieces in this area are bigger in size with more uniformity presenting the level of high runoff and frequency, as well as a higher amount of river sediment. The goal is to combine the conceptual landscape pattern with existing topography and site program to enhance the user experience, terrace connections, and aesthetic value of Newport on the Levee commercial center (Figure 6.1.1). The proposed design recognizes the existing topography in Study Area 1 to be both visually compelling and practical. The existing site layout connects two levels of terraces with the levee system, separating functions and circulation into different levels. More importantly, with the addition of landscape design, the landform allows the changing water levels to be more visible.

In terms of the design for Study Area 1, one of the main feature is a newly proposed amphitheater space which is incorporated into the existing levee slope connecting the upper Newport Plaza to middle level event space (Figure 6.1.2). The center of the amphitheater consists wider steps for seating, lying and gathering; while smaller steps are arranged around the amphitheater space for access to different levels. Blending steps with open space softens the transition between the vertical plane-levee to the rest of the area. People are welcomed to use the space for leisure and for event gathering, for example, different summer fests and live concerts (Figure 6.1.3).

In contrast to the middle and upper level terraces, the lower level, which used to be a neglected space for parking, is transformed into a flood-resistant natural path. Because the lower-level terrace and below is often fully or partially flooded, the design intentionally “sacrifices” a portion of the designed landscape to be submerged in water, including planting area, ribbon boundary and tetrapod piles. Together, they function as a safety buffer for the path. Within each planting parcel, native species that are adapted to moist or wet conditions and high contamination are planted to create artificial wetland (see Section 6.4 Plant Species for Newport Waterfront). More importantly, with changing water levels, different landscapes appear at different times. The design intentionally introduces a landscape that emphasizes flooding as a natural process and invites people to observe and appreciate it.

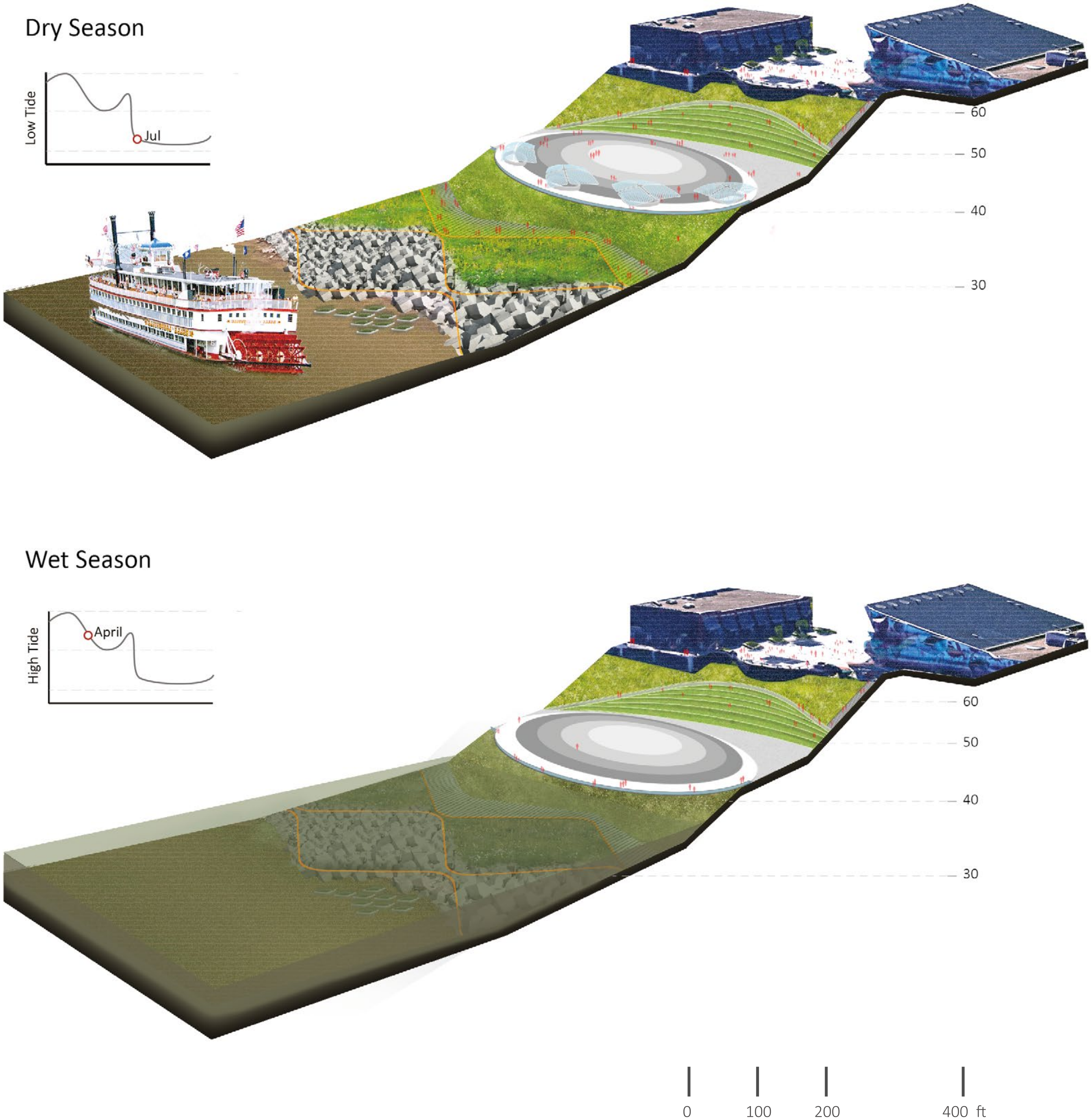


Figure 6.1.1 Study Area 1 Prototype in Dry and Flooded Conditions

Figure 6.1.2. Amphitheater on the Levee

Figure 6.1.3 Newport on the Levee Event Space

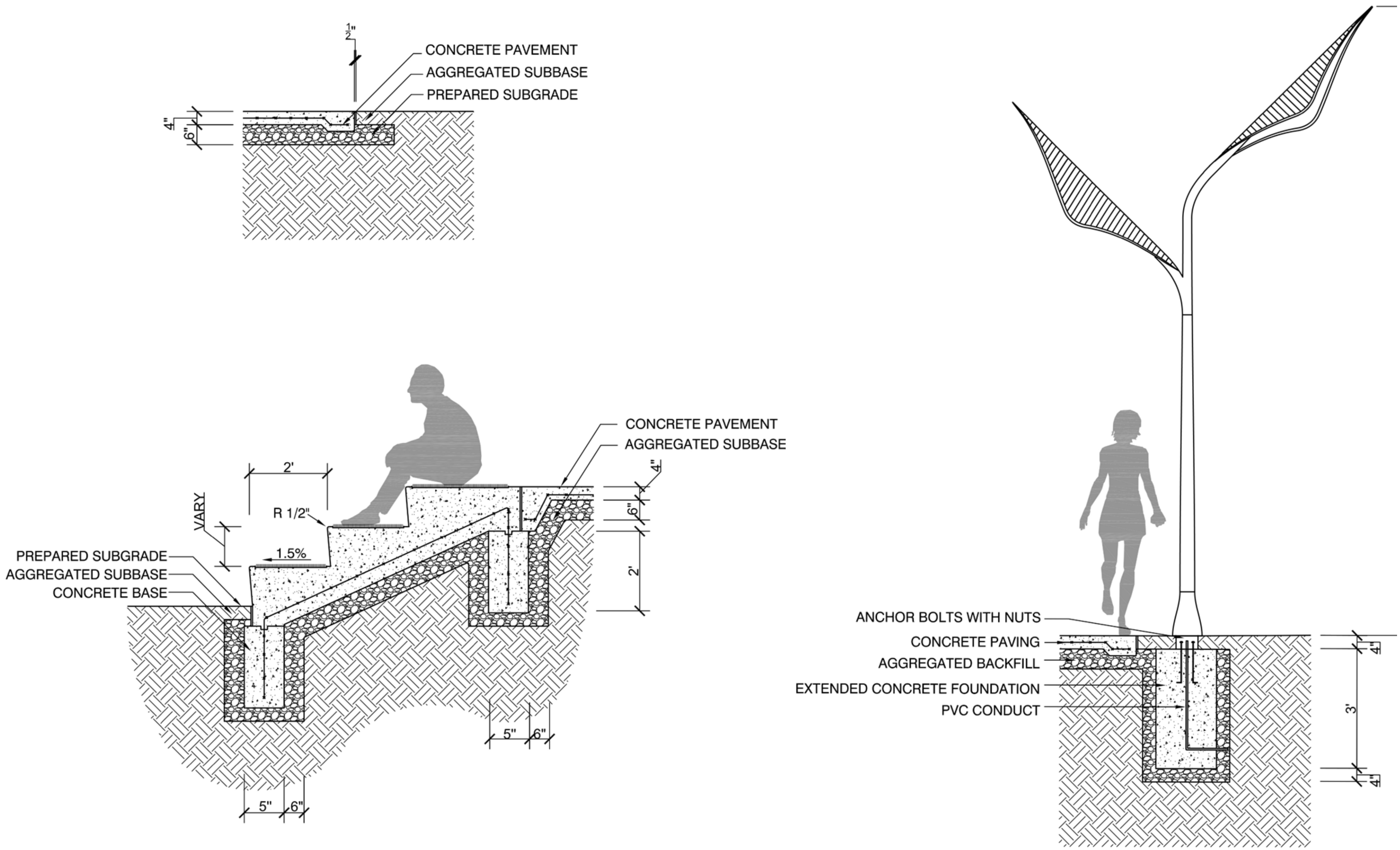


Figure 6.1.4 Typical Paving, Stairs and Light Pole Details

6.2 Study Area 2

Aiming to offer a sustainable waterfront and enhance the user experience, the design for Study Area 2 introduces a better storm water management method and diversifies the function of levee through landscape design. The Study Area 2 is near the confluence of two rivers with high rate of water and contaminants exchange. The flow pattern is less stable indicated by a mixed size of lattice cells. A gradually enlarged pattern from lower to higher level in landscape design of the Study Area reflects this variability and instability (Figure 6.2.1).

On the lower level, which used to be occupied by a large parking lot, the design replaces some of the parking with small artificial wetlands (Figure 6.2.2). Runoff from parking lots is able to be collected and filtered in the planted area before entering the river. Remaining parking spaces are arranged along the zig-zag boundary of the parcel, enabling separation of the pedestrian area from the parking spaces. Special paving elements are used in different parcels to distinguish the right of way.

On the higher level, the levee slope is divided by larger parcels for different types of plant groups to transition to the more naturalized Study Area 3 (Figure 6.2.3). The add-on structures allow the levee to provide not only flood protection, but also function as an integrated landform that is a part of the landscape, enhancing the physical and visual connection from inland to the river. Because this corner of the waterfront is close to apartment complex on the other inland side, it is expected that a higher number of people will use this space as a community amenity. When the waterfront is flooded in a moderate level, the upland levee and platform will still be accessible for observing this natural process.

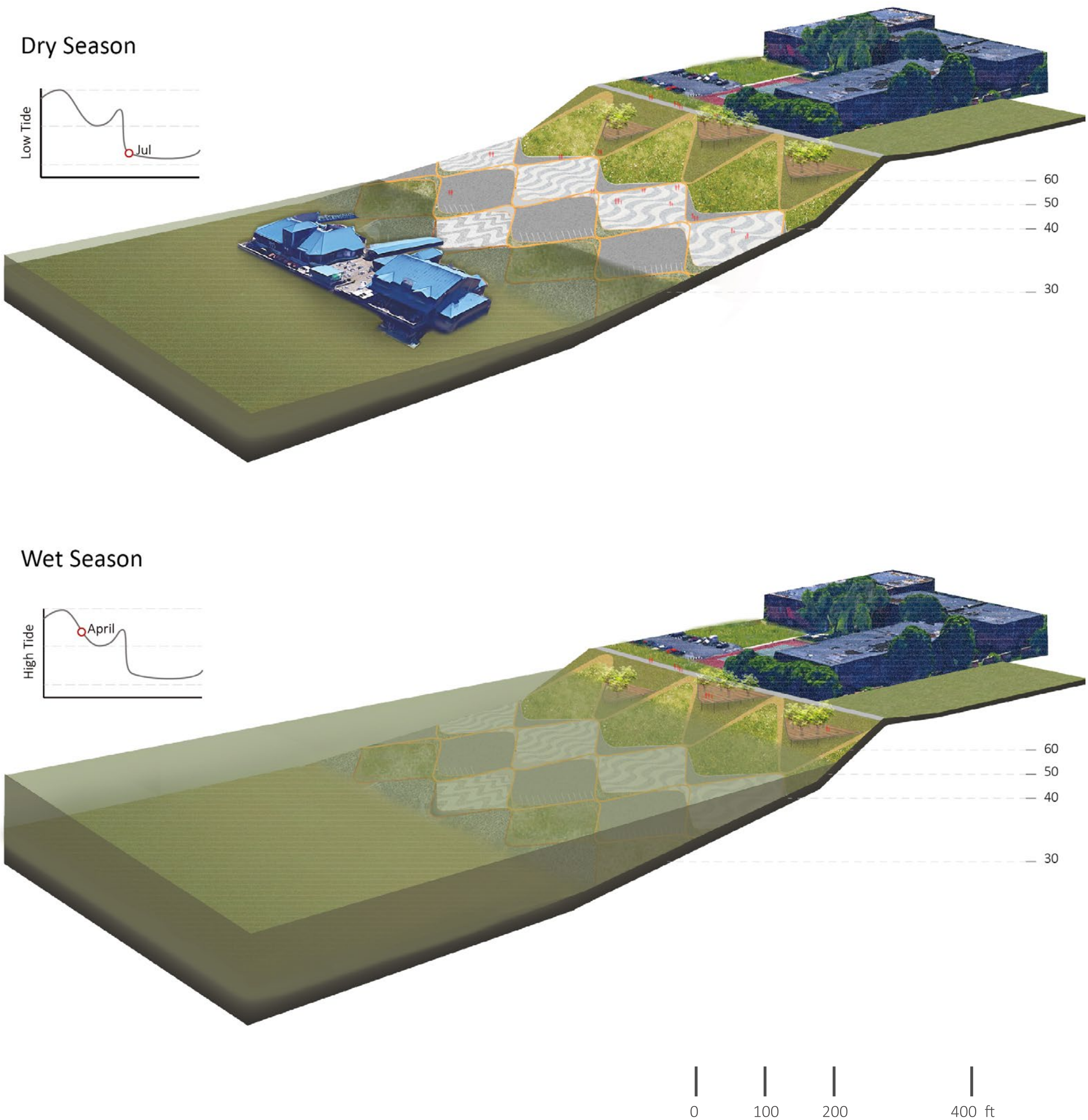


Figure 6.2.1 Study Area 2 Prototype in Dry and Flooded Conditions

Figure 6.2.2 Space as Community Amenity and for Sustainability

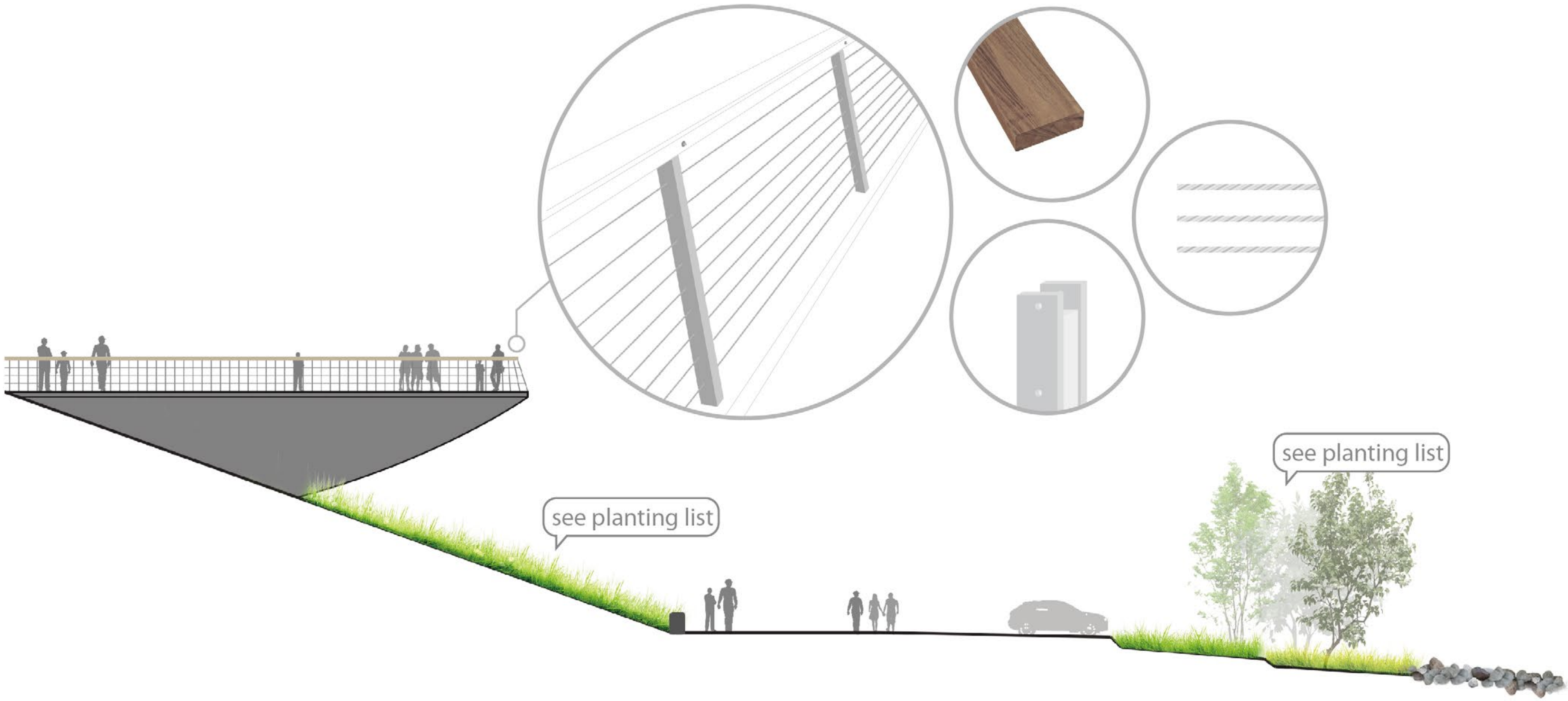
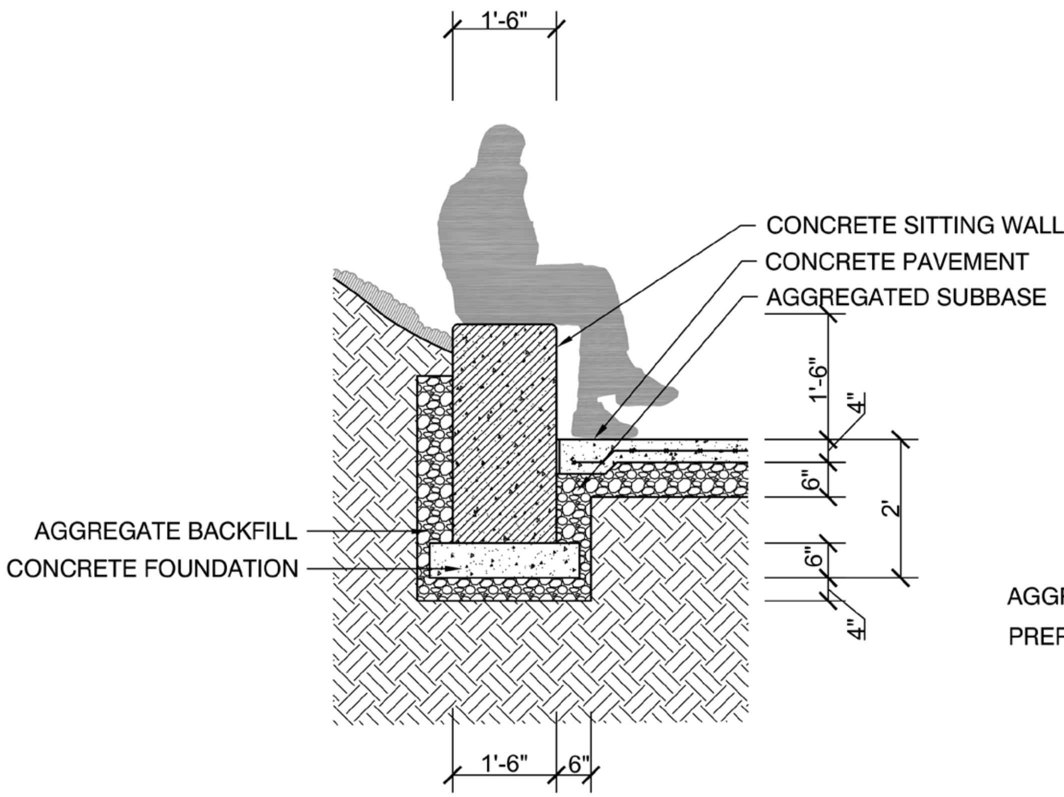


Figure 6.2.3. Implementaion Details



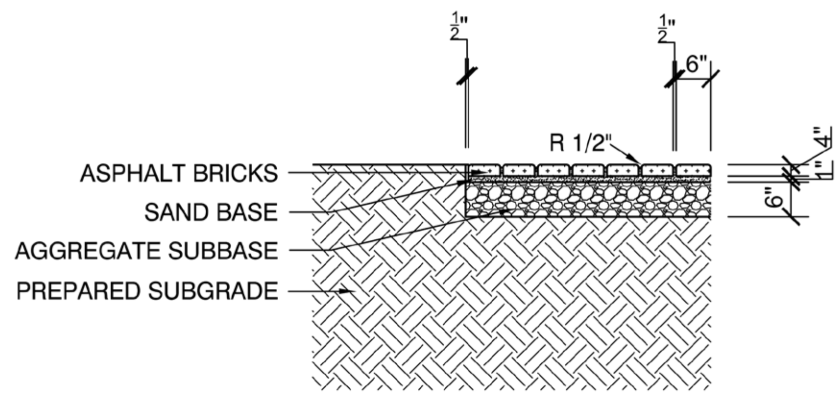


Figure 6.2.4. Typical Retaining Wall Seating and Permeable Brike Paving Details

6.3 Study Area 3

The Licking River is a narrow and calm stream with some remaining natural riparian habitants (Figure 6.3.1). The Study Area 3, located along the Licking River close to its confluence with the Ohio River, is designed to showcase regional ecology as an educational spot. The lattices for Study Area 3 are smaller and denser. A greater portion of the waterfront parcels are dedicated for rebuilding natural habitat, compared to Study Areas 1 and 2. A smaller path runs through some planted area safely, allowing people to walk into some natural space to discover riparian habitats. Along the quiet pedestrian walkway, some parcels are designed to be a children’s playground and learning spot. The design achieves this by reintroducing some neglected regional species and wildlife that are currently live in remaining manmade habitat.

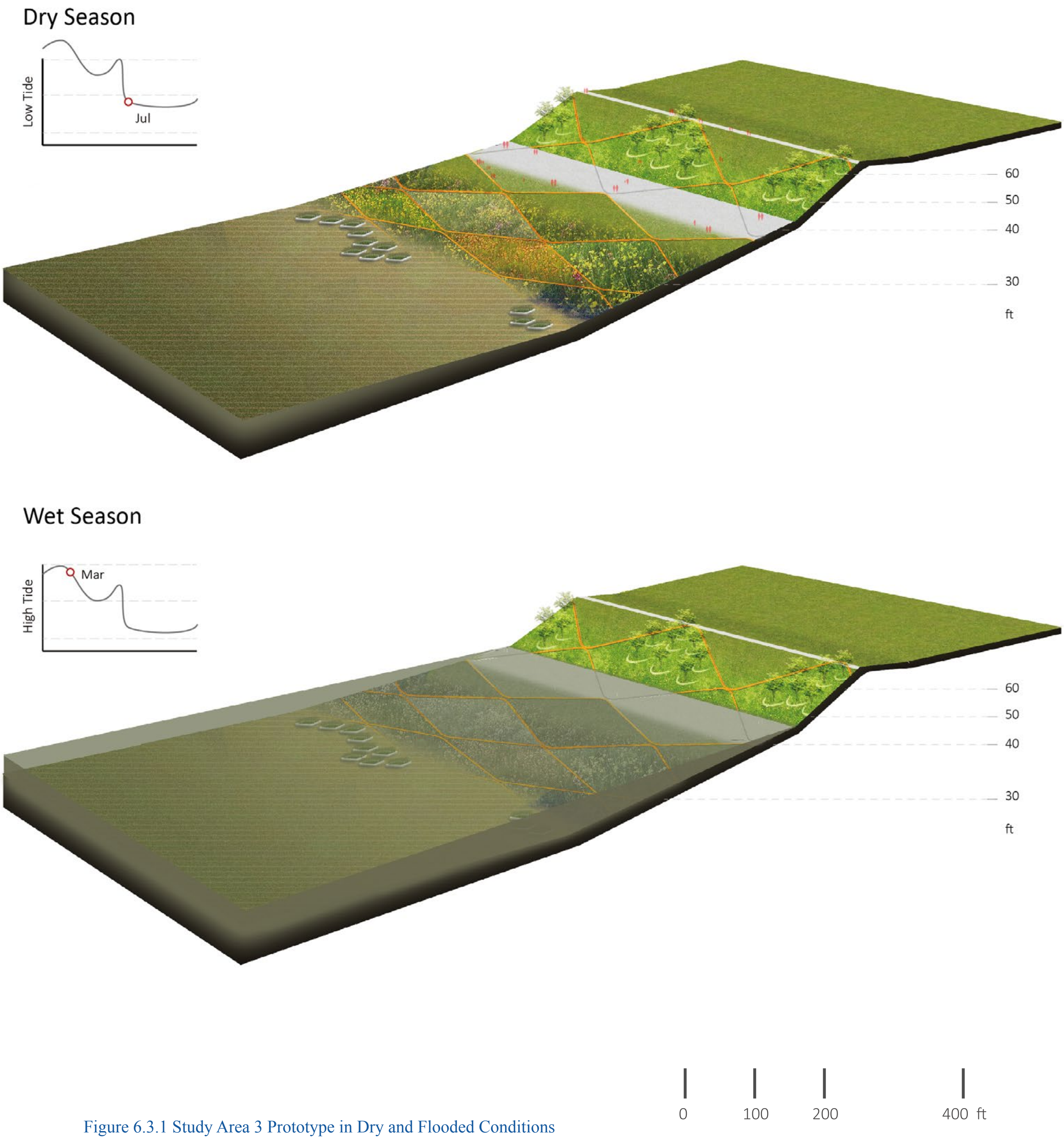


Figure 6.3.1 Study Area 3 Prototype in Dry and Flooded Conditions

Figure 6.3.1. Waterfront as Habitat and Educational Spot

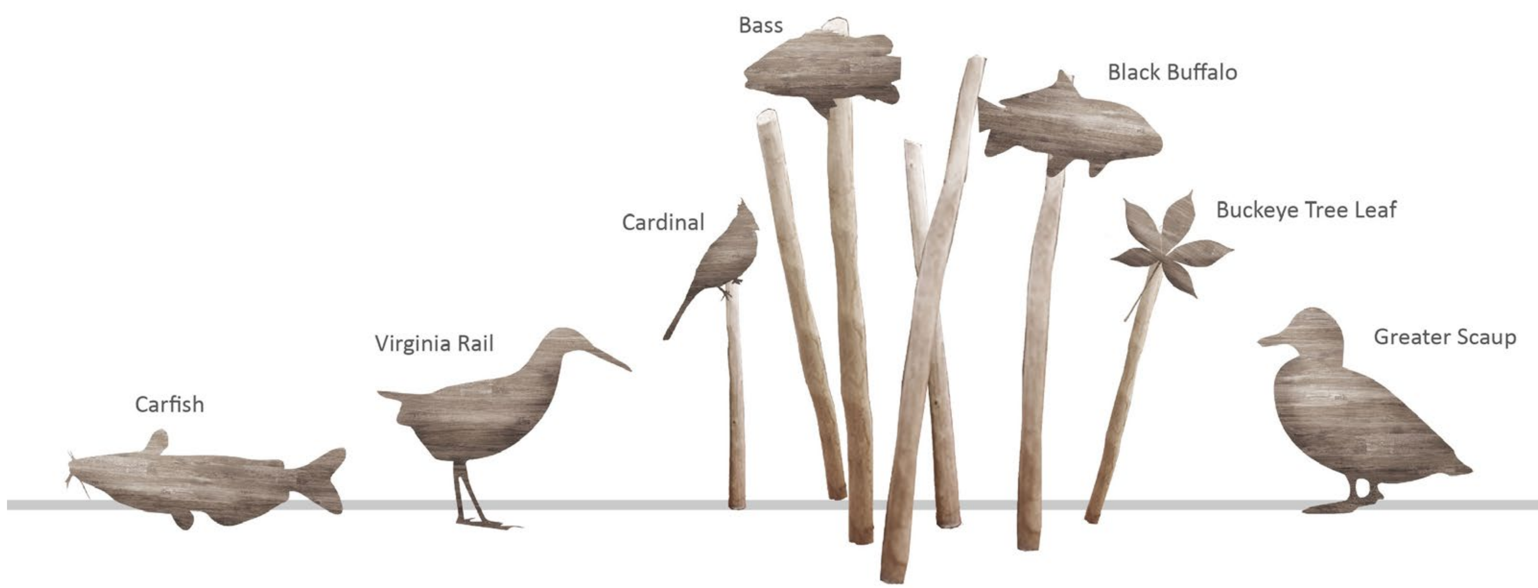


Figure 6.3.2. Design Elements Inspired by Regional Species

6.4 Planting List

Phytoremediation is the use of plants to remove pollutants from the environment. The term and technology was developed in 1990s. Because the key elements in this technology is natural material, phytoremediation for removing pollutants in water is less expensive and has greater public approval compared to use chemicals (EPA, 2000).

Besides removing contaminants from the water, managed planting areas along the shoreline also stabilize soil from erosion, functioning as a safety buffer and natural habitats. Additionally, another benefit of phytoremediation is that these plants can be self-maintaining (Doty et al., 2007). Plants gain energy from the sun and water body, which are completely free. Besides, they do not necessarily require labor; though plants can be harvested and replanted annually to achieve a higher rate of contaminants removal (EPA, 2000).

Although many native plants adapted to moist-to-wet environment are capable of reducing environmental pollutants, the rate is low and the process takes a long time. Plus, as the phytoremediation process mainly occurs during the growing seasons, it requires a mixed use of plants in each planting palette (Doty et al., 2007). Researchers and scientists have been using genetic modification technologies to improve the ability of plants to tolerate higher concentration of contaminants, to absorb contaminants at a higher rate, to increase the growing period, and so on (Fasani, et al., 2017).

The primary considerations for developing the planting lists for the Newport area include use of native species, growing season and color (Figure 6.4.1). The planting list includes a mix of native and non-native (not invasive) flowering and non-flowering perennials. Providing a wide range of plants species also benefits wildlife, including butterflies, bees, and other insects. Each lattice parcel contains a different color palette from adjacent ones.

Overall, the plant types in waterfront area are categorized into two groups-upland and wetland. Upland is the slope on the levee where the ability for soil to retain water is significantly lower than riparian zone. Therefore, plants that are more adapted to dry or wet conditions are chosen to compose the planting schedule. For each group, the intent is to create a diverse plant mix with long flowering and growing span and high aethetic value, in order to achieve a higher rate of contamination removal by phytoremediation processes (Figure 6.4.2).

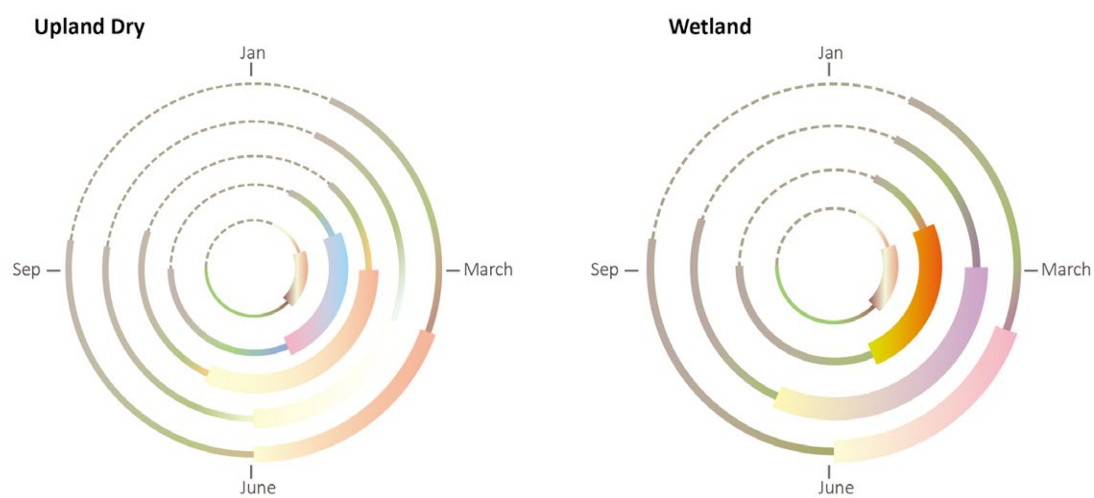


Figure 6.4.2. Growing and Flowering Duration

Upland Dry	Scientific Name	Form	Height	Bloom Time	Color	Moisture Tolerance	Shade/Sun Tolerance
Golden Alexanders	Zizia aurea	Forb	3′	Spring (April-Jun)	Yellow	Dry	Full Sun to Partial Shade
Butterfly Weed	Asclepias tuberosa	Forb	1-3′	Summer (Jun-Aug)	Orange	Dry	Full Sun
Black-Eyed Susan	Rudbeckia hirta	Forb	1-3′	Summer (Jun-Sep)	Yellow	Moist-Dry	Full Sun
June Grass	Koeleria pyramidata	Grass	2′	Spring (May-Jun)	Yellow	Dry	Full Sun
Sand Dropseed	Sporobolus cryptandrus	Grass	2-4′	Summer (Jun-Oct)	Yellow	Dry	Full Sun
Maple-Leaved Viburnum	Viburnum acerifolium	Shrub	3-6′	Summer(Jun)	White	Dry	Full Sun to Shade
Wild Lupine	Lupinus perennis	Forb	1-2′	Spring (May-Jun)	Blue	Dry	Full Sun to Partial Shade
Hoary Vervain	Verbena stricta	Forb	2-3′	Summer (Jun-Sep)	Purple	Dry	Full Sun
Purple Coneflower	Echinacea purpurea	Forb	1-3′	Summer (Jun-Sep)	Purple	Dry	Full Sun
Purple Love Grass	Eragrostis spectabilis	Grass	2′	Fall (Aug-Oct)	Red,Purple	Dry	Full Sun to Partial Shade
Pennsylvania Sedge	Carex pensylvanica	Sedge	1-3′	Summer	N/A	Dry	Full Sun to Shade
Sand Dropseed	Sporobolus cryptandrus	Grass	2-4′	Summer (Jun-Oct)	Yellow	Dry	Full Sun
Sullivant's Milkweed	Asclepias suillivantii	Forb	2-3′	Summer (Jun-Sep)	Pink	Dry	Full Sun to Partial Shade
Wild Bergamot	Monarda fistulosa	Forb	2-4′	Fall (Jul-Sep)	Pink	Dry	Full Sun to Partial Shade
Showy Goldenrod	Solidago speciosa	Forb	2-3′	Fall (Aug-Oct)	Yellow	Dry	Full Sun to Partial Shade
Bottlebrush Grass	Elymus hystric	Grass	2-3′	Summer (Jun-Aug)	Green	Dry	Full Sun to Shade
Little Bluestem	Schizachyrium scoparium	Grass	2-3′	Summer (Aug-Sep)	White,Brown	Moist-Dry	Full Sun to Shade
Fox Sedge	Carax vulpinoidea	Sedge	2-3′	Summer	N/A	Dry	Full Sun to Shade
Pagoda Dogwood	Cornus alternifolia	Small Tree	15-25′	Spring(April-Jun)	White	Dry	Full Sun to Shade
Serviceberry	amelanchier canadensis	Small Tree	15-25′	Spring(April-Jun)	White	Dry	Full Sun to Shade

Wetland	Scientific Name	Form	Height	Bloom Time	Color	Moisture Tolerance	Shade/Sun Tolerance
Ohio Spiderwort	Tradescantia ohiensis	Forb	2-4′	Spring (May-Jul)	Blue, Violet	Moist	Full Sun
Great Blue Lobelia	Lobelia siphilitica	Forb	1-3′	Summer (Jun-Sep)	Blue	Wet-Moist	Full Sun to Partial Shade
New Endland Aster	Aster novae-angliae	Forb	3-6′	Fall(Aug-Oct)	Purple	Wet-Moist	Full Sun to Partial Shade
Queen of the Prairie	Filipendula rubra	Forb	4-6′	Fall(Jun-July)	Pink	Wet-Moist	Full Sun to Partial Shade
Marsh Fern	Thelypteris palustris	Fern	1-3′	Summer	Brown	Wet-Moist	Full Sun
Common Three-square	Schoenoplectus pungens	Sedge	3-6′	Spring	Brown	Wet-Moist	Full Sun
New York Ironweed	Vernonia noveboracensis	Forb	3-6′	Fall(Aug-Sep)	Red	Wet-Moist	Full Sun
Blue Vervain	Verbena hastata	Forb	3-6′	Fall(July-Sep)	Yellow	Wet-Moist	Full Sun
Green-Headed Coneflower	Rudbeckia laciniata	Forb	3-6′	Fall(Jun-Sep)	Yellow	Wet-Moist	Full Sun to Shade
Golden Alexanders	Zizia aurea	Forb	3′	Spring(Apr-Jun)	Yellow	Moist	Full Sun to Partial Shade
Ostrich Fern	Matteuccia struthiopteris	Fern	3-6′	Summer	N/A	Wet-Moist	Full Sun
Marsh Fern	Thelypteris palustris	Fern	1-3′	Summer	Brown	Wet-Moist	Full Sun
Virginia Mountain Mit	Pycnanthemum virginanum	Forb	2-3′	Summer (Jun-Sep)	White	Moist	Full Sun to Partial Shade
False Aster	Boltonia asteroides	Forb	3-5′	Fall(Aug-Oct)	White	Wet-Moist	Full Sun to Partial Shade
Flat Topped Goldenrod	Euthamia graminifolia	Forb	1-4′	Summer (Jun-Sep)	Yellow	Moist	Full Sun to Partial Shade
Golden Alexanders	Zizia aurea	Forb	3′	Spring(Apr-Jun)	Yellow	Moist	Full Sun to Partial Shade
Wool-Grass	Scirpus cyperinus	Grass	4-6′	Summer(Jun-Aug)	Yellow	Wet-Moist	Full Sun
Bluejoint Grass	Calamagrostis canadensis	Grass	2-4′	Summer (Jun-Aug)	Green	Wet-Moist	Full Sun
Bee Balm	Monara didyma	Forb	1-3′	Summer(Jun-Aug)	Red	Moist	Full Sun to Partial Shade
Wild Columbine	Aquilegia canadensis	Forb	2-3′	Sring(Apr-Jun)	Orange	Moist	Full Sun to Partial Shade
Cardinal Flower	Lobelia cardinalis	Forb	2-5′	Summer(Julu-Sep)	Red	Wet-Moist	Full Sun to Partial Shade
Spotted Joe-Pye Weed	Eupatorium maculatum	Forb	3-6′	Summer (Aug-Sep)	Red	Moist	Full Sun to Partial Shade
Virginia Weild Rye	Elumus Virginucus	Grass	1-3′	Spring(May-Jun)	Yellow	Wet-Moist	Full Sun to Shade
Bluejoint Grass	Calamagrostis canadensis	Grass	2-4′	Summer (Jun-Aug)	Green	Wet-Moist	Full Sun
Silky Dogwood	Spiraea alba	Shurb	3-6′	Summer(Jun-Jul)	White	Wet-Moist	Full Sun to Partial Shade
Meadow-Sweet	Spiraea alba	Shurb	3-6′	Summer(Jun-Sep)	White	Wet-Moist	Full Sun to Partial Shade

Figure 6.4.1. Planting List By Group

6.5 Floating Wetlands

Due to environmental friendliness and cost-efficiency of plants, floating wetland is a type of installation that has been widely implemented in field based on phytoremediation techniques. According to a research conducted by the US Environmental Protection Agency (EPA), the advantages of floating wetlands include adaptability in various pond and river conditions, sustainable nitrogen removal process, low cost, shoreline stabilization, suitability for riparian habitat, and aesthetics (Sample, 2017). The City of Baltimore, a city with deep relationships with water, has incorporated this technique for its inner harbor master plan (Waterfront Partnership of Baltimore, Web). In the case of Baltimore, the floating wetland has been a successful project that not only increases the natural wetlands along the shorelines, but also becomes refuges for crabs, mussels, eels and other types of aquatic wildlife. The public, including students, are welcome to volunteer in helping install wetlands and clean up the harbor. Such activities have become valuable opportunities to involve communities and raise awareness.

With the intention of softening the waterfront through phytoremediation, this design project introduces floating wetlands into the water (Figure 6.5.1). Designed as another component from the lattice pattern family, native species are planted in floating units to provide habitat for aquatic life and help clean the water (Sample, 2017). The material for making the units is Polyethylene terephthalate (PET) fiber mesh, which is made from recycled plastic products such as bottles and containers (Texas A&M, 2015). The material is light in weight, allowing it to float on water surface, and it is durable and resistant to water and heat. Plants and bulbs in the units are wrapped with coir blanket, a harmless plant based material commonly used to control erosion. Underneath the planting units, small current-driven turbines generate oxygen and accelerates nitrogen exchange.

Considering a high level of contaminants and limited amount of existing wetlands in the Ohio River near Newport, a small area of floating wetlands may not make any significant changes in nutrients removing. However, as an eye-catching addition to Newport waterfront, they are intended to become an attractive feature and educational project to inspire more places to adopt so as to collectively make a bigger difference. Besides, they are cost efficient with low maintenance required. At the end of each growing season, trimming is needed. Harvested plant residuals can be composted and reuse for fertilizer for inland (Waterfront Partnership of Baltimore, Web).

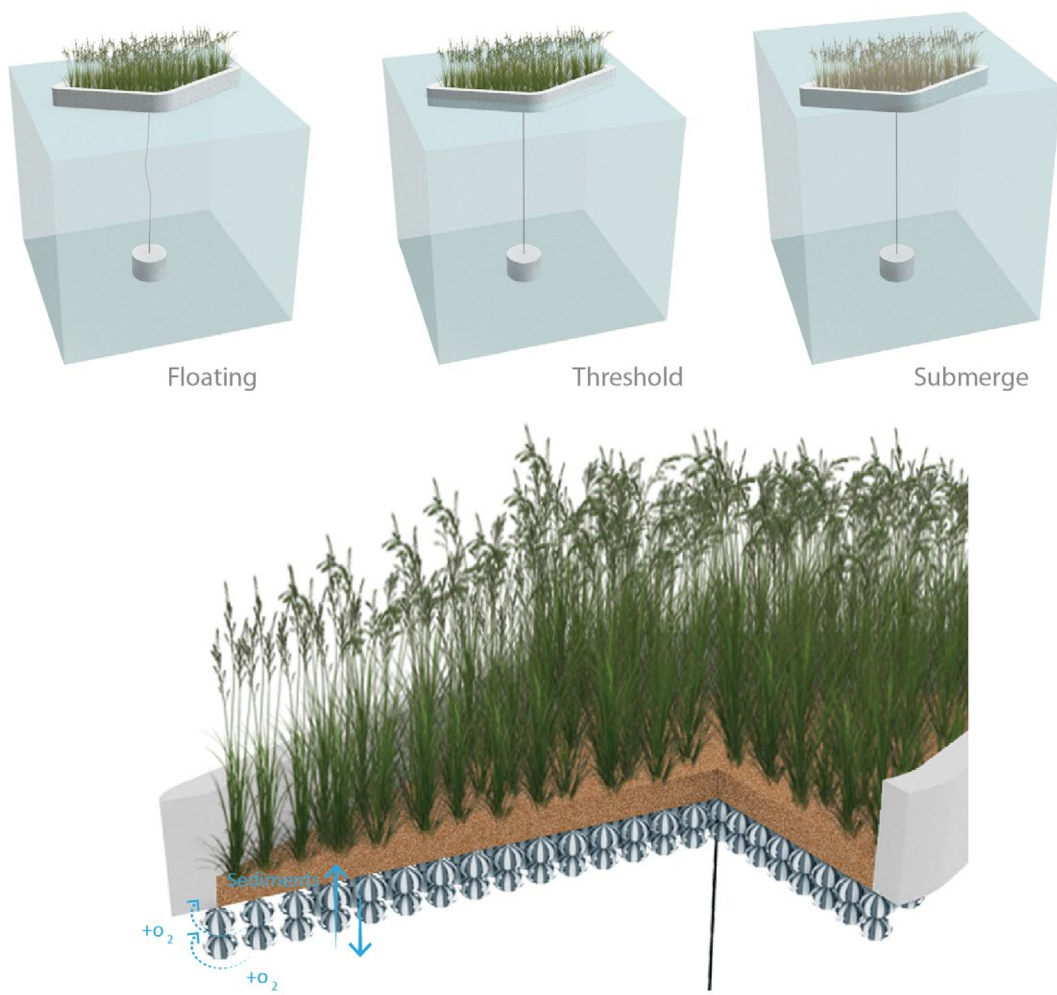


Figure 6.5.1. Floating Wetland Details

6.6 Lattices Inspired Site Structure and Souvenir

The proposed design includes a furniture master plan created especially for the Newport waterfront, with site furniture and installation, as well as souvenirs, featuring the lattice pattern (Figure 6.6.1). The design offers a pattern of rhombus geometric shapes to be the logo of Newport waterfront. A cohesive series of furniture and products help to shape the Newport waterfront with its own feature and identity.

This proposal considers the variety of site elements. Firstly, the light pole consists two bent rhombuses which are made of solar panels (Figure 6.6.1 a). The solar panels collect light during the day and store energy in a battery inserted in the pole. This lighting fixture also functions as a Wi-Fi signal tower for the convenience of visitors to enhance the overall experience of being in a conventional commercial center. Secondly, shop stands with customized canopies are installed on the middle level terrace (Figure 6.6.1 b). Fixed shop stands allow the space to be more organized and easier to use for daily recreation and summer events. Thirdly, a circular planter combines seating, shading and green elements in one, providing a compact feature for users (Figure 6.6.2 c). Moreover, the proposal also brings a set of smaller concrete and wooden seating elements with singular lattice shape. They can be placed and arranged in desired locations. This furniture master plan for Newport waterfront further enhances the new character of the site and meaning to its residents.

STRUCTURE

Figure 6.6.1 a
Solar Powered Street Light
as Signal Tower

Figure 6.6.1 b
Event Stand / Shaded Seating

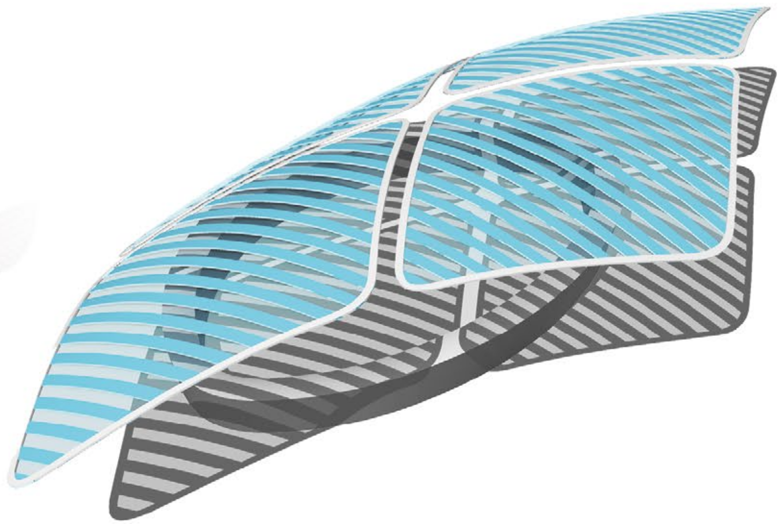


Figure 6.6.1 c
Site Furniture

Figure 6.6.1 d
Planter + Bench + Shaded Seating

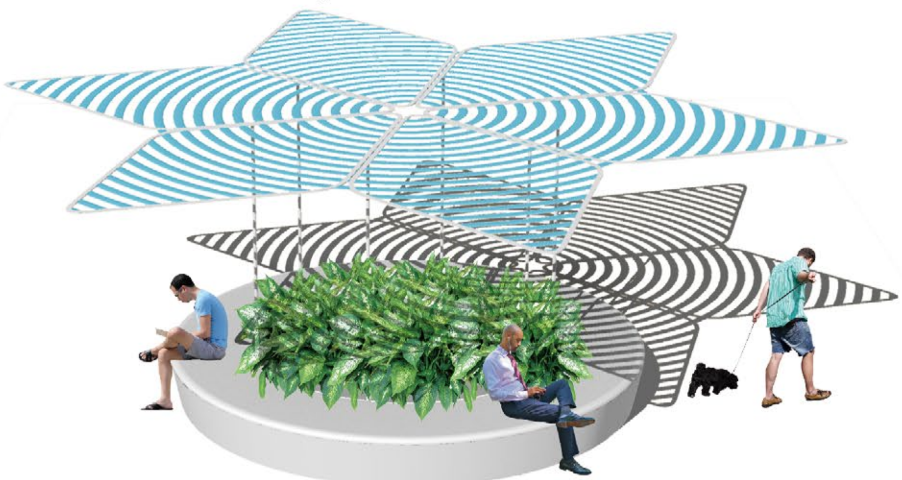


Figure 6.6.1 e
Newport Identity Goods

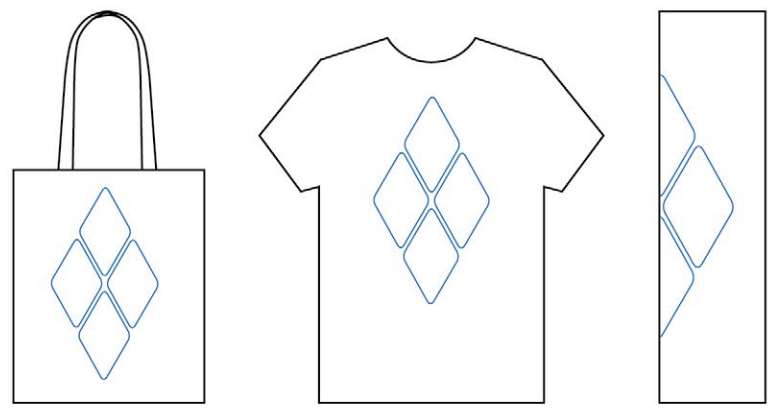


Figure 6.6.1. Site Furniture, Installation and Goods

CHAPTER 7

Summary

During the time of I worked on this thesis, Cincinnati experienced several days of continuous rainfall in mid-February 2018, followed by another major flood on February 21. The river crested at 60.53 feet, and experienced the worst flood the since 1997 (Weiser et al. 2018). Four floodgates on Newport side were completly shut but some major roads and parks along the levee were still heavily flooded. The Ohio River floods every year. It is a natural process, but why do extreme events like this happen so often? Sadly, there is no single strategy to completely solve this problem.

Future city planning often focuses on resolving leftover problems. Urban design efforts try to improve the waterfront in cities such as Newport in small areas. However, climate change is an undeniable fact. Future design seems useless in some ways in the face of such extreme weather events. Ultimately, may we enjoy the peace of good weather, calm river, and use sustainable design efforts to influence other places and strive for a bigger impact amid the challenges of climate change and the impacts that accompany it. That is the essence of this thesis project.

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