FORD PARK:

Creating New Hydrologically Sensitive Connections to the Mississippi Riverfront System

Ford Park: Creating New Hydrologically Sensitive Connections to the Mississippi Riverfront System

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

By

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In Partial Fulfillment of the Requirements
for the Degree of
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Primary Thesis Advisor

Secondary Thesis Advisor

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Introduction

"Enrich the existing downtown and riverfront by creating new parks, village greens and signature open spaces in the urban core and along the riverfront." - Saint Paul Development Framework

Problem Statement/Research Hypothesis

According to the National Weather Service the United States has averaged $7.96 billion in damages from flooding per year over the past thirty years. The current prevention methods range from inexpensive temporary measures to creating billion dollar permanent structures to manipulate the natural flow of the rivers of America. These approaches are very successful at protecting from damages due to flooding; however, they often isolate the river as an amenity for the city that was built around it.

We can reconnect urban neighborhoods to the riverfront through a park that will celebrate the rivers hydrology from flood to famine stages. We can create an experience that will change as the river crests and subsides.

Abstract

The main question this study aims to answer is how can we create an urban space that celebrates the riverfront at all times of the year, while still creating viable flood protection? Other questions considered are, what methods of river flow change will allow for the most efficient water control? What interactive opportunities can we as citizens have with the rivers? With global climate change how large of a future flood event should we be preparing for?

The study is being conducted on the Mississippi River utilizing existing knowledge of the highs and lows of the river along with the natural topography of the river's edge. Water control systems will have been studied to determine the most efficient and aesthetic methods. Case studies from across the world have been researched and there specific elements have been considered to discover what programmatic elements are needed. The last thing needed to be considered is what can we as landscape architects design that will enhance the users experience with the river.

Project Typology: Celebrating the Riverfront, Post industrial riverside park in an urban setting that is programed to engage with natural hydrological cycles.

Statement of Intent

The purpose of this research is to create a solution that allows for an urban park to be developed along with the neighborhood that brings the life of the river back to the residents of the city.

The City of Saint Paul published an initiative in the year 1997, called the Saint Paul Development Framework, to reconnect with the Mississippi River. This publication sets the ideals that the city wants to use to create a new riverfront. The city has been developing a mixed use neighborhood on the location of a recently closed Ford plant which closed in the year 2011. These plans; however, do not include any development along the riverfront and they have no intention to either.

Research will be done on the river and topography to find where the river can be most conveniently diverted to allow for overflow. These areas of overflow will be then be connected to the neighborhood into an urban park that can be enjoyed even during a 500 year flood event.

User/Client Description

Community

The new Ford Plant Neighborhood will be the primary target users as they will have the most convenient entry to the park; however, with the park scale this park will be more of a community type park. The draw to the riverfront will allow for Ford Park to bring the community to the riverfront in celebration in a way that has not happened in Saint Paul since the initial settling of industry along the riverfront.

City of Saint Paul

The new park will serve as a beginning to a larger riverfront system of parks that the city is trying to develop as evident in the released framework plan of 1997 and updated in 2007. The uniqueness of the space to the Midwest will potentially be a draw for tourism to this specific part of Saint Paul, which will increase the economic value of the surrounding region.

Literature Review

"Use public art as an educational tool to develop a greater understanding of the physical and cultural history of Saint Paul." - Saint Paul Development Framework

Literature Reviews

The Saint Paul Riverfront Corporation released the Saint Paul Development Framework in June of the year 1997 and again updated in the year 2007. Saint Paul Riverfront Corporation is a group of individuals that desire the city to reconnect with its portion of the Mississippi River. This project was in collaboration with the city of St Paul as well as its port authority. The idea of the framework is to take the river from an ignored amenity to an economic catalyst. The newest update has six chapters ranging from the environmental context to the movement of networks within the city. This document creates a clear vision for the cities future riverfront developments. The book shows examples of what the city is interested in its public realm as well as its urban structures. The purpose of this framework is to guide designers and planners for the future of the city. Each chapter is broken down into a different topic and is prefaced with the cities goal on for development on the topic. The first chapter is about the environmental context of the city and how it has shifted from a natural area to a more industrial region. The goals in this chapter are to shift to provide a healthy urban ecology that integrates both the built and natural environments. There are six specific goals in this section, but the ones most relevant to this study are develop creative design alternatives for river edge treatments, intensify the use of natural storm-water management solutions, and strengthen Saint Paul's identity by reinforcing topography and the natural environment.

Literature Reviews

The second chapter emphasizes the urban structures including land use and amenities. The main goals of this chapter are to create overlaps in the areas where people live, work, and play. This is intended to be done by clustering activities through mixed use planning. This section is less relevant to the study; however, there are still important things to pull out from it including build on and enhance existing amenities, strengthen " prime" edges, preserve historical and cultural merit of landscapes, and Identify preserve and enhance critical views and panoramas in and around the core and riverfront. The third section is mostly about transportation networks and the only thing to take away from it is the need to balance and maximize use of the river. The fourth section is one of the most relevant sections covering the public realm. The main goals are provide easily recognizable and accessible connections between downtown Saint Paul; the riverfront; and the city-wide and regional open space trail systems, recognize and take full advantage of the historic and recreational significance of Saint Paul's parkway and trail corridor system, strengthen; organize; and humanize the public realm by recognizing that parks and open space are necessities for creating and sustaining a quality; livable downtown environment, enrich the existing downtown and riverfront by creating new parks, village greens and signature open spaces in the urban core and along the riverfront, and acknowledge and celebrate the role of public art in the downtown and riverfront area.

Literature Reviews

Sections five and six are more specific to the main downtown core area and are not relevant to the specific research study area.

This framework will be a helpful tool in the design process because the objectives of the city are laid out in an organized manner. With each goal they go into specifics of what they want to see in order to achieve that goal. Most of these solutions are guidelines that are open to the creative development, while some solutions give exact details of what the city wants in order for cohesiveness throughout the city. This book is something that will be constantly referred back to as the design is being finalized. Section five is not specific to the right site, but it is very good at showing how this framework is implemented in a similar scale.

Literature Reviews

Danilo Palazzo and Frederick Steiner are the co-authors of the book Urban Ecological Design: A Process for Regenerative Places which was published 2011. This book is intended to teach a method of creating urban spaces with the ideas of ecology and sustainability that fit in with urban form. The authors are attempting to create a process model for creating these urban spaces and describe the theories behind the design. It was written for all design professions and is intended for multi-disciplinary use. The method is looking towards designing large urban areas that eventually leads to the site specific scale. It does this by starting out by looking at the major urban area as a whole and analyzing both current and historic growth patterns to determine proper connection points. They also in this point emphasize locating high activity zones as they call them so you can create proper connections to the places people are attempting to go. This is one point where social equality is very important because you do not want to accidentally leave a specific demographic out of your overall plan. The next step is synthesis of ideas. This is a good time to create an opportunities and constraints map to identify locations that can be beneficial to your concept as well as barriers that need to be addressed. Through this and other analysis tools you can start to work out concepts. There is also a new emphasis on using case studies to back up decisions made.

Literature Reviews

From this point it is important to look at density and creating multiple different scenarios that fit the program and using the same metrics analyze in detail how that would affect the user experience, change the current density of the urbanized environment, connect the site to its surrounding region, and effect the flow of the city as a whole. The metrics used to analyze can be quantitative, qualitative, or a mix of both. At this point the designer should begin a more in depth dialogue with the client, especially if the main client is the public, to get as much input as they need to help make their decisions. This can be done by using methods including, but not limited to a survey; town hall meetings; and reaching out specifically to certain demographics. In this phase it is very important to ask the correct questions to be the most time efficient as well as getting all the information you need while the public enthusiasm for the project is high. It is important to include the public with the rest of the decision process from here on out. After collecting all of the data, the next step is to refine the ideas into one master plan. This is the largest scale designing you will be doing. When the master plan is completed, the ideas will be presented including the entire process up to this point to continue the support for the project. It is important to have all of the components required to sell the final project at this point. This is when you should be able to show your designs objectives and show what you did to meet each of these objectives.

Literature Reviews

Following the successful presentation, the specific detail scale is designed. This phase in an urban design scale is usually divided into several smaller design teams, but at smaller scale projects the original team continues to the detail scale. The last step is implementation of the plan and details. So the entire process looks like this.

Inventory/Analysis → Idea Synthesis → Planned Options → Dialogue →
Master Plan → Present to Client → Complete Details → Final Implementation

Urban Ecological Design is a very well written and thought out book that created a method for designing in the urban setting alongside with the future users of the site. The concepts that are brought up will be helpful for taking research and implementing it into design. One of the major problems with this book is the fact that it is more focused on designing at a larger scale than this study is geared towards. The process will be required to be altered in order to fit with the smaller final design site. This study is also not currently planned for implementation so there are certain phases of the method that are not able to be completed. The methodology described in the book will be considered for this study.

Literature Reviews

Antje Stokman, Daniel Stimberg, and Susanne Zeller are all co-authors of the book River. Space. Design: Planning Strategies, Methods and Projects for Urban Rivers which was published in 2012. The book is intended to create a new method for riverfront development that can work on any river in any country. This is to fill a hole where some specific rivers had development methods, but there was not a method that can be used by designers everywhere. This is intended to be a multi-disciplinary approach to design. It is broken down into three sections. They are Prerequisites for Planning Urban River Spaces, Rivers and their Processes, and Designing River Spaces. The book is laid out so that the first two sections are on one side while the third section is on the other. This means that when looking at the design section it is always possible to look back at the other two sections for reference. The first section of the book really looks into the importance of developing a new relationship with our cities waters, while making sure to acknowledge the potential dangers that can come with activities on the water. One way to do this is to add computer systems that monitor water speed and water quality to let the users know if it is safe to use the water. Creating a more naturalized edge promotes ecology while a concrete edge is better at preventing sedimentation shifts. One more important thing to look at is the level of urbanization of the surrounding area to fit into the context.

Literature Reviews

Section two talks about one of the main emphasis' of this method. That is to distinguish two major processes of the specific river. The first process is temporary flow fluctuations including how a vertical rise coincides with horizontal spread on the landscape. The second process is the long term morpho-dynamic process that looks more into how sedimentation will shift with the river based on areas being cut out and areas that where sediment settles to change the shape of the river. An important part of the morpho-dynamic changes is that they are constantly happening, and they can either be limited through concrete channels or they can be predicted to keep the river contained. The containment of the river is especially important to consider in an urban setting. This will show you the full extent of an overlapping border where the river fluctuates between as well as help determine how the river will change in the future. The design of this specific border is the most important part of riverfront development because it determines whether or not the space is usable. The design of this specific border is the most important part of riverfront development because it determines whether or not the space is usable. After these processes have been figured out, the next step is to take this discovered border, or process space, and create a new design strategy that will solve the problem. You are having with integrating the river back into the city. Once you have created an overall design strategy for the area all that is left is to create design tools for the specific scale that is required. This can be as small or as large of a scale that you need for the site.

Literature Reviews

The final work-flow begins to look like this

Process Space → Design Strategy → Design Tool

The third sections goes into case studies and shows how the process was created and shows implementation of the design tools. This section goes into good detail on how these case studies are functioning and backs up to process.

River. Space. Design has a well researched method that is reinforced on its effectiveness throughout the book. It is very helpful to the study because it is looking specifically at river development and how we can use research to back up design choices. It is also very good at stating what types of research are needed and the purpose of each piece. One of the problems to keep into consideration with this book is the fact that it is based out of Europe so some of the cultural values may differ. However, the overall process will remain much the same. The book also has a very good and consistent graphic style that help it to be more easily read and understood, which is something every study should strive for.

Case Studies

Robert C. Beutter Riverfront Park is a park along the Saint Joseph River in the city of Mishawaka, Indiana. It was designed by Rundell Ernstberger Associates LLC and finished in the year 2005. It was created on a former industrial site that was vacated. This park has changed from an underutilized riverfront region to an amenity for the community to celebrate. It integrates the river into the park and also helps to tell the story of the sites history. The site was designed to be a centerpiece of a newly developed mixed use redevelopment of an abandoned industrial site. The highlight of the park is a decorative water feature which follows the route of a historic hydroelectric canal once used by industries along the riverfront. The water feature is broken up using a small scale step pool design to slow the water speed as well as create a unique aesthetic appeal. The park is filled with different types of public art from large scale sculpture all the way to the detail of design on the guardrails. There are a series of gardens throughout the park that give it a unique feel from other parks in the region. Additional amenities within the park include an outdoor performance area, and a promenade along the river with concrete overlook areas. There is also a pedestrian bridge that crosses the river.

Photo Credits to REA, LLC

Case Studies

Robert C. Beutter Riverfront Park is an excellent case study because it has a similar industrial past. It is also apart of a bigger redevelopment of a former industrial space. Beutter park is a smaller sized park, but it is very successful at creating a large number of different types of spaces. It also has public art in several different forms. Everything seems very clean and it gives the feeling of a very tame and safe river environment. The edges and design feel very linear when inside the park. The park definitely uses constructed edges rather than natural edges. This might be because the channel was already this way due to the hydroelectric canal that used to occupy the space. The feeling of the park might not fit the context of the natural park system that is currently along the Mississippi River, but there could be a good opportunity to use this as an example of combining the natural and built environment as the Saint Paul Framework suggests they are intending to do.

Photo Credits to REA, LLC

Case Studies

Confluence Park is a park at the confluence of South Platte River and Cherry Creek in the city of Denver, Colorado. It was most recently updated by Wenk Landscape Architecture and Planning but it was originally designed in the 1970's. With the recent update the park has since become a central hub to the area creating new neighborhoods around is and increasing the diversity of business in the area. It is also currently, as of 2015, getting another makeover to become more ADA compliant. The main features of Confluence Park include an urban whitewater rapids course. There are pedestrian bridges crossing the river that connects to the existing city system of trails. The park has made attempts to honor the sites history by leaving certain areas unaltered and placing plaques on the landscape. The park is actually on all three sides of the different riverbanks, but only two of the sides are physically connected. Because of the design of the rapids the actual confluence point has very calm waters, which allows for large groups to swim at a time. This is also one of the ways that the third side of the park is connected to the rest of the park.

Photo Credits to Wenk

Case Studies

Confluence Park is a very successful park that has been in existence for over forty years. It has been updated to keep it relevant in the city as well as to increase safety. It is a good look at opportunities you can create without requiring very much space or topographic change. The design does a fairly good job at giving the appearance of a natural edge while actually having some very constructed linear forms. It is also smaller than the study area, but it has a strong connection to the river. This is helpful because the river edge is always going to be a similar size no matter how far the park extends behind it. The park has been a good gathering point for the neighborhood so using similar types of connections to surrounding urban areas will help increase the ease of traffic to the Ford Park study area. The size of the whitewater channel is a good example of how much water activity you can accumulate. The rest of the South Platte River is very friendly to small craft travel so this area works better than the Mississippi might as far as kayaking on the actual river.

Photo Credits to Wenk

Case Studies

Balzac Park is a park along the La Maine River in the city of Angers, France. The first sketched of th design began in 1990 and the park as it is today was finished in 2004. The park is partially located on an old landfill site. The biggest feature of this park is not visible for most of the year. The topography was designed in a way so that when the river floods this park is where most of the water is rushed towards. Then, when it is flooding, you can see how the park was designed to be used during high waters. The experience of the park during flooding, or after a large rain event is a completely different experience than when the La Maine River is within its banks. The park's trail system is designed to create a walk with a different point of view of the city than anywhere else in Angers. The city is also using grazing animals to maintain the low lying areas that are often flooded to increase the sustainability of the park. Over half of the irrigation for the 132 acre park is taken directly from the river and not connected to the cities water supply. In an effort to create an outdoor environment for more people of the city to enjoy Balzac Park also includes one hundred twenty garden plots that can be rented out each year.

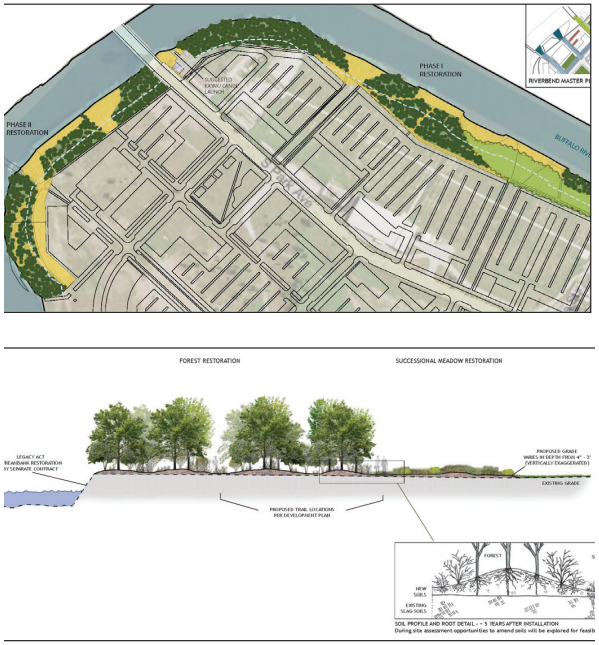
Photo Credits to City of Angers France

Case Studies

Balzac Park is a good change of cultural perspective from looking at case studies in America. The size of the park allows for there to be more areas that are not along the river than any of the other case studies. This is helpful to see what types of activities can be done in the areas that are farther away from the water. The park feels very natural even when some of the mounds are obviously man made. The aspect of the changing feel of the park during flooding is a big appeal because when most riverfront areas are avoided during flooding this park has a completely different experience. It almost makes it a destination when a person knows that there is a flood. The trail system of the park is connected well to the rest of the city and goes through a diverse landscape.

Photo Credits to City of Angers France

Case Studies



Buffalo River Shoreline Restoration is an on going project in Buffalo, New York. It is being created by the Army Corps of Engineers with the help from Biohabitats. The project is to restore four thousand three hundred twenty feet of shoreline in a post-industrial environment. The site itself used to be a steel manufacturing facility that was abandoned, leaving behind poor soil conditions. The plan includes trails that allow for the community to come into the restored waterfront and get a new experience the old river amenity. It is largely to be used as a riparian area for wildlife, but there are several gathering places designed.

The Buffalo River Shoreline Restoration as a case study is helpful to get more knowledge of existing site conditions. It is a good example of what makes up a natural river edge. The human element is a little lacking in the planned region, but the plan is to let the soils be restored and the vegetation to develop before introducing more programs to attract visitors to the site. It is a good site to study to get more information on how they are treating water both from the river and flowing into the river

Image Credits to Biohabitats

3 Methodology

"Renew connections with the Mississippi River, urban forests, and floodplain reaches." - Saint Paul Development Framework

Methodology

For this study, the methodology chosen is a mix between the structures presented in Urban Ecological Design and River. Space. Design. This will be done by combining certain elements from both to allow for an ecological approach that will fit with the cultural values of the Saint Paul region. There are some overlaps with both research types so the combination can become a new method that is well backed by both different methods.
The original method for Urban Ecological Design **(**UED**)** looks like this.

Inventory/Analysis → Idea Synthesis → Planned Options → Dialogue →

Master Plan → Present to Client → Complete Details → Final Implementation

While the method for River. Space. Design **(**RSD**)** looks like this

Process Space → Design Strategy → Design Tool

Combining the two methods is a good idea because in certain times where one of the methods is weaker the other method has a more described plan. The biggest difference between the two original methods is the interaction with the users through the creation of different dialogue to increase the public input on final design.

Methodology

In UED the inventory/analysis and idea synthesis phases are similar to the RSD's process space identification phase. This study will follow RSD plan for identifying the zones by researching the fluctuation of the river and where that ends horizontally. It will also add elements of inventory from UED considering cultural and demographic values. For this particular study this section will be referred to as Inventory and Analysis. The dialogue portion is unique to UED and it will take place before its original time in this study through the use of a survey that is sent out to some of the people of Saint Paul. For this study the survey section will be referred to as Public Interaction. The planned options and master plan of UED and the design strategy of RSD are also very similar in the detail of the product that is produced at these steps. The design strategy from RSD will be used through the research of different water channel types as well as water morphology to find which option best fits the site. With the idea of planned options from the UED this step is taken farther and starts to develop multiple concepts for the implementation of the channel systems on specific site locations. For this study this portion will be referred to as Design Research. The design tool and complete details sections are both about taking the design strategies that were developed in the earlier sections and creating the final design details that are required for project construction. For this project that means that site specifications are completed at a small scale and are at the highest details. For this study this will be referred to as the Final Design

Methodology

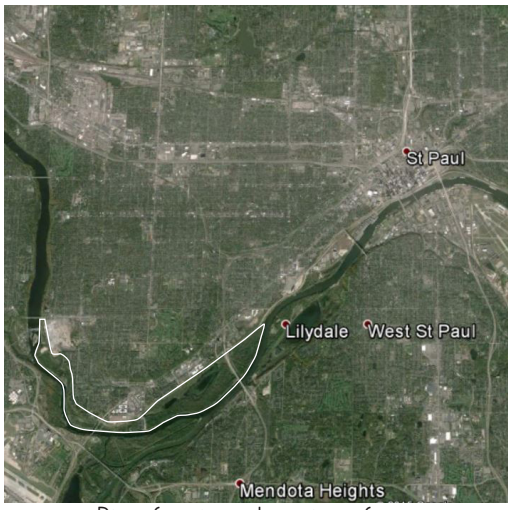
With the combination of the two different structures the final methodology of the study can be described. The path may appear to be linear, but it requires cyclical thinking in order to ensure that different options are considered. The final methodology path looks like this.

Inventory and Analysis → Public Interaction → Design Research → Final Design

The research from the first three steps will combine to create final design for this study. It is important to note that all three steps must be understood and explained for the final design to be its most effective at solving the problem of creating a unique park that allows human interaction with the riverfront.

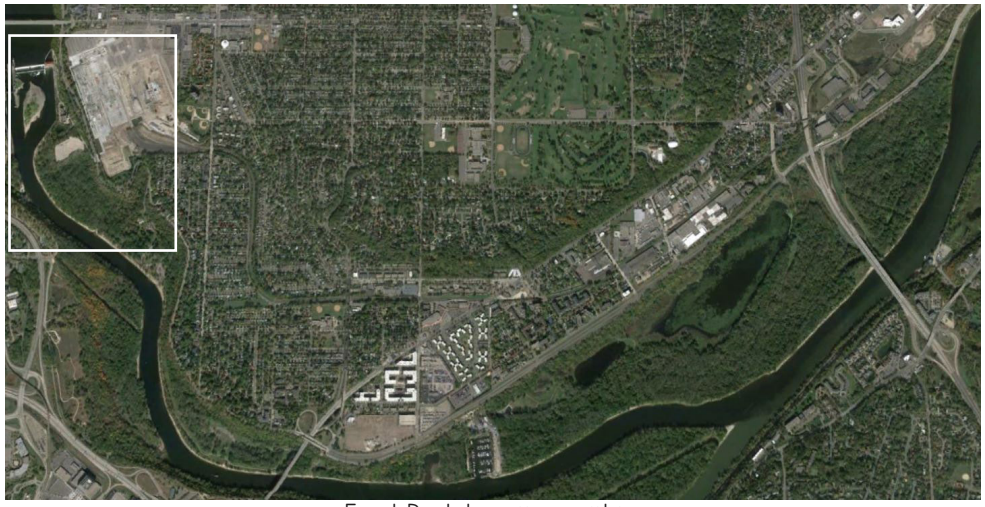
Site introduction

The Saint Paul Ford Plant closed for the last time in 2011 and is currently undergoing a change from industrial to a mixed use neighborhood. The final design for the neighborhood is in its last stages and demolition of the site has already started. With the introduction of the new population to the east this park will have the opportunity to connect this new development to the river that drove Ford to build its factory in the first place.



Riverfront park system from downtown Saint Paul

Size: 51 Acres
Borders: North- Lock and Dam Number One, East- Mississippi River Blvd,
South- Hidden Falls Creek, West- Mississippi River


Ford Park location within riverfront park system

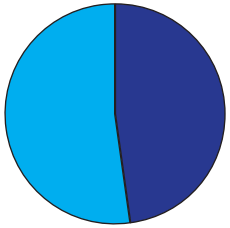

Large scale site location

Images taken from Google Earth

4 Inventory

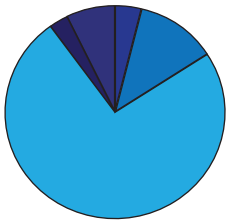
"Open space and parks should be integrated into riverfront redevelopment, and should be linked to other existing or proposed park space to create a seamless flow into the urban core," - Saint Paul Development Framework

Highland Park Neighborhood



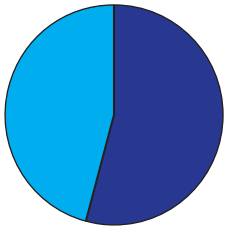
Sex

- Female
- Male



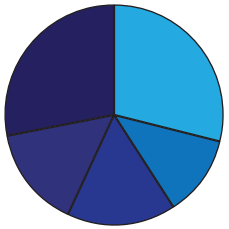
Ethnicity

- White
- Black
- Asian
- Hispanic
- Two or More



Home Ownership

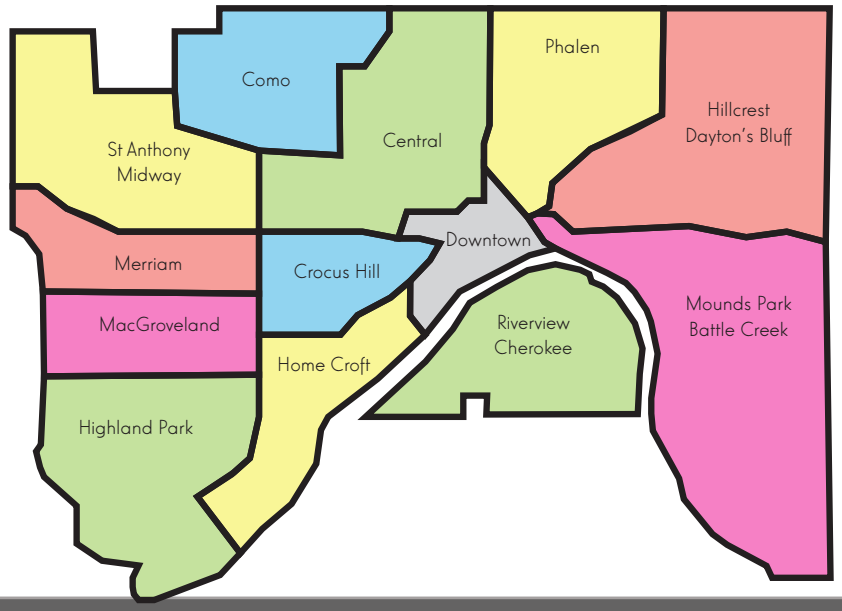
- Renters
- Owners



Annual Income

- >$100,000
- $75,000-$99,999
- $50,000-$74,999
- $35,000-$49,999
- <$35,000

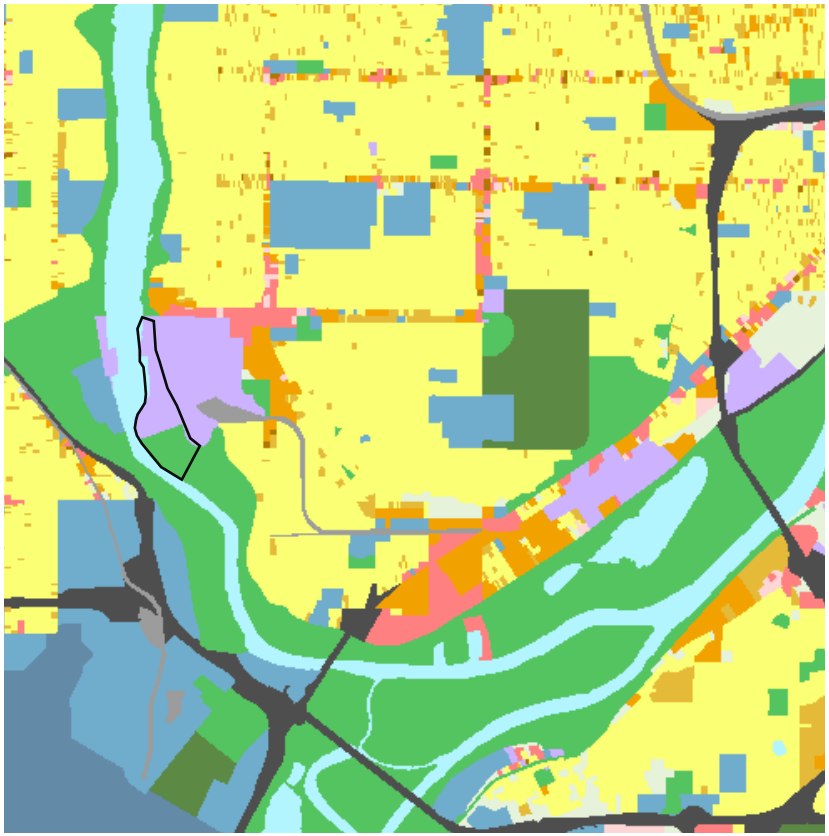
The Highland Park neighborhood is the southwest most neighborhood in the City of Saint Paul. It is within Ramsey County of Minnesota and was mostly developed in the 1920's. There are four public and four private schools within the neighborhood as well as the College of Saint Catherine. Highland Park is a predominately Caucasian neighborhood with a small black, Asian, and Hispanic community. The river wraps around the south and west borders leaving the opportunity for a large park system.



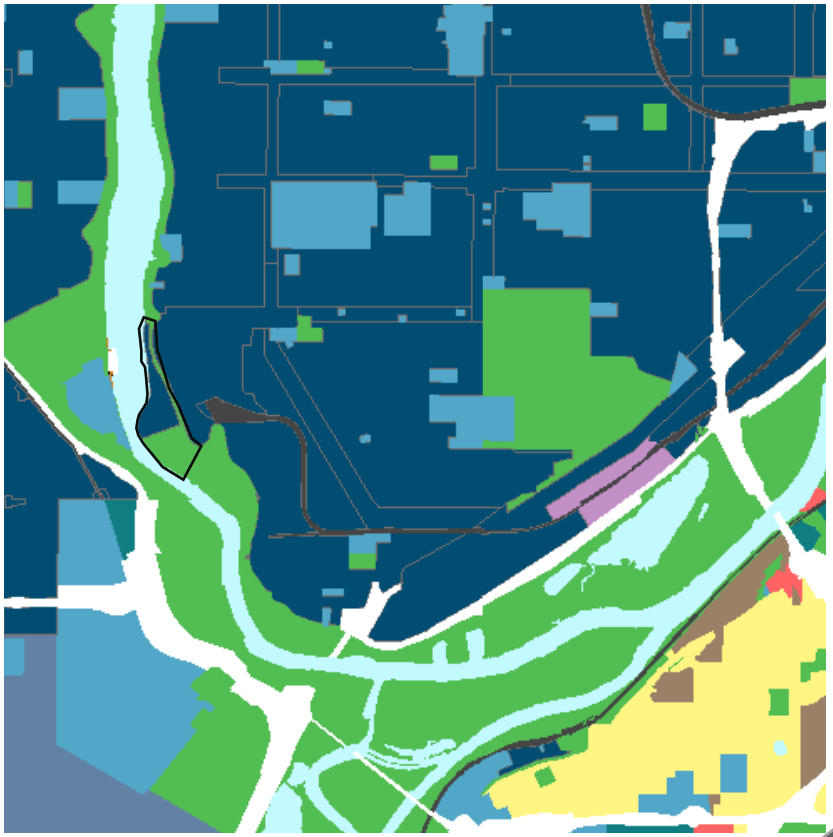
Information from 2010 Census / livemsp.org

Land Use

Current Land Use



Future Land Use Plan



- Single Family Detached
- Single Family Attached
- Multifamily
- Retail and other Commercial
- Mixed Use Industrial
- Institutional
- Park, Recreation or Preserve
- Golf Course
- Major Highway
- Railway
- Airport
- Undeveloped
- Mixed Use
- Mixed Use Commercial
- Multi-Optional Development
- New Lite Rail Routes
- Open Water
- Site Outline

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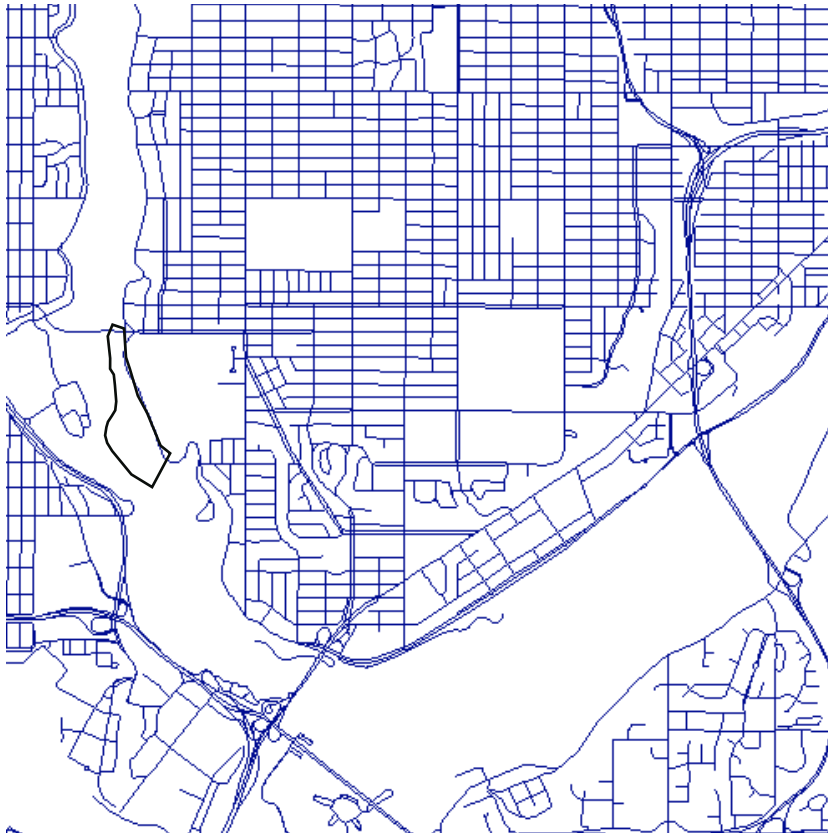
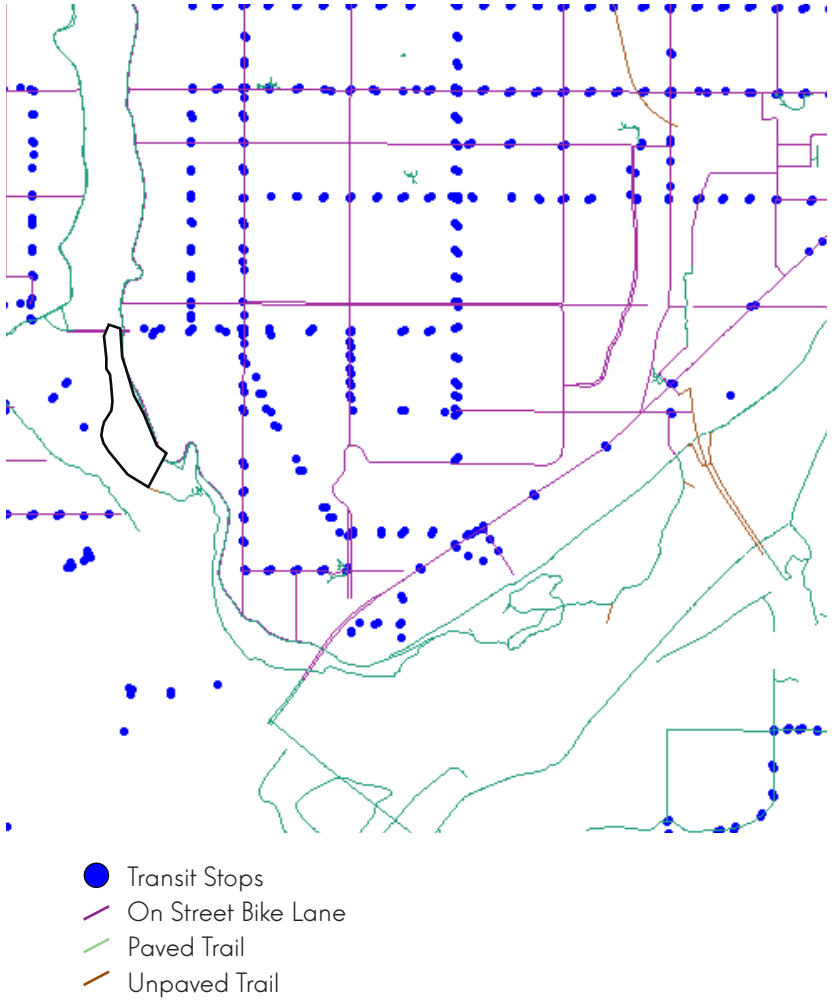
Data From Minnesota Geo-spatial Commons

Transportation

City Streets



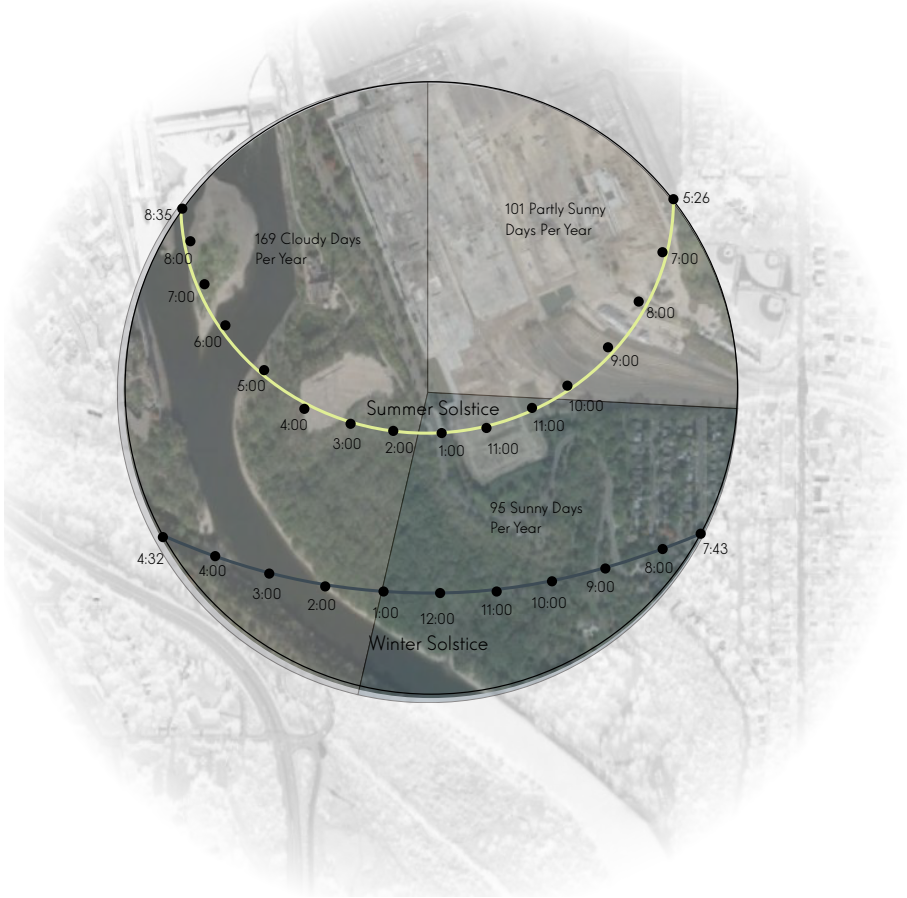
Trails and Transit Stops



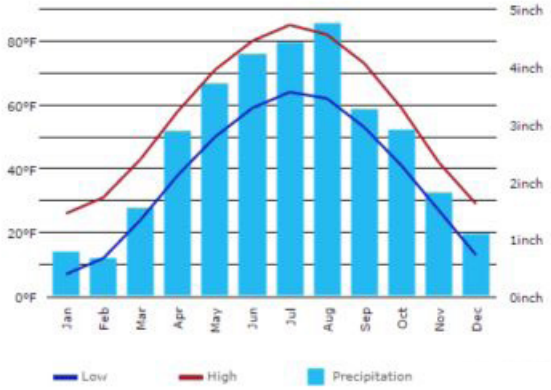
Data From Minnesota
Geo-spatial Commons

Climate

Sun Study



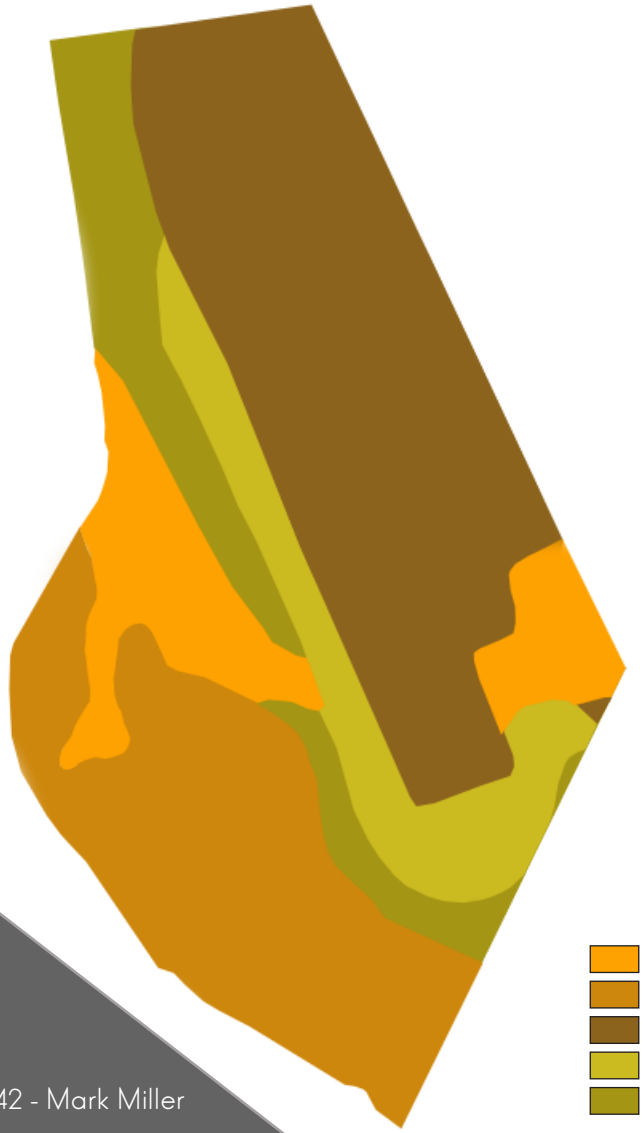
Average High: 57 Degrees Fahrenheit
Average Low: 38 Degrees Fahrenheit
Average Fall Freeze: October 11 - 20
Average Spring Thaw: April 17 - 26
Average Annual Rainfall: 32 inches
Average Annual Snowfall: 16 inches



Average Wind Speeds: 12 mph
Average Visibility: 6 Miles

Data From National
Weather Service

Soils



The soils of the site are generally a fine sand grain with a shallow a horizon. The soils are well draining and require small slopes to stay stable. The edge of the bluff shown is a rock outcrop from the dorerton formation and is a steep limestone based rock. The wet substratum is a larger grain type on the site and consists of rubble and refuse due to its history as a river marsh. The copaston loam is a sandy clay mix with an a horizon that is more deep than any other on site. The areas described as urban land is a fully compacted for of the copaston loam. The last soil type that encompasses most of the lowland is the algansee loamy sand. This is the most historically relevant sand and is particularly useful for creating glass.

- Wet Substratum
- Algansee Loamy Sand
- Urban Land
- Copaston Loam
- Dorerton Rock Outcrop

Data From USDA Web Soil Survey

Vegetation

Photo Credits: Great River Passage

The vegetation zone of the study site is a Southern Floodplain Forest according to an organization called the Great River Greening that works along the Mississippi. One of their goals is to help with the ecological side of riparian restoration. They have released a list of plants that should be planted and some to be avoided. The full list is in appendix A. This list includes some canopy and under story trees, shrubs, vines, forbes, rushes and sedges, and ferns.

One problem to consider in the site is the presence of Emerald Ash Borer. This means that Ash trees and Elm trees, which are both on the list, will not be used.

The current site is heavily vegetated with a full canopy for most of the area. The major current canopy trees are Cottonwood, Black Willow, Silver Maple, and Box Elder. Along the river and farther back there are Northern Pin and Bur Oak

Data From Great River Greening

Wildlife

The southern floodplain forest is naturally a good environment for a divers bird population. Eastern phoebes, red-eyed vireos, robins, and wood thrushes are a common site especially in early spring and throughout the summer. There are also often bald eagles that make nests on the site. The Mississippi River is has a big range of migratory birds as it is the center of a major north south flyway. Bird watching it a common activity for the regional park system.

With the dense vegetation there are also a variety of frog species and turtles. The mammals that life within the forest range from white-tail deer to small fox. There are an abundance of gray and red squirrels within the upland area oak population.

The Mississippi River is filled with a diversity of fish species. Some of the species are walleye, bass, northern pike, and bluegills.

Photo Credits: St Paul Audubon Society

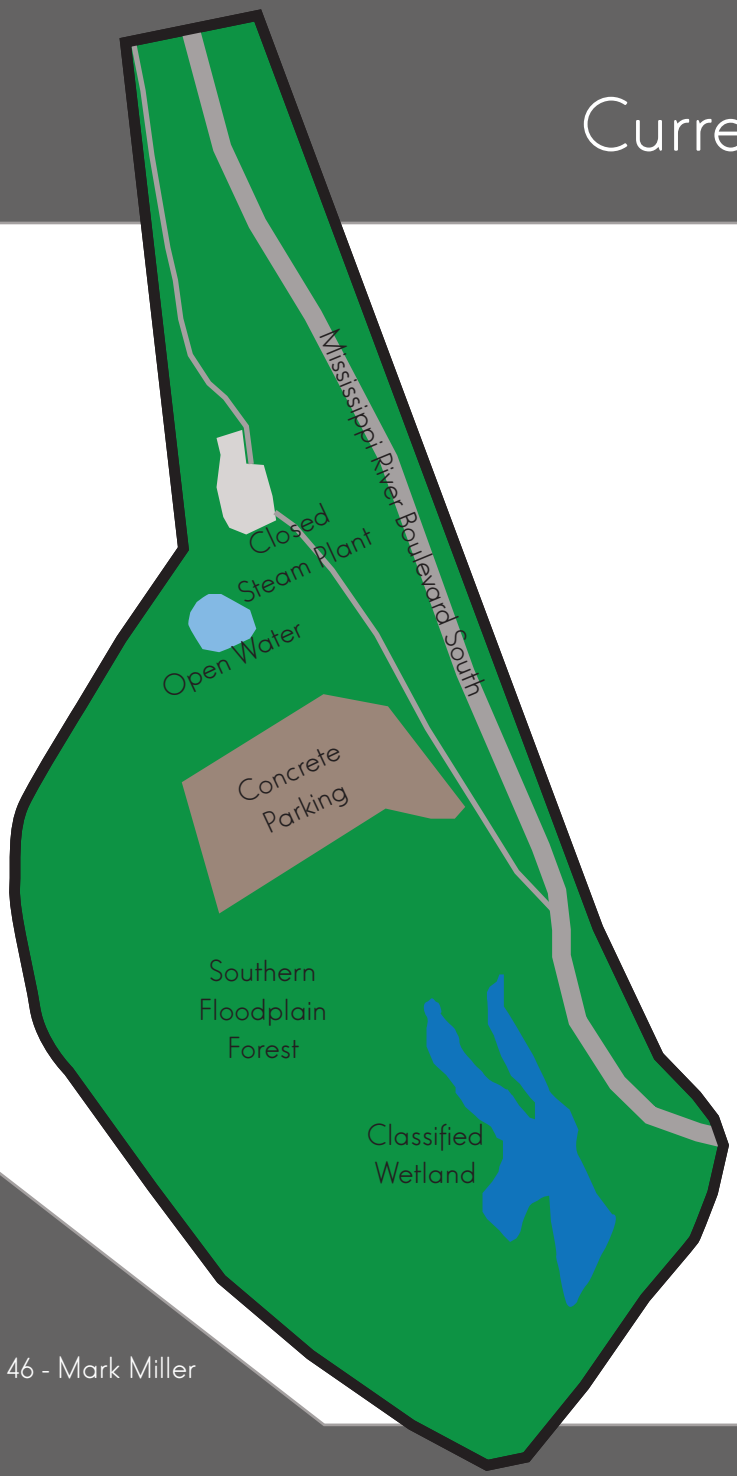
Data From US Audubon Society and MN FWS

Site History

The study area was formerly owned by the Ford Motor Company and had production on it for almost one hundred years. The plant where it is now opened in 1923, utilizing the availability of the river to create hydro-power. The plant reached peak production in 1999 and was one of Ford's most efficient plants. In the year 2007 there was a plan to close the plant down for good. In the fourth quarter of 2011 the Ford Plant. From the early years of the plant the sand that is on the site has been used for making glass products including producing the windshield of the produced cars. Because of this there are tunnels under the site as well as two exits/entrances to the tunnels that connect to the steam plant that is on site.

Dates from Star Tribune
Information from Ford

Current Site Features



The steam plant is an iconic building on the Mississippi River with smokestacks that stick up into the sky. There is a large parking lot that was used for large trucks, and according to a study conducted by Arcadis for the City of Saint Paul **(**Appendix B**)** is also on top of a historical disposal area. The study also goes into more detail on the location of the underground tunnels on the site. According to the study these tunnels are sixty-two feet below the ground, but are up to fifty-six feet from ground to ceiling. There is an open water pit just to the south of the closed steam plant. There is also an area that is classified as a wetland by the state of Minnesota. It is dry throughout most of the year, but collects water from flooding and slowly releases it. The rest of the site is a dense southern floodplain forest that has been established within the last twenty-five years according to data from the Minnesota Geo-spatial Commons.

Data From Minnesota Geo-spatial Commons & City of Saint Paul

5 Public Interaction

"Design and program existing open spaces to encourage greater use." - Saint Paul Development Framework

Survey

For the Public Interaction part of the study a survey was sent out to people living in the Minneapolis Saint Paul area. All answers were completely anonymous and no specific information will be released. The survey was intended for any age group and (numbers still coming in) people responded. Below are some example survey questions

On average how many people do you go to a city park with?

A. Alone
B. 1-2 People
C. 3-4 People
D. A group of 5 or more

How many hours on an average week do you spend outside in the summer? (Work not included)

A. 0-5
B. 5-10
C. 10-15
D. 15 or more

What about in the winter? (Work not included)

A. 0-5
B. 5-10
C. 10-15
D. 15 or more

Survey

Would you be more willing to ride public transit to a park if there was a stop right next to the stop?

A. Yes
B. No

Do you currently see the Mississippi River as an amenity to the Twin Cities to be enjoyed?

A. Yes
B. No

Do you feel that the water of the Mississippi River is safe to swim in?

A. Yes
B. No

If water current speeds were slowed down would you feel more safe swimming in the Mississippi River

A. Yes
B. No

Survey

Which of these images is the most appealing to you?

A.

B.

C.

D.

Survey Results

The final count of people that completed the survey was 212 people from the Minneapolis, Saint Paul area.

The survey results show that there is a need for more accessibility to the site area because even if there was an inclusion of new bus routes most people would prefer to drive to the park system and walk through it from there. The idea of having natural amenities versus a built traditional looking city park is split almost completely down the middle so it is important to develop regions for both types to exist. One aspect that interested me is that 86% of the people asked did not see the river as an amenity to them as a resident of the city.

6 Design Research

"Explore additional opportunities to enhance the natural qualities of the river itself." - Saint Paul Development Framework

Mississippi River Levels

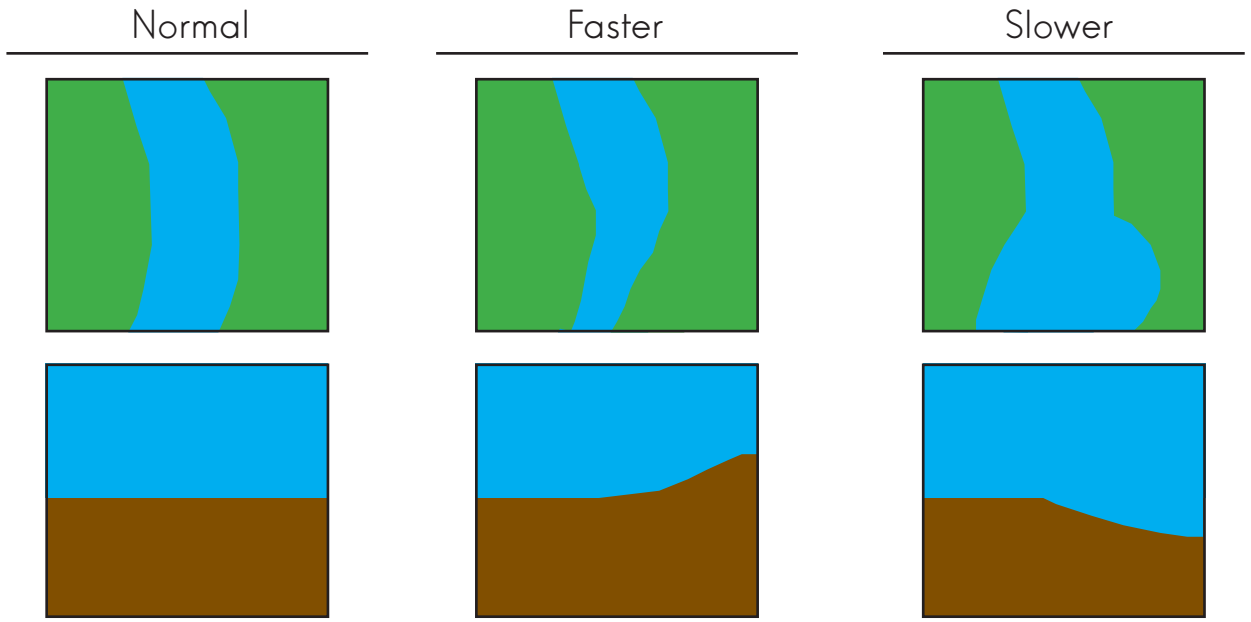
The Mississippi River is monitored constantly at multiple points even within the City of Saint Paul. These monitoring stations have recorded the highs and lows of the Mississippi and are a good historic measurement for how the river will act during any given year.

The gauge used for this study is located one-half of a mile east of the study site so the river stages levels should be considered accurate. The gauge is located at the bottom of the river near the northern shore at the elevation 683.768, which is equivalent to approximately 685 for the study site. National Weather Service has created four flood categories and has designated a feet height that corresponds with each. The categories are; action stage at ten feet, flood stage at fourteen feet, moderate flood stage at fifteen feet, and major flood stage is seventeen feet. There have only been thirteen major flood stage crests; however there have been four in the past five years, as of 2015. The highest crest in history was twenty-six feet in 1965. The data for historic lows is less detailed, but the lowest the river has ever been recorded at this location is two and a half feet. The river is at its peak in the spring then levels recede in the summer and rise slightly in the fall receding again in the winter. There are daily fluctuation, but the average for the spring is six feet, summer and fall are both around four to five feet, and winter is usually in the low four feet range. Some other times that are important to the river heights are the dates of first freeze and the beginning of spring thaw. River temperatures are important to know when inviting activity on the river and they rely heavily on the year. The first time the river is warmer than sixty degrees is usually around May, and the river dips below sixty degrees in mid October. The average summer temperatures are eighty-five degrees. The river flows too fast to freeze over on the average year so areas of low flow will be needed if there is any planned winter activities.

Information from The National Weather Service

Basics for Flow Speed Alteration

When moving water through a site from a river there are three different outcomes that can happen. The first outcome is no speed change and requires complete duplication of existing river conditions. The other two outcomes are a speeding or slowing of the rivers cubic feet per second. In general to slow down water you need to increase width and depth of the water. Contrary-wise in order to speed up water you can reduce depth or decrease the width of the water's edge.



Channel systems are all designed based on these principles, and are balanced to keep water within their banks

Information from The James Hutton Institute

Step Pool Design

Basic Design Concept

The step pool is a common method of slowing fast moving waters. The important part of a step pool is to leave enough depth in the individual pools to allow for the fast flowing water to circulate and settle. This will slow the water in the individual pool areas that can be as short or as long as needed. The water does speed up over the falls because the amount of space available for the water decreases. The bottoms of the pools are great areas to increase the amount of biodiversity, which is what these pools are generally designed to help increase

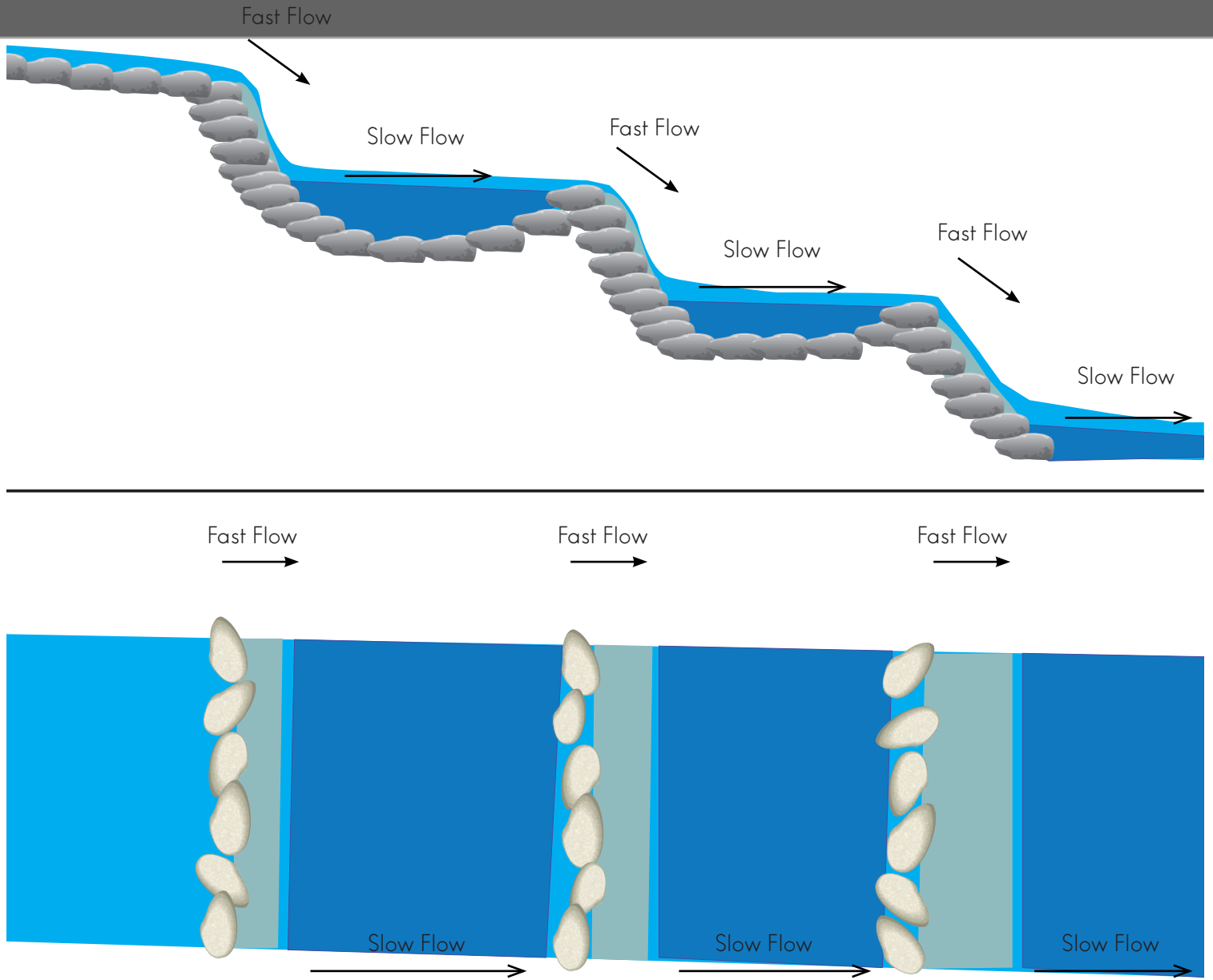
Site Application

Pros: The step pool can be a nice spectacle way to slow water through the site that does not require very much space, but can be spread through a long area easily. It is also common enough to the Midwest rivers and streams that it has a history of working well in a cold weather environment. It could be used in the right environment to create a rapids for kayaking on a site.

Cons: The step pool requires a moderate amount of topography change and is only applicable to the northern part of the site because the north-south grade change is not as drastic. The step pool design is also limiting on the activities that can be done during the winter as e sudden drops can become barriers.

Information from Sizing
Step-Pool Structures

Step Pool Design



Information from The James Hutton Institute

Check Dam Design

Basic Design Concept

Check Dams are less common in the Midwest area, but are helpful to slow water with a reduced amount of vertical elevation change required. Check dams can be made with either a concrete vertical beam or by using large stones that are set at a height just below the normal flow elevation. When using stones the amount of water rippling is larger than when using concrete and is less efficient at changing water flow speeds. This form has a reduced visible disturbance when the water is frozen so there is an increase in winter use from the step pool.

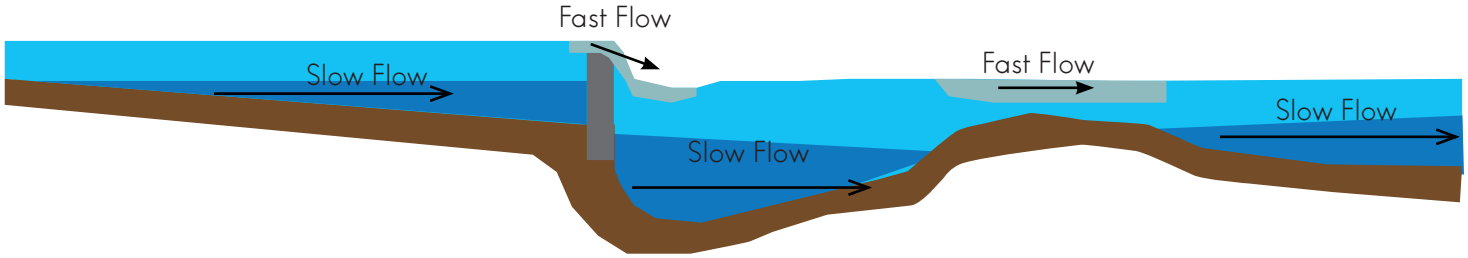
Site Application

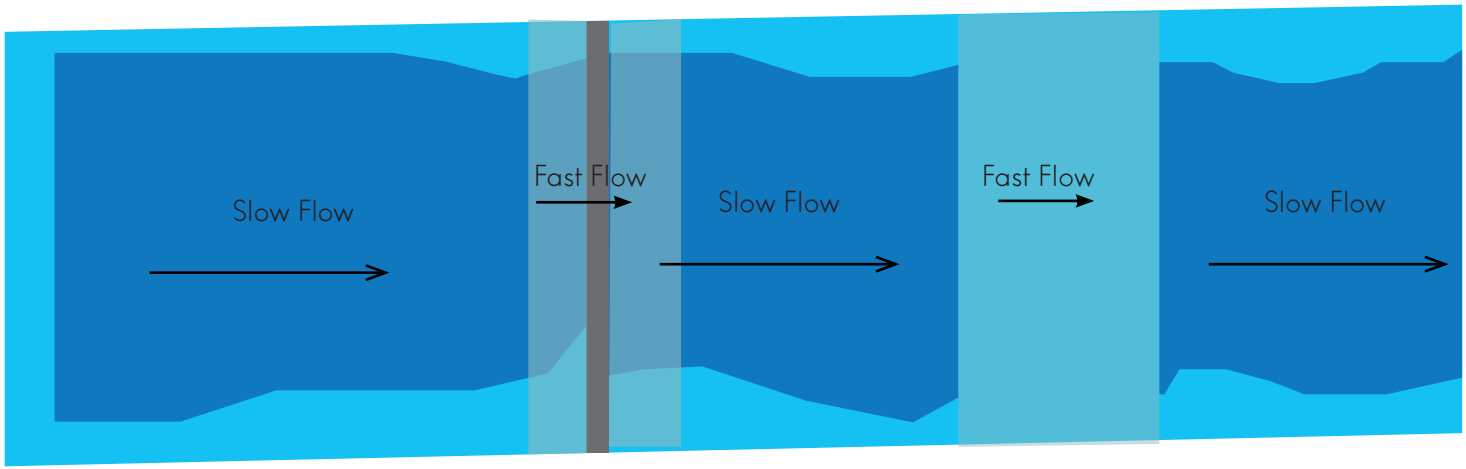
Pros: Check dams have the ability to slow water for a long stretch with only needing one point. The amount of topography required for a check dam is small and a check dam is easier to have an alternative use in a channel that might not always have water flowing through is.

Cons: Check dams are not as common in this region, and the check dams that do exist use stones under the water, which is the less efficient form of a check dam. The base topography needs to come back up sooner which creates the fast flow closer to the check dam itself.

Information from Dane County Erosion Control

Check Dam Design





Information from The James Hutton Institute

Planned Backwater Design

Basic Design Concept

Backwater areas are very natural to streams and river systems and are very effective at slowing water. One thing that comes with a backwater area is a whole new habitat from the rest of the river region because to water is naturally slower. The reason these areas slow the water down so much is that the water that does get into them has no where to go and needs to begin to spin. This motion blocks new water from entering the backwater area, which causes the water that is inside to settle down and stop moving. In high water flows these backwater areas are often fully flushed through.

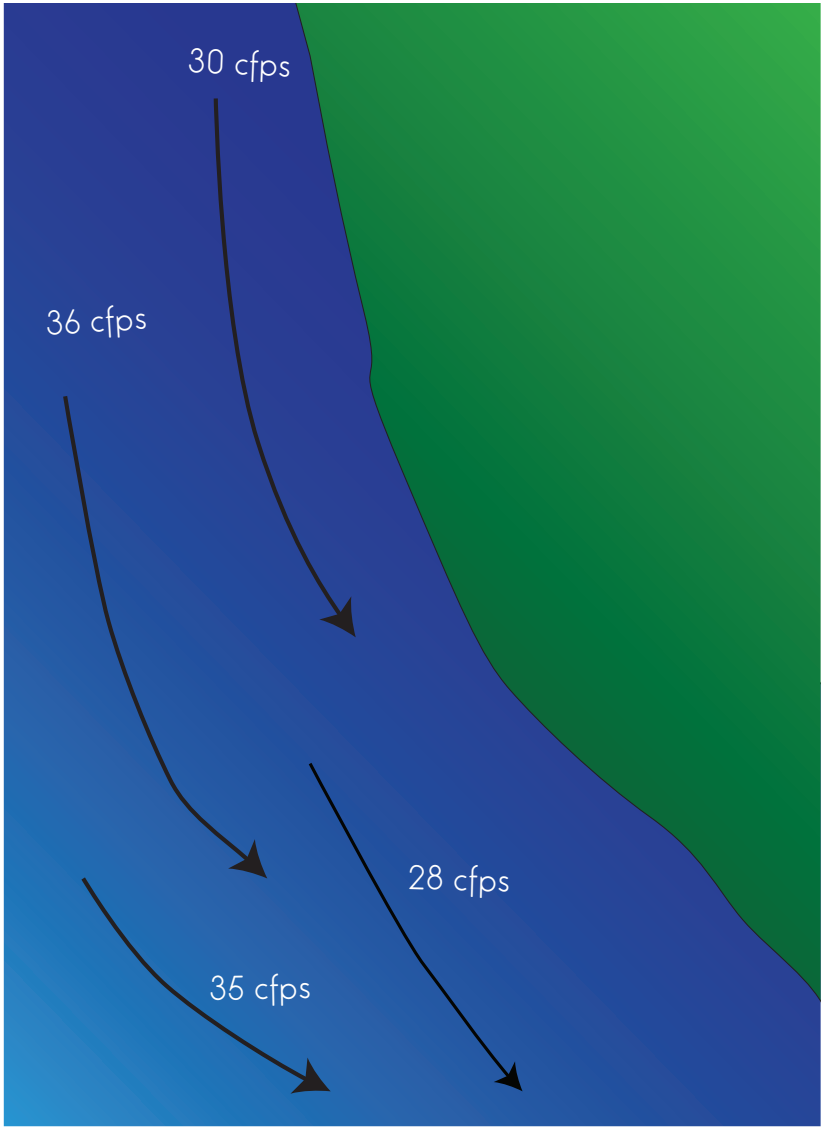
Site Application

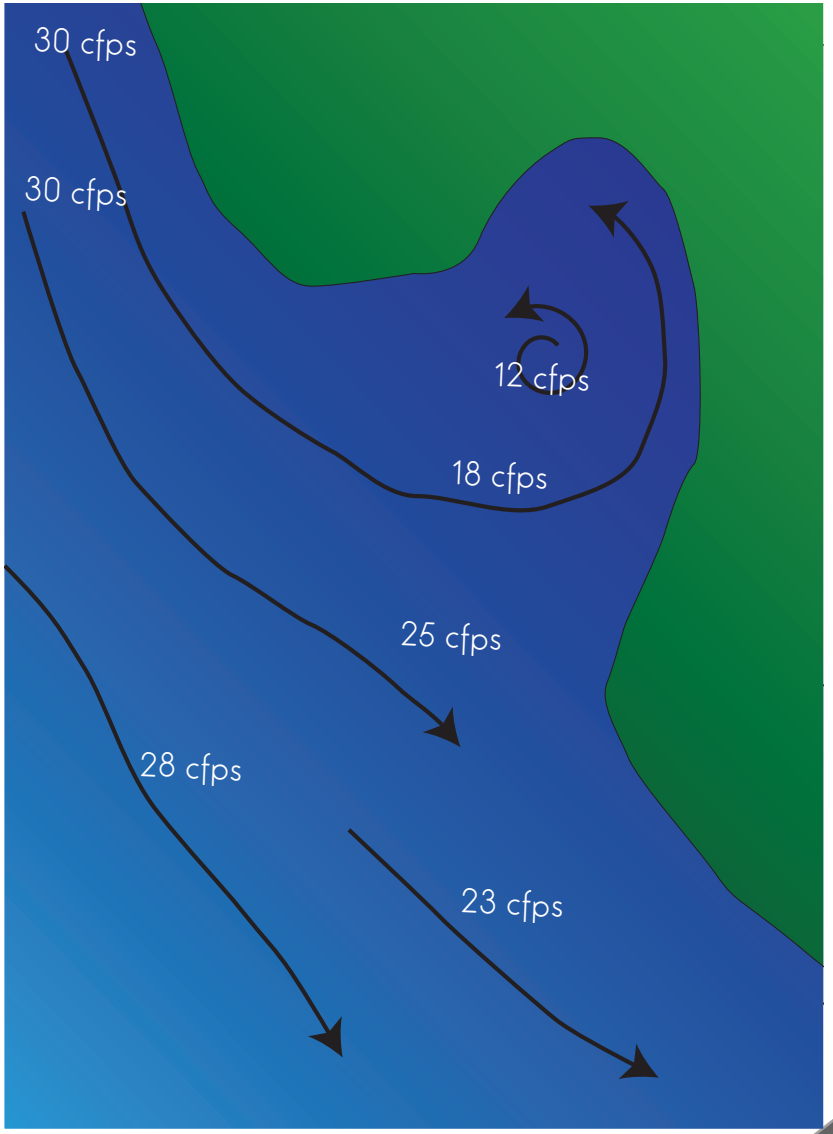
Pros: Backwater's are historically natural along the Mississippi River. They are very efficient at creating a contained pool for swimming and other activities to be isolated from the rest of the river activity. The bend in the river offers a good area to create a backwater area because of the direction and speed of water passing by. The pool created will not be flushed in the winter allowing for winter activities to occur on the water.

Cons: Backwater areas can become stagnant in the summer or other lower water times, and can quickly become a hot ground for misquitos if not allowed to flush. A proper backwater area can take up a large amount of space, which would reduce the amount of room for the rest of the design.

Information from Mississippi River Commission

Planned Backwater Design



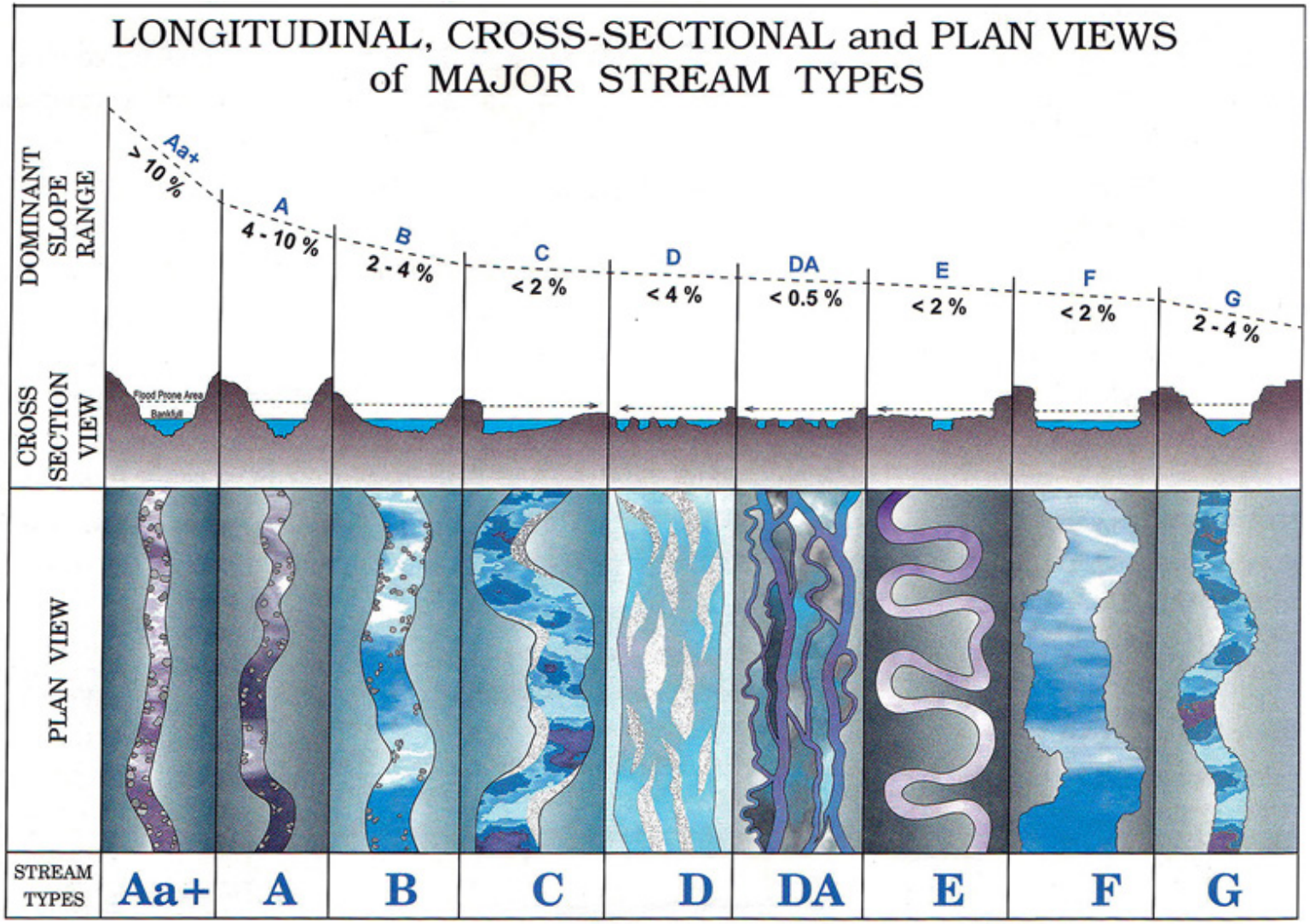


Rosgen Classification System

The Rosgen Classification System is a system developed for stream identification. It is very useful when trying to figure out what the stream is supposed to look like in its natural state, at any point along the channel. This is important to understand if the river system is working properly or if there is a problem that needs to be addressed. One of the main aspects of this system is dividing different regions of a river to figure out what types of wildlife and identify the full floodplain of a river. One important thing to note is that even though there is an alphabetical order streams do not necessarily follow from A to G. In fact, it is often not the case with the streams going forwards and backwards in the system. The use of this for the final design is in its ability to identify the needs of a stream and how you can develop along the stream.

For the Ford Site specifically the Mississippi is a b-type stream and is on the low end of the slope. One problem that has been identified is that there are and abundance of dams on the river so there is a problem with sediment in the channel not being able to replenish itself. This causes the river to cut down faster than it should. The image below displays the difference between the Mississippi and Minnesota River's at there confluence. Note the difference in the color caused by sediment.

Rosgen Classification System



Case Study Results

Case Study	Location	Size	Distance from Core	Former Industry	Connected to park system	Beach Area	Flood Resilient	Intended park scale
Buffalo Shoreline	Buffalo, NY	23.5 acres	2.5 miles	Yes	No	Yes	No	Neighborhood
Robert C Beutter	South Bend, IN	7 acres	4 miles	Yes	No	No	Yes	Community
Balzac	Angers, France	132 acres	.75 miles	No	Yes	No	Yes	Urban
Confluence Park	Denver, CO	5 acres	1.5 miles	Limited	Yes	Yes	Yes	Neighborhood

Case Study	Location	Size	Number of small group environments		Number of medium group environments		Number of large group environments		Public Art
Buffalo Shoreline	Buffalo, NY	23.5 acres	24	1.02 per acre	8	0.34 per acre	6	0.25 per acre	Yes
Robert C Beutter	South Bend, IN	7 acres	7	1 per acre	4	0.57 per acre	3	0.43 per acre	Yes
Balzac	Angers, France	132 acres	112	0.84 per acre	33	0.25 per acre	11	0.08 per acre	Yes
Confluence Park	Denver, CO	5 acres	5	1.6 per acre	5	1 per acre	2	0.4 per acre	Yes

Group Definition

The analysis mentions group sizes that have been distinguished as follows. A small group environment is an area for one to five people, a medium group environment is an area for six to fifteen people, and a large group environment is where sixteen or more people can be doing the same activity in a similar space

Site Application

Based on the case study analysis on group environments these sites averaged 0.9 small group activities, 0.3 medium group activities, and 0.13 large group activities per acre of space. Plugging these averages into the 51 acre Ford Park we come up with needing 45.9 small group spots, 15.3 medium group spots, and 6.6 large group spots. Public art or the availability of public art is a high priority as all case studies had public art no matter what size they were. Having an actual beach is not as important as only two of the four cases had a sand beach along the river.

Case Study Results

Case Study	Location	Size	Distance from Core	Water Speeds	Aquatic activities	Terrestrial activities
Buffalo Shoreline	Buffalo, NY	23.5 acres	2.5 miles	Slow due to natural bend	Swimming, canoeing,	Trails, fields, passive seating,
Robert C Beutter	South Bend, IN	7 acres	4 miles	Slow moving through site	Viewing, hearing, touching	Trails, concerts, passive seating,
Balzac	Angers, France	132 acres	.75 miles	Unaltered	Boating, kayaking,	Trails, gardens, passive, fields, nature watching
Confluence Park	Denver, CO	5 acres	1.5 miles	Both fast areas and slow areas	Kayak, tubing, Swimming,	Trails, gathering, passive seating,

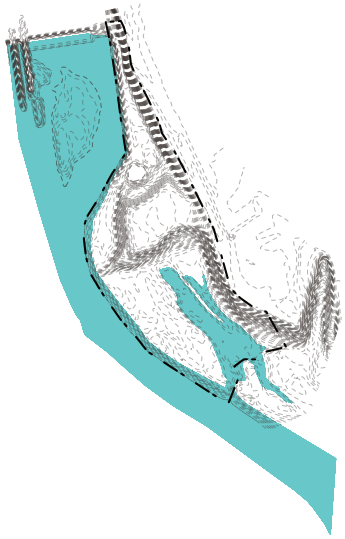
Case Study	Location	Size	Distance from Core	Children's activities	Intended park scale	Natural/Built Water Flow	Method of water change
Buffalo Shoreline	Buffalo, NY	23.5 acres	2.5 miles	None specific	Neighborhood	Natural with berms	Meandering bend
Robert C Beutter	South Bend, IN	7 acres	4 miles	None specific	Community	Built Edge for seating	Step pool channel, widening
Balzac	Angers, France	132 acres	.75 miles	Small Gardens and play area	Urban	Natural swamp design	Wideing and narrowing
Confluence Park	Denver, CO	5 acres	1.5 miles	Swimming spot	Neighborhood	Built Edge for seating	Step pool channel, river spli

Site Application

Based on the case study analysis on activities available to these parks keeping in mind that this chart is a lite version of the case study analysis it is clear that an even number of aquatic and terrestrial activities is used to attracted different people to the site. One thing that is shown is that for the most part children's activities are limited in these waterfront areas, and most of these activities are within an area where there is either heavy supervision along the river or they are pushed back away from the river. The methods of changing the water vary slightly, but with these studies the step pool channel is clearly a favorite. The line between having a built edge and a natural edge is even so the survey results will be more useful for Ford Park specifically.

River Fluctuation

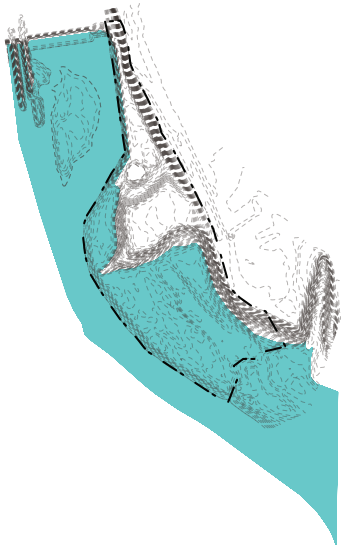
Action Stage 10 feet



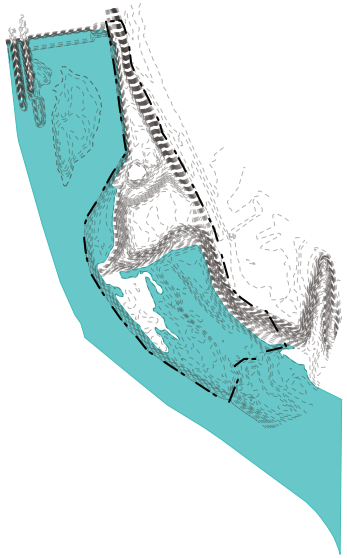
Flood Stage 14 feet

The site is instantly effected by any sign of a flood, but as this study shows; the water is contained within the lower bluffs even in the worst flooding events in history.

Major Flood Stage 17 feet



Moderate Flood Stage 15 feet



Applicable Site Values

Environmental

The current state of the environment on the site is connected to a park that is heavily wooded and has habitat for several bird species as well as scavenging mammals. It also serves as a flood buffer for Saint Paul

Historical

The site has history of industry on it with the Ford Plant that was right next to it. The main reason the plant was placed there was because the sand that is currently on the site is very good for making glass that was used for windshields. The recent shift from this industry has left an opportunity for this location to find a new identity while acknowledging its past.

Cultural

The cultural value of the site and its nearby connections is that the tunnels created to get the sands for the Ford Plant were used as a " haunted house" for many years until recently being closed due to danger.

7 Design Development

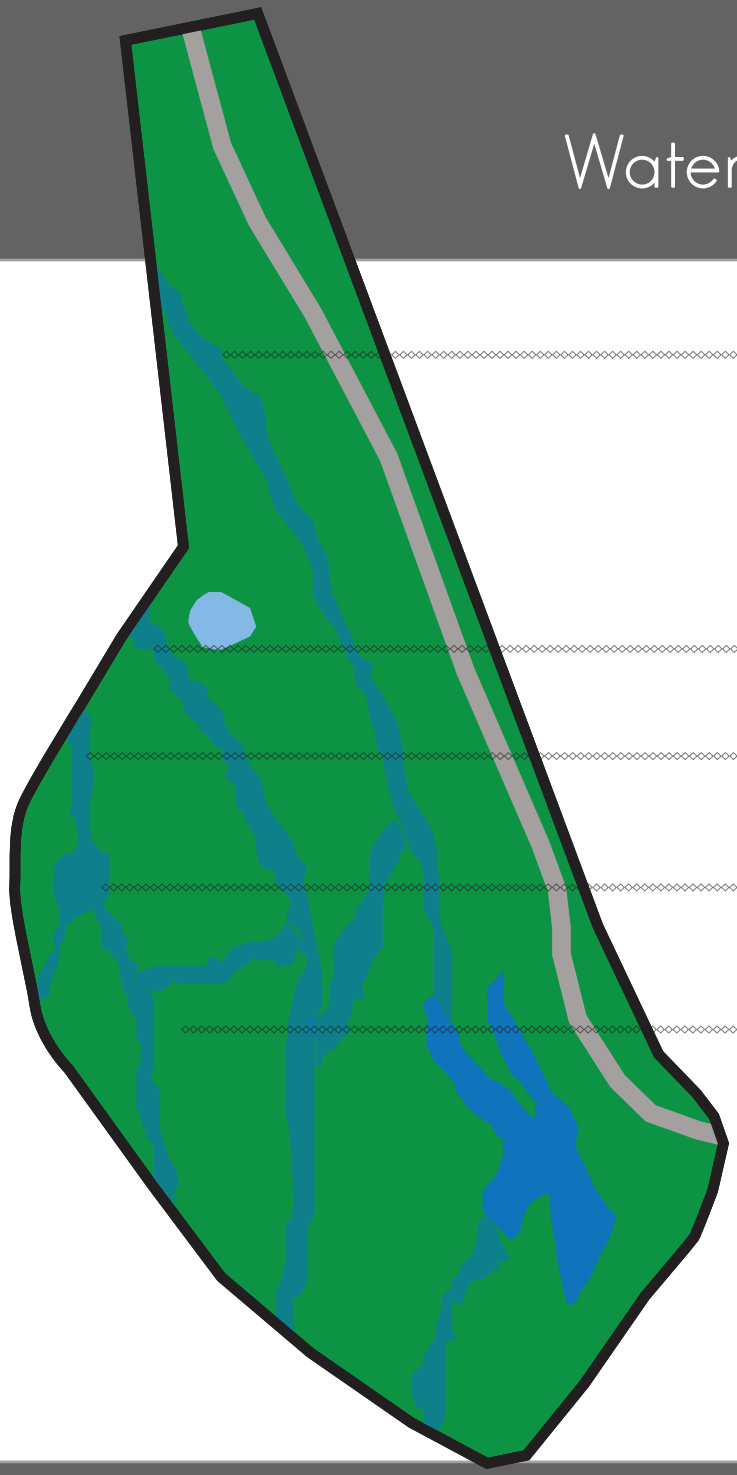
"Where feasible, include park, recreation and open space facilities with high entertainment and tourism value to generate revenue specifically dedicated to the on-going programming and maintenance of a high-quality public realm."
- Saint Paul Development Framework

Site Concept and Elements

The overall goal of this research is to learn how we can design spaces that can reconnect a city to its riverfront, while creating an adaptive site that can still be used at all flood stage.

The research completed through the new mixed methodology has at this point completed three of the four phases including inventory and analysis, public interaction, and design research. The next step is to take the research and start to design the proper program elements that fit with the site. It is important at this point to step back and look at the research as a whole to ensure that every element of this site as well as the case studies is recognized in order to make the space the most it can be. The site is very dynamic because of its industrial past as well as the location along the river. It is an opportunity to welcome a city to a location that was key to its economic growth.

Water Design Concept



Created step flow at high elevation to allow for a slow moving water even at high flood stages.

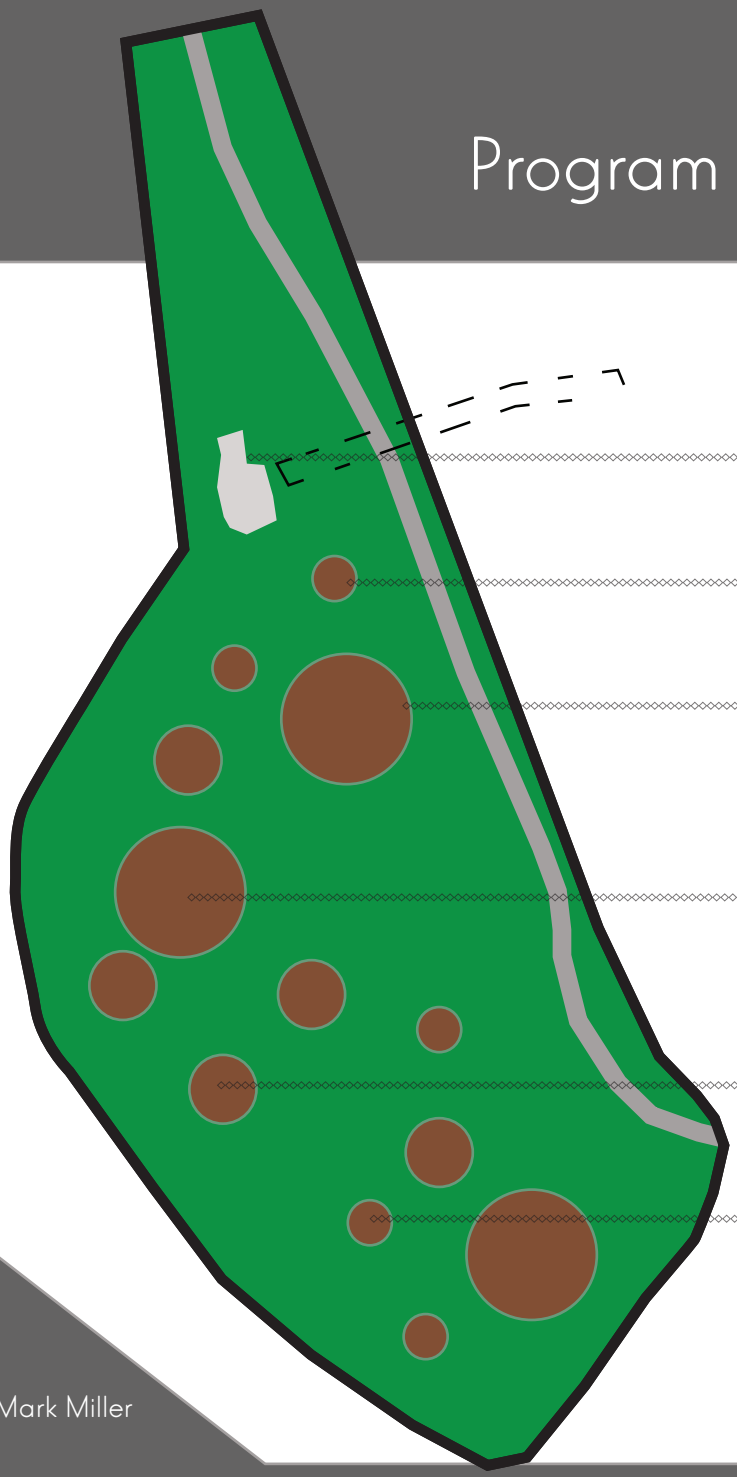
Creation of a new overflow area to redirect water coming in at initial flood stages.

Created offshoot from original river to slow water for day to day swimming use.

Created backwater area that holds water during low river and releases water as the river rises.

Use cut to create new topography that changes the flow of water during floods to allow most of the park to remain usable.

Program Design Concept



Develop a program to incorporate both the steam plant and safely use the tunnels as an amenity

Equally disperse large and smaller group activities

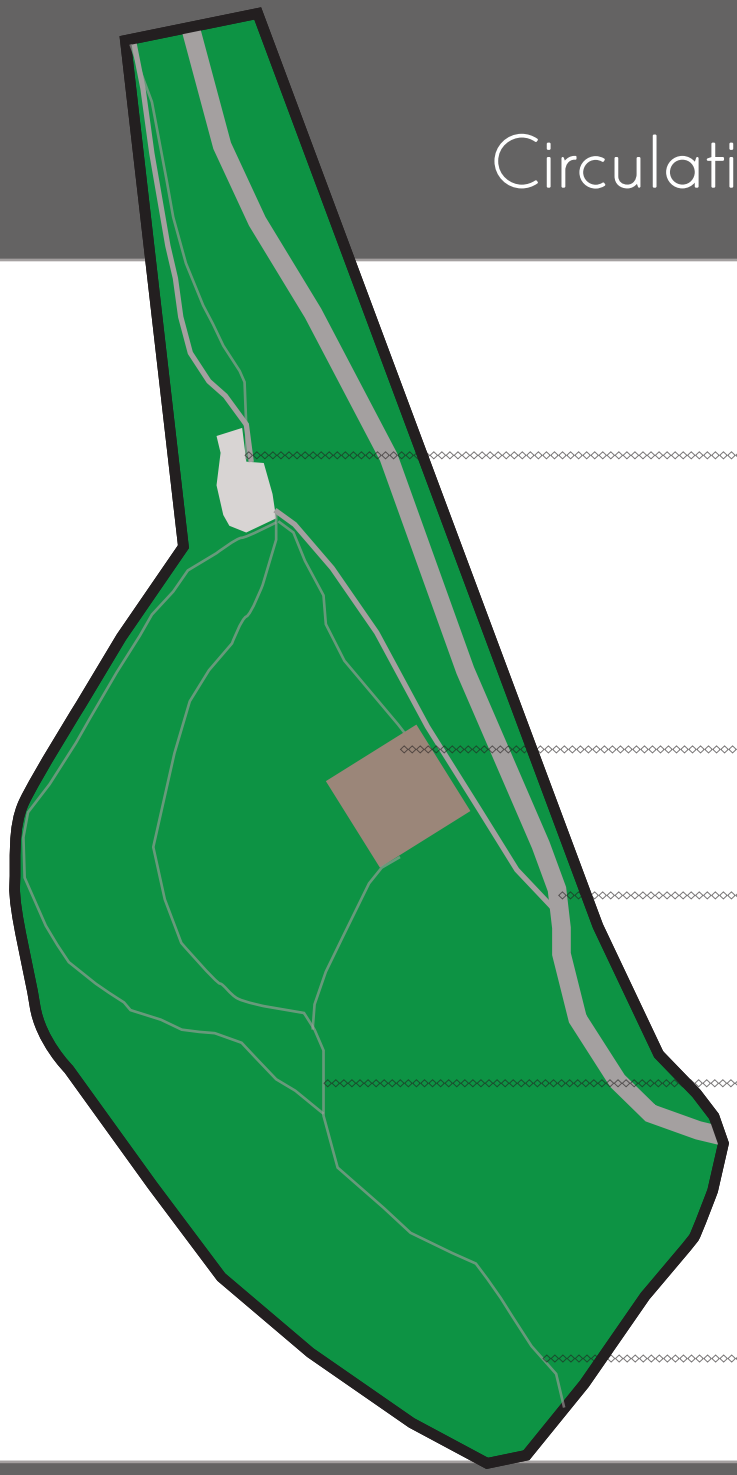
Plan any structure to be placed at a high enough topography to avoid damage from flooding

Create large group settings in the central of the lowest point to encourage gathering near the water.

Create a public art piece near a major water feature out of the blown glass from the extra sand from channel cuts.

Design small outdoor rooms for small groups to feel comfortable enjoying the space.

Circulation Design Concept



Create a destination of the historic steam plant allowing circulation throughout.

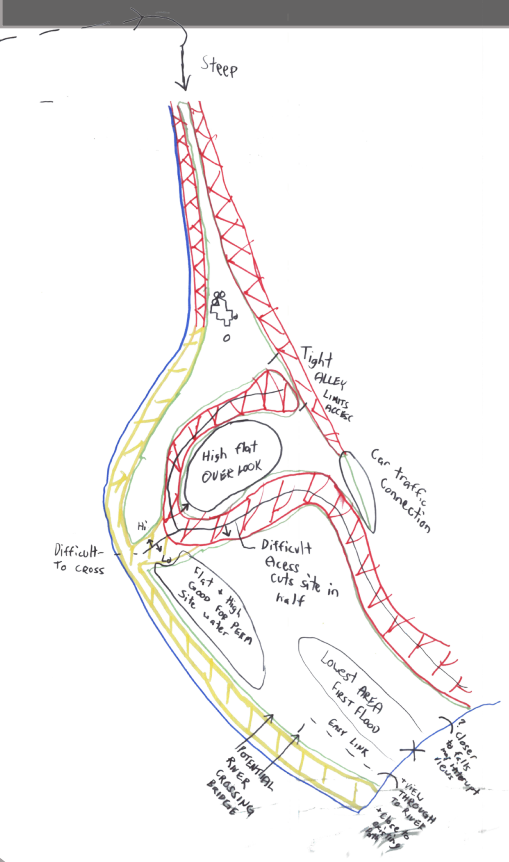
Redesign parking lot to scale the size properly and use less impervious surface.

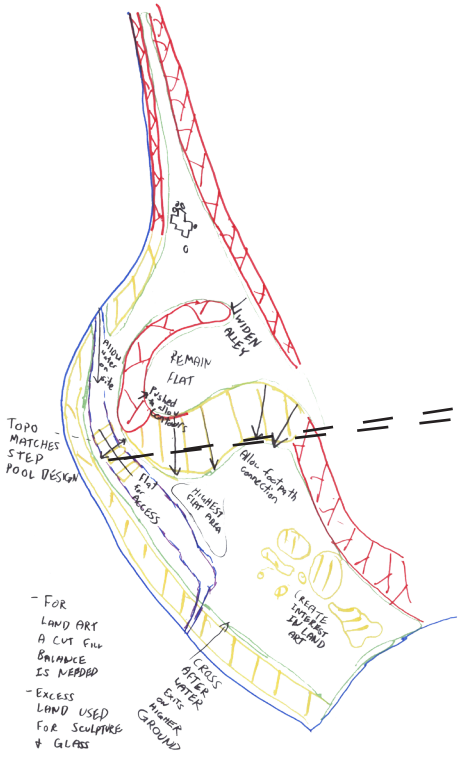
Maintain Main entrance and road because it already moves down through the steep slope.

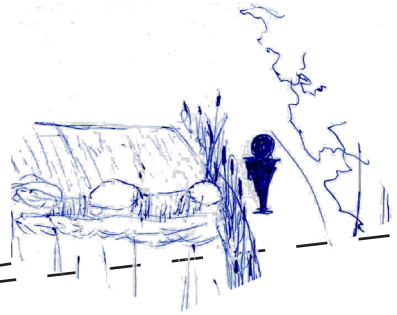
Develop Trail system that enhances the experience for users that are exercising within the site.

Incorporate incoming trails from the existing hidden falls regional park.

Early Design Development

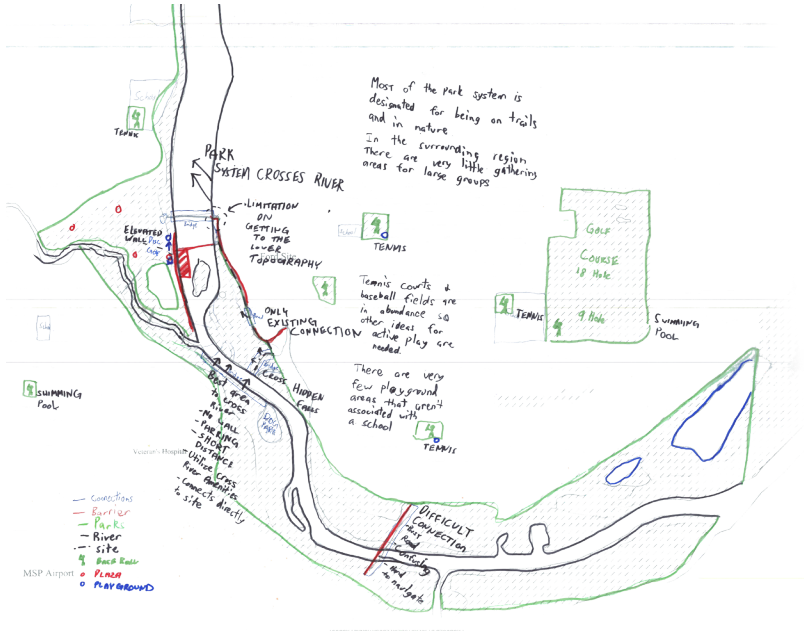






The cut in channel will have a natural feel with step pools to reduce speed and increase habitat

The topography of the site divides the site into different regions. It is important to attempt to reconnect viable paths between those regions to help accessibility to the whole site



Project Goals

GOAL: 1

Create new connections to the river that change according to the different flood levels

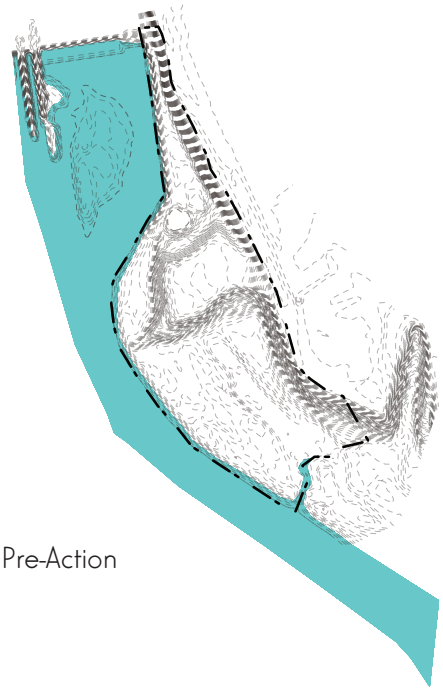
GOAL: 2

Reinforce old and generate new connections to the Saint Paul and Minneapolis riverfront park systems

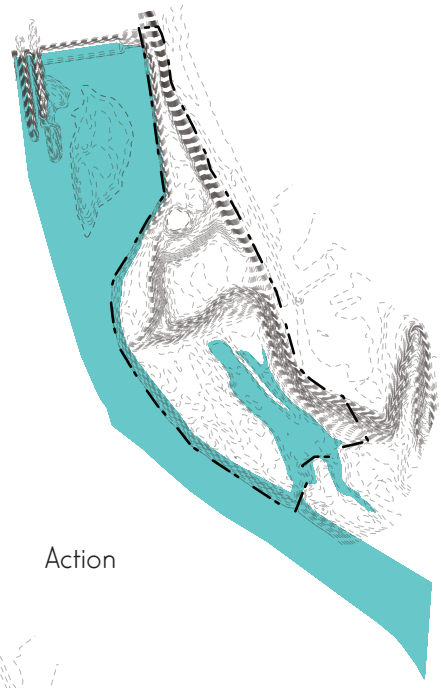
GOAL: 3

Develop program elements to fill needs of the region based on case studies and survey

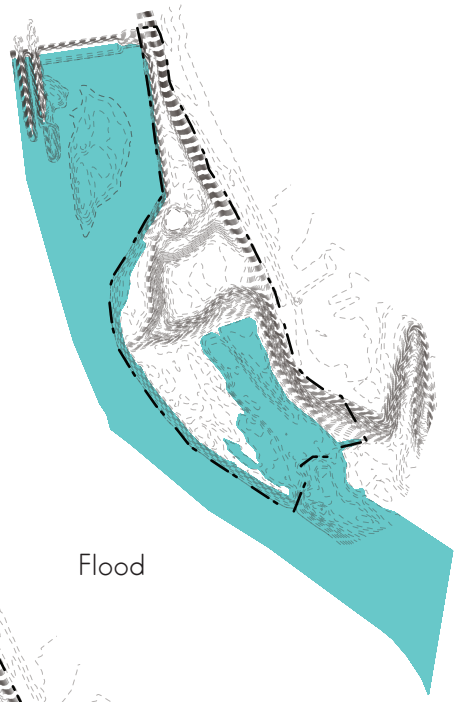
New Flooding Concept



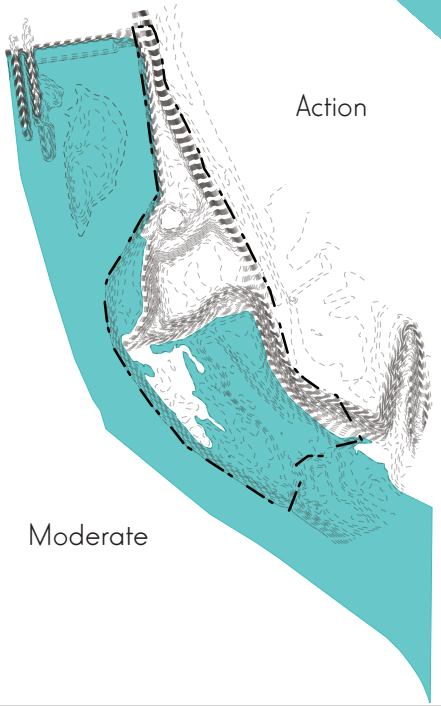
Pre-Action



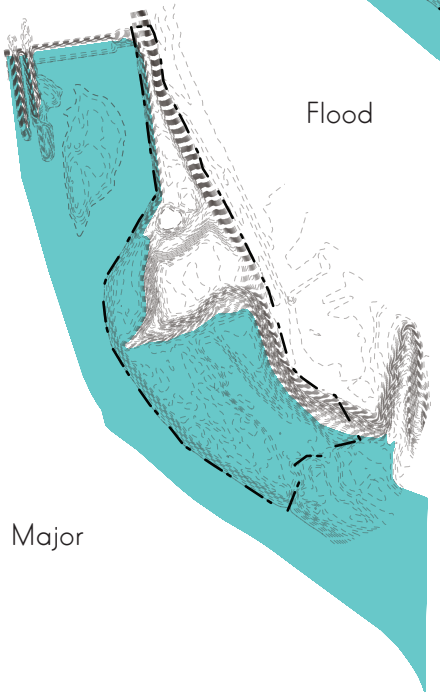
Action



Flood



Moderate



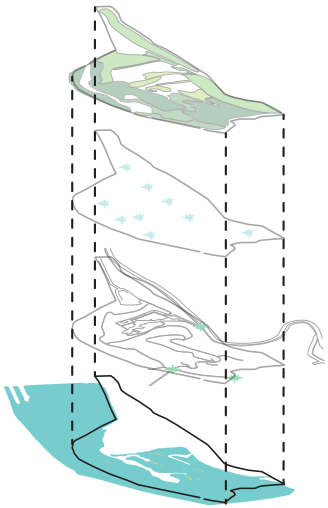
Major

Circulation of the Surrounding Region

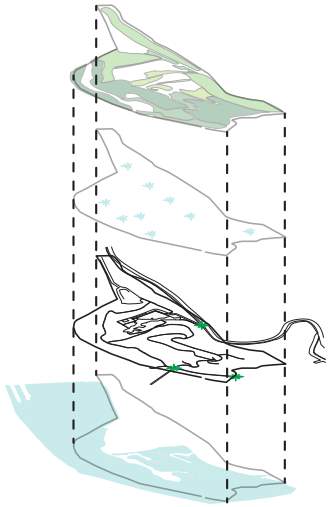
The site is located in a nice spot to make a needed pedestrian connection between the Saint Paul and Minneapolis parks system

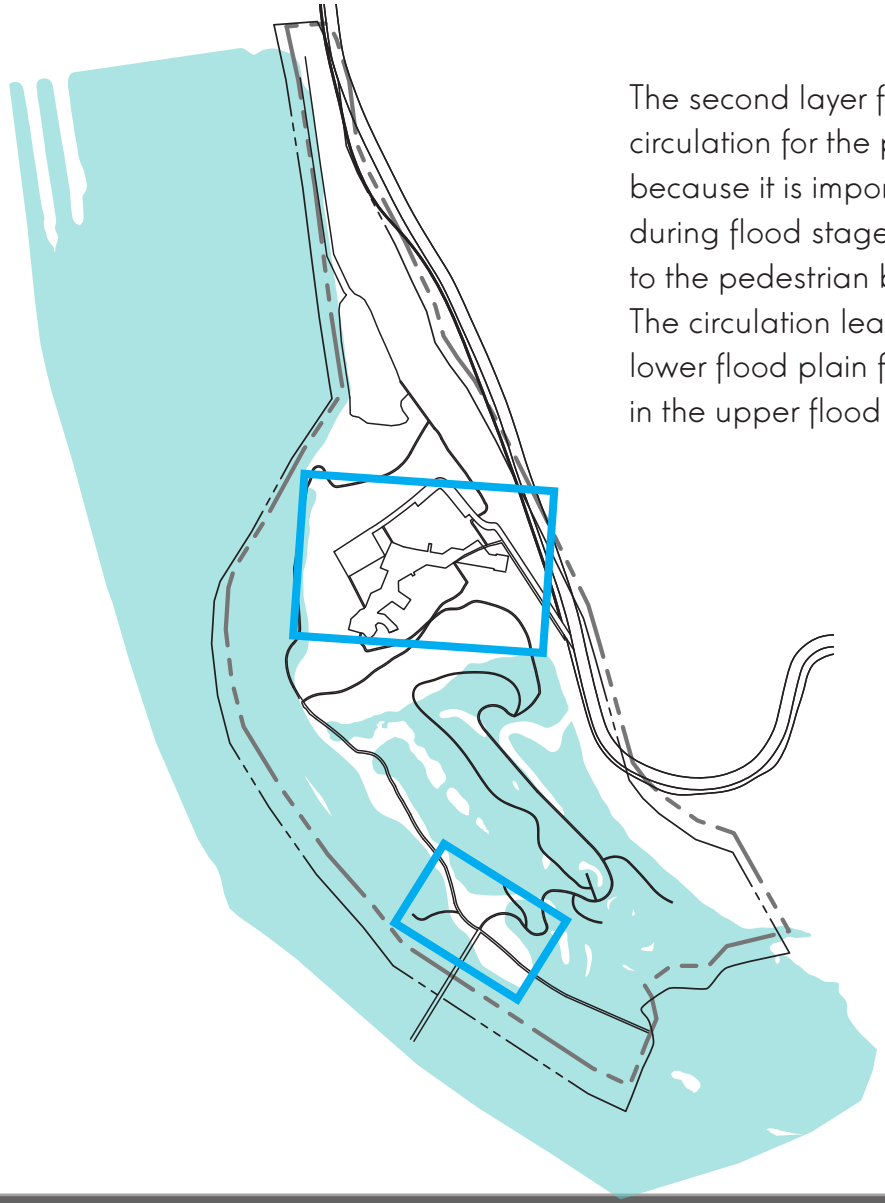
Master Plan Design

The first layer of design for the master plan was based on the new floodplains for the region. This is the most important aspect of the master plan so that there are enough unique places to go to that allow for a variety of experiences depending on the flood levels. The biggest design in the overall plan is a large backwater area to help retain water for the City of Saint Paul to reduce flooding for the downtown area.



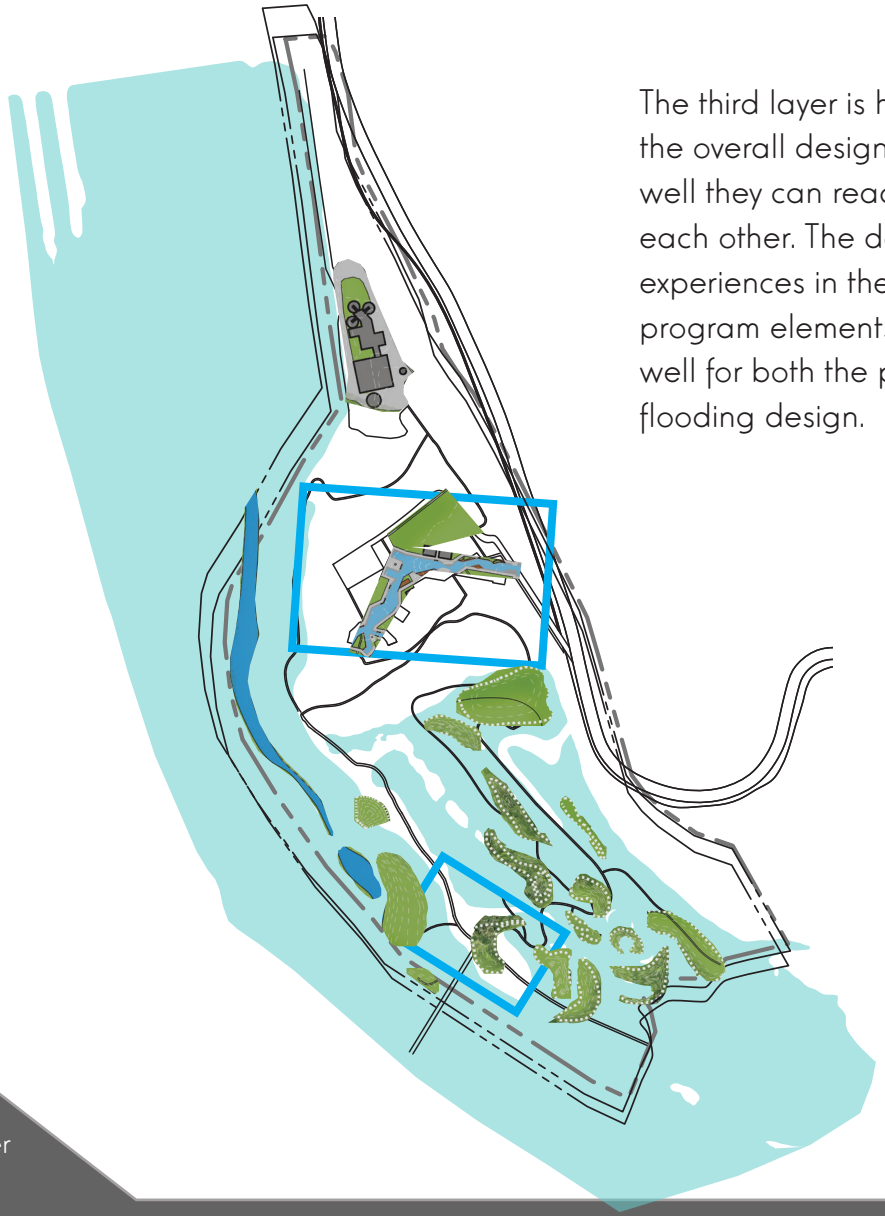
Master Plan Design



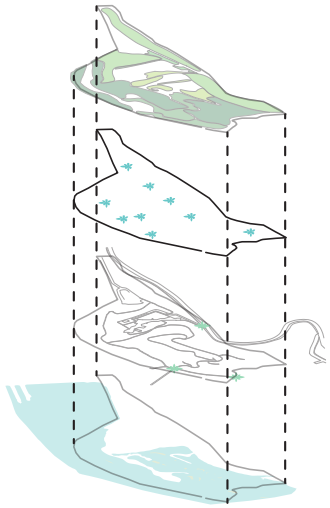


The second layer for the master plan was to design the circulation for the park system. This comes after the flood plain because it is important to make sure that the site is accessible during flood stages. One main aspect of this is the availability to the pedestrian bridge during the different flood stages. The circulation leads to two main gathering areas. One in the lower flood plain for the most pedestrian entrances, and one in the upper flood plain for the more vehicular entrance.

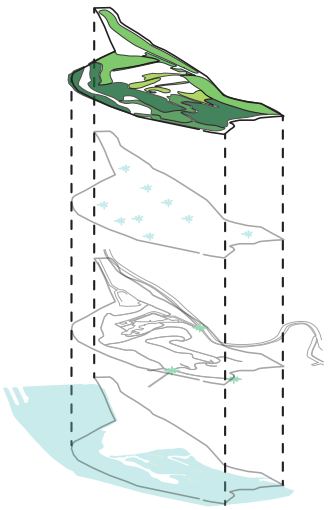
Master Plan Design



The third layer is how the final program elements should fit into the overall design. The elements were placed based on how well they can react to flooding and how they can interact with each other. The design here is intended to provide different experiences in the two different regions. It is important for the program elements to have been placed in areas that work well for both the program, but more importantly the main flooding design.



Master Plan Design



The final layer is the overall planting design. This uses the plants from both appendix A and B in their proper places to help the development of the final plantings. The plan is divided into five main regions that differ by the feeling of the space that they are taking up. It is important when laying out the planting areas to keep in mind the ecology and wildlife of the area and the entire regional parks system to keep consistency in that aspect.

8 References & Appendix

"Integrate future growth and development with restoration programs that recconect and restore remnant landscapes"
- Saint Paul Development Framework

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[1]Native Plant Community Species Lists for East-central Minnesota

Class: Southern Floodplain Forest FFs68

Genus	Species		Variety or Subspecies	Species Author	Variety or Subspecies Author	Common Name	[2]Rarity Status	[3]Freq	[4]Abund	[5]Index
Canopy Trees (>10 m)										
Acer	*saccharinum*			L.		Silver maple		100	69	6900
Populus	*deltoides*	ssp.	*monilifera*	Marsh.	(Ait.) Eckenw.	Cottonwood		38	47	1786
Fraxinus	*pennsylvanica*			Marsh.		Green ash		88	8	704
Acer	*negundo*			L.		Box elder		25	26	650
Salix	*nigra*			Marsh.		Black willow		13	38	494
Celtis	*occidentalis*			L.		Hackberry		13	5	65
Ulmus	*americana*			L.		American elm		13	5	65
Understory Trees										
Ulmus	*americana*			L.		American elm		63	28	1764
Acer	*saccharinum*			L.		Silver maple		88	18	1584
Fraxinus	*pennsylvanica*			Marsh.		Green ash		100	8	800
Acer	*negundo*			L.		Box elder		38	15	570
Celtis	*occidentalis*			L.		Hackberry		50	2	100
Tilia	*americana*			L.		Basswood		13	1	13
Carya	*cordiformis*			(Wang.) K. Koch		Bitternut hickory		13	1	13
Shrubs										
Salix	*exigua*	ssp.	*interior*	Nutt.	(Rowlee) Cronq.	Sandbar willow		13	3	39
Zanthoxylum	*americanum*			Mill.		Prickly ash		13	3	39
Vines										
Vitis	*riparia*			Michx.		Wild grape		63	5	315
Menispermum	*canadense*			L.		Canada moonseed		75	3	225
Polygonum	*scandens*			L.		False buckwheat		13	15	195
Parthenocissus	spp.					Virginia creeper		38	4	152
Smilax	*hispida*			Torr.		Green-briar		25	3	75
Forbs										
Laportea	*canadensis*			(L.) Wedd.		Wood-nettle		88	23	2024
Pilea	cmx.					Clearweed		75	21	1575
Boehmeria	*cylindrica*			(L.) Sw.		False nettle		50	9	450
Rudbeckia	*laciniata*			L.		Goldenglow		63	5	315
Aster	*ontarionis*			Wieg.		Ontario aster		88	4	352
Scutellaria	*lateriflora*			L.		Mad-dog skullcap		50	6	300
Sicyos	*angulatus*			L.		Bur-cucumber		38	7	266
Impatiens	cmx.					Touch-me-not		13	15	195

A joint project of the Minnesota DNR and Great River Greening
Sample size: 8 releves
Published January 2004

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Class: Southern Floodplain Forest FFs68

Genus	Species		Variety or Subspecies	Species Author	Variety or Subspecies Author	Common Name	[2]Rarity Status	[3]Freq	[4]Abund	[5]Index
Polygonum	*punctatum*			Ell.		Dotted smartweed		13	15	195
Bidens	*spp.*					Beggar-ticks		50	4	200
Stachys	*hispida*			Pursh		Smooth hedge-nettle		38	4	152
Ranunculus	*abortivus*			L.		Kidney-leaf buttercup		38	3	114
Urtica	*dioica*	ssp.	*gracilis*	L.	(Ait.) Selander	Stinging nettle		38	3	114
Polygonum	*virginianum*			L.		Virginia knotweed		25	4	100
Cuscuta	*spp.*					Dodder		25	3	75
Lycopus	*uniflorus*			Michx.		Northern bugleweed		25	3	75
Campanula	*americana*			L.		Tall bellflower		25	3	75
Lobelia	*cardinalis*			L.		Cardinal flower		13	5	65
Viola	cm1					Violet		25	2	50
Hackelia	cmx.					Stickseed		13	3	39
Cryptotaenia	*canadensis*			(L.) DC.		Honewort		13	3	39
Helenium	*autumnale*			L.		Autumn sneezeweed		13	3	39
Mimulus	*ringens*			L.		Purple monkey-flower		13	3	39
Ranunculus	*hispidus*			Michx.		Hispid buttercup		13	3	39
Eupatorium	*rugosum*			Houtt.		Common snakeroot		13	3	39
Physalis	*virginiana*			Mill.		Ground-cherry		13	3	39
Physostegia	*virginiana*			(L.) Benth.		Obedient plant		13	3	39
Acalypha	*rhomboidea*			Raf.		Three-seeded mercury		13	3	39
Solanum	*nigrum*	var.	*virginicum*	L.	L.	Black nightshade		13	3	39
Asarum	*canadense*			L.		Wild ginger		13	1	13
Grasses, Rushes and Sedges										
Leersia	*virginica*			Willd.		White grass		50	30	1500
Elymus	*virginicus*			L.		Virginia wild rye		75	9	675
Carex	*lupulina*			Willd.		Hop-sedge		38	8	304
Leersia	*oryzoides*			(L.) Swartz		Rice cut grass		13	15	195
Carex	*intumescens*	var.	*fernaldii*	Rudge	Bailey	Bladder sedge		25	3	75
Carex	*crawfordii*			Fern.		Crawford's sedge		13	5	65
Carex	*tribuloides*			Wahlenb.		Blunt-broom sedge		13	3	39
Carex	*blanda*			Dewey		Charming sedge		13	3	39
Ferns and Fern Allies										
Onoclea	*sensibilis*			L.		Sensitive fern		25	3	75

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Sample size: 8 releves
Published January 2004

[1]Native Plant Community Species Lists for East-central Minnesota

Class: Southern Floodplain Forest FFs68

Genus	Species		Variety or Subspecies	Species Author	Variety or Subspecies Author	Common Name	[2]Rarity Status	[3]Freq	[4]Abund	[5]Index
Exotic Invasive Species - Do Not Plant										
Glechoma	*hederacea*			L.		Creeping Charlie		50	12	600
Phalaris	*arundinacea*			L.		Reed canary-grass		38	7	266
Arctium	*minus*			(Hill) Bernh.		Common burdock		25	4	100
Leonurus	*cardiaca*			L.		Lion's ear		25	3	75
Stellaria	*aquatica*			(L.) Scop.		Giant chickweed		13	5	65
Rhamnus	*cathartica*			L.		Common buckthorn		13	3	39
Melilotus	*spp.*					Sweet clover		13	3	39
Oxalis	cmx.					Wood-sorrel		13	3	39
Taraxacum	*spp.*					Common dandelion		13	3	39
Lysimachia	*nummularia*			L.		Moneywort		13	3	39
Abutilon	*theophrasti*			Medic.		Velvet-leaf		13	3	39
Potentilla	*norvegica*			L.		Rough cinquefoil		13	1	13
Verbascum	*thapsus*			L.		Common mullein		13	1	13
State Listed Rare Species - Do Not Plant Without a Permit										
Carex	*typhina*			Michx.		Cattail-sedge	Concern	25	21	525

[1]See the report *Species Lists for Terrestrial and Palustrine Native Plant Communities in East-central Minnesota* for instructions for using these species lists

[2]Rarity Status: State-listed rare species. E - Endangered, T - Threatened, SC - Special Concern

[3]Frequency: Number of releve plots in which species occurs divided by total number of releve plots, multiplied by 100

[4]Abundance: Average percent cover of species within the community. It is most appropriate to interpret each value as a cover class similar to those used for original data collection (see text of report for more details)

[5]Index of Commonness: Frequency multiplied by Abundance

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Sample size: 8 releves
Published January 2004

[1]Native Plant Community Species Lists for East-central Minnesota

Class: Southern Dry Savanna UPs14 **Type: Dry Sand-Gravel Oak Savanna (Southern) UPs14b**

SOUTHERN DRY SAVANNA, DRY SAND-GRAVEL OAK SAVANNA (SOUTHERN) TYPE										
Genus	**Species**		**Variety or Subspecies**	**Species Author**	**Variety or Subspecies Author**	**Common Name**	**[2]Rarity Status**	**[3]Freq**	**[4]Abund**	**[5]Index**
Canopy Trees (>10 m)										
Populus	*tremuloides*			Michx.		Quaking aspen		11	15	165
Quercus	*macrocarpa*			Michx.		Bur oak		11	15	165
Quercus	*ellipsoidalis*			E. J. Hill		Northern pin oak		22	3	66
Understory Trees										
Quercus	*macrocarpa*			Michx.		Bur oak		100	9	900
Populus	*tremuloides*			Michx.		Quaking aspen		33	10	330
Juniperus	*virginiana*			L.		Red cedar		33	6	198
Quercus	*ellipsoidalis*			E. J. Hill		Northern pin oak		22	2	44
Prunus	*serotina*			Ehrh.		Black cherry		22	1	22
Fraxinus	*pennsylvanica*			Marsh.		Green ash		11	1	11
Acer	*rubrum*			L.		Red maple		11	1	11
Shrubs										
Rhus	*glabra*			L.		Smooth sumac		22	32	704
Corylus	*americana*			Walt.		American hazelnut		67	7	469
Rosa	*arkansana*			Porter		Prairie rose		89	2	178
Salix	*humilis*			Marsh.		Prairie willow		22	5	110
Prunus	*virginiana*			L.		Chokecherry		33	2	66
Symphoricarpos	cmx.					Snowberry		22	3	66
Amelanchier	cmx.					Juneberry		56	1	56
Prunus	*pumila*			L.		Sand cherry		11	3	33
Cornus	*sericea*			L.		Red-osier dogwood		11	1	11
Ribes	*cynosbati*			L.		Prickly gooseberry		11	1	11
Low Shrubs										
Amorpha	*canescens*			Pursh		Lead-plant		56	3	168
Artemisia	*frigida*			Willd.		Prairie sagewort		11	15	165
Toxicodendron	*rydbergii*			(Small) Greene		Poison ivy		33	4	132
Rubus	*idaeus*	var.	*strigosus*	L.	(Michx.) Maxim	Red raspberry		11	3	33
Vaccinium	*angustifolium*			Ait.		Lowbush blueberry		11	3	33
Rubus	cm2					Blackberry		11	1	11
Vines										
Parthenocissus	cmx.					Virginia creeper		33	2	66
Forbs										
Helianthus	*pauciflorus*	var.	*pauciflorus*	Nutt.		Stiff sunflower		33	15	495

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Amphicarpaea	*bracteata*			(L.) Fern.		Hog-peanut		22	21	462
Helianthemum	*bicknellii*			Fern.		Hoary frostweed		89	4	356
Lechea	*stricta*			Leggett		Prairie pinweed		67	5	335
Physalis	*virginiana*			Mill.		Ground-cherry		100	3	300
Geum	*triflorum*			Pursh		Prairie smoke		44	7	308
Artemisia	*ludoviciana*			Nutt.		Western mugwort		44	7	308
Smilacina	*stellata*			(L.) Desf.		Starry false Solomon's-seal		44	7	308
Ambrosia	*psilostachya*			DC		Western ragweed		67	4	268
Lithospermum	*canescens*			(Michx.) Lehm.		Hoary puccoon		89	3	267
Galium	*boreale*	ssp.	*septentrionale*	L.	(Roem. & Schult.) Iltis	Northern bedstraw		33	8	264
Antennaria	*spp.*					Pussytoes		89	3	267
Dalea	*purpurea*			Vent.		Purple prairie-clover		78	3	234
Coreopsis	*palmata*			Nutt.		Stiff tickseed		44	4	176
Viola	*pedatifida*			G. Don		Prairie bird-foot violet		67	3	201
Aster	*oolentangiensis*			Riddell		Sky-blue aster		56	3	168
Conyza	*canadensis*			(L.) Cronq.		Horseweed		44	4	176
Campanula	*rotundifolia*			L.		Harebell		56	3	168
Solidago	*nemoralis*			Ait.		Gray goldenrod		44	3	132
Dalea	*candida*			Michx.		White prairie-clover		44	3	132
Erigeron	*strigosus*			Muhl.		Daisy fleabane		56	2	112
Aster	*sericeus*			Vent.		Silky aster		33	4	132
Potentilla	*arguta*			Pursh		Tall cinquefoil		67	2	134
Asclepias	*syriaca*			L.		Common milkweed		56	2	112
Anemone	*cylindrica*			Gray		Long-headed thimbleweed		33	3	99
Achillea	*millefolium*			L.		Yarrow		33	3	99
Aster	*ericoides*			L.		Heath aster		44	2	88
Liatris	*aspera*			Michx.		Rough blazing star		44	2	88
Lespedeza	*capitata*			Michx.		Round-headed bush-clover		44	2	88
Rumex	*acetosella*			L.		Red sorrel		33	2	66
Asclepias	*ovalifolia*			Dcne.		Oval-leaved milkweed		33	2	66
Oxalis	cmx.					Wood-sorrel		33	2	66
Cerastium	*arvense*			L.		Field chickweed		33	2	66
Euphorbia	*glyptosperma*			Engelm.		Ridge-seeded spurge		22	3	66
Anemone	*patens*	var.	*multifida*	L.	Pritzel	Pasque-flower		22	3	66
Hedeoma	*hispida*			Pursh		Mock pennyroyal		22	3	66
Lathyrus	*venosus*	var.	*intonsus*	Muhl. ex Willd.	Butt. & St. John	Veiny pea		44	2	88
Solidago	*speciosa*			Nutt.		Showy goldenrod		22	3	66

Mirabilis	*hirsuta*			(Pursh) MacM.		Hairy four-o'clock		22	3	66
Penstemon	*gracilis*			Nutt.		Slender beard-tongue		22	3	66
Apocynum	*androsaemifolium*			L.		Spreading dogbane		11	5	55
Lithospermum	*caroliniense*	ssp.	*croceum*	(Walt.) MacM.	(Fern.) Cusick	Hairy puccoon		33	2	66
Rudbeckia	*hirta*	var.	*pulcherrima*	L.	Farw.	Black-eyed Susan		33	2	66
Scutellaria	*leonardi*			Epling		Leonard's skullcap		22	2	44
Phlox	*pilosa*	ssp.	*fulgida*	L.	Wherry	Prairie phlox		22	2	44
Pedicularis	*canadensis*			L.		Wood-betony		11	3	33
Euphorbia	*corollata*			L.		Flowering spurge		11	3	33
Fragaria	*virginiana*			Duchesne		Common strawberry		11	3	33
Geranium	*maculatum*			L.		Wild geranium		11	3	33
Oenothera	*biennis*			L.		Common evening-primrose		11	3	33
Comandra	*umbellata*			(L.) Nutt.		Bastard toad-flax		11	3	33
Monarda	*fistulosa*			L.		Wild bergamot		11	3	33
Solidago	*missouriensis*			Nutt.		Missouri goldenrod		11	3	33
Arabis	*hirsuta*			(L.) Scop.		Hairy rock-cress		33	1	33
Artemisia	*campestris*			L.		Tall wormwood		11	3	33
Ambrosia	*artemisiifolia*			L.		Common ragweed		11	3	33
Allium	*stellatum*			Ker		Prairie wild onion		11	3	33
Solidago	*rigida*			L.		Stiff goldenrod		11	3	33
Asclepias	*tuberosa*			L.		Butterfly-weed		11	3	33
Anaphalis	*margaritacea*			(L.) Clarke		Pearly everlasting		11	3	33
Delphinium	*carolinianum*			Walter		Prairie larkspur		22	1	22
Smilax	cmx.					Carrion-flower		22	1	22
Heuchera	*richardsonii*			R. Br.		Alum-root		11	1	11
Thalictrum	*dasycarpum*			Fisch. & Lall.		Tall meadow-rue		11	1	11
Lathyrus	*ochroleucus*			Hook.		Pale vetchling		11	1	11
Penstemon	*grandiflorus*			Nutt.		Large-flowered beard-tongue		11	1	11
Lactuca	*spp.*					Wild lettuce		11	1	11
Chenopodium	*desiccatum*			Nels.		Narrow-leaved lamb's quarters		11	1	11
Sisyrinchium	*campestre*			Bickn.		Field blue-eyed grass		11	1	11
Desmodium	*canadense*			(L.) DC.		Canadian tick-trefoil		11	1	11
Aralia	*nudicaulis*			L.		Wild sarsaparilla		11	1	11
Silene	*antirrhina*			L.		Sleepy catchfly		11	1	11
Prenanthes	*racemosa*			Michx.		Smooth rattlesnake-root		11	1	11
Ranunculus	*rhomboideus*			Goldie		Prairie buttercup		11	1	11
Arabis	*divaricarpa*			Nels.		Spreading rock-cress		11	1	11
Solidago	*gigantea*			Ait.		Giant goldenrod		11	1	11

Chrysopsis	*villosa*	var.	*villosa*	(Pursh) Nutt.		Prairie golden aster		11	1	11
Grasses, Rushes and Sedges										
Stipa	*spartea*			Trin.		Porcupine-grass		67	26	1742
Schizachyrium	*scoparium*			(Michx.) Nash		Little bluestem		78	22	1716
Andropogon	*gerardii*			Vitman		Big bluestem		100	10	1000
Sporobolus	*heterolepis*			(Gray) Gray		Prairie dropseed		67	10	670
Bouteloua	*curtipendula*			(Michx.) Torr.		Side-oats grama		33	15	495
Carex	*siccata*			Dewey		Hay sedge		78	6	468
Sorghastrum	*nutans*			(L.) Nash		Indian grass		67	5	335
Eragrostis	*spectabilis*			(Pursh) Steud.		Purple lovegrass		78	3	234
Koeleria	*pyramidata*			(Lam.) P. Beauv.		June-grass		67	3	201
Cyperus	*lupulinus*			(Spreng.) Marcks		Hop-like cyperus		67	3	201
Carex	*pensylvanica*			Lam.		Pennsylvania sedge		44	4	176
Panicum	*perlongum*			Nash		Long-leaved panic grass		44	3	132
Panicum	*lanuginosum*			Ell.		Hairy panic grass		33	4	132
Elymus	*trachycaulus*			(Link) Gould.		Slender wheatgrass		33	3	99
Calamovilfa	*longifolia*			(Hook.) Scribn.		Sand reed-grass		22	4	88
Panicum	*oligosanthes*			Schultes		Few-flowered panic grass		22	4	88
Bromus	*kalmii*			Gray		Kalm's brome		11	5	55
Panicum	*linearifolium*			Scribn.		Linnear-leaved panic grass		22	2	44
Setaria	*viridis*			(L.) Beauv.		Green foxtail		22	2	44
Bouteloua	*gracilis*			(HBK.) Lag. ex Steud.		Blue grama		11	3	33
Bouteloua	*hirsuta*			Lag.		Hairy grama		11	3	33
Muhlenbergia	*cuspidata*			(Torr.) Rydb.		Plains muhly		11	3	33
Calamagrostis	*canadensis*			(Michx.) Nutt.		Bluejoint		11	3	33
Aristida	*basiramea*			Engelm.		Base-branched three-awn		11	3	33
Agrostis	*hyemalis*	var.	*scabra*	(Walter) BSP	(Willd.) Blomq.	Rough bent-grass		11	3	33
Carex	*brevior*			(Dewey) Mack.		Short sedge		11	3	33
Carex	*tenera*			Dewey		Marsh-straw sedge		11	3	33
Ferns and Fern Allies								0	0	0
Equisetum	*laevigatum*			A. Br.		Smooth scouring-rush		33	2	66

Selaginella	*rupestris*			(L.) Spring		Rock spikemoss		11	1	11
Exotic Invasive Species - Do Not Plant										
Poa	*pratensis*			L.		Kentucky bluegrass		100	22	2200
Tragopogon	*dubius*			Scop.		Yellow goat's-beard		56	1	56
Trifolium	*repens*			L.		White clover		22	3	66
Elytrigia	*repens*			(L.) Nevski		Quack grass		22	3	66
Berteroa	*incana*			(L.) DC.		Hoary alyssum		11	3	33
Taraxacum	*spp.*					Common dandelion		11	3	33
Potentilla	*recta*			L.		Rough-fruited cinquefoil		11	3	33
Salsola	*tragus*			L.		Russian thistle		11	3	33
Digitaria	*ischaemum*			(Schreb.) Muhl.		Smooth crabgrass		11	3	33
Bromus	*inermis*			Leyss.		Smooth brome		11	3	33
Setaria	*glauca*			(L.) Beauv.		Yellow foxtail		11	3	33
Linaria	*vulgaris*			Hill.		Butter-and-eggs		11	1	11
Verbascum	*thapsus*			L.		Common mullein		11	1	11
State Listsed Rare Species - Do Not Plant Without a Permit										
Carex	*obtusata*			Lilj.		Obtuse sedge	SC	33	4	132
Cirsium	*hillii*			(Canby) Fern.		Hill's thistle	SC	22	3	66
Besseya	*bullii*			(Eat.) Rydb.		Kitten-tails	T	11	5	55
Silene	*drummondii*			Hook.		Drummond's campion	SC	11	1	11

[1]See the report *Species Lists for Terrestrial and Palustrine Native Plant Communities in East-central Minnesota* for instructions for using these species lists

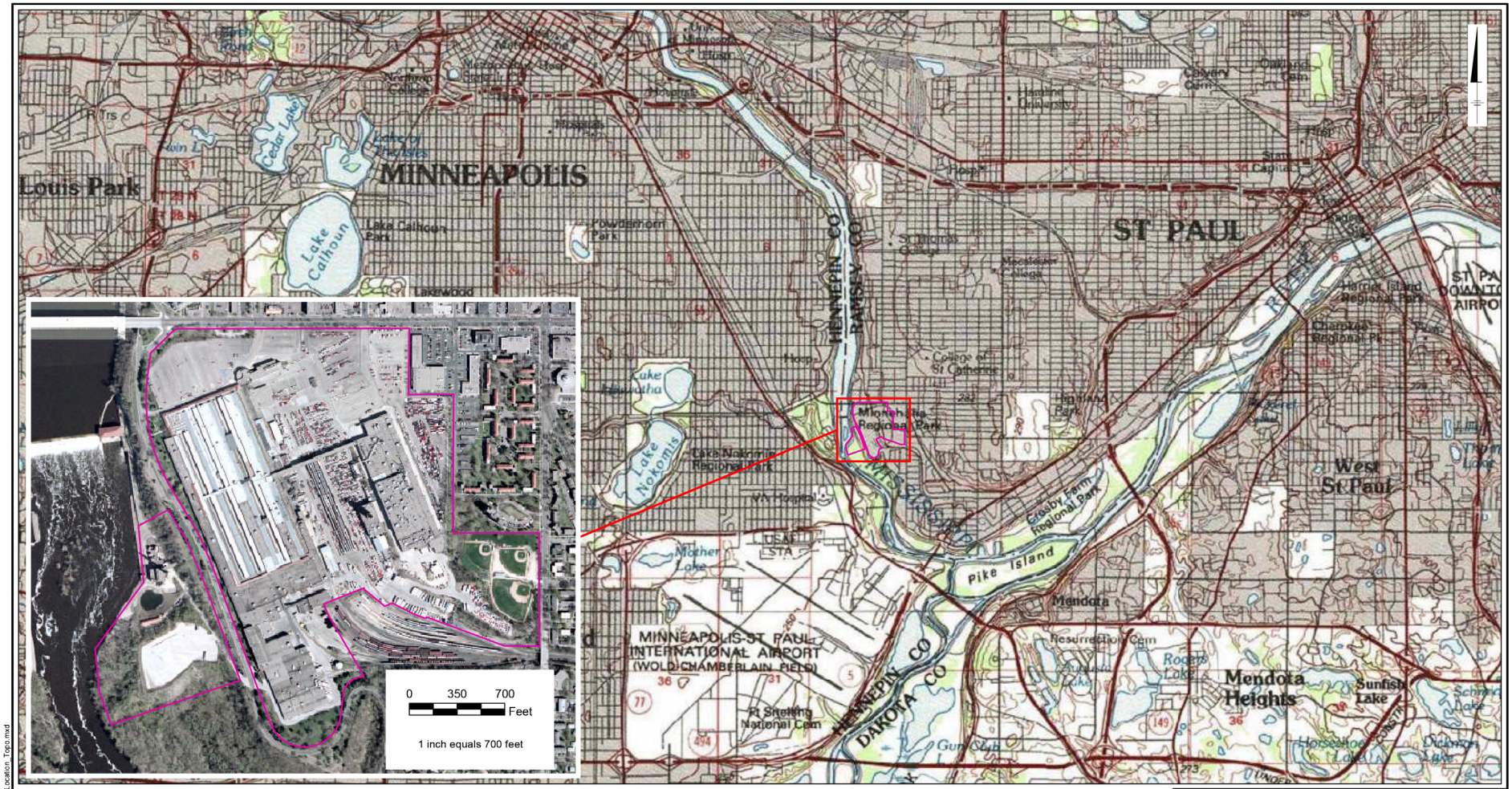
[2]Rarity Status: State-listed rare species. E - Endangered, T - Threatened, SC - Special Concern

[3]Frequency: Number of releve plots in which species occurs divided by total number of releve plots, multiplied by 100

[4]Abundance: Average percent cover of species within the community. It is most appropriate to interpret each value as a cover class similar to those used for original data collection (see text of report for more details)

[5]Index of Commonness: Frequency multiplied by Abundance

A joint project of the Minnesota DNR and Great River Greening
Sample size: 9 releves
Published January 2004



LEGEND:

Ford Property Boundary

NOTES:

Imagery Source: United States Geological Survey
High Resolution Orthoimagery for the Minneapolis-St. Paul, Minnesota Urban Area

Topographic Map Source:
© 2007 National Geographic Society

Twin Cities Assembly Plant
Ford Motor Company
St. Paul, Minnesota

Site Location / Property Layout

ARCADIS

FIGURE 1

CITY: Minneapolis, MN DB: MGress PM: BZinda
Project: MN000593
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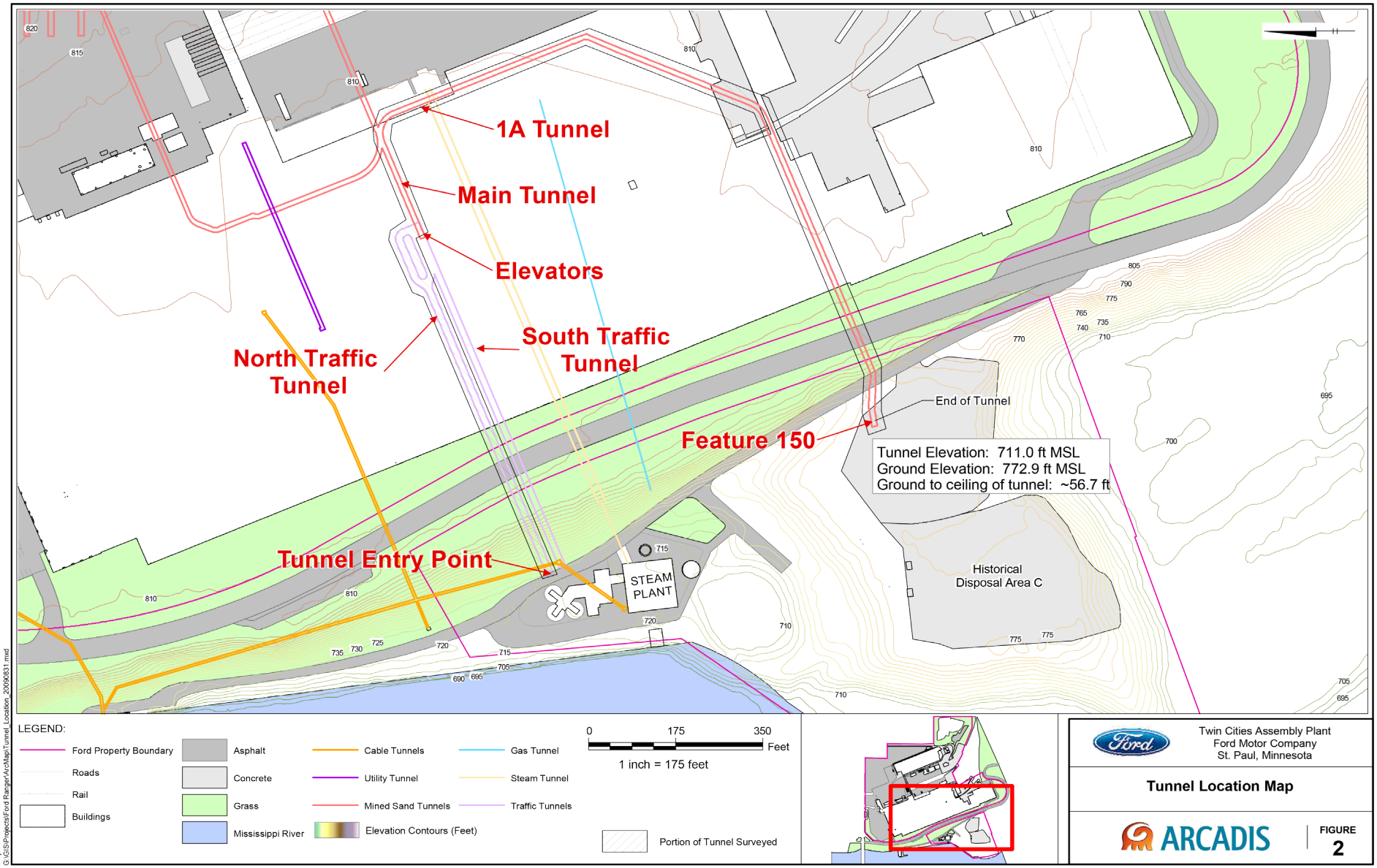
Appendix C


1A Tunnel
Main Tunnel
Elevators
South Traffic Tunnel
North Traffic Tunnel
Feature 150
Tunnel Entry Point
End of Tunnel
Tunnel Elevation: 711.0 ft MSL
Ground Elevation: 772.9 ft MSL
Ground to ceiling of tunnel: ~56.7 ft
STEAM PLANT
Historical Disposal Area C
LEGEND:
Ford Property Boundary
Roads
Rail
Buildings
Asphalt
Concrete
Grass
Mississippi River
Cable Tunnels
Utility Tunnel
Mined Sand Tunnels
Elevation Contours (Feet)
Gas Tunnel
Steam Tunnel
Traffic Tunnels
Portion of Tunnel Surveyed
0 175 350 Feet
1 inch = 175 feet
Twin Cities Assembly Plant
Ford Motor Company
St. Paul, Minnesota
Tunnel Location Map
ARCADIS
FIGURE 2
CITY: Minneapolis, MN DB: MGress PM: BZinda
Project: MN000593
G:\GIS\Projects\Ford Ranger\ArcMap\Tunnel_Location_20090831.mxd

Appendix C