

CREATING A FUNCTIONAL USE OF SPACE ALONG THE ST.  
CROIX RIVER IN CORRELATION TO SEASONAL FLOODING

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Thesis Program

Fall 2020

CREATING A FUNCTIONAL USE OF CITY SPACE  
ALONG THE ST. CROIX RIVER IN CORRELATION  
TO SEASONAL FLOODING

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A Design Thesis Submitted to the Department of  
Architecture & Landscape Architecture of North  
Dakota State University

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In partial fulfillment of the requirements for the  
degree of Masters of Architecture

Primary Thesis Advisor: Anna Maria Vasilia

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## ABSTRACT

Many locations within the United States have major flooding problems. One of these locations is along the St. Croix River. The St. Croix River is a tributary of the Mississippi River and it is approximately 169 miles long. It is considered a National Scenic Riverway, and it is a divider between the states of Wisconsin and Minnesota. It is also a popular recreational location and is under the protection of the National Park Service. The St. Croix river has been home to people for thousands of years and runs through many historical towns and cities. Human residency along the St. Croix River began as early as 10,000 years ago. Historic American Indian sites are present along the river and it was also a favored fur trade route from the Mississippi to Lake Superior. One of the historical communities along the St. Croix that is impacted by seasonal flooding is Stillwater, Minnesota. Stillwater is one of Minnesota's oldest towns. In 1848 the first territorial convention that began establishing Minnesota as a state was held here, and because of this important meeting, Stillwater is called the birthplace of Minnesota. Because of the St. Croix River's location, it is often prone to flooding especially during March and early April. Stillwater's Lowell Park is near the river and consists of park space, sidewalks, the Stillwater Lift Bridge Historical Site, a bike path, restaurants, and a boardwalk with boat ties available to dock. This area floods every year with the boardwalk being most affected. Fifty-four years ago, the river crested to a record of 694.07 feet. A dike had to be built to keep the flood waters from destroying downtown Stillwater. In this study I will use case studies and propose a redesign of Lowell Park to make functional use of the space. Furthermore, the design will allow for the impact of the seasonal rise of the St. Croix River. This plan will incorporate the multiple systems that interface with the park and river and include recreation and historical context.

## Thesis Narrative

The history contained in a river includes both cultural and historical components, which are physically linked by distant locations that connect communities together. The St. Croix River is a good example. It starts in the St. Croix Lake in Douglas county, Wisconsin, and ends when it reaches the Mississippi River in Prescott, Wisconsin. The river itself creates a state boarder between Wisconsin and Minnesota. Evidence of humans living along the St. Croix River goes back as early as 10,000 years ago. The St. Croix National Scenic Riverway shows multiple different examples of past human occupancy, such as wild rice processing locations, burial mounds, and rock art.

The St. Croix River was once a popular fur trade location to Lake Superior. After the treaty of 1837, settlement began to occur and areas along the river became a popular location where people chose to build their permanent homes. This started the development and establishment of towns, including Stillwater, Minnesota. Although the St. Croix River is small in comparison to other rivers, only flowing 165 miles, it has had a large impact on Minnesota history.

## Thesis Narrative

Cities along the St. Croix River, such as Stillwater, once competed with the Twin Cities for the metropolitan status. Stillwater, Minnesota was the location of the first convention in 1884 that established Minnesota as a state. Since then, Stillwater has been considered the birthplace of Minnesota. Even though it did not become the metropolitan location in Minnesota, the city is still full of culture and history today. Over 19,000 people live in Stillwater today, and it provides many recreational opportunities for visitors. Visitors enjoy the beauty and social activities along the St. Croix River. However, due to the city's close proximity to the river, it often struggles with seasonal flooding. The conditions of the St. Croix River depend heavily on seasonal weather, precipitation, and location. One significant area in Stillwater impacted by seasonal flooding consistently is Lowell park, which is located along the river near the historic Stillwater lift bridge.

In this thesis, I will address the flooding functionality of Lowell Park during peak flooding season, as well as provide a redesign plan to correlate with the fluctuations of rising water in the St. Croix River.

## 1) Park Space

Creating a park space for people to gather

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## 2) Flood Protection

Protecting the city of Stillwater from seasonal flooding

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## 3) Biking/Walking Paths

Path ways for pedestrian circulation

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## 4) River Access

Access to the St. Croix River for fishing and kayaks

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## 5) Pedestrian Bridge

Incorporating the existing pedestrian bridge into the design

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## Client List

The potential clients for this thesis include the city of Stillwater and The National Parks Service (NPS).

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## User Description

The project will primarily be designed for public use. Potential user groups will include residents, visitors, walkers/ runners/ bikers, restaurant and food vendors, boaters, and entertainment agencies.



## Location

- Lowell Park
  - Stillwater, Minnesota
  - United States of America
- 

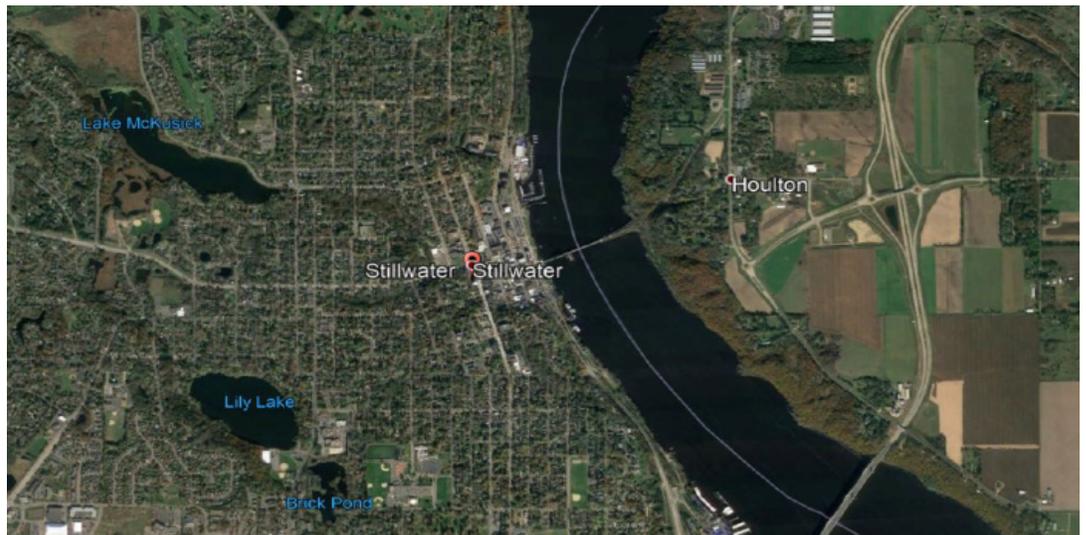
## Site Typology

- Urban
  - Riverfront
- 

## Status

Stillwater, Minnesota currently has a population of 19,404 people. It is also apart of the Twin Cities Metro Area.

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F02

## Flood Remediation

Stopping further environmental Flood damage to the site and the surrounding city

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## Recreation

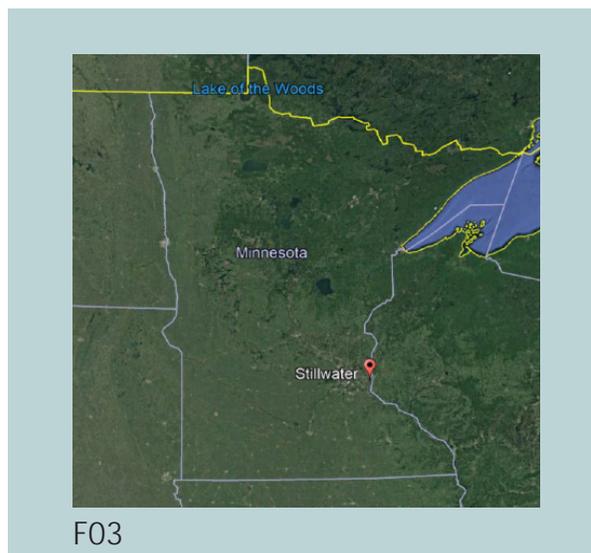
Allow for recreational activities and opportunities such as biking, fishing, and boating.

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## Education

Educate visitors about the history of the site and why it is important.

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## Flood Remediation

Stopping further environmental Flood damage to the site and the surrounding city and allow for the impact of the seasonal rise of the St. Croix River.

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## Community Connection

Creating community connections through recreational opportunities and education about the city of Stillwater and its history.

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F04

## Definition of Research Direction

Research will be done by analyzing case studies and the St. Croix Rivers seasonal flood range in order to come up with the appropriate design for the site.

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## Definition of Research Direction

The research methodologies that I will use for my thesis are quantitative and qualitative analysis and digital analysis.

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## Design Process Documentation Plan

This thesis project will include:

- A compiling of graphic works and data found from research,
  - A thesis proposal, boards, and presentation of research and design results
- 

## Progress Order

- Collection of data
- Analysis of data
- Research results
- Site inventory
- Site analysis
- Concept design
- Final design
- Programming
- Presentation

## Schedule

August - September

Thesis Draft Proposal

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September - October 13th

Thesis Proposal

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October - December 17th

Thesis Program due

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January - March

Thesis Program

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March

Mid Term

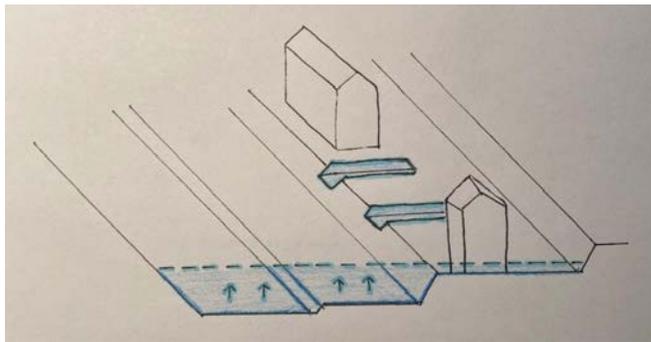
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May

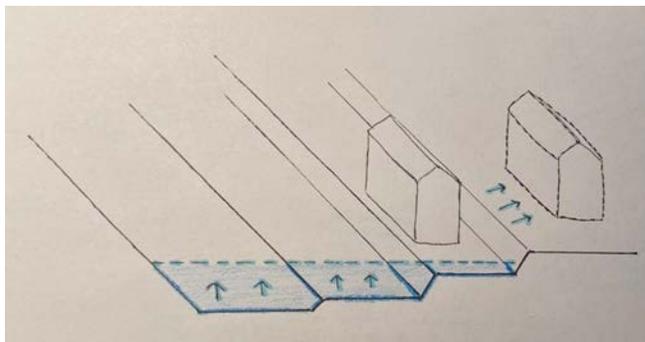
Thesis Book Due

## Research

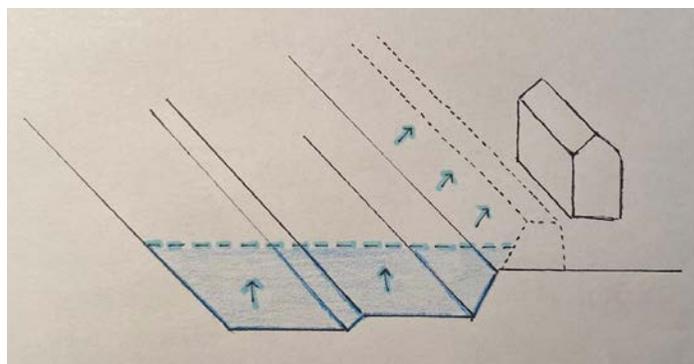
Research for this project began by finding different flood prevention methods. From this research three main flood prevention methods were found and they are Adapt, Defend, and retreat.



Adapt: To allow rising water levels to enter spaces of cities and communities prompting buildings, landscapes, and people to transform in an effort to acclimate to the presence of water.



Defend: To construct a mechanism to keep rising water levels away from people, buildings, and cities.



Retreat: To move people buildings and cities away from rising water levels

## Research Results

After researching the three flood prevention methods (Adapt, Defend, and Retreat) four case studies were researched to understand what flood prevention methods each case study used. This information helped to understand how to incorporate the three flood prevention technique into the Lowell Park design.

Information	Type/Theme	Design	Details
<ul style="list-style-type: none"> <li>- San Antonio Riverwalk</li> <li>- Located in San Antonio, Texas</li> <li>- 15 Miles long</li> <li>- Designed by Robert H. Hugman</li> </ul>	<ul style="list-style-type: none"> <li>- River Flood Prevention</li> <li>- Defend (keep rising waters away from cities and people)</li> </ul>	<ul style="list-style-type: none"> <li>- Includes 41 dams built along the river</li> <li>- Includes bypass channel for water</li> <li>- River ranges from 2 - 24 feet deep</li> <li>- Many bridges connect both sides of the river</li> </ul>	<ul style="list-style-type: none"> <li>- Concrete, stone, and brick were used to create the riverwalk</li> <li>- A variety of plants are used along the riverwalk</li> </ul> 
<ul style="list-style-type: none"> <li>- Bonnet Carre Spillway</li> <li>- Located in St. Charles Parish, Louisiana</li> <li>- 5.7 Miles long</li> <li>- Created by the U.S. Army Corps of Engineers</li> </ul>	<ul style="list-style-type: none"> <li>- River Flood Prevention</li> <li>- Defend (keep rising waters away from cities and people)</li> </ul>	<ul style="list-style-type: none"> <li>- Made up of two main components 1) a control structure along the Mississippi river 2) a floodway that transfers diverted flood waters to Lake Pontchartrain.</li> </ul>	<ul style="list-style-type: none"> <li>- High strength concrete was used to create the spillway</li> <li>- Large wooden planks are used to stop the water flow</li> <li>- To open large planks are removed one by one</li> </ul> 
<ul style="list-style-type: none"> <li>- Governors Island park</li> <li>- Located in New York Harbor NYC</li> <li>- 87 Acres</li> <li>- Designed by West 8 Urban Design and landscape Architecture and Mathews Nielsen Landscape Architects</li> </ul>	<ul style="list-style-type: none"> <li>- Coastal Flood Prevention</li> <li>- Retreat (to move away from rising waters)</li> </ul>	<ul style="list-style-type: none"> <li>- Majority of the island had to be lifted out of the flood zone</li> <li>- A sea edge was designed along the western side of the island to protect the site from waves</li> <li>- There is a lawn around the perimeter of the park that can withstand the flood waters</li> </ul>	<ul style="list-style-type: none"> <li>- Flood tolerant amenities</li> <li>- Concrete sea edge</li> <li>- Less flood tolerant plants are located at the center of the island</li> <li>- New soil was brought in to lift the island out of the flood zone</li> </ul> 
<ul style="list-style-type: none"> <li>- Water Square</li> <li>- Located in Rotterdam, Netherlands</li> <li>- Designed by Hugh Maaskant</li> </ul>	<ul style="list-style-type: none"> <li>- Urban Flood Prevention</li> <li>- Adapt (to allow rising waters to enter the space and acclimate to the presence of water)</li> </ul>	<ul style="list-style-type: none"> <li>- Water Square is made up of three pools that fill up when it rains</li> <li>- The three pools collect water and transports it through large stainless-steel gutters.</li> <li>- Most of the year these pools remain dry and are used for recreation.</li> <li>- Includes a rain wall and a water wall</li> </ul>	<ul style="list-style-type: none"> <li>- Stainless steel is used for gutters</li> <li>- All three basins are made up of concrete</li> <li>- All that can flood is painted in shades of blue and all that transports water is shiny stainless steel</li> </ul> 

## LITERATURE REVIEW

In this review, I will be providing a summary of each book or article, along with an explanation of how each resource provided supporting information to this thesis. The first book is *Water Index: Design Strategies for Drought, Flooding, and Contamination* by Seth McDowell, and the second one is *Rising Waters: The Causes and Consequences of Flooding in the United States* by Samuel D. Brody, Wesley E. Highfield, and Jung Eun Kang. Both books provided useful information and helpful examples to gain a better understanding on the concerns related to flooding.

### WATER INDEX: DESIGN STRATEGIES FOR DROUGHT, FLOODING, AND CONTAMINATION

*Water Index: Design Strategies for Drought, Flooding and Contamination* was written by Seth McDowell and published by the University of Virginia School of Architecture in 2016. It focuses on three main topics throughout the book including: drought, flooding and contamination. The author highlights these three themes, as well as identifies and describes various design projects around the world that deal with water problems, such as flooding.

At the beginning of the book, McDowell described how the rising sea levels has affected many locations around the world. Overall, the rising of the sea levels has caused serious issues including major flooding, loss of agricultural land, acceleration of shorelines and artificial beaches, loss of biodiversity, increase vulnerability to storms, increased flood heights in tidal rivers and the increased salinization of surface and groundwaters. McDowell then went into more detail about locations that are affected by the rise of the sea such as, the Netherlands, which is a location that has spent more money than any other country preparing for the rising sea levels. In addition, Vietnam, which will suffer greatly from the land lost from the sea. Cities will potentially be damaged from the rising waters.

The first chapter of *Water Index: Design Strategies for Drought, Flooding and Contamination* is divided into two parts: Act One: Call to Action, and The Rising Defend. Call to Action talks about people and the rising sea and how communities have had to deal with changing sea levels for thousands of years.

The Rising Defend examines how many different projects that work to reduce flooding. One of these projects is called the Delta Works project. This project is in the Netherlands and has been being built from 1953 to present day. Due to their position between the European rivers called the Rhine, the Maas, and the Scheldt the Dutch are often prone to flooding. After the flood of 1953 there was a push to maintain their dry land. The Dutch quickly made plans to create many massive infrastructural projects to protect the coast from the North Sea. These projects are known as the Delta Works project. This is one of the many examples shown of projects that deal with flood prevention.

The Contaminated. This chapter of the book has four parts called Act Two: The Contaminated Call to Action, The Contaminated Defend, The Contaminated Retreat, and the Contaminated Adapt. Contaminated Call to Action talks about how the growth of cities and population is causing an increase in contaminated water. The section also talks about the "bacteriological city" which is the type of water and sanitation that emerged out of the nineteenth-century. It explains how new technology today has changed the way our communities deal with contaminated water.

The Contaminated Defend. This study explains contaminated water and how it effects cities and the health and wellness of communities. With growing populations and cities contaminated water is becoming a more urgent problem every day. This chapter gives many examples of projects that clean and prevent contaminated water. One of the examples given is called the Whitney Water Purification Facility and Park located in Connecticut and designed by Steven Holl Architects and Michael Van Valkenburg and Associates. The facility includes a stormwater management and renewable energy system. The renewable energy is created by 88 wells of a groundwater heat pump system. This system works to heat and cool the facility. Stormwater management is created from the surface pond located on site. The entire site is also located on an exiting wetland so there is reduced site disturbance. Overall, this site is a great example of a water purification design.

Contaminated Retreat. This section talks about moving buildings, people, and cities away from contaminated water levels. This is usually done in locations where they do not have the recourses to create a defense system against contaminated waters. Moving to a new location is the only option for the safety of the community.

Contaminated Adapt. An example of this type of design is the Qunli stormwater park located in the Heilongjiang Province in China. This park is an existing wetland that acts as a type of green sponge that cleanses and stores the urban stormwater. The outside perimeter of the site is filled with walkways for people to enjoy and the central part of the wetland is left untouched to allow natural growth. All the examples given in Water Index about water contamination were very informative with a variety of existing successful designs.

The Disappearing. This chapter is about the lack of water in key locations around the world. The water around the world is not really disappearing because all the water is continuously being recycled, but water in certain locations is starting to disappear. Because of population growth the demand for water continues to increase. Most of the worlds fresh water is in ice or in aquifers that are being drained too quickly. One of these locations is Los Angeles. Southern California currently struggles with both water quality and supply. One of the projects the book mentions is reconstructing Owens lake located near Los Angeles. A century ago, Los Angeles depended on the Owens watershed to give water to the fast-growing city. For Los Angeles to obtain enough water for their growing population they had to redirect the Owens river 200 miles south across the Mojave Desert. This Aqueduct opened in 1913 and could deliver much more water than local sources within the city could but because of the fast-growing demand for water by 1923 the lowest part of the large lake was dry. A drought began in the 1930's and Los Angeles had to begin to drill many wells to tap into the Owens Valley groundwater. Today this location is known as the Owens Valley, which now remains completely dried up and filled with dust storms. Today there is a Lower Owens River Restoration project to work towards fixing the damages from the aqueduct. Owens Lake is a great example of how destructive a city can be to its surroundings.

Water Index: Design Strategies for Drought, Flooding, and Contamination is a great recourse that provides an extensive amount of information about each topic. Water Index also provides a variety of successful designs that are used around the world today as well as many helpful images and diagrams about each topic. The book has helped me to understand many ways flood prevention can be used for my thesis project as well as learn more about the overall topic of water used in design.

### Rising Waters: The Causes and Consequences of Flooding in the United States

Rising Waters: The Causes and Consequences of Flooding in the United States written by Samuel D. Brody, Wesley E. Highfield, and Jung Eun Kang. This book brings together five years of research focusing on the states of Texas and Florida and how these states have been impacted by flooding. Rising Waters also gives insight on how to make communities more resilient to flooding in the future.

The author starts off by talking about the importance of understanding flooding today. As stated in the book "The little-known fact is that, among all natural hazards, floods pose the greatest threat to the property, safety, and economic well-being of communities in the U.S. More property is lost and more people die from flood events than from tornadoes, earthquakes, and wildfires combined." This is a good example of why flood protection is so important.

The author also examines the causes, consequences, and policy implications of flooding in the U.S. The book examines what has been done in the past with decisions on flooding and flood damage and compares these past decisions on what is being done to prevent flooding today. It is important to research and understand past projects to know what designs have been effective in the past and which ones have not.

The entire book can be categorized into four parts. The first part studies the overall consequences of flooding and trends in flood damage. It also focuses on communities located in the states of Florida and Texas. This section also studies more detailed information regarding injuries, frailties and property damage.

The second looks at overall factors that influence flooding and damage. The third part concentrates on how we can improve flood protection from information gathered and the fourth part discusses research findings and presents recommendations for future flood protection.

Throughout most of the book Texas and Florida are the main locations being studied. This is since they are located along the coast of the Gulf of Mexico and they have high population growth. Texas and Florida are used to study flood mitigation, causes of flooding, flood characteristics, and consequences of flooding. Because of the constant increase in population along the coast there is also an increase in parks and buildings. The increase in the built environment causes these locations to be more susceptible to flooding and flood damage, especially in this location which is a hot spot for severe coastal storms.

Part one of the book is called the consequences of flooding. It is in this section the book discusses the rising cost of floods in the United States. Every year locations around the U.S. get damaged by flooding. Flooding poses as one of the greatest threats for economic well-being, safety, and property in the U.S. today. The most severe impacts of flooding can lead to injury and death. The numbers of fatalities vary every year but since the 1970's casualties have been decreasing. In this section of the Rising waters there are multiple graphs showing information that although casualties have decreased over the years flood damage has increased. This part of the book also goes in depth about impacts of flooding in coastal Florida and Texas. Both locations have large populations and big cities that are vulnerable in these flood-prone areas making both Texas and Florida most the states most susceptible to impacts of flooding in the United States.

Part two examines past flooding decisions as well as identifying the factors that influence flooding. This section describes major variables that contribute to flood events and casualties. The book states "These variables can be groups into five categories or dimensions of flood prediction: natural, built, organizational, socioeconomic, and mitigation." The chapter examines these five categories and the effect they have on locations in Texas and Florida. The text also goes into detail about structural approaches to flood prevention and flood mitigation techniques used in the past. Mitigation techniques include dams, levees, seawalls, and channels to redirect flooding.

Part three focuses on policy learning and local flood mitigation and part four is about recommendations on flood prevention in the future. One of these recommendations being that Non-structural flood mitigation strategies are a good alternative for flood prevention. This is because these structures alter the landscape and cause a false sense of security from massive flooding. It also recommends that there should be more available data about flooding around the U.S.

The book *Rising Waters: The Causes and Consequences of Flooding in the United States* is a great resource to get more information on the effects of flooding in the. The book provides a lot of information and facts and many graphs to show past research. It has helped me to further my own research and understand the consequences of flooding around the U.S.

### Time and the River: A History of the Saint Croix: A Historic Research Study of the Saint Croix National Scenic Riverway

This paper was written by Eileen McMahon and published in 2002 by the Midwest Regional Office, National Park Service, U.S. Department of the Interior. The paper has four chapters. Chapter one is called Valley of Plenty, River of conflict, Chapter two is River of Pine, Chapter three is "The New Land": Settlement and development of Agriculture in the St. Croix Valley, and chapter four is called Up North: The Development of Recreation in the St. Croix Valley.

The first chapter is called Valley of Plenty, River of conflict. This chapter is about the first people that lived along the St. Croix. There were Native Americans lived all along this site. The Sioux and the Dakota lived in this area and used the river for its resources. This chapter also talks about how the St Croix became a popular fur trade location. The second chapter is called River of Pine. This chapter is about how the St. Croix switched from fur trade to frontier logging and an industrial logging location. Chapter three is about farming and the civil war years on the river. Chapter four is called Up North: The Development of Recreation in St. Croix Valley and this chapter is about the start of tourism along the river and the preservation of the St. Croix.

Time and the River: A History of the Saint Croix: A Historic Resource Study of the Saint Croix National Scenic Riverway was used to study the history of the Saint Croix and how the river became what it is today. This resource is important for my thesis because it provides information to understand the history and culture of the site.

## SUMMERY

The resources discussed in the literature review are relevant to this thesis project. The first book discussed is Water Index: Design Strategies for Drought, Flooding and Contamination. This book focuses on multiple existing designs that have been successful with preventing drought, flooding and contamination. The book was useful in helping to find and research different case studies for this thesis project as well as provide insight on flood prevention techniques.

The second resource used is used for research is the book Rising Waters: The Causes and Consequences of Flooding in the United States. This book compiled five years of research and focused on the states of Texas and Florida. It described how these states have been impacted by flooding. The authors also gave insight on how to make communities more resilient to flooding in the future.

The last resource used is Time and the River: A History of the Saint Croix: A Historic Resource Study of the Saint Croix National Scenic Riverway. This article provided a detailed review of the history of the Saint Croix. This also provided more insight of the site and how this location has changed over time. Overall, the research done has provided information and a base to begin designing for this thesis project. Future resources and information will be added in this section as research continues.

The objective of this study is to examine multiple existing flood protection designs that vary in location and size, to consider the most effective and sustainable designs.

This study will also examine the causes and effects of flooding, as well as economic factors that are impacted by flooding. After reviewing multiple case studies, research supports that there are three primary themes when creating a successful design strategy for flooding. These points include a design strategy that defends a site, a strategy that retreats from rising water and a strategy that adapts to the flooding.

# CASE STUDIES

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San Antonio River Walk

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Bonnet Carre Spillway

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Governors Island Park

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Water Square

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# San Antonio River Walk



F05

## History

### Typology

- River walk
- Urban design
- Flood control

### Project Elements

- Public space
- Flood Control
- River walk

The city of San Antonio flooded regularly before the River Walk was designed and built. Many lives were lost due to flooding and the inability to manage to excess water, and in the years of 1845, 1865, 1880, 1899, 1913, and 1921, there were seven floods that devastated the area. Eventually engineers studied the San Antonio River and created a plan to manage the excess water and stabilize the environment, while also creating a functional enjoyable city space. This was the creation of the San Antonio River Walk Control System.

The River Walk itself was designed by a man named Robert Hughman in 1929. He proposed dams and a bypass channel for the river water. His plan for the flood control system proved to be successful, and in 1939, the building of The San Antonio River Walk began.

# San Antonio River Walk

## Context

The San Antonio River Walk, in Texas, is a system of walkways along the San Antonio River. Many businesses, such as bars, shops and restaurants, line the walkway and are enjoyed by locals from within the San Antonio community and visitors. There are 41 dams along the river that were built to help with flooding, along with a tunnel created in 1997 to help move the water flow. Overall, the design and creation of the San Antonio River Walk has made this area a safer and more stable location for businesses and the community.

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## Conclusion

The San Antonio Riverwalk is a good case study and proves to be an exceptional example of problem solving for a location that was dangerously impacted by flooding. The city was able to create a safe and functional alternative to the flooding dilemma, as well as create an area for entertainment and businesses. The San Antonio River Walk is also a good example of the use of public space in an urban design. Although this thesis project will not have any proposed dams, it includes similar concerns regarding flooding and will resemble the same end goal to reduce flooding in an urban area, and to create a functional use of space.

# Bonnet Carre Spillway



F06

## History

The Bonnet Carre Spillway is in St. Charles Parish, Southeastern Louisiana. Louisiana is often vulnerable to destructive flooding from the Mississippi River. The spillway was proposed in 1927 after a flood occurred that killed more than 500 people. The Bonnet Carre Spillway was then built in 1929-1931 by the U.S. Army Corps of Engineers.

## Typology

- Spillway
- Floodway
- River Flood Prevention

## Project Elements

- Protecting nearby cities

# Bonnet Carre Spillway

## Context

The Bonnet Carre Spillway directs the Mississippi flood waters to flow to Lake Pontchartrain, then onto the Gulf of Mexico. The spillway is 5.7 miles long and made of high strength concrete. Large wooden planks are also used to stop the water flow. When the spillway needs to be opened to allow water to flow through, the wooden planks are removed one by one to create an opening.

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## Conclusion

The Bonnet Carre Spillway is made up of two main components. The first is the control structure along the Mississippi River, and the second is the floodway that transfers the diverted flood water. The spillway has saved New Orleans from many floods since it was first opened. Today it continues to be operated and maintained by the U.S. Army Corps of Engineers.

# Governors Island Park



F07

## Typology

- Coastal Flood Prevention

## Project elements

- Public space
- Historic Site

## History

After the American Revolution in 1794 the island was used for coastal defense. Fort Jay was built at the center of the island, then in the 1800's New York started to use the island for military use. Governors Island Park was a major headquarters location for the Coast Guard and U.S. Army until it closed in 1996. In 2007, a decision was made to redevelop the island. An architecture firm called West 8 was selected to create the new design.

## Context

The island is in New York Harbor and is 87 acres. Most of the island is lifted out of the flood zone. This was done by bringing outside soil to cover the island and raise the land level. A sea wall was designed and installed along the western side of the island to protect the site from waves. In addition, the lawn around the perimeter of the island is designed to withstand flooding.

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## Conclusion

Governors Island Park is an historic location that was used as a military base and home to many military families over the years. Today, many people come to visit the island to enjoy the view of the city and the beauty of the island. Since the island level was raised out of the flood zone and has the surrounding sea wall on the western border, the site is protected from the surrounding waters and able to suppress the waves.

# Water Square



F08

## History

### Typology

- Urban flood prevention

### Project Elements

- Public space
- Adapt to floods
- Recreational activities

Water Square is in Rotterdam, Netherlands. The site was designed by Hugh Maaskant, located in a densely populated neighborhood at the center of Rotterdam. The city often endures heavy rainfall and parts of the city tend to flood every year. This design was created to allow flood water into the site.

# Water Square

## Context

This site uses urban flood prevention as it is located at the center of the city. The square is made up of three large pools that fill up with water when it rains. The three pools collect water and transport it through large stainless-steel gutters. Most of the year these pools remain dry and can be used for recreational activities, such as basketball and roller blading. However, during heavy rains, it is a functional site created to collect the water and protect the city from flooding.

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## Conclusion

Water Square is designed and planned to collect excess water during the heavy rainfall season. When the rain and typical flooding season has ended, the Square is then used for many recreational opportunities and becomes a popular gathering space for the surrounding communities. The preventative large pools prevent rain and flood damage to the city of Rotterdam.

## PROJECT JUSTIFICATION

This thesis project is creating a functional use of space along the St. Croix River in correlation to seasonal flooding. The St. Croix River is a divider between the states of Wisconsin and Minnesota. It is a popular recreational location in Minnesota. The historical city of Stillwater is located along the St. Croix River in Minnesota, and it is impacted by the river's seasonal flooding every year. My site location is Lowell park, which is located along the St. Croix River, in the city of Stillwater. Lowell Park is in the center of Stillwater, next to the river, and is a recreational location used often by residents and visitors. For my project, I will create a design that will allow for the impact of the seasonal rise of the St. Croix River, and supporting Lowell Park to be a location that can be used year-round. This project is important to me because I grew up near Stillwater, Minnesota and have been going there since I was young. I have seen the negative impact that seasonal flooding has on the site while visiting Lowell Park in the spring. I believe that this project is important at this stage of my professional development because it will push me out of my comfort zone as a designer, and will encourage me to use skills and technology that I have not yet had the opportunity to use in previous projects.

This project is important to landscape architecture due to the impact of seasonal flooding in cities around the world. Continued research and landscape designs can be implemented to help other locations in the future. I believe the thesis project is important as an academic exercise, as it encourages students to choose their own project based on personal interests. It also encourages research, skill development and use of design to complete. This project will help increase the skill and confidence in students. Further, it will encourage students to see the potential for improvement and problem resolution in future areas.

# PROJECT JUSTIFICATION

I can economically justify my project as I plan to find a solution to seasonal flooding with low impact to the surrounding environment. I can justify expending the funds for the project as it will create a long-term solution and prevent further damage to the identified site. The result will prevent future damage, save the city money which has been used to make seasonal repairs and it will allow increased recreational use to the site. The funds for my project could come from donations, the city of Stillwater, or the National Parks Service (NPS).

The post-occupancy impact of my project would be changing Lowell Park so that the site can be utilized year-round instead of having unusable space during flooding season. The main environmental impacts of my project would be changing the way the river flows to prevent flooding on my site. This could cause flooding in another location. The redesign of Lowell Park will also impact the current park layout.

This project is important to implement in its social context because it will allow the community to use a popular location within their city throughout all seasons. Stillwater is one of Minnesota's oldest towns and is known as the birthplace of Minnesota. There are many historical aspects to the town, such as historical buildings or the historical Stillwater lift bridge that connects the site to Wisconsin. Protection of the town's many historical aspects is an important part of this thesis project.

I believe my project will contribute to the advancement of landscape architecture. I will be providing research of a variety of other sites and designs that work toward flood prevention, and I will be providing a redesign for the location of Lowell Park. The overall project is not imperative, but I chose this location because it is important to me and I believe that it can be improved. My project could also be resolved by someone else in the Profession of Landscape Architecture. Flooding has always been a problem for many locations around the world, and with current climate change and rising waters, there may be an increase in locations that will need flood prevention in the future.

## THESIS CONTEXT

Flooding effects many locations around the world each year. Flooding can be caused by a storm surge, heavy rainfall, or rapid snow melt. Flooding is a very frequent type of natural disaster especially in dry locations. There are four different types of flooding. They are urban floods, coastal floods, pluvial (flash) floods, and fluvial (river) floods. An urban flood is caused when an urban area fills with water faster than it can be absorbed. A coastal flood is when land is flooded by this sea because of a large tropical storm surge. Pluvial (flash) floods are caused by excessive heavy rainfall in a short period of time and fluvial (river) floods are caused from snow melt or consistent rain fall causing the river to overflow. All types of flooding can be dangerous and damaging to communities. There are many existing designs around the world that deal with flood prevention today. These designs protect against coastal, river and flash flooding. These projects explore the effective and unique ways that flooding can be prevented.

Lowell park is one of these locations that is damaged by flood waters every year. Lowell park is effected by fluvial (river) flooding. Creating a site design that uses all flood prevention methods (Adapt, Defend, and retreat will help to protect this historical site as well as create an enjoyable space for the community.

- **Area:** 7 Acres
  - **Bridges:** Stillwater Lift Bridge
  - **Parks:** Lowell Park
  - **Water Bodies:** St. Croix River
  - **Water Quality:** Sediments, Chemicals
- 

- **Trees:** Oaks, Maples, Elm, Lindens, Ash, Others
- **Grasses:** Native
- **Shrubs:** Dogwoods, Lilacs, Others
- **Soils:** Urban Soil, Organic, Sealed
- **Average Climate:** Rainfall (33.7 in.), Snowfall (49.2 in.), Precipitation (107.8 days), Sunny days (198 days)

## PERFORMANCE CRITERIA

Lowell Park is located at 201 Water Street Stillwater, MN. The amenities of the park include an amphitheater, benches, drinking fountains, electricity, a gazebo, open park space, restrooms, uncovered tables, and walking trails. The entire park is about 630 feet long and 65 feet wide. The park includes a walking path that runs along the entire park next to the St. Croix river. Directly next to the park is a new parking lot that is about 390 feet long and 170 feet wide. This parking lot holds around 150 parking spaces and is used for both Lowell Park and surrounding shops and restaurants.

The energy consumption of Lowell Park is low. Most of the site consists of natural open space. There are existing light poles next to the park paths, as well as an irrigation system. There is an existing indoor restroom with toilets, sinks, and lights. For environmental performance, the new design will have a positive impact for both the park and the surrounding area. Currently, the park floods annually, every spring. The flooded area and water flow transport trash, and other items of debris, into the St. Croix River. By preventing seasonal flooding, this unnecessary polluting of the river may be avoided. There is minimal light pollution coming from the site due to the low lighting currently established in the park area.

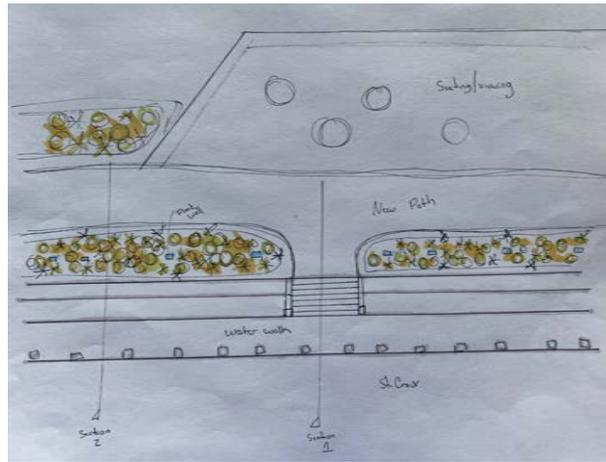
The new design will also improve overall performance of the park and allow the site to be used year-round. Physiological impacts of the site will also improve. Visitors of the park will be able to experience the park to its full capacity, rather than having to avoid the flooded areas in the spring. The area will no longer be damaged by the seasonal perpetual flooding, and the aesthetics of Lowell park will be improved.

Environmental impacts may be impacted by to the creation of a new design of the park, and slightly modify the water flow along the river's edge. If the water flow from the river is redirected to another location, or modified in a design plan, other locations along the St. Croix River may be impacted. If Lowell Park is re-designed to prevent an alleviate seasonal flooding, the natural environment of the park will be improved, and less corrosion will occur. The new design will be based on the legal codes and guidelines established in the city of Stillwater, MN, and follow the laws created to protect he St. Croix River and surrounding area. The design will to have the least amount of negative impact on the site and surrounding environment.

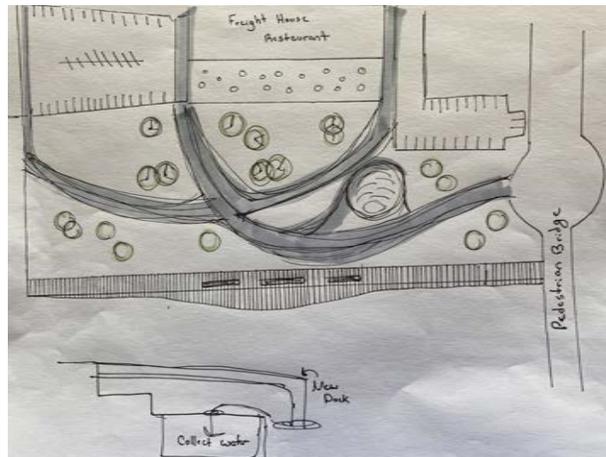
The cost will be dependent on the modification of the river flow and redesign of the river's edge and natural space. The final cost is unknown at this time.

BASE MAP PROCESS

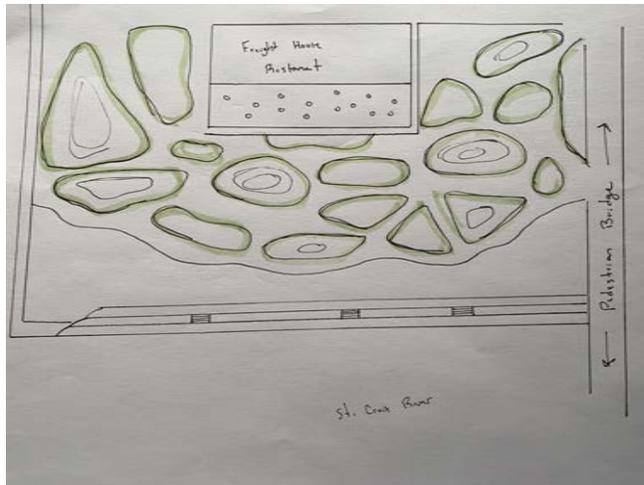
1)



2)

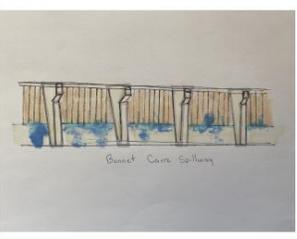
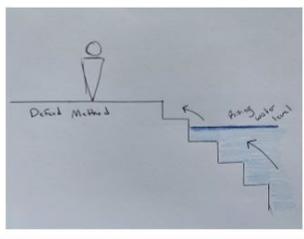
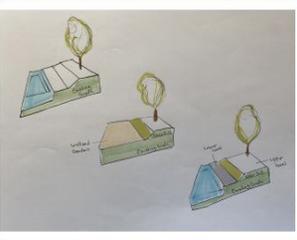
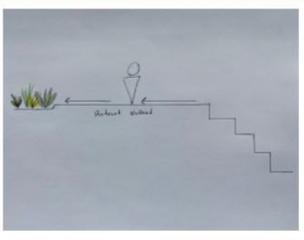
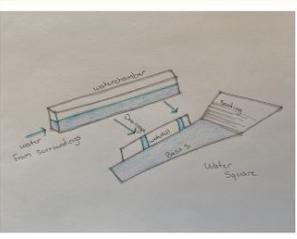
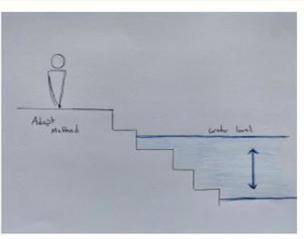


3)



## DESIGN SOLUTION

This solution was found by researching multiple case studies and flood prevention methods to find a way to incorporate all three flood prevention techniques into the Lowell park design. By creating a new design with all three techniques the site will be safe from the rising waters of the St. Croix River.

Case Studies:	Method:	
<p data-bbox="412 793 435 928">Bonnet Carre Spillway</p> 	<p data-bbox="873 814 896 911">Defend Method</p> 	<p data-bbox="1247 793 1528 947">This design uses the Defend Method for flood protection. It works by creating concrete steps between the river and walkway, thus blocking the river water when it rises. This idea was used from the removable wall designed for the Bonnet Carre Spillway, located in St. Charles Parish, Louisiana. The Spillway is used to defend the city of St. Charles Parish.</p>
<p data-bbox="412 1054 435 1188">Governors Island Park</p> 	<p data-bbox="873 1075 896 1171">Retreat Method</p> 	<p data-bbox="1247 1075 1528 1171">This design uses the Retreat Method for flood protection. It creates planting designs located far from the rising waters of the river. The Retreat Method was also used when creating Governors Island Park in NYC.</p>
<p data-bbox="412 1335 435 1432">Water Square</p> 	<p data-bbox="873 1335 896 1432">Adapt Method</p> 	<p data-bbox="1247 1335 1528 1453">This design uses the Adapt Method for flood protection. This method uses the concrete steps to allow the waters to rise naturally on the site. The Adapt Method was also used at Water Square where water was stored and drained into different locations. Water Square is located in Rotterdam, Netherlands.</p>

## DIGITAL PRESENTATION

### Research:

#### Research

#### Matrix

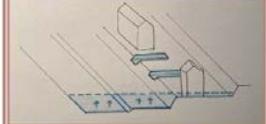
Information	Type/Theme	Design	Details
<ul style="list-style-type: none"> <li>- San Antonio Riverwalk</li> <li>- Located in San Antonio, Texas</li> <li>- 1.5 Miles long</li> <li>- Designed by Robert H. Hugman</li> </ul>	<ul style="list-style-type: none"> <li>- River Flood Prevention</li> <li>- Defend (Keep rising water away from cities and people)</li> </ul>	<ul style="list-style-type: none"> <li>- Includes 41 dams built along the river</li> <li>- Includes bypass channel for water</li> <li>- Span ranges from 2'-24' tall steep</li> <li>- Many bridges connect both sides of the river</li> </ul>	<ul style="list-style-type: none"> <li>- Concrete, stone, and brick were used to create the riverwalk</li> <li>- A variety of plants are used along the riverwalk</li> </ul> 
<ul style="list-style-type: none"> <li>- Bonnet Carré Spillway</li> <li>- Located in St. Charles Parish, Louisiana</li> <li>- 8.7 Miles long</li> <li>- Created by the U.S. Army Corps of Engineers</li> </ul>	<ul style="list-style-type: none"> <li>- River Flood Prevention</li> <li>- Defend (Keep rising water away from cities and people)</li> </ul>	<ul style="list-style-type: none"> <li>- Made up of two main components: 1) a control structure along the Mississippi river 2) a floodway that transfers overflowed flood waters to Lake Fortchartrain</li> </ul>	<ul style="list-style-type: none"> <li>- High strength concrete was used to create the spillway</li> <li>- Large wooden plants are used to stop the water flow</li> <li>- To open large plants are removed one by one</li> </ul> 
<ul style="list-style-type: none"> <li>- Governors Island park</li> <li>- Located in New York Harbor NYC</li> <li>- 87 Acres</li> <li>- Designed by West 8 Urban Design and Landscape Architecture and Mathew Nelson Landscape Architects</li> </ul>	<ul style="list-style-type: none"> <li>- Coastal Flood Prevention</li> <li>- Retreat (to move away from rising water)</li> </ul>	<ul style="list-style-type: none"> <li>- Majority of the island had to be filled out of the flood zone</li> <li>- A leaf edge was designed along the west side of the island to protect the site from waves</li> <li>- There is a lawn around the perimeter of the park that can withstand the flood water</li> </ul>	<ul style="list-style-type: none"> <li>- Flood tolerant amenities</li> <li>- Concrete leaf edge</li> <li>- Less flood tolerant plants are located at the center of the island</li> <li>- These soil was brought in to lift the island out of the flood zone</li> </ul> 
<ul style="list-style-type: none"> <li>- Water Square</li> <li>- Located in Rotterdam, Netherlands</li> <li>- Designed by Hugh Christant</li> </ul>	<ul style="list-style-type: none"> <li>- Urban Flood Prevention</li> <li>- Adapt (to allow rising water to enter the space and accommodate to the presence of water)</li> </ul>	<ul style="list-style-type: none"> <li>- Water Square is made up of three pools that fill up when it rains</li> <li>- The three pools collect water and transport it through large stainless steel gutters</li> <li>- Half of the year these pools remain dry and are used for recreation</li> <li>- Includes a rain wall and a water wall</li> </ul>	<ul style="list-style-type: none"> <li>- Stainless steel is used for gutters</li> <li>- All three basins are made up of concrete</li> <li>- All that can float is painted in shades of blue and all that transport water is shiny stainless steel</li> </ul> 

#### Project Statement

Lowell Park in Stillwater, MN, is along the St. Croix River and consists of park space, picnic tables, sidewalks, restrooms, the Stillwater Lift Bridge historical site, a bike path, restaurants and a boardwalk with boat ties available to dock. This area typically floods annually in the Spring, with the boardwalk being most affected. The goal for this project is to create a functional use of this space in correlation to the St. Croix River's seasonal flooding. I will be analyzing three flood prevention methods (Adapt, Defend, Retreat) to develop and design a solution for this site. Currently, a large portion of the site consists of multi levels of concrete, as well as park space. This project will also explore other materials for this design.

#### Flood Prevention

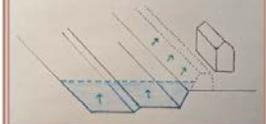
##### Adapt:



To allow rising water levels to enter the spaces of cities and communities prompting buildings, landscapes and people to transform in an effort to acclimate to the presence of water.

*(Image and Description from Water Index, page 64)*

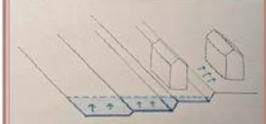
##### Defend:



To construct a mechanism to keep rising water levels away from people, buildings and cities.

*(Image and Description from Water Index, page 72)*

##### Retreat:



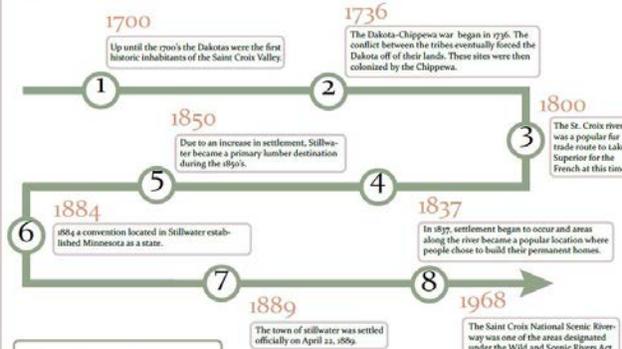
To move people, buildings and cities away from rising water levels.

*(Image and Description from Water Index, page 52)*

### History:

#### The Saint Croix River Over Time

#### General History



#### Transportation

The Palmyra was the first steamboat to travel the St. Croix in 1838. Between 1840-1850, hundreds of steamboats traveled annually on the river. Before the railroads were built in the St. Croix Valley the steamboats were one of the only connections river towns had.



#### First People

Native people lived along the St. Croix River long before Europeans immigrated to the area. Several tribes of the Dakota and Ojibwe still live along the river today. Evidence of people living along the river goes as far back as 5,000 years. Many historical artifacts are still being found today.



#### Logging History



The logging era in this location lasted from 1839-1944. During this time all aspects of the logging industry could be found along the St. Croix.



The St. Croix "Boom" was built in 1856 and located above Stillwater. The Boom was a checkpoint location where all of the logs were collected. The Boom operated for 58 years before closing in 1914. It was the most important industry for this location at the time.



Stillwater had the largest number of saw mills. This image shows the Isaac Staples sawmill in Stillwater. The chimney is still there today.

## DIGITAL PRESENTATION

### Site Analysis:

### Site Analysis

#### The Site

- : Street Access
- : Parking Lots
- : Restaurant Locations
- : Restroom Building
- : River Access Points

#### The Problem

Due to the city's close proximity to the river, it is often impacted by seasonal flooding. The conditions of the St. Croix River depend heavily on seasonal weather, precipitation and location.

#### Flood Levels 2012-2021

USGS 05540500 ST. CROIX RIVER AT STILLWATER, MN

Historic Crests

Date	Height (ft)
(1) 04-10-18 1865	672.30
(2) 02-30-08 1877 2001	672.20
(3) 02-20-08 18 1969	669.10
(4) 03-10-08 18 2001	673.96
(5) 06-25-08 12 1997	668.99
(6) 09-30-08 18 1952	671.88
(7) 08-40-08 05-31-2017 (P)	671.87
(8) 07-30-08 06-28 1995	670.87
(9) 07-13-08 06-27 2014	670.87
(10) 07-50-08 04-06 1986	670.87
(11) 07-30-08 04-30 1975	670.87
(12) 07-28-08 04-12 2011	670.87
(13) 08-09-08 06-01 2012	670.87
(14) 05-05-08 03-25 2010	670.87
(15) 05-08-08 07-10 2010	670.87
(16) 05-05-08 04-20 2018 (P)	670.87
(17) 07-13-08 06-27 2018 (P)	670.87
(18) 04-10-08 07-01 2013	670.87
(19) 03-32-08 10-10 2017	670.87
(20) 03-46-08 07-25 2017	670.87
(21) 01-25-08 05-27 2013	670.87
(22) 00-49-08 06-13 2013	670.87

(P) Preliminary values subject to further review.

#### Site Location

### Design Framework:

### Design Framework

#### Functions:

**Flood Remediation:**  
Stopping further environmental flood damage to the site and the surrounding city

**Recreation:**  
Allow for recreational activities and opportunities such as biking, fishing, and boating.

**Community Connection:**  
Creating community connections through recreational opportunities and education about the city of Stillwater and its history.

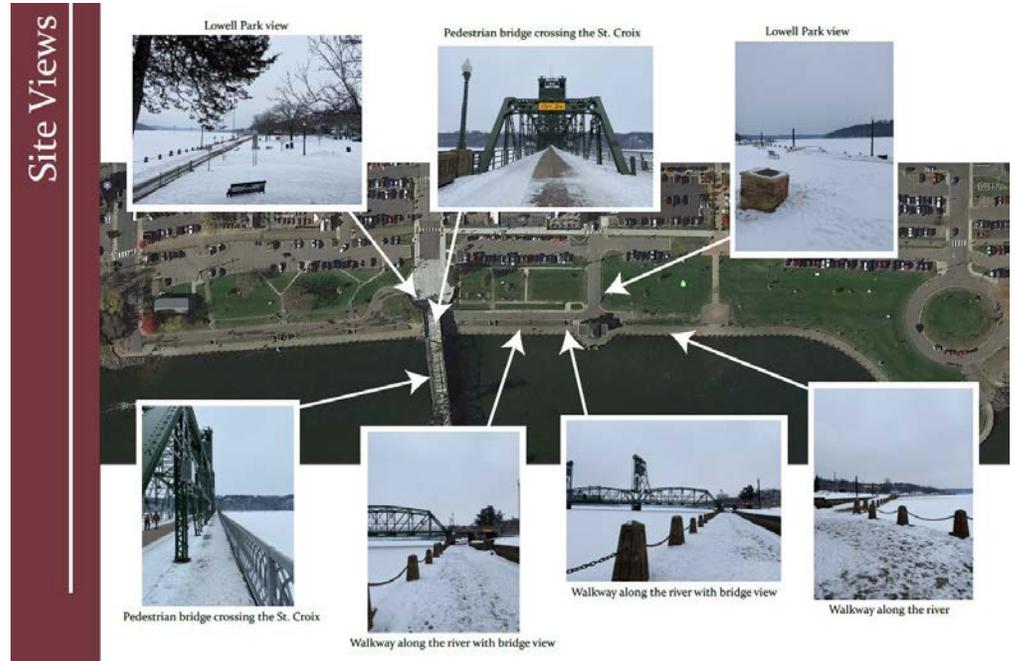
#### Programming Elements:

- Seating areas
- Stormwater Drainage
- River Access: Access to the St. Croix River for fishing and kayaks
- Art
- Park signs
- Restaurants
- Boat Docks: Space for docking boats along the St. Croix River
- Biking/Walking Paths: Path ways for pedestrian circulation
- Pedestrian Bridge
- Food truck
- Public parking
- Walkway along the river
- Bike Rack

#### Existing Conditions:

## DIGITAL PRESENTATION

### Site Views:



### Flooding Images:



## DIGITAL PRESENTATION

### Flooding Images:

Example Flood Images



### Design Strategies:

Design Strategies	Case Studies:	Method:	
Bonnef Carre Spillway			<p>This design uses the Defend Method for flood protection. It works by creating concrete steps between the river and walkway, thus blocking the river water when it rises. This idea was used from the removable wall designed for the Bonnef Carre Spillway, located in St. Charles Parish, Louisiana. The Spillway is used to defend the city of St. Charles Parish.</p>
Governors Island Park			<p>This design uses the Retreat Method for flood protection. It creates planting designs located far from the rising waters of the river. The Retreat Method was also used when creating Governors Island Park in NYC.</p>
Water Square			<p>This design uses the Adapt Method for flood protection. This method uses the concrete steps to allow the waters to rise naturally on the site. The Adapt Method was also used at Water Square where water was stored and drained into different locations. Water Square is located in Rotterdam, Netherlands.</p>

## DIGITAL PRESENTATION

### Base Map:

#### Master Plan

Master Plan



- 1 Waterwalk Steps
- 2 Restaurant
- 3 Patio Space
- 4 Pollinator Garden
- 5 Grass Garden



#### Project Narrative

This updated design of Lowell Park, in Stillwater, MN, will provide a walkway along the St. Croix River for individuals to enjoy throughout all seasons. The existing pathways located around the park provide connections to public parking, local shopping and restaurants. The paths also provide recreational opportunities for walking and biking, as well as lead to other trails in the surrounding area. Groupings of plantings and green space will be incorporated into the design to enhance the area with flowers, plants and natural vegetation. There will be added seating to be used for social interactions and to provide space and opportunities to sit and enjoy a peaceful view of the passing boats along the St. Croix River in the warmer months, or the lights decorating the city and riverfront area in the winter months. This design is intended to provide access to Lowell Park and the surrounding throughout all seasons, and plans for the seasonal flooding that occurs on an annual basis.

### Perspective:

#### Restaurant/Path Perspective



## DIGITAL PRESENTATION

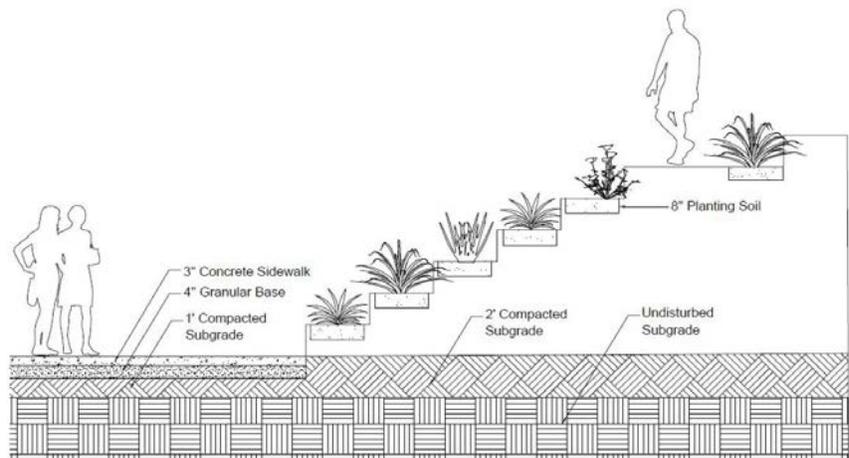
Site View:

Top View of Site



Construction Section:

Construction Section



## DIGITAL PRESENTATION

Perspective:

Restaurant Perspective



Perspective:

Park Perspective



## DIGITAL PRESENTATION

Perspective:

Bridge Perspective



Perspective:

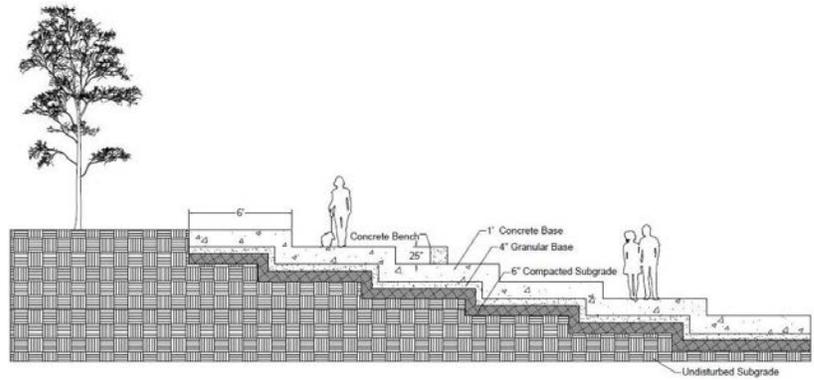
Waterwalk Perspective



## DIGITAL PRESENTATION

Site Views:

Construction Section of Waterwalk



Plant Perspective:

Park Perspective/Planting



Red Spruce  
*Picea rubens*



Norway Spruce  
*Picea abies*



Karl Foerster  
*Calamagrostis x acutiflora*



Blue Fescue  
*Festuca glauca*



Black Mondo  
*Ophiopogon planiscapus*

## DIGITAL PRESENTATION

Plant Perspective:

Park Perspective/Planting



Birds Eye Primrose  
*Primula farinosa*



English lavender  
*Lavandula*



Alpine Aster  
*Aster alpinus*



Red Daisy  
*Bellis perennis*



Linden  
*Tilia*

## References

San Antonio Riverwalk from: <https://www.thesanantonioriverwalk.com/about/our-history/>

Time and the River: A History of the Saint Croix from: <http://npshistory.com/publications/sacn/hrs/chap1.htm>

McDowell, Seth. Water Index: Design Strategies for Drought, Flooding, and Contamination. University of Virginia School of Architecture, 2016

Brody, Samuel. Rising Waters: The Causes and Consequences of Flooding in the United States. Cambridge University Press, March 31, 2011

## Images

F01) Stillwater Bridge (St. Croix River)  
from: [https://en.wikipedia.org/wiki/Stillwater\\_Bridge\\_\(St.\\_Croix\\_River\)](https://en.wikipedia.org/wiki/Stillwater_Bridge_(St._Croix_River))

F02) The Ultimate Guide to Exploring Savannah's River Street, BY LARISSA ALLEN  
from: <https://www.visitsavannah.com/the-ultimate-guide-to-exploring-savannahs-river-street>

F04) 7 Reasons you'll love Stillwater, Minnesota from: <https://www.midwestliving.com/travel/minnesota/stillwater/7-reasons-youll-love-stillwater-minnesota/>

F05) Stroll the Past, Present and Future Along San Antonio's River Walk, By Lea Ann Fessenden-Joseph from: <https://traveler.marriott.com/san-antonio/san-antonio-river-walk/>

F06) [https://en.wikipedia.org/wiki/Bonnet\\_Carr%C3%A9\\_Spillway#/media/File:BonnetCarreOpeningDay.jpg](https://en.wikipedia.org/wiki/Bonnet_Carr%C3%A9_Spillway#/media/File:BonnetCarreOpeningDay.jpg)

F07) <https://www.stvinc.com/news-and-media/stv-celebrates-completion-hills-governors-island>

F08) <https://www.publicspace.org/works/-/project/h034-water-square-in-benthemplein>

Design Studio Experience

2nd year 2017 - 18

LA 271 Introduction to Landscape Architecture

LA 272 Parks and Open Spaces

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3rd year 2018 - 19

LA 371 Site Planning and Design

LA 372 Community Planning and Design

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4th year 2019 - 20

LA 471 Urban Design

LA 472 Environmental Remediation

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5th year 2020 - 21

LA 571 Environmental Planning

Personal Information

Sydney D. Valiquet

